FINAL

GOVERNMENT OF THE PEOPLE'S REPUBLIC OF BANGLADESH

Consultancy Services for Feasibility, Detailed Survey and Design of Chittagong Hill Tracts Connectivity Connecting Thegamukh and Chittagong Port

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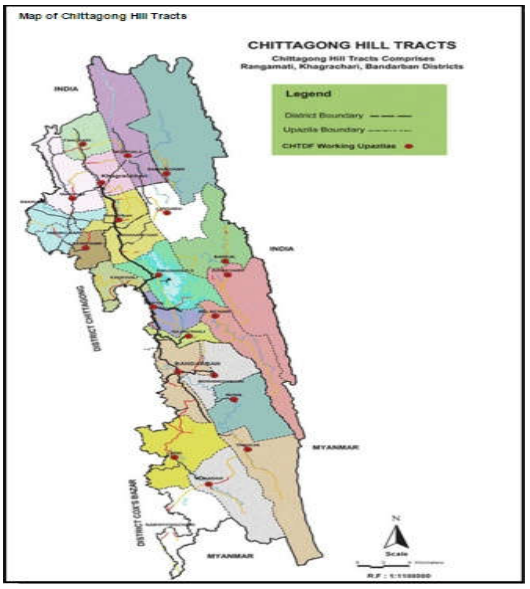

MAIN FEASIBILITY REPORT – VOLUME IA OF IV

JUNE 2016

LOCAL GOVERNMENT ENGINEERING DEPARTMENT (LGED)

SAI Consulting Engineers Pvt.Ltd.,
SAI House, Satyam Corporate Square
B/hRajpath Club, Bodakdev
Ahmedabad–380059,INDIA

In association with

BETS Consulting Services Ltd.,
House-10,Road-135,Gulshan-1,
Dhaka-1212
Bangladesh

Volume I A: Main Feasibility Report

Project: Consultancy services for Feasibility, Detailed Survey and Design of Chittagong Hill Tracts (CHT) Connectivity Connecting Thegamukh and Chittagong Port.

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Abbreviation

Q_p	Maximum Flood Discharge in m^3/s
A	Catchment Area in km^2
AADT	Annual Average Daily Traffic
AASTHO	American Association of State Highway and Transportation Officials
ACGR	Annual Compound Growth Rate
ACV	Aggregate Crushing Value
ADB	Asian Development Bank
ADT	Average Daily Traffic
ALO	Alternative Livelihood Options
ASCE	American Society of Civil Engineers
ASEAN	Association of Southeast Asian Nations
ASTM	American Society for Testing and Materials
BADC	Bangladesh Agricultural Development Corporation
BBS	Bangladesh Bureau of Statistics
BCIM	Bangladesh China India Myanmar
BDT	Bangladeshi Taka
BFDC	Bangladesh Fisheries Development Corporation
BFRI	Bangladesh Fish Research Institute
BGB	Border Guard Bangladesh
BH	Bore Hole
BIDS	Bangladesh Institute of Development Studies
BIWTA	Bangladesh Inland Water Transport Authority
BLPA	Bangladesh Land Ports Authority
BM	Bench Mark
BMD	Bangladesh Meteorological Department
BNBC	Bangladesh National Building Code
BOD	Biological Oxygen Demand
BPC	Bangladesh Petroleum Corporation
BPDB	Bangladesh Power Development Board
BRTA	Bangladesh Road Transport Authority
BUET	Bangladesh University of Engineering and Technology
BWDB	Bangladesh Water Development Board
C	Dimensionless Run-off Coefficient
CBD	Convention on Biological Diversity
CBR	California Bearing Ratio
CBR	Cost Benefit Ratio
CCC	Chittagong City Corporation
CCF	Chittagong-Cox's Bazar Fold
CCHTL	Cherrapunjee-Chittagong Hill Tracts Landscape
CDA	Chittagong Development Authority
CDMPII	Comprehensive Disaster Management Programme Phase II
CES	Cumulative Environmental Sensitivity
CHT	Chittagong Hill Tracts
CHTDB	Chittagong Hill Tract Development Board
CNG	Compressed Natural Gas
CTFB	Chittagong-Tripura Fold Belt
dBa	Decibel
DEO	District Education Officer
DHM	Department of Hydrology and Meteorology
DO	Dissolved Oxygen
DoArch	Department of Architecture

DoE	Directorate of Environment
DoF	Department of Forests
DoF	Department of Forest
DPHE	Department of Public Health Engineering
EA	Environmental Assessment
ECA	Environmentally Critical Area
ECCR	Environmentally Critical Conservative Rules
ECP	Environmentally Critical Projects
ECR	Environmental Compliance Review
EGL	Existing Ground Level
EIRR	Economic Internal Rate of Return
EMP	Environmental Management Plan
EPP	Environmental Protection Policy
EPZ	Export Processing Zone
EQS	Environment Quality Standards
E_s	Apex Distance
ESA	Equivalent Standard Axles
ESIA	Environmental and Social Impact Assessment
FGD	Focus Group Discussion
FL	Finished Level
FM	Fineness Modulus
FY	Fiscal Year
GCM	Global Climate Model
GCM	General Circulation Models
GDP	Gross Domestic Product
GIS	Geographical Information System
GNSS	Global Navigation Satellite System
GO	Government
GoB	Government of Bangladesh
GPS	Global Positioning System
GSB	Geologic Survey of Bangladesh
GWT	Ground Water Table
h	Height of Object Above Pavement Surface
H	Height of Eye Level of Driver Over
H.I.P	Horizontal Intersection Point
HBB	Herring Bone Bond
HDM	Highway design and Maintenance
HFL	High Flood Level
HIV/AIDS	Human Immunodeficiency Virus/Acquired Immune Deficiency Syndrome
HSD	High Speed Diesel
HWF	Hill Women Federation
I	Rainfall Intensity Within the Time of Concentration in mm/hr
IBAs	Important Bird Areas
ICIMOD	International Centre for Integrated Mountain Development
ICS	Institute of Chinese Studies
ICS	Institute of Chinese Studies
ICTP	International Conventions, Treaties and Protocols
ICWFM	International Conference on Water and Flood Management
IFC	International Finance Corporation
IGA	Income Generating Activities
IL	Invert Level
IP	Indigenous People
IPCC	Intergovernmental Panel on Climate Change

IPDP	Indigenous People's Development Plan
IRC	Indian Roads Congress
IRR	Internal Rate of Return
ISG	Improved Sub Grade
IUCN	International Union for Conservation of Nature
IWT	Inland Water Transport
IWTA	Inland Water Transport Authority
JICA	Japan International Cooperation Agency
JRC	Jumma Regional Council
JSG	Joint Study Groups
JSG	Joint Supply Group
JSS	Jana SamhatiSamiti
KII	Key Informant Interview
KM	Kilometre
KPH	Kilometer Per Hour
LAAV	Los Angles Abrasion value
LAD	Least Available Depth
L_c	Length of Circular Curve
LCV	Light Commercial Vehicle
LDD	Land Development Desk Top
LFD	Load Factor Design
LFL	Low Flood Level
LGED	Local Government Engineering Department
LPG	Liquid Petroleum Gas
LRFD	Load & Resistance Factor Design
L_s	Length of Transition
M	Minimum Set-back Distance
MCC	Manual Classified Counts
MEA	Multilateral Environmental Agreements
MoC	Ministry of Commerce
MOEF	Ministry of Environment & Forests
MoH	Ministry of Helth
MoLG	Ministry of Local Government
MoS	Ministry of Shipping
MPN	Most probable number
MS	Motor Spirit
MSA	Million Standard Axles
MSL	Mean Sea Level
MT	Metric Tons
MW	Mega Watts
n	Coefficient of Surface Roughness
N	Deviation Angle
N/A	Not Applicable
n_1	Ascending Gradient
n_2	Descending Gradient
NGO	Non-Government Organization
NNW-SSE	North North West-South South East
NPV	Net Present Value
N-S	North-South
ŋ	Distance Between Center Line of Carriageway and Center Line of Inside Lane
OD	Origin Destination
OP	Operation Policies
OPC	Ordinary Portland Cement

OSD	Overtaking Sight Distance
PAP	Project Affected People
PBCP	ParbatyaBangaleeChattraParishad
PBM	Primary Bench Marks
PC	Public Consultation
PCC	Plain Cement Concrete
PCC	Project Coordinating Consultants
PCJSS	ParbatyaChattagram Jana SamhatiSamiti
PCP	Pahari ChattraParishad
PGP	Pahari GonoParishad
PIA	Project Influence Area
PPB	Perspective Plan of Bangladesh
PSC	Pre-Stressed Concrete
PVC	Present Value of Cost
PWD	Public Works Department
QA	Quality Assurance
QAP	Quality Assurance Plan
QSS	Quality Assurance System
R	Radius of Circular Curve
R_{24}	24 hours Maximum Rainfall (mm)
RAP	Resettlement Action Plan
RBD	Retail Business Development
R_c	Radius of Circular Curve
RCC	Reinforced Cement Concrete
RF	Reserve Forest
RHD	Roads and Highway Department
RHDC	Rangamati Hill District Council
RL	Reduced Level
ROW	Right Of Way
R_{tc}	Rainfall Intensity in t_c Hours (mm/hr)
RTK	Real Time Kinematic
RUC	Road User Cost
s	Shift
S	Sight Distance
SAA	Somo Adhikar Andolon
SAARC	South Asian Association for Regional Co-operation
SAP	Settlement Action Plan
SDGs	Sustainable Development Goals
SHWL	Standard High Water Level
SI	International System
SMCE	Spatial Multiple Criteria Evaluation
SME	Small & Medium Enterprises
SOB	Survey of Bangladesh
SPARSO	Space Research & Remote Sensing Organization
SPM	Suspended Particulate Matter
SPT	Standard Penetration Test
SRCWP	Strengthening Regional Co-operation for Wildlife Protection
SSD	Stopping Sight Distance
T.P.	Tangent Point
TBM	Temporary Bench Marks
t_c	Time of Concentration in hr
TDS	Total Dissolve Solid
TL	Team Leader

TOR	Terms of Reference
TPDP	Tribal People Development Plan
TPDP	Tribal People's Development Plan
TRRL	Transport and Road Research Laboratory (UK)
TS	Topo Survey
T_s	Tangent Distance
UN	United Nation
UNDP	United Nations Development Programme
UNFCCC	UN Framework Convention on Climate Change
UNO	Upazila Nirbahi Officer
UP	Union Parishad
UP	Union Parishad
UPDF	United Peoples Democratic Front
US$	United States Dollar
USF	Unclassified State Forest
UTM	Universal Transverse Mercator
UTM	Universal Transverse Mercator
UZ	Upazilla
V	Speed in Km/h
VAT	Value Added Tax
VCF	Village Common Forests
VGF	Vulnerable Group Feeding
VOC	Vehicle Operating Cost
VOC	Vehicle Operating Cost
VPD	Vehicles Per Day
WB	World Bank
ZOI	Zone of Influence
Δ	Total Deviation Angle
Δ^c	Deviation and Central Angle of Circular Arc
θ_s	Deviation Angle of Transition Curve

EXECUTIVE SUMMARY

The Government of Bangladesh has aimed to provide efficient and effective transport connectivity from Chittagong Port to remote area of North East (N-E) districts, that may lead to development of cross- border transit corridors to N-E states of India. These corridors could be combination of water and land routes in order to improve accessibility for the marginalized people of Chittagong Hills Tract area connecting to the border. One of the borders crossing points is at Thegamukh, which lies in the Chittagong Hills Tract districts on the eastern side of Kaptai Lake and at the border with the State of Mizoram in India. At present, the place is inaccessible by road. The Government had identified eight tentative routes including waterway and roads for providing motorized connectivity between the existing road heads to Chittagong in the Kaptai Lake area. In this respect, the Government has identified four probable land routes and four other routes based on combination of waterway requiring dredging and land routes for the screening of route option leading to detailed feasibility study for one selected land and one multimodal route. .

- **Project Objectives**

The objective of the consulting service is to carry out the study to identify most viable transportation routes from Chittagong Port to remote area of Chittagong Hill Tracts Districts of Bangladesh that may lead to the development of cross-border transit corridors to North Eastern states of India, particularly through Thegamukh. The identification of the routes shall be based on technical, environmental and social screening of the probable routes in order to select the preferred road alignment and combination of waterways and roads, leading to the detailed feasibility study of one road option and one multimodal option.

- **Screening of Land Routes and Multimodal Routes**

The alignment options for screening and their lengths as determined after surveys, investigations and analysis were as follows:

a) ***Only road alignments***:
   1. Rajosthali–Bilaichhari–Juraichhari–Barkal–Thegamukh (about 123.54 km):
   2. Langadu–Bagachattar–Barkal–Thegamukh (50.25 km);
   3. Sajek–Majhipara–Dokanghat–Horina–Thegamukh (97.17 km); and
   4. Bangchara (kaptai)–Chitmaran–Chakuwapara–Bhangamurapara–Bilaichhari–Silchhari–mitngapara (Jurachhari)–Barkal–Chhotoharina- thegamukh (106.12 km).

b) ***Multimodal routes*** 1. Rangamati–Chhotoharina–connected by waterway (63 Km) and Thegamukh by road (about 7.98 km); 2. Rangamiti–Barkal(37.5 Km) waterway and then Thegamukh (23.30 Km) by road; 3.Kaptai–Barkal waterway (64.81 Km) and Thegamukh by road (29.30 Km); 4. Kaptai–Chhotoharina–by waterway (89.62 Km) and Thegamukh by road (7.98 Km).

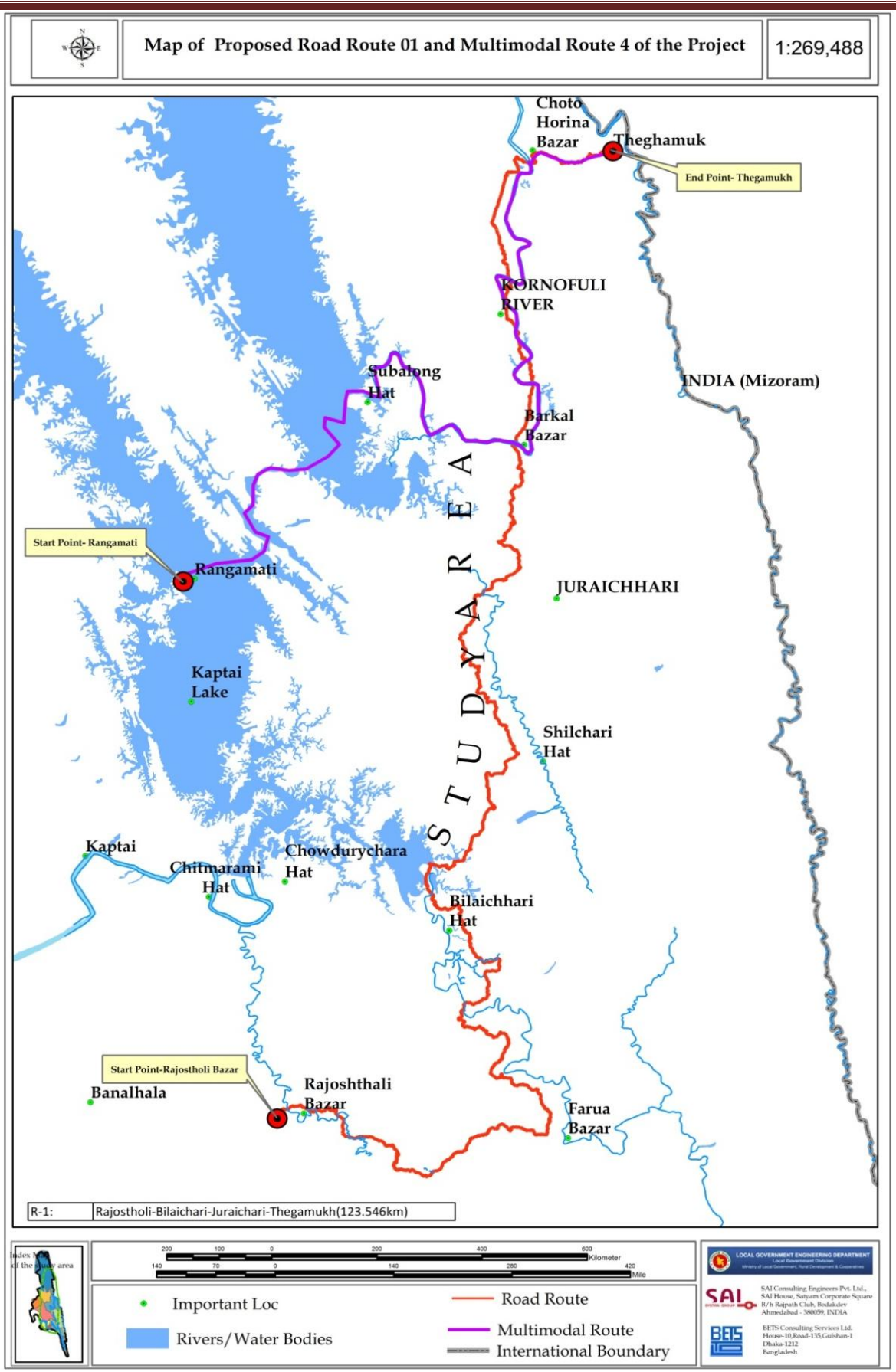
The Screening of above four road routes and four Multimodal routes deals with screening under Engineering, Environmental and Social criterion. The data was collected through Secondary and Primary sources. Under Primary Sources the reconnaissance surveys with GPS, river soundings to assess the dredging requirements, community consultations, traffic assessment for both local and cross border, Social, Environmental Surveys etc. had been done. Extensive data collection was done by consultants through secondary sources and background information, reports, maps, studies, plans, district and village profile and databases etc. had been collected.

- The following criteria and the weights/scores has been used for ranking the routes. The details are provided in Screening Report.

Criteria for screening of routes	Points/weight
1. Technical and Engineering Feasibility	10
2. Adverse Environmental Impact	10
3. Social Impact	10
4. Poverty	10
5. Present Inaccessibility to reach the road head	10
6. Travel time saving after construction from origin of proposed Route to Thegamukh	05
7. Less improvement required to existing road to Chittagong	10
8. Less time of travel between Chittagong to Thegamukh	10
9. Population served per Km of connectivity within zone of Influence	05
10. Length of the road covered by spending US$ 1 million project	10
11. People's Perception for the Project	10
	Total: 100

- Under the Technical and Engineering Feasibility the sub criteria were selected as length, geometrics, condition of existing road on proposed alignment/ availability of draft (for Multimodal routes), cross drainage structures, other structures/landing facilities (for multimodal routes), traffic, slope stability and other criteria like erosion, landslides etc. for road routes/ cost and quantity of dredging (for multimodal routes). Similarly under environmental impact land slippage, severe wind damage, gradient, access to areas/resources, land use, habitats of fish/wildlife, diversion of water, encroachment on tropical rain forests/ wetland, querying of construction material, waste disposal and dredging have been accounted for. Social criteria accounts for land acquisition, Number of house hold rehabilitated, Impacts on economic structures, impacts on cultural properties, loss of agricultural land, loss of commercial land, impact on tribal people and positive impact on population is considered.
- In addition to above other criteria as mentioned above like accessibility of road to Thegamukh/Cost of Operation for water way of Multimodal routes, travel time saving after construction of roads, Poverty, No of bridges and culverts required on existing road, widening and geometrics to be improved, travel time from Chittagong to Thegamukh, how much population is benefitted and construction cost of project is given due weightage. Apart from all this the perception of people about a particular road and in general about project is also given due importance for selecting the best route.
- A multi–criteria analysis had been carried out to evaluate and rank each of the 4 water routes and 4 land routes using above mentioned criteria and sub criteria. The results of Multi-Criteria analysis indicates that
  - Among four land routes the road alignment: Rajosthali–Bilaichhari–Juraichhari–Barkal–Thegamukh(123.54 km) and
  - Among the Multimodal routes the alignment:Rangamati–Chhotoharina–connected by waterway (63 Km) and Thegamukh by road (about 7.98 km) have the highest score.

Thus these alignments have been proposed for detailed feasibility study. These two alignments are indicated in the enclosed map.


Map of Proposed Road Route 01 and Multimodal Route 4 of the Project
1:269,488
Choto Horina Bazar
Theghamuk
End Point- Thegamukh
KORNOFULI RIVER
Subalong Hat
INDIA (Mizoram)
Barkal Bazar
STUDY AREA
Start Point- Rangamati
Rangamati
JURAICHHARI
Kaptai Lake
Shilchari Hat
Kaptai
Chowdurychara Hat
Chitmarami Hat
Bilaichhari Hat
Start Point-Rajostholi Bazar
Banalhala
Rajoshthali Bazar
Farua Bazar
R-1:
Rajostholi-Bilaichari-Juraichari-Thegamukh(123.546km)
Kilometer
Mile
Important Loc
Rivers/Water Bodies
Road Route
Multimodal Route
International Boundary
LOCAL GOVERNMENT ENGINEERING DEPARTMENT
SAI Consulting Engineers Pvt. Ltd., SAI House, Satyam Corporate Square B/h Rajpath Club, Bodakdev Ahmedabad - 380059, INDIA
BETS Consulting Services Ltd. House-10,Road-135,Gulshan-1 Dhaka-1212 Bangladesh

Feasibility study of Selected Routes

Existing Conditions of Proposed Routes

The above two routes were selected for feasibility study and topographic survey was conducted.The existing road in land Route Rajosthali–Bilaichhari–Juraichhari–Barkal–Thegamukhisof length was reduced to 114.751 km due to further refinement of alignment during topographic survey.Due to refinement of alignment all other sections length is slightly changed.

The first segment of the proposed alignment, i.e.

a) **Rajosthali to Bilaichari (49.100 km)** is found 674.67m(Avg. carriage way 4.4m) paved by bituminous carpeting (BC) in green vicinity in hilly terrain and other parts are earthen road where 8 nos (645.90m). RCC Bridges/Culvert are existing. Some missing links are found which aggregated 3226.68m. It is surveyed that 14 nos. Bridges/Culverts are required in different locations.
b) **Bilaichari–Jurichari (29.436 km.)** portion 1053.72 m paved road by Herring Bone Bond (HBB) with 3.217 m width is seen and 6 nos.(142.17m) Bridges/Culvert are existed. It is surveyed that further 15 nos. Bridges/Culverts are required in this portion. Some missing links aggregated 235.121 m are found in different locations. Other parts of the alignment are earthen roads. In this portion remarkable numbers of water lands (Chhara/Canal)) are seen.
c) **Jurichari–Barkal(6.849 km.)** section 3 nos (87.81m)existing Bridges are found.In this initially proposed alignment total 7 nos of Bridges/Culverts are required. In the hilly terrain the proposed alignment following the existing walkway or village road passes almost north direction within the green vicinity.
d) **Barkal–Chhotoharina (21.277 km.)** section 1187.40 m HBB road with 3 m width and 14 nos(308.49m) Bridges/Culverts are seen. Other parts of the alignment are earthen road where 22 nos Bridges/Culverts are required.
e) **Chhotoharina–Thegamukh (8.089 km.)** section 134.19 m HBB road with very narrow width of 1.5 m and 2 nos (79.32m) Bridges have been seen. Further 3 nos. Bridges are required in this section.

Multimodal Route 1: ***Rangamati - Chotoharina by waterway (63 km) and Thegamukh by road (8.089 km), (Proposed total length: 71.089 Km)***

This route enroutes to Chotohorina via Shobolong, Barkal, Bhusionchar. It is about 63km.Chotohorina to Thegamukh is 8.089 km by road. Rangamati to Barkal37.5 km is navigable round the year for small launches and boats. For larger cargo vessels navigable depth will need to be increased by dredging. Barkal to Chotohorina is navigable during monsoon for 3-4 months. This part of the waterway (25.5 km) will need massive dredging to increase navigable depth. **Chhotoharina–Thegamukh** portion 134.19m paved road by Herring Bon Bond (HBB) with 1.5 m width is seen and other parts are earthen road. 2 nos (79.32m) Bridges are existed & 2 Bridges are required.

Traffic Surveys, Analysis and Forecasts

Available traffic data from RHD and other secondary sources were all reviewed. A two-day classified traffic count was conducted at three identified locations namely; Ghagra, Chandraghona and Bangalhalia. Based on these data, base year traffic estimates were prepared. Using the medium and long term GDP growth rates, estimated transport elasticity and base year traffic

estimates, traffic forecasts were made till the year 2040 for three growth scenarios–low, medium and high The traffic forecasts for medium scenario which formed the basis for economic appraisal. In the case of IWT (multi-modal) option, base year traffic assessment is based on data collected from field surveys and discussions with local government agencies and Launch Owners' Association at Rangamati. Projections are made using average GDP growth rate of 6% per year.

Future Potential projects

The future potential coming up projects are namely:

i. Bangladesh-China-India-Myanmar (BCIM) Economic Corridor
ii. Mizoram State Roads II - Regional Transport Connectivity project, India
iii. 22.0 km section of Lunglei –Tlabung–Kawrpuichhuah Road on the border with Bangladesh;
iv. The 27.5km Champhai-Zokhawthar Road on the border with Myanmar; and
v. The 41.7km Chhumkhum-Chawngte North-South alignment connecting to the border roads with Bangladesh to the west and Myanmar to the south.

The above projects have great potential for cross border traffic and the possibility to generate/divert traffic on the proposed corridors of this study. However it requires some more detailed data and in-depth analysis for appropriately allocating this traffic to relevant routes

Design Standards

Principally RHD Geometric Design Standards Manual (Revised) 2005 has been followed for design parameters. Besides the following reference recommendations and standards have been consulted for references

- AASHTO "A policy on Geometric Design of Highway and Streets" 2005
- IRC_SP_48_1998
- Overseas Road Note 6 "A Guide to Geometric Design"
- Nepal Road Standards 2020(July 2013), Government of Nepal, Ministry of Physical Infrastructure and Transport. Department of Roads, Kathmandu, Nepal

AASHTO–Load & Resistance Factor Design (LRFD) method is used as Design Standard for Bridge and culvert design and other drainage structures.Structural analysis and design of Bridge and culverts are made in accordance with American Association of State Highway and Transportation Officials (AASHTO). For vehicular loading, Standard specification for Highway bridges latest edition HL-93 is presently used in Bangladesh. The design method LFD (Load Factor Design) is adopted in design. RHD pavement design manual has been used for the road portion.

Engineering Surveys and Investigations

Following surveys and Investigations have been carried out for collection of field data

- Road and Bridge Inventory and Condition Survey
- Topographical Surveyfor Roads and Bridges
- Soil and MaterialInvestigationsfor Roads
- Hydrological and Hydrographic Investigations
- Environmental Surveys for Roads and Multimodal Route
  i. Assessment of Air pollution
  ii. Assessment of Ground water quality
  iii. Assessment of Surface water quality
  iv. Noise levels at Sensitive locations

Improvements

As mentioned above two lane road with 7.3 m bituminous carriage way as per RHD standards has been developed. During the design process in order to provide acceptable gradients the length of land route is further reduced to 109.67 Km and land portion of Multi Modal Route is reduced to 7.37 Km and total length of Multi Modal Route is 70.37 Km. The lengths from Chittagong Port to Thegamukh by land route via Rajasthali is 184.97 Km while via Rangamati by Multimodal route is 142.88 Km.It is proposed to construct new bridges in place of existing bridges. In total 40 bridges and 21 culverts are proposed. Bridges are of RCC and PCC types as per requirement. Similarly slab culverts of different sizes are proposed as per requirement Earth retaining structures are also essential in the hilly area in order to have protection and slope stability failures. At crucial locations earth retaining structures are proposed. Surface drains are designed and as per discharge requirement they have been proposed.

The details related to waterway Rangamati to Chhotoharina

RangamatitoBarkal 37.5 km is navigable round the year for small launches and boats. For larger cargo vessels navigable depth will need to be increased by dredging. Barkal to Chotohorina25.5 km is navigable during monsoon for 3-4 months. This part of the waterway (25.5 km) will need massive dredging to increase navigable depth.

Dredging quantity:

With Least Available Depth 3.00 m and Width of cutting 61 m. Length from Rangamati to Chhotoharina via Barkal.Dredging quantity & cost are calculated for the portion from Rangamati to Chhotoharina.

Rangamati to Barkal (37.5 km) =	1.18 million m3
Barkal to Chotohorina (25.5 km) =	7.08 million m3
Maintenance Dredging Volume=	0.25 million m3
Total =	**8.51 million m3**

Cost Estimates

Estimation of cost is also done for improvement of existing road like Chittagong Port to Rajosthali and Rangamati. Estimates are also made for new proposed road and waterway routes. Following are the estimates for various sections.

Road Route	Million TK	Million US$
i). Cost for Improvement of Existing Road (Chittagong Port to Rajosthali)	1251.16	16.21
ii). Cost for Construction of New Proposed Road(Rajosthali to Thegamuk)	21,398.66	277.19
iii) Cost Of Environmental Mitigation Measures For Proposed Road Route	1050.00	13.60
Total=	**23699.82**	**307**

Multi Modal Route	Million TK	Million US$
i). Cost for Improvement of Existing Road (Chittagong to Rangamati)	142.4	1.85
ii). Cost for Improvement of Waterway (Rangamati to Chottoharina)	2291.58	29.68

Multi Modal Route	Million TK	Million US$
iii). Cost for Construction of New Proposed Road (Chottoharina to Thegamukh)	1,475.75	19.12
iv) Cost of Environmental Mitigation Measures for proposed Multimodal Route	161	2.09
Total=	**4070.73**	**52.74**

For development of cost estimate latest LGED/R&HD/BIWTA Rate Schedules have been used.

Economic Appraisal

All Road Project: Chittagong-Rajosthali-Thegamukh

Major benefit of road improvement/construction is reduction in vehicle operating cost (VOC) which in turn translates to reduced transport costs for passengers and goods traffic. Upgrading of the project road would result in savings to road users as well as to the society in terms of reduced transport costs and travel time, and improved environmental conditions. Since, the road projects have lengthy operational (or design) lives, the HDM IV model which allows life cycle costing has been used for assessing the costs and benefits traceable to the road upgrading project during its entire economic (design) life period. Within this framework, two mutually exclusive project alternatives viz. i) with the project and ii) without the project, have been considered for assessing the economic viability of proposed road project.

Economic analysis has been carried out based on medium traffic forecast. While the project cost included capital cost of road upgrading/construction work and maintenance cost (routine and periodic), the quantifiable project benefits were savings in vehicle operating costs. Economic analysis results indicate that all the project options have a high Economic Internal Rate of Return (EIRR).

Based on the economic analysis of the proposed project, as well as overall engineering and traffic assessment, construction of the new road between Rajosthali and Thegamukh along with widening of the existing road between Chittagong and Rajosthali with an EIRR of 21.8%, is preferable for the entire project road. Even under the most pessimistic scenario of 15% increase capital cost and 15% decrease in project benefits, the project yields an EIRR of 17.0 % which is much higher than the cut-off rate of 12% applicable in Bangladesh. The EIRR Value for the section Rajosthali to Thegamukh is also 13.3% if considered independently.

Multi-Modal Route: Chittagong-Rangamati-Chotohorina-Thegamukh

Under this, movement between Rangamati and Chotohorina is by water transport and that between i) Chittagong and Rangamati and ii) Chotohorina and Thegamukh is by road. For each of these three constituent sections of the multi-modal route, the investments are economically viable with EIRR more than 12%, the cut-off rate. Here also for new sections Rangamati to Chottoharina(Waterway) EIRR Value is 20.1% and Chottoharina to Thegamukh(Road Portion) EIRR Value is 14.8% which is more than 12% cut of rate.

Environmental Scoping

Biodiversity

Evaluation Objective

To minimize adverse effects on native vegetation and habitat and on threatened flora and fauna species and ecological communities, including any relevant species listed under the Forest Act, and address opportunities for offsetting potential losses consistent with relevant policy.

Key issues

- Direct loss of native vegetation and any associated listed threatened flora and fauna species known or likely to occur in the project site.
- Direct habitat loss for listed threatened fauna species.
- Indirect loss of vegetation or habitat quality resulting from edge effects, habitat fragmentation or other disturbance impacts.
- Potential for other indirect impacts on biodiversity values including changes in hydrology and risk of significantly increasing mortality of Forest Act listed species

Fisheries:Kaptai Lake is the largest manmade lake in the South Asia (App. 725 sq. Km). There is more than 4000 charas/ rivulet falling into the lake. About 1200 charas/ rivulets are directly connected and discharges into the lake. It is one of the largest sources of biodiversity and fish. Substantial amount of fish are being supplied by this charas falling into lake and comparatively higher per area fish are available than Lake.. According to the research of Bangladesh Fish Research Institute (FRI); 2 species of Shrimp, 1 species of Dolphin and 2 species of Tortoise are available in the lake. There are 68 species of local and 8 species of alien fish are available in the lake. At present, 42 species of fish are commercially collected from the lake. The local fish species are mainly come into the lake from the river and nearby wetland after the lake were created.

Flora: The hills, rivers and cliffs are covered with dense bamboo breaks, tall trees and creeper jungles. The valleys are covered with thick forest. The vegetation is characterised by semi-evergreen (deciduous) to tropical evergreen dominated by tall trees belonging to *dipterocarpaceae, euphorbiaceae, lauraceae, leguminacae* and *rubiaceae.*

Fauna: The fauna mainly includes monkey, fox, jungle cat, fishing cat, wild boar, land turtle, king cobra, reticulated python, rat snake and other non-poisonous snakes together with large number of species of lizards and amphibians like frog and toad, and tree frogs. The bird life of the Chittagong Hill Tracts is wonderfully rich. More than 60 families of birds are found.

Endangering Ecosystem

Hunting, fishing and collecting wood and gathering non-timber forest products Many traditional occupations relate to daily livelihood/subsistence activities involving the use of biological resources, such as fishing/fisheries, hunting, gathering of non-timber forest products , such as wild plants, medicinal herbs, fruits, nuts, mushrooms, etc. These activities take place in diverse ecosystems (e.g. marine or inland waters, tropical or boreal forests).

Many species of wildlife have now become critically endangered in the Chittagong Hill Tracts (CHT) due to indiscriminate poaching and rapid depletion of forests. Rare species of wildlife like Yak (goyal), Tiger, Panther (chitabagh), large and small civet cat, Pangolin, Gibbon (Ulluk), Barking deer and Samber, Slow Loris (LajjabatiBanor) and peacock are already on the verge of extinction in the CHT forests. At the same time many common species are also fleeing the forests

across the border as illegal poaching and fast depleting of forests reserves are causing their safe abode to shrink faster, observe zoologists. There is an Elephant Trail close to Barkal and Elephant is traveling across the proposed alignment for food in the area. This route of Elephant trail need to be protected for the benefit of Elephants and the population living in the area.

***Forestry*:** Sources at Department of Forest (DoF) said illegal logging, growing population, lack of wildlife conservation and awareness campaign and hunting by the indigenous people are the major reasons behind depletion of forests and disappearance of wildlife. A survey conducted in 1975 found 76 species of wild mammals, 183 species of wild birds, seven species of amphibious animals and 25 species of reptiles and snakes in the CHT forests. But many of these, including wild elephants, wild pigs, deer, wild dogs, porcupines, wild cocks, snakes, some species of monkeys, baboons (honuman), jackals, hares, few species of frogs, mongoose, leopards, wild buffaloes are now rarely seen in the forests. Even the Jhum cultivation through denudation of hills in and around the reserve forests areas also threatened biodiversity. (Shantimoy Chakma, Rangamati (Daily Star) Thursday, August 12, 2010).

Wild Life Sanctuary Protected area in Chittagong Hill Tract

PABLAKHALI WILDLIFE SANCTUARY
IUCN Management Category: IV (Managed Nature Reserve)
Biogeographical Provine: 4.09.04 (Burmna Monsoon Forest)

RAMPAHAR-SITAPAHAR WILDLIFE SANCTUARY
IUCN Management Category: Proposed
Biogeographical Provine: 4.04.01 (Burmna Rainforest)

Threat to the wildlife sanctuaries in project area.
Transport connectivity route are particularly sensitive from an environmental perspective, especially the areas of the Rampahar and Pablakhali Wildlife Sanctuaries. These areas among others to be studied under the project will require particular attention to ensure appropriate identification of critical habitats (including but not limited to designated protected areas and wildlife sanctuaries).

Rampahar-Sitapahar Wildlife Sanctuary at Rangunia is close to the access road between Chittagong port to Rangamati. If Kaptai road is used for multimodal transportation then Rampahar-Sitapahar Wildlife Sanctuary can be avoided. Pablakhali Wildlife Sanctuary is a bit close at the tip of Rajosthali-Theghamuk road (Chotohorina-Thegamukh). However the road is not passing through the wildlife sanctuary and may not harm it. Care should be taken so that user of this road can't get easy access to the sanctuary.

Social Scoping

Socio-economic situation of CHT districts is different from rest of the parts of Bangladesh due to variant geographical conditions. Most of the areas in CHT are hilly terrains and diverse ethnics groups reside there. Among the tribal people Chakma, Marma, Tanchungya, Tripura, Morung, Pangkhua, etc. are thr main communities.

From the social impact points of view among the road alignments number-1: Rajosthali–Bilaichhari–Juraichhari–Barkal–Thegamukh (about 114.751 km) and from the multi-modal

alignment–1: Rangamati–Chhotoharina–connected by waterway (63 Km) and Thegamukh by road (about 8.089 km) has been recommended.

For social criteria, accounts for land acquisition, number of household to be rehabilitated and mitigation measures to be made, impacts on economic structures, cultural properties, loss of agricultural land, loss of commercial land, impact on tribal people, key poverty impacts, impact of risk on the project and positive impact on population were considered.

After tentative selection of the road and multimodal alignments through pre-feasibility study, a further feasibility study as part II of phase 1 has been carried out through community consultation throughout and along the selected route alignments. Public Consultation along the selected alignments was carried out with different stakeholders to assess different opportunities, threats and cost effectiveness for re-settlements works. And Public Consultations were conducted to gather local people's opinion relevant to identifying social and environmental issues and ensuring the appropriateness and viability of selected alignments.

For feasibility study of Road Alignment-1 and Multimodal Alignment -1, Public Consultation was carried out purposively along the selected 114.751 km long road alignment. The field team conducted 52 Public Consultations throughout the road alignment. The consultation covered the Upazila Officials, Upazila Chairmen, Headman, Karbaries, etc., including the common people along the alignment. Number of consultations was different at different places of the alignments because of the density of the population and problems of movement at different places due to forests and hills. Following the same method Multimodal selected route number 1, starting from Rangamati–Cotohorina along waterway and land up to Thegamukh was done. The investigators carried out 36 Public Consultation along this alignment.

During the feasibility study the respondents reported that the poverty situation has considerably **reduced** during the 5 years period and parameters they mentioned:

1. Rate of education increased and enrolment in schools has also been increased
2. Condition of living house structure improved
3. Increased use of sanitary latrines
4. Food intake in terms of quantity and quality has improved
5. Using solar panel, some Upazila got electricity connection
6. Use of TV, mobile and motorbike increased
7. Movement to other districts increased
8. Job opportunity increased
9. Increased employment in local government offices
10. Increased entrepreneurship

Some 90% participants in public consultation were from potentially affected tribal people. Tribal households were involved in fruit and timber gardening, producing turmeric and ginger, livestock rearing, trading, fishing and operating boat on rent basis. In the PC, it came out that the affected tribal population need to be re-settled in their own original profession, which they consider would be the best option for them. Besides that they are also interested in Income Generating activities (IGA), Alternative Livelihood Options (ALO) and Small & Medium Enterprises (SMEs). Some of them mentioned about training on motor driving.

However, it was found that they were interested both for financial and technical support. Options for support they mentioned include: (i) support for making fruit garden; (ii) support for buying

boat for fishing; (iii) support for starting small business; (iv.) arrange well-resourced IGA training. They tentatively estimated BDT 50,000 for IGA for each affected Tribal household.
\
Following Table highlighted the Socio-economic findings of the Road Alignment-1
Road Alignmen1:Rajosthali ----Belaichhari---Juraichhari---Barkal---Thegamukh—114.750 km

Sl. No.	Name of item	Quantity	Unit	Remark
1	Land to be acquire(approx)	114	Acres	
2	No. of household affected	564	Nos	
3	No. of commercial structure	157	Nos	
4	Agricultural affected(Garden)	241	Nos	
5	Cultural Structure Affected	10	Nos	3 Mosque 3 Temples 4 Schools
6	Water bodies Affected(Pond)	32	Nos	

The tentative cost for Land acquisition and Resettlement has been worked out as BDT/Km 13,56,923 Tk

Some Suggestions from the PAPs:

- In the PC people opined that the Road Construction should be done by the LGED or other similar organization.
- The present proposed Road alignment is supposed to pass through Jurachuri Sadar, then it would need to remove all establishments of Upazila and oher buildings. So, the people opined that the alignment should be changed to save those establishments. They proposed that if the route passes by the Upazila Police station-LabourPara–Kalika Para-Barkal then the upazila establishments will be saved and road length would be shortened by 4-5 km.
- If the Road Alignment follows the old KPM road that passes through Farua, Akuzzapara, Taktanala, and Alikhong to downbridge, then it would be cost effective and a lot of houses and buildings would be saved from acquisition.
- For preparing Road Alignment Maps, important locations should be demarcated on the maps. And at the same time during consultation, investigators should be advised to use Mouza Maps to find out the exact alignment locations and would easily point out the position of the possession to locate.

It would be very much fruitful, if there would be one day small workshop for review of the design and alignment in each of the four Upazilas, through which the road alignment has been passing with the presence of Headmen, Karbari, UNO, UP Chairmen, UP members, Upazila Chairman, Vice-Chairman, etc. These workshops would help the project to do re-settlement works easily.

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CHAPTER - 1

Introduction

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Introduction

1.1 General

In order to improve key multi-modal transport corridor and networks that would address current transport bottlenecks for trade and help boost national, regional and international trade for Bangladesh, the World Bank is providing a Recipient-Executed grant to the Government of Bangladesh (GoB) to finance economic, financial, technical, environmental and social safeguards studies and technical assistance for: (i) dredging of priority inland waterways; (ii) provision of vessels, navigational aids, and safety equipment and improvement of selected river ports along priority waterways; (iii) construction of a new container terminal and improving operational efficiency at Chittagong Port; (iv) investments in selected equipment and improving operational efficiency at Mongla Port; (v) addressing missing links for road and inland waterways to establish transport connectivity between Chittagong Port, Chittagong Hill Tracts Districts, and NE states in India; and (vi) improving selected key priority border posts. These interventions are expected to facilitate domestic trade, international trade with third countries, as well as regional trade with neighboring countries including India, Nepal and Myanmar. These studies and technical assistance are expected to inform decisions on potential Investment opportunities. The Government of Bangladesh has aimed to provide efficient and effective transport connectivity from Chittagong Port to remote area of North East (N-E) districts, that may lead to development of cross-border transit corridors to N-E states of India. These corridors could be combination of water and land routes in order to improve accessibility for the marginalized people of Chittagong Hill Tracts area connecting to the border.

Bangladesh being a reverine country, Inland Water Transport (IWT) is a major mode for transport of goods and people. IWT sector is important for the poor as well as for the competitiveness and economic growth as it is the cheapest mode of transport compared to road & rail. In the previous day waterway routes were neglected for development & maintenance. In the recent years the Bangladesh Govt. has given due attention to develop and maintain the water routes. Bangladesh inland water transport Authority has the chartered responsibilities to develop& maintain the water ways. BIWTA was fighting against the dead & dying rivers with only 8 no. of cutter suction dredgers procured in the year1975 which are very old insufficient with the increasing demand of development & maintenance dredging. Now BIWTA has 18 Nos. of dredgers. 32Nos. of dredgers has been collected by private sector which is engaged to meet dredging need of BIWTA.

Bangladesh is the biggest delta in the world formed with non-cohesive alluvial soil. Erosion and siltation is a continuous process with formation of shoals in the river bed raising river beds continuously high which create navigational hazards.

Total length of the rivers is 24,000km Out of this total river length 6,000km are accessible for plying motor and mechanized vessels during the monsoon. About 3800 kms remains navigable round the year. The rivers are classified in four categories from the point of Least Available Depth (LAD). Classification is as under in **Table 1.1A (Figure no. 1.1 and Annex–1.1)**

Table 1.1A: Classification of Rivers

IWTA Classification	Length (km)	Depth(m)
Class 1	683	3.66-3.96
Class 2	1000	2.10-2.44
Class 3	1885	1.52-1.83
Class 4	2400	Less than 1.52

Source: *BIWTA master plan study*

For connectivity from Chittagong sea port to Thegamukh by waterway is the river Karnaphuli. The route is of class III category which is not normally maintained. The river Karnaphuli originates from the "LUSAI HILL" of Assam (India) and enters into Bangladesh near to Thegamukh. It flows downstream and falls into the Bay of Bengal travelling Chottoharina, Barkal, Shovolong, Rangamati, Kaptai Lake, Chittagong main sea port and Patenga. From Kaptai or Rangamati to Chhotohorina many growth centers have been developed on both banks of the river. There are Bazers, schools, Launch Stations, BGB Check post, College, Police Camps, Other important growth centes are like Bhusionchara, Bamland, Arabunia, Kalabunia, south Kalabunia, Butchara, Simoltala, Baraitala, Maisharia etc. It is the longest river route of the district which proceeds up to Chhotohorina then10 km toThegamukh by road. Different waterway routes (launch routes) of Rangamati district are given in **Table 1.1B**

Table 1.1B: Different Waterway launch Routes of Rangamati District

Name of waterways	Number of launches plying as per route permission of BIWTA.
1.Rangamati - Marisha 2.Rangamati–Chottoharina	31
3.Rangamati- Juracha	6
4.Rangamati–Khagrachari	3
5. Rangamati–Farua via Kaptai route	1
6. Rangamati–Balichari	2
7. RangamatiMaischari	1
8. Kaptai–Maischari	2

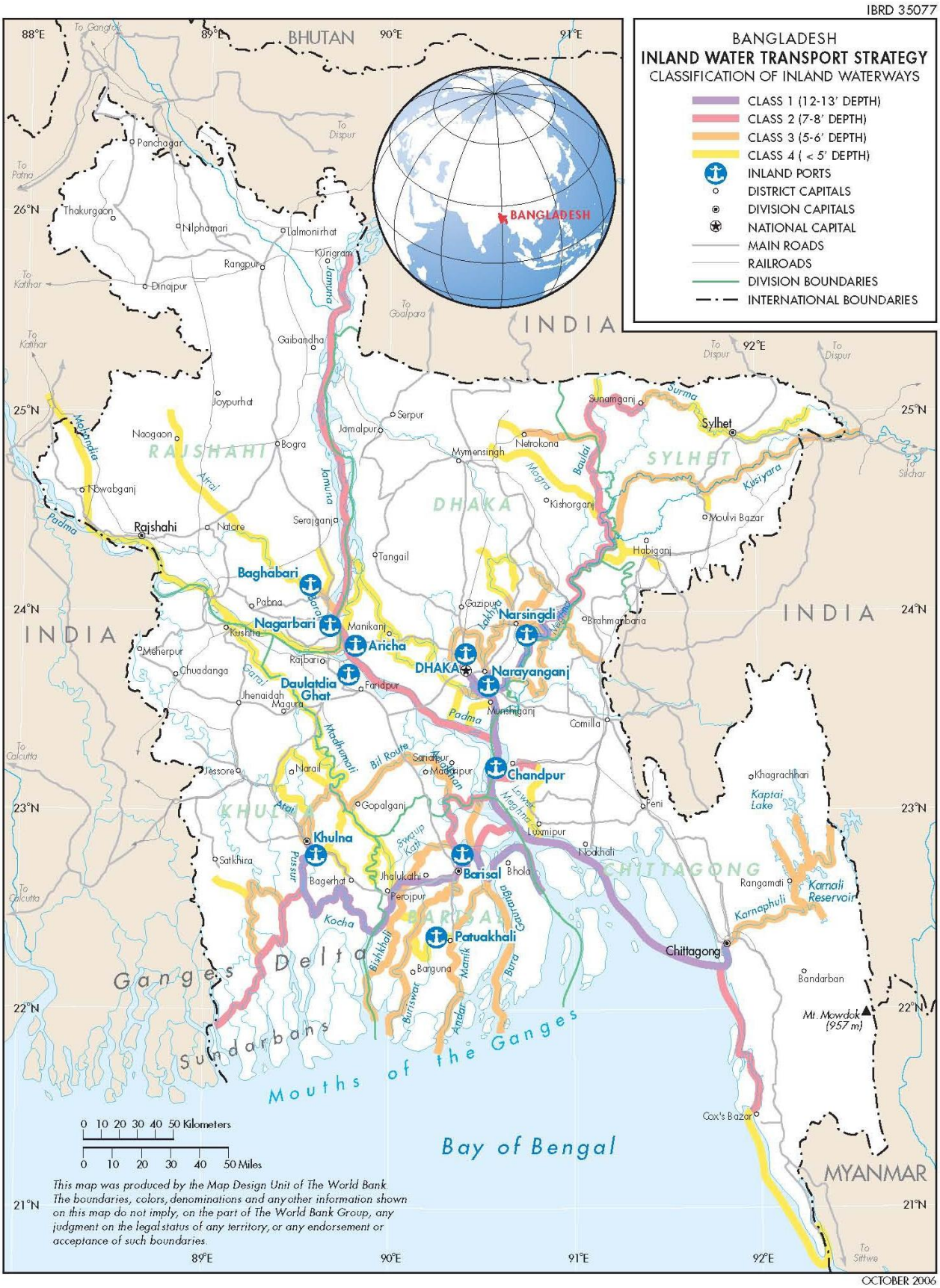


Figure 1.1: Rivers as per IWTA Classification

1.1.1 Development of Transport Connectivity in Chittagong Hill Tracts Area

The Government of Bangladesh has aimed to provide efficient and effective transport connectivity from Chittagong Port to remote area of North East (N-E) districts, that may lead to development of cross- border transit corridors to N-E states of India. These corridors could be combination of water and land routes in order to improve accessibility for the marginalized people of Chittagong Hill Tracts area connecting to the border. One of the borders crossing points is at Thegamukh, which lies in the Chittagong Hill Tracts districts on the eastern side of Kaptai Lake and at the border with the State of Mizoram in India. At present, the place is inaccessible by road. The Government has identified eight tentative routes including waterway and roads for providing motorized connectivity between the existing road heads to Chittagong in the Kaptai Lake area. In this respect, the Government has identified four probable land routes and four other routes based on combination of waterway requiring dredging and land routes for the screening of route option leading to detailed feasibility study.

1.2 Engagement of Consultancy Services

The Contract Agreement for "Consultancy Services for Feasibility, Detailed Survey and Design of Chittagong Hill Tract Connectivity Connecting Thegamukh and Chittagong Port"was signed by the Government of the Peoples Republic of Bangladesh represented by Local Government Engineering Department (LGED) and SAI Consulting Engineers Pvt. Limited of India in association with BETS Consulting Services Ltd, Bangladesh, on May 20, 2015. The following are the various agencies involved in the execution of the project:

Client	:	Government of the Peoples Republic of Bangladesh
Executing Agency	:	Local Government Engineering Department (LGED, Bangladesh
Consultant	:	SAI Consulting Engineers Pvt. Limited of India in association with BETS Consulting Services Ltd, Bangladesh
Funding Agency	:	World Bank

1.3 Project Objectives

The objective of the consulting service is to carry out the study to identify most viable transportation routes from Chittagong Port to remote area of Chittagong Hill Tracts Districts of Bangladesh that may lead to the development of cross-border transit corridors to North Eastern states of India, particularly through Thegamukh.Thegamukh lies in Mizoram in India. Mizoram's capital Aizawl is approximately 98 Km away from Thegamukh. Its latitude is $22^0$52'43" and Longitude $92^0$26'44.5". The routes will be selected in consideration of quick benefits achieved in the short-term and sustainable project effectiveness in the longer-term for designed life cycle cost of the project. The identification of the routes shall be based on technical, environmental and social screening of the probable routes in order to select the preferred road alignment and combination of waterways and roads, leading to the detailed feasibility study of one road option and one multimodal option.

Once the preferred route is selected for further investment based on the findings of the detailed feasibility study, the Employer may activate or contract for Phase II of the consulting service to carry out a survey, detailed engineering design, Cost estimating and preparation of bid documents for the construction of the selected road.

1.4 Scope of Consultancy

The consultancy services are to be provided in two phases

i) Screening including environmental and social screening and alternative analysis of all eight routes, and feasibility study of one road option and a multimodal route for connectivity between Thegamukh and Chittagong Port
ii) Survey, Detailed Design, Cost estimates and preparation of Bid Documents for the selected road option to connect Chittagong Port and Thegamukh that are found feasible.

Review the report as per TOR mention in the Annexure 1.4

1.5 Summary of components associated with the project

As discussed the project has been taken up to boost national, regional and international trade for Bangladesh. The project would address missing links for road and inland waterway to establish transport connectivity between Chittagong Hill Tract Districts, and NE states in India.

Through this project an efficient and effective transport connectivity from Chittagong Port to remote area of North East (N-E) districts will be developed. Following Eight corrdidors have been identified by Governement out of which four are by road and four are by multimodal i.e. water way and road combination.

Road Alignments:

1. Rajosthali–Bilaichhari–Juraichhari–Barkal–Thegamukh (about 123.54 km):
2. Langadu–Bagachattar–Barkal–Thegamukh (50.25 km) ;
3. Sajek–Majhipara–Dokanghat–Horina–Thegamukh (97.17 km); and
4. Bangchara (kaptai)–Chitmaran–Chakuwapara–Bhangamurapara–Bilaichhari–Silchhari–mitngapara (Jurachhari)–Barkal–Chhotoharina- thegamukh (106.12 km).

Multimodal Routes

1. Rangamati–Chhotoharina–connected by waterway (63 Km) and Thegamukh by road (about 7.98 km);
2. Rangamiti–Barkal (37.5 Km) waterway and then Thegamukh (23.30 Km) by road;
3. Kaptai–Barkal waterway (64.81 Km) and Thegamukh by road (29.30 Km);
4. Kaptai–Chhotoharina–by waterway (89.62 Km) and Thegamukh by road (7.98 Km).

Among these eight corridors two routes one by road and other by multi modal i.e.combination of water way and road would be selected after screening. The detailed feasibility study would be carried out of these selected routes. Thus the project involves two major components:

- *Screening and selection of Alignment options*
- *Detailed feasibility study of one road and one multimodal alignment option.*

Brief activities involved in above components are as follows:

- ***Screening and selection of Alignment options***

i. Data Collection

a. Collection of data through primary surveys especially field surveys using GPS and collection of topographic information of all eight route options. Also collection of hydrographic information, data related to Kaptai Lake, Karnfulli River and river sounding etc.

b. Environmental and Social surveys and data collection including public consultations.
c. Review of various reports, existing studies and Collection of data through secondary sources like Topo sheets, Arial photographs, Satellite images, contour maps, Socio economic data, District and Village profiles, Transport Infrastructure, Base maps, design standards , assessment of traffic etc.

ii. Preparation of various base maps like land use pattern, Digital Elevation model, Settlements in project site, flood map of project site, drainage system in project area, Rainfall details in CHT area, Population map, ecological, topographical map of project areaetc.

iii. Screening of route using Multi-criteria Analysis

a. **Identification of criteria** for analysis and selection of appropriate weights: Various criteria which are affecting the multicriteria analysis were identified as Technical and Engineering Feasibility, Adverse Environmental Impact, Social Impact, Poverty , Present Inaccessibility to reach the road head, Travel time saving after the project, Less improvement required to existing road to Chittagong, Less time of travel between Chittagong to Thegamukh, Population served per Km of connectivity with in zone of Influence, Length of the road covered by spending US$ 1 million project, People's perception for the Project. Apart from these in order to address multi modal route requirements criteria related to available draft on water routes, dredging volume and its cost, cost of operation for carrying goods, additional landing and other facilities/structures for water routes have been included for scoring purpose.
b. **Identification of sub- criteria:** The criteria like Technical and Engineering Feasibility, Adverse Environmental Impact, Social Impact were further splitted into subcrietria and their weights have been decided. Following are the subcriteria –

   Under the Technical and Engineering Feasibility the sub criteria were selected as length, geometrics, condition of existing road on proposed alignment/ availability of draft (for Multimodal routes), cross drainage structures, other structures / landing facilities (for multimodal routes), traffic, slope stability and other criteria like erosion, landslides etc. for road routes/ cost and quantity of dredging (for multimodal routes). Similarly under environmental impact land slippage, severe wind damage, gradient, access to areas/resources, land use, habitats of fish/wildlife, diversion of water, encroachment on tropical rain forests/ wetland, querying of construction material, waste disposal and dredging have been accounted for. Social criteria accounts for land acquisition, Number of house hold rehabilitated, Impacts on economic structures, impacts on cultural properties, loss of agricultural land, loss of commercial land, impact on tribal people and positive impact on population is considered.
c. **Allocation of weights/scoring:** Appropriate weights/scores need to be allocated depending on severity and dominance against each subcriteria/ criteria and total score for each route has to be assessed. One road route and one Multi–modal route which scoremaximum weight / score has been considered the most feasible and selected for further investigation.

- ***Detailed feasibility study of one road and one multimodal alignment option.***

As discussed for the selected road and multimodal route detailed feasibility study need to be carried out. The activities involved for this stage are:

a. Fixing the design standards for the proposed alignments
b. Engineering Surveys and preliminary engineering design: Various surveys and field investigations like Topographic, soil and sub soil investigations, Traffic surveys, Hydraulic and hydrological investigations etc to be carried out.
c. Environmental and Social Surveys and Investigations
d. Stake holder meeting and Public consultations
e. Preliminary design of Road and Multimodal route
f. Preparation of Cost Estimates: Assessment of Preliminary quantities and associated costs including cost towards environmental and social mitigation and rehabilitation.
g. Economic and Financial Analysis: Assessment of Economic and Financial Internal Rate of Return using HDM 4, Sensitivity and risk analysis.
h. Preparation of Preliminary plan of proposed alignments and required drawings and reports for feasibility level.
i. Preparation of detailed draft TORs for full ESIA, EMP, RAP and Tribal People Development Plan of the selected routes.

1.6 Selection of Alignment accomplished in Screening Report

The alignment options for screening and their lengths as determined after Screening surveys, investigations and analysis were as follows:

a) ***Only road alignments***: 1.Rajosthali–Bilaichhari–Juraichhari–Barkal–Thegamukh (about 123.54 km): 2. Langadu–Bagachattar–Barkal–Thegamukh (50.25 km) ;3.Sajek–Majhipara–Dokanghat–Horina–Thegamukh (97.17 km); and 4. Bangchara (kaptai)–Chitmaran–Chakuwapara–Bhangamurapara–Bilaichhari–Silchhari–mitngapara (Jurachhari)–Barkal–Chhotoharina- thegamukh (106.12 km).
b) ***Multimodal routes*** 1. Rangamati–Chhotoharina–connected by waterway (63 Km) and Thegamukh by road (about 7.98 km); 2. Rangamiti–Barkal (37.5 Km) waterway and then Thegamukh (23.30 Km) by road; 3.Kaptai–Barkal waterway (64.81 Km) and Thegamukh by road (29.30 Km); 4. Kaptai–Chhotoharina–by waterway (89.62 Km) and Thegamukh by road (7.98 Km).

The Screening of above four road routes and four Multimodal routes deals with screening under Engineering, Environmental and Social criterion. The data was collected through Secondary and Primary sources. Under Primary Sources the reconnaissance surveys with GPS, river soundings to assess the dredging requirements, community consultations, traffic assessment for both local and cross border, Social, Environmental Surveys etc. had been done. Extensive data collection was done by consultants through secondary sources and background information, reports, maps, studies, plans, district and village profile and databases etc. had been collected.

- To operationalize the base year traffic assessment methodology, the latest available AADT (i.e. for the year 2013) data have been collected from RHD for the road sections: Bangalhalia-Rajosthali, Dighinala-Langadu, Khagrachhari-Sajek, Chandragona-Kaptai, Manikchhari-Rangamati as these sections are contiguous to the new routes. The related population data has been gleaned from Bangladesh Bureau of

Statistics. AADT levels for base year (2013) have computed. With the help of population growth trends, Growth trends of motor vehicles, trends in fuel consumption sale and growth in GDP the transport demand elasticities have been calculated and growth rates have been derived which are quite encouraging. Traffic growth rates have been worked out for Pessimistic, Moderate and Optimistic scenarios. Traffic forecasts using the derived growth rates are presented in Screening Report. In studies of this nature, and where there is problem of paucity of relevant data, generated/induced traffic is assumed as percentage of estimated diverted/normal traffic. In the present case, to be on the conservative side, generated/induced traffic has been assumed as 20% of diverted traffic for all three scenarios. Forecasts for generated/induced traffic and total local traffic have been made and presented in Screening Report.

- The following criteria and the weights/scores has been used for ranking the routes.

Criteria for screening of routes	**Points/weight**
1. Technical and Engineering Feasibility	10
2. Adverse Environmental Impact	10
3. Social Impact	10
4. Poverty	10
5. Present Inaccessibility to reach the road head	10
6. Travel time saving after construction from origin of proposed Route to Thegamukh	05
7. Less improvement required to existing road to Chittagong	10
8. Less time of travel between Chittagong to Thegamukh	10
9. Population served per Km of connectivity within zone of Influence	05
10. Length of the road covered by spending US$ 1 million project	10
11. People's Perception for the Project	10
	Total: 100

- Under the Technical and Engineering Feasibility the sub criteria were selected as length, geometrics, condition of existing road on proposed alignment / availability of draft (for Multimodal routes), cross drainage structures, other structures / landing facilities (for multimodal routes), traffic, slope stability and other criteria like erosion, landslides etc. for road routes/ cost and quantity of dredging (for multimodal routes). Similarly under environmental impact land slippage, severe wind damage, gradient, access to areas/resources, land use, habitats of fish/wildlife, diversion of water, encroachment on tropical rain forests/ wetland, querying of construction material, waste disposal and dredging have been accounted for. Social criteria accounts for land acquisition, Number of house hold rehabilitated, Impacts on economic structures, impacts on cultural properties, loss of agricultural land, loss of commercial land, impact on tribal people and positive impact on population is considered.
- In addition to above other criteria as mentioned above like accessibility of road to Thegamukh / Cost of Operation for water way of Multimodal routes, travel time saving after construction of roads, Poverty, No of bridges and culverts required on existing road, widening and geometrics to be improved, travel time from Chittagong to Thegamukh, how much population is benefitted and construction cost of project is given due weightage. Apart from all this the perception of people about a particular

road and in general about project is also given due importance for selecting the best route.

- A multi–criteria analysis had been carried out to evaluate and rank each of the 4 water routes and 4 land routes using above mentioned criteria and sub criteria. The final results of multi–criteria analysis is presented below:

Table 1.6 A: Final Results of Multi Criteria Analysis

Proposed Route										
Sl No	Criteria	No of Points	Road Route				Multimodal Route			
			R-1 (Length =123.54 Km)	R-2 (Length=50.25 Km)	R-3 (Length=97.17 Km)	R-4 (Length=106.12 Km)	M-1 (Length=70.98 Km)	M-2 (Length=66.80 Km)	M-3 (Length=94.11 Km)	M-4 (Length=97.60 Km)
1	Technical and Engineering Feasibility	10	6.81	7.92	7.37	6.95	7.25	6.26	6.66	7.26
2	Adverse Environmental Impact	10	4.5	3.5	1.25	4.25	6.75	5.75	5.75	6.75
3	Social Impact	10	1.5	3	5.5	2.75	5.5	2.75	3	5.25
4	Poverty	10	7.5	10	7.5	5	5	5	5	5
5	Present Inaccessibility to reach the road head	10	9.37	9.49	9.63	9.74	7.13	2.15	1.83	6.82
6	Travel time saving after construction from origin of proposed Route to Thegamukh	5	4.5	4.41	4.38	4.5	1.24	3.15	2.59	0.95
7	Less improvement required to existing road to Chittagong	10	8.22	6.59	6.42	8.77	7.79	7.79	7.21	7.21
8	Less time of travel between Chittagong to Thegamukh	10	3.28	2.16	0	4.43	1.97	3.69	1.67	0
9	Population served per Km of connectivity within zone of Influence	5	2	5	3	4	5	5	2	2
10	Length of the road covered by spending US$ 1 million project	10	10	4.37	6.98	9.30	7.30	6.18	8.67	10
11	People's Perception for the Project	10	10	3	3	3	10	10	10	10
	Total Score	**100**	**67.68**	**59.44**	**55.03**	**62.69**	**64.93**	**57.72**	**54.38**	**61.24**

- The above results of Multi-Criteria analysis indicates that have the highest score. Thus these alignments have been selected for detailed feasibility study. **Figure 1.6** gives the selected route alignments.
  - Among four land routes the road alignment: **Rajosthali–Bilaichhari–Juraichhari–Barkal–Thegamukh (123.54 km) and**
  - Among the Multimodal routes the alignment: **Rangamati–Chhotoharina–connected by waterway (63 Km) and Thegamukh by road (about 7.98 km)**

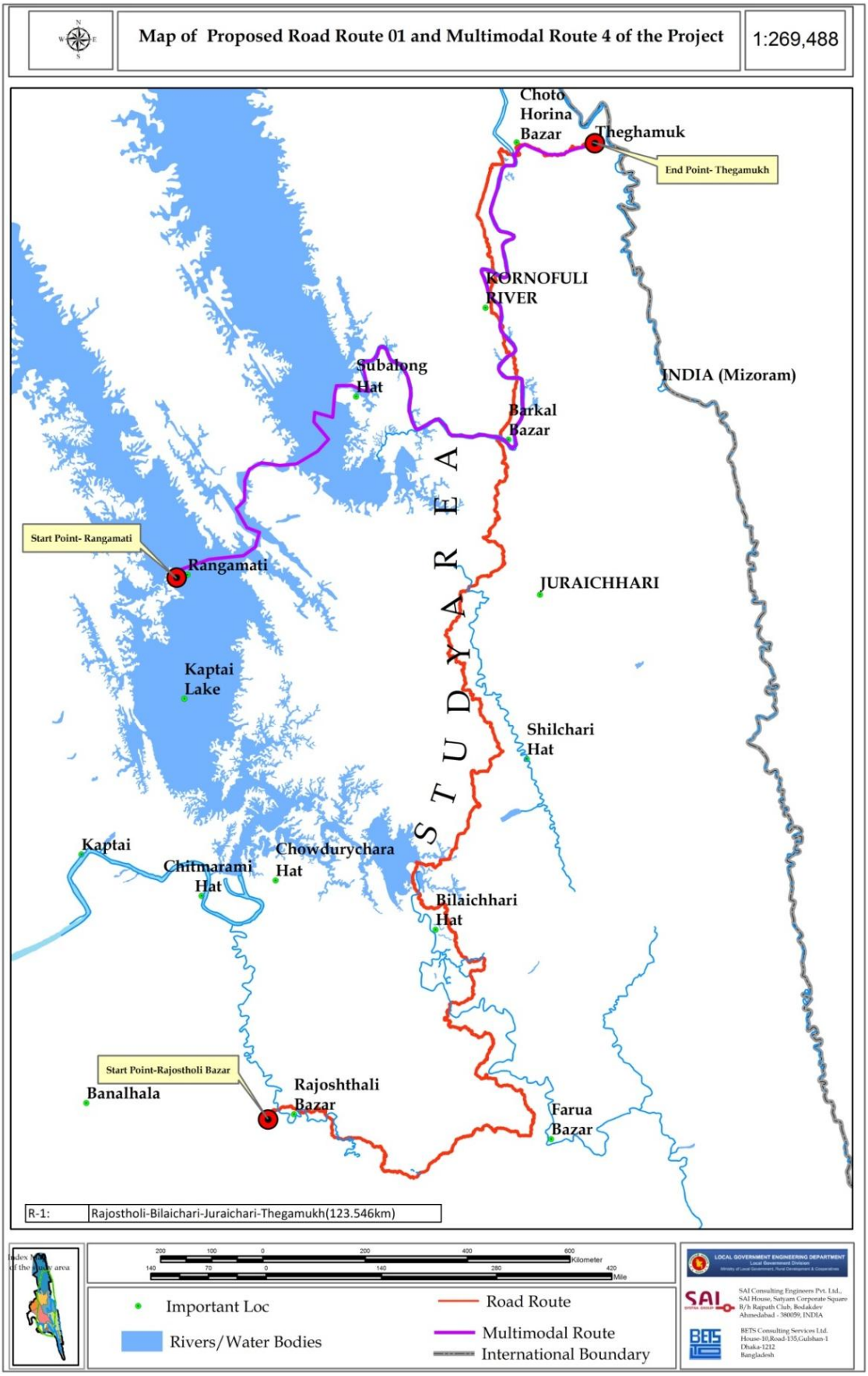


Figure 1.6 gives the selected route alignments.

Table 1.6 B: Lengths of Proposed Routes from Chittagong Port after Screening

Sl. No.	Road No.	Name of the Route	From Chittagong to Starting Point*	From Starting Point to Thegamukh#	Distance (Km)
All Road Routes					
1	R -1	Rajosthali-Bilaichhari-Jurichhari-Thegamukh	Chittagong-Rajosthali (79.062 Km)	Rajosthali-Bilaichhari-Jurichhari-Thegamukh (123.546 Km)	202.608
Multi-Modal (i.e. IWT and Road) Routes					
1	M -1	Rangamati-Chhotohornia by waterway and then by road up to Thegamukh	Chittagong–Rangamati (78.049 Km)	Rangamati- Chhotohornia by waterway and then by road up to Thegamukh (70.98 Km)	148.036

Note: ** The roads from Chittagong to the starting point are all-weather bitumen surfaced roads and are under Roads and Highway Department (RHD), Government of Bangladesh. From the starting point to Thegamukh, there are only tracks and are under Local Government Engineering Department (LGED), Government of Bangladesh*

- After selection of routes by multicriteria analysis the **Stake Holder Consultation** was done in the month of December 2015 and also stakeholder meeting was organized by Executive Engineer, LGED, Rangamati in the month of May 2016 and it was conveyed that out of eight alignments two have been selected and would be taken for feasibility study. The details of Stekeholder meeting is presented in **Volume ID Social Screening and Scoping Report.**

1.7 Feasibility Study of Selected Alignments

Topographic Surveyshave been conducted on the selected alignments and discussed in Chapter 5 and topographic details were indicated with the chainage called as 'Existing Chainage' later based on available topographic data highway design has been carried out and due to refinement of horizontal and vertical highway alignment the total length of proposed alignment has reduced from 114.751 Km to 109.675 km. The **Table 1.7 A and 1.7 B** gives design changes corresponding to existing changages for Road Route and Multimodal Route. This table has been included in order to avoid any confusion due to two chainage. Other details related to feasibility study are given in subsequesnt chapters of this report.

Table 1.7A: Details of Existing Chainange and Design Chainage for Road Route.

Section of the Road	Existing Chainage		Design Chainage	
	Start to End	Length (km)	Start to End	Length (km)
a. Rajosthali to Bilaichari	Ch.0+000-49+100	49.1	Ch.0+000-47+066	47.066
b.Bilaichari - Jurichari	Ch.49+100-78+536	29.436	Ch.47+066-75+157	28.091
c. Jurichari - Barkal	Ch.78+536-85+385	6.849	Ch.75+157-81+600	6.443
d. Barkal to Chottohorina	Ch 85+385-106+662	21.277	Ch.81+600-102+098	20.498
e. Chotohorina to Thegamukh	Ch 106+662-114+751	8.089	Ch.102+098-109+675	7.577
Total Length=		**114.751**		**109.675**

Table 1.7B: Details of Existing Chainange and Design Chainage for Multimodal Route.

Section of the Road	Existing Chainage		Design Chainage	
	Start to End	Length (km)	Start to End	Length (km)
a. Rangamati-Chotohorina	Waterway	63	Waterway	63
b.Chotohorina-Thegamukh	Ch.0+000-8+089	8.089	Ch.0+000-7+370	7.370
Total Length=		**71.089**		**70.370**

1.8 Structure of the Feasibility Report

This Feasibility report is prepared in accordance with Reporting Requirements of the Contract agreement. The report contains the following Volumes with contents mentioned below:

Volume IA **Main Feasibility Report**

Executive Summary

Chapter 1 - Introduction

Chapter 2 - Description of Existing Proposed Project Road and Existing Road connecting Chittagong Port to Origin of Proposed Road Route/ Multimodal Route

Chapter 3 - Traffic Analysis and Forecasts for Road and Multimodal Routes

Chapter 4 - Design Standards for Road and Waterways

Chapter 5 - Engineering Surveys and Investigations

Chapter 6 - Improvement Proposals for Proposed Road and Multimodal Routes

Chapter 7 - Economic Appraisal of Road and Multimodal Route

Chapter 8 - Conclusions and Recommendations

Volume IB **Annexure**

Volume IC **Environmental Screening and Scoping Report**

Volume ID **Social Screening and Scoping Report**

Volume II **Cost Estimates**

Volume II A: Cost Estimates for Road Route

Volume II B: Cost Estimates for Multi Modal Route

Volume III **Structural Drawings of Road and Multimodal Route**

Volume III A

1. **General Alignment Plan (1:25000 Scale)**
   - i) Road Route (Rajosthali to Thegamukh)
   - ii) Waterway (Rangamati to Chotoharina)
   - iii) Section of waterway
   - iv) Longitudinal Profile of waterway
   - v) Road Part of Multimodal route (Chottoharina to Thegamukh)
2. **Plan with GPS Coordinates (1:5000 vertical & 1:50000 horizontal Scale)**
   - i) Road Route (Rajosthali to Thegamukh)

ii) Road part of Multimodal route (Chottoharina to Thegamukh)

3. **Drawings of Structures (Bridges, Culverts, Retaining Wall and other structures for Road way, Structures for Water way)**

Volume III B
Drawings of Plan & Sectional Elevation of Bridge in 1:200 Scale

Volume IV — **Digitized GPS Photographs with Coordinates Presented in Compact disk (7Copies)**
&
Stakeholder Consultation Meeting Video Program, Photograph & Attendence Sheet are presented in Compact Disk (7 Copies)

CHAPTER - 2

Description of Existing Proposed Project Road and Existing Road Connecting Chittagong Port to Origin of Proposed Road Route/ Multimodal Route

CHAPTER - 2

Description of Existing Proposed Project Road and Existing Road Connecting Chittagong Port to Origin of Proposed Road Route/ Multimodal Route

2.1 General

This project basically aims to improve the connectivity between Chittagong port to remote area of North–East (N-E) districts, which may lead to development of cross border transit corridors to N–E states of India.As decided in Screening report these corridors are combination of water and land routes in order to improve accessibility for the marginalized people of Chittagong Hill Tracts area connecting to the border. One of the borders crossing points is at Thegamukh, which lies in the Chittagong Hill Tracts districts on the eastern side of Kaptai Lake and at the border with the State of Mizoram in India. At present, the place is inaccessible by road; the **Figure 2.1** gives details of existing roads in the CHT area. The physical feature in this area is rolling hills with limited plains, full of vegetation with some forests. The soil geology is mostly silt clay with soft sand stone in some areas. Although "katcha" motor able roads are shown in the LGED map for the proposed routes. Only a stretch of about 14101.01 m was found along the alignment to have Herring Bone Bond (HBB) roads with some old jeeps used as public transportation. People use waterway and foot trails to reach their settlements in these areas including Thegamukh.

After screening the consultant has identified two routes one by land and otherone is Multimodal i.e. combination of land and waterway for providing connectivity between Chittagong port to Thegamukh. The identified routes are:

Land Route: Rajosthali–Bilaichhari–Juraichhari–Barkal–Thegamukh (Survey (Existing) 114.751 km, Design Length: 109.67 Km)

Multimodal Route: Rangamati–Chhotoharina–connected by waterway (63 Km) and Thegamukh by road (Survey (Existing) 8.089 km, Design Length: 7.37Km)

The following section discusses the existing site conditions related to these routes.

2.2 Existing Project Roads and Water ways

Existing road from Rajosthali–Bilaichhari–Juraichhari–Barkal–Thegamukh, Survey Existing 114.751 km, Design Length: 109.67 Km

The existing road in land Route Rajosthali–Bilaichhari–Juraichhari–Barkal–Thegamukhisof length 114.751 km. The first segment of the proposed alignment, i.e.

a) **Rajosthali to Bilaichari (49.100 km)** is found 674.67m(Avg. carriage way 4.4m) paved by bituminous carpeting (BC) in green vicinity in hilly terrain and other parts are earthen

road where 8 nos(645.90m). RCC Bridges/Culvert are existed. Some missing links are found which aggregated 3226.68m. It is surveyed that 14 nos. Bridges/Culverts are required in different locations.

b) **Bilaichari–Jurichari (29.436 km.)** portion 1053.72 m paved road by Herring Bone Bond (HBB) with 3.217 m width is seen and 6 nos. (142.17m) Bridges/Culvert are existed. It is surveyed that further 15 nos. Bridges/Culverts are required in this portion. Some missing links aggregated 235.121 m are found in different locations. Other parts of the alignment are earthen roads. In this portion remarkable numbers of water lands (Chhara/Canal)) are seen.

c) **Jurichari–Barkal(6.849 km.)** section 3 nos (87.81m)existing Bridges are found.

In this initially proposed alignment total 7 nos of Bridges/Culverts are required. In the hilly terrain the proposed alignment following the existing walkway or village road passes almost north direction within the green vicinity. In **d) Barkal–Chhotoharina (21.277 km.)** section 1187.40 m HBB road with 3 m width and 14 nos(308.49m) Bridges/Culverts are seen. Other parts of the alignment are earthen road where 22 nos Bridges/Culverts are required. In **e) Chhotoharina–Thegamukh (8.089 km.)** section 134.19 m HBB road with very narrow width of 1.5 m and 2 nos (79.32m) Bridges have been seen. Further 3 nos. Bridges are required in this section.

Multimodal Route 1: Rangamati - Chotoharina by waterway (63 km) and Thegamukh by road (8.089 km), (Proposed total length: 71.089 Km)

This route enroutes to Chotohorina via Shobolong, Barkal, Bhusionchar. It is about 63km. Chotohorina to Thegamukh is 8.089 km by road. Rangamati to Barkal 37.5 km is navigable round the year for small launches and boats. For larger cargo vessels navigable depth will need to be increased by dredging. Barkal to Chotohorina is navigable during monsoon for 3-4 months. This part of the waterway (25.5 km) will need massive dredging to increase navigable depth. **Chhotoharina–Thegamukh** portion 134.19m paved road by Herring Bon Bond (HBB) with 1.5 m width is seen and other parts are earthen road. 2 nos (79.32m) Bridges are existed & 2 Bridges are required.

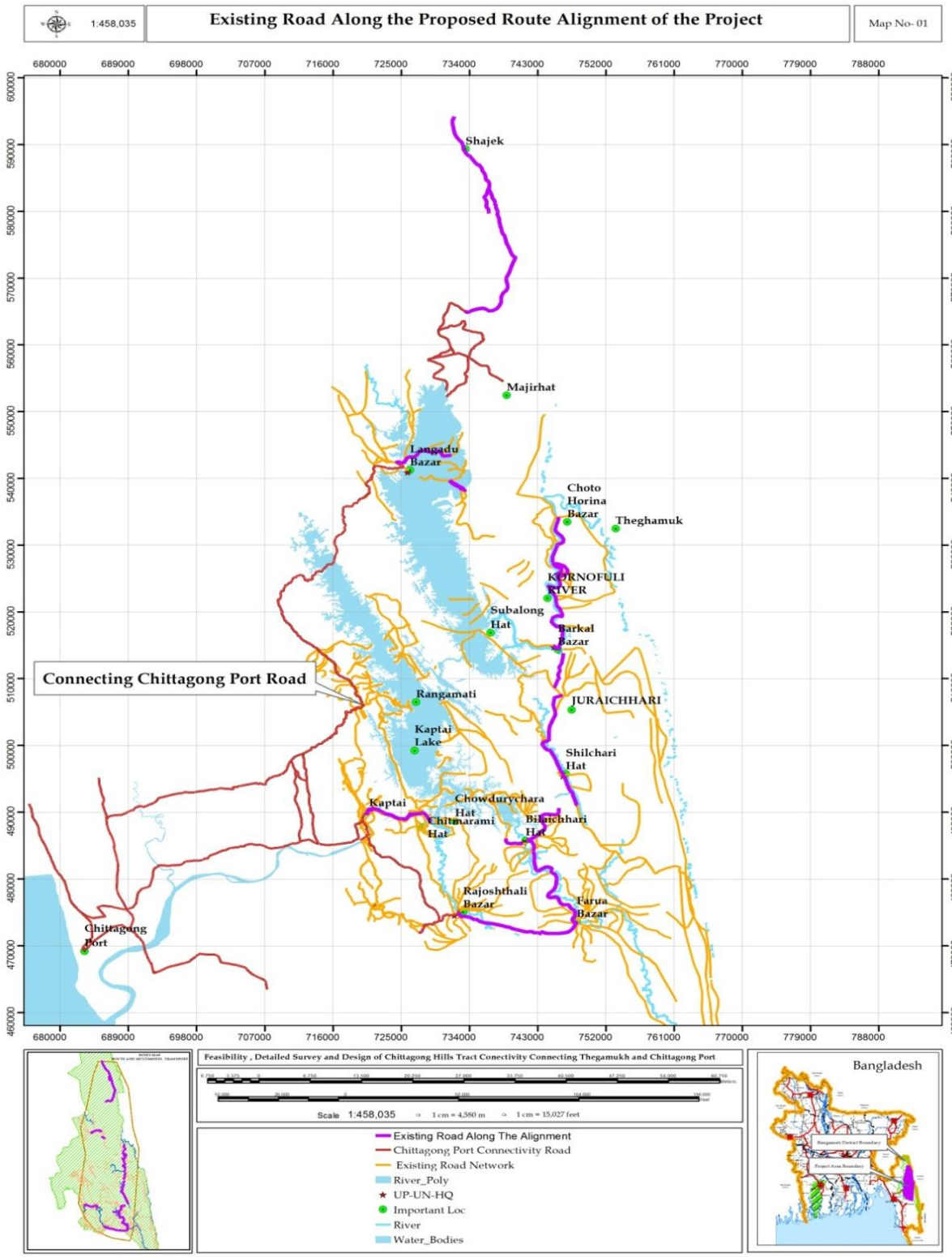


Figure 2.1: Details of existing roads in the CHT area

Following Table 2.2 A and 2.2B indicates the details of road exising from Rajosthali to Thegamukh and Rangamati to Thegamukh and their details in terms of width of road, type of roads, missing link etc are given in **Annex 2.2A and 2.2B**

Table 2.2A: Details of Existing Road Inventory from Rajosthali to Thegamukh (Road Route)

Section of the Road	Owner of the Road	Location	Length (km)	Earthen Road (m)	Pavement Road (m)	RCC Road (m)	Bridge		Culvert		HBB Road (m)	Missing Link (m)	Remark
							Nos	Length (m)	Nos	Length (m)			
a.Rajosthali to Bilaichari (Ch.0+000-49+100)	LGED	**Upozila**: Rajostholi, Bilaichari **District:** Rangamati	49.100	32713.12	674.67	113.90	7	642.60	1	3.30	11725.7	3226.68	
b.Bilaichari - Jurichari (Ch.49+100-78+536)	LGED	**Upozila:** Bilaichari, Juraichhari **District**: Rangamati	29.436	28005.43	N/A	N/A	5	139.30	1	2.87	1053.72	235.121	
c.Jurichari - Barkal (Ch.78+536-85+385)	LGED	**Upozila:** Juraichhari, Barkal **District:** Rangamati	6.849	6237.84	N/A	N/A	3	87.81	N/A	N/A	N/A	522.63	
d. Barkal to Chottohorina (Ch 85+385-106+662)	LGED	**Upozila:** Barkal **District:** Rangamati	21.277	15704.09	N/A	N/A	14	308.49	N/A	N/A	1187.40	4076.86	
e. Chotohorina to Thegamukh (Ch 106+662-14+751)	LGED	**Upozila:** Barkal **District:** Rangamati	8.089	7845.05	N/A	N/A	2	79.32	N/A	N/A	134.19	30.55	
Total Length=			**114.751**										

Table 2.2 B: Details of Existing Road Inventory fromRangamati to Thegamukh (Multimodal Route)

Section of the Road	Owner of the Road	Location	Length (km)	Type of way	Earthen Road (m)	Pavement road (m)	RCC Road (m)	Bridge		Culvert		HBB Road (m)	Missing Link (m)	Remark
								Nos	Length (m)	Nos	Length (m)			
a.Rangamati to Chotoharina	BIWTA	**Upozila:** Rangamati Sadar, Barkal **District:** Rangamati	63	Waterway	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
b.Chotoharina to Thegamukh (Ch.0+000-8+089)	LGED	**Upozila:** Barkal **District:** Rangamati	8.089	Roadway	7845.05	N/A	N/A	2	79.32	N/A	N/A	134.19	30.55	
Total Length=			**71.089**											

2.3 Traffic Flows on Road Routes and Multimodal Routes

The proposed routes from the starting point up to Thegamukh are walking tracks and are under the Local Government Engineering Department (LGED) of GOB.While for RHD road sections traffic data i.e. Annual Average Daily Traffic (AADT) are collected by RHD through volume count surveys, no such data are available for LGED sections as these are tracks and no vehicle traffic moves on them. Given this situation, it is not possible to collect AADT for a base year through conduct of traffic volume counts. In view of this, the consultants have attempted to make a broad estimate of AADT for the base year on these LGED sections assuming continuation of the "***existing RHD road sections into the new sections from the starting point up to Thegamukh***". Thus a part from some upazillas like Barkal which can be reached by IWT, the only means of connectivity in most of the study area (i.e. upazillas through which the proposed route alignments pass through) are "***walking tracks.***

In the case of IWT traffic movements (goods as well as passenger) by inland water transport (IWT) between Rangamati and Chotoharina, all the services are run by private operators and no recorded data are available. During the Consultants discussions with senior officials of Rangamati Hill District Council (RHDC) and Secretary Launch Owners' Association, Rangamati, the following points emerged.

- Every day three launches operate each way between Rangamati and Chotohorina
- Each launch trip, on an average, carries 100 passengers
- On an average, these launches operate for 330 days/year
- Every day about 35 trucks, which carry fish, fruits, forest and agriculture product, etc that are collected from the study area (i.e. Rangamati–Barkal–Chotohorina–Thegamukh) by IWT, move out of Rangamati towards Chittagong and beyond.
- Similar number of trucks comes into Rangamatieveryday and these goods are further transported by IWT for destinations in the study area.
- Each truck, on an average, carries 8 tonnes.
- On an average, each truck operates for 330 day/year

Based on the above information, base year (2015) traffic estimates have been worked for IWT and are presented in **Table 2.3**

Table 2.3: Base Year (2015) IWT Traffic Estimate

O-D Pair	Traffic	Base Year 2015
Goods Traffic		
Rangamati-Chotohorina	Tonnes/day	280
	Tonnes/year	92,400
Chotohorina-Rangamati	Tonnes/day	280
	Tonnes/year	92,400
Total – Bothways	Tonnes/day	560
	Tonnes/year	184,800
Passenger Traffic		
Rangamati-Chotohorina	Passengers/day	600
	Passengers/year	198,00
Chotohorina-Rangamati	Passengers/day	600
	Passengers/year	198,00
Total–Both ways	Passengers/day	1,200
	Passengers/year	396,000

Further details related to base year traffic. Analysis and forecasts are provided in Chapter 3 of this report.

2.4 Cross Drainage Structures & Road Ownership on Road Route and Road Portion of Multimodal Route.

Existing cross drainage structures have been studied and also probability of provision of new cross drainage structures have been identified at missing link.Following **Table 2.4 A and 2.4 B** give details of then along with Ownwrship of road

Table: 2.4 A Indicating cross draianage structure (Road Route)

From Chittagong to Rajosthali

Location	ID	Name	Chainage (km)	Length (m)	Carriageway/ Witdh (m)	Condition	Type	Bridge Name
Chittagong Port to Raster Mata	1	Bridge	2.000	320.000	16.00	Good	Bridge	Dewan Hat Bridge
	2	Bridge	6.500	7.100	31.00	Good	Box Culvert	
	3	Bridge	7.282	5.400	18.00	Good	Box Culvert	
	4	Bridge	8.069	3.800	18.00	Good	Box Culvert	
	5	Bridge	8.385	5.800	21.00	Good	Box Culvert	
	6	Bridge	8.717	4.400	29.70	Good	Box Culvert	
	7	Bridge	9.056	7.400	21.00	Good	Box Culvert	
	8	Bridge	9.674	4.700	20.00	Good	Box Culvert	
	9	Bridge	10.139	23.000	9.00	Good	Bridge	
	10	Bridge	10.923	2.100	27.00	Good	Box Culvert	
Raster Matha To Chandragona	1	Bridge	0.953	9.600	8.00	Good	Box Culvert	
	2	Bridge	3.130	5.100	7.00	Good	Box Culvert	
	3	Bridge	3.680	8.000	12.00	Good	Box Culvert	
	4	Bridge	4.608	20.600	8.00	Good	Bridge	
	5	Bridge	4.926	224.200	6.50	Good	Bridge	
	6	Bridge	6.267	3.600	17.50	Good	Pipe Culvert	
	7	Bridge	7.338	3.600	17.50	Good	Pipe Culvert	
	8	Bridge	7.480	3.600	17.50	Good	Pipe Culvert	
	9	Bridge	7.680	3.600	17.80	Good	Pipe Culvert	
	10	Bridge	8.060	3.600	17.80	Good	Pipe Culvert	
	11	Bridge	9.871	3.600	17.80	Good	Pipe Culvert	
	12	Bridge	10.668	25.000	7.50	Good	Bridge	
	13	Bridge	11.395	1.600	14.70	Good	Pipe Culvert	
	14	Bridge	11.510	3.600	17.80	Good	Pipe Culvert	
	15	Bridge	11.795	3.500	9.90	Good	Box Culvert	
	16	Bridge	12.225	3.500	9.10	Good	Box Culvert	
	17	Bridge	13.105	2.800	9.10	Good	Box Culvert	
	18	Bridge	13.360	24.200	6.00	Good	Sluice gate Bridge	Nawahat Sluice gate
	19	Bridge	13.959	1.600	17.70	Good	Pipe Culvert	
	20	Bridge	14.662	10.000	9.80	Good	Pipe Culvert	
	21	Bridge	15.192	3.600	17.80	Good	Box Culvert	

Location	ID	Name	Chainage (km)	Length (m)	Carriageway/ Witdh (m)	Condition	Type	Bridge Name
	22	Bridge	16.827	6.600	9.80	Good	Box Culvert	
	23	Bridge	19.099	1.600	14.70	Good	Box Culvert	
	24	Bridge	20.490	1.600	14.70	Good	Pipe Culvert	
	25	Bridge	20.940	1.600	15.30	Good	Pipe Culvert	
	26	Bridge	21.484	1.800	14.80	Good	Box Culvert	
	27	Bridge	22.971	12.900	8.00	Good	Box Culvert	
	28	Bridge	23.059	3.800	9.50	Good	Box Culvert	
	29	Bridge	23.911	11.000	10.50	Good	Box Culvert	
	30	Bridge	24.269	1.600	10.50	Good	Box Culvert	
	31	Bridge	24.704	3.800	9.70	Good	Box Culvert	
	32	Bridge	25.248	15.500	7.80	Good	Box Culvert	
	33	Bridge	25.651	54.600	6.00	Good	Sluice gate Bridge	Rajarhat Sluice gate Bridge
	34	Bridge	25.753	34.400	6.50	Good	Sluice gate Bridge	Rajarhat Sluice gate Bridge
	35	Bridge	26.476	2.000	18.20	Good	Box Culvert	
	36	Bridge	27.594	18.500	6.00	Good	Sluice gate Bridge	
	37	Bridge	28.342	3.400	9.20	Good	Box Culvert	
	38	Bridge	28.957	3.400	9.30	Good	Box Culvert	
	39	Bridge	29.567	3.400	9.30	Good	Box Culvert	
	40	Bridge	30.239	9.900	6.40	Good	Sluice gate Bridge	
	41	Bridge	32.446	5.800	9.40	Good	Box Culvert	
Chandragona To Bangalhalia		River	20.175	315.000	315.00	River		
	1	Bridge	21.085	21.500	4.00	Good	Bailey Bridge	Raikhali Bridge
	2	Bridge	21.738	1.600	7.50	Good	Box Culvert	
	3	Bridge	22.711	1.600	9.00	Good	Box Culvert	
	4	Bridge	23.275	1.600	9.00	Good	Box Culvert	
	5	Bridge	26.959	1.800	8.60	Good	Box Culvert	
	6	Bridge	32.085	18.400	4.00	Good	Bailey Bridge	Bangalhalia Bridge
Bangalhalia To Rajasthali	1	Bridge	0.038	1.800	7.00	Good	Box Culvert	
	2	Bridge	0.194	1.800	7.00	Good	Box Culvert	
	3	Bridge	3.019	25.000	3.70	Good	Bailey Bridge	
	4	Bridge	3.104	6.800	6.80	Good	Box Culvert	
	5	Bridge	3.584	1.100	6.50	Good	Box Culvert	
	6	Bridge	17.640	42.800	9.60	Good	Bridge	
	7	Bridge	19.623	61.600	4.00	Good	Bailey Bridge	

From Rajosthali to Thegamukh

Location	Chainage(m)			Length (m)	Road/Bridge Width (m)	Existing Feature Types	Ownership	LGED Road Code No
	Ch-Start	To	CH-End					
Rajostholi to Bilaichhari	0.000	to	23.961	Pavement Road			LGED	UNR-484783004
	23.961	to	27.261	3.300	6.100	UNR-484783004	LGED	
	27.261	to	348.064	walkway				
	348.064	to	409.958	61.895	4.108	UNR-484783004	LGED	
	409.958	to	739.865	Pavement Road			LGED	UNR-484783004
	739.865	to	3742.484	HBB Road			LGED	UNR-484783004
	3742.484	to	5129.191	Earthen Road				UNR-484783004
	5129.191	to	5161.306	32.115	Chhara			
	5161.306	to	8358.958	Earthen Road				
	8358.958	to	8387.152	28.195	Chhara			
	8387.152	to	11834.515	Earthen Road				
	11834.515	to	11864.893	30.379	Chhara			
	11864.893	to	14717.324	Footpath				
	14717.324	to	19333.349	Earthen Road				
	19333.349	to	19344.035	10.686	Chhara			
	19344.035	to	20964.871	Earthen Road				
	20964.871	to	20973.654	8.783	1.654	UZR-484292001	LGED	UZR-484292001
	20973.654	to	21030.301	Earthen Road				
	21030.301	to	21035.704	5.403	1.064	UZR-484292001	LGED	UZR-484292001
	21035.704	to	21212.085	Earthen Road				
	21212.085	to	21217.312	5.227	1.051	UZR-484292001	LGED	UZR-484292001
	21217.312	to	22772.354	Earthen Road				
	22772.354	to	22886.256	RCC Road			LGED	UZR-484292001
	22886.256	to	22952.760	Earthen Road				UZR-484292001
	22952.760	to	22956.183	3.422	Chara			
	22956.183	to	33468.496	Earthen Road				UZR-484292001
	33468.496	to	33509.626	41.130	Chhara	UZR-484292001		
	33509.626	to	39587.275	Earthen Road				UZR-484292001
	39587.275	to	39815.599	228.324	Footpath	UZR-484292001		
	39815.599	to	40106.141	290.542	5.694	UZR-484292001	LGED	
	40106.141	to	47788.051	HBB Road			LGED	UZR-484292001
	47788.051	to	47918.691	130.640	4.310	UZR-484292001	LGED	
	47918.691	to	48183.769	HBB Road			LGED	UZR-484292001
	48183.769	to	48323.886	140.116	5.370	UZR-484292001	LGED	
	48323.886	to	49100.000	HBB Road			LGED	UZR-

Location	Chainage(m)			Length (m)	Road/Bridge Width (m)	Existing Feature Types	Ownership	LGED Road Code No
	Ch-Start	To	CH-End					
								484292001
Bilaichhari to Juraichhari	49100.000	to	50153.721	HBB Road			LGED	UZR-484292001
	50153.721	to	50841.620	Earthen Road				UZR-484292001
	50841.620	to	50970.015	128.395	Chhara	Chhara		UZR-484292001
	50970.015	to	51829.465	Earthen Road				UZR-484292001
	51829.465	to	51846.363	16.897	Chhara	Chhara		UZR-484292001
	51846.363	to	59896.056	Earthen Road				UZR-484292001
	59896.056	to	59903.271	7.215	Chhara	Chhara		UZR-484292001
	59903.271	to	62201.521	Earthen Road				UZR-484292001
	62201.521	to	62209.349	7.828	Chhara	Chhara		UZR-484292001
	62209.349	to	62971.533	Earthen Road				UZR-484292001
	62971.533	to	62978.156	6.623	Chhara	Chhara		UZR-484292001
	62978.156	to	64093.074	Earthen Road				UZR-484292001
	64093.074	to	64095.938	2.865	4.056	Existing Culvert	LGED	UZR-484292001
	64095.938	to	65335.951	Earthen Road				UZR-484292001
	65335.951	to	65370.102	34.151	1.270	Wooden Bridge		UZR-484292001
	65370.102	to	65608.381	Earthen Road				UZR-484292001
	65608.381	to	65611.988	3.608	4.487	Existing Bridge	LGED	UZR-484292001
	65611.988	to	66849.652	Earthen Road				UZR-484292001
	66849.652	to	66855.339	5.687	Chhara	Chhara		UZR-484292001
	66855.339	to	68975.895	Earthen Road				
	68975.895	to	68994.628	18.733	Chhara	Chhara		
	68994.628	to	70175.109	Earthen Road				
	70175.109	to	70183.944	8.835	Chhara	Chhara		
	70183.944	to	72235.415	Earthen Road				
	72235.415	to	72270.324	34.909	Chhara	Chhara		
	72270.324	to	77081.639	Earthen Road				
	77081.639	to	77089.830	8.191	2.870	Existing Bridge	LGED	UZR-484292005
	77089.830	to	77231.353	Earthen Road				UZR-484292005
	77231.353	to	77318.040	86.687	6.117	Existing Bridge	LGED	UZR-484292005

Location	Chainage(m)			Length (m)	Road/Bridge Width (m)	Existing Feature Types	Ownership	LGED Road Code No
	Ch-Start	To	CH-End					
	77318.040	to	77940.857	Earthen Road				UZR-484292005
	77940.857	to	77947.520	6.663	6.235	Existing Bridge	LGED	UZR-484292005
	77947.520	to	78536.433	Earthen Road				UZR-484292005
Juraichhari to Barkal	78536.433	to	78779.785	243.351	Chhara/Missing	Missing Link		UZR-484472003
	78779.785	to	78884.999	Earthen Road				UZR-484472003
	78884.999	to	78896.643	11.644	4.384	Existing Bridge	LGED	UZR-484472003
	78896.643	to	78996.006	Earthen Road				UZR-484472003
	78996.006	to	79002.077	6.071	4.333	Existing Bridge	LGED	UZR-484472003
	79002.077	to	79292.012	Earthen Road				UZR-484472003
	79292.012	to	79362.111	70.099	1.274	Existing Bridge	LGED	UZR-484472003
	79362.111	to	80103.883	Earthen Road				UZR-484472003
	80103.883	to	80131.556	27.673	Chhara	Missing Link		UZR-484472003
	80131.556	to	83331.256	Earthen Road				UZR-484472003
	83331.256	to	83344.094	12.838	Chhara	Missing Link		
	83344.094	to	84588.964	Earthen Road				UZR-484472003
	84588.964	to	84599.817	10.853	Chhara	Missing Link		
	84599.817	to	85156.797	Earthen Road				UZR-484472003
	85156.797	to	85384.711	227.914	River	River		
Barkal to Chotoharina	85384.711	to	85414.863	30.152	Missing	Missing Link		
	85414.863	to	86918.927	Earthen Road				UPZ-484212001
	86918.927	to	86936.825	17.898	Chhara	Missing Link		
	86936.825	to	88126.540	Earthen Road				UPZ-484212001
	88126.540	to	88292.492	165.952	River	River		
	88292.492	to	91720.015	3427.523	Marshy Land/Chhara	Missing Link		
	91720.015	to	94291.406	Earthen Road				
	94291.406	to	95011.949					UPZ-484212001
	95011.949	to	95055.799	43.850	2.059	Existing Bridge	LGED	UPZ-484212001
	95055.799	to	95522.651	HBB Road			LGED	UPZ-484212001
	95522.651	to	95561.773	39.122	2.441	Existing Bridge	LGED	UPZ-484212001
	95561.773	to	95973.167	Earthen Road				UPZ-484212001

Location	Chainage(m)			Length (m)	Road/Bridge Width (m)	Existing Feature Types	Ownership	LGED Road Code No
	Ch-Start	To	CH-End					
	95973.167	to	95996.472	23.305	2.469	Existing Bridge	LGED	UPZ-484212001
	95996.472	to	97334.003	Earthen Road				UPZ-484212001
	97334.003	to	97461.519	127.516	River	River		
	97461.519	to	97570.930	109.411	Missing	Missing Link		
	97570.930	to	100182.114	Earthen Road				UPZ-484212001
	100182.114	to	100193.891	11.778	4.364	Existing Bridge	LGED	UPZ-484212001
	100193.891	to	100944.814	Earthen Road				UPZ-484212001
	100944.814	to	100951.599	6.784	4.295	Existing Bridge	LGED	UPZ-484212001
	100951.599	to	101725.574	Earthen Road				UPZ-484212001
	101725.574	to	101755.251	29.676	4.370	Existing Bridge	LGED	UPZ-484212001
	101755.251	to	103338.302	Earthen Road				UPZ-484212001
	103338.302	to	103361.763	23.461	4.273	Existing Bridge	LGED	UPZ-484212001
	103361.763	to	103481.112	Earthen Road				UPZ-484212001
	103481.112	to	103489.055	7.943	4.272	Existing Bridge	LGED	UPZ-484212001
	103489.055	to	103709.674	Earthen Road				UPZ-484212001
	103709.674	to	103736.249	26.575	3.096	Existing Bridge	LGED	UPZ-484212001
	103736.249	to	103960.805	Earthen Road				UPZ-484212001
	103960.805	to	103987.271	26.466	3.109	Existing Bridge	LGED	UPZ-484212001
	103987.271	to	104069.610	Earthen Road				UPZ-484212001
	104069.610	to	104081.493	11.883	4.298	Existing Bridge	LGED	UPZ-484212001
	104081.493	to	104845.704	Earthen Road				UPZ-484212001
	104845.704	to	104855.780	10.076	4.295	Existing Bridge	LGED	UPZ-484212001
	104855.780	to	105377.157	Earthen Road				UPZ-484212001
	105377.157	to	105408.733	31.575	1.601	Existing Bridge	LGED	UPZ-484212001
	105408.733	to	106305.600	Earthen Road				UPZ-484212001
	106305.600	to	106321.598	15.998	4.331	Existing Bridge	LGED	UPZ-484212001
	106321.598	to	106463.144	Earthen Road				UPZ-484212001
	106463.144	to	106495.148	32.003	Missing	Missing Link		
	106495.148	to	106661.551	166.404	158.830	River		

Location	Chainage(m)			Length (m)	Road/Bridge Width (m)	Existing Feature Types	Ownership	LGED Road Code No
	Ch-Start	To	CH-End					
Chotoharina to Thegamukh	106661.551	to	106832.850	Earthen Road				UNR-484213004
	106832.850	to	106894.025	61.175	1.563	Existing Bridge		UNR-484213005
	106894.025	to	108226.548	Earthen Road				UNR-484213006
	108226.548	to	108227.673	1.125	Chhara	Missing Link		
	108227.673	to	113130.745	Earthen Road				UNR-484213004
	113130.745	to	113160.170	29.425	Chhara	Missing Link		
	113160.170	to	114148.386	Earthen Road				UNR-484213004
	114148.386	to	114166.531	18.145	1.854	Existing Bridge	LGED	UNR-484213004
	114166.531	to	114304.224	Earthen Road			LGED	UNR-484213004
	114304.224	to	114438.415	HBB Road			LGED	UNR-484213004
	114438.415	to	114750.772	Earthen Road			LGED	UNR-484213004

Table: 2.4 B indicating cross draianage structure (Multimodal Route)

From Chittagong to Rangamati

Location	ID	Name	Chainage (km)	Length (m)	Carriageway /Witdh (m)	Condition	Type	Bridge Nsme
Chittagong port to Oxygen More	1	Bridge	2.000	320.000	16.000	Good	Bridge	Dewan hat Bridge
	2	Bridge	6.600	7.200	25.400	Good	Box Culvert	Nasirabad Bridge
	3	Bridge	7.252	7.200	29.400	Good	Box Culvert	
	4	Bridge	7.609	4.400	23.000	Good	Box Culvert	
	5	Bridge	8.402	4.400	23.000	Good	Box Culvert	
	6	Bridge	8.690	4.400	23.000	Good	Box Culvert	
	7	Bridge	9.267	4.400	23.000	Good	Box Culvert	
	8	Bridge	14.816	4.400	23.000	Good	Box Culvert	
	9	Bridge	15.368	17.100	20.000	Good	Bridge	
Oxygen More to Hathazari	10	Bridge	0.480	3.700	17.50	Under Conostraction	Box Culvert	Chadni Hall Culvert
	11	Bridge	0.648	2.300	7.00	Under Conostraction	Box Culvert	
	12	Bridge	0.822	16.900	3.60	Good	Box Culvert	
	13	Bridge	1.280	3.600	16.40	Good	Box Culvert	
	14	Bridge	2.156	13.300	11.00	Under Conostraction	Box Culvert	
	15	Bridge	2.532	18.700	7.30	Good	Bridge	Notun Para Bridge
	16	Bridge	3.317	4.500	17.00	Under Conostraction	Box Culvert	
	17	Bridge	3.552	6.200	10.20	Good	Box Culvert	
	18	Bridge	4.292	6.700	15.00	Under Conostraction	Box Culvert	
	19	Bridge	4.948	3.700	15.80	Under	Box Culvert	

Location	ID	Name	Chainage (km)	Length (m)	Carriageway /Witdh (m)	Condition	Type	Bridge Nsme
						Conostraction		
	20	Bridge	5.107	7.000	25.50	Under Conostraction	Box Culvert	
	21	Bridge	5.834	6.800	25.50	Good	Box Culvert	
	22	Bridge	6.642	9.200	17.80	Good	Box Culvert	
	23	Bridge	6.882	8.900	13.00	Under Conostraction	Box Culvert	
	24	Bridge	7.096	10.200	18.30	Good	Box Culvert	
	25	Bridge	7.294	6.800	14.70	Good	Box Culvert	
	26	Bridge	7.882	3.000	17.80	Good	Box Culvert	
	27	Bridge	8.271	10.100	16.10	Good	Box Culvert	
	28	Bridge	8.572	10.500	14.60	Good	Box Culvert	
	29	Bridge	8.880	13.700	10.00	Good	Bridge	
	30	Bridge	9.756	6.800	18.00	Good	Box Culvert	
	31	Bridge	11.239	5.400	17.50	Under Conostraction	Box Culvert	
	32	Bridge	11.918	13.100	18.00	Under Conostraction	Bridge	
	33	Bridge	13.552	10.100	7.30	Under Conostraction	Box Culvert	
	34	Bridge	14.082	10.100	7.30	Good	Box Culvert	
	35	Bridge	14.564	63.000	9.80	Good	Bridge	Sobeda Pukur Bridge
	36	Bridge	15.263	48.000	10.40	Good	Bridge	
	37	Bridge	16.191	11.200	12.00	Good	Box Culvert	
Hathazari To Ghagra	38	Bridge	16.872	103.000	9.80	Good	Bridge	
	39	Bridge	17.253	3.500	9.50	Good	Box Culvert	
	40	Bridge	17.956	26.200	11.10	Under construction	Bridge	
	41	Bridge	18.622	12.900	9.20	Good	Box Culvert	
	42	Bridge	18.921	3.600	11.60	Good	Box Culvert	
	43	Bridge	19.150	3.200	7.00	Good	Box Culvert	
	44	Bridge	19.723	3.500	6.90	Good	Box Culvert	
	45	Bridge	20.212	37.400	9.00	Good	Bridge	
	46	Bridge	20.850	26.200	11.50	Under construction	Bridge	
	47	Bridge	22.129	26.200	11.60	Under construction	Bridge	
	48	Bridge	22.367	3.800	11.30	Good	Box Culvert	
	49	Bridge	22.608	3.400	11.60	Good	Box Culvert	
	50	Bridge	22.981	18.200	7.00	Good	Bridge	
	51	Bridge	23.142	10.000	9.20	Good	Bailey Bridge	
	52	Bridge	23.425	26.200	11.60	Under construction	Bridge	
	53	Bridge	23.810	2.900	6.60	Good	Box Culvert	
	54	Bridge	24.100	13.000	10.50	Good	Box Culvert	
	55	Bridge	24.867	6.700	11.80	Good	Box Culvert	
	56	Bridge	25.151	10.000	9.10	Good	Box Culvert	
	57	Bridge	25.736	6.700	9.30	Good	Box Culvert	

Location	ID	Name	Chainage (km)	Length (m)	Carriageway /Witdh (m)	Condition	Type	Bridge Nsme
	58	Bridge	26.112	1.400	8.50	Good	Box Culvert	
	59	Bridge	26.255	2.500	9.00	Good	Box Culvert	
	60	Bridge	29.154	15.300	7.30	Good	Bridge	Rawzan Khal Bridge
	61	Bridge	29.217	2.100	8.60	Good	Box Culvert	
	62	Bridge	30.247	3.500	11.80	Good	Box Culvert	
	63	Bridge	30.817	19.100	7.40	Good	Bridge	Godar Pahar Bridge
	64	Bridge	31.247	13.800	8.60	Good	Box Culvert	
	65	Bridge	31.347	1.400	10.40	Good	Box Culvert	
	66	Bridge	31.495	7.400	10.50	Good	Box Culvert	
	67	Bridge	31.596	5.200	9.50	Good	Box Culvert	
	68	Bridge	31.680	3.800	12.10	Good	Box Culvert	
	69	Bridge	31.861	10.100	11.80	Good	Box Culvert	
	70	Bridge	32.113	2.800	9.60	Good	Box Culvert	
	71	Bridge	32.354	1.700	9.30	Good	Box Culvert	
	72	Bridge	32.517	6.300	10.50	Good	Box Culvert	
	73	Bridge	32.672	3.100	7.08	Good	Box Culvert	
	74	Bridge	32.887	6.400	10.50	Good	Box Culvert	
	75	Bridge	32.999	8.600	8.80	Good	Box Culvert	
	76	Bridge	33.161	4.600	11.70	Good	Box Culvert	
	77	Bridge	33.480	2.800	9.20	Good	Box Culvert	
	78	Bridge	33.624	3.500	9.40	Good	Box Culvert	
	79	Bridge	33.738	3.600	9.10	Good	Box Culvert	
	80	Bridge	34.087	1.500	10.50	Good	Box Culvert	
	81	Bridge	34.220	3.600	12.00	Good	Box Culvert	
	82	Bridge	34.410	7.200	9.60	Good	Box Culvert	
	83	Bridge	34.440	1.600	10.40	Good	Box Culvert	
	84	Bridge	34.936	13.100	9.00	Good	Box Culvert	
	85	Bridge	35.020	5.100	9.60	Good	Box Culvert	
	86	Bridge	35.917	1.800	8.80	Good	Box Culvert	
	87	Bridge	36.024	2.000	11.70	Good	Box Culvert	
	88	Bridge	36.594	3.500	9.30	Good	Box Culvert	
	89	Bridge	36.827	9.100	9.40	Good	Box Culvert	
	90	Bridge	37.318	26.200	7.80	Good	Bridge	
	91	Bridge	37.459	3.700	12.10	Good	Box Culvert	
	92	Bridge	37.704	6.000	9.20	Good	Box Culvert	
	93	Bridge	38.086	1.900	11.70	Good	Box Culvert	
	94	Bridge	39.137	2.300	9.30	Good	Box Culvert	
	95	Bridge	39.639	5.200	12.10	Good	Box Culvert	
	96	Bridge	40.040	3.600	9.30	Good	Box Culvert	
	97	Bridge	40.892	130.000	7.50	Good	Bridge	Ranir Hat Bridge
	98	Bridge	41.364	6.600	12.50	Good	Box Culvert	
	99	Bridge	41.609	1.300	8.60	Good	Box Culvert	

Location	ID	Name	Chainage (km)	Length (m)	Carriageway /Witdh (m)	Condition	Type	Bridge Nsme
	100	Bridge	42.186	3.700	10.00	Good	Box Culvert	
	101	Bridge	42.349	10.000	12.00	Good	Box Culvert	
	102	Bridge	43.186	3.600	12.10	Good	Box Culvert	
	103	Bridge	44.000	11.400	11.90	Good	Box Culvert	
	104	Bridge	45.260	14.900	7.00	Good	Bailey Bridge	Moghachhary Bailey Bridge
	105	Bridge	45.735	3.100	11.90	Good	Box Culvert	
	106	Bridge	46.170	3.700	11.90	Good	Box Culvert	
	107	Bridge	46.422	1.700	13.00	Good	Box Culvert	
	108	Bridge	49.001	1.400	8.30	Good	Box Culvert	
	109	Bridge	49.617	6.800	12.00	Good	Box Culvert	
Ghagra To Rangamati	110	Bridge	49.720	5.200	10.30	Good	Box Culvert	
	111	Bridge	49.966	2.400	15.00	Good	Box Culvert	
	112	Bridge	50.365	3.000	9.10	Good	Box Culvert	
	113	Bridge	50.608	1.200	8.80	Good	Box Culvert	
	114	Bridge	50.910	4.400	8.90	Good	Box Culvert	
	115	Bridge	50.970	3.200	11.60	Good	Box Culvert	
	116	Bridge	51.118	3.800	8.60	Good	Box Culvert	
	117	Bridge	51.289	4.400	8.90	Good	Box Culvert	
	118	Bridge	51.780	4.400	8.70	Good	Box Culvert	
	119	Bridge	51.940	4.400	9.50	Good	Box Culvert	
	120	Bridge	52.145	4.000	11.70	Good	Box Culvert	
	121	Bridge	52.272	3.600	9.90	Good	Box Culvert	
	122	Bridge	52.361	9.800	9.50	Good	Box Culvert	
	123	Bridge	52.630	4.400	10.30	Good	Box Culvert	
	124	Bridge	53.511	1.400	9.10	Good	Box Culvert	
	125	Bridge	53.700	1.400	9.10	Good	Box Culvert	
	126	Bridge	54.410	4.600	9.10	Good	Box Culvert	
	127	Bridge	54.787	4.600	9.30	Good	Box Culvert	
	128	Bridge	57.142	75.800	8.60	Good	Bridge	Manikchhari Bridge

From Chotohorina to Thegamukh

Route ID	Location	Chainage (m)				Length (m)	Road/Bridge Width (m)	Existing Feature Types	Ownership	LGED Road Code No
		CH-Start		TO	CH-End					
Multimodal Route Road Part	Chotoharin to Thegamukh	CH	0.000	to	171.298	171.298				UNR-484213004
		CH	171.298	to	232.473	61.175	1.563	Existing Bridge	LGED	UNR-484213005
		CH	232.473	to	1564.891	1332.417				UNR-484213006
		CH	1564.891	to	1566.015	1.125	Chhara	Missing Link		
		CH	1566.015	to	6469.088	4903.072				UNR-484213004

Route ID	Location	Chainage (m)				Length (m)	Road/Bridge Width (m)	Existing Feature Types	Ownership	LGED Road Code No
		CH-Start		TO	CH-End					
		CH	6469.088	to	6498.513	29.425	Chhara	Missing Link		
		CH	6498.513	to	7486.729	988.216				UNR-484213004
		CH	7486.729	to	7504.873	18.145	1.854	Existing Bridge	LGED	UNR-484213004
		CH	7504.873	to	7642.566	137.693				UNR-484213004
		CH	7642.566	to	7776.758	134.192				UNR-484213004
		CH	7776.758	to	8089.114	312.356				UNR-484213004

2.5 Details of Existing Roads Connecting Chittagong Port for Road and Multimodal Routes

Connectivity of Chittagong to Rajosthali: Rajosthali - Bilaichhari - Juraichhari - Barkal - Thegamukh, about 114.751 km)

For traffic movement from Chittagong Port to Rajosthali there are three existing Route Options as shown in **Figure no.2.5** such as

a) Chittagong Port–Mohora–Chondraghona–Banglahalia–Rajosthali (Total length 75.302 km.),
b) Chittagong Port–Kalurghat–Boalkhali–8 km. missing link–Banlahalia–Rajosthali (Total length 79.321 km.),
c) Chittagong Port–Kalurghat–Fultol- 8 km. missing link–Banglahalia–Rajosthali (71.328 km.)

During investigation it is found in the **Route Option "a"** that existing road width on an average is 5.3 m after the City area portion which needs widening as required for double lane road. In Chandraghona area a big Bridge about 315 m long is required. Total length of road up to Rajosthali is 75.302 km.

In the **Route Option"b"**existing road width is 3.78 m only and total length of the road up to Rajosthali is 79.321 km where about 8 km. missing link is there. Also in one place at least 40 m long Bridge is required. Moreover, existing single lane 614 m Kalurghat Bridge has to be replaced by double Lane Bridge of same length. A long portion of this road is going beside the river which becomes very vulnerable during flood season. About 7/8 km. existing road is going through hilly area.

In the **Route option "c"** existing road width is 4.4 m only which needs to be widen. There is about 8 km. missing link where hilly area is existing. Total length of this road is 71.328 km.
Based on all the investigations, data analysis, and experts' discussion/decision it is opinioned that Route Option "a" i.e., Chittagong Port –Mohora-Chondraghona-Bagalhali-Rajostholi Route is more feasible to take into consideration under this project having length of 75.302 Km.

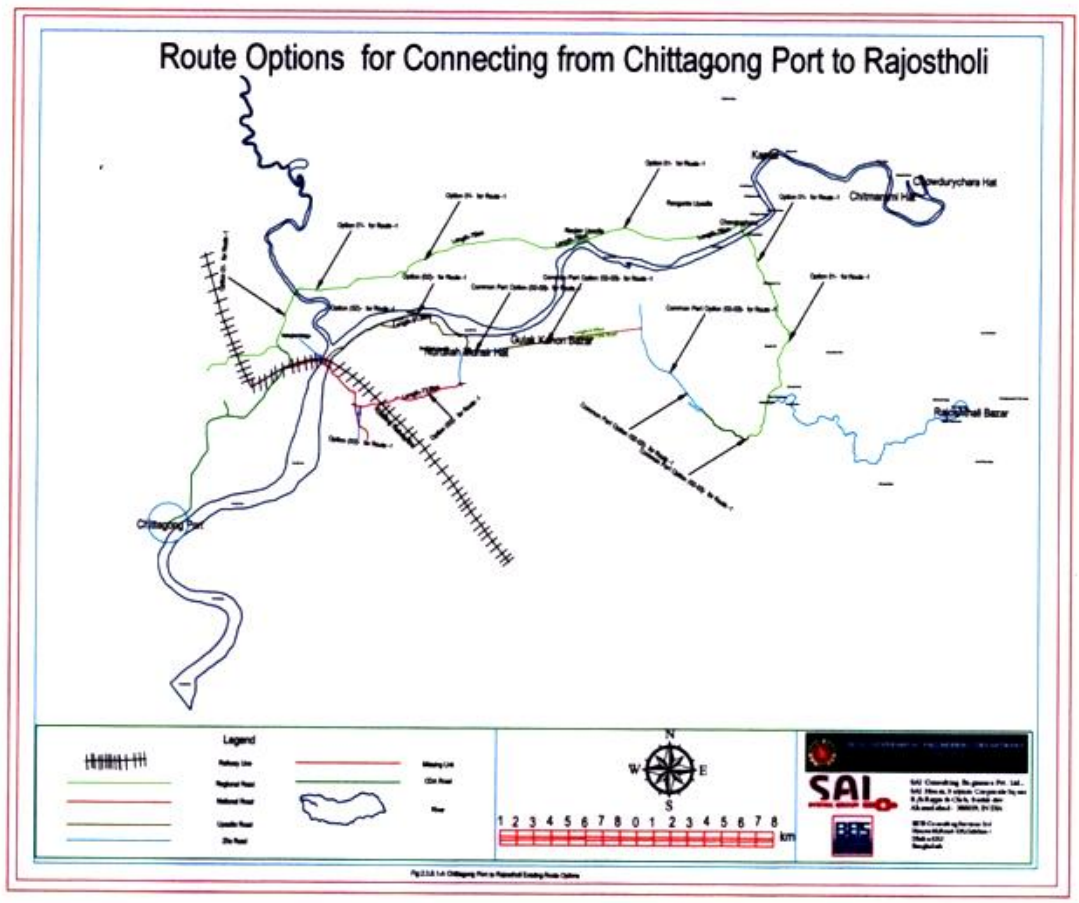


Fig 2.5: Connectivity of Chittagong to Rajosthali

Multi–Modal Route

Connectivity of Chittagong to Rangamati (Route No 1) :

Rangarnati-Chhotoharina connected by waterway (63 Km) andThegamukh by road (about 8.089 km) Total: 71.089Km

There is only one existing route from Chittagong Port to Rangamati via Oxygen more. The total length of existing road is 72.51 Km with 21 bridges and 107 culverts. The existing road is of BC with an average width of 7.1 m. Thus no major improvements are required on this road.

Table 2.5Agives details of existing routes from Chttagong Port to Rajasthali / Rangamati and **Table 2.5B** gives lengths of proposed route from Chittagong Port.

Table No 2.5A: Details of Existing Roads from Chittagong Port to Origins of Proposed routes

Sl. No	Details of Existing road	Length (Km)	Average carriageway (m)	Pavement type	Widening required (Sq. m.)	Total no of existing bridges	Existing bridge length (m)	Existing Culvert Length in m (Nos)	No of Sharp Turns	Improvement
Road Routes										
1	Chittagong Port - Mohora-Chondraghona-Banglahalia-Rajosthali	75.302	4.34 to 6.20	BC Road	116794.38	15	923.70	213 (49)	83	About 315 m bridge is required on the Karnafuly river at Chandraghona ferry ghat, 21.5,18.4,25,61.6 m baily bridge will replace by RCC/PC girder bridge
Multi-Modal Routes										
1	Chittagong Port - Oxygen More - Rangamati	72.51	6.80 to7.45	BC Road	18669.5	21	1048.3	575.9 (107)	48	16.9 m ,2.9m box culvert will be replace by RCc bridge & 15m baily bridge will replace by RCC bridge

Table 2.5B: Lengths of Proposed Routes from Chittagong Port

Sl. No.	Road No.	Name of the Route	From Chittagong to Starting Point*	From Starting Point to Thegamukh#	Distance (Km)
All Road Routes					
1	R -1	Rajosthali-Bilaichhari-Jurichhari-Thegamukh	Chittagong-Rajosthali (75.302 Km)	Rajosthali-Bilaichhari-Jurichhari-Thegamukh (114.751 Km)	190.053
Multi-Modal (i.e. IWT and Road) Routes					
1	M -1	Rangamati- Chhotohorniaby waterway and then by road up to Thegamukh	Chittagong -Rangamati (72.51 Km)	Rangamati- Chhotohornia by waterway and then by road up to Thegamukh (71.089Km)	143.599

Note: ** The roads from Chittagong to the starting point are all-weather bitumen surfaced roads and are under Roads and Highway Department (RHD), Government of Bangladesh. From the starting point to Thegamukh, there are only tracks and are under Local Government Engineering Department (LGED), Government of Bangladesh*

In case of all the proposed routes, the road sections from Chittagong up to the starting point of the new route are all-weather bitumen top roads and are under the jurisdiction of the Roads and Highway Department (RHD) of the Government of Bangladesh (GoB). Whereas the proposed routes from the starting point up to Thegamukh are walking tracks and are under the Local Government Engineering Department (LGED) of GoB.

2.6 Details of existing waterway:

Multimodal Route 1: Rangamati - Chotoharina by waterway (63 km) and Thegamukh by road (8.089 km), (Proposed total length: 71.089 Km)

This route enroutes to Chotohorina via Shobolong, Barkal, Bhusionchar. It is about 63km. Chotohorina to Thegamukh is 8.089 km by road. Rangamati to Barkal 37.5 km is navigable round the year for small launches and boats. For larger cargo vessels navigable depth will need to be increased by dredging. Barkal to Chotohorina is navigable during monsoon for 3-4 months. This part of the waterway (25.5 km) will need massive dredging to increase navigable depth. **Chhotoharina–Thegamukh (8.089Km)** portion 134.19 m paved road by Herring Bon Bond (HBB) with 1.5 m width is seen and other parts are earthen road. 2 nos. Bridges/Culverts are existed & 2 Bridges/Culverts are required.

2.6.1 Available draft for movement of vessels:

Multimodal Route 1: Rangamati - Chotoharina by waterway (63 km) and Thegamukh by road (8.089 km), (Proposed total length: 71.089 Km)

Rangamati to Barkal 37.5 km is navigable round the year for small launches and boats. For larger cargo vessels navigable depth will need to be increased by dredging. Barkal to Chotohorina 25.5 km is navigable during monsoon for 3-4 months. This part of the waterway (25.5 km) will need massive dredging to increase navigable depth.

CHAPTER - 3

Traffic Analysis and Forecasts for Road and Multimodal Route

CHAPTER - 3

Traffic Analysis and Forecasts for Road and Multimodal Route

3.1 Preliminary Traffic Assessment (Base Year) for Different Proposed Routes

3.1.1 Background

This section briefly set out the methodology adopted and data used for assessing base year traffic levels on each of the two identified routes – one all road route and the other multi-modal (i.e. water way and road combination) route. The two routes have been identified on the basis of multi-criteria analysis which takes into account various aspects like: i) technical and engineering feasibility, ii) adverse environmental impact, iii) social impact, iv) poverty alleviation, v) present inaccessibility to reach the road head, vi) travel time savings with the new road, vii) less improvement required to the existing road up to Chittagong, viii) less travel time between Chittagong and Thegamukh, ix) population served per Km of connectivity within zone of influence, x) length of road constructed per US$ 1 million and xi) People's Perception for the project.

Details of the two identified routes are presented in **Table 3.1.1.**

Table 3.1.1: Details of Proposed Routes from Chittagong

S. #	Road No.	Name of the Route	From Chittagong to Starting Point*	From Starting Point to Thegamukh#	Distance (Km)
All Road Route					
1	R -1	Rajosthali-Bilaichhari-Jurichhari-Thegamukh	Chittagong-Rajosthali (75.302 Km)	Rajosthali-Bilaichhari-Jurichhari-Thegamukh (109.675 Km)	184.977
Multi-Modal (i.e. IWT and Road) Route					
2	M -1	Rangamati- Chhotohornia by waterway and then by road up to Thegamukh	Chittagong – Rangamati (72.51Km)	Rangamati- Chhotohornia by waterway and then by road up to Thegamukh (70.370 Km)	142.880

***Note**: * The roads from Chittagong to the starting point are all-weather bitumen surfaced roads and are under Roads and Highway Department (RHD), Government of Bangladesh. #From the starting point to Thegamukh, there are only tracks and are under Local Government Engineering Department (LGED), Government of Bangladesh*

In case of both the identified routes, the road sections from Chittagong up to the starting point of the new route are all-weather bitumen top roads and are under the jurisdiction of the Roads and Highway Department (RHD) of the Government of Bangladesh (GOB). Whereas the proposed routes from the starting point up to Thegamukh are walking tracks and are under the Local Government Engineering Department (LGED) of GOB.

While for RHD road sections traffic data i.e. Annual Average Daily Traffic (AADT) are collected by RHD through volume count surveys, no such data are available for LGED sections as these are tracks and no vehicle traffic moves on them. Given this situation, it is not possible to collect AADT for a base year through conduct of traffic volume counts. In view of this, the consultants have attempted to make a broad estimate of AADT for the base year on these LGED sections assuming

continuation of the "***existing RHD road sections into the new sections from the starting point up to Thegamukh***". Before going into details of this approach, it is important to have a brief appreciation of the economic base of the influence zone of the new routes i.e. Rangamati District.

3.1.2 Economic Base of Rangamati District

Situated in the South-eastern side of Bangladesh, Rangamati district is the largest district (in terms of area – 6,116 sq. km of which 2,234 sq. km i.e. about 36.5% is under forest) of the country. Upazilla-wise population, total area and forest area for Rangamati district are presented in the **Table 3.1.2.**

Table 3.1.2 Upazilla-wise Population, Total Area and Forest Area – Rangamati Zilla

S.#	Upazilla	Population (Census 2011)	Total Area (Sq. Km)	Forest Area (Sq.km)	Population Density/Sq.km
1	Baghaichhari	96,899	1931.26	137.39	50
2	Barkal	47,523	760.88	64.65	62
3	Belaichhari	28,525	746.00	669.76	38
4	Juraichhari	27,786	606.05	407.52	46
5	Kaptai	59,693	259.00	120.62	230
6	Kwakhali	59,578	339.29	165.97	176
7	Langudu	81,548	388.50	173.78	210
8	Naniarchar	43,616	393.68	174.95	111
9	Rangamati Sadar	124,728	546.49	210.32	228
10	Rajosthali	26,083	145.04	108.88	180
Total		**595,979**	**6116.19**	**2233.84**	**97**

Total population of Rangamati district, as per census 2011, was 595,979 with an inter-census growth rate of 1.66 % per year. As expected, population density is higher in areas which are connected with all-weather bitumen roads i.e. Rangamati Sadar (220), Kaptai (230), Langadu (210), etc., whereas the density is very low in areas not connected by road i.e. Belaichhari (38), Juraichhari (46), Baghaichhari (50), etc.

Agriculture is the mainstay of Rangamati economy. Out of total 108,263 holdings of the district, 74.10% holdings are farms that produce varieties of crops namely local and HYV rice, wheat, vegetable, cash crops and others. Jackfruits and pineapples are abundantly grown in the district. The other important fruits are banana, guava, olive, papaya etc. Fish of special varieties ruhi, katal & chital abound in this district. All these varieties of fish are caught from lake. Besides crops, livestock, forestry and fishery are the main sources of household income. The district is very rich in forest resources.

The level of non-farming activities in the district is rather low. Main industrial activity in the district is rice milling (403 units) and textiles (17 units with 160 looms).

In spite of abundant agriculture and forest potential, the production levels are mostly subsistence due to the lack of market traceable mostly to the absence of proper connectivity. A part from some upazillas like Barkal which can be reached by IWT, the only means of connectivity in most of the study area (i.e. upazillas through which the proposed route alignments pass through) are "***walking tracks***". With availability of proper connectivity, there is great potential for surplus agriculture and horticultural production and establishment of agro-based industries. In this context it may be

pertinent to mention that most of the industrial and other economic activities in the district are concentrated in upazillas like Rangamati Sadar, Langadu, Kaptai, etc. which are connected by RHD roads.

3.1.3 Base Year Traffic Assessment

3.1.3.1 Road Traffic – Secondary Data

As mentioned earlier, no vehicular traffic is moving in the project area as the only means of connectivity in this area is ***walking tracks.*** As such traffic count data on the contiguous RHD road section were collected from RHD website. The AADT details collected from RHD website are presented in **Table 3.1.3.1**

Table 3.1.3.1: AADT (2013) on RHD Road Sections Contiguous to Study Area

Location	Details	Heavy Truck	Medium Truck	Small Truck	Large Bus	Medium Bus	Micro Bus	Utility	Car	Auto-Rickshaw	Motor Cycle	Total - Motor Vehicles
Rajosthali	AADT	0	18	38	0	24	11	11	0	367	563	1032
	%Share	0%	2%	4%	0%	2%	1%	1%	0%	36%	55%	100%
Ghagra	AADT	0	137	122	73	22	99	38	75	692	521	1779
	%Share	0%	8%	7%	4%	1%	6%	2%	4%	39%	29%	100%
Chandraghona	AADT	1	238	224	146	97	203	52	164	4453	838	6416
	%Share	0%	4%	3%	2%	2%	3%	1%	3%	69%	13%	100%
Chittagong	AADT	0	776	362	197	220	281	217	296	5481	1078	8908
	%Share	0%	9%	4%	2%	2%	3%	2%	3%	62%	12%	100%
Munishihat	AADT	0	342	189	185	120	184	418	103	520	372	2433
	%Share	0%	14%	8%	8%	5%	8%	17%	4%	21%	15%	100%

***Source**: Latest RHD webs*

3.1.3.2 Traffic Surveys

Since the latest data available on RHD website relate to the year 2013, the Consultants identified the following three road side locations and conducted the traffic count and O-D survey as per details given in **Table 3.1.3.2 A**

Table 3.1.3.2 A: Location, Type, Date and Duration of Traffic Surveys

S.#	Location	Type of Survey	Date of Survey	Duration of Survey
1	Bangalhalia : Rajosthali Road	Traffic Count	19-12-2015 and 20-12-2015	16 hours (6 AM to 10 PM)
		O-D Survey	20-12-2015	24 hours (starting 6 AM)
2	Ghagra: Rangamati Road	Traffic Count	21-12-2015 and 22-12-2015	16 hours (6 AM to 10 PM)
		O-D Survey	21-12-2015	24 hours (starting 6 AM)
3	Rangunia: Chandraghona – Chittagong Road	Traffic Count	19-12-2015 and 20-12-2015	16 hours (6 AM to 10 PM)
		O-D Survey	19-12-2015	24 hours (starting 6 AM)

The locations were identified and surveys conducted as per the procedure outlined in **Manual Classified Traffic Counts – Instruction Guide, RHD, 2001.** The results of the two-day traffic count survey in terms of ADT (Average Daily Traffic) are presented in **Table 3.1.3.2**

Table 3.1.3.2 B: ADT - Based on Two-day Traffic Count

Location	Details	Heavy Truck	Medium Truck	Small Truck	Large Bus	Medium Bus	Micro Bus	Utility	Car	Auto-Rickshaw	Motor Cycle	Total - Motor Vehicles
Rajosthali	ADT	0	64	61	0	32	37	20	35	595	550	1462
	%age	0%	4%	4%	0%	2%	3%	1%	2%	41%	38%	100%
Ghagra	ADT	69	200	180	136	140	266	54	153	635	464	2394
	%age	3%	8%	7%	6%	6%	11%	2%	6%	27%	19%	100%
Chandraghona	ADT	7	124	179	73	132	173	51	136	3004	662	4761
	%age	0%	3%	4%	2%	3%	4%	1%	3%	63%	14%	100%

***Source**: Traffic Count Survey by Consultants*

Since the traffic counts are done for 16 hrs in a particular month/season, these do not represent daily average on the one hand and the annual average traffic flow pattern i.e. Annual Average Daily Traffic (AADT) on the other. To address these two aspects, RHD have, based on their earlier surveys, developed traffic coefficient/expansion factors for converting 16 hr based traffic counts carried out in any particular month of a year into AADT. The expansion factors and monthly adjustment factors developed by RHD are as under:

Traffic AADT Expansion Factors

SL No	Vehicle Category	Type of Road		
		National	Regional	Zilla
1	Motorized	1.15	1.15	1.12
2	Non Motorized	1.06	1.06	1.06

***Source**: RHD, Bangladesh*

Traffic AADT Monthly Adjustment Factors

Month	Trucks	Other
January	0.92	1.00
February	0.90	0.98
March	0.90	0.98
April	0.97	1.01
May	0.97	0.96
June	0.99	0.95
July	1.04	0.96
August	1.10	0.99
September	1.17	1.04
October	1.16	1.07
November	1.03	1.04
December	0.95	1.02

***Source**: RHD, Bangladesh*

Applying these expansion/adjustment factors to the ADT figures given in **Table 3.1.3.2 B**, annual average daily traffic (AADT) figures at the three survey locations have been worked out. The same are presented in **Table 3.1.3.2 C**

Table 3.1.3.2 C: AADT - At Survey Locations - 2015

Location	Year	Heavy Truck	Medium Truck	Small Truck	Large Bus	Medium Bus	Micro Bus	Utility	Car	Auto-Rickshaw	Motor Cycle	Total - Motor Vehicles
Rajosthali	AADT	0	68	65	0	38	43	23	40	697	645	1,619
	%share	0%	4%	4%	0%	2%	3%	1%	2%	43%	40%	100%
Ghagra	AADT	75	219	196	159	164	312	63	179	744	544	2,655
	%share	3%	8%	7%	6%	6%	12%	2%	7%	28%	20%	100%
Chandraghona	AADT	7	135	196	86	155	202	59	160	3,523	777	5,299
	%share	0%	3%	4%	2%	3%	4%	1%	3%	66%	15%	100%

***Source**: Consultants' Two-day Traffic Count Survey.*
***Note**: The %shares may not add up to 100 due to rounding-off.*

As can be seen from the figures set out in **Table 3.1.3.2 C**, the AADT level is the lowest at Rajosthali (1,619), followed by Ghagra (2,655) and Chandraghona (5,299). These levels are as expected because Rajosthli is on a zilla road, and Ghagra and Chandragona are on regional roads. Further, Chadraghona is a junction from where traffic flows in the directions of Ghagra as well as Rajosthali. As to the vehicle composition, irrespective of the locations auto-rickshaws and motor cycles accounted for the maximum share i.e. 83% at Rajosthali, 81% at Chandraghona and 48% at Ghagra. These higher shares are in line with the ground reality as these two modes are the major carriers for local and short distance passenger trips.

In order to validate the survey AADT data, a comparison is made with the available RHD traffic data (AADT). Since RHD data relate to the year 2013, the same has been updated using appropriate growth rate and compared with survey AADT. **Table 3.1.3.2** Dpresents a comparative statement of survey AADT and RHD AADT. The following comparisons have been done:

1) Comparing RHD AADT 2013 with Consultants' (SAI) AADT 2015
2) Comparing updated RHD AADT (2015) with Consultants' (SAI) AADT 2015

Under the first comparison, annual compound growth rate (ACGR) of AADT works out to 25% at Rajosthali and 22% at Ghagra. These two appear to be very high as compared to 10% ACGR normally adopted by RHD on national roads and 7% AGCR on regional and zilla roads. Since Consultants' AADT have been arrived at after adjusting for seasonality, the high growth rates do not find any reasonable explanation in terms of seasonal traffic relating to tourism, construction, etc. Further, AADT at Chadraghona as revealed from Consultants' survey registered a high negative growth (i.e. -9.12%) as compared to RHD AADT.

Under the 2nd comparison, RHD data has been updated using 10% ACGR and then compared with Consultants' survey-based AADT. Even in this case, Consultants' AADT figures are much higher as compared to RHD data i.e. 30% higher at Rajosthali and 23% more at Ghagra. At Chadraghona, however, the Consultants' survey-based AADT is about 68% of the RHD data.

The foregoing analysis points to some unusual features during the Consultant's survey period that contributed to very high/low level of traffic. Since these levels could not be rationally explained, the Consultants felt it prudent to use the RHD AADT data (**Table 3.1.3.1**) for the present purpose asThese data are broad-based and validated.

Table 3.1.3.2 D: Comparison of RHD and Consultants' (SAI)Traffic Count

AADT	Details	Agency	Year	Heavy Truck	Medium Truck	Small Truck	Large Bus	Medium Bus	Micro Bus	Utility	Car	Auto-Rickshaw	Motor Cycle	Total - Motor Vehicles	Average Annual Growth@	SAI/RHD (2015 AADT)$
Rajosthali	AADT	RHD	2013	0	18	38	0	24	11	11	0	367	563	1,032		
	AADT	SAI	2015	0	68	65	0	38	43	23	40	697	645	1,619	25.26%	
	AADT	RHD*	2015	0	22	46	0	29	13	13	0	444	681	1,249		1.30
	%Share	SAI	2015	0%	4%	4%	0%	2%	3%	1%	2%	43%	40%	100%		
	%Share	RHD	2015	0%	2%	4%	0%	2%	1%	1%	0%	36%	55%	100%		
Ghagra	AADT	RHD	2013	0	137	122	73	22	99	38	75	692	521	1,779		
	AADT	SAI	2015	75	219	196	159	164	312	63	179	744	544	2,655	22.16%	
	AADT	RHD*	2015	0	166	148	88	27	120	46	91	837	630	2,153		1.23
	%Share	SAI	2015	3%	8%	7%	6%	6%	12%	2%	7%	28%	20%	100%		
	%Share	RHD	2015	0%	8%	7%	4%	1%	6%	2%	4%	39%	29%	100%		
Chandraghona	AADT	RHD	2013	1	238	224	146	97	203	52	164	4,453	838	6,416		
	AADT	SAI	2015	7	135	196	86	155	202	59	160	3,523	777	5,299	-9.12%	
	AADT	RHD*	2015	1	288	271	177	117	246	63	198	5,388	1,014	7,763		0.68
	%Share	SAI	2015	0%	3%	4%	2%	3%	4%	1%	3%	66%	15%	100%		
	%Share	RHD	2015	0%	4%	3%	2%	2%	3%	1%	3%	69%	13%	100%		

Note 1 : *Latest RHD website is the source for RHD AADT*
Note 2 : *To work out AADT, Traffic Count Data collected by SAI has been adjusted with the Expansion Factors obtained from RHD.*
Note 3* : *For RHD, an annual growth rate of 10% has been used to arrive at 2015 AADT.*
Note 4 : *@The growth rate is RHD 2013 AADT vs SAI 2015 AADT*
Note 5 : *$Ratio of SAI 2015 AADT and RHD 2015AADT*

3.1.3.2.1 ***Base Year AADT Estimates***

Though no vehicle movement is taking place in the study area, at present consumer durables and other commodities which are required to meet the demands of the population of the study area (i.e. influence zone of the proposed routes) are transported into the area in 2 or 3 stages as under:

- Truck movement on Bitumen top RHD road up to the ***starting point*** of new route
- From ***starting point*** to the next point by IWT where available and from there by head loads to different population settlements; or
- From ***starting point*** by head loads to different population settlements

Since there is no significant industrial activity in the study area, whatever movements are taking place from/to the study area are mainly to meet the requirements of the study area population. The situation is not much different for upazillas like Rangamati Sadar, Kaptai, etc. which are connected by RHD roads. ***In other words, the commodity and allied movements from/to these areas are mainly population related; implying thereby that higher level of population results in higher level of movement i.e. higher traffic.***

Given the above situation, the following assumptions have been made to assess base year traffic levels (AADT) on the new routes:

- RHD roads that are contiguous to the ***starting point*** will continue up to Thegamukh, and
- Traffic level (AADT) on each road is proportional to population in its influence zone.

It may be clarified here that traffic data (AADT) for the new routes are not available from secondary sources. Further, there is no use conducting volume counts on the new road alignment as no vehicle movements are observed on these routes. In this backdrop, an attempt is made here to make an AADT estimate under the above two assumptions.

To operationalize the base year traffic assessment methodology, the latest available AADT (i.e. for the year 2013) data have been collected from RHD for the 3 locations on RHD road sections that are contiguous to the new route. The AADT figures are presented in **Table 3.1.3.1**

The related population data has been gleaned from Bangladesh Bureau of Statistics (BBS) website. Using these two sets of data, AADT for 1000 population have been worked out. This statistic ranged between 8.09 and 39.57 with an average of 17.29. Applying this average of 17.29 to the population figures of the study area population, the corresponding AADT levels for base year (2013) have computed and presented in **Table 3.1.3.2.1**.

Table 3.1.3.2.1: Base Year (2013) Traffic Assessment
Rajosthali-Biliaichari-Jurichhari-Thegamukh (Rangamati Zilla)

Section of the Road	Owner of the Road	Location	Average Population	Traffic AADT (2013)
i. Rajosthali to Bilaichari	LGED	**Upozila**: Rajostholi, Bilaichari	27,304	472
ii Bilaichari to Jurichhari	LGED	**Upozila:** Bilaichari, Juraichhari	28,156	487
iii. Jurichhari to Thegamukh	LGED	**Upozila:** Juraichhari, Barkal	37,655	651

The above AADT, on an average, composed of 6% trucks (medium and small), 3% buses, 1% cars and utility, 36% auto-rickshaws and 54% motor cycles.
To sum up, the above AADT estimates are based on the following assumptions:

- RHD roads that are contiguous to the ***starting point*** will continue up to Thegamukh, and
- Traffic level (AADT) on each road is proportional to population in its influence zone.

3.1.3.3 IWT Traffic Estimates – Base Year

In the case of IWT traffic movements (goods as well as passenger) by inland water transport (IWT) between Rangamati and Chotoharina, all the services are run by private operators and no recorded data are available. During the Consultants discussions with senior officials of Rangamati Hill District Council (RHDC) and Secretary Launch Owners' Association, Rangamati, the following points emerged.

- Every day three launches operate each way between Rangamati and Chotohorina
- Each launch trip, on an average, carries 100 passengers
- On an average, these launches operate for 330 days/year
- Every day about 35 trucks, which carry fish, fruits, forest and agriculture product, etc that are collected from the study area (i.e. Rangamati – Barkal – Chotohorina – Thegamukh) by IWT, move out of Rangamati towards Chittagong and beyond.
- Similar number of trucks comes into Rangamati everyday and these goods are further transported by IWT for destinations in the study area.
- Each truck, on an average, carries 8 tonnes.
- On an average, each truck operates for 330 day/year

Based on the above information, base year (2015) traffic estimates have been worked for IWT and are presented in **Table 3.1.3.3.**

Table 3.1.3.3: Base Year (2015) IWT Traffic Estimate

O-D Pair	Traffic	Base Year 2015
Goods Traffic		
Rangamati-Chotohorina	Tonnes/day	280
	Tonnes/year	92,400
Chotohorina-Rangamati	Tonnes/day	280
	Tonnes/year	92,400
Total - Bothways	Tonnes/day	560
	Tonnes/year	184,800
Passenger Traffic		
Rangamati-Chotohorina	Passengers/day	600
	Passengers/year	198,00
Chotohorina-Rangamati	Passengers/day	600
	Passengers/year	198,00
Total – Both ways	Passengers/day	1,200
	Passengers/year	396,000

3.1.3.4 O-D Traffic Surveys

As indicated in **Table 3.1.3.2 A**, road O-D traffic surveys were conducted for a day at the three identified road side locations. The purpose of organizing these surveys was to identify the initial origin or final destination of the cargo flows that are originating from or terminating in the study area. Such information could not be collected due to lack awareness of the truck drivers. However, while attempting to elicit such information from the truck drivers, the following problems were encountered.

- ***Initial origin of the cargo if it is coming from the study area***: For instance, a truck carrying fruits and moving out of Rajosthali is intercepted at Rajosthali survey location and asked about its initial origin. The driver obviously tells that the origin is Rajosthali as the truck started from Rajosthali. But in fact the fruits may have been collected from various places in the study area and aggregated at Rajosthali from where it is loaded into the truck. This is because that driver does not really know the initial origin of the cargo. Such data does not provide correct information for developing O-D traffic flows.
- Similar problem also arose in case of cargo traffic coming into the study area after the truck is unloaded at say Rajosthali.

Because of the foregoing data lacunae, the information collected during the O-D survey could not be used.

3.2 Traffic Forecasts

3.2.1 Introduction

S.#	Details of Data/Reference	Source
1	District/upazilla level statistics covering area, population, agriculture, industry, socio-economic infrastructure, etc	Bangladesh Bureau of Statistics – website: www.bbs.gov.bd
2.	Bangladesh Economic Review - 2014	Ministry of Finance – website: mof.gov.bd
3.	Sector-wise GDP, its composition and growth at constant (Base: 2005-06) prices	Statistical Year Book, Bangladesh Bureau of Statistics – website: www.bbs.gov.bd
4.	Category-wise number of Motor Vehicles Registered in Bangladesh (2009 – 2015)	Bangladesh Road Transport Authority – website: www.brta.gov.bd
5.	Sale of MS and HSD during 2004-05 to 2013-14 in Metric Tons (M.T.)	Bangladesh Petroleum Corporation – website: www.bpc.gov.bd
6.	Import – Export Data, Bangladesh (2001-02 to 2013-14) in Billion USD	Ministry of Commerce – website: www.mincom.gov.bd
7.	Import and Export through Land Custom Check-posts, Bangladesh	Bangladesh Land Port Authority – website: www.bsbk.gov.bd
8.	Macro-economic indicators and allied data	Bangladesh Bank – website: www.bb.org.bd
9.	Traffic Count Data (AADT) on RHD Roads	HDM Division, Roads and Highway Department and website: www.rhd.gov.bd
10.	Vision – 2021 and Perspective Plan of Bangladesh 2010-2021	Ministry of Finance – website: mof.gov.bd
11.	The BCIM Economic Corridor: A Leap into the Unknown?, **Patricia Uberoi,** Working Paper, November 2014, Institute of Chinese Studies (ICS), Delhi	Institute of Chinese Studies (ICS), Delhi – website: www.icsin.org
12	Mizoram State Roads II – Regional Transport Connectivity Project, April 3, 2014, Report No: 83244-IN, World Bank	World Bank website: www.worldbank.org

3.2.1.1 This section presents data sources and traffic forecasting methodology, and results there-of. The Chittagong Hill Tracts Area Transport Connectivity project has two objectives i.e. i) to provide efficient and effective transport connectivity from Chittagong Port to remote areas of North-east districts of Bangladesh and ii) to develop cross-border transit corridors to North-eastern states of India. In other words, the proposed routes will need to cater for two streams of traffic i.e. local traffic and cross-border traffic.

3.2.2 Methodology and Approach

3.2.2.1 Transport is only an intermediate service and the extent of transport activity depends on the need for spatial movement of freight and passengers which in turn will be guided by the on-going and planned activities/ programs of different economic sectors. Based on the above criterion, the base year traffic will be projected taking into account some or all of the following aspects:

- Population growth trends
- M*otor* Vehicle Fleet growth trends
- Trends in fuel consumption
- Growth in GDP
- Economic Development Vs. traffic growth

3.2.2.2 ***Data Sources***: Relevant data have been gleaned from various secondary sources. Details of the data/references and their source are as under:

3.2.2.3 Using the data collected from the various above indicated sources, each of the aforementioned five aspects i.e. i) population trends, ii) Motor vehicle fleet growth, iii) trends in fuel consumption, iv) GDP growth and v) economic development vs traffic growth have been analysed as presented below:

3.2.2.3.1 *Population Growth Trends***:** Transport requirements of people mainly depend on their need for mobility for work, education, health, social activities, recreation, etc.Further, the level and composition of mobility needs, in turn, are determined by population size and structure (i.e. male & female, rural & urban, etc.). In this context, the type and composition of transport activity in a region/ area is guided by the existing and anticipated population sizes and structure of that region/ area. As per Census 2011, the total population of Rangamati district, which mainly constitutes the study area, was 5.96 million, with an inter-census growth rate of 1.66% per year. Of the total, male population was 3.13 million (52.5%) and female 2.83 million (47.5%). While there are no population forecasts at district level, national level forecasts are made up to the year 2035. Urban and rural and Population forecasts for Bangladesh as given in Statistical Hand Book – 2013 (Bangladesh Bureau of Statistics – BBS) are presented in **Table 3.2.2.3.1.**

Table 3.2.2.3.1: Population Forecasts - Bangladesh

(Million)

Year	Urban			Rural			Total Bangladesh			Share of Urban in the total (%)
	Male	Female	Total	Male	Female	Total	Male	Female	Total	
2011*	23.63	20.43	44.06	54.22	53.13	107.35	77.85	73.56	151.41	29.10%
2015	27.39	23.83	51.22	54.24	53.50	107.74	81.63	77.33	158.96	32.22%

Year	Urban			Rural			Total Bangladesh			Share of Urban in the total (%)
	Male	Female	Total	Male	Female	Total	Male	Female	Total	
2020	32.86	28.80	61.66	54.10	53.78	107.88	86.96	82.58	169.54	36.37%
2025	39.98	34.43	74.41	53.35	53.45	106.80	93.33	87.88	181.21	41.06%
2030	45.48	40.47	85.95	51.71	52.21	103.92	97.19	92.68	189.87	45.27%
2035	52.11	46.70	98.81	49.19	50.03	99.22	101.30	96.73	198.03	49.90%

Note ** Census 2011 figures*
Source*: Statistical Hand Book - 2013, Bangladesh Bureau of Statistics*

A quick look at the population forecasts brings out the following:

- The population has been projected to increase at a declining rate
- As expected the growth rate for urban segment is positive and that rural it is negative. This phenomenon is traceable to anticipated migration from rural to urban areas in search of better employment opportunities. The increasing urbanization would have significant impact on size, structure and quality of transport activities.
- Sex ratio remained more or less at the same level

Though no population forecasts are available for the study area, similar observations as above may be valid.

3.2.2.3.2 *Motor Vehicles – Growth Trend:* Road transport plays a significant role in Bangladesh and its share in carrying of freight and passenger traffic is more than 80 percent in tonne-km and more than 88 percent in passenger-km respectively. Given the importance of road transport, level and composition of motor vehicle population and its growth is expected to serve as a fairly reliable indicator of economic growth. In other words, vehicle fleet requirement and its extent of utilization are determined by the level of economic development of a region/ country. **Table 3.2.2.3.2** gives the total motor vehicle population and its growth during 2009-2014.

Table 3.2.2.3.2: Registered Motor Vehicles - Bangladesh

Year	Total Number of Motor Vehicles Registered	Growth (%)
2009	1,307,386	
2010	1,498,244	14.60%
2011	1,683,630	12.37%
2012	1,844,335	9.55%
2013	1,981,444	7.43%
2014	2,142,083	8.11%

Source*: BRTA, website*

During the period, the total vehicle fleet has increased from 1,307,386 in 2009 to 2,142,083 in 2014 indicating an average annual growth rate of 10.4%.

3.2.2.3.3 *Trends in Fuel Consumption/Sale:* Level of fuel consumption is another important indicator of traffic growth. Sale of MS and HSD during 2004-05 to 2013-14 in Bangladesh is presented in **Table 3.2.2.3.3.**

Table 3.2.2.3.3: Sale of MS and HSD during the Last Ten Years

Year	MS (Petroleum)		HSD	
	Quantity (M.T)	Growth (%)	Quantity (M.T)	Growth (%)
2004-05	143,965		2,264,843	
2005-06	153,340	6.51%	2,298,667	1.49%
2006-07	129,549	-15.52%	2,294,223	-0.19%
2007-08	124,823	-3.65%	2,333,597	1.72%
2008-09	115,381	-7.56%	2,301,269	-1.39%
2009-10	127,247	10.28%	2,568,208	11.60%
2010-11	141,491	11.19%	3,239,279	26.13%
2011-12	158,707	12.17%	3,240,349	0.03%
2012-13	169,710	6.93%	2,964,604	-8.51%
2013-14	178,674	5.28%	3,242,554	9.38%
Average Growth		**2.85%**		**4.47%**

***Source**: Bangladesh Petroleum Corporation (Website:www.bpc.gov.bd)*

During the period 2004-05 to 2013-14, the average growth in MS sale was 2.85% per year, the corresponding figure for HSD being 4.47%. These average growth rates are lower than the motor vehicle growth rate presented in Table 3.2, which may be attributable to: i) improved to road condition, ii) enhanced fuel efficiency of vehicles and iii) change from MS/HSD to CNG.

3.2.2.3.4 *Growth in GDP*: The extent of need for transport in a region/ country is determined by the level and composition of mobility requirements of different sectors of the economy which in turn depend on the spatial spread of production/ consumption areas and major marketing/ distribution centers. Demand for transport services at these areas/ centers is a function of the size and type of economic activity which is reflected by the economic development in terms of GDP. **Tables 3.2.2.3.4 A** and **3.2.2.3.4 B** present respectively GDP (at 2005-06 constant prices) of Bangladesh and the year-to-year growth rates for the period 2008-09 to 2013-14, respectively.

Tables 3.2.2.3.4 A: GDP at Constant Prices (Base: 2005-06) for Important Sectors and Total (Crore Taka)

Sector	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14*
Agriculture & Forestry	79,682	84,904	88,206	90,332	91,656	93,912
Fishing	22,793	24,601	28,482	31,827	36,995	42,669
Mining & Quarrying	8,841	9,561	9,907	10,593	11,584	12,188
Manufacturing	93,459	99,671	109,651	120,567	132,994	144,544
Electricity, Gas & Water Supply	7,012	8,346	11,589	14,189	16,381	17,900
Construction	44,180	49,474	57,072	68,304	82,432	97,538
Wholesale & Retail Trade	96,094	106,606	121,332	137,396	154,579	172,322
Hotel & Restaurants	5,790	7,028	8,228	9,755	11,263	13,033
Transport, Storage & commu.	67,185	80,454	94,571	112,702	124,281	136,470
Total GDP at Constant Prices	575,056	607,097	646,342	688,493	729,896	774,539

** Provisional*

***Source**: Appendix 1.1 - Bangladesh Economic Review 0 2014*

Table 3.2.2.3.4 B: Growth of GDP at Constant Prices (Base: 2005-06) for Important Sectors and Total

Sector	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14*
Agriculture & Forestry	3.09%	6.55%	3.89%	2.41%	1.47%	2.46%
Fishing	4.94%	7.93%	15.78%	11.74%	16.24%	15.34%
Mining & Quarrying	10.47%	8.14%	3.62%	6.92%	9.36%	5.21%
Manufacturing	6.69%	6.65%	10.01%	9.96%	10.31%	8.68%
Electricity, Gas & Water Supply	7.26%	19.02%	38.86%	22.44%	15.45%	9.27%
Construction	6.58%	11.98%	15.36%	19.68%	20.68%	18.33%
Wholesale & Retail Trade	5.86%	10.94%	13.81%	13.24%	12.51%	11.48%
Hotel & Restaurants	5.87%	21.38%	17.07%	18.56%	15.46%	15.72%
Transport, Storage & commu.	8.05%	19.75%	17.55%	19.17%	10.27%	9.81%
Total GDP at Constant Prices	**5.05%**	**5.57%**	**6.46%**	**6.52%**	**6.01%**	**6.12%**

During the period 2008-09 to 2013-14, the total GDP grew at an average rate of about 6% per year and varied in very narrow band i.e. 5.05% in 2008-09 to 6.52% in 2011-12. In other words Bangladesh economy maintained a study growth trajectory during the 6 years despite the resurgence of global recession during the first half of 2011-12.

3.2.2.3.5 *Economic Development vis-à-vis Traffic Growth*: It is widely recognized that the need for transport services in a region/ country increases with economic development which is normally measured in terms of GDP. At the initial stages of economic development, especially in developing countries, the demand for transport far exceeds the rate of economic growth. As the economy grows and reaches stability, the rate of growth for transport declines. Available empirical evidence suggests that transport demand tends to increase at a somewhat faster rate than the economic growth rate as measured by national and regional GDPs. In other words, for a given unit growth rate in GDP, the corresponding rate of increase in transport demand is expected to be more than unity. This relationship is called transport demand elasticity.

Transport demand elasticity estimates are not available for Bangladesh. However, considering the contribution of Land Transport in the total GDP as the proxy for transport output, the consultants have worked out transport demand elasticity. The same is presented in **Table 3.2.2.3.5**

Table 3.2.2.3.5: Bangladesh - Total and Land Transport GDP and Transport Demand Elasticity

Year	Total GDP		GDP from Land Transport			Elasticity of Land Transport w.r.t GDP
	Crore Taka	Growth (%)	Crore Taka	Share in Total GDP (%)	Growth (%)	
2008-09	575,056	5.05	39,296	6.83%	6.59	1.30
2009-10	607,097	5.57	42,169	6.95%	7.31	1.31
2010-11	646,342	6.46	45,198	6.99%	7.18	1.11
2011-12	688,493	6.52	48,283	7.01%	6.83	1.05
2012-13	729,896	6.01	51,136	7.01%	5.91	0.98
2013-14*	774,539	6.12	54,301	7.01%	6.19	1.01
Average						**1.13**

** Provisional*

***Source**: Appendix 1.1 - Bangladesh Economic Review - 2014*

The average transport demand elasticity during the period 2008-09 to 2013-14 works out to 1.13, the range being 0.98 to 1.31. A transport demand elasticity value of 1.13 indicates that for every one 1% increase GDP (i.e. economic development), the demand for transport will increase by 1.13%. This is line with transport demand elasticity values adopted in some developing countries.

3.2.3 Traffic Forecasts

3.2.3.1 ***All-Road Route***: The total all-road route between Chittagong and Thegamukh has two distinct sections namely, i) Rajosthali-Thegamukh (proposed new road section), and ii) Chittagong-Rajosthali (existing RHD road section). Details of these road sections are as under:

S. #	Name of the Road Section	Status	Length (Km)
I	**A. Rajosthali -Thegamukh**		
	A.1 Rajosthali - Bilaichari	Proposed New Road	47.066
	A.2 Bilaichari - Jurichari		28.091
	A.3 Jurichari - Thegamukh		34.518
	Total - A		109.675
II	**B. Chittagong - Rajosthali**		
	B.1 Chittagong - Chandraghona	Existing RHD Road	43.369
	B.2 Chandraghona - Rajosthali		31.933
	Total - B		75.302
	Total -(A+ B)		184.977

3.2.3.2 ***Traffic Forecasts – Proposed New Road***: The proposed new route, as mentioned earlier, will serve two broad streams of traffic:

i) Local traffic by providing improved accessibility for marginalized people of Chittagong Hill Tracts (CHT) area. This stream will have two components – a) diverted/normal traffic and b) induced or generated traffic.

Diverted traffic refers to that component of traffic which is currently coming into/going out of the study area (i.e. base year traffic) by other means of transport (IWT or head-loading) in the absence of the proposed route. When the proposed route becomes operational, all thistraffic will get diverted because of the overall cost advantage. In a way, this component may also be considered as '***normal traffic***' as no road currently exists in the study area.

Generated traffic connotes that element of traffic which will get generated/ induced due to better accessibility. This may emanate from suppressed demand or location of new economic and social activities in the study area.

ii) ***Cross-border/inter-regional*** traffic to North-eastern states of India, mainly adjoining Mizoram state.

3.2.3.2.1 Growth Rates and Forecasts for Local Traffic: From the foregoing analysis of various growth indicators, it emerges that transport demand elasticity would provide a meaningful basis for traffic forecasting. During the last 6 year period while total real GDP of Bangladesh was growing at about 6% per year, the GDP from Land transport grew at more

than 6% per year; yielding an average demand elasticity of 1.13. This statistic can be used to estimate future growth rates for forecasting, if GDP growth rates are given. In this context, Government of Bangladesh has prepared "Perspective Plan of Bangladesh (PPB) 2010-21: Making Vision 2021 A Reality". Vision 2021 envisions transformation of socio-economic environment of Bangladesh from a low income economy to the first stages of a middle income nation by 2021. To make the vision a reality, PPB 2010-21 stipulated the growth trajectory of real GDP of Bangladesh as under:

Year	FY 10	FY 15	FY 21
Real GDP Growth Rate (%) per year	6.1	8.0	10.0

In the present exercise, the foregoing real GDP growth rates have been used to work out relevant traffic growth rates for local traffic.

While adopting the GDP growth rates, the following approach has been used.

Though the PPB 2010-21 has envisaged a real GDP growth of 8.0% by 2014-15, the actual rate was 6%. Keeping this in view, the following 3 growth scenarios have been assumed.

Real GDP Growth Scenario	FY 15	FY 21	FY 26	FY 31	FY 36
Scenario 1 - Pessimistic	6.0%	6.0%	6.0%	6.0%	6.0%
Scenario 2 - Moderate	6.0%	7.0%	8.0%	9.0%	8.0%
Scenario 3 - Optimistic	6.0%	10.0%	10.0%	10.0%	8.0%

Applying, transport demand elasticity of 1.13 to the above assumed GDP growth rates, the corresponding traffic growth rates have been worked. However, since the traffic from/to the study area has been assumed to grow in proportion to the population growth in the area (refer paragraph 3.1.3.2.1), the traffic has been assumed to grow (irrespective of growth scenario) in line with population growth (i.e. 1.66% per year) till the 1st year of commencement of the new road i.e. year 2020. The growth rates adopted for traffic projection are presented in **Table 3.2.3.2.1 A**

Table 3.2.3.2.1A: Traffic Growth Rates for Local Traffic

Real GDP Growth Scenario	2013 to 2020	2020 to 2025	2025 to 2030	Beyond 2030
Scenario 1 - Pessimistic	1.66%	6.78%	6.78%	6.78%
Scenario 2 - Moderate	1.66%	9.04%	10.17%	9.04%
Scenario 3 - Optimistic	1.66%	11.30%	11.30%	9.04%

Local traffic forecasts worked using the above growth rate scenario are presented Table 3.8. These forecasts, as mentioned earlier, refer to diverted traffic. In studies of this nature, and where there is problem of paucity of relevant data, generated/induced traffic is assumed as percentage of estimated diverted/normal traffic. In the present case, to be on the conservative side, generated/induced traffic has been assumed as 20% of diverted traffic for all three scenarios. Forecasts for generated/induced traffic and total local traffic (diverted +generated/induced) are presented in **Tables 3.2.3.2.1B.**

Table 3.2.3.2.1B: Local Traffic Forecasts - Diverted (Vehicles/Day – Both-ways)

Section of the Road	Scenario 1 - Pessimistic					Scenario 2 - Moderate					Scenario 3 - Optimistic				
	2020	2025	2030	2035	2040	2020	2025	2030	2035	2040	2020	2025	2030	2035	2040
i. Rajosthali to Bilaichari	530	735	1021	1417	1967	530	816	1325	2043	3148	530	905	1545	2382	3671
ii Bilaichari to Jurichhari	546	759	1053	1462	2029	546	842	1367	2107	3249	546	933	1594	2457	3788
iii. Jurichhari to Thegamukh	731	1014	1408	1954	2713	731	1126	1828	2817	4342	731	1248	2131	3285	5063
Local Traffic Forecasts - Generated/Induced															
i. Rajosthali to Bilaichari	106	147	204	283	393	106	163	265	409	630	106	181	309	476	734
ii Bilaichari to Jurichhari	109	152	211	292	406	109	168	273	421	650	109	187	319	491	758
iii. Jurichhari to Thegamukh	146	203	282	391	543	146	225	366	563	868	146	250	426	657	1013
Local Traffic Forecasts - Diverted and Generated/Induced															
i. Rajosthali to Bilaichari	636	882	1225	1700	2360	636	980	1590	2451	3778	636	1086	1854	2858	4405
ii Bilaichari to Jurichhari	656	910	1264	1754	2435	656	1011	1641	2529	3898	656	1120	1913	2949	4545
iii. Jurichhari to Thegamukh	877	1217	1689	2345	3255	877	1351	2193	3381	5211	877	1497	2557	3942	6076

When the project road i.e. two lane bitumen surfaced road commences operation, the above diverted/normal traffic will enjoy benefits traceable to reduced vehicle operating cost (VOC) and travel time and increased comfort. There will also be easy accessibility to medical centers, educational institutes (schools, colleges, etc.), social interaction, etc. At present, due to lack of proper transport facility, the potential of the area i.e. agriculture, horticulture, forestry, etc. remains mostly under/un-utilized. This is corroborated by the fact, as revealed during the discussions with concerned government agencies and local leaders in the project area, most of the agriculture and allied production in this area is mostly limited to meeting only the subsistence needs. This is because lack of proper transport and storage facilities has been hampering fruit production in this area and in some cases resulting in damage of millions taka worth of fruits. As such when the new road is available which in turn ensures easy accessibility to inputs and product markets, substantial quantum of traffic gets generated due to additional production. Further, this will also encourage setting up of related industries e.g. agro-processing, fruit canning and forest-based industries. This will in turn create employment to local population and result in additional income.

For the purpose of further analysis i.e. economic appraisal, moderate traffic projections i.e. Scenario 2, have been adopted. Detailed projections in this regard are presented in **Annexure 3.1**

3.2.3.3 ***Traffic Forecasts – Existing Chittagong – Rajosthali Road***: In the case of this existing road section, the RHD traffic count data as given in **Table 2.3.3** has been considered as the base year AADT. Using this as base and adopting RHD annual growth rate of 7% relevant for regional roads, traffic projections have been worked out and presented in **Table 3.2.3.3**

Table 3.2.3.3: Traffic Projections on Existing Chittagong-Chandraghona-Rajosthali Road Section - Normal Traffic

Road Section	Traffic Projections (AADT -Both Directions)				
	2020	2025	2030	2035	2040
Chandraghona-Rajosthali	1,657	2,324	3,260	4,572	6,413
Chandraghona-Chittagong	6,865	9,629	13,505	18,941	27,311

Detailed traffic projections for the existing road are presented in **Annexure 3.2**

Cross-border traffic i.e. traffic between CHT area and North-eastern states of India (mainly Mizoram State in this case), occupies important role on this Chittagong-Thegamukh road. Since this component is common for the entire stretch of the road, the component is discussed in the following section.

3.2.3.4 ***Cross-Border Traffic Forecasts***:
In Bangladesh land-based cross-border traffic is handled at custom check posts. Currently there are 9 operational land custom check posts – 5 under BOT and 4 directly operated by Bangladesh Land Ports Authority (BLPA) – Map3.2.3.4 A

Map -3.2.3.4 A Bangladesh Land Ports

Besides, there are a number of border land custom check posts that are under development or proposed **(Map 3.2.3.4 A).** As may be seen from the above map, a land custom post is under process of development at Thegamukh, which is the terminal point of the proposed routes and also bordering with Mizoram state of North-eastern region of India.

At present, there are no available cross-border moments through Thegamukh. Majority of cross-border traffic is moving through Benapole custom post. **Table 3.2.3.4 A** presents cross-border traffic (imports and exports) through land ports for period 2008-09 to 2013-14. As may be seen, this data does not provide any meaningful basis for forecast of cross-border traffic through Thegamukh.

Table 3.2.3.4 A: Imports - Exports through Land Ports: Bangladesh

(M.T.)

Year	Imports		Exports		Total		Exports as %age of Imports	Imports as %age of total
	Quantity (Tonnes)	Growth (%)	Quantity (Tonnes)	Growth (%)	Quantity (Tonnes)	Growth (%)		
2008-09	2,511,422		914,639		3,426,061		36.42%	73.30%
2009-10	2,834,003	12.84%	948,403	3.69%	3,782,406	10.40%	33.47%	74.93%
2010-11	3,539,251	24.89%	1,144,279	20.65%	4,683,530	23.82%	32.33%	75.57%
2011-12	4,631,403	30.86%	1,189,248	3.93%	5,820,651	24.28%	25.68%	79.57%
2012-13	4,990,898	7.76%	1,162,687	-2.23%	6,153,585	5.72%	23.30%	81.11%
2013-14	6,866,286	37.58%	731,433	-37.09%	7,597,719	23.47%	10.65%	90.37%
Average		22.79%		-2.21%		17.54%	26.97%	79.14%

***Source**: Bangladesh Land Port Authority, Website: www.bsbk.gov.bd*

However, some of the on-going regional initiatives like Bangladesh-China-India-Myanmar (BCIM) Economic Corridor and Mizoram State Roads II - Regional Transport Connectivity project, India (funded by World Bank) may provide a basis for broad assessment of cross-border traffic at Thegamukh.

BCIM Economic Corridor

The BCIM economic corridor is a sub-regional initiative for fostering cooperation among the four member countries. The proposed economic corridor originates from Kunming in China's Yunan province and pass through Yangon and Mandalay in Myanmar, Chittagong-Dhaka-Sylhet in Bangladesh before entering India's North Eastern states of Manipur and Assam and finally West Bengal and ending in Kolkata (**Map 3.2.3.4 B**). The hinterland region of BCIM corridor is one of the richest in the world in terms natural, mineral and other resources.

Map 3.2.3.4 B– BCIM Corridor

Enveloping about 9% of worlds area, the BCIM region accounts for 440 million people and 7.3% global GDP. The region has potential to generate enormous economic benefits in the area of trade, investment, energy, transportation and communications. For instance, intra-regional trade among BCIM member states amounted to 5 per cent of total BCIM trade in 2012, as opposed to ASEAN, where 35 per cent of total trade is intra-regional. The BCIM Corridor will allow all four countries to exploit existing complementarities in trade — in terms of both sectors and products. Myanmar is a primary goods exporter and has abundant cheap labour. India has an edge as a leading services exporter. China is the largest manufacturing exporter in the world; and Bangladesh, like many other South Asian countries, engages in both services export and low-end manufactured goods.

In view of the development potential, the four member countries have, of late, provided impetus for the development of BCIM Economic Corridor. Joint Study Groups (JSG) set up for the purpose are identifying various projects, infrastructure improvements, etc. to make the corridor operational. However, it is long way before some usable estimates of anticipated traffic levels are available.

One of the major beneficiaries of the BCIM corridor will be North-eastern state of India, which for all practical purposes are landlocked and far-removed from the main stream. Further, current BCIM corridor (**Map 3.2.3.4 B**) passes through Manipur and Assam, but does not link Mizoram and through it the biggest port of Bangladesh i.e. Chittagong Port. Provision of this link would benefit North-eastern region of India as well Bangladesh.

Given the above, no useable cross-border trade data could be drawn from the available BCIM references.

Mizoram State Roads II - Regional Transport Connectivity project, India (funded by World Bank): Taken up as part of the SAARC multi-modal transport initiative, this improved link to Bangladesh will facilitate greater bilateral trade as well as provide better access for Mizoram and

other North-eastern Indian states to Chittagong Port (which is the nearest shipping port for NER states of India).

Among others, the project comprises: widening and strengthening of three sections of (Group 1) road totaling 91 km including (i) a 22.0 km section of Lunglei –Tlabung – Kawrpuichhuah Road on the border with Bangladesh; (ii) the 27.5km Champhai-Zokhawthar Road on the border with Myanmar; and (iii) the 41.7km Chhumkhum-Chawngte North-South alignment connecting to the border roads with Bangladesh to the west and Myanmar to the south. The project implementation period is 2015-2015 and is found economically viable with an EIRR above the cut-off rate of 12%.

Base year estimates (2013) for cross-border traffic are based on the detailed review of regional trade prospects and its impacts on the project road. For the road linking Thegamukh, AADT of 657, with the following composition has been assumed.

Bus	Multi-axle Truck	Truck	LCV	Two wheeler	Car	Auto-rickshaw	Total
23	19	65	177	114	158	101	657

For the present study, only bus, multi-axle truck, truck, LCV and car traffic have been considered to constitute the cross-border traffic as these entail relatively long lead trips. Others like two-wheelers and auto-rickshaws mainly run for trips and are not relevant for the purpose. Based on the above assumption, the following traffic has been adopted as cross-border traffic for the present study.

Bus	Multi-axle Truck	Truck	LCV	Car	Total
23	19	65	177	158	442

The above cross-border traffic estimates are the only available information. Though all the proposed routes emanate from Thegamukh and diverge in three directions, since the proposed route constitutes the shortest road to Chittagong, it has been assumed that all the cross-border traffic considered above i.e. 442 vpd will follow this route. Assuming that the base cross-border traffic level for the 1st year of opening of the new road and further grow in line with the current average GDP growth of Bangladesh i.e. 6% per year, projections for this component of traffic have been made and presented in **Table 3.2.3.4 B**

Table 3.2.3.4 B: Cross-Border Traffic Projections – Vehicles Per Day (VPD)

Year	Heavy Truck	Medium Truck	Medium Bus	Utility	Car	Total - Motor Vehicles
2020	19	65	23	177	158	442
2025	25	87	31	237	211	591
2030	34	116	41	317	283	792
2035	46	156	55	424	379	1059
2040	61	208	74	568	507	1418

Detailed year-wise traffic projections including cross-border traffic for the proposed new road and existing road are presented in **Annexure 3.1** and **Annexure 3.2** respectively.

3.2.3.5 *IWT Traffic Projections*:

Using the base year traffic presented in Table **Table3.1.3.3** which are based on wide consultations with local government agencies and IWT vessel owners' association and adopting

current average GDP growth rate of Bangladesh (i.e. 6% per year), IWT traffic projections have been arrived at and presented in **Table 3.2.3.5**

Table 3.2.3.5: IWT Traffic Projections: Rangamati-Chotoharina

O-D Pair	Traffic	Base Year 2015	2020	2025	2030	2035	2040
Goods Traffic							
Rangamati-Chotohorina	Tonnes/day	280	375	501	671	898	1202
	Tonnes/year	92,400	123,652	165,474	221,442	296,339	396,569
Chotohorina-Rangamati	Tonnes/day	280	375	501	671	898	1202
	Tonnes/year	92,400	123,652	165,474	221,442	296,339	396,569
Total – Both-ways	Tonnes/day	560	749	1,003	1,342	1,796	2,403
	Tonnes/year	184,800	247,304	330,949	442,884	592,679	793,138
Passenger Traffic							
Rangamati-Chotohorina	Passengers/day	600	803	1,075	1,438	1,924	2,575
	Passengers/year	198,000	264,969	354,588	474,519	635,013	849,790
Chotohorina-Rangamati	Passengers/day	600	803	1,075	1,438	1,924	2,575
	Passengers/year	198,000	264,969	354,588	474,519	635,013	849,790
Total – Both-ways	Passengers/day	1,200	1,606	2,149	2,876	3,849	5,150
	Passengers/year	396,000	529,937	709,176	949,037	1,270,026	1,699,581

Note: Marginal difference in totals may be due to rounding-off.
Yearly figures worked out assuming 330 working days/year

The foregoing traffic projections along with capital cost of i) new road construction, ii) widening of the existing road and iii) deepening of water channel, terminals, etc., form the main inputs for assessing the economic viability of the proposed investment on the new road/IWT channel

3.2.3.6 Traffic Forecasts for Chittagong-Rangamati Road Section

Base year traffic (AADT) for this road section is given **Table 3.1.3.1**. This is a national road and RHD, Bangladesh recommends 10% traffic growth per year on these roads. Based on this traffic forecasts on different subsections of the road are presented in **Table 3.2.3.6**

Table 3.2.3.6: Traffic Forecasts on Chittagong-Rangamati Road (AADT)

Road Section	Year	Medium Truck	Small Truck	Large Bus	Medium Bus	Micro bus	Utility	Car	Auto Rickswa	Motor Cycle	Total Motor Vehicles
Chittagong – Munshihat	2020	906	422	230	257	328	253	345	6395	1258	10396
	2025	1458	680	370	413	528	408	556	10301	2026	16742
	2030	2349	1096	596	666	851	657	896	16590	3263	26964
	2035	3783	1765	960	1072	1370	1058	1443	26719	5255	43425
	2040	6092	2842	1547	1727	2206	1704	2324	43031	8463	69937
Munshihat-Ghagra	2020	666	368	361	234	359	815	201	1013	725	4741
	2025	1073	593	581	377	577	1312	323	1632	1167	7636
	2030	1729	955	935	607	930	2113	512	2628	1880	12298
	2035	2784	1539	1506	977	1498	3403	838	4233	3028	19805
	2040	4484	2478	2425	1573	2412	5480	1350	6817	4877	31897
Ghagra-Rangamati	2020	179	247	109	203	201	162	68	1762	918	3849
	2025	289	399	176	326	323	260	110	2837	1478	6198
	2030	465	642	283	526	521	420	177	4569	2381	9983
	2035	749	1034	456	847	838	676	285	7359	3834	16077
	2040	1206	1665	734	1363	1350	1088	459	11851	6175	25892

CHAPTER – 4

Design Standards for Road and Waterways

CHAPTER – 4

Design Standards for Road and Waterways

4 Design Standards for Road and Waterways

4.1 Introduction

Topographically Bangladesh can be divided into alluvial plains and hilly areas. More than 90 percent of total area of Bangladesh is low land, an alluvial plain formed by the sediments of several great rivers and their tributaries and distributaries which traverse the country. There are, however, some local variations in the nature and extent of the plain land.

Low hills are found in the north-eastern extremities of Bangladesh. These hills are part or extension of the Khasia-Garo-Jainta and the Tippera Hills of India. The more important hilly areas are concentrated in hill districts of Chittagong Division and are geologically the offshoots of the ArakanYoma running through Eastern India to Burma. The Chittagong hills are steep sloped parallel ranges, largely covered with tropical forests. These hills rise steeply to narrow ridge lines, generally no wider than 120 feet and no higher than 2000 to 3000 feet. The highest hill in Bangladesh is Keokradang (4034 feet) in south-east end of Bandarban district.

4.2 Design Standards for Project Roads and Waterways

The selection of design standards is related to function of road, volume of traffic and type of terrain, with additional procedures for the recognition and appropriate treatment of potential hazards.

Since the proposed road is going to be one of the major road corridor of category regional/national highway with 7.3 m width (two lane) principally RHD Geometric Design Standards Manual (Revised) 2005 has been followed for design parameters. Besides the following reference recommendations and standards have been consulted.

- AASHTO "A policy on Geometric Design of Highway and Streets" 2005
- IRC _SP_48_1998
- Overseas Road Note 6 "A Guide to Geometric Design" published by TRRL 1988
- Nepal Road Standards 2020(July 2013), Government of Nepal, Ministry of Physical Infrastructure and Transport. Department of Roads, Kathmandu, Nepal

Design Standards for waterways

Depth:

As per classification of rivers, the Kornafuli is class III routes. Designed depths of river routes are given below.

IWTA classification	Length (km)	Depth(m)
Class 1	683	3.66-3.96
Class 2	1000	2.10-2.44
Class 3	1885	1.52-1.83
Class 4	2400	Less than 1.52

Source: *BIWTA master plan study*

For class III routes, the recommended depth is1.52-1.83m. The route will be developed as waterway for comparative large passengers& cargo vessels. Its depth should be as per recommended depth of 2.10-2.44 m of class II river routes. In this case, the least available depth (LAD) is taken 3m.

Width:

The width of dredging of the channel depends on the traffic volume and size of the vessels plying. In case of the river Karnafuli width may be taken as 61 m (200') for easy, smooth & safe navigation & crossing of two vessels. After dredging, the side slope will be adjusted automatically by sliding the upper part & filling the lower formation bottom.Then the actual width of the bed will remain about 46 m (150').

4.3 General Design Considerations for Road and Waterways

Design consideration for Road

Sl.No.	Design Element	Unit	Plain				Rolling				Hilly		
			IRC	IRC With Same Speed As RHD	RHD 2005	Suggestedto Adopted	IRC	IRC With Same Speed As RHD	RHD 2005	Suggested To Adopted	IRC	RHD 2005	Suggested to Adopted
1	Design Speed	Km/h	100	80	80	80	80	65	65	65	50	50	50
2	Min. Stopping Sight Distance	m	180	120	120	120	120	90	90	90	60	60	60
3	Min. Intermediate Sight Distance	m	360	240	250	250	240	180	180	180	120	120	120
4	Min. Horizontal Radius	m	360	230	500	500	230	160	250	250	80	120	120
5	Transition Curve Required	-	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
6	Maximum Gradient	%	3.3	3.3	0-3	0-3	5	5	1-5.0	1-5.0	0-5.0	1-7.0	1-7.0
7	Maximum Super elevation	%	7	7	5	5	7	7	5	5	7	5	5
8	Min. Crest Vertical Radius	m			6000	6000			2500	2500		1500	1500
9	Min. Sag Vertical Radius	m			3000	3000			2000	2000		1000	1000
10	Traffic Lane Normal Cross fall	%	2.5	2.5	3	3	2.5	2.5	3	3	2.5	3	3
11	Shoulder Normal Cross fall	%	3	3	5	5	3	3	5	5	3	5	5
12	Right of Way	m	45	45	30	30	45	45	30	30	24	30	24

Design consideration for waterway:
In case of this water route, width of 61 m and LAD of 3 m has been considered. Considering the above width & depth dredging need has been calculated.

4.4 Geometric Design for Proposed Roads

4.4.1 Horizontal Curvature

Maximum Speed	80 kph.
Minimum Speed (Hill)	50 kph
Maximum Rate of Super elevation	5.00%
Minimum Radius without Super elevation, 80 kph	2,000 m
Minimum Radius without Super elevation, 50 kph (Hill)	500 m
Minimum Radius (Hill)	65 m

4.4.2 Longitudinal Gradient

Minimum K value, Crest Curve, 80 kph	35
Minimum K value, Crest Curve, 50 kph	9
Minimum K value, Sag Curve, 80 kph	25.3
Minimum K value, Sag Curve, 50 kph	10
Minimum Longitudinal Gradient	0.50 %
Maximum Longitudinal Gradient (Hill)	7.00 %

4.5 Safe Cut Slopes

Considering the heavy rainfall and poor maintenance of pavement in Bangladesh, a cross fall of 3% has been applied for carriageway and paved shoulder as recommended in RHD's Standard Design Manual. For the soft shoulder/verge a cross fall of 5.0% has been provided as per RHD's Standard.

For embankment construction the side slopes at 1V: 2H has been adopted as per RHD guideline. This has been adopted for both cut and fills section for the project road. The safe cut slope is 1V:1.5H (IRC recommendation) and berm 2m would be provided each 10m height.

Various types of soils occur along the alignment of hill roads. They include ordinary soils comprising colluviums, alluviums and completely decomposed rocks, disintegrated rocks, Soft rocks, medium rocks and hard rocks. The soils/rocks can stand safely at certain angles during cutting without any support. The safe stable angles are summarized in **Table 4.5** below.

Table 4.5: Safe Cut Slopes

SL No	Type of Soil	Side Slopes			Average Slope Angle in Degrees
1	Ordinary Soils	1:1	to	1.5:1	56
2	Disintegrated rock or Conglomerate	2 :1	to	4:1	71
3	Soft rock, Shale, Phyllite	4:1	to	8:1	80
4	Medium Rock	12:1	to	16:1	85
5	Hard Rock	Nearly vertical or half tunnelling if cut height exceeds 7.5 m			

4.6 Design standard for Bridges & culverts:

Introduction:
During the feasibility study phase, a comprehensive reconnaissance field survey was done to have an idea about the overall length of various options, approximate length of cross drainage structures, major or minor bridges and culverts etc. The Team also tried to collect the information from the local people regarding the hydrological data like flooding type, erosion of channel bed, low water & high water level etc for preliminary design of structures along the proposed alignment.

Preliminary Design of Bridge, Culverts & other drainage structures are based on Reconnaissance Survey :

4.6.1 Design Specifications :

AASHTO – Load & Resistance Factor Design (LRFD) method is used as Design Standard for Bridge and culvert design and other drainage structures.

The structure shall be analyzed for the following limit states:

Strength-1 :	Basic load combination relating to normal vehicular use of the Bridge with out wind.
Strength-2:	Load combination relating to special design vehicles with out wind.
Strength-3:	Load combination relating to wind velocity exceeding 90km / hr.
Strength-4:	Load combination relating to very high dead load to live load force effect ratios.
Strength-5:	Load combination relating to normal vehicular used with wind of 90km /hr velocity.
	Extreme event-1: Load combination including earthquake.
	Extreme event-2: Load combination relating to collision of vessels / barges, vehicles and certain hydraulic events.
Service-1:	Load combination relating to normal operational use with a 90km / hr wind.
Service-2:	Load combination intended to control yielding of steel structures.
Service-3:	Load combination relating only to tension in pre-stressed concrete superstructures for crack control.
Service-4:	Load combination relating only to tension in pre-stressed concrete substructures for crack control.
Fatigue:	Fatigue and fracture load combination. (Generally not critical for concrete bridges except in the case of pre-stressed cable stress range).

4.6.2 Analysis and Design :

Structural analysis and design of Bridge and culverts will be in accordance with American Association of State Highway and Transportation Officials (AASHTO). For vehicular loading, Standard specification for Highway bridges latest edition HL-93 is presently used in Bangladesh. The design method LFD (Load Factor Design) is adopted in design.

4.6.3 Vehicular Loading :

Vehicular Live load : AASHTO HL-93 Loading is used as vehicular live load for design of bridge.

4.6.4 Environmental Loading :

- Wind load analysis is done as per AASHTO-LRFD 2007 but wind speed is taken from latest approved BNBC 93.
- Seismic load analysis shall be done as per AASHTO-LRFD but seismic zone co-efficient will be taken from BNBC 93.

4.6.5 Other Loading :

Other loading shall be considered as per AASHTO-LRFD 2007.

4.6.6 Deck Geometry of Bridge and culverts :

Deck geometry is used following the guide line of "Bridge Design Standard for RHD & LGED, June' 2012 as approved by Planning Commission and considered Regional highway type 4.

- According to type 4, carriage-way width is 7.30m and 1.25m footpath including railing on each side. So total crest width for all bridges and culverts are 9.80m.

4.6.7 Railing Geometry :

Railing geometry like height of post, section of post and rail, rail numbers, c/c distance of post and rail etc. will be as per "Bridge Design standard for LGED, June' 2012".

4.6.8 Navigational Clearance :

The Navigational Clearance is considered in accordance with current BIWTA requirement. However, for waterways which is not been classified by BIWTA, consideration is given to the local requirements of river traffic movement like, engine boat, trawler, fishing boat etc.

Table for navigational clearance as per BIWTA requirements:

Sl. No.	Classification of waterways	Min. vertical clearance (m)	Min. horizontal clearance (m)	Remarks
1.	Class-I	18.30	76.22	
2.	Class-II	12.20	76.22	
3.	Class-III	7.62	30.48	
4.	Class-IV	5.0	20.00	

The vertical clearance should be measured from the Standard High Water Level (SHWL).

4.6.9 Girder type & Geometry :

Number of girder in each span of bridge for both RCC & PSC girder depending on the carriage-way width shall be as follows:

- For 3.70m carriage width nos. of girder shall be 2 (two)
- For 5.5m carriage width nos. of girder shall be 3 (three)
- For 7.3m carriage width nos. of girder shall be 5 (five)

For road type 4 of carriage way, 5 numbers of girder are provided for the bridges of both RCC and Pre-stressed.

4.6.10 Material Properties :

Concrete :

The concrete is to be produced from natural coarse aggregate, coarse sand, ordinary port land cement (OPC) and water without harmful chemical and suspended particles. Natural coarse sand is available from north zone of Sylhet district along the Indian border. Mechanically crushed stone aggregate to achieve proper gradient is proposed.

Cement :

Cement is produced in Bangladesh. This has to be comply with criteria for ordinary port land cement (OPC) and is considered to be suitable for the project.

Steel :

Reinforcing steel for both mild (276 Mpa) and high yield (410 Mpa) confirming to ASTM A615, A616, A617 or A706 is manufactured in Bangladesh. The maximum limiting bar size 32mm. The following bar size are available in Bangladesh :

8, 10, 12, 16, 20, 22, 25, 28 & 32mm diameter.

Pre-stressing Tendons :

Pre-stressing Tendons are not available in Bangladesh. Uncoated wire strand as required by the designer's shall confirm to the requirement of AASHTO M203 (ASTM A416) supplement SI (Low-relaxation).

Coarse and fine aggregate :

Coarse aggregate materials of boulder and gravel are available in the river beds of Sunamganj, Sylhet and other district which meets the standard requirement of Los Angles Abrasion value (LAAV) and Aggregate crushing value (ACV). Natural Sylhet sand usually meets the standard requirement of fineness modulus (FM 2.8) and specific gravity (≈ 2.6).

Construction water:

Water from streams and wells should be allowed to stand in settling basin and the impurities should be treated before use. Normally a deep tube well should be installed for use of water.

Stone chips / or Brick chips:

Mechanically crashed Stone chips or well burnt brick chips are available in local market.

4.6.11 Bridge Location And Approach Road Study :

Selection of a bridge alignment on a specified road network route depends mainly on river width, river geometry, navigational clearance requirements, and historical change in the water course. Before selecting the bridge alignment the above mentioned points are considered.

4.6.12 Preliminary Selection of Bridge Type :

As per site condition, construction facilities, material availability, type of river traffic, technical analysis and also from economic consideration, different type of girder like Pre-stressed concrete girder, RCC T-girder is considered after details bathymetric & topographical survey work. In ideal cases it is economical to construct RCC T-girder where the span is within the range of 25.0m but more than 25.0m, PSC girder is economical to construct. In the remote area where PS construction is difficult, then RCC box girder may be constructed for longer span more than 25.0m. Where the channel gap is within 6.0m and height is limited to 6.0m, RCC box culvert will be economical to construct.

CHAPTER - 5

Engineering Surveys and Investigations

CHAPTER - 5

Engineering Surveys and Investigations

5.1 Road and Bridge Inventory and Condition Survey

The River/Stream data and condition for existing structure has been collected. It has been found that most of the existing bridges are not suitable for the amount and type of the traffic expected on the proposed road hence all the existing bridges need to be replaced.The format for Inventory & Condition Survey of Existing Structures (Bridges & culverts) is provided in **Annexure 5.1**

It was decided that all the physical features, such as ponds, permanent structures, drains, hills, wells etcrelated to bridge should be demarcated properly. River/ channel/ khal cross section was exclusively taken along the center line of the proposed bridge alignment and other sections at distances of 0.50, 1, 2 and 4 times the channel widths at upstream and at distances of 0.50, 1 and 2 times channel widths at downstream. Spot levels on river cross section were taken at 3.0m intervals or as necessary.The length of each cross section covered the full channel width plus same length of left & right banks.Road cross section was taken along approach road at both ends of the proposed bridge. Four road sections at each end of the bridge @ 25m interval were taken. Bank line survey of the channel was proposed to be conducted by the following manner:

a) For less than 100m bridges, bank line survey of both sides shall be carried out minimum 300m towards the upstream and downstream of the river course way.
b) For bridges of proposed length 100~300m, the bank line survey of both side shall be carried out minimum 500m towards upstream and downstream of the river course way.
c) For bridges of the proposed length more than 300m, the bank line survey of both sides shall be carried out minimum 1 kM or as required towards upstream and downstream of the river course way.

It was decided to collect the information for HFL with reference to the PWD/ SOB Bench mark (BM).All RLs to be taken with respect to SOB/ PWD Bench mark available near by the bridge site and location of TBM to be clearly shown on the map.

The sub soil investigation was also carried out for bridge design. Following salient points were decided for this.

1. The borehole layout plan should be shown in the Digital Topographical survey map in x, y, z Co-ordinate.
2. Conduct sub-soil investigation work using 100mm exploratory boring for SPT test and soil sample collection.
3. For each bore-hole, minimum depth of boring shall be 20.0m, if poor quality soil encountered (say SPT value<20) the depth shall be extended upto 30.0m nor more.
4. Normally SPT is taken @ 1.50m interval, but SPT must be taken @ 1.0m interval upto top 6.0m depth.

5. If clayey soil encountered at any depth during boring, undisturbed soil samples must be collected with the help Shelby tubes.
6. Following laboratory test have been carried out :
   a) Unconfined compression for cohesive soil (C)
   b) Direct shear (φ)

5.2 Topographical Survey

The study approach includes collecting and analyzing information on topographic, cross section and longitudinal survey data, present scenario of the road. Basic idea of survey area for the whole project is defined as follows:

- The corridor of topographic survey measured 150m in average 75m left and 75m right from route center line.
- Special survey conducted for Bridge, Chhara/Canal/Khal and River

Study Area of selected road route alignment are presented in following

Datum Height and Coordinates

The horizontal and vertical control network derived from National Benchmark of Survey of Bangladesh (SOB). UTM Grid zone 46 used for horizontal datum or coordinate system. Mean Sea level MSL was used for vertical datum. The survey parameters are as follows:

Latitude of natural origin	0°
Central Meridian	93°
Scale factor	0.9996
False Easting	500000m
False Northing	0m
Linear Unit Metter	1m

Bench Mark Establishment

Primary benchmarks, secondary benchmarks points and associate/reference points set as suitable location along with the alignment.

Static GPS Survey

Static GPS survey designed considering the satellite position and availability on particular day and time. 2(two) nos. of Trimble 5700 GNSS Receiver, 1 (one) nos. of Trimble R9 GNSS permanent receiver (Chittagong Cantonment Officers Mess, Top of the Uttarayan Building) was used for establishment for this static survey. Observation time is depending on number of satellite and length of baseline. As 3 no of primary benchmarks established within 114.717 km for the feasibility survey works; with presence of 10 to 15 numbers of satellites, 1.5 hour observation in each control point is sufficient but for more confidence & safety, the observation has to be taken more than 1.45 hour.Three receivers used for establishing a single BM. The receiver states are given below.

a) SoB Chittagong Station (Permanent GNSS) used for reference Point. (Known)
b) R5700 receiver setup on SoB BM Pillarused as reference Point (Known)
c) R5700receiver setup on BM 01, 02, 03 used astarget Point (unknown)

Equipment and Software

Following equipment's was deployed for the static survey works:
RTK GPS (High Frequency GPS):

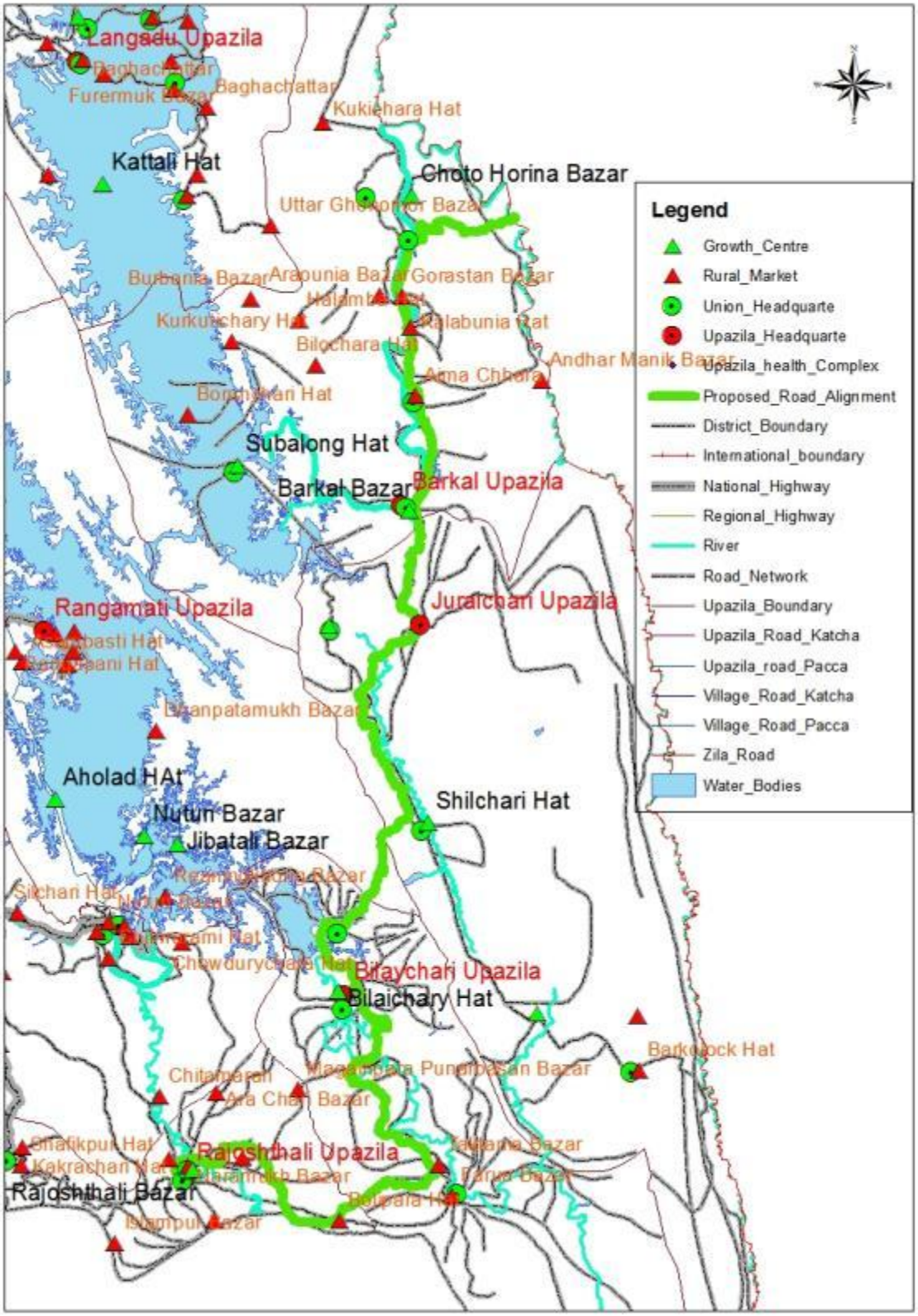


Figure 5.2 : Location Map of Proposed Road Route Alignment from Rajoshthali to Thegamukh

i) Trimble R9 GNSS (Chittagong reference station of SoB)

ii) Trimble 5700 GNSS (SL # 017561032263A6)
iii) Trimble 5700 GNSS (SL # 017561032263A6)

The following software was used for network adjustment
Data Processing Software: Trimble Business Centre 2.4 used for post processing
Network Adjustment Method: Least Square Adjustment

Equipment and Software
Following equipment's was deployed for the Topo survey works:

i) Leica TS 09 (SL # 1302071)
ii) Leica TS 06 (SL# 1360880)
iii) Leica TS 06 (SL# 1369139)
iv) Optical Level

Vertical Control Setup (Levelling Work)
Vertical control or level transfer to all primary and secondary control points double run using optical level from SOB BM.

Topographic Detail Survey (Planimetric)
Detail planimetric survey carried out using Total station and the measurement method by Radial Tachometric method.
The following mapping objects (but not limited) was recorded during topographic detail survey i.e.:

i. Edge of the road
ii. Ditch/Chhara/River
iii. Road components and Road furniture
iv. Boundaries of properties as indicated by existing landmarks or land use along the road. The name of the specific building also recorded such as office, market, hospital post office, mosque, church etc.
v. Building, shed, commercial etc
vi. Bridge, culvert, river, drainage, chharaetc

During survey a log sheet maintained to keep note of every object points and activities for further data processing and reference.

Cross Section & Longitudinal Profile
Cross section measurements
Cross section measurement performed at every interval of 100m along the centerline and at 5m intervals along cross section; with greater detail over all accessible position. The cross section survey performed by using total station and level device.

Long sections
The ground elevation of center line at every interval of 25m along the centerline measured to derive a long sectional profile.

Data Processing
Survey data collected at field at string of followings:

Point, easting, northing, elevation, point description/code, specialized survey software Trimble's Terramodel and Eagle points used to created AutoCAD 2D/3D mapping and prepare cross section and long sections as per specification.

Topographic Survey of Alignment Corridor

Accessibility and Limitations

The study area is hardly accessible and unsecured and is a restricted area also. It does not have motor able roads in any form. The topographical survey is very difficult and cumbersome. The physical features of all the land routes are rolling hills with limited plains, full of vegetation with some forests. People use waterway and foot trails to reach their settlements. Kaptai Lake is spreaded over the tributaries and small streams/ chharas. The water area is in the deep forests in upstream of the kaptai Dam, most of the area is mountainous valley with combination of hills.

Data collection

The survey team equipped with hand held GPS, camera and sketching accessories travelled physically all the proposed alignments.

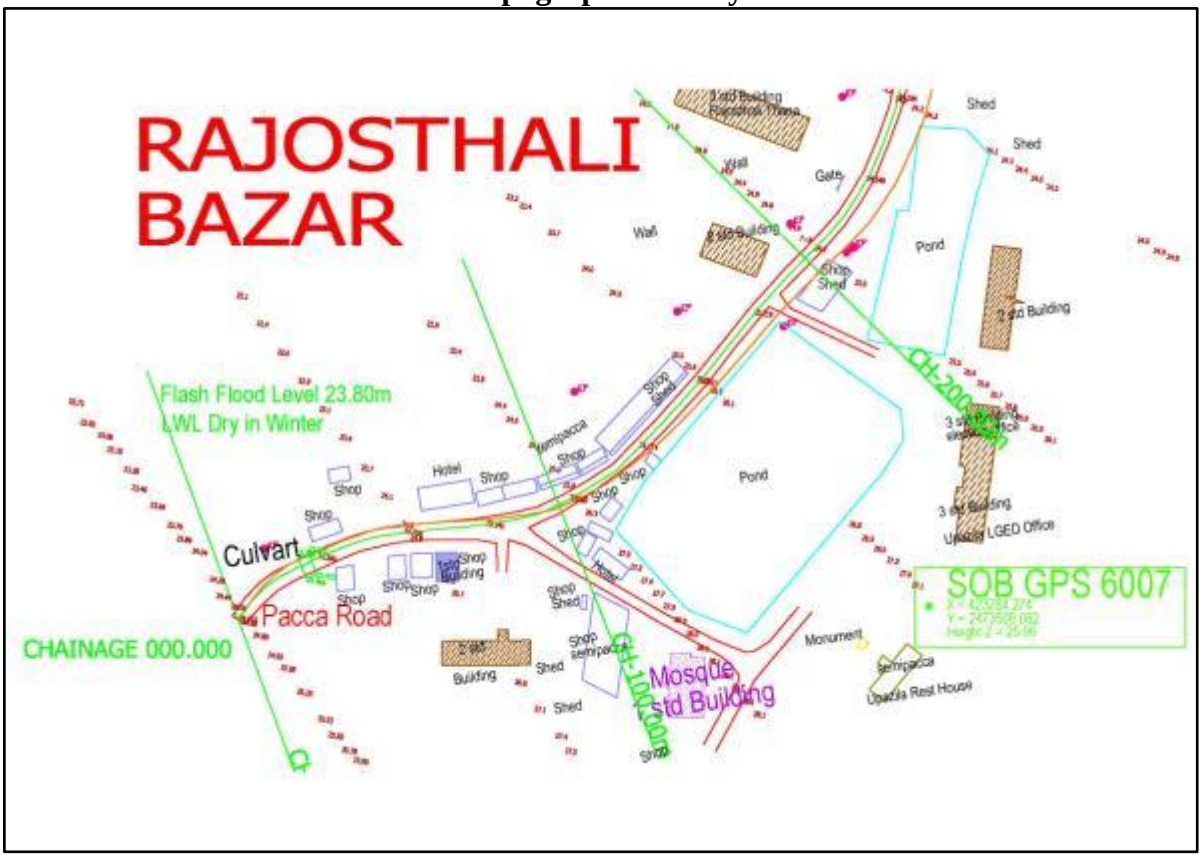
The surveyor collected the coordinated of road alignment by Total Station and records all possible important features like existing road width, existing bridge culverts, rivers,lakes ponds, chharas, hills, house, shed and important landmarks within the survey strips (150m).

1. The following observations are noticed during the topographic survey
    - I. Photographic identification information
    - II. Survey point coordinates recorded by Total Station
    - III. The land topography/ terrain of proposed route
    - IV. Edge of the road, Fence, Brick wall, Fence, Islands etc
    - V. Ditch, Pond, Chhara, River etc
    - VI. Electric Poles, Road components an Road Furniture'setc
    - VII. Boundaries of properties as indicated by existing landmarks or land use along the road such as fence, wall etc. The name of the specific building also recorded such as Office, market, hospital post office, mosque, church etc.
    - VIII. Building, Shed, Shop, Mosque, Temple, School, Madrashaetc
    - IX. Bridge, Culvert, Drainage etc
    - X. Accessibility of survey crew and inconvenience of survey works
    - XI. Fixed the locations of benchmarks and control points

Topographic Survey: The details measurement of Road Route Alignment corridor from Rajoshthali to Thegamukh as per survey corridor specification. All natural and manmade features within the survey corridor were measured accurately.

Detail topographic survey was conducted total length 114.717km from Rajoshthali to Thegamukh. A sample picture and drawing of topographic survey is given in following figure

Topographic Survey



Topographic survey map of road route alignment-01

Benchmarks (BM) /Control Point Establishment:

Some benchmarks along road route alignment were stablished. These are Primary Benchmark (PBM), Secondary Benchmark (SBM)and Temporary Benchmark (TBM). All survey activities of the project were carried out based on these benchmarks. In case of the location of the benchmark is concrete or hard surface, and then a survey nail is installed as a benchmark along

with appropriate marking. A sample picture of primary and secondary benchmarks are presented in following

Primary Benchmark at Barkal

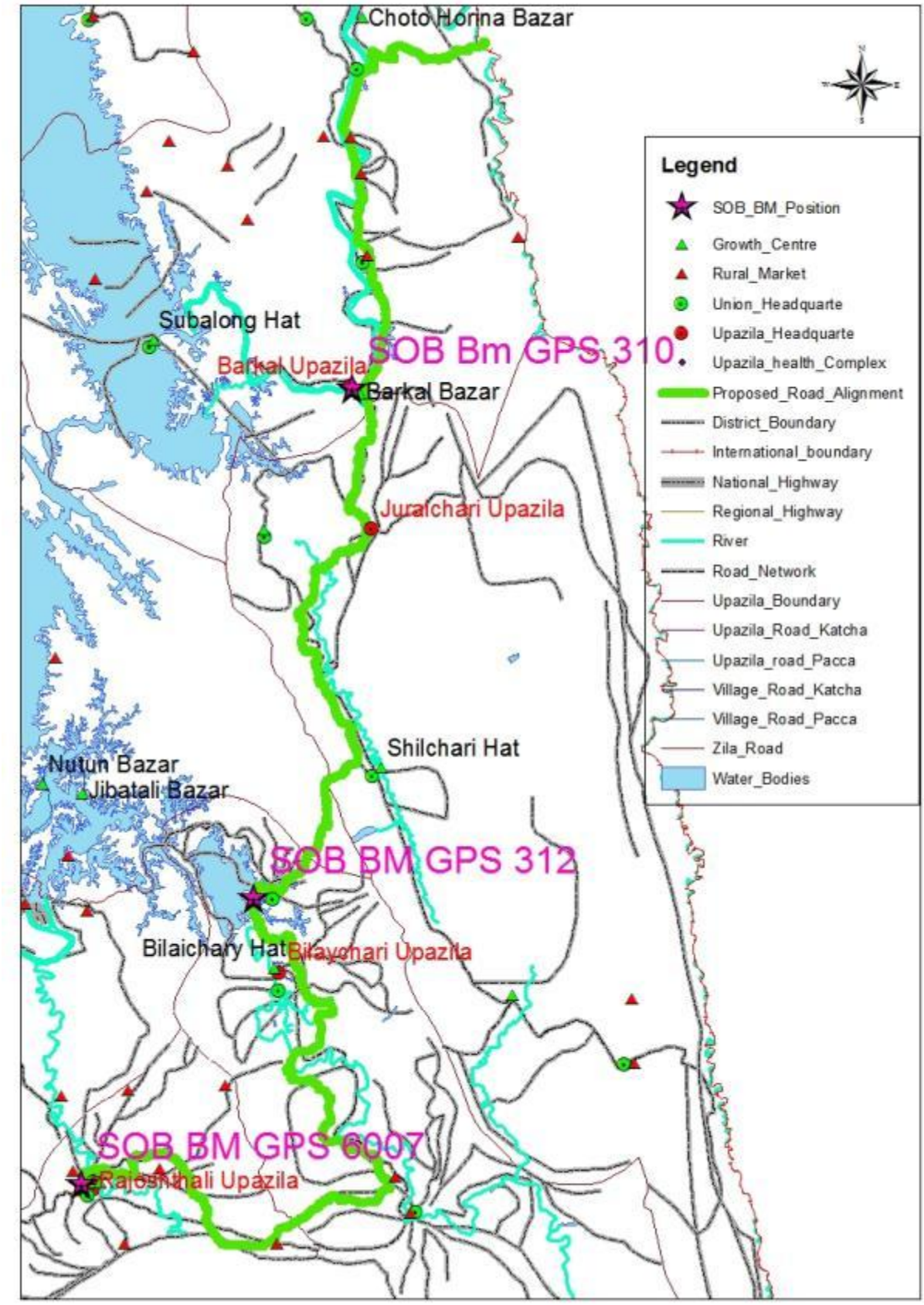
Secondary Benchmark

List of traverse points and Bench Marks for Road and Multimodal Alignment are given in Annexures 5.2

Horizontal Control Point Measurement

Identification of Reference/Datum Point

For the static GPS survey, Survey team used the SOB BM-GPS 6007, GPS 312, GPS 310 and SOB Chittagong reference point (top of the building) as reference points.The most important part of this survey to select the reference points that it has to give 15^{o} (fifteen degree) angle clear sky above and away from any element that interrupts electro-magnetic wave transmission, e.g. high-voltage electric tower. Detail of the reference points as shown in following Map-



SOB BM Reference Points

Table 5.2: SOB Benchmarks description

ID	Height m.MSL	Easting (m)	Northing (m)	Location	Description
GPS 6007	25.96	92°15'17.53"	22°21'56.96"	Rajoshthali, Rangamati	The pillar is situated at 50 feet south from Rajoshthali UpazilaBhoban and 15 feet north from Dhakbanglow
GPS 312	39.89	92°20'14.66670"	22°29'39.75676"	Bilaichari, Rangamati	The pillar is situated at BilaichariUpazilla compound. It is about 100m south from U.N.O's residence & south of Bilaichari Bazar.
GPS 310	32.84	92°23'02.61267"	22°43'24.23920"	Barkal,Rangamati	The pillar is situated north side of Karnafuly river. It is east of B.D.R camp and west of Family Planing Health Complex.
SOB GNSS		91°48'10.84914"	22°24'48.76380"	SOB Chittagong Station	Chittagong Cantonment Officers Mess, Top of the Uttarayan Building

*** mPWD = mMSL + 46 cm*

GPS Static Survey

After completing Primary Benchmarks (PBM) installation static survey works has beencompleted within January, 2016 with three SOB reference points. These are located at Rajoshthali (GPS 6007), Biliachhari (GPS 312), Barkal (GPS 310) and Chittagong reference station (GNSS point, Chittagong Cantonment Officers Mess, Top of the Uttarayan Building)).Static GPS Survey designed considering the satellite position and availability on particular day and time. 2(two) nos of Trimble R-5700 GNSS and SOB at Chittagong reference station (SOB Building Top), With presence of at least 10 numbers of satellites, 1 hour observation in each control point is sufficient but for more confidence & safety, the observation has been taken more than 1.45 hour. Static GPS Survey picture are presented in following

Bangalhalia

Rjoshthali SOB BM GPS 6007

Bilaichhari SOB BM GPS 312

Bilaichhari

Barkal SOB BM GPS 310

Barkal

Cross Section and Longitudinal Section Measurement

Cross Section Measurement

Cross section measurement performed at every interval 100m along the centerline and at 5m intervals along cross section line with greater detail. The width of the cross section 150 m depends on the location of the centerline. The detailed measurements on cross section survey performed by using Total Station which maintain same accuracy/quality. Near about 1400 cross section along the alignment, each and every Chhara/River location cross section has taken across the Chhara/River. With the help of cross sections and longitudinal sections the highway design has been carried out with the MXRoad software. The Plan and Profile of designed highway and road portiona of Multimodal is presented in Volume III.

5.3 Geotechnical and Material Investigations for Roads

Ground investigation is a predominant feature in designing foundation of important structure in an intelligent, economic and satisfactory way. It provides the necessary information of strength and compressibility characteristics of the sub-soil to the design engineer for selection of Suitable

depth and type of foundation for the proposed structure. The investigation works including execution of 10 (Ten) borings up to31.0m depth from the existing ground level and execution of SPT test, collection of disturbed and undisturbed and bulk samples at specified depth under consideration, record of ground water level etc. All of these items of the field investigation have subsequently been followed by the performance of laboratory tests. The overall field investigation works includes the following sub items of works.

- **Extraction of Disturbed Soil Sample :**

Soil sample in the disturbed state have been extracted from the each 1.0m depth of each boring using split spoon sampler. These soil samples after extraction, have duly been classified in situ, in order to reconstruct a depth wise stratification chart of the each bore hole.

- **Extraction of Undisturbed Soil Sample :**

As both of the physical and the engineering properties of the soil are greatly affected by the disturbance of the soil sample, soil sample in the undisturbed state are generally preferred in collection in order to perform certain laboratory tests which eventually help to evaluate the bearing capacities as well as Geotechnical observations. Undisturbed soils are collected from cohesive strata.

- **Execution of Standard Penetration Test :**

Standard penetration tests were executed at each 1.0m interval in all the bore holes with the simultaneous collection of the disturbed soil samples. The tests were executed by using a split spoon sampler of 50mm outer dia. and 37.5mm inner dia. attached to the lower end of the drilling rod. 63.5 kg hammer was allowed to fall freely from a height of 760mm. The blows of the hammer drove the spoon into the soil up to 450mm. The nos. of blows required for each 150mm of penetration of the spoon was recorded. The number of blows required for last 300mm of penetration of the spoon was entered into the bore chart as being the standard penetration test results.

The standard blow count N_{70} can be computed from the measured N as follows:

$N'_{70} = C_N \times N \times \eta_1 \times \eta_2 \times \eta_3 \times \eta_4$

Where,

C_N= Adjustment for effective overburden pressure p'_o(kPa) computed [Liao and Whitman (1986)] CN= $(\frac{95.76}{p'o})$^0.5

N= Field SPT

η_i = adjustment factors

η_1 =0.79 energy ratio Er/70 for Er=55

η_2= 1.0 for Rod length > 10m

η_2= 0.95 for Rod length, 6-10m

η_2= 0.85 for Rod length, 4-6m

η_2= 0.75 for Rod length, 0-4m

η_3 = 1.0 for sampler correction without liner

η_4= 1.0 bore hole diameter correction for hole diameter of 60-120mm

- **Recording of Ground Water Table:**

After 24 hour completing the field investigations the level of ground water in each of the bore hole has been recorded by a measuring tape and found within a variable depth measured from the existing level of the ground. These are apparent level of ground water formed by the entrapped surface water.

Figure 5.3 shows the locations of bore holes**. Table 5.3** shows Existing ground level &Ground water table (stable) of investigated points

Table 5.3: Depth of Drilling, Existing ground level &Ground water table (stable) of investigated points

BOREHOLE ID	Depth of drilling (m)	Existing ground level (EGL) (m) PWD	Ground water table (GWT) (m)PWD
BH01	12.0	71	Not seen
BH02	15.0	41	38.1
BH03	15.0	34	30.95
BH04	24.0	45	42.5
BH05	15.0	31	28.6
BH06	31.0	33	30.65
BH07	26.0	30	27.05
BH08	15.0	32	29.8
BH09	15.0	35	33.9
BH10	15.0	101	Not seen

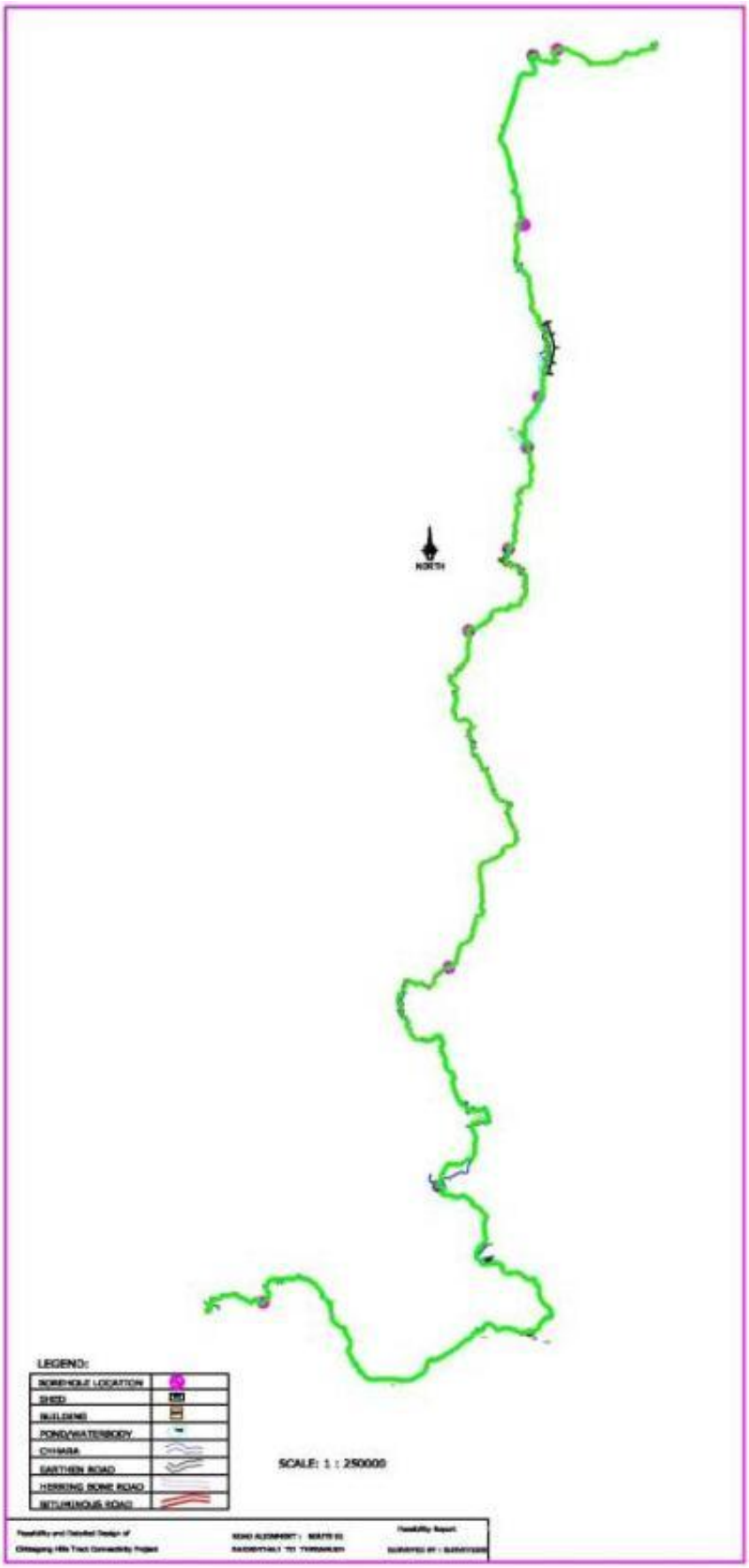


Figure 5.3: Locations of Bore Holes

5.3.1 Laboratory Testing

The following laboratory tests have been conducted on disturbed and undisturbed samples in the laboratory:

i) Grain Size Distribution (Mechanical)
ii) Grain Size Distribution (Hydrometer)
iii) Atterberg Limits (Liquid limit & Plastic limit)
iv) Moisture Content
v) Specific gravity
vi) Density test
vii) Unconfined Compression test
viii) Direct Shear test
ix) CBR test

The overall physical and engineering properties of the subsoil formation of the project area have been evaluated on the basis of 10 (Ten) boring 31.0m depth as per direction of the client.

The plasticity characteristics of the cohesive soils are found low to high and the consistency of the cohesive soils vary from soft to hard. The above classification has been made on the basis of ASTM procedure, according to unified soil classification systems, the cohesive formations fall in ML-CL Group and non-cohesive formations fall in SM Group. The detailed information of bore logs and summary sheet may be consulted in **Annexure 5.3.**

Description of the Geotechnical Units

The characteristics of the geotechnical units described based upon the test borings and the laboratory testing and other observation on site.

Stratification of soil:

The project area mainly comprises plastic CLAY, sandy SILT and silty fine SAND. Subsurface cohesive strata in nature consisting ofsoft to hard, Grey mixed brown to reddish brown low to high plastic CLAY and brown to yellowish brown low plastic sandy SILT. The non-cohesive layers consist of medium dense to dense, yellowish brown silty fine SAND with trace of mica.

Natural moisture content:

Natural moisture content of the investigated soil usually varies from 20% to 64%.

Specific gravity and Density:

Specific gravity of the investigated soil usually varies from 2.56 to 2.77

Atterberg limits:

The liquid limit of the cohesive soil varies from 18% to 46% and the plastic limit of the cohesive soil varies from 15% to 28%.

Shear Strength parameters: The shear strength parameters of various layers are described below:

Cohesion:

As reported from the performance of unconfined compression strength test, the values of cohesion vary from 17.25 kPa to 83.0 kPa.

Angle of internal friction:
As reported from the performance of direct shear test, the values of internal friction angle vary from 2 to 21 degrees. The value of Cohesion vary from 4.0 kPa to 6.0 kPa

5.3.1.1 Observations

On the basis of information available from geotechnical investigation and laboratory test report the allowable bearing capacity of different depths is given in the following **Table 5.3.1.1**

Table 5.3.1.1: Recommended allowable loads for 450mm and 600 mm diameter bored cast-in-situ pile

BH No.	Pile Penetration Depth (m)	Pile diameter (mm)	Pile Type	Compression Capacity (kN/pile)	Tension Capacity (kN/pile)
BH01	12.0	450	Bored pile	225.56	79.24
BH02	12.0	450	Bored pile	195.40	49.08
BH03	12.0	450	Bored pile	356.41	221.26
BH04	24.0	450	Bored pile	433.67	280.77
BH05	10.0	450	Bored pile	443.18	295.14
BH06	30.0	450	Bored pile	313.11	216.22
BH07	25.0	450	Bored pile	499.12	187.39
BH08	15.0	450	Bored pile	292.01	146.96
BH09	15.0	450	Bored pile	294.07	124.84
BH10	15.0	450	Bored pile	296.43	124.24
BH01	12.0	600	Bored pile	401.00	140.88
BH02	12.0	600	Bored pile	347.37	87.25
BH03	12.0	600	Bored pile	633.62	393.36
BH04	24.0	600	Bored pile	770.97	499.15
BH05	10.0	600	Bored pile	787.88	524.69
BH06	30.0	600	Bored pile	536.35	384.40
BH07	25.0	600	Bored pile	887.32	333.14
BH08	15.0	600	Bored pile	519.13	261.26
BH09	15.0	600	Bored pile	552.78	221.93
BH10	15.0	600	Bored pile	526.99	220.88

***Note**: Pile bearing capacity calculated according to BNBC-2012, by the use of static bearing capacity equations, 3.10.1.10 article.*

5.3.2 Interpretation of Test Result

1. The subsurface of the project area consists of three geological units. The top **Alluvium Formation** consisting of grey mixed brown to grey , very soft to soft, low to medium plastic unconsolidated silty Clay, Silt and fine Sand of Holocene/Recent age. Generally the thickness of this unit ranges between 0.0m to 14.0 m, in an average 6.0 m. The DihingSandstone / Siltstone Formation consist of moderately consolidated low to medium plastic yellowish brown highly oxidized Silty Clay of Late Piocene age. The thickness of this unit ranges between 0.0m to 19m with average thickness of about 8.0m. The **DupiTila Sandstone/ Claystone Formation** consists of over consolidated low to highly plastic reddish brown to yellowish brown highly oxidized mottled Silty Clay of Middle Pliocene age. The thickness of this unit ranges between 5.0 m to 31 m with an average thickness of about 9.0 m. The **Tipam Sandstone Formation** consists of yellowish brown to light brown, medium dense to very dense, fine to medium Sand with silt and race of mica of Middle

Miocene. The thickness of this unit ranges between 7.0m to 31.0m with an average thickness of about 8.0m.

2. The top Holocene Alluvium Formation has generally a low bearing capacity. The compaction of this unit is very loose to moderate. The SPT values ranges from 1 to 9 with an average of 3. The Dihing Siltstone / Sandstone Formation is mainly medium stiff to stiff with moderate bearing capacity. The SPT values ranges from 4 to 49 with an average of 21. The DupiTila Claystone/Sandstone Formation is mainly medium stiff to very stiff with moderate to high bearing capacity. The SPT values ranges from 5 to 53 with an average of 27. The Tipam Sandstone Formation is mainly medium dense to very dense. The SPT values ranges from 29 to 43 with an average of 35. This formation is very good for foundation layer; it is less vulnerable during the moderate to high earthquake.
3. According to observation regarding the sub soil condition of the proposed area Pile foundation is recommended, bearing capacity calculation of typical pile 450mm and 600mm foundation is attached in Appendix-4 of Annexure 5.3. The relevant Photographs are presented in Appendix-5 of Annexure 5.3.
4. The design engineer have to decide the type, depth and size of foundation depending on the load and he has to confirm the bearing capacity of the foundation. Hence the analysis may help in decision making.
5. Annexure 5.3 provides following details
   Appendix - 1: Borehole Location Map
   Appendix - 2: Borehole Logs
   Appendix - 3: Geological Profile
   Appendix - 4: Pile Bearing Capacity of Soil
   Appendix - 5: Photographs
6. The summary for results of Laboratory test have been provided in **Table 5.3.2**

Table 5.3.2: Summary for Results of Laboratory Tests

Type of Test														
SL No	Bbore Hole No.	Depth (m)	Moisture Content (%)	Specific gravity as per ASTM-854	Atterberg Limits			Density		Unconfined Compression strength		Direct shear test		CBR (%)
					Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (PI)	Wet Density (gm/cm^3)	Dry Density (gm/cm^3)	qu (kPa)	Cohesion soil (kPa)	Cohesion C (kPa)	Angle internal Friction Φd(deg)	
1	**BH NO-01**	2	19.89	2.67	33	19	14							13
		4	24.01	2.77	38	26	12							
		5	23											
		8	29.08											
2	**BH NO-02**	UD1	1.1											
		2	17.91	2.73										
		4		2.67										
		5	21.33		18	15	3							
		9						2.37	2.04			0	16	
		14						1.17	0.88			0	18	
3	**BH NO-03**	3	15.9	2.67	26	17	10							
		5		2.7										
		6	64		27	16	11							
		10										0	14	
4	**BH NO-04**	1	34.33											8
		2		2.67	35	21	14							
		3	24.54											
		4			33	25	8							
		UD2						1.8	1.32	44.5	22.25			
		8										3	12	
		14										0	21	
5	**BH NO-05**	UD2	32					1.77	1.28	41	21			11
		4	19.35		43	26	20							
		5		2.67										
6	**BH NO-06**	2	40.54	2.69										
		5		2.63	37	21	15							
		UD2						1.77	1.28	39	19.5			

Type of Test														
SL No	Bbore Hole No.	Depth (m)	Moisture Content (%)	Specific gravity as per ASTM-854	Atterberg Limits			Density		Unconfined Compression strength		Direct shear test		CBR (%)
					Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (PI)	Wet Density (gm/cm^3)	Dry Density (gm/cm^3)	qu (kPa)	Cohesion soil (kPa)	Cohesion C (kPa)	Angle internal Friction Φd(deg)	
		11										6	2	
		16	20.2		28	21	7							
		20										4	8	
		24										4	8	
		27			28	17	11							
		30	20.99											
7	**BH NO-07**	3	16.07											9.5
		8	22.7		28	17	10							
		12		2.63										
		UD1	25		40	16	24	1.97	1.58	166	83			
		17		2.63										
		22										6	6	
8	**BH NO-08**	UD1	21.61		29	20	9	2	1.64	73	36.5			
		6										6	6	
		10	21.59	2.56								4	6	
		15			46	28	18							
9	**BH NO-09**	1	28.69											
		UD1	35.18		31	21	10			34.5	17.25			
		3	33.62	2.69										
		4		2.64										
		5			32	18	14							
		UD1			31	21	10	1.85	1.37	34.5	17.3			
		10		2.65										
		12	29.63											
10	**BH NO-10**	1	18.31	2.65	41	27	15							10
		2	21.45	2.64										

5.4 Hydrological and Hydrographic Investigation:

The Karnafuli is a meandering river. During rainy season water level rises sharply facilitating plying of all types of vessels like passenger and cargo traffic. Sometimes damages the local cultivated crops. Though the river is a meandering one it does not create any problem of heavy erosion and siltation like other inland rivers the Padma, the Jamuna& the Meghnaetc. Which creates navigational hazards forming enormous shoals in their way to Bay of Bengal.

Water Level & Flow:

As per hydrographic survey, the water levels are found as below:

Highest water level of Kaptai reservoir is 33.69 m PWD and lowest water level is 23.63 m PWD from the graph of water level (**Fig 5.4 A and 5.4 B**) it is seen that water level dropped drastically in the month of April & May of 1998.Dredge Volumes for Multimodal RouteNo-1 is shown in **Annexure- 5.4** . Flow of the river is Karnafuli regulated by the barrage. Its flow is not directly connected to the sea. When upstream water level is high due to continuous rainfall and about to inundate the crops & households, the water is disposed off by opening the spillway of the barrage. If needed water is also disposed off by diversion tunnel.

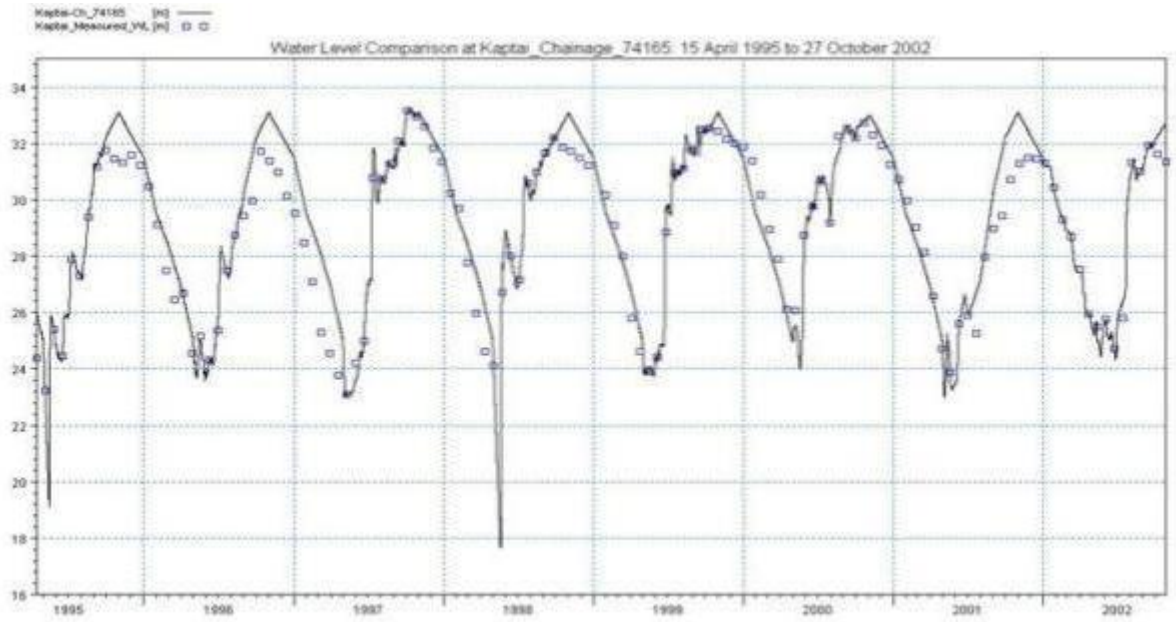


Figure 5.4 A: Graph of Water Levls in Kaptai Lake (1995 – 2002)

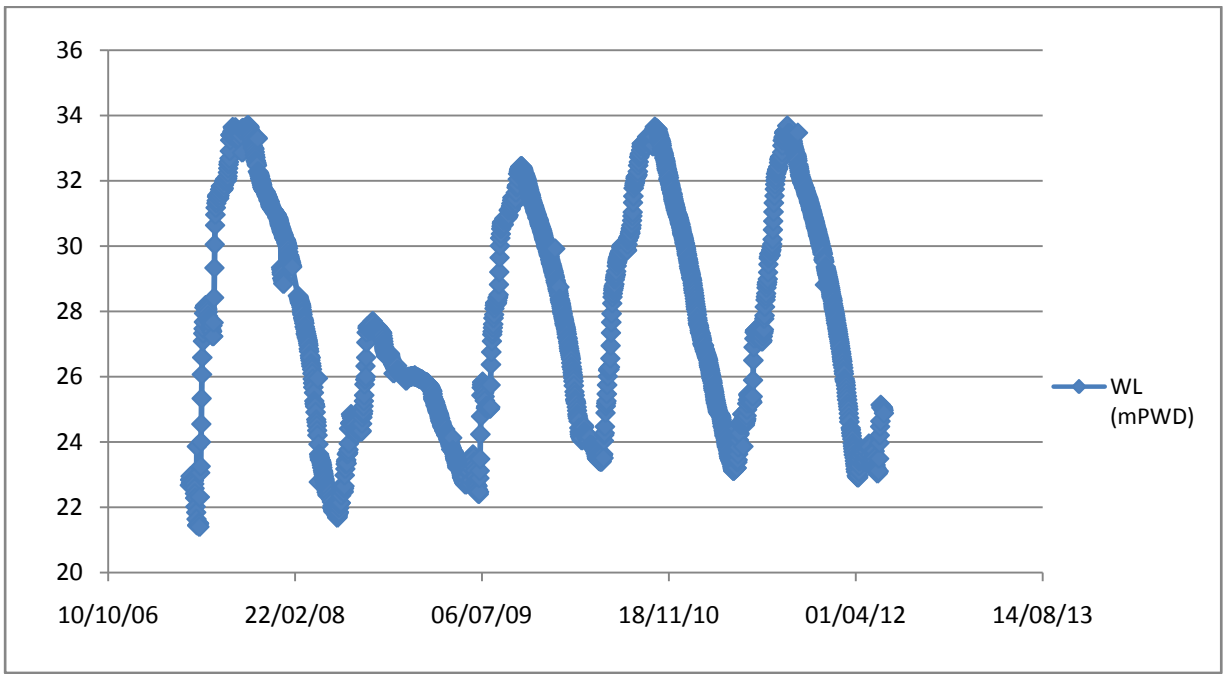
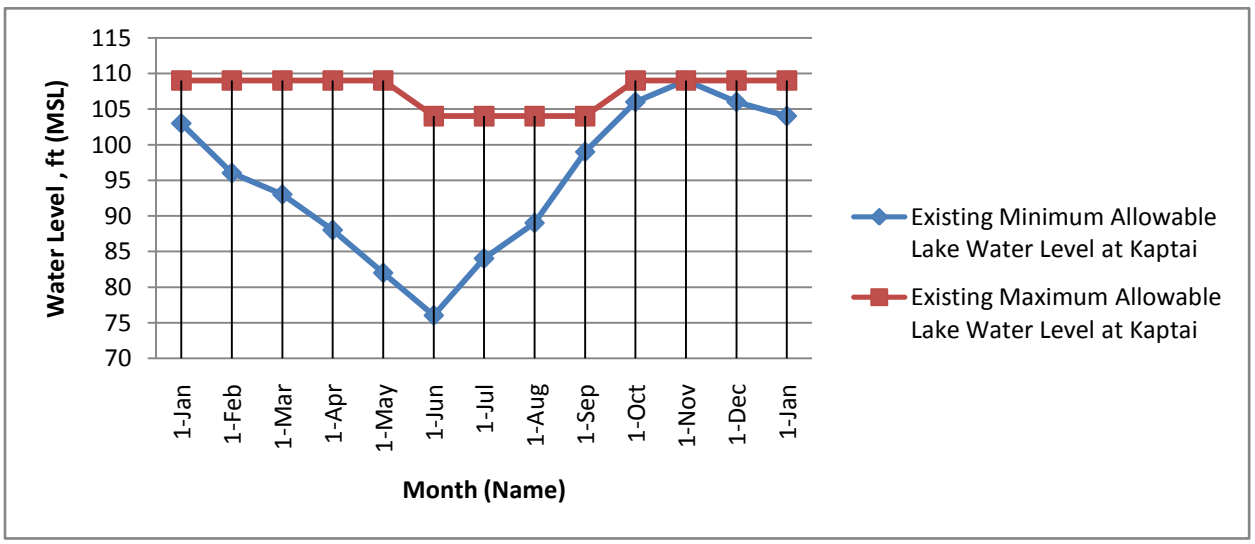


Figure 5.4 B: Graph of Water Levels in Kaptai Lake (2008 – 2012)

Operation policy of Kaptai reservoir is appended below:

The Reservoir is operated under a policy guided by a set of two rule curves. The upper rule curve gives the maximum allowable water level at the dam site. It is set at 33.23 m, MSL (109 ft, MSL) with a minimum flood cushioning between June and October of 1.52m (5 ft). The upper rule curve is the constraint to be maintained to ensure the safety of the dam. The lower rule curve has been constructed to maximize the power generation with the available water resources with 5 units. This rule curve allows storage of water during the months from June to October. The stored water is then utilized in the dry season for power generation. The lower rule curve varies from the lowest level of 23.17 m, MSL (76 ft, MSL) on the first day of June to maximum level of 33.23 m, MSL (109 ft, MSL) on the first day of November



Source: *Hydroelectric Power Plant atKaptai.*

- **Erosion:**

It is seen that from records of 2008-2011, no case of erosion was observed in this river. No storm occurredduring 2008-2011 (source Bangladesh meteorological Department).

- **Siltation & Re-siltation:**

The river is embraced by small hills & high lands. So its flow remains in the same path for years together. The river is assumed to be stable. It was not maintained any time by dredging or other river training works from its very creation. During the visit of SAI Expert team on 2.10.2015 in the month of October which is high water period, we observed the flowing water almost clean. Siltation is not prominent. Since dredging was not done previously, there is no previous record of re-siltation. So rate of re-siltation is not being possible to be reviewed and used for this assessment.

- **Rainfall / Precipitation**

It is seen from above statistics of 2008-2011 of Rangamati hill tract district that Annual rainfall varies from 1824 mm to 2535 mm/Annam

- **Temperature & Humidity:**

Temperature varies from 11.5 ºc – 36.2 ºc and humidity varies from 62.8 % to 76 %.

- **River bed material sampling**

The River bed material sampling analysis was done at Suvalong and Barkalof the river bed.The particle dia range and Locations of soil samples are given in the following **Table-5.4.A& 5.4 B**

Table 5.4A Particle dia Range

Class	Particle dia Range
Clay	<0.002 mm
Silt	0.002 mm to 0.06 mm
Sand	0.06 mm to 2 mm

Table 5.4B Locations of soil samples

Serial no.	Sample ID	From		River
		Latitude	Longitude	
1	SHU2015_01	22°44’25.183”	92°16’14.659”	Kasalong
2	BOR 2015_02	22°48’55.860”	92°23’31.035	Karnafuli

- **Hydrographic Chart:**

From the hydrographic chart it can be seen that the cross section of Kaptai Lake (Ch 33.00 – Ch 227.00) & Cross section at Karnafuly River (Ch 65.45 km – 68.75 km). (**Figure 5.4 C and 5.4 D**). The typical longitudinal profile is also drawn along the Thalweg from Kaptai to Chottohorina in **Figure 5.4 E**

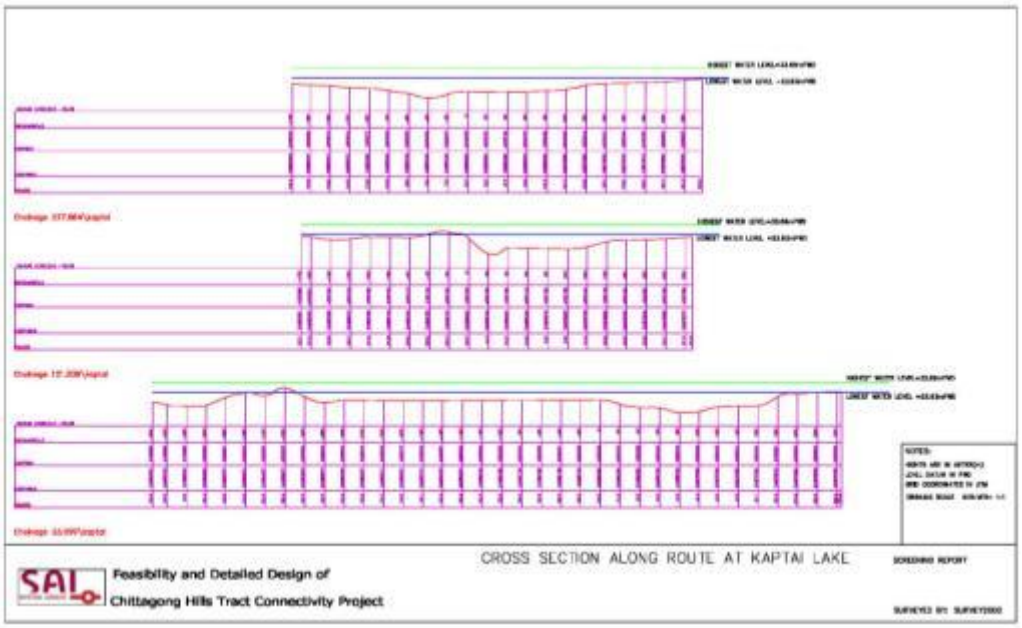


Figure 5.4 C: Typical Cross section at kaptai Lake (Ch 33.00 ~ Ch227.00)

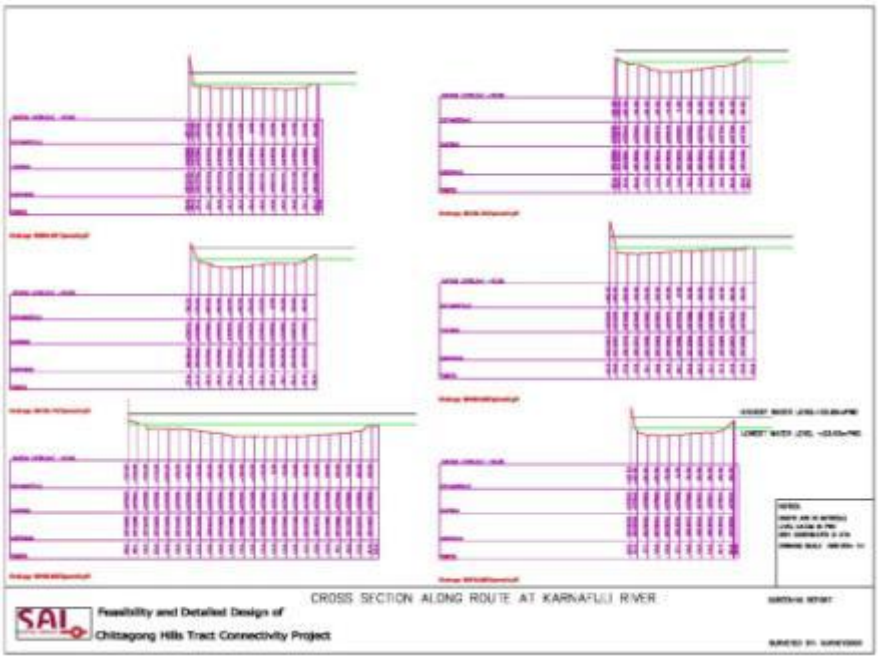


Figure 5.4 D: Typical Cross section at Karnafuly river (Ch 65.45km~Ch 68.75km)

Figure 5.4 E: Typical Longitudinal Profile in Kaptai Lake

5.5 Facilities Associated with Construction of Routes

5.5.1 Availability of construction material

Construction material such as Silty Soil/Soil for Sub-grade, Fine Sand/Sand, Bricks/Bricks aggregates, Stone/Stone aggregate, Bitumen, Road Marker Paint, Coarse Sand, Cement, and Reinforcement etc will be used for the proposed alignment. The availability of borrow and quarry sites are as follows:

5.5.1.1 Quarry Sites

Suitable sources for quarry sites have been identified along the project by local enquiry. However, Survey agency has carried out tests on selected sources to find their suitability for use. Sufficient number of quarries have been identified to verify availability of materials. The information on the materials sources was summarized in Geological Profile in Chapter 5 with the following number of quarries for stone, sand, gravel and quarry areas for the project area. The top Alluvium Formation consisting of plastic unconsolidated silty Clay, Silt and fine Sand of Holocene/Recent age. Generally the thickness of this unit ranges between 0.0m to 14.0m, in an average 6.0m. The **Dihing Sandstone/ Siltstone Formation** consists of moderately consolidated low to medium plastic Silty Clay of Late Pliocene age. The thickness of this unit ranges between 0.0m to 19.0m with an average thickness of about 8.0m.

Borrow and Quarry sites location maps are presented in following **Figure 5.5.1.1**

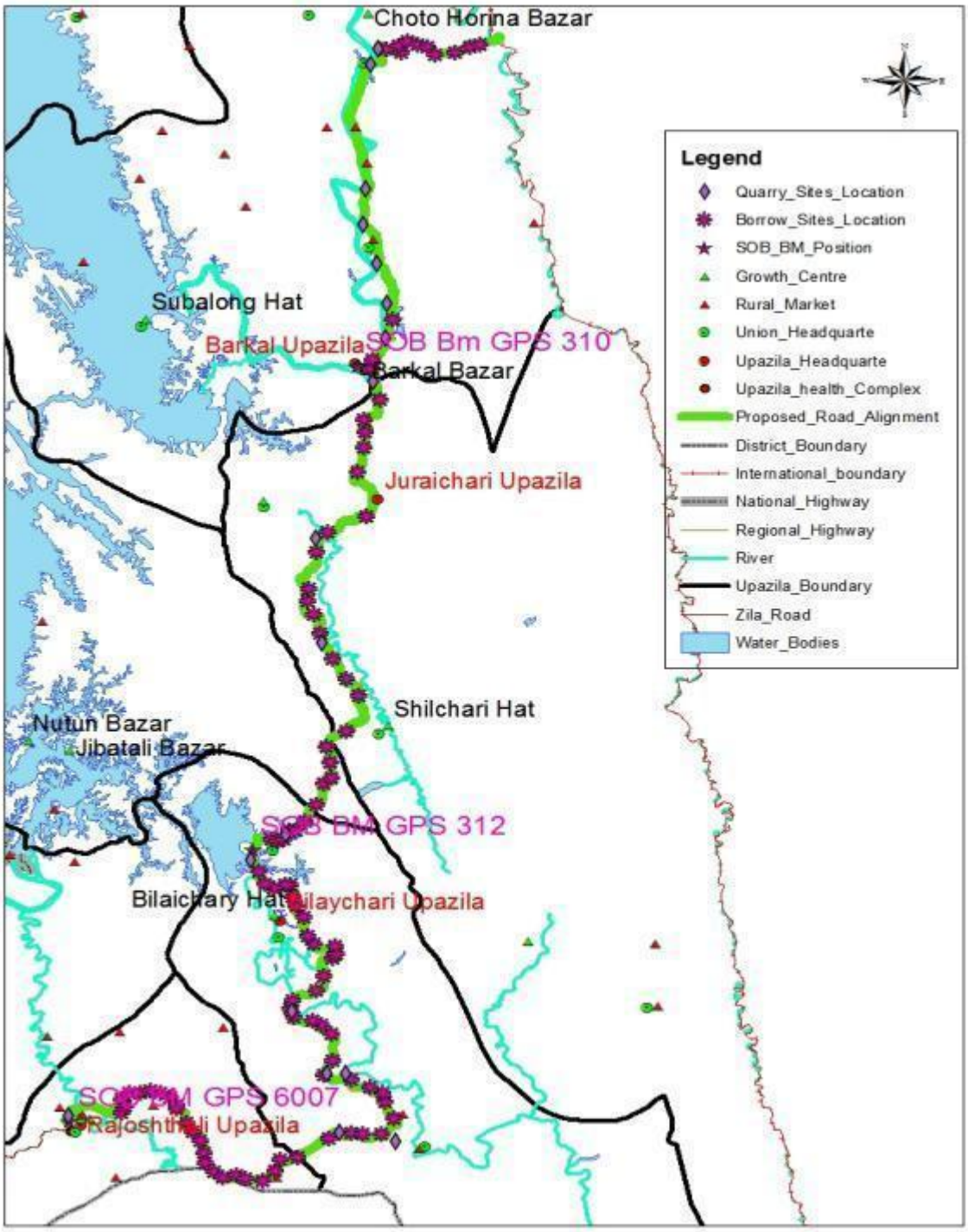


Figure 5.5.1.1:Possible Location Map of Borrow and Quarry Sites for Road Route

5.5.1.2 Borrow Sites

For the proposed route alignment borrow siteshas been identifiedwith material (soil, sand, stone, etc.) along with the alignment for use at other location.Only for soil and sand borrow siteswas found close to many location along the alignment. Soiland sand might be excavated to cut and fill for this project road route alignment. There is a need to provide acceptable resources to implement and maintain the environmental and safety management system including with labor and materials. For minimizing the amount of construction labor borrow sites location identified near to the alignment. Borrow sites location maps are presented in following **Figure 5.5.1.1**

5.5.1.3 Surveys of Construction Material

Table 5.5.1.3: List of Construction Materials & Sources

Route: 1			
Sl.N0	**Name of Construction Materials**	**Source**	**Remarks**
1	Silty Soil for Sub-grade	Rajoshthali, Farua, Bilaichari, Barkal, Chhotohorina. (Maximum area along with the alignment)	Available
2	Fine Sand (0.5 FM.) for ISG, Sub-base, etc.	Rajoshthali, Farua, Bilaichari, Barkal, Chhotohorina (Selected location along with the alignment up to Chhotohorina)	Available
3	Bricks/Bricksaggregates	Rangunia, Raowzan, Chhittagong	Available
4	Stone/Stone aggregate	Chittagong, Sylhet	Depends on volume of materials
5	Bitumen	Chittagong	Available
6	Road Marker Paint	Rangamati, Chittagong	Available
7	Coarse Sand	Chittagong, Sylhet	Depends on volume of materials
8	Cement	Rangamati, Chittagong	Available
9	Reinforcement	Rangamati, Chittagong	Available
10	Diesel, Petrol	Rangamati, Chittagong	Available

5.5.1.4 Construction Camps and Associated Services

Proper construction camps of the road maintenance provides many advantages to the project area. Construction camp locations based on current plans, this project covered 114.71km (Survey length) of the land-based road route alignment. Main objective to balance the number and location of camps to reduce distance from sources to destination for better and maximum productivity. By locating a camp near the proposed road routethat reduce travel time.

Safety of the workers in the camp and the nearby communities is considerable. Construction team will work with local police/BGB/Army to ensure that they are aware of project update/security and potential activity in the project area. Construction material camps location and associated services maps are presented in following **Figure 5.5.1.4**

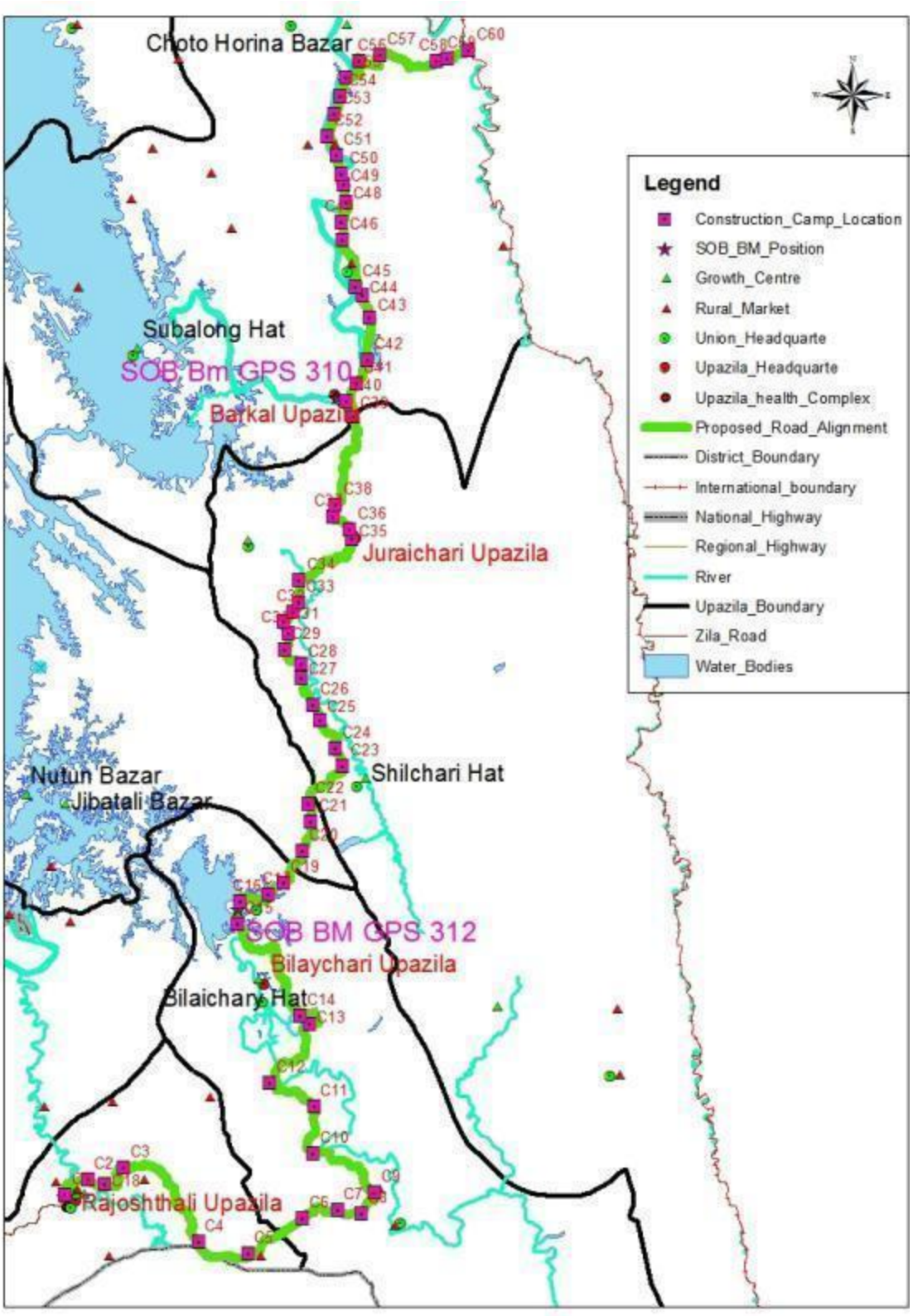


Figure 5.5.1.4: Possible Location Map of Construction Camps for Road Route

5.5.2 Soil and Dredged Material Disposal

Dredging Period

The dredging works can be started in early January when average water level is about +30 m.MSL and can be continued up to June. But early flash flood and monsoon may cause disruption of works in the months of March to June. Special measures are required to secure the dredgers and other equipment in these periods. On an average one month's work disruption may be estimated. As such, total of 5 (five) months working period would be available for each year's dredging in between January to June.

Dredge Material Management

The both banks along the dredging length of Karnafuli River and Kaptai Lake have been examined and found that the river banks are mostly flat in the fringe. At present only one crop of rice is being cultivated on most of the lands. The crop is being grown when the land is clear of water in the dry/low water period. The dredge material if placed on these cultivable lands would be useful for agriculture use.

By placing dredge material on the cultivable land, the height of the land would be raised. Some low lying areas will be filled up that will increase cultivable land. As the dredge material is suitable for agriculture use, this will be highly beneficial to the local farmers. Efforts should be made to fill up low lying areas as much as possible. When this would not be possible, the cultivable land should be raised within 1.0m meter. The dredge material is to be placed minimum 100 m beyond the river bank and within a distance of 1.5 Km. Crop compensation/land compensation to the farmers is to be arranged within the project cost.

Soil and Dredged material Disposal Site Management

The dredge material dumping reaches are selected at least 100 meter (if there is Space) away from bank line. The distance between outermost dredging point and the spoil dumping reach would not be more than 1.5 km. The sides of the dredging reaches should be developed in such a way so that dumped dredge material remains within the spoil reach, do not return back to the river. The low lying lands are preferred for development through spoil dumping. The center co-ordinates of spoil reach is presented in **Table 5.5.2** and location map is shown in **Figure-** (**5.5.2 a, b, c, d and e**). The dumping positions have been shown in the maps. The dimension of dredge material dumping reaches would be located with dimension during implementation of the project. During implementation of the project, the forest department, Kaptai Lake and local stakeholders might be contacted to finalize the dredge material dumping reach. The monitoring and quality control team would take necessary measure.

Table 5.5.2: Location of Centre Point of Proposed Spoil Dumping Zones at Kaptai Lake and Karnafuli River

ID	Easting	Northing
1	418982.585	2505258.510
2	419788.187	2506979.925
3	420756.618	2505618.768
4	422101.363	2507016.420
5	421996.177	2508163.087
6	421618.081	2509864.665
7	421252.912	2510883.921
8	422061.626	2511478.237

ID	Easting	Northing
9	424878.602	2512796.335
10	425277.792	2513517.394
11	426819.557	2514085.237
12	426517.565	2515070.023
13	426999.227	2515651.136
14	428010.735	2515749.670
15	427469.628	2516534.951
16	429150.274	2516669.661
17	429342.379	2517712.054
18	430522.968	2517850.175
19	431295.922	2516563.283
20	431382.215	2514729.955
21	431801.879	2514161.937
22	432135.873	2513360.452
23	433980.178	2513325.172
24	435451.112	2512861.514
25	437392.114	2512526.637
26	437721.549	2512259.868
27	437788.872	2512932.028
28	437635.630	2513712.067
29	437840.409	2514401.249
30	438295.216	2514951.203
31	437945.961	2515930.506
32	437414.814	2516275.948
33	437235.272	2516700.316
34	437311.474	2517437.807
35	437440.276	2518288.463
36	437103.329	2519180.209
37	436799.577	2519837.550
38	436733.476	2520581.253
39	436606.684	2521178.612
40	436033.713	2521900.073
41	436035.790	2522626.094
42	436640.771	2522271.896
43	437149.571	2522455.352
44	437493.722	2522978.840
45	437301.482	2524032.784
46	437587.469	2524325.448
47	437541.761	2524611.069
48	437680.926	2524984.618
49	436755.422	2526050.388
50	437061.800	2527407.135
51	437317.966	2528463.386
52	438165.463	2528985.719
53	437916.078	2529568.443

Location Map of spoil dumping reaches indicative (⊙) Alignment of Multimodal Route

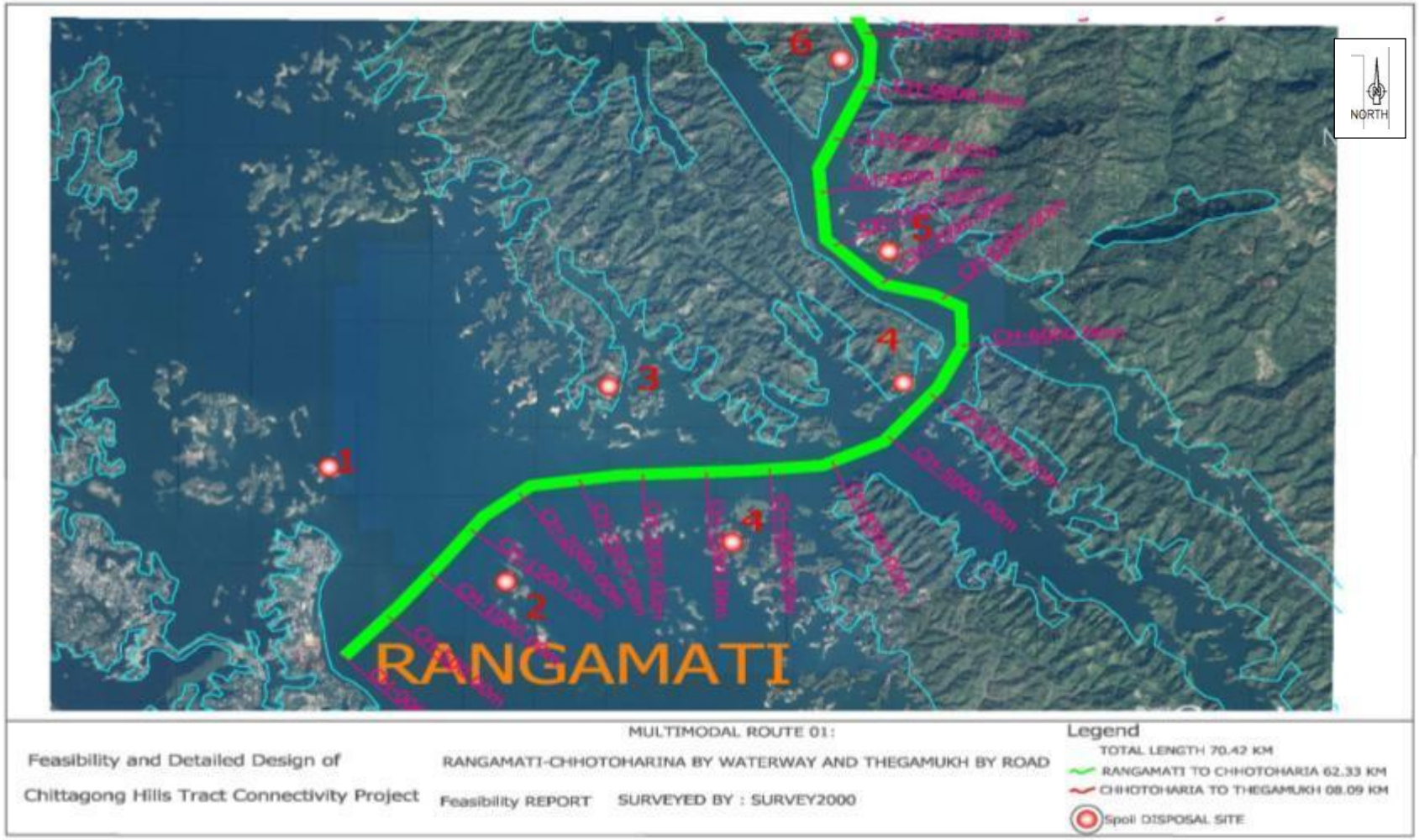


Figure 5.5.2 a: Location Map of Spoil Dumping Zoneof Multimodal Route-01 From Chainage 00.000m to 9500.00m

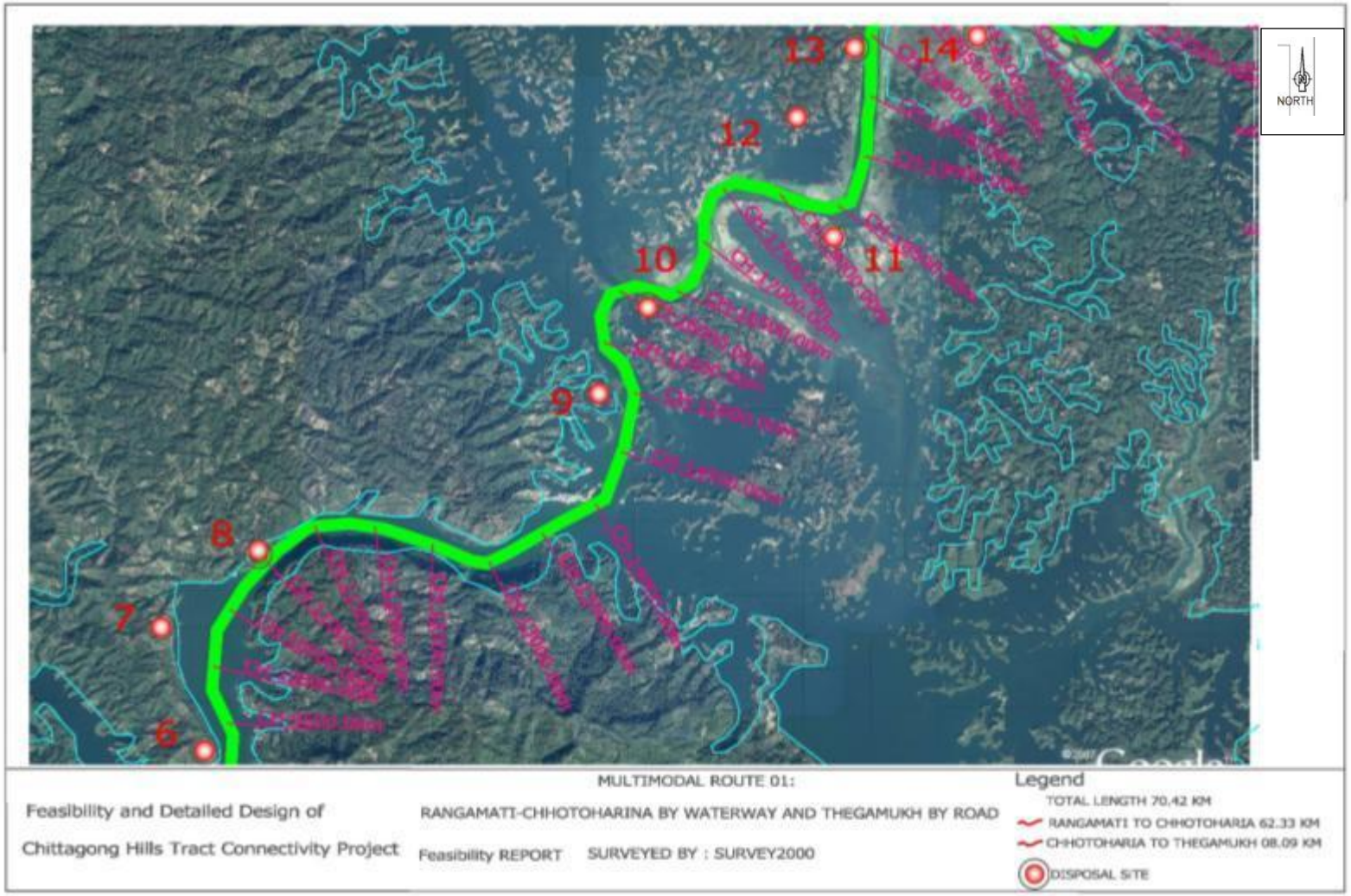


Figure 5.5.2 b: Location Map of Spoil Dumping Zone of Multimodal Route From Chainage From 9500.00m to 20000.00m

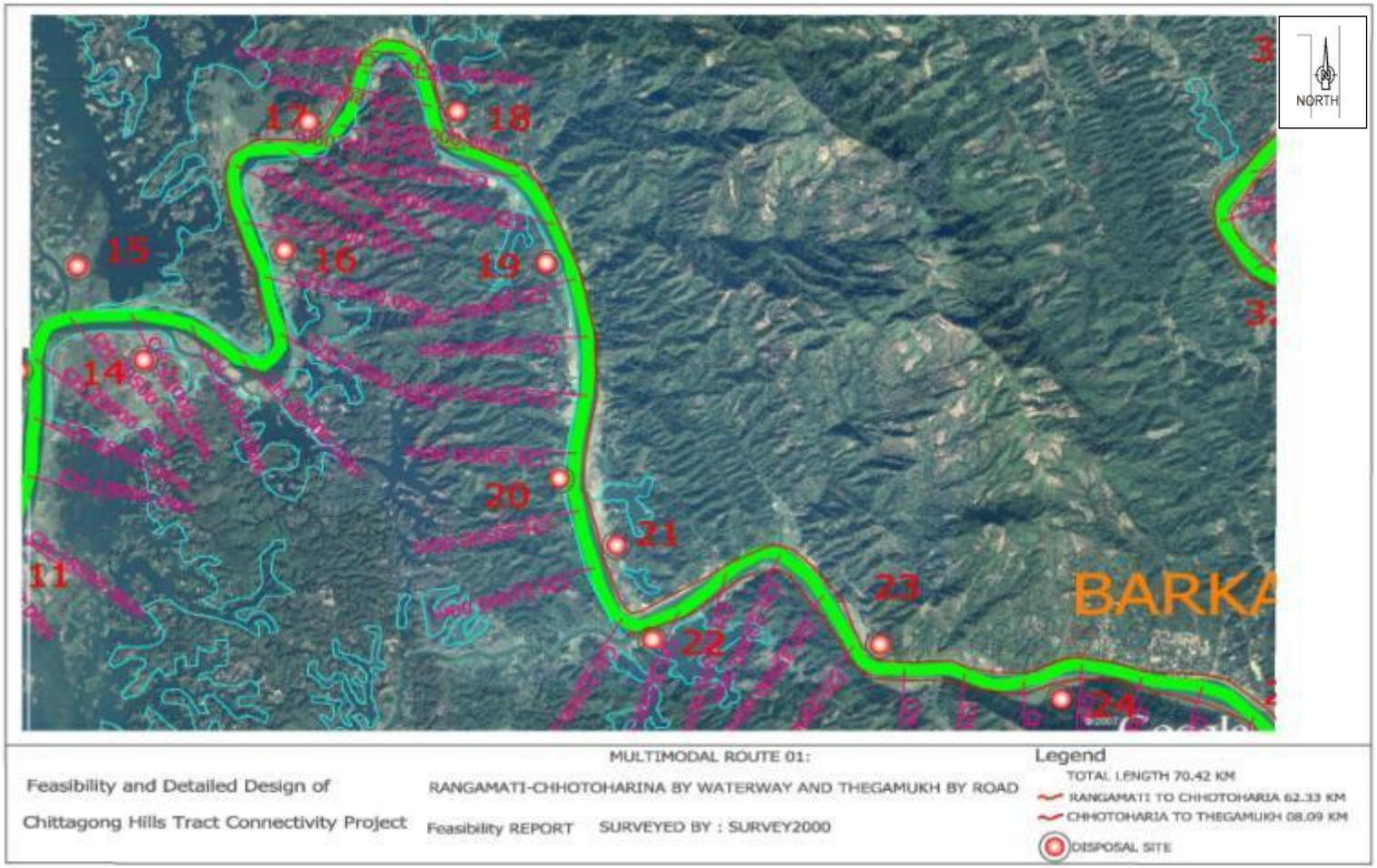


Figure 5.5.2 c: Location Map of Spoil Dumping Zone ofMultimodal Route From Chainage From 20000.00m to 34000.00m

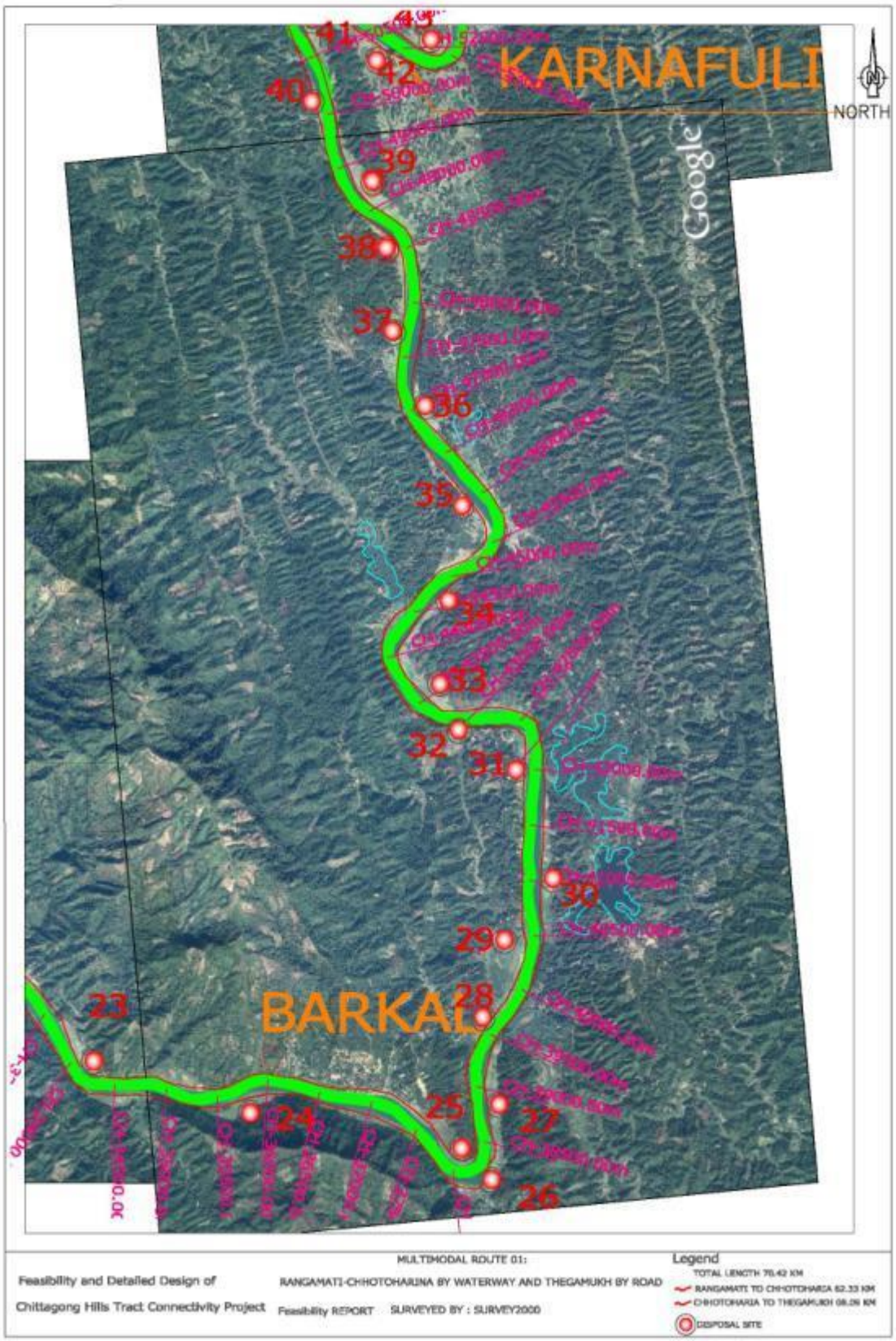


Figure 5.5.2 d: Location Map of Spoil Dumping Zone of Multimodal Route-01 From Chainage 34000.00m to 52500.00m

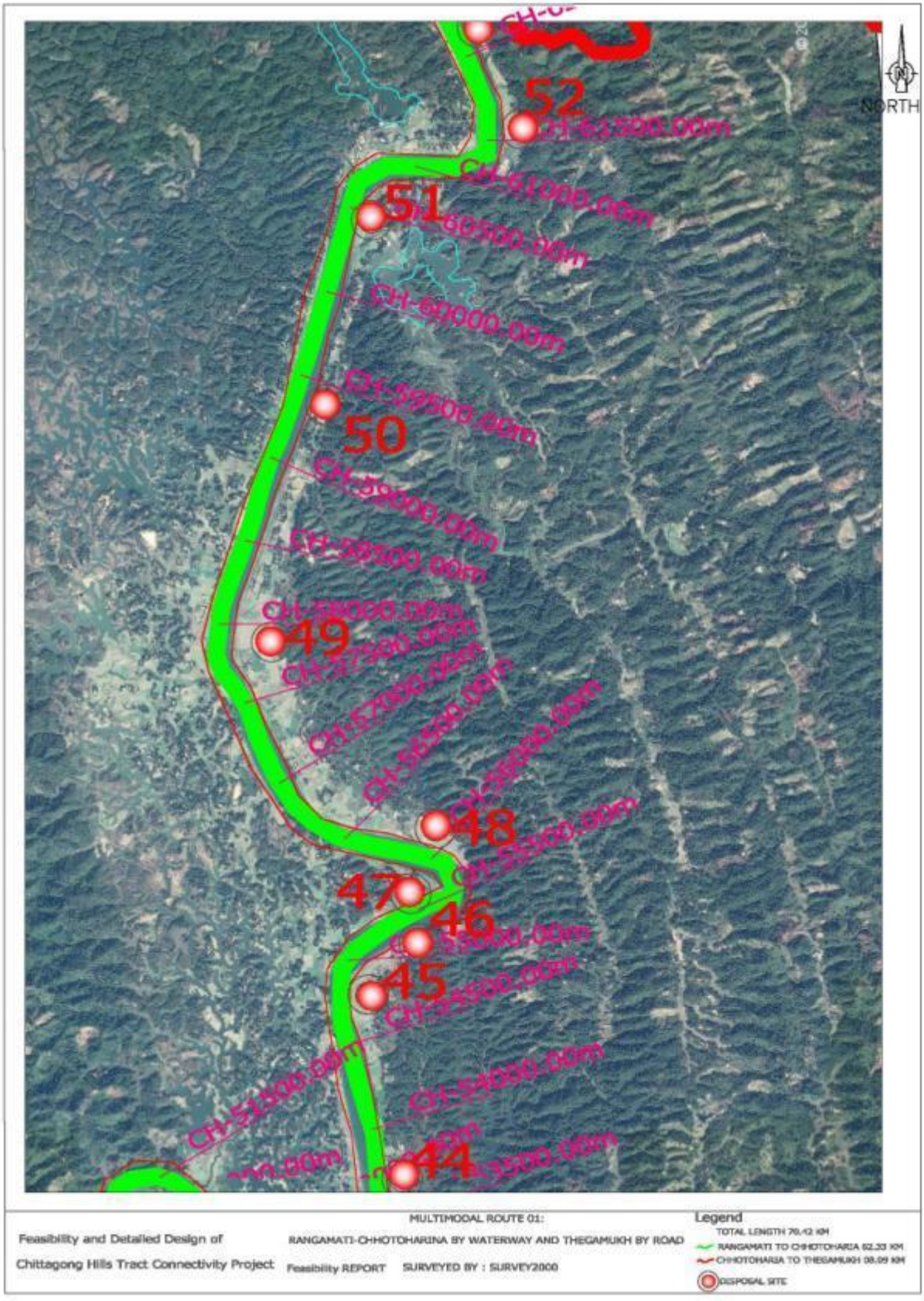


Figure 5.5.2 e: Location Map of Spoil Dumping Multimodal Route From Chainage 52500.00m to 62300.00m

CHAPTER - 6

Improvement Proposals for Proposed Road and Multimodal Routes

CHAPTER - 6

Improvement Proposals for Proposed Road and Multimodal Routes

6. 1 Design of Road Geometrics

6.1.1 Horizontal Alignment

The new road (horizontal) alignment has been designed to follow the existing one as much as possible with minor modifications like easing sharp bends and realigning short sections to connect some structures constructed or under construction and to avoid religious structures like mosques, temple, graveyards, etc. Alignment shifting has also been done to connect proposed bridges. Major deviation has been made at market/built-up areas to avoid demolishing multi storied residential and commercial buildings & structures. The details of horizontal curves used in the design have been given in the drawings.

6.1.2 Vertical Alignment

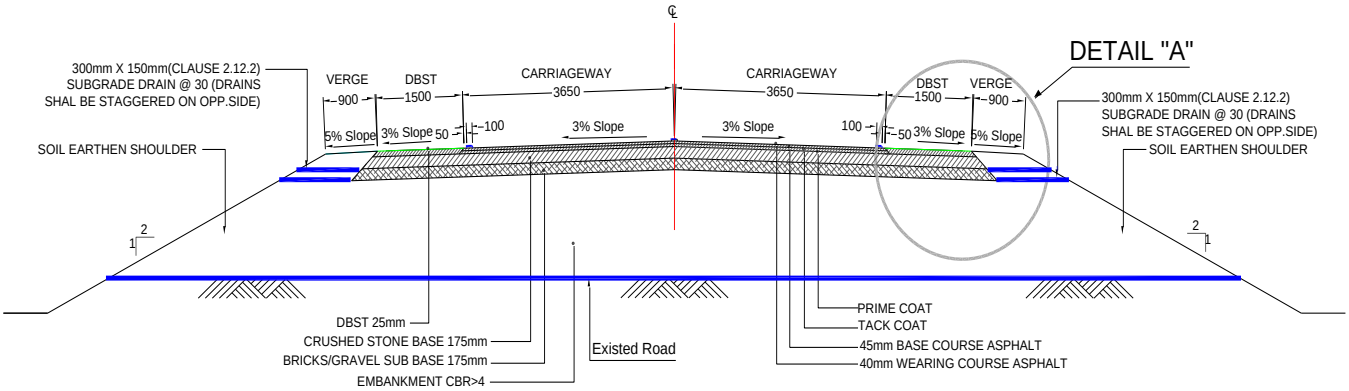
The design level of the sub grade has been fixed with minimum 1.0m above the Design Flood Level based on 30 years return flood as per RHD Standareds. The vertical alignments of the road have been designed for smooth transition. Standared longitudinal gradients have been provided for the road. For connecting the approach roads with design road profile and bridge ends vertical curves have been inserted. Navigational clearances for new Bridge have been provided as per requirements of Bangladesh Inland Water Transport Authority (BIWTA). The details of vertical curves used in the road design have been presented in the drawings.

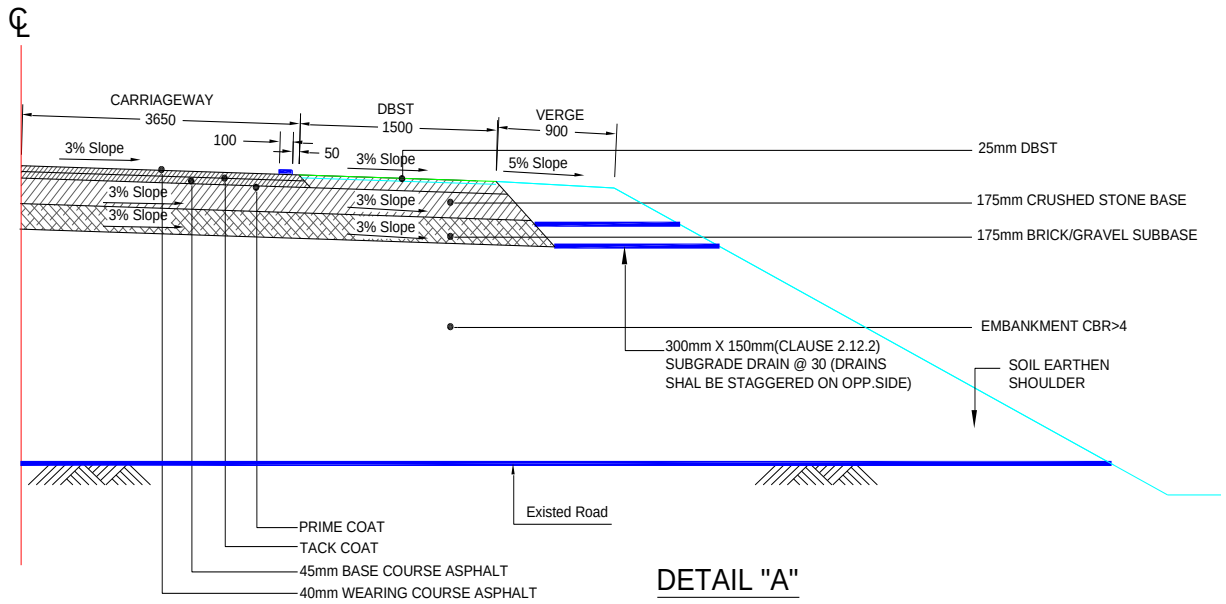
6.1.3 Road Cross-section

In the Cross section of the road has been considerded to be 12.10 m top (crest width). But modified cross sections have been taken for builtup areas and hilly areas. Adopted cross section carries 2 lane carriage way (each carriageway 3.65m wide), 1.50 m paved shoulder on each side. Alongside the paved shoulders there are verges of width 0.9m. Lane width and other parameters have been selected as per RHD & IRC standard but with appropriate modification. Typical cross sections of the road have been presented in **Figure 6.1.3 below**

Single Carriageway-	
Road Lane Width	2 x 3.65 m
Bridge Lane Width	2 x 3.65 m
Bridge Sidewalk Width	2 x 0.9 m
Railing width	2 x 0.2 m
Shoulder Width-	
Flat, Rolling (Hard Shoulder)	2 x 1.50 m
Hill (Hard Shoulder)	2 x 0.90 m
Flat and Rolling (Soft Shoulder)	2 x 0.90 m
Built-up Area	2 x 3.50 m
Shoulder Slope (Hard)	3.0%
Shoulder Slope (Soft)	5.0%
Normal Crossfall	3.0%

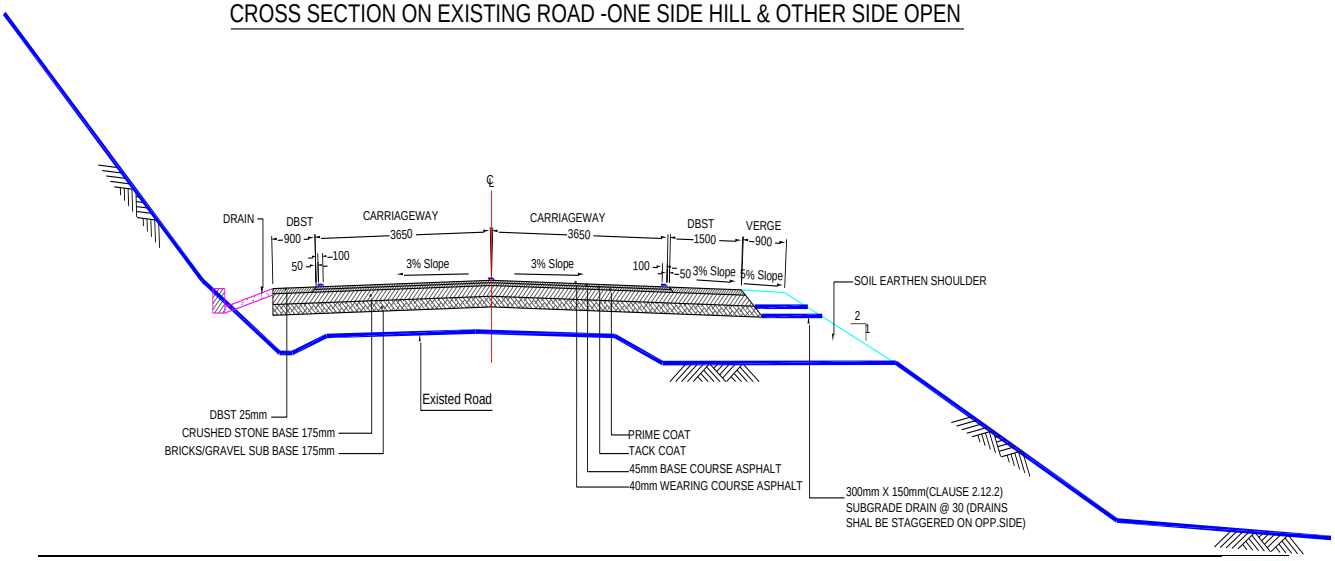
TYPICAL CROSS SECTION & DETAIL DRAWINGS (1)
CROSS SECTION OF ROAD OPEN AREA

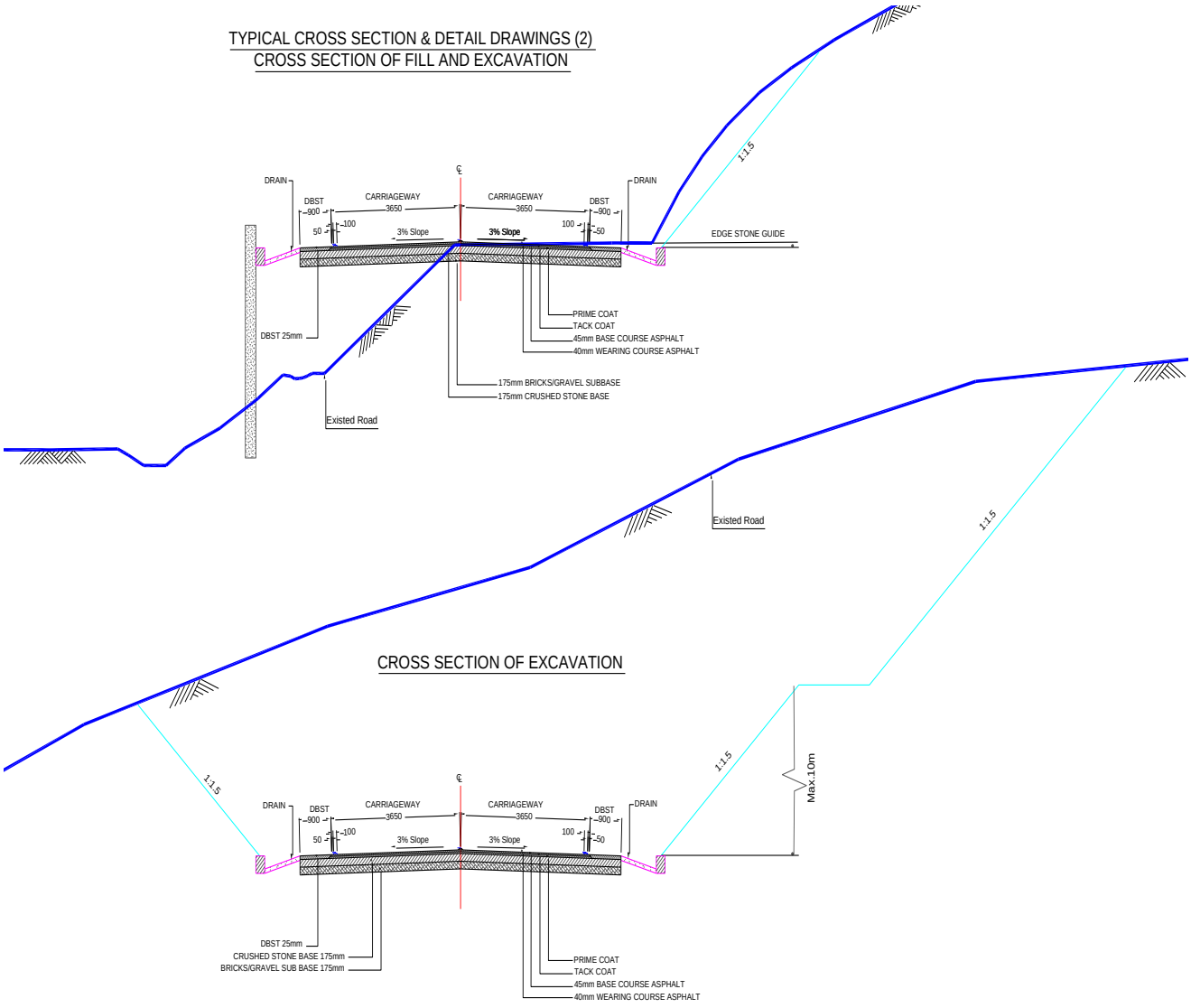




DETAIL "A"

CROSS SECTION ON EXISTING ROAD -ONE SIDE HILL & OTHER SIDE OPEN





TYPICAL CROSS SECTION & DETAIL DRAWINGS (3)

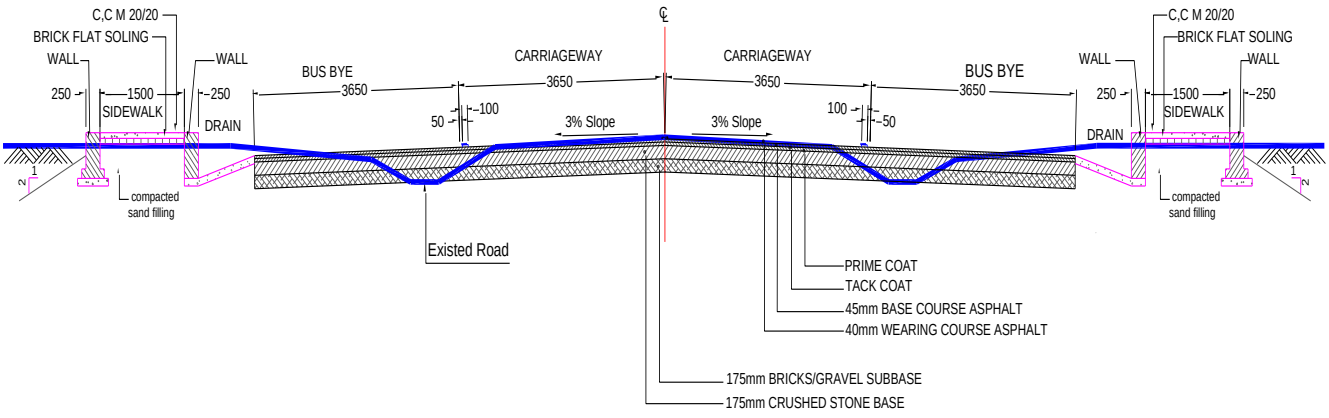


Figure 6.1.3: Typical cross sections of the road

6.2 Slope Stability of Proposed Road Routes and Road Portion of Multimodal Route

Slope stability conditions are studied along Rajosthali - Bilaichhari - Juraichhari - Barkal - Chhotoharina-ThegamukhRoad. In general the problems of slope stability are of small scale, localized and superficial. They include mostly of cut slope failure, soil erosion on cut slopes, improper water management and absence of side drains in these roads along most of the stretches.

6.2.1 General Review of Slope Stability Problems

The erosion of cut slopes causes the following harmful effects:

- Danger to stability of cut slope due to increased weight of the saturated soil and reduced shear strength.
- Seepage of water into the soil causing excess pressure on the slope.
- Loosening of soil and silting of side ditches and culverts.

The Extent of erosion depends on various factors such as soil type, slope of embankment, intensity of rainfall, height of embankment and various other factors. In general, the following situation call for close study:

- Approaches to bridges, especially in flood plains, where the height of embankment is high, and parallel flow is expected.
- High approaches to over-bridges.
- Embankments in loose sandy soils lacking in cohesion.
- Steep cuts specially in soil

A Variety of treatments is possible for slope protection, depending upon the severity of the erosion expected. Some of the well-known remedies are:

- Turfing
- Pitching with rip-rap, sand cement slabs, cement concrete slabs and bricks.
- Raised curbs, gutters and flumes
- Geotextiles and netlon
- Bituminous treatment.

Turfing is the most well-known and cheapest form of slope protection. The success of the measure depends upon the suitability of the soil to the development of turf culture.Purely sandy soils are unsuitable for growth of turf.In such cases, layer of clay soil (0.25-.03) m thick) from suitable borrow area can be laid to (i) confine the sand and (ii) foster growth of turf. Turf can be grown by planting sods or by seeding. Sods are preferred on steeper slopes, whereas seeding is resorted to on flatter slopes. The use of jute netting, coir netting and geo-grids helps the turf to grow by holding the soil firmly. After the turf grows, the jute and coir netting decomposes.

Pitching with rip-rap (boulders), sand-cement slabs, cement concrete slabs and bricks is very common when dealing with high embankments in flood zones and heavy rainfall areas. Open jointed pitching is to be preferred to joints with cement mortar because of the need to provide outlet for seepage water in the embankment. The pitching should be provided with a graded inverted filter bedding to prevent the soil particles from getting lost. The pitching must have a good stout toe wall.

Bituminous treatment (BT) is used for erosion control in a number of ways. The asphalt, sprayed as an emulsion at 0.7-1.0 kg/m^2 helps in a number of ways. It cuts down the susceptibility to erosion. It helps to retain the moisture content and it helps to raise the soil temperature by absorbing light rays and promoting the emergence of tiny saplings. The second type of treatment consists of laying and compacting asphalt mixes or spraying or spraying a low viscosity cut-back. The rate of application of asphalt is about 1 kg per m^2 so as to penetrate the soil to a depth of about 12 mm.

The following tentative locations have been identified where there is a need for Detailed Investigation (DI) during detailed design phase and appropriate measure need to be adopted as discussed above in the form of Bio- Engineering (BE), Turfing (TF), Water Management (WM), Trimming etc.

Sl. No.	Area Prone to Slope Stability		Remedial Measures
	From	To	
1	Ch. 8+150	Ch. 8+250	DI/BE/TF/WM/BT
2	Ch. 8+250	Ch. 8+350	DI/BE/TF/WM/BT
3	Ch. 8+350	Ch. 8+450	DI/BE/TF/WM/BT
4	Ch. 8+450	Ch. 8+550	DI/BE/TF/WM/BT
5	Ch. 8+550	Ch. 8+650	DI/BE/TF/WM/BT
6	Ch. 8+650	Ch. 8+750	DI/BE/TF/WM/BT
7	Ch. 8+750	Ch. 8+850	DI/BE/TF/WM/BT
8	Ch. 8+850	Ch. 8+950	DI/BE/TF/WM/BT
9	Ch. 8+950	Ch. 9+050	DI/BE/TF/WM/BT
10	Ch. 9+050	Ch. 9+150	DI/BE/TF/WM/BT
11	Ch. 9+650	Ch. 9+750	DI/BE/TF/WM/BT
12	Ch. 9+750	Ch. 9+850	DI/BE/TF/WM/BT
13	Ch. 9+850	Ch. 9+950	DI/BE/TF/WM/BT
14	Ch. 9+950	Ch. 10+050	DI/BE/TF/WM/BT
15	Ch. 10+05	Ch. 10+150	DI/BE/TF/WM/BT
16	Ch. 10+150	Ch. 10+250	DI/BE/TF/WM/BT
17	Ch. 10+250	Ch. 10+350	DI/BE/TF/WM/BT
18	Ch. 10+350	Ch. 10+450	DI/BE/TF/WM/BT
19	Ch. 10+450	Ch. 10+550	DI/BE/TF/WM/BT
20	Ch. 10+550	Ch. 10+650	DI/BE/TF/WM/BT
21	Ch. 10+650	Ch. 10+750	DI/BE/TF/WM/BT
22	Ch. 10+750	Ch. 10+850	DI/BE/TF/WM/BT
23	Ch. 10+850	Ch. 10+950	DI/BE/TF/WM/BT
24	Ch. 10+950	Ch. 11+050	DI/BE/TF/WM/BT
25	Ch. 11+050	Ch. 11+150	DI/BE/TF/WM/BT
26	Ch. 11+150	Ch. 11+250	DI/BE/TF/WM/BT
27	Ch. 11+450	Ch. 11+550	DI/BE/TF/WM/BT
28	Ch. 11+550	Ch. 11+650	DI/BE/TF/WM/BT
29	Ch. 11+650	Ch. 11+750	DI/BE/TF/WM/BT
30	Ch. 11+750	Ch. 11+850	DI/BE/TF/WM/BT
31	Ch. 11+850	Ch. 11+950	DI/BE/TF/WM/BT
32	Ch. 11+950	Ch. 12+050	DI/BE/TF/WM/BT
33	Ch. 12+050	Ch. 12+150	DI/BE/TF/WM/BT
34	Ch. 12+150	Ch. 12+250	DI/BE/TF/WM/BT
35	Ch. 12+550	Ch. 12+650	DI/BE/TF/WM/BT

Sl. No.	Area Prone to Slope Stability		Remedial Measures
	From	To	
36	Ch. 12+650	Ch. 12+750	DI/BE/TF/WM/BT
37	Ch. 12+750	Ch. 12+850	DI/BE/TF/WM/BT
38	Ch. 12+850	Ch. 12+950	DI/BE/TF/WM/BT
39	Ch. 12+950	Ch. 13+050	DI/BE/TF/WM/BT
40	Ch. 13+050	Ch. 13+150	DI/BE/TF/WM/BT
41	Ch. 13+150	Ch. 13+250	DI/BE/TF/WM/BT
42	Ch. 13+250	Ch. 13+350	DI/BE/TF/WM/BT
43	Ch. 13+350	Ch. 13+450	DI/BE/TF/WM/BT
44	Ch. 13+450	Ch. 13+550	DI/BE/TF/WM/BT
45	Ch. 13+750	Ch. 13+850	DI/BE/TF/WM/BT
46	Ch. 13+850	Ch. 13+950	DI/BE/TF/WM/BT
47	Ch. 13+950	Ch. 14+050	DI/BE/TF/WM/BT
48	Ch. 14+050	Ch. 14+150	DI/BE/TF/WM/BT
49	Ch. 14+150	Ch. 14+250	DI/BE/TF/WM/BT
50	Ch. 14+250	Ch. 14+350	DI/BE/TF/WM/BT
51	Ch. 14+350	Ch. 14+450	DI/BE/TF/WM/BT
52	Ch. 14+450	Ch. 14+550	DI/BE/TF/WM/BT
53	Ch. 14+550	Ch. 14+650	DI/BE/TF/WM/BT
54	Ch. 14+650	Ch. 14+750	DI/BE/TF/WM/BT
55	Ch. 14+750	Ch. 14+850	DI/BE/TF/WM/BT
56	Ch. 14+850	Ch. 14+950	DI/BE/TF/WM/BT
57	Ch. 14+950	Ch. 15+050	DI/BE/TF/WM/BT
58	Ch. 15+050	Ch. 15+150	DI/BE/TF/WM/BT
59	Ch. 15+150	Ch. 15+250	DI/BE/TF/WM/BT
60	Ch. 15+250	Ch. 15+350	DI/BE/TF/WM/BT
61	Ch. 15+350	Ch. 15+450	DI/BE/TF/WM/BT
62	Ch. 15+450	Ch. 15+550	DI/BE/TF/WM/BT
63	Ch. 15+550	Ch. 15+650	DI/BE/TF/WM/BT
64	Ch. 15+650	Ch. 15+750	DI/BE/TF/WM/BT
65	Ch. 15+750	Ch. 15+850	DI/BE/TF/WM/BT
66	Ch. 15+850	Ch. 15+950	DI/BE/TF/WM/BT
67	Ch. 15+950	Ch. 16+050	DI/BE/TF/WM/BT
68	Ch. 16+050	Ch. 16+150	DI/BE/TF/WM/BT
69	Ch. 16+150	Ch. 16+250	DI/BE/TF/WM/BT
70	Ch. 16+250	Ch. 16+350	DI/BE/TF/WM/BT
71	Ch. 16+350	Ch. 16+450	DI/BE/TF/WM/BT
72	Ch. 16+450	Ch. 16+550	DI/BE/TF/WM/BT
73	Ch. 16+550	Ch. 16+650	DI/BE/TF/WM/BT
74	Ch. 16+650	Ch. 16+750	DI/BE/TF/WM/BT
75	Ch. 16+750	Ch. 16+850	DI/BE/TF/WM/BT
76	Ch. 16+850	Ch. 16+950	DI/BE/TF/WM/BT
77	Ch. 16+950	Ch. 17+050	DI/BE/TF/WM/BT
78	Ch. 17+050	Ch. 17+150	DI/BE/TF/WM/BT
79	Ch. 17+150	Ch. 17+250	DI/BE/TF/WM/BT
80	Ch. 36+700	Ch. 37+950	DI/BE/TF/WM/BT
81	Ch. 51+000	Ch. 56+400	DI/BE/TF/WM/BT
82	Ch. 78+950	Ch. 80+800	DI/BE/TF/WM/BT

6.3 Road Safety Aspects

6.3.1 Safety-Barriers/Crash Barrier& Delineators

The accident prone areas are sharp curves, approaches to roadway bridges, and high embankment sections. Crash barriers are provisioned on the bridges also safety barriers are proposed on high embankments, sharp curveys. On bridge approaches Guard posts are proposed. Delineators are also proposed as light – retro – reflecting devices by the side of roadway alignment, specially for night driving. It is proposed to provide delinators on the curves, guard rails , bridges, abutments etc.

6. 3.2 Signs and Road Markings

For traffic signs and road markings, Bangladesh Road Transport Authority (BRTA) Traffic Signs Manuel 2000 has been followed. In the hilly area as given in geometric standards 50 Kmph speed is followed but on the curves where it was found difficult to maintain the speed is reduced and speed control sign posts are indicated at appropriate locations. Similarly as per the Manual Regulatory, Warning and Informatorysignes are also proposed.

Other Safety Measures

- It is decided to provide Sidewalk/ footpath (1.5m desirable, 1 m minimum) on both sides of the carriageway passing through major settlements. Ensure that the footpaths are installed at a higher level than the carriageway to separate out the carriageway and footpaths at the same time enhance the visibility of pedestrians.
- Separate provisions are made for bus bays at the locations of bus stops in order not to create hindrance to moving traffic.
- Various types of soils can occur along the alignment of the roadway segments. They can include ordinary soils comprising colluviums, alluviums and completely decomposed rocks, disintegrated rocks, Soft rocks, medium rocks and hard rocks. The soils/rocks can stand safely at certain angles during cutting without any support. The safe stable angles are summarized in **Table 6.3.2** below and the roadway segments should be designed to provide safe stable slopes.

Table 6.3.2 Indicates Tentative Safe Cut Slopes Recommended

SL. No	Type of Soil	Side Slopes (V:H)			Average Slope Angle in Degrees
1	Ordinary Soils	1:1	to	1.5:1	56
2	Disintegrated rock or Conglomerate	2 :1	to	4:1	71
3	Soft rock, Shale, Phyllite	4:1	to	8:1	80
4	Medium Rock	12:1	to	16:1	85
5	Hard Rock	Nearly vertical or half tunneling if cut height exceeds 7.5 m			

- Traffic-calming is necessary to safeguard the pedestrians at major settlements and bazar this road passes through and it should be considered in the design process.
- Cover all open side drains proposed in the market areas to be forgiving to the pedestrians and facilitate them to access the adjacent properties.
- Cover slabs of the side drains should be installed at a higher level than the carriageway in order to separate them from the carriageway to protect the pedestrians.
- Warning signs are recommended to warn of the settlements along the road this roadway passes through.
- Explore the feasibility of providing safe side slope (1:4) at the valley side or

embankment. If this is not feasible and the valley side does not warrant safety barriers, provide concrete post delineators at closer intervals to improve delineation.

- For pipe culverts Install sign to warn about shoulder obstruction due to modification for both directions.
- If the culvert is located along a sharp horizontal or steep vertical curve, extend the parapet recommended above up to the length of the approach curve. Install delineator posts (reflective) at 2 m interval at both sides of the roadway over these parapets as well as the approach curves, to improve delineation.
- Design barriers on both sides of slab culverts to be 0.9 m in order to effectively prevent vehicles from running over the roadway in the vicinity of these structures.
- For slab culverts located along a sharp horizontal or steep vertical curve, extend the RCC barriers recommended above up to the length of the approach curve and supplement it with delineator posts (reflective) at 2 m interval over approach and the barrier on both sides.
- Explore the feasibility of extending a 1 m wide cantilever slab or steel fabricated assembly on both sides or at a minimum on one side of the bridges to provide side-walks. If this is feasible ensure that the side-walks are 0.5 m above the carriageway by means of kerbs and paving blocks or other appropriate means to separate pedestrian from vehicular traffic and enhance pedestrian visibility. To facilitate easy access for the pedestrians along the bridges either adjust the grades of the approach shoulder to ramp to the level of side-walks or construct steps.
- If provision of side-walks is not feasible, install necessary signs at both ends of the bridge-parapets to caution drivers about lateral constraints across the bridge as an intermediate measure.

6. 4 Design of Pavements for Road Route and Road Portion of Multimodal Route.

RHDpavement design manual,2005 has been used for the road portion. The RHD Pavement Design Guide has been prepared based on two internationally recognized design standards, namely the AASHTO Pavement Design Manual and the TRL Overseas Road Note 31, with a view to making the design of road pavements as straightforward as possible. The strength of each layer is expressed in terms of the California Bearing Ratio (CBR) and it is essential that the materials used, and compaction obtained, for each layer achieves the required CBR for that layer. If the underlying layers do not have the required CBR then the upper layers of a road pavement will fail even if they have been correctly constructed.All road pavements require to be designed with the thickness of the various pavement layers, including the bituminous surfacing, being determined by estimating the cumulative number of Equivalent Standard Axles (ESAs) that the road will be subjected to over its design life, and then reading off the required thickness for each layer from the design chart.

For the design of road pavements, an estimate must be made of the cumulative number of heavy axle loads that the road pavement will be subjected to over its design life. In this cars, rickshaws and other light traffic may be ignored with only trucks and other commercial vehicles being considered.For single carriageway roads the average truck and commercial vehicle flow in both directions is adopted for design purposes i.e. 0.5 x the sum of both directions. For dual carriageways, where trucks may be more heavily loaded in one direction than the other, the pavement for each carriageway should be subject to a separate design based on the forecast commercial traffic for that carriageway (heaviest loaded lane). Thus all the commercial vehicles

are converted in to Equivalent Standard Axles (ESA) and finally million standard axle (msa) values are derived.

The cumulative ESA values have been estimated from the traffic data using RHD Pavement Design Guide 2005 with annual traffic growth rate for Regional roads 'r' = 7%. The Traffic (ESA in million) has been adopted in the range of 3 – 4. Following are the estimated CBR values which have been adopted for pavement design at different locations:

Rajosthali : 13%
Bilaichhari : 8%
Juraichhari : 11%
Barkal : 9.5%
Chhotoharina : 10%

Based on the above CBR values and MSA (Million Standard Axles) following complosition of Pavement is adopted based on above manual:

Asphalt Wearing course : 40 mm
Asphalt Base Course : 45 mm
Granular Base (Type I) : 175 mm
Sub – Base : 175 mm
Total Pavement thickness : 435 mm

Since the CBR of Subgrade is more than 5% Improved Subgrade is not required. Moreover the MSA values are also on lower side the above pavment composition seems to be adequate.

6.5 Drainage and Cross Drainage Structures for Road Route and Road Portion of Multimodal Route.

Discharge in the drainage structure is the function of basin characteristics (size, shape, slope, vegetation cover, land use practices etc.) and rainfall (intensity, forms, amount, distribution etc.) over the catchments. To estimate the rainfall over the catchment for different durations, extremerainfall data recorded by department of Hydrology and Meteorology (DHM) inside the catchment and/ or nearby stations are collected.

Catchment Characteristics

Discharge through a particular catchment is a function of its catchment size and associated parameters like shape, slope, channel length, roughness coefficient, runoff coefficient, soil type and land use type. So it is more important to delineate the corresponding catchment area of crossdrainages (streams/ Rivers) crossing the road alignment precisely.

Drainage Area

Catchment area of cross drainages directly reflects the size of that river streams and vice versa so precise calculation of catchment area is more important to calculate the more reliable design discharge. Large rivers have the larger catchments and it requires a number of topography maps even to delineate catchment of single cross drainage. This process is not only tedious but also has more chances of mistakes during delineation of watershed. To minimise these things catchment area of each cross drainage are calculated by different computer software like Google Earth Pro and Arc GIS V10 using ASTR data.

Runoff Coefficient

The runoff coefficient depends on catchment characteristics such as slope, vegetation, shape and size of the catchment. These characteristics are different even in a single watershed. It is very difficult to define the accurate value of runoff coefficient. However standard tables are available to select this coefficient roughly for different cases.

In present study it is impossible to establish this coefficient for individual catchments as they are in plenty. However it is very clear from topographical maps and field visit that the catchments are more or less homogeneous. Hence the single value of runoff coefficient may be used for all the catchments in the project area.

Slope of these catchments are not so steep, most of the catchments are well vegetated and forested. It seems that more than 50% of rainfall will be retained by catchments due to dense vegetation and forests as well as by infiltration. Considering all these factors an average value of 0.35 to 0.4 is used for catchments of the study road.

Design Flood Estimation

Rational Method

Rational formula is well applicable to small catchments. Hence it is used to calculate the design floods for cross and side drains using maximum hourly rainfall intensity for determined duration and adopted frequency. The average runoff coefficient is assumed equal to 0.35 to 0.4 for catchments. The formula is as follows:

$$Q_P = \frac{C * I * A}{3.6}$$

Where, Q_p = Maximum flood discharge in m^3/s

I = Rainfall intensity within the time of concentration in mm/hr

A = Catchment area in km^2

C = Dimensionless run-off coefficient

Following formula has been used for rainfall intensity.

$$R_{t_c} = \frac{R_{24}}{24}\left(\frac{24}{t_c}\right)^{\frac{2}{3}} \qquad (1)$$

Where,

R_{tc} = Rainfall intensity in tc hours (mm/hr)

R_{24} = 24 hours maximum rainfall (mm)

t_c = Time of concentration in hr, calculated by equation 2.

$$t_c = \left(\frac{0.87L^3}{h}\right)^{0.385} \qquad (2)$$

L = Stream length in km

h = Difference of the maximum and minimum elevations in m.

If the time of concentration is less than 15 minutes then it is assumed to be 15 minutes as recommended by ASCE (American Society of Civil Engineers).

Design of Cross Drainage:

The cross-drainages are constructed in the form of Bridges, Culverts (**box/slab/pipe**) and Causeways etc. The choice of the structures depends on the design discharge, anticipatedsediment loads, configuration of flow, foundation condition, ease of construction

and cost of structures etc. Out of many types of the culverts, the choice depends on the local topography, sediment load, availability of material and costs. Mainly masonry slab culverts, concrete pipe culverts, concrete box culverts and concrete or masonry causeways/floodways are considered for the design of the cross drainages.

Locations of the cross drainages have to be chosen from the plan and profile of the road. Care has been taken that as far as possible the natural channel/gullies are maintained. Culverts are also provided at the valley curves /lowest point of the road to allow the side drain water to cross the road. Adequate sized inlet and out let structures are designed for each of the culverts considering the topography and probability of siltation, debris flow and mud flow.

The **Table 6.5A** shows the data for maximum discharge for each of the group of gullies or drainage system and the recommended size of the culverts to accommodate the discharge of streams. The culverts are designed to accommodate the design discharge as a grouped together in each of the groups given in the **Table 6.5A**. The maximum value is considered for the design of the cross drainages for each group.

The slope provided for pipe culverts is 3% which causes water to flow with a velocity of 4.27 m/sec through it. This velocity is expected to self-flush the culvert, although, it may cause erosion at the outlet of the cross drain. To encounter this problem aprons of appropriate sizes along with the cascades are provided at the out lets. The standard inlets are also designed to accommodate and channelized the flow from the gullies and the side drains. For the purpose of cross drain design, discharge values are extracted from the hydrology part and group is separated. Each group is provided with different sized culverts as per the discharges.

Table 6.5A: Maximum Values for Design of Cross Drains

Description	Design Discharge (20 year return period) cum/sec	Size of culverts recommended
Group I	Up to 2.00	900 mm dia. pipe culverts
Group II	2.00 – 5.00	2*900 mm dia. pipe or 1.5m*1.5m slab culvert.
Group III	5.00 - 15.00	2m*2m Slab culvert
Group IV	15.00 – 50.00	3m*3m Slab culvert
Group V	50.00 – 100.00	4m*4m Slab culvert
Group VI	Above 100	5m*5m Slab culvert

Hydraulic Design

For the design of cross drainages over watercourses, the design discharge for return period of 20 years is taken into consideration. The hydrological study requires the discharges of 20 years return period, for all significant watercourses along the road. Other streams or watercourse also need to be bridged to allow the water to flow through even if the discharge is insignificant. The objective of the hydraulic design is to determine the opening of the culvert over the watercourse, so that the estimated discharge flow freely through it.To determine the size of opening for pipe, slab or box culverts, side drains and causeways, to allow the design discharge of a stream to flow freely through it, Manning's formula is used. For this purpose allowable discharge capacity of different sized culverts and side drains are determined using the formula. The Manning's formula is as follows:

$V = 1/n*R^{2/3}*S^{1/2}$, Where,V = velocity in m/sec
n = coefficient of surface roughness which depends in the roughness of the surfaces. It is generally taken as 0.02 for slab culverts having random stone masonry in cement mortar concrete bottom and it is 0.017 for rubble stone masonry side drains. For pipe culverts it could be taken as that for trowel finished concrete which has a value for n as 0.014.

Hydraulic Radius in meters, R = Aw/Pw
Where, Aw = Area of flow cross section in m^2, Pw = Wetted Perimeter in m, S = Bed slope of channel, which is roughly taken as a slope of culvert bed in % . Finally, the discharge is calculated using the formula,

Q = V*Aw, Where, Q = discharge in m3/sec.
For calculating the discharge capacity of the open or covered trapezoidal and right triangular or tick drains, same formula as above is applied.

Using above formula, allowable discharge capacity of the standard size pipe, slab and box culverts and different section of road side drains with different bed slopes, are determined and provided in **Annexure 6.5A**. Generally, a freeboard of 0.6 m is provided for slab and box culverts while determining the discharge capacity. The size of the slab or box culverts and its freeboard depends upon the topography of the stream, expected sedimentation load, debris flow, design profile of road and locations like in valleys, mid-hill and ridges. The bed slope of the culvert is limited to maximum of 3% because higher the bed slope increases the velocity of flow consequently cause erosion at outlets, requiring additional preventive measures. Hence bed slope is considered as 3% in all and allowable discharges are taken for all types of culverts. However, the road side drain slopes are determined as per road profile gradient. Generally the drains will have the same slope as the road gradient. Higher the velocity of the flow, higher the discharge capacity of the drain and higher the probability of erosion. Therefore to encounter the erosion, concrete bedding is recommended for side drains. The capacities of 600 mm, 900 mm and 1200 mm diameter pipes are calculated using the Manning's formula. For the calculation of the discharge capacity of the pipes, Manning's formula is used. The roughness value ("n") for concrete is taken as 0.014.

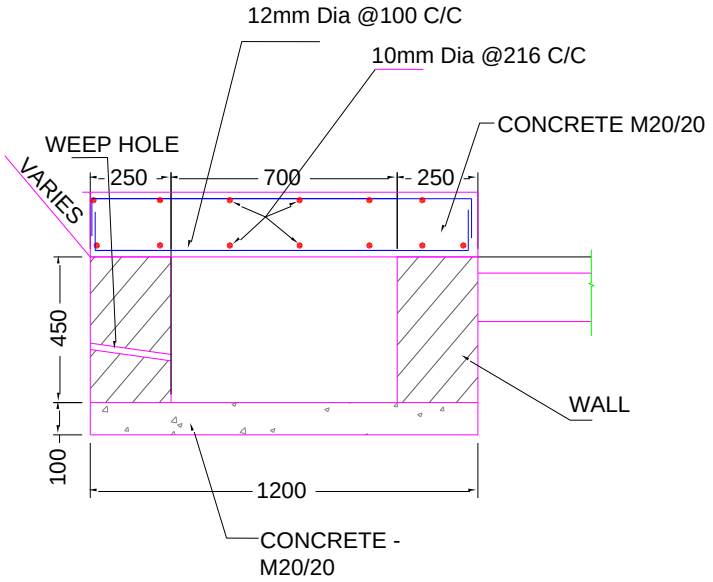
Design of Side Drains

Conservation of the natural drainage system around the roads and highways is one of the most important concerns during design and construction period. For this purposes network of side drains and cross drains along with other related structures are proposed for the project as per hydrological data obtain from the report provided above.The side drain is the most important component of roads to intercept water coming from seepages, surface runoff and pavement surfaces and lead to the safe discharge point. It is constructed mainly as open channels, however, covered drains are also constructed in the built up areas. The side drains are generally constructed throughout the length of hilly road on foot hill side whereas drains are also provided on either side of the road at box cutting gullies/wide plain land and developed area. Side drains are constructed at the same level or below the shoulder level/ pavement surfaces, so that water from the surfaces can be drained out quickest possible.

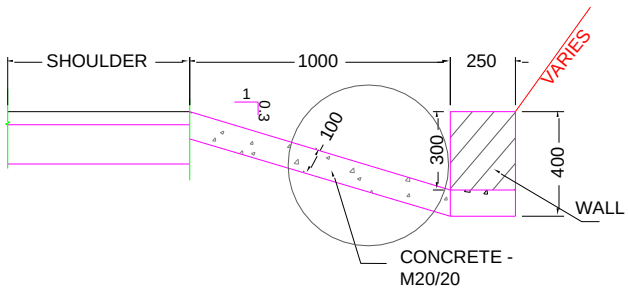
The side drains are designed to collect and remove surface water from the immediate vicinity of the road and to prevent any sub-surface water adversely affecting the road pavement structures. The cross- sections of side drain were selected considering hydraulic capacity, ease of

maintenance, space restriction and traffic safety etc. Design volumes of runoff are adopted to comply with the cross section proposed for side drains. The rainfall intensity for duration of 15 minutes (0.25 hrs.) for a returned period of 5 years and design discharge of 5 years returned period is normally taken into account.

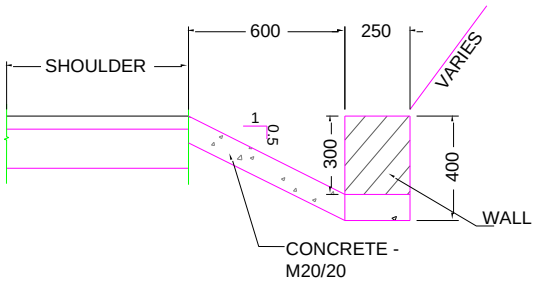
The hydraulic design of side drain sections are carried out with the help of Manning's equation and checked for non-eroding velocity of 4 m/sec. For this value of Manning's roughness coefficient (n), for masonry is taken as 0.017. The longitudinal slope (S) of the side drain conform the longitudinal slope of the road profile. Wherever longitudinal gradient exceeds 7 %, the side drain longitudinal slopes (S) are cascaded to maintain the slope not beyond 5 %. The flow capacities and velocities for different longitudinal slopes (S) of various side drain types adopted. The cross sectional dimensions of drains types adopted in design are given in **Fig 6.5** and **Annexure 6.5 B** gives details of locations of different types of side drains.



ROAD SIDE DRAIN (TYPE -U WITH SLAB)



ROAD SIDE DRAIN (TYPE -V) END



ROAD SIDE DRAIN (TYPE -V) START

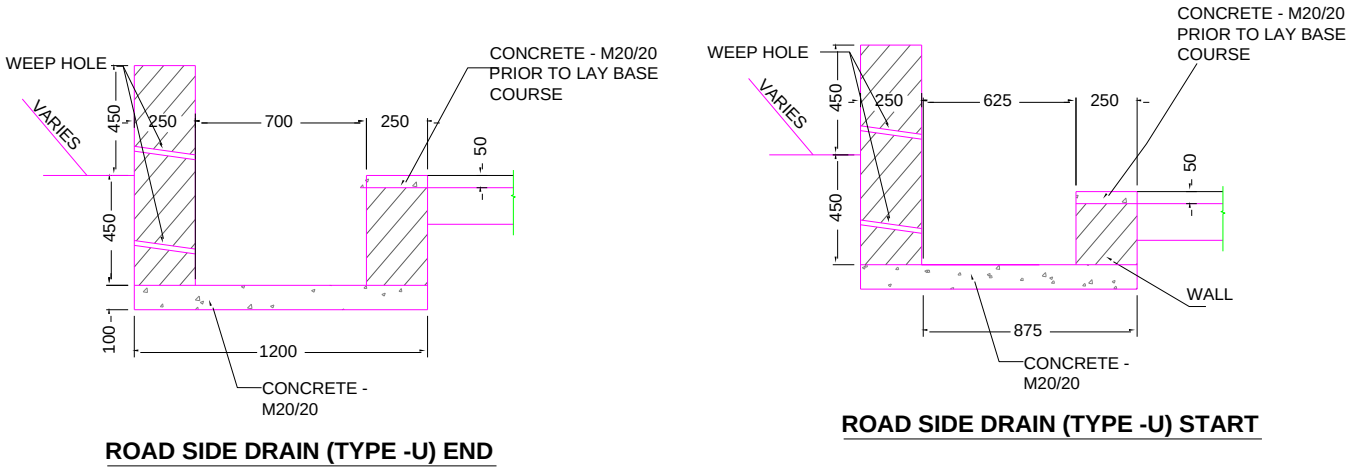


Fig 6.5: Road Side Drain

6.6 Bridges, Culverts and cross drainage structures: Improvement proposal for Road Route and Road Portion of Multimodal Route

For improvement of the existing road structures along the proposed alignment, an inventory survey was carried out for assessment of structural soundness, stability and adequacy for future traffic movement. Maximum of the structures were found as pedestrian and a few numbers were 2.50m to 3.0m carriage width. According to Bridge design specification AASHTO LRFD 2007 &for two lane road, width of all the existing structures is sub-standard and constructed a few years before. So as per Bridge design standard specification AASHTO LRFD 2007, all the existing structures are to be replaced by new construction. Following **Table 6.6 A, 6.6 B** indicates proposed culverts and bridges for Road Route & **Table 6.6 C** indicates proposed bridges for road portion of Multimodal Route. **Discharge & Catchment area calculation are shown in Annexure 6.6**

Table 6.6A: Proposed Culverts

Culvert No.	Existing Chainage No.	Road Design Chainage No.	Size of Culvert Vent x b x h, (m)	Slab top finished Level (FL), m (PWD)	Invert Level (IL), m (PWD)	Remarks
From Ch.00+000-47+066= 47.066 Km						
CUL-01	Ch 0+025	Ch 0+025	1x4.0x3.0	24.70	21.30	Existing to be replaced
CUL-02	Ch 19+340	Ch 18+533	2x6.0x3.0	51.45	48.00	New
CUL-03	Ch 20+970	Ch 20+119	2x5.0x5.0	56.45	51.45	Existing to be replaced
CUL-04	Ch 21+030	Ch 20+175	1x6.0x4.0	58.00	53.55	Existing to be replaced
CUL-05	Ch 21+215	Ch 20+353	1x6.0x4.5	69.95	65.45	Existing to be replaced
CUL-06	Ch 22+955	Ch 22+079	1x4.0x3.0	36.00	32.60	New
From Ch.47+066-75+157=28.091km						
CUL-07	Ch 50+850	Ch 48+705	1x6.0x5.0	46.50	53.00	New, Shifted from Ch. 50+900 as per site cond.
CUL-08	Ch 59+900	Ch 57+321	2x4.0x6.0	59.40	53.00	New
CUL-09	Ch 62+205	Ch 59+560	2x4.0x3.0	51.90	48.50	New
CUL-10	Ch 62+975	Ch 60+290	2x3.5x4.0	55.40	51.00	New

CUL-11	Ch 64+100	Ch 61+373	2x3.0x4.0	43.35	39.00	Existing to be replaced
CUL-12	Ch 65+610	Ch 62+864	2x4.5x3.0	48.40	45.00	Existing to be replaced
CUL-13	Ch 66+850	Ch 64+042	1x6.0x4.5	60.90	56.45	New
CUL-14	Ch 70+180	Ch 67+183	2x4.5x4.0	34.90	30.50	New
CUL-15	Ch 77+085	Ch 73+730	2x4.5x4.0	32.25	27.85	New
CUL-16	Ch 77+940	Ch 74+567	2x3.5x3.0	36.65	33.25	Existing to be replaced
From Ch.75+157-81+600=6.443km						
CUL-17	Ch 79+000	Ch 75+615	1x6.0x6.0	45.00	38.50	Existing to be replaced
From Ch.81+600-102+098=20.498km						
CUL-18	Ch 86+920	Ch 82+980	2x4.0x5.0	34.70	28.30	New
CUL-19	Ch 89+602	Ch 85+638	2x5.0x4.0	34.68	30.23	New
CUL-20	Ch 91+115	Ch 87+059	2x4.0x3.0	37.00	33.60	Marcy Land
CUL-21	Ch 104+850	Ch 100+306	3.0x5.0x5.0	56.45	51.45	Existing to be replaced

Table 6.6 B: Proposed Bridges for Road Route

Bridge No.	Existing Chainage No	Road Design Chainage	Missing Length (m)	Proposed Structural Deck Length(m)	Existing Ground Level (m)	Pile Cap Level (m)	Finish Level/Deck Level(m)	Type of Bridge	HFL (m)	LFL(m)	Remarks
From Ch.00+000-47+066= 47.066 Km											
1	Ch 0+0380	Ch 0+378	61.894	(3x21.0)	18.4	20.55	26.02	RCC Bridge	22.30	Dry in winter	Existing to be replaced
2	Ch 5+145	Ch 4+932	32.116	(1x35.0)	27.93	25.26	32.52	PCC Bridge	28.50	Dry in winter	New
3	Ch 8+385	Ch 8+040	28.004	(1x30.0)	51.05	44.80	56.02	PCC Bridge	52.20	Dry in winter	New
4	Ch 11+850	Ch 11+268	30.378	(1x35.0)	57.12	60.21	67.47	PCC Bridge	62.96	Dry in winter	New
5	Ch 33+490	Ch 32+251	41.129	(3x15.0)	32.34	34.08	39.42	RCC Bridge	35.00	Dry in winter	New
6	Ch 39+960	Ch 38+543	286.628	(9x32.0)	36.01	38.22	48.82	PCC Bridge	44.00	38	Existing to be replaced
7	Ch 47+850	Ch 45+862	131.687	(5x26.0)	20.55	26.69	35.32	PCC Bridge	30.50	22	Existing to be replaced
8	Ch 48+240	Ch 46+262	112.074	(3x38.0)	19.69	27.99	35.92	PCC Bridge	30.50	22	Existing to be replaced
From Ch.47+066-75+157=28.091km											
9	Ch 51+840	Ch 49+645	16.891	(1x20.0)	33.13	34.37	39.52	RCC Bridge	35.00	Dry in winter	New
10	Ch 65+340	Ch 62+607	33.989	(1x35.0)	45.56	43.80	52.02	PCC Bridge	47.00	Dry in winter	Existing to be replaced
11	Ch 68+985	Ch 66+047	18.967	(1x20.0)	41.56	41.00	46.52	RCC Bridge	44.00	Dry in winter	New
12	Ch 72+250	Ch 69+197	34.896	(1x35.0)	30.77	28.80	37.52	PCC Bridge	33.02	Dry in winter	New
13	Ch 77+275	Ch 73+925	86.631	(3x30)	27.9	28.00	36.32	PCC Bridge	31.50	Dry in winter	Existing to be replaced
From Ch.75+157-81+600=6.443km											
14	Ch 78+890	Ch 75+507	11.643	(1x15.0)	43.69	39.68	45.77	RCC Bridge	41.00	Dry in winter	Existing to be replaced
15	Ch 79+315	Ch 75+870	18.593	(1x20.0)	26.35	33.00	38.52	RCC Bridge	34.50	Dry in winter	Existing to be replaced
16	Ch 80+115	Ch 76+660	30.907	(1x35.0)	34.39	34.76	41.02	PCC Bridge	36.00	Dry in winter	New
17	Ch 83+340	Ch 79+700	11.685	(1x15.0)	163.88	164.96	171.07	RCC Bridge	166.65	Dry in winter	New
18	Ch 84+595	Ch 80+842	11.197	(1x15.0)	37.75	37.67	42.67	RCC Bridge	39.25	Dry in winter	New
19	Ch 85+270	Ch 81+480	227.194	(7x33.0)	12.2	22.00	42.76	PCC Bridge	33.23	23.17	New

From Ch.81+600-102+098=20.498km											
20	Ch 88+215	Ch 84+250	153.816	(5x32.0)	19.2	27.00	42.67	PCC Bridge	33.23	23.17	New
21	Ch 89+530	Ch 85+570	11.123	(1x15.0)	31.51	31.54	36.65	RCC Bridge		Dry in winter	New
22	Ch 90+075	Ch 86+104	28.512	(1x30.0)	30.1	29.67	37.05	PCC Bridge		Dry in winter	New
23	Ch 90+690	Ch 86+685	22.422	(1x25.0)	29.37	31.86	37.05	RCC Bridge		Dry in winter	New
24	Ch 91+030	Ch 86+972	14.307	(1x15.0)	35.59	31.54	36.65	RCC Bridge		Dry in winter	New
25	Ch 91+440	Ch 87+379	11.53	(1x15.0)	36.8	31.54	36.65	RCC Bridge		Dry in winter	New
26	Ch 95+040	Ch 90+825	43.842	(3x15.0)	33.64	31.31	36.65	RCC Bridge	33.23	Dry in winter	Existing to be replaced
27	Ch 95+530	Ch 91+327	39.001	(3x15.0)	30.64	31.31	36.65	RCC Bridge	33.23	Dry in winter	Existing to be replaced
28	Ch 95+985	Ch 91+770	23.394	(1x30.0)	27.5	29.68	37.05	PCC Bridge	29.90	Dry in winter	Existing to be replaced
29	Ch 97+400	Ch 93+082	130.426	(3x30.0-2x26.0)	12.2	18.00	42.67	PCC Bridge	33.23	23.17	New
30	Ch 100+190	Ch 95+687	11.777	(1x15.0)	30.3	31.54	36.65	RCC Bridge	33.23	Dry in winter	Existing to be replaced
31	Ch 101+740	Ch 97+200	29.676	(1x30.0)	31.8	30.87	37.25	PCC Bridge	33.23	Dry in winter	Existing to be replaced
32	Ch 103+360	Ch 98+802	23.461	(1x25.0)	31.8	31.86	37.05	RCC Bridge	33.23	Dry in winter	Existing to be replaced
33	Ch 103+725	Ch 99+175	36.574	(1x30.0)	31.9	30.82	37.05	PCC Bridge	33.23	Dry in winter	Existing to be replaced
34	Ch 103+975	Ch 99+425	26.466	(1x30.0)	31.5	30.82	37.05	PCC Bridge	33.23	Dry in winter	Existing to be replaced
35	Ch 104+085	Ch 99+527	11.883	(1x15.0)	32.5	31.54	36.65	RCC Bridge	33.23	Dry in winter	Existing to be replaced
36	Ch 105+395	Ch 100+837	31.63	(1x35.0)	32.2	29.98	37.25	PCC Bridge	33.23	Dry in winter	Existing to be replaced
37	Ch 106+580	Ch 101+997	167.496	(5x35.0)	12.2	31.00	42.87	PCC Bridge	33.23	23.17	New
From Ch.102+098-109.675=7.577km											
38	Ch 106+840	Ch 102+265	27.541	(1x30.0)	13.5	30.80	37.05	PCC Bridge	33.23	Dry in winter	Existing to be replaced
39	Ch 113+145	Ch 108+152	29.36	(1x35.0)	41.34	39.58	47.02	PCC Bridge	43.00	Dry in winter	New
40	Ch 114+150	Ch 109+105	18.145	(1x20.0)	35.1	36.37	41.52	RCC Bridge	38.01	Dry in winter	Existing to be replaced

Size	No.	Type of Bridge
1x15	8	RCC Bridge
1x20	4	RCC Bridge
1x25	2	RCC Bridge
1x30	7	PCC Bridge
1x35	7	PCC Bridge
3x15	3	RCC Bridge
3x21	1	RCC Bridge
3x30	1	PCC Bridge
3x38	1	PCC Bridge
5x26	1	PCC Bridge
9x32	1	PCC Bridge
5x32.0	1	PCC Bridge
5x35.0	1	PCC Bridge
7x33.0	1	PCC Bridge
3x30.0-2x26	1	PCC Bridge

RCC Bridge	18
PCC Bridges	22
TOTAL=	**40**

Table 6.6 C: Proposed bridges for road portion of Multimodal Route

Bridge No.	Existing Chainage No	Road Design Chainage	Missing Length (m)	Proposed Structural Deck Length (m)	Existing Ground Level (m)	Pile Cap Level (m)	Finish Level/Deck Level(m)	Type of Bridge	HFL (m)	LFL (m)	Remarks
From Ch.00+000-7+370=7.370 Km											
1	Ch 6+280	Ch 5+855	29.36	(1x35.0)	41.34	39.58	47.02	PCC Bridge	43.00	Dry in winter	New
2	Ch 7+495	Ch 6+805	18.145	(1x20.0)	35.1	36.37	41.52	RCC Bridge	38.01	Dry in winter	Existing to be replaced

Size	No.	Type of Bridge
1x20	1	RCC Bridge
1x35	1	PCC Bridge
Total	2	

6.7 Design of Earth Retaining structures for Road Route and Road portion of Multimodal Route

Earth retaining wall is a structure that retains (holds back) any material (usually earth) and prevents it from sliding or eroding away. It is designed so that to resist the pressure of the material that it is holding back.

Types of Retaining Walls
An earth retaining structure can be considered to have the following types:

1. Gravity Walls
    - Reinforced Gravity Walls
        1. Concrete Cantilever retaining wall
        2. Counter-fort / Buttressed retaining wall
        3. Precast concrete retaining wall
        4. Prestressed retaining wall

    Brick
    Brick Masonry retaining wall
    Stone
    Reinforced Soil Walls
    - Reinforced Soil
    - Soil Nailing

    Hybrid System
    - Anchored Earth
    - Tailed Gabion
    - Tailed Concrete Block

As per site condition where the hilly area exist, there may be required some earth retainingstructures to protect the soil or sliding materials from the hill nearby the proposed road. Due to economic consideration, availability of materials and stability of the structure, RCC gravity type retaining wall is proposed. In some cases where the retaining wall to be constructed near the river bank or canal side and there is a possibility of soil erosion or scouring, pile foundation below the retaining wall base to be provided to protect from sliding, overturning and stability of the structure.Locations where these structures are required are given in following **Table 6.7 A & 6.7 B** for road route and multimodal route.

Table 6.7A: Locations of Retaining Walls for Road Route (Rajosthali to Thegamukh)

Sl No	Chainage	Left Side/Right Side	Length of Road Side (m)	Proposed Retaining Wall Height (m)	Remark
1	Ch.3+250-3+350	Right side	100	5	
2	Ch.6+050-12+150	Right side	100	4	
3	Ch.12+350-12+450	Right side	100	9	
4	Ch.17+950-18+050	Left Side	100	4	
5	Ch.18+350-18+450	Left Side	100	4	
6	Ch.18+450-18+550	Left Side	100	7	
7	Ch.20+950-21+050	Right side	100	10	
8	Ch.21+050-21+150	Right side	100	4	
9	Ch.21+150-21+250	Right side	100	4	
10	Ch.21+350-21+450	Right side	100	4	
11	Ch.21+450-21+550	Right side	100	4	

Sl No	Chainage	Left Side/Right Side	Length of Road Side (m)	Proposed Retaining Wall Height (m)	Remark
12	Ch.24+425-24+475	Left Side	50	6	
13	Ch.24+475-24+525	Left Side	50	7	
14	Ch.24+525-24+575	Left Side	50	4	
15	Ch.24+875-24+925	Left Side	50	5	
16	Ch.25+275-25+325	Left Side	50	9	
17	Ch.25+325-25+375	Left Side	50	7	
18	Ch.25+975-26+025	Right side	50	5	
19	Ch.26+825-26+875	Right side	50	10	
20	Ch.26+875-26+925	Right side	50	10	
21	Ch.26+925-26+975	Right side	50	6	
22	Ch.28+225-28+275	Left Side	50	6	
23	Ch.28+375-28+425	Right side	50	8	
24	Ch.28+425-28+475	Right side	50	6	
25	Ch.34+550-34+600	Right side	50	7	
26	Ch.34+600-34+650	Right side	50	10	
27	Ch.34+650-34+700	Right side	50	8	
28	Ch.34+700-34+750	Right side	50	6	
29	Ch.35+050-35+100	Right side	50	5	
30	Ch.35+100-35+150	Right side	50	4	
31	Ch.35+550-35+600	Right side	50	6	
32	Ch.35+600-35+650	Right side	50	4	
33	Ch.35+800-35+850	Right side	50	6	
34	Ch.35+850-35+900	Right side	50	4	
35	Ch.36+600-36+650	Left Side	50	9	
36	Ch.38+100-38+150	Left Side	50	9	
37	Ch.38+350-38+400	Left Side	50	9	
38	Ch.38+500-38+550	Both Side	100	9	
39	Ch.40+200-40+250	Right side	50	9	
40	Ch.42+200-42+250	Right side	50	9	
41	Ch.42+250-42+300	Right side	50	8	
42	Ch.42+550-42+600	Right side	50	6	
43	Ch.42+700-42+750	Right side	50	9	
44	Ch.50+600-50+700	Right Side	100	5	
45	Ch.50+800-50+900	Both Side	200	10	
46	Ch.56+500-56+600	Right Side	100	10	
47	Ch.57+400-57+500	Right Side	100	7	
48	Ch.58+300-58+400	Left Side	100	4	
49	Ch.58+600-58+700	Left Side	100	7	
50	Ch.59+100-59+200	Right Side	100	8	
51	Ch.60+200-60+300	Right Side	100	4	
52	Ch.61+400-61+500	Right Side	100	7	
53	Ch.60+200-60+250	Right Side	50	4	
54	Ch.60+300-60+350	Right Side	50	4	
55	Ch.60+350-60+400	Right Side	50	3	
56	Ch.61+400-61+450	Right Side	50	6	
57	Ch.61+750-61+800	Right Side	50	3	
58	Ch.75+100-75+150	Both Side	100	10	

Sl No	Chainage	Left Side/Right Side	Length of Road Side (m)	Proposed Retaining Wall Height (m)	Remark
59	Ch.75+150-75+200	Both Side	100	10	
60	Ch.75+200-75+250	Both Side	100	10	
61	Ch.75+250-75+300	Both Side	100	10	
62	Ch.75+300-75+450	Both Side	300	9	
63	Ch.81+350-81+450	Both Side	200	9	
64	Ch.97+200-97+300	Both Side	200	6	
65	Ch.101+700-102+000	Right Side	300	7	
66	Ch.102+300-102+500	Both Side	400	9	
67	Ch.103+200-103+300	Both Side	200	9	
Total Length=			**6000**		

Hight of Walls (m)	Nos. of Walls	Remarks
3	2	
4	15	
5	5	
6	10	
7	8	
8	4	
9	13	
10	10	
Total No=	**67**	

Table 6.7 B: Locations of Retaining Walls for Multimodal Route (Chotohorina to Thegamukh)

Sl No	Chainage	Left Side/Right Side	Length of Road Side (m)	Proposed Retaining Wall Height(m)	Remark
1	Ch.102+300-102+500	Both Side	400	9	
2	Ch.103+200-103+300	Both Side	200	9	
Total Length=			**600**		

Hight of Walls (m)	Nos. of Walls	Remarks
9	13	
Total No=	**13**	

6.8 Improvement of Waterway for Multimodal Route

6.8.1 Improvement of draft by dredging:

The route will be improved as class II route. As per recommendation of depth of class II routes the route will be dredged upto the formation level where 3 m depth will be ensured round the year.

6.8.1.1 Maintenance Dredging:

Rate of re-siltation is not being possible to be reviewed and esed for this assessment accurately.Maintenance dredging wil be required.During project implementation period (3

years) maintenance dredging may be taken as 1% of the Capital dredging per year for 3 years time the maintenance will come to 8260000x1%x3 years=2478000 m^3 and cost will be = 247800 m^3 x250 Tk/m^3= 61950000 Tk

This cost is provided in the cost estimate.

Repair & Maintenance of structure will not be required with project implementation period of 3 years.If needed cost may be met from the item of other ancilliary works.

Capital & Maintenance dredging should be closely monitored through Engineering and Post dredging hydrographic survey to ensure dredging according to the designed formation level and width of the channel.

6.8.2 Provision of additional structures for waterway:

Structure like R.C.C,jetty, spud, Pontoon passengers waiting shed have been provide in the estimate for each major landing station. In addition a transit shed may be provided at Rangamati and Chottohorina for cargo transit storage and cargo yard.Accordingly about 3 acres of land will be needed for each of the above landing station. Arrangements are to be made for providing this land either by acquisition or by the Government. The details can be worked out during details design phage. Besides, bank protection work may be required. This cost is also provided in the cost estimate as lump-sum.

Landing Facilities

From Rangamati to Chottohorina via Barkal the places of traffic importance are:

(i) Rangamatisadar
(ii) Shovolong
(iii) Barkal
(iv) Chottohorina
(v)Thagamukh

(I)Rangamatisadar	(i) One R.C.C Jetty (straight 30 m+ sloping 43.55 m) (ii) One 19.50 m Pontoon (iii) 2 Steel spuds (iv) One Terminal Building (v) One Transit shed of 10m * 5 m (vi)Tube-well (vii) Electric Connection
(II) Shovolong	(i) One14.60 m Pontoon including 2 wooden planks
(III) Barkal	(i) One R.C.C Jetty (straight 30 m+ sloping 43.55 m) (ii) One 19.50 m Pontoon (iii) 2 Steel spuds (iv) One Terminal Building. (v) One Transit shed of 10m * 5 m (vi) Tube-well vii) Electric Connection
(IV) Chottohorina	(i) One R.C.C Jetty (straight 30 m+ sloping 43.55 m) (ii) One 19.50 m Pontoon (iii) 2 Steel spuds

(iv) One Terminal Building
(v) One Transit shed of 10m * 5 m
(vi) Tube-well
vii) Electric Connection

(V) Thegamukh Land customs will build the necessary structures under their project

Besides the above important launch stations, there are also some launch stations namely:
1. Bhushionchara, 2. Arabunia, 3. Bamland, 4. Kala bunia,
5.SouthKalabunia, 6. Bhutchara, 7. Baraitala, 8. Nutun Bazar.

In each of the landing stations, at least one 14.63 m pontoon may be provided with supply of two wooden planks as shore connection from pontoon to shore.
Other 8 Stations: (i) 8 pontoons

Typical drawing of R.C.C jetty, Pontoon, Spud, Terminal are provided in volume III. Details will be worked out during detailed design phase.

Cost of landing facilities:

Rangamati:	
(i) One R.C.C Jetty (straight 30 m+ sloping 43.55 m) (ii) One 19.52 m Pontoon (iii) 2 Steel spuds 17m and 10m (iv) One Terminal Building (v) One semi puccaTransit shed of 10m * 5 m @Tk. 12000/m^2 (vi)Tube-well (Shalow) (vii) Electric Connection	=Tk.90.60 Lac =Tk.74.90 Lac =Tk.15.15 Lac =Tk.149.50 Lac =Tk.6.00 Lac =Tk.0.80 Lac =Tk.0.20 Lac
Sub Total	**=Tk. 337.15 Lac**
Shovolong: 14.60 m Pontoon including 2 wooden planks@ Tk 50 lac	**=Tk. 54.98 Lac**
Barkal:	
(i) One R.C.C Jetty (straight 30 m+ sloping 43.55 m) (ii) One 19.52 m Pontoon (iii) 2 Steel spuds 17m and 10m (iv) One Terminaal Building (v) One semi puccaTransit shed of 10m * 5 m @Tk. 12000/m^2 (vi)Tube-well (Shalow) (vii) Electric Connection	=Tk.90.60 Lac =Tk. 74.90 Lac =Tk. 15.15 Lac =Tk. 149.50 Lac =Tk. 6.00 Lac = Tk. 0.80 Lac =Tk.0 .20 Lac
Sub Total	**=Tk. 337.15Lac**

Chottohorina:	
(i) One R.C.C Jetty (straight 30 m+ sloping 43.55 m) (ii) One 19.52 m Pontoon (iii) 2 Steel spuds 17m and 10m (iv) One Terminaal Building (v) One semi puccaTransit shed of 10m * 5 m @Tk. 12000/m^2 (vi)Tube-well (Shalow) (vii) Electric Connection	=Tk.90.60 Lac =Tk. 74.90 Lac =Tk. 15.15 Lac =Tk. 149.50 Lac =Tk. 6.00 Lac = Tk. 0.80 Lac =Tk.0 .20 Lac
Sub Total	**=Tk. 337.15 Lac**

Other 8 Launce Stations:

(i) One 14.63 m (48') pontoon in each station with supply of two wooden planks @ Tk.54.98lac each.	**=Tk. 439.84 Lac**
Cost of Landing Facilities	**=Tk. 1506.27 Lac**
	Say =Tk. 150.63 million

Source: Rates are collected from BIWTA.

		Total Cost (TK)
a)	Cost of Capital dredging	= Tk. 2065 million
b)	Cost of Maintenance Dredging	= Tk. 61.95 million
c)	Cost of Landing Facilities	= Tk. 150.63 million
d)	Cost of Bank Protection L. S	= Tk. 7.00 million
e)	Cost of Other ancillary works	= Tk. 7.00 million
	Grand Total	**=Tk. 2291.58 million**

Calculation sheets showing quantity & cost of R. C. C. jetty, steel pontoon & steel spuds are given in volume II (Cost Estimate) part item (II B) Table 6.8.2 A, 6.8.2 B, 6.8.2 C, 6.8.2 D.

6.9 Improvement in Existing Road Connecting Chittagong Port for Road Route and Multimodal Route

It is investigated that existing land route from Chittagong Port to Rajoshthali already constructed long time before in which first 10.923 km i.e, Chittagong Port to Mohora/Raster Matha constructed & maintained by Chittagong City Corporation and does not require any further development right now.

From Mohora/Raster Matha to Chandraghona 32.446 km regional road (R163) is constructed and maintained by RHD. But insufficent carriageway width 6.20m has to be extended to 7.3m by proper rehabilitation works. The aggregated rehabilitation works is 35690.60 sqm of carriageway From Chandraghona to Bangalhalia 12.310 km regional road (R161) is constructed and maintained by RHD. But here also insufficent carriageway width 5.43m has to be extended to 7.3m width by proper rehabilitation works. The aggregated rehabilitation works is 23019.70 sqm of carriageway. In this portion also 315m long Bridge is required on the Karnafully River to eleminate the Chandraghona Ferry Ghat. In other two locations of this portion two RCC Bridges are required by replacing the existing Baily Bridges of 21.5m & 18.4m length.

From Bangalhalia to Rajoshtholi 19.623 km Zilla road (Z1814) is already constructed & maintained by RHD. But the insufficient road width 4.34m has to be extended to 7.3m width by proper rehabilitation works. The aggregated rehabilitation works is 58084.08 sqm of carriageway. The existing two Baily Bridges of 25m & 61.6m length have to be replaced by RCC Bridges.

The existing land route from Chittagong Port to Rangamati for multimodal route option the investigation and inventory have been done. It is seen that Chittagong Port to Oxygen More 15.368 km bituminous carpeting road with 19.33m width of carriageway already constructed and

maintained by CDA/CCC (Chittagong Development Authority/Chittagong City Corporation) and it does not require any development right now.

From Oxygen More to Hathazari 16.191 km. bituminous carpeting road with 7.45m width of carriageway already constructed and maintained by RHD as National Highway (N106). It does not require any development now but one boxculvert of 16.9m length has to be replaced by a RCC Bridge.

From Hathazari to Ghagra 33.426 km bituminous carpeting road with 6.80m width of carriageway is constructed and maintained by RHD as National Highway (N106). But the insufficient road width 6.80m has to be extended to 7.3m width by proper rehabilitation works. The aggregated rehabilitation works is 16713 sqm of carriageway. The existing one Bailey Bridge of 15m length has to be replaced by RCC Bridge and one old & small Box culvert of 2.9m length has to be replaced by a new Box culvert.

From Ghagra to Rangamati 7.525 km bituminous carpeting road with 7.04m width of carriageway is constructed and maintained by RHD as National Highway (N106). The shortage carriage way width (7.04m) has to be rehabilitated for 7.3m width of carriageway and aggregated rehabilitation works is 1956.5 sqm of carriageway.

The various improvement required on this route are tabulated as below in Table 6.9A. **Annexure 6.9 A gives details of Existing road from Cittagong to Rajosthali.**

Table 6.9A: Improvements required on Existing Land Route from Chittagong-Rajoshthali

Section of the Road	Owner of the Road	Location	Length (km)	Avg. Carriage way (m)	Pavement Type	Widening of carriageway to 7.3m	Total No of existing Bridge	Existing Total length of Bridge (m)	Existing total no of culvert	Existing Total length of Culvert (m)	Missing Link (m)	Improvements
a.Chittagong Port to Mohora/Raster Matha (Ch.0+000-10.923)	CDA	Chittagong City Corporation	10.923	17.95	BC Road	N/A	2	343	8	40.7	N/A	N/A
b. Mohora/Raster Matha to Chandraghona (Ch.0+000-32.446)	RHD (R163)	**Upozila**: Boalkhali,Rangunia Kaptai **District:** Chittagong, Rangamati	32.446	6.20	BC Road	35690.60	8	411.40	33	154	N/A	**35690.60 sqm** Carriage way widening
c.Chandraghona to Bangalhalia (Ch.19+775-32+085	RHD (R161)	**Upozila**: Kaptai **District:**Rangamat	12.310	5.43	BC Road	23019.70	2	39.90	4	6.6	315	**315 m** bridge should be constructed on the karnafuly river at chandraghona ferry ghat ,**21.5 m,18.4 m** existing Baily Bridge should be replace by RCC or PC Girder bridge &**23019.70 sqm** Carriage way wideningrequired
d.Bangalhalia to Rajosthali (Ch.0+000-19+623)	RHD (Z1814)	**Upozila:** Rajosthol **District:**Rangamat	19.623	4.34	BC Road	58084.08	3	129.40	4	12	N/A	**25 m ,61.6 m** existing Baily Bridge should be replace by RCC or PC Girder bridge &**58084.08 sqm** Carriage way widening
Total=			**75.302**			**116794.38**	**15**	**923.70**	**49**	**213**		

The road which is connecting Chittagong Port to Multimodal Route at Rangamati passes through Oxygen more. The total length of existing road is 72.51 Km with 21 bridges and 107 culverts. The existing road is Bituminous concrete with an average width of 7.1 m. The **Annexure 6.9Bgives details of existing road from Chittagong to Rangamati.**

Table 6.9B: Improvements required on Existing Land Route from Chittagong-Rangamati

Section of the Road	Owner of the Road	Location	Length (km)	Avg. Carriage way (m)	Pavement Type	Widening of arriageway to 7.3m	Total No of existing Bridge	Existing Total length of Bridge (m)	Existing total no of culvert	Existing Total length of Culvert (m)	Missing Link (m)	Improvements
a. Chittagong Port to Oxygen more (Ch.0+000-15+368)	CDA	Chittagong City Corporation	15.368	19.33	BC Road	N/A	2	337.1	7	36.4	N/A	N/A
b.Oxygen more to Hathazari (Ch.0+000-19+191)	RHD (N 106)	**Upozila**:Hathazari Manikchhari **District:** Chittagong, Rangamati	16.191	7.45	BC Road	N/A	5	156.5	23	177	N/A	**16.9m** Box Culvert should be replace by RCC Bridge
c.Hatgazari to Ghagra (Ch.16+191-49+617)			33.426	6.80		16713	13	478.9	59	292.3	N/A	**2.9m** Box culvert should be replace by another Box culvert &**15 m** baily Bridge will be replace by RCC bridge &**16713**sqm Carriage way widening
d.Ghagra to Rangamati (Ch.49+617-57+142)			7.525	7.04		1956.5	1	75.8	18	70.2	N/A	**1956.5 sqm** Carriage way widening
Total =			**72.51**			**18669.5**	**21**	**1048.3**	**107**	**575.9**		

6.10 Cost Estimates forRoad Route and Multimodal routes:

The detailed construction Cost for all concerned components of the proposed road route i.e, Rajostholi to Thegamukh, 109.670 km and development works of existing portion i.e, Chittagong to Rajostholi are computed item-wise on the basis of detailed bills of quantities. Unit rates for all items of works are considered according to RHD Schedule of Rates, August 2015 and some of rates which are not available or does not match in RHD Schedule of rates have been taken from LGED Schedule of Rates, July 2014.**Unit rates and quantity estimates for major activities are shown in Annex 6.10**. The construction cost is summarized as follows:

1.ROAD ROUTE:

A) Cost Estimate for all items of Proposed Road Route (Rajoshtholi to Thegamukh=109.670 km)

SL. No	Name of Component	Division as per RHD & LGED	Total Taka (Including VAT & TAX)
1	General & Site facilities	Division-1	23038941.00
2	Earth work & Pavement works	Division-2	12822660852.20
		Division-3	4574709695.42
3	Bridges (PCC & RCC), Structures, Foundation works, etc.	Division-2	25950037.50
		Division-4	591471751.50
		Division-5	1422988043.69
5	Box Culverts, Backfilling earth works,etc.	Division-2	3388589.70
		Division-5	147101221.92
6	RCC Retaining wall, Back filling, etc.	Division-2,3,5 & 6	1435825378.10
7	Drains, backfilling earth works, etc.	Division-2 & 5	307070451.35
8	Incidental	Division-6	44456650.00
	Total Tk.		21,398,661,612.38

21398.66 Million Taka

277.19 Million US$

B) Cost Estimate for all items of Existing Road Development (Chittagong Port to Rajoshtholi=75.302 km)

SL. No	Name of Component	Division as per RHD & LGED	Total Taka (Including VAT & TAX)
1	General & Site facilities	Division-1	0.00
2	Earth work & Pavement works	Division-2	84403936.75
		Division-3	838946249.00
3	Bridges (PCC & RCC), Structures, Foundation works, etc.	Division-2	2254500.00
		Division-4	73195440.50
		Division-5	252355837.30
	Total Tk.		1,251,155,963.55

1251.156 Million Taka

16.207 Million US$

C). Cost Of Environmental Mitigation Measures For Road Route =1050 Million Taka

TOTAL COST (A+B+C) FOR ROAD ROUTE = 23699.82 MILLION TAKA
=307 MILLION US$

2. Multimodal Route:

A) Cost for Multimodal Route from Rangamati to Chotohorina (Waterway) & Chotohorina Thegamukh by Road					
Dredging Cost					
SL. No.	**Description**	**Unit**	**Quantity**	**Rate (Taka) (Including VAT & TAX)**	**Amount (Taka)**
1	Dredging from Rangamati to Barkal	m^3	1180000	250	295000000.00
2	Dredging from Barkal to Chotohorina	m^3	7080000	250	1770000000.00
3	Cost of Maintenance Dredging	m^3	247800	250	61950000.00
				Sub Total	2126950000.00
Cost of Landing Facilities					
1	R.C.C Jetty	No	3	9060000	27180000.00
2	Pontoon (Big)	No	3	7490000	22470000.00
3	Pontoon(Small)	No	9	5498000	49482000.00
4	Spud	No	6	757550	4545300.00
5	One Terminal Building	No	3	14949834	44849502
6	One Semi Pucca Transit shed	No	3	600000	1800000.00
7	Tube-well(shallow)	No	3	80000	240000.00
8	Electric Connection	No	3	20000	60000.00
				Sub Total	150626802.00
1	Bank protection work		L.S		7000000.00
2	Other ancillary work		L.S		7000000.00
				Total	**2291576802.00**
Cost of Road (From Chotohorina to Thegamukh) Road Portion					
1	General				21058941.00
2	Road Pavement				789628180.85
					312618255.29
3	Bridges (PCC & RCC)				1955857.50
					34362497.50
					61810356.69
4	RCC Retaining wall				219924966.00
5	Drain				31330639.92
6	Incidental				3063339.99
				Sub Total	**1,475,753,034.74**
				Grand Total(Including 15% VAT)	**3767329836.74**
				Million Tk	**3767.33**
				Million US$	**48.79**

B) Cost Estimate for all items of Development/Rehabilitation works required on existing roads (Multimodal route) i,e,Chittagong port to Rangamati (72.51km)			
SL. No	**Name of Component**	**Divisions**	**Total Taka (Including VAT & TAX)**
1	General	Division-1	0.00
2	Road Pavement	Division-2	11443992.75
		Division-3	107501638.00

3	Bridges (PCC & RCC)	Division-2	529449.50
		Division-4	6352496.50
		Division-5	16574266.42
	Grand total		142,401,843.17

142.40 Million Taka
1.845 Million US$

C) Cost of Environmental Mitigation Measures for Multimodal Route =161 MillionTaka

TOTAL COST FOR MULTIMODAL ROUTE (A+B+C) = 4070.73 MILLION TAKA.
= 52.74 MILLION US$

6.11 Implementation Plan for Road Route and Multimodal Route:

Implementation Plan For Road Route Chittagong Port To Thegamukh

			1st Year		2nd Year		3rd Year	
Sr. No.	**Items of Work**	**Unit**	**Quantity**	**Amount(Tk)**	**Quantity**	**Amount(Tk)**	**Quantity**	**Amount(Tk)**
1	**Earthwork**	cu. meter	33,420,371.57	5,781,657,723.84	33,420,371.57	5,781,657,723.84	7,426,749.24	1,284,812,827.52
2	**Road Pavement**	cu. meter			186,971.63	1,264,261,478.33	436,267.13	3,792,784,434.99
3	**RCC Work s**	cu. meter	8,522.06	335,296,793.12	34,088.22	1,005,890,379.35	14,203.43	894,124,781.64
4	**Drain**	lin. Metre	5,227.50	15,353,522.57	31,365.00	76,767,612.84	6,795.75	214,949,315.95
5	**Enviroment/Social**	Lump sum		315,000,000.00		420,000,000.00		315,000,000.00
6	**Road Furniture**	Lump sum						44,456,650.00
7	**General**	Lump sum		577,552,856.69		817,904,000.60		478,732,886.12
	Total			6,709,860,896.21		8,946,481,194.95		6,709,860,896.21

Implementation Plan For Multimodal Route Chittagong Port To Thegamukh

			1st Year		2nd Year		3rd Year	
Sr. No.	**Items of Work**	**Unit**	**Quantity**	**Amount(Tk)**	**Quantity**	**Amount(Tk)**	**Quantity**	**Amount(Tk)**
1	**Earthwork**	cu. meter	2,308,533.79	399,050,483.81	1,846,827.03	319,240,387.04	1,846,827.03	79,810,096.76
2	**Road Pavement**	cu. meter			20,749.34	137,851,290.92	33,717.68	256,009,540.27
3	**RCC Work s**	cu. meter	0,342.02	38,211,868.32	0,684.03	127,372,894.40	0,912.04	89,161,026.08
4	**Drain**	lin. Metre	0,430.00	1,566,532.00	2,580.00	12,532,255.97	3,440.00	17,231,851.96
5	**Enviroment/Social**	Lump sum		48,300,000.00		64,400,000.00		48,300,000.00
6	**Road Furniture**	Lump sum						3,063,339.99
7	**dredging**	cu. meter	2,478,000.00	619,500,000.00	3,304,000.00	826,000,000.00	2,478,000.00	619,500,000.00
8	**R.C.C Jetty**	NO.	1	9,060,000.00	1	9,060,000.00	1	9,060,000.00
9	**Cost of Maintenance dredging**	cu. meter	74,340.00	18,585,000.00	99,120.00	24,780,000.00	74,340.00	18,585,000.00
10	**pontoon**	NO.	4	17,988,000.00	4	29,980,000.00	4	23,984,000.00
11	**Bank protection work**	Lump sum		2,100,000.00		2,800,000.00		2,100,000.00
12	**Other ancillay work**	Lump sum		2,100,000.00		2,800,000.00		2,100,000.00
13	**General**	Lump sum		64,757,619.85		71,475,843.64		52,314,648.91
	Total			1,221,219,503.97		1,628,292,671.96		1,221,219,503.97

Remark: Detailed Implementation plan with construction schedule and activities would be provided in the detailed design phase with No. of packages in consultation with client, availability of finances, actual date of start of activities etc.

CHAPTER – 7

Economic Appraisal of Road and Multimodal Route

CHAPTER – 7

Economic Appraisal of Road and Multimodal Route

7.1 Introduction

Economic appraisal is carried out to assess the viability of the proposed investment in the transport infrastructure (i.e. road and IWT) duly taking into account various benefits (positive as well as negative) that are likely to accrue to the users of the facility as well as the different types of stakeholders in the project influence area (PIA). Further, in economic analysis project costs and benefits are assessed from the point of view of the economy. Given the base year traffic estimates (Section 2.3), traffic forecasts during the design life of the project (Chapter 3), this chapter presents methodology, inputs and results of economic appraisal. As mentioned in Section 2.3 and Chapter 3, two routes namely, i) all-road route: ***Chittagong-Rajosthali-Thegamukh*** and ii) multi-modal route: ***Chittagong-Rangamati by road***, ***Rangamati-Chotohorina (by waterway) and Chotohorina-Thegamukh by road***. For the sake of convenience and clarity, appraisal methodology and results are presented first for all-road route and then for multi-modal-route.

7.2 Appraisal Methodology

7.2.1 *All-Road Route: Chittagong-Rajosthali-Thegamukh*

In the case of road widening/construction projects like the current one, major benefit emanates from reduction in vehicle operating cost (VOC) which in turn translates to reduced transport cost for passengers and goods traffic. Further, improved road condition will facilitate comfortable travel at higher speeds on the one hand and contribute to better environment in the project area in terms of reduction of dust pollution, etc. on the other. In other words, improved/new project road would result in savings to road users as well as to the society in terms of reduced transport costs and travel time, and improved environmental conditions. Since, the road projects normally entail lengthy operational (or design) lives, all the relevant costs and benefits of the project need to be estimated for each year of the project life (including construction period) and appropriately compared to arrive at the overall viability of the proposed investment on road improvement works. To this end, the HDM IV model which allows life cycle costing has been used for assessing the costs and benefits traceable to the road upgrading project during its entire design life period. Within this framework, two mutually exclusive project alternatives viz. i) with the project and ii) without the project, have been considered for assessing the economic viability of proposed road project.

In economic appraisal, all the project costs and benefits are required to be expressed in their economic terms (or in terms true cost of resource consumption) rather than financial / market prices which are used in financial appraisal. This is because the market/ financial prices of a commodity/ services do not reflect their true value to the economy due to market distortions traceable to administered prices, taxes, subsidies, etc. Another important factor in economic appraisal is the ***discount rate*** (***or cut-off rate***) used for discounting future economic costs and benefits of the project to their present values. The discount rate represents *opportunity cost of capital* in economic appraisal. Since the information on cost of various items collected from the

market and other sources are in financial terms, the same have been converted into economic costs by using standard methods.

The HDM-IV model is a life-cycle costing model in as much as it computes costs and benefits traceable to the road investment project for each year of its design life. Given the inputs relating to i) road improvement/construction and maintenance costs, ii) base year traffic levels by vehicle category and their corresponding growth rates, iii) physical characteristics and utilization data of various types of vehicles and their cost, iv) cost of fuel, v) cost of tyre, vi) cost of vehicle crew and maintenance labour, vii) value of time for passenger and freight traffic, etc., the HDM-IV model output yields, among others, the following project viability parameters:

- Net Present Value (NPV)
- Economic Internal Rate of Return (EIRR)

Various inputs that are required for calibration of the HDM-IV model are presented in the ensuing sections.

As mentioned earlier, for the purpose economic appraisal, financial/ market prices of all the inputs for HDM-IV are required to converted in to their economic terms. To this end, the information contained in the report on *"RHD Road User Cost Annual Report 2004-05"* and *latest updates on VOC from RHD* coupled with data on vehicle related data collected by the Consultants have been used to arrive at the economic costs. Details in this regard are presented in the following paragraphs.

7.2.1.1 HDM-IV Model Inputs

a) Vehicle Related Inputs

Various inputs/ parameter-estimates that are required for calibrating the vehicle operating cost and other user costs sub-routines within the HDM 4 include market prices of different types of motor vehicles, tyres, fuels (petrol, diesel and lube oil), vehicle characteristics and their utilization, cost of vehicles crew and maintenance labour per hour, value of passenger time per hour and cost cargo delay per hour relevant for the project area.

Information on vehicle prices and their physical characteristics has been collected from the major auto dealers in Dhaka. As to vehicle utilization, cost of crew and maintenance labour, the relevant information was gathered from major truck/ bus companies, travel agencies and auto garages (repair/ service stations). In the case of tyres, relevant market prices have been collected from tyre dealers in Dhaka. All these market prices relate to October 2015. Latest fuel prices have been collected from the website of Bangladesh Petroleum Corporation (BPC). Broadly speaking, the consultants collected all the relevant information on input prices through market surveys. In certain cases such as vehicle utilization data, value of passenger travel time and cargo delay time, the information contained in the *"RHD Road User Cost Annual Report 2004-05"*. Further, as mentioned above, latest vehicle related input data for the year 2011 used in the RHD's HDM database has been collected. Using latest market/financial data collected by the Consultants, RHD's vehicle-related HDM input data has been updated and the resultant estimates form the inputs in the present analysis. The vehicle-related HDM-IV inputs are presented in Table 7.1

Table 7.1: Vehicle Related HDM-IV Inputs (2015 Prices)

Cost Item	Unit	Type of Vehicle									
		Heavy Truck		Medium Truck		Small Truck		Large Bus		Mini Bus	
		Fin	Eco	Fin	Eco	Fin	Eco	Fin	Eco	Fin	Eco
New Vehicle	Tk' 1000/Veh	7540	5608	2467	1835	1750	1291	4817	4088	2967	2144
New Tyre	Tk' per Tyre	39242	27626	33000	23232	17300	12181	31000	21824	16400	11545
Maint. Labour	Tk' per Hour	125	101	125	101	125	101	125	101	125	101
Overheads	Tk' 000/annum	514	412	514	412	230	186	2798	2239	156	125
Crew Wages	Tk' per Hour	76	61	76	61	44	35	76	61	52	43
Fuel - Diesel	Tk' per litre	68	56	68	56	68	56	68	56	68	56
Fuel - Petrol	Tk' per litre	99	81	99	81	99	81	99	81	99	81
Lubricants	Tk' per litre	450	360	450	360	450	360	450	360	450	360
Utilization											
Auual Km Driven	Kms/year	86000		80700		74000		129800		66700	
Annual Hrs. Working	Hrs./year	3110		3100		3600		3450		3060	
Annual Hrs. Driven	Hrs./year	2050		2036		1748		2864		2131	
Average Service Life	Years	14		9		8		5		5	
Travel Time Cost											
Passenger	per Pass Hr. (Tk)							59	47	59	47
Cargo	per Veh. Hr. (Tk)	27.76	22.21	27.76	22.21	27.76	22.21				
Average Payload											
Passenger Vehicles	No. of Passengers							39		32	
Cargo Vehicles	Tonnes	13		9.5		2.5					

Cost Item	Unit	Type of Vehicle									
		Micro Bus		Utility		Car		Motor Cycle		Auto Rickshaw	
		Fin	Eco	Fin	Eco	Fin	Eco	Fin	Eco	Fin	Eco
New Vehicle	Tk' 1000/Veh	2500	1682	5117	2365	3039	1855	215	128	375	224
New Tyre	Tk' per Tyre	11500	8096	13600	9581	8800	6198	3085	2171	3033	2131
Maint. Labour	Tk' per Hour	125	101	125	101	125	101	125	101	125	101
Overheads	Tk' 000/annum	268	215	275	220	73	59	32	26	35	29
Crew Wages	Tk' per Hour	44	35	46	37	50	43	0	0	40	34
Fuel - Diesel	Tk' per litre	68	56	68	56	68	56	68	56	68	56
Fuel - Petrol	Tk' per litre	99	81	99	81	99	81	99	81	99	81
Lubricants	Tk' per litre	450	360	450	360	450	360	450	360	450	360
Utilization											
Auual Km Driven	Kms/year	56800		22800		50000		46000		13000	
Annual Hrs. Working	Hrs./year	3200		4700		2850		3950		3850	
Annual Hrs. Driven	Hrs./year	1171		863		1276		588		2126	
Average Service Life	Years	6		7		5		5		5	
Travel Time Cost											
Passenger	per Pass Hr. (Tk)	84	67	104	83	104	83	77	62	56	44
Cargo	per Veh. Hr. (Tk)										
Average Payload											
Passenger Vehicles	No. of Passengers	6		3		3		1		4	
Cargo Vehicles	Tonnes										

***Source**: Consultant's Market Survey Data and RHD's HDM-IV Database*

b) Traffic Related Inputs

As mentioned in Chapter 3, the total all-road route between Chittagong and Thegamukh has two distinct sections namely, i) Rajosthali-Thegamukh (proposed new road section), and ii) Chittagong-Rajosthali (existing RHD road section). Details of these road sections are as under:

S. #	Name of the Road Section	Status	Length (Km)
A. Rajosthali -Thegamukh			
	A.1 Rajosthali - Bilaichari	Proposed New Road	47.066
	A.2 Bilaichari - Jurichari		28.091
	A.3 Jurichari - Thegamukh		34.518
		Total - A	109.67
B. Chittagong - Rajosthali			
	B.1 Chittagong - Chandraghona	Existing RHD Road	43.369
	B.2 Chandraghona - Rajosthali		31.933
		Total - B	79.07
		Total -(A+ B)	188.74

Viability or otherwise of road upgrading/construction projects mainly depends on the savings in motor vehicle operating cost (VOC) that is likely to accrue to the road users. Further, the pavement design and road geometry are also determined by the level and composition of base year traffic and their projections. Based on the field studies and detailed analysis of the available primary and secondary sources of information, the consultants have estimated base year (2013) traffic level and composition (Section 2.3) and their projections till the end of the design life (Chapter 3) for the project road. For ease of referencing summary of traffic projections are presented in Tables 7.2 and 7.3 for the proposed road and existing road espectively.

Table 7.2: Traffic Projections on New Road Section : Rajosthali-Theghamukh (Moderate Scenario)

Road Section	Traffic Projections (AADT -Both Directions)				
	2020 - 1st Year	2025	2030	2035	2040
Normal/Diverted Traffic					
Rajosthali - Bilaichari	530	816	1,325	2,043	3,148
Bilaichari - Juraichari	546	842	1,367	2,107	3,249
Juraichari - Theghamukh	731	1,126	1,828	2,817	4,342
Including Generated Traffic (20% of Normal Traffic)					
Rajosthali - Bilaichari	636	980	1,590	2,451	3,778
Bilaichari - Juraichari	656	1,011	1,640	2,529	3,898
Juraichari - Theghamukh	877	1,351	2,194	3,381	5,211
Cross-border Traffic					
Rajosthali - Theghamukh	442	591	792	1,059	1,418
Total Traffic Projections including Cross-Border Traffic					
Rajosthali - Bilaichari	1,078	1,571	2,382	3,510	5,196
Bilaichari - Juraichari	1,098	1,602	2,432	3,588	5,316
Juraichari - Theghamukh	1,319	1,943	2,985	4,440	6,629

Table 7.3: Traffic Projections on Existing Road

Traffic Projections on Existing Chittagong-Chandraghona-Rajosthali Road Section - Normal Traffic					
Road Section	Traffic Projections (AADT -Both Directions)				
	2020 - 1st Year	2025	2030	2035	2040
Chandraghona-Rajosthali	1,657	2,324	3,260	4,572	6,413
Chandraghona-Chittagong	6,865	9,629	13,505	18,941	27,311
Cross-border Traffic Bothways - AADT from the year					
Chittagong - Rajosthali	8,522	591	792	1,059	1,418
Traffic Projections on Existing Chittagong-Chandraghona-Rajosthali Road Section - Normal Traffic and Cross-border traffic					
Chandraghona-Rajosthali	2,099	2,916	4,051	5,631	7,830
Chandraghona-Chittagong	7,307	10,220	14,296	20,000	28,728

c) Infrastructure Related Inputs

Infrastructure related inputs include i) capital cost of the road improvement/construction works and cost of maintenance (routine as well as periodic) for each of the alternatives considered for the road works under the project and ii) design parameters for each alternative.

i) Capital Cost of Road Widening/Construction Works

For the purpose of economic appraisal two mutually exclusive project scenarios have been considered, namely "*without the project*" and "*with the project*". Under *without the project* scenario only do-minimum situation (i.e. maintaining the existing road in its present condition) has been assumed and it is termed as **Alternative 0** (**Alt-0**). In the case of *with the project* scenario, alternative only one below:

Alternative 0: Do-minimum **(Alt-0):** To maintain current roughness and service levels. Since there is no existing road between Rajosthali and Thegamukh, a two-lane very badly deteriorated (> IRI 12) all-weather road has been assumed for HDM analysis.

Alternative 1: Proposed:(Rajosthali to Thegamukh) 7.3m wide road with 0.9 m shoulder on either side in hilly area and 7.3 m wide road with 1.5 m shoulder and 0.9 m verge on either side in open area.

Existing: (Chittagong to Rajosthali) 7.3 m wide road with 1.5 m shoulder and 0.9m verge on either side of road

Under alternative 1, the capital cost of construction of the new road from Rajosthali to Thegamukh and of widening of the existing road from Chittagong to Rajosthali is given in Table 7.4.

Table 7.4: Capital Cost of Construction/Widening

Road Section	Status	Type of Work	Length (Km)	Capital Cost (mill. Taka)	
				Financial	Economic*
Chittagong – Rajosthali	Existing Road	Widening	75.30	1,251.16	1,000.93
Rajosthali – Thegamukh	New Road	New Construction	109.67	21,398.66	17,118.93
Total			**184.97**	**22,649.82**	**18,119.86**

*Economic costs are calculated by applying conversion factor of 0.8 to financial cost.

For all road route, environmental mitigation cost has been estimated at 1,050 million taka.

ii) Maintenance cost

The following two maintenance types are considered in the analysis:

i) Routine Maintenance: Includes grass cutting, drain clearing, re-cutting ditches to the proper shape, culvert maintenance, road sign maintenance etc.

ii) Periodic Maintenance: Includes repairing of potholes, repair edge, sealing cracks, resealing (surface dressing, slurry sealing etc.), re-gravelling road and shoulders etc.

The estimates for maintenance works have been estimated within the framework of RHD's Pavement Design Guide (2005) using the information on unit rates for maintenance works and standards collected from the relevant divisions of RHD. The unit costs adopted for maintenance operation are given in Table 7.5. Economic costs presented in the table are calculated by applying conversion factor of 0.8 to financial cost.

Table 7.5: Unit Costs of Work for Maintenance

Work Class	Work Type	Predominant Activity	Unit	Maintenance Cost (Taka)	
				Fin. (1)	Econ
Routine	Routine Maintenance	Maintenance Outside Carriageway	Per Km	66,290	53,032
		Patching Potholes 1,272	Per Sq. m	1,686	1,349
		Crack Sealing	Per Sq. m	251	201
		Edge Repair	Per Sq. m	1,686	1,349
Periodic	Resurfacing	Seal Coat 15 mm	Per Sq. m	251	201
		DBST	Per Sq. m	398	318
	Asphalt Mix	Bituminous Carpeting 40mm	Per Sq. m	850	680
	Resurfacing	Overlay 40 mm	Per Sq. m	793	634
		Overlay 50 mm	Per Sq. m	981	784
		Overlay 60 mm	Per Sq. m	1,171	937
		Overlay 80 mm	Per Sq. m	1,549	1,239
		Overlay 100 mm	Per Sq. m	1,928	1,542
		Overlay 120 mm	Per Sq. m	2,306	1,845

Source: **Maintenance & Rehabilitation Needs Report of 2012-2013 for Paved Roads, RHD**
Table 3.3, pages 13 and 14.

Note (1) **Updated using average CPI from 2011 to 2015**

iii) Other Inputs and Assumptions

The following assumptions and parameter-estimates have been considered for HDM-IV model calibration.

a) Design life of the project (or period of analysis) has been taken as 20 years.

b) Opportunity cost of capital is 12%.

c) Base Alternative is "do-minimum" scenario (**Alt-0**)

d) Salvage or residual value of the road upgrading/ improvement works is assumed as 10% of the initial value.

e) Construction period as 3 years (2017-2019)

f) The spread of road widening/ construction cost over the 3 years has been assumed as 30% (1st year), 40% (2nd year) and 30% (3rd year).

g) Medium Traffic Forecast Scenario has been considered for economic appraisal

7.3 Economic Appraisal Analysis and Results

Within the methodological framework described above, the economic appraisal has been carried out by comparing the costs and benefits of the road upgrading project throughout its design life under two mutually exclusive scenarios namely: ***without the project*** and ***with the project***. Under *the with the project* scenario, the project costs include capital cost of road widening/ construction works including project supervision, cost of environmental mitigation measures and cost of relocation of /compensation to project affected people (PAP). Further, recurrent expenditures on routine and periodic maintenance to maintain the road at the specified service levels form part of the project cost.

As to the project benefits, savings in vehicle operating cost that is expected due to the proposed road improvement works constitute major quantifiable benefit for the project. Other quantifiable project benefits include: user savings, (travel time saving), residual value of capital works at the end of economic life of the road, arising due to 'the with the project scenario' as against the 'without the project scenario'. Costs and benefits traceable to possible reduction in accidents were not considered due to unavailability of reliable sources of data.

The project cost and benefit streams under *with the project* scenario have been computed for each year of the project life. Each of these cost/benefit streams were compared with the corresponding streams of Base Case Alternative (*without the project* scenario) and economic internal rate of returns (EIRRs) have been worked out using discounting technique. In addition, net present value (NPV) has been computed at 12% rate of discount; opportunity cost of capital used for public project appraisal in Bangladesh.

The economic appraisal has been carried out separately for the following two distinct road situations.

- **Situation 1**: For the entire road stretch from Chittagong to Thegamukh i.e. Chittagong-Rajosthali-Chotohorina-Thegamukh. This includes the existing road from Chittagong to Rajosthali and new road from Rajosthali to Thegamukh.
- **Situation 2**: For the new road from Rajosthali to Thegamukh.

HDM-4 model output containing summary results of economic appraisal are presented in Annex 7.1. Brief summary results of the economic appraisal are presented in Table 7.6.

Table 7.6: Economic Appraisal: Summary Results

(Do-minimum versus With the Project Alternatives)

With the Project Alternative	Status of the Road Section	EIRR (%)	NPV @10% (Taka Million)
1. Chittagong-Rajosthali-Thegamukh	Situation 1	21.8	16,004
2. Rajosthali - Thegamukh	Situation 2	13.3	1,735

From the economic appraisal indicators set out in Table 7.6, both the Situations 1 and 2 are economically viable; the EIRRs being higher than the cut-off rate of 12%. As expected, Situation 1 has yielded a higher EIRR (21.8%) as the investment is relatively low with higher traffic levels. In case of Situation 2, the EIRR is marginally higher (i.e. 13.3%) than the cut-off rate. In this context it may be mentioned that Situation 2 represents all new road construction (i.e. green field project) in a very difficult terrain which entailed very high construction cost. Further, only quantifiable savings arising from reduction in vehicle operating cost (VOC) and travel time have only been considered. Since this road provides all-weather accessibility to project area which hitherto was practically inaccessible, a number of benefits accrue because of this new road. These include a) easy accessibility to education and health facilities, markets for agriculture/horticulture inputs and outputs, etc., b) establishment of new industries and creation of employment, and c) additional employment to local population due to construction of new road, etc. If all these all factored in, the EIRR for the new road (Situation 2) will be much higher.

7.3.1 Sensitivity Analysis

Economic viability of the road widening/construction project crucially depends on robustness of the project cost estimates and traffic forecasts. In reality, these estimates are likely to vary from their actual values. It is in this context, an attempt has been made to gauge the extent of impact of variations in project costs and benefits on the economic viability of the project. To this end, the following sensitivity scenarios have been considered.

a) 15% increase in the capital cost of the project (Scenario I)

b) 15% decrease in project benefits (Scenario II)

c) Scenario I and Scenario II taken together (Scenario III)

Results of the sensitivity analysis are presented in Table 7.7.

Table 7.7: Results of Sensitivity Analysis – All Road Route

Sensitivity Analysis Scenario	Economic Internal Rate of Return (%)	
	Situation 1	Situation 2
Base Case	21.8	13.3
1. 15% increase in Capital Cost (Scenario I)	19.2	11.5
2. 15% decrease in Project Benefits (Scenario II)	19.3	11.2
3. Scenarios I and II combined (Scenario III)	17.0	9.6

As expected, the results of sensitivity analysis indicate that the project under Situation 1 is economically viable even if the project cost increases by 15% or project benefits decrease by 15% or both taken together. In case of Situation 2, the EIRRs are close to the cut-off rate of 12%

indicating economic viability. These EIRR values should not be taken at their face value. This is because influence area of Rajosthali-Thegamukh road has vast traffic potential and due to lack of accessibility there is a huge latent/suppressed demand for traffic. Again, with the new road there will be exponential development. If all these things are considered, the traffic levels will be much more than the Moderate Scenario considered for economic analysis. Thus, considering all these additional aspects including benefits attributable to this new road mentioned earlier, the EIRRs will be higher than 12% indicating economic viability. Further, for fulfilling the objectives of the study i.e. to connect Chittagong port to CHT area as well as to promote border trade with North-east India, the entire road stretch i.e. Chittagong-Rajosthali-Thegamukh need to be improved/developed as a whole and as such it is not rational to develop only one stretch i.e. Chittagong-Rajosthali and ignoring the rest.

It may be pertinent to add here that results of the economic appraisal are valid subject to the realisation of the following assumptions.

- The road widening/ construction works have been assumed to commence from 1st Quarter 2017, implying that all the pre-construction process – securing adequate funds, selection of supervision consultant and civil works contractor and award of contracts – should be completed before the end of 2016.
- The construction work is assumed to spread over a 3 year period (2017-2019).
- Timely completion of the widening/ construction works within the planned budget (i.e. no time and cost over-runs)
- Adequate funds will be available for attending to routine and periodic maintenance of the upgraded road so as to ensure sustainability of its condition at the required service levels.
- Various developmental and allied projects will be taken up in the project area to ensure materialization of the GDP growth profile projected Perspective Plan of Bangladesh (2010-21) which formed the basis for traffic projections.
- Adequate feeder roads will be provided to the villages/ population settlements which are away from the project road so as to ensure that benefits of the improved road reach rural poor in remote areas.
- Strict enforcement of traffic and axle load regulations. This would check overloading and reduce accident rates.

Socio-economic Benefits

Apart from the quantifiable benefits like reduction in the vehicle operating cost (VOC), value of time, etc. a number of socio-economic benefits are likely to be enjoyed by the population in the project area. Some of these benefits are illustrated below.

Accessibility to Markets: Reduction in transport cost will facilitate access to bigger markets and in turn ensure better prices for agriculture and related produce of the project area.

Agricultural Inputs: Availability of better transport facilities at lower tariffs would facilitate timely availability of required agricultural inputs at reasonable prices. This in turn would enhance production levels.

Employment Opportunities: Large construction works like the present road construction project provide better employment opportunity for local poor during the construction period. The extent of employment and its impact on poverty reductions depends on the technology adopted for construction. The experience in the case of many developing countries indicates higher employment opportunities for labour if labour-based techniques are used for construction and maintenance of roads.

7.4 Economic Appraisal of Multi-modal Route: Chittagong-Rangamati-Thegamukh

The multi-modal route involves travel/transport by road and waterway. In the present route, transport on Chittagong-Rangamati is by road, Rangamati-Chotohorina by waterway and Chotohorina-Thegamukh by road. Details of distance and mode of transport on these stretches are given below:

Table 7.8: Multi-modal Route Distances

Section	Mode of Transport	Distance (Km)
Chittagong-Rangamati	Road	72.5
Rangamati-Chotohorina	Waterway	63.0
Chotohorina-Thegamukh	Road	7.4
Total Distance (Km)		142.9

In the case of the multi-modal route also, the economic appraisal has been done within the similar frame work as mentioned earlier i.e. using "with the project" and "without the project" approach. For the two road sections, HDM-IV model formed the basis for economic analysis, the vehicle related and other inputs being the same. Traffic forecast details for these two road sections are given in Chapter 3. The following paragraphs present relevant inputs for economic analysis for the waterway section i.e. Rangamati-Chotohorina.

a) **Traffic Forecast**: For easy referencing, traffic forecasts presented in **Chapter 3** are given below.

Table 7.9: IWT Traffic Forecasts

O-D Pair	Traffic	Base Year 2015	2020	2025	2030	2035	2040
Goods Traffic							
Rangamati-Chotohorina	Tonnes/day	280	375	501	671	898	1202
	Tonnes/year	92,400	123,652	165,474	221,442	296,339	396,569
Chotohorina-Rangamati	Tonnes/day	280	375	501	671	898	1202
	Tonnes/year	92,400	123,652	165,474	221,442	296,339	396,569
Total – Both-ways	Tonnes/day	560	749	1,003	1,342	1,796	2,403
	Tonnes/year	184,800	247,304	330,949	442,884	592,679	793,138
Passenger Traffic							
Rangamati-Chotohorina	Passengers/day	600	803	1,075	1,438	1,924	2,575
	Passengers/year	198,000	264,969	354,588	474,519	635,013	849,790
Chotohorina-Rangamati	Passengers/day	600	803	1,075	1,438	1,924	2,575
	Passengers/year	198,000	264,969	354,588	474,519	635,013	849,790
Total – Both-ways	Passengers/day	1,200	1,606	2,149	2,876	3,849	5,150
	Passengers/year	396,000	529,937	709,176	949,037	1,270,026	1,699,581

b) **Capital Cost of Infrastructure**: Improved IWT services for providing faster, better, comfortable and competitive services would require deeper channel for plying bigger and faster vessels, fully equipped terminals for handling different types of cargo and passengers, etc. The total investment required on these infrastructure facilities to handle the projected traffic is presented in Table 7.10.

Table 7.10: Capital Cost (Million Taka)

Cost Item	Financial	Economic*
Dredging	2126.95	1701.56
Terminals/Landing Facilities	150.63	120.50
Bank Protection	7.00	5.60
Other Ancillary works	7.00	5.60
Grand Total	2291.58	1833.26

* Calculated by multiplying financial cost with 0.8.

For the multi-modal route, the environmental mitigation cost has been estimated as 185 million taka.

c) **Vessel Cost and Speed**: The type of vessels required under the existing and improved situations, their unit costs, O& M cost and operational speeds are given in Table 7.11.

Table 7.11: Vessel Cost and Speed

S.no.	Type of Vessel/Cost Item	Unit	Existing Situation	After Improvement
1	**Cargo Vessels**			
	i) Capital Cost of Vessel	Million Taka	0.70	29.32
	ii) O & M cost per Vessel*	Million Taka	0.07	0.29
	iii) Travel Speeds	Km/hour	5-10, Average 7.5	15
2	**Passenger Vessels**			
	i) Capital Cost of Vessel	Million Taka	1.50	34.3
	ii) O & M cost per Vessel*	Million Taka	0.015	0.343
	iii) Travel Speeds	Km/hour	5-10, Average 7.5	15-20, 17.5Aaverage

* 1% of capital cost

d). Other inputs/Assumptions: Various other inputs that go into the economic analysis like vessel life, handling time and cost, salvage value, etc under the exiting and improved situations are presented in Table 7.12.

Table 7.12: Other Inputs and Assumptions

S.#	Description	Exiting Situation	Improved Situation
1	Working Days/Year	330	330
2	Working hours/Day	12	12
3	Handling Time at Terminal (hr/tonne)	5	4
4.	Handling Costs (taka/tonne)	5000	4000
6	O& Cost		
	- Vessel	10% of Capital	1% of Capital
	- Terminal	10% improved situation	1% of Capital
7	Vessel life (Cargo/Passenger)	7 Years	20 Years
8	Carrying Capacity		
	- Cargo Vessel	20 Tonne	300 Tonne
	- Passenger Vessel	100 Passengers	400 Passengers
9	Average Utilization		

S.#	Description	Exiting Situation	Improved Situation
	- Cargo Vessel	80%	80%
	- Passenger Vessel	100%	100%
10	Empty Haulage – Cargo Vessel	25%	25%
11	Salvage Value of Vessel	20%	20%
12	Construction Period		3 years (2017-2019)

Based on the traffic forecasts and cost and allied inputs, the cost of moving passenger and cargo traffic by IWT has been worked out separately under the existing (Without the Project) and improved (With the Project) situations for each of the year. The cash flows thus worked out under each situation have been compared and the economic internal rate of return (EIRR) and net present value (NPV) have been worked out for the project.

7.4.1 Results of Economic Appraisal for Multimodal:

The results of the economic analysis for multi-modal route comprising three sections are presented in Table 7.13. Details regarding economic appraisal are given in Annexure 7.2.

Table 7.13: Results of Economic Analysis – Multi-modal Route

Section	Mode of Transport	EIRR (%)	NPV (Million Taka)
Chittagong-Rangamati	Road	23.8	2,124.2
Rangamati-Chotohorina	Waterway	20.1	1,476.7
Chotohorina-Thegamukh	Road	14.8	281.9

It may be seen from Table 7.13 that the EIRR for each of the three constituent sections of the multi-modal route has an EIRR much above the cut-off rate of 12% implying that each of the sections is economically viable. Since each constituent section is economically viable, the entire multi-modal route is viable. Similar sensitivity analysis as for the all-road route has also been carried in this case also. The results are as under.

Table 7.14: Results of Sensitivity Analysis – Multi-Modal Route

Sensitivity Analysis Scenario	Economic Internal Rate of Return (%)		
	Chittagong-Rangamati (Road Section)	Rangamati-Chotohorina (Waterway)	Chotohorina-Thegamukh (Road Section)
Base Case	23.8	20.1	14.8
1. 15% increase in Capital Cost (Scenario I)	23.7	18.2	13.0
2. 15% decrease in Project Benefits (Scenario II)	18.9	4.4	12.7
3. Scenarios I and II combined (Scenario III)	18.8	3.4	10.9

Sensitivity analysis results in Table 7.14 reveal that both the road sections stand economically viable in all three sensitivity scenarios. In the case of waterway route, while increase in cost by 15% would not affect the viability, 15% decline in benefits will adversely impact the project viability bringing down the EIRR to 4.4%. However, in view of the huge latent/ unsatisfied demand for transport in the hitherto inaccessible area, such decline in demand for transport is a very distant possibility and may be ruled out. As such, the multi-modal route as a whole is economical under all the sensitivity scenarios.

It may be pertinent to add here that results of the economic appraisal are valid subject to the realisation of the following assumptions.

- The channel deepening and terminal construction works have been assumed to commence from 1st Quarter 2017, implying that all the pre-construction process – securing adequate funds, selection of supervision consultant and civil works contractor and award of contracts – should be completed before the end of 2016.
- The construction work is assumed to spread over a 3 year period (2017-2019).
- Timely completion of the works within the planned budget (i.e. no time and cost over-runs)
- Adequate funds will be available for attending to maintenance of the facilities to ensure sustainability of their condition at the required service levels.

7.5 Conclusion and Recommendation for the Preferred Option

All-Road Route: Considering the results of the economic appraisal and sensitivity analysis, widening of the existing road and construction of the new project road to paved standard alternative is imperative. As stated above, the new project road would lead to reduction in Road User Cost (RUC), including VOC, travel time for road users. The benefits could be higher if factors such as improved access to public service deliveries, the horizontal integration of markets and others could be considered.

Multi-Modal Route: Based on the results of the economic appraisal and sensitivity analysis, investment on multi-modal route is economically viable. The benefit would be higher if aspects such as enhanced income levels due to additional production of agricultural products traceable to better market access, better employment opportunities due to establishment of agro-based industry, etc. could be considered.

CHAPTER - 8
Conclusions and Recommendations

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Conclusions and Recommendations

1. Road Alignment Rajostholi – Billaichhari –Juraichhari – Barakal – Thegamukh (109.67 Km) will be the most feasible one considering Technical and Engineering parameters and also with different social parameters which include: land acquisition (per km), number of households to be rehabilitated (per km.), impacts on economic structures (per km.), impacts on cultural properties (per km.), loss of agricultural land (per km.), loss of commercial land (per km.), impacts on tribal people (per km.), positive impact on population, poverty level, population to be influenced per km, and People's perception of the proposed project. That road has much potential, such as, it has highest area of hinterland to be covered, in case of non-operation of Chittagong-Cox's Bazaar road it can be used for traffic diversion, in future when the deep sea port will be developed, it would be used for trade facilities. Moreover, it would strengthen connectivity to all areas of CHT district.
   Among the Multimodal routes the alignment: Rangamati – Chhotoharina – connected by waterway (63 Km) and Thegamukh by road (about 7.37 km) have the highest scores. Thus these two alignments have been proposed for detailed feasibility study.
2. The connectivity with Chittagong port will enhance the economic activities in the hill region for which the people of the area were deprived so long. The area has very negligible number of road infrastructure except in the urban area of Rangamati, Bandarbon, and Khagrachari. Most roads are stopped while entering the hills. Though some roads are available in the western fringe of the CHT but the eastern fringe running north to south devoid of any communication. This lead to the marginalization of agricultural producer in the area. This road connectivity can change the socio economic scenario of the area. During Public Consultation it is revealed that the farmers can't take products to market due to non-availability of motorized transport. The health care facility cannot reach to the marginalized farmers due to lack of communication. Thus people of the area are deprived from the access to basic needs and services of the country.
3. The CHT areas also have presence of tribal peoples in their ancestral territories with distinct culture, language and livelihood practices. These peoples will be socially impacted by the growth in transportation and commerce in that region which are among the goals of the eventual investments. The strategic framework for sustainable development in CHT has been launched. 25 action points to support Sustainable Development Goals in CHT has been incorporated in the 7th five year plan of Bangladesh.
4. Road only connectivity may not be compared with multimodal one. Carrying cargo by vessel along the river/ lake route will not help in improvement of socio economic condition of the indigenous people (IP) of hill population. The people living along the lake or river may not improve much in transporting their produce what they are doing now with passenger/cargo launches. Most benefit will go to the bulk carrier from Chittagong port to transboundary destination (negligible cargo traffic between Chittagong port to Barkal/Chotohorina/Thegamukh). The planned road connectivity is must for the 'sustainable development goal' what government has out lined 25 points of action in the 7th five year plan in consultation with the ICIMOD.
5. The Kaptai Lake is the hot spot of biological diversity. Most families lost their land due to Kaptai reservoir and are living along the shore line of Kaptai lake and heavily dependent on the lake for water for drinking, household use, irrigation and fishing. It facilitates local

transportation to connect between the hills around the lake. The dredging of Lake Route has high risk of damaging flora and fauna population particularly of fish habitat. If the lake is left without dredging (between Kaptai-Rangamati-Barkal along the Karnafuli channel in the lake) part of the year the vessel can't ply because of draft problem. The constraint of lost draft during dry season will have to be accepted. This need detail hydrological study and hydrographic survey. Moreover maintenance of dredger fleet, cargo vessel inside the lake is another impediment in protecting the habitat.

6. However the draft between Barkal and Chhothorina can be increased by dredging. This portion of the channel is out of the Kaptai reservoir. Depending on the quality of dredged material it can be used to close the gaps of charas for road construction. The water control structure at the bottom may be needed. The careful dredging in this part of the multimodal route can avoid destruction/ upsetting fish habitat in the Kaptai lake. Chhotoharina-Theghamuk is connected by road. But it is the same Karnafuli river which has made loop between Chhotoharina and Theghamuk. Chhotoharina can be connected to Theghamuk by dredging the Karnafuli river which likely to be about 18 km or cutting a loop of 1 km a bit upstream of Chhotoharina and Theghamuk.
7. In future Rajostholi can be connected to the Karnafuli left bank if further port facilities are developed. On the left bank there are small port activity like KAFCO has one jetty for their own use. Moreover, in future, Rajostholi can be connected to the Cox's Bazar highway which may lead to another connectivity with deep sea port at Kutubdia/Moheshkhali. Tunnel at the outfall of Karnafuli has been planned that will effectively connect the eastern part of Chittagong with west. One bypass along the coastal embankment is under construction to connect western part of the country (Dhaka, Sylhet etc.) avoiding city traffic congestion of Chittagong.

Potential Expansion of Trade and Benefits

8. During the last 6 year period while total real GDP of Bangladesh was growing at about 6% per year, the GDP from Land transport grew at more than 6% per year; yielding an average demand elasticity of 1.13. Government of Bangladesh has prepared "Perspective Plan of Bangladesh (PPB) 2010-21: Making Vision 2021 A Reality". Vision 2021 envisions transformation of socio-economic environment of Bangladesh from a low income economy to the first stages of a middle income nation by 2021. To make the vision a reality, PPB 2010-21 stipulated the growth trajectory of real GDP of Bangladesh as 6.1%, 8% and 10% during the years 2010, 2015 and 2021. Using appropriate GDP growths in pessimistic, moderate and optimistic scenarios the following traffic growth rates have been worked out

Real GDP Growth Scenario	FY 15	FY 21	FY 26	FY 31	FY 36
Scenario 1 - Pessimistic	6.0%	6.0%	6.0%	6.0%	6.0%
Scenario 2 - Moderate	6.0%	7.0%	8.0%	9.0%	8.0%
Scenario 3 - Optimistic	6.0%	10.0%	10.0%	10.0%	8.0%

These growth rates will decide the future traffic forecasts which are quite encouraging.

9. In Bangladesh land-based cross-border traffic is handled at custom check posts. Currently there are 9 operational land custom check posts – 5 under BOT and 4 directly operated by Bangladesh Land Ports Authority. Besides, there are a number of border land custom check posts that are under development or proposed. A land custom post is under process of development at Thegamukh, which is the terminal point of the proposed routes and also

bordering with Mizoram state of North-eastern region of India. At present, there are no available cross-border movements through Thegamukh. Majority of cross-border traffic is moving through Benapole custom post.
However, some of the on-going regional initiatives like Bangladesh-China-India-Myanmar (BCIM) Economic Corridor and Mizoram State Roads II - Regional Transport Connectivity project, India (funded by World Bank) may provide a basis for broad assessment of cross-border traffic at Thegamukh.

The BCIM economic corridor is a sub-regional initiative for fostering cooperation among the four member countries. The proposed economic corridor originates from Kunming in China's Yunan province and pass through Yangon and Mandalay in Myanmar, Chittagong-Dhaka-Sylhet in Bangladesh before entering India's North Eastern states of Manipur and Assam and finally West Bengal and ending in Kolkata. The hinterland region of BCIM corridor is one of the richest in the world in terms of natural, mineral and other resources. Enveloping about 9% of worlds area, the BCIM region accounts for 440 million people and 7.3% global GDP. The region has potential to generate enormous economic benefits in the area of trade, investment, energy, transportation and communications. The BCIM Corridor will allow all four countries to exploit existing complementarities in trade — in terms of both sectors and products. Myanmar is a primary goods exporter and has abundant cheap labor. India has an edge as a leading services exporter. China is the largest manufacturing exporter in the world; and Bangladesh, like many other South Asian countries, engages in both services export and low-end manufactured goods. Provision of this link would benefit North-eastern region of India as well Bangladesh.

Mizoram State Roads II - Regional Transport Connectivity project, India (funded by World Bank): Taken up as part of the SAARC multi-modal transport initiative, this improved link to Bangladesh will facilitate greater bilateral trade as well as provide better access for Mizoram and other North-eastern Indian states to Chittagong Port (which is the nearest shipping port for NER states of India). Among others, the project comprises: widening and strengthening of three sections of (Group 1) road totaling 91 km including (i) a 22.0 km section of Lunglei –Tlabung – Kawrpuichhuah Road on the border with Bangladesh; (ii) the 27.5km Champhai-Zokhawthar Road on the border with Myanmar; and (iii) the 41.7km Chhumkhum-Chawngte North-South alignment connecting to the border roads with Bangladesh to the west and Myanmar to the south.

Thus the above discussion indicates a great potential for cross border traffic and the possibility to generate / divert traffic on the proposed corridors of this study. However it requires some more detailed data and in-depth analysis for appropriately allocating this traffic to relevant routes

10. When the project road i.e. two lane bitumen surfaced road commences operation, the above diverted/normal traffic will enjoy benefits traceable to reduced vehicle operating cost (VOC) and travel time and increased comfort. There will also be easy accessibility to medical centers, educational institutes (schools, colleges, etc.), social interaction, etc. At present, due to lack of proper transport facility, the potential of the area i.e. agriculture, horticulture, forestry, etc. remains mostly under/un-utilized. This is corroborated by the fact, as revealed during the discussions with concerned government agencies and local leaders in the project area, most of the agriculture and allied production in this area is mostly limited to meeting only the subsistence needs. This is because lack of proper transport and storage facilities has been hampering fruit production in this area and in some cases resulting in damage of

millions taka worth of fruits. As such when the new road is available which in turn ensures easy accessibility to inputs and product markets, substantial quantum of traffic gets generated due to additional production. Further, this will also encourage setting up of related industries e.g. agro-processing, fruit canning and forest-based industries. This will in turn create employment to local population and result in additional income.

11. Economic Appraisal : All Road Project: Chittagong-Rajosthali-Thegamukh

Major benefit of road improvement/construction is reduction in vehicle operating cost (VOC) which in turn translates to reduced transport costs for passengers and goods traffic. Upgrading of the project road would result in savings to road users as well as to the society in terms of reduced transport costs and travel time, and improved environmental conditions. Since, the road projects have lengthy operational (or design) lives, the HDM IV model which allows life cycle costing has been used for assessing the costs and benefits traceable to the road upgrading project during its entire economic (design) life period. Within this framework, two mutually exclusive project alternatives viz. i) with the project and ii) without the project, have been considered for assessing the economic viability of proposed road project.

Economic analysis has been carried out based on medium traffic forecast. While the project cost included capital cost of road upgrading/construction work and maintenance cost (routine and periodic), the quantifiable project benefits were savings in vehicle operating costs. Economic analysis results indicate that all the project options have a high economic rate of return.

Based on the economic analysis of the proposed project, as well as overall engineering and traffic assessment, construction of the new road between Rajosthali and Thegamukh along with widening of the existing road between Chittagong and Rajosthali with an EIRR of 21.8%, is preferable for the entire project road. Even under the most pessimistic scenario of 15% increase capital cost and 15% decrease in project benefits, the project yields an EIRR of 17.0 % which is much higher than the cut-off rate of 12% applicable in Bangladesh.
Thus considering the results of the economic appraisal and sensitivity analysis, widening of the existing road and construction of the new project road to paved standard alternative is imperative. As stated above, the new project road would lead to reduction in Road User Cost (RUC), including VOC, travel time for road users. The benefits could be higher if factors such as improved access to public service deliveries, the horizontal integration of markets and others could be considered.

Economic Appraisal: Multi-Modal Route - Chittagong-Rangamati-Chotohorina-Thegamukh
Under this, movement between Rangamati and Chotohorina is by water transport and that between i) Chittagong and Rangamati and ii) Chotohorina and Thegamukh is by road. For each of these three constituent sections of the multi-modal route, the investments are economically viable with EIRR more than 12%, the cut-off rate.

Based on the results of the economic appraisal and sensitivity analysis, investment on multi-modal route is economically viable. The benefit would be higher if aspects such as enhanced income levels due to additional production of agricultural products traceable to better market access, better employment opportunities due to establishment of agro-based industry, etc. could be considered.

Recommendations

1.The detailed design of the selected routes is very much essential because being hilly terrain more detailed and extensive data collection is required. In order to maintain desired speed the desirable geometric standards need to be maintained and many places the alignment may get shifted which requires availability of more data. If more data is available the possibility of further refinement of alignment can be explored.

2.During the detailed design there is a need for more detailed investigations in certain areas like the present proposed Road alignment is supposed to pass through Jurachuri Sadar, and then it would need to remove all establishments of Upazila and other buildings. The possibility should be explored for modifying the alignment to save those establishments. If the route passes by the Upazila Police station-Labour Para –Kalika Para-Barkal then the upazila establishments will be saved and road length would be shortened by 4-5 km. This possibility should be explored. Similarly if the Road Alignment follows the old KPM road that passes through Farua, Akuzzapara,Taktanala, Alikhong to down bridge, then it would prove to be cost effective and a lot of houses and buildings would be saved from acquisition. There is a need to look for these options during detailed design phase.

3.During the detailed design phase for preparing Road Alignment Maps, important locations should be demarcated on the mouza maps. And at the same time during consultation, surveyors should be advised to use Mouza Maps to find out the exact alignment locations. It would be very much fruitful, if there would be one day small workshop for review of the design and alignment in each of the four Upazilas, through which the road alignment has been passing with the presence of Headman, Karbari, UNO, UP Chairmen, UP members, Upazila Chairman, Vice-Chairman, etc. These workshops would help the project to do re-settlement works easily.

ANNEXURE 1.1

Classification of Rivers

CLASSIFICATION OF RIVERS

Class	Sl. No.	Route	Description (River/Town)	Distance (km)	Remarks
Class I	1	Dhaka-Chittagong	Buriganga, Dhaleswari, (Lower) Meghna, Shahbazpur, Hatia Channel, Karnafuli River.	306	Sandbars in Bay of Bangle
	2	Shambhupura-Demra	Lakhaya River, Narayanganj	22	
	3	Shambhupura-Bhairab Bazar	Upper Meghna, Ashuganj	85	
	4	Chowkighata-Maheswarpasha	Lower Meghna, Arialkhan, Kirtankhola, Gab Khan, Baleshwar, Meghna-	270	
	Total Class I Route = 683km				

Waterway Route Classification

Class	Sl. No.	Route	Description (River/Town)	Distance (km)	Remarks
Class II	1	Bhairab Bazar-chattak	Upper Meghna, Kalni, Surma river	228	Some stretches sometimes 'seasonal' Channel to Barisal changes from Year to Year
	2	Mohanpur-Diakhawa	Meghna-chandpur, Padma, Jamuna (Brahmaputra)	358	
	3	Deara-Barishal via Nandibazar	Meghna, Jayanti, Arial Khan	84	
	4	Pussur-Chalna-Raimangal	Sutarkhali, Sibsa, Bajboza, sekbaria, Arpangasi, Malanchi-Border	143	
	5	Hizla-Shaistabad	MeghnaAzimhur/Dharmaganj, Arial Khan	30	
	6	Satnal-Daudkandi	Meghna	24	
	7	Chandpur-Ichuli	DakatiaNullah	7	
	8	Chittagong- Cox' Bazar	Karnafuli, Kutubdia&Maiskhal Channels, Bagkhali	99	
	Total Class- II Route = 1000km				

Class	Sl. No.	Route	Description (River/Town)	Distance (km)	Remarks
Class III	1	Dilapur-Markuli-Sherpur	Meghna, Kalni, Kushiyara rivers	168	
	2	Sherpur-Zakigang	Kushiyara river	117	'Seasonal'
	3	Gaglajor-Mohanganj	Kangsa River	43	'Seasonal'
	4	Chitri-NabinagarKuti Bazar	Meghna, Pagla, Buri Rivers	20	
	5	Mahisherchar-Salimganj	Meghna, Titas rivers	31	'Seasonal'
	6	Marichakandi-Narsingdi	Meghna river	8	
	7	Narsingdi-Katiadi	Old Brahmaputtra	84	'Seasonal'
	8	Demra-Ghorasal	Lakhya river	37	
	9	Dhaka-Mirpur-Tongi- Demra	Turag,tongi, Balu rivers	53	Route Round

Class	Sl. No.	Route	Description (River/Town)	Distance (km)	Remarks
					Dhaka 'Seasonal'
	10	Buriganga Mouth-Saidpur	Dhaleswari river	15	
	11	Nakalia-Baghabari	Hurasgar	15	
	12	Khulna-Bardia-Manikdah-Kalikapur	Bhairab, Atai, Madhumati, Beel route, Upper Kumar, Arial Khan	138	(Seasonal)
	13	Atai/Bhairab Confluence-Abalganti	Atai river	15	(Seasonal)
	14	Kalikapur-Madaripur-Nandibazar	Arial Khan, Jayanti	56	
	15	Kaukhali-Jugirkanda-Babugang	SwarupkatiTengrakali (Amtoli)	52	
	16	Ghasiakhali-Bagerhat	Ghasiakhali river	18	
	17	Kobadak-Tepakhali	Kapatakshi, river	85	(Seasonal)
	18	(Chalna)-Paikgacha-Assasuni, Protapagnar	Sibsa, Harikhali, Kholpetua rivers	85	
	19	Jhalakati-Barguna-Patharghata	Gazalia, Bishkhali rivers	89	
	20	Dapdabia-Angaria-Mirzagang-Amtali-Taltalipara	Khairabad, Rajagang, Bighai, Buriswar rivers	115	
	21	Charpower-(bhola)Patuakhali-Galachipa-Bara-Baishdia	Tetulia, Karkhanalohalia, Galachipa, Rabnabad, Agunmukha, (Edtuarium)	137	
	22	Bara Baishdia-Khepupara	Nilganj river	19	
	23	Khepupara-Mohipur-Kuakata	Nilganj, Khprabhanga, Andaramanick river	36	
	24	Badartoni-Rajapur	NayaBangani R/Muladi N	35	
	25	Bhola-(Charpower) Nazirpur-Ghoserhat-CharMontaz	Tetulia, Bura, Gauranga, Bay of Bangla	95	
	26	Chittagong-Kaptai dam	Karnafhuli river	65	
	27	Rangamati-Kaptai	Kaptai Lake	29	
	28	Kaptai-Belaichari	Kaptai lake	20	
	29	Rangamati-Chotohorina	Kaptai lake	64	
	30	Rangamiti-Mahalchari	Kaptai lake (Chiringa Khal)	44	
	31	Rangamati-Marisha	Kaptai lake (Myani River)	97	
Total Class-III Route			**= 1885km**		

Class	Sl. No.	Route	Description (River/Town)	Distance (km)	Remarks
Class-IV	1	Markuli-Diral	Kalni river	5	'Seasonal'
	2	Takerghat-Lalpur	Baulai river	19	S
	3	Chattak-Atgram	Surma river	48	'Seasonal'
	4	Mohangonj-Thakurkona	Kangsa river	141	S
	5	Ghoradiga-Netrakona	Mogra river	46	S
	6	Ghorasal-Toke	Lakhya, Old Brahmaputra	130	S
	7	Savar-Nayarhat-Dhamrai	Bansi river	62	S
	8	Mirpur-saver	Karnapara, Dhaleswari R	10	S
	9	Rustampur-Kaliakoir	Turag river	15	S
	10	Saidpur-Singair-Tilli	Dhaleswari river	55	S
	11	Paragaon-Tara-Shajani	Dhaleswari river	80	S
	12	Katpatty-Gourgonj	Ichamati R.-Taltala C	86	S
	13	Dubaldia-Kalikapur	DubaldiaNullah	22	S
	14	Kabirajpur-Tepakhola	Arial Khan	39	S
	15	Kaukhali-Manikdah	Madhumati river	3667	S
	16	Bardia-talbaria	Madhumati, Garai rivers	170	S
	17	Bardia-Narail-gazirhat	Upper Nabaganga, ChitraMadhumati rivers	75	S
	18	Khuna-Manikdah	Attarabanki river	43	S
	19	Khuna-Alaipur-Bagerhat	Bhairab river	43	S
	20	Assasuni-Ellarchar	Harikhali, Morirchap river	21	S
	21	Sripur-Bhola Kheyaghat Rangapur/Bhola Town	Tetulia, Bholakhal	28 5	S S
	22	Aricha-Rajshahi-Godagari-Bholahat	Padma/Ganma, Mohananda rivers	307	S
	23	Aricha-Salimabad	Jamuna river	22	S
	24	Baghabari-Badalgachi	Hurasgar, Baral, Gumani, Atrai, Gurgu R.	163	S
	25	Bag'bari-Ullapara	Karatoya river	32	S
	26	Saidpur-Sreenagar	Lchamati river	18	S
	27	Saidpur-Salla	Dhaleswari river	10	S
	28	Cox's bazaar-st. Martin's island		111	
	29	St.Martin's island-Teknaf		31	
	30	Kuti Bazar-Saldanandi-Gokarnaghat	Pagla, Saldanandi rivers	13	S
	31	Toke-trimohini-Kaoraid	Banar, Kaoraid rivers	20	S
	32	Madna-Habigonj-Saistaganj	Barak river	62	S
	33	Manumukh-Manlavibazar	Manu iver	20	S

Class	Sl. No.	Route	Description (River/Town)	Distance (km)	Remarks
	34	Sachna –Suala-Tahirpur	Nawa river	37	S
	35	Ichuli-Faridganj	DakatiaNullah	64	S
	36	Char Pagla-Raipur	Dakatia river	20	S
	37	Patuakhali-Mirzaganj	Patuakhali river	10	
	38	Khantakhata-MatiBhanga	Balaswar river	52	
	39	Aorabania-Mirzaganj	SrimantaNullah	18	
	40	Pakhira-Naria	Palang R. Nariakh.	37	S
	41	Bhitabaria-Gazipur	SialkatiNullah	9	
	42	Badla-Tarail	Batnal river	33	S
	43	Tepurakandi-Kazirtak	Padma river	21	S
	44	Bahadurabad-Balashi	Old Brahmaputra	22	S
	45	Shajani-Bochamara	Jamuna river	27	S
	Total Class IV Route			**= 2,400km**	

ANNEXURE: 1.4

Review the report as per TOR

Review the report as per TOR

The present assignment deals phase I only.

Phase 1: Screening and Detailed feasibility study

Part 1: ***Screening***

Screening shall cover the entire probable routes minimum of alternative alignment option for each route. Each alignment option shall be evaluated based on multi criteria analysis for preliminary technical/engineering, adverse environment and social impact assessment, poverty impacts, traffic, population served and other key factors pertinent to the screening. Based on the total sectors of each alignment, one top ranking alignment from each group of rode and multimodal route shall be selected (one for all road routes, and one for multimodal road and inland waterway route) as candidates for detailed feasibility study. The final results will be shared in the national level consultation workshop for the preferred connectivity option. However, the Client/Employer retains the right to substitute any alignment prior to commencement of work as the situation demands.

Part 2: Detailed feasibility study of two options

Detailed Feasibility study shall include the study of two selected routes (1 road and 1 multimodal route). The detailed feasibility shall comprise the economic and financial cost / benefits analysis (IRR)of the routes for saving in transportation costs, travel time for the projected traffic, life cycle costs of the routes (about 20 years), estimated cost of implementing approximate environmental and social mitigation measures (including compensation for land acquisition, involuntary resettlement and tribal people economic enhancement measures) and costs of improvement to existing roads to Chittagong. The Consultant will not be responsible for completing detailed environmental and Social Impact Assessments of the route in this phase, but will be required to conduct preliminary assessment on the basis of social and environmental screening at a level of detail sufficient to gauge approximate cost for key social and environmental mitigation measures for the alternatives under study. (Detailed Environmental and Social Impact Assessments and Inclusion Tribal People Development Plan and Resettlement Action Plan (RAP) Environmental Management Plan (EMP) for the selected alternative road option would then be completed under separate consulting services in parallel to Phase II of this Consultancy.

Detailed Tasks: The Consultant's tasks include, but are not limited to the following:

Phase I: Screening and Detailed Feasibility study

The consultant will conduct the in depth screening of all options and will carry out the detailed feasibility assessments for top two preferred options (one from each of road only and multinational options under initial consideration) which will be decided from technical, economic, social and environmental screening and multi- criteria analysis. During the study, the consultant will follow all applicable World Bank safeguard policies (e.g. environmental Assessment (OP4.01) Natural Habitats (OP 4.04), forests (OP 4.36), Pest Management (OP 4.09) and Physical Cultural Resources (OP 4.11) as applicable), as well as special assessment and analysis of tribal peoples issues (in accordance with OP 4.10) and involuntary resettlement issues (in Accordance with OP 4.12). The consultant's tasks in phase shall include, but not be limited to, the following:

Part 1: For each of the 4 water routes (about 150 km in total) and 4 land routes (about 400 km in total) preliminary identification of road and multimodal transport alternatives, conduct screening of two potential alignments. The screening process should include the following:

1.4.1. Collect or produce relevant preliminary information on physical, environmental, socioeconomic, cultural, and market demand aspects, which will enable determination of technical and engineering requirements, screening of key environmental and social impacts and risks, preliminary evaluation of social benefits and future market demand, and evaluation of social benefits and future market demand, and evaluation of technical feasibility and compilation for each route. Data collection methods should include secondary (e.g., compilation of available reports, aerial photos, maps, studies, plans, district and village profiles and databases, etc.)as well as primary sources (adequate field reconnaissance survey with GPS camera, other necessary surveys including river sounding to assess the dredging requirements, limited community consultations, traffic assessments for both local and cross border, participatory rural appraisal methods, etc.). The filed reconnaissance should identify important environmental and social features at critical points along each proposed route, as well as near possible locations of quarry and borrow sites, materials storage sites, construction camps and associated services (water supply sources and others), access roads, spoils disposal sites for wastes, dredge material disposal sites, and other ancillary facilities associated with route construction. In addition, preliminary consultations with local communities should be carried out in order to glean useful knowledge and experience of local people relevant to identifying social and environmental constraints and sensitive issues, tribal issues, and to help identify appropriate alignments and areas for supporting infrastructure and services.

Baseline information to collect or produce should cover the following aspects in particular (collect information from primary or secondary source that are relevant to understanding each baseline aspect). The consultant's Inception Report (see section 7 below) should outline the proposed baseline to be assembled, including proposed field data collection methods and scope, based on review of secondary information of the proposed route alternative.

1.4.1.1 Physical and biological information, including:

1.4.1.1.1 Existing transport infrastructure:

Identify, map and characterize existing transport
Infrastructure proximity of each route such as water crossing structures (Bridges and Culverts), river Ports, roads and tracks, etc.

1.4.1.1.2 ***Climate Conditions and projected climate change:***

Compile all available historical and present-day data on average annual and monthly temperature and precipitation, as well as record highs and lows, and available information on flood levels (including flood maps where available) in the study area for storm events of various intervals (for example S-Year, 20-yearand 100-year storm events). Compile available information on climate change projections for the area of study. Make a conclusion on the potential effects of temperature / rainfall variations from both present variability and with the anticipated effects of climate change—along the different routes which may need to be considered in sitting and design of road segments and bridges, dredging depth and disposal areas for water ways, etc.

1.4.1.1.3 Geological condition:

Analyzed the geological condition along the proposed routes. Collect available geological geomorphologic and geotechnical maps.

1.4.1.1.4 River crossings:

All route alignment will cross numerous canal, streams or creeks as well as major rivers like the Karnaphuli River. Preliminary assessment of need of river crossing structures and desirable type of structure.

1.4.1.1.5 Environmental Components and Biological Diversity:

The potential routes will pass though natural habitats (both terrestrial and aquatic) of importance to diverse plant and animal species including potentially sensitive and endangered species, rare plants, fisheries resources, wetlands species, bird migration and nesting areas etc. Characterize areas of natural habitat in proximity to each route, including preliminary identification of areas of critical habitat as defined ender World Bank OP 4.04 (including but not limited to legally protected areas, and areas of particular significance to species of conservation important.

1.4.1.1.6 Land use:

Characterize the existing land use within the area of influence of each route, including areas for cultivation, grazing areas, hilly areas, forested areas, industrials areas, residential areas, common properties etc. Although a full demographic survey is not required at this stage, villages, population centre and dwelling within 500m of each proposed transit corridor should be at least generally characterized. Identify and describe the known physical culture Resources (historical, religious or architectural) as well as socially sensitive areas (School, Bazar etc) within 150mof each route alignment.

1.4.1.2 Preliminary Socioeconomic and cultural information, including:

1.4.1.2.1 Sample household socioeconomic survey data for communities potentially affected by the routes.

1.4.1.2.2 Demographic population information in order to estimate population to be benefited (most recent census report).

1.4.1.2.3 Land holding and tenancy, cropping pattern, and access to forest resources, Occupation and income of the beneficiary and potential affected communities including poverty situation, Identification of stakeholders and their influence on design and implementation of the connectivity interventions; Identification of tribal peoples in areas of influence of each route and application of the World Bank

1.4.1.2.4 Land acquisition and resettlement needs and application of World Bank OperationalPolicy 4.12 and Government policy and legislations.

1.4.1.3 Road infrastructure and traffic including:

1.4.1.3.1 Capacity and condition of existing roads to Chittagong and their improvementrequirements to cross border transit traffic.

1.4.1.3.2 Identification of problem source of construction materials for road construction.

1.4.1.3.3 Preliminary traffic assessment for each route in order to forecast 20 years traffic (local and cross border) for each alignment option.

1.4.2. Develop two potential alignments and identify basic technical, engineering, environmental and social aspects for each route option.

1.4.2.1Considering the baseline information collected, identify one potential alignment from each group of the route options.

1.4.2.2 Provide preliminary engineering designs including necessary culverts, drainage, bridges and other structures and dredging requirements for the top 1 road and top 1 multimodal route (as per outcomes of multi criteria analysis, illustrated below).Moreover in

consideration of the future development of the corridor as a sub-regional transit route, the formation width and bridge/ culvert capacity should follow double lane requirements.

1.4.2.3 Identify preliminary candidate areas for quarry and borrow sites, materials storage sites, construction camps and associated services (water supply source and other), access roads, spoils disposal sited for waste, dredge material disposal sites, and other ancillary facilities associated with construction of each route.

1.4.2.4 Study the availability of construction materials such as aggregates, timber, fuel, water, cement, steel, etc. and possible access to the quarry sites.

1.4.2.5 Assess availability of labor (skilled and unskilled) in the project area, and capacity of contractors in the project area.

1.4.2.6 Estimate of the number of households to be benefited per km along each route.

1.4.2.7 Prepare a comparative environment and social scoping repot, covering for each route studied: (a) summary (high level) of environment, social and poverty baseline characterization and stakeholder analyses, (b) identification of key likely environment and social impacts and sensitivities (positive and negative) requiring mitigation or which could be enhance and (c) key World Bank Safeguard Policy as well as national legal compliance consideration. Where possible, the comparative analysis will highlight costs vs. benefits from an environmental and social perspective associated with development of the alternative routes.

1.4.3. Conduct multi criteria analysis of all route option and alignment:

1.4.3.1 Using the outputs of (2) above rank each route option and alignment according to: technical/ engineering feasibility (10 points), adverse environment impact (10 points) social impact (10 points) and poverty (10 points) , present inaccessibility to reach the road head (5 points), travel time savings after the project (5 points), less improvement required to existing road to Chittagong (10 points) less time of travel between Chittagong to Thegamukh (10 points), population served per km of connectivity within the Zone of influence (ZOI) (15 points) and population served within the ZOI per US$ 1 million project cost (15 points). Recommend one road and one multimodal route alignment for further analysis (detailed feasibility study), based on the outcomes of the multi-criteria analysis. (The criteria and maximum points provided are the examples. The consultant may propose suitable decision tool in accordance with international practice acceptable and agreed to the government and Word Bank. However, such tool shall be included and agreed by the GOB World Bank at the approval of the inception report).

1.4.4 Part 2: Detailed feasibility (including preliminary environmental and social) study of top selected routes (1 road and 1 multimodal route).

1.4.4.1 For each of the feasibility study routes, finalize the alignment, standards, and technology and risk and impact mitigation measures.

1.4.4.2 Carryout adequate engineering surveys necessary for the feasibility assessments.

1.4.4.3 Geological conditions: Analyze the geological condition along the proposed routes collect available geological, geomorphological, and geotechnical maps.

1.4.4.4 Hydrography and water quality: All route alignments will cross numerous canal, streams or creeks as well as major rivers like Karnaphuli River. Identify discharge, currents, depts., span of water crossing structures, river protection needs and other physical features of the navigable waters.

1.4.4.5 Assess current sources of water pollution by communal waste waters from inhabited places, and pollution from industrial and agricultural activities.

1.4.4.6 Water Quality data: Groundwater (measure at least Mn, As, Fe, EC, at minimum 5 km interval for the route), Surface water Quality (measure at least PH, DO, BOD5, TDS, AS, Feat Karnaphuli river crossing point and a sample canal stretch).

1.4.4.7 Noise Level: At all sensitive locations for the route.

1.4.4.8 Air Quality: Collect and test samples for Air quality (measure at least PM10, PM2.5 and SPM at terrestrial and aquatic habitat area for the route.

1.4.4.9 Environmental Components and Biological Diversity: Identify and list the species present in the area of influence of the route, including their conversation status as per IUCN as well as under national legislation.

1.4.4.10 Carry out Upazila community consultation for updating preliminary screening/assessment conducted under part 1 of key social impacts, resettlement impacts and tribal people issues, and identify potential measures and technical option to minimize resettlement impact. Prepare initial cost estimate for land acquisition and resettlement, and for major components of broader social impact management.

1.4.4.11 Update preliminary screening/assessment conducted under part 1 of key environmental and hazard risks and impacts, to identify impact minimization and mitigation measures: (a) which could be incorporated into the proposed alignments / project design and (b) which would be require mitigation. Prepare initial cost estimate key environmental mitigation measures.

1.4.4.12 Assess people's participation, labor-based or capital investment method recommend an appropriate construction technology for the alignment.

1.4.4.13 Traffic surveys (traffic count and origin-destination survey), in order to develop 20 years traffic projection for generated and diverted traffic (local and cross border) (cross border traffic projected based on the most recent report published by GOB, GOI, and regional and international agencies) for the alignment in compliance with international standards. The projection shall also include probable cross border transit traffic.

1.4.4.14 Carry out comparative economic and financial analysis, sensitivity and risk analysis for the project alternatives and under different investment scenarios, considering construction and key impact mitigation and resettlement costs, rehabilitation and maintenance life cycle costs including costs of improving existing roads to Chittagong, vehicle operating costs (RED models), cost of carriage by porters, travel time costs and indirect benefits, benefit distribution and poverty impact ration.

1.4.4.15 People the following outputs, for each of the routes / alignments:

- Preliminary plan of the proposed alignment, taking into account measures to minimize resettlement, social and environmental impacts, and hazard risks. The plan should show structures (retaining walls, breast wells, bridges and culverts) and their link to other road; horizontal and vertical alignments; well types and drainage type following Hill road guidelines; and locations and relavent design aspects of key support infrastructure including bridges and service areas, including quarry and borrow sites, materials storage sites, construction cams and associated services (water supply sources and others), access roads, spoils disposal sites for wastes, dredge material disposal sites etc.

- Required feasibility level drawings and reports with a content and format acceptance to the GoB and the World Bank.
- Economic and Financial analysis and initial cost based on reasonable quantity estimates and prevailing construction cost per km of similar transport routes and cost per meter of the major structures.
- Preliminary project implementation plans including construction technology considerations.

1.4.4.16 Once the single route alignment to be studied further under phase II (Survey and Detailed Engineering Design) is selected, prepare detailed draft TORs for the full ESIA, EMP, RAP and Tribal peoples Development Plan(TPDP) for this route.

ANNEXURES

ANNEXURES OF

CHAPTER 1

Introduction

ANNEXURE 2.2 A

Road Route 01 Inventory Rajostholi to Thegamukh

Road Route 01 Inventory: Rajostholi to Bilaichhari

Route ID	Location	Chainage (m)				Length (m)	Road/Bridge Width (m)	Existing Feature Types	Ownership
		CH-Start		To	CH-End				
Road Route -1	Rajostholi to Bilaichhari	CH	0.000	to	23.961	23.961	5.082	Pavement Road	LGED
		CH	23.961	to	27.261	3.300	6.100	Culvert	LGED
		CH	27.261	to	348.064	320.803	4.469	Pavement Road	LGED
		CH	348.064	to	409.958	61.895	4.108	Existing Bridge	LGED
		CH	409.958	to	739.865	329.906	3.669	Pavement Road	LGED
		CH	739.865	to	3742.484	3002.619	3.741	HBB Road	LGED
		CH	3742.484	to	5129.191	1386.707	4.000	Earthen Road	LGED
		CH	5129.191	to	5161.306	32.115	Chhara	Missing Link	
		CH	5161.306	to	8358.958	3197.652	4.000	Earthen Road	
		CH	8358.958	to	8387.152	28.195	Chhara	Missing Link	
		CH	8387.152	to	11834.515	3447.362	4.000	Earthen Road	
		CH	11834.515	to	11864.893	30.379	Chhara	Missing Link	
		CH	11864.893	to	14717.324	2852.431	Footpath	Missing Link	
		CH	14717.324	to	19333.349	4616.025	4.000	Earthen Road	
		CH	19333.349	to	19344.035	10.686	Chhara	Missing Link	
		CH	19344.035	to	20964.871	1620.836	3.000	Earthen Road	

		CH	20964.871	to	20973.654	8.783	1.654	Existing Bridge	LGED
		CH	20973.654	to	21030.301	56.648	3.000	Earthen Road	
		CH	21030.301	to	21035.704	5.403	1.064	Existing Bridge	LGED
		CH	21035.704	to	21212.085	176.381	3.000	Earthen Road	
		CH	21212.085	to	21217.312	5.227	1.051	Existing Bridge	LGED
		CH	21217.312	to	22772.354	1555.042	3.000	Earthen Road	
		CH	22772.354	to	22886.256	113.902	1.500	RCC Road	LGED
		CH	22886.256	to	22952.760	66.505	3.000	Earthen Road	LGED
		CH	22952.760	to	22956.183	3.422	Chara	Missing Link	
		CH	22956.183	to	33468.496	10512.314	2.833	Earthen Road	
		CH	33468.496	to	33509.626	41.130	Chhara	Missing Link	
		CH	33509.626	to	39587.275	6077.649	1.500	Earthen Road	
		CH	39587.275	to	39815.599	228.324	Footpath	Missing Link	
		CH	39815.599	to	40106.141	290.542	5.694	Existing Bridge	LGED
		CH	40106.141	to	47788.051	7681.910	3.548	HBB Road	LGED
		CH	47788.051	to	47918.691	130.640	4.310	Existing Bridge	LGED
		CH	47918.691	to	48183.769	265.079	5.370	HBB Road	LGED
		CH	48183.769	to	48323.886	140.116	5.370	Existing Bridge	LGED
		CH	48323.886	to	49100.000	776.114	2.423	HBB Road	LGED
Total Length (m)						**49100.000**			

Summary	Earthen Road (m)	32713.120
	Pavement Road (m)	674.670
	RCC Road (m)	113.902
	Bridge (m)	645.904
	Herring Bond Bricks Road(m)	11725.723
	Missing Link (m)	3226.682
Total Length (m)		**49100.000**

Inventory: Road Route 01 Bilaichhari to Juraichhari

Route ID	Location	Chainage (m)				Length (m)	Road/Bridge Width (m)	Existing Feature Types	Ownership
		CH-Start		To	CH-End				
Road Route -1	Bilaichhari to Juraichhari	CH	49100.000	to	50153.721	1053.721	3.217	HBB Road	LGED
		CH	50153.721	to	50841.620	687.899	3.000	Earthen Road	LGED
		CH	50841.620	to	50970.015	128.395	Chhara	Chhara	
		CH	50970.015	to	51829.465	859.451	3.000	Earthen Road	
		CH	51829.465	to	51846.363	16.897	Chhara	Chhara	
		CH	51846.363	to	59896.056	8049.693	3.000	Earthen Road	
		CH	59896.056	to	59903.271	7.215	Chhara	Chhara	
		CH	59903.271	to	62201.521	2298.250	3.000	Earthen Road	
		CH	62201.521	to	62209.349	7.828	Chhara	Chhara	
		CH	62209.349	to	62971.533	762.184	3.110	Earthen Road	
		CH	62971.533	to	62978.156	6.623	Chhara	Chhara	
		CH	62978.156	to	64093.074	1114.918	3.000	Earthen Road	
		CH	64093.074	to	64095.938	2.865	4.056	Existing Culvert	LGED
		CH	64095.938	to	65335.951	1240.013	3.000	Earthen Road	
		CH	65335.951	to	65370.102	34.151	1.270	Wooden Bridge	

		CH	65370.102	to	65608.381	238.279	3.000	Earthen Road	
		CH	65608.381	to	65611.988	3.608	4.487	Existing Bridge	LGED
		CH	65611.988	to	66849.652	1237.663	3.100	Earthen Road	
		CH	66849.652	to	66855.339	5.687	Chhara	Chhara	
		CH	66855.339	to	68975.895	2120.556	3.000	Earthen Road	
		CH	68975.895	to	68994.628	18.733	Chhara	Chhara	
		CH	68994.628	to	70175.109	1180.481	2.960	Earthen Road	
		CH	70175.109	to	70183.944	8.835	Chhara	Chhara	
		CH	70183.944	to	72235.415	2051.472	3.000	Earthen Road	
		CH	72235.415	to	72270.324	34.909	Chhara	Chhara	
		CH	72270.324	to	77081.639	4811.315	3.000	Earthen Road	
		CH	77081.639	to	77089.830	8.191	2.870	Existing Bridge	LGED
		CH	77089.830	to	77231.353	141.523	3.000	Earthen Road	LGED
		CH	77231.353	to	77318.040	86.687	6.117	Existing Bridge	LGED
		CH	77318.040	to	77940.857	622.817	3.000	Earthen Road	LGED
		CH	77940.857	to	77947.520	6.663	6.235	Existing Bridge	LGED
		CH	77947.520	to	78536.433	588.914	3.000	Earthen Road	LGED
Total Length						**29436.433**			

Summary	Earthen Road (m)	28005.426
	Bridge (m)	142.165
	Herring Bond Bricks Road(m)	1053.721
	Missing Link (m)	235.121
Total Length (m)		**29436.433**

Road Route 01 Inventory: Juraichhari to Barkal

Route ID	Location	Chainage (m)				Length (m)	Road/Bridge Width (m)	Existing Feature Types	Ownership
		CH-Start		To	CH-End				
Road Route -1	Juraichhari to Barkal	CH	78536.433	to	78779.785	243.351	Chhara/Missing	Missing Link	
		CH	78779.785	to	78884.999	105.214	2.121	Earthen Road	
		CH	78884.999	to	78896.643	11.644	4.384	Existing Bridge	LGED
		CH	78896.643	to	78996.006	99.363	2.120	Earthen Road	
		CH	78996.006	to	79002.077	6.071	4.333	Existing Bridge	LGED
		CH	79002.077	to	79292.012	289.935	2.150	Earthen Road	
		CH	79292.012	to	79362.111	70.099	1.274	Existing Bridge	LGED
		CH	79362.111	to	80103.883	741.772	2.120	Earthen Road	
		CH	80103.883	to	80131.556	27.673	Chhara	Missing Link	
		CH	80131.556	to	83331.256	3199.700	2.120	Earthen Road	LGED
		CH	83331.256	to	83344.094	12.838	Chhara	Missing Link	
		CH	83344.094	to	84588.964	1244.870	2.120	Earthen Road	
		CH	84588.964	to	84599.817	10.853	Chhara	Missing Link	

		CH	84599.817	to	85156.797	556.980	2.12	Earthen Road	
		CH	85156.797	to	85384.711	227.914	River	River	
Total Length						**6848.278**			

Summary	Earthen Road (m)	6237.835
	Bridge (m)	87.813
	Missing Link (m)	522.630
Total Length (m)		**6848.278**

Road Route 01 Inventory: Barkal to Chhotohorina

Route ID	Location	Chainage (m)				Length (m)	Road/Bridge Width (m)	Existing Feature Types	Ownership
		CH-Start		To	CH-End				
Road Route -1	Barkal To Chotoharina	CH	85384.711	to	85414.863	30.152	Missing	Missing Link	
		CH	85414.863	to	86918.927	1504.064	3.000	Earthen Road	
		CH	86918.927	to	86936.825	17.898	Chhara	Missing Link	
		CH	86936.825	to	88126.540	1189.715	2.000	Earthen Road	
		CH	88126.540	to	88292.492	165.952	River	River	
		CH	88292.492	to	91720.015	3427.523	Marcy Land/Chhara	Missing Link	
		CH	91720.015	to	94291.406	2571.391	3.500	Earthen Road	
		CH	94291.406	to	95011.949	720.544	3.000	HBB Road	LGED
		CH	95011.949	to	95055.799	43.850	2.059	Existing Bridge	LGED
		CH	95055.799	to	95522.651	466.852	3.000	HBB Road	LGED
		CH	95522.651	to	95561.773	39.122	2.441	Existing Bridge	LGED
		CH	95561.773	to	95973.167	411.394	3.500	Earthen Road	
		CH	95973.167	to	95996.472	23.305	2.469	Existing Bridge	LGED
		CH	95996.472	to	97334.003	1337.531	3.500	Earthen Road	
		CH	97334.003	to	97461.519	127.516	River	River	
		CH	97461.519	to	97570.930	109.411	Missing	Missing Link	

		CH	97570.930	to	100182.114	2611.184	2.000	Earthen Road	
		CH	100182.114	to	100193.891	11.778	4.364	Existing Bridge	LGED
		CH	100193.891	to	100944.814	750.923	2.000	Earthen Road	
		CH	100944.814	to	100951.599	6.784	4.295	Existing Bridge	LGED
		CH	100951.599	to	101725.574	773.976	2.000	Earthen Road	
		CH	101725.574	to	101755.251	29.676	4.370	Existing Bridge	LGED
		CH	101755.251	to	103338.302	1583.052	2.000	Earthen Road	
		CH	103338.302	to	103361.763	23.461	4.273	Existing Bridge	LGED
		CH	103361.763	to	103481.112	119.349	2.000	Earthen Road	
		CH	103481.112	to	103489.055	7.943	4.272	Existing Bridge	LGED
		CH	103489.055	to	103709.674	220.619	2.000	Earthen Road	
		CH	103709.674	to	103736.249	26.575	3.096	Existing Bridge	LGED
		CH	103736.249	to	103960.805	224.556	2.000	Earthen Road	
		CH	103960.805	to	103987.271	26.466	3.109	Existing Bridge	LGED
		CH	103987.271	to	104069.610	82.339	2.000	Earthen Road	
		CH	104069.610	to	104081.493	11.883	4.298	Existing Bridge	LGED
		CH	104081.493	to	104845.704	764.210	2.000	Earthen Road	
		CH	104845.704	to	104855.780	10.076	4.295	Existing Bridge	LGED
		CH	104855.780	to	105377.157	521.377	2.000	Earthen Road	

		CH	105377.157	to	105408.733	31.575	1.601	Existing Bridge	LGED
		CH	105408.733	to	106305.600	896.867	2.000	Earthen Road	
		CH	106305.600	to	106321.598	15.998	4.331	Existing Bridge	LGED
		CH	106321.598	to	106463.144	141.546	2.000	Earthen Road	
		CH	106463.144	to	106495.148	32.003	Missing	Missing Link	
		CH	106495.148	to	106661.551	166.404	158.830	River	
Total Length						**21276.840**			

Summary	Earthen Road (m)	15704.092
	Bridge (m)	308.493
	Herring Bond Bricks Road(m)	1187.396
	Missing Link (m)	4076.859
Total Length (m)		**21276.840**

Road Route 01 Inventory: Chhotohorina to Theghamukh

Route ID	Location	Chainage (m)				Length (m)	Road/Bridge Width (m)	Existing Feature Types	Ownership
		CH-Start		TO	CH-End				
Road Route -1	Chotoharina To Thegamukh	CH	106661.551	to	106832.850	171.298	1.540	Earthen Road	
		CH	106832.850	to	106894.025	61.175	1.563	Existing Bridge	
		CH	106894.025	to	108226.548	1332.417	1.502	Earthen Road	
		CH	108226.548	to	108227.673	1.125	Chhara	Missing Link	
		CH	108227.673	to	113130.745	4903.072	1.500	Earthen Road	
		CH	113130.745	to	113160.170	29.425	Chhara	Missing Link	
		CH	113160.170	to	114148.386	988.216	1.502	Earthen Road	
		CH	114148.386	to	114166.531	18.145	1.854	Existing Bridge	LGED
		CH	114166.531	to	114304.224	137.693	1.502	Earthen Road	LGED
		CH	114304.224	to	114438.415	134.192	1.500	HBB Road	LGED
		CH	114438.415	to	114750.772	312.356	1.502	Earthen Road	LGED
Total Length						**8089.114**			

Summary	Earthen Road (m)	7845.053
	Bridge (m)	79.320
	Herring Bond Bricks Road(m)	134.192
	Missing Link (m)	30.550
Total Length (m)		**8089.114**

ANNEXURE 2.2 B

Multimodal Route Inventory: Chhotohorina to Thegamukh

Multimodal Route Inventory: Chhotohorina to Theghamukh

Route ID	Location	Chainage (m)				Length (m)	Road/Bridge Width (m)	Existing Feature Types	Ownership
		CH-Start		TO	CH-End				
Multimodal Route Road Part	Chotoharina to Thegamukh	CH	0.000	to	171.298	171.298	1.540	Earthen Road	
		CH	171.298	to	232.473	61.175	1.563	Existing Bridge	LGED
		CH	232.473	to	1564.891	1332.417	1.502	Earthen Road	
		CH	1564.891	to	1566.015	1.125	Chhara	Missing Link	
		CH	1566.015	to	6469.088	4903.072	1.500	Earthen Road	
		CH	6469.088	to	6498.513	29.425	Chhara	Missing Link	
		CH	6498.513	to	7486.729	988.216	1.502	Earthen Road	
		CH	7486.729	to	7504.873	18.145	1.854	Existing Bridge	LGED
		CH	7504.873	to	7642.566	137.693	1.502	Earthen Road	LGED
		CH	7642.566	to	7776.758	134.192	1.500	HBB Road	LGED
		CH	7776.758	to	8089.114	312.356	1.502	Earthen Road	LGED
Total Length						**8089.114**			

Summary	Earthen Road (m)	7845.053
	Bridge (m)	79.320
	Herring Bond Bricks Road(m)	134.192
	Missing Link (m)	30.550
Total Length (m)		**8089.114**

ANNEXURES OF

CHAPTER-2

Description of Existing Proposed Project Road and Existing Road Connecting Chittagong Port to Origin of Proposed Road Route/ Multimodal Route

ANNEXURES OF
CHAPTER 3
Traffic Analysis and Forecasts for Road and Multimodal Routes

Annexure 3.1

Diverted/Normal Traffic Projections on the Proposed Road

Yearly Traffic Projections for Rajosthai- Bilaichari New Road Section (Vehicles per day - both directions)											
Year	Heavy Truck	Medium Truck	Small Truck	Large Bus	Medium Bus	Micro Bus	Utility	Car	Auto-Rickshaw	Motor Cycle	Total - Motor Vehicles
2013 - Base Year	-	8	17	-	11	5	5	-	168	257	472
2020- 1st Year	-	9	20	-	12	6	6	-	188	289	530
2021	-	10	21	-	13	6	6	-	205	315	578
2022	-	11	23	-	15	7	7	-	224	344	630
2023	-	12	25	-	16	7	7	-	244	375	687
2024	-	13	28	-	17	8	8	-	266	408	749
2025	-	14	30	-	19	9	9	-	290	445	816
2026	-	16	33	-	21	10	10	-	320	491	899
2027	-	17	36	-	23	11	11	-	352	541	991
2028	-	19	40	-	25	12	12	-	388	596	1,092
2029	-	21	44	-	28	13	13	-	428	656	1,203
2030	-	23	49	-	31	14	14	-	471	723	1,325
2031	-	25	53	-	34	15	15	-	514	788	1,445
2032	-	27	58	-	37	17	17	-	560	859	1,575
2033	-	30	63	-	40	18	18	-	611	937	1,718
2034	-	33	69	-	44	20	20	-	666	1,022	1,873
2035	-	36	75	-	48	22	22	-	726	1,114	2,043
2036	-	39	82	-	52	24	24	-	792	1,215	2,227
2037	-	42	89	-	56	26	26	-	864	1,325	2,429
2038	-	46	98	-	62	28	28	-	942	1,445	2,648
2039	-	50	106	-	67	31	31	-	1,027	1,575	2,887
2040	-	55	116	-	73	34	34	-	1,120	1,718	3,148

Annexure 3.1/1

Yearly Traffic Projections for Bilaichari-Juraichari New Road Section (Vehicles per day - both directions)											
Year	Heavy Truck	Medium Truck	Small Truck	Large Bus	Medium Bus	Micro Bus	Utility	Car	Auto-Rickshaw	Motor Cycle	Total - Motor Vehicles
2013 - Base Year	0	8	18	0	11	5	5	0	173	266	487
2020- 1st Year	-	10	20	-	13	6	6	-	194	298	546
2021	-	10	22	-	14	6	6	-	212	325	596
2022	-	11	24	-	15	7	7	-	231	354	650
2023	-	12	26	-	16	8	8	-	252	387	708
2024	-	13	28	-	18	8	8	-	275	421	773
2025	-	15	31	-	20	9	9	-	300	460	842
2026	-	16	34	-	22	10	10	-	330	506	928
2027	-	18	38	-	24	11	11	-	364	558	1,022
2028	-	20	41	-	26	12	12	-	401	615	1,126
2029	-	22	46	-	29	13	13	-	441	677	1,241
2030	-	24	50	-	32	15	15	-	486	746	1,367
2031	-	26	55	-	35	16	16	-	530	813	1,491
2032	-	28	60	-	38	17	17	-	578	887	1,626
2033	-	31	65	-	41	19	19	-	630	967	1,772
2034	-	34	71	-	45	21	21	-	687	1,054	1,933
2035	-	37	78	-	49	22	22	-	749	1,150	2,107
2036	-	40	85	-	53	24	24	-	817	1,254	2,298
2037	-	44	92	-	58	27	27	-	891	1,367	2,506
2038	-	48	101	-	64	29	29	-	972	1,491	2,732
2039	-	52	110	-	69	32	32	-	1,059	1,625	2,979
2040	-	57	120	-	76	35	35	-	1,155	1,772	3,249

Annexure 3.1/2

Yearly Traffic Projections for Juraichari -Thegamukh New Road Section (Vehicles per day - both directions)											
Year	Heavy Truck	Medium Truck	Small Truck	Large Bus	Medium Bus	Micro Bus	Utility	Car	Auto-Rickshaw	Motor Cycle	Total - Motor Vehicles
2013 - Base Year	0	11	24	0	15	7	7	0	232	355	651
2020- 1st Year	-	13	27	-	17	8	8	-	260	399	731
2021	-	14	29	-	19	8	8	-	283	435	797
2022	-	15	32	-	20	9	9	-	309	474	869
2023	-	17	35	-	22	10	10	-	337	517	947
2024	-	18	38	-	24	11	11	-	367	563	1,033
2025	-	20	41	-	26	12	12	-	400	614	1,126
2026	-	21	45	-	29	13	13	-	437	670	1,228
2027	-	23	49	-	31	14	14	-	476	730	1,339
2028	-	26	54	-	34	16	16	-	525	805	1,475
2029	-	28	60	-	38	17	17	-	578	887	1,625
2030	-	31	66	-	42	19	19	-	637	977	1,790
2031	-	34	72	-	45	21	21	-	694	1,065	1,952
2032	-	37	78	-	50	23	23	-	757	1,161	2,129
2033	-	40	85	-	54	25	25	-	825	1,266	2,321
2034	-	44	93	-	59	27	27	-	900	1,381	2,531
2035	-	48	102	-	64	29	29	-	981	1,505	2,760
2036	-	52	111	-	70	32	32	-	1,070	1,642	3,009
2037	-	57	121	-	76	35	35	-	1,167	1,790	3,281
2038	-	62	132	-	83	38	38	-	1,272	1,952	3,578
2039	-	68	144	-	91	42	42	-	1,387	2,128	3,901
2040	-	74	157	-	99	45	45	-	1,513	2,321	4,254

Annexure 3.1 A

Traffic Projections on the New Road including Generated Traffic (20% of Normal/Diverted traffic)

Yearly Traffic Projections for Rajosthai- Bilaichari New Road Section (Vehicles per day - both directions)

Year	Heavy Truck	Medium Truck	Small Truck	Large Bus	Medium Bus	Micro Bus	Utility	Car	Auto-Rickshaw	Motor Cycle	Total - Motor Vehicles
2013 - Base Year	-	8	17	-	11	5	5	-	168	257	472
2020- 1st Year	-	11	23	-	15	7	7	-	226	347	636
2021	-	12	26	-	16	7	7	-	246	378	693
2022	-	13	28	-	18	8	8	-	269	412	756
2023	-	14	30	-	19	9	9	-	293	450	824
2024	-	16	33	-	21	10	10	-	320	490	898
2025	-	17	36	-	23	10	10	-	348	534	980
2026	-	19	39	-	25	11	11	-	380	583	1,068
2027	-	21	43	-	27	13	13	-	419	642	1,177
2028	-	23	48	-	30	14	14	-	461	707	1,297
2029	-	25	53	-	33	15	15	-	508	779	1,428
2030	-	27	58	-	37	17	17	-	560	859	1,574
2031	-	30	64	-	40	18	18	-	617	946	1,734
2032	-	33	70	-	44	20	20	-	672	1,031	1,891
2033	-	36	76	-	48	22	22	-	733	1,125	2,061
2034	-	39	83	-	52	24	24	-	799	1,226	2,248
2035	-	43	90	-	57	26	26	-	872	1,337	2,451
2036	-	47	98	-	62	28	28	-	950	1,458	2,673
2037	-	51	107	-	68	31	31	-	1,036	1,590	2,914
2038	-	55	117	-	74	34	34	-	1,130	1,734	3,178
2039	-	60	128	-	81	37	37	-	1,232	1,890	3,465
2040	-	66	139	-	88	40	40	-	1,344	2,061	3,778

Annexure 3.1 A/1

Yearly Traffic Projections for Bilaichari-Juraichari New Road Section (Vehicles per day - both directions)											
Year	Heavy Truck	Medium Truck	Small Truck	Large Bus	Medium Bus	Micro Bus	Utility	Car	Auto-Rickshaw	Motor Cycle	Total - Motor Vehicles
2013 - Base Year	0	8	18	0	11	5	5	0	173	266	487
2020- 1st Year	-	11	24	-	15	7	7	-	233	358	656
2021	-	12	26	-	17	8	8	-	254	390	715
2022	-	14	29	-	18	8	8	-	277	425	780
2023	-	15	31	-	20	9	9	-	302	464	850
2024	-	16	34	-	22	10	10	-	330	506	927
2025	-	18	37	-	24	11	11	-	359	551	1,011
2026	-	19	41	-	26	12	12	-	392	601	1,102
2027	-	21	45	-	28	13	13	-	432	662	1,214
2028	-	23	49	-	31	14	14	-	476	730	1,338
2029	-	26	54	-	34	16	16	-	524	804	1,474
2030	-	28	60	-	38	17	17	-	577	886	1,624
2031	-	31	66	-	42	19	19	-	636	976	1,789
2032	-	34	72	-	45	21	21	-	694	1,064	1,951
2033	-	37	78	-	49	23	23	-	756	1,160	2,127
2034	-	40	85	-	54	25	25	-	825	1,265	2,319
2035	-	44	93	-	59	27	27	-	899	1,380	2,529
2036	-	48	102	-	64	29	29	-	981	1,504	2,758
2037	-	52	111	-	70	32	32	-	1,069	1,640	3,007
2038	-	57	121	-	76	35	35	-	1,166	1,789	3,279
2039	-	62	132	-	83	38	38	-	1,271	1,950	3,575
2040	-	68	144	-	91	42	42	-	1,386	2,127	3,898

Annexure 3.1 A/2

Yearly Traffic Projections for Juraichari-Thegamukh New Road Section (Vehicles per day - both directions)											
Year	Heavy Truck	Medium Truck	Small Truck	Large Bus	Medium Bus	Micro Bus	Utility	Car	Auto-Rickshaw	Motor Cycle	Total - Motor Vehicles
2013 - Base Year	0	11	24	0	15	7	7	0	232	355	651
2020- 1st Year	-	15	32	-	20	9	9	-	312	478	877
2021	-	17	35	-	22	10	10	-	340	521	956
2022	-	18	38	-	24	11	11	-	371	569	1,042
2023	-	20	42	-	26	12	12	-	404	620	1,137
2024	-	22	46	-	29	13	13	-	441	676	1,239
2025	-	24	50	-	31	14	14	-	481	737	1,351
2026	-	26	54	-	34	16	16	-	524	804	1,473
2027	-	28	60	-	38	17	17	-	577	886	1,623
2028	-	31	66	-	42	19	19	-	636	976	1,788
2029	-	34	73	-	46	21	21	-	701	1,075	1,970
2030	-	38	80	-	50	23	23	-	772	1,184	2,171
2031	-	42	88	-	56	25	25	-	850	1,305	2,391
2032	-	45	96	-	61	28	28	-	927	1,423	2,608
2033	-	50	105	-	66	30	30	-	1,011	1,551	2,843
2034	-	54	114	-	72	33	33	-	1,103	1,691	3,100
2035	-	59	124	-	79	36	36	-	1,202	1,844	3,381
2036	-	64	136	-	86	39	39	-	1,311	2,011	3,686
2037	-	70	148	-	93	43	43	-	1,429	2,193	4,019
2038	-	76	161	-	102	47	47	-	1,559	2,391	4,383
2039	-	83	176	-	111	51	51	-	1,699	2,607	4,779
2040	-	91	192	-	121	56	56	-	1,853	2,843	5,211

Annexure 3 B

Total Traffic Projections including Cross-Border Traffic

Yearly Traffic Projections for Rajosthai- Bilaichari New Road Section (Vehicles per day - both directions)

Year	Heavy Truck	Medium Truck	Small Truck	Large Bus	Medium Bus	Micro Bus	Utility	Car	Auto-Rickshaw	Motor Cycle	Total - Motor Vehicles
2013 - Base Year	-	8	17	-	11	5	5	-	168	257	472
2020- 1st Year	19	76	23	-	38	7	184	158	226	347	1,078
2021	20	81	26	-	40	7	195	167	246	378	1,162
2022	21	86	28	-	43	8	207	178	269	412	1,252
2023	23	92	30	-	47	9	220	188	293	450	1,350
2024	24	98	33	-	50	10	233	199	320	490	1,457
2025	25	104	36	-	54	10	247	211	348	534	1,571
2026	27	111	39	-	57	11	262	224	380	583	1,695
2027	29	118	43	-	62	13	279	238	419	642	1,842
2028	30	126	48	-	67	14	296	252	461	707	2,001
2029	32	135	53	-	72	15	314	267	508	779	2,175
2030	34	144	58	-	78	17	334	283	560	859	2,365
2031	36	154	64	-	84	18	354	300	617	946	2,573
2032	38	164	70	-	90	20	376	318	672	1,031	2,780
2033	41	175	76	-	97	22	400	337	733	1,125	3,004
2034	43	186	83	-	104	24	424	357	799	1,226	3,247
2035	46	199	90	-	112	26	450	379	872	1,337	3,510
2036	48	212	98	-	121	28	478	401	950	1,458	3,795
2037	51	226	107	-	130	31	508	425	1,036	1,590	4,104
2038	54	241	117	-	140	34	539	451	1,130	1,734	4,439
2039	57	257	128	-	150	37	572	478	1,232	1,890	4,802
2040	61	274	139	-	162	40	608	507	1,344	2,061	5,196

Annexure 3 B/1

Yearly Traffic Projections for Bilaichari-Juraichari New Road Section (Vehicles per day - both directions)											
Year	Heavy Truck	Medium Truck	Small Truck	Large Bus	Medium Bus	Micro Bus	Utility	Car	Auto-Rickshaw	Motor Cycle	Total - Motor Vehicles
2013 - Base Year	0	8	18	0	11	5	5	0	173	266	487
2020- 1st Year	19	76	24	-	38	7	184	158	233	358	1,098
2021	20	81	26	-	41	8	195	167	254	390	1,184
2022	21	87	29	-	44	8	207	178	277	425	1,276
2023	23	92	31	-	47	9	220	188	302	464	1,377
2024	24	98	34	-	51	10	233	199	330	506	1,485
2025	25	105	37	-	54	11	248	211	359	551	1,602
2026	27	111	41	-	58	12	263	224	392	601	1,729
2027	29	119	45	-	63	13	279	238	432	662	1,879
2028	30	127	49	-	68	14	296	252	476	730	2,042
2029	32	136	54	-	73	16	315	267	524	804	2,221
2030	34	145	60	-	79	17	334	283	577	886	2,415
2031	36	155	66	-	85	19	355	300	636	976	2,628
2032	38	165	72	-	92	21	377	318	694	1,064	2,840
2033	41	176	78	-	99	23	400	337	756	1,160	3,070
2034	43	187	85	-	106	25	425	357	825	1,265	3,319
2035	46	200	93	-	114	27	451	379	899	1,380	3,588
2036	48	213	102	-	123	29	479	401	981	1,504	3,880
2037	51	227	111	-	132	32	509	425	1,069	1,640	4,197
2038	54	243	121	-	142	35	540	451	1,166	1,789	4,540
2039	57	259	132	-	153	38	574	478	1,271	1,950	4,912
2040	61	276	144	-	164	42	609	507	1,386	2,127	5,316

Annexure 3 B/2

Yearly Traffic Projections for Juraichari-Thegamukh New Road Section (Vehicles per day - both directions)											
Year	Heavy Truck	Medium Truck	Small Truck	Large Bus	Medium Bus	Micro Bus	Utility	Car	Auto-Rickshaw	Motor Cycle	Total - Motor Vehicles
2013 - Base Year	0	11	24	0	15	7	7	0	232	355	651
2020- 1st Year	19	80	32	-	43	9	186	158	312	478	1,319
2021	20	86	35	-	47	10	198	167	340	521	1,424
2022	21	91	38	-	50	11	210	178	371	569	1,539
2023	23	97	42	-	54	12	223	188	404	620	1,663
2024	24	104	46	-	58	13	237	199	441	676	1,797
2025	25	111	50	-	62	14	251	211	481	737	1,943
2026	27	118	54	-	67	16	267	224	524	804	2,100
2027	29	126	60	-	72	17	283	238	577	886	2,288
2028	30	135	66	-	78	19	301	252	636	976	2,493
2029	32	144	73	-	85	21	320	267	701	1,075	2,717
2030	34	154	80	-	92	23	340	283	772	1,184	2,962
2031	36	165	88	-	99	25	361	300	850	1,305	3,230
2032	38	176	96	-	107	28	384	318	927	1,423	3,497
2033	41	188	105	-	115	30	408	337	1,011	1,551	3,786
2034	43	201	114	-	124	33	433	357	1,103	1,691	4,100
2035	46	215	124	-	134	36	460	379	1,202	1,844	4,440
2036	48	229	136	-	144	39	489	401	1,311	2,011	4,809
2037	51	245	148	-	155	43	519	425	1,429	2,193	5,210
2038	54	262	161	-	168	47	552	451	1,559	2,391	5,644
2039	57	280	176	-	181	51	586	478	1,699	2,607	6,116
2040	61	299	192	-	195	56	623	507	1,853	2,843	6,629

Annexure 3.2

Normal Traffic Projections on Existing Chittagong - Rajosthali Road											
Yearly Traffic Projections for Chandraghona - Rajosthali Existing Road Section (Vehicles per day - both directions)											
Year	Heavy Truck	Medium Truck	Small Truck	Large Bus	Medium Bus	Micro Bus	Utility	Car	Auto-Rickshaw	Motor Cycle	Total - Motor Vehicles
2013 - Base Year	-	18	38	-	24	11	11	-	367	563	1,032
2020- 1st Year	-	29	61	-	39	18	18	-	589	904	1,657
2021	-	31	65	-	41	19	19	-	631	967	1,773
2022	-	33	70	-	44	20	20	-	675	1,035	1,897
2023	-	35	75	-	47	22	22	-	722	1,108	2,030
2024	-	38	80	-	51	23	23	-	772	1,185	2,172
2025	-	41	86	-	54	25	25	-	827	1,268	2,324
2026	-	43	92	-	58	27	27	-	884	1,357	2,487
2027	-	46	98	-	62	28	28	-	946	1,452	2,661
2028	-	50	105	-	66	30	30	-	1,013	1,553	2,847
2029	-	53	112	-	71	32	32	-	1,083	1,662	3,047
2030	-	57	120	-	76	35	35	-	1,159	1,778	3,260
2031	-	61	128	-	81	37	37	-	1,240	1,903	3,488
2032	-	65	137	-	87	40	40	-	1,327	2,036	3,732
2033	-	70	147	-	93	43	43	-	1,420	2,179	3,994
2034	-	75	157	-	99	46	46	-	1,520	2,331	4,273
2035	-	80	168	-	106	49	49	-	1,626	2,494	4,572
2036	-	85	180	-	114	52	52	-	1,740	2,669	4,892
2037	-	91	193	-	122	56	56	-	1,862	2,856	5,235
2038	-	98	206	-	130	60	60	-	1,992	3,056	5,601
2039	-	105	221	-	139	64	64	-	2,131	3,270	5,993
2040	-	112	236	-	149	68	68	-	2,280	3,498	6,413

Annexure 3.2/1

Yearly Traffic Projections for Chittagong -Chandraghona Existing Road Section (Vehicles per day - both directions)											
Year	Heavy Truck	Medium Truck	Small Truck	Large Bus	Medium Bus	Micro Bus	Utility	Car	Auto-Rickshaw	Motor Cycle	Total - Motor Vehicles
2013 - Base Year	1	238	224	146	97	203	52	164	4,453	838	6,416
2020- 1st Year	1	255	240	156	104	217	56	175	4,765	897	6,865
2021	1	272	256	167	111	232	60	188	5,098	959	7,346
2022	1	292	274	179	119	249	64	201	5,455	1,027	7,860
2023	1	312	294	191	127	266	68	215	5,837	1,098	8,410
2024	1	334	314	205	136	285	73	230	6,246	1,175	8,999
2025	2	357	336	219	146	305	78	246	6,683	1,258	9,629
2026	2	382	360	234	156	326	84	263	7,151	1,346	10,303
2027	2	409	385	251	167	349	89	282	7,651	1,440	11,024
2028	2	438	412	268	178	373	96	302	8,187	1,541	11,796
2029	2	468	441	287	191	399	102	323	8,760	1,648	12,621
2030	2	501	471	307	204	427	109	345	9,373	1,764	13,505
2031	2	536	504	329	218	457	117	369	10,029	1,887	14,450
2032	2	574	540	352	234	489	125	395	10,731	2,019	15,462
2033	3	614	578	376	250	523	134	423	11,482	2,161	16,544
2034	3	657	618	403	268	560	143	452	12,286	2,312	17,702
2035	3	703	661	431	286	599	154	484	13,146	2,474	18,941
2036	3	752	708	461	306	641	164	518	14,066	2,647	20,267
2037	3	804	757	493	328	686	176	554	15,051	2,832	21,686
2038	4	861	810	528	351	734	188	593	16,104	3,031	23,204
2039	4	921	867	565	375	786	201	635	17,232	3,243	24,828
2040	4	1,013	953	621	413	864	221	698	18,955	3,567	27,311

Annexure 3.2 A

Traffic Projections including Cross-Border Traffic

Yearly Traffic Projections for Chandraghona - Rajosthali Existing Road Section (Vehicles per day - both directions)

Year	Heavy Truck	Medium Truck	Small Truck	Large Bus	Medium Bus	Micro Bus	Utility	Car	Auto-Rickshaw	Motor Cycle	Total - Motor Vehicles
2013 - Base Year	-	18	38	-	24	11	11	-	367	563	1,032
2020- 1st Year	19	94	61	-	62	18	195	158	589	904	2,099
2021	20	100	65	-	66	19	207	167	631	967	2,242
2022	21	106	70	-	70	20	219	178	675	1,035	2,394
2023	23	113	75	-	75	22	232	188	722	1,108	2,557
2024	24	120	80	-	80	23	247	199	772	1,185	2,730
2025	25	128	86	-	85	25	262	211	827	1,268	2,916
2026	27	136	92	-	90	27	278	224	884	1,357	3,114
2027	29	144	98	-	96	28	295	238	946	1,452	3,326
2028	30	153	105	-	103	30	312	252	1,013	1,553	3,552
2029	32	163	112	-	110	32	332	267	1,083	1,662	3,793
2030	34	173	120	-	117	35	352	283	1,159	1,778	4,051
2031	36	184	128	-	125	37	373	300	1,240	1,903	4,327
2032	38	196	137	-	133	40	396	318	1,327	2,036	4,622
2033	41	208	147	-	142	43	420	337	1,420	2,179	4,936
2034	43	221	157	-	151	46	446	357	1,520	2,331	5,272
2035	46	236	168	-	161	49	473	379	1,626	2,494	5,631
2036	48	250	180	-	172	52	502	401	1,740	2,669	6,015
2037	51	266	193	-	184	56	532	425	1,862	2,856	6,425
2038	54	283	206	-	196	60	565	451	1,992	3,056	6,863
2039	57	301	221	-	209	64	599	478	2,131	3,270	7,331
2040	61	320	236	-	223	68	636	507	2,280	3,498	7,830

Annexure 3.2 A/1

Yearly Traffic Projections for Chittagong -Chandraghona Existing Road Section (Vehicles per day - both directions)											
Year	Heavy Truck	Medium Truck	Small Truck	Large Bus	Medium Bus	Micro Bus	Utility	Car	Auto-Rickshaw	Motor Cycle	Total - Motor Vehicles
2013 - Base Year	1	238	224	146	97	203	52	164	4,453	838	6,416
2020- 1st Year	20	320	240	156	127	217	233	333	4,765	897	7,307
2021	21	341	256	167	135	232	247	355	5,098	959	7,814
2022	23	365	274	179	145	249	263	378	5,455	1,027	8,357
2023	24	389	294	191	155	266	279	403	5,837	1,098	8,936
2024	25	416	314	205	165	285	296	429	6,246	1,175	9,557
2025	27	444	336	219	176	305	315	458	6,683	1,258	10,220
2026	29	474	360	234	188	326	335	487	7,151	1,346	10,930
2027	30	507	385	251	201	349	355	519	7,651	1,440	11,688
2028	32	541	412	268	215	373	378	553	8,187	1,541	12,500
2029	34	578	441	287	230	399	401	590	8,760	1,648	13,368
2030	36	617	471	307	245	427	426	628	9,373	1,764	14,296
2031	38	659	504	329	262	457	453	669	10,029	1,887	15,289
2032	41	704	540	352	280	489	481	713	10,731	2,019	16,351
2033	43	752	578	376	299	523	512	760	11,482	2,161	17,487
2034	46	804	618	403	320	560	544	810	12,286	2,312	18,701
2035	48	858	661	431	341	599	578	863	13,146	2,474	20,000
2036	51	917	708	461	365	641	614	919	14,066	2,647	21,390
2037	55	979	757	493	390	686	652	980	15,051	2,832	22,876
2038	58	1,046	810	528	416	734	693	1,044	16,104	3,031	24,465
2039	61	1,118	867	565	445	786	737	1,113	17,232	3,243	26,165
2040	65	1,222	953	621	487	864	789	1,205	18,955	3,567	28,728

ANNEXURE
Relevant Photographs of Traffic Survey

District: Chittagong	**Program: Traffic Survey**
Venue: Chandraghona To Chittagong Road (Rangunia), Chittagong	**Date:10-12-2015**

District: Chittagong	**Program: Traffic Survey**
Venue: Chandraghona To Chittagong Road (Rangunia), Chittagong	**Date:10-12-2015**

District: Rangamati	**Program: Traffic Survey**
Location: Rajostholi Road (Bangalhalia), Rangamati	**Date: 19-12-2015**

District: Rangamati	**Program: Traffic Survey**
Location: Rangamati Road (Ghagra), Rangamati	**Date: 21-12-2015**

ANNEXURES OF

CHAPTER 5

Engineering Surveys and Investigations

ANNEXURE -5.1

Inventory & Condition Survey of Existing Structures

(Bridges & Culverts)

CONSULTANCY SERVICE FOR FEASIBILITY, DETAIL SURVEY AND DESIGN OF CHITTAGONG HILL TRACT CONNECTIVITY CONNECTING THEGAMUKH AND CHITTAGONG PORT, RETF PROJECT

Inventory & Condition Survey of Existing Structures (Bridges & culverts)

ProjectName : _____ Location:_____Date of Survey: _____

Surveyor's Representative: _____ Consultant's Representative: _____Surveyedby: _____

Str. No.	**Locations (Chainage)**	**Existing Structure Description (length, span, slab/girder type, carriage-way width, total width, abutment & pier type)**	**River/Canal Data**				**Condition of Existing Structure**				**Any scour / erosion / protection work exists at canal bank Yes**/No	**Recommendation**
			Bank / Bank Distance. (m) Top / Bottom	Max. depth from exist Road top/ HFL (m)	River/ Canal geometry Straight / bend	Existing or proposed free board from HFL	Deck slab / girder / bearings (Details)	Railings / wearing course	Abutment / wing wall (Details)	Pier / vertical wall (Details)		Replace / repair / retain (For replace propose type / length/vent/size)

Note: Include all existing structures, canal/river gap, additional drainage structures (if required) with details information Provide one hand sketch map of proposed road alignment showing all the structures as listed above with their location

Annexure 5.2 List of Traverse Points and Bench Marks for Road And Multimodal Alignment

Benchmarks List of Road Route

ID	Easting	Northing	Benchmarks
PBM	423284.274	2473509.082	PBM-1
1	423091.601	2473513.301	SBM/TBM
2	423135.889	2473531.831	SBM/TBM
3	423167.954	2473527.223	SBM/TBM
4	423185.052	2473539.591	SBM/TBM
5	423225.864	2473584.304	SBM/TBM
6	423270.521	2473635.726	SBM/TBM
7	423302.034	2473735.198	SBM/TBM
8	423340.745	2473867.939	SBM/TBM
9	423369.083	2473907.402	SBM/TBM
10	423337.136	2473987.689	SBM/TBM
11	423319.325	2474059.319	SBM/TBM
12	423443.454	2474108.234	SBM/TBM
13	423464.658	2474083.987	SBM/TBM
14	423504.688	2474045.371	SBM/TBM
15	423751.359	2474099.240	SBM/TBM
16	423788.742	2474152.401	SBM/TBM
17	423829.662	2474203.187	SBM/TBM
18	423863.392	2474228.610	SBM/TBM
19	423972.117	2474262.194	SBM/TBM
20	424042.861	2474229.082	SBM/TBM
21	424139.849	2474234.223	SBM/TBM
22	424198.160	2474251.996	SBM/TBM
23	424254.499	2474246.779	SBM/TBM
24	424302.796	2474262.134	SBM/TBM
25	424366.425	2474297.399	SBM/TBM
26	424424.407	2474301.667	SBM/TBM
27	424473.403	2474271.703	SBM/TBM
28	424493.889	2474243.305	SBM/TBM
29	424508.055	2474204.506	SBM/TBM
30	424560.648	2474166.119	SBM/TBM
31	424618.932	2474170.058	SBM/TBM
32	424693.405	2474129.068	SBM/TBM
33	424786.811	2474075.990	SBM/TBM
34	424838.403	2474078.014	SBM/TBM
35	424870.696	2474037.248	SBM/TBM
36	424989.447	2473970.961	SBM/TBM
37	425093.337	2473904.003	SBM/TBM
38	425147.532	2473900.217	SBM/TBM
39	425198.607	2473918.583	SBM/TBM
40	425245.531	2474018.980	SBM/TBM
41	425292.455	2474067.261	SBM/TBM
42	425371.142	2474058.258	SBM/TBM
43	425416.744	2473992.010	SBM/TBM
44	425482.826	2473991.912	SBM/TBM
45	425590.515	2473920.544	SBM/TBM
46	425634.701	2473935.945	SBM/TBM
47	425779.833	2473998.636	SBM/TBM
48	425828.292	2474039.917	SBM/TBM
49	425942.039	2474114.272	SBM/TBM

ID	Easting	Northing	Benchmarks
50	425858.270	2474409.980	SBM/TBM
51	425775.630	2474625.220	SBM/TBM
52	425748.120	2474657.560	SBM/TBM
53	425771.410	2474677.580	SBM/TBM
54	425841.630	2474672.560	SBM/TBM
55	425860.280	2474678.840	SBM/TBM
56	425864.050	2474689.480	SBM/TBM
57	425873.950	2474757.440	SBM/TBM
58	425911.190	2474790.010	SBM/TBM
59	425930.050	2474826.230	SBM/TBM
60	425922.850	2474886.470	SBM/TBM
61	425938.410	2474921.090	SBM/TBM
62	425957.560	2474935.650	SBM/TBM
63	426044.750	2474974.860	SBM/TBM
64	426160.280	2474923.020	SBM/TBM
65	426207.690	2474909.280	SBM/TBM
66	426307.350	2474923.460	SBM/TBM
67	426334.060	2474927.660	SBM/TBM
68	426397.430	2474897.520	SBM/TBM
69	426429.920	2474888.900	SBM/TBM
70	426459.940	2474850.970	SBM/TBM
71	426539.350	2474863.890	SBM/TBM
72	426605.100	2474896.280	SBM/TBM
73	426631.030	2474957.450	SBM/TBM
74	426661.190	2475001.650	SBM/TBM
75	426698.160	2475015.540	SBM/TBM
76	426750.710	2475013.510	SBM/TBM
77	426796.240	2475009.380	SBM/TBM
78	427010.950	2474936.370	SBM/TBM
79	427052.240	2474952.590	SBM/TBM
80	427084.600	2474992.690	SBM/TBM
81	427239.870	2475073.680	SBM/TBM
82	427273.730	2475030.580	SBM/TBM
83	427353.460	2475023.100	SBM/TBM
84	427404.030	2475021.600	SBM/TBM
85	427468.010	2475012.360	SBM/TBM
86	427508.200	2475000.340	SBM/TBM
87	427643.630	2474942.780	SBM/TBM
88	427795.400	2474851.460	SBM/TBM
89	427961.230	2474764.310	SBM/TBM
90	428052.060	2474654.430	SBM/TBM
91	428247.940	2474439.580	SBM/TBM
92	428293.210	2474205.920	SBM/TBM
93	428684.730	2473810.190	SBM/TBM
94	428720.620	2473493.080	SBM/TBM
95	428737.380	2473181.530	SBM/TBM
96	428841.920	2473031.310	SBM/TBM
97	428932.390	2472965.690	SBM/TBM
98	428957.610	2472977.570	SBM/TBM
99	429365.960	2472751.830	SBM/TBM
100	429330.350	2472685.620	SBM/TBM
101	429380.070	2472485.780	SBM/TBM

ID	Easting	Northing	Benchmarks
102	429439.230	2472384.530	SBM/TBM
103	429561.060	2472279.440	SBM/TBM
104	429603.600	2472052.340	SBM/TBM
105	429489.810	2471841.880	SBM/TBM
106	429479.830	2471780.550	SBM/TBM
107	429782.000	2471124.760	SBM/TBM
108	429868.549	2471050.677	SBM/TBM
109	430039.108	2470869.024	SBM/TBM
110	430266.985	2470609.112	SBM/TBM
111	430550.592	2470474.580	SBM/TBM
112	430804.924	2470472.385	SBM/TBM
113	431307.669	2470496.813	SBM/TBM
114	431855.925	2470428.786	SBM/TBM
115	432193.785	2470442.261	SBM/TBM
116	432327.643	2470438.216	SBM/TBM
117	432421.208	2470508.254	SBM/TBM
118	432916.024	2470821.153	SBM/TBM
119	433313.676	2471334.823	SBM/TBM
120	433515.713	2471375.348	SBM/TBM
121	433897.942	2471617.189	SBM/TBM
122	434027.310	2471669.681	SBM/TBM
123	434254.995	2471847.777	SBM/TBM
124	434129.522	2471771.217	SBM/TBM
125	434346.505	2471902.837	SBM/TBM
126	434428.863	2471964.587	SBM/TBM
127	434842.744	2472276.523	SBM/TBM
128	435055.784	2472385.852	SBM/TBM
129	435061.610	2472494.496	SBM/TBM
130	435190.046	2472649.260	SBM/TBM
131	435260.055	2472552.104	SBM/TBM
132	435276.345	2472615.990	SBM/TBM
133	435365.820	2472692.149	SBM/TBM
134	435383.675	2472681.734	SBM/TBM
135	435469.115	2472695.169	SBM/TBM
136	435487.567	2472672.557	SBM/TBM
137	435538.125	2472682.905	SBM/TBM
138	435588.576	2472744.737	SBM/TBM
139	435574.011	2472827.396	SBM/TBM
140	435600.226	2472863.214	SBM/TBM
141	435634.202	2472901.989	SBM/TBM
142	435671.171	2472915.959	SBM/TBM
143	435760.686	2472954.307	SBM/TBM
144	435783.773	2472962.397	SBM/TBM
145	435869.353	2472940.365	SBM/TBM
146	435963.662	2472859.359	SBM/TBM
147	436072.771	2472819.159	SBM/TBM
148	436009.763	2472847.224	SBM/TBM
149	436091.886	2472797.884	SBM/TBM
150	436113.660	2472730.634	SBM/TBM
151	436180.116	2472677.862	SBM/TBM
152	436317.640	2472716.298	SBM/TBM
153	436420.110	2472768.942	SBM/TBM

ID	Easting	Northing	Benchmarks
154	436437.930	2472783.630	SBM/TBM
155	436522.983	2472769.419	SBM/TBM
156	436588.485	2472765.932	SBM/TBM
157	436625.551	2472749.632	SBM/TBM
158	436648.540	2472744.958	SBM/TBM
159	436812.550	2472727.790	SBM/TBM
160	436870.588	2472711.382	SBM/TBM
161	436897.236	2472707.301	SBM/TBM
162	436979.743	2472674.442	SBM/TBM
163	437071.942	2472634.297	SBM/TBM
164	437107.304	2472604.204	SBM/TBM
165	437141.435	2472597.431	SBM/TBM
166	437178.023	2472583.504	SBM/TBM
167	437225.961	2472551.316	SBM/TBM
168	437296.832	2472555.610	SBM/TBM
169	437332.321	2472560.131	SBM/TBM
170	437344.349	2472559.954	SBM/TBM
171	438010.129	2472677.899	SBM/TBM
172	438092.503	2472836.849	SBM/TBM
173	438204.701	2472986.126	SBM/TBM
174	438306.927	2473186.936	SBM/TBM
175	438533.167	2473291.127	SBM/TBM
176	438547.118	2473281.416	SBM/TBM
177	438555.736	2473276.574	SBM/TBM
178	438588.858	2473314.923	SBM/TBM
179	438589.290	2473387.529	SBM/TBM
180	438548.946	2473600.001	SBM/TBM
181	438515.860	2473656.000	SBM/TBM
182	438490.330	2473660.005	SBM/TBM
183	438454.286	2473659.185	SBM/TBM
184	438444.820	2473695.500	SBM/TBM
185	438415.486	2473760.236	SBM/TBM
186	438402.349	2473791.437	SBM/TBM
187	438338.398	2473788.282	SBM/TBM
188	438297.834	2473803.369	SBM/TBM
189	438284.644	2473822.340	SBM/TBM
190	438244.563	2473843.472	SBM/TBM
191	438245.687	2473876.037	SBM/TBM
192	438232.239	2473942.716	SBM/TBM
193	438176.191	2473975.099	SBM/TBM
194	438121.092	2474083.771	SBM/TBM
195	438095.747	2474104.394	SBM/TBM
196	438064.445	2474186.618	SBM/TBM
197	438072.130	2474306.406	SBM/TBM
198	438025.733	2474410.793	SBM/TBM
199	438038.720	2474435.523	SBM/TBM
200	438046.964	2474448.015	SBM/TBM
201	438040.823	2474596.683	SBM/TBM
202	438036.863	2474675.834	SBM/TBM
203	437987.454	2474710.120	SBM/TBM
204	437940.051	2474693.447	SBM/TBM
205	437914.119	2474727.630	SBM/TBM

ID	Easting	Northing	Benchmarks
206	437908.220	2474759.862	SBM/TBM
207	437872.144	2474788.033	SBM/TBM
208	437860.012	2474857.952	SBM/TBM
209	437797.293	2475004.331	SBM/TBM
210	437737.136	2474977.988	SBM/TBM
211	437630.928	2474915.199	SBM/TBM
212	437477.988	2474987.006	SBM/TBM
213	437225.741	2475177.142	SBM/TBM
214	437010.123	2475264.817	SBM/TBM
215	436532.467	2475221.517	SBM/TBM
216	436415.577	2475319.262	SBM/TBM
217	436402.022	2475547.683	SBM/TBM
218	436357.204	2475648.528	SBM/TBM
219	435804.010	2475664.212	SBM/TBM
220	435643.170	2475597.999	SBM/TBM
221	435363.607	2475801.351	SBM/TBM
222	435219.240	2475941.913	SBM/TBM
223	435305.985	2476304.955	SBM/TBM
224	435647.216	2476864.847	SBM/TBM
225	435581.236	2477455.171	SBM/TBM
226	435700.985	2477796.597	SBM/TBM
227	435339.183	2478188.060	SBM/TBM
228	435046.221	2478285.095	SBM/TBM
229	435044.800	2478454.696	SBM/TBM
230	434685.457	2478721.907	SBM/TBM
231	434394.517	2478615.856	SBM/TBM
232	433907.764	2478746.899	SBM/TBM
233	433784.261	2478707.006	SBM/TBM
234	433682.511	2478838.903	SBM/TBM
235	433750.371	2478960.274	SBM/TBM
236	433789.848	2478999.911	SBM/TBM
237	433766.091	2479069.709	SBM/TBM
238	433647.464	2479134.884	SBM/TBM
239	433455.110	2479128.906	SBM/TBM
240	433462.480	2479238.028	SBM/TBM
241	433475.950	2479254.607	SBM/TBM
242	433502.259	2479256.159	SBM/TBM
243	433543.277	2479268.309	SBM/TBM
244	433551.236	2479257.246	SBM/TBM
245	433605.454	2479268.359	SBM/TBM
246	433687.397	2479369.106	SBM/TBM
247	433627.592	2479588.999	SBM/TBM
248	433764.240	2479758.270	SBM/TBM
249	433886.124	2480049.624	SBM/TBM
250	434638.153	2480144.012	SBM/TBM
251	435099.147	2480418.781	SBM/TBM
252	435162.795	2480752.922	SBM/TBM
253	435162.380	2481040.504	SBM/TBM
254	435232.802	2481166.927	SBM/TBM
255	435154.115	2481431.547	SBM/TBM
256	435086.750	2481629.623	SBM/TBM
257	435000.296	2481729.209	SBM/TBM

ID	Easting	Northing	Benchmarks
258	435086.148	2481953.649	SBM/TBM
259	434914.020	2482461.500	SBM/TBM
260	434898.120	2482493.490	SBM/TBM
261	434774.410	2482715.560	SBM/TBM
262	434707.680	2482707.990	SBM/TBM
263	434667.330	2482724.140	SBM/TBM
264	434628.420	2482762.440	SBM/TBM
265	434574.640	2482775.430	SBM/TBM
266	434543.200	2482807.680	SBM/TBM
267	434525.090	2482817.930	SBM/TBM
268	434504.060	2482839.920	SBM/TBM
269	434468.850	2482943.020	SBM/TBM
270	434446.880	2482989.440	SBM/TBM
271	434390.410	2483034.110	SBM/TBM
272	434366.590	2483115.700	SBM/TBM
273	434365.810	2483152.000	SBM/TBM
274	434329.210	2483269.530	SBM/TBM
275	434312.660	2483308.770	SBM/TBM
276	434296.050	2483321.860	SBM/TBM
277	434225.710	2483404.330	SBM/TBM
278	434202.110	2483504.470	SBM/TBM
279	434205.860	2483532.050	SBM/TBM
280	434231.340	2483569.160	SBM/TBM
281	434187.890	2483675.400	SBM/TBM
282	434127.200	2483746.020	SBM/TBM
283	434132.230	2483756.770	SBM/TBM
284	434225.910	2483879.140	SBM/TBM
285	434175.440	2483853.130	SBM/TBM
286	434194.130	2483985.670	SBM/TBM
287	434214.540	2484031.540	SBM/TBM
288	434203.220	2484119.110	SBM/TBM
289	434187.890	2484142.350	SBM/TBM
290	434181.600	2484193.170	SBM/TBM
291	434113.390	2484205.180	SBM/TBM
292	434043.570	2484242.990	SBM/TBM
293	434002.150	2484282.080	SBM/TBM
294	433956.270	2484320.670	SBM/TBM
295	433945.220	2484391.310	SBM/TBM
296	433893.170	2484409.630	SBM/TBM
297	433879.360	2484439.550	SBM/TBM
298	433857.660	2484467.330	SBM/TBM
299	433835.340	2484545.780	SBM/TBM
300	433809.380	2484580.010	SBM/TBM
301	433887.390	2484670.850	SBM/TBM
302	433897.000	2484720.150	SBM/TBM
303	433863.360	2484806.470	SBM/TBM
304	433858.080	2484836.190	SBM/TBM
305	433863.330	2484855.430	SBM/TBM
306	433857.040	2484876.170	SBM/TBM
307	433774.710	2484995.360	SBM/TBM
308	433711.090	2485054.470	SBM/TBM
309	433698.800	2485074.380	SBM/TBM

ID	Easting	Northing	Benchmarks
310	433683.420	2485084.430	SBM/TBM
311	433656.320	2485112.410	SBM/TBM
312	433651.290	2485152.920	SBM/TBM
313	433681.580	2485175.670	SBM/TBM
314	433684.080	2485237.960	SBM/TBM
315	433679.620	2485278.800	SBM/TBM
316	433658.310	2485293.280	SBM/TBM
317	433633.470	2485327.340	SBM/TBM
318	433641.240	2485365.930	SBM/TBM
319	433671.930	2485405.230	SBM/TBM
320	433685.420	2485432.230	SBM/TBM
321	433728.060	2485456.770	SBM/TBM
322	433736.100	2485467.690	SBM/TBM
323	433750.590	2485510.360	SBM/TBM
324	433763.560	2485570.930	SBM/TBM
325	433742.150	2485597.540	SBM/TBM
326	433719.670	2485620.560	SBM/TBM
327	433635.310	2485662.020	SBM/TBM
328	433617.170	2485699.570	SBM/TBM
329	433696.410	2485765.700	SBM/TBM
330	433679.090	2485813.910	SBM/TBM
331	433643.180	2485833.860	SBM/TBM
332	433578.110	2485836.640	SBM/TBM
333	433571.960	2485857.080	SBM/TBM
334	433536.560	2485884.220	SBM/TBM
335	433477.770	2485879.770	SBM/TBM
336	433449.410	2485859.900	SBM/TBM
337	433432.030	2485817.200	SBM/TBM
338	433390.790	2485795.980	SBM/TBM
339	433375.870	2485781.500	SBM/TBM
340	433308.380	2485716.430	SBM/TBM
341	433253.040	2485700.450	SBM/TBM
342	433210.060	2485673.060	SBM/TBM
343	433133.800	2485659.030	SBM/TBM
344	432999.110	2485614.820	SBM/TBM
345	432964.730	2485643.770	SBM/TBM
346	432890.740	2485670.500	SBM/TBM
347	432878.090	2485692.960	SBM/TBM
348	432858.820	2485718.430	SBM/TBM
349	432815.490	2485717.490	SBM/TBM
350	432675.480	2485664.480	SBM/TBM
351	432643.830	2485676.570	SBM/TBM
352	432596.830	2485671.430	SBM/TBM
353	432524.070	2485701.190	SBM/TBM
354	432452.430	2485750.330	SBM/TBM
355	432427.110	2485753.230	SBM/TBM
356	432385.710	2485817.330	SBM/TBM
357	432340.820	2485897.360	SBM/TBM
358	432247.800	2485949.930	SBM/TBM
359	432226.970	2485981.600	SBM/TBM
360	432234.400	2486019.790	SBM/TBM
361	432307.370	2486094.650	SBM/TBM

ID	Easting	Northing	Benchmarks
362	432295.430	2486114.790	SBM/TBM
363	432285.440	2486141.490	SBM/TBM
364	432225.070	2486169.430	SBM/TBM
365	432128.470	2486218.100	SBM/TBM
366	432101.520	2486251.070	SBM/TBM
367	432097.520	2486324.670	SBM/TBM
368	432158.060	2486383.800	SBM/TBM
369	432200.620	2486400.610	SBM/TBM
370	432206.690	2486460.580	SBM/TBM
371	432168.560	2486536.090	SBM/TBM
372	432096.410	2486559.320	SBM/TBM
373	432064.820	2486562.190	SBM/TBM
374	432038.020	2486693.970	SBM/TBM
375	432003.620	2486717.450	SBM/TBM
376	431966.690	2486755.310	SBM/TBM
377	431908.980	2486832.010	SBM/TBM
378	431896.120	2486868.180	SBM/TBM
379	431864.000	2486964.010	SBM/TBM
380	431899.090	2487040.920	SBM/TBM
381	431874.130	2487084.840	SBM/TBM
382	431792.320	2487128.760	SBM/TBM
383	431776.510	2487282.370	SBM/TBM
384	431800.420	2487350.480	SBM/TBM
385	431795.650	2487405.390	SBM/TBM
386	431786.030	2487456.300	SBM/TBM
387	431785.740	2487538.590	SBM/TBM
388	431832.010	2487709.460	SBM/TBM
PBM	431845.143	2487699.984	PBM-2
389	431876.150	2487773.780	SBM/TBM
390	431925.440	2487826.890	SBM/TBM
391	431943.170	2487872.070	SBM/TBM
392	431958.800	2487900.110	SBM/TBM
393	431983.110	2487953.520	SBM/TBM
394	432037.000	2488069.000	SBM/TBM
395	432049.000	2488083.000	SBM/TBM
396	432050.500	2488153.110	SBM/TBM
397	432053.710	2488255.680	SBM/TBM
398	432096.580	2488292.910	SBM/TBM
399	432141.140	2488297.140	SBM/TBM
400	432249.220	2488281.660	SBM/TBM
401	432289.770	2488286.130	SBM/TBM
402	432373.820	2488282.190	SBM/TBM
403	432583.370	2488178.510	SBM/TBM
404	432652.770	2488171.370	SBM/TBM
405	432688.000	2488180.130	SBM/TBM
406	432720.080	2488208.050	SBM/TBM
407	432772.660	2488196.160	SBM/TBM
408	432821.700	2488219.940	SBM/TBM
409	432861.040	2488125.210	SBM/TBM
410	432868.170	2488110.020	SBM/TBM
411	432914.540	2488100.200	SBM/TBM
412	432977.060	2488123.470	SBM/TBM

ID	Easting	Northing	Benchmarks
413	432990.710	2488109.420	SBM/TBM
414	433008.113	2488073.692	SBM/TBM
415	433023.030	2488059.320	SBM/TBM
416	433075.670	2488054.390	SBM/TBM
417	433115.410	2488069.860	SBM/TBM
418	433133.940	2488043.570	SBM/TBM
419	433146.180	2488033.950	SBM/TBM
420	433179.440	2488080.670	SBM/TBM
421	433231.820	2488126.690	SBM/TBM
422	433262.030	2488145.410	SBM/TBM
423	433298.310	2488166.040	SBM/TBM
424	433320.330	2488172.010	SBM/TBM
425	433347.520	2488235.810	SBM/TBM
426	433359.490	2488257.400	SBM/TBM
427	433359.090	2488284.030	SBM/TBM
428	433336.060	2488305.750	SBM/TBM
429	433343.890	2488331.230	SBM/TBM
430	433325.000	2488335.380	SBM/TBM
431	433425.040	2488545.660	SBM/TBM
432	433442.410	2488584.690	SBM/TBM
433	433502.270	2488609.720	SBM/TBM
434	433584.630	2488644.380	SBM/TBM
435	433619.360	2488740.100	SBM/TBM
436	433707.450	2488804.830	SBM/TBM
437	433722.370	2488782.370	SBM/TBM
438	433780.510	2488784.310	SBM/TBM
439	433867.840	2488889.090	SBM/TBM
440	433924.900	2488892.530	SBM/TBM
441	433947.300	2488905.490	SBM/TBM
442	434087.130	2488988.210	SBM/TBM
443	434104.980	2488963.520	SBM/TBM
444	434121.760	2489015.530	SBM/TBM
445	434198.830	2489047.810	SBM/TBM
446	434264.040	2489110.430	SBM/TBM
447	434293.730	2489126.520	SBM/TBM
448	434326.670	2489141.490	SBM/TBM
449	434359.140	2489142.580	SBM/TBM
450	434381.950	2489146.600	SBM/TBM
451	434382.110	2489159.860	SBM/TBM
452	434368.870	2489189.810	SBM/TBM
453	434351.150	2489221.150	SBM/TBM
454	434340.820	2489238.800	SBM/TBM
455	434342.350	2489251.280	SBM/TBM
456	434363.840	2489270.870	SBM/TBM
457	434365.730	2489325.960	SBM/TBM
458	434374.730	2489358.360	SBM/TBM
459	434385.800	2489395.040	SBM/TBM
460	434380.660	2489433.360	SBM/TBM
461	434390.320	2489485.210	SBM/TBM
462	434386.250	2489532.940	SBM/TBM
463	434404.750	2489570.960	SBM/TBM
464	434440.950	2489625.890	SBM/TBM

ID	Easting	Northing	Benchmarks
465	434452.900	2489679.000	SBM/TBM
466	434456.350	2489715.300	SBM/TBM
467	434462.860	2489745.460	SBM/TBM
468	434482.620	2489810.370	SBM/TBM
469	434543.410	2489909.660	SBM/TBM
470	434622.420	2489980.370	SBM/TBM
471	434650.440	2489996.510	SBM/TBM
472	434678.600	2489987.360	SBM/TBM
473	434739.460	2490004.910	SBM/TBM
474	434793.880	2490013.530	SBM/TBM
475	434825.560	2490029.190	SBM/TBM
476	434844.100	2490061.080	SBM/TBM
477	437112.865	2510182.835	SBM/TBM
478	434864.260	2490095.730	SBM/TBM
479	434862.160	2490110.490	SBM/TBM
480	434890.790	2490143.770	SBM/TBM
481	434934.740	2490166.430	SBM/TBM
482	434987.170	2490182.830	SBM/TBM
483	435017.050	2490187.310	SBM/TBM
484	435018.930	2490233.450	SBM/TBM
485	435023.050	2490266.800	SBM/TBM
486	434981.610	2490319.960	SBM/TBM
487	435006.700	2490339.940	SBM/TBM
488	435058.710	2490381.560	SBM/TBM
489	435070.820	2490397.450	SBM/TBM
490	435105.330	2490547.500	SBM/TBM
491	435095.550	2490637.590	SBM/TBM
492	435081.310	2490690.660	SBM/TBM
493	435099.650	2490710.060	SBM/TBM
494	435108.800	2490755.100	SBM/TBM
495	435119.160	2490774.260	SBM/TBM
496	435121.070	2490798.380	SBM/TBM
497	435174.650	2490879.830	SBM/TBM
498	435198.090	2490915.500	SBM/TBM
499	435220.020	2490935.770	SBM/TBM
500	435222.990	2490953.520	SBM/TBM
501	435214.770	2490989.150	SBM/TBM
502	435222.690	2491050.690	SBM/TBM
503	435230.550	2491071.970	SBM/TBM
504	435208.870	2491131.500	SBM/TBM
505	435211.740	2491162.210	SBM/TBM
506	435408.800	2491280.620	SBM/TBM
507	435483.150	2491244.600	SBM/TBM
508	435501.860	2491248.840	SBM/TBM
509	435512.080	2491276.430	SBM/TBM
510	435507.920	2491353.220	SBM/TBM
511	435541.700	2491355.790	SBM/TBM
512	435578.050	2491398.080	SBM/TBM
513	435581.530	2491420.460	SBM/TBM
514	435536.743	2491507.440	SBM/TBM
515	435473.814	2491530.253	SBM/TBM
516	435461.940	2491723.540	SBM/TBM

ID	Easting	Northing	Benchmarks
517	435464.390	2491726.070	SBM/TBM
518	435473.730	2491734.230	SBM/TBM
519	435499.370	2492026.680	SBM/TBM
520	435473.360	2492189.750	SBM/TBM
521	435488.150	2492278.110	SBM/TBM
522	435500.240	2492571.690	SBM/TBM
523	435464.980	2492696.740	SBM/TBM
524	435409.740	2492782.550	SBM/TBM
525	435393.720	2492838.940	SBM/TBM
526	435408.410	2492924.740	SBM/TBM
527	435436.170	2493415.530	SBM/TBM
528	435434.590	2493464.900	SBM/TBM
529	435445.840	2493523.410	SBM/TBM
530	435455.810	2493556.470	SBM/TBM
531	435524.130	2493592.450	SBM/TBM
532	435763.330	2493676.680	SBM/TBM
533	435793.420	2493717.510	SBM/TBM
534	435859.030	2493743.170	SBM/TBM
535	436117.580	2493838.510	SBM/TBM
536	436211.880	2493893.490	SBM/TBM
537	436293.800	2493963.540	SBM/TBM
538	436320.850	2493995.280	SBM/TBM
539	436366.580	2494018.950	SBM/TBM
540	436405.630	2494043.740	SBM/TBM
541	436437.460	2494078.890	SBM/TBM
542	436695.950	2494376.780	SBM/TBM
543	436773.380	2494376.350	SBM/TBM
544	436984.980	2494789.590	SBM/TBM
545	437015.290	2494873.860	SBM/TBM
546	437005.970	2494949.720	SBM/TBM
547	436964.750	2495041.780	SBM/TBM
548	436804.870	2495299.930	SBM/TBM
549	436753.450	2495360.460	SBM/TBM
550	436769.330	2496086.680	SBM/TBM
551	436768.890	2496167.930	SBM/TBM
552	436808.700	2496228.160	SBM/TBM
553	436739.100	2496245.220	SBM/TBM
554	436584.140	2496261.290	SBM/TBM
555	436519.180	2496380.710	SBM/TBM
556	436336.160	2496383.220	SBM/TBM
557	436171.550	2496501.200	SBM/TBM
558	436119.820	2496636.520	SBM/TBM
559	436093.820	2496715.520	SBM/TBM
560	436030.710	2496757.980	SBM/TBM
561	435980.060	2496887.300	SBM/TBM
562	435907.860	2497068.940	SBM/TBM
563	435915.200	2497137.390	SBM/TBM
564	435677.440	2497696.530	SBM/TBM
565	435677.190	2497763.400	SBM/TBM
566	435520.760	2497886.640	SBM/TBM
567	435460.780	2497934.970	SBM/TBM
568	435410.610	2498019.330	SBM/TBM

ANNEXURES

ID	Easting	Northing	Benchmarks
569	435401.599	2498126.080	SBM/TBM
570	435364.190	2498224.590	SBM/TBM
571	435335.600	2498254.470	SBM/TBM
572	435318.560	2498270.420	SBM/TBM
573	435289.370	2498326.460	SBM/TBM
574	435273.780	2498361.750	SBM/TBM
575	435042.210	2498556.400	SBM/TBM
576	435034.880	2498588.860	SBM/TBM
577	435072.270	2498653.140	SBM/TBM
578	435109.420	2498718.060	SBM/TBM
579	435070.600	2499008.250	SBM/TBM
580	435010.330	2499144.320	SBM/TBM
581	434989.980	2499179.510	SBM/TBM
582	434961.740	2499211.420	SBM/TBM
583	434928.630	2499257.920	SBM/TBM
584	434917.160	2499420.080	SBM/TBM
585	434883.990	2499430.710	SBM/TBM
586	434893.690	2499468.100	SBM/TBM
587	434925.020	2499510.320	SBM/TBM
588	434944.390	2499529.440	SBM/TBM
589	435018.731	2499669.996	SBM/TBM
590	434725.424	2500034.923	SBM/TBM
591	434329.663	2500160.062	SBM/TBM
592	434225.122	2500268.537	SBM/TBM
593	434244.632	2500412.275	SBM/TBM
594	434260.843	2500699.361	SBM/TBM
595	434281.527	2501066.387	SBM/TBM
596	434299.715	2501453.249	SBM/TBM
597	434016.738	2501815.504	SBM/TBM
598	434252.774	2502058.592	SBM/TBM
599	434521.797	2502466.761	SBM/TBM
600	434694.258	2502702.369	SBM/TBM
601	434817.389	2502908.112	SBM/TBM
602	434787.595	2503308.189	SBM/TBM
603	434904.239	2503643.701	SBM/TBM
604	434877.924	2503884.676	SBM/TBM
605	434865.405	2503913.065	SBM/TBM
606	434873.773	2504010.874	SBM/TBM
607	434890.485	2504045.704	SBM/TBM
608	434911.819	2504081.500	SBM/TBM
609	435001.129	2504092.928	SBM/TBM
610	435052.919	2504139.919	SBM/TBM
611	435118.067	2504095.459	SBM/TBM
612	435171.784	2504073.811	SBM/TBM
613	435208.228	2504091.584	SBM/TBM
614	435255.385	2504102.520	SBM/TBM
615	435308.403	2504154.874	SBM/TBM
616	435344.623	2504184.251	SBM/TBM
617	435380.726	2504243.055	SBM/TBM
618	435389.648	2504252.854	SBM/TBM
619	435410.724	2504249.472	SBM/TBM
620	435444.228	2504244.054	SBM/TBM

ID	Easting	Northing	Benchmarks
621	435696.519	2504449.458	SBM/TBM
622	435806.966	2504485.773	SBM/TBM
623	435545.152	2504288.549	SBM/TBM
624	435839.577	2504487.165	SBM/TBM
625	435602.898	2504292.158	SBM/TBM
626	435869.618	2504496.832	SBM/TBM
627	435614.430	2504301.179	SBM/TBM
628	435885.365	2504566.697	SBM/TBM
629	435653.084	2504310.357	SBM/TBM
630	435876.045	2504616.443	SBM/TBM
631	435649.942	2504345.802	SBM/TBM
632	435877.184	2504645.669	SBM/TBM
633	435617.944	2504376.723	SBM/TBM
634	435891.449	2504669.561	SBM/TBM
635	435622.848	2504395.390	SBM/TBM
636	435903.962	2504716.011	SBM/TBM
637	435684.941	2504417.434	SBM/TBM
638	435914.927	2504761.744	SBM/TBM
639	435933.718	2504847.685	SBM/TBM
640	436000.056	2504856.838	SBM/TBM
641	436047.646	2504888.927	SBM/TBM
642	436057.522	2504906.388	SBM/TBM
643	436083.900	2504915.800	SBM/TBM
644	436178.194	2504931.429	SBM/TBM
645	436235.368	2504912.692	SBM/TBM
646	436256.261	2504960.226	SBM/TBM
647	436290.445	2504970.529	SBM/TBM
648	436318.971	2504979.079	SBM/TBM
649	436406.252	2504963.111	SBM/TBM
650	436481.010	2505000.903	SBM/TBM
651	436510.225	2504949.585	SBM/TBM
652	436622.727	2504942.292	SBM/TBM
653	436662.546	2504960.450	SBM/TBM
654	436704.208	2504992.160	SBM/TBM
655	436690.744	2505055.191	SBM/TBM
656	436710.480	2505091.674	SBM/TBM
657	436707.997	2505106.174	SBM/TBM
658	436735.224	2505137.292	SBM/TBM
659	436744.726	2505154.807	SBM/TBM
660	436780.892	2505167.469	SBM/TBM
661	436806.071	2505146.862	SBM/TBM
662	436845.358	2505114.065	SBM/TBM
663	436901.392	2505055.463	SBM/TBM
664	436931.047	2505088.899	SBM/TBM
665	436984.146	2505146.379	SBM/TBM
666	437003.699	2505170.920	SBM/TBM
667	437034.112	2505170.188	SBM/TBM
668	437065.213	2505123.680	SBM/TBM
669	437113.881	2505093.857	SBM/TBM
670	437150.708	2505114.462	SBM/TBM
671	437158.576	2505163.844	SBM/TBM
672	437188.566	2505177.566	SBM/TBM

ID	Easting	Northing	Benchmarks
673	437244.070	2505223.123	SBM/TBM
674	437253.306	2505251.179	SBM/TBM
675	437197.856	2505268.855	SBM/TBM
676	437192.237	2505310.652	SBM/TBM
677	437185.995	2505353.474	SBM/TBM
678	437189.778	2505370.750	SBM/TBM
679	437216.961	2505382.066	SBM/TBM
680	437242.545	2505414.808	SBM/TBM
681	437307.745	2505462.206	SBM/TBM
682	437354.316	2505474.987	SBM/TBM
683	437376.565	2505505.543	SBM/TBM
684	437372.305	2505536.874	SBM/TBM
685	437374.991	2505573.635	SBM/TBM
686	437404.923	2505617.648	SBM/TBM
687	437432.946	2505625.376	SBM/TBM
688	437451.711	2505662.172	SBM/TBM
689	437431.452	2505724.455	SBM/TBM
690	437459.417	2505757.006	SBM/TBM
691	437475.929	2505795.763	SBM/TBM
692	437453.283	2505846.550	SBM/TBM
693	437441.089	2505906.538	SBM/TBM
694	437437.893	2505961.036	SBM/TBM
695	437447.533	2506001.551	SBM/TBM
696	437463.134	2506020.685	SBM/TBM
697	437473.346	2506066.760	SBM/TBM
698	437432.770	2506127.999	SBM/TBM
699	437416.939	2506201.445	SBM/TBM
700	437437.513	2506436.940	SBM/TBM
701	437341.218	2506661.398	SBM/TBM
702	437325.816	2506680.040	SBM/TBM
703	437255.198	2506681.852	SBM/TBM
704	437190.134	2506698.226	SBM/TBM
705	437127.916	2506748.404	SBM/TBM
706	437094.557	2506768.236	SBM/TBM
707	437038.848	2506838.937	SBM/TBM
708	437000.686	2506870.785	SBM/TBM
709	436995.974	2506896.377	SBM/TBM
710	436971.883	2506932.004	SBM/TBM
711	436906.684	2506933.527	SBM/TBM
712	436847.635	2506957.176	SBM/TBM
713	436784.266	2506972.789	SBM/TBM
714	436716.181	2506958.415	SBM/TBM
715	436674.759	2506950.177	SBM/TBM
716	436610.072	2506953.666	SBM/TBM
717	436584.876	2506996.014	SBM/TBM
718	436525.402	2507019.660	SBM/TBM
719	436563.456	2507246.952	SBM/TBM
720	436640.208	2507326.542	SBM/TBM
721	436646.935	2507348.903	SBM/TBM
722	436671.781	2507401.131	SBM/TBM
723	436675.140	2507465.696	SBM/TBM
724	436640.408	2507479.792	SBM/TBM

ID	Easting	Northing	Benchmarks
725	436620.028	2507546.012	SBM/TBM
726	436606.682	2507563.238	SBM/TBM
727	436675.242	2507645.921	SBM/TBM
728	436687.316	2507705.150	SBM/TBM
729	436712.560	2507712.139	SBM/TBM
730	436734.797	2507728.813	SBM/TBM
731	436740.838	2507753.030	SBM/TBM
732	436862.622	2507889.151	SBM/TBM
733	436956.376	2508120.619	SBM/TBM
734	436986.020	2508368.218	SBM/TBM
735	436983.735	2508406.067	SBM/TBM
736	436995.658	2508449.602	SBM/TBM
737	436996.016	2508481.743	SBM/TBM
738	436981.751	2508498.546	SBM/TBM
739	436994.063	2508533.805	SBM/TBM
740	436992.786	2508560.838	SBM/TBM
741	436979.601	2508579.404	SBM/TBM
742	436948.901	2508685.100	SBM/TBM
743	436946.070	2508723.489	SBM/TBM
744	436960.011	2508757.848	SBM/TBM
745	436983.692	2508788.492	SBM/TBM
746	436994.048	2508836.742	SBM/TBM
747	437021.143	2508873.441	SBM/TBM
748	437051.210	2508924.807	SBM/TBM
749	437035.419	2508965.456	SBM/TBM
750	437089.221	2509067.799	SBM/TBM
751	437094.762	2509149.235	SBM/TBM
752	437099.469	2509278.626	SBM/TBM
753	437058.749	2509349.046	SBM/TBM
754	437052.123	2509391.772	SBM/TBM
755	437013.241	2509441.189	SBM/TBM
756	437008.411	2509500.958	SBM/TBM
757	437029.783	2509558.659	SBM/TBM
758	437039.052	2509590.219	SBM/TBM
759	437062.883	2509620.433	SBM/TBM
760	437186.262	2509669.911	SBM/TBM
761	437235.844	2509717.261	SBM/TBM
762	437228.405	2509755.273	SBM/TBM
763	437174.405	2509796.376	SBM/TBM
764	437152.199	2509856.537	SBM/TBM
765	437153.042	2509929.496	SBM/TBM
766	437153.748	2509949.654	SBM/TBM
767	437139.060	2509986.448	SBM/TBM
768	437124.273	2510003.267	SBM/TBM
769	437084.942	2510056.353	SBM/TBM
770	437081.912	2510088.900	SBM/TBM
771	437068.813	2510131.110	SBM/TBM
772	437094.763	2510144.226	SBM/TBM
773	437112.383	2510157.248	SBM/TBM
774	437194.981	2510260.623	SBM/TBM
775	437222.840	2510260.608	SBM/TBM
776	437243.596	2510278.984	SBM/TBM

ID	Easting	Northing	Benchmarks
777	437255.820	2510296.872	SBM/TBM
778	437270.294	2510316.129	SBM/TBM
779	437288.782	2510377.195	SBM/TBM
780	437325.619	2510436.554	SBM/TBM
781	437357.088	2510430.104	SBM/TBM
782	437405.853	2510437.675	SBM/TBM
783	437466.562	2510431.667	SBM/TBM
784	437526.891	2510436.326	SBM/TBM
785	437543.106	2510447.535	SBM/TBM
786	437611.713	2510471.748	SBM/TBM
787	437638.761	2510486.641	SBM/TBM
788	437667.716	2510537.529	SBM/TBM
789	437649.762	2510585.426	SBM/TBM
790	437668.724	2510625.056	SBM/TBM
791	437701.584	2510653.215	SBM/TBM
792	437704.545	2510775.993	SBM/TBM
793	437678.830	2510831.343	SBM/TBM
794	437667.932	2510893.924	SBM/TBM
795	437653.164	2510946.787	SBM/TBM
796	437657.952	2510975.288	SBM/TBM
797	437691.110	2511072.168	SBM/TBM
798	437668.511	2511093.837	SBM/TBM
799	437698.513	2511212.252	SBM/TBM
800	437726.534	2511252.659	SBM/TBM
801	437769.374	2511271.190	SBM/TBM
802	437738.239	2511376.603	SBM/TBM
803	437706.636	2511443.429	SBM/TBM
804	437666.559	2511496.368	SBM/TBM
805	437639.686	2511537.017	SBM/TBM
806	437657.428	2511628.925	SBM/TBM
807	437679.411	2511661.343	SBM/TBM
808	437655.658	2511699.392	SBM/TBM
809	437657.308	2511799.776	SBM/TBM
810	437633.628	2511927.347	SBM/TBM
811	437596.385	2511968.606	SBM/TBM
812	437591.120	2512039.998	SBM/TBM
813	437599.545	2512068.790	SBM/TBM
814	437576.079	2512191.866	SBM/TBM
815	437535.502	2512464.630	SBM/TBM
816	437434.803	2512555.864	SBM/TBM
817	437375.784	2512629.142	SBM/TBM
818	437277.553	2512785.591	SBM/TBM
819	437239.362	2512856.045	SBM/TBM
820	437200.744	2512840.442	SBM/TBM
PBM	436748.691	2513032.064	PBM-3
821	437317.926	2512843.828	SBM/TBM
822	437419.510	2512870.409	SBM/TBM
823	437455.031	2512885.360	SBM/TBM
824	437448.216	2512910.647	SBM/TBM
825	437402.975	2512950.994	SBM/TBM
826	437460.496	2513377.504	SBM/TBM
827	437546.586	2513448.981	SBM/TBM

ID	Easting	Northing	Benchmarks
828	437638.821	2513584.643	SBM/TBM
829	437964.165	2514055.386	SBM/TBM
830	438026.679	2514465.000	SBM/TBM
831	438236.539	2514534.439	SBM/TBM
832	438219.757	2514995.006	SBM/TBM
833	438210.748	2515164.790	SBM/TBM
834	438236.605	2515346.624	SBM/TBM
835	438238.761	2515700.203	SBM/TBM
836	438313.042	2515822.302	SBM/TBM
837	438352.228	2516084.266	SBM/TBM
838	438439.506	2516383.460	SBM/TBM
839	438444.826	2516468.236	SBM/TBM
840	438404.326	2516678.928	SBM/TBM
841	438397.696	2516787.942	SBM/TBM
842	438450.083	2516896.811	SBM/TBM
843	438356.300	2516927.361	SBM/TBM
844	438315.555	2517016.855	SBM/TBM
845	438341.686	2517065.756	SBM/TBM
846	438365.536	2517162.844	SBM/TBM
847	438349.159	2517280.050	SBM/TBM
848	438226.183	2517440.972	SBM/TBM
849	438087.133	2517539.285	SBM/TBM
850	438058.640	2517772.180	SBM/TBM
851	437998.290	2517933.345	SBM/TBM
852	437990.978	2518013.169	SBM/TBM
853	437748.500	2518310.045	SBM/TBM
854	437681.763	2518510.904	SBM/TBM
855	437740.459	2518551.397	SBM/TBM
856	437745.756	2518597.894	SBM/TBM
857	437761.672	2518641.192	SBM/TBM
858	437744.234	2518748.247	SBM/TBM
859	437689.647	2518932.322	SBM/TBM
860	437674.868	2519132.470	SBM/TBM
861	437613.910	2519239.310	SBM/TBM
862	437611.742	2519325.833	SBM/TBM
863	437589.448	2519397.996	SBM/TBM
864	437671.614	2519479.836	SBM/TBM
865	437654.933	2519526.000	SBM/TBM
866	437575.461	2519654.555	SBM/TBM
867	437610.524	2519793.525	SBM/TBM
868	437582.441	2519879.530	SBM/TBM
869	437414.262	2520002.678	SBM/TBM
870	437315.780	2520118.924	SBM/TBM
871	437296.466	2520193.768	SBM/TBM
872	437205.096	2520224.573	SBM/TBM
873	437094.633	2520267.685	SBM/TBM
874	437038.398	2520325.482	SBM/TBM
875	437042.091	2520465.920	SBM/TBM
876	436998.853	2520641.924	SBM/TBM
877	437027.049	2520799.858	SBM/TBM
878	437019.028	2520872.511	SBM/TBM
879	437062.811	2521001.759	SBM/TBM

ID	Easting	Northing	Benchmarks
880	437084.272	2521045.324	SBM/TBM
881	437069.288	2521198.210	SBM/TBM
882	437066.206	2521312.369	SBM/TBM
883	436984.483	2521509.508	SBM/TBM
884	436998.137	2521664.315	SBM/TBM
885	437080.613	2521848.250	SBM/TBM
886	437114.563	2521977.867	SBM/TBM
887	437048.974	2522120.486	SBM/TBM
888	437047.846	2522184.038	SBM/TBM
889	437072.274	2522215.698	SBM/TBM
890	437255.473	2522345.656	SBM/TBM
891	437290.469	2522505.396	SBM/TBM
892	437272.736	2522581.177	SBM/TBM
893	437238.897	2522634.773	SBM/TBM
894	437216.802	2522730.278	SBM/TBM
895	437156.292	2522882.899	SBM/TBM
896	437147.600	2522902.472	SBM/TBM
897	437168.200	2522947.764	SBM/TBM
898	437155.121	2523022.927	SBM/TBM
899	437161.726	2523100.604	SBM/TBM
900	437153.214	2523174.531	SBM/TBM
901	437126.947	2523320.538	SBM/TBM
902	437120.360	2523430.125	SBM/TBM
903	437108.609	2523503.646	SBM/TBM
904	437073.141	2523538.905	SBM/TBM
905	436981.833	2523546.333	SBM/TBM
906	436885.484	2523660.600	SBM/TBM
907	436913.738	2523608.749	SBM/TBM
908	436882.394	2523730.955	SBM/TBM
909	437009.949	2523822.898	SBM/TBM
910	437015.736	2523885.973	SBM/TBM
911	436990.064	2523924.230	SBM/TBM
912	436997.537	2524019.491	SBM/TBM
913	436972.896	2524088.534	SBM/TBM
914	436916.385	2524136.050	SBM/TBM
915	436929.974	2524200.671	SBM/TBM
916	436902.064	2524303.659	SBM/TBM
917	436862.430	2524388.047	SBM/TBM
918	436860.769	2524537.123	SBM/TBM
919	436745.666	2524681.127	SBM/TBM
920	436724.101	2524780.388	SBM/TBM
921	436719.529	2524856.474	SBM/TBM
922	436722.984	2524937.330	SBM/TBM
923	436727.514	2524983.507	SBM/TBM
924	436705.777	2525120.186	SBM/TBM
925	436672.100	2525223.655	SBM/TBM
926	436598.605	2525366.550	SBM/TBM
927	436577.353	2525442.616	SBM/TBM
928	436569.142	2525512.664	SBM/TBM
929	436544.436	2525589.552	SBM/TBM
930	436511.125	2525660.007	SBM/TBM
931	436488.129	2525710.921	SBM/TBM

ID	Easting	Northing	Benchmarks
932	436447.379	2525733.080	SBM/TBM
933	436428.270	2525808.624	SBM/TBM
934	436330.492	2525885.862	SBM/TBM
935	436404.889	2526294.575	SBM/TBM
936	436434.556	2526381.789	SBM/TBM
937	436466.364	2526512.347	SBM/TBM
938	436481.581	2526579.929	SBM/TBM
939	436513.299	2526667.918	SBM/TBM
940	436541.073	2526750.940	SBM/TBM
941	436609.267	2526882.531	SBM/TBM
942	436703.040	2527220.510	SBM/TBM
943	436720.781	2527292.007	SBM/TBM
944	436757.727	2527340.664	SBM/TBM
945	436802.791	2527457.070	SBM/TBM
946	436822.346	2527529.425	SBM/TBM
947	436883.082	2527740.971	SBM/TBM
948	436933.947	2527897.257	SBM/TBM
949	436960.638	2528011.489	SBM/TBM
950	436981.679	2528128.395	SBM/TBM
951	437026.449	2528273.901	SBM/TBM
952	437061.828	2528368.891	SBM/TBM
953	437106.839	2528504.610	SBM/TBM
954	437111.013	2528597.455	SBM/TBM
955	437166.096	2528727.160	SBM/TBM
956	437215.239	2528757.450	SBM/TBM
957	437200.372	2528811.247	SBM/TBM
958	437197.977	2528869.181	SBM/TBM
959	437250.599	2528933.105	SBM/TBM
960	437273.997	2528950.193	SBM/TBM
961	437368.118	2528918.081	SBM/TBM
962	437441.105	2528922.688	SBM/TBM
963	437487.228	2528940.498	SBM/TBM
964	437527.430	2528922.741	SBM/TBM
965	437646.079	2528928.616	SBM/TBM
966	437771.643	2528908.760	SBM/TBM
967	437856.843	2528965.372	SBM/TBM
968	437865.487	2528990.634	SBM/TBM
969	437858.551	2529095.315	SBM/TBM
970	437808.392	2529274.732	SBM/TBM
971	437790.794	2529320.689	SBM/TBM
972	437733.092	2529424.247	SBM/TBM
973	437772.142	2529753.901	SBM/TBM
974	437753.005	2529771.894	SBM/TBM
975	437739.634	2529811.850	SBM/TBM
976	437753.169	2529837.835	SBM/TBM
977	437813.366	2529823.005	SBM/TBM
978	437859.167	2529759.155	SBM/TBM
979	437860.062	2529701.598	SBM/TBM
980	437932.804	2529668.006	SBM/TBM
981	438000.978	2529663.285	SBM/TBM
982	438041.393	2529658.725	SBM/TBM
983	438079.176	2529586.076	SBM/TBM

ANNEXURES

ID	Easting	Northing	Benchmarks
984	438299.641	2529488.141	SBM/TBM
985	438333.314	2529476.614	SBM/TBM
986	438383.133	2529511.002	SBM/TBM
987	438466.007	2529524.037	SBM/TBM
988	438527.742	2529462.842	SBM/TBM
989	438593.959	2529420.043	SBM/TBM
990	438660.927	2529422.977	SBM/TBM
991	438839.108	2529472.955	SBM/TBM
992	438823.625	2529516.186	SBM/TBM
993	438644.840	2529867.740	SBM/TBM
994	438780.055	2529922.733	SBM/TBM
995	438853.278	2529940.365	SBM/TBM
996	438899.223	2530039.840	SBM/TBM
997	439173.250	2530068.647	SBM/TBM
998	439380.202	2529987.788	SBM/TBM
999	439590.051	2529905.840	SBM/TBM
1000	439678.695	2529824.156	SBM/TBM
1001	439946.163	2529779.640	SBM/TBM
1002	439986.184	2529746.629	SBM/TBM
1003	440050.401	2529685.288	SBM/TBM
1004	440098.617	2529653.850	SBM/TBM
1005	440186.968	2529584.975	SBM/TBM
1006	440243.558	2529546.749	SBM/TBM
1007	440267.507	2529458.008	SBM/TBM
1008	440302.718	2529389.987	SBM/TBM
1009	440341.484	2529357.264	SBM/TBM
1010	440506.437	2529400.471	SBM/TBM
1011	440616.724	2529408.315	SBM/TBM
1012	440915.389	2529444.625	SBM/TBM
1013	441167.765	2529432.116	SBM/TBM
1014	441366.531	2529447.462	SBM/TBM
1015	441422.603	2529430.937	SBM/TBM
1016	441459.065	2529426.700	SBM/TBM
1017	441468.553	2529445.185	SBM/TBM
1018	441507.559	2529512.132	SBM/TBM
1019	441531.666	2529550.713	SBM/TBM
1020	441541.889	2529572.279	SBM/TBM
1021	441549.575	2529584.189	SBM/TBM
1022	441562.448	2529591.305	SBM/TBM
1023	441579.686	2529592.744	SBM/TBM
1024	441592.423	2529594.265	SBM/TBM
1025	441671.826	2529584.480	SBM/TBM
1026	441770.269	2529630.016	SBM/TBM
1027	441795.876	2529722.294	SBM/TBM
1028	441811.879	2529743.067	SBM/TBM
1029	441921.493	2529890.779	SBM/TBM
1030	442124.148	2529798.100	SBM/TBM
1031	442159.646	2529798.010	SBM/TBM
1032	442273.029	2529816.005	SBM/TBM
1033	442423.661	2529820.491	SBM/TBM
1034	442480.334	2529816.464	SBM/TBM
1035	442507.141	2529869.550	SBM/TBM

ID	Easting	Northing	Benchmarks
1036	442552.707	2529950.100	SBM/TBM
1037	442623.914	2530005.838	SBM/TBM
1038	442666.745	2530017.647	SBM/TBM
1039	442719.281	2529982.899	SBM/TBM
1040	442781.171	2530014.661	SBM/TBM
1041	442845.125	2529994.359	SBM/TBM
1042	442900.010	2530009.235	SBM/TBM
1043	442976.796	2530013.479	SBM/TBM
1044	443001.720	2530027.822	SBM/TBM
1045	443077.418	2530063.767	SBM/TBM
1046	443164.576	2530057.307	SBM/TBM
1047	443175.651	2530049.344	SBM/TBM
1048	443193.386	2530059.030	SBM/TBM
1049	443239.362	2530076.814	SBM/TBM
1050	443262.681	2530120.028	SBM/TBM
1051	443243.132	2530179.549	SBM/TBM
1052	443243.418	2530200.950	SBM/TBM
1053	443284.948	2530282.253	SBM/TBM
1054	443317.137	2530269.140	SBM/TBM

Benchmarks List of Multimodal Route (Road Part)

ID	Easting	Northing	Benchmarks
1	437772.142	2529753.901	SBM/TBM
2	437753.005	2529771.894	SBM/TBM
3	437739.634	2529811.850	SBM/TBM
4	437753.169	2529837.835	SBM/TBM
5	437813.366	2529823.005	SBM/TBM
6	437859.167	2529759.155	SBM/TBM
7	437860.062	2529701.598	SBM/TBM
8	437932.804	2529668.006	SBM/TBM
9	438000.978	2529663.285	SBM/TBM
10	438041.393	2529658.725	SBM/TBM
11	438079.176	2529586.076	SBM/TBM
12	438299.641	2529488.141	SBM/TBM
13	438333.314	2529476.614	SBM/TBM
14	438383.133	2529511.002	SBM/TBM
15	438466.007	2529524.037	SBM/TBM
16	438527.742	2529462.842	SBM/TBM
17	438593.959	2529420.043	SBM/TBM
18	438660.927	2529422.977	SBM/TBM
19	438839.108	2529472.955	SBM/TBM
20	438823.625	2529516.186	SBM/TBM
21	438644.840	2529867.740	SBM/TBM
22	438780.055	2529922.733	SBM/TBM
23	438853.278	2529940.365	SBM/TBM
24	438899.223	2530039.840	SBM/TBM
25	439173.250	2530068.647	SBM/TBM
26	439380.202	2529987.788	SBM/TBM
27	439590.051	2529905.840	SBM/TBM
28	439678.695	2529824.156	SBM/TBM
29	439946.163	2529779.640	SBM/TBM
30	439986.184	2529746.629	SBM/TBM

ANNEXURES

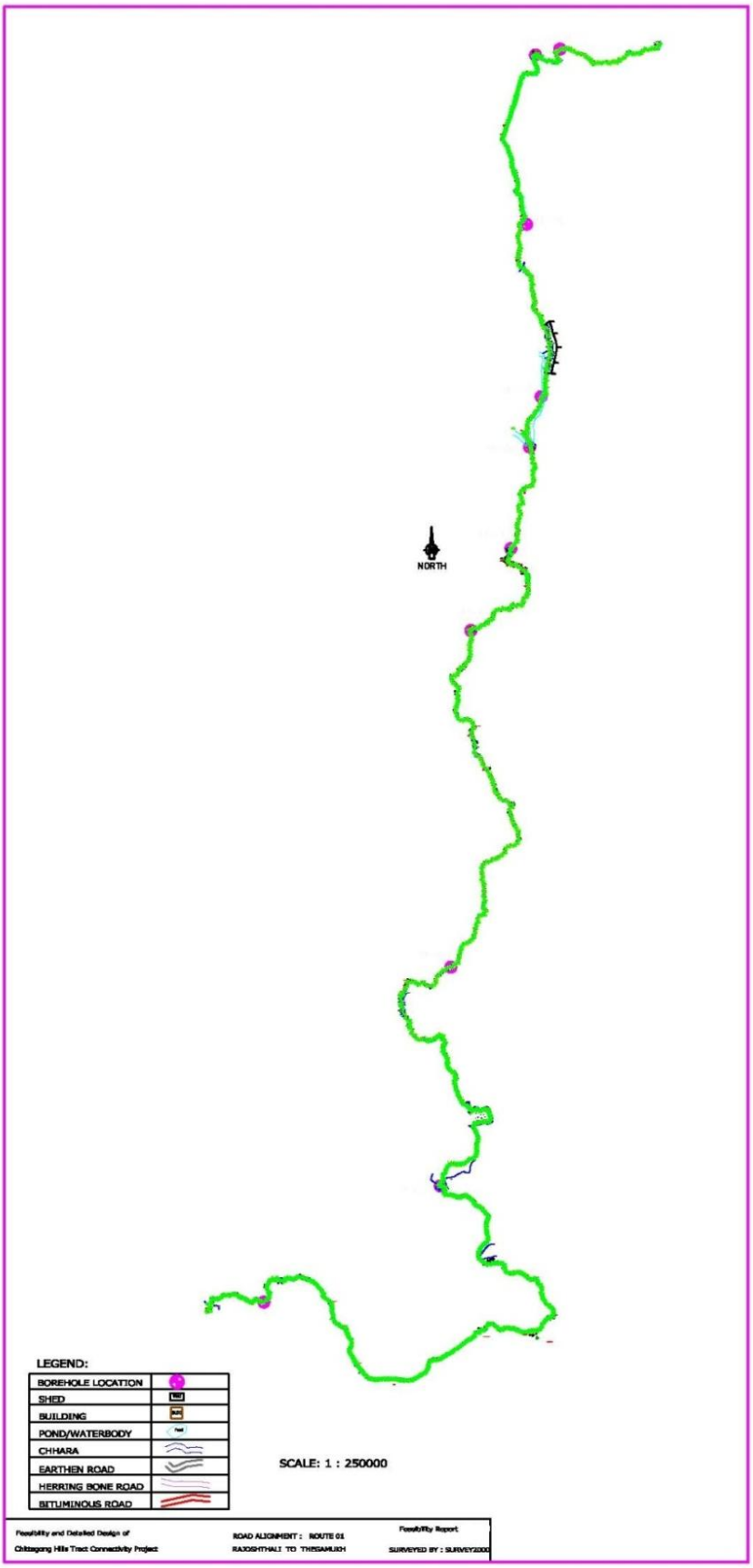
ID	Easting	Northing	Benchmarks
31	440050.401	2529685.288	SBM/TBM
32	440098.617	2529653.850	SBM/TBM
33	440186.968	2529584.975	SBM/TBM
34	440243.558	2529546.749	SBM/TBM
35	440267.507	2529458.008	SBM/TBM
36	440302.718	2529389.987	SBM/TBM
37	440341.484	2529357.264	SBM/TBM
38	440506.437	2529400.471	SBM/TBM
39	440616.724	2529408.315	SBM/TBM
40	440915.389	2529444.625	SBM/TBM
41	441167.765	2529432.116	SBM/TBM
42	441366.531	2529447.462	SBM/TBM
43	441422.603	2529430.937	SBM/TBM
44	441459.065	2529426.700	SBM/TBM
45	441468.553	2529445.185	SBM/TBM
46	441507.559	2529512.132	SBM/TBM
47	441531.666	2529550.713	SBM/TBM
48	441541.889	2529572.279	SBM/TBM
49	441549.575	2529584.189	SBM/TBM
50	441562.448	2529591.305	SBM/TBM
51	441579.686	2529592.744	SBM/TBM
52	441592.423	2529594.265	SBM/TBM
53	441671.826	2529584.480	SBM/TBM
54	441770.269	2529630.016	SBM/TBM
55	441795.876	2529722.294	SBM/TBM
56	441811.879	2529743.067	SBM/TBM
57	441921.493	2529890.779	SBM/TBM
58	442124.148	2529798.100	SBM/TBM
59	442159.646	2529798.010	SBM/TBM
60	442273.029	2529816.005	SBM/TBM
61	442423.661	2529820.491	SBM/TBM
62	442480.334	2529816.464	SBM/TBM
63	442507.141	2529869.550	SBM/TBM
64	442552.707	2529950.100	SBM/TBM
65	442623.914	2530005.838	SBM/TBM
66	442666.745	2530017.647	SBM/TBM
67	442719.281	2529982.899	SBM/TBM
68	442781.171	2530014.661	SBM/TBM
69	442845.125	2529994.359	SBM/TBM
70	442900.010	2530009.235	SBM/TBM
71	442976.796	2530013.479	SBM/TBM
72	443001.720	2530027.822	SBM/TBM
73	443077.418	2530063.767	SBM/TBM
74	443164.576	2530057.307	SBM/TBM
75	443175.651	2530049.344	SBM/TBM
76	443193.386	2530059.030	SBM/TBM
77	443239.362	2530076.814	SBM/TBM
78	443262.681	2530120.028	SBM/TBM
79	443243.132	2530179.549	SBM/TBM
80	443243.418	2530200.950	SBM/TBM
81	443284.948	2530282.253	SBM/TBM
82	443317.137	2530269.140	SBM/TBM

Annexure 5.3 Detailed Information of Bore Logs and Summary Sheet

Appendices

- Appendix-1: Borehole Location Map
- Appendix-2: Borehole Logs
- Appendix-3: Geological profile of bore logs
- Appendix-4: Bearing capacity of soil
- Appendix-5: Photograph

Appendix-1: Borehole Location Map


NORTH
LEGEND:
BOREHOLE LOCATION
SHED
BUILDING
POND/WATERBODY
CHHARA
EARTHEN ROAD
HERRING BONE ROAD
BITUMINOUS ROAD
SCALE: 1 : 250000
Feasibility and Detailed Design of
Chittagong Hills Tract Connectivity Project
ROAD ALIGNMENT : ROUTE 01
RAJOSHTHALI TO THEGAMUKH
Feasibility Report
SURVEYED BY : SURVEY2008

Appendix-2: Borehole Logs

SURVEY2000

Bore hole No: BH-01
Method of Boring: Percussion
Boring Dia.:100(mm)
Boring Depth: 12.0m

Exixting ground level: 71 m
Ground water level: Not seen
Started on: 24.12.2015
Completed on: 24.12.2015

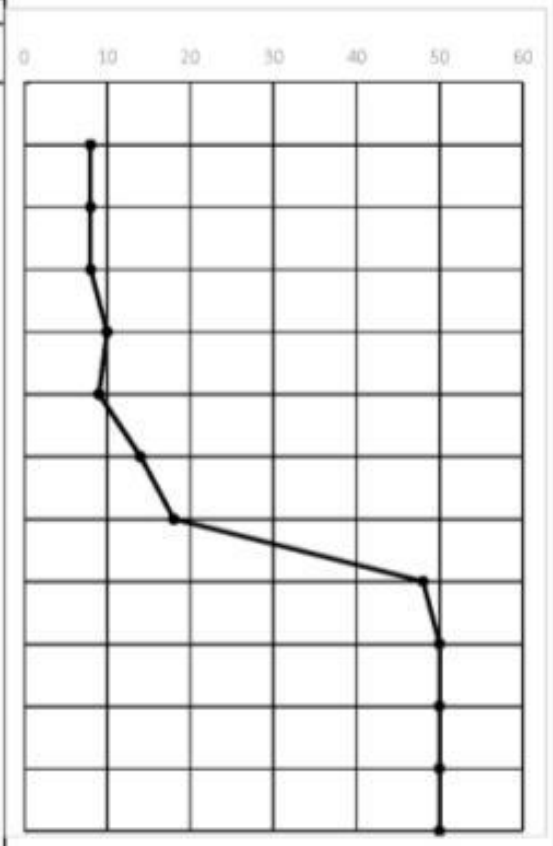
Client: BETS Consulting Services Ltd.
Project: Chittagong Hills Tracts Connectivity Project
Location: Gillamukh,Rajostholi,Rangamati

Legend: Clay, Silt, Sand

Coordinates: X=427609, Y=2472398

Depth (m)	Visual Description	Symbols	Sample	Thickness(m)	Standard Penetration Test: Blows on Spoon 15cm	15cm	15cm	N-Values 30cm
1.0	Medium stiff reddish brown low plastic sandy SILT ,little clay			3.0	2	3	5	8
2.0					2	3	5	8
3.0					3	4	4	8
4.0	Stiff reddish brown to brown medium plastic silty CLAY			2.0	3	5	5	10
5.0					3	4	5	9
6.0					4	7	7	14
7.0					5	8	10	18
8.0	Medium dense to very dense brown to yellowish brown silty SAND trace of mica			7.0	13	22	26	48
9.0					15	25	25	50
10.0					17	28	22	50
11.0					18	30	20	50
12.0	**End of Boring**				20	35	15	50
13.0								
14.0								
15.0								
16.0								
17.0								
18.0								
19.0								
20.0								

SPT blows per 0.3 m penetration



Disturbed Sample(Split Spoon)

Undisturbed Sample(Shelby Tube)

Logged by: Azahar

Checked by: Engr. Sharif

SURVEY2000

Bore hole No: BH-02
Method of Boring: Percussion
Boring Dia.:100(mm)
Boring Depth: 15.0m

Exixting ground level: 41m
Ground water level: 2.90m(below)
Started on: 24.12.2015
Completed on: 24.12.2015

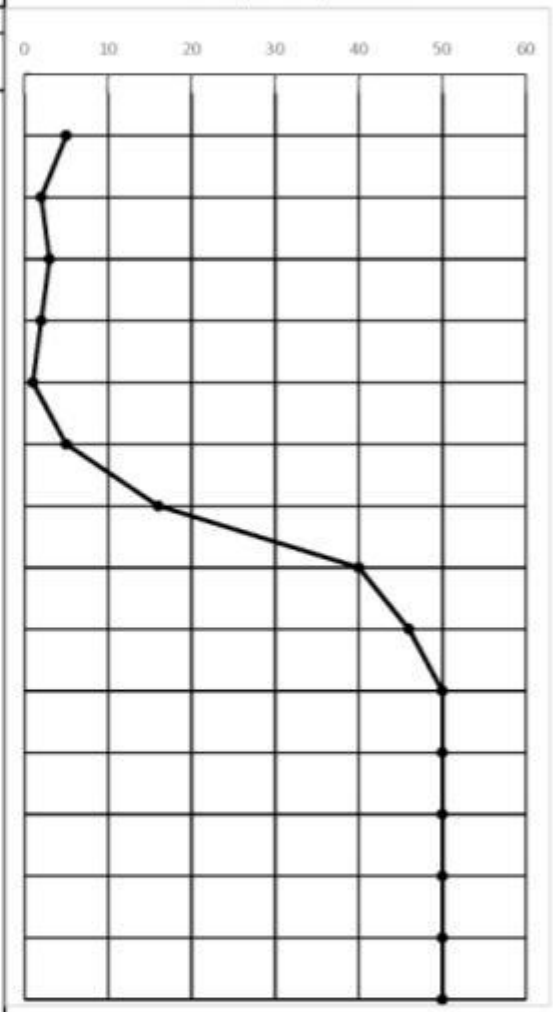
Client: BETS Consulting Services Ltd.
Project: Chittagong Hills Tracts Connectivity Project
Location: Alikol,Rajostholi,Rangamati

Legend: Clay, Silt, Sand

Coordinates: X=433525, Y=2479137

Depth (m)	Visual Description	Symbols	Sample	Thickness(m)	Standard Penetration Test: Blows on Spoon 15cm	15cm	15cm	N-Values 30cm
1.0	Loose brown silty fine SAND trace of mica			1.0	2	2	3	5
2.0	Very Soft brown sandy non plastic SILT trace of mica			1.0	1	1	1	2
3.0	Loose brown silty fine SAND trace of ica			1.0	1	1	2	3
4.0	Very soft brown medium to low plastic silty CLAY			2.0	1	1	1	2
5.0					1	0	1	1
6.0	Very loose to loose yellowish brown silty fine SAND trace of mica				1	2	3	5
7.0					3	7	9	16
8.0					8	18	22	40
9.0					11	16	30	46
10.0				11.0	20	30	20	50
11.0	Medium dense to very dense yellowish brown to brown silty fine SAND trace of mica				50	0	0	50
12.0					50	0	0	50
13.0					50	0	0	50
14.0					50	0	0	50
15.0	End of Boring				50	0	0	50
16.0								
17.0								
18.0								
19.0								
20.0								

SPT blows per 0.3 m penetration



Disturbed Sample(Split Spoon)
Undisturbed Sample(Shelby Tube)

Logged by: Azahar
Checked by: Engr. Sharif

SURVEY2000

Bore hole No: BH-03
Method of Boring: Percussion
Boring Dia.: 100(mm)
Boring Depth: 15.0m

Exixting ground level: 34 m
Ground water level: 3.05m(below)
Started on: 21.12.2015
Completed on: 21.12.2015

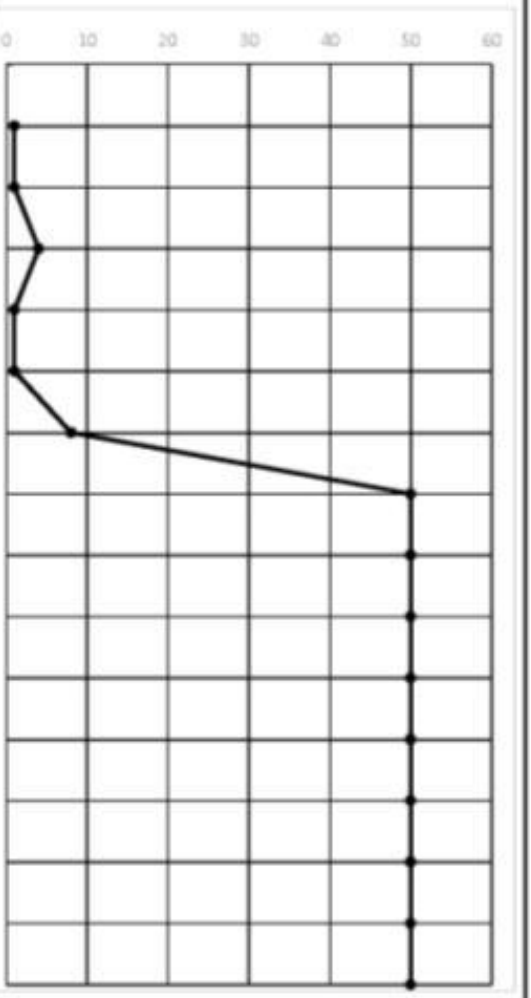
Client: BETS Consulting Services Ltd.
Project: Chittagong Hills Tracts Connectivity Project
Location: Bangal Kathachora,rajostholi,Rangamati

Legend: Clay, Sand, Silt

Coordinates: X=434006 , Y= 2488924

Depth (m)	Visual Description	Symbols	Sample	Thickness(m)	Standard Penetration Test: Blows on Spoon 15cm	15cm	15cm	N-Values 30cm
1.0	Very soft to soft gray medium plastic silty CLAY			4.0	1	0	1	1
2.0					1	0	1	1
3.0					1	2	2	4
4.0					1	0	1	1
5.0	very soft gray low plastic sandy SILT with trace of mica			1.0	1	0	1	1
6.0	Medium stiff gray medium plastic silty CLAY			1.0	3	4	4	8
7.0	Hard gray spotted brown to light grey non-plastic sandy SILT trace of mica			9.0	40	50	0	50
8.0					43	50	0	50
9.0					50	0	0	50
10.0					50	0	0	50
11.0					50	0	0	50
12.0					50	0	0	50
13.0					50	0	0	50
14.0					50	0	0	50
15.0	**End of Boring**				50	0	0	50
16.0								
17.0								
18.0								
19.0								
20.0								

SPT blows per 0.3 m penetration



Disturbed Sample(Split Spoon)
Undisturbed Sample(Shelby Tube)

Logged by: Azahar
Checked by: Engr. Sharif

SURVEY2000

Bore hole No: BH-04
Method of Boring: Percussion
Boring Dia.:100(mm)
Boring Depth: 24.0m

Exixting ground level: 45.0m
Ground water level: 2.50m(below)
Started on: 10.12.2015
Completed on: 11.12.2015

Client: BETS Consulting Services Ltd.
Project: Chittagong Hills Tracts Connectivity Project
Location: Samira primary school,Juraichora,Rangamati

Legend: Clay, Silt, Sand

Coordinates: X=434884, Y=2503987

Depth (m)	Visual Description	Symbols	Sample	Thickness(m)	Standard Penetration Test: Blows on Spoon 15cm	15cm	15cm	N-Values 30cm
1.0	Very soft to soft gray medium plastic gray silty CLAY			2.0	1	1	1	2
2.0					1	1	2	3
	Very loose gray silty fine SAND trace of mica			1.0				
3.0					1	0	1	1
4.0	Soft gray low to medium plastic silty CLAY			3.0	1	2	2	4
5.0					1	1	2	3
6.0					1	1	3	4
7.0	Loose grey silty fine SAND trace of mica			4.0	2	2	4	6
8.0					1	3	3	6
9.0					3	4	4	8
10.0	Medium stiff liht grey medium plastic sandy CLAY			1.0	3	4	5	9
11.0					1	3	4	7
12.0	Mdium dense gray to brownish gray silty fine SAND trace of mica			6.0	4	5	8	13
13.0					3	5	8	13
14.0					3	5	8	13
15.0					4	6	8	14
16.0					5	6	8	14
17.0					5	7	8	15
18.0	Stiff to hard light hray to gray medium plastic silty CLAY			3.0	3	4	6	10
19.0					5	7	8	15
20.0					17	50	0	50

SPT blows per 0.3 m penetration

0 10 20 30 40 50 60 70 80

Disturbed Sample(Split Spoon)
Undisturbed Sample(Shelby Tube)

Page 1 of 2

Logged by: Azahar
Checked by: Engr. Sharif

SURVEY2000

Bore hole No: BH-04
Method of Boring: Percussion
Boring Dia.: 100(mm)
Boring Depth: 24.0m

Exixting ground level: 45.0m
Ground water level: 2.50m(below)
Started on: 10.12.2015
Completed on: 11.12.2015

Client: BETS Consulting Services Ltd.
Project: Chittagong Hills Tracts Connectivity Project
Location: Samira primary school,Juraichora,Rangamati

Legend: Clay, Sand, Silt

Coordinates: X=434884, Y=2503987

SPT blows per 0.3 m penetration

Depth (m)	Visual Description	Symbols	Sample	Thickness(m)	Standard Penetration Test: Blows on Spoon 15cm	15cm	15cm	N-Values 30cm
21.0	Hard gray medium plastic silty CLAY			6.0	65	0	0	65
22.0					50	50	0	50
23.0					70	0	0	70
24.0	**End of Boring**				80	0	0	80
25.0								
26.0								
27.0								
28.0								
29.0								
30.0								
31.0								
32.0								
33.0								
34.0								
35.0								
36.0								
37.0								
38.0								
39.0								
40.0								

Disturbed Sample(Split Spoon)
Undisturbed Sample(Shelby Tube)

Page 2 of 2

Logged by: Azahar
Checked by: Engr. Sharif

SURVEY2000

Bore hole No: BH-05
Method of Boring: Percussion
Boring Dia.: 100(mm)
Boring Depth: 15.0m

Exixting ground level:31.0 m
Ground water level: 2.4m(below)
Started on: 18.12.2015
Completed on: 18.12.2015

Client: BETS Consulting Services Ltd.
Project: Chittagong Hills Tracts Connectivity Project
Location: Chakrachora, Juraichora, Rangamati

Legend: Clay, Silt, Sand

Coordinates: X=436674, Y=2507666

Depth (m)	Visual Description	Symbols	Sample	Thickness(m)	Standard Penetration Test: Blows on Spoon 15cm	15cm	15cm	N-Values 30cm
1.0	Soft to very stiff brown medium plastic silty CLAY			3.0	1	2	2	4
2.0					2	5	6	11
3.0					4	11	15	26
4.0	Hard brown medium plastic silty CLAY			12.0	16	27	23	50
5.0					15	30	20	50
6.0					18	35	15	50
7.0					20	40	10	50
8.0					22	43	7	50
9.0					25	47	3	50
10.0					27	50	0	50
11.0					30	50	0	50
12.0					32	50	0	50
13.0					35	50	0	50
14.0					40	50	0	50
15.0	**End og Boring**				48	50	0	50
16.0								
17.0								
18.0								
19.0								
20.0								

SPT blows per 0.3 m penetration

0 10 20 30 40 50 60

Disturbed Sample(Split Spoon)
Undisturbed Sample(Shelby Tube)

Logged by: Azahar
Checked by: Engr. Sharif

SURVEY2000

Bore hole No: BH-06
Method of Boring: Percussion
Boring Dia.:100(mm)
Boring Depth: 31.0m

Exixting ground level: 33.0 m
Ground water level: 2.35m(below)
Started on: 15.12.2015
Completed on: 16.12.2015

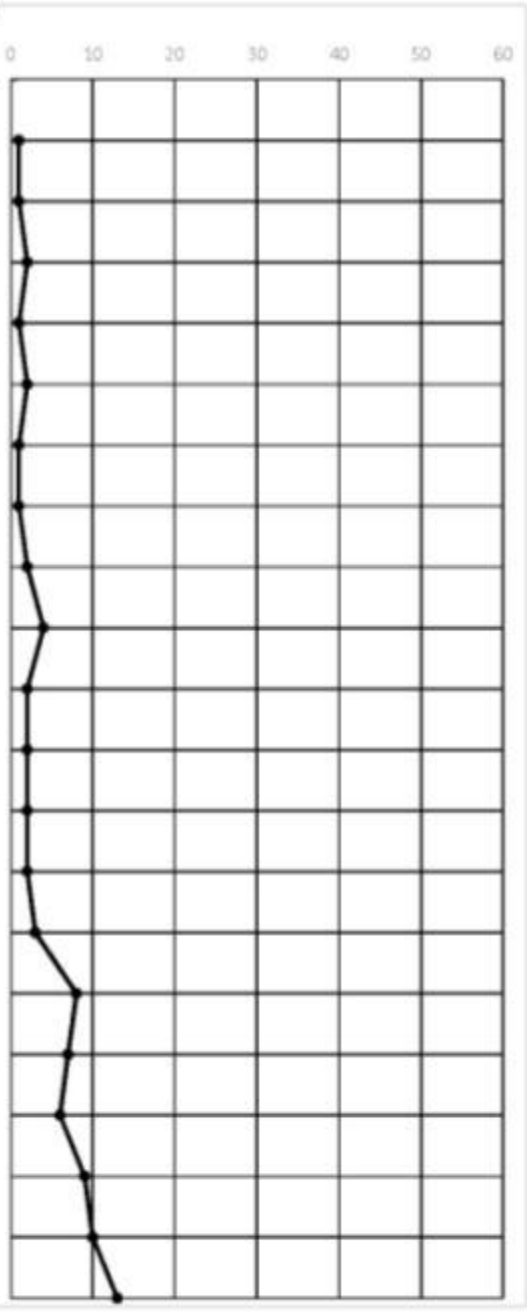
Client: BETS Consulting Services Ltd.
Project: Chittagong Hills Tracts Connectivity Project
Location: Borkal Post Office ,Borkal, Rangamati

Legend: Clay, Silt, Sand

Coordinates: X=437513, Y=2512208

Depth (m)	Visual Description	Symbols	Sample	Thickness(m)	Standard Penetration Test: Blows on Spoon 15cm	15cm	15cm	N-Values 30cm
0.0	Very soft brown low plastic clayey SILT			1.0	1	0	1	1
1.0	Very soft gray medium plastic silty CLAY			1.0	1	0	1	1
2.0	Soft gray non-plastic sandy SILT			1.0	1	1	1	2
3.0	Very soft to soft gray medium plastic silty CLAY			7.0	1	0	1	1
4.0					1	1	1	2
5.0					1	0	1	1
6.0					1	0	1	1
7.0					1	1	1	2
8.0					1	2	2	4
9.0					1	1	1	2
10.0	Very loose gray silty fine SAND trace of mica			2.0	1	1	1	2
11.0					1	1	1	2
12.0	Very soft to medium stiff gray low plastic clayey SILT trace of mica			4.0	1	1	1	2
13.0					1	1	2	3
14.0					3	3	5	8
15.0					2	3	4	7
16.0	Medium stiff light gray medium plastic silty CLAY			1.0	2	3	3	6
17.0	Stiff light gray lo plastic Clayey SILT trace of mica			2.0	3	4	5	9
18.0					3	4	6	10
19.0	Medium dense gray silty fine SAND trace of mica			1.0	3	5	8	13
20.0								

SPT blows per 0.3 m penetration



Disturbed Sample(Split Spoon)
Undisturbed Sample(Shelby Tube)

Page 1 of 2

Logged by: Azahar
Checked by: Engr. Sharif

SURVEY2000

Bore hole No: BH-06
Method of Boring: Percussion
Boring Dia.:100(mm)
Boring Depth: 31.0m

Exixting ground level: 33.0 m
Ground water level: 2.35m(below)
Started on: 15.12.2015
Completed on: 16.12.2015

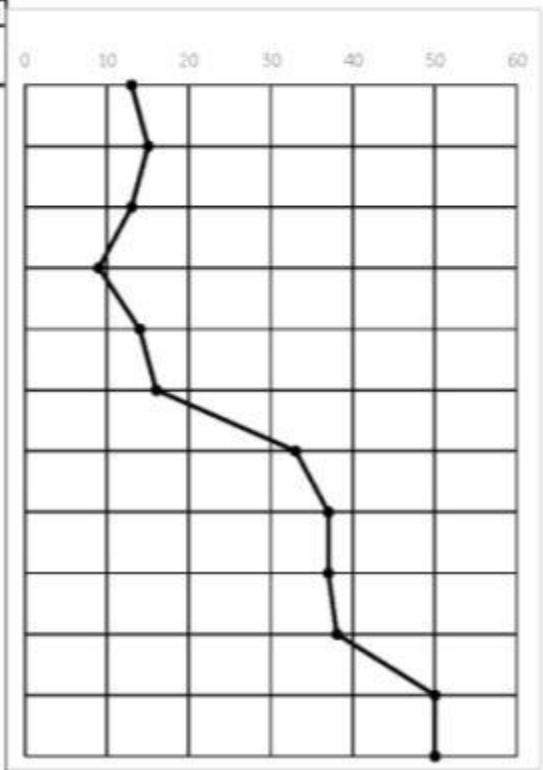
Client: BETS Consulting Services Ltd.
Project: Chittagong Hills Tracts Connectivity Project
Location: Borkal Post Office ,Borkal, Rangamati

Legend: Clay, Sand, Silt

Coordinates: X=437513, Y=2512208

Depth (m)	Visual Description	Symbols	Sample	Thickness(m)	Standard Penetration Test: Blows on Spoon 15cm	15cm	15cm	N-Values 30cm
21.0	Medium dense gray silty fine SAND trace of mica			2.0	7	7	8	15
22.0					5	6	7	13
23.0	Stiff gray medium plastic silty CLAYwith organic			1.0	3	4	5	9
24.0	Medium dense gray silty fine SAND trace of mica			2.0	3	5	9	14
25.0					3	6	10	16
26.0					3	13	20	33
27.0					10	17	20	37
28.0	Hard gray medium plastic sandy CLAY			6.0	10	18	19	37
29.0					11	18	20	38
30.0					15	23	27	50
31.0	**End of Boring**				18	25	25	50
32.0								
33.0								
34.0								
35.0								
36.0								
37.0								
38.0								
39.0								
40.0								

SPT blows per 0.3 m penetration



Disturbed Sample(Split Spoon)
Undisturbed Sample(Shelby Tube)

Page 2 of 2

Logged by: Azahar
Checked by: Engr. Sharif

SURVEY2000

Bore hole No: BH-07
Method of Boring: Percussion
Boring Dia.: 100(mm)
Boring Depth: 26.0m

Exixting ground level: 30.0m
Ground water level: 2.95m(below)
Started on: 14.12.2015
Completed on: 15.12.2015

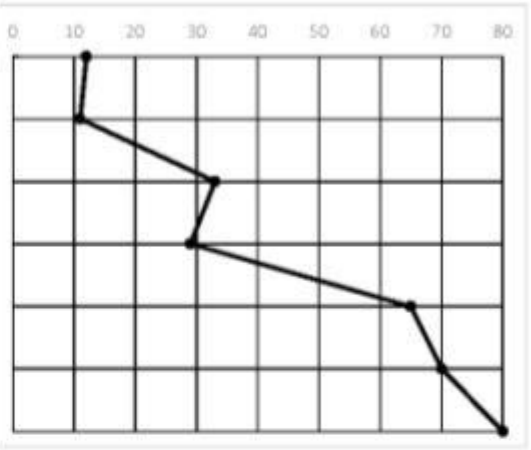
Client: Power Energy management & Engineering Company
Project: Chittagong Hills Tracts Connectivity Project
Location: Jagachora,Borkal,rangamati

Legend: Clay, Silt, Sand

Coordinates: X=438028, Y=2514462

Depth (m)	Visual Description	Symbols	Sample	Thickness(m)	Standard Penetration Test: Blows on Spoon 15cm	15cm	15cm	N-Values 30cm
21.0	Very stiff light gray medium plastic silty CLAY			2.0	3	4	7	11
22.0					6	13	20	33
23.0					12	13	16	29
24.0	Dense gray clayey fine SAND trace of mica			4.0	65	0	0	65
25.0					70	0	0	70
26.0	**End of Boring**				80	0	0	80
27.0								
28.0								
29.0								
30.0								
31.0								
32.0								
33.0								
34.0								
35.0								
36.0								
37.0								
38.0								
39.0								
40.0								

SPT blows per 0.3 m penetration



Disturbed Sample(Split Spoon)
Undisturbed Sample(Shelby Tube)

Page 2 of 2

Logged by: Azahar
Checked by: Engr. Sharif

SURVEY2000

Bore hole No: BH-07
Method of Boring: Percussion
Boring Dia.: 100(mm)
Boring Depth: 26.0m

Exixting ground level: 30.0m
Ground water level: 2.95m(below)
Started on: 14.12.2015
Completed on: 15.12.2015

Client: BETS Consulting Services Ltd.
Project: Chittagong Hills Tracts Connectivity Project
Location: Jagachora,Borkal,rangamati

Legend: Clay, Silt, Sand

Coordinates: X=438028, Y=2514462

Depth (m)	Visual Description	Symbols	Sample	Thickness(m)	Standard Penetration Test: Blows on Spoon 15cm	15cm	15cm	N-Values 30cm
1.0	Very soft brown low plastic clayey SILT trace of mica			2.0	1	0	1	1
2.0					1	0	1	1
3.0	Very soft brown low plastic sandy SILT trace of mica			1.0	1	1	1	2
4.0	Very soft brown low plastic clayey SILT trace of mica			3.0	0	0	1	1
5.0					1	1	1	2
6.0	Soft brown low to medium plastic silty CLAY			4.0	1	0	2	2
7.0					1	2	2	4
8.0					1	1	1	2
9.0					1	2	2	4
10.0	Stiff reddish brown non-plastic sandy SILT trace of mica			1.0	1	1	2	3
11.0	Very stiff gray spotted brown medium plastic silty CLAY			1.0	3	5	8	13
12.0	Very stiff gray non-plastic sandy SILT trace of mica			1.0	6	8	10	18
13.0	Medium stiff to very stiff gray medium plastic silty CLAY			7.0	6	10	11	21
14.0					2	3	5	8
15.0					3	5	8	13
16.0					3	8	11	19
17.0					5	7	10	17
18.0					5	8	11	19
19.0					7	8	10	18
20.0					4	5	7	12

SPT blows per 0.3 m penetration

0 10 20 30 40 50 60 70 80

Disturbed Sample(Split Spoon)
Undisturbed Sample(Shelby Tube)

Page 1 of 2

Logged by: Azahar
Checked by: Engr. Sharif

SURVEY2000

Bore hole No: BH-08
Method of Boring: Percussion
Boring Dia.:100(mm)
Boring Depth: 15.0m

Exixting ground level: 32.0 m
Ground water level: 2.2m(below)
Started on: 13.12.2015
Completed on: 13.12.2015

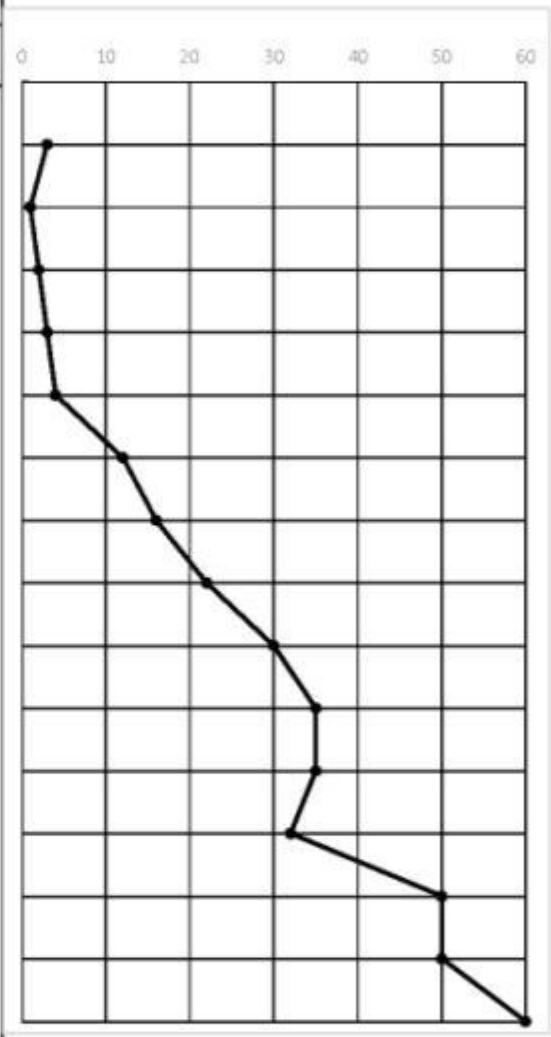
Client: BETS Consulting Services Ltd.
Project: Chittagong Hills Tracts Connectivity Project
Location: Kolabunia, Borkal, Rangamati

Legend: Clay, Silt, Sand

Coordinates: X=437370, Y=2522177

Depth (m)	Visual Description	Symbols	Sample	Thickness(m)	Standard Penetration Test: Blows on Spoon 15cm	15cm	15cm	N-Values 30cm
1.0	Soft to very soft brown to reddish brown medium plastic silty CLAY			5.0	1	1	2	3
2.0					1	0	1	1
3.0					1	1	1	2
4.0					1	1	2	3
5.0					1	2	2	4
6.0	Medium dense to dense brown to reddish brown silty fine SAND trace of mica			7.0	4	5	7	12
7.0					4	6	10	16
8.0					5	9	13	22
9.0					7	10	20	30
10.0					9	16	19	35
11.0					10	16	19	35
12.0					9	13	19	32
13.0	Hard light gray medium plastic silty CLAy			4.0	12	45	5	50
14.0					28	50	0	50
15.0	**End of Boring**				60	0	0	60
16.0								
17.0								
18.0								
19.0								
20.0								

SPT blows per 0.3 m penetration



Disturbed Sample(Split Spoon)
Undisturbed Sample(Shelby Tube)

Logged by: Azahar
Checked by: Engr. Sharif

SURVEY2000

Bore hole No: BH-09
Method of Boring: Percussion
Boring Dia.:100(mm)
Boring Depth: 15.0m

Exixting ground level: 35.0m
Ground water level: 1.10m(below)
Started on: 10.12.2015
Completed on: 11.12.2015

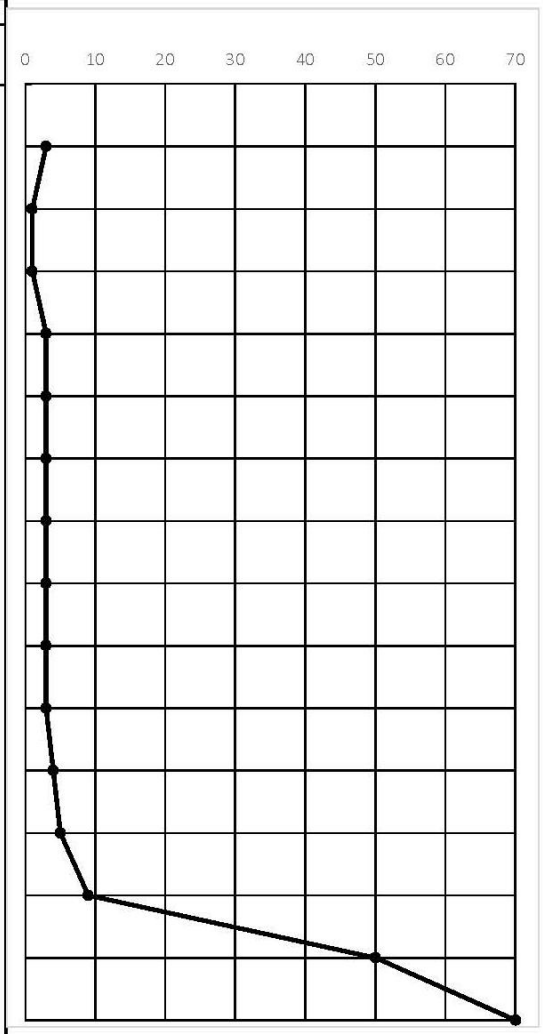
Client: BETS Consulting Services Ltd.
Project: Chittagong Hills Tracts Connectivity Project
Location: Chotohorina ,Borkal, Rangamati

Legend: Clay, Silt, Sand

Coordinates: X=437776, Y=2529760

Depth (m)	Visual Description	Symbols	Sample	Thickness(m)	Standard Penetration Test: Blows on Spoon 15cm	15cm	15cm	N-Values 30cm
1.0	Very soft to soft brown to gray low plastic to medium plastic silty CLAY			4.0	1	1	2	3
2.0					1	0	1	1
3.0					1	0	1	1
4.0	Soft light gray non-plastic sandy SILT trace of mica			1.0	1	1	2	3
5.0	Soft to medium stiff light gray low plastic to medium plastic silty CLAY			8.0	1	1	2	3
6.0					1	1	2	3
7.0					1	1	2	3
8.0					1	1	2	3
9.0					1	1	2	3
10.0					1	1	2	3
11.0					1	2	2	4
12.0					1	2	3	5
13.0					3	4	5	9
14.0	Hard light gray medium plastic silty CLAY			2.0	12	35	15	50
15.0	**End of Boring**				70	0	0	70
16.0								
17.0								
18.0								
19.0								
20.0								

SPT blows per 0.3 m penetration



Disturbed Sample(Split Spoon)
Undisturbed Sample(Shelby Tube)

Logged by: Azahar
Checked by: Engr. Sharif

SURVEY2000

Bore hole No: BH-10
Method of Boring: Percussion
Boring Dia.: 100(mm)
Boring Depth: 15.0m

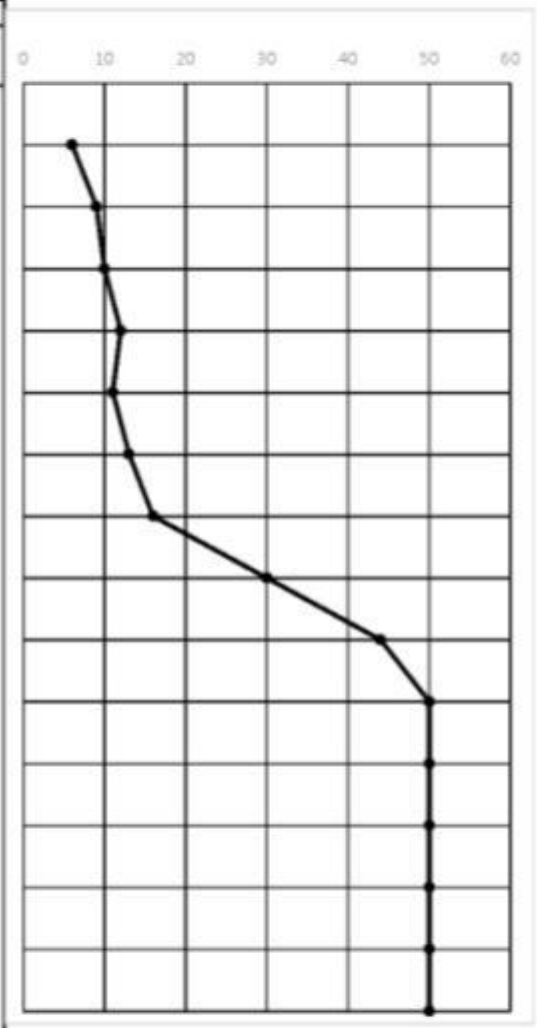
Exixting ground level: 101.0 m
Ground water level: Not seen
Started on: 12.12.2015
Completed on: 12.12.2015

Client: BETS Consulting Services Ltd.
Project: Chittagong Hills Tracts Connectivity Project
Location: Teghamukh, Borkal,Rangamati

Legend: Clay, Silt, Sand

Coordinates: X=438868, Y=2530019

SPT blows per 0.3 m penetration



Depth (m)	Visual Description	Symbols	Sample	Thickness(m)	Standard Penetration Test: Blows on Spoon 15cm	15cm	15cm	N-Values 30cm
1.0	Medium stiff to stiff brown to reddish brown sandy SILT trace of mica			3.0	2	3	3	6
2.0					3	4	5	9
3.0					3	5	5	10
4.0	Stiff to very stiff reddish brown medium plastic silty CLAY			4.0	3	5	7	12
5.0					3	5	6	11
6.0					4	6	7	13
7.0					5	7	9	16
8.0	Dense to very dense yellowish brown silty fine SAND trace of mica				10	13	17	30
9.0					13	19	25	44
10.0					17	29	21	50
11.0					18	31	19	50
12.0					21	34	16	50
13.0					24	40	10	50
14.0					27	45	5	50
15.0	End of Boring				30	50	0	50
16.0								
17.0								
18.0								
19.0								
20.0								

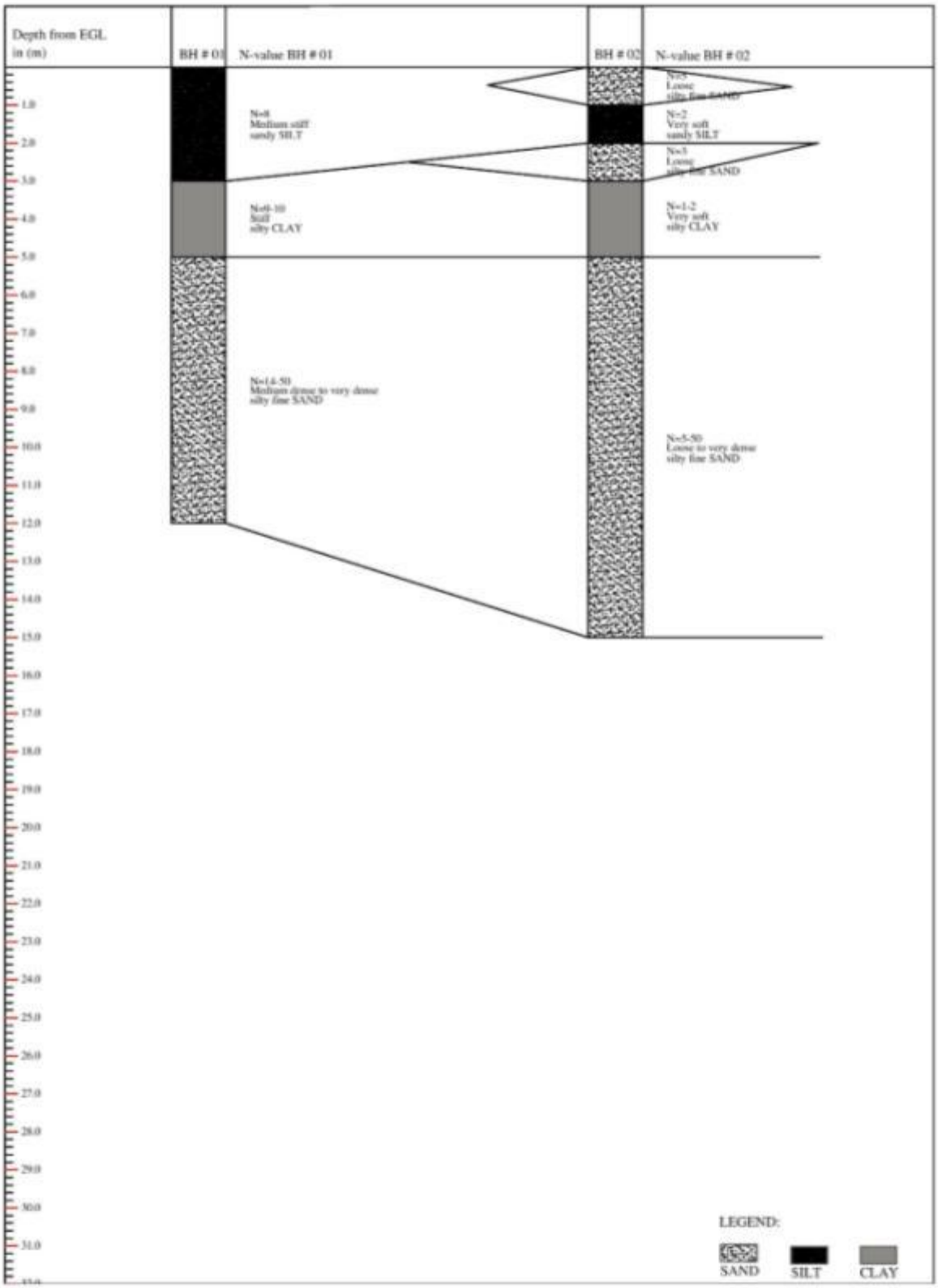
Disturbed Sample(Split Spoon)
Undisturbed Sample(Shelby Tube)

Logged by: Azahar
Checked by: Engr. Sharif

Appendix-3: Geological Profile of Bore Logs

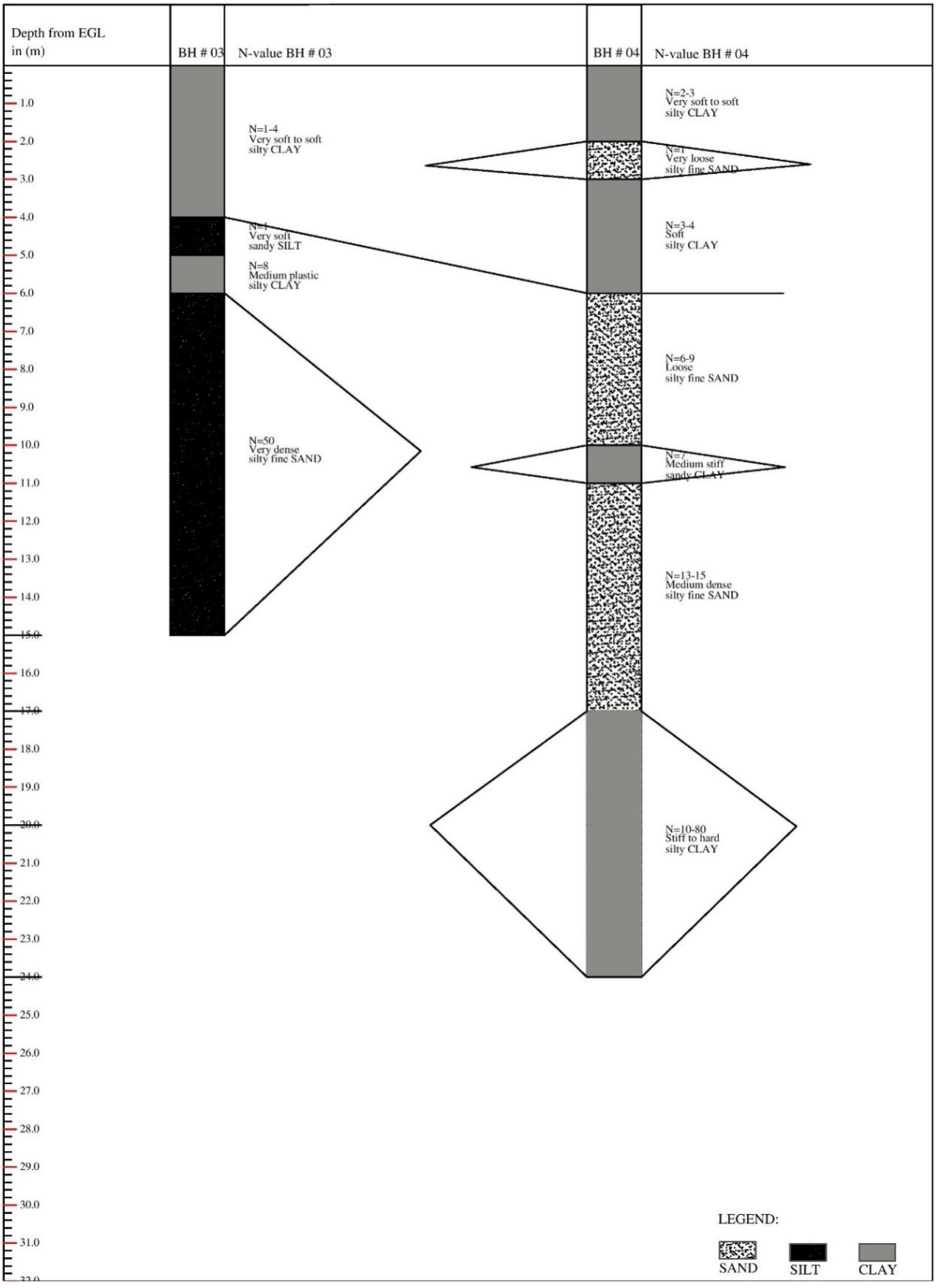
SURVEY 2000

GEOLOGICAL PROFILE ALONG THE BOREHOLE 01 & 02 AT SITE-1
CHITTAGONG HILLS TRACTS CONNECTIVITY PROJECT



SURVEY 2000

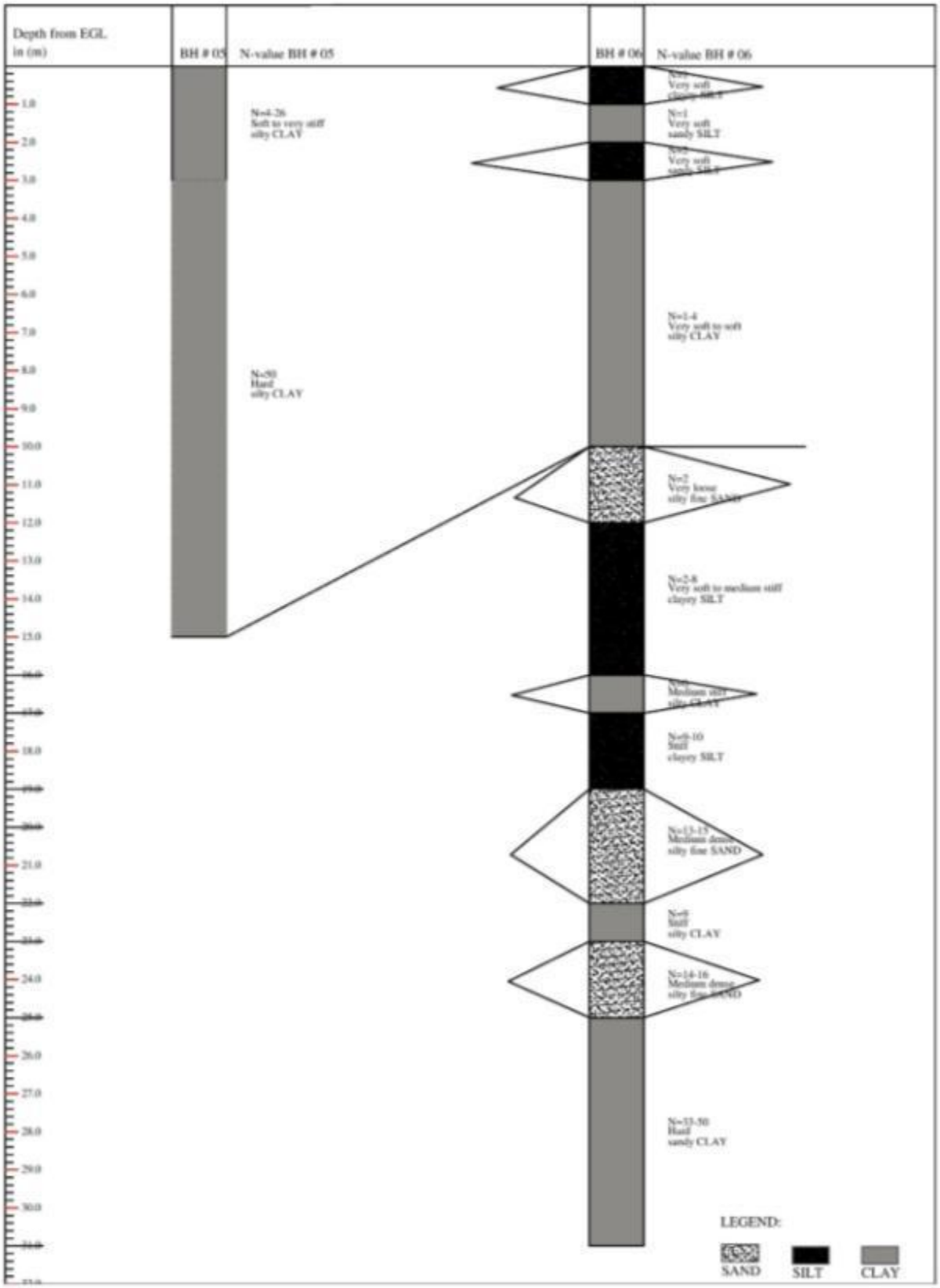
GEOLOGICAL PROFILE ALONG THE BOREHOLE 03 & 04 AT SITE-2
CHITTAGONG HILLS TRACTS CONNECTIVITY PROJECT



SURVEY 2000

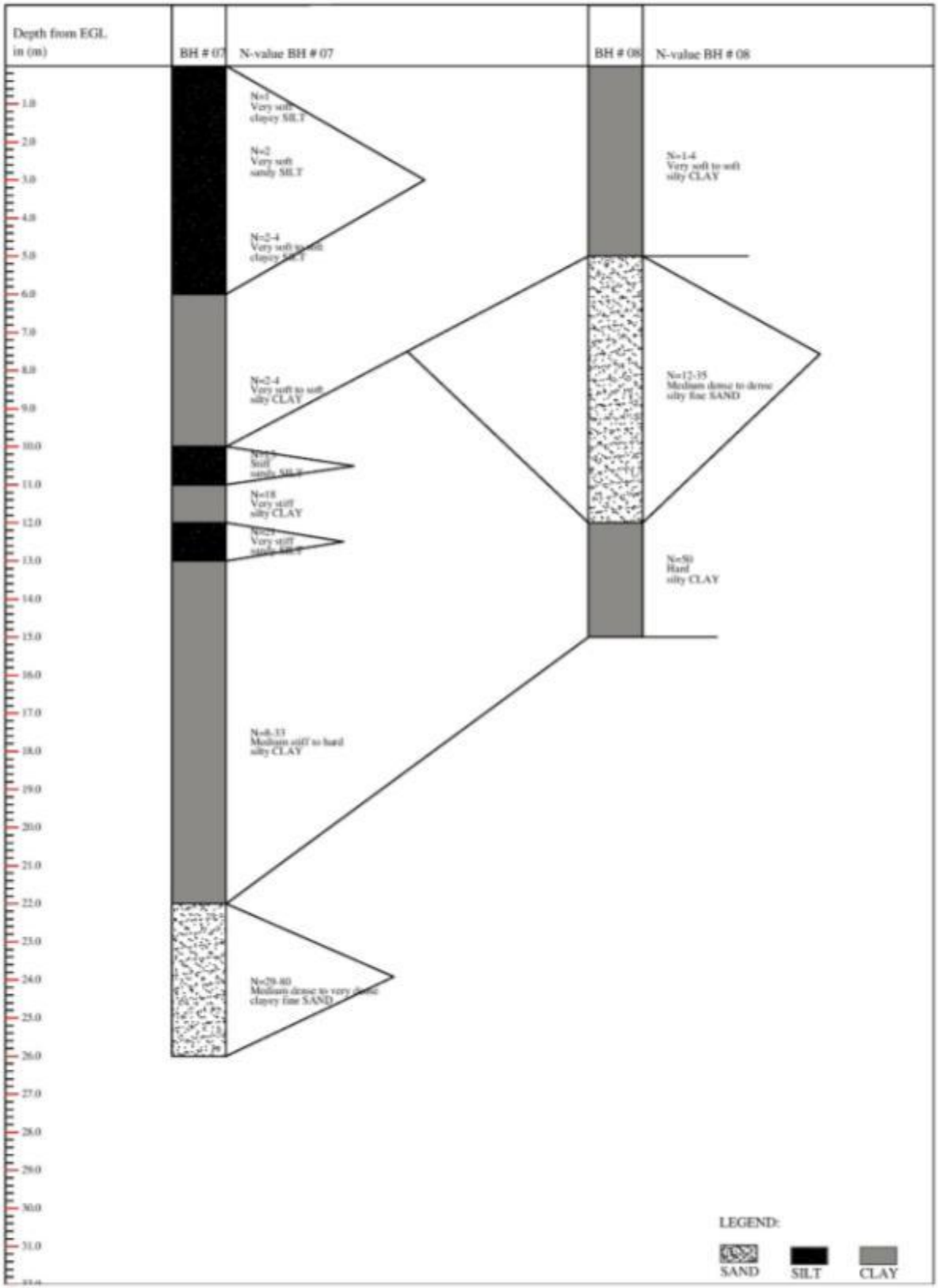
GEOLOGICAL PROFILE ALONG THE BOREHOLE 05 & 06 AT SITE-3

CHITTAGONG HILLS TRACTS CONNECTIVITY PROJECT



SURVEY 2000

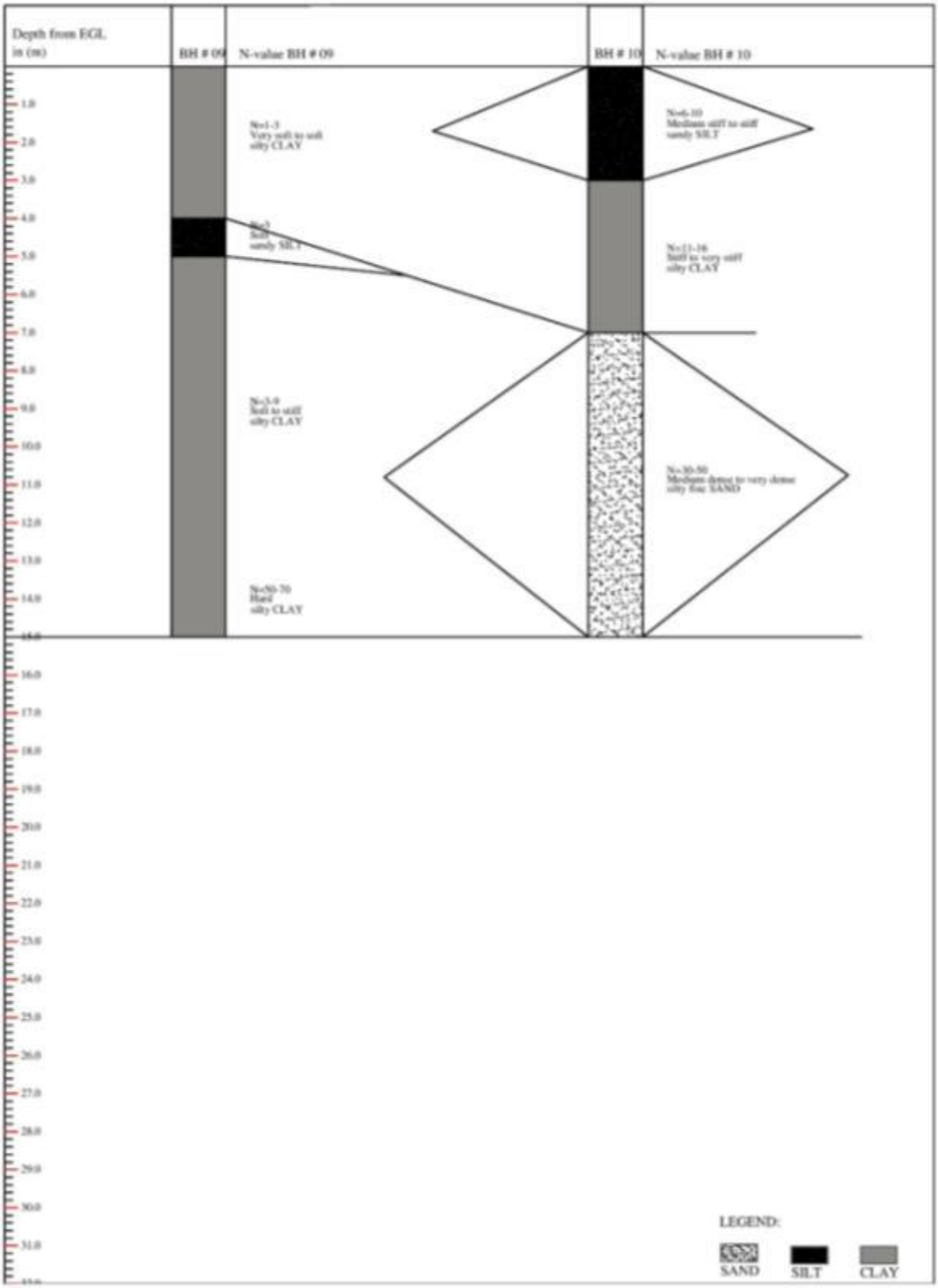
GEOLOGICAL PROFILE ALONG THE BOREHOLE 07 & 08 AT SITE-4
CHITTAGONG HILLS TRACTS CONNECTIVITY PROJECT



SURVEY 2000

GEOLOGICAL PROFILE ALONG THE BOREHOLE 09 & 10 AT SITE-5

CHITTAGONG HILLS TRACTS CONNECTIVITY PROJECT

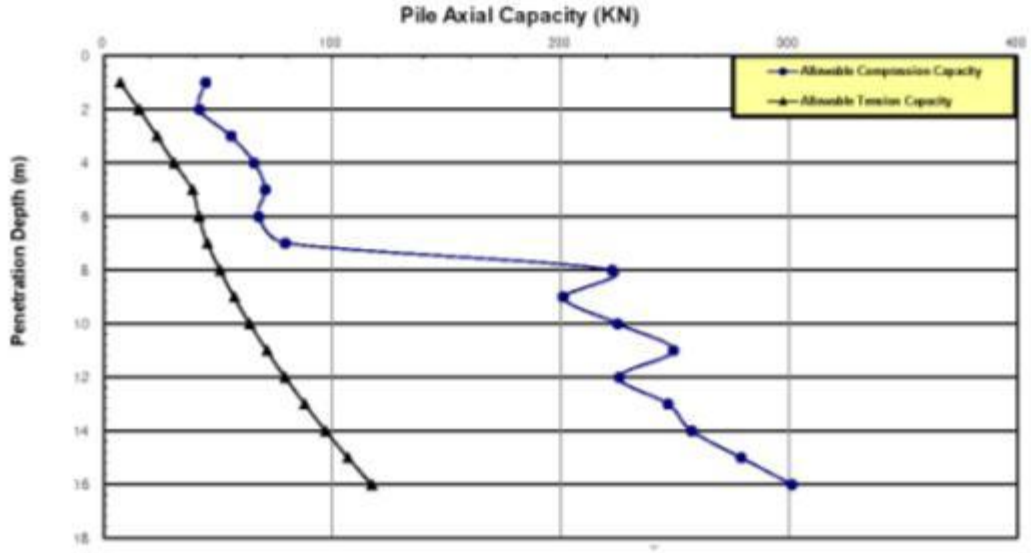


Appendix-4: Bearing Capacity of Soil

BH-01 Dia of Pile (450 mm) S.F 2.5

Depth in metre measured from EGL																				
from	to	Average	Layer thickness, m	Field SPT	Corrected SPT N'	Soil Type	Effective unit weight of soil, γ (kN/m3)	Cohesion, c (kN/m2)	Friction Angle ϕ (degree)	Angle, δ (degree)	Effective over burden pressure, P' (kN/m2)	α	λ	Nq	Nc	Surface area, As (m2)	Unit Skin Friction, fs (kN/m2)	Unit End Bearing, fb (kN/m2)	Skin friction, kN	End bearing, kN	Tension Capacity kN (FS=2.5)	Compression Capacity kN (FS=2.5)
0	1	0.5	1.0	8	11	Silt	18	65	-	-	9	1	0.42	-	9	0.64	18.52	196.24	17.59	93.63	**7.04**	**44.49**
1	2	1.5	1.0	8	8	Silt	18	46	-	-	27	1	0.7	-	9	0.64	21.58	138.76	20.49	66.21	**16.23**	**41.71**
2	3	2.5	1.0	8	9	Silt	8	57	-	-	20	1	0.55	-	9	0.64	20.79	169.96	19.74	81.09	**23.13**	**55.56**
3	4	3.5	1.0	10	10	Clay	8	61	-	-	28	1	0.48	-	9	0.64	19.77	183.97	18.77	87.76	**30.64**	**65.75**
4	5	4.5	1.0	9	9	Clay	8	56	-	-	36	1	0.56	-	9	0.64	20.91	167.84	19.86	80.09	**38.58**	**70.61**
5	6	5.5	1.0	14	15	Sand	8	-	29	21.8	44	1	-	28	-	0.64	11.76	410.67	7.48	65.31	**41.57**	**67.70**
6	7	6.5	1.0	18	18	Sand	8	-	30	22.5	52	1	-	31	-	0.64	14.43	537.33	9.18	85.46	**45.25**	**79.43**
7	8	7.5	1.0	49	44	Sand	8	-	38	28.5	60	1	-	135	-	0.64	21.83	2700	13.89	429.42	**50.80**	**222.67**
8	9	8.5	1.0	50	43	Sand	8	-	37	27.8	68	1	-	100	-	0.64	23.97	2298.7	15.25	360.50	**56.90**	**201.10**
9	10	9.5	1.0	50	43	Sand	8	-	37	27.8	76	1	-	100	-	0.64	26.79	2533.3	17.04	402.91	**63.72**	**224.88**
10	11	10.5	1.0	50	41	Sand	8	-	37	27.8	84	1	-	100	-	0.64	29.61	2800	18.84	445.32	**71.25**	**249.38**
11	12	11.5	1.0	50	39	Sand	8	-	36	27.0	92	1	-	75	-	0.64	31.41	2300	19.98	365.80	**79.24**	**225.56**
12	13	12.5	1.0	50	38	Sand	8	-	36	27.0	100	1	-	75	-	0.64	34.14	2500	21.72	397.61	**87.93**	**246.97**
13	14	13.5	1.0	50	37	Sand	8	-	35	26.3	108	1	-	70	-	0.64	35.68	2520	22.70	400.79	**97.01**	**257.33**
14	15	14.5	1.0	50	35	Sand	8	-	35	26.3	116	1	-	70	-	0.64	38.33	2706.7	24.38	430.48	**106.76**	**279.86**
15	16	15.5	1.0	50	34	Sand	8	-	35	26.3	124	1	-	70	-	0.64	40.97	2893.3	26.06	460.17	**117.19**	**301.26**
																			292.97	**4252.56**		

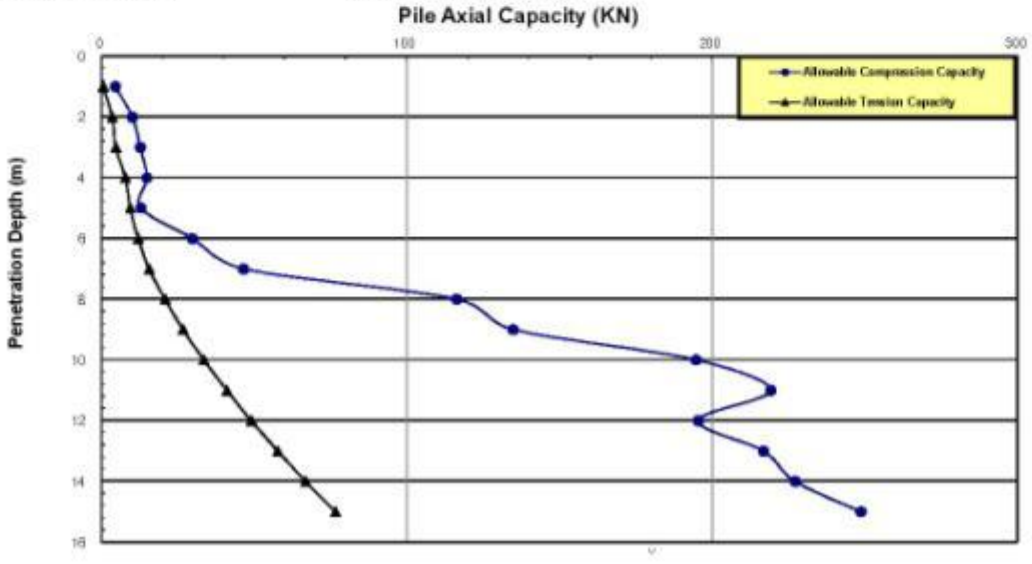
		PILE TYPE	BORED CAST IN SITU RCC
Ultimate capacity of pile Qu	4545.5 kN	Pile dia	0.45 m
Factor of safety against axial compression, FS	2.5	Pile length	30.0 m from EGL
Safe capacity Qa	1818.2 kN	Soil profile (Ref. Sub-Soil report borehole # BH-01)	
Group efficiency	1	Axial Compression and Tension capacity	
Reduced capacity due to group efficiency	1818.2 kN	Skin friction = $k_s \cdot \gamma' \cdot N' \cdot \tan\delta$	



BH-02 Dia of Pile (450 mm) S.F 2.5

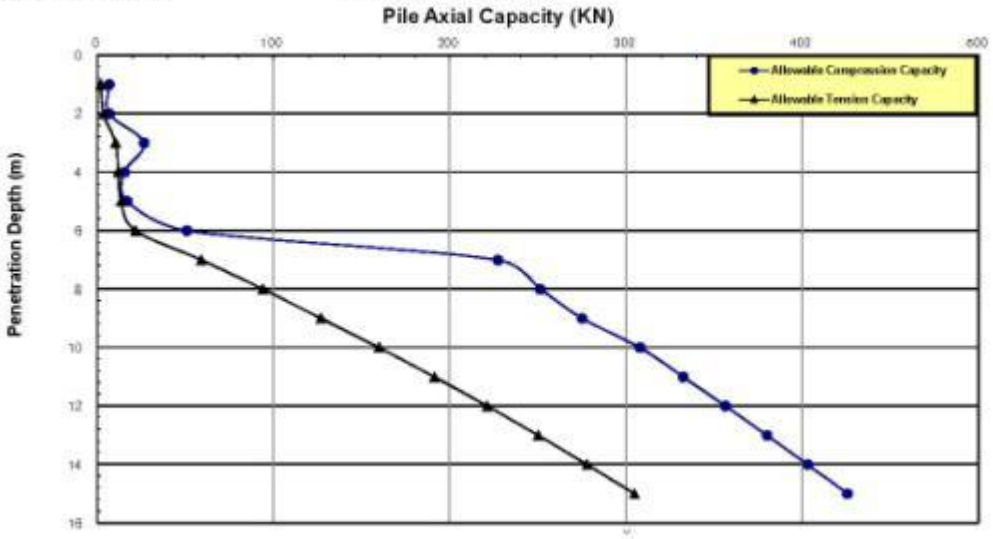
Depth in m below measured from EGL: from	to	Average	Layer thickness, m	Field SPT	Corrected SPT N'	Soil Type	Effective unit weight of soil, γ (kN/m3)	Cohesion, c (kN/m2)	Friction Angle ◆ (degree)	Angle δ (degree)	Effective over burden pressure, P' (kN/m2)	K	α	Nq	Nc	Surface area, A_s (m2)	Unit Skin Friction, f_s (kN/m2)	Unit End Bearing, f_b (kN/m2)	Skin friction, KN	End bearing, KN	Tension Capacity KN (FS=2.5)	Compression Capacity KN (FS=2.5)
0	1	0.5	1.0	5	7	Sand	18	-	27	20.3	9	1	-	21	-	0.64	2.22	63	1.42	10.02	0.57	4.57
1	2	1.5	1.0	2	2	Silt	18	12	-	-	27	1	1	-	9	0.64	7.75	34.69	7.36	16.55	3.51	10.13
2	3	2.5	1.0	3	4	Sand	8	-	26	19.5	20	1	-	19	-	0.64	4.75	126.67	3.02	20.15	4.72	12.77
3	4	3.5	1.0	2	2	Clay	8	12	-	-	28	1	1	-	9	0.64	8.22	36.795	7.80	17.56	7.84	14.86
4	5	4.5	1.0	1	1	Clay	8	6	-	-	36	1	1	-	9	0.64	4.38	18.649	3.95	8.90	9.42	12.96
5	6	5.5	1.0	5	5	Sand	8	-	26	19.5	44	1	-	19	-	0.64	10.44	278.67	6.64	44.32	12.08	29.80
6	7	6.5	1.0	16	16	Sand	8	-	29	21.8	52	1	-	28	-	0.64	13.90	485.33	8.84	77.19	15.61	46.49
7	8	7.5	1.0	40	37	Sand	8	-	36	27.0	60	1	-	75	-	0.64	20.48	1500	13.03	238.57	20.82	116.25
8	9	8.5	1.0	46	40	Sand	8	-	36	27.0	68	1	-	75	-	0.64	23.21	1700	14.77	270.37	26.73	134.88
9	10	9.5	1.0	50	43	Sand	8	-	37	27.8	76	1	-	100	-	0.64	26.79	2533.3	17.04	402.91	33.55	194.71
10	11	10.5	1.0	50	41	Sand	8	-	37	27.8	84	1	-	100	-	0.64	29.61	2800	18.84	445.32	41.08	219.21
11	12	11.5	1.0	50	39	Sand	8	-	36	27.0	92	1	-	75	-	0.64	31.41	2300	19.98	365.80	49.08	195.40
12	13	12.5	1.0	50	38	Sand	8	-	36	27.0	100	1	-	75	-	0.64	34.14	2500	21.72	397.61	57.76	216.81
13	14	13.5	1.0	50	37	Sand	8	-	35	26.3	108	1	-	70	-	0.64	35.68	2520	22.70	400.79	66.84	227.16
14	15	14.5	1.0	50	35	Sand	8	-	35	26.3	116	1	-	70	-	0.64	38.33	2706.7	24.38	430.48	76.60	249.79
																			191.49	0.0		

		PILE TYPE	BORED CAST IN SITU RCC
Ultimate capacity of pile Qu	191.5 kN	Pile dia	0.45 m
Factor of safety against axial compression, FS	2.5	Pile length	38.0 m from EGL
Safe capacity Qa	76.6 kN	Soil profile :Ref. Sub-Soil report borehole # BH-02	
Group efficiency	1	Axial Compression and Tension capacity	
Reduced capacity due to group efficiency	76.6 kN	Skin friction = k_s*γ'h*tanδ	



BH-03						Dia of Pile		(450 mm)												S.F	2.5
Depth m (refer measured from EGL)			Layer thickness, m	Field SPT	Corrected SPT N'	Soil Type	Effective unit weight of soil, γ (kN/m3)	Cohesion, c (kN/m2)	Friction Angle ϕ (degree)	Angle δ (degree)	Effective over burden pressure, p' (kN/m2)	Nc	α	Nq	Nc	Surface area, As (m2)	Unit Skin Friction, fs (kN/m2)	Unit End Bearing, fb (kN/m2)	Skin friction, kN	End bearing, kN	Tension Capacity kN (FS=2.5)	Compression Capacity kN (FS=2.5)
from	to	Average																				
0	1	0.5	1.0	1	1	Clay	18	6	-	-	9	1	1	-	9	0.64	5.48	24.53	5.20	11.70	**2.08**	**6.76**
1	2	1.5	1.0	1	1	Clay	18	6	-	-	27	1	1	-	9	0.64	3.87	17.345	3.68	8.28	**3.56**	**6.66**
2	3	2.5	1.0	4	5	Clay	8	28	-	-	20	1	0.95	-	9	0.64	18.08	84.974	17.16	40.54	**10.42**	**26.63**
3	4	3.5	1.0	1	1	Clay	8	6	-	-	28	1	1	-	9	0.64	4.11	18.397	3.90	8.78	**11.98**	**15.49**
4	5	4.5	1.0	1	1	Silt	8	6	-	-	36	1	1	-	9	0.64	4.16	18.649	3.95	8.90	**13.56**	**17.12**
5	6	5.5	1.0	8	8	Clay	8	51	-	-	44	1	0.83	-	9	0.64	21.50	152.22	20.41	72.63	**21.72**	**50.77**
6	7	6.5	1.0	50	49	Silt	8	294	-	-	52	1	0.5	-	9	0.64	98.35	880.78	93.39	420.25	**59.09**	**227.18**
7	8	7.5	1.0	50	46	Silt	8	275	-	-	60	1	0.5	-	9	0.64	92.00	823.9	87.36	393.11	**94.02**	**251.26**
8	9	8.5	1.0	50	43	Silt	8	259	-	-	68	1	0.5	-	9	0.64	86.74	776.78	82.36	370.62	**126.97**	**275.22**
9	10	9.5	1.0	50	43	Silt	8	259	-	-	76	1	0.5	-	9	0.64	86.62	775.7	82.25	370.11	**159.86**	**307.91**
10	11	10.5	1.0	50	41	Silt	8	247	-	-	84	1	0.5	-	9	0.64	82.59	739.6	78.42	352.89	**191.23**	**332.39**
11	12	11.5	1.0	50	39	Silt	8	236	-	-	92	1	0.5	-	9	0.64	79.07	708.11	75.08	337.86	**221.26**	**356.41**
12	13	12.5	1.0	50	38	Silt	8	227	-	-	100	1	0.5	-	9	0.64	75.97	680.33	72.13	324.61	**250.12**	**379.96**
13	14	13.5	1.0	50	37	Silt	8	219	-	-	108	1	0.5	-	9	0.64	73.21	655.59	69.51	312.80	**277.92**	**403.04**
14	15	14.5	1.0	50	35	Silt	8	211	-	-	116	1	0.5	-	9	0.64	70.72	633.36	67.15	302.19	**304.78**	**425.66**
																			761.96	0.0		

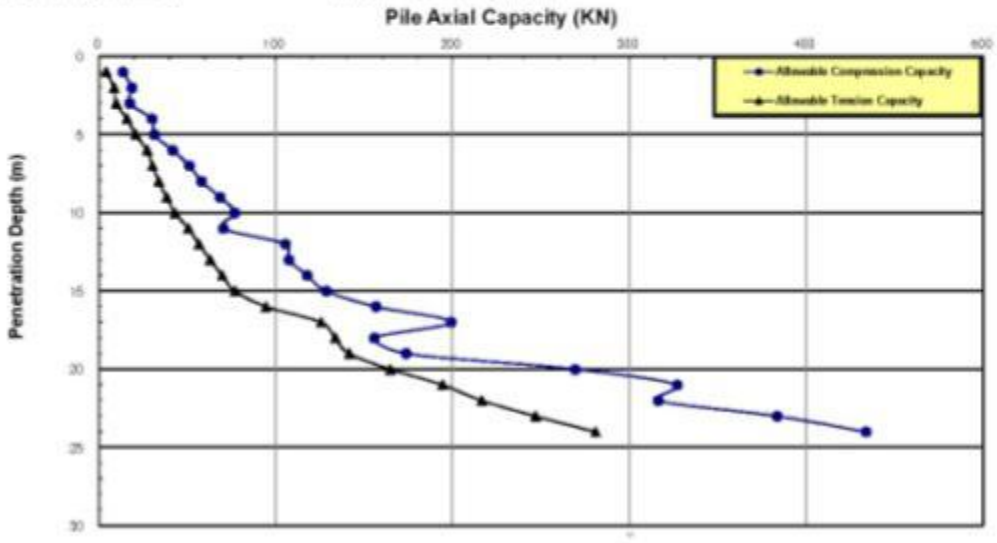
		PILE TYPE	BORED CAST IN SITU RCC
Ultimate capacity of pile Qu	762.0 kN	Pile dia	0.45 m
Factor of safety against axial compression, FS	2.5	Pile length	30.0 m from EGL
Safe capacity Qa	304.8 kN	Soil profile :Ref. Sub-Soil report borehole # BH-03	
Group efficiency	1	Axial Compression and Tension capacity	
Reduced capacity due to group efficiency	304.8 kN	Skin friction = k_s*γ'*h*tanδ	



BH-04 Dia of Pile (450 mm) F.F 2.5

Depth in m below mentioned Ref. EGL																				
from	to	Average	Layer thickness, m	Field SPT	Corrected SPT N'	Soil Type	Effective unit weight of soil, γ (kN/m3)	Cohesion, c (kN/m2)	Friction Angle ϕ (degree)	Angle, ϕ (degree)	Effective overburden pressure, p' (kN/m2)	Nc	Nq	Nγ	Nd	Surface area, As (m)	Unit Skin Friction, fs (kN/m2)	Unit End Bearing, fb (kN/m2)	Skin friction, kN	End bearing, kN	Tension Capacity kN (FS=2.5)	Compression Capacity kN (FS=2.5)
0	1	0.5	1.0	2	3	Clay	18	16	-	-	9	1	1	-	9	0.64	10.96	49.06	10.40	23.41	4.16	13.52
1	2	1.5	1.0	3	3	Clay	18	17	-	-	27	1	1	-	9	0.64	11.62	52.036	11.03	24.83	8.59	18.51
2	3	2.5	1.0	1	1	Sand	8	-	25	18.8	20	1	-	18	-	0.64	4.55	120	2.89	19.09	9.73	17.37
3	4	3.5	1.0	4	4	Clay	8	25	-	-	28	1	1	-	9	0.64	16.43	73.589	15.61	35.11	15.97	30.02
4	5	4.5	1.0	3	3	Clay	8	19	-	-	36	1	1	-	9	0.64	12.49	55.947	11.86	26.69	20.72	31.40
5	6	5.5	1.0	4	4	Clay	8	25	-	-	44	1	0.99	-	9	0.64	16.91	76.108	16.05	36.31	27.14	41.67
6	7	6.5	1.0	6	6	Sand	8	-	26	19.5	52	1	-	19	-	0.64	12.34	329.33	7.85	52.38	30.28	51.23
7	8	7.5	1.0	6	6	Sand	8	-	26	19.5	60	1	-	19	-	0.64	14.24	380	9.06	60.44	33.90	58.09
8	9	8.5	1.0	8	7	Sand	8	-	27	20.3	68	1	-	21	-	0.64	16.81	476	10.69	75.70	39.18	68.46
9	10	9.5	1.0	9	8	Sand	8	-	27	20.3	76	1	-	21	-	0.64	18.79	532	11.95	84.61	42.96	76.61
10	11	10.5	1.0	7	6	Clay	8	35	-	-	84	1	0.86	-	9	0.64	19.98	103.54	16.97	49.40	50.55	70.31
11	12	11.5	1.0	13	10	Sand	8	-	28	21.0	92	1	-	25	-	0.64	23.66	766.67	15.05	121.93	66.57	106.34
12	13	12.5	1.0	13	10	Sand	8	-	27	20.3	100	1	-	21	-	0.64	24.72	700	15.72	111.33	62.86	107.39
13	14	13.5	1.0	13	9	Sand	8	-	27	20.3	108	1	-	21	-	0.64	26.70	756	16.98	120.24	69.65	117.75
14	15	14.5	1.0	14	10	Sand	8	-	27	20.3	116	1	-	21	-	0.64	28.67	812	18.24	129.14	76.95	129.61
15	16	15.5	1.0	14	10	Sand	9	-	27	20.3	139.5	2	-	21	-	0.64	68.96	976.5	43.87	155.31	94.50	166.62
16	17	16.5	1.0	15	10	Sand	10	-	27	20.3	165	3	-	21	-	0.64	122.35	1155	77.84	183.70	125.83	199.11
17	18	17.5	1.0	30	6	Clay	11	39	-	-	192.5	4	0.81	-	9	0.64	20.83	115.83	19.78	55.17	133.54	166.61
18	19	18.5	1.0	15	9	Clay	12	56	-	-	222	5	0.55	-	9	0.64	20.86	168.83	19.81	80.55	141.47	173.89
19	20	19.5	1.0	50	31	Clay	13	183	-	-	253.5	6	0.5	-	9	0.64	61.25	548.5	58.16	261.71	164.73	269.41
20	21	20.5	1.0	65	39	Clay	14	232	-	-	287	7	0.5	-	9	0.64	77.71	695.67	73.78	332.02	194.24	327.05
21	22	21.5	1.0	50	29	Clay	15	174	-	-	322.5	8	0.5	-	9	0.64	58.40	522.98	55.45	249.53	216.42	315.23
22	23	22.5	1.0	70	40	Clay	16	239	-	-	360	9	0.5	-	9	0.64	79.96	716.07	75.92	341.66	246.79	393.46
23	24	23.5	1.0	80	45	Clay	17	267	-	-	399.5	10	0.5	-	9	0.64	89.46	801.14	84.94	382.25	280.77	433.67
																			701.93	332.0		

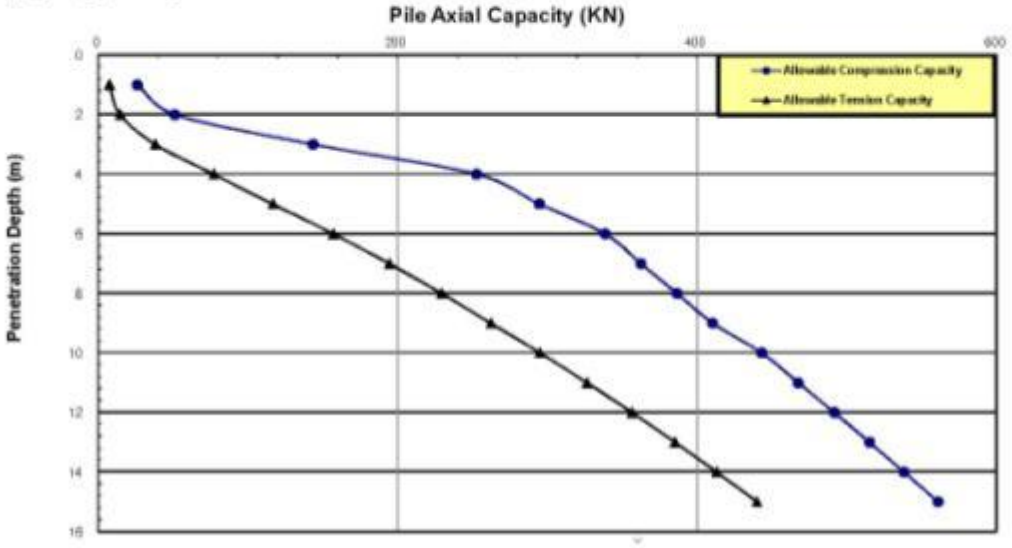
		PILE TYPE	BORED CAST IN SITU RCC
Ultimate capacity of pile Qu	1033.9 kN	Pile dia	0.45 m
Factor of safety against axial compression, FS	2.5	Pile length	30.0 m from EGL
Safe capacity Qa	413.6 kN	Soil profile (Ref. Sub Soil report borehole # BH-04	
Group efficiency	1	Axial Compression and Tension capacity	
Reduced capacity due to group efficiency	413.6 kN	Skin friction = $k_s \cdot \gamma' \cdot h \cdot \tan\delta$	



BH-05 Dia of Pile (450 mm) S.F 2.5

Depth in metar measured from EGL from	to	Average	Layer thickness, m	Field SPT	Corrected SPT N'	Soil Type	Effective unit weight of soil, γ (kN/m3)	Cohesion, c (kN/m2)	Friction Angle Φ (Degrees)	Angle δ (degrees)	Effective over burden pressure, p' (kN/m2)	K	Φ	Kd	Nc	Surface area, As (m2)	Unit Skin Friction, fs (kN/m2)	Unit End Bearing, fb (kN/m2)	Skin friction, KN	End bearing, KN	Tension Capacity KN (FS=2.5)	Compressive Capacity KN (FS=2.5)
0	1	0.5	1.0	4	5	Clay	18	33	-	-	9	1	0.89	-	9	0.64	19.50	98.119	19.52	46.82	**7.41**	**26.13**
1	2	1.5	1.0	11	11	Clay	18	64	-	-	27	1	0.45	-	9	0.64	19.11	190.8	19.15	91.03	**14.67**	**51.00**
2	3	2.5	1.0	26	31	Clay	8	184	-	-	20	1	0.5	-	9	0.64	61.68	552.33	58.56	263.53	**38.09**	**143.50**
3	4	3.5	1.0	50	51	Clay	8	307	-	-	28	1	0.5	-	9	0.64	102.72	919.67	97.53	438.90	**77.10**	**252.66**
4	5	4.5	1.0	50	52	Clay	8	311	-	-	36	1	0.5	-	9	0.64	104.12	932.45	98.87	444.90	**116.65**	**294.61**
5	6	5.5	1.0	50	53	Clay	8	317	-	-	44	1	0.5	-	9	0.64	106.23	951.35	100.87	453.92	**157.00**	**338.57**
6	7	6.5	1.0	50	49	Clay	8	294	-	-	52	1	0.5	-	9	0.64	98.35	880.78	93.39	420.25	**194.35**	**362.45**
7	8	7.5	1.0	50	46	Clay	8	275	-	-	60	1	0.5	-	9	0.64	92.00	823.9	87.36	393.11	**229.30**	**396.54**
8	9	8.5	1.0	50	43	Clay	8	259	-	-	68	1	0.5	-	9	0.64	86.74	776.78	82.36	370.62	**262.24**	**410.49**
9	10	9.5	1.0	50	43	Clay	8	259	-	-	76	1	0.5	-	9	0.64	86.62	775.7	82.25	370.11	**295.14**	**443.18**
10	11	10.5	1.0	50	41	Clay	8	247	-	-	84	1	0.5	-	9	0.64	82.59	739.6	78.42	352.89	**326.51**	**467.66**
11	12	11.5	1.0	50	39	Clay	8	236	-	-	92	1	0.5	-	9	0.64	79.07	708.11	75.08	337.86	**356.64**	**491.68**
12	13	12.5	1.0	50	38	Clay	8	227	-	-	100	1	0.5	-	9	0.64	75.97	680.33	72.13	324.61	**385.39**	**515.24**
13	14	13.5	1.0	50	37	Clay	8	219	-	-	108	1	0.5	-	9	0.64	73.21	655.59	69.51	312.80	**413.20**	**538.32**
14	15	14.5	1.0	50	35	Clay	8	211	-	-	116	1	0.5	-	9	0.64	70.72	633.36	67.15	302.19	**440.06**	**560.94**
																			1100.15	0.0		

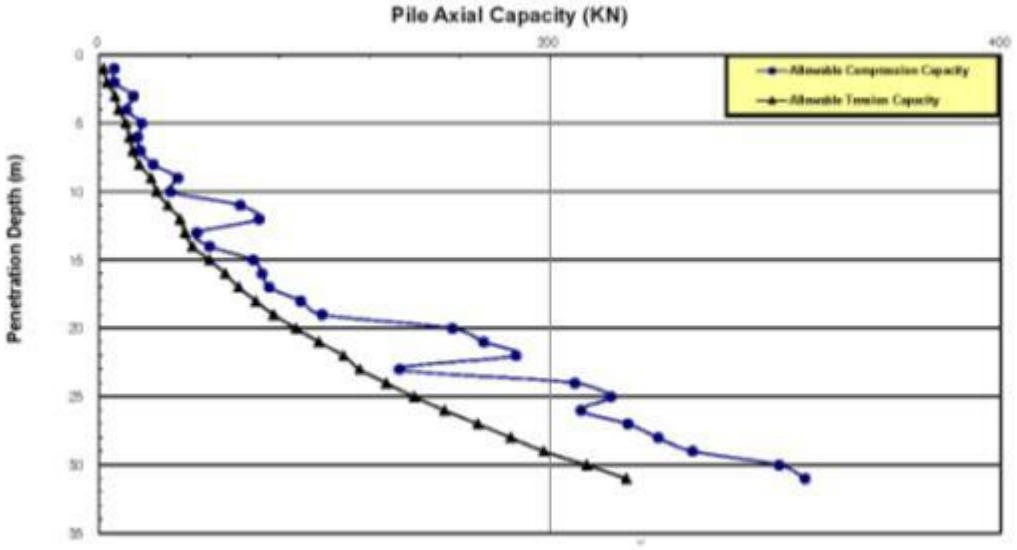
		PILE TYPE	BORED CAST IN SITU RCC
Ultimate capacity of pile Qu	1100.1 kN	Pile dia	0.45 m
Factor of safety against axial compression, FS	2.5	Pile length	30.0 m from EGL
Safe capacity Qa	440.1 kN	Soil profile :Ref. Sub Soil report borehole # BH #5	
Group efficiency	1	Axial Compression and Tension capacity	
Reduced capacity due to group efficiency	440.1 kN	Skin friction = $k_s * \gamma' * z * \tan\delta$	



BH-06 Dia of Pile (450 mm) S.F 2.5

From	To	Average	Layer thickness, m	Field SPT	Corrected SPT N'	Soil Type	Effective unit weight of soil, γ (kN/m3)	Cohesion, c (kN/m2)	Friction Angle δ (Degree)	Angle ϕ (Degree)	Effective overburden pressure, P (kN/m2)	Nc	Nq	Nγ	Nb	Surface area, As (m2)	Ult Skin Friction, fs (kN/m2)	Ult End Bearing, fb (kN/m2)	Skin friction, KN	End bearing, KN	Tension Capacity KN (FS=2.5)	Compression Capacity KN (FS=2.5)
0	1	0.5	1.0	1	1	Silt	18	8	-	-	9	1	1	-	9	0.64	5.48	24.53	5.20	11.70	**2.00**	**6.76**
1	2	1.5	1.0	1	1	Clay	18	6	-	-	27	1	1	-	9	0.64	3.87	17.345	3.68	8.28	**3.55**	**6.96**
2	3	2.5	1.0	2	2	Silt	8	14	-	-	20	1	1	-	9	0.64	9.49	42.487	9.01	20.27	**7.16**	**15.26**
3	4	3.5	1.0	1	1	Clay	8	6	-	-	28	1	1	-	9	0.64	4.11	18.397	3.90	8.78	**8.72**	**12.23**
4	5	4.5	1.0	2	2	Clay	8	12	-	-	36	1	1	-	9	0.64	8.33	37.299	7.91	17.80	**11.89**	**19.00**
5	6	5.5	1.0	1	1	Clay	8	6	-	-	44	1	1	-	9	0.64	4.25	19.027	4.03	9.06	**13.49**	**17.13**
6	7	6.5	1.0	1	1	Clay	8	6	-	-	52	1	1	-	9	0.64	3.93	17.616	3.74	8.40	**14.99**	**18.36**
7	8	7.5	1.0	2	2	Clay	8	11	-	-	60	1	1	-	9	0.64	7.36	32.956	6.99	15.72	**17.78**	**24.07**
8	9	8.5	1.0	4	3	Clay	8	21	-	-	68	1	1	-	9	0.64	13.88	62.142	13.18	29.65	**23.05**	**34.91**
9	10	9.5	1.0	2	2	Clay	8	10	-	-	76	1	1	-	9	0.64	6.93	31.029	6.58	14.80	**25.69**	**31.61**
10	11	10.5	1.0	2	2	Sand	8	-	25	18.8	84	1	-	18	-	0.64	19.10	504	12.15	80.16	**30.55**	**62.61**
11	12	11.5	1.0	2	2	Sand	8	-	25	18.8	92	1	-	18	-	0.64	20.92	552	13.31	87.79	**36.87**	**70.99**
12	13	12.5	1.0	2	2	Silt	8	9	-	-	100	1	1	-	9	0.64	8.68	27.213	5.77	12.98	**38.18**	**43.37**
13	14	13.5	1.0	3	2	Silt	8	13	-	-	108	1	1	-	9	0.64	8.79	29.325	8.34	18.77	**41.52**	**49.02**
14	15	14.5	1.0	8	6	Silt	8	34	-	-	116	1	0.87	-	9	0.64	19.79	101.34	18.79	48.35	**49.04**	**68.30**
15	16	15.5	1.0	7	5	Silt	8	29	-	-	124	1	0.95	-	9	0.64	18.18	85.854	17.27	40.96	**55.94**	**72.33**
16	17	16.5	1.0	6	4	Clay	8	24	-	-	132	1	1	-	9	0.64	15.94	71.392	15.14	34.06	**62.00**	**76.62**
17	18	17.5	1.0	9	6	Silt	8	35	-	-	140	1	0.89	-	9	0.64	20.02	104.07	19.01	49.66	**69.60**	**89.46**
18	19	18.5	1.0	10	6	Silt	8	38	-	-	148	1	0.82	-	9	0.64	20.64	112.55	19.60	53.70	**77.44**	**98.92**
19	20	19.5	1.0	12	8	Sand	8	-	27	20.3	156	1	-	21	-	0.64	38.56	1092	24.53	173.68	**87.25**	**166.72**
20	21	20.5	1.0	15	9	Sand	8	-	27	20.3	164	1	-	21	-	0.64	40.54	1148	25.79	182.58	**97.57**	**170.60**
21	22	21.5	1.0	12	8	Sand	8	-	27	20.3	172	1	-	21	-	0.64	42.51	1204	27.05	191.49	**108.39**	**184.98**
22	23	22.5	1.0	9	5	Clay	8	31	-	-	180	1	0.92	-	9	0.64	18.89	92.067	17.94	43.93	**115.66**	**133.13**
23	24	23.5	1.0	14	8	Sand	8	-	27	20.3	188	1	-	21	-	0.64	46.47	1316	29.56	209.30	**127.39**	**211.11**
24	25	24.5	1.0	16	9	Sand	8	-	27	20.3	196	1	-	21	-	0.64	48.45	1372	30.82	218.21	**139.72**	**227.00**
25	26	25.5	1.0	33	18	Clay	9	106	-	-	204	1	0.5	-	9	0.64	35.45	317.51	33.66	151.49	**153.19**	**213.79**
26	27	26.5	1.0	37	19	Clay	9	116	-	-	238.5	1	0.5	-	9	0.64	39.01	349.34	37.04	166.69	**168.00**	**234.67**
27	28	27.5	1.0	37	19	Clay	10	114	-	-	275	1	0.5	-	9	0.64	38.31	343.04	36.37	163.68	**182.55**	**249.02**
28	29	28.5	1.0	38	19	Clay	11	115	-	-	313.5	1	0.5	-	9	0.64	38.66	346.18	36.71	165.18	**197.23**	**263.30**
29	30	29.5	1.0	50	25	Clay	12	149	-	-	354	1	0.5	-	9	0.64	50.01	447.65	47.49	213.68	**216.22**	**301.70**
30	31	30.5	1.0	50	23	Clay	13	138	-	-	396.5	1	0.5	-	9	0.64	46.38	415.37	44.04	186.19	**233.84**	**313.11**
																			584.60	182.6		

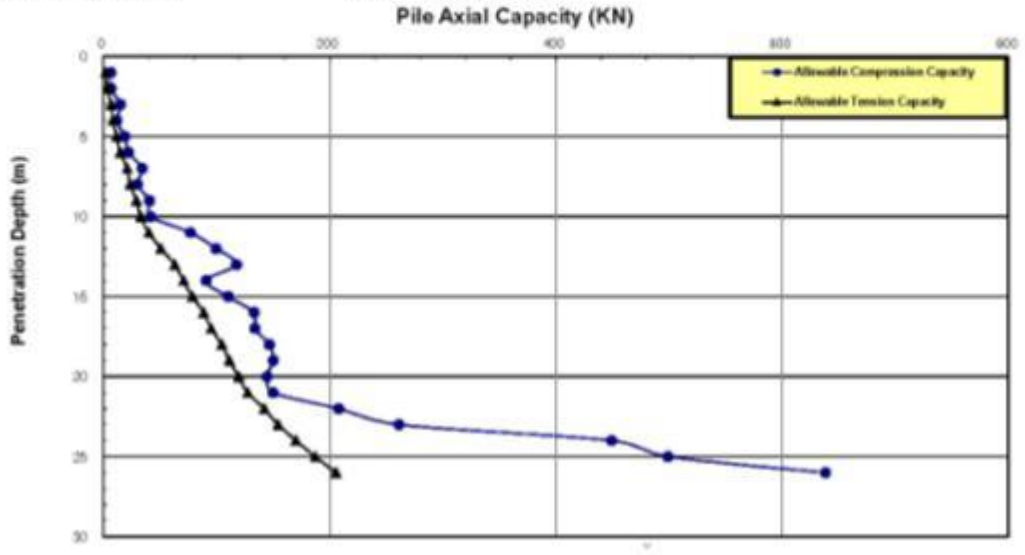
		PILE TYPE	BORED CAST IN SITU RCC
Ultimate capacity of pile Qu	767.2 kN	Pile dia	0.45 m
Factor of safety against axial compression, FS	2.5	Pile length	30.0 m from ESL
Safe capacity Qa	306.9 kN	Soil profile :Ref. Sub Soil report borehole # BH-06	
Group efficiency	1	Axial Compression and Tension capacity	
Reduced capacity due to group efficiency	306.9 kN	Skin friction = $k_s \cdot \sigma'_v \cdot \tan\delta$	



BH-07 | Dia of Pile (450 mm) | F.S 2.5

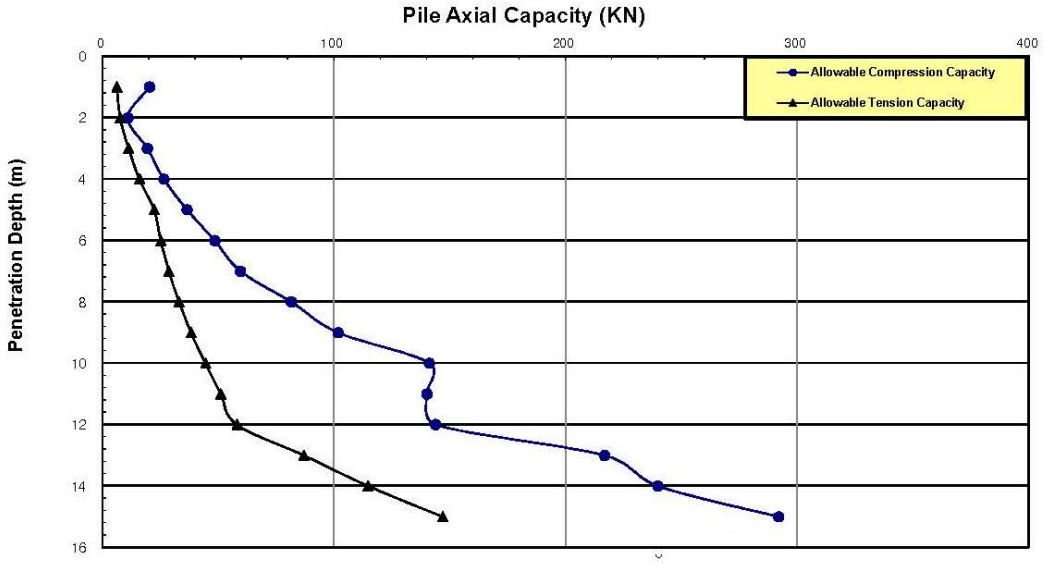
Depth in meter measured from EGL from	to	Average	Layer thickness, m	Field SPT	Corrected SPT N'	Soil Type	Effective unit weight of soil, γ (kN/m3)	Cohesion, c (kN/m2)	Friction Angle ϕ (degree)	Angle β (degree)	Effective average overburden pressure, P' (kN/m2)	K	α	Nq	Nc	Surface area, As (m2)	Unit Skin Friction, fs (kN/m2)	Unit End Bearing, fb (kN/m2)	Skin friction, KN	End bearing, KN	Tensile Capacity KN (Ff+Wp/1.5)	Compressive Capacity KN (Ff+Fb/2.5)
0	1	0.5	1.0	1	1	Silt	18	6	-	-	9	1	1	-	9	0.64	5.48	24.53	5.20	11.70	**2.00**	**6.76**
1	2	1.5	1.0	1	1	Silt	18	6	-	-	27	1	1	-	9	0.64	3.87	17.345	3.68	8.26	**3.56**	**6.96**
2	3	2.5	1.0	2	2	Silt	18	14	-	-	45	1	1	-	9	0.64	9.49	42.487	9.01	20.27	**7.16**	**15.26**
3	4	3.5	1.0	1	1	Silt	9	6	-	-	28	1	1	-	9	0.64	4.11	18.397	3.90	8.79	**9.72**	**12.23**
4	5	4.5	1.0	2	2	Silt	8	12	-	-	36	1	1	-	9	0.64	8.33	37.298	7.91	17.80	**11.88**	**19.00**
5	6	5.5	1.0	2	2	Silt	9	13	-	-	44	1	1	-	9	0.64	8.50	38.054	8.07	18.16	**15.11**	**22.37**
6	7	6.5	1.0	4	4	Clay	8	23	-	-	52	1	1	-	9	0.64	15.74	70.463	14.94	33.62	**21.08**	**34.53**
7	8	7.5	1.0	2	2	Clay	9	11	-	-	60	1	1	-	9	0.64	7.36	32.956	6.99	15.72	**23.89**	**30.17**
8	9	8.5	1.0	4	3	Clay	8	21	-	-	68	1	1	-	9	0.64	13.88	62.142	13.18	29.65	**29.15**	**41.01**
9	10	9.5	1.0	3	3	Clay	9	16	-	-	76	1	1	-	9	0.64	10.39	46.542	9.87	22.21	**33.10**	**41.86**
10	11	10.5	1.0	13	11	Silt	9	64	-	-	84	1	0.44	-	9	0.64	18.96	192.3	18.00	91.75	**40.30**	**77.00**
11	12	11.5	1.0	18	14	Clay	8	85	-	-	92	1	0.5	-	9	0.64	28.47	254.92	27.03	121.63	**51.11**	**99.76**
12	13	12.5	1.0	21	16	Silt	8	96	-	-	100	1	0.5	-	9	0.64	31.91	285.74	30.30	136.34	**63.23**	**117.76**
13	14	13.5	1.0	6	6	Clay	9	35	-	-	108	1	0.36	-	9	0.64	20.09	104.89	19.08	50.05	**70.86**	**90.89**
14	15	14.5	1.0	15	9	Clay	8	55	-	-	116	1	0.57	-	9	0.64	21.07	164.67	20.01	78.57	**78.86**	**110.29**
15	16	15.5	1.0	19	13	Clay	9	78	-	-	124	1	0.5	-	9	0.64	26.02	233.03	24.71	111.19	**88.75**	**133.22**
16	17	16.5	1.0	17	11	Clay	8	67	-	-	132	1	0.39	-	9	0.64	17.80	202.28	16.90	96.51	**95.51**	**134.11**
17	18	17.5	1.0	19	12	Clay	9	73	-	-	140	1	0.5	-	9	0.64	24.53	219.71	23.30	104.83	**104.02**	**146.76**
18	19	18.5	1.0	18	11	Clay	8	68	-	-	148	1	0.39	-	9	0.64	17.76	202.59	16.86	96.66	**111.67**	**150.23**
19	20	19.5	1.0	12	7	Clay	8	44	-	-	156	1	0.73	-	9	0.64	21.47	131.64	20.39	62.81	**119.72**	**144.85**
20	21	20.5	1.0	11	7	Clay	8	39	-	-	164	1	0.8	-	9	0.64	20.94	117.76	19.89	56.19	**127.68**	**150.15**
21	22	21.5	1.0	33	19	Clay	8	115	-	-	172	1	0.5	-	9	0.64	33.54	345.16	31.60	164.69	**142.32**	**208.19**
22	23	22.5	1.0	29	17	Sand	8	-	29	21.8	180	1	-	28	-	0.64	48.11	1680	30.61	267.19	**154.66**	**261.44**
23	24	23.5	1.0	65	36	Sand	9	-	35	26.3	189	1	-	70	-	0.64	62.12	4388.7	39.52	697.67	**170.37**	**449.43**
24	25	24.5	1.0	70	38	Sand	8	-	36	27.0	196	1	-	75	-	0.64	66.91	4900	42.57	779.31	**187.39**	**499.12**
25	26	25.5	1.0	80	43	Sand	8	-	37	27.8	204	1	-	100	-	0.64	71.91	6800	45.75	1081.50	**205.69**	**638.29**
																			514.23	66.2		

		PILE TYPE	BORED CAST IN SITU RCC
Ultimate capacity of pile Qu	570.4 kN	Pile dia	0.45 m
Factor of safety against axial compression, FS	2.5	Pile length	30.0 m from EGL
Safe capacity Qa	228.2 kN	Soil profile /Ref. Sub Soil report borehole # BH-07	
Group efficiency	1	Axial Compression and Tension capacity	
Reduced capacity due to group efficiency	228.2 kN	Skin friction = $k_s \cdot \gamma' h' \tan\delta$	



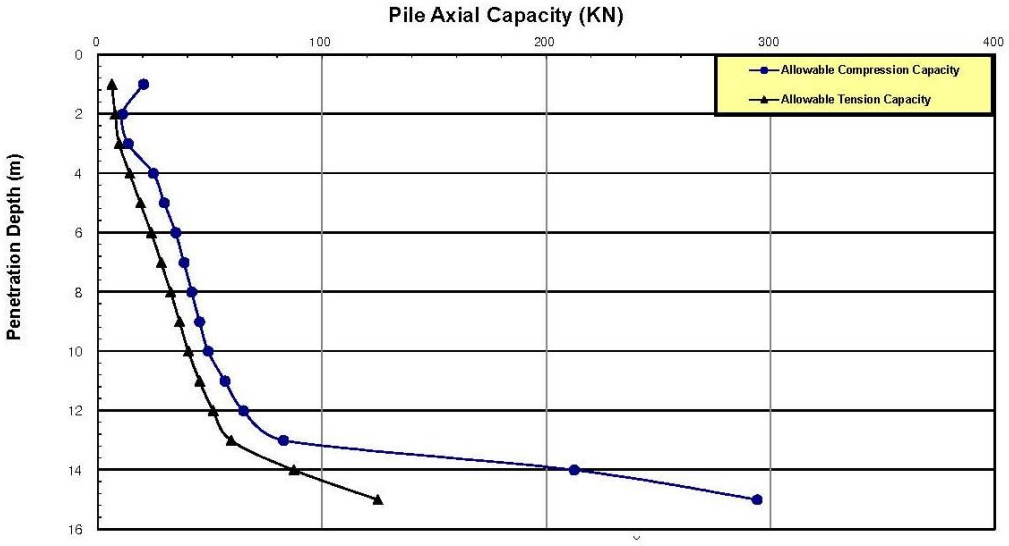
BH-08								Dia of Pile		(450 mm)									S.F	2.5		
Depth in meter measured from EGL			Layer thickness, m	Field SPT	Corrected SPT N'	Soil Type	Effective unit weight of soil, γ (kN/m3)	Cohesion, c (kN/m2)	Friction Angle, Φ (degrees)	Angle, β (degrees)	Effective over burden pressure, P (KN/m2)	K	α	Nq	Nc	Surface area, A_s (m2)	Unit Skin Friction, f_s (kN/m2)	Unit End Bearing, f_b (kN/m2)	Skin friction, KN	End bearing, KN	Tension Capacity KN (FS=2.5)	Compression Capacity KN (FS=2.5)
from	to	Average																				
0	1	0.5	1.0	3	4	Clay	18	25	-	-	9	1	1	-	9	0.64	16.43	73.589	15.61	35.11	**6.24**	**20.29**
1	2	1.5	1.0	1	1	Clay	18	6	-	-	27	1	1	-	9	0.64	3.87	17.345	3.68	8.28	**7.71**	**11.02**
2	3	2.5	1.0	2	2	Clay	8	14	-	-	20	1	1	-	9	0.64	9.49	42.487	9.01	20.27	**11.32**	**19.43**
3	4	3.5	1.0	3	3	Clay	8	18	-	-	28	1	1	-	9	0.64	12.33	55.192	11.70	26.33	**16.00**	**26.53**
4	5	4.5	1.0	4	4	Clay	8	25	-	-	36	1	1	-	9	0.64	16.66	74.596	15.82	35.59	**22.33**	**36.56**
5	6	5.5	1.0	12	13	Sand	8	-	28	21.0	44	1	-	25	-	0.64	11.32	366.67	7.20	58.32	**25.21**	**48.53**
6	7	6.5	1.0	16	16	Sand	8	-	29	21.8	52	1	-	28	-	0.64	13.90	485.33	8.84	77.19	**28.74**	**59.62**
7	8	7.5	1.0	22	20	Sand	8	-	31	23.3	60	1	-	38	-	0.64	17.27	760	10.99	120.87	**33.14**	**81.49**
8	9	8.5	1.0	30	26	Sand	8	-	32	24.0	68	1	-	44	-	0.64	20.28	997.33	12.90	158.62	**38.30**	**101.75**
9	10	9.5	1.0	35	30	Sand	8	-	34	25.5	76	1	-	60	-	0.64	24.29	1520	15.45	241.75	**44.48**	**141.18**
10	11	10.5	1.0	35	29	Sand	8	-	33	24.8	84	1	-	50	-	0.64	25.95	1400	16.51	222.66	**51.08**	**140.15**
11	12	11.5	1.0	32	25	Sand	8	-	32	24.0	92	1	-	44	-	0.64	27.44	1349.3	17.46	214.60	**58.07**	**143.91**
12	13	12.5	1.0	50	38	Clay	8	227	-	-	100	1	0.5	-	9	0.64	75.97	680.33	72.13	324.61	**86.92**	**216.76**
13	14	13.5	1.0	50	37	Clay	8	219	-	-	108	1	0.5	-	9	0.64	73.21	655.59	69.51	312.80	**114.72**	**239.84**
14	15	14.5	1.0	60	42	Clay	8	253	-	-	116	1	0.5	-	9	0.64	84.87	760.03	80.58	362.63	**146.96**	**292.01**
																			367.40	**0.0**		

		PILE TYPE	BORED CAST IN SITU RCC
Ultimate capacity of pile Qu	367.4 kN	Pile dia	0.45 m
Factor of safety against axial compression, FS	2.5	Pile length	30.0 m from EGL
Safe capacity Qa	147 kN	Soil profile :Ref. Sub-Soil report-borehole # BH-08	
Group efficiency	1	Axial Compression and Tension capacity	
Reduced capacity due to group efficiency	147 kN	Skin friction = k_s*γ*h'*tanδ	



BH-09							Dia of Pile			(450 mm)									S.F	2.5		
Depth in meter measured from EGL			Layer thickness, m	Field SPT	Corrected SPT N'	Soil Type	Effective unit weight of soil, γ (KN/m3)	Cohesion, c (kN/m2)	Friction Angle, ϕ (degrees)	Angle, β (degrees)	Effective over burden pressure, P (KN/m2)	K	α	Nq	Nc	Surface area, A_s (m2)	Unit Skin Friction, f_s (kN/m2)	Unit End Bearing, f_b (kN/m2)	Skin friction, KN	End bearing, KN	Tension Capacity KN (FS=2.5)	Compression Capacity KN (FS=2.5)
from	to	Average																				
0	1	0.5	1.0	3	4	Clay	18	25	-	-	9	1	1	-	9	0.64	16.43	73.589	15.61	35.11	**6.24**	**20.29**
1	2	1.5	1.0	1	1	Clay	18	6	-	-	27	1	1	-	9	0.64	3.87	17.345	3.68	8.28	**7.71**	**11.02**
2	3	2.5	1.0	1	1	Clay	8	7	-	-	20	1	1	-	9	0.64	4.74	21.243	4.50	10.14	**9.52**	**13.57**
3	4	3.5	1.0	3	3	Clay	8	18	-	-	28	1	1	-	9	0.64	12.33	55.192	11.70	26.33	**14.20**	**24.73**
4	5	4.5	1.0	3	3	Silt	8	19	-	-	36	1	1	-	9	0.64	12.49	55.947	11.86	26.69	**18.94**	**29.62**
5	6	5.5	1.0	3	3	Clay	8	19	-	-	44	1	1	-	9	0.64	12.75	57.081	12.10	27.24	**23.78**	**34.68**
6	7	6.5	1.0	3	3	Clay	8	18	-	-	52	1	1	-	9	0.64	11.80	52.847	11.21	25.21	**28.27**	**38.35**
7	8	7.5	1.0	3	3	Clay	8	16	-	-	60	1	1	-	9	0.64	11.04	49.434	10.48	23.59	**32.46**	**41.89**
8	9	8.5	1.0	3	3	Clay	8	16	-	-	68	1	1	-	9	0.64	10.41	46.607	9.88	22.24	**36.41**	**45.31**
9	10	9.5	1.0	3	3	Clay	8	16	-	-	76	1	1	-	9	0.64	10.39	46.542	9.87	22.21	**40.36**	**49.24**
10	11	10.5	1.0	4	3	Clay	8	20	-	-	84	1	1	-	9	0.64	13.21	59.168	12.55	28.23	**45.38**	**56.67**
11	12	11.5	1.0	5	4	Clay	8	24	-	-	92	1	1	-	9	0.64	15.81	70.811	15.02	33.79	**51.39**	**64.90**
12	13	12.5	1.0	9	7	Clay	8	41	-	-	100	1	0.77	-	9	0.64	21.17	122.46	20.10	58.43	**59.43**	**82.80**
13	14	13.5	1.0	50	37	Clay	8	219	-	-	108	1	0.5	-	9	0.64	73.21	655.59	69.51	312.80	**87.23**	**212.35**
14	15	14.5	1.0	70	49	Clay	8	296	-	-	116	1	0.5	-	9	0.64	99.01	886.7	94.02	423.07	**124.84**	**294.07**
																			312.09	**0.0**		

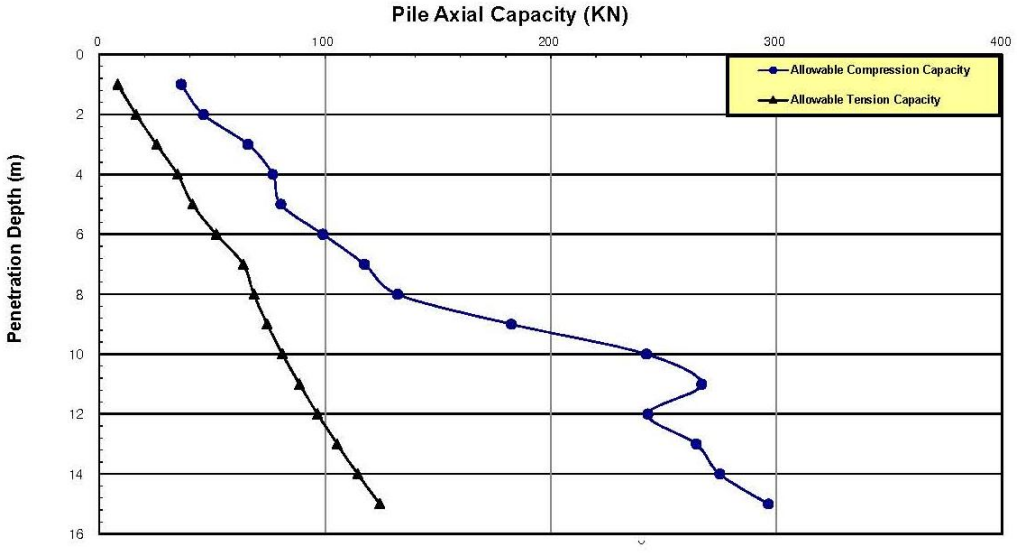
		PILE TYPE	BORED CAST IN SITU RCC
Ultimate capacity of pile Qu	312.1 kN	Pile dia	0.45 m
Factor of safety against axial compression, FS	2.5	Pile length	30.0 m from EGL
Safe capacity Qa	124.8 kN	Soil profile :Ref. Sub-Soil report-borehole # BH-09	
Group efficiency	1	Axial Compression and Tension capacity	
Reduced capacity due to group efficiency	124.8 kN	Skin friction = k_s*γ*h*tanδ	



BH-10 | Dia of Pile (450 mm) | S.F 2.5

Depth in meter measured from EGL			Layer thickness, m	Field SPT	Corrected SPT N'	Soil Type	Effective unit weight of soil, γ (KN/m3)	Cohesion, c (kN/m2)	Friction Angle, ϕ (degrees)	Angle, δ (degrees)	Effective over burden pressure, P (KN/m2)	K'	α	Nq	Nc	Surface area, A_s (m2)	Unit Skin Friction, f_s (kN/m2)	Unit End Bearing, f_b (kN/m2)	Skin friction, KN	End bearing, KN	Tension Capacity KN (FS=2.5)	Compression Capacity KN (FS=2.5)
from	to	Average																				
0	1	0.5	1.0	6	8	Silt	18	49	-	-	9	1	0.66	-	9	0.64	21.57	147.18	20.48	70.22	**8.19**	**36.28**
1	2	1.5	1.0	9	9	Silt	18	52	-	-	27	1	0.61	-	9	0.64	21.40	156.11	20.32	74.48	**16.32**	**46.11**
2	3	2.5	1.0	10	12	Silt	8	71	-	-	20	1	0.5	-	9	0.64	23.72	212.43	22.52	101.36	**25.33**	**65.87**
3	4	3.5	1.0	12	12	Clay	8	74	-	-	28	1	0.5	-	9	0.64	24.65	220.77	23.41	105.34	**34.69**	**76.83**
4	5	4.5	1.0	11	11	Clay	8	68	-	-	36	1	0.38	-	9	0.64	17.42	205.14	16.54	97.88	**41.31**	**80.46**
5	6	5.5	1.0	13	14	Clay	8	82	-	-	44	1	0.5	-	9	0.64	27.62	247.35	26.23	118.02	**51.80**	**99.01**
6	7	6.5	1.0	16	16	Clay	8	94	-	-	52	1	0.5	-	9	0.64	31.47	281.85	29.88	134.48	**63.75**	**117.55**
7	8	7.5	1.0	30	28	Sand	8	-	33	24.8	60	1	-	50	-	0.64	18.53	1000	11.79	159.04	**68.47**	**132.09**
8	9	8.5	1.0	44	38	Sand	8	-	36	27.0	68	1	-	75	-	0.64	23.21	1700	14.77	270.37	**74.38**	**182.53**
9	10	9.5	1.0	50	43	Sand	8	-	37	27.8	76	1	-	100	-	0.64	26.79	2533.3	17.04	402.91	**81.20**	**242.36**
10	11	10.5	1.0	50	41	Sand	8	-	37	27.8	84	1	-	100	-	0.64	29.61	2800	18.84	445.32	**88.73**	**266.86**
11	12	11.5	1.0	50	39	Sand	8	-	36	27.0	92	1	-	75	-	0.64	31.41	2300	19.98	365.80	**96.72**	**243.04**
12	13	12.5	1.0	50	38	Sand	8	-	36	27.0	100	1	-	75	-	0.64	34.14	2500	21.72	397.61	**105.41**	**264.45**
13	14	13.5	1.0	50	37	Sand	8	-	35	26.3	108	1	-	70	-	0.64	35.68	2520	22.70	400.79	**114.49**	**274.81**
14	15	14.5	1.0	50	35	Sand	8	-	35	26.3	116	1	-	70	-	0.64	38.33	2706.7	24.38	430.48	**124.24**	**296.43**
																			310.61	0.0		

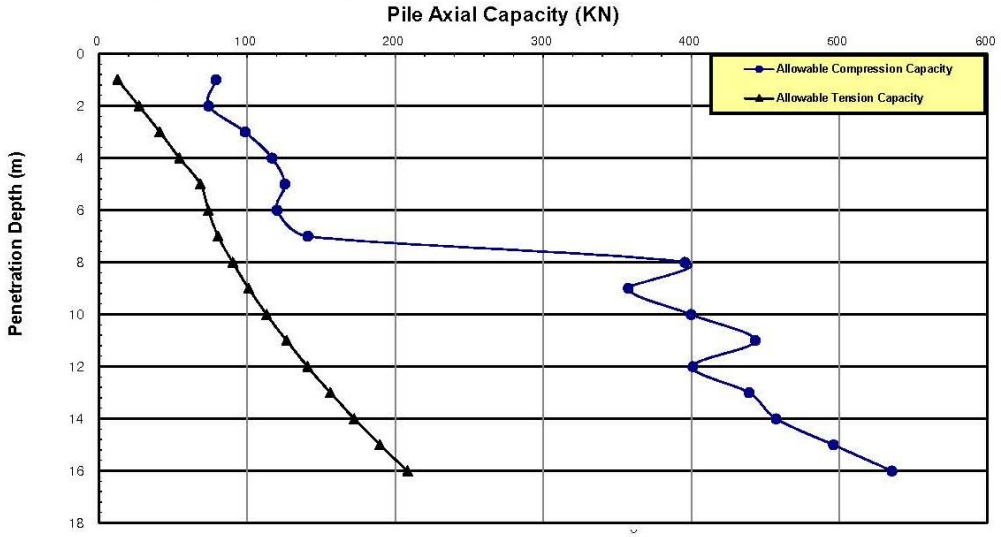
		PILE TYPE	BORED CAST IN SITU RCC
Ultimate capacity of pile Qu	310.6 kN	Pile dia	0.45 m
Factor of safety against axial compression, FS	2.5	Pile length	30.0 m from EGL
Safe capacity Qa	124.2 kN	Soil profile :Ref. Sub-Soil report-borehole # BH-10	
Group efficiency	1	Axial Compression and Tension capacity	
Reduced capacity due to group efficiency	124.2 kN	Skin friction = k_s*γ*h'*tanδ	



BH-01 | Dia of Pile (600 mm) | S.F 2.5

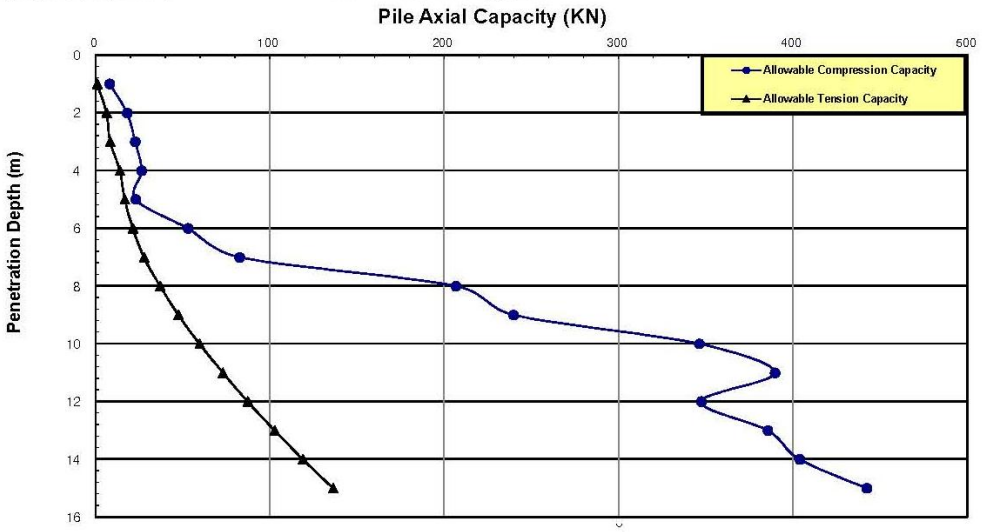
Depth in meter measured from EGL			Layer thickness, m	Field SPT	Corrected SPT N'	Soil Type	Effective unit weight of soil, γ (KN/m3)	Cohesion, c (kN/m2)	Friction Angle, ϕ (degrees)	Angle, β (degrees)	Effective over burden pressure, P' (KN/m2)	K	α	Nq	Nc	Surface area, A_s (m2)	Unit Skin Friction, f_s (kN/m2)	Unit End Bearing, f_b (kN/m2)	Skin friction, KN	End bearing, KN	Tension Capacity KN (FS=2.5)	Compression Capacity KN (FS=2.5)
from	to	Average																				
0	1	0.5	1.0	8	11	Silt	18	65	-	-	9	1	0.42	-	9	1.13	18.52	196.24	31.27	166.46	**12.51**	**79.09**
1	2	1.5	1.0	8	8	Silt	18	46	-	-	27	1	0.7	-	9	1.13	21.58	138.76	36.43	117.70	**27.08**	**74.16**
2	3	2.5	1.0	8	9	Silt	8	57	-	-	20	1	0.55	-	9	1.13	20.79	169.95	35.10	144.15	**41.12**	**98.78**
3	4	3.5	1.0	10	10	Clay	8	61	-	-	28	1	0.48	-	9	1.13	19.77	183.97	33.37	156.05	**54.47**	**116.89**
4	5	4.5	1.0	9	9	Clay	8	56	-	-	36	1	0.56	-	9	1.13	20.91	167.84	35.30	142.37	**68.59**	**125.53**
5	6	5.5	1.0	14	15	Sand	8	-	29	21.8	44	1	-	28	-	1.13	11.76	410.67	13.30	116.11	**73.91**	**120.35**
6	7	6.5	1.0	18	18	Sand	8	-	30	22.5	52	1	-	31	-	1.13	14.43	537.33	16.32	151.93	**80.44**	**141.21**
7	8	7.5	1.0	48	44	Sand	8	-	38	28.5	60	1	-	135	-	1.13	21.83	2700	24.69	763.41	**90.31**	**395.67**
8	9	8.5	1.0	50	43	Sand	8	-	37	27.8	68	1	-	100	-	1.13	23.97	2266.7	27.11	640.89	**101.15**	**357.51**
9	10	9.5	1.0	50	43	Sand	8	-	37	27.8	76	1	-	100	-	1.13	26.79	2533.3	30.30	716.28	**113.27**	**399.79**
10	11	10.5	1.0	50	41	Sand	8	-	37	27.8	84	1	-	100	-	1.13	29.61	2800	33.49	791.68	**126.67**	**443.34**
11	12	11.5	1.0	50	39	Sand	8	-	36	27.0	92	1	-	75	-	1.13	31.41	2300	35.52	650.31	**140.88**	**401.00**
12	13	12.5	1.0	50	38	Sand	8	-	36	27.0	100	1	-	75	-	1.13	34.14	2500	38.61	706.86	**156.32**	**439.06**
13	14	13.5	1.0	50	37	Sand	8	-	35	26.3	108	1	-	70	-	1.13	35.68	2520	40.36	712.51	**172.46**	**457.47**
14	15	14.5	1.0	50	35	Sand	8	-	35	26.3	116	1	-	70	-	1.13	38.33	2706.7	43.35	765.29	**189.80**	**495.92**
15	16	15.5	1.0	50	34	Sand	8	-	35	26.3	124	1	-	70	-	1.13	40.97	2893.3	46.34	818.07	**208.34**	**535.57**
																			520.84	**7560.09**		

		PILE TYPE	BORED CAST IN SITU RCC
Ultimate capacity of pile Qu	8080.9 kN	Pile dia	0.60 m
Factor of safety against axial compression, FS	2.5	Pile length	30.0 m from EGL
Safe capacity Qa	3232.4 kN	Soil profile :Ref. Sub-Soil report-borehole # BH-01	
Group efficiency	1	Axial Compression and Tension capacity	
Reduced capacity due to group efficiency	3232.4 kN	Skin friction = $k_s \sigma'_v h \tan\delta$	



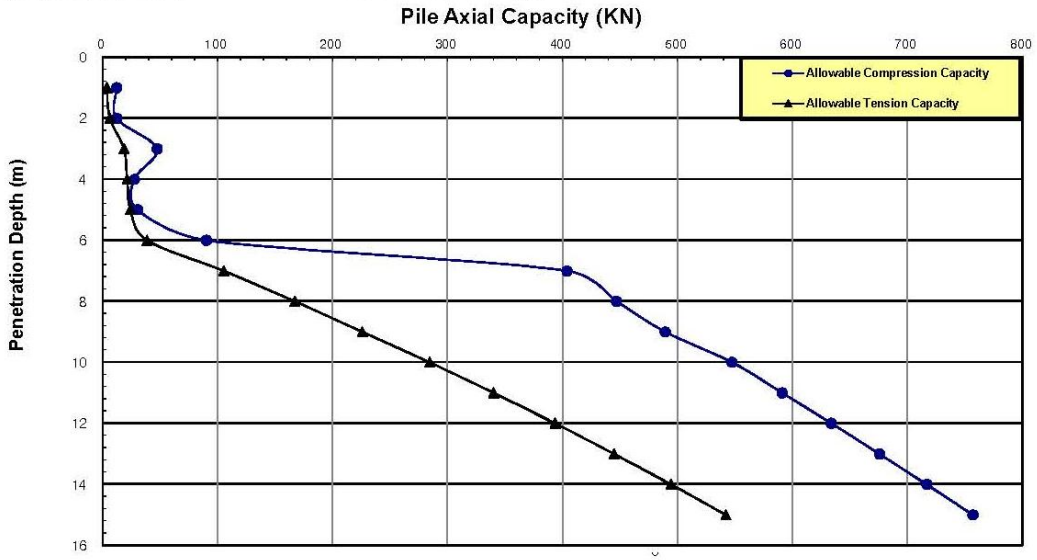
BH-02							Dia of Pile		(600 mm)									S.F	2.5		
Depth in meter measured from EGL			Layer thickness, m	Field SPT	Corrected SPT N'	Soil Type	Effective unit weight of soil, γ (KN/m3)	Cohesion, c (kN/m2)	Friction Angle, ϕ (degrees)	Angle, δ (degrees)	Effective over burden pressure, P (KN/m2)	K	α	Nq	Nc	Surface area, A_s (m2)	Unit Skin Friction, f_s (kN/m2)	Unit End Bearing, f_b (kN/m2)	Skin friction, KN	End bearing, KN	Tension Capacity KN (FS=2.5)	Compression Capacity KN (FS=2.5)
from	to	Average																				
0	1	0.5	1.0	5	7	Sand	18	-	27	20.3	9	1	-	21	-	1.13	2.22	63	2.52	17.81	1.01	8.13
1	2	1.5	1.0	2	2	Silt	18	12	-	-	27	1	1	-	9	1.13	7.75	34.69	13.08	29.43	6.24	18.01
2	3	2.5	1.0	3	4	Sand	8	-	26	19.5	20	1	-	19	-	1.13	4.75	126.67	5.37	35.81	8.38	22.71
3	4	3.5	1.0	2	2	Clay	8	12	-	-	28	1	1	-	9	1.13	8.22	36.795	13.87	31.21	13.93	26.42
4	5	4.5	1.0	1	1	Clay	8	6	-	-	36	1	1	-	9	1.13	4.16	18.649	7.03	15.82	16.74	23.07
5	6	5.5	1.0	5	5	Sand	8	-	26	19.5	44	1	-	19	-	1.13	10.44	278.67	11.81	78.79	21.47	52.98
6	7	6.5	1.0	16	16	Sand	8	-	29	21.8	52	1	-	28	-	1.13	13.90	485.33	15.72	137.23	27.76	82.65
7	8	7.5	1.0	40	37	Sand	8	-	36	27.0	60	1	-	75	-	1.13	20.48	1500	23.17	424.12	37.02	206.67
8	9	8.5	1.0	46	40	Sand	8	-	36	27.0	68	1	-	75	-	1.13	23.21	1700	26.25	480.66	47.52	239.79
9	10	9.5	1.0	50	43	Sand	8	-	37	27.8	76	1	-	100	-	1.13	26.79	2533.3	30.30	716.28	59.64	346.16
10	11	10.5	1.0	50	41	Sand	8	-	37	27.8	84	1	-	100	-	1.13	29.61	2800	33.49	791.68	73.04	389.71
11	12	11.5	1.0	50	39	Sand	8	-	36	27.0	92	1	-	75	-	1.13	31.41	2300	35.52	650.31	87.25	347.37
12	13	12.5	1.0	50	38	Sand	8	-	36	27.0	100	1	-	75	-	1.13	34.14	2500	38.61	706.86	102.69	385.43
13	14	13.5	1.0	50	37	Sand	8	-	35	26.3	108	1	-	70	-	1.13	35.68	2520	40.36	712.51	118.83	403.84
14	15	14.5	1.0	50	35	Sand	8	-	35	26.3	116	1	-	70	-	1.13	38.33	2706.7	43.35	765.29	136.17	442.29
																			340.43	0.0		

		PILE TYPE	BORED CAST IN SITU RCC
Ultimate capacity of pile Qu	340.4 kN	Pile dia	0.60 m
Factor of safety against axial compression, FS	2.5	Pile length	30.0 m from EGL
Safe capacity Qa	136.2 kN	Soil profile :Ref. Sub-Soil report-borehole # BH-02	
Group efficiency	1	Axial Compression and Tension capacity	
Reduced capacity due to group efficiency	136.2 kN	Skin friction = k_s*γ'h'*tanδ	



BH-03								Dia of Pile		(600 mm)									S.F	2.5		
Depth in meter measured from EGL			Layer thickness, m	Field SPT	Corrected SPT N'	Soil Type	Effective unit weight of soil, γ (kN/m3)	Cohesion, c (kN/m2)	Friction Angle, ϕ (degrees)	Angle, β (degrees)	Effective over burden pressure, P (KN/m2)	K	α	Nq	Nc	Surface area, A_s (m2)	Unit Skin Friction, f_s (kN/m2)	Unit End Bearing, f_b (kN/m2)	Skin friction, KN	End bearing, KN	Tension Capacity KN (FS=2.5)	Compression Capacity KN (FS=2.5)
from	to	Average																				
0	1	0.5	1.0	1	1	Clay	18	8	-	-	9	1	1	-	9	1.13	5.48	24.53	9.25	20.81	**3.70**	**12.02**
1	2	1.5	1.0	1	1	Clay	18	6	-	-	27	1	1	-	9	1.13	3.87	17.345	6.54	14.71	**6.31**	**12.20**
2	3	2.5	1.0	4	5	Clay	8	28	-	-	20	1	0.95	-	9	1.13	18.08	84.974	30.51	72.08	**18.52**	**47.35**
3	4	3.5	1.0	1	1	Clay	8	6	-	-	28	1	1	-	9	1.13	4.11	18.397	6.94	15.61	**21.29**	**27.54**
4	5	4.5	1.0	1	1	Silt	8	6	-	-	36	1	1	-	9	1.13	4.16	18.649	7.03	15.82	**24.11**	**30.43**
5	6	5.5	1.0	8	8	Clay	8	51	-	-	44	1	0.63	-	9	1.13	21.50	152.22	36.28	129.11	**38.62**	**90.27**
6	7	6.5	1.0	50	49	Silt	8	294	-	-	52	1	0.5	-	9	1.13	98.35	880.78	166.02	747.11	**105.03**	**403.87**
7	8	7.5	1.0	50	46	Silt	8	275	-	-	60	1	0.5	-	9	1.13	92.00	823.9	155.30	698.85	**167.15**	**446.69**
8	9	8.5	1.0	50	43	Silt	8	259	-	-	68	1	0.5	-	9	1.13	86.74	776.78	146.42	658.89	**225.72**	**489.27**
9	10	9.5	1.0	50	43	Silt	8	259	-	-	76	1	0.5	-	9	1.13	86.62	775.7	146.22	657.97	**284.20**	**547.39**
10	11	10.5	1.0	50	41	Silt	8	247	-	-	84	1	0.5	-	9	1.13	82.59	739.6	139.41	627.35	**339.97**	**590.91**
11	12	11.5	1.0	50	39	Silt	8	236	-	-	92	1	0.5	-	9	1.13	79.07	708.11	133.48	600.64	**393.36**	**633.62**
12	13	12.5	1.0	50	38	Silt	8	227	-	-	100	1	0.5	-	9	1.13	75.97	680.33	128.24	577.08	**444.65**	**675.49**
13	14	13.5	1.0	50	37	Silt	8	219	-	-	108	1	0.5	-	9	1.13	73.21	655.59	123.57	556.09	**494.08**	**716.52**
14	15	14.5	1.0	50	35	Silt	8	211	-	-	116	1	0.5	-	9	1.13	70.72	633.36	119.38	537.23	**541.84**	**756.73**
																			1354.60	**0.0**		

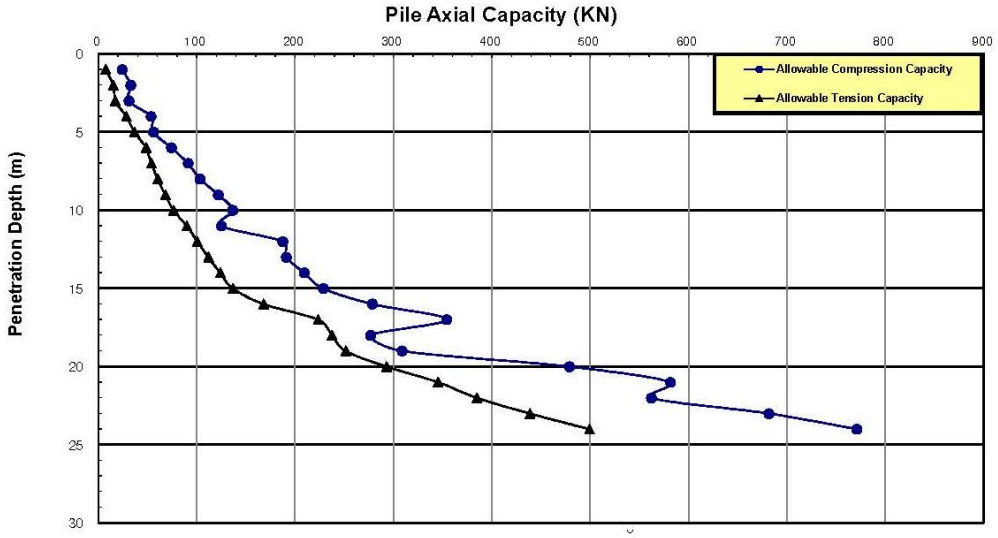
		PILE TYPE	BORED CAST IN SITU RCC
Ultimate capacity of pile Qu	1354.6 kN	Pile dia	0.60 m
Factor of safety against axial compression, FS	2.5	Pile length	30.0 m from EGL
Safe capacity Qa	541.8 kN	Soil profile :Ref. Sub-Soil report-borehole # BH-03	
Group efficiency	1	Axial Compression and Tension capacity	
Reduced capacity due to group efficiency	541.8 kN	Skin friction = $k_s \cdot \gamma \cdot h \cdot \tan\delta$	



BH-04 | Dia of Pile (600 mm) | S.F 2.5

Depth in meter measured from EGL			Layer thickness, m	Field SPT	Corrected SPT N'	Soil Type	Effective unit weight of soil, γ (kN/m3)	Cohesion, c (kN/m2)	Friction Angle, ϕ (degrees)	Angle, β (degrees)	Effective over burden pressure, P (kN/m2)	K	α	Nq	Nc	Surface area, A_s (m2)	Unit Skin Friction, f_s (kN/m2)	Unit End Bearing, f_b (kN/m2)	Skin friction, KN	End bearing, KN	Tension Capacity KN (FS=2.5)	Compression Capacity KN (FS=2.5)
from	to	Average																				
0	1	0.5	1.0	2	3	Clay	18	16	-	-	9	1	1	-	9	1.13	10.96	49.06	18.50	41.61	**7.40**	**24.04**
1	2	1.5	1.0	3	3	Clay	18	17	-	-	27	1	1	-	9	1.13	11.62	52.036	19.62	44.14	**15.24**	**32.90**
2	3	2.5	1.0	1	1	Sand	8	-	25	18.8	20	1	-	18	-	1.13	4.55	120	5.14	33.93	**17.30**	**30.87**
3	4	3.5	1.0	4	4	Clay	8	25	-	-	28	1	1	-	9	1.13	16.43	73.589	27.74	62.42	**28.40**	**53.37**
4	5	4.5	1.0	3	3	Clay	8	19	-	-	36	1	1	-	9	1.13	12.49	55.947	21.09	47.46	**36.84**	**55.82**
5	6	5.5	1.0	4	4	Clay	8	25	-	-	44	1	0.99	-	9	1.13	16.91	76.108	28.54	64.56	**48.25**	**74.08**
6	7	6.5	1.0	6	6	Sand	8	-	26	19.5	52	1	-	19	-	1.13	12.34	329.33	13.95	93.12	**53.83**	**91.08**
7	8	7.5	1.0	6	6	Sand	8	-	26	19.5	60	1	-	19	-	1.13	14.24	380	16.10	107.44	**60.27**	**103.25**
8	9	8.5	1.0	8	7	Sand	8	-	27	20.3	68	1	-	21	-	1.13	16.81	476	19.01	134.59	**67.88**	**121.71**
9	10	9.5	1.0	9	8	Sand	8	-	27	20.3	76	1	-	21	-	1.13	18.79	532	21.25	150.42	**76.38**	**136.54**
10	11	10.5	1.0	7	6	Clay	8	35	-	-	84	1	0.86	-	9	1.13	19.98	103.54	33.73	87.83	**89.87**	**125.00**
11	12	11.5	1.0	13	10	Sand	8	-	28	21.0	92	1	-	25	-	1.13	23.66	766.67	26.76	216.77	**100.57**	**187.28**
12	13	12.5	1.0	13	10	Sand	8	-	27	20.3	100	1	-	21	-	1.13	24.72	700	27.95	197.92	**111.75**	**190.92**
13	14	13.5	1.0	13	9	Sand	8	-	27	20.3	108	1	-	21	-	1.13	26.70	756	30.19	213.75	**123.83**	**209.33**
14	15	14.5	1.0	14	10	Sand	8	-	27	20.3	116	1	-	21	-	1.13	28.67	812	32.43	229.59	**136.80**	**228.64**
15	16	15.5	1.0	14	10	Sand	9	-	27	20.3	139.5	2	-	21	-	1.13	68.96	976.5	77.99	276.10	**168.00**	**278.44**
16	17	16.5	1.0	15	10	Sand	10	-	27	20.3	165	3	-	21	-	1.13	122.35	1155	138.38	326.57	**223.35**	**353.98**
17	18	17.5	1.0	10	6	Clay	11	39	-	-	192.5	4	0.81	-	9	1.13	20.83	115.63	35.16	98.08	**237.41**	**276.65**
18	19	18.5	1.0	15	9	Clay	12	56	-	-	222	5	0.55	-	9	1.13	20.86	168.83	35.21	143.20	**251.50**	**308.78**
19	20	19.5	1.0	50	31	Clay	13	183	-	-	253.5	6	0.5	-	9	1.13	61.25	548.5	103.39	465.26	**292.85**	**478.96**
20	21	20.5	1.0	65	39	Clay	14	232	-	-	287	7	0.5	-	9	1.13	77.71	695.87	131.17	590.26	**345.32**	**581.42**
21	22	21.5	1.0	50	29	Clay	15	174	-	-	322.5	8	0.5	-	9	1.13	58.40	522.98	98.58	443.61	**384.75**	**562.19**
22	23	22.5	1.0	70	40	Clay	16	239	-	-	360	9	0.5	-	9	1.13	79.96	716.07	134.98	607.40	**438.74**	**681.70**
23	24	23.5	1.0	80	45	Clay	17	267	-	-	399.5	10	0.5	-	9	1.13	89.46	801.14	151.01	679.55	**499.15**	**770.97**
																			1247.87	**590.3**		

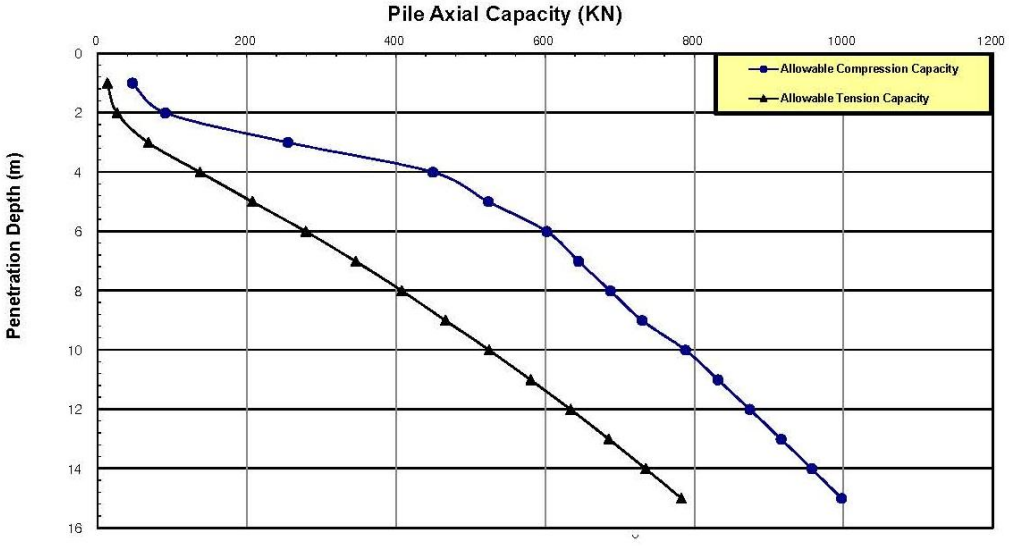
		PILE TYPE	BORED CAST IN SITU RCC
Ultimate capacity of pile Qu	1838.1 kN	Pile dia	0.60 m
Factor of safety against axial compression, FS	2.5	Pile length	30.0 m from EGL
Safe capacity Qa	735.3 kN	Soil profile :Ref. Sub-Soil report-borehole # BH-04	
Group efficiency	1	Axial Compression and Tension capacity	
Reduced capacity due to group efficiency	735.3 kN	Skin friction = k_s*γ*h**tanδ	



BH-05 | Dia of Pile (600 mm) | S.F 2.5

Depth in meter measured from EGL			Layer thickness, m	Field SPT	Corrected SPT N'	Soil Type	Effective unit weight of soil, γ (KN/m3)	Cohesion, c (kN/m2)	Friction Angle, ♦ (degrees)	Angle, ♦ (degrees)	Effective over burden pressure, P (KN/m2)	K	α	Nq	Nc	Surface area, A_s (m2)	Unit Skin Friction, f_s (kN/m2)	Unit End Bearing, f_b (kN/m2)	Skin friction, KN	End bearing, KN	Tension Capacity KN (FS=2.5)	Compression Capacity KN (FS=2.5)
from	to	Average																				
0	1	0.5	1.0	4	5	Clay	18	33	-	-	9	1	0.89	-	9	1.13	19.50	98.119	32.92	83.23	**13.17**	**46.46**
1	2	1.5	1.0	11	11	Clay	18	64	-	-	27	1	0.45	-	9	1.13	19.11	190.8	32.27	161.84	**26.07**	**90.81**
2	3	2.5	1.0	26	31	Clay	8	184	-	-	20	1	0.5	-	9	1.13	61.68	552.33	104.11	468.50	**67.72**	**255.12**
3	4	3.5	1.0	50	51	Clay	8	307	-	-	28	1	0.5	-	9	1.13	102.72	919.87	173.39	780.26	**137.07**	**449.18**
4	5	4.5	1.0	50	52	Clay	8	311	-	-	36	1	0.5	-	9	1.13	104.12	932.45	175.76	790.94	**207.38**	**523.75**
5	6	5.5	1.0	50	53	Clay	8	317	-	-	44	1	0.5	-	9	1.13	106.23	951.35	179.33	806.97	**279.11**	**601.90**
6	7	6.5	1.0	50	49	Clay	8	294	-	-	52	1	0.5	-	9	1.13	98.35	880.78	166.02	747.11	**345.52**	**644.36**
7	8	7.5	1.0	50	46	Clay	8	275	-	-	60	1	0.5	-	9	1.13	92.00	823.9	155.30	698.85	**407.64**	**687.18**
8	9	8.5	1.0	50	43	Clay	8	259	-	-	68	1	0.5	-	9	1.13	86.74	776.78	146.42	658.89	**466.21**	**729.76**
9	10	9.5	1.0	50	43	Clay	8	259	-	-	76	1	0.5	-	9	1.13	86.62	775.7	146.22	657.97	**524.69**	**787.88**
10	11	10.5	1.0	50	41	Clay	8	247	-	-	84	1	0.5	-	9	1.13	82.59	739.6	139.41	627.35	**580.46**	**831.40**
11	12	11.5	1.0	50	39	Clay	8	236	-	-	92	1	0.5	-	9	1.13	79.07	708.11	133.48	600.64	**633.85**	**874.11**
12	13	12.5	1.0	50	38	Clay	8	227	-	-	100	1	0.5	-	9	1.13	75.97	680.33	128.24	577.08	**685.14**	**915.98**
13	14	13.5	1.0	50	37	Clay	8	219	-	-	108	1	0.5	-	9	1.13	73.21	655.59	123.57	556.09	**734.57**	**957.01**
14	15	14.5	1.0	50	35	Clay	8	211	-	-	116	1	0.5	-	9	1.13	70.72	633.36	119.38	537.23	**782.33**	**997.22**
																			1955.82	**0.0**		

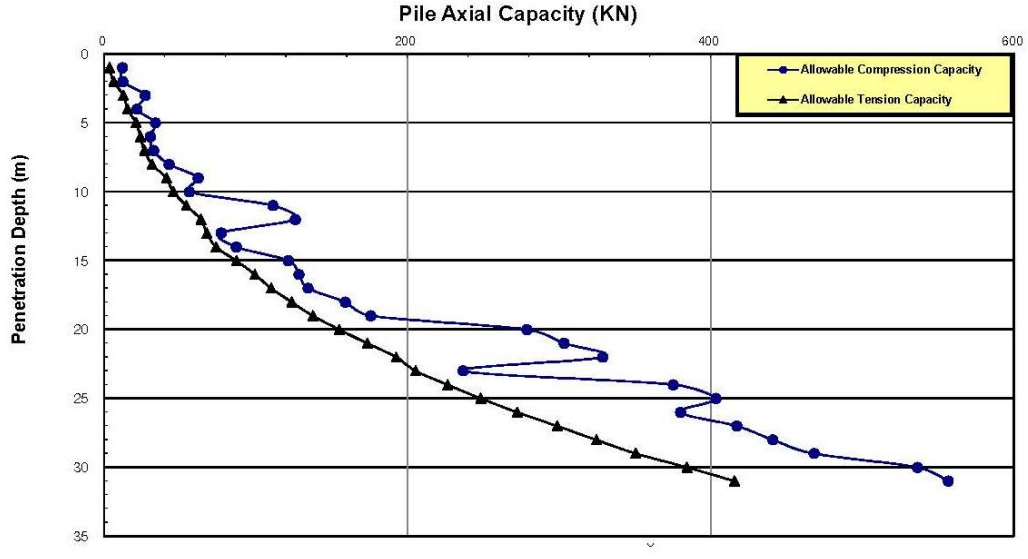
		PILE TYPE	BORED CAST IN SITU RCC
Ultimate capacity of pile Qu	1955.8 kN	Pile dia	0.60 m
Factor of safety against axial compression, FS	2.5	Pile length	30.0 m from EGL
Safe capacity Qa	782.3 kN	Soil profile :Ref. Sub-Soil report-borehole # BH-05	
Group efficiency	1	Axial Compression and Tension capacity	
Reduced capacity due to group efficiency	782.3 kN	Skin friction = k_s*γ'h'*tanδ	



BH-06 | Dia of Pile (600 mm) | S.F 2.5

Depth in meter measured from EGL			Layer thickness, m	Field SPT	Corrected SPT N'	Soil Type	Effective unit weight of soil, γ (KN/m3)	Cohesion, c (kN/m2)	Friction Angle, ϕ (degrees)	Angle, β (degrees)	Effective over burden pressure, P (KN/m2)	K	α	Nq	Nc	Surface area, A_s (m2)	Unit Skin Friction, f_s (kN/m2)	Unit End Bearing, f_b (kN/m2)	Skin friction, KN	End bearing, KN	Tension Capacity KN (FS=2.5)	Compression Capacity KN (FS=2.5)
from	to	Average																				
0	1	0.5	1.0	1	1	Silt	18	8	-	-	9	1	1	-	9	1.13	5.48	24.53	9.25	20.81	**3.70**	**12.02**
1	2	1.5	1.0	1	1	Clay	18	6	-	-	27	1	1	-	9	1.13	3.87	17.345	6.54	14.71	**6.31**	**12.20**
2	3	2.5	1.0	2	2	Silt	8	14	-	-	20	1	1	-	9	1.13	9.49	42.487	16.02	36.04	**12.72**	**27.14**
3	4	3.5	1.0	1	1	Clay	8	6	-	-	28	1	1	-	9	1.13	4.11	18.397	6.94	15.61	**15.50**	**21.74**
4	5	4.5	1.0	2	2	Clay	8	12	-	-	36	1	1	-	9	1.13	8.33	37.298	14.06	31.64	**21.12**	**33.78**
5	6	5.5	1.0	1	1	Clay	8	6	-	-	44	1	1	-	9	1.13	4.25	19.027	7.17	16.14	**23.99**	**30.45**
6	7	6.5	1.0	1	1	Clay	8	6	-	-	52	1	1	-	9	1.13	3.93	17.616	6.64	14.94	**26.65**	**32.62**
7	8	7.5	1.0	2	2	Clay	8	11	-	-	60	1	1	-	9	1.13	7.36	32.956	12.42	27.95	**31.62**	**42.80**
8	9	8.5	1.0	4	3	Clay	8	21	-	-	68	1	1	-	9	1.13	13.88	62.142	23.43	52.71	**40.99**	**62.07**
9	10	9.5	1.0	2	2	Clay	8	10	-	-	76	1	1	-	9	1.13	6.93	31.028	11.70	26.32	**45.67**	**56.19**
10	11	10.5	1.0	2	2	Sand	8	-	25	18.8	84	1	-	18	-	1.13	19.10	504	21.61	142.50	**54.31**	**111.31**
11	12	11.5	1.0	2	2	Sand	8	-	25	18.8	92	1	-	18	-	1.13	20.92	552	23.66	156.07	**63.77**	**126.20**
12	13	12.5	1.0	2	2	Silt	8	9	-	-	100	1	1	-	9	1.13	6.08	27.213	10.26	23.08	**67.88**	**77.11**
13	14	13.5	1.0	3	2	Silt	8	13	-	-	108	1	1	-	9	1.13	8.78	39.335	14.83	33.37	**73.81**	**87.15**
14	15	14.5	1.0	8	6	Silt	8	34	-	-	116	1	0.87	-	9	1.13	19.79	101.34	33.41	85.96	**87.17**	**121.56**
15	16	15.5	1.0	7	5	Silt	8	29	-	-	124	1	0.95	-	9	1.13	18.18	85.854	30.69	72.82	**99.45**	**128.58**
16	17	16.5	1.0	6	4	Clay	8	24	-	-	132	1	1	-	9	1.13	15.94	71.392	26.91	60.56	**110.22**	**134.44**
17	18	17.5	1.0	9	6	Silt	8	35	-	-	140	1	0.86	-	9	1.13	20.02	104.07	33.80	88.28	**123.74**	**159.05**
18	19	18.5	1.0	10	6	Silt	8	38	-	-	148	1	0.82	-	9	1.13	20.64	112.55	34.84	95.47	**137.67**	**175.86**
19	20	19.5	1.0	13	8	Sand	8	-	27	20.3	156	1	-	21	-	1.13	38.56	1092	43.61	308.76	**155.12**	**278.62**
20	21	20.5	1.0	15	9	Sand	8	-	27	20.3	164	1	-	21	-	1.13	40.54	1148	45.85	324.59	**173.46**	**303.29**
21	22	21.5	1.0	13	8	Sand	8	-	27	20.3	172	1	-	21	-	1.13	42.51	1204	48.08	340.42	**192.69**	**328.86**
22	23	22.5	1.0	9	5	Clay	8	31	-	-	180	1	0.92	-	9	1.13	18.89	92.067	31.89	78.09	**205.45**	**236.68**
23	24	23.5	1.0	14	8	Sand	8	-	27	20.3	188	1	-	21	-	1.13	46.47	1316	52.56	372.09	**226.47**	**375.30**
24	25	24.5	1.0	16	9	Sand	8	-	27	20.3	196	1	-	21	-	1.13	48.45	1372	54.79	387.92	**248.38**	**403.55**
25	26	25.5	1.0	33	18	Clay	8	106	-	-	204	1	0.5	-	9	1.13	35.45	317.51	59.85	269.32	**272.32**	**380.05**
26	27	26.5	1.0	37	19	Clay	9	116	-	-	238.5	1	0.5	-	9	1.13	39.01	349.34	65.85	296.32	**298.66**	**417.19**
27	28	27.5	1.0	37	19	Clay	10	114	-	-	275	1	0.5	-	9	1.13	38.31	343.04	64.66	290.98	**324.53**	**440.92**
28	29	28.5	1.0	38	19	Clay	11	115	-	-	313.5	1	0.5	-	9	1.13	38.66	346.18	65.25	293.65	**350.63**	**468.09**
29	30	29.5	1.0	50	25	Clay	12	149	-	-	354	1	0.5	-	9	1.13	50.01	447.85	84.42	379.88	**384.40**	**536.35**
30	31	30.5	1.0	50	23	Clay	13	138	-	-	396.5	1	0.5	-	9	1.13	46.38	415.37	78.30	352.33	**415.71**	**556.65**
																			1039.29	**324.6**		

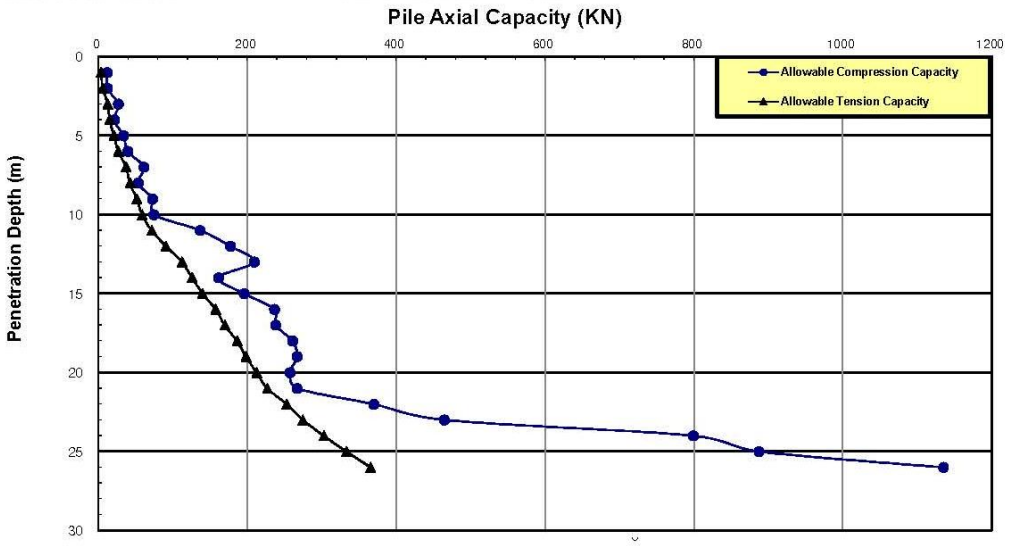
		PILE TYPE	BORED CAST IN SITU RCC
Ultimate capacity of pile Qu	1363.9 kN	Pile dia	0.60 m
Factor of safety against axial compression, FS	2.5	Pile length	30.0 m from EGL
Safe capacity Qa	545.6 kN	Soil profile : Ref. Sub-Soil report-borehole # BH-06	
Group efficiency	1	Axial Compression and Tension capacity	
Reduced capacity due to group efficiency	545.6 kN	Skin friction = k_s*γ*h*tanδ	



BH-07 | Dia of Pile (600 mm) | S.F 2.5

Depth in meter measured from EGL			Layer thickness, m	Field SPT	Corrected SPT N'	Soil Type	Effective unit weight of soil, γ (kN/m3)	Cohesion, c (kN/m2)	Friction Angle ϕ (degrees)	Angle, β (degrees)	Effective over burden pressure, P (kN/m2)	K	α	Nq	Nc	Surface area, A_s (m2)	Unit Skin Friction, f_s (kN/m2)	Unit End Bearing, f_b (kN/m2)	Skin friction, KN	End bearing, KN	Tension Capacity KN (FS=2.5)	Compression Capacity KN (FS=2.5)
from	to	Average																				
0	1	0.5	1.0	1	1	Silt	18	8	-	-	9	1	1	-	9	1.13	5.48	24.53	9.25	20.81	**3.70**	**12.02**
1	2	1.5	1.0	1	1	Silt	18	6	-	-	27	1	1	-	9	1.13	3.87	17.345	6.54	14.71	**6.31**	**12.20**
2	3	2.5	1.0	2	2	Silt	18	14	-	-	45	1	1	-	9	1.13	9.49	42.487	16.02	36.04	**12.72**	**27.14**
3	4	3.5	1.0	1	1	Silt	8	6	-	-	28	1	1	-	9	1.13	4.11	18.397	6.94	15.61	**15.50**	**21.74**
4	5	4.5	1.0	2	2	Silt	8	12	-	-	36	1	1	-	9	1.13	8.33	37.298	14.06	31.64	**21.12**	**33.78**
5	6	5.5	1.0	2	2	Silt	8	13	-	-	44	1	1	-	9	1.13	8.50	38.054	14.35	32.28	**26.86**	**39.77**
6	7	6.5	1.0	4	4	Clay	8	23	-	-	52	1	1	-	9	1.13	15.74	70.463	26.56	59.77	**37.48**	**61.39**
7	8	7.5	1.0	2	2	Clay	8	11	-	-	60	1	1	-	9	1.13	7.36	32.956	12.42	27.95	**42.45**	**53.64**
8	9	8.5	1.0	4	3	Clay	8	21	-	-	68	1	1	-	9	1.13	13.88	62.142	23.43	52.71	**51.82**	**72.91**
9	10	9.5	1.0	3	3	Clay	8	16	-	-	76	1	1	-	9	1.13	10.39	46.542	17.55	39.48	**58.84**	**74.63**
10	11	10.5	1.0	13	11	Silt	8	64	-	-	84	1	0.44	-	9	1.13	18.96	192.3	32.00	163.11	**71.64**	**136.89**
11	12	11.5	1.0	18	14	Clay	8	85	-	-	92	1	0.5	-	9	1.13	28.47	254.92	48.05	216.23	**90.86**	**177.36**
12	13	12.5	1.0	21	16	Silt	8	95	-	-	100	1	0.5	-	9	1.13	31.91	285.74	53.86	242.37	**112.41**	**209.36**
13	14	13.5	1.0	8	6	Clay	8	35	-	-	108	1	0.86	-	9	1.13	20.09	104.89	33.91	88.97	**125.97**	**161.56**
14	15	14.5	1.0	13	9	Clay	8	55	-	-	116	1	0.57	-	9	1.13	21.07	164.67	35.57	139.68	**140.20**	**196.08**
15	16	15.5	1.0	19	13	Clay	8	78	-	-	124	1	0.5	-	9	1.13	26.02	233.03	43.93	197.67	**157.77**	**236.84**
16	17	16.5	1.0	17	11	Clay	8	67	-	-	132	1	0.39	-	9	1.13	17.80	202.28	30.04	171.58	**169.79**	**238.42**
17	18	17.5	1.0	19	12	Clay	8	73	-	-	140	1	0.5	-	9	1.13	24.53	219.71	41.41	186.36	**186.35**	**260.90**
18	19	18.5	1.0	18	11	Clay	8	68	-	-	148	1	0.39	-	9	1.13	17.76	202.59	29.97	171.84	**198.34**	**267.08**
19	20	19.5	1.0	12	7	Clay	8	44	-	-	156	1	0.73	-	9	1.13	21.47	131.64	36.24	111.66	**212.84**	**257.50**
20	21	20.5	1.0	11	7	Clay	8	39	-	-	164	1	0.8	-	9	1.13	20.94	117.76	35.36	99.89	**226.98**	**266.94**
21	22	21.5	1.0	33	19	Clay	8	115	-	-	172	1	0.5	-	9	1.13	38.54	345.16	65.06	292.78	**253.01**	**370.12**
22	23	22.5	1.0	29	17	Sand	8	-	29	21.8	180	1	-	28	-	1.13	48.11	1680	54.42	475.01	**274.77**	**464.78**
23	24	23.5	1.0	65	36	Sand	8	-	35	26.3	188	1	-	70	-	1.13	62.12	4386.7	70.25	1240.30	**302.87**	**799.00**
24	25	24.5	1.0	70	38	Sand	8	-	36	27.0	196	1	-	75	-	1.13	66.91	4900	75.67	1385.45	**333.14**	**887.32**
25	26	25.5	1.0	80	43	Sand	8	-	37	27.8	204	1	-	100	-	1.13	71.91	6800	81.33	1922.66	**365.68**	**1134.74**
																			914.19	**99.9**		

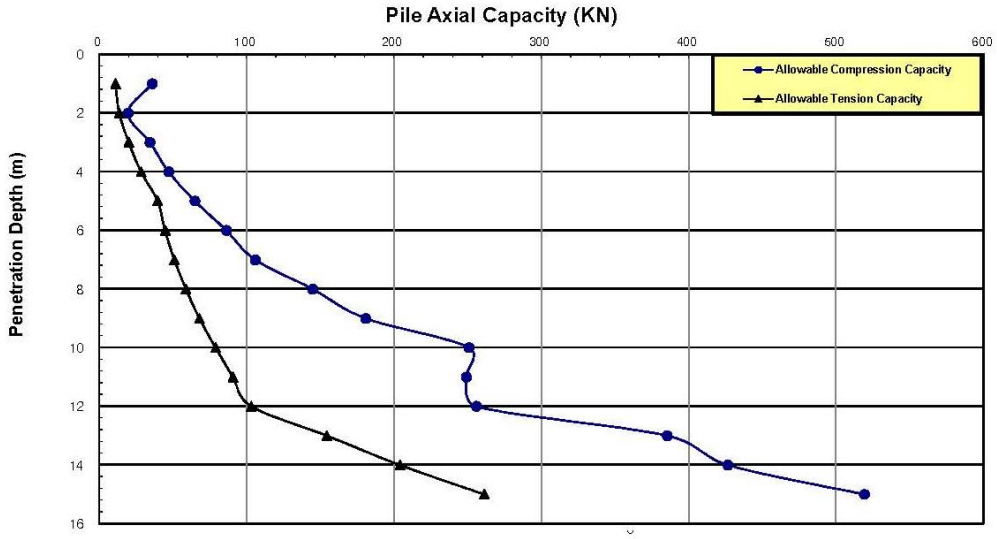
		PILE TYPE	BORED CAST IN SITU RCC
Ultimate capacity of pile Qu	1014.1 kN	Pile dia	0.60 m
Factor of safety against axial compression, FS	2.5	Pile length	30.0 m from EGL
Safe capacity Qa	405.6 kN	Soil profile :Ref. Sub-Soil report-borehole # BH-07	
Group efficiency	1	Axial Compression and Tension capacity	
Reduced capacity due to group efficiency	405.6 kN	Skin friction = k_s*γ'h'*tanδ	



BH-08 Dia of Pile (600 mm) S.F 2.5

Depth in meter measured from EGL			Layer thickness, m	Field SPT	Corrected SPT N'	Soil Type	Effective unit weight of soil, γ (kN/m3)	Cohesion, c (kN/m2)	Friction Angle, ϕ (degrees)	Angle, β (degrees)	Effective over burden pressure, P (KN/m2)	K	α	Nq	Nc	Surface area, A_s (m2)	Unit Skin Friction, f_s (kN/m2)	Unit End Bearing, f_b (kN/m2)	Skin friction, KN	End bearing, KN	Tension Capacity KN (FS=2.5)	Compression Capacity KN (FS=2.5)
from	to	Average																				
0	1	0.5	1.0	3	4	Clay	18	25	-	-	9	1	1	-	9	1.13	16.43	73.589	27.74	62.42	**11.10**	**36.07**
1	2	1.5	1.0	1	1	Clay	18	6	-	-	27	1	1	-	9	1.13	3.87	17.345	6.54	14.71	**13.71**	**19.60**
2	3	2.5	1.0	2	2	Clay	8	14	-	-	20	1	1	-	9	1.13	9.49	42.487	16.02	36.04	**20.12**	**34.53**
3	4	3.5	1.0	3	3	Clay	8	18	-	-	28	1	1	-	9	1.13	12.33	55.192	20.81	46.82	**28.44**	**47.17**
4	5	4.5	1.0	4	4	Clay	8	25	-	-	36	1	1	-	9	1.13	16.66	74.596	28.12	63.27	**39.69**	**65.00**
5	6	5.5	1.0	12	13	Sand	8	-	28	21.0	44	1	-	25	-	1.13	11.32	366.67	12.80	103.67	**44.81**	**86.28**
6	7	6.5	1.0	16	16	Sand	8	-	29	21.8	52	1	-	28	-	1.13	13.90	485.33	15.72	137.23	**51.10**	**105.99**
7	8	7.5	1.0	22	20	Sand	8	-	31	23.3	60	1	-	38	-	1.13	17.27	760	19.53	214.89	**58.91**	**144.87**
8	9	8.5	1.0	30	26	Sand	8	-	32	24.0	68	1	-	44	-	1.13	20.28	997.33	22.94	281.99	**68.09**	**180.88**
9	10	9.5	1.0	35	30	Sand	8	-	34	25.5	76	1	-	60	-	1.13	24.29	1520	27.47	429.77	**79.08**	**250.98**
10	11	10.5	1.0	35	29	Sand	8	-	33	24.8	84	1	-	50	-	1.13	25.95	1400	29.34	395.84	**90.81**	**249.15**
11	12	11.5	1.0	32	25	Sand	8	-	32	24.0	92	1	-	44	-	1.13	27.44	1349.3	31.04	381.52	**103.23**	**255.84**
12	13	12.5	1.0	50	38	Clay	8	227	-	-	100	1	0.5	-	9	1.13	75.97	680.33	128.24	577.08	**154.52**	**385.36**
13	14	13.5	1.0	50	37	Clay	8	219	-	-	108	1	0.5	-	9	1.13	73.21	655.59	123.57	556.09	**203.95**	**426.39**
14	15	14.5	1.0	60	42	Clay	8	253	-	-	116	1	0.5	-	9	1.13	84.87	760.03	143.26	644.68	**261.26**	**519.13**
																			653.15	0.0		

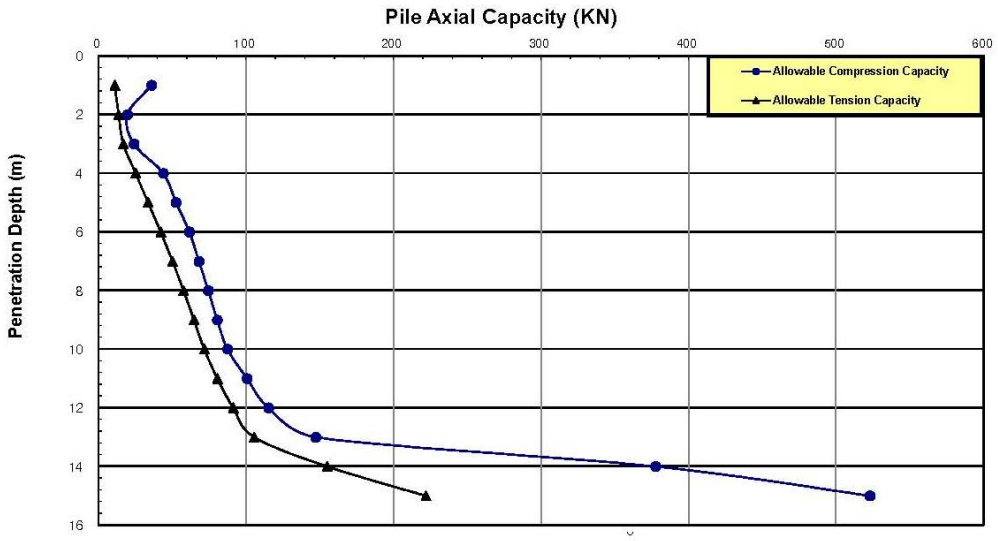
		PILE TYPE	BORED CAST IN SITU RCC
Ultimate capacity of pile Qu	653.1 kN	Pile dia	0.60 m
Factor of safety against axial compression, FS	2.5	Pile length	30.0 m from EGL
Safe capacity Qa	261.3 kN	Soil profile : Ref. Sub-Soil report-borehole # BH-08	
Group efficiency	1	Axial Compression and Tension capacity	
Reduced capacity due to group efficiency	261.3 kN	Skin friction = k_s*γ*h**tanδ	



BH-09 | Dia of Pile (600 mm) | S.F 2.5

Depth in meter measured from EGL			Layer thickness, m	Field SPT	Corrected SPT N'	Soil Type	Effective unit weight of soil, γ (kN/m3)	Cohesion, c (kN/m2)	Friction Angle, ϕ (degrees)	Angle, δ (degrees)	Effective over burden pressure, P (kN/m2)	K	α	Nq	Nc	Surface area, A_s (m2)	Unit Skin Friction, f_s (kN/m2)	Unit End Bearing, f_b (kN/m2)	Skin friction, KN	End bearing, KN	Tension Capacity KN (FS=2.5)	Compression Capacity KN (FS=2.5)
from	to	Average																				
0	1	0.5	1.0	3	4	Clay	18	25	-	-	9	1	1	-	9	1.13	16.43	73.589	27.74	62.42	**11.10**	**36.07**
1	2	1.5	1.0	1	1	Clay	18	6	-	-	27	1	1	-	9	1.13	3.87	17.345	6.54	14.71	**13.71**	**19.60**
2	3	2.5	1.0	1	1	Clay	8	7	-	-	20	1	1	-	9	1.13	4.74	21.243	8.01	18.02	**16.92**	**24.12**
3	4	3.5	1.0	3	3	Clay	8	18	-	-	28	1	1	-	9	1.13	12.33	55.192	20.81	46.82	**25.24**	**43.97**
4	5	4.5	1.0	3	3	Silt	8	19	-	-	36	1	1	-	9	1.13	12.49	55.947	21.09	47.46	**33.68**	**52.66**
5	6	5.5	1.0	3	3	Clay	8	19	-	-	44	1	1	-	9	1.13	12.75	57.081	21.52	48.42	**42.28**	**61.65**
6	7	6.5	1.0	3	3	Clay	8	18	-	-	52	1	1	-	9	1.13	11.80	52.847	19.92	44.83	**50.25**	**68.18**
7	8	7.5	1.0	3	3	Clay	8	16	-	-	60	1	1	-	9	1.13	11.04	49.434	18.64	41.93	**57.71**	**74.48**
8	9	8.5	1.0	3	3	Clay	8	16	-	-	68	1	1	-	9	1.13	10.41	46.607	17.57	39.53	**64.73**	**80.55**
9	10	9.5	1.0	3	3	Clay	8	16	-	-	76	1	1	-	9	1.13	10.39	46.542	17.55	39.48	**71.75**	**87.54**
10	11	10.5	1.0	4	3	Clay	8	20	-	-	84	1	1	-	9	1.13	13.21	59.168	22.31	50.19	**80.68**	**100.75**
11	12	11.5	1.0	5	4	Clay	8	24	-	-	92	1	1	-	9	1.13	15.81	70.811	26.70	60.06	**91.35**	**115.38**
12	13	12.5	1.0	9	7	Clay	8	41	-	-	100	1	0.77	-	9	1.13	21.17	122.46	35.73	103.87	**105.65**	**147.20**
13	14	13.5	1.0	50	37	Clay	8	219	-	-	108	1	0.5	-	9	1.13	73.21	655.59	123.57	556.09	**155.08**	**377.51**
14	15	14.5	1.0	70	49	Clay	8	296	-	-	116	1	0.5	-	9	1.13	99.01	886.7	167.14	752.13	**221.93**	**522.78**
																			554.83	**0.0**		

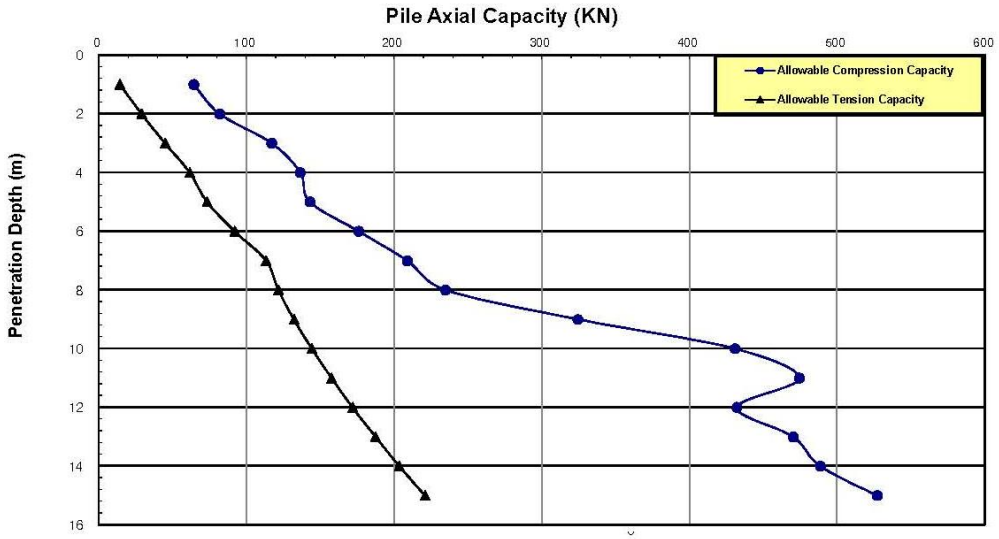
		PILE TYPE	BORED CAST IN SITU RCC
Ultimate capacity of pile Qu	554.8 kN	Pile dia	0.60 m
Factor of safety against axial compression, FS	2.5	Pile length	30.0 m from EGL
Safe capacity Qa	221.9 kN	Soil profile :Ref. Sub-Soil report-borehole # BH-09	
Group efficiency	1	Axial Compression and Tension capacity	
Reduced capacity due to group efficiency	221.9 kN	Skin friction = k_s*γ*h*tanδ	



BH-10 Dia of Pile (600 mm) S.F 2.5

Depth in meter measured from EGL			Layer thickness, m	Field SPT	Corrected SPT N'	Soil Type	Effective unit weight of soil, γ (kN/m3)	Cohesion, c (kN/m2)	Friction Angle ϕ (degrees)	Angle, β (degrees)	Effective over burden pressure, P (kN/m2)	K	α	Nq	Nc	Surface area, A_s (m2)	Unit Skin Friction, f_s (kN/m2)	Unit End Bearing, f_b (kN/m2)	Skin friction, KN	End bearing, KN	Tension Capacity KN (FS=2.5)	Compression Capacity KN (FS=2.5)
from	to	Average																				
0	1	0.5	1.0	6	8	Silt	18	49	-	-	9	1	0.66	-	9	1.13	21.57	147.18	36.41	124.84	**14.57**	**64.50**
1	2	1.5	1.0	9	9	Silt	18	52	-	-	27	1	0.61	-	9	1.13	21.40	156.11	36.12	132.41	**29.01**	**81.98**
2	3	2.5	1.0	10	12	Silt	8	71	-	-	20	1	0.5	-	9	1.13	23.72	212.43	40.04	180.19	**45.03**	**117.11**
3	4	3.5	1.0	12	12	Clay	8	74	-	-	28	1	0.5	-	9	1.13	24.65	220.77	41.61	187.26	**61.68**	**136.58**
4	5	4.5	1.0	11	11	Clay	8	68	-	-	36	1	0.38	-	9	1.13	17.42	205.14	29.41	174.01	**73.44**	**143.04**
5	6	5.5	1.0	13	14	Clay	8	82	-	-	44	1	0.5	-	9	1.13	27.62	247.35	46.62	209.81	**92.09**	**176.02**
6	7	6.5	1.0	16	16	Clay	8	94	-	-	52	1	0.5	-	9	1.13	31.47	281.85	53.13	239.07	**113.34**	**208.97**
7	8	7.5	1.0	30	28	Sand	8	-	33	24.8	60	1	-	50	-	1.13	18.53	1000	20.96	282.74	**121.73**	**234.82**
8	9	8.5	1.0	44	38	Sand	8	-	36	27.0	68	1	-	75	-	1.13	23.21	1700	26.25	480.66	**132.23**	**324.49**
9	10	9.5	1.0	50	43	Sand	8	-	37	27.8	76	1	-	100	-	1.13	26.79	2533.3	30.30	716.28	**144.35**	**430.86**
10	11	10.5	1.0	50	41	Sand	8	-	37	27.8	84	1	-	100	-	1.13	29.61	2800	33.49	791.68	**157.74**	**474.42**
11	12	11.5	1.0	50	39	Sand	8	-	36	27.0	92	1	-	75	-	1.13	31.41	2300	35.52	650.31	**171.95**	**432.08**
12	13	12.5	1.0	50	38	Sand	8	-	36	27.0	100	1	-	75	-	1.13	34.14	2500	38.61	706.86	**187.39**	**470.14**
13	14	13.5	1.0	50	37	Sand	8	-	35	26.3	108	1	-	70	-	1.13	35.68	2520	40.36	712.51	**203.54**	**488.54**
14	15	14.5	1.0	50	35	Sand	8	-	35	26.3	116	1	-	70	-	1.13	38.33	2706.7	43.35	765.29	**220.88**	**526.99**
																			552.19	**0.0**		

		PILE TYPE	BORED CAST IN SITU RCC
Ultimate capacity of pile Qu	552.2 kN	Pile dia	0.60 m
Factor of safety against axial compression, FS	2.5	Pile length	30.0 m from EGL
Safe capacity Qa	220.9 kN	Soil profile :Ref. Sub-Soil report-borehole # BH-10	
Group efficiency	1	Axial Compression and Tension capacity	
Reduced capacity due to group efficiency	220.9 kN	Skin friction = k_s*γ'h'*tanδ	



Appendix-5: Photographs

Photograph

Preparation of drilling

Drilling execution

Drilling at river site

Drilling preparation at bottom of hill

Drilling at bottom of hill

Disturbed sample

Disturbed sample

Undisturbed sample

ANNEXURE 5.4

Dredged Volume for Multimodal Routes

Item I (I): Dredging Volume Calculations for 3 M Least Available Depth (Lad)

TABLE 6.10 A

Dredging volume calculation from RANGAMATI TO BARKAL

Chainage Zero (00.00) starts from Kaptai.

Dredging level considered 18.50m RL PWD where LAD (least available draft) 3.00m.

FROM CHAINAGE	TO CHAINAGE	DISTANCE(m)	SECTION AREA(sq.m)	VOLUME(cu.m)
	45250	0	0	-
45250	45309	59	62.1	1,832
45309	45566	257	28.62	11,658
45566	46105	539	136.61	44,529
46105	46361	256	172.89	39,616
46361	46602	241	182.81	42,862
46602	46850	248	142.66	40,358
46850	47126	276	0	19,687
47126	47427	301	0	-
47427	47827	400	60.49	12,098
47827	48098	271	83.48	19,508
48098	48374	276	16.64	13,817
48374	48675	301	75.44	13,858
48675	48915	240	69.91	17,442
48915	49439	524	0	18,316
49439	49701	262	0	-
49701	49963	262	95.68	12,534
49963	50231	268	153.89	33,442
50231	50469	238	156.64	36,953
50469	50712	243	84.86	29,342
50712	50971	259	0	10,989
50971	51901	930	0	-
51901	52147	246	56.88	6,996
52147	52398	251	129.98	23,451
52398	52652	254	0	16,507
52652	53268	616	0	-
53268	53525	257	125.07	16,071
53525	53784	259	11.26	17,655
53784	54036	252	0	1,419
54036	54319	283	110.06	15,573
54319	54838	519	0	28,561
54838	55099	261	138.42	18,064
55099	55359	260	232.58	48,230
55359	55610	251	94.66	41,069
55610	55862	252	116.22	26,571
55862	56108	246	157.02	33,609
56108	56360	252	93.43	31,557
56360	56626	266	120.08	28,397
56626	56857	231	106.47	26,167
56857	57110	253	114.39	27,939
57110	57354	244	50.37	20,101
57354	57608	254	203.41	32,230
57608	57876	268	246.68	60,312
57876	58137	261	196.13	57,787
58137	58398	261	99.4	38,567
58398	58667	269	0	13,369

FROM CHAINAGE	TO CHAINAGE	DISTANCE(m)	SECTION AREA(sq.m)	VOLUME(cu.m)
58667	59006	339	85.07	14,419
59006	59265	259	181.43	34,512
59265	59525	260	203.72	50,070
59525	59806	281	14.01	30,591
	TOTAL DREDGING VOLUME (CU M)			**1,178,634**

Source: *Hydrographic survey done by the Consultant Survey-2000.*

TABLE 6.10 B

Dredging volume calculation from BARKAL to CHHOTOHARINA:

Chainage Zero (00.00) starts from Kaptai

Dredging level considered 17.00m RL PWD where LAD (least available draft) 3.00m.

FROM CHAINAGE	TO CHAINAGE	DISTANCE(m)	SECTION AREA(sq.m)	VOLUME(cu.m)
	66884	0	0	0
66884	66984	100	63.33	3167
66984	67255	271	202.9	36074
67255	67527	272	87.2	39454
67527	67754	227	294.71	43347
67754	68256	502	296.08	148288
68256	68522	266	320.18	81963
68522	68742	220	238.18	67789
68742	69017	275	330.79	76775
69017	69266	249	223	70837
69266	69495	229	0	63409
69495	69801	306	120.62	34119
69801	70051	250	241.74	15078
70051	70307	256	0	46382
70307	70573	266	98.64	32151
70573	70840	267	304.83	13168
70840	71081	241	85.43	48618
71081	71403	322	126.7	62832
71403	71669	266	274.08	47815
71669	71925	256	138.2	52772
71925	72180	255	154.46	37314
72180	72441	261	203.8	46753
72441	72695	254	14.92	27777
72695	72960	265	81.36	12757
72960	73220	260	305.27	50262
73220	73704	484	293.55	144914
73704	73985	281	172.76	65517
73985	74249	264	0	22804
74249	74545	296	309.76	45844
74545	75308	763	198.05	193730
75308	76344	1036	72.63	140212
76344	76636	292	194.05	38935
76636	76904	268	183.57	50601
76904	77141	237	215.44	47283
77141	77410	269	127.65	46146
77410	77650	240	290.71	50203
77650	77917	267	163.77	60673
77917	78255	338	0	27677
78255	78967	712	253.86	90374

FROM CHAINAGE	TO CHAINAGE	DISTANCE(m)	SECTION AREA(sq.m)	VOLUME(cu.m)
78967	79274	307	262.61	79278
79274	79522	248	283.37	67702
79522	79794	272	148.95	58796
79794	80069	275	19.46	23156
80069	80426	357	0	3474
80426	80717	291	272.33	39624
80717	80980	263	304.62	75869
80980	81229	249	309.92	76510
81229	81477	248	325.93	78845
81477	81745	268	217.25	72786
81745	82007	262	82.57	39276
82007	82319	312	125.41	2799129
82319	82549	230	292.77	48091
82549	83020	471	68.14	84994
83020	83528	508	277.11	87694
83528	83784	256	0	35470
83784	84045	261	134.82	17594
84045	84611	566	288.16	119703
84611	84827	216	25.7	33897
84827	85169	342	139.07	28176
85169	85412	243	277.97	50670
85412	85675	263	248.29	69203
85675	85899	224	326.22	64345
85899	86170	271	315.14	86904
86170	86427	257	343.97	84696
86427	86956	529	210.68	146705
86956	87172	216	253.1	50088
87172	87413	241	292.46	65740
87413	87712	299	212.83	75541
87712	87990	278	170.85	53332
87990	89624	1634	180	286644
	TOTAL DREDGING VOLUME (CU M)			**7,087,746**

Source: *Hydrographic survey done by the Consultant Survey-2000 Ltd.*

Item I (ii): Cost of dredging of the route option-1 (Rangamati to Chotohorina via Barkal).

Normally dredging cost is Tk. 150 per m^3. Project influence area is a vulnerable one. For vulnerable area dredging rate is Tk. 250 per m^3.

Name of Route	Quantity Million (m^3)	Cost Million (Taka)
1. Rangamati – Chotohorina (63 km) waterway and then Thegamukh (7.987 km) by road.	8.26 @ Tk. 250/ m^3	2065

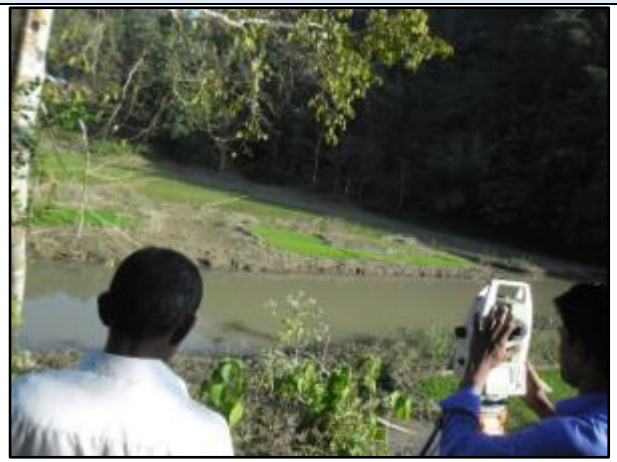
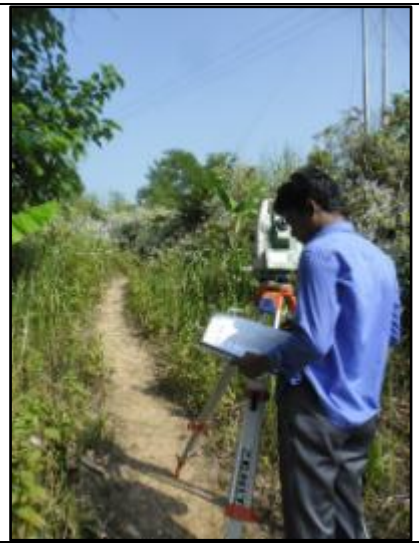
Source: *Dredging rates from BIWTA.*

ANNEXURE

Relevant Photographs Related to Engineering Surveys and Investigations

District: Rangamati	**Program: Photographs Related to Engineering Surveys and Investigations**
Location: Rajoshthali to Down Bridge	

District: Rangamati	**Program: Photographs Related to Engineering Surveys and Investigations**
Location: Bilaichhary to Down Bridge	

District: Rangamati	**Program: Photographs Related to Engineering Surveys and Investigations**
Location: Bilaichhary to Juraichhary to Barkal	
	
	

District: Rangamati	Program: Photographs Related to Engineering Surveys and Investigations
Location: Barkal to Chotohorina (Rainy Season)	

District: Rangamati	**Program: Photographs Related to Engineering Surveys and Investigations**
Location: Chhotohorina to Theghamukh	

ANNEXURES OF

CHAPTER 6

Improvement Proposals for Proposed Road and Multimodal Routes

Economic Analysis Summary

Study Name: **Bangladesh Project**

Run Date: **25-05-2016**

Chittagong to Thegamukh

Base Case

Analysis Mode: Analysis-by-Project

Alternative: Improvement vs Alternative: Base Case

	Increase in Road Agency Costs			Savings in MT VOC	Savings in MT Travel Time Costs	Savings in NMT Travel & Operating Costs	Reduction in Accident Costs	Net Exogenous Benefits	Net Economic Benefits (NPV)
	Capital	Recurrent	Special						
Undiscounted	17,617.77	-13,365.08	0.00	57,482.28	55,403.74	0.00	0.00	0.00	108,633.33
Discounted	17,566.61	-6,492.65	0.00	14,479.83	12,598.49	0.00	0.00	0.00	16,004.36

Economic Internal Rate of Return (EIRR) = 21.8% (No. of solutions = 1)

Economic Analysis Summary

Study Name: **Bangladesh Project**

Run Date: **25-05-2016**

Chittagong to Thegamukh

Base Case +15% Cost

Analysis Mode: Analysis-by-Project

Alternative: Improvement vs Alternative: Base Case

	Increase in Road Agency Costs			Savings in MT VOC	Savings in MT Travel Time Costs	Savings in NMT Travel & Operating Costs	Reduction in Accident Costs	Net Exogenous Benefits	Net Economic Benefits (NPV)
	Capital	Recurrent	Special						
Undiscounted	21,263.39	-13,365.08	0.00	57,482.28	55,403.74	0.00	0.00	0.00	104,987.70
Discounted	20,296.07	-6,492.65	0.00	14,479.83	12,598.49	0.00	0.00	0.00	13,274.90

Economic Internal Rate of Return (EIRR) = 19.2% (No. of solutions = 1)

Economic Analysis Summary

Study Name: **Bangladesh Project**

Run Date: **25-05-2016**

Chittagong to Thegamukh

Base Case -15% Traffic

Analysis Mode: Analysis-by-Project

Alternative: Improvement vs Alternative: Base Case

	Increase in Road Agency Costs			Savings in MT VOC	Savings in MT Travel Time Costs	Savings in NMT Travel & Operating Costs	Reduction in Accident Costs	Net Exogenous Benefits	Net Economic Benefits (NPV)
	Capital	Recurrent	Special						
Undiscounted	18,603.08	-13,113.17	0.00	51,305.91	46,357.95	0.00	0.00	0.00	92,173.94
Discounted	17,681.01	-6,744.50	0.00	12,242.02	10,184.87	0.00	0.00	0.00	11,490.38

Economic Internal Rate of Return (EIRR) = 19.4% (No. of solutions = 1)

Economic Analysis Summary

Study Name: **Bangladesh Project**

Run Date: **25-05-2016**

Chittagong to Thegamukh

Base Case -15% Traffic & +15% Cost

Analysis Mode: Analysis-by-Project

Alternative: Improvement vs Alternative: Base Case

	Increase in Road Agency Costs			Savings in MT VOC	Savings in MT Travel Time Costs	Savings in NMT Travel & Operating Costs	Reduction in Accident Costs	Net Exogenous Benefits	Net Economic Benefits (NPV)
	Capital	Recurrent	Special						
Undiscounted	21,263.39	-13,177.55	0.00	50,496.68	45,590.77	0.00	0.00	0.00	88,001.60
Discounted	20,296.07	-6,779.30	0.00	12,079.02	10,037.18	0.00	0.00	0.00	8,599.43

Economic Internal Rate of Return (EIRR) = 17.0% (No. of solutions = 1)

Economic Analysis Summary

Study Name: **Bangladesh Project**

Run Date: **25-05-2016**

Rajasthali to Thegamukh

Base Case

Analysis Mode: Analysis-by-Project

Alternative: Improvement vs Alternative: Base Case

	Increase in Road Agency Costs			Savings in MT VOC	Savings in MT Travel Time Costs	Savings in NMT Travel & Operating Costs	Reduction in Accident Costs	Net Exogenous Benefits	Net Economic Benefits (NPV)
	Capital	Recurrent	Special						
Undiscounted	17,794.41	0.00	0.00	36,293.47	28,564.27	0.00	0.00	0.00	47,063.33
Discounted	16,886.10	0.00	0.00	10,444.81	8,176.35	0.00	0.00	0.00	1,735.06

Economic Internal Rate of Return (EIRR) = 13.3% (No. of solutions = 1)

Economic Analysis Summary

Study Name: **Bangladesh Project**

Run Date: **25-05-2016**

Rajasthali to Thegamukh

Base Case +15% Cost

Analysis Mode: Analysis-by-Project

Alternative: Improvement vs Alternative: Base Case

	Increase in Road Agency Costs			Savings in MT VOC	Savings in MT Travel Time Costs	Savings in NMT Travel & Operating Costs	Reduction in Accident Costs	Net Exogenous Benefits	Net Economic Benefits (NPV)
	Capital	Recurrent	Special						
Undiscounted	20,333.42	0.00	0.00	36,293.47	28,564.27	0.00	0.00	0.00	44,524.32
Discounted	19,381.92	0.00	0.00	10,444.81	8,176.35	0.00	0.00	0.00	-760.76

Economic Internal Rate of Return (EIRR) = 11.5% (No. of solutions = 1)

Economic Analysis Summary

Study Name: **Bangladesh Project**

Run Date: **25-05-2016**

Rajasthali to Thegamukh

Base Case -15% Traffic

Analysis Mode: Analysis-by-Project

Alternative: Improvement vs Alternative: Base Case

	Increase in Road Agency Costs			Savings in MT VOC	Savings in MT Travel Time Costs	Savings in NMT Travel & Operating Costs	Reduction in Accident Costs	Net Exogenous Benefits	Net Economic Benefits (NPV)
	Capital	Recurrent	Special						
Undiscounted	17,794.41	0.00	0.00	30,872.94	24,288.55	0.00	0.00	0.00	37,367.08
Discounted	16,886.10	0.00	0.00	8,890.75	6,952.45	0.00	0.00	0.00	-1,042.90

Economic Internal Rate of Return (EIRR) = 11.2% (No. of solutions = 1)

Economic Analysis Summary

Study Name: **Bangladesh Project**

Run Date: **25-05-2016**

Chhotaharina to Thegamukh

Base Case -15% Traffic & +15% Cost

Analysis Mode: Analysis-by-Project

Alternative: Improvement vs Alternative: Base Case

	Increase in Road Agency Costs			Savings in MT VOC	Savings in MT Travel Time Costs	Savings in NMT Travel & Operating Costs	Reduction in Accident Costs	Net Exogenous Benefits	Net Economic Benefits (NPV)
	Capital	Recurrent	Special						
Undiscounted	20,333.42	0.00	0.00	30,872.94	24,288.55	0.00	0.00	0.00	34,828.07
Discounted	19,381.92	0.00	0.00	8,890.75	6,952.45	0.00	0.00	0.00	-3,538.72

Economic Internal Rate of Return (EIRR) = 9.6% (No. of solutions = 1)

Economic Analysis Summary

Study Name: **Bangladesh Project**

Run Date: **25-05-2016**

Chittagong to Rangamati

Base Case +15% Cost

Analysis Mode: Analysis-by-Project

Alternative: Improvement vs Alternative: Base Case

	Increase in Road Agency Costs			Savings in MT VOC	Savings in MT Travel Time Costs	Savings in NMT Travel & Operating Costs	Reduction in Accident Costs	Net Exogenous Benefits	Net Economic Benefits (NPV)
	Capital	Recurrent	Special						
Undiscounted	97.56	201.21	0.00	9,666.46	7,636.97	0.00	0.00	0.00	17,004.66
Discounted	95.91	73.59	0.00	1,154.54	1,126.60	0.00	0.00	0.00	2,111.64

Economic Internal Rate of Return (EIRR) = 23.7% (No. of solutions = 1)

Economic Analysis Summary

Study Name: **Bangladesh Project**

Run Date: **25-05-2016**

Chittagong to Rangamati

Base Case -15% Traffic

Analysis Mode: Analysis-by-Project

Alternative: Improvement vs Alternative: Base Case

	Increase in Road Agency Costs			Savings in MT VOC	Savings in MT Travel Time Costs	Savings in NMT Travel & Operating Costs	Reduction in Accident Costs	Net Exogenous Benefits	Net Economic Benefits (NPV)
	Capital	Recurrent	Special						
Undiscounted	84.84	198.60	0.00	6,985.55	5,619.60	0.00	0.00	0.00	12,321.71
Discounted	83.40	72.73	0.00	578.27	683.65	0.00	0.00	0.00	1,105.79

Economic Internal Rate of Return (EIRR) = 18.9% (No. of solutions = 1)

Economic Analysis Summary

Study Name: **Bangladesh Project**

Run Date: **25-05-2016**

Chittagong to Rangamati

Base Case -15% Traffic & +15% Cost

Analysis Mode: Analysis-by-Project

Alternative: Improvement vs Alternative: Base Case

	Increase in Road Agency Costs			Savings in MT VOC	Savings in MT Travel Time Costs	Savings in NMT Travel & Operating Costs	Reduction in Accident Costs	Net Exogenous Benefits	Net Economic Benefits (NPV)
	Capital	Recurrent	Special						
Undiscounted	97.56	198.60	0.00	6,985.55	5,619.60	0.00	0.00	0.00	12,308.98
Discounted	95.91	72.73	0.00	578.27	683.65	0.00	0.00	0.00	1,093.29

Economic Internal Rate of Return (EIRR) = 18.8% (No. of solutions = 1)

Annexure 7.2.2

Economic Analysis - Cash Flows (Economic Cost - in Million Taka) - At 2015 Prices

Year	Improved Situation													Existing Situation												Net Benefits
	Capital Cost					Operation & Maintenance (O & M) Cost							Total Cost (capital & OM)	Capital Cost					Operation & Maintenance (O & M) Cost							Total Cost (capital & OM)	
	Channel*	Terminal	Vessel		Total	Channel Maint.	Bank Protection	Terminals	Vessel		Cargo handling	Total		Channel*	Terminal	Vessel		Total	Channel Maint.	Bank Protection	Terminals	Vessel		Cargo handling	Total		
			Cargo	Passenger					Cargo	Passenger						Cargo	Passenger						Cargo	Passenger			
2017	539.5	39.5			579.0								579.0	0	0			0							0.00	0.00	-579.04
2018	719.4	52.7			772.1								772.1	0	0			0							0.00	0.00	-772.06
2019	539.5	39.5			579.0								579.0	0	0			0							0.00	0.00	-579.04
2020			187.6	137.2	324.8	18.0	0.056	1.3	1.9	1.4	1582.7	1605.4	1930.2			62.72	22.80	85.52	1.80	0.006	0.13	6.27	2.28	1978.43	1988.92	2074.44	144.23
2021						18.0	0.056	1.3	2.0	1.4	1677.7	1700.5	1700.5						1.80	0.006	0.13	6.65	2.43	2097.14	2108.15	2108.15	407.66
2022						18.0	0.056	1.3	2.1	1.5	1778.4	1801.3	1801.3						1.80	0.006	0.13	7.05	2.58	2222.97	2234.53	2234.53	433.21
2023						18.0	0.056	1.3	2.2	1.5	1885.1	1908.2	1908.2						1.80	0.006	0.13	7.47	2.75	2356.34	2368.50	2368.50	460.30
2024						18.0	0.056	1.3	2.4	1.6	1998.2	2021.5	2021.5						1.80	0.006	0.13	7.92	2.93	2497.72	2510.51	2510.51	489.01
2025			70.4	27.4	97.8	18.0	0.056	1.3	2.6	1.6	2118.1	2141.7	2239.5			21.28	8.40	29.68	1.80	0.006	0.13	8.40	3.12	2647.59	2661.05	2690.73	451.26
2026						18.0	0.056	1.3	2.7	1.7	2245.2	2268.9	2268.9						1.80	0.006	0.13	8.90	3.31	2806.45	2820.60	2820.60	551.67
2027						18.0	0.056	1.3	2.8	1.8	2379.9	2403.8	2403.8			50.18	18.24	68.42	1.80	0.006	0.13	9.44	3.51	2974.83	2989.72	3058.14	654.31
2028						18.0	0.056	1.3	2.9	2.0	2522.7	2546.8	2546.8						1.80	0.006	0.13	10.00	3.73	3153.32	3168.99	3168.99	622.17
2029						18.0	0.056	1.3	2.9	2.1	2674.0	2698.4	2698.4						1.80	0.006	0.13	10.60	3.96	3342.52	3359.02	3359.02	660.63
2030			46.9	54.9	101.8	18.0	0.056	1.3	3.0	2.2	2834.5	2859.1	2960.8			28.56	10.80	39.36	1.80	0.006	0.13	11.26	4.20	3543.07	3560.46	3599.82	638.98
2031						18.0	0.056	1.3	3.3	2.4	3004.5	3029.5	3029.5						1.80	0.006	0.13	11.93	4.44	3755.66	3773.96	3773.96	744.45
2032						18.0	0.056	1.3	3.5	2.6	3184.8	3210.2	3210.2			17.02	6.72	23.74	1.80	0.006	0.13	12.65	4.69	3981.00	4000.26	4024.01	813.80
2033						18.0	0.056	1.3	3.7	2.8	3375.9	3401.7	3401.7						1.80	0.006	0.13	13.41	4.95	4219.86	4240.15	4240.15	838.40
2034						18.0	0.056	1.3	4.0	3.0	3578.4	3604.8	3604.8			50.18	18.24	68.42	1.80	0.006	0.13	14.21	5.23	4473.05	4494.42	4562.84	958.05
2035			117.3	109.8	227.0	18.0	0.056	1.3	4.2	3.3	3793.1	3820.0	4047.1			47.60	16.50	64.10	1.80	0.006	0.13	15.06	5.52	4741.43	4763.95	4828.05	780.99
2036						18.0	0.056	1.3	4.5	3.4	4020.7	4048.0	4048.0						1.80	0.006	0.13	15.97	5.86	5025.92	5049.68	5049.68	1001.67
2037						18.0	0.056	1.3	4.7	3.6	4262.0	4289.7	4289.7			22.85	8.64	31.49	1.80	0.006	0.13	16.93	6.22	5327.47	5352.55	5384.04	1094.37
2038						18.0	0.056	1.3	5.0	3.8	4517.7	4545.8	4545.8						1.80	0.006	0.13	17.94	6.60	5647.12	5673.60	5673.60	1127.76
2039						18.0	0.056	1.3	5.3	3.9	4788.8	4817.4	4817.4			17.02	6.72	23.74	1.80	0.006	0.13	19.02	7.01	5985.95	6013.91	6037.66	1220.28
2040	-179.8	-26.3	-79.7	-79.6	-365.4	18.0	0.056	1.3	5.6	4.1	5076.1	5105.2	4739.8			7.75	2.88	10.63	1.80	0.006	0.13	20.22	7.44	6345.10	6374.70	6385.33	1645.55
																									EIRR		**20.13%**
																									NPV at 12%		**1476.76**

Economic Analysis Summary

Study Name: **Bangladesh Project**

Run Date: **25-05-2016**

Chhotaharina to Thegamukh

Base Case

Analysis Mode: Analysis-by-Project

Alternative: Improvement vs Alternative: Base Case

	Increase in Road Agency Costs			Savings in MT VOC	Savings in MT Travel Time Costs	Savings in NMT Travel & Operating Costs	Reduction in Accident Costs	Net Exogenous Benefits	Net Economic Benefits (NPV)
	Capital	Recurrent	Special						
Undiscounted	1,254.36	0.00	0.00	2,716.96	2,414.68	0.00	0.00	0.00	3,877.29
Discounted	1,190.33	0.00	0.00	781.07	691.19	0.00	0.00	0.00	281.92

Economic Internal Rate of Return (EIRR) = 14.8% (No. of solutions = 1)

Economic Analysis Summary

Study Name: **Bangladesh Project**

Run Date: **25-05-2016**

Chhotaharina to Thegamukh

Base Case +15% Cost

Analysis Mode: Analysis-by-Project

Alternative: Improvement vs Alternative: Base Case

	Increase in Road Agency Costs			Savings in MT VOC	Savings in MT Travel Time Costs	Savings in NMT Travel & Operating Costs	Reduction in Accident Costs	Net Exogenous Benefits	Net Economic Benefits (NPV)
	Capital	Recurrent	Special						
Undiscounted	1,433.34	0.00	0.00	2,716.96	2,414.68	0.00	0.00	0.00	3,698.31
Discounted	1,366.27	0.00	0.00	781.07	691.19	0.00	0.00	0.00	105.99

Economic Internal Rate of Return (EIRR) = 13.0% (No. of solutions = 1)

Economic Analysis Summary

Study Name: **Bangladesh Project**

Run Date: **25-05-2016**

Chhotaharina to Thegamukh

Base Case -15% Traffic

Analysis Mode: Analysis-by-Project

Alternative: Improvement vs Alternative: Base Case

	Increase in Road Agency Costs			Savings in MT VOC	Savings in MT Travel Time Costs	Savings in NMT Travel & Operating Costs	Reduction in Accident Costs	Net Exogenous Benefits	Net Economic Benefits (NPV)
	Capital	Recurrent	Special						
Undiscounted	1,254.36	0.00	0.00	2,310.17	2,052.48	0.00	0.00	0.00	3,108.30
Discounted	1,190.33	0.00	0.00	664.51	587.51	0.00	0.00	0.00	61.69

Economic Internal Rate of Return (EIRR) = 12.7% (No. of solutions = 1)

Economic Analysis Summary

Study Name: **Bangladesh Project**

Run Date: **25-05-2016**

Chhotaharina to Thegamukh

Base Case -15% Traffic & +15% Cost

Analysis Mode: Analysis-by-Project

Alternative: Improvement vs Alternative: Base Case

	Increase in Road Agency Costs			Savings in MT VOC	Savings in MT Travel Time Costs	Savings in NMT Travel & Operating Costs	Reduction in Accident Costs	Net Exogenous Benefits	Net Economic Benefits (NPV)
	Capital	Recurrent	Special						
Undiscounted	1,433.34	0.00	0.00	2,310.17	2,052.48	0.00	0.00	0.00	2,929.32
Discounted	1,366.26	0.00	0.00	664.51	587.51	0.00	0.00	0.00	-114.24

Economic Internal Rate of Return (EIRR) = 10.9% (No. of solutions = 1)

ANNEXURES OF

CHAPTER 7

Economic Appraisal of Road and Multimodal Route

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Annexure 7.1.2 HDM – IV Results of Economic Analysis All Road Route Rajosthali-Thegamukh Road (New Construction)

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Abbreviation

AADT	Annual Average Daily Traffic
AASTHO	American Association of State Highway and Transportation Officials
ACGR	Annual Compound Growth Rate
ADB	Asian Development Bank
ADT	Average Daily Traffic
ASCE	American Society of Civil Engineers
ASEAN	Association of Southeast Asian Nations
ASTM	American Society for Testing and Materials
BADC	Bangladesh Agricultural Development Corporation
BBS	Bangladesh Bureau of Statistics
BCIM	Bangladesh China India Myanmar
BDT	Bangladeshi Taka
BFDC	Bangladesh Fisheries Development Corporation
BFRI	Bangladesh Fish Research Institute
BGB	Border Guard Bangladesh
BH	Bore Hole
BIDS	Bangladesh Institute of Development Studies
BIWTA	Bangladesh Inland Water Transport Authority
BLPA	Bangladesh Land Ports Authority
BM	Bench Mark
BMD	Bangladesh Meteorological Department
BOD	Biological Oxygen Demand
BPDB	Bangladesh Power Development Board
BRTA	Bangladesh Road Transport Authority
BUET	Bangladesh University of Engineering and Technology
BWDB	Bangladesh Water Development Board
CBD	Convention on Biological Diversity
CBR	Cost Benefit Ratio
CDMPII	Comprehensive Disaster Management Programme Phase II
CES	Cumulative Environmental Sensitivity
CHT	Chittagong Hill Tracts
CHTDB	Chittagong Hill Tract Development Board
dBa	Decibel
DO	Dissolved Oxygen
DoArch	Department of Architecture
DoE	Directorate of Environment
DoF	Department of Forests
DoF	Department of Forest
DPHE	Department of Public Health Engineering
EA	Environmental Assessment
ECA	Environmentally Critical Area
ECCR	Environmentally Critical Conservative Rules
ECP	Environmentally Critical Projects
ECR	Environmental Compliance Review
EMP	Environmental Management Plan
EPP	Environmental Protection Policy
EPZ	Export Processing Zone

EQS	Environment Quality Standards
ESIA	Environmental and Social Impact Assessment
FY	Fiscal Year
GCM	Global Climate Model
GDP	Gross Domestic Product
GIS	Geographical Information System
GO	Government
GoB	Government of Bangladesh
GPS	Global Positioning System
GSB	Geologic Survey of Bangladesh
GWT	Ground Water Table
HBB	Herring Bone Bond
HDM	Highway design and Maintenance
HFL	High Flood Level
HIV / AIDS	Human Immunodeficiency Virus/Acquired Immune Deficiency Syndrome
HWF	Hill Women Federation
IBAs	Important Bird Areas
ICIMOD	International Centre for Integrated Mountain Development
ICTP	International Conventions, Treaties and Protocols
ICWFM	International Conference on Water and Flood Management
IFC	International Finance Corporation
IP	Indigenous People
IPCC	Intergovernmental Panel on Climate Change
IPDP	Indigenous People's Development Plan
IRC	Indian Roads Congress
IUCN	International Union for Conservation of Nature
IWT	Inland Water Transport
IWTA	Inland Water Transport Authority
JICA	Japan International Cooperation Agency
KM	Kilometre
KPH	Kilometer Per Hour
LFL	Low Flood Level
LGED	Local Government Engineering Department
LPG	Liquid Petroleum Gas
MEA	Multilateral Environmental Agreements
MoC	Ministry of Commerce
MOEF	Ministry of Environment & Forests
MoH	Ministry of Health
MoLG	Ministry of Local Government
MoS	Ministry of Shipping
MSL	Mean Sea Level
MT	Metric Tons
MW	Mega Watts
N/A	Not Applicable
NGO	Non-Government Organization
NNW-SSE	North North West-South South East
N-S	North-South
PC	Public Consultation
PIA	Project Influence Area
RCC	Reinforced Cement Concrete

RF	Reserve Forest
SDGs	Sustainable Development Goals
SI	International System
SPM	Suspended Particulate Matter
TDS	Total Dissolve Solid
TL	Team Leader
TOR	Terms of Reference
TPDP	Tribal People Development Plan
UN	United Nation
UNDP	United Nations Development Programme
UP	Union Parishad
US$	United States Dollar
USF	Unclassified State Forest
V	Speed in Km/h
VAT	Value Added Tax
VCF	Village Common Forests
VGF	Vulnerable Group Feeding
WB	World Bank

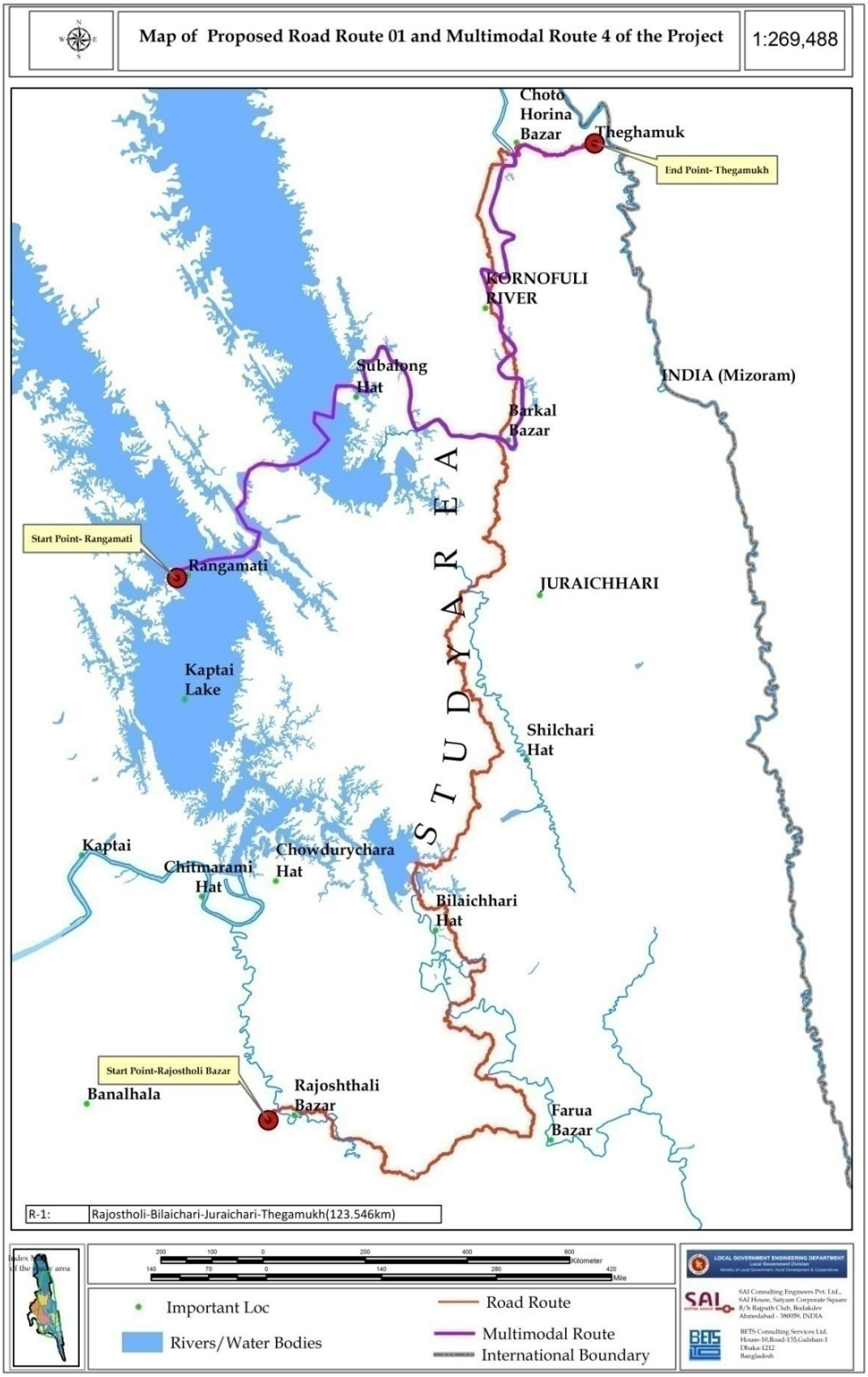
EXECUTIVE SUMMARY

The Government of Bangladesh has aimed to provide efficient and effective transport connectivity from Chittagong Port to remote area of North East (N-E) districts, that may lead to development of cross- border transit corridors to N-E states of India. These corridors could be combination of water and land routes in order to improve accessibility for the marginalized people of Chittagong Hills Tract area connecting to the border.

A multi – criteria analysis had been carried out to evaluate and rank each of the 4 water routes and 4 land routes using above mentioned criteria and sub criteria. The results of Multi-Criteria analysis indicates that

- Among four land routes the road alignment: Rajosthali – Bilaichhari – Juraichhari – Barkal – Thegamukh(123.54 km) and
- Among the Multimodal routes the alignment: Rangamati – Chhotoharina – connected by waterway (63 Km) and Thegamukh by road (about 7.98 km) have the highest score.

Thus these alignments have been proposed for detailed feasibility study. These two alignments are indicated in the enclosed map.


Map of Proposed Road Route 01 and Multimodal Route 4 of the Project
1:269,488
Choto Horina Bazar
Theghamuk
End Point- Thegamukh
KORNOFULI RIVER
Subalong Hat
INDIA (Mizoram)
Barkal Bazar
STUDY AREA
Start Point- Rangamati
Rangamati
JURAICHHARI
Kaptai Lake
Shilchari Hat
Kaptai
Chitmarami Hat
Chowdurychara Hat
Bilaichhari Hat
Start Point-Rajostholi Bazar
Banalhala
Rajoshthali Bazar
Farua Bazar
R-1:
Rajostholi-Bilaichari-Juraichari-Thegamukh(123.546km)
Kilometer
Mile
Important Loc
Rivers/Water Bodies
Road Route
Multimodal Route
International Boundary
LOCAL GOVERNMENT ENGINEERING DEPARTMENT
SAI Consulting Engineers Pvt. Ltd., SAI House, Satyam Corporate Square R/h Rajpath Club, Bodakdev Ahmedabad - 380059, INDIA
BETS Consulting Services Ltd. House-10,Road-135,Gulshan-1 Dhaka-1212 Bangladesh

Future Potential projects

The future potential coming up projects are namely:

i. Bangladesh-China-India-Myanmar (BCIM) Economic Corridor
ii. Mizoram State Roads II - Regional Transport Connectivity project, India
iii. 22.0 km section of Lunglei –Tlabung – Kawrpuichhuah Road on the border with Bangladesh;
iv. The 27.5km Champhai-Zokhawthar Road on the border with Myanmar; and
v. The 41.7km Chhumkhum-Chawngte North-South alignment connecting to the border roads with Bangladesh to the west and Myanmar to the south.

The above projects have great potential for cross border traffic and the possibility to generate / divert traffic on the proposed corridors of this study. However it requires some more detailed data and in-depth analysis for appropriately allocating this traffic to relevant routes.

Design Standards

Principally RHD Geometric Design Standards Manual (Revised) 2005 has been followed for design parameters. Besides the following reference recommendations and standards have been consulted for references

- AASHTO "A policy on Geometric Design of Highway and Streets" 2005
- IRC _SP_48_1998
- Overseas Road Note 6 "A Guide to Geometric Design"
- Nepal Road Standards 2020(July 2013), Government of Nepal, Ministry of Physical Infrastructure and Transport. Department of Roads, Kathmandu, Nepal

AASHTO – Load & Resistance Factor Design (LRFD) method is used as Design Standard for Bridge and culvert design and other drainage structures. Structural analysis and design of Bridge and culverts are made in accordance with American Association of State Highway and Transportation Officials (AASHTO). For vehicular loading, Standard specification for Highway bridges latest edition HL-93 is presently used in Bangladesh. The design method LFD (Load Factor Design) is adopted in design. RHD pavement design manual has been used for the road portion.

Engineering Surveys and Investigations

Following surveys and Investigations have been carried out for collection of field data:
Road and Bridge Inventory and Condition Survey
Topographical Survey for Roads and Bridges
Soil and Material Investigationsfor Roads
Hydrological and Hydrographic Investigations
Environmental Surveys for Roads and Multimodal Route

i. Assessment of Water pollution
ii. Assessment of Ground water quality
iii. Assessment of Surface water quality
iv. Noise levels at Sensitive locations

Improvements

As mentioned above two lane road with 7.3 m bituminous carriage way as per RHD standards has been developed. During the design process in order to provide acceptable gradients the length of land route is further reduced to 109.67 Km and land portion of Multi Modal Route is reduced to 7.37 Km and total length of Multi Modal Route is 70.37 Km. The lengths from Chittagong Port to Thegamukh by land route via Rajosthali is 184.97 Km while via Rangamati

by Multimodal route is 142.88 Km. It is proposed to construct new bridges in place of existing bridges. In total 40 bridges and 21 culverts are proposed. Bridges are of RCC and PCC types as per requirement. Similarly slab culverts of different sizes are proposed as per requirement Earth retaining structures are also essential in the hilly area in order to have protection and slope stability failures. At crucial locations earth retaining structures are proposed. Surface drains are designed and as per discharge requirement they have been proposed.

The details related to waterway Rangamati to Chhotoharina

Rangamati to Barkal 37.5 km is navigable round the year for small launches and boats. For larger cargo vessels navigable depth will need to be increased by dredging. Barkal to Chhotoharina 25.5 km is navigable during monsoon for 3-4 months. This part of the waterway (25.5 km) will need massive dredging to increase navigable depth.

Dredging quantity: With Least Available Depth 3.00 m and Width of cutting 61 m. Length from Rangamati to Chhotoharina via Barkal. Dredging quantity & cost are calculated for the portion from Rangamati to Chhotoharina.

Rangamati to Barkal (37.5 km) = 1.18 million m3
Barkal to Chhotoharina (25.5 km) = 7.08 million m3
Total = 8.26 million m3

Cost Estimates: Estimation of cost is also done for improvement of existing road like Chittagong Port to Rajosthali and Rangamati. Estimates are also made for new proposed road and waterway routes. Following are the estimates for various sections.

Road Route	**Million TK**	**Million US$**
i).Cost for Improvement of Existing Road (Chittagong Port to Rajosthali)	1251.16	16.21
ii). Cost for Construction of New Proposed Road(Rajosthali to Thegamukh)	21,398.66	277.18
Total=	**22649.82**	**293.39**
Multi Modal Route	**Million TK**	**Million US$**
i).Cost for Improvement of Existing Road (Chittagong to Rangamati)	142.4	1.84
ii). Cost for Improvement of Waterway (Rangamati to Chhotoharina)	2186.07	28.32
iii). Cost for Construction of New Proposed Road(Chhotoharina to Thegamukh)	1,475.75	19.12
Total=	**3804.22**	**49.28**

For development of cost estimate latest LGED/R&HD/BIWTA Rate Schedules have been used.

Environmental Scoping

Biodiversity

Evaluation Objective

To minimize adverse effects on native vegetation and habitat and on threatened flora and fauna species and ecological communities, including any relevant species listed under the Forest Act, and address opportunities for offsetting potential losses consistent with relevant policy.

Key issues

- Direct loss of native vegetation and any associated listed threatened flora and fauna species known or likely to occur in the project site.
- Direct habitat loss for listed threatened fauna species.
- Indirect loss of vegetation or habitat quality resulting from edge effects, habitat fragmentation or other disturbance impacts.
- Potential for other indirect impacts on biodiversity values including changes in hydrology and risk of significantly increasing mortality of Forest Act listed species

Fauna: The fauna mainly includes monkey, fox, jungle cat, fishing cat, wild boar, land turtle, king cobra, reticulated python, rat snake and other non-poisonous snakes together with large number of species of lizards and amphibians like frog and toad, and tree frogs. The bird life of the Chittagong Hill Tracts is wonderfully rich. More than 60 families of birds are found.

Endangering Ecosystem: Hunting, fishing and collecting wood and gathering non-timber forest products Many traditional occupations relate to daily livelihood/subsistence activities involving the use of biological resources, such as fishing/fisheries, hunting, gathering of non-timber forest products, such as wild plants, medicinal herbs, fruits, nuts, mushrooms, etc. These activities take place in diverse ecosystems (e.g. marine or inland waters, tropical or boreal forests).
Many species of wildlife have now become critically endangered in the Chittagong Hill Tracts (CHT) due to indiscriminate poaching and rapid depletion of forests. Rare species of wildlife like Yak (goyal), Tiger, Panther (chitabagh), large and small civet cat, Pangolin, Gibbon (Ulluk), Barking deer and Samber, Slow Loris (Lajjabati Banor) and peacock are already on the verge of extinction in the CHT forests. At the same time many common species are also fleeing the forests across the border as illegal poaching and fast depleting of forests reserves are causing their safe abode to shrink faster, observe zoologists.

Forestry: Sources at Department of Forest (DoF) said illegal logging, growing population, lack of wildlife conservation and awareness campaign and hunting by the indigenous people are the major reasons behind depletion of forests and disappearance of wildlife. A survey conducted in 1975 found 76 species of wild mammals, 183 species of wild birds, seven species of amphibious animals and 25 species of reptiles and snakes in the CHT forests. But many of these, including wild elephants, wild pigs, deer, wild dogs, porcupines, wild cocks, snakes, some species of monkeys, baboons (honuman), jackals, hares, few species of frogs, mongoose, leopards, wild buffaloes are now rarely seen in the forests. Even the Jhum cultivation through denudation of hills in and around the reserve forests areas also threatened biodiversity. (Shantimoy Chakma, Rangamati (Daily Star), Thursday, August 12, 2010).

Fisheries: Kaptai Lake is the largest manmade lake in the South Asia (App. 725 sq. Km). There is more than 4000 charas/ rivulet falling into the lake. About 1200 charas/ rivulets are directly connected and discharges into the lake. It is one of the largest sources of biodiversity and fish.

Substantial amount of fish are being supplied by this charas falling into lake and comparatively higher per area fish are available than Lake.. According to the research of Bangladesh Fish Research Institute (FRI); 2 species of Shrimp, 1 species of Dolphin and 2 species of Tortoise are available in the lake. There are 68 species of local and 8 species of alien fish are available in the lake. At present, 42 species of fish are commercially collected from the lake. The local fish species are mainly come into the lake from the river and nearby wetland after the lake were created.

Flora: The hills, rivers and cliffs are covered with dense bamboo breaks, tall trees and creeper jungles. The valleys are covered with thick forest. The vegetation is characterised by semi-evergreen (deciduous) to tropical evergreen dominated by tall trees belonging to dipterocarpaceae, euphorbiaceae, lauraceae, leguminacae and rubiaceae.

Relevance of Road alignment to the Wild Life Sanctuary / Protected / Birds area in Chittagong Hill Tract

PABLAKHALI WILDLIFE SANCTUARY
IUCN Management Category: IV (Managed Nature Reserve)
Bio-geographical Province: 4.09.04 (Burmna Monsoon Forest)

RAMPAHAR-SITAPAHAR WILDLIFE SANCTUARY
IUCN Management Category: Proposed
Bio-geographical Province: 4.04.01 (Burmna Rainforest)

Threat to the wildlife sanctuaries in project area

Transport connectivity route are particularly sensitive from an environmental perspective, especially the areas of the Rampahar and Pablakhali Wildlife Sanctuaries. These areas among others to be studied under the project will require particular attention to ensure appropriate identification of critical habitats (including but not limited to designated protected areas and wildlife sanctuaries).
Rampahar-Sitapahar Wildlife Sanctuary at Rangunia is close to the access road between Chittagong Ports to Rangamati. If Kaptai road is used for multimodal transportation then Rampahar-Sitapahar Wildlife Sanctuary can be avoided. Pablakhali Wildlife Sanctuary is a bit close at the tip of Rajosthali-Thegamukh road (Chhotoharina-Thegamukh). However the road is not passing through the wildlife sanctuary and may not harm it. Care should be taken so that user of this road can't get easy access to the sanctuary.
However it is known from the local people that ELEPHANT exist close to Barkal. But most elephant trail is in Bandarban

CHAPTER - 1

Introduction

CHAPTER - 1

Introduction

1.1 Introduction

Globalization and climate change have an increasing influence on the stability of fragile mountain ecosystems and the livelihoods of mountain people. Cherrapunjee-Chittagong Hill Tracts Landscape (CCHTL) is a globally unique geographical area. Geologically, the CCHTL represents ancient formations, largely igneous rock, unlike any other area in the Hindu Kush Himalayas. Connecting the Himalayas to mainland Bangladesh, the Chittagong Hill Tracts are blessed with vast evergreen forests, silvery waterfalls, swift mountain rivers, and a cool temperate climate. Although there are few protected areas within the landscape, a number of scared groves, scared caves, and forests make the landscape an important repository of biodiversity with one of the highest concentrations of endemic species in the Hindu Kush Himalayas. The people inhabiting this landscape are from diverse cultural groups. Agriculture is their main source of livelihood, followed by forests. Decreases in the shifting cultivation cycle, family fragmentation, unplanned and extensive mining, heavy overland flow and soil erosion, and development activities have significantly reduced the forest, biodiversity, and water retention capacity of the area in the recent years. In addition, although it is the wettest place on the Earth, the landscape has acute shortages of potable water because of pollution and development activities. Furthermore, climate change and its impact on rainfall patterns and hydrology, and the consequences of such changes for those living downstream, have not yet been investigated.

This project basically aims to improve the connectivity between Chittagong port to remote area of North–East (N-E) districts, which may lead to development of cross border transit corridors to N – E states of India. These corridors could be road or combination of water and land routes. In this respect, the Government has identified 4 (four) probable land routes and 4 (four) other routes based on all combinations of waterways requiring dredging and land routes for the screening of route options leading to detailed feasibility study.

The construction of roads in hilly areas is usually beset with a lot of environmental and ecological aspects and related impacts. Main aspects which may be impacted are forests, wildlife, surface and groundwater, air noise and soil quality, hill slope stability due to irresponsible hill cuttings, disturbance to geological start as, drainage pattern and related interruptions, public health and pollution, etc. Roads are constructed, adopting a state welfare approach, in order to ensure sustainable mobility, a prerequisite for the sustainable development of hill areas and concerned inhabitants. Considering the inevitable significance of road construction and the protection of environmental aspects from being impacted adversely, Environmental Management Plan (EMP), an integral and legally binding part of Contract Agreements, prepared for the mitigation of adverse impacts anticipated during design phase, Ministry of Environment and Forests (MoEF) and Department of Environment regulatory frameworks and funding agency's environmental and social safeguards requirements, is implemented under strict monitoring governed by an institutional set-up. Post-implementation public consultation regarding project benefits to society indicates that road construction activities have been/being completed in an environmentally and socially sustainable manner without creating any significant adverse impact to any aspects of the environment and society.

The challenge of global climate change has motivated transportation agencies involved in the construction and maintenance of transportation infrastructure to investigate strategies that replace the life cycle GHG emissions associated with the construction and rehabilitation of highway infrastructure. The road sector is coming under pressure to review current practice and the potential to reduce carbon emissions. To reduce GHG emissions, different approaches are adopted for road construction and maintenance, such as warm mix and cold mix technologies. Warm mix asphalt is produced at temperatures 20 to 40° lower than hot mix asphalt (HMA). Cold mix asphalt is produced and paved at ambient temperature using bitumen emulsion. The immediate benefit of producing and placing asphalt mixes at a lower temperature is the reduction in energy consumption, greenhouse gas emissions, fumes, and odors generated at the plant and the paving site. The life cycle approach has been accepted as a robust method of measuring carbon footprint. Tools and data sets have been developed to facilitate the measurement. Among them is the Calculator for Harmonised Assessment and Normalisation of Greenhouse Gas Emissions for Roads (CHANGER) developed by the International Road Federation (IRF).

1.2 Description of the Project

(i) ***Type of project:*** In order to improve key multi-modal transport corridor and networks that would address current transport bottlenecks for trade and help boost national, regional and international trade for Bangladesh, the World Bank is providing a Recipient-Executed grant to the Government of Bangladesh (GoB) to finance economic, financial, technical, environmental and social safeguards studies and technical assistance for addressing missing links for road and inland waterways to establish transport connectivity between Chittagong Port, Chittagong Hill Tracts Districts, and NE states in India. These interventions are expected to facilitate domestic trade, international trade with third countries, as well as regional trade with neighboring countries including India, Nepal and Myanmar. The Government of Bangladesh has aimed to provide efficient and effective transport connectivity from Chittagong Port to remote area of North East (N-E) districts, that may lead to development of cross-border transit corridors to N-E states of India. These corridors could be combination of water and land routes in order to improve accessibility for the marginalized people of Chittagong Hill Tracts area connecting to the border.

(ii) ***Need for project:*** This project basically aims to improve the connectivity between Chittagong port to remote area of North–East (N-E) districts, which may lead to development of cross border transit corridors to N – E states of India. As decided in Screening report these corridors are combination of water and land routes in order to improve accessibility for the marginalized people of Chittagong Hill Tracts area connecting to the border. For each of the 4 water routes (about 150 km in total) and 4 land routes (about 400 km in total) preliminary identification of road and multimodal transport alternatives, conduct screening of two potential alignments.

(iii) ***Location:*** The eight options for Chittagong Port - Chittagong Hill Tracts (CHT) Districts connectivity lie in the periphery of Kaptai Lake and all the routes require numerous water crossings. The physical feature in this area is rolling hills with limited plains, full of vegetation with some forests. The soil geology is mostly silt clay with soft sand stone in some areas. Although “katcha” motor able roads are shown in the LGED map for the proposed routes. Only a stretch of about 12 km in Bi1aichari was found to have Herring Bone Bond (HBB) roads with some old jeeps used as public transportation. People use waterway and foot trails to reach their settlements in these areas including Thegamukh.

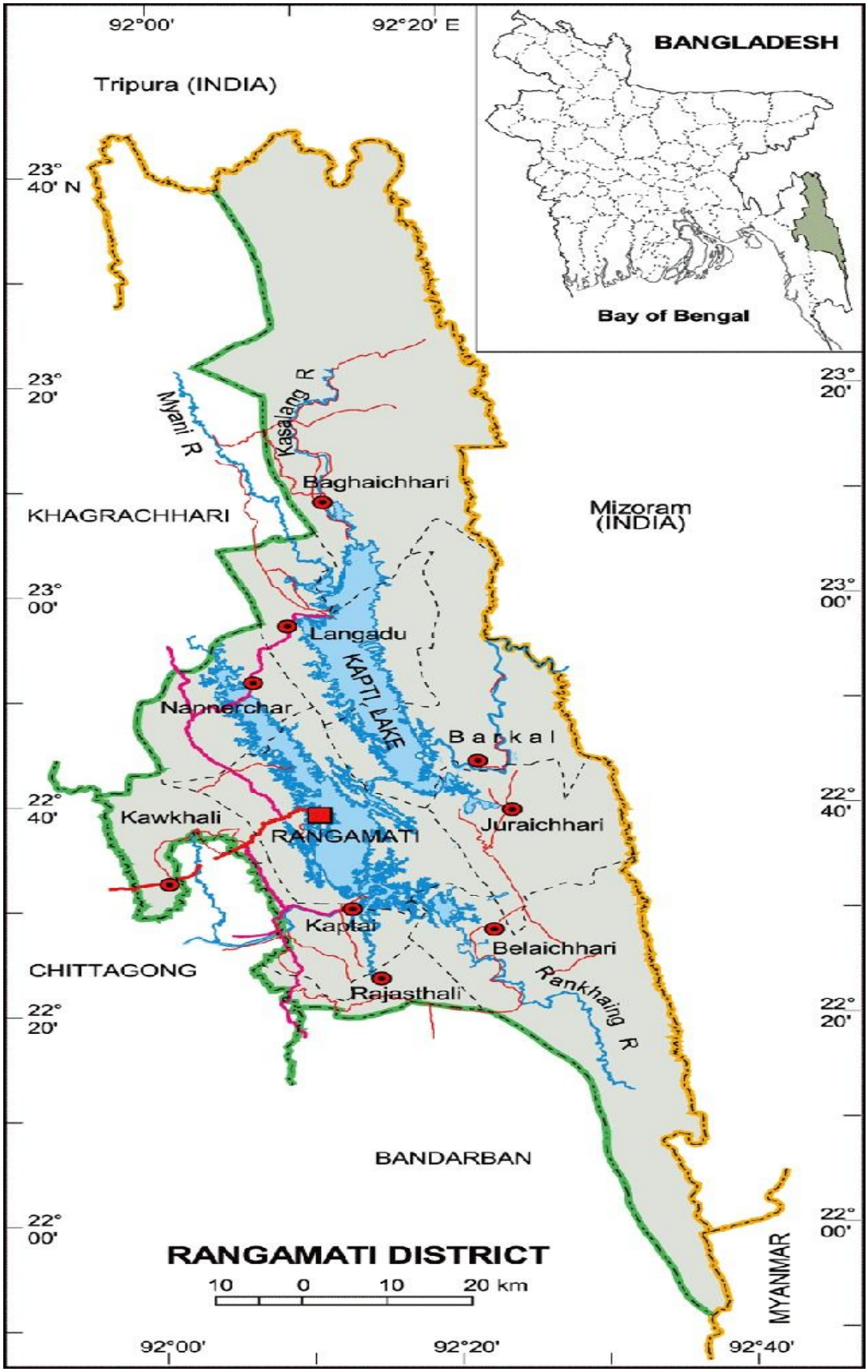


Fig 1.2A : Project Location

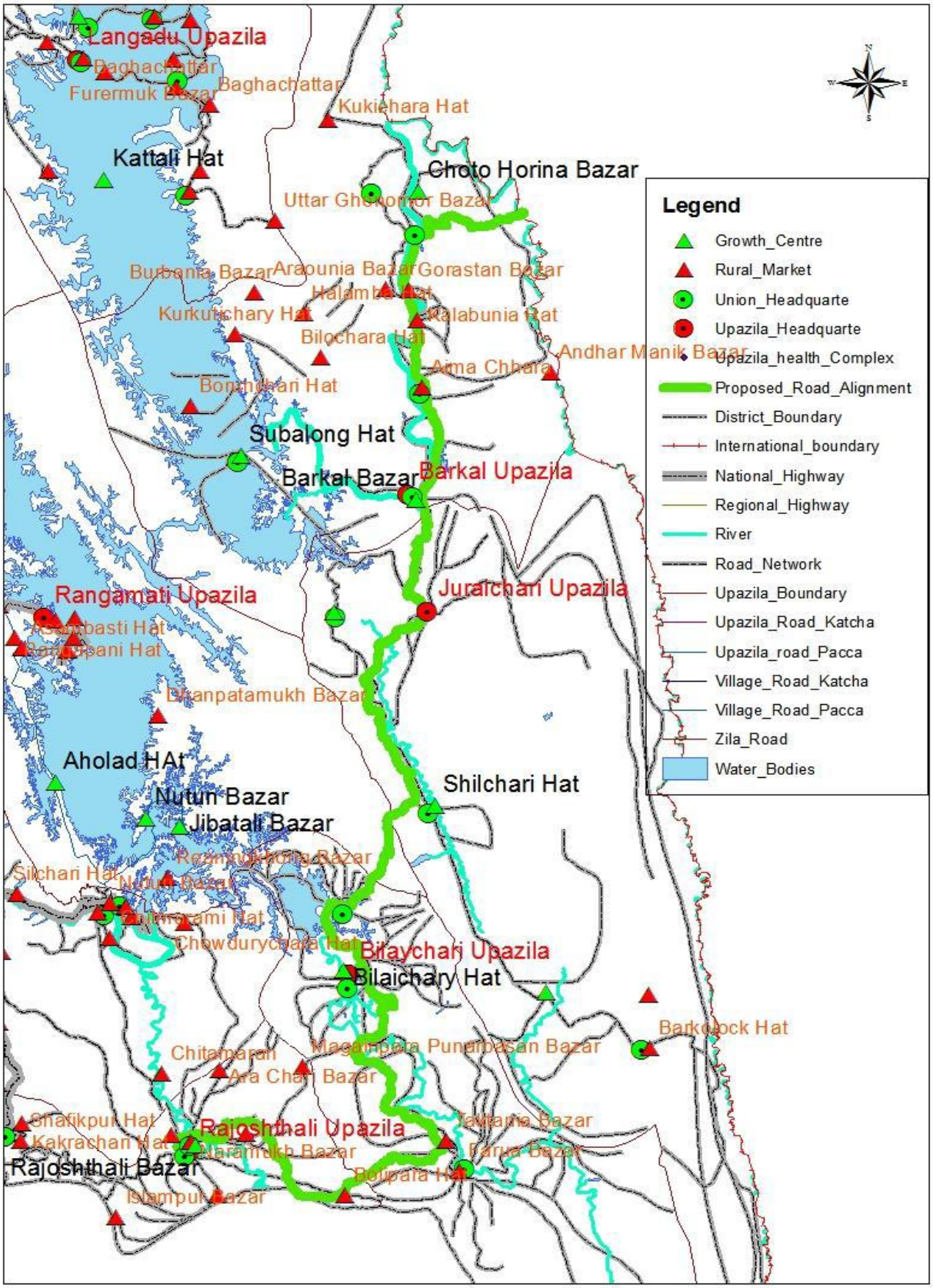


Fig 1.2B: Project Location Map

CHAPTER - 2

Description of Existing Proposed Project Roads and Waterways

CHAPTER - 2

Description of Existing Proposed Project Roads and Waterways

2.1 Candidate Road alignments

1. Rajosthali–Bilaichhari–Juraichhari–Barkal–Thegamukh (about 114.751 km);
2. Langadu–Bagachattar–Barkal–Thegamukh (50.25 km);
3. Sajek–Majhipara–Dokanghat–Horina–Thegamukh (97.17 km); and
4. Bangchara (kaptai)–Chitmaran–Chakuwapara–Bhangamurapara–Bilaichhari–Silchhari–mitngapara (Jurachhari)–Barkal–Chhotoharina- thegamukh (106.12 km).

2.2 Multimodal Routes

1. Rangamati–Chhotoharina–connected by waterway (63 Km) and Thegamukh by road (about 7.98 km);
2. Rangamiti–Barkal (37.5 Km) waterway and then Thegamukh (23.30 Km) by road;
3. Kaptai–Barkal waterway (64.81 Km) and Thegamukh by road (29.30 Km);
4. Kaptai–Chhotoharina–by waterway (89.62 Km) and Thegamukh by road (7.98 Km).

2.3 Selected Road alignments

1. Rajosthali– Bilaichhari–Juraichhari–Barkal–Thegamukh (about 114.751 km): (Road only).
2. Rangamati–Chhotoharina–connected by waterway (63 Km) and Thegamukh by road (about 8.089 km); (Multimodal).

2.4 Existing Project Roads and Waterways

Existing road from Rajosthali–Bilaichhari–Juraichhari–Barkal–Thegamukh (Survey (Existing) 114.751 km, Design Length: 109.67 Km)

The existing road in land Route Rajosthali–Bilaichhari–Juraichhari–Barkal–Thegamukhisof length 114.751 km. The first segment of the proposed alignment, i.e. a)Rajosthali to Bilaichari (49.100 km) is found 674.67m(Avg. carriage way 4.4m) paved by bituminous carpeting (BC) in green vicinity in hilly terrain and other parts are earthen road where 8 nos(645.90m). Rcc Bridges/Culvert is existed. Some missing links are found which aggregated 3226.68m. It is surveyed that 14 nos. Bridges/Culverts are required in different locations. In b) Bilaichari–Jurichari (29.436 km.) portion 1053.72 m paved road by Herring Bone Bond (HBB) with 3.217 m width is seen and 6 nos. (142.17m) Bridges/Culvert are existed. It is surveyed that further 15 nos. Bridges/Culverts are required in this portion. Some missing links aggregated 235.121 m are found in different locations. Other parts of the alignment are earthen roads. In this portion remarkable numbers of water lands (Chhara/Canal)) are seen. In c) Jurichari–Barkal (6.849 km.) section 3 nos (87.81m) existing Bridges are found.

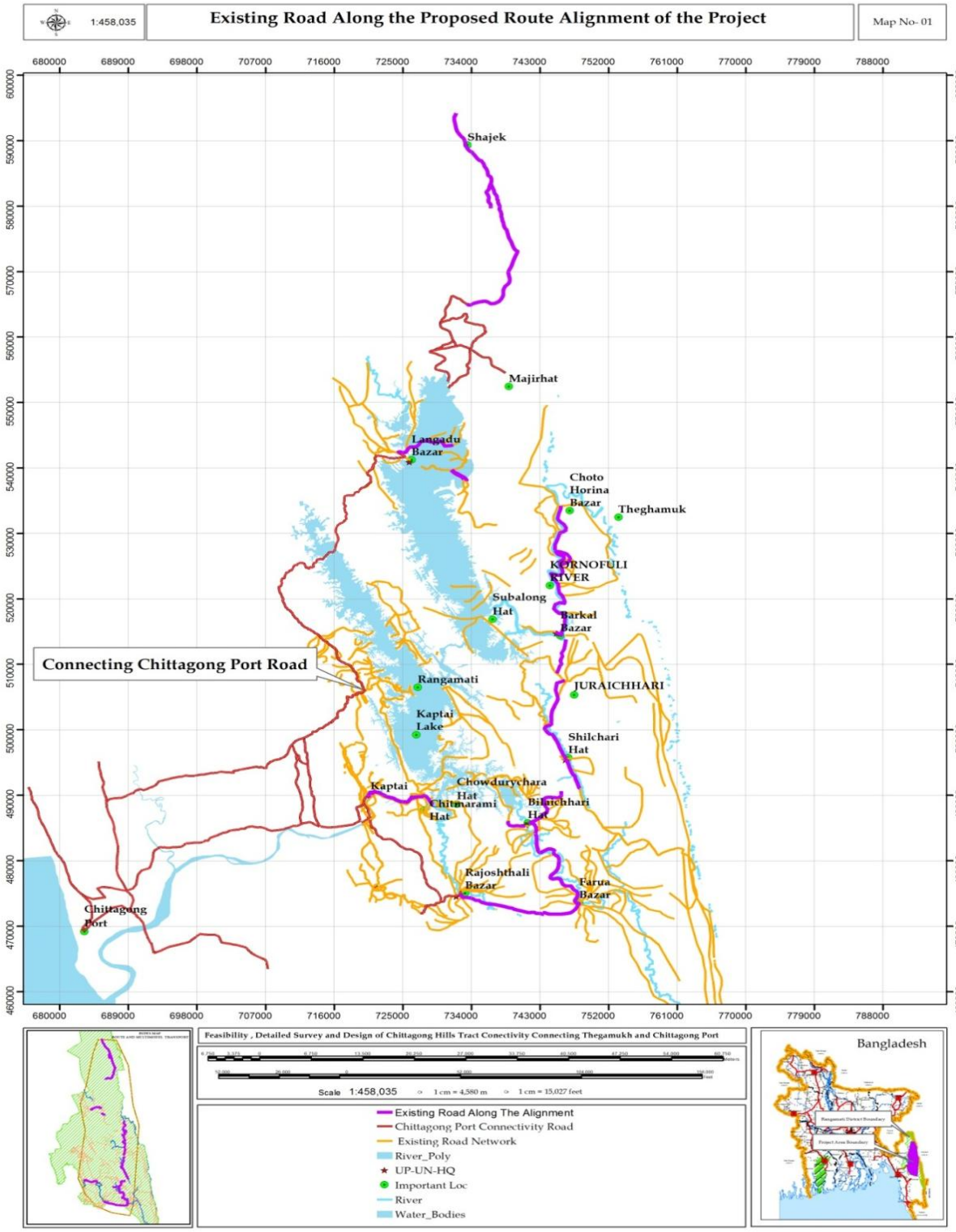


Fig 2.4A: Details of Existing Roads in the CHT Area

In this initially proposed alignment total 7 nos of Bridges/Culverts are required. In the hilly terrain the proposed alignment following the existing walkway or village road passes almost north direction within the green vicinity. In d) Barkal–Chhotoharina (21.277 km.) section 1187.40 m HBB road with 3 m width and 14 nos (308.49m) Bridges/Culverts are seen. Other parts of the alignment are earthen road where 22 nos Bridges/Culverts are required. In e)

Chhotoharina–Thegamukh (8.089 km.) section 134.19 m HBB road with very narrow width of 1.5 m and 2 nos (79.32m) Bridges have been seen. Further 3 nos. Bridges are required in this section.

Multimodal Route 1: Rangamati - Chotoharina by waterway (63 km) and Thegamukh by road (8.089 km), (Proposed total length: 71.089 Km)

This route enroutes to Chotohorina via Shobolong, Barkal, Bhusionchar. It is about 63km. Chotohorina to Thegamukh is 8.089 km by road. Rangamati to Barkal 37.5 km is navigable round the year for small launches and boats. For larger cargo vessels navigable depth will need to be increased by dredging. Barkal to Chotohorina is navigable during monsoon for 3-4 months. This part of the waterway (25.5 km) will need massive dredging to increase navigable depth. Chhotoharina–Thegamukh portion 134.19 m paved road by Herring Bon Bond (HBB) with 1.5 m width is seen and other parts are earthen road. 2 nos (79.32 m) Bridges are existed & 2 Bridges are required. Following Table 2.4A and 2.4B indicates the details of road exising from Rajosthali to Thegamukh and Rangamati to Thegamukh and their details in terms of width of road, type of roads, missing link etc are given in Annexure 2.2A and 2.2B (Final Feasibility Report Volume IB)

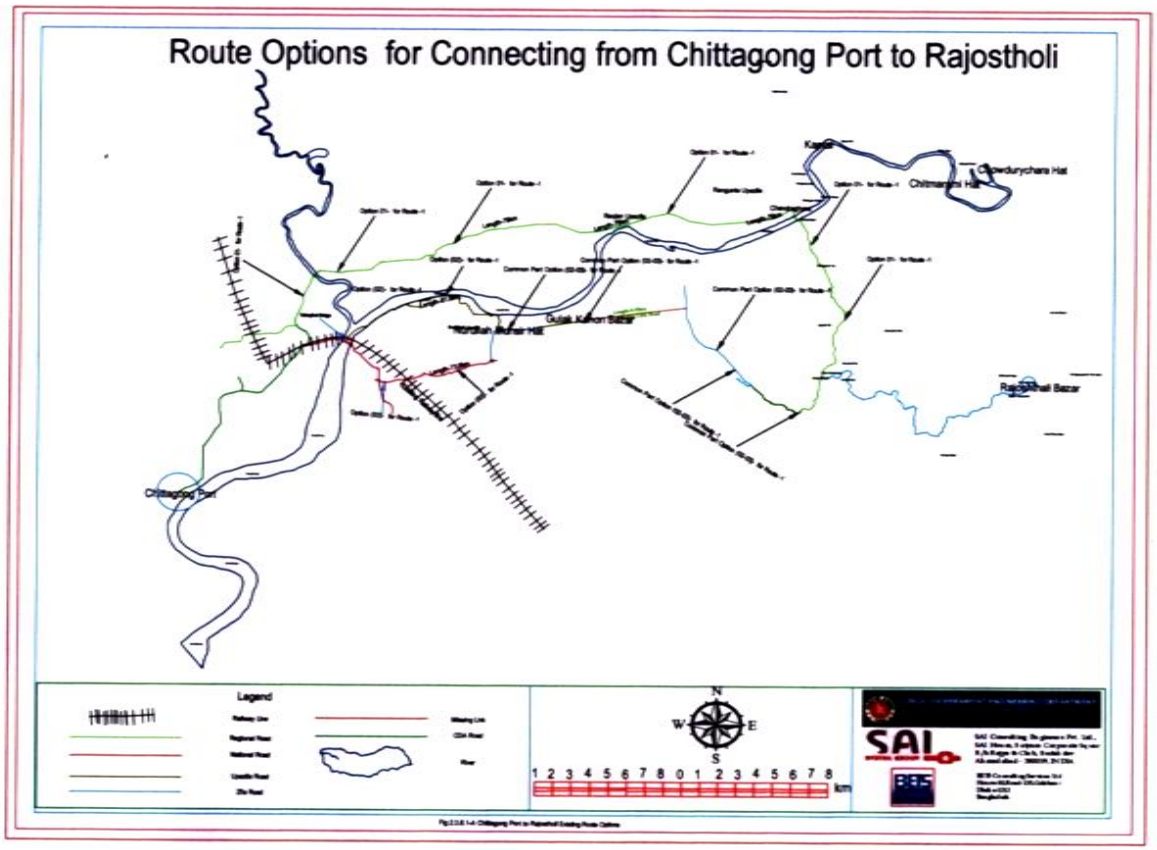


Fig 2.4B: Route Options for Connecting from Chittagong Port to Rajosthali

Table 2.4A: Details of Existing Road Inventory from Rajosthali to Thegamukh (Road Route)

Section of the Road	Owner of the Road	Location	Length (km)	Earthen Road (m)	Pavement Road (m)	RCC Road (m)	Bridge		Culvert		HBB Road (m)	Missing Link (m)	Remark
							Nos	Length(m)	Nos	Length (m)			
a.Rajosthali to Bilaichari (Ch.0+000-49+100)	LGED	Upozila: Rajostholi, Bilaichari District: Rangamati	49.100	32713.12	674.67	113.90	7	642.60	1	3.30	11725.7	3226.68	
b.Bilaichari - Jurichari (Ch.49+100-78+536)	LGED	Upozila: Bilaichari, Juraichhari District: Rangamati	29.436	28005.43	N/A	N/A	5	139.30	1	2.87	1053.72	235.121	
c.Jurichari - Barkal (Ch.78+536-85+385)	LGED	Upozila: Juraichhari, Barkal District: Rangamati	6.849	6237.84	N/A	N/A	3	87.81	N/A	N/A	N/A	522.63	
d. Barkal to Chottohorina (Ch 85+385-106+662)	LGED	Upozila: Barkal District: Rangamati	21.277	15704.09	N/A	N/A	14	308.49	N/A	N/A	1187.40	4076.86	
e. Chotohorina to Thegamukh (Ch 106+662-114+751)	LGED	Upozila: Barkal District: Rangamati	8.089	7845.05	N/A	N/A	2	79.32	N/A	N/A	134.19	30.55	
Total Length=			114.751										

Table 2.4B: Details of Existing Road Inventory fromRangamati to Thegamukh (Multimodal Route)

Section of the Road	Owner of the Road	Location	Length (km)	Type of way	Earthen Road (m)	Pavement road (m)	RCC Road (m)	Bridge		Culvert		HBB Road (m)	Missing Link (m)	Remark
								Nos	Length (m)	Nos	Length (m)			
a.Rangamati to Chotoharina	BIWTA	Upozila: Rangamati Sadar, Barkal District: Rangamati	63	Waterway	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
b.Chotoharina to Thegamukh (Ch.0+000-8+089)	LGED	Upozila: Barkal District: Rangamati	8.089	Roadway	7845.05	N/A	N/A	2	79.32	N/A	N/A	134.19	30.55	
Total Length=			71.089											

2.5 Area of Influence

Connecting the Himalayas to mainland Bangladesh, the Chittagong Hill Tracts are blessed with vast evergreen forests, silvery waterfalls, swift mountain rivers, and a cool temperate climate. Low hills are found in the north-eastern extremities of Bangladesh. These hills are part or extension of the Khasia-Garo-Jainta and the Tippera Hills of India. The more important hilly areas are concentrated in hill districts of Chittagong Division and are geologically the offshoots of the ArakanYoma running through Eastern India to Burma. The Chittagong hills are steep sloped parallel ranges, largely covered with tropical forests. These hills rise steeply to narrow ridge lines, generally no wider than 120 feet and no higher than 2000 to 3000 feet. The highest hill in Bangladesh is Keokradang (4034 feet) in south-east end of Bandarban district.

2.5.1 Project area of influence

The area likely to be affected by the project, including all its ancillary aspects, such as power transmission corridors, pipelines, canals, tunnels, relocation and access roads, borrow and disposal areas, and construction camps, as well as unplanned developments induced by the project (e.g., spontaneous settlement, logging, or shifting agriculture along access roads). Provides a logical structure for defining project boundaries of assessment and accountability, including the spatial, temporal and thematic boundaries of the project which is essential for issues scoping, screening and defining the content of environmental and social impact assessments · the boundary conditions for conducting economic analysis · The formulation of a structure for public consultations and stakeholder engagement - where and with whom to consult.

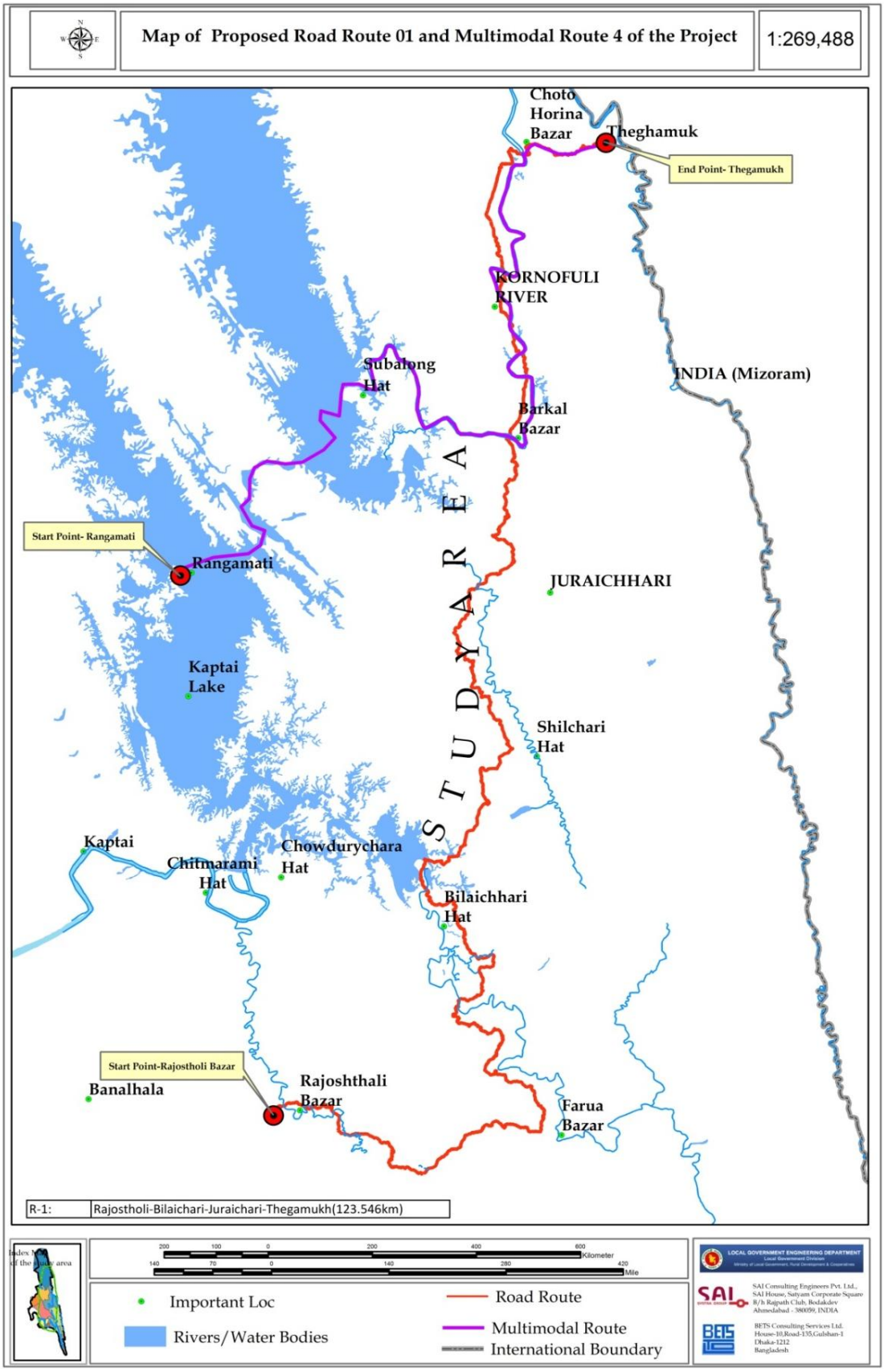


Fig 2.3: Selected Route Alignments (Road and Multimodal)

2.5.2 Cross-Border Traffic

In Bangladesh land-based cross-border traffic is handled at custom check posts. Currently there are 9 operational land custom check posts–5 under BOT and 4 directly operated by Bangladesh Land Ports Authority (BLPA)–Fig 2.5.2A: Bangladesh Land Ports

Fig 2.5.2A: Bangladesh Land Ports.

Besides, there are a number of border land custom check posts that are under development or proposed Fig 2.5.2A. As may be seen from the above map, a land custom post is under process of development at Thegamukh, which is the terminal point of the proposed routes and also bordering with Mizoram state of North-eastern region of India.

At present, there are no available cross-border movents through Thegamukh. Majority of cross-border traffic is moving through Benapole custom post. Table 2.5.2 presents cross-border traffic (imports and exports) through land ports. Available data does not provide any meaningful basis for forecast of cross-border traffic through Thegamukh.

Table 2.5.2: Imports - Exports through Land Ports: Bangladesh

Year	Imports		Exports		Total		Exports as % of Imports	Imports as % of total
	Quantity (Tonnes)	Growth (%)	Quantity (Tonnes)	Growth (%)	Quantity (Tonnes)	Growth (%)		
2008-09	2,511,422		914,639		3,426,061		36.42%	73.30%
2009-10	2,834,003	12.84%	948,403	3.69%	3,782,406	10.40%	33.47%	74.93%
2010-11	3,539,251	24.89%	1,144,279	20.65%	4,683,530	23.82%	32.33%	75.57%
2011-12	4,631,403	30.86%	1,189,248	3.93%	5,820,651	24.28%	25.68%	79.57%
2012-13	4,990,898	7.76%	1,162,687	-2.23%	6,153,585	5.72%	23.30%	81.11%
2013-14	6,866,286	37.58%	731,433	-37.09%	7,597,719	23.47%	10.65%	90.37%
Average		22.79%		-2.21%		17.54%	26.97%	79.14%

Source: *Bangladesh Land Port Authority, Website: www.bsbk.gov.bd*

The following figure (Fig 2.4A) shows that the proposed connectivity road Ctg-Rajotholi-Barkal-Teghamukh will connect to the possible deep sea port likely to be developed in south-eastern part of Chittagong. This will lead to the connectivity of whole of north eastern India, Bhutan and Nepal. This will create easy and shortest route to the available sea port to those land lock countries and areas of the subcontinent.

The future potential coming up projects within the area of influence are namely:

i. Bangladesh-China-India-Myanmar (BCIM) Economic Corridor
ii. Mizoram State Roads II - Regional Transport Connectivity project, India
iii. 22.0 km section of Lunglei –Tlabung–Kawrpuichhuah Road on the border with Bangladesh;
iv. The 27.5km Champhai-Zokhawthar Road on the border with Myanmar; and
v. The 41.7km Chhumkhum-Chawngte North-South alignment connecting to the border roads with Bangladesh to the west and Myanmar to the south.

Fig 2.5.2B: Bangladesh-China-India-Myanmar (BCIM) Economic Corridor

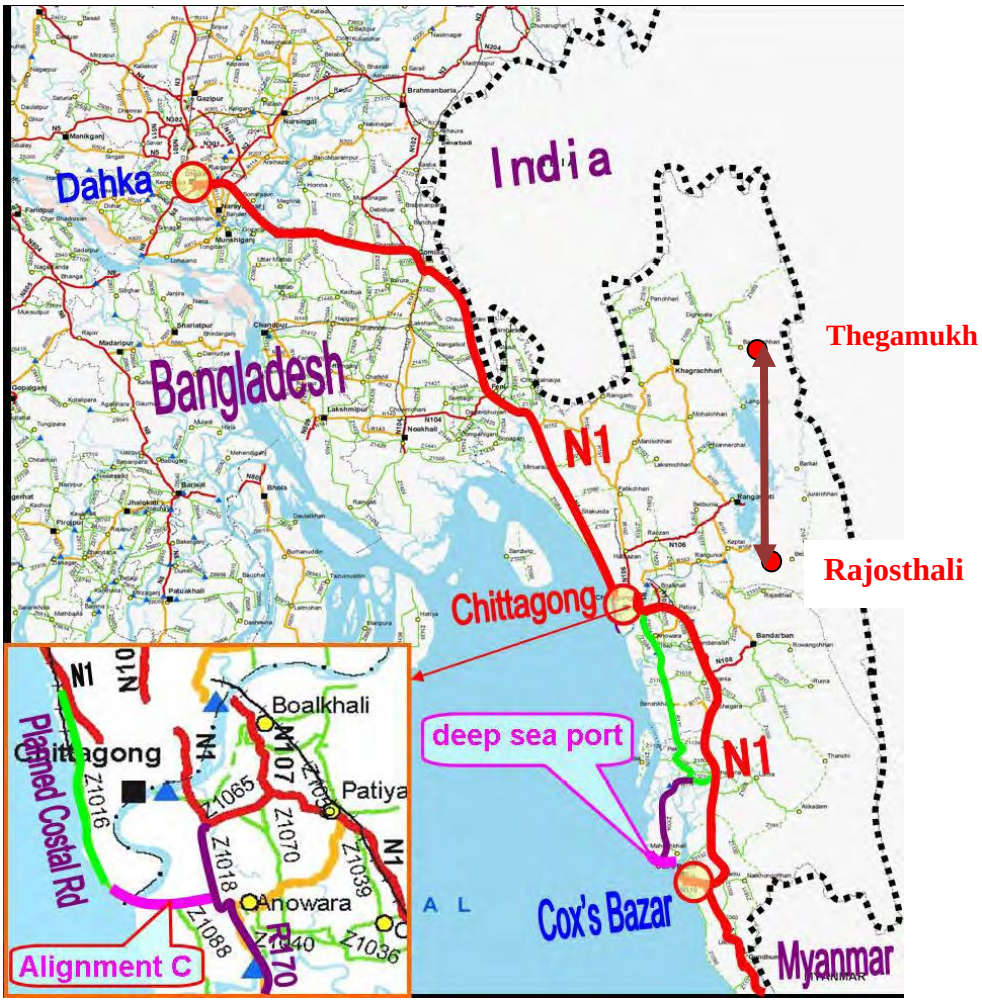


Fig. 2.5.2C: Area of influence with in Bangladesh

2.6 Design Standard

Since the proposed road is going to be one of the major road corridors of category regional/national highway with 7.3 m width (two lanes) principally RHD Geometric Design Standards Manual (Revised) 2005 has been followed for design parameters. Besides the following reference recommendations and standards have been consulted.

- AASHTO "A policy on Geometric Design of Highway and Streets" 2005
- IRC _SP_48_1998
- Overseas Road Note 6 "A Guide to Geometric Design" published by TRRL 1988
- Nepal Road Standards 2020(July 2013), Government of Nepal, Ministry of Physical Infrastructure and Transport. Department of Roads, Kathmandu, Nepal

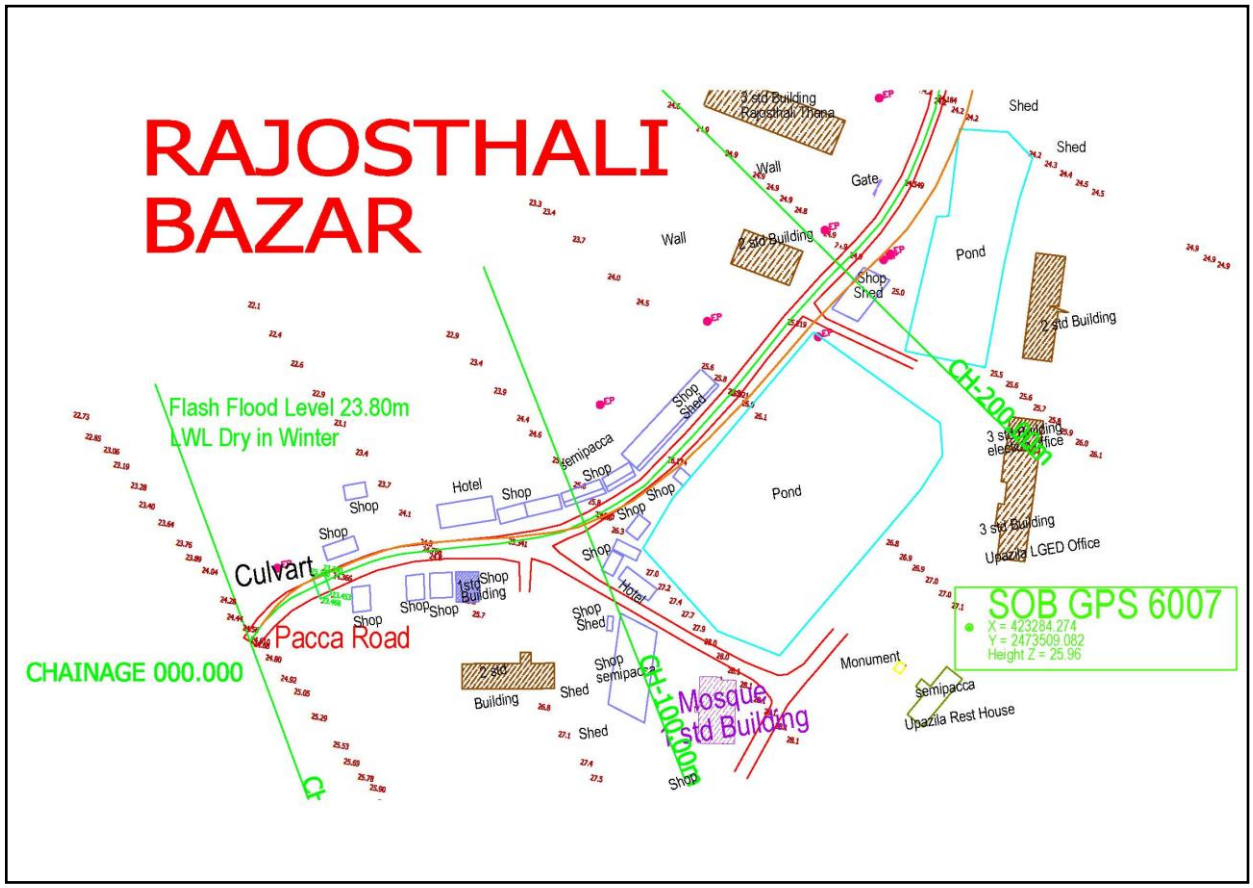


Fig. 2.6A: Details of Aligned Road

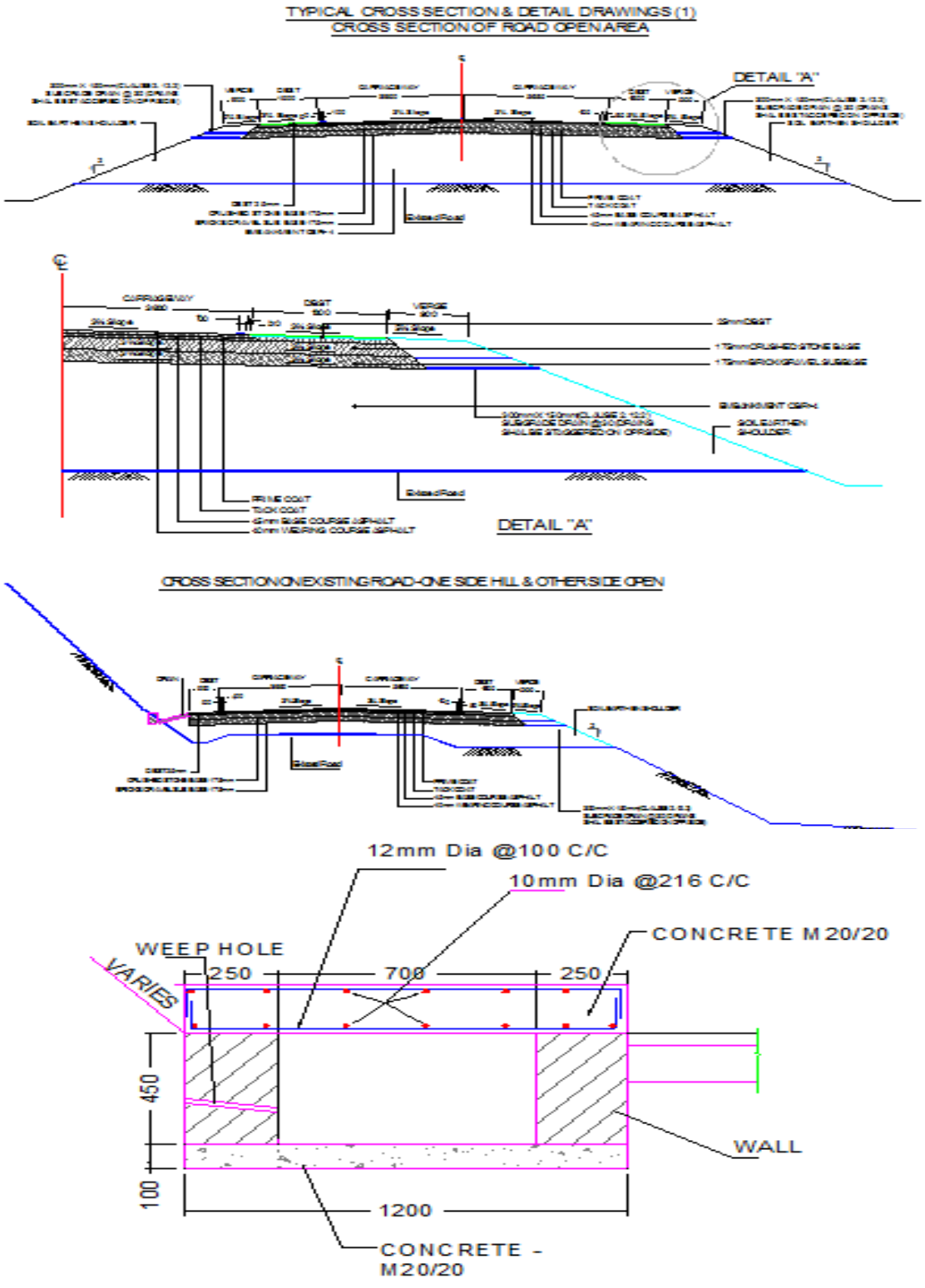


Fig. 2.6B: Typical Cross-section and Detail Design

Table 2.6A: Proposed Culverts for Road Route

Culvert No.	Existing Chainage No.	Road Design Chainage No.	Size of Culvert Vent x b x h, (m)	Slab top finished Level (FL), m (PWD)	Invert Level (IL), m (PWD)	Remarks
From Ch.00+000-47+066= 47.066 Km						
CUL-01	Ch 0+025	Ch 0+025	1x4.0x3.0	24.70	21.30	Existing to be replaced
CUL-02	Ch 19+340	Ch 18+533	2x6.0x3.0	51.45	48.00	New
CUL-03	Ch 20+970	Ch 20+119	2x5.0x5.0	56.45	51.45	Existing to be replaced
CUL-04	Ch 21+030	Ch 20+175	1x6.0x4.0	58.00	53.55	Existing to be replaced
CUL-05	Ch 21+215	Ch 20+353	1x6.0x4.5	69.95	65.45	Existing to be replaced
CUL-06	Ch 22+955	Ch 22+079	1x4.0x3.0	36.00	32.60	New
From Ch.47+066-75+157=28.091km						
CUL-07	Ch 50+850	Ch 48+705	1x6.0x5.0	46.50	53.00	New, Shifted from Ch. 50+900 as per site cond.
CUL-08	Ch 59+900	Ch 57+321	2x4.0x6.0	59.40	53.00	New
CUL-09	Ch 62+205	Ch 59+560	2x4.0x3.0	51.90	48.50	New
CUL-10	Ch 62+975	Ch 60+290	2x3.5x4.0	55.40	51.00	New
CUL-11	Ch 64+100	Ch 61+373	2x3.0x4.0	43.35	39.00	Existing to be replaced
CUL-12	Ch 65+610	Ch 62+864	2x4.5x3.0	48.40	45.00	Existing to be replaced
CUL-13	Ch 66+850	Ch 64+042	1x6.0x4.5	60.90	56.45	New
CUL-14	Ch 70+180	Ch 67+183	2x4.5x4.0	34.90	30.50	New
CUL-15	Ch 77+085	Ch 73+730	2x4.5x4.0	32.25	27.85	New
CUL-16	Ch 77+940	Ch 74+567	2x3.5x3.0	36.65	33.25	Existing to be replaced
From Ch.75+157-81+600=6.443km						
CUL-17	Ch 79+000	Ch 75+615	1x6.0x6.0	45.00	38.50	Existing to be replaced
From Ch.81+600-102+098=20.498km						
CUL-18	Ch 86+920	Ch 82+980	2x4.0x5.0	34.70	28.30	New
CUL-19	Ch 89+602	Ch 85+638	2x5.0x4.0	34.68	30.23	New
CUL-20	Ch 91+115	Ch 87+059	2x4.0x3.0	37.00	33.60	Marcy Land
CUL-21	Ch 104+850	Ch 100+306	3.0x5.0x5.0	56.45	51.45	Existing to be replaced

Table 2.6B: Proposed Bridges for Road Route

Bridge No.	Existing Chainage No	Road Design Chainage	Missing Length (m)	Proposed Structural Deck Length(m)	Existing Ground Level (m)	Pile Cap Level (m)	Finish Level/Deck Level(m)	Type of Bridge	HFL (m)	LFL(m)	Remarks
From Ch.00+000-47+066= 47.066 Km											
1	Ch 0+0380	Ch 0+378	61.894	(3x21.0)	18.4	20.55	26.02	RCC Bridge	22.30	Dry in winter	Existing to be replaced
2	Ch 5+145	Ch 4+932	32.116	(1x35.0)	27.93	25.26	32.52	PSC Bridge	28.50	Dry in winter	New
3	Ch 8+385	Ch 8+040	28.004	(1x30.0)	51.05	44.80	56.02	PSC Bridge	52.20	Dry in winter	New
4	Ch 11+850	Ch 11+268	30.378	(1x35.0)	57.12	60.21	67.47	PSC Bridge	62.96	Dry in winter	New
5	Ch 33+490	Ch 32+251	41.129	(3x15.0)	32.34	34.08	39.42	RCC Bridge	35.00	Dry in winter	New
6	Ch 39+960	Ch 38+543	286.628	(9x32.0)	36.01	38.22	48.82	PSC Bridge	44.00	38	Existing to be replaced

Bridge No.	Existing Chainage No	Road Design Chainage	Missing Length (m)	Proposed Structural Deck Length(m)	Existing Ground Level (m)	Pile Cap Level (m)	Finish Level/Deck Level(m)	Type of Bridge	HFL (m)	LFL(m)	Remarks
7	Ch 47+850	Ch 45+862	131.687	(5x26.0)	20.55	26.69	35.32	PSC Bridge	30.50	22	Existing to be replaced
8	Ch 48+240	Ch 46+262	112.074	(3x38.0)	19.69	27.99	35.92	PSC Bridge	30.50	22	Existing to be replaced
From Ch.47+066-75+157=28.091km											
9	Ch 51+840	Ch 49+645	16.891	(1x20.0)	33.13	34.37	39.52	RCC Bridge	35.00	Dry in winter	New
10	Ch 65+340	Ch 62+607	33.989	(1x35.0)	45.56	43.80	52.02	PSC Bridge	47.00	Dry in winter	Existing to be replaced
11	Ch 68+985	Ch 66+047	18.967	(1x20.0)	41.56	41.00	46.52	RCC Bridge	44.00	Dry in winter	New
12	Ch 72+250	Ch 69+197	34.896	(1x35.0)	30.77	28.80	37.52	PSC Bridge	33.02	Dry in winter	New
13	Ch 77+275	Ch 73+925	86.631	(3x30)	27.9	28.00	36.32	PSC Bridge	31.50	Dry in winter	Existing to be replaced
From Ch.75+157-81+600=6.443km											
14	Ch 78+890	Ch 75+507	11.643	(1x15.0)	43.69	39.68	45.77	RCC Bridge	41.00	Dry in winter	Existing to be replaced
15	Ch 79+315	Ch 75+870	18.593	(1x20.0)	26.35	33.00	38.52	RCC Bridge	34.50	Dry in winter	Existing to be replaced
16	Ch 80+115	Ch 76+660	30.907	(1x35.0)	34.39	34.76	41.02	PSC Bridge	36.00	Dry in winter	New
17	Ch 83+340	Ch 79+700	11.685	(1x15.0)	163.88	164.96	171.07	RCC Bridge	166.65	Dry in winter	New
18	Ch 84+595	Ch 80+842	11.197	(1x15.0)	37.75	37.67	42.67	RCC Bridge	39.25	Dry in winter	New
19	Ch 85+270	Ch 81+480	227.194	(7x33.0)	12.2	22.00	42.76	PSC Bridge	33.23	23.17	New
From Ch.81+600-102+098=20.498km											
20	Ch 88+215	Ch 84+250	153.816	(5x32.0)	19.2	27.00	42.67	PSC Bridge	33.23	23.17	New
21	Ch 89+530	Ch 85+570	11.123	(1x15.0)	31.51	31.54	36.65	RCC Bridge		Dry in winter	New
22	Ch 90+075	Ch 86+104	28.512	(1x30.0)	30.1	29.67	37.05	PSC Bridge		Dry in winter	New
23	Ch 90+690	Ch 86+685	22.422	(1x25.0)	29.37	31.86	37.05	RCC Bridge		Dry in winter	New
24	Ch 91+030	Ch 86+972	14.307	(1x15.0)	35.59	31.54	36.65	RCC Bridge		Dry in winter	New
25	Ch 91+440	Ch 87+379	11.53	(1x15.0)	36.8	31.54	36.65	RCC Bridge		Dry in winter	New
26	Ch 95+040	Ch 90+825	43.842	(3x15.0)	33.64	31.31	36.65	RCC Bridge	33.23	Dry in winter	Existing to be replaced
27	Ch 95+530	Ch 91+327	39.001	(3x15.0)	30.64	31.31	36.65	RCC Bridge	33.23	Dry in winter	Existing to be replaced
28	Ch 95+985	Ch 91+770	23.394	(1x30.0)	27.5	29.68	37.05	PSC Bridge	29.90	Dry in winter	Existing to be replaced
29	Ch 97+400	Ch 93+082	130.426	(3x30.0-2x26.0)	12.2	18.00	42.67	PSC Bridge	33.23	23.17	New
30	Ch 100+190	Ch 95+687	11.777	(1x15.0)	30.3	31.54	36.65	RCC Bridge	33.23	Dry in winter	Existing to be replaced
31	Ch 101+740	Ch 97+200	29.676	(1x30.0)	31.8	30.87	37.25	PSC Bridge	33.23	Dry in winter	Existing to be replaced
32	Ch 103+360	Ch 98+802	23.461	(1x25.0)	31.8	31.86	37.05	RCC Bridge	33.23	Dry in winter	Existing to be replaced
33	Ch 103+725	Ch 99+175	36.574	(1x30.0)	31.9	30.82	37.05	PSC Bridge	33.23	Dry in winter	Existing to be replaced
34	Ch	Ch 99+425	26.466	(1x30.0)	31.5	30.82	37.05	PSC	33.23	Dry in	Existing to

Bridge No.	Existing Chainage No	Road Design Chainage	Missing Length (m)	Proposed Structural Deck Length(m)	Existing Ground Level (m)	Pile Cap Level (m)	Finish Level/Deck Level(m)	Type of Bridge	HFL (m)	LFL(m)	Remarks
	103+975							Bridge		winter	be replaced
35	Ch 104+085	Ch 99+527	11.883	(1x15.0)	32.5	31.54	36.65	RCC Bridge	33.23	Dry in winter	Existing to be replaced
36	Ch 105+395	Ch 100+837	31.63	(1x35.0)	32.2	29.98	37.25	PSC Bridge	33.23	Dry in winter	Existing to be replaced
37	Ch 106+580	Ch 101+997	167.496	(5x35.0)	12.2	31.00	42.87	PSC Bridge	33.23	23.17	New
From Ch.102+098-109.675=7.577km											
38	Ch 106+840	Ch 102+265	27.541	(1x30.0)	13.5	30.80	37.05	PSC Bridge	33.23	Dry in winter	Existing to be replaced
39	Ch 113+145	Ch 108+152	29.36	(1x35.0)	41.34	39.58	47.02	PSC Bridge	43.00	Dry in winter	New
40	Ch 114+150	Ch 109+105	18.145	(1x20.0)	35.1	36.37	41.52	RCC Bridge	38.01	Dry in winter	Existing to be replaced

Table 2.6C: Road Portion of Multimodal Alignment

From Chotohorina to Thegamukh (Multimodal)										
Route ID	Location	Chainage (m)				Length (m)	Road/Bridge Width (m)	Existing Feature Types	Ownership	LGED Road Code No
		CH-Start		To	CH-End					
Multimodal Route Road Part	Chotoharina to Thegamukh	Ch	0.000	to	171.298	171.298				UNR-484213004
		Ch	171.298	to	232.473	61.175	1.563	Existing Bridge	LGED	UNR-484213005
		Ch	232.473	to	1564.891	1332.417				UNR-484213006
		Ch	1564.891	to	1566.015	1.125	Chhara	Missing Link		
		Ch	1566.015	to	6469.088	4903.072				UNR-484213004
		Ch	6469.088	to	6498.513	29.425	Chhara	Missing Link		
		Ch	6498.513	to	7486.729	988.216				UNR-484213004
		Ch	7486.729	to	7504.873	18.145	1.854	Existing Bridge	LGED	UNR-484213004
		Ch	7504.873	to	7642.566	137.693				UNR-484213004
		Ch	7642.566	to	7776.758	134.192				UNR-484213004
		Ch	7776.758	to	8089.114	312.356				UNR-484213004

The following tentative locations have been identified where there is a need for Detailed Investigation (DI) during detailed design phase and appropriate measure need to be adopted as discussed above in the form of Bio- Engineering (BE), Turfing (TF), Water Management (WM), Trimming etc.

Table 2.6D: Area Prone to Slope Stability

Sl. No.	Area Prone to Slope Stability		Remedial Measures
	From	To	
1	Ch. 8+150	Ch. 9+150	DI/BE/TF/WM/BT
2	Ch. 9+650	Ch. 11+250	DI/BE/TF/WM/BT
3	Ch. 11+450	Ch. 12+250	DI/BE/TF/WM/BT
4	Ch. 12+550	Ch. 13+550	DI/BE/TF/WM/BT
5	Ch. 13+750	Ch. 17+250	DI/BE/TF/WM/BT
6	Ch. 36+700	Ch. 37+950	DI/BE/TF/WM/BT
7	Ch. 51+000	Ch. 56+400	DI/BE/TF/WM/BT
8	Ch. 78+950	Ch. 80+800	DI/BE/TF/WM/BT

Turfing is the most well-known and cheapest form of slope protection. The success of the measure depends upon the suitability of the soil to the development of turf culture. Purely sandy soils are unsuitable for growth of turf. In such cases, layer of clay soil (0.25-.03 m thick) from suitable borrow area can be laid to (i) confine the sand and (ii) foster growth of turf. Turf can be grown by planting sods or by seeding. Sods are preferred on steeper slopes, whereas seeding is resorted to on flatter slopes. The use of jute netting, coir netting and geo-grids helps the turf to grow by holding the soil firmly. After the turf grows, the jute and coir netting decomposes.

2.6.1 Erosion Mitigation Measures

Measures	Effectiveness	Comparative Costs
Grass seeding	Only surface effective, avoids start of erosion	Least expensive
Vetiver grass	Excellent, even at depth	Inexpensive
Shrubs	Excellent	Two to three times cost of grass

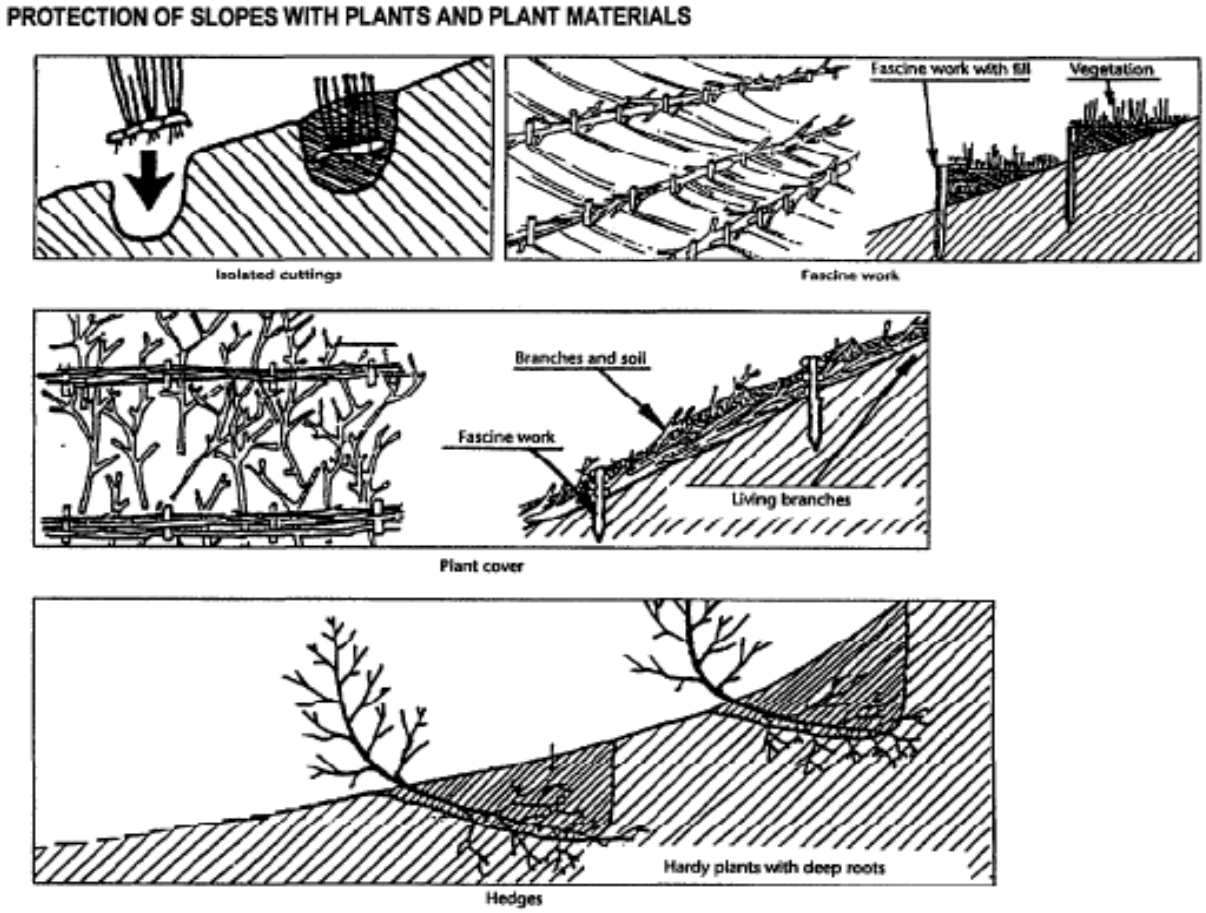


Fig 2.6.1A: Protection of Slopes with Plants and Plants Materials.

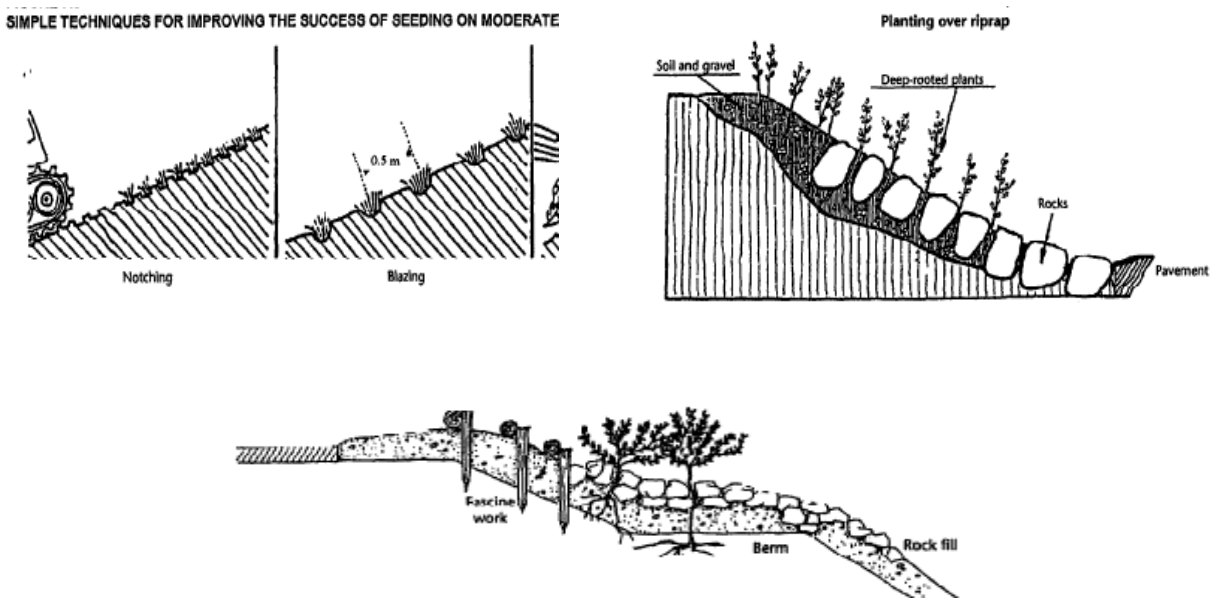


Fig 2.6.1B: Seeding for Slopes Protection

CHAPTER - 3

Environmental Baseline Characterization

CHAPTER - 3

Environmental Baseline Characterization

3.1 Environmental Baseline Characterizations

Rangamati is located in the Chittagong Division. It is bordered by the Tripura state of India to the north, Bandarban District to the south, Mizoram State of India and Chin State of Myanmar to the east, and Khagrachari and Chittagong Districts to the west.

The area of the district is 6116 km^2 of which 1292 km^2 is riverine and 4825 km^2 is under forest vegetation

3.1.1 Air Quality

Chittagong Hill Tracts are blessed with vast evergreen forests, silvery waterfalls, swift mountain rivers, and a cool temperate climate. Although there are few protected areas within the landscape, a number of scared groves, scared caves, and forests make the landscape an important repository of biodiversity with one of the highest concentrations of endemic species in the Hindu Kush Himalayas. The people inhabiting this landscape are from diverse cultural groups. Agriculture is their main source of livelihood, followed by forests. Decreases in the shifting cultivation cycle, family fragmentation, unplanned and extensive mining, heavy overland flow and soil erosion, and development activities have significantly reduced the forest, biodiversity, and water retention capacity of the area in the recent years.

Three representative samples of air were collected on 21th -24th November 2015 to analyze PM_{10}, $PM_{2.5}$ & SPM. The analyses of the parameters have been done in Enviro Consultants Limited Laboratory, Dhaka and results dated 29th November 2015 have been placed in the report. The analysis results fully comply with the DoE standards. All the parameters are much lower than the allowable limit. Therefore, it can be concluded that the air is not creating any harm to the environment in terms of air quality.

Table 3.1.1A: WHO air quality guidelines and interim targets for particulate matter: 24-hour concentrations.

	PM_{10} (µg/ m^3)	$PM_{2.5}$ (µg/m^3)	Basis for the selected level
Interim target-1 (IT-1)	150	75	Based on published risk coefficients from multi-centre studies and meta-analyses (about 5% increase of shortterm mortality over the AQG value).
Interim target-2 (IT-2)	100	50	Based on published risk coefficients from multi-centre studies and meta-analyses (about 2.5% increase of shortterm mortality over the AQG value).
Interim target-3 (IT-3)	75	37.5	Based on published risk coefficients from multi-centre studies and meta-analyses (about 1.2% increase in short-term mortality over the AQG value).
Air quality guideline (AQG)	50	25	Based on relationship between 24-hour and annual PM levels.

Table 3.1.1B: Air Quality Analysis Report

Sl. No.	Parameter for Analysis	Bangladesh Standard (Industrial and Mixed Area)	World Bank Standard (Industrial and Mixed Area)	Kaptai	Rangamati	Rajosthali
1	PM_{10}	150 microgram per m3	50 Microgram per cubic meter	19.91	87.79	28.11
2	$PM_{2.5}$	65 microgram per m3	25 Microgram per cubic meter	12.21	24.53	13.26
3	SPM	200 microgram per m3	-	43.06	148.05	35.21

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3.1.2 Topography

Generally, the hill ranges and the river valleys are longitudinally aligned. Four ranges, with an average elevation of over three hundred metres, strike in a north-south direction in the northern part of the hill tract districts. These are Phoromain range (Phoromain, 463m), Dolajeri range (Langtrai, 429m), Bhuachhari (Changpai, 611m) and Barkal range (Thangnang, 735m). South of the Karnafuli River within the Chittagong Hill Tracts, there are seven main mountain ranges within Bangladesh. These are: Muranja range (Basitaung, 664m), Wayla range (most of this range is in Myanmar), Chimbook range (Tindu, 898m), Batimain range (Batitaung, 526m), Politai range (Keokradang, 884m; Ramiu Taung 921m, Saichal-Mowdok range (Bilaisari, 669m) and Saichal range. Saichal range contains the highest peaks of Bangladesh. These are Waibung (808m), Rang Tlang (958m), Mowdok Tlang (905m), and Mowdok Mual (1,003m) which is on the border with Myanmar.

3.1.3 Soils

The hill soils (dystric cambisols) are mainly yellowish brown to reddish brown loams which grade into broken shale or sandstone as well as mottled sand at a variable depth. The soils are very strongly acidic. Soil erosion is one of the challenging problems in Upland Watershed. Clearance of forests in Himalayan Watershed, in the hill of Tripura, Meghalaya and Chittagong Hill tracts, are making the existing condition of the degraded area more intensive. Actually, small creeks and streams are getting filled by different types of degradation like deforestation, hill cutting, soil erosion, landslides, and extraction of landslides. Flash flood, short rotation of Jhum cycle.

3.1.4 Physiography

According to the physiography of Bangladesh the CHT falls under the Northern and Eastern Hill unit and the High Hill or Mountain Ranges sub-unit. This sub-unit covers most of CHT, some small parts of southern Habiganj and the south and eastern borders of Maulvi Bazar. At present, all the mountain ranges of the Chittagong Hill Tracts are almost hogback ridges. They rise steeply, thus looking far more impressive than their height would imply. Most of the ranges have scarps in the west, with cliffs and waterfalls.

The region is characterised by a huge network of trellis and dendritic drainage consisting of some major rivers draining into the Bay of Bengal. The major rivers are karnafuli, sangu, matamuhuri and feni. Within the hill tracts, the Karnafuli has several important tributaries, of which Chengi, kasalong and Rainkhiang are the main ones.

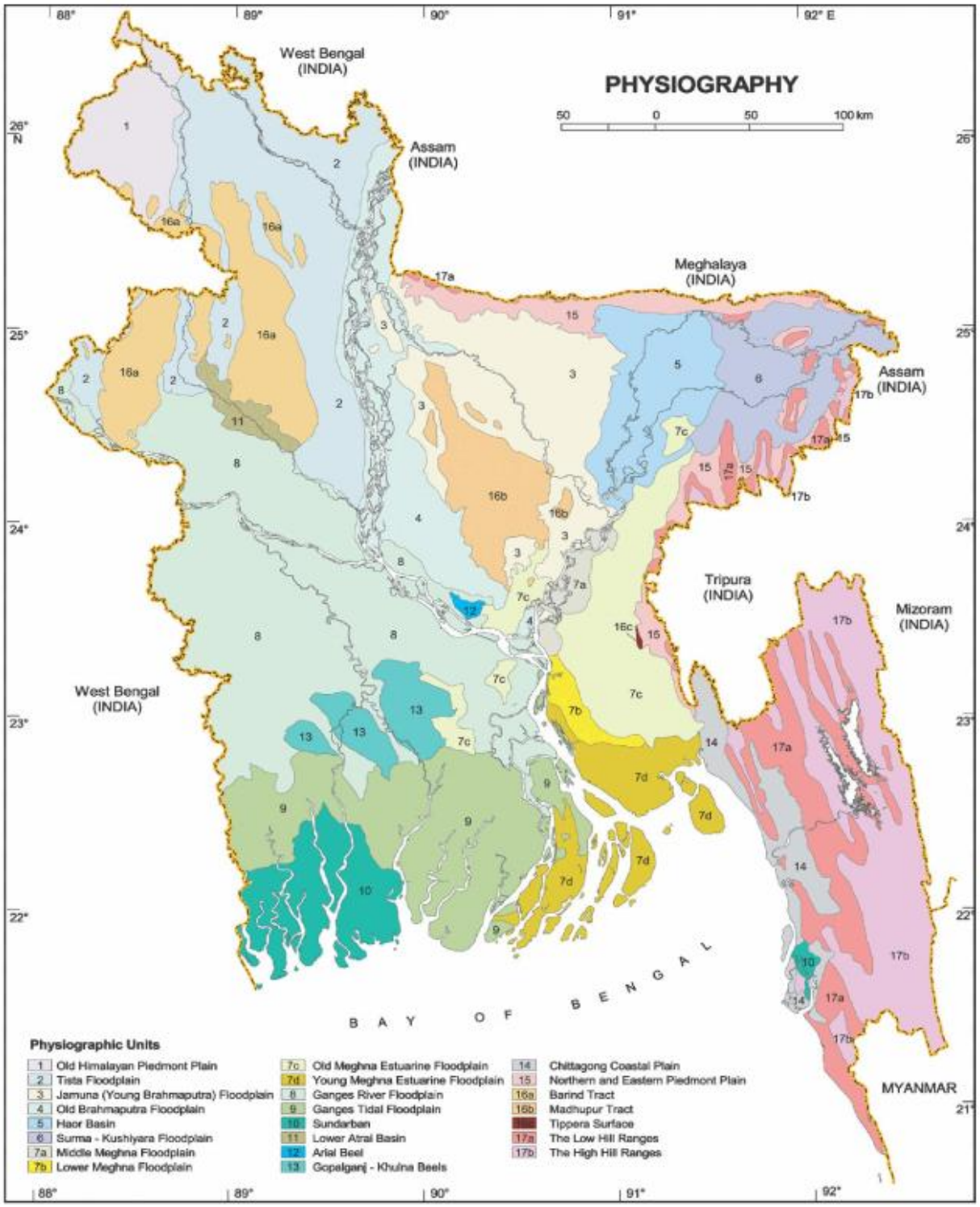

Fig 3.1.4: Physiographic Map of Bangladesh

3.1.5 Water Resources

3.1.5.1 Surface Water

Karnafuli, Chengi, Maini, Sangu, Matamuhuri, Feni, Raingkyong and Bagkhali with a total length of 1,400 km. Significant Rivers are transboundary with: (i) Karnafuli originating in Mizoram, India; (ii) Chengi and Feni originating in Tripura, India and (iii) Sangu originating in Myanmar. The principle tributaries, the Thega, Subalong, Rinkong, Kaptai and Ichhamati join

the Karnaphuli from the south and those which unite with it from the north are the Sajek, Horina, Kasalong, Chengi and Halda.The Halda has two tributaries, the Dhurung and Sarta.

Degradation of forest quality and substantial loss in canopy coverage are likely to be the most significant causes behind the deteriorating flows observed in the study. Dense forest has drastically been reduced in the recent years. Between 1989 and 2003, an estimated 170,000 ha of dense forest, (approximately 50% of the total area of dense forest) was lost in the CHT. The most severe condition was observed in Khagrachari district (approximately 95% loss), a likely consequence of changes in agricultural practices and scale. This type of change facilitates fast surface runoff and thereby reduces the soils' water retention capacity and percolation of water into the water table.

It was also observed that there is an overall decreasing rainfall pattern in 6 of the 7 stations within CHT. Increasing trend of evaporation and sunshine hours are also important concerns. In general, there is scant data on current status of natural resources of the area, specifically in terms of current land use mapping and hydrological (there are only 7 rainfall stations in CHT) and meteorological data (only 1 Bangladesh Meteorology Department weather station at Kaptai). The Water Aid report highlights lack of data availability and requirement for establishment of a comprehensive hydro-meteorological monitoring network in the area (including stream gauging) as fundamental requirements. Changing land use and long-term climatic variations require effective monitoring to better understand spatial and temporal variation in the resource base and for sustainable natural resources planning and management.

Table 3.1.5.1: Surface Water Quality Analysis Report

Sl. No.	Parameter	Bangladesh Standard (Drinking Water)	WHO Standard (Drinking Water)	Kaptai	Rangamati	Rajosthali	Belaichari	Barkal	Chotohorina
1	Arsenic	0.2 mg/L	0.1 mg/L	0.001	0.001	0.001	<LOQ	<LOQ	<LOQ
2	BOD_5	50 mg/L	50 mg/L	07	06	06	05	06	08
3	DO	4.5-8 mg/L	-	5.56	5.56	6.59	5.65	6.52	5.81
4	Iron	2 mg/L	2.0 mg/L	<LOQ	<LOQ	0.26	0.12	0.10	0.12
5	pH	6-9	6-9	7.1	7.1	7.7	7.3	6.5	7.4
6	TDS	2100 mg/L	-	41	40	88	81	65	69

Result Summary: The analysis result of the surface water listed in the Table 3.1.4.1 shows that all the parameters are within the standard limit. Therefore, it can be concluded that the surface is not creating any harm to the environment in terms of water quality. [See Annexure II]

3.1.4.2 Hydrology

The Karnafuli is a meandering river. During rainy season water level rises sharply facilitating plying of all types of vessels like passenger and cargo traffic. Sometimes damages the local cultivated crops. Though the river is a meandering one it does not create any problem of heavy erosion and siltation like other inland rivers the Padma, the Jamuna & the Meghna etc. This creates navigational hazards forming enormous shoals in their way to Bay of Bengal.

3.1.5.3 Water Level & Flow

As per hydrographic survey, the water levels are found as below:

Highest water level of Kaptai reservoir is 33.69 m PWD and lowest water level is 23.63 m PWD from the graph of water level (Fig 3.1.4.3) it is seen that water level dropped drastically in the month of April & May of 1998. Dredge Volumes for Multimodal RouteNo-1 is shown in Annexure- 5.4. Flow of the river is Karnafuli regulated by the barrage. Its flow is not directly connected to the sea. When upstream water level is high due to continuous rainfall and about to inundate the crops & households, the water is disposed off by opening the spillway of the barrage. If needed water is also disposed off by diversion tunnel.

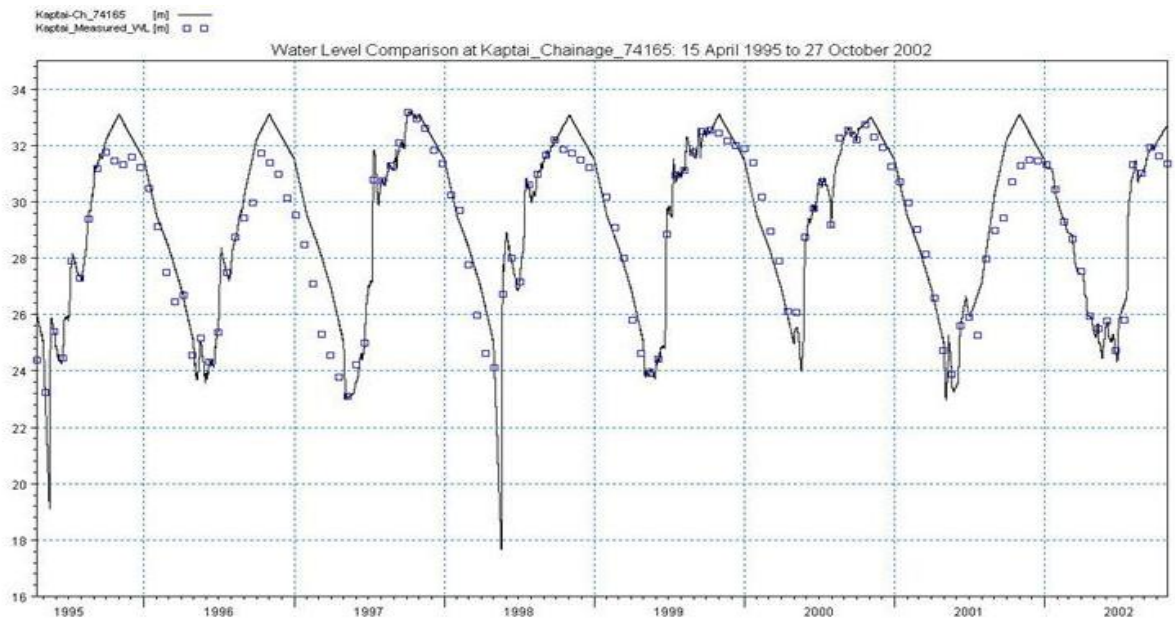

Fig 3.1.5.3: Water Levels in Kaptai Lake (1995 – 2002)

3.1.5.4 Groundwater

In addition to perennial rivers, upland communities rely predominantly on relatively shallow (0.5m to 4.0m) subsurface flows from local springs. These are commonly found along spring-lines where the groundwater table is intersected. However, over the past 2 decades there has been a noticeable depletion in spring flows resulting in significant impacts on rural communities who rely on such sources, mainly for potable water supplies.

A recent study of water resource in the CHT states that there is an observed deterioration of spring flows over the past several years. The main underlying causes were identified as:

- Widespread degradation of natural dense forests;
- Large changes in land use;
- Changes in climate; and
- Physical interventions constructed without understanding the effects on surrounding environment (such as road construction).

Reduction in stream flows results in communities considering alternatives options for potable water. This includes accessing groundwater at greater depths which is likely to be more reliable than the highly seasonally fluctuating (or depleting) shallow subsurface flows. However, due to hard bedrock underlying much of the upland area, tube well installation at greater depths is difficult. Coupled with minimal hydrological and hydro geological information groundwater development often results in (at best) an estimated depth of drilling and again, uncertainty in the

yield potential of the aquifer. With an increasing reliance on groundwater and increasing depths for accessing potable supplies, there is a need for comprehensive monitoring of CHT water resources. This will enable a more planned and systematic basis for sector development interventions.

Table 3.1.5.4: Ground Water Quality Analysis Report

Sl. No.	Parameter	Bangladesh Standard (Drinking Water)	WHO Standard	Kaptai	Rangamati	Rajosthali	Belaichari	Barkal	Chotohorina
1	Arsenic	0.05 mg/L	0.1 mg/L	<LOQ	<LOQ	<LOQ	0.001	0.001	<LOQ
2	EC	-	-	474	103	473	331	122	366
3	Iron	0.3-1.0 mg/L	2.0 mg/L	0.12	0.19	0.23	<LOQ	<LOQ	<LOQ
4	Manganese	0.1 mg/l	0.2 mg/L	0.07	0.06	0.11	<LOQ	<LOQ	<LOQ

Result Summary: The analysis result of the ground water listed in the Table 3.1.4.4 shows that all the parameters are within the standard limit except one point of manganese test result. There is no standard for EC for drinking water. [See Annexure II]

3.1.6 Geology

3.1.6.1 Surface Geology

The Chittagong Hill Tracts is originated as a result of the collision between India and Asia. Chittagong Hill Tracts the Upper Tertiary sandy- argillaceous sediments have been folded into a series of long sub meridional (NNW-SSE) anticlines and synclines represented in the surface topography by elongated hill ranges and intervening valleys. The folded structures are characterized by en-echelon orientation with an increasing degree of intensity and complexity toward the east. The surface geology of Chittagong and Chittagong hill tract districts includes Valley Alluvium and Colluvium, Beach and Dune Sand, Dihing and Dupitila Formation, Girujan Clay Formation and Tipam sandstone Formation, BokaBil and Bhuban Formation. gives the surface geological map of the study area.

Geology: Some of these hill ranges also contain important geological structures to form excellent structural traps for natural gas accumulation. The structures are: Semutang anticline (average elevation is 80m except in some areas where it reaches over 160m), Sitapahar anticline (245 to 330m in the south to middle of the structure and 330 to 410m in the northern part), Matamuhuri anticline (average elevation ranges from 245 to 330m in the northern part, but in the southern part it increases from 410 to 570m and the maximum elevation is 710m in the south) and Bandarban anticline (maximum elevation varies between 650 and 800m, with three peaks of around 935m, 960m and 965m located from north to south).

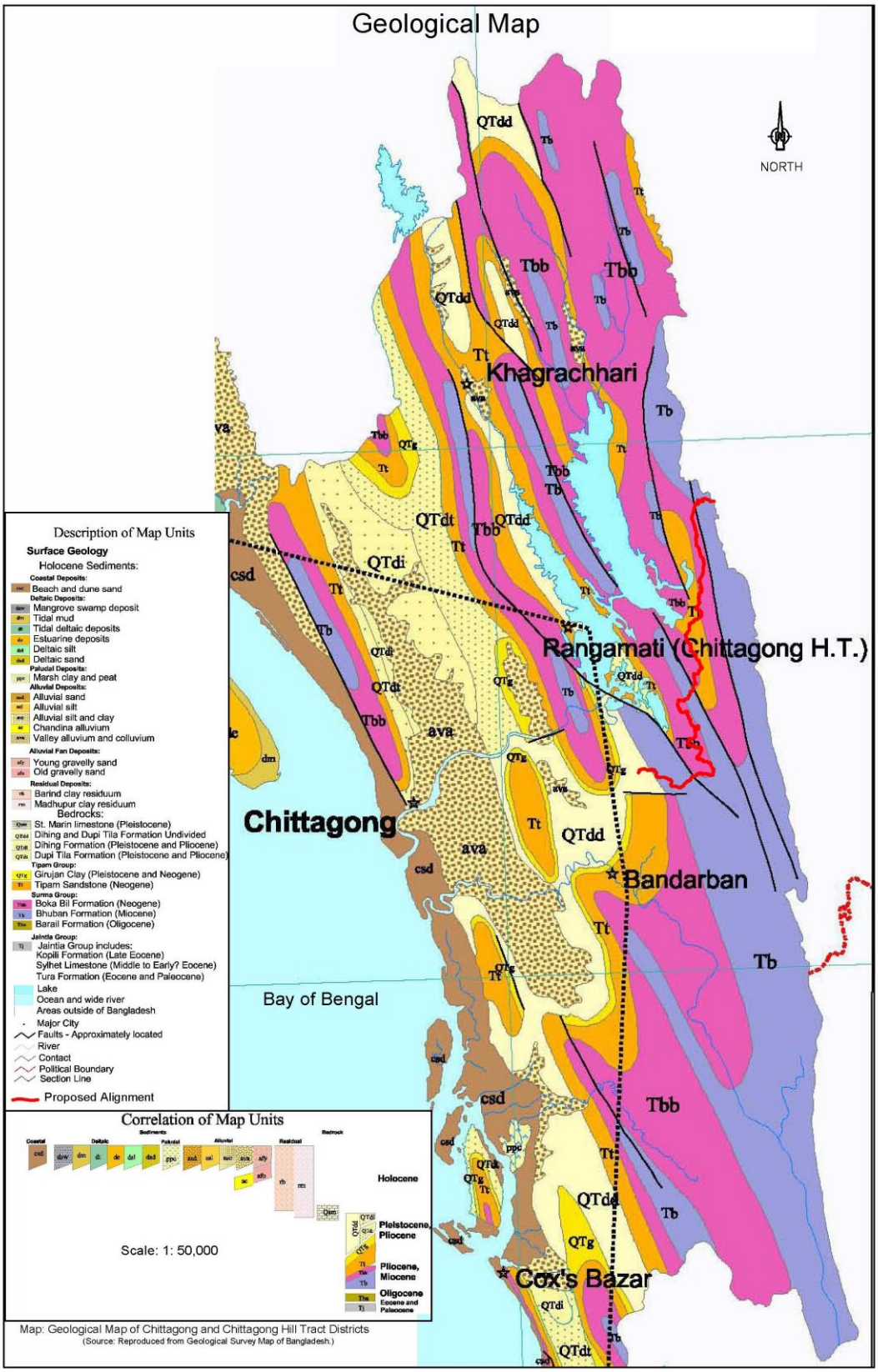

Fig 3.1.6.1: Geological Survey Map of Chittagong and Chittagong Hill Tract Areas

3.1.7 Land Slide

Nadim, Kjekstad, Domaas, Rafat and Peduzzi (2006) provide one of the most comprehensive studies related to landslides around the world. They show that the landslide hazard level depends on a combination of trigger and susceptibility factors, whereby the precipitation and seismic conditions are triggers while the slope factor within a selected grid, the lithological (or geological) conditions and the soil moisture conditions are susceptibility factors. They provide a global landslide hazard zonation. While the degree of landslide hazard is not clearly visible, it is clear that the whole Chittagong Division is within the medium to severe global landslide hazard zonation.

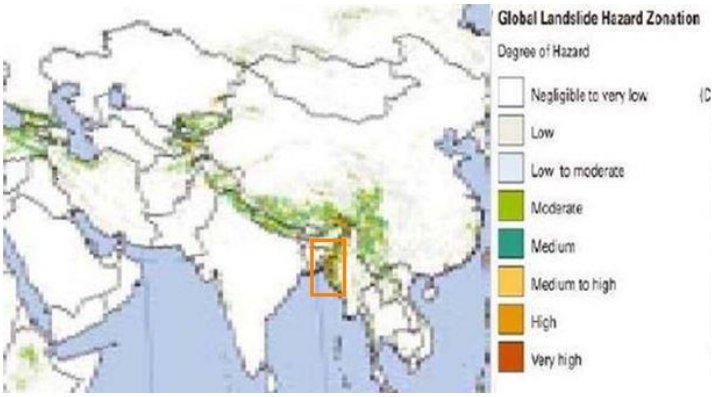

Fig 3.1.7A: Global Landslide Hazard Zonation

Fig 3.1.7B: Landslide at Rajosthali

3.2 Ecological Resources

3.2.1 Biological Diversity

Hunting, fishing and collecting wood and gathering non-timber forest products. Many traditional occupations relate to daily livelihood/subsistence activities involving the use of biological resources, such as fishing/fisheries, hunting, gathering of non-timber forest products, such as wild plants, medicinal herbs, fruits, nuts, mushrooms, etc. These activities take place in diverse ecosystems (e.g. marine or inland waters, tropical or boreal forests).

Table 3.2.1A: List of Medicinal Plants (IUCN)

Sl no	Bangla name	Marma name	English name	Scientific name	Family
1	Akanda	Chi kang mui	Swallow Wort	*Calotropis gigantea*	Asclepiadaceae
2	Amloki	Kala shi	Emblic Myrobalan	*Phyllanthus emblica*	Euphorbiaceae
3	Amrul	Ko cho chi	Wood Sorrel	*Oxalis corniculata*	Oxalidaceae
4	Ashok	Koin khrow	Asoca Tree	*Saraca indica*	Caesalpiniaceae
5	Aurjun	Chi to long	Aurjuna Myrobalan	*Terminalia arjuna*	Combretaceae
6	Bashak	Bosaka	Malabar Nut Tree	*Adhatoda vasica*	Acanthaceae
7	Bohera	Ang gara ani	Beleric Myrobalan	*Terminalia bellirica*	Combretaceae
8	Bon Tulsi	Paing new	Hoary Basil	*Ocimum sanctum*	Labiatae
9	Dadmardan	Pou chi bang	Ringworm Shrub	*Cassia alata*	Caesalpiniaceae
10	Ghritakumari	Lang hi	Aloe	*Aloe barbadensis*	Liliaceae
11	Haritaki	Tara taba	Gall Nut	*Terminalia chebula*	Combretaceae
12	Kalo dutra	Gaing sang roi mro	Thornapple	*Datura metel*	Solanaceae
13	Kalomegh	Kojomi	Creat	*Andrographis paniculata*	Acanthaceae
14	Karamcha	Row koa pai bong	Indian Beech	*Pongamia pinnata*	Apocynaceae
15	Nim gachh	Kala duru	Indian Lilac	*Azadirachta indica*	Meliaceae
16	Nishinda	Tong joi sobai	Caste Tree	*Vitex negundo*	Verbenaceae
17	Patharkuchi	Aney choilote	American Life Plant	*Kalanchoe pinnata*	Crassulaceae
18	Punarnaba	Chi sai dai	Pig Weed	*Boerhaavia diffusa*	Nyctaginaceae
19	Shatamuli	Boma raja	Asparagus	*Asparagus racemosus*	Liliaceae
20	Shetochandon	Nahosa	Sandal Wood	*Santalum album*	Santalaceae
21	Shialkanta	Long	Prickly Poppy	*Argemone mexicana*	Papaveraceae
22	Shimul	Agaroi	Silk Cotton Tree	*Bombax ceiba*	Bombacaceae
23	Tentul gachh	Kia mong	Tamarind Tree	*Tamarindus indica*	Caesalpiniaceae
24	Thankuni	Ki ching shi	Indian Pennywort	*Centella asiatica*	Apiaceae
25	Ulatkambal	Chi row afrow	Devil's Cotton	*Abroma augusta*	Sterculiaceae

Fauna: The fauna mainly includes monkey, fox, jungle cat, fishing cat, wild boar, land turtle, king cobra, reticulated python, rat snake and other non-poisonous snakes together with large number of species of lizards and amphibians like frog and toad, and tree frogs. The bird life of the Chittagong Hill Tracts is wonderfully rich. More than 60 families of birds are found.

Table 3.2.1B: List of the Important Bird Areas (IBAs) of Bangladesh

Country/Territory	International name	IBA Code	Criteria
Bangladesh	Aila Beel	BD003	A1, A4i, A4iii
Bangladesh	Ganges-Brahmaputra-Meghna delta	BD011	A1, A4i, A4iii
Bangladesh	Hail Haor	BD006	A1, A4i, A4iii

Bangladesh	Hakaluki Haor	BD004	A1, A4i, A4iii
Bangladesh	Hazarikhil Wildlife Sanctuary	BD013	A3
Bangladesh	Himchari National Park	BD018	A3
Bangladesh	Jamuna-Brahmaputra river	BD009	A1, A4i
Bangladesh	Lawachara / West Bhanugach Reserved Forest	BD005	A1, A3
Bangladesh	Madhupur National Park	BD001	A3
Bangladesh	Muhuri Dam	BD012	A4i
Bangladesh	Pablakhali Wildlife Sanctuary	BD014	A1, A3
Bangladesh	Patenga Beach	BD016	A1, A4i
Bangladesh	Rajkandi Reserved Forest	BD007	A3
Bangladesh	Rampahar-Sitapahar Wildlife Sanctuary	BD015	A3
Bangladesh	Rema-Kalenga Wildlife Sanctuary	BD008	A3
Bangladesh	Sangu Matamuhari	BD017	A3
Bangladesh	Sunderbans (East, South, West Wildlife Sanctuaries)	BD010	A1, A4iii
Bangladesh	Tanguar Haor and Panabeel	BD002	A1, A4i, A4iii
Bangladesh	Teknaf Game Reserve	BD019	A1, A3

According to the Bird Life International the Important Bird Areas (IBAs) of Bangladesh are shown in Table 3.2.1B and Fig 3.2.1A.

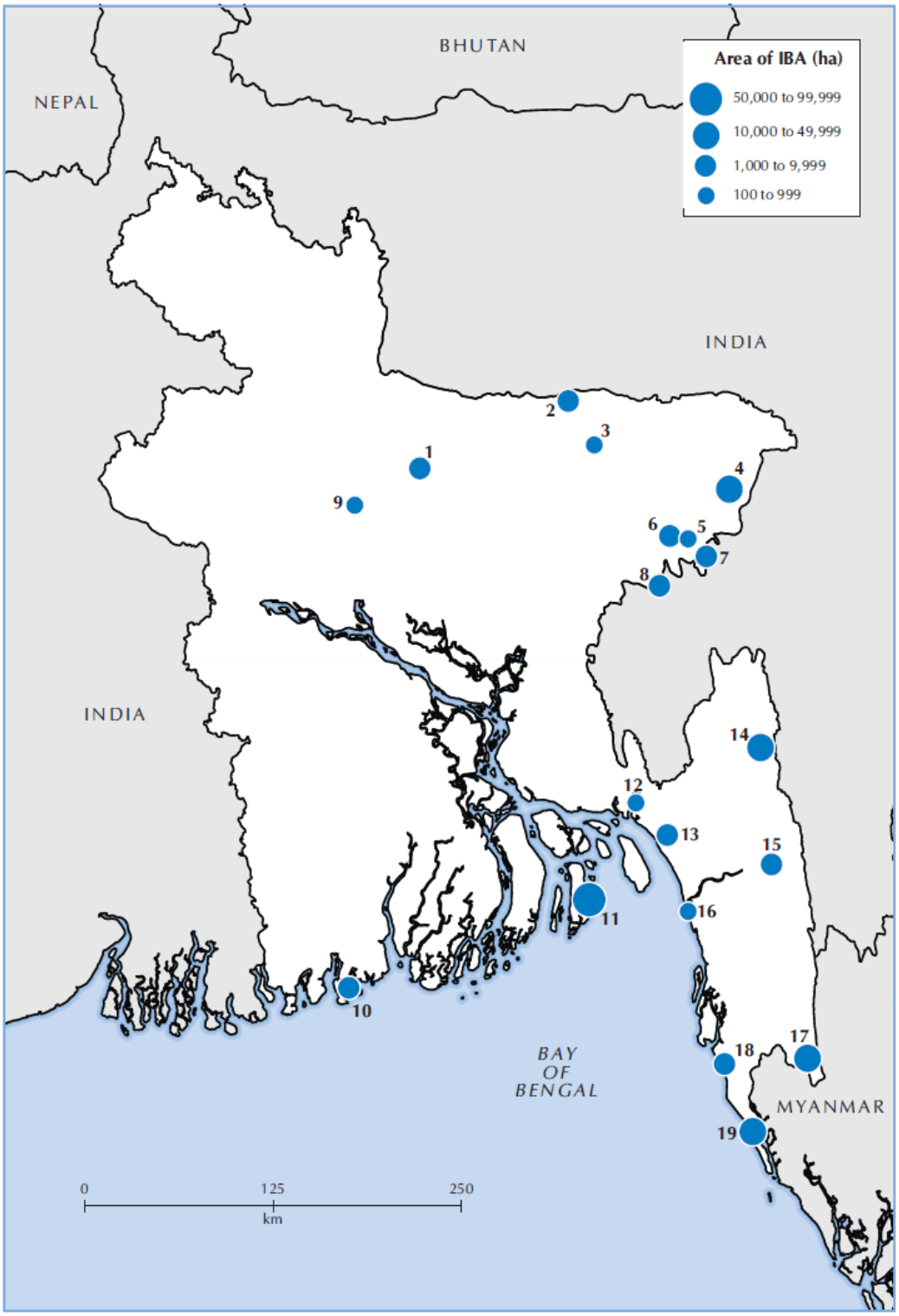

Fig 3.2.1A: Area of IBA

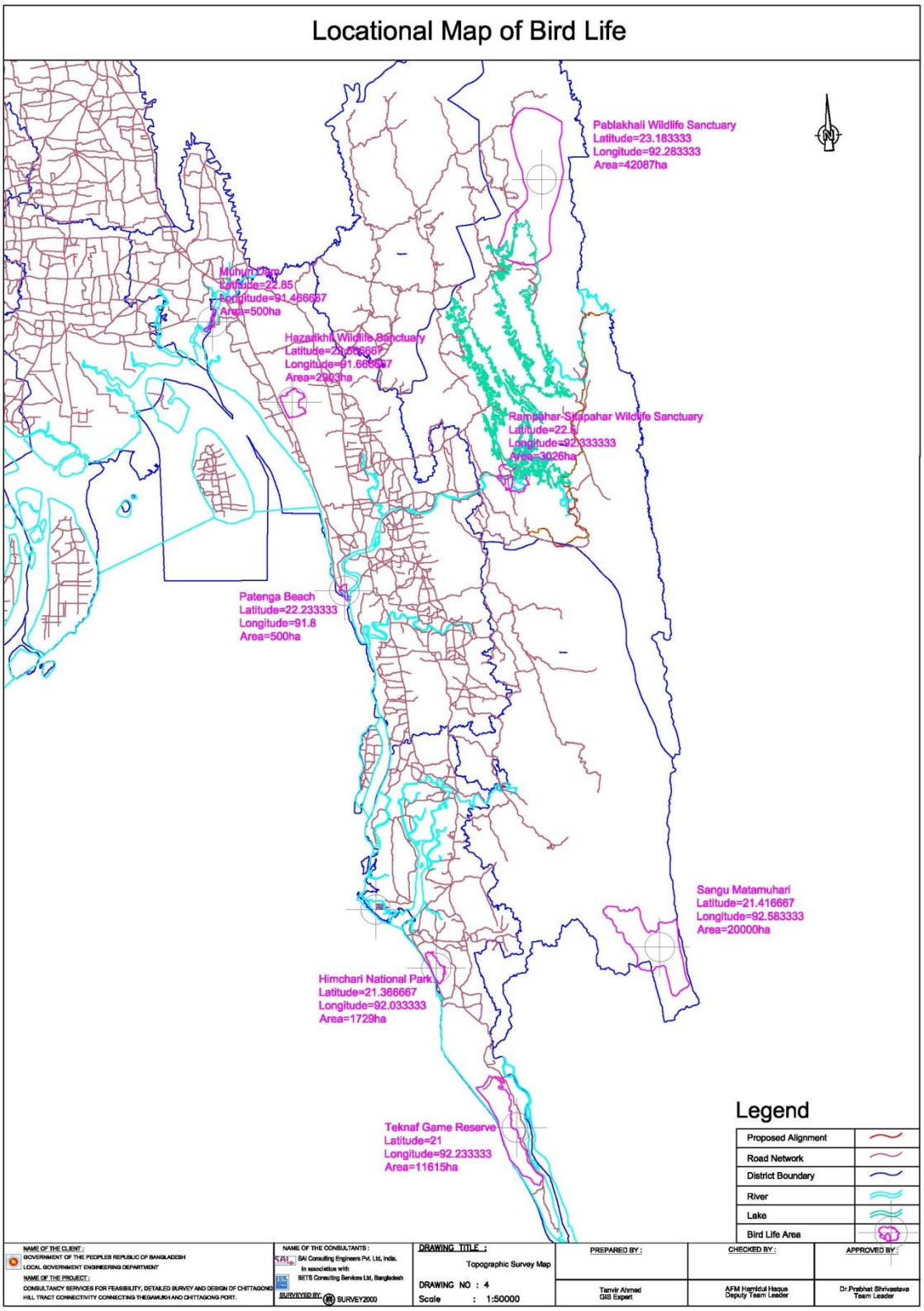

Fig 3.2.1B: The Important Bird Areas (IBAs) of Bangladesh.

3.2.2 Wild Life Sanctuary Protected area in Chittagong Hill Tract

Threat to the wildlife sanctuaries in project area: Transport connectivity route are particularly sensitive from an environmental perspective, especially the areas of the Rampahar and Pablakhali Wildlife Sanctuaries. These areas among others to be studied under the project will require particular attention to ensure appropriate identification of critical habitats (including but not limited to designated protected areas and wildlife sanctuaries).

Rampahar-Sitapahar Wildlife Sanctuary at Rangunia is close to the access road between Chittagong port to Rangamati. If Kaptai road is used for multimodal transportation then Rampahar-Sitapahar Wildlife Sanctuary can be avoided. Pablakhali Wildlife Sanctuary is a bit close at the tip of Rajosthali-Theghamuk road (Chotohorina-Thegamukh). However the road is not passing through the wildlife sanctuary and may not harm it. Care should be taken so that user of this road can't get easy access to the sanctuary.

Wildlife diversity: Macaca mulatta (Rhesus Macaque), *Sus scrofa* (Wild Pig), *Muntiacus muntiak* (Barking deer), *Panthera pardus* (Indian Leopard), *Felis chaus* (Jungle cat), *Hystrix indica* (Porcupine), *Ophiophagus hannah* (King Cobra), *Python reticulate* (Python), *Caloted versicolor* (Monitor Lizard), *Varanus begalansis* (Bengal Monitor Lizard), *Suncus murinus* (Grey Musk Shrew), *Helogale parvula* (Common Mongoose), *Viverra zibetha* (Civet), *Lutra lutra* (Common otter), *Vulpes bengalensis* (Bengal fox), *Vulpes vulpes* (Red fox), *Pteropus giganteus* (Indian flying fox), *Gallus gallus* (Red jungle fowl), *Elanus caeruleus* (Black- winged Kite), *Lophura leucomelanos* (Mathura), *Bubo* spp. (Owl), *Lonchura* spp.
Some lost wildlife: Elephas maximus, *Panthera* spp., *Rhinoceros unicornis*, *R. sondiacus*, *Didermocerus sumatrensis*, *Ursus thibetanus* (Asian black bear), *Boselaphus tragocamelus* (Nilgai), *Bubalus bubalis* (Wild buffalo), *Bos frontalis* (Gayal), *Bos gaurus*, *Bos banteng*, *Cervus unicolor* (Sambhar), *Axis porcinus* (Hog deer), *Canis lupus* (Marbled cat), *Rhodonessa caryophyllacea* (Pink headed duck), *Pavo cristatus* (Common peafowl), *Polyplectron bicalcaratum* (Peacock-pheasant), *Accipiter* spp. (Hawk), *Aquila* spp. (Eagle) Source: Jasimuddin, mjashimuddin2001@yahoo.co.uk

Flora: The hills, rivers and cliffs are covered with dense bamboo breaks, tall trees and creeper jungles. The valleys are covered with thick forest. The vegetation is characterised by semi-evergreen (deciduous) to tropical evergreen dominated by tall trees belonging to *dipterocarpaceae*, *euphorbiaceae*, *lauraceae*, *leguminacae* and *rubiaceae*.
Vegetation: The hills are unsuitable for cultivation but natural vegetation remains widely. Jhum cultivation is being practiced on the hill slopes. Cotton, rice, tea and oilseeds are raised in the valleys between the hills.

3.2.2.1 Pablakhali Wildlife Sanctuary

IUCN Management Category: IV (Managed Nature Reserve)
Biogeographical Provine: 4.09.04 (Burmna Monsoon Forest)
Geographical Location: Lies at the northern end of Kaptai Reservoir in the south-eastern part of Kassalong Reserve Forest in the Chittagong Hill Tracts, some 112km from Rangamati Town. The western boundary is formed by Kassalong River. 23'08'N, 92'16'E.
Date and History of Establishment: Declared a wildlife sanctuary in 1983 under the Bangladesh Wildlife (Preservation) (Amendment) Act, 1974. First established as a game sanctuary in June 1962.
Area: 42,087 ha

Land Tenure: State
Altitude: Ranges from 100m to 300m
Physical Features: The topography comprises a complex of hills and valleys aligned north-south, with spurs branching from the ridges. The hills are rugged and steeply sloping to the north and smaller with gentler slopes to the south. Some 3,885ha in working unit I have been under water since 1963, following the construction of a dam at Kaptai as part of the Karnafuli hydro-electric project (Olivier, 1979). Soils are typically clay or clay loams in the valleys and pale brown to yellow-red (acidic) clay loams and loams in the hills with localized concretions of iron-manganese.
Climate: Conditions are typically sub-tropical with a long dry season lasting from November to May. Mean annual rainfall is 2500mm. Mean temperature ranges from 23'C in December to 35'C in May. Humidity is high throughout the year.
Vegetation: Three forest types can distinguish. Tropical wet evergreen forest commonly occurs in valleys and on sheltered slopes with plentiful water supply. The irregular canopy, characterized by emergent trees, is dense and rich in species. Typical trees included civit *Swintonia floribunda, garjan Dipterocarpus* spp., *Pterygota alata, Quercus* spp. And *Castanopsis* spp. Tropical semi-evergreen forest the most extensive forest type in the sanctuary includes a significant proportion of deciduous canopy species. The predominant tree genera are *Dipterocarpus, Mangifera, Amoora, Cinnamomum, Syzygium, Tetrameles, Artocarpus, Salmalia* and *Albizia.* Tropical moist deciduous forest is confined to new alluvial areas near rivers ans streams. The trees are scattered and interspersed with extensive patches of khagra and nal grassland and stands of wild banana. Characteristic tree genera include Albizia, Salmalia, Terminalia and Ficus. Bamboo grows beneath the canopy of all three forest types (Sarker and Fazlul Haq. 1985).
Fauna: According to reports in old district gazetteers. Kassalong Valley used to be rich in wildlife, with tiger Panthera tigris (E), two species of rhinoceros Rhinocerotidae spp., gaur Bos gaurus (V) and banteng B.\Javanicus (V) present in the 19th and early 20th centuries. Tiger, gaur and banteng were last seen in the early 1970s (Khan. 1985), but tiger and also leopard Panthera pardus (T) are reported to still occur (Sarker and Fazlul Huq, 1985). Most important is the small population of Asian elephant Elephas maximus (E) that commonly uses the southern part of the sanctuary, probably because of the mosaic of habitats and permanent water supply (Olivier, 1979). Many other large mammals are present, including rhesus macaque Macaca mulatta, capped langur Presbytis pileata, Hoolock gibbon Hylobates hoolock (V), dhole Cuon alpines (V), small cats, otters and wild boar Sus scrofa (Sarker and Fazlul Huq, 1985) and also Indian muntjac Muntiacus muntjak and samber ICervus unicolor (Olivier, 1979). Hague (1989) lists 61 species of mammals recorded in the late 1970s.
Some 133 bird species have been recorded from the sanctuary (Husain, 1975). This total includes 25 species previously reported by Mountfort (1969). Following the formation of Kaptai Reservoir and with the continuing reduction of former wintering grounds in Sylhet and Mymensingh the sanctuary supports increasing numbers of resident and migratory waterfowl (Olivier, 1979), notably little grabe Tachybaptus ruficollis, a variety of herons and egrets, common moorhen Gallinula chloropus, common coot Fulica atra and Asian openbill stork Anastomus oscitans (Scott, 1989). White-winged wood duck Cairina scutulata (V) used to be common but population has declined in recent years, most probably due to systematic clear-felling of primary forest and its replacement with commercially viable timber species (Khan, 1986). Some five pairs were present up to 1979, but the status of the species has since become uncertain owing to political disturbances (Khan, 1985). Khan (1986) estimates there to be some 20 pairs within an area of 240 sq. km in and around the sanctuary.
Of the reptiles, Indian python Python molurus (V) is common (Sarker and Fazlul Huq, 1985).

Cultural Heritage: No information.
Local Human Population: Part of the sanctuary has been allotted to settlers from the plains. Rebel tribal groups operate in the area (Khan, 1985).
Visitors and Visitor Facilities: Access to the Chittagong Hill Tracts has been restricted since 1982 for security reasons. There are two rest houses.

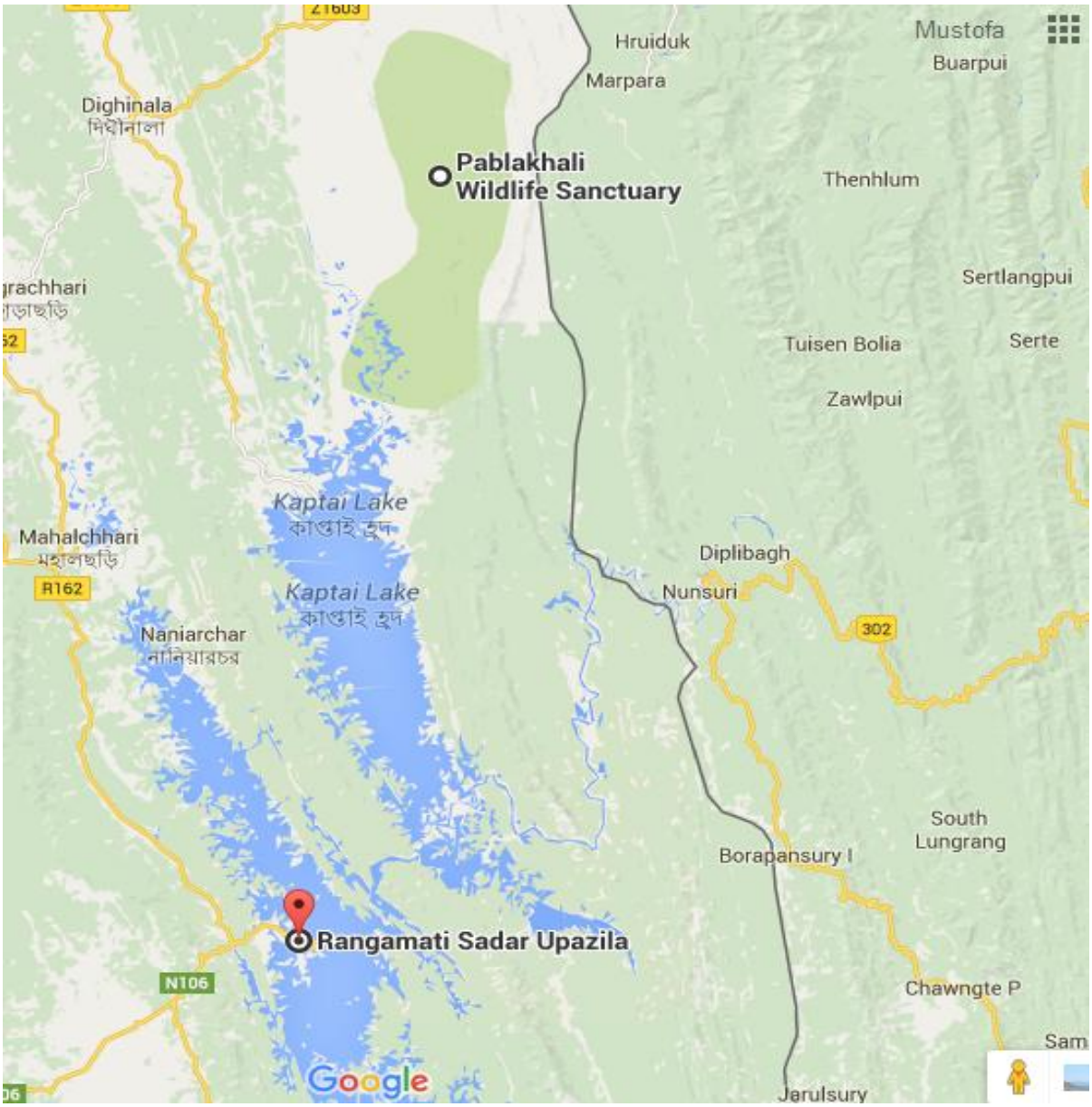

Fig 3.2.2.1: Location of Pablakhali wild life Sanctuary from Rangamati

3.2.2.2 Rampahar-Sitapahar Wildlife Sanctuary

IUCN Management Category: Proposed
Biogeographical Provine: 4.04.01 (Burmna Rainforest)
Geographical Location Establishment: Presently classified as reserved forest, Rampahar-Sitapahar has not yet been designated a wildlife sanctuary under the Bangladesh Wildlife (Preservation) Amendment) Act. 1974 but has been maintained as such by the Forest Department since 1973 (Sarker and Fazlul Huq, 1985).

Area: 3,026ha,
Land Tenure: State,
Altitude: No information
Physical Features: Comprises low, gently sloping hills which are steeper in Sitapahar block than Rampahar block. The Karnaphuli River flows through the area. Soils are clays or clayey loams in valley bottoms and mostly pale brown (acidic) clay loams and loams on hills (Sirker and Fazlul Huq, 1985).
Climate: Conditions are typically sub-tropical with a long dry season from October to May mean temperatures vary from 24'C in December to 35'C in May. Mean annual rainfall is 1500mm.
Vegetation: Comprises evergreen and semi-evergreen forests. Predominant tree species are Dipterocarpus spp., *Artocarpus chaplasha, Tetrameles nudiflora, Cedrelatoona, Mesuaferrea, Eugenia spp., Ficus spp.* And *Albizia procera* (Sirker and Fazlul Huq, 1985).

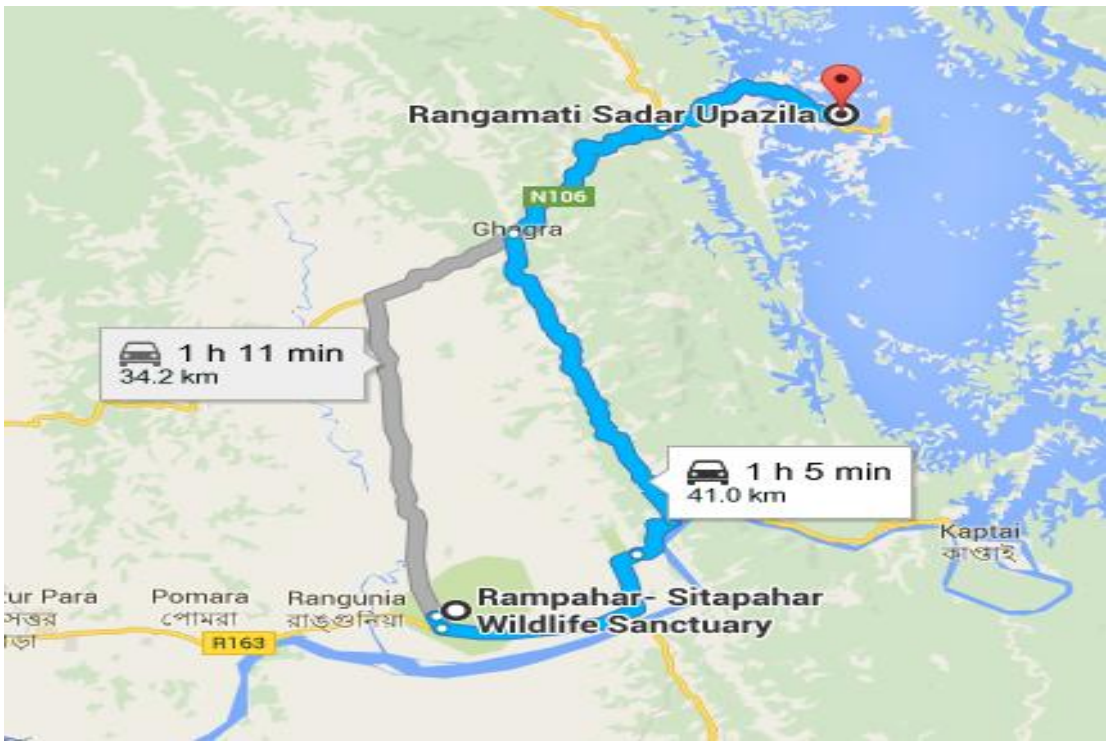

Fig 3.2.2.2: Location of Rampahar-Sitapahar wild life Sanctuary from Rangamati

3.2.3 Aquatic Biology

Fisheries: Kaptai Lake is the largest manmade lake in the South Asia (App. 725 sq. Km). There is more than 4000 charas/ rivulet falling into the lake. About 1200 charas/rivulets are directly connected and discharges into the lake. It is one of the largest sources of biodiversity and fish. Substantial amount of fish is being supplied by this charas falling into lake and comparatively higher per area fish are available than Lake. According to the research of Bangladesh Fish Research Institute (BFRI); 2 species of Shrimp, 1 species of Dolphin and 2 species of Tortoise are available in the lake. There are 68 species of local and 8 species of alien fish are available in the lake. At present, 42 species of fish are commercially collected from the lake. The local fish species are mainly come into the lake from the river and nearby wetland after the lake were created. As a result of formation of lake the flowing charecteristics of rivers has been

transformed into static water. The change in flowing charecteristics of water causes change in aquatic environment. As a result of man made pressure on lake and change in flowing charecteristics some of the native fish species extinct from the lake. On the other hand, some alian fish species like Silver Carp, Grass Carp, Carpio, Rajputi, and Thai Pangas are added to the lake by Bangladesh Fisheries Development Corporation (BFDC). African Catfish and Telapia is accidentally added to the lake.

In the Year 1965-66, the amount of commercial fishing is 1206 Metric Ton. On 70th decades this amount is increased to 3681 Metric Ton. At present, the commercial fishin from the lake is nearly 6000 Metric Ton and its only the 50% of actual amount (BFDC 2002, BFRI 2003).

There are 4727 creeks (Among them 1200 creeks are adjacent to the Kaptai Lake; [Alamgir and Ahmed, 2008]) in Chittagong hill tracts are suitable for fish culture (DoF, 2012). The annual fish production of Chittagong hill tracts is 14773.46 MT (culture and capture) which is comparatively less amount (0.62%) of total annual inland catch and aquaculture is decreasing in Chittagong hill tracts due to various reasons (DoF.2012). the production capacity of these creeks is 2100 kg/hectare that is 8 to 9 times more than the Kaptai Lake (Alamgir and Ahmed. 2005). As fish production in the country from the natural sources is gradually declining, intensive efforts are being directed towards Poly-culture of Indian major carps and some exotic carps (Kohinoor et al., 1998). The last three years' fish production were 29(2009-10), 31(2010-11), 33(2011-12) lakh MT. Every year extra 2 lakh MT fish is needed for filling up the increasing population demand (DoF, 2012)

Fisheries Act 1950 is follows to protect the fish and aquatic biodiversity in kaptai lake. Three month (May-July) fishing is strictly prohibited in the lake for conservation of fish. Government help poor fisherman by VGF card for these three month. Some type of fishing like use "Current Net" and "Jak" is prohibited in th lake. There are 7 different place use as conserved area where fishing is prohibited whole year. In breeding season fishing is prohibited. Government (BFDC) aid minnow to the lake. But till now there is no exertion of fishery.

DoF implemented a project in the mid-1990s "Fish Culture Development (in hills) and Extension" created 11.5 ha of nursery ponds and 92 ha of other water bodies by modifications of creek flows and construction of small dams, and these were brought under fish culture. Training of farmers about aquaculture was given special attention under this project. DoF has also implemented a project entitled Improvement and Extension of Fish Culture by developing creek in the Chittagong Hill Tracts from 2000 to 2010. By this project DoF developed 287 creeks and establish 3 mini hatcheries in Chittagong hill tracts. The third phase of the project is on the process. Third phase will repair 903 creeks and establish 1 hatchery by five years (DoF, 2012).

3.2.4 Forest Resources

Most of the hills are covered with forests containing valuable timber trees, bamboos, canes and a kind of grass known as *Shan*. Forest classification: Hill forests (38%), Mangrove (30%), Plantation (17%), Bamboo forest (13%) and Sal forest (2%). Forests in Rangamati under the CHTs are an important biodiversity hotspot covering the tropical wet mixed forest ecosystem. The rich diversity in flora and fauna in the developed a unique forest ecosystem with numerous numbers of fountains and streams provided a nature dependent livelihood of the indigenous communities (Jashimuddin 2009). Before 3 to 4 decades, this area had a dense evergreen forest harboring innumerable biodiversity. The present decrease of the floral diversity in the Rangamati forests made a serious threat to the indigenous communities for sustaining their traditional medicare system (JP 2011) By far the largest natural resource in the CHT is forest, of which about 325,000 ha (about 25% of the total area of CHT) is exclusively controlled by the Department of Forest (DoF) of MoEF. The region's forests may be broadly classified into

tropical evergreen semi evergreen and deciduous types. Reserve forests include Kassalong and Sangu in Khagrachari and Banderban districts, respectively. Historically pre-existing community-based land ownership system of the people in CHT was changed for the first time when in 1865 and 1878, the British introduced the colonial land policy and took off a large portion of natural forest under state ownership. Since then, the people of CHT lost their customary right on the use of certain categories of land.

In addition, DoF has gradually taken up lands traditionally under jhum cultivation for conversion into reserve forests, invariably failing to secure alternative livelihood options for affected communities. These "Reserve Forests" (RF) have been managed according to a succession of forest management plans that have set targets for timber extraction and reforestation. Their principal objectives have been to (i) replace endemic and/or natural and less commercially productive forest with more commercially valuable and productive species; (ii) manage the forests on the basis of sustained yield; (iii) keep sufficient forest cover in the watersheds to prevent denuding of the hills and the consequent erosion; and (iv) derive the highest possible financial return and ensure the maximum use of produce from these forests. However, unsustainable practices such as monoculture have resulted in serious pest and erosion problems.

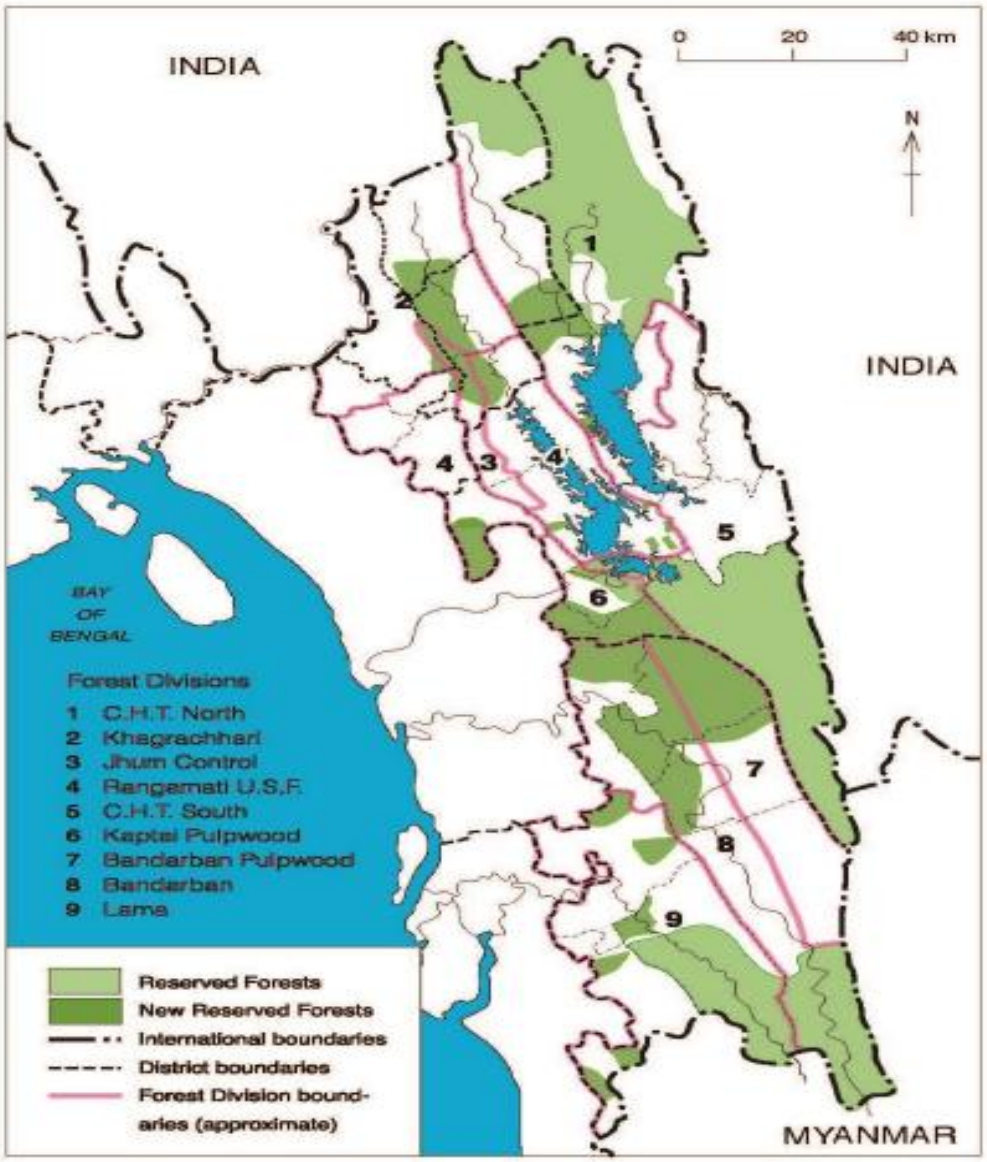

Fig 3.2.4A: Forest Division of CHT with old and New Reserved Forest

Remaining categories of forest include protected forest, which covered about 1% of CHT but was later reclassified as RF. Private forest are owned by small-scale indigenous farmers and plantation owners – their extent is unknown. The remaining forest area is Unclassified State Forest (USF), which is theoretically the remainder of the land area not under DoF control. Overall, this is a residual category of forested land under the control of District Collectorates which is considered by IPs to be their own forest and common lands. Considerable quantities of timber and bamboo are produced from this area. However, overall management of USF remains unclear.

Village Common Forests (VCF) is an innovation based upon traditional resource management patterns to retain forest cover for long-term use and play an important role in conserving forest resources as well as fulfilling daily necessities. VCF shows a rich biodiversity compared to government managed reserve forests in CHT. Development of hydroelectric power plant displacing more than 100,000 people, Displacement due to population migration programs, CHT regulation 1900 and Indian Forest Act 1927 paved the way to start VCF. These are mostly small

(average 20-120 ha), consisting of naturally grown or regenerated vegetation, and are traditionally managed, protected and utilized by village communities. Acknowledged in the CHT Regulation of 1900 and Indian Forest Act 1927 but does not recognize full ownership rights of the community or provide safeguards against alienation and privatization. There are around 700-800 VCF in CHT. A management committee headed bykarbari or headmen manages VCF with the customary rules and regulations only the local kabiraj or medicine men are permitted to enter and collect herbs Every week they go inside the reserve in small group on rotational basis and patrol the reserve to protect it from any sort of theft or stealing or illegal cutting of trees or bamboo.

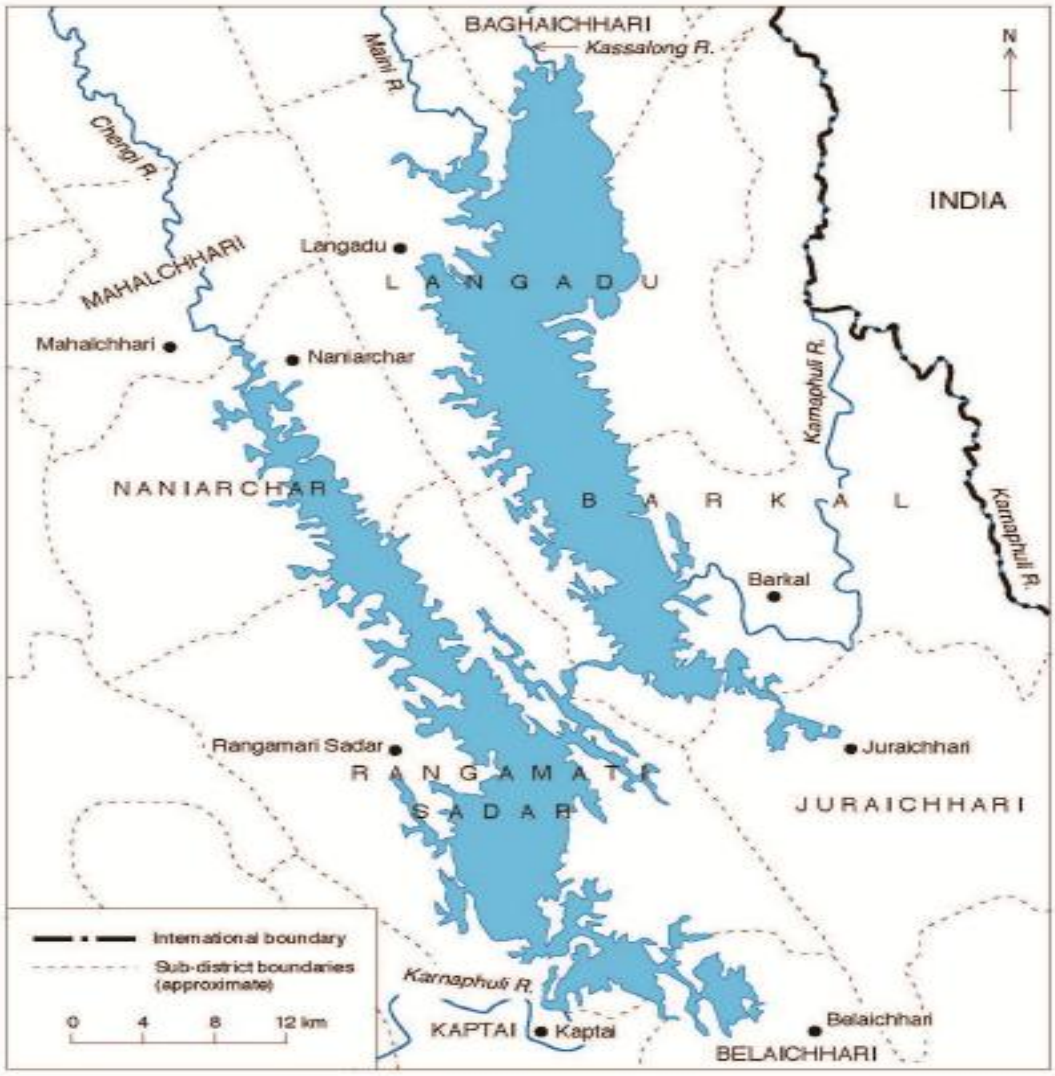

Fig 3.2.4B: Majority of VCFs.

Table 3.2.4A: Floral Statistics of VCF Area

Types of Plants Species	No. of Plants Species	Total
Woody plant	70	
Medicinal plant	20	173
Fodder plant	77	
Bamboo	06	

Table 3.2.4B: Faunal Statistics of VCF Area

Types of Animal Species	No. of Animal Species	Total
Wild Animal	20	60
Bird Species	40	

A recent study undertaken by Water Aid Bangladesh, in which a combination of remote sensing, ground truthing and community consultation was undertaken, indicates that dense forest has drastically been reduced in the recent years. Between 1989 and 2003, an estimated 170,000 ha of dense forest, (approximately 50%) was lost over the CHT area. The most severe condition was observed in Khagrachari district (approximately 95% loss), a likely consequence of changes in agricultural practices and scale. This type of change facilitates fast surface runoff and thereby reducing the soils water retention capacity and percolation into water table. The study further concludes that degradation of forest quality, that is, loss in canopy coverage, is probably the most significant cause for deterioration in spring flows in CHT. Overall, forest resources, their use and sustainability are complex and remain a sensitive issue in CHT.

3.2.5 Forest Management

Chittagong Port-Thegamukh-Mizoram Corridor going through the reserve forest at Rajosthali, Farua, Juraichari and Barkal. It need more research before construction to avoid the forest area as well as the commercial garden. The animal's habitat has not been found along the route but it may need further investigation if they are affected by project at all. Ecological survey may have to be undertaken to avoid any unwanted damage to the existing habitat and destruction of the medicinal plants on which the tribal people are dependent for the treatment in the remote forest area.

Potential impacts on forest health and quality and on the rights and welfare of the people who depend on them and forest restoration projects are the responsibility of Forest department. None is allowed to intervene in the forest for any kind of project and construction work. The forest is reserve forest and owned by the government and none is allowed to enter into the forest even the tribal people needs permission to extract any forest product for their daily necessity. The proposed route map needs to be supplied to the conservator of forest in the area who in turn will examine the extent of damage that might be caused to the reserve forest. It is understood from the forest official that highest office of the country needs to be consented if such road and bridges for the connectivity is to be made.

3.2.6 Rare or Endangered Species

Different type of trees, animal and birds are presence in the forest. Segun, Gamar, Goda, Ghutghutia, Mehgani, Black Berry etc. are the main tree in this forest. Animals like Deer, fox, elephant, monkey and different species of snake like boa, python are existing in the forest. There are more than hundred species of birds are existing in these forest. Tiger, Peacock, Rhino etc. are extinct species.

Many species of wildlife have now become critically endangered in the Chittagong Hill Tracts (CHT) due to indiscriminate poaching and rapid depletion of forests. Rare species of wildlife like Yak (goyal), Tiger, Panther (chitabagh), large and small civet cat, Pangolin, Gibbon (Ulluk), Barking deer and Samber, Slow Loris (Lajjabati Banor) and peacock are already on the verge of extinction in the CHT forests. At the same time many common species are also fleeing the

forests across the border as illegal poaching and fast depleting of forests reserves are causing their safe abode to shrink faster, observe zoologists.

Sources at Department of Forest (DoF) said illegal logging, growing population, lack of wildlife conservation and awareness campaign and hunting by the indigenous people are the major reasons behind depletion of forests and disappearance of wildlife. A survey conducted in 1975 found 76 species of wild mammals, 183 species of wild birds, seven species of amphibious animals and 25 species of reptiles and snakes in the CHT forests. But many of these, including wild elephants, wild pigs, deer, wild dogs, porcupines, wild cocks, snakes, some species of monkeys, baboons (honuman), jackals, and hares, few species of frogs, mongoose, leopards, and wild buffaloes are now rarely seen in the forests. Even the Jhum cultivation through denudation of hills in and around the reserve forests areas also threatened biodiversity. (Shantimoy Chakma, Rangamati (Daily Star) Thursday, August 12, 2010)

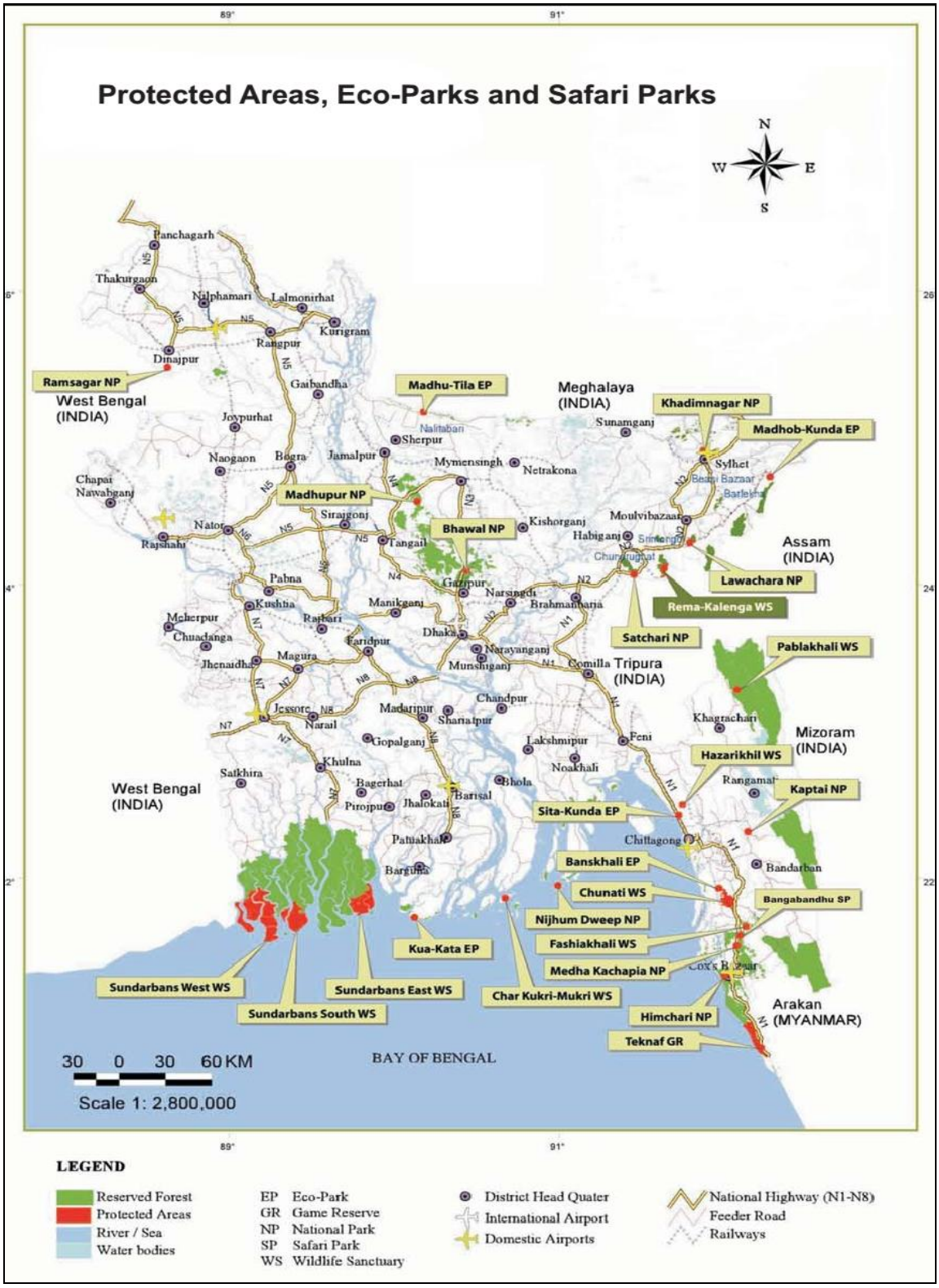

Fig 3.2.6: Protected Areas of Bangladesh

3.2.7 Protected Areas

In 1989 the area is declared as reserved forest. After that cutting of trees is strictly prohibited in the region. Forest Division guards the forest to protect the forest and biodiversity with the help of Bangladesh Army, BGB and Police Force. Poaching is punished according to Forest Act 1927

(Amended 2012) and Wildlife (Conservation and Protection 1972) Act.

There is no community forestation project with local people. Local people use their land for commercial gardening of different types of fruits and wood trees. There is a project known as "Pulpwood Project" for the raw materials of Chandraghona Paper Mills. Department of forest (South Division) took two major project in the forest area, those are (i) Strengthening Regional Co-operation for Wildlife Protection (SRCWP) Project and the other is(ii) Development of Ecotourism and Biodiversity Conservation at Kaptai National Park which is a sub-project of "Ecotourism and Biodiversity Conservation of Bangladesh Project".

3.3 Economic Development

The economy of Rangamati is hugely dependent on agriculture with a total of 41.94% of the population employed there. Other occupational percentages are: agricultural labourer 12.06%, wage labourer 4.95%, commerce 8.22%, service 13.04%, fishing 2.02%, industry 4.57%, forestry 3.2% and others 10%. A grand total of 12275 hectares of land is used for cultivation, producing food and non food crops such as rice, potato, corn, mustard seed, cotton and jute among others. Fruits such as mango, jackfruit, banana, pineapple, litchi, black berry are also grown in Rangmati.

Industries: Notable cottage industries of Rangamati are weaving, blacksmithing and wood work.Weaving is particularly famous for their woolen and jute rugs and hand loom cloth. Major industries include Chandraghona paper and rayon mill, Plywood Factory, Ghagra Textile and a Satellite Station at Betbunia amongst many others, producing and exporting goods.

CHTDB: Chittagong Hill Tracts Development Boardwas established as an autonomous body by an Ordinance (Ordinance No. LXXVII of 1976) of the President of the People's Republic of Bangladesh in 1976 to undertake the responsibility of socio- economic and infrastructural development of this hilly region in the background of inefficient road network, poor literacy rate, absence of necessary infrastructure paucity of safe drinking water, inadequate health care and sanitation and many other draw backs of the region. CHTDB's tireless endeavor for last couple of decades to address all those issues brought a significant change in the socio economic condition and infrastructural development in this region. The main mission and vision of the Board is to Development of rural road and infrastructure, Poverty reduction though Socio-economic Rehabilitation, Introduction of sustainable land use technology, Welfare of mother and children, Human resource development. They are very much interested about the CHT connectivity project. This project helps to fulfill their mission and vision.

Communication: Highways and waterways are the chief means of communication. The length of the metalled roads within Rangamati, Khagrachhari and Bandarban districts is 123 km, 134 km and 296 km respectively. Similarly, the length of the waterways in the above districts is 444 km, 640 km and 166 km respectively.

Two major navigational channels cater needs of the local people for the most of the year. But there is draft problem (LAD) if bulk cargo vessel to run:

i) Rangamati-Barkal-Chotohorina-Borohorina
ii) Rangamati-Langadu-Maini-Dudhchari-Baghaichari

There is several minor channel and charas are used by the local people and boat man. But some navigational route is dried up in dry season and navigation becomes problem for boatman during that period. The navigation channels are blocked by water hyacinth in wet season. Boat owner's association meets and discusses with local administration about their problems but these is not

so easy to solve. Dredging may be required to enhance the navigation. Bangladesh Power Development Board, responsible for generation of electricity from the stored water is not interested in dredging the lake. Low water period of the lake creates huge reduction in the generation of power. Bangladesh Army and BGB guard the lake for safety.

Economy: Semutang gas field located in Khagrachhari district is the only gas field in Chittagong Hill Tracts. It was discovered in 1969 by the national oil company (Oil and Gas Development Corporation of the then Pakistan). However, gas seeps are reported from Sitapahar (Kaptai) and Jaldi wells, while oil seeping from Uttan Chatra. Other resources include sandstones, boulders (calcareous concretions), conglomerates and lignitic coals. A paper mill is built on the bank of the karnafuli at Chandraghona and a hydro power station (Karnafuli Hydro Power Station) at Kaptai with the aim of generating electricity and providing irrigation and flood control facilities. Hill people produce woven cotton goods and bamboo nets and baskets.

Land Use (e.g. dedicated area uses): The processing of tobacco requires fuel wood from the adjoining hill forests. Demand for fuel wood from the growing number of brickfields all over the CHT has been another contributing factor for environmental degradation.

The gradual depletion of natural resources like water and bamboo has a negative impact on the livelihoods of people living in the CHT. They also said that the production of cereals is decreasing due to decrease of agricultural land, affecting the income and consumption of the people of CHT. They mentioned that these have chain reaction for environmental degradation in the CHT; these include a decline in soil fertility, an increase in soil erosion, declining retention of water and the loss of natural habitats and biodiversity.

Although, Jhum cultivation is decreases but the gardening of different trees is increasing in the hill region. People are very much interested in gardening because it is profitable than jhum and other methods. The main trees people use for gardening is Segun, Gamar, Goda, Black Berry, Mangoes, Lichy, Jackfruits, Banana and Guava etc. Segun trees are harmful for the land but it is profitable that's why people planting Segun trees for gardening. It needs less care than any other trees and more than four thousands of trees can plant in about 2 acre of hilly land. The road alignment may cross some of those gardens. So, resettlement is required for the farmer. It needs nearly 100000 tk to make a garden in three years in one acre of land.

3.4 Power Sources and Transmission

Power Generation: Kaptai Lake was created for the power generation. The hydro Power Plant uses the potential force of water to generate power. The maximum efficiency of the power plant is 242 MW and Minimum is 70 MW. They used to maintain the water level at maximum 109 ft MSL to minimum 70 ft MSL. Below that level of water power generation is not possible. So they actually concern with the level of water, not about the capacity of water. As a result, they opposed to dredge in the lake. BPDB also planning to increase their production as the scarcity of power. So they are planning to start two new units (unit 5 and 6). The power is sbeing transferred to the national grid. This may only shared by the Rangamati and other hill cities of CHT. However electricity is scare most of the places where the alignment is through.

3.5 Agricultural Development

Agriculture: Once Jhum cultivation is the main agricultural activities in hilly region. But now people are not interested in Jhum cultivation because of low production rate and low profit. Now people are more interested in making Garden or Orchard. It is more profitable than Jhum.

3.6 Tourism

Scenic beauty of the project area attracted the visitors it is may increases the tourism business. Proper development planning should take from the public and private sector. Tourism is very much prospectus for the region. The cultural characteristics of tribal people and their life style are very much attractive for the tourist from home and abroad. Tourist buys the homemade handicraft of tribal people. It can be a great opportunity for the hilly people to change their financial conditions. It may decrease the discrimination between tribal and Bengali people. It gives them the opportunity to be educated as same as other citizens of the country.

Kaptai Lake is a man made lake in south-eastern Bangladesh. It is located in the Kaptai Upazila under Rangamati District of Chittagong Division. The lake was created as a result of building the Kaptai Dam on the Karnaphuli River, as part of the Karnaphuli Hydro-electric project. The Kaptai Lake's average depth is 100 feet (30 m) and maximum depth is 490 feet (150 m). This lake was developed by inundating valleys and plain lands between lots of hills. This made a beautiful scenario while forested mountains and highland climb from within the water.

Kaptai National Park cascades between the Karnaphuly and Kaptai Mountain assortments. It was conventional in 1999 and its area is 5,464.78 hectares (13,503.8 acres). Prior to announcement of the national park it was Sitapahar Reserve. It is about 57 kilometer from Chittagong city. In this park one can find plenty of old trees which were planted in 1873. In Kaptai National Park, there is various wildlife such as deer, jungle cat, elephant, monkey, etc. Many species of birds may also be of interest to tourists and bird lovers. Kaptai National Park is a safe and sanctuary for birds and other wildlife. The Forest Division founded picnic spots, and restaurants in this park.

Shuvolong Waterfalls: Shuvolong a place in Barkol sub district, located about 25 kilometers (11 kilometers as the crow flies) away from Rangamati town. There are few waterfalls in Shuvolong area with the largest one falling from as high as 300 feet. In the past several years, this place has turned into a tourist destination due to beautiful waterfalls and the nearby market. Shuvolong is easily accessible by speed boat or motor boats from Rangamati.

Sajek valley: Sajek is a union at Baghaichari Upazila in Rangamati districts. Basically it is name of a river which separates Bangladesh from India. The river flows into the Karnafuli River in the Chittagong Hill Tracts. Sajek Valley is situated in the North angle of Rangamati, near the Mizoram border boundary area. The valley is 1,800 ft high form sea lavel. Many small rivers flow through the hills among them Kachalon and Machalong are famous. The main ethnic minorities on the valley are Chakma, Marma, Tripura, Pankua, Lushai and Sagma. The place is known as hill queen for its natural beauty and roof of Rangamati. Marishsha is a name of a place near Sajek Valley. Most of the houses are made with bamboo. There is another place near Sajek, it is Kanlak, and it is famous for its orange orchard.

Most attractions of the spot are sun set, rain, morning, evening, and night and aborigine people. Tourists can buy indigenous peoples' products from haat (markets). Roads are like big snake spirals on the mountains. Most of the people are Buddhist and others are Christian here. A new road has been built up to the Ruilui Para by the guidance of Bangladesh army. On the way traveler need to take permission from the army camp. Bangladesh army is very helpful and cooperative. Now mobile network is available here. The valley is in Rangamati but tourists can reach there from Khagrachhari too. The route is Khagrachhori – Dighinala Bazaar – Bagaihat

Bazaar – Machalong Haat – then Sajek. It is 62 km from Khagrachhari. Dighinala to Sajek is 40 km. Main transportation is Chander Gari.

3.7 Social and Cultural Resources

3.7.1 Population and Communities

Population: Dominated by Mongolian group. The major Mongolian tribes are Chakma, Tipra, Murong and Magh. In fact the Chittagong Hill Tracts host thirteen different tribes who are divided into nearly a hundred different sects. Total population enumerated in the 1991 census was 1.042 million of which 562,597 were male and 479,776 female. Buddhism is being followed by Chakma and Marma, the Hinduism by the Tripura and Christianity by Mizo and Bawm. Some other tribes maintain harmony amongst the spirit, animal and plant.

Ethnicity*:* 12 ethnic groups (51%) (*Chakma, Marma, Tripura, Tanchangya, Mro, Bawm, Kheyang, Pankhu, Chak, Lushai, Khumi & Rakhain*) and Bengali (49%)

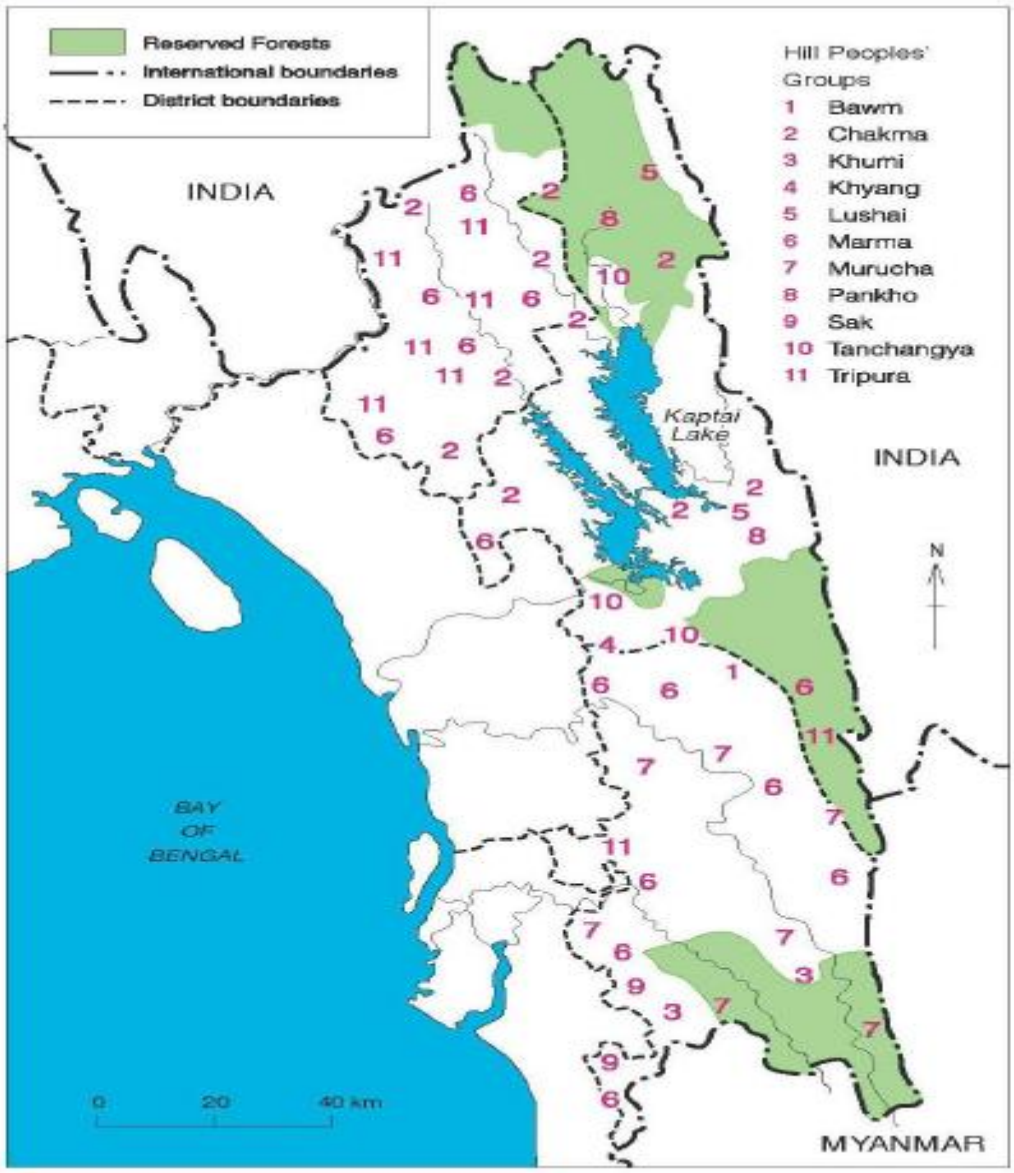

Fig 3.7.1: Distribution of Hill People in CHT

Tribal group Main religion 1956 1981 Chakma Buddhism 140,000 230,000 Taungchengya Buddhism 15,000 20,000 Marma Buddhism 80,000 120,000 Sak Buddhism 2,000 1,500 Khyeng Community religion 1,000 1,500 Tripura Hinduism 30,000 40,000 Riang/Brong Hinduism 7,000 10,000 Mru Community Religion 17,000 20,000 Khumi Community Religion 2,500 1,000 Bawm Christianity 3,500 8,000 Pangkhua Christianity 1,500 2,000 Lushai/Mizo Christianity 500 1,000 *Tribal total 300,000 455,000* Bangali Islam 30,000 290,000 *CHT Total 330,000 745,000.*

The pattern of human settlement throughout the CHT showed much territorial intermingling. Some groups dominated in certain parts of the CHT (eg the Chakma in the centre, and Marma in the tract between the Karnafuli and Sangu rivers) and others were concentrated in specific areas (e.g. Tripura in the north, Mru in the south). There was also a distinction between groups living in hill valleys and groups living on the ridges of the hills. Nevertheless, in many places local settlement patterns were highly complex. For example, seven different groups could be found living in close proximity in an area of about 15 by 10 km around the township of Ruma on the Sangu River in the southern CHT.

Agriculture is the main occupation of all the ethinic minority groupe. Jhum cultivation is their primary agricultural activities. In addition to that nowadays they go for banana, pineapple, papaya, lemon, ginger, turmeric production. They also collect jackfruits, guava and other seasonal fruits from the forest area what they sell in the local market. In Rangamati town two days in a week they sell all their production covering almost everything but mainly farm productions and handloom products, bamboo products, etc. They basically have two types of products - home based and farm based in addition to some forest and water-based outputs.

They also supplement their food requirement by gathering tree leaves, roots, and tubers from hill forests. Small-scale homestead gardening is also common among them. Other important economic activities include basketry, brewing and wage labour. Weaving is a very common activity of women. Most of them area now market oriented what was not there earlier. Some tribal people now operate small retail shops in the nearby markets. One NGO has constructed some landing stationsin the forest area for the tribal people to deposit their production at the center where one tribal family sells it to the outsiders.

Some educated tribal people mostly Chakmasalso work in different government and NGO offices in the CHT area. There are about 50 local NGOs organized by the tribal people centering different development activities funded by different donor agencies and humanitarian organizations. Indeed, most of the office staff in CHT area also from the tribals but mainly from the Chakma and Marma communities.

905 Farmer Field Schools have been established cumulatively, helping over 19,700 farmers gain access to new and innovative farming techniques. Food security has increased for 50,000 households as a result of 1,729 established Rice Banks and 67 producer groups engaging 1,513 bananas producing households has been formed, supporting farmers to access economic opportunities. Moreover, 824 infrastructure facilitates have been developed in response to community needs. (UNDP in Bangladesh)

3.7.2 Health Facilities

Health issues like mother care, vaccination program etc can easily accessible in the area where people could not find the proper health care. The cultural activities like Songs, Dances, Script and Literature of tribal people enrich the countries tradition and culture.

The capacity of CHT institutions has been strengthened through the provision of technical support in planning and implementation of multi-sectoral development projects. Hill District Councils are now successfully managing the delivery of health services in CHT. 500,000 CHT people have access to basic health services through a network of 1,000 CHSWs, 16 mobile medical teams and operating 80 weekly satellite clinics managed by 3 Hill District Councils. Cumulatively a total of 2.9 million patient cases treated, and over 3,469 safe births conducted by 158 Community Skilled Birth Attendants since the commencement of the project (UNDP in Bangladesh)

3.7.3 Education Facilities

More than 20,000 children in the CHT have gained access to education through 315 schools managed by the Hill District Councils. Mother tongue based pre-primary multi-lingual education tools have been rolled out across 7 ethnic communities in the region, reducing language barriers faced in school. In 2014, 95% of all project supported students who sat the Primary Education Certificate passed and to date 343 renovations and infrastructure upgrades took place across Hill Tract's schools. (UNDP in Bangladesh)

There are 291 government primary schools, 120 non-government primary schools, 22 junior schools, 6 government high schools, 45 non-government high schools, 2 government colleges, 13 non-government colleges, 61 madrasa, 7 technical schools,1 medical college and 1 science and technology university located throughout the district.

3.7.4 Socio-Economic Conditions

As a result of the UNDP's project support for tribal communities, it has been empowered to manage their own development affairs through the establishment of 3,507 Para Development Committees and 1,935 women-led Para Nari Development Groups.

Advocacy efforts have contributed to the commitment by government to transfer 1,500 indigenous/tribal police officers to be stationed in their home districts. Over 281 police officers have been transferred to date. Furthermore, 600 Community Police Forums have been reactivated, 610 local police personnel trained on the CHT context and 11 women friendly police centres established.

3.7.5 Physical or Cultural Heritage

Current Use of Lands and Resources for Traditional Purposes by Ethnic minority groupe.

3.8 Land Resources

CHT lands are limited in terms of economic productivity. While about 70% of Bangladesh's soils are cultivatable and have few production limitations, only 6% of CHT land is cultivatable and its generally poor soils and steep contours severely limit production enterprise options. The creation of Kaptai Lake in 1960 and inundation of a significant area of CHT's prime agricultural land permanently left it as a cereal deficit area. The loss of land due to Kaptai Lake was further exacerbated in the mid-1980s when the Government of Bangladesh (the Government) initiated a

transmigration program with ethnic Bengalis from plain areas being settled in CHT. The insurgency internally displaced many families who are still in the process of re-establishing themselves and had significant impacts on economic growth and development of the area.

There are three types of land ownership in CHT: (i) common property which is recognized as a customary right of indigenous people; (ii) non-recorded traditional customary property which indicates property which may be owned by an individual, family or clan; and (iii) registered property ownership (having deeds certified by the Government). Average landholding in CHT (all households) is 0.18 hectares (ha) of plough land and 0.78 ha of jhum land. About 79%6 of IPs do not have registered private ownership of land (i.e. no security of rights to land use) – clearly a disincentive to their investing in improved farming techniques and resource management. Additionally, CHT has limited infrastructure, underdeveloped markets and the institutional support system is not oriented to address the needs of rural poor and landless.

Land pressures have impacted on traditional land use practices. Jhum is the dominant farming system in the lower and upper hills of CHT. Integrated shifting cultivation, or rotational agro-forestry in practice, is considered valuable for its conservation and production aspects. The fallow period of land rested from deliberate cropping, not necessarily without cultivation or grazing but without sowing, is used to rest and vitalize the soils after cropping. Forest fallows Enable restoration and conservation of forest ecosystems functions, while making the land suitable for the cropping phase that follows. Pressures on land during the past 2–3 decades have forced jhum farmers to reduce the fallow period, which is crucial in order to maintain land productivity, from the traditional time period of 10 to 12 years to 3 years on average today, thereby severely affecting the fertility of the soil. As a result of the land degradation caused by reduced fallow periods, deforestation, loss of topsoil, and increased water runoff,7 has serious implications on food security and environmental sustainability. Water resources in CHT comprise surface flows from main rivers systems namely.

Lakes: There are two natural lakes (Rainkhiangkine Lake and Bagakine Lake) and one artificial lake (Kaptai Lake). The Kaptai Lake covers an area of about 767 sq km in dry season and about 1,036 sq km in the monsoon.

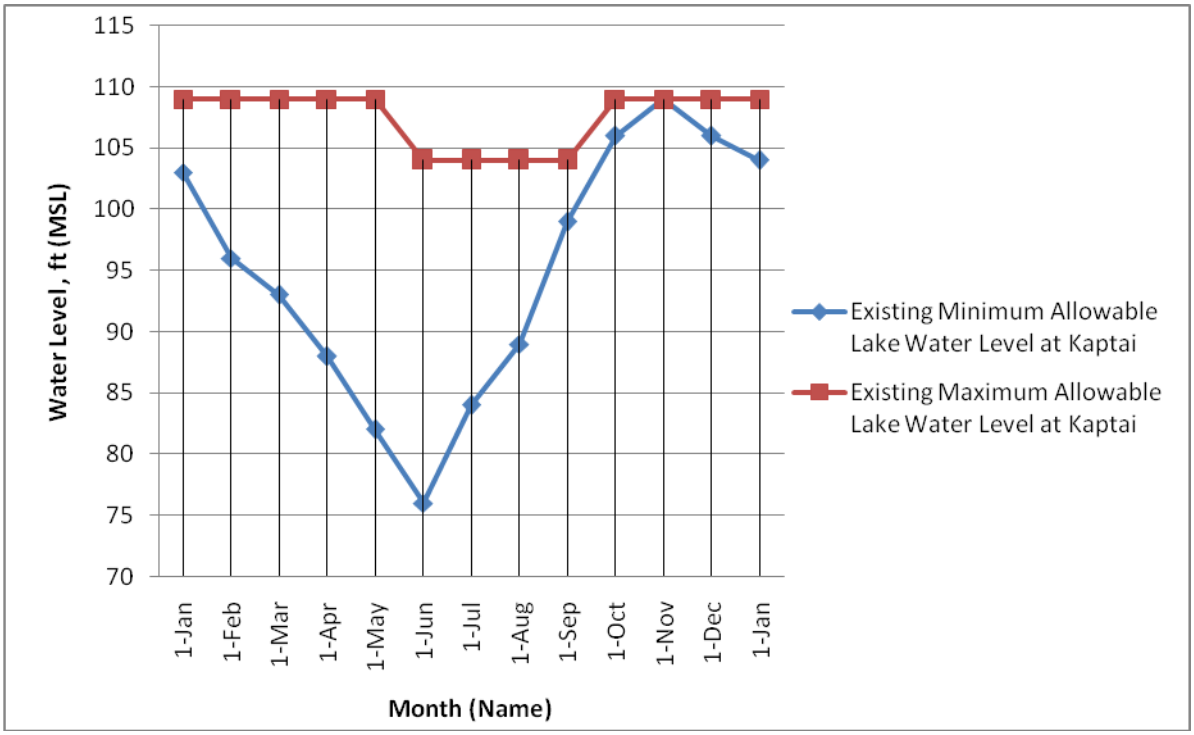

Fig 3.8: Existing Water Level at Kaptai Lake

Structures or Sites that are of Historical, Archaeological, Paleontological, or Architectural Significance: No such structure or site that is historical, archaeological, Paleontological or architectural significance is found.

CHAPTER - 4

World Bank Safeguard Policy

CHAPTER - 4

World Bank Safeguard Policy

4.1 World Bank Safeguard Policy

Since the mid-1980s, there had been a growing awareness and understanding in Bangladesh that the natural resources and the environment of the country are being degraded. The Government of Bangladesh recognizes the importance of environmental sustainability as the basis for long term development in the country. In 1989, the Ministry of Environment and Forest (MoEF) was created, and within the ministry, the Department of Environment (DoE) was formed as the principal implementing line agency for all environmental actions. Bangladesh is a signatory to Agenda 21 of the 1992 Earth Summit, and it is committed to implement the international legal instrument in its national policies and programs. A National Conservation Strategy was prepared by the Government in 1991, which formed the basis for the formulation of the National Environment Policy (NEP) in 1992. The principal objectives of the NEP are:

a) Maintenance of the ecological balance;
b) Protection against natural disasters;
c) Prevention of all types of activities related to pollution and environmental degradation;
d) Ensuring environmentally sound development in all sectors; and
e) Ensuring sustainable, long term, environmentally congenial utilization of all natural resources.

4.1.1 Key Environmental Issues

Given that the chosen route will likely pass through sensitive habitats and will also have transformational effects on what is currently an isolated, poorly connected region of the country. Aside from direct impacts, the new transport corridor will also lead to broader indirect and induced impacts across the CHT region, which need to be carefully analyzed so that adequate management and mitigation measures can be developed. Some of the key environmental issues include: direct and indirect impacts to natural habitats (potentially including protected areas / designated wildlife areas and other critical habitats), slope stability, landslide and rockfall, and soil erosion, earth cutting of hills and filling of wetlands / low-lying lands, clearing of vegetation including forested areas; effects to historic and cultural heritage; disturbance of waterways, waterfalls, rivulets, wetlands, and the variety of water-dwelling plant and animal species who rely on affected habitat; selection and management of areas for disposal of dredged material on land; road safety.

Categorization: Based on environmental screening of proposed project is to determine the appropriate extent and type of EA. The Bank classifies the proposed project into one of four categories, depending on the type, location, sensitivity, and scale of the project and the nature and magnitude of its potential environmental impacts.

(a) *Category A*: A proposed project is classified as Category A if it is likely to have significant adverse environmental impacts that are sensitive, diverse, or unprecedented. These impacts may affect an area broader than the sites or facilities subject to physical works. EA for a Category A project examines the project's potential negative and positive environmental impacts, compares

them with those of feasible alternatives (including the "without project" situation), and recommends any measures needed to prevent, minimize, mitigate, or compensate for adverse impacts and improve environmental performance. For a Category A project, the borrower is responsible for preparing a report, normally an EIA (or a suitably comprehensive regional or sectoral EA) that includes, as necessary, elements of the other instruments.

(b) *Category B*: A proposed project is classified as Category B if its potential adverse environmental impacts on human populations or environmentally important areas--including wetlands, forests, grasslands, and other natural habitats--are less adverse than those of Category A projects. These impacts are site-specific; few if any of them are irreversible; and in most cases mitigatory measures can be designed more readily than for Category A projects.

(c) *Category C*: A proposed project is classified as Category C if it is likely to have minimal or no adverse environmental impacts. Beyond screening, no further EA action is required for a Category C project.

(d) *Category FI*: A proposed project is classified as Category FI if it involves investment of Bank funds through a financial intermediary, in subprojects that may result in adverse environmental impacts.
The project falls under Category 'A' according to the screening process undertook

Public Consultation: project-affected groups were consulted and local nongovernmental organizations (NGOs) informed about the project's environmental aspects and takes their views into account. As Category A projects, the groups were consulted at least twice: (a) shortly after environmental screening and before the terms of reference for the EA are finalized; and (b) next consultation is awaiting till draft EA report is prepared. In addition, the project will continue onsultation with such groups throughout project implementation as necessary to address EA-related issues that affect them.

Bangladesh has a wide range of laws and regulations related to environmental parameters, and many of them date back to pre-independence days. Some of these are: The Canals Act (1864), the Irrigation Act (1876), the Agriculture and Sanitary Improvement Act (1920), the Forest Act of 1927, amended in 1989, the Factories Act (1965), the Pesticides Ordinance (1971), the Wild Life Preservation Act (1974), and the Environment Pollution Control Ordinance (1977). However, the most recent and the most important of the environmental laws are the Environment Conservation Act (ECA) of 1995 and the Environment Conservation Rules (ECR) of 1997. The ECR spells out rules and regulations for the enforcement of the ECA. Under the ECR, various development interventions are grouped into three main categories: Green (no environmental assessment required), Orange (IEE required) and Red (EIA required) – in accordance with increasing potentials for adverse environmental impacts. The project interventions under the fall into Red category, and thus require the preparation of the EIA report. Both the ECA and the ECR cover a wide range of environmental issues, but they are neither fully comprehensive nor unambiguous, and demonstrate the characteristics of a collection of adhoc rules. A more recent legislation for enforcement has been the formulation of the Environment Court Act of 2000, which is authorized to try cases related to offences under the ECA/ECR.

4.2 Applicable safeguard policies of World Bank

Safeguard Policies	Triggering
Environmental Assessment (OP 4.01) – a full Environmental Assessment (EA) will be required.	i. Use a screening process ii. physical, biological, socio-economic and physical cultural resources, including transboundary and global concerns, and potential impacts on human health and safety iii. legal and institutional framework, iv. siting alternatives, including the "no action" alternative v. . Involve stakeholders, including project-affected groups and local nongovernmental organizations vi. . Disclose draft EA in a timely manner
Natural Habitats (OP 4.04) – including river bed, coastline, and on-shore habitats which may be impacted by disposal of dredged material and/or other on-land activities, as well as critical habitat (including but not limited to legally designated protected areas) and other natural habitat which may be affected by induced development resulting from the opening of a new transportation corridor through a currently isolated region.	i. natural resources management to ensure opportunities for environmentally sustainable development ii. legally protected, (b) officially proposed for protection, (c) identified by authoritative sources for their high conservation value, or (d) recognized as protected by traditional local communities iii. Consult key stakeholders, design and implementation of mitigation iv. Disclose draft mitigation plan
Forests (OP 4.36) -- the new connectivity route will affect forested areas.	i. for potential impacts on forest health and quality and on the rights and welfare of the people who depend on them ii. forest restoration projects iii. preference to small-scale community-level management approaches iv. Use forest certification systems
Physical Cultural Resources (OP 4.11) – particularly with respect to locations of on-land dredge disposal.	i. to identify PCR and prevent or minimize or compensate ii. "chance find" procedures
Involuntary Resettlement (OP 4.12) – to be confirmed during implementation, but some land acquisition is likely to be required for on-land disposal of dredged material, as well as potentially for construction of access roads or river port development activities.	Ref: Social Scoping
Indigenous Peoples (OP 4.10) – for any IWT included in the final prioritized list that passes through the Chittagong Hill Tracts (CHT)(road through forest land and dredged navigational route through Kaptai Lake), this policy may apply. Full screening of the IWTs and river ports to be subject to further study will need to be conducted to verify applicability.	Ref: Social Scoping

Likely applicable national legal requirements (partial list only; to be confirmed and further developed during project implementation):

- Environmental Policy (1992).
- Environment Conservation Act (1995).
- Environment Conservation Rules (1997).

- Wildlife Conservation (protection and safety) Act (2012).
- Fisheries Policy (1998).
- The Acquisition and Requisition of Immovable Property Ordinance, 1982 (Ordinance IIof 1982).
- The Chittagong Hill Tracts (Land Acquisition) Regulations, 1958.
- Chittagong Hill Tracts Regional Council Act, 1998 (Act XII of 1998).
- CHT Development Board Ordinance 1976 (Ordinance LXXVII of 1976).
- Chittagong Hill Tracts Peace Accord of 1997.

4.3 Relevant Government of Bangladesh Environmental Legislations

Legislation	Description	Regulatory Body	Applicable Requirements for the Project
Environmental Conservation Act of 1995 and amendments in 2000, 2002 and 2010	- Provide, amongst others items, standards and guidelines for: (i) categorization of industries and development projects, (ii) requirement for undertaking IEE and EIA, as well as formulating an EMP according to categories of industries/development projects/activities, (iii) procedure for obtaining environmental clearance; and (iv) environmental quality standards for air, surface water, groundwater, drinking water, industrial effluents, emissions, noise and vehicular exhaust - Specify which activities are permissible and which restricted in ecologically critical areas	Department of Environment (DOE) under the Ministry of Environment and Forest (MoEF)	- Restriction on operation and process, which can be continued or cannot be initiated in the ecologically critical areas - Regulation on vehicles emitting smoke harmful to the environment - Remedial measures for injuries to ecosystems - Standards for quality of air, water, noise and soil for different areas for various purposes - Standard limit for discharging and emitting waste - Environmental guidelines
Environmental Conservation Rules of 1997 and amendments in 2002 and 2003			- Environmental clearances - Compliance to environmental quality standards
Forest Act of 1927 and amendments (2000)	- Emphasis is on the protection of reserved forest: (i) all rights or claims over forestlands have been settled at the time of the reservation and prohibits the grant of any new rights of any kind to individuals or communities; (ii) any activity within the forest reserves is prohibited, unless permitted by the Forest Department; (iii) most of the violations may result in court cases; and (iv) empowers the Forest Department to regulate the use of water-courses within Reserve Forests.	Forest Department	- Clearance for any felling, extraction, and transport of forest produce

Legislation	Description	Regulatory Body	Applicable Requirements for the Project
Bangladesh Climate Change Strategy and Action Plan of 2009	- A comprehensive strategy to address climate change challenges built around the following six themes: (i) food security, social protection and health; (ii) comprehensive disaster management; (iii) infrastructure; (iv) research and knowledge management; (v) mitigation and low carbon development; and (vi) Capacity building and Institutional strengthening	Climate Change Unit of MoEF	- Ensure existing assets (e.g., coastal and river embankments) are well maintained and fit for purpose and that urgently needed infrastructures (cyclone shelters and urban drainage) is put in place to deal with the likely impacts of climate change. - enhance the capacity government ministries, civil society and private sector to meet the challenge of climate change
National Water Policy of1999	- All agencies and departments entrusted with water resource management responsibilities (regulation, planning, construction, operation and maintenance) will have to enhance environmental amenities and ensure that environmental resources are protected and restored while executing their activities. The policy has several clauses related to the protection and conservation of the natural environment to ensure sustainable development.	Water Resources Planning Organization (WARPO) under the National Water Resources Council of the Ministry of Water Resources	- EIA for water development projects and increase surface water flow - Pre-screening of IEEs/EIAs for water sector projects by WARPO, in advance of submission to DOE for final clearance. - Augmentation for dry season water flow - Awareness-raising in consumptive use of surface and groundwater for irrigation - Structural and non-structural mitigation (early warning and flood proofing)
National Safe Drinking Water Supply and Sanitation Policy of 1998	- Basic framework for the improvement of public health quality and to ensure an improved environment, together with a set of broad sectoral action guidelines.	Department of Public Health Engineering (DPHE)	- Pourasabhas and WASAs will take actions to prevent wastage of water. In addition they will take necessary steps to increase public awareness to prevent misuse of water. - Sanitation systems shall be self- sufficient and self-sustaining. - Pourasabhas shall be responsible for solid waste collection, disposal and their management. DOE shall be consulted on solid waste management. - Where WASAs exists, they shall be responsible for sewerage and storm water drainage systems.

***Note**: ECA Amendment 2000 focuses on ascertaining responsibility for compensation in cases of damage to ecosystems, increased provision of punitive measures both for fines and imprisonment and the authority to take cognizance of offences. ECA Amendment 2002 elaborates restrictions on polluting automobiles; restrictions on the sale, production of environmentally harmful items like polythene bags; assistance from*

law enforcement agencies for environmental actions; break up of punitive measures; and authority to try environmental cases. In ECA Amendment 2010, no individual or institution (government or semi-government/non-government/self-governing can cut any hill or hillock; fill-up or changed any remarked water body however in case of national interest; the mentioned activities can be done after getting clearance from respective the departments.

4.4 Environmental Governance

The most important governance elements include access to environmental information, strengthening EIA system as an environmental management tool, transparency and consultation for accountable decision-making, adequate institutional capacity for credible enforcement, and economic policies that promote improved environmental performance.

So-called "command and control" model of pollution control, imported from industrial countries, has failed to cut poisonous discharges. This approach, which is widely used by government regulators, sets maximum pollution levels and then fines companies that exceed them. Where enforcement agencies are weak - companies run little risk of being caught and punished.

Therefore, polluting firms which violate regulatory standards have little incentive to clean up their activities, and firms that do respect legal limits have even less incentive to cut their pollution.

To address these limitations, a new approach is necessary. For Greening Industry, the community/ key stakeholders should play a monitoring role which combines market-based incentives and public information disclosure to encourage factory managers to improve their environmental performance while they are pursuing profits.

Key strength of the policies/programs/projects:

- Acknowledgement of the integrate linkage of poverty, population pressure, illiteracy, inadequate health care facility and environmental awareness in environmental management and acknowledgement of the need to address these situations in an integrated manner.
- The Environment Policy attempts to address environment degradation and pollution by providing guidelines to the sectors which are responsible for this degradation and pollution.
- Under ECA'95, EIA has been accepted as a mandatory tool to identify and predict impacts and undertake proper mitigation measures in a project scale. To ensure that people likely to be affected takes part in making development decision. EIAs of projects & industries are made public & scrutinized.

Policy Opportunities: There are policy opportunities for greening the environment as evident from the following features.

- Policy initiatives, strategies and plans emphasize on sustainable natural resources management.
- Environment quality standards (EQS) for ambient water quality, air quality, noise and effluent/ emission discharges standards have been set.
- EIA has been accepted as mandatory tool to identify and predict impacts and undertake proper mitigation measures in the execution of a project. A good number of Sectoral EIA

guidelines have been prepared to assist the process.

- Acknowledges linkage between poverty, population pressure, illiteracy, inadequate health care and environment management in achieving sustainable development DoE has been able to undertake measures to amend certain Acts and Rules to better enforce the law to protect the environment from further degradation. These include:
  - ✓ Bangladesh Environment Conservation Act, 1995 (Amendment 2010).
  - ✓ Environment Court Act 2010
  - ✓ Hazardous Waste and Ship Breaking Waste Management Rules, 2011.
  - ✓ Bangladesh Bio-safety Rules, 2012.
  - ✓ Brick Manufacture and Brick Kiln Installation (Control) Act, 2013.

In order to fulfill the objective of the Seven Five Years Plan (7th FYP) the following policies, *Strategies and programs could be undertaken during the 7th FYP:*

- Environment committees at Division, District and Upazila levels will be made more functional with the participation of all stakeholders.
- National Environment Council headed by the Prime Minister and Executive Committee of National Environment Council headed by the Minister for Environment and Forests will be made more functional.
- Drafting of EIA guidelines for all sectors under the Environment Conservation Act (ECA) 1995 will be formulated in order to ensure effective enforcement of EIA. Drafted EIA guideline will make operational.
- 'Polluters Pay Principle' will be followed in order to ensure strict compliance of environment legislation.
- Environmental Impact Assessment (EIA) will be made mandatory while processing each Development project requiring approval of the Government.
- Facility of data -base and documentation on different environmental subjects and fields will be created to help decision makers, other professional groups, institution to formulate appropriate plan of action to protect environment.

During this plan period the government has adopted Article 18A in the Constitution of thePeople's Republic of Bangladesh by incorporating environment and biodiversity conservation and development as the key state policy. The policy states: "The state shall end Endeavour to protect and improve the environment and preserve and safeguard the natural resources, bio-diversity, wetlands, forests and wild life for the present and future citizens."

Multilateral Environmental Agreements (MEA's) and their Implications

Bangladesh has so far signed, ratified and or accessed 35 international Conventions, Treaties and Protocols (ICTPs). Among them the following ICTP's received attention of the government for follow up implementation.

- Stockholm Convention on Persistent Organic Pollutants
- Vienna Convention for The Protection of Ozone Layer.
- Montreal Protocol on Substances that Deplete the Ozone Layer (1987).
- UN Framework Convention on Climate Change (UNFCCC) 1992.
- Kyoto Protocol to The UN Framework Convention Climate Change (1997).
- United Nations Convention on Biological Diversity (CBD).
- Cartagena Protocol on Bio safety.
- Convention on Wetland of International Importance Especially as Waterfowl Habitat.
- Convention on International Trade in Endangered Species of Wild Fauna and Flora.

- United Nations Convention to Combat Desertification.
- Basel Convention on the Control of Trans-Boundary Movements of Hazardous Wastes and their Disposal.
- The United Nations Convention on the Law of the Sea.
- The International Convention for the Prevention of Pollution from Ships, 1973, as Modified by the Protocol of 1978 Relating Thereto.
- Minamata Convention on Mercury.
- Nagoya Protocol on Access and Benefit sharing

Other Laws: There are a number of other laws and regulations applicable which are relevant for the project. These are presented in the Table below.

Table 4.4A: Relevant Laws and Regulation

Act/Law/Ordinance	Brief description	Responsible Agency
The Vehicle Act (1927) andThe Motor Vehicles Ordinance (1983)	Provides rules for exhaust emission, air and noise pollution and road and traffic safety	Road Authority
Rules for Removal of Wrecks andObstructions in inland NavigableWater Ways (1973)Dredging	Rules for removal of wrecks andObstructions.Safe depositing of spoils from dredging activity	BIWTA
The Water Supply and Sanitation Act (1996)	Regulates the management and control of water supply and sanitation in urban areas.	MoLG, RD&C
The Ground Water Management Ordinance (1985)	Describes the management of ground water resources and licensing of tube wells	Upazila Parishad
The Private Forests Ordinance (1959)	Deals with the conservation of private forests and afforestation of wastelands.	MoEF
The Antiquities Act (1968)	Describes the preservation of cultural heritage, historic monuments and protected sites	DoArch

International Treaties Signed by GoB: Bangladesh has signed most international treaties, conventions and protocols on environment, pollution control, bio-diversity conservation and climate change, including the Ramsar Convention, the Bonn Convention on migratory birds, the Rio de Janeiro Convention on biodiversity conservation and the Kyoto protocol on climate change. An overview of the relevant international treaties signed by GoB is shown in Table 4.4B.

Table 4.4B: Relevant International Treaties

Treaty	Year	Brief Description / Relevance	Relevant Department
Protection of birds (Paris)	1950	Protection of birds in wild state Broadly applicable for birds in and around the project influence area; mitigation measures included in EMP address potential impacts on birds as well.	DoE/DoF
Ramsar Convention	1971	Protection of wetlands. Broadly applicable for wetlands in and around the project influence area; mitigation measures included in EMP address potential impacts on wetlands and associated resources as well.	DoE/DoF
Protocol on Waterfowl Habitat	1982	Amendment of Ramsar Convention to Protect specific habitats for waterfowl. Broadly applicable for wetlands in and around the project influence area; mitigation measures included in EMP address potential impacts on wetlands and associated ecological Resources as well.	DoE/DoF

Treaty	Year	Brief Description / Relevance	Relevant Department
World Cultural and Natural Heritage (Paris)	1972	Protection of major cultural and natural Monuments. Not applicable since no major cultural or natural monuments are known to exist in the project influence area. However Chance Find Procedures have been included in the EMP	DoArch
CITES convention	1973	Ban and restrictions on international trade in endangered species of wild fauna and Flora. Not directly relevant to the RMIP since the project does not involve in any international trade of endangered species of wild fauna and flora. General restrictions have however been included in the Environmental Code of Practice.	DoE/DoF
Bonn Convention	1979	Conservation of migratory species of wild Animals. Broadly applicable to the migratory birds in and around the project influence area. Project activities are not likely to have any significant impacts on these species; precautionary measures have nonetheless been included in EMP.	DoE/DoF
Prevention and Control of Occupational hazards	1974	Protect workers against occupational exposure to carcinogenic substances and agents. Broadly applicable to the construction and O&M activities under the project. Appropriate mitigation and protective measures have been included in the EMP.	MoH
Occupational hazards due to air pollution, noise & vibration (Geneva)	1977	Protect workers against occupational hazards in the working environment. Broadly applicable to the construction and O&M activities under the project. Appropriate mitigation and protective measures have been included in the EMP.	MoH
Occupational safety and health in working environment (Geneva)	1981	Prevent accidents and injury to health by minimizing hazards in the working environment. Broadly applicable to the construction and O&M activities under the project. Appropriate mitigation and protective measures have been included in the EMP.	MoH
Occupational Health services	1985	To promote a safe and healthy working environment. Broadly applicable to the construction and O&M activities under the project. Appropriate mitigation and protectivemeasures have been included in the EMP.	MoH
Convention on oil pollution damage (Brussels)	1969	Civil liability on oil pollution damage from ships. Not applicable since no oil carrying cargos are involved in the proposed project.	DoE/MoS
Civil liability on transport of dangerous goods (Geneva)	1989	Safe methods for transport of dangerous goods by road, railway and inland vessels. Broadly applicable to transportation of substances such as fuels during the project construction phase. Appropriate mitigation measures are included in the EMP.	MoC
Safety in use of chemicals during work	1990	Occupational safety of use of chemicals in the work place. Broadly applicable to the construction and O&M activities under the project. Appropriate mitigation and protective measures have been included in the EMP.	DoE
Convention on oil pollution	1990	Legal framework and preparedness for control of oil pollution. Broadly applicable to the construction and O&M activities under the project. Appropriate mitigation and protective measures have been	DoE/MoS

Treaty	Year	Brief Description / Relevance	Relevant Department
		included in the EMP.	
UN framework convention on climate change (Rio de Janeiro)	1992	Regulation of greenhouse gases (GHGs) emissions. Broadly applicable to the construction and O&M activities under the project. Appropriate mitigation and protective measures have been included in the EMP to minimize emissions of GHGs.	DoE
Convention on Biological Diversity (Rio de Janeiro)	1992	Conservation of bio-diversity, sustainable use of its components and access to genetic resources. Broadly applicable to the construction and O&M activities under the project. Appropriate mitigation and protective measures have been included in the EMP for the conservation of biodiversity.	DoE
International Convention on Climate Changes (Kyoto Protocol)	1997	International treaty on climate change and emission of greenhouse gases. Broadly applicable to the construction and O&M activities under the project. Appropriate mitigation and protective measures have been included in the EMP to minimize emissions of GHGs	DoE

Table 4.4C: Comparison of Requirements between GoB & World Bank

Sl. No.	Criteria	Government of Bangladesh Requirements	Word Bank Requirements
1	Environmental Analysis	Project specific	Project specific, regional and sectoral
2	Basis for Categorization	Currently, screening criteria available only for industrial projects, where assessment is done based on: Level of pollution emission Type of project and location Scale of project Operational activities Non–industrial projects are reviewed on a case by case basis by DOE	Detailed screening criteria for all projects based on Sensitivity Nature and magnitude of potential impacts
3	EA Outputs	Since detailed rules and regulations for EA have not been prescribed, EA outputs are not specified. However, the industrial sector guidelines, the water sector guidelines and the road sector guidelines have specific EA output requirements, such as: Baseline survey IEE/EIA Report Site clearance Risk analysis and management Analysis of alternatives	EA Report Analysis of alternatives Environmental Management Plan
4	Public Consultation	No special mention is made for public consultation in BECA. Sectoral guidelines mentioned above have prescribed consultation.	Mandatory at the stage of Preparation of EA Project appraisal Project design Project implementation and monitoring
5	Disclosure of Information	BECA makes no reference to disclosure. The Sectoral guidelines prescribe some provisions for disclosure	Mandatory at Summary of project description an potential adverse impact Summary of EA report and conclusion EA report

CHAPTER - 5
Public Consultation

CHAPTER - 5

Public Consultation

5.1 Stakeholder Analyses

5.1.1 Public Consultation

The formal opportunities for public comment on the draft Scoping Requirements and then the EA, informal consultation also plays an important role in the preparation of the EA. The proponent is responsible for informing the public and engaging with stakeholders in order to identify and respond to their concerns in conjunction with the EA studies.
Relevant stakeholders include potentially affected parties, the community and interested organizations and individuals, as well as pertinent government agencies.
The proponent has prepared and is to implement a stakeholder consultation plan to ensure that the public is familiar with the EA investigations and that key stakeholders are consulted on pertinent issues.
The plan should:

- Identify the relevant stakeholder groups.
- Characterise the stakeholder groups in terms of their interests, concerns and consultation needs and potential to provide local knowledge.
- Describe consultation methods to be used and outline a schedule of consultation activities.
- Outline how inputs from stakeholders will be recorded, considered and/or addressed in the preparation of the EA.

5.1.2 Methodology

Stakeholder analysis is the identification of a project's key stakeholders, an assessment of their interests, and the ways in which these interests affect project riskiness and viability. It is linked to both institutional appraisal and social analysis: drawing on the information deriving from these approaches, but also contributing to the combining of such data in a single framework. Stakeholder analysis contributes to project design through the logical framework, and by helping to identify appropriate forms of stakeholder participation.

Primary stakeholders are those ultimately affected, either positively (beneficiaries) or negatively (for example, those involuntarily resettled). Secondary stakeholders are the intermediaries in the aid delivery process.
A stakeholder analysis can:

- Identify conflicts of interests between stakeholders.
- Help to identify relations between stakeholders which can be built upon, and may enable coalitions; of project sponsorship, ownership and Cupertino.
- Help to assess the appropriate type of participation by different stakeholders, at successive stages of the project cycle.

Stakeholder analysis will:

- Draw up a ‘stakeholder table’.
- Does an assessment of each stakeholder's importance to project success and their relative power/influence?

- Identify risks and assumptions which will affect project design and success.

Table 5.1.2: List of Stake Holders for the Project

Sl.No.	Stakeholders	No of Participants
1	**NGO Representatives (Male & Female)**	
	UNDP	1
	SAS	1
	tangya	1
	Green Hill	1
	CIPD	1
	CCDR	1
	Himawanti	1
	Maleya Foundation	1
	PAHRA	1
	Shining Hill	1
2	Launch owners association (Male)	1
3	Truck owners association (Male)	3
4	Bus owners association (Male)	2
5	Fishers Association (Male)	2
6	Transport Operator Association	2
7	Journalists (Male & Female)	4
8	Forest Department	1
9	Roads & Highway Department (R&HD)	1
10	Department of Fisheries(DoF)	1
11	Local Government Engineering Department, LGED	9
12	Rangamati Hill District Council	1
13	CHT Regional Council	1
14	Chittagong Hill Tract Development Board (CHTDB)	1
15	Rangamati Culture Center	1
16	Rangamati Chamber of Commerce & Industries	1
17	Upazila Chairmen	4
18	UNO	4
19	Chakma Royal Kingdom	2
20	Rangamati Bar Council	1
21	Bangladesh Legal Aid and Services Trust (BLAST)	1
22	Headmen (Male & Female)	10
23	Karbari (Male & Female)	7
24	College Principal (Male & Female)	3
25	Headmaster / Headmistress	2
26	College and School Teachers (Male & Female)	3
27	Local Businessman	5
28	Hill Women Federation	1
29	UP Chairman	5
30	UP Members	4
31	Religious persons	2

Sl.No.	Stakeholders	No of Participants
32	CHTRDP II Representative	1
33	DC OFFICE, Rangamati	
	ADC General	1
	ADC Revenue	1
	ADM	1
34	Additional SP	1
35	Prakriti Ranjan Chakma X-Deputy Secretary	1
36	Saktipada Tripura Prsident ,CHT Headmen Network	1
37	Professor Mongshanu Chhowdhury	1
38	Santi Bijay Dewan General Secretary, CHT Headmen Network	1
39	Thowaiwary Marma Headmen	1
40	Goutam Dewan President,CHT Movement for the Conservation of Land and Forests	1
	Total	**106**
**	**Consultant Team**	**6**
	Grand Total	**112**

5.1.3 Outcomes of Consultation

The proponent is responsible for informing the public and consulting with stakeholders throughout the assessment process in accordance with a suitable 'Consultation Plan'. The process and results of the consultation undertaken, including:

- Issues and suggestions raised by stakeholders or members of the public and the responses made by the proponent in the context of either the studies or any additional mitigation measures; and
- An outline of a program for community consultation, stakeholder engagement and communications during the construction and operation of the project, including opportunities for local stakeholders to engage with the proponent to seek responses to issues that might arise when the project is undertaken.

The alignment of Road Route 1 is going through the area of South Forest Division, Rangamati. There are 755693.69 acres of forest land exists in Rangamati District. From which the reserve forests are 685315.95 acre, 65674.98 acre under the Forest Law (1927) and 4702.76 acre are unclassified forest. [DoF (Rangamati circle)]

In our field visits, from focus group discussions and informant interviews with indigenous/tribal people and Bengalis, respondents identified soil erosion and landslides caused by deforestation, increase of population in CHT and changes of intensity of rain, as the major environmental problems they faced. They mentioned that forests have become denuded due to illegal logging and using wasteful methods of timber extraction from the natural forest the CHT by both public agencies and illegal loggers. Tobacco cultivation and the number of brickfields are increasing in the CHT.

5.1.4 Important Stakeholder Analysis Matrix

Sl No	Stakeholder Name	Contact Person *Phone, Email, Website, Address*	Impact *How much does the project impact them? (Low, Medium, High)*	Influence *How much influence do they have over the project? (Low, Medium, High)*	What is important to the stakeholder?	How could the stakeholder contribute to the project?	How could the stakeholder block the project?	Strategy for engaging the stakeholder
1	Ministry of Chittagong Hill Tracts Affairs		High	High	Road Connectivity	Approval and opinion mobilization	Disagree	*Monthly round-table discussions*
2	Chittagong Hill Tract Development Board (CHTDB)		High	High	Road Connectivity	Approval and opinion mobilization	Disagree	*Monthly round-table discussions*
3	Deputy Commissioner (Rangamati)		High	High	Road Connectivity	Approval in land acquisition	Not approving land acquisition	*Monthly round-table discussions*
4	CHT Regional Council		High	High	Road Connectivity	Approval and opinion mobilization	Disagree	*Monthly round-table discussions*
5	Rangamati Hill District Council		High	High	Road Connectivity	Approval and opinion mobilization	Disagree	*Monthly round-table discussions*
6	BGB (Rangamati)							
7	Local Government Engineering Department(LGED)		High	High	Construction of Road Connectivity	Proponent	Disagree	*Monthly round-table discussions*
8	Shipping Corporation		High	High	Construction of Road Connectivity	Proponent and investor	Disagree	*Monthly round-table discussions*
9	Roads & Highway Department (R&HD)		High	High	Road Connectivity	Authority in Highway maintenance	Disagree	*Information and feedback meetings every 6 months*
10	Bangladesh Inland Water Transport Authority (BIWTA)		High	High	Construction of Multimodal Road Connectivity	Maintenance of navigational channel in Kaptai Lake	Not approving the navigation route	*Monthly round-table discussions*
11	Area Commander, Bangladesh Army							
12	Local Administration (Thana, Upazila& Union Parishad)		High	High	Construction of Road Connectivity	Proponent	Disagree	*Monthly round-table discussions*

Sl No	Stakeholder Name	Contact Person *Phone, Email, Website, Address*	Impact *How much does the project impact them? (Low, Medium, High)*	Influence *How much influence do they have over the project? (Low, Medium, High)*	What is important to the stakeholder?	How could the stakeholder contribute to the project?	How could the stakeholder block the project?	Strategy for engaging the stakeholder
13	XEN, Bangladesh Water Development Board (BWDB)		Medium	Medium	Maintenance of drainage and flood control structures	Drainage And Flood Control Authority	Disagree	*Monthly round-table discussions*
14	Bangladesh Agricultural Development Corporation (BADC)		Medium	Medium	Maintenance of irrigation both surface and ground water for agriculture	Development of Irrigation Surface and Ground Water for Agriculture	Disagree / opposing project	*Monthly round-table discussions*
15	Bangladesh Fisheries Development Corporation (BFDC)		High	High	Construction of Navigation Channel	Aquaculture in Kaptai Lake	Oppose to dredging of lake channel	*Monthly round-table discussions*
16	Bangladesh Power Development Board (BPDB), (Kaptai Power station)		High	High	Use of navigational channel inside reservoir/ lake	User of lake water for hydroelectricity	Disagree to navigation inside reservior	*Monthly round-table discussions*
17	Forest Department		High	High	Construction of Road Connectivity through reserve forest	Authority of reserve forest management	Disagree because of loss in biodiversity	*Monthly round-table discussions*
18	Department of Environment (Rangamati)		High	High	Environmental clearance for Construction of Road Connectivity	Environmental clearance and monitoring authority	Disagree/ not approving clearance	*Monthly round-table discussions*
19	Ministry of Environment and Forest		High	High	Environmental clearance for Construction of Road Connectivity	Environmental clearance and monitoring authority	Disagree/ not approving clearance	*Information and feedback meetings every 6 months*
20	Department of Social Welfare		Medium	Medium	Disturbance to the infrastructure along the road	Welfare to the local people	Disagree for Community safety	*Information and feedback meetings every 6 months*
21	District Education Officer (DEO)		Medium	Medium	Disturbance to the school children	Education and school management	Disagree for Community	*Information and feedback*

Sl No	Stakeholder Name	Contact Person *Phone, Email, Website, Address*	Impact *How much does the project impact them? (Low, Medium, High)*	Influence *How much influence do they have over the project? (Low, Medium, High)*	What is important to the stakeholder?	How could the stakeholder contribute to the project?	How could the stakeholder block the project?	Strategy for engaging the stakeholder
					along the road	to the local people	safety for school children	*meetings every 6 months*
22	Elected Representatives (MP, Upazila and Union Chairman)		Medium	Medium	Disturbance to the infrastructure along the road	Welfare to the local people	Not mobilizing people in favour of the project	*Information and feedback meetings every 6 months*
23	Launch Owners Association		High	High	User of navigational route (multimodal)	Waterway Transportation	*Going on strike*	*Information and feedback meetings every 6 months*
24	Cargo Owners Association		High	High	User of road/ navigational route (multimodal)	Road/ Waterway Transportation	*Going on strike*	*Information and feedback meetings every 6 months*
25	The Lessee of Launch Landing Station		High	High	User of road/ navigational route (multimodal)	Road/ Waterway Transportation	*Going on strike*	*Information and feedback meetings every 6 months*
26	Bus Owners Association		High	High	User of road/ navigational route (multimodal)	Road/ Waterway Transportation	*Going on strike*	*Information and feedback meetings every 6 months*
27	Truck Owners Association		High	High	User of road/ navigational route (multimodal)	Road/ Waterway Transportation	*Going on strike*	*Information and feedback meetings every 6 months*
28	Boat Owners Association		High	High	User of road/ navigational route (multimodal)	Road/ Waterway Transportation	*Going on strike*	*Information and feedback meetings every 6 months*

Sl No	Stakeholder Name	Contact Person *Phone, Email, Website, Address*	Impact *How much does the project impact them? (Low, Medium, High)*	Influence *How much influence do they have over the project? (Low, Medium, High)*	What is important to the stakeholder?	How could the stakeholder contribute to the project?	How could the stakeholder block the project?	Strategy for engaging the stakeholder
29	Local Trade & Commerce Association (Federation of Chamber of Commerce)		High	High	User of road/ navigational route (multimodal)	Road/ Waterway Transportation	*Going on strike*	*Information and feedback meetings every 6 months*
30	Dept of Women & Children Affairs							*Information and feedback meetings every 6 months*
31	NGO Representatives							*Information and feedback meetings every 6 months*
32	Rangamati Anchalik Parishad		High	High	Road Connectivity	Approval and opinion mobilization	Disagree	*Monthly round-table discussions*
33	Journalist, Reporters							*Information and feedback meetings every 6 months*
34	Headmen (Village)/ Karbari (Mouza)		High	High	Road Connectivity	Approval and opinion mobilization	Disagree	*Monthly round-table discussions*

CHAPTER - 6

Environmental Issues in CHT

CHAPTER - 6

Environmental Issues in CHT

6.1 General

Environmental degradation and resource depletion mechanisms are the major determining factors of creating poverty among the people of CHT. Decline in the aggregate stock of land and forests, as well as changes in their distribution between the Paharis and non-paharis, constitute factors that are likely to have critical roles in explaining the causation of poverty in the specific socio-historical context of CHT. The environmental issues have not been directly addressed in the accord, despite the huge environmental problems being faced in the CHT, including deforestation, mono plantation and industrial logging, siltation of rivers and lakes, floods, the drying up of streams, springs and other aquifers and the arbitrary killing of rare species of wildlife, including elephants, bison and bears for sale in a black market that is linked to Southeast Asia and Hong Kong.

A recent study of water resources in the CHT notes that there is an observed deterioration of spring flows over the past several years. The most significant causes behind this are related to degradation of forest quality and substantive loss in canopy coverage. The main underlying causes identified during the study are:

- Changes in climate; and
- Large changes in land use;
- Physical intervention (such as road construction, industry etc.).

Though the overall impacts of climate change are hard to predict, they are likely to have far-reaching consequences. Water-extreme events, such as floods and droughts, are predicted to impact more people and economies over time in South Asia than in any other region of the world. The effects of these trends will be magnified by population growth and the industrialization of South Asian economies, increasing the need to expedite progress in preparing the region to cope with the impacts of climate change. A fundamental challenge facing the water sector will be how to find a balance between increasing variability of water supply and accelerating demand for water.

Bangladesh; A future of conflict:
As yet, climate change has not led to high levels of violence or conflict in Bangladesh. However, Safer World's research shows that socio-political pressures are increasing as more and more people migrate due to pressures brought on by an increase in the frequency and intensity of flooding, rising water salinity and loss of land. This in turn may lead to growing insecurity and instability in the regions of origin, transit and destination, as competition increases over resources such as water and land and people form groups prepared to use violence to defend their interests.

In Bangladesh, this violent unrest may have an effect on the stability and internal security of the country. There is also risk that international security will be affected by regional destabilization. The study's research highlights that disputes between locals and newcomers has led to violent

conflict between the Chittagong Hill tribes and Bengali settlers as well as tensions between Bengalis and locals in the Indian state of Assam. Increased migration flows could further fuel tensions in these regions and India has already responded to the prospect of large-scale migration by building a 4,095 kilometer double-wire fence along the border with Bangladesh.

Another perspective on climate change risks in Bangladesh is provided in a BMZ study on climate change and conflict (Brauch, 2002). Its case study on Bangladesh showed that this country has already been a primary victim of extreme weather events (cyclones, floods and droughts) that forced people to migrate. The increase in environmental stress due to climate change may further raise the conflict potential and might eventually lead to international tensions and regional instability: "In Bangladesh the struggle for survival against the impacts of global environmental change has been real for decades. Without more intensive efforts to address the causes at their roots a major human catastrophe may be possible that will not only affect the neighboring states (India, Myanmar) but the other countries as well." No attention to these trans-boundary risks however was reflected in any of the donor strategies. [Climate Change in Bangladesh: Coping and Conflict. By Thomas Absorb & Thomas Donnelly, Safer world ISIS Europe – European Security Review no.40, September, 2008]

6.2 Environmental Impact

Key environmental issues: Given that the chosen route will pass through sensitive habitats and will also have transformational effects on what is currently an isolated, poorly connected region of the country. Aside from direct impacts, the new transport corridor will also lead to broader indirect and induced impacts across the CHT region, which needs to be carefully analyzed so that adequate management and mitigation measures can be developed. Some of the key environmental issues include: direct and indirect impacts to natural habitats (potentially including protected areas / designated wildlife areas and other critical habitats), slope stability, landslide and rock fall, and soil erosion, earth cutting of hills and filling of wetlands / low-lying lands, clearing of vegetation including forested areas; effects to historic and cultural heritage; disturbance of waterways, waterfalls, rivulets, wetlands, and the variety of water-dwelling plant and animal species who rely on affected habitat; selection and management of areas for disposal of dredged material on land; road safety.

Key issues related to dredging: Impacts to aquatic ecosystems and habitat (especially fish spawning areas) from dredging operations; impacts to terrestrial flora/fauna and natural habitats at sites of on-land disposal of dredged material (especially if dredged material is contaminated); potential impacts to cultural heritage resources; noise and air emissions from equipment and machinery; health and safety aspects of dredging operations, among others.

Table 6.2: Waste Management Strategies for Dredging

Action	Responsibility
1. On vessels, allocate areas for solid and liquid waste storage. Waste will not be stored outside these areas. Any waste fuels, oils or other chemicals shall be collected in separate drums and transported an approved facility for disposal.	Contractor
2. If wastes listed as 'trackable wastes' are handled or transferred, documentation in accordance with Environmental Protection Policy (EPP) will apply.	Contractor
3. Waste will be removed from vessels and disposed of at an approved facility.	Contractor
4. Housekeeping procedures, including spillage control, will be implemented to minimize the generation of waste.	Contractor

Action	Responsibility
5. All waste awaiting disposals will be stored appropriately.	Contractor
6. Ensure safe and effective fuel, oil and chemical storage and handling.	Contractor
7. Contain any fuel, oil or chemical spills and clean up immediately.	Contractor
8. Ensure no leakage from pipeline during transit.	Contractor
9. Ensure land based placement site is appropriately constructed.	Contractor
10. Contaminants must not be released from any dredging vessel/s, support craft or dredge-related machinery to any waters or the bed and bank of any waters.	Contractor
11. The only contaminants to be released to surface waters are sediments disturbed whilst conducting the dredging activity, within the limits set out.	Contractor

6.3 Environmental Sensitivity

In the Environmental Impact Statement mention that relevant natural resources and environmental sensitivities should be described as environmental baseline report. Cumulative environmental sensitivities mean existing environmental problems and pressures on the environment. Baseline data commonly cover environmental sensitivities of resources such as current surface water at risk and current ground waters at risk which describes the current state of sensitive area of environmental degradation. Further environmental sensitivity also includes ecological designations, cultural heritage and sensitive habitats which are categorized as protected areas from the development. In many cases, site designations for landscape, archaeological interest may indicate the sensitive environment. The aim of identification sensitive areas is to generate alternative plan and evaluate the impact of the planning activities. Thus, environmental pressures (e.g. urban expansion, population changes and land contamination) need to be considered to anticipate potential environmental impacts.

Environmental sensitivity called as the baseline situation or the do- nothing or do-minimum scenario. The environment sensitive area will be used to facilitate the identification of the impacts of the proposed plan and its alternative. Data were analyzed to generate the criteria and indicators of environmental sensitivity.

6.3.1 Indicators for Environmental Sensitivity

Document Review: Standard choice of criteria and indicators used could;

1) Represent key issues;
2) Be based on valid principle and assumptions;
3) Be based on relatively easy to collect information, preferably information that has already been available;
4) Lead to the measurement of baseline information and / or the prediction of impacts;
5) Stimulate the input of decision-makers and the public choice.

The indicators to measure environmental sensitivity were determined based on expert opinion and supported with the regulation or standard and the relevant previous study.

6.4 Environmental Hazard

Hazard denotes a property (of substances, microorganisms, and so on) or a situation that in particular circumstances could lead to harm. If these circumstances occur, they result in adverse consequences. Hazard assessment is thus the identification of hazards, their potential receptors

(people, natural resources, plants or animals) and the determination of the con- sequences.

In simple terms, hazards refer to sources of potential harm, whereas risk considers frequency and severity of damage from hazards. A risk assessment involves evaluating actual and perceived risks as the basis for decision making.

Risk Assessment is a combination of risk estimation and risk evaluation. The technique of risk assessment may be used to assess the relative costs and benefits of a situation, development proposal or regulatory approach. Risks that are under voluntary control are considered less potentially hazardous than those over which there can be no control, such as seismic events.

Risk management is the process of implementing decisions about accepting or controlling, based usually on cost-benefit analysis. Risks may be controlled through the application of technology, procedures or alternative practices. The iterative nature of risk management requires that control technologies or alternative practices be re-evaluated for associated risk.

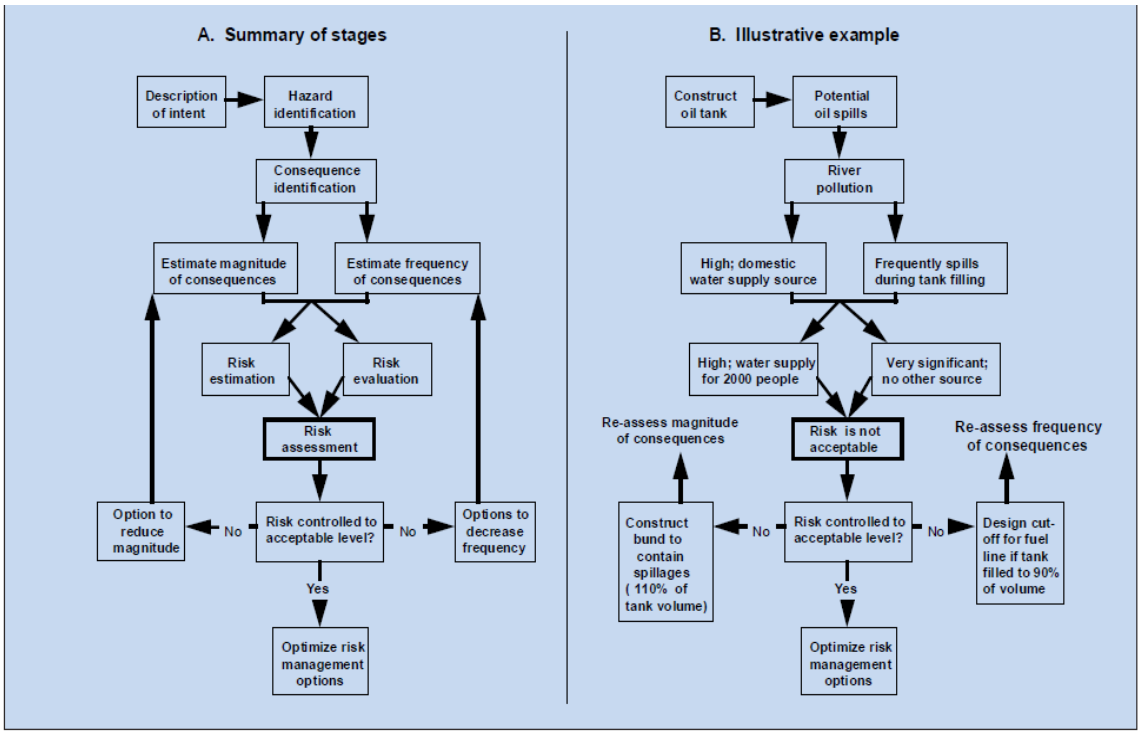

Fig 6.4: Risk Management (Source WBS)

CHAPTER - 7

Environmental and Social Scoping

CHAPTER - 7

Environmental and Social Scoping

7.1 Environmental Scoping

Purpose: The purpose of the EA is to provide a description of the project and its potential effects on the environment to inform the public and stakeholders and then to enable an Assessment of the project and its effects

This document is the Scoping Requirements for the Chittagong Port-Thegamukh Connectivity (Scoping Requirements), which sets out the environmental matters to be investigated and documented.

The project and its setting: The location of road and Multi Modal routes are shown in Figure 7.1A and 7.1B.

Scoping: the following key matters that is primarily to focus on:

(i) The EA is to document investigations of potential environmental effects of the proposed project, including the feasibility of associated environmental mitigation and management measures, in particular for:
   a. potential effects on biodiversity, including through loss, degradation or fragmentation of habitat or through other causes including road-kill, as well as related ecological effects;
   b. potential effects on water environments and related beneficial uses, including as a result of changes to stream flows, and discharge of sediment
   c. effects on Indigenous cultural heritage values;
   d. any environmental effects of vehicle transport and equipment use and management; and
   e. Other effects on land uses and the community.

These draft Scoping Requirements provide further detail on the specific matters to be investigated in the EA.

Evaluation Objectives: The following draft evaluation objectives identify desired outcomes in the context of potential project effects. They provide a framework to guide an integrated assessment of environmental effects. The objectives, together with specific assessment criteria, may be refined by the proponent as the EA is prepared.

Objectives and measures or procedures for managing environmental performance with respect to:

- Biodiversity issues, including offsets
- Surface runoff and groundwater discharges
- Water sources and use

- Community engagement
- Traffic
- Disruption of and hazards to infrastructure of connectivity Road
- Geotechnical stability
- Air emissions
- Noise and vibration
- Site rehabilitation
- Establishment of sustainable vegetation covers
- Fire management
- Forestry operations

- Complaints recording and resolution procedures; and
- Procedures for auditing and reporting of performance including compliance with relevant statutory conditions and standards.
- Provide indicative accident and emergency response contingency plans.

7.2 Development of Alternative Route

7.2.1 Analysis of Alternatives

Systematically compares feasible alternatives to the proposed project site, technology, design, and operation--including the "without project" situation--in terms of their potential environmental impacts; the feasibility of mitigating these impacts; their capital and recurrent costs; their suitability under local conditions; and their institutional, training, and monitoring requirements. For each of the alternatives, quantifies the environmental impacts to the extent possible, and attaches economic values where feasible. States the basis for selecting the particular project design proposed and justifies recommended emission levels and approaches to pollution prevention and abatement.

The EA should investigate and document the likely environmental effects of relevant alternatives, where these offer a distinct potential for superior environmental outcomes and are capable of meeting the objectives of the project. In the first instance, the discussion of relevant alternatives should include:

- The basis for the preferred site layout (for example the preferred sitting).
- The selection process for roads, including the access feeder road.
- The technical feasibility and environmental implications of alternative road alignment

Where appropriate, the assessment of environmental effects of relevant alternatives is to address the matters set out in the subsequent sections of this document.

The depth of investigation of alternatives should be proportionate to their potential to minimise potential adverse effects and meet project objectives.

The two (1 Road and 1 Multimodal) probable route alignment is selected from 8 candidate routes (4 Roads and 4 Multimodal). The most appropriate road route is Rajosthali – Bilaichhari – Juraichhari – Barkal – Thegamukh (about 114.751 Km) Multimodal Route is Rangarnati-Chhotoharina connected by waterways (about 63 Km) and Thegamukh by road (about 8.089 Km) portion is the same as Road Route 1. Eight alignments for road and multimodal routes were tested by multi-criteria analysis (ref. to the project report) and finally selected the 2 routes. So option for alternative has been exhausted in alignment selection. Further analysis may not be

required at this stage. However, during detailed design of the Routes (Road and Multimodal) in the 2nd phase the alternative "without project" & others can be analysed.

The “no project” alternative versus “with project” alternative was analyzed from the financial, technical, economic, social and environmental point of view. It was found that for all cases the project area, local people and wildlife are better off with the project. While the local people will be impacted by land acquisition and resettlement required for the project, they will be benefitted in the long term due to improved access and less vulnerable conditions due to flooding from different Charas/ rivulet. In light of the existing human-wildlife conflicts in the project area, the project will bring complementary efforts targeted at improving wildlife and ecological conservation by addressing the conflict situation. Therefore even from the environment point of view it is better to have the project than not.

7.3 Description of the Existing Environment

Physical features – Ecosystem components	
Topography and terrain	The Chittagong Hill Tracts (CHT), south-eastern part of Bangladesh, comprises a total area of 5,093 sq. miles (13,189 sq. km.) encompassing three hill districts, namely, Rangamati, Khagrachari and Bandarban. It shares borders with Myanmar on the south and southeast, India on the north and northeast and Chittagong district of Bangladesh on the west.Some of these hill ranges also contain important geological structures to form excellent structural traps for natural gas accumulation. The structures are: Semutang anticline (average elevation is 80m except in some areas where it reaches over 160 m), Sitapahar anticline (245 to 330m in the south to middle of the structure and 330 to 410m in the northern part), Matamuhuri anticline (average elevation ranges from 245 to 330 m in the northern part, but in the southern part it increases from 410 to 570m and the maximum elevation is 710m in the south) and Bandarban anticline (maximum elevation varies between 650 and 800m, with three peaks of around 935m, 960m and 965m located from north to south).
Soil (*type and quality*)	The hill soils (dystric cambisols) are mainly yellowish brown to reddish brown loams which grade into broken shale or sandstone as well as mottled sand at a variable depth. The soils is very strongly acidic. The region is characterised by a huge network of trellis and dendritic drainage consisting of some major rivers draining into the Bay of Bengal. The major rivers are Karnafuli, Sangu, Matamuhuri and Feni. Within the hill tracts, the Karnafuli has several important tributaries, of which Chengi, Kasalong and Rainkhiang are the main ones. Generally the hill ranges and the river valleys are longitudinally aligned. Four ranges, with an average elevation of over three hundred metres, strike in a north-south direction in the northern part of the hill tract districts. These are Phoromain range (Phoromain, 463m), Dolajeri range (Langtrai, 429m), Bhuachhari (Changpai, 611m) and Barkal range (Thangnang, 735m). South of the Karnafuli river within the Chittagong Hill Tracts, there are seven main mountain ranges within Bangladesh. These are: Muranja range (Basitaung, 664m), Wayla range (most of this range is in Myanmar), Chimbook range (Tindu, 898m), Batimain range (Batitaung, 526m), Politai range (Keokradang, 884m; Ramiu Taung 921m, Saichal-Mowdok range (Bilaisari, 669m) and Saichal range. Saichal range contains the highest peaks of Bangladesh. These are Waibung (808m), Rang Tlang (958m), Mowdok Tlang (905m), and Mowdok Mual (1,003m) which is on the border with Myanmar. The project area mainly comprises plastic CLAY, sandy SILT and silty fine SAND. Subsurface cohesive strata in nature consisting of soft to hard, Grey mixed brown to reddish brown low to high plastic CLAY and brown to yellowish brown low plastic sandy SILT. The non-cohesive layers consist of medium dense to dense, yellowish brown silty fine SAND with trace of mica.The surface geology of Chittagong and Chittagong hill tract districts includes Valley Alluvium and Colluvium, Beach and

	Dune Sand, Dihing and Dupitila Formation, Girujan Clay Formation and Tipam sandstone Formation, Boka Bil and Bhuban Formation **Fig 3.1.5.1** gives the surface geological map of the study area. The hill soils (dystric cambisols) are mainly yellowish brown to reddish brown loams which grade into broken shale or sandstone as well as mottled sand at a variable depth. The soils is very strongly acidic.
Surface water (*sources, distance from the site, local uses and quality*)	Karnafuli, Chengi, Maini, Sangu, Matamuhuri, Feni, Raingkyong and Bagkhali with a total length of 1,400 km. Significant rivers are transboundary with: (i) Karnafuli originating in Mizoram, India; (ii) Chengi and Feni originating in Tripura, India and (iii) Sangu originating in Myanmar. In addition to perennial rivers, upland communities rely predominantly on relatively shallow (0.5m to 4.0m) subsurface flows from local springs. These are commonly found along spring-lines where the groundwater table is intersected. The local people use the river water to meet some of their domestic needs, such as washing, bathing etc. No irrigated lands are noted within this area and water extraction for irrigation purposes was not observed. Many of the creeks originating from Sangu river have crossed the road alignment. (Crossing point of creeks on the aligned road has been shown in Table: 2.4A and Table: 2.4B shows cross drainage of structure along the alignment for Road Route and Multimodal respectively with chainage. (Feasibility report) Table 3.1.4.1and Annexure II shows assessment of surface water quality and surface water quality monitoring point and location.
Groundwater(*sources, distance from the site, local uses and quality*)	Reduction in stream flows results in communities considering alternatives options for potable water. This includes accessing groundwater at greater depths which is likely to be more reliable than the highly seasonally fluctuating (or depleting) shallow subsurface flows. However, due to hard bedrock underlying much of the upland area, tube well installation at greater depths is difficult. Coupled with minimal hydrological and hydro geological information groundwater development often results in (at best) an estimated depth of drilling and again, uncertainty in the yield potential of the aquifer. With an increasing reliance on groundwater and increasing depths for accessing potable supplies, there is a need for comprehensive monitoring of CHT water resources. Groundwater table is relatively shallow in areas close to the river. However, due to the sloping terrain the groundwater table lies fairly deep in hilly areas. Houses located in the valley areas, use shallow well water for domestic consumption; however, use of such wells is not widespread. Groundwater in the housing area is often contaminated with the high concentration of coliform bacteria and most of coliform bacteria are concentrated in the lowest depth of the aquifer. Coliform contamination of groundwater can be caused by inappropriate location and/or poorn construction of the wells. See Table 3.1.4.4 and Annexure II for assessment, sample location and test result.
Flooding and Drainage	A unique river network drains the study area. The Karnaphuli River is the major river drained the area, which is running along East-West trend. This is the most important and largest river the Chittagong Hill Tracts. It rises from the western slope of Lushai Hill in Indian Territory. There are numerous streams and streamlets, more or less dendritic pattern. These streams locally named as “Chara” or “Chari” is of subsequent or consequent type. The most important tributaries are Manik Chari, Ghagra Chari, Sundari Chara, etc. During the rains, they are deep and the current is strong and do great erosion to the area, but they are mostly dry during winter season. A large water body known as Kaptai lake was made for hydro - electric project in the eastern flank. [Feasibility report] Highest water level of Kaptai reservoir is 33.69 m PWD and lowest water level is 23.63 m PWD from the graph of water level (Fig 5.4 A and 5.4 B) it is seen that water level dropped drastically in the month of April & May of 1998. Dredge Volumes for Multimodal Route No-1 is shown in Annexure- 5.4. Flow of the river is Karnafuli regulated by the barrage. Its flow is not directly connected to the sea. When upstream water level is high due to continuous rainfall and about to inundate the crops & households, the water is disposed off by opening the spillway of the barrage. If needed water is also disposed off by diversion tunnel.
Landslide Prone Areas	Nadim, Kjekstad, Domaas, Rafat and Peduzzi (2006) provide one of the most comprehensive studies related to landslides around the world. They show that the

<table>
<tr><td></td><td>landslide hazard level depends on a combination of trigger and susceptibility factors, whereby the precipitation and seismic conditions are triggers while the slope factor within a selected grid, the lithological (or geological) conditions and the soil moisture conditions are susceptibility factors. They provide a global landslide hazard zonation. While the degree of landslide hazard is not clearly visible, it is clear that the whole Chittagong Division is within the medium to severe global landslide hazard zonation.
Nevertheless, the risk of landslides can be mitigated by properly addressing the issue by providing engineered soil embankments where natural slopes are presently exposed or existing slopes are to be disturbed, further ensuring adequate surface drainage and toe protection by means of well-connected drain system, soil anchoring, gabion/rubble masonry, concrete retaining structures, etc. Therefore, nominal provisions for embankment strengthening, enhanced drainage and silt control in the above identified sections with steep exposed slopes as provided in the design</td></tr>
<tr><td>Air quality (any pollutionissues)</td><td>Three representative samples of air were collected on 21th -24th November 2015 to analyze PM_{10}, $PM_{2.5}$ & SPM. The analyses of the parameters have been done in Enviro Consultants Limited Laboratory, Dhaka and results dated 29th November 2015 have been placed in the report. The analysis results fully comply with the DoE standards. All the parameters are much lower than the allowable limit. Therefore, it can be concluded that the air is not creating any harm to the environment in terms of air quality.
<table>
<tr><th>Sl. No.</th><th>Parameter for Analysis</th><th>Bangladesh Standard (Industrial and Mixed Area)</th><th>World Bank Standard (Industrial and Mixed Area)</th><th>1A</th><th>2A</th><th>3A</th></tr>
<tr><td>1</td><td>PM_{10}</td><td>150 microgram per m^3</td><td>50 Microgram per cubic meter</td><td>19.91</td><td>87.79</td><td>28.11</td></tr>
<tr><td>2</td><td>$PM_{2.5}$</td><td>65 microgram per m^3</td><td>25 Microgram per cubic meter</td><td>12.21</td><td>24.53</td><td>13.26</td></tr>
<tr><td>3</td><td>SPM</td><td>200 microgram per m^3</td><td>-</td><td>43.06</td><td>148.05</td><td>35.21</td></tr>
</table></td></tr>
<tr><td>Noise level andvibration(Any anticipatedissues)</td><td>Noise levels measured indicated higher background levels predominantly due to vehicular movements. It was clear from the levels of measurements that at townships ambient noise levels were high and in between townships values were comparatively low. Noise levels varied between 46.1-58.5 dB (A) indicating somewhat higher background levels by the side of the road. The analysis results fully comply with the DoE standards. Therefore, it can be concluded that the noise is not creating any harm to the environment in terms of noise quality.
<table>
<tr><th>Sl.</th><th>Point</th><th>Bangladesh Standard</th><th>Test Time</th><th>Result</th></tr>
<tr><td rowspan="2">1</td><td rowspan="2">Upazilla Campus at Kaptai</td><td>Day Time 75 dBa</td><td>Day</td><td>54.2 dBa</td></tr>
<tr><td>Night Time 70 dBa</td><td>Night</td><td>48.7 dBa</td></tr>
<tr><td rowspan="2">2</td><td rowspan="2">Upazilla Campus at Rangamati</td><td>Day Time 75 dBa</td><td>Day</td><td>58.5 dBa</td></tr>
<tr><td>Night Time 70 dBa</td><td>Night</td><td>52.6 dBa</td></tr>
<tr><td rowspan="2">3</td><td rowspan="2">Upazilla Campus at Rajosthali</td><td>Day Time 75 dBa</td><td>Day</td><td>52.4 dBa</td></tr>
<tr><td>Night Time 70 dBa</td><td>Night</td><td>46.1 dBa</td></tr>
</table></td></tr>
<tr><td colspan="2">Ecological features – Eco-system components</td></tr>
<tr><td>Vegetation (trees, ground cover,aquatic vegetation)</td><td>The main land use types found along the road trace are commercial establishments, public building such as schools, offices, hospitals, religious places etc., home gardens, abandoned lands, and marshy lands including abandoned and cultivated paddy lands. Most of the hills are covered with forests containing valuable timber trees, bamboos, canes and a kind of grass known as shan. Forest classification: Hill forests (38%), Mangrove (30%), Plantation (17%), Bamboo forest (13%) and Sal forest (2%).Details of vegetation types found along the road trace are described below. However, during the study, rapid screening has been done; hence details of riverine (reservation) vegetation could not be observed.</td></tr>
</table>

Presence of wetlands	The main wetland habitats that could be found along the road stretch were cultivated and abandoned paddy lands (Chainages between 11 + 600 ~ 13 + 600, 15 + 6000 ~ 18 + 700, 18 + 700 ~ 20 + 300, 109 + 100 ~ 110 + 500). Rajosthali-Thegamukh road stretch, [Final Screening Report] there were noprominent wetland areas within the close proximity of the road trace. Consideringthe paddy lands, some are being cultivated and some are abandoned.
Fish and fishhabitats	Kaptai Lake is the largest manmade lake in the South Asia (App. 725 sq. Km). There is more than 4000 charas/ rivulet falling into the lake. About 1200 charas/ rivulets are directly connected and discharges into the lake. It is one of the largest sources ofbiodiversity and fish. Substantial amount of fish are being supplied by this charas falling into lake and comparatively higher per area fish are available than Lake. According to the research of Bangladesh Fish Research Institute (FRI); 2 species of Shrimp, 1 species of Dolphin and 2 species of Tortoise are available in the lake. There are 68 species of local and 8 species of alien fish are available in the lake. Raaing khong, Karnafully, Kalabunia Chhara, shuvolong khal etc are cross the alignment.
Birds (*waterfowl, migratory birds, others*)	There are waterfowl species and terrestrial bird species among the recorded list of species. The Kaptai lake is important location for migratory birds as the lake is in abundance in fish. It should also be noted that making observations of bird species had been a difficult task as study was conducted during the day time and it was a rapid study along the trace.
Presence of special habitat areas (specialdesignations andidentified sensitivezones)	According to IUCN Directory of South Asian Protected Areas Pablakhali Wildlife Sanctuary lies at the northern end of Kaptai Reservoir in the south-eastern part of Kassalong Reserve Forest in the Chittagong Hill Tracts, Bangladesh, some 112 km from Rangamati Town. the western boundary is from by Kassalong river 23°08´N and 92°16´E. Pablakhali declared a Wildlife Sanctuary in 1983 under Bangladesh Wildlife (Preservation) (Amendment) Act, 1974. First established as a game sanctuary in June 1962.The area of the sanctuary is 42,087ha. Altitude Ranges from 100m to 300m. The topography comprises a complex of hills and valleys aligned northsouth, with spurs branching from the ridges. The hills are rugged and steeply sloping to the north, and smaller with gender slopes to the south. Some 3,885ha in Working Unit I have been under water since 1963, following the construction of a dam at Kaptai as pan of the Kamafuli hydro-electric project (Olivier, 1979). Soils are typically clay or clay loams in die valleys, and pale brown to yellow-red (acidic) clay loams and loams in die hills with localised concretions of iron-manganese. Three forest types can be distinguished. Tropical wet evergreen forest commonly occurs in valleys and on sheltered slopes wiUi a plentiful water supply. The irregular canopy, characterized by emergent trees, is dense and rich in species. Typical trees include civit *Swintonia floribunda*, *garjan Dipterocarpus* spp., *Pterygota alata, Quercus* spp. and *Castanopsis* spp. Tropical semi-evergreen forest, the most extensive forest type in the sanctuary, includes a significant proportion of deciduous canopy species. The predominant tree genera are Dipterocarpus, Mangifera, Amoora, Cinnamomum, Syzygium, Tetrameles, Artocarpus, Salmalia and Albizia. Tropical moist deciduous forest is confined to new alluvial areas near rivers and streams. The trees are scattered and interspersed with extensive patches of khagra and nal grassland and stands of wild banana. Characteristic tree genera include Albizia, Salmalia, Terminalia and Ficus. Bamboo grows beneath the canopy ofaU three forest types (Sarker and Fazlul Huq, 1985). According to reports in old district gazetteers, Kassalong Valley used to be rich in wildlife, with tiger Panthera tigris (E), two species of rhinoceros Rhinocerotidae spp., gaur *Bos gaurus* (V) and banteng B.\javanicus (V) present in the 19th and early 20th centuries. Tiger, gaur and banteng were last seen in the early 1970s (Khan, 1985), but tiger and also leopard Panthera pardus (T) are reported to still occur (Sarker and Fazlul Huq, 1985). Most important is the small population of Asian elephant Elephas maximus (E) that commonly uses the southern part of the sanctuary, probably because of the mosaic of habitats and permanent water supply (Olivier, 1979). Many other large mammals are present, including rhesus macaque

	Macaca mulatta, capped langur Presbytis pileata, Hoolock gibbon Hylobates hoolock (V), dhole Cuon alpinus (V), small cats, otters and wild boar Sus scrofa (Sarker and Fazlul Huq, 1985), and also Indian muntjac Muntiacus muntjak and sambar Cervus unicolor (Olivier, 1979). Hague (1989) lists 61 species of mammals recorded in the late 1970s. Some 133 bird species have been recorded from the sanctuary (Husain, 1975). This total includes 25 species previously reported by Mountfort (1969). Following the formation of Kaptal Reservoir and with the continuing reduction of former wintering grounds in Sylhet and Mymensingh, the sanctuary supports increasing numbers of resident and migratory waterfowl(Olivier, 1979), notably little grebe Tachybaptus ruficollis, a variety of herons and egrets, common moorhen Gallinula chloropiis, common coot Fulica atra and Asian openbill stork Anastomus oscitans (Scott, 1989). White-winged wood duck Cairina scutulata (V) used to be common but the population has declined in recent years, most probably due to systematic clear-felling of primary forest and its replacement with commercially viable timberspecies (Khan, 1986). Some five pairs were present up to 1979, but the status of the species has since become uncertain owing to political disturbances (Khan, 1985). Khan (1986) estimates there to be some20 pairs within an area of 240 sq.km in and around the sanctuary. Of the reptiles, Indian python Python molurus (V) is common (Sarker and Fazlul Huq, 1985). Rampahar-Sitapahar lies 48km north-east of Chittagong Port approximately 22°30'N, 92°20'E, Presently classified as reserved forest, Rampahar Sitapahar has not yet been designated a wildlife sanctuary under the Bangladesh Wildlife (Preservation)(Amendment) Act, 1974 but has been maintained as such by the Forest Department since 1973 (Sarker and Fazlul Huq, 1985). Area of the Sanctuary is 3,026ha. Physical features: comprises low, gently sloping hills which arc steeper in Sitapahar block than Rampahar block. The Kamaphuli River flows through the area. Soils are clays or clayey loams in valley bottoms and mosdy pale brown (acidic) clay loams and loams on hills (Sarker and Fazlul Huq, 1985). Vegetation: comprises evergreen and semi-evergreen forests. Predominant tree species are Dipterocarpus spp., Artocarpus chaplasha, Tetrameles nudiflora, Cedrela toona, Mesuaferrea, Eugenia spp., Ficus spp. and Albizia procera (Sarker and Fazlul Huq, 1985).
Traditional economic and cultural activities	The major Mongolian tribes are Chakma, Tipra, Murong and Magh. In fact the Chittagong Hill Tracts host thirteen different tribes who are divided into nearly a hundred different sects. Total population enumerated in the 1991 census was 1.042 million of which 562,597 were male and 479,776 female. Buddhism is being followed by Chakma and Marma, the Hinduism by the Tripura and Christianity by Mizo and Bawm. Some other tribes maintain harmony amongst the spirit, animal and plant. **Ethnicity**: 12 ethnic groups (51%) (*Chakma, Marma, Tripura, Tanchangya, Mro,Bawm, Kheyang, Pankhu, Chak, Lushai, Khumi & Rakhain*) and Bengali (49%).
Archeological resources(*recorded or potential to exist)*	No Archeological resources are found along the alignment.

CHAPTER – 8

Mitigation Measures and EMP

CHAPTER – 8

Mitigation Measures and EMP

8.1 Environmental Effects and Mitigation Measures

8.1.1 Screening for Potential Environmental Impacts

No.	Screening question	Yes	No	Significance of the effect (Low, moderate, high)
1	Will construction and operation of the Project involve actions which will cause physical changes in the locality (topography, land use, changes in water bodies etc.)	Yes		Low Most of the interventions are carried out along the road trace hence no physical changes in topography and landform except at the bend correction/widening at chainages Ch. 0+260~0+800, Ch. 8+000~8+100, Ch. 17+741~18+0412, Ch. 25+631~25+836, Ch. 29+000~29+100, Ch. 30+500~30+600, Ch. 31+500~32+500, Ch. 38+000~38+400, Ch. 41+100~41+600, Ch. 42+300~42+900, Ch. 46+900~47+100, Ch. 47+500~48+200, Ch. 51+000~54+000, Ch. 52+500~53+200, Ch. 65+400~65+900, Ch. 69+100~69+500, Ch. 70+000~72+700, Ch. 73+700~73+750, Ch. 75+700~75+900, Ch. 79+400~81+000, Ch. 82+000~82+500, Ch. 100+200~100+400, Ch. 102+100~102+300 and Ch. 105+600~106+500 Digana end where landform would be altered very lightly. In addition, minor changes will be possible in the case of extension of shoulders at either side of the carriage way. However, no major alterations in terms of physical changes to topography, land use, and water bodies would occur due to this project.
2	Will the Project involve use, storage, transport, handling or production of substances or materials which could be harmful to human health or the environment or raise concerns about actual or perceived risks to human health?	**Yes**		**Low** Transport of material and construction activities will emit dust, and fugitive particles. However, the affected area is small and mitigation is straight forward; therefore significance of the effect can be considered as low. Dust and other particulate matter will be deposited on roofs, windows, open areas of households, plants and trees and may be unpleasant and/or create health hazards to vulnerable persons in the neighborhood. However, this effect would be limited to a short time period.
3	Will the Project produce solid wastes during construction or operation?	**Yes**		**Low** **During Construction:** The project interventions, which mainly involve re-surfacing, will not produce significant amounts of construction debris or solid waste. There will be small quantities of spoilage(construction debris) produced during demolition of existing structures (mainly temporary)and pavements, excavation of trenches, cut and fill activities, debris from the rock blasting and material storage. **During operations:** Good solid waste collection practices will lead to alleviation of any solid Waste-related problems. There will be street sweepings, solid

No.	Screening question	Yes	No	Significance of the effect (Low, moderate, high)
				waste collected at garbage bins/ bays and dump areas which need regular collection and disposal. In addition, debris and sediments, floating matter and other solid waste carried by surface drainage which can be collected at manholes, catch pits etc. needs proper disposal. Regular cleaning of side drains and the roadside will also generate such material. Culverts will also generate spoil material.
4	Will the Project release pollutants or any hazardous, toxic or noxious substances to air?	**Yes**		**Low** There will be bituminous material used during overlay and surfacing of roads, bituminous laying of carriage way and shoulders. Paints and solvents used for road markings can emit toxic and noxious air-borne substances.
5	Will the Project cause noise and vibration or release of light, heat energy or electromagnetic radiation?	**Yes**		**Low** Noise and vibration will be generated during drilling and blasting, excavation of trenches, compaction and transport of material etc. It is envisaged that the small boulders could be broken in to pieces only by drilling by means of hydraulically driven machinery while large pieces of rock boulders will be removed by chemical blasting so as to minimize the anticipated high noise and vibration. However sporadic high noise levels could be expected on temporary basis hence, low impact. In the sensitive areas such as schools, hospitals and religious places, Ch. 0+000~1+000 (Rajosthali)(Residential area, School, Mosque, Buddhist Temple, Govt. Office), Ch. 5 +000~6+000 (Mbachara; School, residential area); At the Chainage 6+000~8+000 Chabachara, Temple, Residential area; In Taktanala beyond the Ch. 27+000~27+800 is Residential area with School and Buddhist temple, at the Ch. 39+400~41+000 is Residential area and there is a temple, at the Ch. 46+600~48+000 the area is known as Degholchari and there is a School, Ch. 48+000~50+000 (Bilaichari) there is residence, govt office, Upazilla office etc, Ch. 57+900~62+100 (Jameshari) residential area with a temple and school, Ch. 77+200~78+800 (Juraichari) residential area with govt. office, school and mosque, Ch. 94+00095+000 (kalabunia) is residential area with school, mosque and grave yard, Ch. 95+000~97+200 (Bamland) is a residential area with community clinic, school and mosque, Ch. 97+200~101+500 (Arabunia) is residential area with school and community clinic, Ch. 101+500~104+500 (Bhusanchara) is residential area with school and mosque, Ch. 105+500~106+700 (Amtala) is residential area and there is a mosque, Ch. 106+700~108+200 (Chotohorina) is residential area and there is a school and a temple and the end point of the alignment is Thegamukh, there is a school and Community clinic.
6	Will the Project lead to risks of contamination of land or water from releases of pollutants onto the ground or into surface waters, groundwater ?	**Yes**		**Low** Stock piling of material will lead to washing away of soil and may increase turbidity and TSS (Total Suspended Solids) in road side drainage and nearby canals/streams temporarily during the construction. Construction activities in the proposed project site may also involve excavation and storage of soil, which might increase erosion risk of top soil layers and cause siltation during wet weather, if engineering best practices not adopted during construction. On the other hand, proper construction practices like soil compaction and stabilization,

No.	Screening question	Yes	No	Significance of the effect (Low, moderate, high)
				turfing, maintaining naturally stable slopes, etc. will improve soil stability, reducing erosion risk and siltation effects during the construction phase and in the aftermath of project completion. It is noted that endemic fish species are found in the riverine habitats of the project area, hence care should be exercised to control turbid matter contaminating riverine habitats as a consequence of erosion laden with silt, sediment or any other colloidal material. The specific recommendations for embankment protection and enhanced drainage along the road stretch directly exposed to the riverfront targeting silt control as designed by LGED are important to be adhered to.
7	Will the project cause localized flooding and poor drainage during construction Is the project area located in a flooding location?		**No**	The project area is not located in a floodplain/flooding location. Despite theclose proximity to Raaing khong River (less than 50 m in the section Ch. 48+100~48+400 where HFL is 30.50m, Ch. 39+800~40+200 is wet land where Flash Flood Level is 44.00 m, Ch. 83+300~83+400 where FFL 166.65m and dry in winter, at the Ch. 85+100~85+400 and a Ch. 88+100~88+300 Karnafully river crossing where HFL 33.23 m, at the Ch. 11+800~11+900 mitingachari chara where HFL is 67.47 m and dry in winter, at the Ch. 8+040~8+385 Naraichari chara is located where HFL 62.96 m and dry in winter. **Construction Phase:** Raised embankments and raised finish levels, stock piling of construction debris and other materials, excavations in cut and fill sections, etc., may block existing drainage flow paths, causing flow stagnation leading to localized inundations on temporary basis. However, ensuring proper construction practices like provision of improved drainage network, maintaining naturally stable slopes, etc. will improve drainage conditions, reducing flood risk during the construction phase and in the aftermath of project completion. **During Operation:** Lack of routine maintenance may lead to silting of drains/culverts and cause local inundation/ overtopping of drain.
8	Will there be any risks and vulnerabilities to public safety due to Physical hazards during construction or operation of the Project?	**Yes**		**Low** **Construction phase:** All the safety measures deployed in "Best Engineering Practices" need to be adopted during the construction. In General, disturbance to pedestrians, motorcyclists and motorists may be very likely on a temporary basis due to traffic congestions. Safety issues in terms of injuries due to construction work, drilling and blasting operation using heavy machinery, working in slopes could be anticipated. However, such incidences can be avoided with proper precautions exercised on health and safety aspects. **Operation phase:** During the operation phase, a smooth traffic flow can be expected and particularly due to correction of undesirable curves traffic problems and potential accidents that are prevailing at present can be overcome.
9	Are there any transport routes on or around the location which are susceptible to			**Low** It is likely to cause temporary congestion on those roads during construction near the entrances. Potential environmental impacts would be creation of dust and noise during construction

No.	Screening question	Yes	No	Significance of the effect (Low, moderate, high)
	congestion or which cause environmental problems, which could be affected by the project?			which is temporary in nature.
10	Are there any routes or facilities on or around the location which are used by the public for access to recreation or other facilities, which could be affected by the project?		**No**	Recreation or other facilities are not close to the road alignment.
11	Are there any areas or features of high landscape or scenic value on or around the location which could be affected by the project?	**Yes**		**Low** The whole alignment is in hilly terrain which has scenic beauty but not revealed to the tourist as there is no communication or accommodation facilities. The project will open the door of tourism at the area.
12	Are there any other areas on or around the location which are important or sensitive for reasons of their ecology e.g. wetlands, watercourses or other water bodies, mountains, forests which could be affected by the project?	**Yes**		**Low** From Rangamati to Chotohorina by waterway goes through the Kaptai Lake which proposed in Multimodal option. Kaptai lake is the biggest manmade lake. The total distance is 63 Km. On the other hand, the road route is going through mountainous terrain, with Jhum land, charas and mountainous forests. At the chainage Ch. 39+000~41+000 and Ch. 60+900~62+100 is wetland. At the Ch. 0+800~6+000, and Ch. 8+000~77+000 there is some mountainous forest, jhum cultivation, orchard and hilly region but there is no protected areas along the alignment.
13	Are there any areas on or around the location which are used by protected, important or sensitive species of fauna or flora e.g. for breeding, nesting, foraging, Resting, migration, which could be affected by the project?	**Yes**		**Low** Pablakhali Wildlife Sanctuary and Bird area is located not very close the alignment. But the road alignment is far away and did not intercept the sesitive area. The waterways/navigational channel of multimodal route option intercepting the Kaptai Lake. This lake is one of biggest source of fishand acuatic habitat. Dredging and navigation may harm the spawing, breeding of fish. Hence care should be exercised to prevent washing away of material laden with silt, sediment or any other colloidal material like diesel, petrol or other poisonous liquid that causes high turbidity, pollutes water. There are many charas falling into the lake are intercepted by the alignment. So, the embankments are likely to be steep and prone to erosion. Low levels of impacts could occur but these impacts are generally mitigable.
14	Is the project located in a previously undeveloped area where there will be loss of green-field land		**No**	No such green fields are encountered.
15	Will the project cause the removal of trees in the locality?	**Yes**		**High** In areas where road is planned, a appreciable number of trees would need to be removed. Further, during removal or cutting of hill along the road, floral species may be affected. In the

No.	Screening question	Yes	No	Significance of the effect (Low, moderate, high)
				sections where there is a necessity to have safety measures also some trees have to be removed. The trees has not been counted as detail ecological survey and detail engineering will prepare the listing. The road alignment is through forest land good number of trees are to be fallen.
16	Are there any areas or features of historic or cultural importance on or around the location which could be affected by the project?	**Yes**		**Low** So far nothing of historic or cultural importance on or around the road alignment found except some of the worship places like mosque, temple, church.
17	Are there existing land uses on or around the location e.g. homes, gardens, other private property, industry, commerce ,recreation, public open space, community facilities, agriculture, forestry, tourism, mining or quarrying which could be affected by the project?	**Yes**		**Low** Present land use of the area is mixed along the road road alignment (commercial, industrial, residential etc.) and agriculture and home garden type uses in interior areas. The project will not create any significant negative impacts that would change the land use character of the area. Agriculture, forestry, tourism, mining or quarrying area are no close to the alignment.
18	Are there any areas on or around the location which are densely populated or built-up, which could be affected by the project?	**Yes**		**Low** <u>Construction Period</u> A very few locations along the alignment are densely populated. However they will not be significantly affected by the project activities as except for a few uses others are located outside the road alignment. However noise, dust and traffic congestion would be potential impacts during construction period which are of temporary nature. <u>Operation Period</u> During the operation period due to improvements to the road network, it is likely that motorists will speed up which will create potential accidents. However deployment of adequate traffic management systems can overcome such potential impacts.
19	Are there any areas on or around the location which are occupied by sensitive land uses e.g. hospitals, schools, places of worship, community facilities, which could be affected by the project	**Yes**		**Low** In the sensitive areas such as schools, hospitals and religious places, Ch. 0+000~1+000 (Rajosthali)(Residential area, School, Mosque, Buddhist Temple, Govt. Office), Ch. 5 +000~6+000 (Mbachara; School, residential area); At the Chainage 6+000~8+000 Chabachara, Temple, Residential area; In Taktanala beyond the Ch. 27+000~27+800 is Residential area with School and Buddhist temple, at the Ch. 39+400~41+000 is Residential area and there is a temple, at the Ch. 46+600~48+000 the area is known as Degholchari and there is a School, Ch. 48+000~50+000 (Bilaichari) there is residence, govt office, Upazilla office etc, Ch. 57+900~62+100 (Jameshari) residential area with a temple and school, Ch. 77+200~78+800 (Juraichari) residential area with govt. office, school and mosque, Ch. 94+00095+000 (kalabunia) is residential area with school, mosque and grave yard, Ch.

No.	Screening question	Yes	No	Significance of the effect (Low, moderate, high)
				95+000~97+200 (Bamland) is a residential area with community clinic, school and mosque, Ch. 97+200~101+500 (Arabunia) is residential area with school and community clinic, Ch. 101+500~104+500 (Bhusanchara) is residential area with school and mosque, Ch. 105+500~106+700 (Amtala) is residential area and there is a mosque, Ch. 106+700~108+200 (Chotohorina) is residential area and there is a school and a temple and the end point of the alignment is Thegamukh, there is a school and Community clinic.
20	Are there any areas on or around the location which contain important, high quality or scarce resources e.g. groundwater, surface waters, forestry, agriculture, fisheries, tourism, minerals, which could be affected by the project?	**Yes**		**Low** Habitats connected may be affected due to surface runoff bringing in additional loading of suspended particles together with high levels of bituminous material, oil and grease during construction. However at present such value is not optimized. The project will not involve in creating negative impact on this scenic value. During the operation period due to the opening up of such areas it will create a better incentive for developers to invest in tourist and recreational related projects that will make a positive impact on the local economy.
21	Are there any areas on or around the location which are already subject to pollution or environmental damage e.g. where existing legal environmental standards are exceeded, which could be affected by the project?		**No**	No such area was found and no measurement of pollution level was made

8.2 Environmental Management Plan

8.2.1 Environmental Management Plan

Key project activities	Potential Environmental Effects	Mitigation Measures
1. Drainage management	**Physical** Localized flooding (sideways and carriageway) canal ordrain overtopping due to blockage of drains/gullies/grates due to silting/debris accumulation	**Physical** Regular monitoring and routine maintenance practices to ensure that drainage systems are in proper order especially prior to monsoon rain season and after extreme storm events
2. Enhanced traffic	**Physical** In the case of increased traffic there will be traffic congestions causing delays. In addition, diversion of traffic by motorists to other routes will also create considerable traffic in the other routes as well. With enhanced traffic, increased noise levels could be observed particularly due to the road surfaces being in good conditions,	**Physical** Signage clearly indicating speed limits is of paramount in this route. The interim standard on vibration levels caused by vehicular movement should be complied with controlling the maximum axel loads for this improved road. Idling of vehicles at road sides should be controlled as practical as possible in order to lessen the air

Key project activities	Potential Environmental Effects	Mitigation Measures
	which in turn help motorist to go fast. Further there may be sporadic events of high vibrations due to heavy vehicle movements as more heavy vehicles are expected in this route. This enhanced traffic will be responsible for increased air pollution which may be aggravated under different meteorological conditions.	pollution events and also the possible traffic jams. Proper signage is necessary is important to indicate bends and other critical aspects in the road trace. Parking lots should be aligned away from shoulders.
3. Flood management	**Physical** No flood risk is envisaged in the road stretch	**Physical** Not necessary
4. Regular maintenance	**Physical** Monitoring for drainage issues/blocked drains/culverts Maintenance repairs may create high noise levels on temporary basis.	**Physical** Desalting of blocked drains/culverts Carrying out of such repair work should be limited only to daytime.

8.2.2 EMP Cost Matrix (Road)

Environmental Attributes	Mitigation Measures	Responsible Organization	Tk. in Million
Diversion of traffic	▪ Appropriate traffic diversion schemes shall be implemented so as to avoid inconvenience due to project operations to present road users, particularly during nighttimes. ▪ Proper diversion schemes will ensure smooth traffic flow minimizes accidents, traffic snarl ups, and commotion. ▪ The diversion signs should be bold and clearly visible particularly at night.	Consultants and contractors	30
Construction Camp Sites	▪ The construction campsites shall be away from any local human settlements and preferably located on lands, which are not productive barren/waste lands presently. The camps shall have adequate water supply, sanitation and all requisite infrastructure facilities. This would minimize dependence of construction personnel on outside resources, presently being used by local populace and minimize undesirable social friction thereof. ▪ The camps shall have septic tank/soak pitof adequate capacity so that it can function properly for the entire duration of its use. ▪ All construction camps shall have rationing facilities particularly for kerosene/LPG so that dependence on firewood for cooking is avoided completely to the extent possible. ▪ The construction camps shall have health care facilities particularly for kerosene/LPG so that dependence on firewood for cooking is avoided completely to the extent possible. ▪ The camps shall have septic tank/soak pit of adequate capacity so that it can function properly for the entire duration of its use. ▪ All construction camps shall have rationing facilities particularly for kerosene/LPG so that dependence on firewood for cooking is avoided completely to the extent possible. ▪ The construction camps shall have health care facilities for	Supervising engineer with contractor Department of the Environment	60

Environmental Attributes	Mitigation Measures	Responsible Organization	Tk. in Million
	adults, pregnant women and children. ▪ All construction personnel shall be subjected to routine vaccinations and other preventive/ healthcare measures. ▪ The construction camps shall have in house community/common entertainment facilities. Dependence of local entertainment outlets by construction camps should be discouraged /prohibited to the extent possible		
Work sites	▪ All personnel in work sites shall have protective gears like helmets, boots etc. so that injuries to personnel are minimized. ▪ Children and pregnant women shall not be allowed to work under any circumstances. ▪ No personnel shall be allowed to work at site for more than 10 hours per day (8 hour makes one work shift). Personnel who are likely to exposed to noise levels beyond stipulated limits shall be provided with protective gears like ear plugs etc and regularly rotated. ▪ Regular water sprinkling of water shall be ensured so that dust levels are kept to minimum	Design consultants Supervising engineer with contractor and DoE	20
Construction Equipment Vehicles	▪ All equipment/vehicles deployed for construction activities shall be regularly maintained and not older than 5 years. ▪ Vehicles/equipment shall be regularly subjected for emission tests and shall have valid POLLUTION UNDER CONTROL certificates. Revalidation of certificates shall be done once in a month. ▪ All vehicles deployed for material movement shall be spill proof to the extent possible. ▪ In any case all material movement routes shall be inspected daily twice to clear off any accidental spills.	Design consultants Supervising engineer with contractor and DoE	50
Water resources & Drainage channels	▪ Thel road construction will also require construction of several cross drainage structures, minor and major bridges to facilitate development in accordance with design requirements and standards. ▪ Impacts arising out of construction of drainage structures is not likely to impact drainage pattern since under the road design, pattern of flow and discharge capacities of all drainage structures are reviewed and designed to negate any heading up or flooding problems. ▪ Impacts on water quality are not significant or either negligible since construction activities to be scheduled to complete during dry months of year. ▪ Adequate precaution is to be taken to prevent oil/lubricant/hydrocarbon contamination of channel beds. Spillage if any shall be immediately cleared with utmost caution to leave no traces. ▪ Channel beds are to be cleaned up (50 m u/s & 50 m d/s sides of water courses) and restored to its previous state after completion of construction but prior to onset of monsoon.	Design consultants Supervising engineer with contractor and DoE	150
Borrow areas	▪ Borrow areas identified / suggested during project preparation are to be investigated for presence of ecologically sensitive areas if any and cleared thereof. ▪ Within these locations, the actual extent of area/zones to be excavated areas is to be demarcated with signboards. All such operational areas are to be access controlled particularly for locals and for grazing cattle. ▪ Through this project, the borrow areas/pits may be converted	Supervising engineer with contractor	100

Environmental Attributes	Mitigation Measures	Responsible Organization	Tk. in Million
	into surface/ponds wherever possible, as a derivative of development. Some of the ponds could serve as source of water for agriculture, a practice prevalent in some part of the country. ▪ The top soil recovered from newly acquired land areas for road construction is preserved and used for turfing of embankment(s) of project highway.		
Air Quality	▪ All operational areas under the road construction works are to be regularly monitored (atleast ONCE in a season) for air quality parameters such as SPM, RPM, SO2, NOx, HC, CO etc. ▪ This will ensure identification of operations/ areas of concern with regard to air pollution. Operational areas include, work sites, haulage roads, hot mix plants, quarries, borrow sites, human settlement etc. mitigation measures such water sprinkling for dust suppression, permitting construction equipment/vehicles having POLLUTION UNDER CONTROL certificates will reduce work area concentration of air pollutants like RPM, SO2, NOx, HC, CO etc. does not exceed permissible limits and therefore does not contribute to build up of pollutants	Supervising engineer with contractor and DoE	20
Removal of trees	▪ The most of the alignment of the road along the reserve forest and vegetation. Appreciable number of trees to be removed and further forest to be regenerated to replace the trees felled.	Forest Dept, Supervising engineer with contractor	300
Soil erosion and conservation	▪ Along rural roads the widening activities will raise, extend and enlarge existing roadway/tracks all along the alignment therefore mitigation measures to contain erosion and drainage problems are essential along RoW ▪ Measures to ensure embankment stabilization including selection of less erodable material, good compaction, re-vegetation, placement of gabions or any suitable measures around bridges and culverts etc. (in case required) are included in technical specification and contract documents. The engineering measures for countering soil erosion, slope protection, drainage wherever required considered for project highway and detailed project report. ▪ Many of impacts on soil due to road construction can be significantly mitigated by some of the following measures a) Minimizing area of ground clearance only to the extent required. b) Balancing the filling and cutting of earth to the extent possible. c) Avoiding creation of cut slopes and embankment which are of an angle greater than natural angle of repose for locally available soil type. d) Replanting disturbed area(s) immediately after disturbance due to construction has stopped and NOT after construction has been completed.	Design consultants Supervising engineer with contractor	150
Hot Mix Plants	▪ Hot mix plants shall be at least 1.5 km away from any human settlements and preferably located on leeward side. ▪ Hot mix plants/sites shall be located on barren/uncultivable lands. Diversion of cultivable/agricultural lands, even preferred by local people for economic gain shall not be allowed unless otherwise warranted by specific local conditions.	Design consultants Supervising engineer with contractor and DoE	20

Environmental Attributes	Mitigation Measures	Responsible Organization	Tk. in Million
Loss of Fertile soil	▪ Clearing operations within RoW and at all places of operational areas like borrow areas, work areas, labour camps, construction of new/upgradation of existing to new haulage roads, hot mix plants, storage areas etc. shall consider preservation of fertile soil . • As a first option, topsoil should be restored to its initial place after the specific activity is completed for which the area was vacated, or for enriching some other place like embankment slopes for turfing/erosion protective measure. The topsoil can also be used for supporting re-plantation activities within RoW/median.	Design consultants Supervising engineer with contractor and DoE NGOs, LGED	100
Location of campsites, storage depots	▪ The location of campsites, storage depots shall preferably on unproductive/barren lands, away from forest areas (minimum 1.5 km). ▪ Use of agricultural/ cultivable lands shall not be allowed under any circumstances. ▪ All fuel loading, unloading, storage areas shall be spill proof, leakage proof and carried out on paved areas. ▪ The sites shall have suitable system to drain storm water, sanitary facilities and shall not contaminate any near by water courses/drains. ▪ The site shall also have a system for handling any emergency situation like fire, explosion etc.	Design consultants Supervising engineer with contractor and DoE , LGED	30
Storage of hazardous materials	▪ All areas intended for storage of hazardous materials shall be quarantined and provided with adequate facilities to combat emergency situations. ▪ The personnel in charge of such areas shall be properly trained, licensed and with sufficient experience. ▪ The areas shall be access controlled and entry shall be allowed only under authorization	Supervising engineer with contractor and DoE, LGED	20
Total			**1050**

The detail mitigation cost can be calculated based on detail engineering design of infrastructure facilities of the project. The following need to be included:

Temporary excavation and embankment

- Silt fence,
- Seeding,
- Stream by-pass system,
- Air quality (dust prevention)
- Erosion control and planting,
- High-visibility fencing,
- Additional fencing
- Tire/Wheel wash area

Any alterations to the roadway design needed to avoid or minimize wetland impacts:

- Retaining walls,
- Altered roadway alignment,
- Steeper side slopes,
- Guardrail
- Bridges , Culvert installation

8.2.3 EMP Cost Matrix: Environmental Management Action Plan for Pre-Construction & Construction Phases (Water Ways: Rangamati-Chhotoharina)

Environmental Attributes	Mitigation Measures	Responsible Organization	Tk. in Million
Dredge Material Disposal	The disposed material to be in a convenient location so that does not return to the channel. Toxic material if found should be contained and dispose off with care and processing	Design consultants Supervising engineer with contractor	15
Dredging Work Sites	▪ The dredging camp sites shall be away from any local human settlements, Fishing area, and shelter of fish. The camps shall have adequate water supply, sanitation and all requisite infrastructure facilities. This would minimize dependence of construction personnel on outside resources, presently being used by local populace and minimize undesirable social friction thereof. ▪ The work site shall have septic tank/soak pit of adequate capacity so that it can function properly for the entire duration of its use. ▪ All sites have rationing facilities particularly for kerosene/LPG so that dependence on firewood for cooking is avoided completely to the extent possible. ▪ The sites shall have health care facilities particularly for kerosene/LPG so that dependence on firewood for cooking is avoided completely to the extent possible. ▪ The sites shall have health care facilities ▪ All workers shall be subjected to routine vaccinations and other preventive/ healthcare measures. ▪ The sites shall have in house community/common entertainment facilities. Dependence of local entertainment outlets by construction camps should be discouraged /prohibited to the extent possible	Supervising engineer with contractor Department of the Environment	35
Dredging Work sites	▪ All personnel in work sites shall have protective gears like helmets, boots etc. so that injuries to personnel are minimized. ▪ Children and pregnant women shall not be allowed to work under any circumstances. ▪ No personnel shall be allowed to work at site for more than 10 hours per day (8 hour makes one work shift). Personnel who are likely to exposed to noise levels beyond stipulated limits shall be provided with protective gears like ear plugs etc and regularly rotated. ▪ Regular water sprinkling of water shall be ensured so that dust levels are kept to minimum	Design consultants Supervising engineer with contractor and DoE	1
Construction Equipment Vessel	▪ All equipment/vessel deployed for dredging activities shall be regularly maintained and not older than 5 years. ▪ Vessel/equipment shall be regularly subjected for emission tests and shall have valid POLLUTION UNDER CONTROL certificates. Revalidation of certificates shall be done once in a month. ▪ All vessels deployed for material movement shall be spill proof to the extent possible. ▪ In any case all material movement navigation routes shall be inspected daily twice to clear off any accidental spills.	Design consultants Supervising engineer with contractor and DoE	3
Total			**74**

8.2.4 EMP Cost Matrix Environmental Management Action Plan for Pre-Construction & Construction Phases (Road Route: Chhotoharina-Thegamukh)

Environmental Attributes	Mitigation Measures	Responsible Organization	Tk. in Million
Diversion of traffic	▪ Appropriate traffic diversion schemes shall be implemented so as to avoid inconvenience due to project operations to present road users, particularly during nighttimes during dredging of navigational channel.. ▪ Proper diversion schemes will ensure smooth traffic flow minimizes accidents, traffic snarl ups, and commotion. ▪ The diversion signs should be displayed and be clearly visible particularly at night.	Consultants and contractors	5
Construction Camp Sites	▪ The construction camp sites shall be away from any local human settlements and preferably located on lands, which are not productive barren/waste lands presently. The camps shall have adequate water supply, sanitation and all requisite infrastructure facilities. This would minimize dependence of construction personnel on outside resources, presently being used by local populace and minimize undesirable social friction thereof. ▪ The camps shall have septic tank/soak pit of adequate capacity so that it can function properly for the entire duration of its use. ▪ All construction camps shall have rationing facilities particularly for kerosene/LPG so that dependence on firewood for cooking is avoided completely to the extent possible. ▪ The construction camps shall have health care facilities particularly for kerosene/LPG so that dependence on firewood for cooking is avoided completely to the extent possible. ▪ The camps shall have septic tank/soak pit of adequate capacity so that it can function properly for the entire duration of its use. ▪ All construction camps shall have rationing facilities particularly for kerosene/LPG so that dependence on firewood for cooking is avoided completely to the extent possible. ▪ The construction camps shall have health care facilities ▪ All construction personnel shall be subjected to routine vaccinations and other preventive/ healthcare measures. ▪ The construction camps shall have in house community/common entertainment facilities. Dependence of local entertainment outlets by construction camps should be discouraged /prohibited to the extent possible	Supervising engineer with contractor Department of the Environment	5
Work sites	▪ All personnel in work sites shall have protective gears like helmets, boots etc. so that injuries to personnel are minimized. ▪ Children and pregnant women shall not be allowed to work under any circumstances. ▪ No personnel shall be allowed to work at site for more than 10 hours per day (8 hour makes one work shift). Personnel who are likely to exposed to noise levels beyond stipulated limits shall be provided with protective gears like ear plugs etc and regularly rotated. ▪ Regular water sprinkling of water shall be ensured so that dust levels are kept to minimum	Design consultants Supervising engineer with contractor and DoE	3

Environmental Attributes	Mitigation Measures	Responsible Organization	Tk. in Million
Construction Equipment Vehicles	▪ All equipment/vehicles deployed for construction activities shall be regularly maintained and not older than 5 years. ▪ Vehicles/equipment shall be regularly subjected for emission tests and shall have valid POLLUTION UNDER CONTROL certificates. Revalidation of certificates shall be done once in a month. ▪ All vehicles deployed for material movement shall be spill proof to the extent possible. ▪ In any case all material movement routes shall be inspected daily twice to clear off any accidental spills.	Design consultants Supervising engineer with contractor and DoE	3
Water resources & Drainage channels	▪ The road construction will also require construction of several cross drainage structures, minor and major bridges to facilitate development in accordance with design requirements and standards. ▪ Impacts arising out of construction of drainage structures is not likely to impact drainage pattern since under the road design, pattern of flow and discharge capacities of all drainage structures are reviewed and designed to negate any heading up or flooding problems. ▪ Impacts on water quality are not significant or either negligible since construction activities to be scheduled to complete during dry months of year. ▪ Adequate precaution is to be taken to prevent oil/lubricant/hydrocarbon contamination of channel beds. Spillage if any shall be immediately cleared with utmost caution to leave no traces. ▪ Channel beds are to be cleaned up (50 m u/s & 50 m d/s sides of water courses) and restored to its previous state after completion of construction but prior to onset of monsoon.	Design consultants Supervising engineer with contractor and DoE	20
Borrow areas	▪ Borrow areas identified / suggested during project preparation are to be investigated for presence of ecologically sensitive areas if any and cleared thereof. ▪ Within these locations, the actual extent of area/zones to be excavated areas is to be demarcated with signboards. All such operational areas are to be access controlled particularly for locals and for grazing cattle. ▪ Through this project, the borrow areas/pits may be converted into surface/ponds wherever possible, as a derivative of development. Some of the ponds could serve as source of water for agriculture, a practice prevalent in some part of the country. ▪ The top soil recovered from newly acquired land areas for road construction is preserved and used for turfing of embankment(s) of project highway.	Supervising engineer with contractor	10
Removal of trees	The most of the alignment of the road along the reserve forest and vegetation. Appreciable number of trees to be removed and further forest to be regenerated to replace the trees felled.	Forest Dept, Supervising engineer with contractor	20
Soil erosion and conservation	▪ Along rural roads the widening activities will raise, extend and enlarge existing roadway/tracks all along the alignment therefore mitigation measures to contain erosion and drainage problems are essential along RoW ▪ Measures to ensure embankment stabilization including selection of less erodable material, good compaction, re-vegetation, placement of gabions or any suitable measures around bridges and culverts etc. (in case required) are	Design consultants Supervising engineer with contractor	10

Environmental Attributes	Mitigation Measures	Responsible Organization	Tk. in Million
	included in technical specification and contract documents. The engineering measures for countering soil erosion, slope protection, drainage wherever required considered for project highway and detailed project report. ▪ Many of impacts on soil due to road construction can be significantly mitigated by some of the following measures a) Minimizing area of ground clearance only to the extent required. b) Balancing the filling and cutting of earth to the extent possible. c) Avoiding creation of cut slopes and embankment which are of an angle greater than natural angle of repose for locally available soil type. d) Replanting disturbed area(s) immediately after disturbance due to construction has stopped and NOT after construction has been completed.		
Hot Mix Plants	▪ Hot mix plants shall be at least 1.5 km away from any human settlements and preferably located on leeward side. ▪ Hot mix plants/sites shall be located on barren/uncultivable lands. Diversion of cultivable/agricultural lands, even preferred by local people for economic gain shall not be allowed unless otherwise warranted by specific local conditions.	Design consultants Supervising engineer with contractor and DoE	2
Loss of Fertile soil	▪ Clearing operations within RoW and at all places of operational areas like borrow areas, work areas, labour camps, construction of new/upgradation of existing to new haulage roads, hot mix plants, storage areas etc. shall consider preservation of fertile soil . • As a first option, topsoil should be restored to its initial place after the specific activity is completed for which the area was vacated, or for enriching some other place like embankment slopes for turfing/erosion protective measure. The topsoil can also be used for supporting re-plantation activities within RoW/median.	Design consultants Supervising engineer with contractor and DoE NGOs, LGED	7
Storage of hazardous materials	• All areas intended for storage of hazardous materials shall be quarantined and provided with adequate facilities to combat emergency situations. • The personnel in charge of such areas shall be properly trained, licensed and with sufficient experience. • The areas shall be access controlled and entry shall be allowed only under authorization	Supervising engineer with contractor and DoE, LGED	2
Total			**87**

CHAPTER – 9
Conclusions and Recommendation

CHAPTER – 9
Conclusions and Recommendation

1. The CHT areas also have presence of tribal peoples in their ancestral territories with distinct culture, language and livelihood practices. These peoples will be socially impacted by the growth in transportation and commerce in that region which are among the goals of the eventual investments. The strategic framework for sustainable development in CHT has been launched. 25 action points to support Sustainable Development Goals in CHT has been incorporated in the 7th five year plan of Bangladesh.
2. Road only connectivity may not be compared with multimodal one. Carrying cargo by vessel along the river/ lake route will not help in improvement of socio economic condition of the indigenous people (IP) of hill population. The people living along the lake or river may not improve much in transporting their produce what they are doing now with passenger/cargo launches. Most benefit will go to the bulk carrier from Chittagong port to transboundary destination (negligible cargo traffic between Chittagong port to Barkal/Chhotoharina/Thegamukh). The planned road connectivity is must for the 'sustainable development goal' what government has out lined 25 points of action in the 7th five year plan in consultation with the ICIMOD.
3. The Kaptai Lake is the hot spot of biological diversity. Most families lost their land due to Kaptai reservoir and are living along the shore line of Kaptai lake and heavily dependent on the lake for water for drinking, household use, irrigation and fishing. It facilitates local transportation to connect between the hills around the lake. The dredging of Lake Route has high risk of damaging flora and fauna population particularly of fish habitat. If the lake is left without dredging (between Kaptai-Rangamati-Barkal along the Karnafuli channel in the lake) part of the year the vessel can't ply because of draft problem. The constraint of lost draft during dry season will have to be accepted. This need detail hydrological study and hydrographic survey. Moreover maintenance of dredger fleet, cargo vessel inside the lake is another impediment in protecting the habitat.
4. However the draft between Barkal and Chhotoharina can be increased by dredging. This portion of the channel is out of the Kaptai reservoir. Depending on the quality of dredged material it can be used to close the gaps of charas for road construction. The water control structure at the bottom may be needed. The careful dredging in this part of the multimodal route can avoid destruction/ upsetting fish habitat in the Kaptai Lake. Chhotoharina-Thegamukh is connected by road. But it is the same Karnafuli river which has made loop between Chhotoharina and Thegamukh. Chhotoharina can be connected to Thegamukh by dredging the Karnafuli river which likely to be about 18 km or cutting a loop of 1 km a bit upstream of Chhotoharina and Thegamukh.
5. In future Rajosthali can be connected to the Karnafuli left bank if further port facilities are developed. On the left bank there are small port activity like KAFCO has one jetty for their own use. Moreover, in future, Rajosthali can be connected to the Cox's Bazar highway which may lead to connectivity with deep sea port at Kutubdia/Moheshkhali. Tunnel at the outfall of Karnafuli has been planned that will effectively connect the eastern part of Chittagong with west. One bypass along the coastal embankment is under construction to

connect western part of the country (Dhaka, Sylhet etc.) avoiding city traffic congestion of Chittagong.

6. In Bangladesh land-based cross-border traffic is handled at custom check posts. Currently there are 9 operational land custom check posts – 5 under BOT and 4 directly operated by Bangladesh Land Ports Authority. Besides, there are a number of border land custom check posts that are under development or proposed. A land custom post is under process of development at Thegamukh, which is the terminal point of the proposed routes and also bordering with Mizoram state of North-eastern region of India. At present, there are no available cross-border movements through Thegamukh. Majority of cross-border traffic is moving through Benapole custom post.
7. However, some of the on-going regional initiatives like Bangladesh-China-India-Myanmar (BCIM) Economic Corridor and Mizoram State Roads II - Regional Transport Connectivity project, India (funded by World Bank) may provide a basis for broad assessment of cross-border traffic at Thegamukh.
8. The BCIM economic corridor is a sub-regional initiative for fostering cooperation among the four member countries. The proposed economic corridor originates from Kunming in China's Yunan province and pass through Yangon and Mandalay in Myanmar, Chittagong-Dhaka-Sylhet in Bangladesh before entering India's North Eastern states of Manipur and Assam and finally West Bengal and ending in Kolkata. The hinterland region of BCIM corridor is one of the richest in the world in terms natural, mineral and other resources. Enveloping about 9% of worlds area, the BCIM region accounts for 440 million people and 7.3% global GDP. The region has potential to generate enormous economic benefits in the area of trade, investment, energy, transportation and communications. The BCIM Corridor will allow all four countries to exploit existing complementarities in trade — in terms of both sectors and products. Myanmar is a primary goods exporter and has abundant cheap labor. India has an edge as a leading services exporter. China is the largest manufacturing exporter in the world; and Bangladesh, like many other South Asian countries, engages in both services export and low-end manufactured goods. Provision of this link would benefit North-eastern region of India as well Bangladesh.

Recommendations

1. During the detailed design there is a need for more detailed investigations in certain areas like the present proposed Road alignment is supposed to pass through Juraichari Sadar, and then it would need to remove all establishments of Upazila and other buildings.
2. Additional studies should be based on:
    - Information on ecological resources within the zone of influence;
    - Information gaps/survey needs that should be addressed in order to assess potential impacts and their significance.
    - During the evolution of the project to identify:
        - opportunities for preventative management;
        - the need for impact avoidance and mitigation; and
        - opportunities for enhancement;
    - After the mitigation strategies have been fully devised and their likely success considered;
    - After the residual impacts have been assessed if significant negative impacts are still likely; and
    - During construction, operational and decommissioning phases(s).
    - The proponent's ecologist should expect to liaise with other members of the proponent's team as the changes to be considered may relate to a wide range of issues such as hydrology, water quality, coastal processes, noise, or shipping and navigation.

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ANNEXURE I

Terms of Reference

for

Environmental and Social Impact Assessment (ESIA)

ANNEXURE I

Chittagong Hill Tract Connectivity Connecting Thegamukh and Chittagong Port; Bangladesh Trade and Transport Studies, RETF Project

Terms of Reference
for
Environmental and Social Impact Assessment (ESIA)

May 2016

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ANNEXURE I

Terms of Reference for ESIA

1. Introduction

Globalization and climate change have an increasing influence on the stability of fragile mountain ecosystems and the livelihoods of mountain people. Cherrapunjee-Chittagong Hill Tracts Landscape (CCHTL) is a globally unique geographical area. Geologically, the CCHTL represents ancient formations, largely igneous rock, unlike any other area in the Hindu Kush Himalayas. Connecting the Himalayas to mainland Bangladesh, the Chittagong Hill Tracts are blessed with vast evergreen forests, silvery waterfalls, swift mountain rivers, and a cool temperate climate. Although there are few protected areas within the landscape, a number of scared groves, scared caves, and forests make the landscape an important repository of biodiversity with one of the highest concentrations of endemic species in the Hindu Kush Himalayas. The people inhabiting this landscape are from diverse cultural groups. Agriculture is their main source of livelihood, followed by forests. Decreases in the shifting cultivation cycle, family fragmentation, unplanned and extensive mining, heavy overland flow and soil erosion, and development activities have significantly reduced the forest, biodiversity, and water retention capacity of the area in the recent years. In addition, although it is the wettest place on the Earth, the landscape has acute shortages of potable water because of pollution and development activities. Furthermore, climate change and its impact on rainfall patterns and hydrology, and the consequences of such changes for those living downstream, have not yet been investigated.

This project basically aims to improve the connectivity between Chittagong port to remote area of North–East (N-E) districts, which may lead to development of cross border transit corridors to N–E states of India. These corridors could be road or combination of water and land routes. In this respect, the Government has identified 4(four) probable land routes and 4(four) other routes based on all combinations of waterways requiring dredging.

Through the process of screening among the 8 routes (4 Road and 4 Multimodal) originally selected by the government of Bangladesh of which the 2 routes (1 Road and 1 Multimodal) has been selected for feasibility study.

Existing Project Roads and Water ways:
Existing road from Rajosthali–Bilaichhari–Juraichhari–Barkal–Thegamukh (Survey (Existing) 114.751 km, Design Length: 109.67 Km)

The existing road in land Route: Rajosthali–Bilaichhari–Juraichhari–Barkal–Thegamukh is of length 114.751 km. The first segment of the proposed alignment, i.e. a)Rajosthali to Bilaichari (49.100 km) is found 674.67m(Avg. carriage way 4.4m) paved by bituminous carpeting (BC) in green vicinity in hilly terrain and other parts are earthen road where 8 nos(645.90m). Rcc Bridges/Culvert are existed. Some missing links are found which aggregated 3226.68m. It is surveyed that 14 nos. Bridges/Culverts are required in different locations. In b) Bilaichari–Jurichari (29.436 km.) portion 1053.72 m paved road by Herring Bone Bond (HBB) with 3.217 m width is seen and 6 nos.(142.17m) Bridges/Culvert are existed. It is surveyed that further 15 nos. Bridges/Culverts are required in this portion. Some missing links aggregated 235.121 m are found in different locations. Other parts of the alignment are earthen roads. In this portion remarkable numbers of water lands (Chhara/Canal)) are seen. In c) Jurichari–Barkal(6.849 km.) section 3 nos (87.81m)existing Bridges are found.

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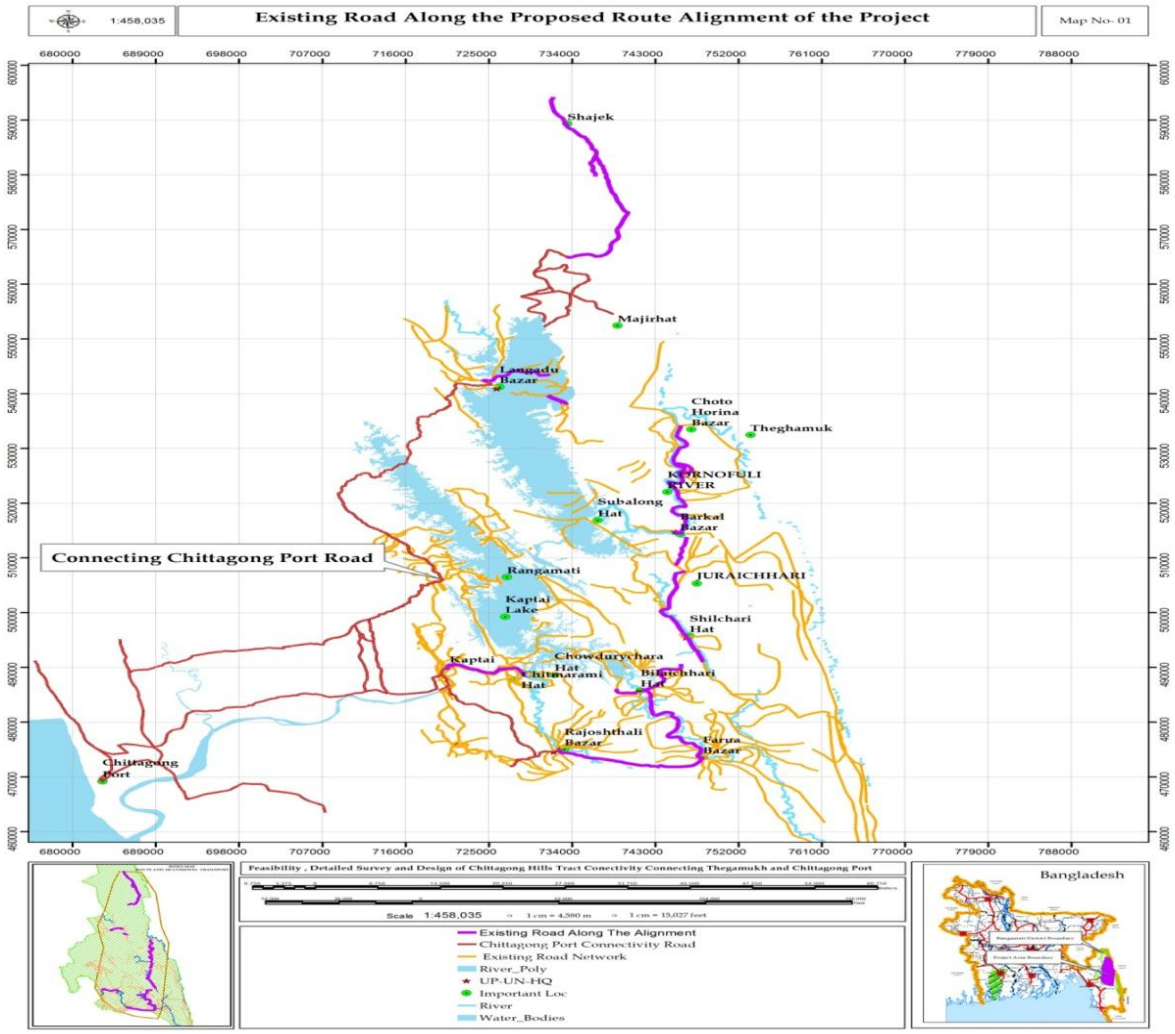

Fig 1.1A: Details of Existing Roads in the CHT Area

In this initially proposed alignment total 7 nos of Bridges/Culverts are required. In the hilly terrain the proposed alignment following the existing walkway or village road passes almost north direction within the green vicinity. In d) Barkal–Chhotoharina (21.277 km.) section 1187.40 m HBB road with 3 m width and 14 nos (308.49m) Bridges/Culverts are seen. Other parts of the alignment are earthen road where 22 nos Bridges/Culverts are required. In e) Chhotoharina–Thegamukh (8.089 km.) section 134.19 m HBB road with very narrow width of 1.5 m and 2 nos (79.32m) Bridges have been seen. Further 3 nos. Bridges are required in this section.

Multimodal Route 1: Rangamati - Chotoharina by waterway (63 km) and Thegamukh by road (8.089 km), (Proposed total length: 71.089 Km)

This route enroutes to Chotohorina via Shobolong, Barkal, Bhusionchar. It is about 63km. Chotohorina to Thegamukh is 8.089 km by road. Rangamati to Barkal 37.5 km is navigable round the year for small launches and boats. For larger cargo vessels navigable depth will need to be increased by dredging. Barkal to Chotohorina is navigable during monsoon for 3-4 months. This part of the waterway (25.5 km) will need massive dredging to increase navigable depth. Chhotoharina–Thegamukh portion 134.19m paved road by Herring Bon Bond (HBB) with 1.5 m

width is seen and other parts are earthen road. 2 nos (79.32m) Bridges are existed & 2 Bridges are required.

Following Table 1.1B and 1.1C indicates the details of road exising from Rajosthali to Thegamukh and Rangamati to Thegamukh.

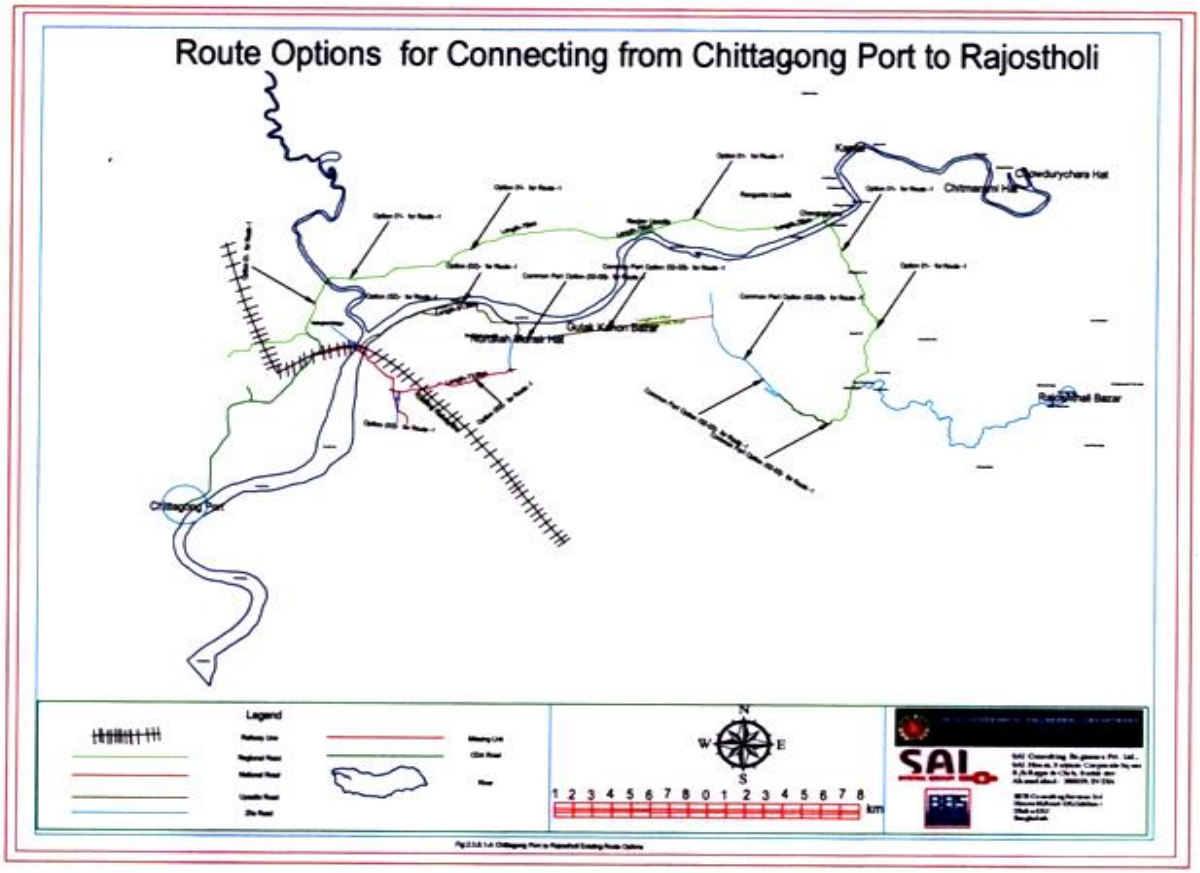

Fig 1.1B: Route Options for Connecting from Chittagong Port to Rajosthali

Candidate Road alignments:

1. Rajosthali–Bilaichhari–Juraichhari–Barkal–Thegamukh (about 123.54 km):
2. Langadu–Bagachattar–Barkal–Thegamukh (50.25 km) ;
3. Sajek–Majhipara–Dokanghat–Horina–Thegamukh (97.17 km); and
4. Bangchara (kaptai)–Chitmaran–Chakuwapara–Bhangamurapara–Bilaichhari–Silchhari–mitngapara (Jurachhari)–Barkal–Chhotoharina- thegamukh (106.12 km).

Multimodal routes

1. Rangamati–Chhotoharina–connected by waterway (63 Km) and Thegamukh by road (about 7.98 km);
2. Rangamiti–Barkal (37.5 Km) waterway and then Thegamukh (23.30 Km) by road;
3. Kaptai–Barkal waterway (64.81 Km) and Thegamukh by road (29.30 Km);
4. Kaptai–Chhotoharina–by waterway (89.62 Km) and Thegamukh by road (7.98 Km).

Selected Road alignments

1. Rajosthali– Bilaichhari–Juraichhari–Barkal–Thegamukh (about 114.751 km): (Road only).
2. Rangamati–Chhotoharina–connected by waterway (63 Km) and Thegamukh by road (about 8.089 km); (Multimodal).

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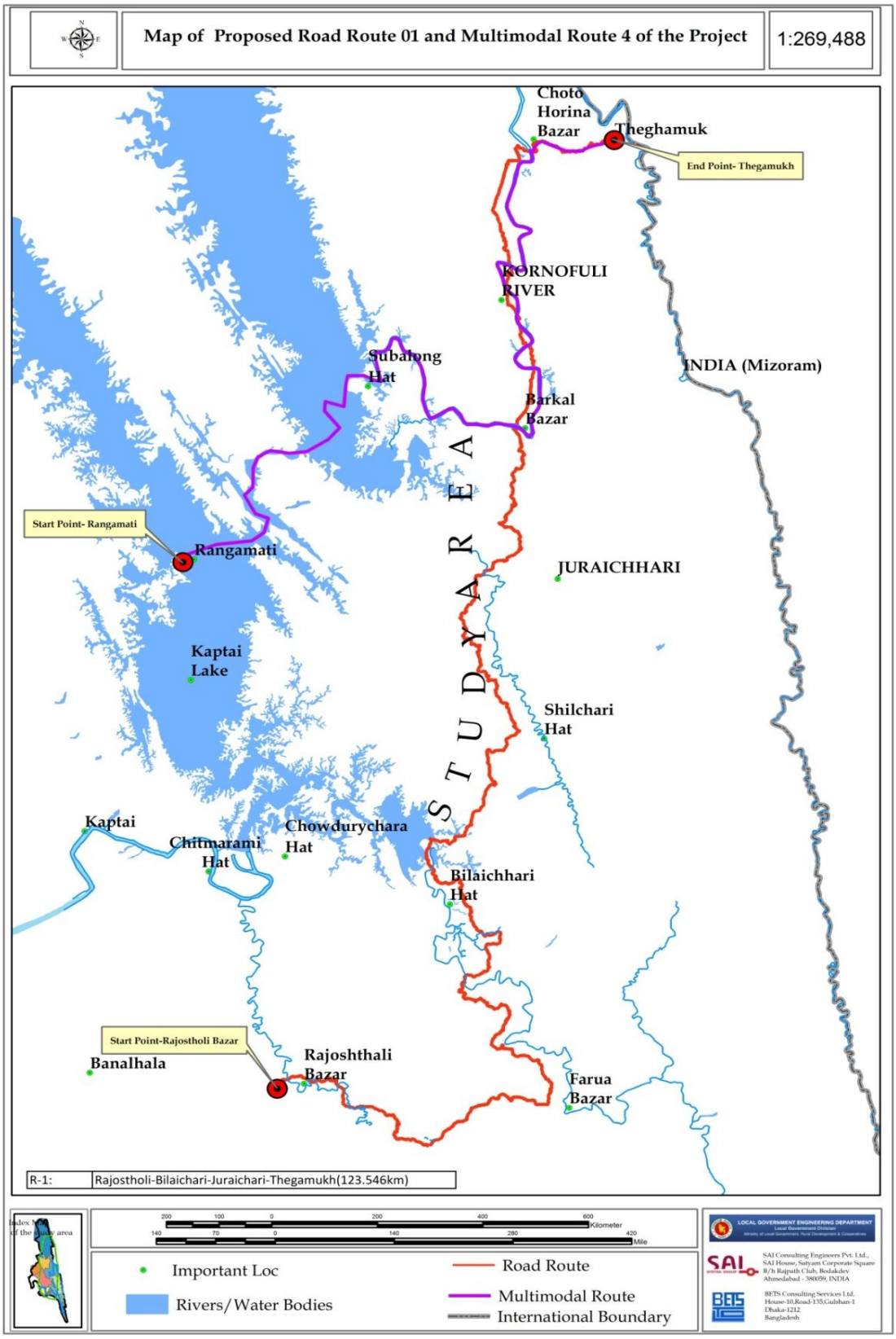

Fig 1.1C: Selected Route Alignments (Road and Multimodal)

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Project area of influence:

Connecting the Himalayas to mainland Bangladesh, the Chittagong Hill Tracts are blessed with vast evergreen forests, silvery waterfalls, swift mountain rivers, and a cool temperate climate. Low hills are found in the north-eastern extremities of Bangladesh. These hills are part or extension of the Khasia-Garo-Jainta and the Tippera Hills of India. The more important hilly areas are concentrated in hill districts of Chittagong Division and are geologically the offshoots of the ArakanYoma running through Eastern India to Burma. The Chittagong hills are steep sloped parallel ranges, largely covered with tropical forests. These hills rise steeply to narrow ridge lines, generally no wider than 120 feet and no higher than 2000 to 3000 feet. The highest hill in Bangladesh is Keokradang (4034 feet) in south-east end of Bandarban district.

Area of Influence OP 4.01, Annex A, para. 6: Project area of influence: The area likely to be affected by the project, including all its ancillary aspects, such as power transmission corridors, pipelines, canals, tunnels, relocation and access roads, borrow and disposal areas, and construction camps, as well as unplanned developments induced by the project (e.g., spontaneous settlement, logging, or shifting agriculture along access roads). The area of influence may include, for example, (a) the watershed within which the project is located; (b) any affected estuary and coastal zone; (c) off-site areas required for resettlement or compensatory tracts; (d) the airshed (e.g., where airborne pollution such as smoke or dust may enter or leave the area of influence; (e) migratory routes of humans, wildlife, or fish, particularly where they relate to public health, economic activities, or environmental conservation; and (f) areas used for livelihood activities (hunting, fishing, grazing, gathering, agriculture, etc.) or religious or ceremonial purposes of a customary nature. Why is AOI important?· As it Provides a logical structure for defining project boundaries of assessment and accountability, including…· the spatial, temporal and thematic boundaries of the project which is essential for issues scoping, screening and defining the content of environmental and social impact assessments · the boundary conditions for conducting economic analysis · The formulation of a structure for public consultations and stakeholder engagement - where and with whom to consult?

No standard methodology but AOI usually incorporates two concepts.
AOI = Area of direct impacts + Area of Indirect impacts

Area of Direct Impacts: usually considered the physical footprint of the project such as right-of-way, construction

Indirect Impacts: more difficult to define precisely but includes areas which may experience induced or cumulative changes in combination with activities not under the direct control of the project sites, work staging areas, and areas affected during the operational phase (e.g., new traffic patterns).

Cross-Border Traffic

In Bangladesh land-based cross-border traffic is handled at custom check posts. Currently there are 9 operational land custom check posts–5 under BOT and 4 directly operated by Bangladesh Land Ports Authority (BLPA)–Fig 1.1D: Bangladesh Land Ports

ANNEXURE I

Fig 1.1D: Bangladesh Land Ports.

Besides, there are a number of border land custom check posts that are under development or proposed Fig 1.1D. As may be seen from the above map, a land custom post is under process of development at Thegamukh, which is the terminal point of the proposed routes and also bordering with Mizoram state of North-eastern region of India.

At present, there are no available cross-border movents through Thegamukh. Majority of cross-border traffic is moving through Benapole custom post. Table 1.1A presents cross-border traffic (imports and exports) through land ports. Available data does not provide any meaningful basis for forecast of cross-border traffic through Thegamukh.

Table 1.1A: Imports - Exports through Land Ports: Bangladesh

Year	Imports		Exports		Total		Exports as % of Imports	Imports as % of total
	Quantity (Tonnes)	Growth (%)	Quantity (Tonnes)	Growth (%)	Quantity (Tonnes)	Growth (%)		
2008-09	2,511,422		914,639		3,426,061		36.42%	73.30%
2009-10	2,834,003	12.84%	948,403	3.69%	3,782,406	10.40%	33.47%	74.93%

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Year	Imports		Exports		Total		Exports as % of Imports	Imports as % of total
	Quantity (Tonnes)	Growth (%)	Quantity (Tonnes)	Growth (%)	Quantity (Tonnes)	Growth (%)		
2010-11	3,539,251	24.89%	1,144,279	20.65%	4,683,530	23.82%	32.33%	75.57%
2011-12	4,631,403	30.86%	1,189,248	3.93%	5,820,651	24.28%	25.68%	79.57%
2012-13	4,990,898	7.76%	1,162,687	-2.23%	6,153,585	5.72%	23.30%	81.11%
2013-14	6,866,286	37.58%	731,433	-37.09%	7,597,719	23.47%	10.65%	90.37%
Average		22.79%		-2.21%		17.54%	26.97%	79.14%

Source: *Bangladesh Land Port Authority, Website: www.bsbk.gov.bd*

The following figure (Fig 1.1A) shows that the proposed connectivity road Ctg-Rajotholi-Barkal-Teghamukh will connect to the possible deep sea port likely to be developed in south-eastern part of Chittagong. This will lead to the connectivity of whole of north eastern India, Bhutan and Nepal. This will create easy and shortest route to the available sea port to those land lock countries and areas of the subcontinent.

The future potential coming up projects within the area of influence are namely:

i. Bangladesh-China-India-Myanmar (BCIM) Economic Corridor
ii. Mizoram State Roads II - Regional Transport Connectivity project, India
iii. 22.0 km section of Lunglei –Tlabung–Kawrpuichhuah Road on the border with Bangladesh;
iv. The 27.5km Champhai-Zokhawthar Road on the border with Myanmar; and
v. The 41.7km Chhumkhum-Chawngte North-South alignment connecting to the border roads with Bangladesh to the west and Myanmar to the south.

Fig 1.1E: Bangladesh-China-India-Myanmar (BCIM) Economic Corridor

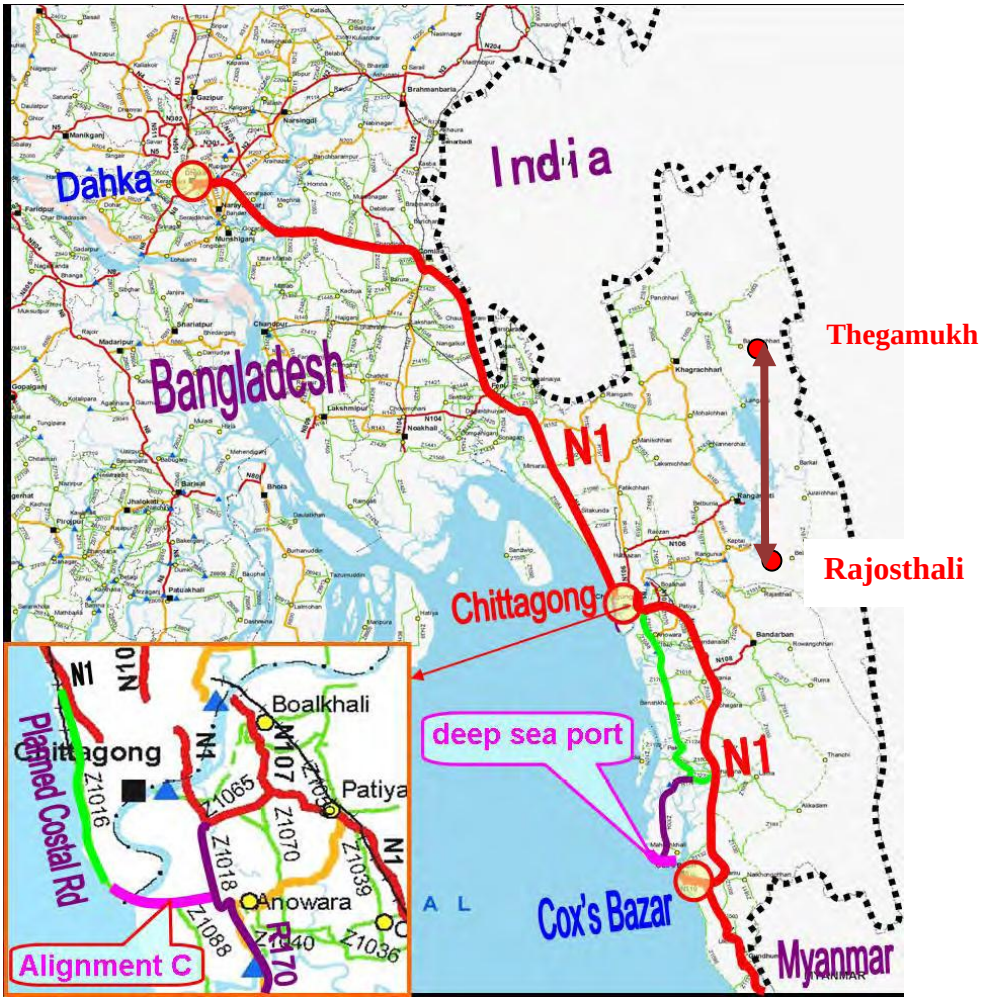

Fig 1.1F: Area of influence with in Bangladesh

Description of the project

Since the proposed road is going to be one of the major road corridor of category regional/national highway with 7.3 m width (two lane) principally RHD Geometric Design Standards Manual (Revised) 2005 has been followed for design parameters. Besides the following reference recommendations and standards have been consulted.

- AASHTO "A policy on Geometric Design of Highway and Streets" 2005
- IRC _SP_48_1998
- Overseas Road Note 6 "A Guide to Geometric Design" published by TRRL 1988
- Nepal Road Standards 2020(July 2013), Government of Nepal, Ministry of Physical Infrastructure and Transport. Department of Roads, Kathmandu, Nepal

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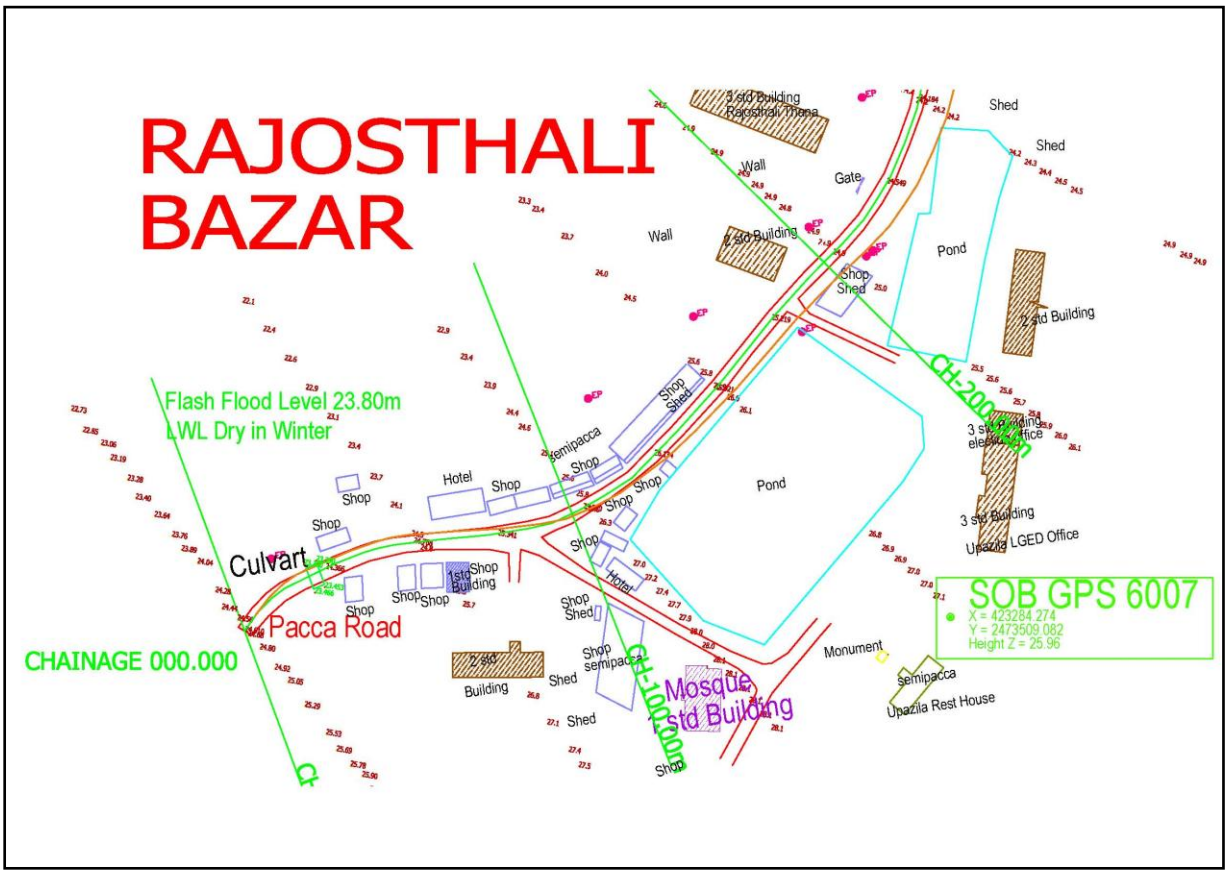

Fig. 1.1G: Details of Aligned Road is Shown in CAD Map

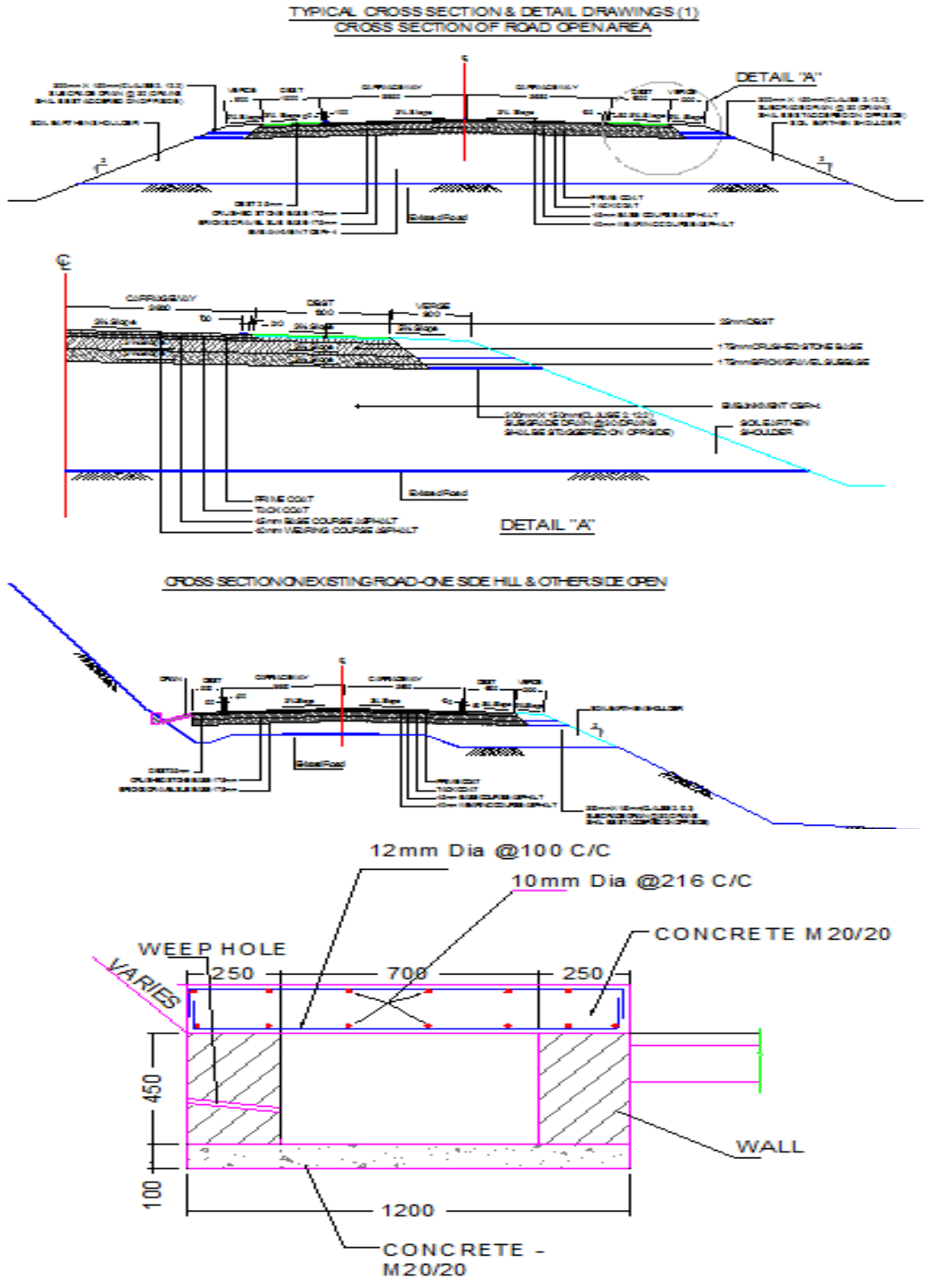

Fig. 1.1H: Typical Cross-section and Detail Design

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Table 1.1B: Proposed Culverts for Road Route

Culvert No.	Existing Chainage No.	Road Design Chainage No.	Size of Culvert Vent x b x h, (m)	Slab top finished Level (FL), m (PWD)	Invert Level (IL), m (PWD)	Remarks
From Ch.00+000-47+066= 47.066 Km						
CUL-01	Ch 0+025	Ch 0+025	1x4.0x3.0	24.70	21.30	Existing to be replaced
CUL-02	Ch 19+340	Ch 18+533	2x6.0x3.0	51.45	48.00	New
CUL-03	Ch 20+970	Ch 20+119	2x5.0x5.0	56.45	51.45	Existing to be replaced
CUL-04	Ch 21+030	Ch 20+175	1x6.0x4.0	58.00	53.55	Existing to be replaced
CUL-05	Ch 21+215	Ch 20+353	1x6.0x4.5	69.95	65.45	Existing to be replaced
CUL-06	Ch 22+955	Ch 22+079	1x4.0x3.0	36.00	32.60	New
From Ch.47+066-75+157=28.091km						
CUL-07	Ch 50+850	Ch 48+705	1x6.0x5.0	46.50	53.00	New, Shifted from Ch. 50+900 as per site cond.
CUL-08	Ch 59+900	Ch 57+321	2x4.0x6.0	59.40	53.00	New
CUL-09	Ch 62+205	Ch 59+560	2x4.0x3.0	51.90	48.50	New
CUL-10	Ch 62+975	Ch 60+290	2x3.5x4.0	55.40	51.00	New
CUL-11	Ch 64+100	Ch 61+373	2x3.0x4.0	43.35	39.00	Existing to be replaced
CUL-12	Ch 65+610	Ch 62+864	2x4.5x3.0	48.40	45.00	Existing to be replaced
CUL-13	Ch 66+850	Ch 64+042	1x6.0x4.5	60.90	56.45	New
CUL-14	Ch 70+180	Ch 67+183	2x4.5x4.0	34.90	30.50	New
CUL-15	Ch 77+085	Ch 73+730	2x4.5x4.0	32.25	27.85	New
CUL-16	Ch 77+940	Ch 74+567	2x3.5x3.0	36.65	33.25	Existing to be replaced
From Ch.75+157-81+600=6.443km						
CUL-17	Ch 79+000	Ch 75+615	1x6.0x6.0	45.00	38.50	Existing to be replaced
From Ch.81+600-102+098=20.498km						
CUL-18	Ch 86+920	Ch 82+980	2x4.0x5.0	34.70	28.30	New
CUL-19	Ch 89+602	Ch 85+638	2x5.0x4.0	34.68	30.23	New
CUL-20	Ch 91+115	Ch 87+059	2x4.0x3.0	37.00	33.60	Marcy Land
CUL-21	Ch 104+850	Ch 100+306	3.0x5.0x5.0	56.45	51.45	Existing to be replaced

Table 1.1C: Proposed Bridges for Road Route

Bridge No.	Existing Chainage No	Road Design Chainage	Missing Length (m)	Proposed Structural Deck Length(m)	Existing Ground Level (m)	Pile Cap Level (m)	Finish Level/Deck Level(m)	Type of Bridge	HFL (m)	LFL(m)	Remarks
From Ch.00+000-47+066= 47.066 Km											
1	Ch 0+0380	Ch 0+378	61.894	(3x21.0)	18.4	20.55	26.02	RCC Bridge	22.30	Dry in winter	Existing to be replaced
2	Ch 5+145	Ch 4+932	32.116	(1x35.0)	27.93	25.26	32.52	PSC Bridge	28.50	Dry in winter	New
3	Ch 8+385	Ch 8+040	28.004	(1x30.0)	51.05	44.80	56.02	PSC Bridge	52.20	Dry in winter	New
4	Ch 11+850	Ch 11+268	30.378	(1x35.0)	57.12	60.21	67.47	PSC Bridge	62.96	Dry in winter	New
5	Ch 33+490	Ch 32+251	41.129	(3x15.0)	32.34	34.08	39.42	RCC Bridge	35.00	Dry in winter	New
6	Ch 39+960	Ch 38+543	286.628	(9x32.0)	36.01	38.22	48.82	PSC Bridge	44.00	38	Existing to be

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Bridge No.	Existing Chainage No	Road Design Chainage	Missing Length (m)	Proposed Structural Deck Length(m)	Existing Ground Level (m)	Pile Cap Level (m)	Finish Level/Deck Level(m)	Type of Bridge	HFL (m)	LFL(m)	Remarks
											replaced
7	Ch 47+850	Ch 45+862	131.687	(5x26.0)	20.55	26.69	35.32	PSC Bridge	30.50	22	Existing to be replaced
8	Ch 48+240	Ch 46+262	112.074	(3x38.0)	19.69	27.99	35.92	PSC Bridge	30.50	22	Existing to be replaced
From Ch.47+066-75+157=28.091km											
9	Ch 51+840	Ch 49+645	16.891	(1x20.0)	33.13	34.37	39.52	RCC Bridge	35.00	Dry in winter	New
10	Ch 65+340	Ch 62+607	33.989	(1x35.0)	45.56	43.80	52.02	PSC Bridge	47.00	Dry in winter	Existing to be replaced
11	Ch 68+985	Ch 66+047	18.967	(1x20.0)	41.56	41.00	46.52	RCC Bridge	44.00	Dry in winter	New
12	Ch 72+250	Ch 69+197	34.896	(1x35.0)	30.77	28.80	37.52	PSC Bridge	33.02	Dry in winter	New
13	Ch 77+275	Ch 73+925	86.631	(3x30)	27.9	28.00	36.32	PSC Bridge	31.50	Dry in winter	Existing to be replaced
From Ch.75+157-81+600=6.443km											
14	Ch 78+890	Ch 75+507	11.643	(1x15.0)	43.69	39.68	45.77	RCC Bridge	41.00	Dry in winter	Existing to be replaced
15	Ch 79+315	Ch 75+870	18.593	(1x20.0)	26.35	33.00	38.52	RCC Bridge	34.50	Dry in winter	Existing to be replaced
16	Ch 80+115	Ch 76+660	30.907	(1x35.0)	34.39	34.76	41.02	PSC Bridge	36.00	Dry in winter	New
17	Ch 83+340	Ch 79+700	11.685	(1x15.0)	163.88	164.96	171.07	RCC Bridge	166.65	Dry in winter	New
18	Ch 84+595	Ch 80+842	11.197	(1x15.0)	37.75	37.67	42.67	RCC Bridge	39.25	Dry in winter	New
19	Ch 85+270	Ch 81+480	227.194	(7x33.0)	12.2	22.00	42.76	PSC Bridge	33.23	23.17	New
From Ch.81+600-102+098=20.498km											
20	Ch 88+215	Ch 84+250	153.816	(5x32.0)	19.2	27.00	42.67	PSC Bridge	33.23	23.17	New
21	Ch 89+530	Ch 85+570	11.123	(1x15.0)	31.51	31.54	36.65	RCC Bridge		Dry in winter	New
22	Ch 90+075	Ch 86+104	28.512	(1x30.0)	30.1	29.67	37.05	PSC Bridge		Dry in winter	New
23	Ch 90+690	Ch 86+685	22.422	(1x25.0)	29.37	31.86	37.05	RCC Bridge		Dry in winter	New
24	Ch 91+030	Ch 86+972	14.307	(1x15.0)	35.59	31.54	36.65	RCC Bridge		Dry in winter	New
25	Ch 91+440	Ch 87+379	11.53	(1x15.0)	36.8	31.54	36.65	RCC Bridge		Dry in winter	New
26	Ch 95+040	Ch 90+825	43.842	(3x15.0)	33.64	31.31	36.65	RCC Bridge	33.23	Dry in winter	Existing to be replaced
27	Ch 95+530	Ch 91+327	39.001	(3x15.0)	30.64	31.31	36.65	RCC Bridge	33.23	Dry in winter	Existing to be

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Bridge No.	Existing Chainage No	Road Design Chainage	Missing Length (m)	Proposed Structural Deck Length(m)	Existing Ground Level (m)	Pile Cap Level (m)	Finish Level/Deck Level(m)	Type of Bridge	HFL (m)	LFL(m)	Remarks
											replaced
28	Ch 95+985	Ch 91+770	23.394	(1x30.0)	27.5	29.68	37.05	PSC Bridge	29.90	Dry in winter	Existing to be replaced
29	Ch 97+400	Ch 93+082	130.426	(3x30.0-2x26.0)	12.2	18.00	42.67	PSC Bridge	33.23	23.17	New
30	Ch 100+190	Ch 95+687	11.777	(1x15.0)	30.3	31.54	36.65	RCC Bridge	33.23	Dry in winter	Existing to be replaced
31	Ch 101+740	Ch 97+200	29.676	(1x30.0)	31.8	30.87	37.25	PSC Bridge	33.23	Dry in winter	Existing to be replaced
32	Ch 103+360	Ch 98+802	23.461	(1x25.0)	31.8	31.86	37.05	RCC Bridge	33.23	Dry in winter	Existing to be replaced
33	Ch 103+725	Ch 99+175	36.574	(1x30.0)	31.9	30.82	37.05	PSC Bridge	33.23	Dry in winter	Existing to be replaced
34	Ch 103+975	Ch 99+425	26.466	(1x30.0)	31.5	30.82	37.05	PSC Bridge	33.23	Dry in winter	Existing to be replaced
35	Ch 104+085	Ch 99+527	11.883	(1x15.0)	32.5	31.54	36.65	RCC Bridge	33.23	Dry in winter	Existing to be replaced
36	Ch 105+395	Ch 100+837	31.63	(1x35.0)	32.2	29.98	37.25	PSC Bridge	33.23	Dry in winter	Existing to be replaced
37	Ch 106+580	Ch 101+997	167.496	(5x35.0)	12.2	31.00	42.87	PSC Bridge	33.23	23.17	New
From Ch.102+098-109.675=7.577km											
38	Ch 106+840	Ch 102+265	27.541	(1x30.0)	13.5	30.80	37.05	PSC Bridge	33.23	Dry in winter	Existing to be replaced
39	Ch 113+145	Ch 108+152	29.36	(1x35.0)	41.34	39.58	47.02	PSC Bridge	43.00	Dry in winter	New
40	Ch 114+150	Ch 109+105	18.145	(1x20.0)	35.1	36.37	41.52	RCC Bridge	38.01	Dry in winter	Existing to be replaced

Table 1.1D: Road Portion of Multimodal Alignment

From Chotohorina to Thegamukh (Multimodal)										
Route ID	Location	Chainage (m)				Length (m)	Road/Bridge Width (m)	Existing Feature Types	Ownership	LGED Road Code No
		CH-Start		To	CH-End					
Multimodal Route Road Part	Chotoharina to Thegamukh	Ch	0.000	to	171.298	171.298				UNR-484213004
		Ch	171.298	to	232.473	61.175	1.563	Existing Bridge	LGED	UNR-484213005
		Ch	232.473	to	1564.891	1332.417				UNR-484213006
		Ch	1564.891	to	1566.015	1.125	Chhara	Missing Link		
		Ch	1566.015	to	6469.088	4903.072				UNR-

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From Chotohorina to Thegamukh (Multimodal)										
Route ID	Location	Chainage (m)				Length (m)	Road/Bridge Width (m)	Existing Feature Types	Ownership	LGED Road Code No
		CH-Start		To	CH-End					
										484213004
		Ch	6469.088	to	6498.513	29.425	Chhara	Missing Link		
		Ch	6498.513	to	7486.729	988.216				UNR-484213004
		Ch	7486.729	to	7504.873	18.145	1.854	Existing Bridge	LGED	UNR-484213004
		Ch	7504.873	to	7642.566	137.693				UNR-484213004
		Ch	7642.566	to	7776.758	134.192				UNR-484213004
		Ch	7776.758	to	8089.114	312.356				UNR-484213004

The following tentative locations have been identified where there is a need for Detailed Investigation (DI) during detailed design phase and appropriate measure need to be adopted as discussed above in the form of Bio- Engineering (BE), Turfing (TF), Water Management (WM), Trimming etc.

Table 1.1E: Area Prone to Slope Stability

Sl. No.	Area Prone to Slope Stability		Remedial Measures
	From	To	
1	Ch. 8+150	Ch. 9+150	DI/BE/TF/WM/BT
2	Ch. 9+650	Ch. 11+250	DI/BE/TF/WM/BT
3	Ch. 11+450	Ch. 12+250	DI/BE/TF/WM/BT
4	Ch. 12+550	Ch. 13+550	DI/BE/TF/WM/BT
5	Ch. 13+750	Ch. 17+250	DI/BE/TF/WM/BT
6	Ch. 36+700	Ch. 37+950	DI/BE/TF/WM/BT
7	Ch. 51+000	Ch. 56+400	DI/BE/TF/WM/BT
8	Ch. 78+950	Ch. 80+800	DI/BE/TF/WM/BT

Bioengineering: Turfing is the most well-known and cheapest form of slope protection. The success of the measure depends upon the suitability of the soil to the development of turf culture. Purely sandy soils are unsuitable for growth of turf. In such cases, layer of clay soil (0.25-.03 m thick) from suitable borrow area can be laid to (i) confine the sand and (ii) foster growth of turf. Turf can be grown by planting sods or by seeding. Sods are preferred on steeper slopes, whereas seeding is resorted to on flatter slopes. The use of jute netting, coir netting and geo-grids helps the turf to grow by holding the soil firmly. After the turf grows, the jute and coir netting decomposes.

Erosion Mitigation Measures

Measures	Effectiveness	Comparative Costs
Grass seeding	Only surface effective, avoids start of erosion	Least expensive
Vetiver grass	Excellent, even at depth	Inexpensive
Shrubs	Excellent	Two to three times cost of grass

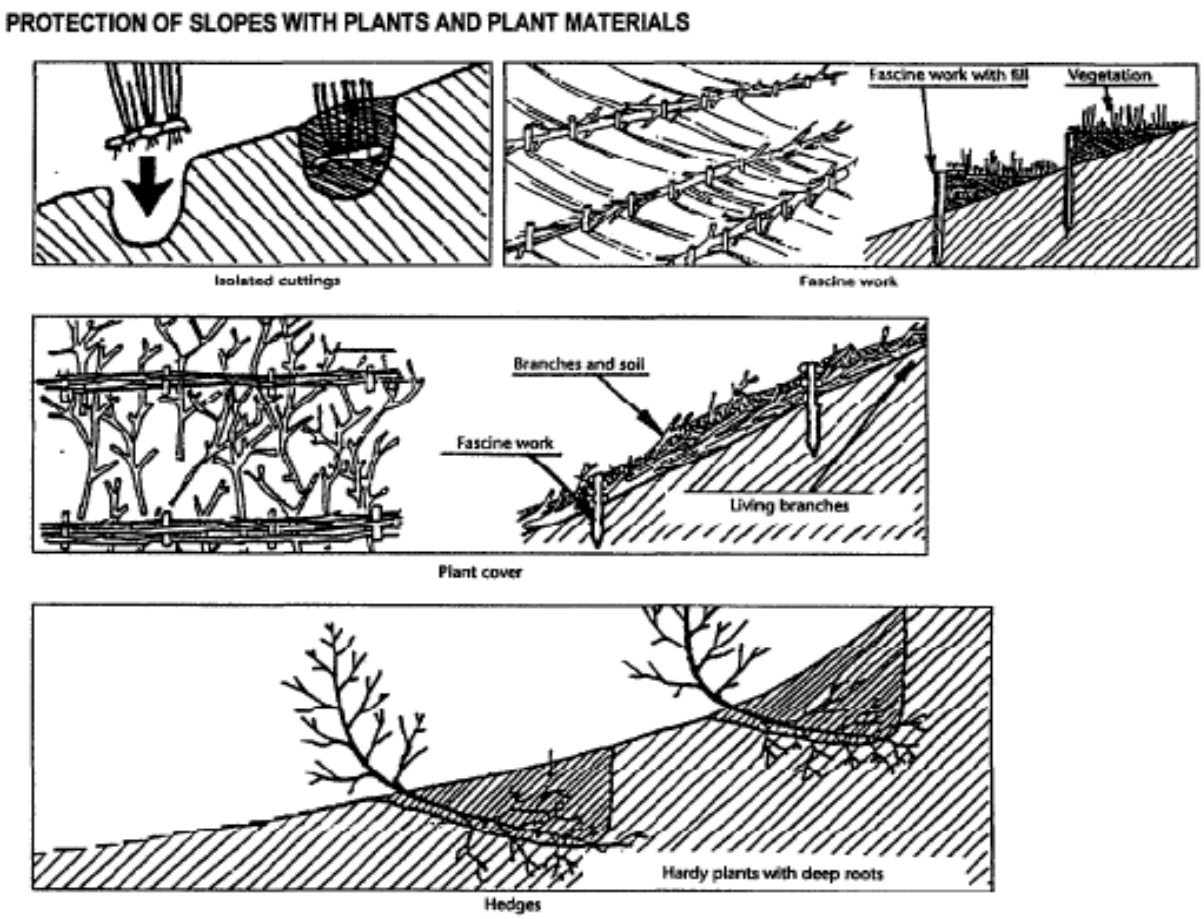

Fig 1.1I: Protection of Slopes with Plants and Plants Materials.

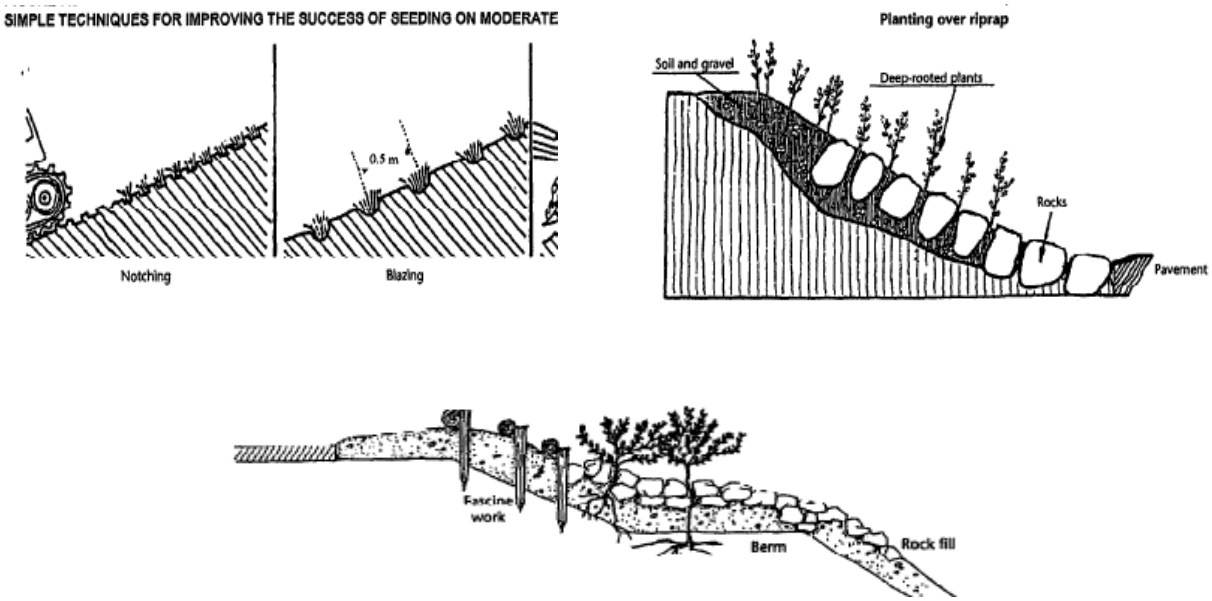

Fig 1.1J: Seeding for Slopes Protection

ANNEXURE I

Analysis of alternatives

Systematically compares feasible alternatives to the proposed project site, technology, design, and operation--including the "without project" situation--in terms of their potential environmental impacts; the feasibility of mitigating these impacts; their capital and recurrent costs; their suitability under local conditions; and their institutional, training, and monitoring requirements. For each of the alternatives, quantifies the environmental impacts to the extent possible, and attaches economic values where feasible. States the basis for selecting the particular project design proposed and justifies recommended emission levels and approaches to pollution prevention and abatement.

The EA should investigate and document the likely environmental effects of relevant alternatives, where these offer a distinct potential for superior environmental outcomes and are capable of meeting the objectives of the project. In the first instance, the discussion of relevant alternatives should include:

- The basis for the preferred site layout (for example the preferred sitting).
- The selection process for roads, including the access feeder road.
- The technical feasibility and environmental implications of alternative road alignment

Where appropriate, the assessment of environmental effects of relevant alternatives is to address the matters set out in the subsequent sections of this document.

The depth of investigation of alternatives should be proportionate to their potential to minimise potential adverse effects and meet project objectives.

The two (1 Road and 1 Multimodal) probable route alignment is selected from 8 candidate routes (4 Roads and 4 Multimodal). The most appropriate road route is Rajosthali–Bilaichhari–Juraichhari–Barkal–Thegamukh (about 114.751 Km) Multimodal Route is Rangarnati-Chhotoharina connected by waterways (about 63 Km) and Thegamukh by road (about 8.089 Km) portion is the same as Road Route 1. Eight alignments for road and multimodal routes were tested by multi-criteria analysis (ref. to the project report) and finally selected the 2 routes. So option for alternative has been exhausted in alignment selection. Further analysis may not be required at this stage. However, during detailed design of the Routes (Road and Multimodal) in the 2nd phase the alternative "without project" & others can be analysed.

The “no project” alternative versus “with project” alternative was analyzed from the financial, technical, economic, social and environmental point of view. It was found that for all cases the project area, local people and wildlife are better off with the project. While the local people will be impacted by land acquisition and resettlement required for the project, they will be benefitted in the long term due to improved access and less vulnerable conditions due to flooding from different Charas/ rivulet. In light of the existing human-wildlife conflicts in the project area, the project will bring complementary efforts targeted at improving wildlife and ecological conservation by addressing the conflict situation. Therefore even from the environment point of view it is better to have the project than not.

ANNEXURE I

Consultancy Services

This term of reference has been prepared as a general guideline for the preparation of an Environmental, Social Impact Assessment for use with projects that are being implemented within the Bangladesh context. If the project is to be funded or supported in any way by external support agencies it is important that all the safeguard requirements of that funding agency are adhered to the WB guidelines in relation to environmental and social impacts of a project and also if there is any disruption to livelihoods, housing and incomes during and after implementation these need to be addressed in compliance with the donor's requirements.

For example, the World Bank has 4 categories A, B, C, FI which are listed and defined in Annex 1 along with a brief description of what is required. Other agencies may have slightly different requirements but generally the multinational banks have to most stringent requirements hence the reason for including that as an Annex.

Resettlement is also another major issue within the safeguards category an if there is any, purchase/acquisition of land or people and property displacement of any kind it is strongly advised that the resettlement action plan requirements of the respective donor be adopted or at least fully understood.

2. Objectives

The aim of the study is to achieve the following objectives:

- To review of existing Environmental Impact Assessment (EIA) reports.
- To identify and assess potential environmental and social impacts of the project.
- To identify all potential significant adverse environmental and social impacts, of the projects and recommend measures for mitigation.
- To review and develop an Environmental and Social Management Plan (ESMP).
- To prepare an Environmental and Social Impact Assessment and ESMP reports compliant to the relevant authorities, and detailing findings and recommendations.

Scope of the Consultancy Services

The consultant is expected to undertake investigations on social aspects, economic activities, and conservation of natural resources, historical and anthropological heritages, public consultations and disclosures. The proposed road connectivity between Chittagong Port and Theghamukh on the north eastern boarder will have two alignments one road and another multimodal (road combined with navigational route through Kaptai Lake) will be provided to give a guideline of the facilities to be studied.

The scope of services to be undertaken by the Consultant shall include the following tasks.

Task 1. Detailed Desk-top Review

The Consultant is to review all existing documentation, and any previous EIA and ESMP reports. They shall further undertake a detailed study of the proposed (project), mapping on actual map of appropriate scale. The Consultant shall then concisely describe each facility assessed, its geographic, ecological, general layout of facilities including maps at appropriate scale where necessary Information on size, capacity, facilities and services should also be provided.

Task 2. Description of the Baseline Environment

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The Consultant is required to collect, collate and present baseline information on the environmental characteristics of the existing situation around each facility. This description should involve but not limited to:

1. Physical environment (topography, land cover, geology, climate and meteorology air quality, hydrology, etc.)
2. Biological environment (i.e., flora and fauna types and diversity, endangered species, sensitive habitats etc.)
3. Social and cultural environment, including present and projected. Where appropriate (i.e., population, land use, planned development activities, community social structure, employment and labor market, sources and distribution of income, cultural/religious sites and properties, vulnerable groups and indigenous populations etc.)
4. Economic activities, agriculture, livestock, fisheries, small scale industries etc.

Task 3. Legislative and Regulatory Framework

The Consultant shall identify and describe the pertinent regulations and standards - both local and international, governing the environmental quality, health and safety, protection of sensitive areas, land use control at the national and local levels and ecological and socio- economic issues. Thereafter, the Consultant shall identify the project activities that should comply with the identified regulations.

Task 4. Determination of impacts of project facilities and activities

From the detailed field study, the Consultant shall analyze and describe all significant changes brought about by each facility/activity. These would encompass environmental, ecological and social impacts, both positive and negative, as a result of each facility/activity intervention that are likely to bring about changes in the baseline environmental and social conditions discussed in Task

The Consultant will make a prioritization of all concerns identified and differentiate between short, medium, long-term and cumulative impacts during construction, operation and decommissioning. The Consultant shall also identify both temporary and permanent impacts. A detailed outline and discussion of specific conditions that might affect the environment which are unique to the type of facility and/or operation being audited should be provided.

Task 5. Occupational Health and Safety Concerns

The Consultant shall analyze and describe all occupational health and safety concerns brought about by activities during all the phases of the project. The Consultant shall make recommendations on corrective and remedial measures to be implemented under the environmental management plan.

Task 6. Development of Management Plan to Mitigate Negative Impacts

The Consultant shall develop a comprehensive environmental management plan (EMP). The plan should recommend a set of mitigation, monitoring and institutional measures to eliminate, minimize or reduce to acceptable levels of adverse environmental impacts and/or maximize socio-economic benefits. The Consultant should provide cost outlays for the proposed mitigation measures as well as their institutional and financial support, time frame and responsibility. This shall be provided for all the project phases.

Task 7. Development of Monitoring Plan

ANNEXURE I

The Consultant is required to give a specific description, and technical details, of monitoring measures for ESMP, including the parameters to be measured, methods to be used, sampling locations, frequency of measurements, and definition of thresholds that will signal the need for corrective actions as well as deliver a monitoring and reporting procedure. The Consultant should provide a time frame and implementation mechanism, staffing requirements, training and cost outlays.

Task 8. Comparison
The consultant shall undertake a comparison of any other options that have been considered and studied. These other alternatives shall be compared to the proposed final concept; and pros/cons of each proposal detailed.

Task 9. Study Reports
The output will be an Environmental and Social Impact Assessment report prepared in accordance with the regulatory provisions. The report shall be in the English Language and be clear and concise. The reports should be in a format acceptable to local competent authorities, international environmental standards and development partners. The Consultant shall present the reports to relevant environmental authorities for approval in the required number of copies (Should specify 5 hard copies bound, provided in both word and pdf).

Task 10. Approval
The Consultant shall present the report prepared under Task 9 for approval by the relevant authorities. The Consultant shall be responsible for making any modifications that the authorities may demand before approval of the report.

Task 11. Counterpart Staff
For the purpose of capacity building the Consultant shall undertake the study together with counterpart staff seconded by the Client.

Task 12. Other Relevant Documents
All the comments in the Attachment to this TOR from the various EIA Authorities which are considered vital but not considered on the last Final ESIA reports shall be carefully addressed.

2.1 Carrying Out a Desk Study: Establishing the Zone of Influence
Activities will differ throughout the lifetime of a project therefore, it is important to define those associated with the construction, operation (best and worst-case operating conditions), and decommissioning and restoration phases. The location of infrastructure and the distribution of the related activities are best addressed by the provision of appropriate scale charts, maps and plans. Note that positions should be geo-referenced to latitude and longitude and the datum(s) used should be specified. Areas and resources affected (including their physical extent) and their responses should be identified. It is important to ensure that these include all impacts, however remote from the project site, to identify the zone of influence of the project.

The zone of influence should be continually reviewed and amended as the project evolves. Where appropriate, the zone of influence should be identified with the aid of hydrodynamic models that can take changes in factors such as, the pattern of currents, temperature, salinity, sediment and other water quality parameters into account. These models will show the potential extent of a change in the existing conditions and are a useful tool for assessing the likely impacts

on the communities or species in a particular area. If inadequate information is available to properly define the zone of influence, this should be acknowledged.

- Direct construction impacts e.g. direct removal of benthic biodiversity;
- Damage to spawning grounds within and adjacent to the infrastructure, through vibration and noise disturbance;
- Obstruction of migration routes of mobile species, especially fish, birds and marine mammals;
- impacts of vibrations/electromagnetic interference on fish, birds and marine mammals; and
- Disturbance to vegetation and ecological features resulting from requirements for additional infrastructure and land-links, (e.g. piers and jetties) together with possible needs for safeguarding their integrity (e.g. armoring a cable); and
- Provision of substrate for colonization by native or non-native species.

3. Study Description

This being a category (??) (wording assumes WB Cat A) project, the consultants will conduct a full Environmental and Social Impact Assessment (ESIA) and prepare an Environmental and Social Management Plan (ESMP) and an inaccordance with the donors' Environmental and Social Assessment Procedures, and Bank's policy on Involuntary Resettlement (2003). This will comprise all the tasks that are required for a full environmental assessment, as described hereafter. The Consultant will be responsible for gathering, reviewing and analyzing all necessary data and information. Where these are insufficient, the Consultant shall make all practical efforts to produce the missing information/data including professional estimates and predictions based on the most likely conditions at the project area, reliable information and data from similar situations and conditions, etc.

The Consultant shall characterize the extent and quality of available data and describe the key-data gaps and the uncertainties associated with estimates, predictions, and data used from similar situations. The methods of accommodating these gaps and uncertainties in the ESIA should be well stated and presented by the Consultant. When estimated values are used in place of data, the Consultant will be required to provide the uncertainty limits associated with these values and perform an appropriate sensitivity analysis.

The work will also include thorough consultations and meetings with all parties concerned (affected population or their representatives; local, regional, and national authorities; representatives of the scientific community; NGOs; etc.); in strict accordance with the requirements of the Bangladesh Government the policies and procedures.

Table 3A: Disclosure and consultation requirements for the proposed environmental and social studies

Document	Author	Disclosure Responsibility(ies) and Location(s)	Expected Disclosure Date	Consultation Requirements and Responsibilities
Chittagong Hill Tracts Connectivity–ESIA TOR	LGED, based on consultant report from initial feasibility/screening of 10 routes	LGED to disclose on website, and in hard copy at culturally appropriate public locations accessible to affected communities	At minimum 2 weeks prior to consultations on TOR (est: January 2015)	LGED to consult TORs with international, national and local stakeholders and finalize in light of feedback received (in accordance with detailed guidance in this document)

Chittagong Hill Tracts Connectivity– ESIA, RAP and TPDP	Independent consultants contracted by LGED	LGED to disclose draft and final documents in full (English versions) as well as Executive Summary (in Bangla) on website and in hard copy at public, culturally appropriate locations accessible to affected communities. WB to disclose on Infoshop.	*Draft reports:* est. April 2015, at minimum 2 weeks prior to holding consultations on ESIA *Final reports:* est. June 2015	LGED to broadly consult draft ESIA with international, national and local stakeholders and finalize study in light of feedback received (in accordance with detailed guidance in this document). Consultations with tribal peoples as part of ESIA, RAP and TPDP preparation must constitute Free, Prior and Informed Consultation

3.1 Main Tasks

The consultant will be responsible to review and update the following tasks:

1. Examine all aspects of the Project and will produce an inception report which will review the tasks to be carried out and agree with the client on any modifications and additions that may be required.
2. Prepare a detailed work plan indicating schedules and inputs required to complete the tasks.
3. During this inception period the consultant will carry out a scoping exercise that will provide the basis for the final report and detailed work plan.
4. Prepare a public consultation and disclosure plan.

3.2 Detailed Tasks

3.2.1 Provide description of the proposed Project

The consultant will provide a brief description of the Project including maps (at appropriate scales) where necessary.

3.2.2 Public Consultation Process

The consultant will:

1. Identify all affected people (e.g. people affected by construction activities and during operation) and will facilitate dissemination of information to relevant authorities and interested and affected parties (IAPs) concerning the proposed project NGOs and government departments and agencies that may have a stake in the Project and its effects should be consulted.
2. Prepare a Stakeholder Consultation Plan, providing an opportunity for the relevant authorities and IAPs to raise issues and concern pertaining to the proposed project and allow the identification of the additional alternatives and recommendations.
3. Describe a schedule for public consultation with these different groups, including number and timing of public input, and the methods to be employed (e.g. media announcements, public meetings questionnaires, one-on-one meetings, public EA steering committees). Public consultation should occur, at least, during the inception and collection of baseline information, and at the draft report stage. An annex of ESIA should summarize the Public consultation process and the results of the consultation process.

4. Gather more detailed information through which the study team could anticipate issues not raised by the IAPs that will be addressed by the environmental impact assessment report.
5. Focus the study on relevant issues and recommend specific investigations, such that the resulting ESIA is useful to decision makers and it addresses the concerns of IAPs

3.2.3 Legal and Administrative Framework

1. Describe the pertinent regulations and standards governing environmental quality, health and safety, protection of sensitive areas, protection of endangered species, land use control, etc., at national and local levels.
2. Describe the current administrative arrangements for environmental regulation, enforcement and management in the Bangladesh Government, and more specifically, within agencies of the government.
3. Provide a general assessment of the (name of agency who will be managing the project) and relevant government agencies involved in environmental and social management issues, to ensure that the EMP will be effectively implemented. The agencies may need strengthening through capacity building measures to be specified in the Environmental Management Plan.

3.2.4 Description of the Environment/Project Setting

Assemble, evaluate and present baseline data on the relevant environmental and social characteristics of the study area. In addition to the data being used for determining and assessing impacts it will be used as a baseline against which future changes caused by the Project can be measured and monitored. The data should include any information on changes anticipated before the Project commences. The description should contain relevant descriptions of the following:

1. Physical environment: geology, topography, soils, climate and meteorology; ground water and surface hydrology
2. Biological environment: flora; fauna; forests; rare or endangered (maybe name anything specific, if known, or create Appendix) significant natural sites, etc.; species of commercial importance, and species with potential to become nuisances, vectors or dangerous.
    a) Geologic Condition: Analyze the geological condition along the proposed routes. Collect available geological, geo-morphological and geo-technical maps.
    b) Hydrography and Water Quality: All route alignments will cross numerous canal, streams or creeks as well as major rivers like the Karnafully River. Identify discharge, currents, depth, and span of water crossing structure, river protection needs and other physical features of the navigable waters.
    c) Assess current sources of water pollution by communal waste waters from inhabited places and pollution from industrial and agricultural activities.
    d) Water Quality Data: Groundwater (measure at least Mn, As, Fe, EC at minimum 5 km interval for the route), Surface Water Quality (measure at least P^H, DO, BOD_5, TDS, As, Fe at Karnafully River crossing point and a sample canal stretch).
    e) Noise Level: At all sensitive locations for the route.
    f) Air Quality: Collect and test sample for Air quality (measure at least PM_{10}, $PM_{2.5}$, and SPM at terrestrial and aquatic habitat area for the route).
    g) Environmental Components and Biological Diversity: Identify and list the species present in the area of influence of the route, including their conservation status as per IUCN as well as under national legislation.

3. Socio-cultural environment: (include both present and projected where appropriate); population affected (numbers and subsistence systems), land use where appropriate and property (including houses, crops trees, plants, other properties. etc.); planned development activities; public health; cultural characteristics (including cultural property and heritage); and gender differentiation.
4. Economic activities: livelihood; employment; gender composition cross border migration. Some examples of the specific activities are: recording plant species that may be affected, based on field surveys; identification of any species of special concern, namely species with conservation status or endemic to the area; commentary on conservation status of specific species; compilation of a broad scale vegetation or habitat map of the area indicating the extent to which the project would affect each vegetation or habitat type; description of current land use and compilation of a broad land use map.

EIA Scoping

Biodiversity

Evaluation Objective

To minimize adverse effects on native vegetation and habitat and on threatened flora and fauna species and ecological communities, including any relevant species listed under the Forest Act, and address opportunities for offsetting potential losses consistent with relevant policy.

Key issues

- Direct loss of native vegetation and any associated listed threatened flora and fauna species known or likely to occur in the project site.
- Direct habitat loss for listed threatened fauna species.
- Indirect loss of vegetation or habitat quality resulting from edge effects, habitat fragmentation or other disturbance impacts.
- Potential for other indirect impacts on biodiversity values including changes in hydrology and risk of significantly increasing mortality of Forest Act listed species

Priorities for Characterising the Existing Environment

- Describe the biodiversity values that could be affected by the project, including:
  - Native vegetation and any ecological communities listed under the Forest Act
  - Presence of, or suitable habitats for, native flora and fauna species, in particular species listed under the Forest Act
  - Use of the site and its environs for movement by Forest Act listed fauna species.
- Describe hazards that the project could present to biodiversity values, including:
  - Direct removal or destruction of habitat
  - Disturbance or alteration of habitat conditions or other sources of increased habitat threat
  - Operations that could significantly exacerbate risk of increasing mortality of listed threatened fauna
  - The presence of any declared weeds or pathogens in the project area that could be dispersed.

Design and mitigation measures

- Describe the measures both considered and proposed to avoid and minimise the potential for significant effects on native vegetation, native flora and fauna species and in particular listed species and ecological communities.

Assessment of likely effects

- Assess the direct and indirect effects of the project and relevant alternatives on native vegetation, ecological communities and flora species, in particular any relevant species listed under the Forest Act.
- Assess the direct and indirect effects of the project and relevant alternatives on indigenous fauna, including listed threatened and migratory species, relative to existing hazards and risks where relevant.

Approach to manage performance

- Describe and evaluate proposed measures to manage residual effects of the project on biodiversity values, including an outline of an offset strategy that sets out the offsets that have been secured or are proposed to satisfy offset policy requirements.

Catchment Values

Evaluation Objective

To ensure that local and downstream hydrology, surface water and groundwater quality (including Kaptai Lake) and associated beneficial uses, are adequately protected from adverse impacts arising from the project.

Key issues

- Potential impacts on beneficial uses of groundwater in the vicinity of the project, due to extraction, interception of flows or discharges to groundwater.
- Potential impacts on surface water quality arising from polluted run-off from operational areas or other areas disturbed by project works.
- Potential impacts on downstream water environments (including Kaptai Lake) due to changed water quality, flow regimes or waterway conditions downstream of the mine site during operations and site rehabilitation or due to discharges or releases from the lake proposed to form in the exhausted pit post-closure, resulting from chemical or physical characteristics of discharged water.

Priorities for Characterizing the Existing Environment

- Describe the existing groundwater environment in the vicinity of works proposed to be developed or used for project purposes, as known or inferred from available information, including a clear rationale for the extent of the vicinity adopted for the EA.
- Describe the local surface water environment in the context of the catchment within which the project site is located.
- Describe the interaction between surface water and ground water in the vicinity of the site.
- Identify existing water users and allocations in the catchment.
- Prepare a water balance model for the project to quantify the volume of groundwater to be extracted and released and the volume of surface water to be captured during the construction, and maintenance of project.

Environmental Management Framework

Evaluation Objective

To provide a transparent framework with clear accountabilities for managing environmental effects and hazards associated with construction, operation, decommissioning and rehabilitation phases of the project, in order to achieve acceptable environmental outcomes.

Key issues

- Weak management of environmental effects during project construction, operation and rehabilitation could result in failure to meet statutory requirements and sustain stakeholder confidence.
- Potential for landslide, accidents or failures of infrastructure leading to potential adverse impacts on the environment.

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Priorities for characterizing the existing environment

- Outline the means by which a register of environmental risks associated with the project will be developed and maintained during project implementation (including matters identified in preceding sections in these directions as well as other pertinent risks).

Design and mitigation measures

- Describe a proposed framework for managing the risks of adverse environmental effects, including:
  - The context of required approvals and consents, in particular requirements for the work plan;
  - The environmental management system which will apply, including organisational responsibilities and accountabilities;
  - Objectives and measures or procedures for managing environmental performance with respect to:
    - Biodiversity issues, including offsets
    - Surface runoff and groundwater discharges
    - Water sources and use
    - Community engagement
    - Traffic
    - Disruption of and hazards to infrastructure of connectivity Road
    - Geotechnical stability
    - Air emissions
    - Noise and vibration
    - Site rehabilitation
    - Establishment of sustainable vegetation covers
    - Fire management
    - Forestry operations
  - Complaints recording and resolution procedures; and
  - Procedures for auditing and reporting of performance including compliance with relevant statutory conditions and standards.
  - Provide indicative accident and emergency response contingency plans.

Assessment of likely effects

- Evaluate the likely effectiveness of the proposed environmental management framework in controlling adverse effects.

Approach to manage performance

- Procedures for:
  - Verifying or monitoring compliance with performance requirements; and
  - Review of the effectiveness of the environmental management framework for continuous improvement.
- Arrangements for management of and access to baseline and monitoring data, to ensure the transparency and accountability of environmental management as well as to contribute to the improvement of environmental knowledge.

Terms of reference for additional studies are based on:

- Information on ecological resources within the zone of influence;
- The timeframe for all phases of the project; and
- Information gaps/survey needs that should be addressed in order to assess potential impacts and their significance.
- During the evolution of the project to identify:
  - Opportunities for preventative management;
  - The need for impact avoidance and mitigation; and

- Opportunities for enhancement;

- After the mitigation strategies have been fully devised and their likely success considered;
- After the residual impacts have been assessed if significant negative impacts are still likely; and during construction, operational and decommissioning phases(s).
- The proponent's ecologist should expect to liaise with other members of the proponent's team as the changes to be considered may relate to a wide range of issues such as hydrology, water quality, coastal processes, noise, or shipping and navigation.

3.2.5 ESIA Methodology Used

As a chapter of the ESIA report the consultant will describe the methods used for conducting the ESIA (scoping and bounding, impact analysis and public consultation process, etc.). The consultant will include a public participation plan to include stakeholder identification process, stakeholders identified, stages within the ESIA process where stakeholders have participated, and the different levels of participation used. Identification of impacts will include the identification of the important environmental components, and selection criteria used for identifying the significant impacts (positive and negative) whenever possible. Significant levels may be determined through the application of scoring system if the consultant is of the opinion that such an approach is warranted. The consultant will employ environmental economic analysis where applicable, particularly to justify significant impacts to be mitigated.

3.2.6 Potential Impacts of the Proposed Project

Using the collected baseline data and the system or monitoring and evaluation, the consultant will take a systematic approach to identification mitigation and evaluation of all impacts and will identify potential changes which the Project may cause. These would include, but not be limited to, changes in the following:

1. Physical environment
2. Biological environment.
3. Socio-cultural environment.
4. Economic activities.
5. Employment opportunities.
6. Safety issues, including (i) measures to assure safety of local residents; (ii) ensure that the safety and health concerns of temporary and migrant workers are addressed, and (iii) an HIV, AIDS program for workers and affected communities.
7. Construction phase impacts.
8. Impacts of work camps.
9. Waste management for the entire project, including the work camps and construction sites. Changes in land use, land tenure patterns and land grabbing as a consequence of improved access: (i) residential patterns; (ii} agricultural practice; (iii) livestock management (pastoralism); (iv) Commercial use; (v) traditional use (herb, firewood collection, sacred sites etc.); (vi) access to public services (health, education etc.).
10. Impacts of access roads and how to manage these impacts and if needed closure or immobilization of access roads. In case of improved access to sensitive natural and critical natural habitats through access road to be constructed under the project, an Induced Access Management Plan needs to be prepared, in order to manage longer term impacts on natural habitat.
11. Traffic density, safety and dust control.
12. Land acquisition and settlement and per (donor /Bank) Guidelines

The Consultant will analyze:

13. Positive and negative impacts.
14. Direct and indirect impacts, short term and long term.
15. Impacts those are avoidable/unavoidable - reversible/irreversible
16. Pre-construction actions to avoid or minimize negative impacts.
17. Construction and operational phase impacts.
18. Cumulative impacts occurring as a consequence of other activities in
19. The project area: existing activities, projects under construction or planned activities within a reasonable time frame.
20. Impacts in critical and non-critical habitats.
21. Identify the potential risk of the spread of HIV/AIDS and other sexually transmitted diseases during the construction period, and prepare a detailed plan for awareness and prevention including resource implications.

Wherever possible, the consultant will describe impacts quantitatively. In terms of environmental costs and benefits, and assign economic values when feasible. Impact analysis should be divided between construction and operation impacts.

3.2.7 Environmental and Social Management Plan

An Environmental and Social Management Plan (ESMP) that addresses the following aspects should be prepared (Social Management Plan has been given in a separate report):

Activities and impacts

Predicted adverse environmental and social impacts (and any uncertainties about their effects) for which mitigation is necessary should be identified and summarized. Effective measures to prevent or reduce significant negative impacts to acceptable levels during (i) construction and (ii) operation. Estimate the impacts and costs of those measures. Estimate the costs of any residual impacts. Another area of impacts that could contribute substantially is the cumulative effects of construction and operational phases of the Project. Most of these, if not all, can be avoided by following a set of best practices that the consultant will prepare (e g. construction workers not littering, soil stockpiled in such a way as to prevent erosion andwaterway sedimentation, only working day shifts to avoid unnecessary noise to adjacent households).

3.3 Environmental Management Plan

The EMP is a key outcome of the Environmental Impact Assessment and the backbone for environmental safeguards implementation and management during physical project implementation. It generally covers the following information:

Introduction/Responsible Party: Link to the specific project and identifythe authors who prepared the EMP along with the date of preparation.

Project Description: brief summary description of the project, including nature of the investment, location of the project, baseline situation/geographic description, and any characteristics of the area that are of particular interest (e.g. near a protected area, area of cultural or historical interest). Also this should include a description of the socio-economic conditions in the area and illustrative maps and drawings.

Project Impact: Identify the expected short-term and long-term impacts of the project during the design, construction, and operation phases. If these can be quantified, this should be included.

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Mitigation Plan: Include a description of the steps to be taken to mitigate the major potential impacts on land, water, air, ecosystem services and other aspects of the environment during the construction and operation phases. Themitigation plan should be keyed to the impacts identified in the previous section.
Particular attention should be paid to the specification of emission limits, environmental norms, water management and regulation, and design standards with specific reference to Bangladesh laws and any other relevant guidelines such as the World Bank Group Environmental, Health and Safety Guidelines (EHS), inparticular the General EHS Guideline, (2007), or other relevant international norms. The Mitigation Plan should parallel the risk from impacts identified in (c) above.

Monitoring Plan: Include a description of the key parameters to be monitored (including monitoring locations, schedules and responsible entities) to ensure that the construction and operation of the project is in conformance with Bangladesh law, other relevant norms and standards, operating commitments and trans-boundary agreements.

Again, the Monitoring Plan should parallel the structure and issues included in the Environmental Management and Mitigation Plan. If permits or construction or monitoring contracts cover such details, these can be referenced as attachments. The development of this plan will require consultation with responsible agencies for EMP monitoring such as the Ministry of Environment (DoE).

Institutional Arrangements: There should be a narrative discussion that provide a brief presentation on how the monitoring data is going to be used for sound environmental performance and water management - who collects the data, who analyzes it, who prepares reports, who are the reports sent to and how often, what is done by the responsible authorities after they receive the information; how decisions are taken, responses generated and enforced, regarding non-compliance with the EMP. Particular discussion needs to be given to the role of the Ministry of Environment and other Ministries and Agencies that may play a monitoring role, as well as trans-boundary organizations..

Training requirements and costs: Training opportunities should be organized for technical and management staff from relevant Bangladesh authorities and institutions (environmental, land management, geological / geophysical / meteorological / hydrological surveys and institutes), to create / raise awareness of international best practice in safeguards issues, close technical knowledge gaps and enhance staff skills and experience. The Consultant should develop specific plans and schedules stating the groups / persons to be trained, contents, timeframe, venues, trainers and the cost such as venues, travel, per diem, fees / remuneration for lecturers / trainers.

Instrumentation and Monitoring Plan: Drawing upon the work of the SAI Consultants this consultancy will update and supplement the plan for monitoring and recording of the behavior of the Road alignment and related hydro- meteorological, structural and seismic factors with environmentally relevant data such as water quality, and downstream discharge and availability and ensure that the quality and frequency of data recording corresponds to the requirements of ensuring good environmental performance and avoiding of any negative downstream impacts, especially in trans-boundary context.

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Appendices

Consultations with affected groups and non-governmental organizations.

The following should be included: (i) date(s) of consultation(s); (ii) location of consultation(s); (iii) names and addresses of attendees (as appropriate); (iv) meeting program/schedule: (v) what is to be presented and by whom; (vi) summary Meeting Minutes (Comments, questions and responses by presenters); (vii) agreed actions. Since the investment project would be a Category A, specific public consultations are to include (i) an initial consultation in relation to the planned work and then (ii) a second consultation in terms of the findings.

Sample contract terms and positions for the bill of quantities (BoQ) for contractors to mitigate short-term impacts from construction and decommissioning plan for significantly sized temporary works, such as access and haulage roads, borrow areas, quarries, and construction camps.

Information Disclosure and Consultations of the Public

a. A public consultation and disclosure campaign as required by OP 4.01 and OP4.12 will be prepared, organized and carried out. For a project of such complex area at least 2 rounds of consultations will have to be carried out: One round before commissioning of the ESIA, on the TOR and the planned safeguards approach. These will be carried out independently by a third party and are not part of these TOR. The second round (or series) will be held on draft environmental and social documents to integrate stakeholder concerns into the final versions and especially the derivative environmental and social management plans.
b. The Consultant will assemble appropriate materials, (maps, graphs, drawings, simulations, models, key environmental figures) disclose them in a manner acceptable to Bank policies (timely prior to consultation, in a form and language that are understandable, in locations accessible with reasonable effort to the groups being consulted) and organize venues which will enable the affected population to participate without excessive undue efforts. Suggested venues would be near the construction site and in the Kaptai Lake area, ensuring accessibility to all affected people, i.e., with a spacing allowing for a travel distance of not more than 20 km for any participants. The initial consultations on the ESIA TOR will be organized in the same manner as described above after publication on appropriate websites and invitation of affected local population, relevant NGOs and other appropriate parties.
c. The materials and information to be disclosed will have to cover the following aspects of the project: (i) General project design and layout, emphasizing areas directly impacted by permanent or temporary works and structures, access and service roads, and areas indirectly impacted by construction or operation (noise, dust, borrow pits, landscape aesthetics etc.), areas impacted by Lake/ Chara (small creeks discharging in the lake) filling and downstream hydrological changes; (ii) summary of all major direct and indirect environmental and socio-economic impacts generally associated with large scale hilly road construction, (iii) overview of relevant World Bank environmental and social safeguards policies applicable to the project (OP4.01, OP4.12) and the approaches and instruments for mitigation of environmental and social impacts, which are commonly applied in Road connectivity projects; (iv) overview of TOR for the ESIA for the project.
d. The Consultant will ensure the presence, at the consultations, of competent technical staff highly familiar with the project. Discussions will be conducted in language(s) understandable to all affected stakeholders. With assistance of the project proponent

materials, will be prepared clearly describing the project in a manner understandable for non-specialists and conduct the presentation(s). These can be maps, pictures, plans,diagrams and other information materials which are understandable to a non-technical audience, yet truly and fully characterize the project, the expected impacts and plannedmitigation measures.

e. The Consultant will provide documentation of the following:

Manner in which notification of the consultation was announced: media(s) used, date(s), description or copy of the announcement Date(s) consultation(s) was (were) held Location(s) consultation(s) was (were) heldWho was invited (Name, Organization or Occupation, Telephone/Fax/e- mail number/address (home and/or office) Who attended (Name, Organization or Occupation, Telephone/Fax/e-mail number/address (home and/or office) Meeting Program/Schedule (What is to be presented and by whom), Summary Meeting Minutes (Comments, Questions and Response by Presenters) List of decisions reached, and any actions agreed upon with schedules, deadlines and responsibilities.

Participation and Consultation

A consultation strategy building on the stakeholder analysis, which describes:

Process of promoting meaningful consultation of the affected people and stakeholders in the preparation and implementation of resettlement activities, including facilitating the participation of vulnerable groups and women. Process of involving the affected population and other stakeholders in project monitoring. Plan for disseminating information about the RAP, grievance channels, ongoing project activities, and other issues such as an awareness program for contractors and local communities on HIV/AIDS transmission Grievance Procedures. Identification of affordable and accessible procedures for settlement of disputes related to the planning and implementation of resettlement activities. Establish a procedure for recording grievances and response times for resolution of problems. Identify agencies responsible for implementing these procedures.

Institutional Arrangements

The institutional arrangement for the implementation of RAP(as shown in the social part RAP).

Costs and Budget: Aside from the compensation calculation tables and the entitlement matrix which will have detailed costs to estimate losses, this section will project the costing of resettlement program, taking into account a range of potential compensation packages for different categories of affected people. It will also estimate costs for identified additional resettlement measures such as training and associated development programs in the new area along the proposed alignment.

Monitoring and Evaluation.

Framework defining the arrangements for evaluating impacts and measuring outcomes, including:

Performance monitoring indicators derived from the socioeconomic baseline to measure inputs, outputs, and outcomes for resettlement activities; Frequency of reporting and integrating feedback from monitoring activities into project implementation. Institutional responsibilities ensuring adequate role and representation of civil society, private sector and community groups.

<u>Description of Implementation and Monitoring Program</u>

Prepare detailed institutional arrangements (responsibilities) for implementing and for monitoring implementation of mitigation measures and the impacts of the project during

construction and operation and maintenance. This will include a description of monitoring methodology, specific operations and features to be monitored, monitoring reporting relationships, and arrangements to ensure that monitoring is effective and leads to modifications were required to ensure minimal impact on the environment. Include in the plan an estimate of costs and description of other inputs such as training and institutional strengthening to ensure effective monitoring. An indication of what performance indicators to be used is to be provided.

Institutional strengthening and training

Identification of institutional needs to implement environmental recommendations: Review the authority and capability of (implementing agent) and other relevant institutions and recommend steps to strengthen or expand these institutions to ensure that effective environmental management and monitoring will occur.

Socio-economic survey

Findings of socio-economic studies to be conducted in the early stages of project preparation and with the involvement of potentially displaced people, including:

The results of a census survey covering the following:

1) The current occupants of the affected area to establish a basis for the design of the resettlement program and to exclude subsequent inflows of people for eligibility for compensation and resettlement assistance; Standard characteristics of displaced households.
2) The magnitude of the expected loss - total or partial–of assets, and the extent of displacement, physical or economic;
3) Information on vulnerable groups or persons, for whom special provisions may have to be made; and
4) Provisions to update information on the displaced people's livelihoods and standards of living at regular intervals

Other studies describing the following

5) Land tenure and transfer systems, including an inventory of common property natural resources from which people derive their livelihoods and sustenance, non-title-based usufruct systems, and any issues raised by different tenure systems in the project area;
6) The patterns of social interaction in the affected communities, including social networks and social support systems, and how they will be affected by the project
7) Public infrastructure and social services that will be affected and
8) Social and cultural characteristics of displaced communities including a description of formal and informal institutions that may be relevant to the consultation strategy and to designing and implementing the resettlement activities

Legal framework including the following:

9) The scope of the power of eminent domain and the nature of compensation associated with it in terms of both the valuation methodology and the timing of payment;
10) The applicable legal and administrative procedures;
11) Relevant laws governing land tenure, valuation of assets and losses, compensation and natural resource usage rights customary personal law related to displacement and
    - Laws and regulations relating to the agencies responsible for implementing resettlement activities:

- Gaps, if any, between local laws in the two countries covering eminent domain and resettlement and the (donor or bank) resettlement policy, and the mechanisms to bridge such gaps and
- Any legal steps necessary to ensure the effective implementation of Resettlement activities under the project.

Institutional framework covering the following:

12) The identification of agencies responsible for resettlement activities and NGOs that may have a role in project implementation;
13) An assessment of the institutional capacity of agencies and NGOs; and
14) Any steps that are proposed to enhance the institutional capacity of agencies and NGOs responsible for resettlement implementation.

4 Reporting

The consultant will produce the following reports in draft and final versions:

1. Inception Report including a detailed work plan (if completed)
2. Environmental and Social Impact Assessment
3. Induced Access Management Plan (If needed)
4. Environmental Management Plan
5. Resettlement Action Plan
6. Stakeholder Consultation Plan
7. Others (to be specified)

ANNEXURE I

Appendices: WB Environmental Assessment

1. The Bank requires Environmental Assessment (EA) of projects proposed for Bank financing to help ensure that they are environmentally sound and sustainable, and thus to improve decision making.
2. EA is a process whose breadth, depth, and type of analysis depend on the nature, scale, and potential environmental impact of the proposed project. EA evaluates a project's potential environmental risks and impacts in its area of influence; examines project alternatives; identifies ways of improving project selection, sitting, planning, design, and implementation by preventing, minimizing, mitigating, or compensating for adverse environmental impacts and enhancing positive impacts; and includes the process of mitigating and managing adverse environmental impacts throughout project implementation. The Bank favors preventive measures over mitigatory or compensatory measures, whenever feasible.
3. EA takes into account the natural environment (air, water, and land); human health and safety; social aspects (involuntary resettlement, indigenous peoples, and physical cultural resources); and trans-boundary and global environmental aspects. EA considers natural and social aspects in an integrated way. It also takes into account the variations in project and country conditions; the findings of country environmental studies; national environmental action plans; the country's overall policy framework, national legislation, and institutional capabilities related to the environment and social aspects; and obligations of the country, pertaining to project activities, under relevant international environmental treaties and agreements. The Bank does not finance project activities that would contravene such country obligations, as identified during the EA. EA is initiated as early as possible in project processing and is integrated closely with the economic, financial, institutional, social, and technical analyses of a proposed project.
4. The borrower is responsible for carrying out the EA. For Category A projects, the borrower retains independent EA experts not affiliated with the project to carry out the EA. For Category A projects that are highly risky or contentious or that involve serious and multidimensional environmental concerns, the borrower should normally also engage an advisory panel of independent, internationally recognized environmental specialists to advise on all aspects of the project relevant to the EA. The role of the advisory panel depends on the degree to which project preparation has progressed, and on the extent and quality of any EA work completed, at the time the Bank begins to consider the project.
5. The Bank advises the borrower on the Bank's EA requirements. The Bank reviews the findings and recommendations of the EA to determine whether they provide an adequate basis for processing the project for Bank financing. When the borrower has completed or partially completed EA work prior to the Bank's involvement in a project, the Bank reviews the EA to ensure its consistency with this policy. The Bank may, if appropriate, require additional EA work, including public consultation and disclosure.
6. The Pollution Prevention and Abatement Handbook describes pollution prevention and abatement measures and emission levels that are normally acceptable to the Bank. However, taking into account borrower country legislation and local conditions, the EA may recommend alternative emission levels and approaches to pollution prevention and abatement for the project. The EA report must provide full and detailed justification for the levels and approaches chosen for the particular project or site.

The World Bank Environmental and Social Safeguards and their policy objectives are briefly described below:

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OP/BP 4.01 - Environmental Assessment. Policy objective is to help ensure the environmental and social soundness and sustainability of investment projects and support the integration of environmental and social aspects of projects in the decision-making process.

OP/BP 4.04 - Natural Habitats. Policy objective is to promote environmentally sustainable development by supporting the protection, conservation, maintenance, and rehabilitation of natural habitats and their functions.

OP/BP 4.11 - Physical Cultural Resources (PCR). Policy objective is to assist in preserving PCR and in avoiding their destruction or damage. PCR includes resources of archaeological, paleontological, historical, architectural, religious, (including graveyards and burial sites), aesthetic, or other cultural significance

OP/BP 4.12 - Involuntary Resettlement. Policy objective is to avoid or minimize involuntary resettlement caused by land acquisition or loss/restriction of access to land and related resources. Where this is not feasible, assist displaced persons in improving or at least restoring their livelihoods and standards of living in real terms relative to pre- displacement levels or to levels prevailing prior to the beginning of project implementation, whichever is higher.

OP/BP 4.20 -Indigenous Peoples. Policy objective is to design and implement projects in a way that fosters full respect for indigenous peoples' dignity, human rights, and cultural uniqueness and so that they (1) receive culturally compatible social and economic benefits, and (2) do not suffer adverse effects during the development process.

OP/BP 4.36–Forests. Policy objective is to realize the potential of forests to reduce poverty in a sustainable manner, integrate forests effectively into sustainable economic development, and protect the vital local and global environmental services and values of forests.

OP/BP 4.37 - Safety of Dams. Policy objective: if a dam does not function properly or fails there are serious consequences. This policy is to ensure that appropriate measures are taken and sufficient resources provided for the safety of the dam.

OP/BP 7.50 - Projects on International Waterways. Policy objective: if a project to be developed involves the use of or potential pollution of international waterways including tributaries or other body of surface water that flows through, two or more states, notification of riparian states is required.

OP/BP 7.60 - Projects in Disputed Areas. Policy objectives may affect the relations between the Bank and its borrowers, and between the claimants to the disputed area.

EA Instruments

7. Depending on the project, a range of instruments can be used to satisfy the Bank's EA requirement: environmental impact assessment (EIA), regional or sectoral EA, environmental audit, hazard or risk assessment, and environmental management plan (EMP). EA applies one or more of these instruments, or elements of them, as appropriate. When the project is likely to have sectoral or regional impacts, sectoral or regional EA is required.

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Environmental Screening

8. The Bank undertakes environmental screening of each proposed project to determine the appropriate extent and type of EA. The Bank classifies the proposed project into one of four categories, depending on the type, location, sensitivity, and scale of the project and the nature and magnitude of its potential environmental impacts.
    a. *Category A:* A proposed project is classified as Category A if it is likely to have significant adverse environmental impacts that are sensitive, diverse, or unprecedented. These impacts may affect an area broader than the sites or facilities subject to physical works. EA for a Category A project examines the project's potential negative and positive environmental impacts, compares them with those of feasible alternatives (including the "without project" situation), and recommends any measures needed to prevent, minimize, mitigate, or compensate for adverse impacts and improve environmental performance. For a Category A project, the borrower is responsible for preparing a report, normally an EIA (or a suitably comprehensive regional or sectoral EA) that includes, as necessary, elements of the other instruments. Referred to in parra. 7.
    b. *Category B:* A proposed project is classified as Category B if its potential adverse environmental impacts on human populations or environmentally important areas--including wetlands, forests, grasslands, and other natural habitats--are less adverse than those of Category A. These impacts are site-specific; few if any of them are irreversible; and in most cases mitigatory measures can be designed more readily than for Category A projects. The scope of EA for a Category B project may vary from project to project, but it is narrower than that of CategoryA EA. Like Category A EA, it examines the project's potential negative and positive environmental impacts and recommends any measures needed to prevent, minimize, mitigate, or compensate for adverse impacts and improve environmental performance.
    c. *Category C:* A proposed project is classified as Category C if it is likely to have minimal or no adverse environmental impacts. Beyond screening, no further EA action is required for a Category C project.
    d. *Category FI:* A proposed project is classified as Category FI if it involves investment of Bank funds through a financial intermediary, in subprojects that may result in adverse environmental impacts.

Content of an Environmental Assessment Report for a Category A Project

1. An environmental assessment (EA) reports for a Category A project focuses on the significant environmental issues of a project. The report's scope and level of detail should be commensurate with the project's potential impacts. The report submitted to the Bank is prepared in English.
2. The EA report should include the following items (not necessarily in the order shown):
    a. Executive summary. Concisely discusses significant findings and recommended actions.
    b. Policy, legal, and administrative framework. Discusses the policy, legal, and administrative framework within which the EA is carried out. Explains the environmental requirements of any co-financiers. Identifies relevant international environmental agreements to which the country is a party.
    c. Project description. Concisely describes the proposed project and its geographic, ecological, social, and temporal context, including any offsite investments that may be required (e.g., dedicated pipelines, access roads, power plants, water

supply, housing, and raw material and product storage facilities). Indicates the need for any resettlement plan or indigenous people's development plan (see also sub-para. (h)(v) Below). Normally includes a map showing the project site and the project's area of influence.

d. Baseline data. Assesses the dimensions of the study area and describes relevant physical, biological, and socioeconomic conditions, including any changes anticipated before the project commences. Also takes into account current and proposed development activities within the project area but not directly connected to the project. Data should be relevant to decisions about project location, design, operation, or mitigatory measures. The section indicates the accuracy, reliability, and sources of the data.

e. Environmental impacts. Predicts and assesses the project's likely positive and negative impacts, in quantitative terms to the extent possible. Identifies mitigation measures and any residual negative impacts that cannot be mitigated. Explores opportunities for environmental enhancement. Identifies and estimates the extent and quality of available data, key data gaps, and uncertainties associated with predictions, and specifies topics that do not require further attention.

f. Analysis of alternatives. Systematically compares feasible alternatives to the proposed project site, technology, design, and operation--including the "without project" situation--in terms of their potential environmental impacts; the feasibility of mitigating these impacts; their capital and recurrent costs; their suitability under local conditions; and their institutional, training, and monitoring requirements. For each of the alternatives, quantifies the environmental impacts to the extent possible, and attaches economic values where feasible. States the basis for selecting the particular project design proposed and justifies recommended emission levels and approaches to pollution prevention and abatement.

g. Environmental management plan (EMP). Covers mitigation measures, monitoring, and institutional strengthening; see outline in OP 4.01, Annex C.

h. Appendixes:

   I. List of EA report preparers--individuals and organizations.

   II. References--written materials both published and unpublished, used in study preparation.

   III. Record of interagency and consultation meetings, including consultations for obtaining the informed views of the affected people and local nongovernmental organizations (NGOs). The record specifies any means other than consultations (e.g., surveys) that were used to obtain the views of affected groups and local NGOs.

   IV. Tables presenting the relevant data referred to or summarized in the main text.

   V. List of associated reports (e.g., resettlement plan or indigenous people's development plan).

ANNEXURE I

Requirement for the Consultant Team

Consultants Required

The lead Consulting Team should be an international consulting firm or a consortium experienced in conducting work on projects similar in size. The international Consulting Team awarded this service shall form joint venture with an experienced Bangladeshi organizations and company with this project.

Consultant Team will determine the identity and biography of specialists to be involved in specific positions within the Consultant Team. Furthermore, the Consultant Team will qualify main members of the Consultant Team and all essential specialists immediately. Consultant Team must confirm that all specialists are available to work during the Project implementation period. The estimated total input of staff months, shared between international and national experts.

Key Professional Qualifications and Competence for the Assignment Minimum qualification requirements of Consultant Team specialists for Feasibility study are presented below:

EA Team Leader

Education: Advanced University (Masters or higher) Degree in Environmental management, Impact assessment or area planning; the person with Civil Engineering background will be an advantage.

Experience: Minimum 15 year's of which 5 years international experience in project management in environmental and ecological impact assessments, nature resource utilization planning, river management, land planning strategy and environmental impact assessments. It is competitive advantage if have a experience of management and coordination in similar project in Bangladesh; Demonstrated expertise working on similar projects; Demonstrated experience working with multilateral banks and the application of World Bank guidelines. Analytical ability, practical problem-solving skills and resourcefulness in performing varied tasks in the area; Demonstrated skills in retrieving, gathering and obtaining information from various sources; Sound organizational skills and ability to prioritize and deliver assignments in a timely manner often under severe time pressures; Demonstrated initiative in developing practical approaches that improve efficiency and effectiveness of the project; Strong inter-personnel skills and commitment to work in a team-oriented, multi-cultural environment; Ability to provide guidance to the Working Group;

Language skills: Fluent oral and written skills in English;

Computer literacy: Proficient in PC based applications such as Word, Excel and Power Point etc.

Biologist

Education: Advanced University (Masters or higher) Degree in Biology or relevant fields;

Experience: Minimum 10 year's professional experience in research of fish fauna. Demonstrated experience working with international development organizations, preferably with WB. Demonstrated skills in retrieving, gathering and obtaining information from various sources; Sound organizational skills and ability to prioritize and deliver assignments in a timely manner often under severe time pressures; Demonstrated initiative in developing practical approaches that improve efficiency and effectiveness of the project; Strong inter-personnel skills and commitment to work in a team-oriented, multi- cultural environment; Ability to provide guidance to the Working Group;

Language skills: Fluent oral and written skills in English;

Computer literacy: Proficient in PC based applications such as Word, Excel and Power Point etc.

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Hydrologist/Sedimentation Specialist
Education: Advanced University (Masters or higher) Degree in relevant fields;
Experience: Minimum 10 year's professional experience in water research including sediment inflow projection and downstream hydrological/sedimentation impact; Demonstrated experience working with international development organizations, preferably with WB. Demonstrated skills in retrieving, gathering and obtaining information from various sources; Sound organizational skills and ability to prioritize and deliver assignments in a timely manner often under severe time pressures; Demonstrated initiative in developing practical approaches that improve efficiency and effectiveness of the project; Strong inter-personnel skills and commitment to work in a team-oriented, multi-cultural environment; Ability to provide guidance to the Working Group; Language skills: Fluent oral and written skills in English; Proficient in PC based applications such as Word, Excel and Power Point etc.

Water Pollution Control/Water Quality Specialists
Education: Advanced University (Masters or higher) Degree in relevant fields;
Experience: Minimum 10 year's professional experience in water quality analysis, identification of existing and potential future point and non-point pollution sources, and water quality projections; Demonstrated experience working with international development organizations, preferably with WB. Demonstrated skills in retrieving, gathering and obtaining information from various sources; Sound organizational skills and ability to prioritize and deliver assignments in a timely manner often under severe time pressures; Demonstrated initiative in developing practical approaches that improve efficiency and effectiveness of the project; Strong inter-personnel skills and commitment to work in a team-oriented, multi- cultural environment; Ability to provide guidance to the Working Group;
Language skills: Fluent oral and written skills in English;
Computer literacy: Proficient in PC based applications such as Word, Excel and Power Point etc.

Environmental Management Specialist/s
Education: Advanced University (Masters or higher) Degree in Environmental science or relevant fields;
Experience: Minimum 10 year's professional experiences in natural habitat, flora and fauna research, and development of environmental management and monitoring strategies etc.; Demonstrated experience working with international development organizations, preferably with WB. Demonstrated skills in retrieving, gathering and obtaining information from various sources; Sound organizational skills and ability to prioritize and deliver assignments in a timely manner often under severe time pressures; Demonstrated initiative in developing practical approaches that improve efficiency and effectiveness of the project; Strong inter-personnel skills and commitment to work in a team-oriented, multi- cultural environment; Ability to provide guidance to the Working Group;
Language skills: Fluent oral and written skills in English;
Computer literacy: Proficient in PC based applications such as Word, Excel and Power Point etc.

Environmental/Social Assessment Specialist
Education: Advanced University (Masters or higher) Degree in environmental management, EIA, environmental planning or relevant fields;

Experience: Minimum 10 year's professional experience with planning and carrying out environmental impact assessments, river management, complex land-use projects etc. Experience with strategic and sectoral EIA; Experience with designing analysis of alternatives according to international requirements; Analytical ability, practical problem-solving skills and resourcefulness in performing varied tasks in the area; Demonstrated experience working with international development organizations, preferably with WB. Demonstrated skills in retrieving, gathering and obtaining information from various sources; Sound organizational skills and ability to prioritize and deliver assignments in a timely manner often under severe time pressures; Demonstrated initiative in developing practical approaches that improve efficiency and effectiveness of the project; Strong inter-personnel skills and commitment to work in a team-oriented, multi- cultural environment; Ability to provide guidance to the Working Group;
Language skills: Fluent oral and written skills in English;
Computer literacy: Proficient in PC based applications such as Word, Excel and Power Point etc.

Social Scientist cum LA & RAP Specialist
Masters degree in Sociology or equivalent having 15 year's experience in the related field, with experience in the assignments of similar nature and complexity on donor funded projects and having age not more than 65 years on last date of proposal submission. Hill experience is preferred.

Hydro-Geological Engineer
Education: Advanced university (Masters or higher) degree in hydrologic sciences or relevant discipline;
Experience: Minimum 10 year's professional experience underground water investigation, using computer technologies to calculate flow statistics, and underground water modeling. Demonstrated expertise working on similar projects; Demonstrated experience working with multilateral banks and the application of World Bank guidelines. Demonstrated skills in retrieving, gathering and obtaining information from various sources; Sound organizational skills and ability to prioritize and deliver assignments in a timely manner often under severe time pressures; Demonstrated initiative in developing practical approaches that improve efficiency and effectiveness of the project; Strong inter-personnel skills and commitment to work in a team-oriented, multi- cultural environment; Ability to provide guidance to the Working Group;
Language skills: Fluent oral and written skills in English;
Computer literacy: Proficient in PC based applications such as Word, Excel and Power Point etc.

Financial Specialist
Education: Advanced University (Masters or higher) finance and economics;
Experience: Minimum 10 year's professional experience in project related fields in developing countries. Ability to estimate, assess and prepare financial analysis of investment in natural resource and infrastructure development project. Demonstrated expertise working on similar projects; Demonstrated experience working with multilateral banks and the application of World Bank guidelines. Demonstrated skills in retrieving, gathering and obtaining information from various sources; Sound organizational skills and ability to prioritize and deliver assignments in a timely manner often under severe time pressures; Demonstrated initiative in developing practical approaches that improve efficiency and effectiveness of the project; Strong inter-personnel skills

and commitment to work in a team-oriented, multi- cultural environment; Ability to provide guidance to the Working Group;
Language skills: Fluent oral and written skills in English;
Computer literacy: Proficient in PC based applications such as Word, Excel and Power Point etc.

Communication specialist
Education: Advanced University (Masters or higher) in Communication;
Experience: Minimum 10 year's professional work experience his profession; Prepare internal speeches, key messages, Q&A and presentations for the project management team; Provide writing support and advice for conveying information in lay terms to the project's various section as well as writing and editing various project documents. Attend meetings and events and draft minutes or summaries; Conduct terminological research and check content; Provide linguistic and typographical revision services; Draft and edit a variety of documents and content, including blogs, newsletters and other content for the project's intranet site.
Language skills: Fluent oral and written skills in English;
Computer literacy: Proficient in PC based applications such as Word, Excel and Power Point etc.

Phasing of ESIA and EMP Activities
The following Table presents the timing of major milestone events for the production of the reports described above. The Consultants Team should begin work upon contract signature. The Consultants Team should submit a detailed work plan and schedule with critical milestones with allowance for PMU and external reviews.

Table: Timing of major milestone events for the production of the reports.

No	Objective	Month
1	Submit work program for EISAs	1
2	Submit Inception Report	1
3	Participate in Inception Workshop	2
4	Submit Consultation and Communication Program	3
5	Draft Preliminary ESIA report for site selection	10
5	Final Preliminary ESIA report for site selection	12
6	Submit Draft Detailed ESIA and EMP	17
8	Issue Final Draft Detailed ESIA and EMP	18

The ESIA Consultant shall plan its work to accommodate the months indicated in following Table. The Consultant shall include in the work to participate in the workshops for presentation of results.

Table: Details of work schedule with duration

ESIA STUDY FOR THE CONNECTIVITY BETWEEN CTG PORT AND THEGAMUKH	DURATION	
ESIA	MONTHS	CUMULATIVE
Inception and Review of Previous Studies	2	2
Update of Project Area Characteristics	1	3
- Updated Socio-economic Assessment	1	4
- Updated biodiversity, Forest and Fishery Assessment	1	5

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- Updated cultural and heritage assessments	1	6
Stakeholder surveys and consultations	1	7
Assessments of cumulative impacts	1	8
Identified Environmental Impacts of alternative sites	1	9
Identified Social Impacts of alternative sites	1	10
Updated impact assessment of selected site	1	11
Stakeholder consultations for EMP	1	12
Formulation of EMP	2	14
Reporting and Finalization of Study	2	18

ANNEXURE I

PART-2

ANNEX A

Documents and Deliverables Generally Required under the World Bank's Safeguard Policies.

Policy No.	Topic	Documents / deliverables required during		
		preparation	implementation	operation
OP4.01	Environmental Assessment(EA)	EA process, including EIA, EMP,MP	EMP/ MP	(EMP)/MP
OP4.04	NaturalHabitats	Included in EA under OP4.01	Compensation plan, Included in EMP+MP, OP 4.01	Included in EMP+MP, OP4.01
OP4.09	Pest Management	Included in EA under OP4.01	Pest Management Plan(PMP)	(reference in ISR/ICR)
OP4.10	Indigenous Peoples	Social Assessment, IPP	IPP / RAP	(reference in ISR/ICR)
Op 4.11	Physical Cultural Resources	Included in EA under OP4.01	PCR management plan (part of EA)	(reference in ISR/ICR)
OP4.12	Involuntary Resettlement	RPF, RAP (and other instruments)	RAP (and other instruments)	(reference in ISR/ICR)
Op 4.36	Forest	Included in EA under OP4.01	Included in EMP = MP, OP 4.01	Included in EMP = MP, OP 4.01
Op 4.37	Safety of Dams	Dam safety report (DSR), TOR For PoE	DSR & emergency preparedness plan (ERP)	DSR & emergency preparedness plan , dam instrumentation & monitoring plan
OP17.50	Disclosure	SIR	SCR, disclosure of ESIA&EMP	Contd. Information & consultation
OP/BP 7.50	International Waterways	Notification of riparian states		
OP/BP 7.60	Disputed Areas	legal / political negotiations		

Acronyms:

DSR	Dam Safety Report	EA	Environmental Assessment Process
EIA	Category A Environmental Impact Assessment Report	EMP	Environmental Management Plan
ERP	Emergency Response Plan	ESIA	Environmental /Social Impact Assessment
ICR	Implementation Completion Report	IPP	Indigenous Peoples Plan
ISR	Implementation Status Report	MP	Monitoring Plan
PCR	Physical Cultural Resources	PoE	Panel of Experts
RAP	Resettlement Action Plan	RPF	Resettlement Policy Framework
SCR	Stakeholder Consultation Report	SIR	Stakeholder Identification Report

ANNEX B

ENVIRONMENTAL MANAGEMENT PLAN: FORMAT FOR SUMMARYTABLES/APPENDICES

A. MITIGATIONPLAN

Phase	Issue	Mitigating Measure	Cost of Mitigation(if Substantial)	Responsibility*
I. Implementation /Construction				
II. Operation				

B. MONITORINGPLAN

[Parameters in Monitoring Plan should be matched to issues in Mitigation Plan]

Phase	What parameter is to be monitored?	Where is the parameter to be monitored?	How is the parameter to be monitored/ type of monitoring equipment?	When is the parameter to be monitored- frequency of measurement or continuous?	Monitoring Cost What is the cost of equipment or contractor charges to perform monitoring	Responsibility
Construction						
Operation						

A. INSTITUTIONAL STRENGTHENING

1. Equipment Purchases

List items in tabular form showing:

Type of Equipment	
Number of units	
Local or international purchase	
Total Cost	

2. TRAINING

List in tabular form showing:

Type of Training	
Number of students [also indicate current and future organization unit or current and future title/job description]	
Duration of training	
Start/ends dates for each student	
Venue [domestic or abroad]	
Institute/Provider	
Total costs	

3. CONSULTANT SERVICES/SPECIAL STUDIES

Provide description of:

Type of Services	
Summary TOR [attach full TOR]	
Justification	
Local or international purchase	
Cost	

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B. SCHEDULE

Present (preferably in Chart Form) Start Dates and Finish Dates for:

- Mitigation Activities
- Monitoring Activities
- Training Activities

This information should be keyed to the overall project schedule (as defined in the Project Implementation Plan)

C. INSTITUTIONAL ARRANGEMENTS

Provide a narrative discussion supported by organizational charts detailing:

- Responsibilities for mitigation and monitoring
- Environmental information flow (reporting—from who and to who and how often)
- Decision making chain of command for environmental management (to take action, to authorize expenditures, to shut down, etc.)

In short, how is all the monitoring data going to be used to maintain sound environmental performance—who collects the data, who analyzes it, who prepares reports, who are the reports sent to and how often, and who does that person send it to, or what does he/she do with the information—who has the authority to spend, shutdown, change operations etc.

D. CONSULTATION WITH LOCAL NGOS AND PROJECT-AFFECTEDGROUPS

(May be presented as an appendix)

Provide documentation of the following:

- Date(s) consultation(s) was (were)held
- Location(s) consultation(s) was (were)held
- Who was invited Name, Organization or Occupation, Telephone/Fax/e-mail number/address (home and/or office)
- Who attended Name, Organization or Occupation, Telephone/Fax/e-mail number/address (home and/or office)
- Meeting Program/Schedule
- What is to be presented and by whom
- Summary Meeting Minutes (Comments, Questions and Response by Presenters**)**

ANNEXURE 2.1

Assessment of Air Quality

2.1.1 Assessment of Air Pollution

Three representative samples of air were collected on 21th -24th November 2015 to analyze PM_{10}, $PM_{2.5}$ & SPM. The analyses of the parameters have been done in Enviro Consultants Limited Laboratory, Dhaka and results dated 29th November2015 have been placed in the report.

2.1.2 Assessment of Air Quality

The Ambient Air standards in Bangladesh as per Department of Environment suggest standards for different categories of areas (see the following table).
(Density in microgram per cusec meter)

Table 2.1.2A: Standard for Ambient Air

Sl. No.	Categories of area	Suspended Particulate Maters (SPM)	Sulphur di oxide	Carbon Monoxide	Oxides of Nitrogen
A	Industrial and Mixed	500	120	5000	100
B	Commercial and Mixed	400	100	5000	100
C	Residential and rural	200	80	2000	80
D	Sensitive	100	30	1000	30

According to the location of the most part would fall under 'A' category, which is 'Industrial and Mixed area". No data should exceed the Bangladesh regulatory limit.

***Notes**:*

- At national level, sensitive area includes monuments, health cancer, hospital, archeological site, educational institute, and government designated areas (if any).
- Industrial units located in areas not designated as industrial areas shall not discharge pollutants which may contribute to exceeding the standard for air surrounding the area specified at sl. Nos. c and d above.
- Suspended Particulate Matter means air borne particles of a diameter of 10 micron or less.

The sampling points are listed in the table below.

Table 2.1.2B: Air Monitoring Point and Location

Identity No.	Location	GPS Location
ID # 1A	Upazilla Campus at Kaptai	22^0 30.119 N & 092^0 08.368 E
ID # 2A	Upazilla Campus at Rangamati	22^0 39.710 N & 092^0 09.956 E
ID # 3A	Upazilla Campus at Rajosthali	22^0 21.989 N & 092^0 15.308 E

Table 2.1.2C: WHO air quality guidelines and interim targets for particulate matter: 24-hour concentrations.

	PM_{10} (µg/ m^3)	**$PM_{2.5}$ (µg/m^3)**	**Basis for the selected level**
Interim target-1 (IT-1)	150	75	Based on published risk coefficients from multi-centre studies and meta-analyses (about 5% increase of shortterm mortality over the AQG value).
Interim target-2 (IT-2)	100	50	Based on published risk coefficients from multi-centre studies and meta-analyses (about 2.5% increase of shortterm mortality over the AQG value).
Interim target-3 (IT-3)	75	37.5	Based on published risk coefficients from multi-centre studies and meta-analyses (about 1.2% increase in short-term mortality over the AQG value).
Air quality guideline (AQG)	50	25	Based on relationship between 24-hour and annual PM levels.

2.1.3 Analysis Report

Table 2.1.3A: Air Monitoring Report

Sl. No.	**Parameter for Analysis**	**Bangladesh Standard (Industrial and Mixed Area)**	**World Bank Standard (Industrial and Mixed Area)**	**1A**	**2A**	**3A**
1	PM_{10}	150 microgram per cubic meter	50 Microgram per cubic meter	19.91	87.79	28.11
2	$PM_{2.5}$	65 microgram per cubic meter	25 Microgram per cubic meter	12.21	24.53	13.26
3	SPM	200 microgram per cubic meter	-	43.06	148.05	35.21

2.1.4 Air Monitoring:

Picture of Air Monitoring and GPS Location Monitoring

Fig 2.1.4A: Picture of Kaptai Points Air Sampling

Fig 2.1.4B: Picture of Kaptai GPS Location Monitoring

Fig 2.1.4C: Picture of Rangamati Points Air Sampling

Fig 2.1.4D: Picture of Rangamati GPS Location Monitoring

Fig 2.1.4E:Picture of Rajosthali Points Air Sampling

Fig 2.1.4F:Picture of Rajosthali GPS Location Monitoring

2.1.5 Result Summary

The analysis results fully comply with the DoE standards. All the parameters are much lower than the allowable limit. Therefore, it can be concluded that the air is not creating any harm to the environment in terms of air quality.

ANNEXURE 2.2
Assessment of Ground Water Quality

2.2.1 Assessment of Ground Water Quality

Sample from Six ground water points were collected on 21t^{h} -24th November 2015 to analyze Manganese, Arsenic, Iron & EC. The analyses of the parameters have been done in DPHE Central Laboratory, Dhaka and results dated 6th December 2015 has been placed in the report.

2.2.2 Annexure: Water Quality Data- Ground Water

Government of the People's Republic of Bangladesh
Office of the Chief Chemist
Department of Public Health Engineering
Central Lab, 38-39, Mohakhali C/A, Dhaka-1212
Phone: 88-02-9881927, Fax: 88-02-9882003 , Email: wqmsc_central_lab@yahoo.com

Lab Memo: 175/ CC, DPHE, CL, Dhaka. Date: 06/12/2015

Physical /Chemical/ Bacteriological Analysis of Water Sample

Sample ID: CEN2015110029	Sample Receiving date: 25/11/2015
Ref. Memo No: BETS/Nill & Dated: 25/11/2015	Sample Source: Tube Well
Sent by: Md. Zahidul Islam Miah ,BETS Consulting Services Ltd. , For Thegamukh Connectin Road.	Dist:Rangamati, Upa:Kaptai Upazila
Care Taker: ID # 1G (TW of Kaptai)	Union:, Vill.:
Sample Collection date: 24/11/2015	Date of Testing: 25/11/2015 - 06/12/2015

LABORATORY TEST RESULTS:

Sl.#	Water quality parameters	Bangladesh Standard	Concentration present	Unit	Analysis Method	LOQ
1	Arsenic (As)	0.05	<LOQ	mg/L	AAS	0.001
2	EC	-	474	µS/cm	EC-Meter	-
3	Iron (Fe)	0.3-1	0.12	mg/L	AAS	0.09
4	Manganese (Mn)	0.1	0.07	mg/L	AAS	0.05

Comments: AAS- Atomic Absorption Spectrophotometer, LOQ- Limit of Quantitation.
Sample was collected & supplied by client.

Test Performed by: Signature

1.) Name: Mahabuba Sabina Motin
Designation: Sample Analyzer
06-12-15

2.) Name: Md. Saiful Alam Khosru
Designation: Sample Analyzer
06.12.15
Sample Analyzer
DPHE, Central Laboratory
Mohakhali, Dhaka.

Countersigned/Approved by: Signature

1.) Name: Md. Abdus Sattar Miah
Designation: Chief Chemist
6/12/15

2.) Name:
Designation:
Md. Abdus Sattar Miah
Chief Chemist
DPHE Central Laboratory
Mohakhali, Dhaka.

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Office of the Chief Chemist
Department of Public Health Engineering
Central Lab, 38-39, Mohakhali C/A, Dhaka-1212
Phone: 88-02-9881927, Fax: 88-02-9882003 , Email: wqmsc_central_lab@yahoo.com

Lab Memo: 175/ CC, DPHE, CL, Dhaka. Date: 06/12/2015

Physical /Chemical/ Bacteriological Analysis of Water Sample

Sample ID: CEN2015110030	Sample Receiving date: 25/11/2015
Ref. Memo No: BETS/Nill & Dated: 25/11/2015	Sample Source: Tube Well
Sent by: Md. Zahidul Islam Miah ,BETS Consulting Services Ltd. , For Thegamukh Connectin Road.	Dist:Rangamati, Upa:Rangamati Sadar Up
Care Taker: ID # 2G (TW of Rangamati)	Union:, Vill.:
Sample Collection date: 23/11/2015	Date of Testing: 25/11/2015 - 06/12/2015

LABORATORY TEST RESULTS:

Sl.#	Water quality parameters	Bangladesh Standard	Concentration present	Unit	Analysis Method	LOQ
1	Arsenic (As)	0.05	<LOQ	mg/L	AAS	0.001
2	EC	-	103	µS/cm	EC-Meter	-
3	Iron (Fe)	0.3-1	0.19	mg/L	AAS	0.09
4	Manganese (Mn)	0.1	0.06	mg/L	AAS	0.05

Comments: AAS- Atomic Absorption Spectrophotometer, LOQ- Limit of Quantitation.
Sample was collected & supplied by client.

Test Performed by:	Signature	Countersigned/Approved by:	Signature
1.) Name: Mahabuba Sabina Motin Designation: Sample Analyzer	06-12-15	1.) Name: Md. Abdus Sattar Miah Designation: Chief Chemist	6/12/15
2.) Name: Md. Saiful Alam Khosru Designation: Sample Analyzer	06.12.15	2.) Name: Designation:	

Sample Analyzer
DPHE, Central Laboratory
Mohakhali, Dhaka.

Md. Abdus Sattar Miah
Chief Chemist
DPHE, Central Laboratory
Mohakhali, Dhaka.

Government of the People's Republic of Bangladesh
Office of the Chief Chemist
Department of Public Health Engineering
Central Lab, 38-39, Mohakhali C/A, Dhaka-1212
Phone: 88-02-9881927, Fax: 88-02-9882003 , Email: wqmsc_central_lab@yahoo.com

Lab Memo: 175/ CC, DPHE, CL, Dhaka. Date: 06/12/2015

Physical /Chemical/ Bacteriological Analysis of Water Sample

Sample ID: CEN2015110031	Sample Receiving date: 25/11/2015
Ref. Memo No: BETS/Nill & Dated: 25/11/2015	Sample Source: Tube Well
Sent by: Md. Zahidul Islam Miah ,BETS Consulting Services Ltd. , For Thegamukh Connectin Road.	Dist:Rangamati, Upa:Rajasthali Upazila
Care Taker: ID # 3G (TW of Rajasthali)	Union:, Vill.:
Sample Collection date: 24/11/2015	Date of Testing: 25/11/2015 - 06/12/2015

LABORATORY TEST RESULTS:

Sl.#	Water quality parameters	Bangladesh Standard	Concentration present	Unit	Analysis Method	LOQ
1	Arsenic (As)	0.05	<LOQ	mg/L	AAS	0.001
2	EC	-	473	µS/cm	EC-Meter	-
3	Iron (Fe)	0.3-1	0.23	mg/L	AAS	0.09
4	Manganese (Mn)	0.1	0.11	mg/L	AAS	0.05

Comments: AAS- Atomic Absorption Spectrophotometer, LOQ- Limit of Quantitation.
Sample was collected & supplied by client.

Test Performed by:	Signature	Countersigned/Approved by:	Signature
1.) Name: Mahabuba Sabina Motin Designation: Sample Analyzer	06-12-15	1.) Name: Md. Abdus Sattar Miah Designation: Chief Chemist	6/12/15
2.) Name: Md. Saiful Alam Khosru Designation: Sample Analyzer	06.12.15	2.) Name: Designation:	

Md. Abdus Sattar Miah
Chief Chemist
DPHE Central Laboratory
Mohakhali, Dhaka.

DPHE, Central Laboratory
Mohakhali, Dhaka.

Government of the People's Republic of Bangladesh
Office of the Chief Chemist
Department of Public Health Engineering
Central Lab, 38-39, Mohakhali C/A, Dhaka-1212
Phone: 88-02-9881927, Fax: 88-02-9882003 , Email: wqmsc_central_lab@yahoo.com

Lab Memo: 175/ CC, DPHE, CL, Dhaka. Date: 06/12/2015

Physical /Chemical/ Bacteriological Analysis of Water Sample

Sample ID: CEN2015110032	Sample Receiving date: 25/11/2015
Ref. Memo No: BETS/Nill & Dated: 25/11/2015	Sample Source: Tube Well
Sent by: Md. Zahidul Islam Miah ,BETS Consulting Services Ltd. , For Thegamukh Connectin Road.	Dist:Rangamati, Upa:Belai Chhari Upazi
Care Taker: ID # 4G (TW of Belai Chhari)	Union:, Vill.:
Sample Collection date: 22/11/2015	Date of Testing: 25/11/2015 - 06/12/2015

LABORATORY TEST RESULTS:

Sl.#	Water quality parameters	Bangladesh Standard	Concentration present	Unit	Analysis Method	LOQ
1	Arsenic (As)	0.05	0.001	mg/L	AAS	0.001
2	EC	-	331	µS/cm	EC-Meter	-
3	Iron (Fe)	0.3-1	<LOQ	mg/L	AAS	0.09
4	Manganese (Mn)	0.1	<LOQ	mg/L	AAS	0.05

Comments: AAS- Atomic Absorption Spectrophotometer, LOQ- Limit of Quantitation.
Sample was collected & supplied by client.

Test Performed by:	Signature	Countersigned/Approved by:	Signature
1.) Name: Mahabuba Sabina Motin Designation: Sample Analyzer	06-12-15	1.) Name: Md. Abdus Sattar Miah Designation: Chief Chemist	6/12/15
2.) Name: Md. Saiful Alam Khosru Designation: Sample Analyzer	06.12.15	2.) Name: Designation:	

Sample Analyzer
DPHE, Central Laboratory
Mohakhali, Dhaka.

Md. Abdus Sattar Miah
Chief Chemist
DPHE Central Laboratory
Mohakhali, Dhaka.

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Office of the Chief Chemist
Department of Public Health Engineering
Central Lab, 38-39, Mohakhali C/A, Dhaka-1212
Phone: 88-02-9881927, Fax: 88-02-9882003 , Email: wqmsc_central_lab@yahoo.com

Lab Memo: 175/ CC, DPHE, CL, Dhaka. Date: 06/12/2015

Physical /Chemical/ Bacteriological Analysis of Water Sample

Sample ID: CEN2015110033	Sample Receiving date: 25/11/2015
Ref. Memo No: BETS/Nill & Dated: 25/11/2015	Sample Source: Tube Well
Sent by: Md. Zahidul Islam Miah ,BETS Consulting Services Ltd. , For Thegamukh Connectin Road.	Dist:Rangamati, Upa:Barkal Upazila
Care Taker: ID # 5G (Fall Water of Barkal)	Union:Barkal Union, Vill.:
Sample Collection date: 25/11/2015	Date of Testing: 25/11/2015 - 06/12/2015

LABORATORY TEST RESULTS:

Sl.#	Water quality parameters	Bangladesh Standard	Concentration present	Unit	Analysis Method	LOQ
1	Arsenic (As)	0.05	0.001	mg/L	AAS	0.001
2	EC	-	122	µS/cm	EC-Meter	-
3	Iron (Fe)	0.3-1	<LOQ	mg/L	AAS	0.09
4	Manganese (Mn)	0.1	<LOQ	mg/L	AAS	0.05

Comments: AAS- Atomic Absorption Spectrophotometer, LOQ- Limit of Quantitation.
Sample was collected & supplied by client.

Test Performed by:	Signature	Countersigned/Approved by:	Signature
1.) Name: Mahabuba Sabina Motin Designation: Sample Analyzer	06-12-15	1.) Name: Md. Abdus Sattar Miah Designation: Chief Chemist	6/12/15 Md. Abdus Sattar Miah Chief Chemist DPHE Central Laboratory Mohakhali, Dhaka.
2.) Name: Md. Saiful Alam Khosru Designation: Sample Analyzer	06.12.15 Sample Analyzer DPHE, Central Laboratory Mohakhali, Dhaka.	2.) Name: Designation:	

Government of the People's Republic of Bangladesh
Office of the Chief Chemist
Department of Public Health Engineering
Central Lab, 38-39, Mohakhali C/A, Dhaka-1212
Phone: 88-02-9881927, Fax: 88-02-9882003 , Email: wqmsc_central_lab@yahoo.com

Lab Memo: 175/ CC, DPHE, CL, Dhaka. Date: 06/12/2015

Physical /Chemical/ Bacteriological Analysis of Water Sample

Sample ID: CEN2015110034	Sample Receiving date: 25/11/2015
Ref. Memo No: BETS/Nill & Dated: 25/11/2015	Sample Source: Tube Well
Sent by: Md. Zahidul Islam Miah ,BETS Consulting Services Ltd. , For Thegamukh Connectin Road.	Dist:Rangamati, Upa:Barkal Upazila
Care Taker: ID # 6G (Tube Well Water of Sotohorina)	Union:, Vill.:
Sample Collection date: 23/11/2015	Date of Testing: 25/11/2015 - 06/12/2015

LABORATORY TEST RESULTS:

Sl.#	Water quality parameters	Bangladesh Standard	Concentration present	Unit	Analysis Method	LOQ
1	Arsenic (As)	0.05	<LOQ	mg/L	AAS	0.001
2	EC	-	366	µS/cm	EC-Meter	-
3	Iron (Fe)	0.3-1	<LOQ	mg/L	AAS	0.09
4	Manganese (Mn)	0.1	<LOQ	mg/L	AAS	0.05

Comments: AAS- Atomic Absorption Spectrophotometer, LOQ- Limit of Quantitation.
Sample was collected & supplied by client.

Test Performed by:	Signature	Countersigned/Approved by:	Signature
1.) Name: Mahabuba Sabina Motin Designation: Sample Analyzer	Motin 06-12-15	1.) Name: Md. Abdus Sattar Miah Designation: Chief Chemist	Md. Abdus Sattar Miah Chief Chemist DPHE, Central Laboratory Mohakhali, Dhaka.
2.) Name: Md. Saiful Alam Khosru Designation: Sample Analyzer	06.12.15 Sample Analyzer DPHE, Central Laboratory Mohakhali, Dhaka.	2.) Name: Designation:	

2.2.3 Ground Water Quality Monitoring

Picture of Ground Water Sampling and GPS Location Monitoring

Fig 2.2.3A: Picture of Kaptai Points Water Sampling

Fig 2.2.3B: Picture of Kaptai GPS Location Monitoring

Fig 2.2.3C: Picture of Rangamati Points Water Sampling

Fig 2.2.3D: Picture of Rangamati GPS Location Monitoring

Fig 2.2.3E: Picture of Rajosthali Points Water Sampling

Fig 2.2.3F: Picture of Rajosthali GPS Location Monitoring

ANNEXURES II

Fig 2.2.3 G: Picture of Belaichari Points Water Sampling

Fig 2.2.3H: Picture of Belaichari GPS Location Monitoring

2.2.3I: Picture of Barkal Points Water Sampling

2.2.3J: Picture of Barkal GPS Location Monitoring

Fig 2.2.3K: Picture of Chotohorina Points Water Sampling

Fig 2.2.3L: Picture of Chotohorina GPSLocation Monitoring

Table 1.2.3A: Ground Water Sampling Location

Identity No.	Location	GPS Location
ID # 1G	Ground Water of Kaptai	22^0 30.082 N & $092^0$08.309 E
ID # 2G	Ground Water of Rangamati	$22^0$39.558 N & $092^0$10.481 E
ID # 3G	Ground Water of Rajosthali	$22^0$21.964 N & $092^0$15.334 E
ID # 4G	Ground Water of Belaichari	$22^0$29.643 N & $092^0$20.227 E
ID # 5G	Water Falls Water of Barkal	$22^0$43.473 N & $092^0$22.701 E
ID # 6G	Ground Water of Chotohorina	$22^0$52.565 N & $092^0$23.543 E

The sampling points are listed in the table below.

2.2.4 Analysis Results

Table 2.2.4: Ground Water quality Analysis Report

Sl. No.	Parameter	Bangladesh Standard (Drinking Water)	WHO Standard	Kaptai	Rangamati	Rajosthali	Belaichari	Barkal	Chotohorina
1	Arsenic	0.05 mg/L	0.1 mg/L	<LOQ	<LOQ	<LOQ	0.001	0.001	<LOQ
2	EC	-	-	474	103	473	331	122	366
3	Iron	0.3-1.0 mg/L	2.0 mg/L	0.12	0.19	0.23	<LOQ	<LOQ	<LOQ
4	Manganese	0.1 mg/l	0.2 mg/L	0.07	0.06	0.11	<LOQ	<LOQ	<LOQ

2.2.5 Result Summary

The analysis result of the ground water listed in the Table 2.2.4 shows that all the parameters are within the standard limit except one point of manganese test result. There is no standard for EC for drinking water.

ANNEXURE 2.3
Assessment of Surface Water Quality

2.3.1 Assessment of Surface Water Quality

Sample from Six surface water points were collected on 21th -24th November 2015 to analyze pH, DO, BOD_5, TDS, Arsenic & Iron. The analyses of the parameters have been done in DPHE Central Laboratory, Dhaka and results dated 6th December 2015 has been placed in the report.

2.3.2 Assessment of Surface Water Quality

Government of the People's Republic of Bangladesh
Office of the Chief Chemist
Department of Public Health Engineering
Central Lab, 38-39, Mohakhali C/A, Dhaka-1212
Phone: 88-02-9881927, Fax: 88-02-9882003 , Email: wqmsc_central_lab@yahoo.com

Lab Memo: 175/ CC, DPHE, CL, Dhaka. Date: 06/12/2015

Physical /Chemical/ Bacteriological Analysis of Water Sample

Sample ID: CEN2015110035	Sample Receiving date: 25/11/2015
Ref. Memo No: BETS/Nill & Dated: 25/11/2015	Sample Source: Surface Water
Sent by: Md. Zahidul Islam Miah ,BETS Consulting Services Ltd. , For Thegamukh Connectin Road.	Dist:Rangamati, Upa:Kaptai Upazila
Care Taker: ID # 1S (Lake Water of Kaptai)	Union:, Vill.:
Sample Collection date: 24/11/2015	Date of Testing: 25/11/2015 - 06/12/2015

LABORATORY TEST RESULTS:

Sl.#	Water quality parameters	Bangladesh Standard	Concentration present	Unit	Analysis Method	LOQ
1	Arsenic (As)	0.05	0.001	mg/L	AAS	0.001
2	Biochemical Oxygen Demand (BOD)	0.2	07	mg/L	5 days Incubation	-
3	Dissolved Oxygen (DO)	6.0	5.46	mg/L	Multimeter	-
4	Iron (Fe)	0.3-1	<LOQ	mg/L	AAS	0.09
5	pH	6.5-8.5	7.1	-	pH Meter	-
6	Total Dissolved Solid (TDS)	1000	41	mg/L	Multimeter	-

Comments: AAS- Atomic Absorption Spectrophotometer, LOQ- Limit of Quantitation.
Sample was collected & supplied by client.

Test Performed by:	Signature	Countersigned/Approved by:	Signature
1.) Name: Mahabuba Sabina Motin Designation: Sample Analyzer	06-12-15	1.) Name: Md. Abdus Sattar Miah Designation: Chief Chemist	Md. Abdus Sattar Miah Chief Chemist DPHE, Central Lab Mohakhali, Dhaka
2.) Name: Md. Saiful Alam Khosru Designation: Sample Analyzer	Sample Analyzer DPHE, Central Laboratory Mohakhali, Dhaka	2.) Name: Designation:	

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Office of the Chief Chemist
Department of Public Health Engineering
Central Lab, 38-39, Mohakhali C/A, Dhaka-1212
Phone: 88-02-9881927, Fax: 88-02-9882003 , Email: wqmsc_central_lab@yahoo.com

Lab Memo: 175/ CC, DPHE, CL, Dhaka. Date: 06/12/2015

Physical /Chemical/ Bacteriological Analysis of Water Sample

Sample ID: CEN2015110036	Sample Receiving date: 25/11/2015
Ref. Memo No: BETS/Nill & Dated: 25/11/2015	Sample Source: Surface Water
Sent by: Md. Zahidul Islam Miah ,BETS Consulting Services Ltd. , For Thegamukh Connectin Road.	Dist:Rangamati, Upa:Rangamati Sadar Up
Care Taker: ID # 2S (Lake Water of Rangamati)	Union:, Vill.:
Sample Collection date: 23/11/2015	Date of Testing: 25/11/2015 - 06/12/2015

LABORATORY TEST RESULTS:

Sl.#	Water quality parameters	Bangladesh Standard	Concentration present	Unit	Analysis Method	LOQ
1	Arsenic (As)	0.05	0.001	mg/L	AAS	0.001
2	Biochemical Oxygen Demand (BOD)	0.2	06	mg/L	5 days Incubation	-
3	Dissolved Oxygen (DO)	6.0	5.56	mg/L	Multimeter	-
4	Iron (Fe)	0.3-1	<LOQ	mg/L	AAS	0.09
5	pH	6.5-8.5	7.1	-	pH Meter	-
6	Total Dissolved Solid (TDS)	1000	40	mg/L	Multimeter	-

Comments: AAS- Atomic Absorption Spectrophotometer, LOQ- Limit of Quantitation.
Sample was collected & supplied by client.

Test Performed by:	Signature	Countersigned/Approved by:	Signature
1.) Name: Mahabuba Sabina Motin Designation: Sample Analyzer	06-12-15	1.) Name: Md. Abdus Sattar Miah Designation: Chief Chemist	Md. Abdus Sattar Miah Chief Chemist DPHE Central Laboratory Mohakhali, Dhaka.
2.) Name: Md. Saiful Alam Khosru Designation: Sample Analyzer	06.12.15 Sample Analyzer DPHE, Central Laboratory Mohakhali, Dhaka.	2.) Name: Designation:	

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Office of the Chief Chemist
Department of Public Health Engineering
Central Lab, 38-39, Mohakhali C/A, Dhaka-1212
Phone: 88-02-9881927, Fax: 88-02-9882003 , Email: wqmsc_central_lab@yahoo.com

Lab Memo: 175/ CC, DPHE, CL, Dhaka. Date: 06/12/2015

Physical /Chemical/ Bacteriological Analysis of Water Sample

Sample ID: CEN2015110037	Sample Receiving date: 25/11/2015
Ref. Memo No: BETS/Nill & Dated: 25/11/2015	Sample Source: Surface Water
Sent by: Md. Zahidul Islam Miah ,BETS Consulting Services Ltd. , For Thegamukh Connectin Road.	Dist:Rangamati, Upa:Rajasthali Upazila
Care Taker: ID # 3S (Karnafuly River Water of Rajasthali)	Union:, Vill.:
Sample Collection date: 24/11/2015	Date of Testing: 25/11/2015 - 06/12/2015

LABORATORY TEST RESULTS:

Sl.#	Water quality parameters	Bangladesh Standard	Concentration present	Unit	Analysis Method	LOQ
1	Arsenic (As)	0.05	0.001	mg/L	AAS	0.001
2	Biochemical Oxygen Demand (BOD)	0.2	06	mg/L	5 days Incubation	-
3	Dissolved Oxygen (DO)	6.0	6.59	mg/L	Multimeter	-
4	Iron (Fe)	0.3-1	0.26	mg/L	AAS	0.09
5	pH	6.5-8.5	7.7	-	pH Meter	-
6	Total Dissolved Solid (TDS)	1000	88	mg/L	Multimeter	-

Comments: AAS- Atomic Absorption Spectrophotometer, LOQ- Limit of Quantitation.
Sample was collected & supplied by client.

Test Performed by:	Signature	Countersigned/Approved by:	Signature
1.) Name: Mahabuba Sabina Motin Designation: Sample Analyzer	06-12-15	1.) Name: Md. Abdus Sattar Miah Designation: Chief Chemist	Md. Abdus Sattar Miah Chief Chemist DPHE, Central Laboratory Mohakhali, Dhaka.
2.) Name: Md. Saiful Alam Khosru Designation: Sample Analyzer	06.12.15	2.) Name: Designation:	

Sample Analyzer
DPHE, Central Laboratory
Mohakhali, Dhaka.

Government of the People's Republic of Bangladesh
Office of the Chief Chemist
Department of Public Health Engineering
Central Lab, 38-39, Mohakhali C/A, Dhaka-1212
Phone: 88-02-9881927, Fax: 88-02-9882003 , Email: wqmsc_central_lab@yahoo.com

Lab Memo: 175/ CC, DPHE, CL, Dhaka. Date: 06/12/2015

Physical /Chemical/ Bacteriological Analysis of Water Sample

Sample ID: CEN2015110038	Sample Receiving date: 25/11/2015
Ref. Memo No: BETS/Nill & Dated: 25/11/2015	Sample Source: Surface Water
Sent by: Md. Zahidul Islam Miah ,BETS Consulting Services Ltd. , For Thegamukh Connectin Road.	Dist:Rangamati, Upa:Belai Chhari Upazi
Care Taker: ID # 4S (Charas Water of Belai Chhari)	Union:, Vill.:
Sample Collection date: 22/11/2015	Date of Testing: 25/11/2015 - 06/12/2015

LABORATORY TEST RESULTS:

Sl.#	Water quality parameters	Bangladesh Standard	Concentration present	Unit	Analysis Method	LOQ
1	Arsenic (As)	0.05	<LOQ	mg/L	AAS	0.001
2	Biochemical Oxygen Demand (BOD)	0.2	05	mg/L	5 days Incubation	-
3	Dissolved Oxygen (DO)	6.0	5.65	mg/L	Multimeter	-
4	Iron (Fe)	0.3-1	0.12	mg/L	AAS	0.09
5	pH	6.5-8.5	7.3	-	pH Meter	-
6	Total Dissolved Solid (TDS)	1000	81	mg/L	Multimeter	-

Comments: AAS- Atomic Absorption Spectrophotometer, LOQ- Limit of Quantitation.
Sample was collected & supplied by client.

Test Performed by:

1.) Name: Mahabuba Sabina Motin
Designation: Sample Analyzer
Signature 06-12-15

2.) Name: Md. Saiful Alam Khosru
Designation: Sample Analyzer
06.12.15
Sample Analyzer
DPHE, Central Laboratory
Mohakhali, Dhaka

Countersigned/Approved by:

1.) Name: Md. Abdus Sattar Miah
Designation: Chief Chemist
Signature
Md. Abdus Sattar Miah
Chief Chemist
DPHE Central Laboratory
Mohakhali, Dhaka.

2.) Name:
Designation:

Government of the People's Republic of Bangladesh
Office of the Chief Chemist
Department of Public Health Engineering
Central Lab, 38-39, Mohakhali C/A, Dhaka-1212
Phone: 88-02-9881927, Fax: 88-02-9882003 , Email: wqmsc_central_lab@yahoo.com

Lab Memo: 175/ CC, DPHE, CL, Dhaka. Date: 06/12/2015

Physical /Chemical/ Bacteriological Analysis of Water Sample

Sample ID: CEN2015110039	Sample Receiving date: 25/11/2015
Ref. Memo No: BETS/Nill & Dated: 25/11/2015	Sample Source: Surface Water
Sent by: Md. Zahidul Islam Miah ,BETS Consulting Services Ltd. , For Thegamukh Connectin Road.	Dist:Rangamati, Upa:
Care Taker: ID # 5S (Karnafuly River Water of Barkal)	Union:, Vill.:Barkal
Sample Collection date: 23/11/2015	Date of Testing: 25/11/2015 - 06/12/2015

LABORATORY TEST RESULTS:

Sl.#	Water quality parameters	Bangladesh Standard	Concentration present	Unit	Analysis Method	LOQ
1	Arsenic (As)	0.05	<LOQ	mg/L	AAS	0.001
2	Biochemical Oxygen Demand (BOD)	0.2	06	mg/L	5 days Incubation	-
3	Dissolved Oxygen (DO)	6.0	6.52	mg/L	Multimeter	-
4	Iron (Fe)	0.3-1	0.10	mg/L	AAS	0.09
5	pH	6.5-8.5	6.5	-	pH Meter	-
6	Total Dissolved Solid (TDS)	1000	65	mg/L	Multimeter	-

Comments: AAS- Atomic Absorption Spectrophotometer, LOQ- Limit of Quantitation.
Sample was collected & supplied by client.

Test Performed by:	Signature	Countersigned/Approved by:	Signature
1.) Name: Mahabuba Sabina Motin Designation: Sample Analyzer	06-12-15	1.) Name: Md. Abdus Sattar Miah Designation: Chief Chemist	Md. Abdus Sattar Miah Chief Chemist DPHE Central Laboratory Mohakhali, Dhaka.
2.) Name: Md. Saiful Alam Khosru Designation: Sample Analyzer	06.12.15 Sample Analyzer DPHE, Central Laboratory Mohakhali, Dhaka	2.) Name: Designation:	

Government of the People's Republic of Bangladesh
Office of the Chief Chemist
Department of Public Health Engineering
Central Lab, 38-39, Mohakhali C/A, Dhaka-1212
Phone: 88-02-9881927, Fax: 88-02-9882003 , Email: wqmsc_central_lab@yahoo.com

Lab Memo: 175/ CC, DPHE, CL, Dhaka. Date: 06/12/2015

Physical /Chemical/ Bacteriological Analysis of Water Sample

Sample ID: CEN2015110040	Sample Receiving date: 25/11/2015
Ref. Memo No: BETS/Nill & Dated: 25/11/2015	Sample Source: Surface Water
Sent by: Md. Zahidul Islam Miah ,BETS Consulting Services Ltd. , For Thegamukh Connectin Road.	Dist:Rangamati, Upa:
Care Taker: ID # 6S (River Water of Sotohorina)	Union:, Vill.:Sotohorina
Sample Collection date: 23/11/2015	Date of Testing: 25/11/2015 - 06/12/2015

LABORATORY TEST RESULTS:

Sl.#	Water quality parameters	Bangladesh Standard	Concentration present	Unit	Analysis Method	LOQ
1	Arsenic (As)	0.05	<LOQ	mg/L	AAS	0.001
2	Biochemical Oxygen Demand (BOD)	0.2	08	mg/L	5 days Incubation	-
3	Dissolved Oxygen (DO)	6.0	5.81	mg/L	Multimeter	-
4	Iron (Fe)	0.3-1	0.12	mg/L	AAS	0.09
5	pH	6.5-8.5	7.4	-	pH Meter	-
6	Total Dissolved Solid (TDS)	1000	69	mg/L	Multimeter	-

Comments: AAS- Atomic Absorption Spectrophotometer, LOQ- Limit of Quantitation.
Sample was collected & supplied by client.

Test Performed by:	Signature	Countersigned/Approved by:	Signature
1.) Name: Mahabuba Sabina Motin Designation: Sample Analyzer	06-12-15	1.) Name: Md. Abdus Sattar Miah Designation: Chief Chemist	Md. Abdus Sattar Miah Chief Chemist DPHE Central Laboratory Mohakhali, Dhaka.
2.) Name: Md. Saiful Alam Khosru Designation: Sample Analyzer	06.12.15	2.) Name: Designation:	

Sample Analyzer
DPHE Central Laboratory
Mohakhali, Dhaka.

2.3.3 Picture of Surface Water Sampling and GPS Location Monitoring

Fig 2.3.3A: Picture of Kaptai Points Water Sampling

Fig 2.3.3B: Picture of Kaptai GPS Location Monitoring

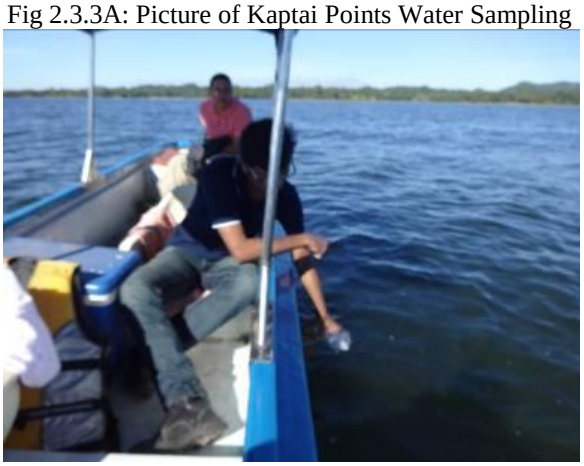


Fig 2.3.3C: Picture of Rangamati Points Water Sampling

Fig 2.3.3D: Picture of Rangamati GPS Location Monitoring

Fig 2.3.3E: Picture of Rajosthali Points Water Sampling

Fig 2.3.3F: Picture of Rajosthali GPS Location Monitoring

ANNEXURES II

Fig 2.3.3G: Picture of Belaichari Points Water Sampling

Fig 2.3.3H: Picture of Belaichari GPS Location Monitoring

Fig 2.3.3I: Picture of Barkal Points Water Sampling

Fig 2.3.3J: Picture of Barkal GPS Location Monitoring

Fig 2.3.3K: Picture of Chotohorina Points Water Sampling

Fig 2.3.3L: Picture of Chotohorina GPS Location Monitoring

Table 2.3.3: Surface Water Quality Monitoring Point and Location

Identity No.	Location	GPS Location
ID # 1S	Kaptai Lakes Water at Kaptai	22^0 30.113 N & $92^0$08.405 E
ID # 2S	Rangamati Lakes Water at Rangamati	$22^0$39.523 N & $92^0$12.927 E
ID # 3S	Karnafully Rivers Water at Rajosthali	$22^0$21.987 N & $92^0$15.569 E
ID # 4S	Charas Water at Belaichari	$22^0$29.635 N & $92^0$20.205 E
ID # 5S	Karnafully Rivers Water at Barkal	$22^0$43.391 N & $92^0$22.919 E
ID # 6S	Rivers Water of Chotohorina	$22^0$52.449 N & $92^0$23.605 E

2.3.4 Analysis Results

Table 2.3.4: Surface Water Quality Analysis Report

Sl. No.	Parameter	Bangladesh Standard (Drinking Water)	WHO Standard (Drinking Water)	Kaptai	Rangamati	Rajosthali	Belaichari	Barkal	Chotohorina
1	Arsenic	0.2 mg/L	0.1 mg/L	0.001	0.001	0.001	<LOQ	<LOQ	<LOQ
2	BOD_5	50 mg/L	50 mg/L	07	06	06	05	06	08
3	DO	4.5-8 mg/L	-	5.56	5.56	6.59	5.65	6.52	5.81
4	Iron	2 mg/L	2.0 mg/L	<LOQ	<LOQ	0.26	0.12	0.10	0.12
5	pH	6-9	6-9	7.1	7.1	7.7	7.3	6.5	7.4
6	TDS	2100 mg/L	-	41	40	88	81	65	69

2.3.5 Result Summary

The analysis result of the surface water listed in the Table 2.3.4 shows that all the parameters are within the standard limit. Therefore, it can be concluded that the surface is not creating any harm to the environment in terms of water quality.

ANNEXURE 2.4
Assessment of Noise Level

2.4.1 Noise Levels at Sensitive Locations

Three representative points of Noise monitored 21th -24th November 2015 to analyze Noise level. The analyses of the parameters have been done in Enviro Consultant Limited Laboratory, Dhaka and results dated 29th November 2015 have been placed in the report.

2.4.2 Noise Monitoring

Fig 2.4.2A: Picture of kaptai points noise sampling

Fig 2.4.2B: Picture of Rangamati Points Noise Sampling

Fig 2.4.2C: Picture of Rajosthali Points Noise Sampling

2.4.3 Result Summary

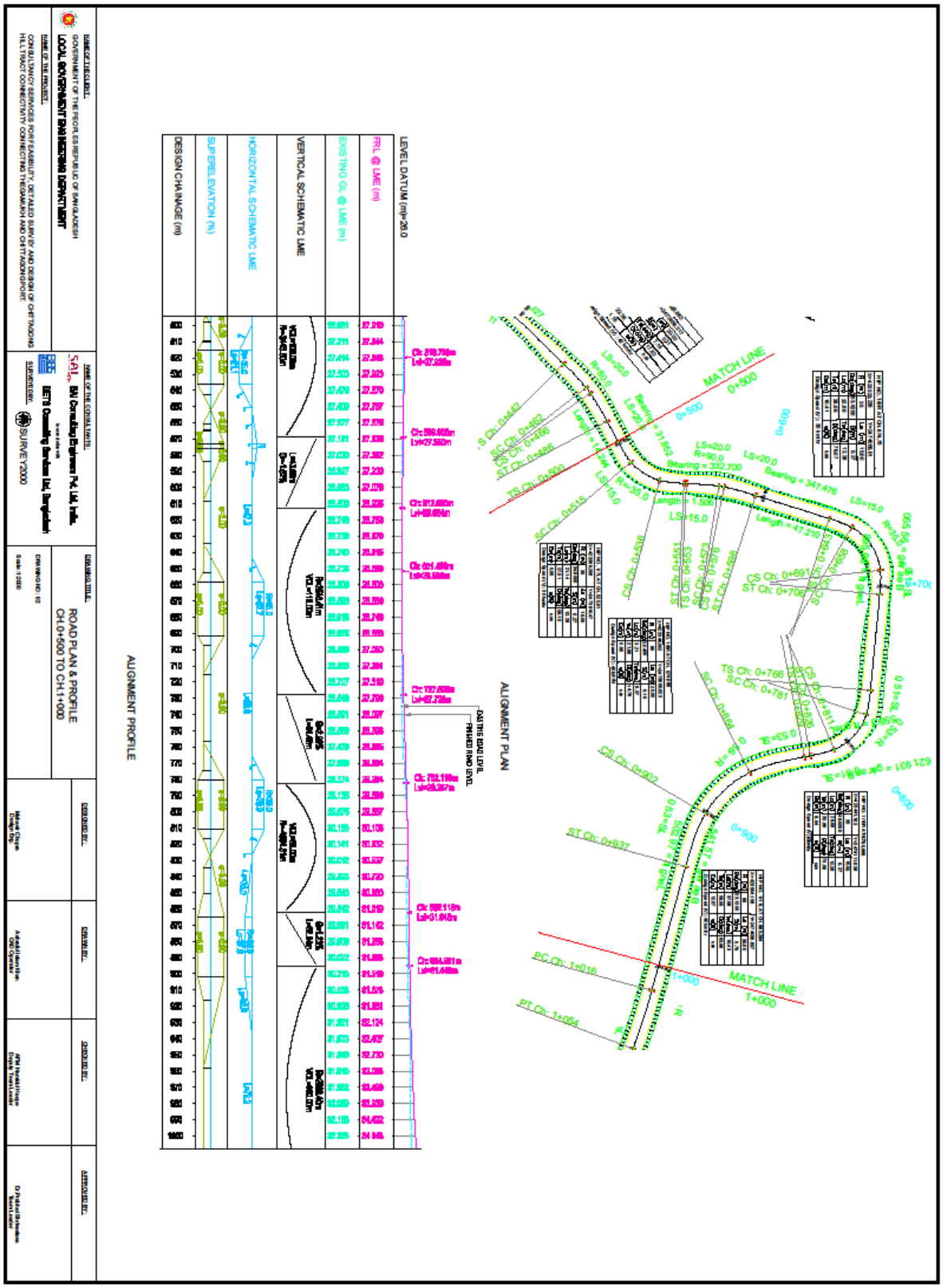
The analysis results fully comply with the DoE standards. Therefore, it can be concluded that the noise is not creating any harm to the environment in terms of noise quality.

ANNEXURE III

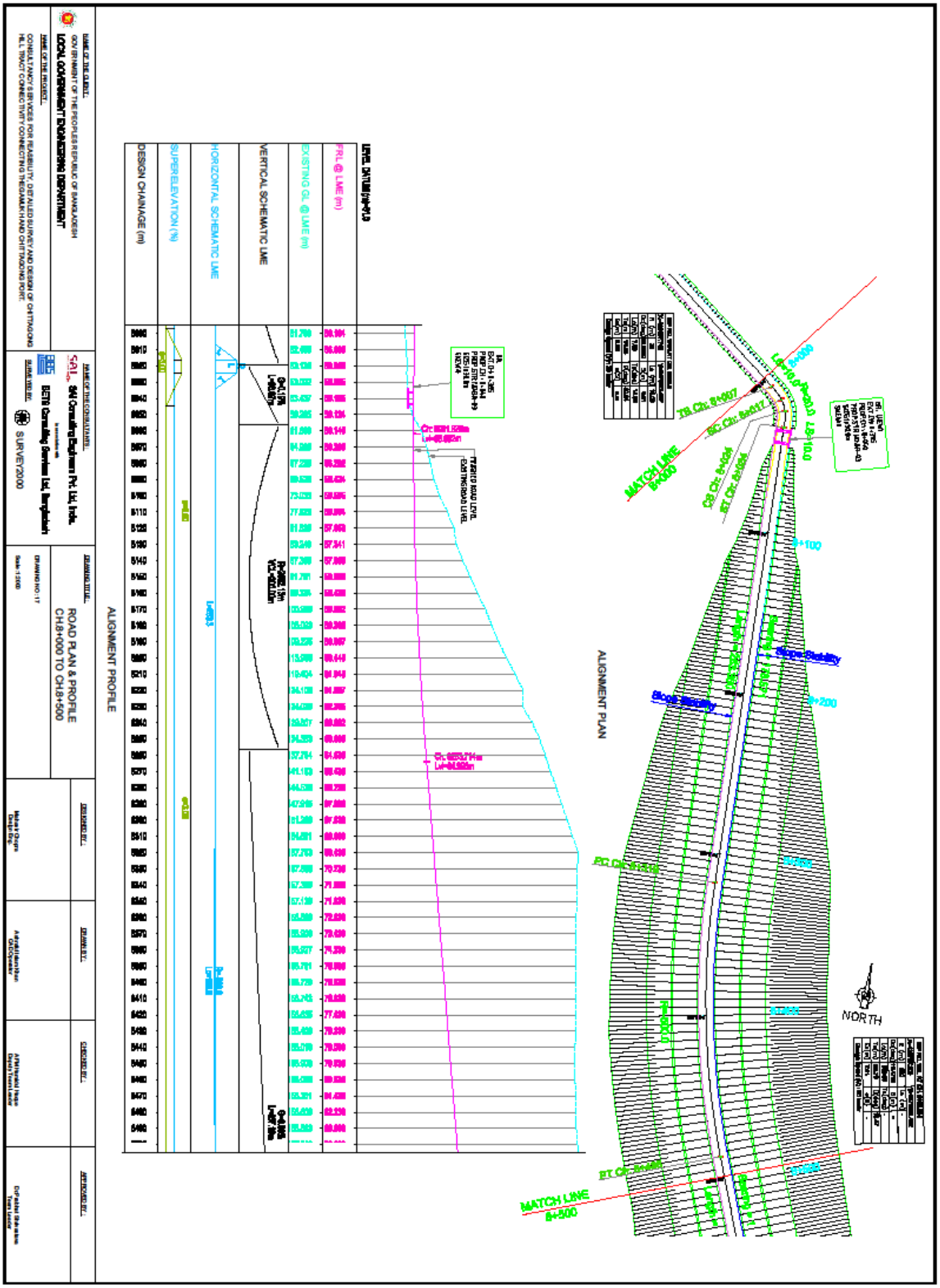
Sensitive Area Map

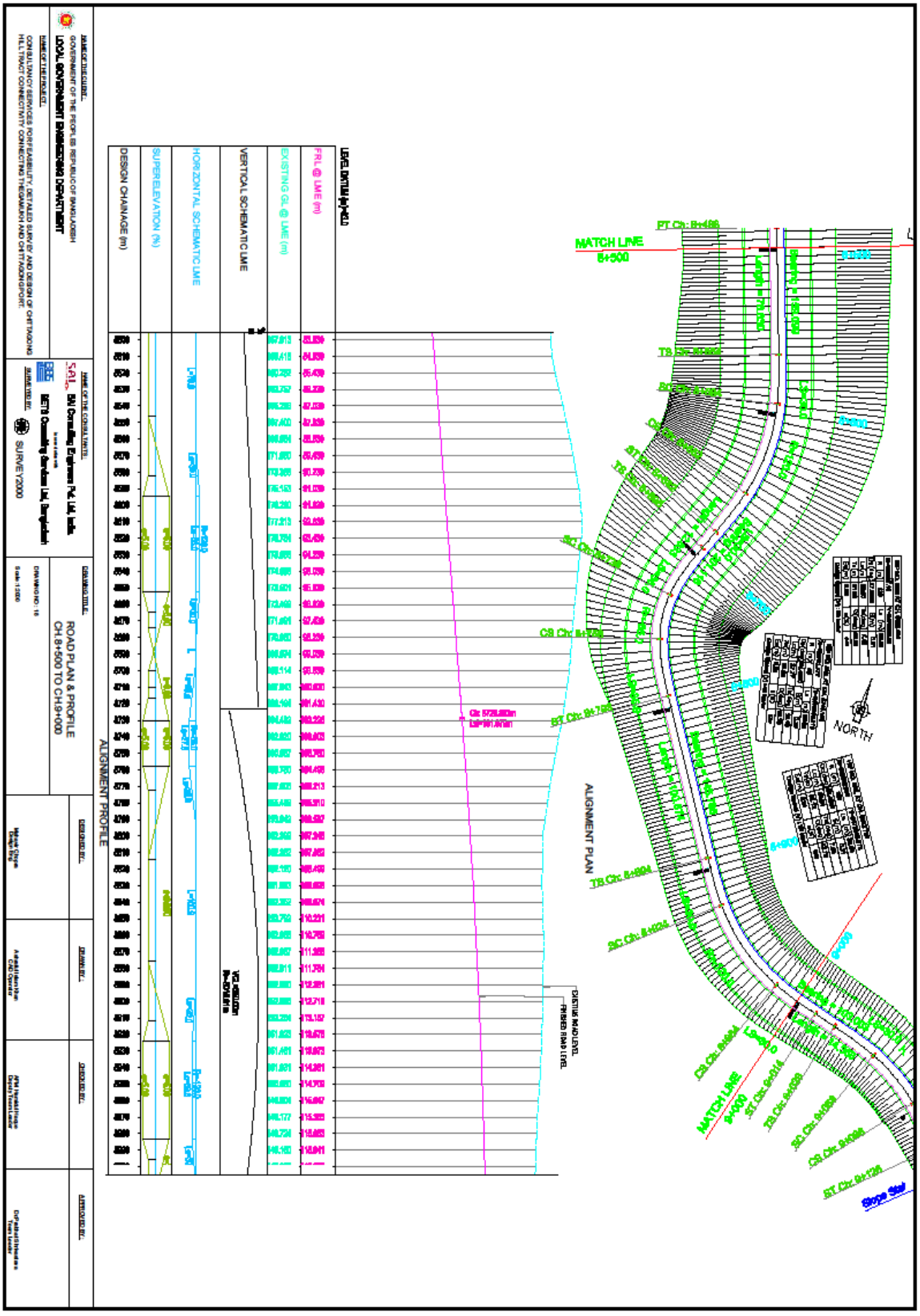
ANNEXURE 3.1

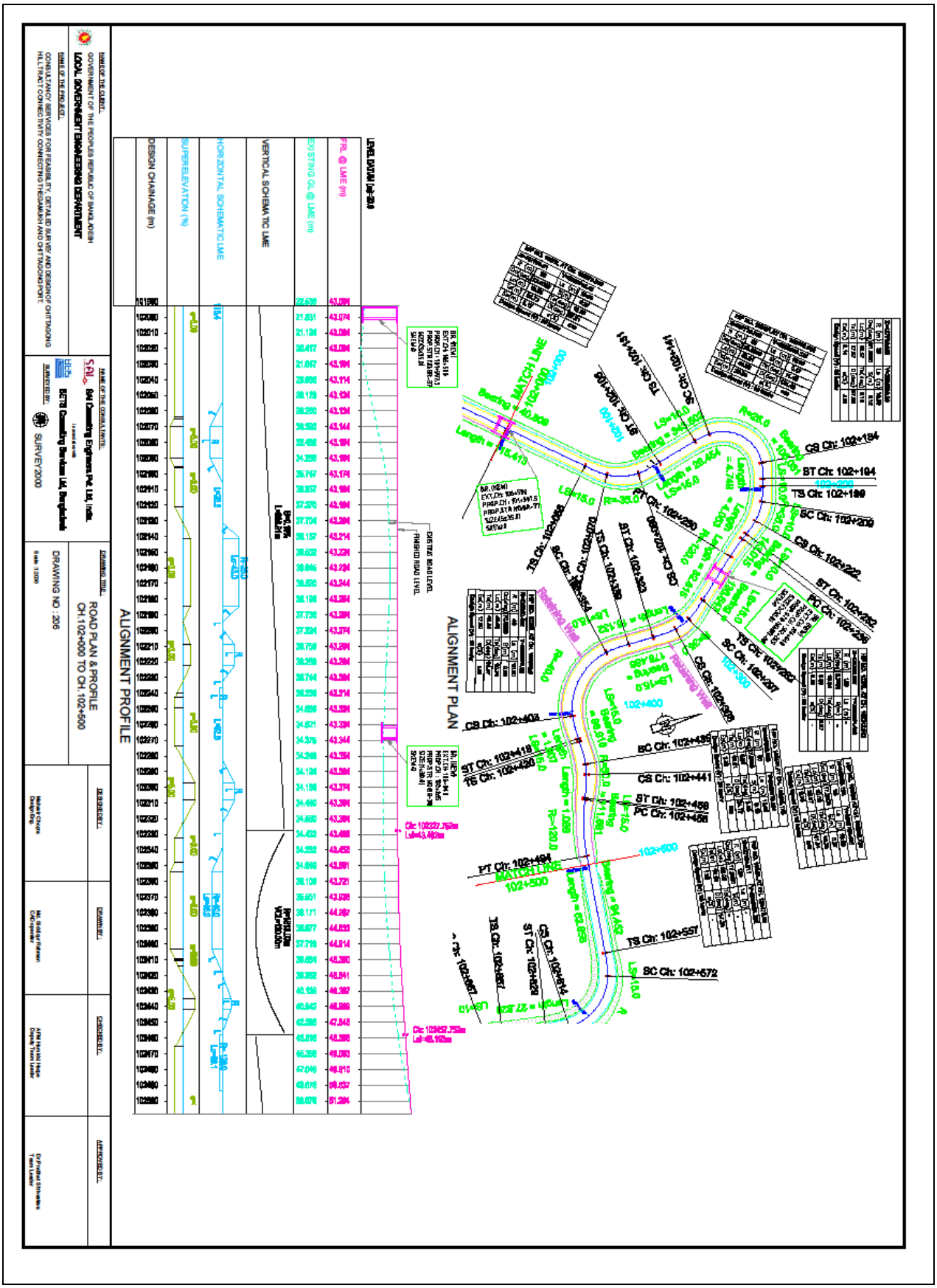
Sensitive Area Map


NAME OF CLIENT:
GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH
LOCAL GOVERNMENT ENGINEERING DEPARTMENT
NAME OF THE PROJECT:
CONSULTANCY SERVICES FOR FEASIBILITY, DETAILED SURVEY AND DESIGN OF CHITTAGONG HILL TRACT CONNECTIVITY CONNECTING THEGAMUKH AND CHITTAGONG PORT.
NAME OF THE CONSULTANTS:
SAI Consulting Engineers Pvt. Ltd., India.
BETS Consulting Services Ltd, Bangladesh
SURVEY2000
DRAWING TITLE:
ROAD PLAN & PROFILE
CH.0+500 TO CH.1+000
DRAWING NO: 02
Scale: 1:2000
Mahesh Chhetri
Design Eng.
Arpan Mukherjee
GIS Operator
APM Harshal Hirapure
Design Team Leader
Dr Prabhat Shrivastava
Team Leader
AUGMENT PROFILE
LEVEL DATUM (mPWD)
FRL @ LME (m)
EXISTING GL @ LME (m)
VERTICAL SCHEMATIC LME
HORIZONTAL SCHEMATIC LME
SUPERELEVATION (%)
DESIGN CHAINAGE (m)
ALIGNMENT PLAN
MATCH LINE
0+500
MATCH LINE
1+000
0+600
0+700
0+800
0+900
1+000
1+016
1+054

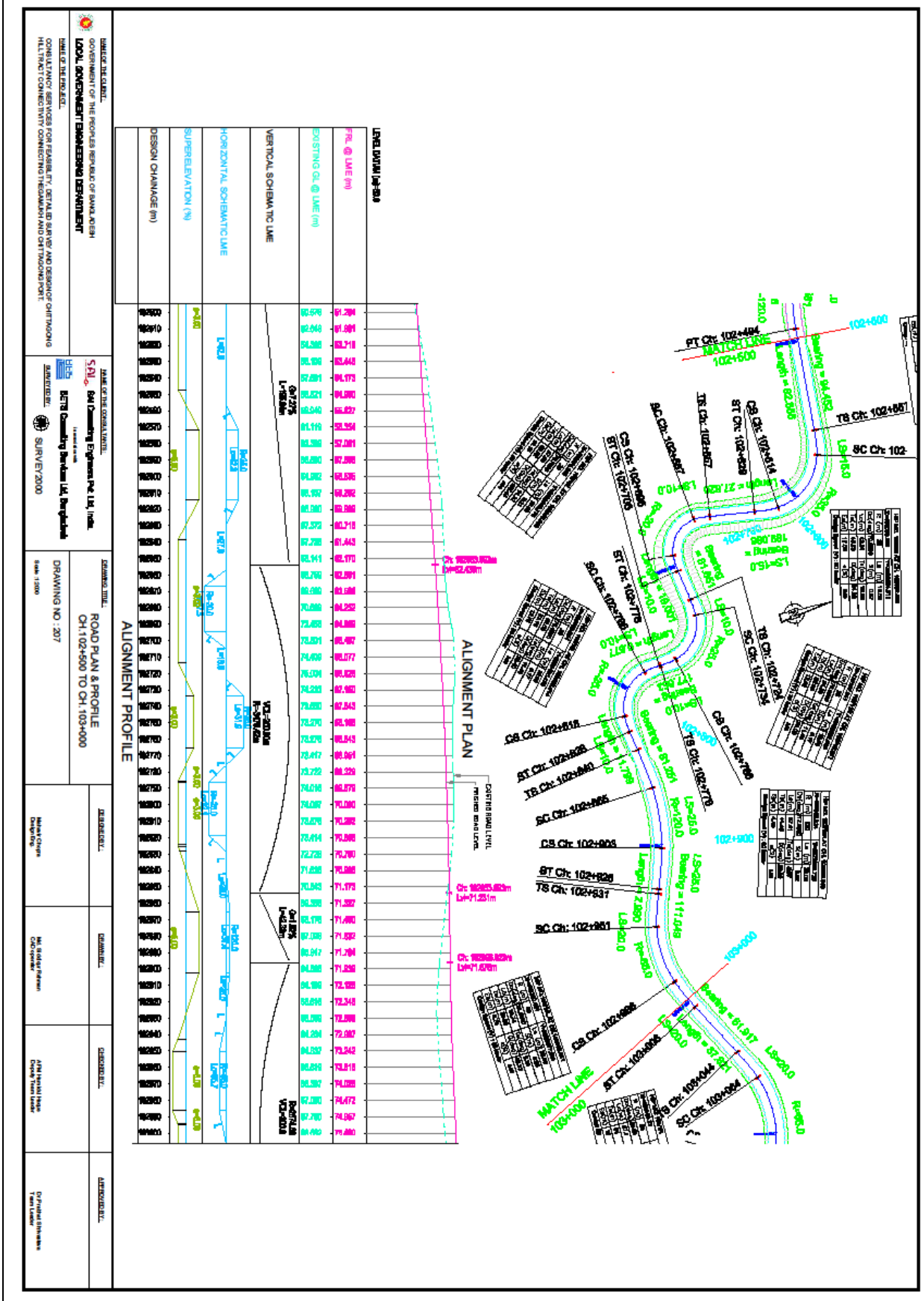
ANNEXURES III



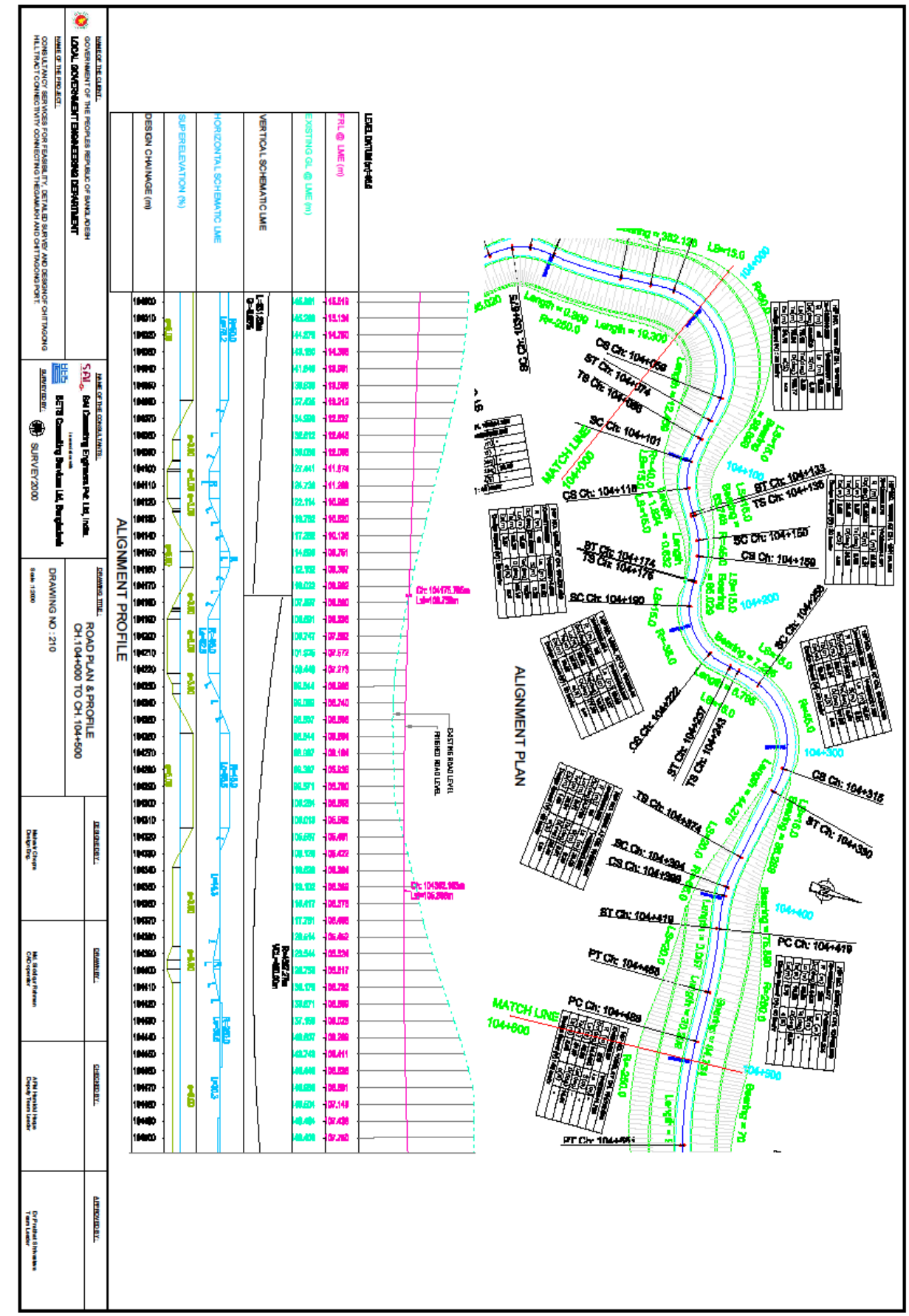

MATCH LINE
8+500
PT Ch: 8+498
TS Ch: 8+484
ST Ch: 8+464
SC Ch: 8+424
CS Ch: 8+404
ST Ch: 8+384
Ch: 8+328.883m
DIA=191.067m
NORTH
ALIGNMENT PLAN
TS Ch: 8+884
SC Ch: 8+924
CS Ch: 8+944
MATCH LINE
9+000
ST Ch: 9+014
TS Ch: 9+058
SC Ch: 9+098
CS Ch: 9+118
ST Ch: 9+128
Stone Slab
LEVEL DATUM (mPWD)
FRL @ LME (m)
EXISTING GL @ LME (m)
VERTICAL SCHEMATIC LME
HORIZONTAL SCHEMATIC LME
SUPERELEVATION (%)
DESIGN CHAINAGE (m)
ALIGNMENT PROFILE
DRAWING TITLE:
ROAD PLAN & PROFILE
CH 8+500 TO CH 9+000
DRAWING NO: 16
Scale: 1:2000
SURVEY2000
SAI Consulting Engineers Pvt. Ltd., India
BETS Consulting Services Ltd, Bangladesh
LOCAL GOVERNMENT ENGINEERING DEPARTMENT
GOVERNMENT OF THE PEOPLE'S REPUBLIC OF BANGLADESH
CONSULTANCY SERVICES FOR FEASIBILITY, DETAILED SURVEY AND DESIGN OF CHITTAGONG HILL TRACT CONNECTIVITY CONNECTING THEGAMUKH AND CHITTAGONG PORT.


ALIGNMENT PLAN
ALIGNMENT PROFILE
ROAD PLAN & PROFILE
CH.102+000 TO CH.102+500
DRAWING NO : 206
LOCAL GOVERNMENT ENGINEERING DEPARTMENT
SURVEY2000

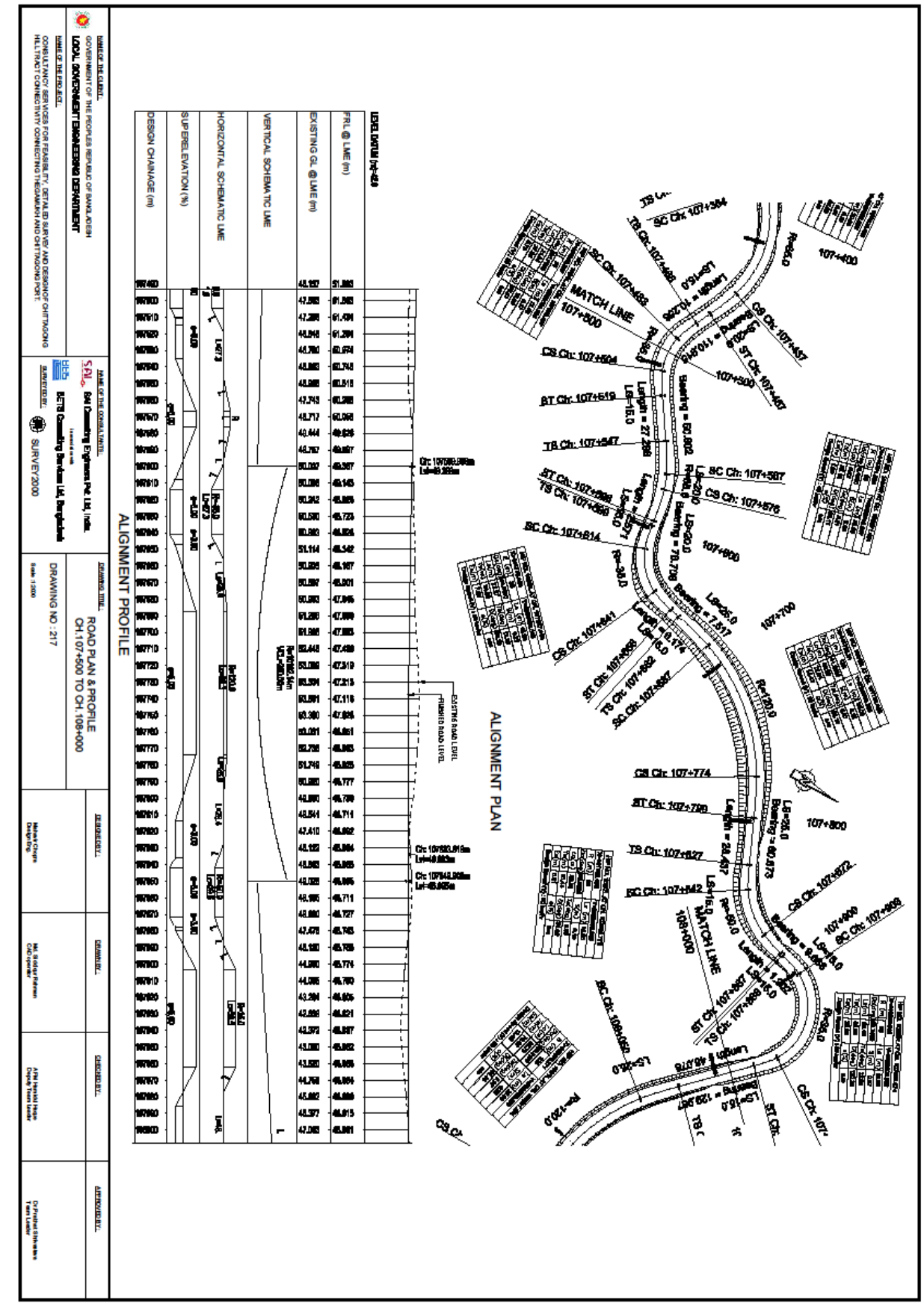
ANNEXURES III



ANNEXURES III



ANNEXURES III



ANNEXURE 3.2

Borrow and Quarry Sites

3.2.1 Facilities Associated with Construction of Routes

3.2.1.1 Availability of construction material

Construction material such as Silty Soil/Soil for Sub-grade, Fine Sand/Sand, Bricks/Bricks aggregates, Stone/Stone aggregate, Bitumen, Road Marker Paint, Coarse Sand, Cement, and Reinforcement etc will be used for the proposed alignment. The availability of borrow and quarry sites are as follows:

3.2.1.2 Quarry Sites

Suitable sources for quarry sites have been identified along the project by local enquiry. However, Survey agency has carried out tests on selected sources to find their suitability for use. Sufficient numbers of quarries have been identified to verify availability of materials. The information on the materials sources was summarized in Geological Profile in Chapter 5 with the following number of quarries for stone, sand, gravel and quarry areas for the project area. The top Alluvium Formation consisting of plastic unconsolidated silty Clay, Silt and fine Sand of Holocene/Recent age. Generally the thickness of this unit ranges between 0.0m to 14.0m, in an average 6.0m. The Dihing Sandstone/ Siltstone Formation consists of moderately consolidated low to medium plastic Silty Clay of Late Pliocene age. The thickness of this unit ranges between 0.0m to 19.0m with an average thickness of about 8.0m. Borrow and Quarry sites location maps are presented in Fig 3.2.1.2.

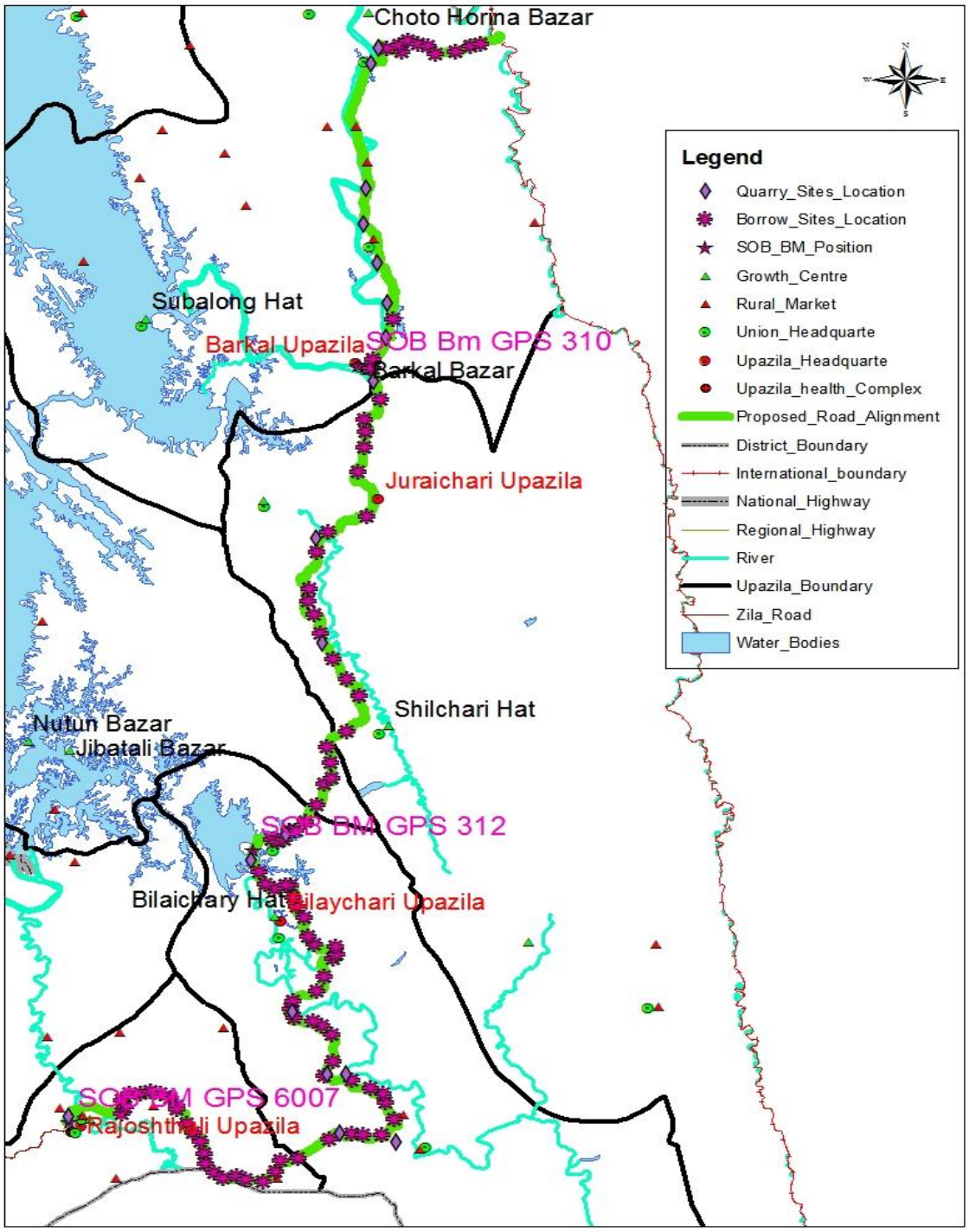


Fig 3.2.1.2: Possible Location Map of Borrow and Quarry Sites for Road Route

3.2.1.3 Borrow Sites

For the proposed route alignment borrow siteshas been identifiedwith material (soil, sand, stone, etc.) along with the alignment for use at other location.Only for soil and sand borrow siteswas found close to many location along the alignment. Soiland sand might be excavated to cut and fill for this project road route alignment. There is a need to provide acceptable resources to implement and maintain the environmental and safety management system including with labor and materials. For minimizing the amount of construction labor borrow sites location identified

near to the alignment. Borrow sites location maps are presented in Fig 3.2.1.2. Surveys of Construction Material

Table 3.2.1.3: List of Construction Materials & Sources

Route: 1			
Sl.N0	**Name of Construction Materials**	**Source**	**Remarks**
1	Silty Soil for Sub-grade	Rajoshthali, Farua, Bilaichari, Barkal, Chhotohorina. (Maximum area along with the alignment)	Available
2	Fine Sand (0.5 FM.) for ISG, Sub-base, etc.	Rajoshthali, Farua, Bilaichari, Barkal, Chhotohorina (Selected location along with the alignment up to Chhotohorina)	Available
3	Bricks/Bricksaggregates	Rangunia, Raowzan, Chhittagong	Available
4	Stone/Stone aggregate	Chittagong, Sylhet	Depends on volume of materials
5	Bitumen	Chittagong	Available
6	Road Marker Paint	Rangamati, Chittagong	Available
7	Coarse Sand	Chittagong, Sylhet	Depends on volume of materials
8	Cement	Rangamati, Chittagong	Available
9	Reinforcement	Rangamati, Chittagong	Available
10	Diesel, Petrol	Rangamati, Chittagong	Available

3.2.1.4 Construction Camps and Associated Services

Proper construction camps of the road maintenance provides many advantages to the project area. Construction camp locations based on current plans, this project covered 114.71km (Survey length) of the land-based road route alignment. Main objective to balance the number and location of camps to reduce distance from sources to destination for better and maximum productivity. By locating a camp near the proposed road routethat reduce travel time.

Safety of the workers in the camp and the nearby communities is considerable. Construction team will work with local police/BGB/Army to ensure that they are aware of project update/security and potential activity in the project area. Construction material camps location and associated services maps are presented in Fig 3.2.1.4.

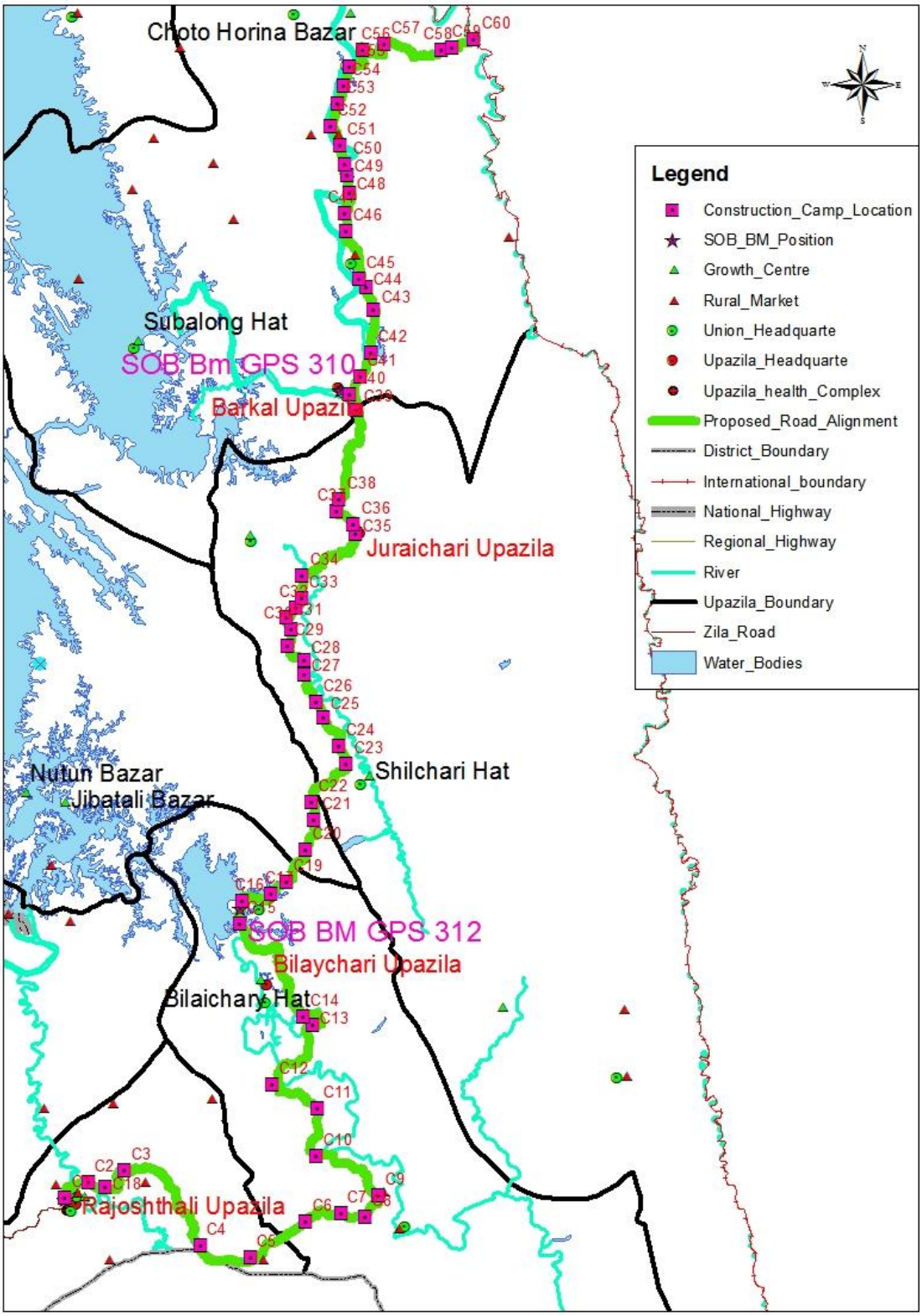


Fig 3.2.1.4: Possible Location Map of Construction Camps for Road Route

3.2.1.5 Soil and Dredged Material Disposal

Dredging Period: The dredging works can be started in early January when average water level is about +30 m.MSL and can be continued up to June. But early flash flood and monsoon may cause disruption of works in the months of March to June. Special measures are required to secure the dredgers and other equipment in these periods. On an average one month's work

disruption may be estimated. As such, total of 5 (five) months working period would be available for each year's dredging in between January to June.

Dredge Material Management: The both banks along the dredging length of Karnafuli River and Kaptai Lake have been examined and found that the river banks are mostly flat in the fringe. At present only one crop of rice is being cultivated on most of the lands. The crop is being grown when the land is clear of water in the dry/low water period. The dredge material if placed on these cultivable lands would be useful for agriculture use.

By placing dredge material on the cultivable land, the height of the land would be raised. Some low lying areas will be filled up that will increase cultivable land. As the dredge material is suitable for agriculture use, this will be highly beneficial to the local farmers. Efforts should be made to fill up low lying areas as much as possible. When this would not be possible, the cultivable land should be raised within 1.0m meter. The dredge material is to be placed minimum 100 m beyond the river bank and within a distance of 1.5 Km. Crop compensation/land compensation to the farmers is to be arranged within the project cost.

Soil and Dredged material Disposal Site Management: The dredge material dumping reaches are selected at least 100 meter (if there is Space) away from bank line. The distance between outermost dredging point and the spoil dumping reach would not be more than 1.5 km. The sides of the dredging reaches should be developed in such a way so that dumped dredge material remains within the spoil reach, do not return back to the river. The low lying lands are preferred for development through spoil dumping. The center co-ordinates of spoil reach is presented in Table 3.2.1.5 and location map is shown in Figure- (3.2.1.5 A, B, C, D and E). The dumping positions have been shown in the maps. The dimension of dredge material dumping reaches would be located with dimension during implementation of the project. During implementation of the project, the forest department, Kaptai Lake and local stakeholders might be contacted to finalize the dredge material dumping reach. The monitoring and quality control team would take necessary measure.

Table 3.2.1.5: Location of Centre Point of Proposed Spoil Dumping Zones at Kaptai Lake and Karnafuli River

ID	Easting	Northing
1	418982.585	2505258.510
2	419788.187	2506979.925
3	420756.618	2505618.768
4	422101.363	2507016.420
5	421996.177	2508163.087
6	421618.081	2509864.665
7	421252.912	2510883.921
8	422061.626	2511478.237
9	424878.602	2512796.335
10	425277.792	2513517.394
11	426819.557	2514085.237
12	426517.565	2515070.023
13	426999.227	2515651.136
14	428010.735	2515749.670
15	427469.628	2516534.951

ANNEXURES III

ID	Easting	Northing
16	429150.274	2516669.661
17	429342.379	2517712.054
18	430522.968	2517850.175
19	431295.922	2516563.283
20	431382.215	2514729.955
21	431801.879	2514161.937
22	432135.873	2513360.452
23	433980.178	2513325.172
24	435451.112	2512861.514
25	437392.114	2512526.637
26	437721.549	2512259.868
27	437788.872	2512932.028
28	437635.630	2513712.067
29	437840.409	2514401.249
30	438295.216	2514951.203
31	437945.961	2515930.506
32	437414.814	2516275.948
33	437235.272	2516700.316
34	437311.474	2517437.807
35	437440.276	2518288.463
36	437103.329	2519180.209
37	436799.577	2519837.550
38	436733.476	2520581.253
39	436606.684	2521178.612
40	436033.713	2521900.073
41	436035.790	2522626.094
42	436640.771	2522271.896
43	437149.571	2522455.352
44	437493.722	2522978.840
45	437301.482	2524032.784
46	437587.469	2524325.448
47	437541.761	2524611.069
48	437680.926	2524984.618
49	436755.422	2526050.388
50	437061.800	2527407.135
51	437317.966	2528463.386
52	438165.463	2528985.719
53	437916.078	2529568.443

ANNEXURES III

Location Map of spoil dumping reaches indicative ( ) Alignment of Multimodal Route

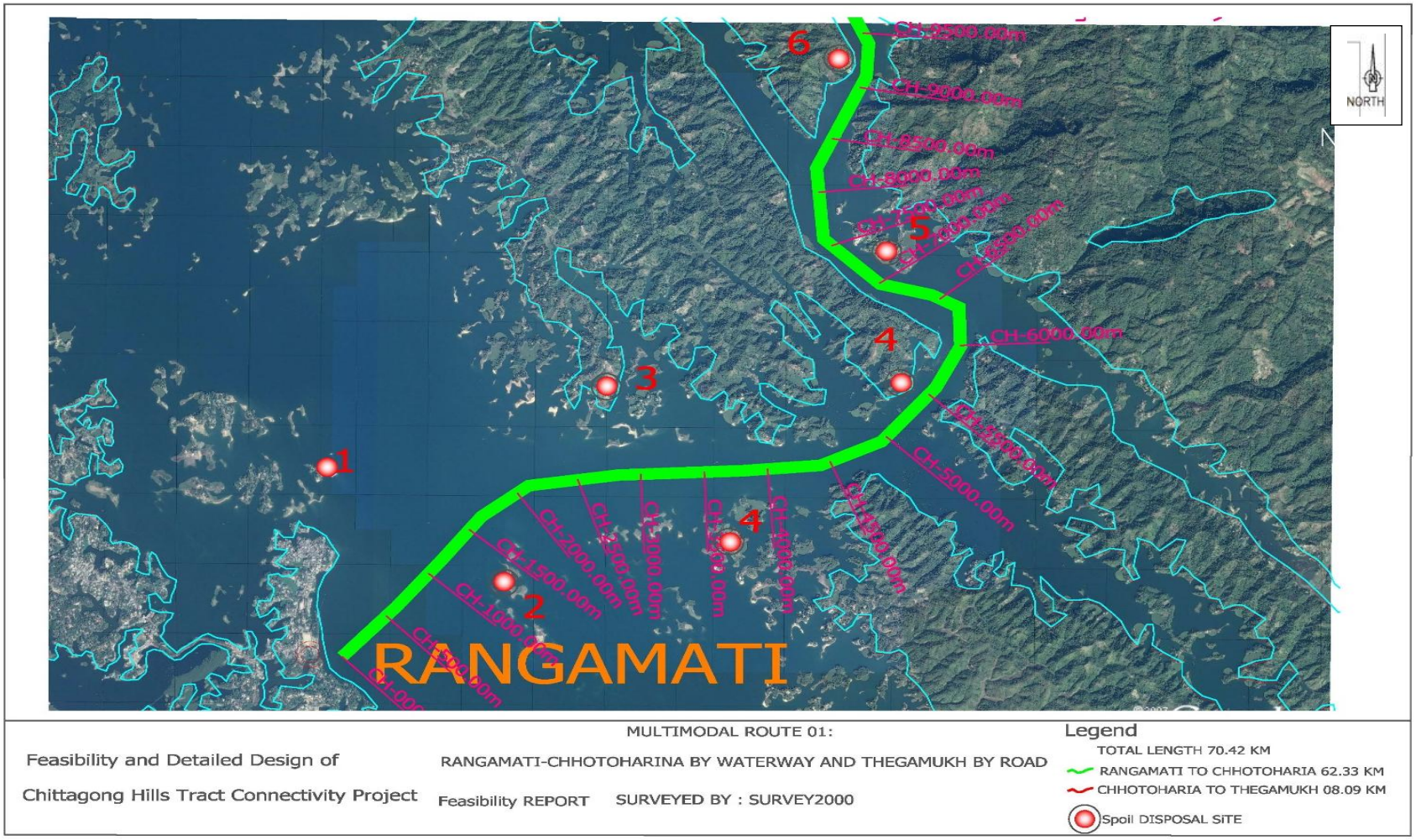


Fig 3.2.1.5A: Location Map of Spoil Dumping Zoneof Multimodal Route-01 From Chainage 00.000m to 9500.00m

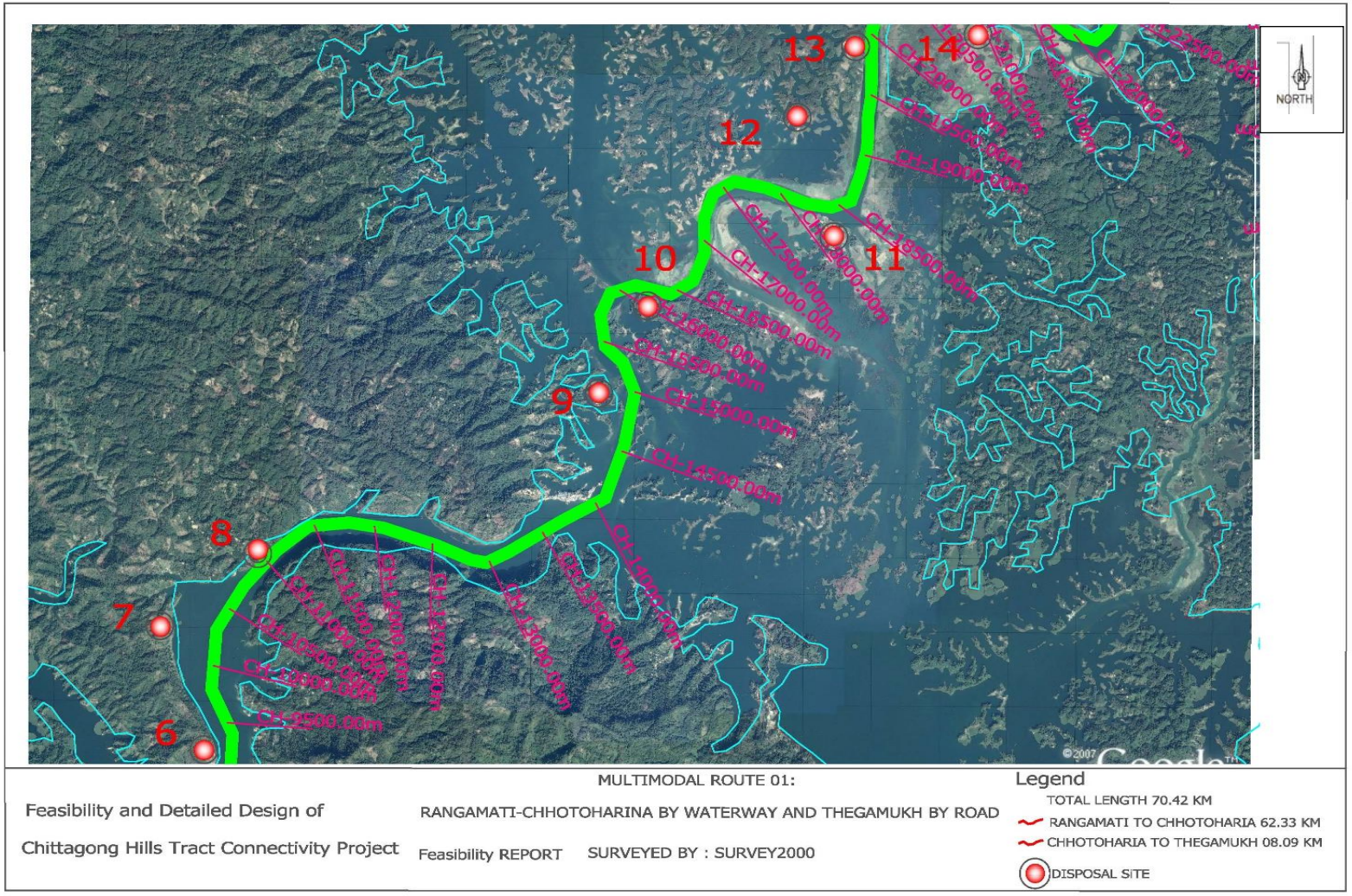


Fig 3.2.1.5B: Location Map of Spoil Dumping Zone of Multimodal Route From Chainage From 9500.00m to 20000.00m

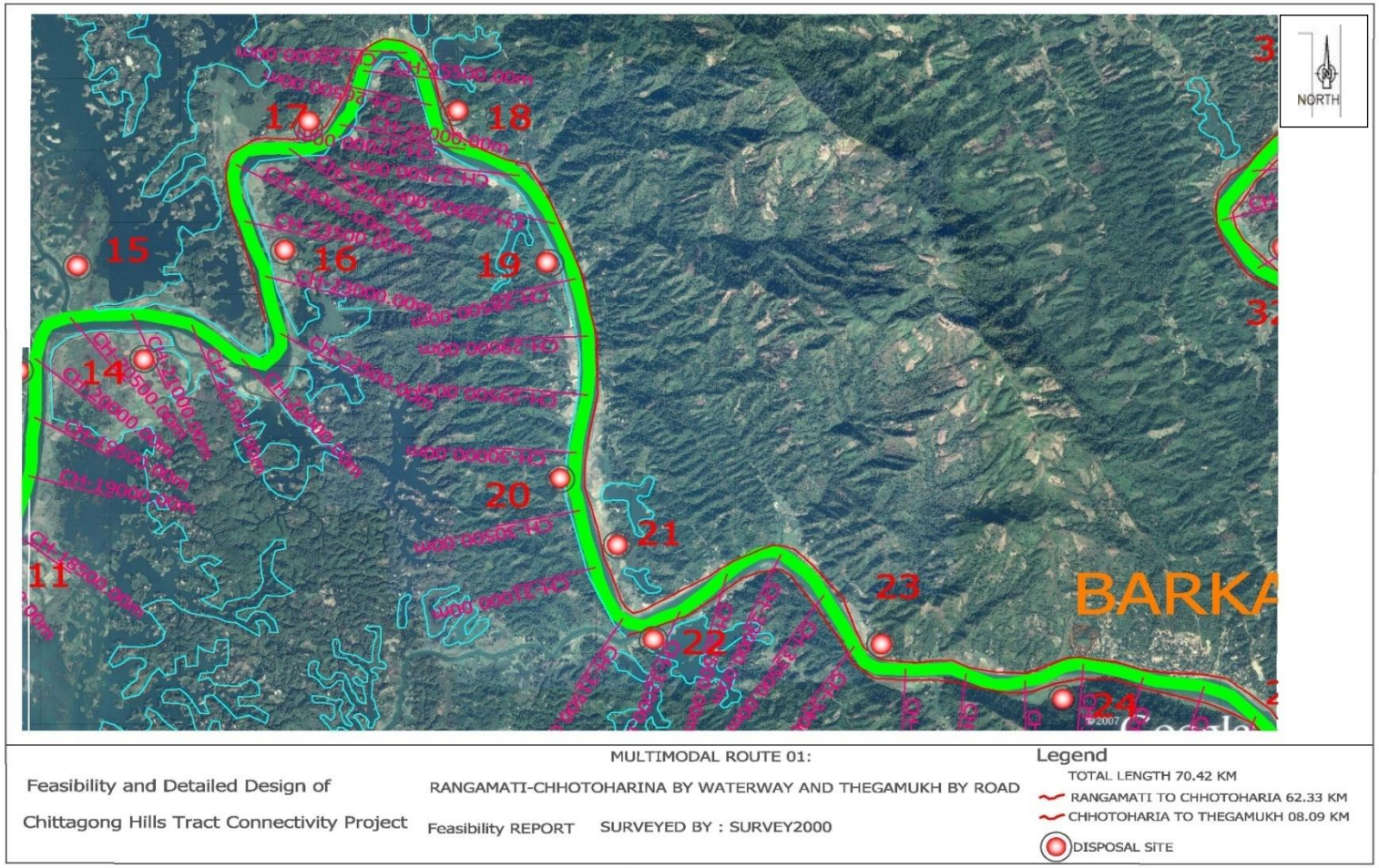


Fig 3.2.1.5C: Location Map of Spoil Dumping Zone ofMultimodal Route From Chainage From 20000.00m to 34000.00m

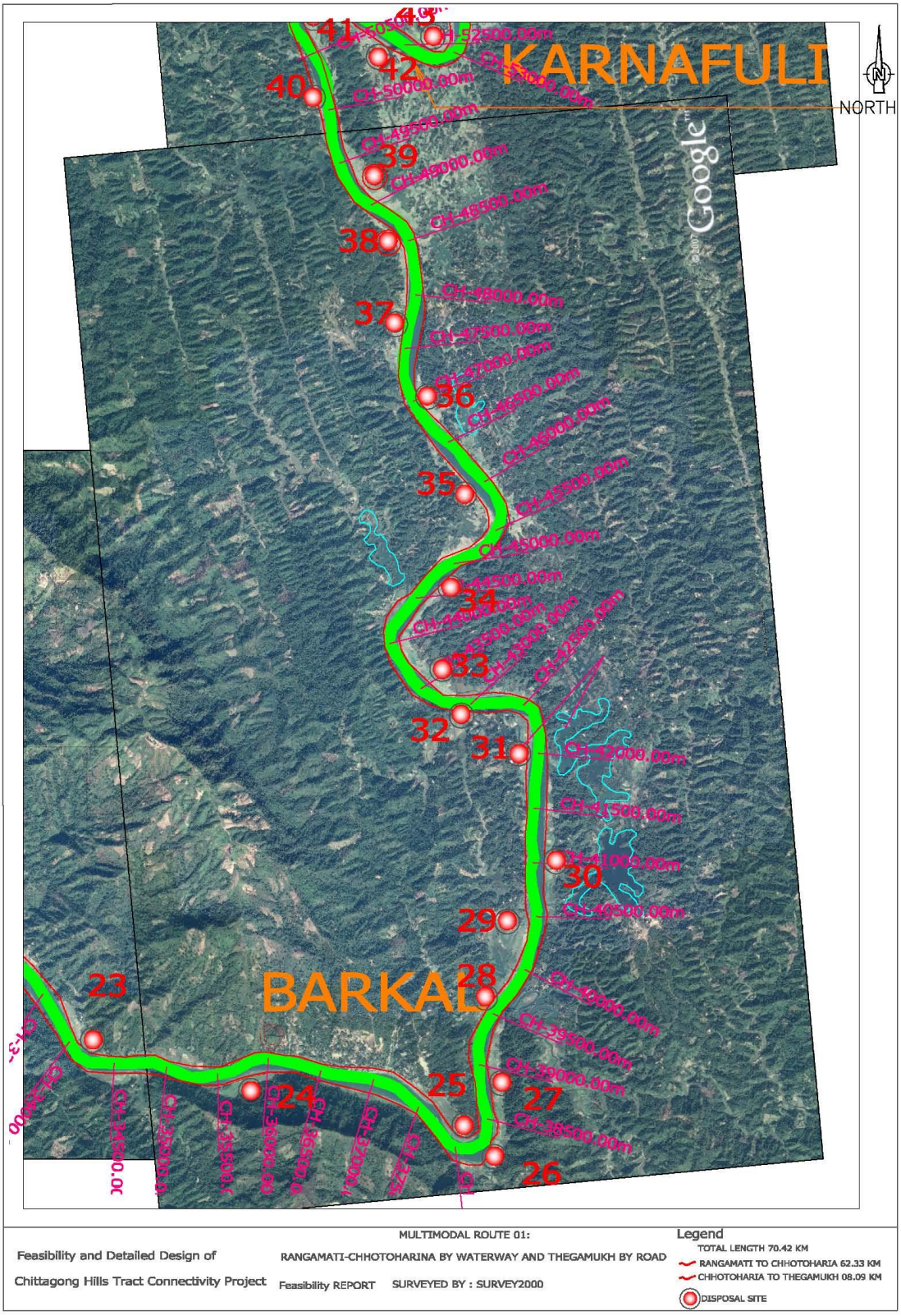


Fig 3.2.1.5D: Location Map of Spoil Dumping Zone of Multimodal Route-01 From Chainage 34000.00m to 52500.00m

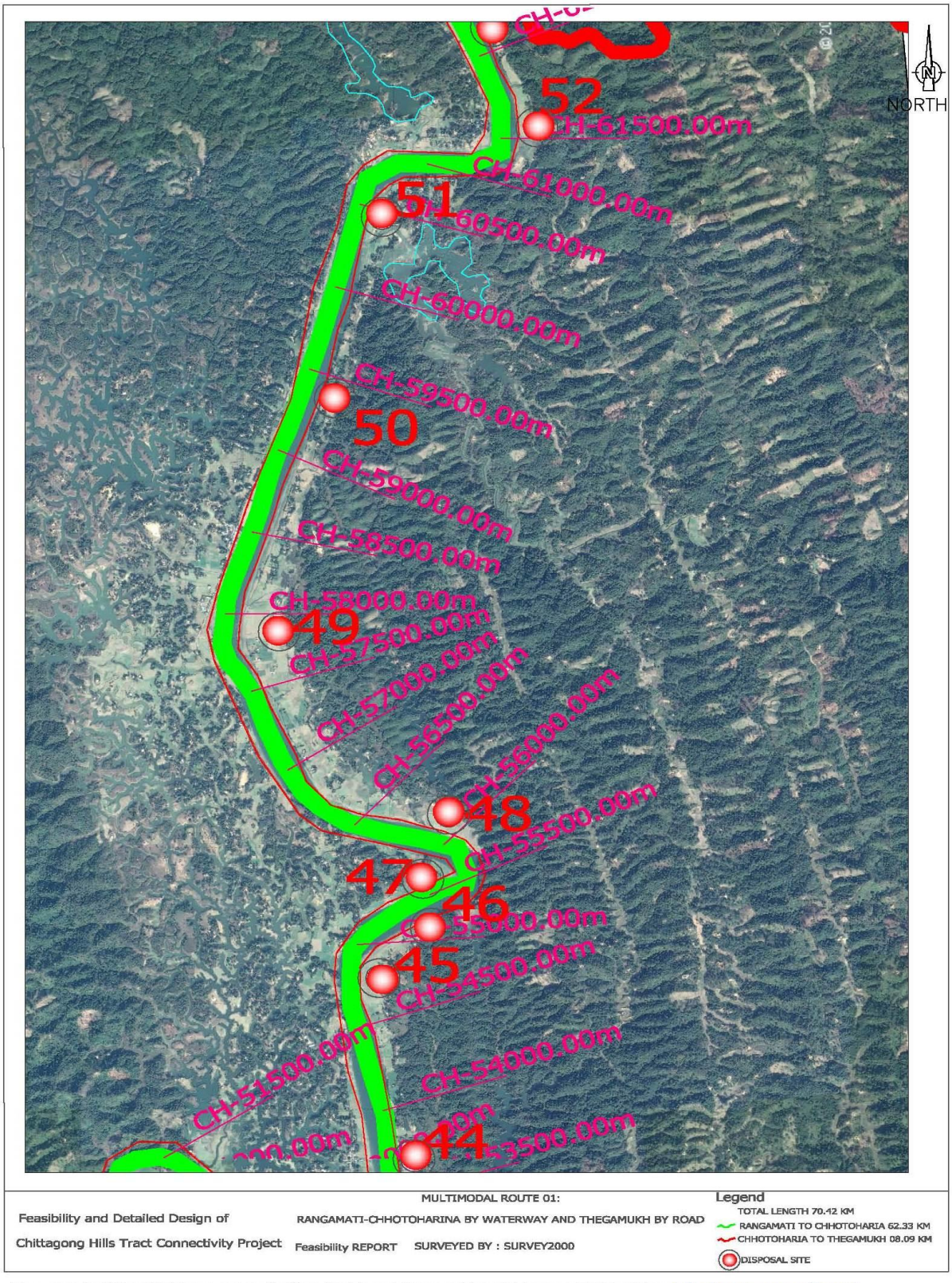


Fig 3.2.1.5E: Location Map of Spoil Dumping Multimodal Route From Chainage 52500.00m to 62300.00m

ANNEXURE IV

Initial Environmental Findings

Table 4A: Route -1. Rajosthali-Bilaichari-Juraichari-Barkal-Thegamukh (Proposed Route Length 123.546)

	Initial Issues Identification Questions	**Initial Findings**
	Is the site vulnerable to major natural or induced hazards such as:	
1	Landslides	123.546 Km Proposed project areas may be affected by landslide. Steep slope and heavy rainfall may create landslide. The landslide in Bandarban is a regular feature during rainy season. More information about geological formation, soil condition and rainfall trend will be collected during feasibility study.
2	Flooding	Flash flood is very common in hilly area and in the Charas. Protection needed when such situation needed
	Storm Surge	Storm surge and cyclones is more frequent in the coastal region of Bangladesh but the area of influence also crosses over Chittagong Hill Tract.
3	Sever wind damage (associated with hurricanes, tropical storms or weather system)	Seasonal storm known as Nor'westers (kalboishakhi) is common in the month April and May.
4	Is the site vulnerable to major natural or induced hazards such as:	
5	Fire	People set fire on hill vegetation for cultivation of Jhum (burn and slash method) for nutrient of the crop.
6	Explosion	Transportation of different explosive chemical can causes explosion; safety in transportation will be required.
7	Chemical or Oil spill	Transportation of different chemical and oil can be cause of spill and contaminated the project area; safety in transportation will be required.
8	Is the road gradient likely to be very steep?	The project area is a hilly zone, have many fold and the construction of road is likely to be very steep but not unreachable for motor vehicle.
9	Is there any past record of landslides, or land slippage along the route?	Some location along the route may affected by landslide. There is a scarcity of information about the landslide or land slippage along the route. Careful consideration will be required to ensure appropriate road design to avoid landslides, slope failure and erosion.
10	Is the project site within or adjacent to any areas of historical, religious, traditional or cultural significance?	There are 13 religious, 21 school and 4 health centre are found besides the road alignment. So far such historical and cultural relics have not been found. In case of chance find during construction will be reported according to the rules of the government. Continuous public consultation and stake holder discussion can throw some more light.
11	Will the project operation disturb any traditional activity on adjoining or nearby properties?	The hilly population in the project area very scanty and unlike plane lands. Most tribal community is away from the project area with some exception of villages and market place. It will not disturb any traditional activity of tribal people
12	Preservation of land use/Impact of adjoining users	Preservation of land use will have an impact on adjoining users.
13	Is the project area zoned for the intended use?	Not yet. However whole forest in many way controlled by government and tribal people has little access to forest products.
14	Will the sub-project affect existing land uses around the site during operation?	There are 27 bridge and culverts are exist and required to be remodeled. More than 100 km earthen road should be constructing. The construction of the road will definitely affect the farmland around the project site with runoff coming from construction activities.

15	Will nearby activities in surrounding areas adversely affect the sub-project (for instance, noise, run-off, air/exhaust emissions from surrounding land uses)?	During construction and operation, noise and vibration will be generated from construction equipment, equipment will generate emissions and during operation, air pollutants from traffic will be generated in the ambient air.
16	Will the new road significantly increase access to areas/resources that were once largely inaccessible to the general public?	The project area is nearly inaccessible. If the project is successful then the road significantly increases the accessibility of different forest and mineral resources. It also increase the business between Bangladesh and India
17	Is this increase access likely to place pressure on local natural resources and wildlife?	It may create pressure on local resources like forest and its habitat. Govt. will take appropriate measure.
18	Is the new road likely to cause an increased demand for new permanent residence and businesses in the community?	The 123.546 km road may increase the demand of business and new permanent resident in the surrounding communities. Huge transportation will take place between Chittagong port and the interior area of CHT. Trans-boundary business will increase and as such demand for facilities for business and living will increase.
19	Is the presence of the new road likely to cause an influx of visitors/tourists into the community?	The scenic beauty, tribal population and their cultural activities attracted visitors and tourist both nationally and internationally.
20	Will the new road affect community cohesion?	No. Rather community will enjoy better communication facility in the area and better access to the facilities of the government like health care, schooling for the children
21	Will the new road result in the use of vehicles with excess tonnage?	The road connected between the Chittagong sea port to interior of CHT and across the border. Increased number of vehicles and excess tonnage are expected.
22	Is the diversion likely to have an adverse impact on local users (e.g. loss of irrigation water for farmers in dry season)?	More than 39 Charas and river are the main sources of water for farmers. The diversion of these sources has an adverse effect on irrigation and household works.
23	Is the sub-project site part of a protected or environmentally sensitive area?	The protected or environmentally sensitive area is far away from the project site.
24	Loss of bottom habitat and fishery resources are also significant problem included in this category?	More than 39 Charas and river crossing need to dredging or pilling. Dredging and pilling foundation for bridge construction may lead to loss of bottom habitat and fishery resources in the project area. If dredging is required for navigation purpose that can create more problem in the area.
25	Does the sub-project encroach on tropical rain forests, wetland, mangrove forests, coral reefs, coastal zone or other vulnerable areas?	The project is located in tribal and pristine area. Water bodies at Kaptaii lake and forest surrounded by woodlands. 124 Km road sections are passing through several upazilas of Rangamati district in the mountainous terrain, where road safety, landslide, and slope stability will be of concerns. Approximately 69% of total land use area is forest land.
26	Does the sub-project involve significant removal of vegetation cover?	The project will need 150 m ROW for construction of road. If forest and vegetation may need to be cleared for the construction however it does not involve significant removal of vegetation in the area.
27	Will the project require sourcing of significant quantities of aggregate material?	No. There is no such significant amount of aggregate available and need to be transported to the project area by road or by waterways.
28	Is the sub-project right-of-way/route/corridor likely to bisect or cross a protected area or environmentally sensitive area?	No. It will not bisect or cross a protected area or environmentally sensitive area The protected or environmentally sensitive area is far away from the project site.
29	Is the sub-project's right-of-way/route/corridor likely to affect:	
	-the habitats of fish?	About 7936.331 m long Chara and river crossing existed on the alignment. The diversion of those Chara, rivers, dredging, constructing bridges and culverts will affect the habitats of fish.
	-habitats of wildlife species including endangered species?	The habitats of wildlife species including endangered species are not on the road alignment or nearby though it is passing through the forest.
	-wildlife or livestock movement/crossing patterns?	As stated this will not happen in the project area.
30	Will the seasonal flow create conditions of stagnant	During construction proper drainage system must be built

	water?	otherwise seasonal flow creates conditions of stagnant water. There are 39 Charas and Rivers existed on the alignment.
31	Is the new drain likely to change the normal flow of water run-off	Proper design should take care for the drainage system.
32	Will the construction work generate significant amounts of dust, odor or noxious gases that are likely to disturb local residents (reproductive and informal activities) and businesses?	The construction work will generate dust, odor or noxious gases that are likely to disturb local resident. Measures will be taken to reduce the effect.
33	Will the construction work cause a noise nuisance due to the operation of heavy machinery and other on-site activities?	The construction work will causes of noise due to the operation of heavy machinery on the site. Necessary steps should taken to reduce the effect
34	Will the construction work produce significant amount of run-off, change drainage patterns and/or erosion?	Construction work produce significant amount of run-off, and may change drainage patterns and/or erosion
35	Will the construction work disrupt traffic (pedestrian and vehicular)?	The percentage of settlement is 4.6% of total land use needed. That means population density is very low along the project areas. The disruption of traffic (pedestrian and vehicular) will be minimal.
36	Will the construction of the sub-project affect access to existing land uses?	Heavy machinery for construction may causes will the movement and location of heavy equipment, trenching, etc. for rural roads, large drains, interfere with access to private property.
37	Will construction worker be provided with hard hats and boots, and be required to wear them?	Comply with all types of health and safety issues. It will be part of bid document.
38	Will visitors to the sub-project construction site be provided with hard hats?	Comply with all types of health and safety issues. It will be part of bid document.
39	Will the site be secured during construction to prevent unimpeded public access and protect area users?	Comply with all types of health and safety issues. It will be part of bid document.
40	Will precautions be put in place during construction to protect area users (e.g. barriers, lighting and signage)?	Comply with all types of health and safety issues. It will be part of bid document.
41	Are construction workers trained and equipped with the required personal protective equipment (PPE) to undertake the tasks assigned to them?	Comply with all types of health and safety issues. It will be part of bid document.
42	Does the Contractor convene regular health and safety meeting with workers?	Comply with all types of health and safety issues. It will be part of bid document.
43	Are there separate washroom facilities, adequate restroom/eating areas and first aid kit on site, and are these freely accessible to workers when needed?	Comply with all types of health and safety issues. It will be part of bid document.
44	Are any development activities within a legally protected area (e.g. natural reserve, national park) for the protection or conservation of biodiversity?	The protected or environmentally sensitive area is far away from the project site.
45	Does the project involve significant extraction, diversion or containment of surface or ground water?	No. Extraction, diversion or containment of surface or ground water and will be limited to the construction requirements only.
46	Does the project pose a risk of degrading soils?	A huge quantity of cutting and filling can take place. Project may pose a risk of degrading soils & need mitigation.
47	Would the propose project result in the release of pollutants to the environment due to routine or non-routine circumstances with the potential for adverse local, regional and trans boundary impacts?	Instead of road from Chotohorina to Thegamukh, if waterway is planned, international water bodies will be affected. The project will be located close to Kaptaii Lake and tribal communities. Extensive tribal community consultation and engagement will be required for smooth implementation of the project.
48	Would the proposed project result in the generation of waste that cannot be recovered, reused or disposed of in an environmentally and socially sound manner?	Waste generated during construction will be disposed of in safe way. The contractor will be instructed and it will be part of bid documents.
49	Is the proposed project likely to directly or indirectly increase environmental and social vulnerability to climate change now or in the future (also known as maladaptive practices)?	Though road is passing through forest land/ Greenfield but it will create minimal harm to the community. It will not directly or indirectly increase environmental and social vulnerability to climate change now or in the future.
50	Is the project likely to result in a substantial influx of people into the affected community (ies)?	The scenic beauty, tribal population and their cultural activities attracted visitors and tourist. There is enormous possibility in the

		development of tourism and project aiming at financing tourism infrastructure in the mounting.
51	Will the proposed project result in physical interventions (during construction or implementation) that would affect areas that have known physical or cultural significance to Tribal groups and other communities with settled recognized cultural claims?	Project will not make any physical interventions (during construction or operation) that would affect areas that have known physical or cultural significance to Tribal groups. Public consultation and focus group discussion is continuing to understand the situation.
52	Would the proposed project be susceptible to or lead to increased vulnerability to earthquakes, subsidence and landslide, erosion, flooding or extreme climatic conditions?	There is high risk of earthquakes, subsidence, landslide, erosion, flooding or extreme climatic conditions as risk of the mountainous road alignment. Proper slope protection and drainage infrastructure will be required.
53	Will the project result in increased health risks as a result of a change in living and working conditions? In particular, will it have the potential to lead to an increase in HIV/AIDS infection?	India is heavily affected by HIV/AIDS. The connectivity may create a threat for increase in HIV/AIDS in Bangladesh. All precaution will be taken in the labor camp for construction workers to meet such health hazards.
54	Will the proposed project required additional health services including testing?	The connectivity will give more access to the health services into the area which is inaccessible before.
55	Is the proposed project location subject to currently approved land use plans (e.g. roads, settlements) which could affect the environmental and social sustainability of the project?	The area was inaccessible before. Government may have future plans for urban growth, industrial development, if the transportation infrastructure (road construction) is complete. There is no land use plan at the moment.
56	Would the proposed project result in secondary or consequential development which could lead to environmental and social effects, or would it have potential to generate cumulative impacts with other known existing or planned activities in the area?	New road through forested land will generate direct environmental and social impacts through the cutting of forest and earthwork associated with construction and potential relocation of inhabitants. Approximately 69% of total land use area should be removed. These are direct impacts. In addition, however, the new road would likely also bring new commercial and domestic development (houses, shops, businesses). In turn, these will generate indirect impacts.
	Multimodal	
57	Habitat (especially fish spawning areas) from dredging operations;	Dredging operation will cause damage of fish habitat.
58	Impacts to terrestrial flora/fauna and natural habitats at site of on-land disposal of dredged material (especially if dredged material is contaminated);	An ecological survey will be required in the project area including in the Kaptaii lake. The presence of sensitive species needs to be further verified during the feasibility study.
59	Impact critical habitats, potentially including but not limited to legally designate protected areas.	An ecological survey will be required in the project area including in Kaptaii lake. The presence of sensitive species needs to be further verified during the feasibility study. The road alignment is not proposed through designated protected area.
60	Open water disposal of dredging materials should be avoided wherever possible given its tremendous benthic effects.	Proper disposal of riverbed material will be required. Where no other alternatives to open water disposal exist, a benthic survey will be required. Evaluation of environmental issues related to selection and management of areas for disposal of dredging material on land will be required. Feasibility study will further quarry these.
61	Community participation in the management of dredging materials	Stake holder meeting and community consultation has been undertaken and management of the dredged materials will be done through this process.
62	Land acquisition is likely to be required for on-land disposal of dredging material, access roads or river port development activities	Disposal of dredging materials can be matched with fill section of the road between Barkal and Chotohorina. About 90% of the dredged material will be generated in this section of navigational channel. The dredged material can be used for the road construction provided the dredged materials are suitable for road embankment.
63	River bed, coastline and on-shore habitats which may be impacted by disposal of dredged material and/or other on-land activities, as well as critical habitat (including but not limited to legally designated protected areas)	This will be taken care during dredging of the proposed navigational channel. Further investigation will be made during detailed feasibility study.

Table 4B: Route 2: Langadu-BagachattarBarkal-Thegamukh (Proposed Route Length 50.259 km)

	Initial Issues Identification Questions	**Initial Findings**
	Is the site vulnerable to major natural or induced hazards such as:	
1	Landslides	50.259 km Proposed project areas may be affected by landslide. Steep slope and heavy rainfall may create landslide. The landslide in Bandarban is a regular feature during rainy season. More information about geological formation, soil condition and rainfall trend will be collected during feasibility study.
2	Flooding	Flash flood is very common in hilly area and in the Charas. Protection needed when such situation needed
	Storm Surge	Storm surge and cyclones is more frequent in the coastal region of Bangladesh but the area of influence also crosses over Chittagong Hill Tract.
3	Sever wind damage (associated with hurricanes, tropical storms or weather system)	Seasonal storm known as Nor'westers (kalboishakhi) is common in the month April and May.
4	Is the site vulnerable to major natural or induced hazards such as:	
5	Fire	People set fire on hill vegetation for cultivation of Jhum (burn and slash method) for nutrient of the crop.
6	Explosion	Transportation of different explosive chemical can causes explosion and safety in transportation will be required.
7	Chemical or Oil spill	Transportation of different chemical and oil can be cause of spill and contaminated the project area; safety in transportation will be required.
8	Is the road gradient likely to be very steep?	The project area is a hilly zone, have many fold and the construction of road is likely to be very steep but not unreachable for motor vehicle.
9	Is there any past record of landslides, or land slippage along the route?	Some location along the route may affected by landslide. There is a scarcity of information about the landslide or land slippage along the route. Careful consideration will be required to ensure appropriate road design to avoid landslides, slope failure and erosion.
10	Is the project site within or adjacent to any areas of historical, religious, traditional or cultural significance?	There are 6 religious, 7 school and 2 health centre are found besides the road alignment. So far such historical and cultural relics have not been found. In case of chance find during construction will be reported according to the rules of the government. Continuous public consultation and stake holder discussion can throw some more light.
11	Will the project operation disturb any traditional activity on adjoining or nearby properties?	The hilly population in the project area very scanty and unlike plane lands. Most tribal community is away from the project area with some exception of villages and market place. It will not disturb any traditional activity of tribal people
12	Preservation of land use/Impact of adjoining users	Preservation of land use will have an impact on adjoining users.
13	Is the project area zoned for the intended use?	Not yet. However whole forest in many way controlled by government and tribal people has little access to forest products.
14	Will the sub-project affect existing land uses around the site during operation?	There are 6 bridge and culverts are exist and required to be remodeled. More than 42.3 km earthen road should be constructing. The construction of the road will definitely affect the farmland around the project site with runoff coming from construction activities.
15	Will nearby activities in surrounding areas adversely affect the sub-project (for instance, noise, run-off,	During construction and operation, noise and vibration will be generated from construction equipment, equipment will generate

	air/exhaust emissions from surrounding land uses)?	emissions and during operation, air pollutants from traffic will be generated in the ambient air.
16	Will the new road significantly increase access to areas/resources that were once largely inaccessible to the general public?	The project area is nearly inaccessible. If the project is successful then the road significantly increases the accessibility of different forest and mineral resources. It also increase the business between Bangladesh and India
17	Is this increase access likely to place pressure on local natural resources and wildlife?	It may create pressure on local resources like forest and its habitat. Govt. will take appropriate measure.
18	Is the new road likely to cause an increased demand for new permanent residence and businesses in the community?	The 50.259 km road may increase the demand of business and new permanent resident in the surrounding communities. Huge transportation will take place between Chittagong port and the interior area of CHT. Trans-boundary business will increase and as such demand for facilities for business and living will increase.
19	Is the presence of the new road likely to cause an influx of visitors/tourists into the community?	The scenic beauty, tribal population and their cultural activities attracted visitors and tourist both nationally and internationally.
20	Will the new road affect community cohesion?	No. Rather community will enjoy better communication facility in the area and better access to the facilities of the government like health care, schooling for the children
21	Will the new road result in the use of vehicles with excess tonnage?	The road connected between the Chittagong sea port to interior of CHT and across the border. Increased number of vehicles and excess tonnage are expected.
22	Is the diversion likely to have an adverse impact on local users (e.g. loss of irrigation water for farmers in dry season)?	More than 10 Charas and river is the main sources of water for farmers. The diversion of those sources has an adverse effect on irrigation and household works.
23	Is the sub-project site part of a protected or environmentally sensitive area?	The protected or environmentally sensitive area is far away from the project site.
24	Loss of bottom habitat and fishery resources are also significant problem included in this category?	More than 10 Charas and River crossing need to dredging or pilling. Dredging and pilling foundation for bridge construction may lead to loss of bottom habitat and fishery resources in the project area. If dredging is required for navigation purpose that can create more problem in the area.
25	Does the sub-project encroach on tropical rain forests, wetland, mangrove forests, coral reefs, coastal zone or other vulnerable areas?	The project is located in tribal and pristine area. Water bodies at Kaptaii lake and forest surrounded by woodlands. 24.2 km road sections are passing through several upazilas in the mountainous terrain, where road safety, landslide, and slope stability will be of concerns. Approximately 50.7% of total land use area is forest land.
26	Does the sub-project involve significant removal of vegetation cover?	The project will need 150m ROW for construction of road. If forest and vegetation may need to be cleared for the construction however it does not involve significant removal of vegetation in the area.
27	Will the project require sourcing of significant quantities of aggregate material?	No. There is no such significant amount of aggregate available and need to be transported to the project area by road or by waterways.
28	Is the sub-project right-of-way/route/corridor likely to bisect or cross a protected area or environmentally sensitive area?	No. It will not bisect or cross a protected area or environmentally sensitive area The protected or environmentally sensitive area is far away from the project site.
29	Is the sub-project's right-of-way/route/corridor likely to affect:	
	-the habitats of fish?	About 861.009 m long Chara and River crossing existed on the alignment. The diversion of those Chara, Rivers, dredging, constructing bridges and culverts will affect the habitats of fish.
	-habitats of wildlife species including endangered species?	The habitats of wildlife species including endangered species are not on the road alignment or nearby though it is passing through the forest.
	-wildlife or livestock movement/crossing patterns?	As stated this will not happen in the project area.
30	Will the seasonal flow create conditions of stagnant water?	During construction proper drainage system must be built otherwise seasonal flows create conditions of stagnant water. There are 9 Charas and Rivers existed on the alignment.

31	Is the new drain likely to change the normal flow of water run-off	Proper design should take care for the drainage system.
32	Will the construction work generate significant amounts of dust, odor or noxious gases that are likely to disturb local residents (reproductive and informal activities) and businesses?	The construction work will generate dust, odor or noxious gases that are likely to disturb local resident. Measures will be taken to reduce the effect.
33	Will the construction work cause a noise nuisance due to the operation of heavy machinery and other on-site activities?	The construction work will causes of noise due to the operation of heavy machinery on the site. Necessary steps should taken to reduce the effect
34	Will the construction work produce significant amount of run-off, change drainage patterns and/or erosion?	Construction work produce significant amount of run-off, and may change drainage patterns and/or erosion
35	Will the construction work disrupt traffic (pedestrian and vehicular)?	The approximate percentage of settlement is 13.83% of total land use needed. That means population density is very low along the project areas. The disruption of traffic (pedestrian and vehicular) will be minimal.
36	Will the construction of the sub-project affect access to existing land uses?	Heavy machinery for construction may causes will the movement and location of heavy equipment, trenching, etc. for rural roads, large drains, interfere with access to private property.
37	Will construction worker be provided with hard hats and boots, and be required to wear them?	Comply with all types of health and safety issues. It will be part of bid document.
38	Will visitors to the sub-project construction site be provided with hard hats?	Comply with all types of health and safety issues. It will be part of bid document.
39	Will the site be secured during construction to prevent unimpeded public access and protect area users?	Comply with all types of health and safety issues. It will be part of bid document.
40	Will precautions be put in place during construction to protect area users (e.g. barriers, lighting and signage)?	Comply with all types of health and safety issues. It will be part of bid document.
41	Are construction workers trained and equipped with the required personal protective equipment (PPE) to undertake the tasks assigned to them?	Comply with all types of health and safety issues. It will be part of bid document.
42	Does the Contractor convene regular health and safety meeting with workers?	Comply with all types of health and safety issues. It will be part of bid document.
43	Are there separate washroom facilities, adequate restroom/eating areas and first aid kit on site, and are these freely accessible to workers when needed?	Comply with all types of health and safety issues. It will be part of bid document.
44	Are any development activities within a legally protected area (e.g. natural reserve, national park) for the protection or conservation of biodiversity?	The protected or environmentally sensitive area is far away from the project site.
45	Does the project involve significant extraction, diversion or containment of surface or ground water?	No. Extraction, diversion or containment of surface or ground water and will be limited to the construction requirements only.
46	Does the project pose a risk of degrading soils?	A huge quantity of cutting and filling can take place. Project may pose a risk of degrading soils & need mitigation.
47	Would the propose project result in the release of pollutants to the environment due to routine or non-routine circumstances with the potential for adverse local, regional and trans boundary impacts?	Instead of road from Chotohorina to Thegamukh, if waterway is planned, international water bodies will be affected. The project will be located close to Kaptaii Lake and tribal communities. Extensive tribal community consultation and engagement will be required for smooth implementation of the project.
48	Would the proposed project result in the generation of waste that cannot be recovered, reused or disposed of in an environmentally and socially sound manner?	Waste generated during construction will be disposed of in safe way. The contractor will be instructed and it will be part of bid documents.
49	Is the proposed project likely to directly or indirectly increase environmental and social vulnerability to climate change now or in the future (also known as maladaptive practices)?	Though road is passing through forest land/ Greenfield but it will create minimal harm to the community. It will not directly or indirectly increase environmental and social vulnerability to climate change now or in the future
50	Is the project likely to result in a substantial influx of people into the affected community (ies)?	The scenic beauty, tribal population and their cultural activities attracted visitors and tourist. There is enormous possibility in the development of tourism and project aiming at financing tourism infrastructure in the mounting.
51	Will the proposed project result in physical	Project will not make any physical interventions (during

	interventions (during construction or implementation) that would affect areas that have known physical or cultural significance to Tribal groups and other communities with settled recognized cultural claims?	construction or operation) that would affect areas that have known physical or cultural significance to Tribal groups. Public consultation and focus group discussion is continuing to understand the situation.
52	Would the proposed project be susceptible to or lead to increased vulnerability to earthquakes, subsidence and landslide, erosion, flooding or extreme climatic conditions?	There is high risk of earthquakes, subsidence, landslide, erosion, flooding or extreme climatic conditions as risk of the mountainous road alignment. Proper slope protection and drainage infrastructure will be required.
53	Will the project result in increased health risks as a result of a change in living and working conditions? In particular, will it have the potential to lead to an increase in HIV/AIDS infection?	India is heavily affected by HIV/AIDS. The connectivity may create a threat for increase in HIV/AIDS in Bangladesh. All precaution will be taken in the labor camp for construction workers to meet such health hazards.
54	Will the proposed project required additional health services including testing?	The connectivity will give more access to the health services into the area which is inaccessible before.
55	Is the proposed project location subject to currently approved land use plans (e.g. roads, settlements) which could affect the environmental and social sustainability of the project?	The area was inaccessible before. Government may have future plans for urban growth, industrial development, if the transportation infrastructure (road construction) is complete. There is no land use plan at the moment.
56	Would the proposed project result in secondary or consequential development which could lead to environmental and social effects, or would it have potential to generate cumulative impacts with other known existing or planned activities in the area?	New road through forested land will generate direct environmental and social impacts through the cutting of forest and earthwork associated with construction and potential relocation of inhabitants. Approximately 50.7% of total land use area should be removed. These are direct impacts. In addition, however, the new road would likely also bring new commercial and domestic development (houses, shops, businesses). In turn, these will generate indirect impacts.
	Multimodal	
57	Habitat (especially fish spawning areas) from dredging operations;	Dredging operation will cause damage of fish habitat.
58	Impacts to terrestrial flora/fauna and natural habitats at site of on-land disposal of dredged material (especially if dredged material is contaminated);	An ecological survey will be required in the project area including in the Kaptaii lake. The presence of sensitive species needs to be further verified during the feasibility study.
59	Impact critical habitats, potentially including but not limited to legally designate protected areas.	An ecological survey will be required in the project area including in Kaptaii lake. The presence of sensitive species needs to be further verified during the feasibility study. The road alignment is not proposed through designated protected area.
60	Open water disposal of dredging materials should be avoided wherever possible given its tremendous benthic effects.	Proper disposal of riverbed material will be required. Where no other alternatives to open water disposal exist, a benthic survey will be required. Evaluation of environmental issues related to selection and management of areas for disposal of dredging material on land will be required. Feasibility study will further quarrify these.
61	Community participation in the management of dredging materials	Stake holder meeting and community consultation has been undertaken and management of the dredged materials will be done through this process.
62	Land acquisition is likely to be required for on-land disposal of dredging material, access roads or river port development activities	The dredged material can be used for the road construction provided the dredged materials are suitable for road embankment.
63	River bed, coastline and on-shore habitats which may be impacted by disposal of dredged material and/or other on-land activities, as well as critical habitat (including but not limited to legally designated protected areas)	This will be taken care during dredging of the proposed navigational channel. Further investigation will be made during detailed feasibility study.

ANNEXURES IV

Table 4C: Route-3. Sajek-Majhipara-Dokanghat-Horina-Thegamukh (Proposed Route Length 97.171 km)

	Initial Issues Identification Questions	**Initial Findings**
	Is the site vulnerable to major natural or induced hazards such as:	
1	Landslides	97.171 Km Proposed project areas may highly affected by landslide. Steep slope and heavy rainfall may create landslide. The landslide in Bandarban is a regular feature during rainy season. More information about geological formation, soil condition and rainfall trend will be collected during feasibility study.
2	Flooding	Flash flood is very common in hilly area and in the Charas. Protection needed when such situation needed
	Storm Surge	Storm surge and cyclones is more frequent in the coastal region of Bangladesh but the area of influence also crosses over Chittagong Hill Tract.
3	Sever wind damage (associated with hurricanes, tropical storms or weather system)	Seasonal storm known as Nor'westers (kalboishakhi) is common in the month April and May.
4	Is the site vulnerable to major natural or induced hazards such as:	
5	Fire	People set fire on hill vegetation for cultivation of Jhum (burn and slash method) for nutrient of the crop.
6	Explosion	Transportation of different explosive chemical can causes explosion; safety in transportation will be required.
7	Chemical or Oil spill	Transportation of different chemical and oil can be cause of spill and contaminated the project area; safety in transportation will be required.
8	Is the road gradient likely to be very steep?	The project area is a hilly zone, have many fold and the construction of road is likely to be very steep but not unreachable for motor vehicle.
9	Is there any past record of landslides, or land slippage along the route?	Some location along the route may affected by landslide. There is a scarcity of information about the landslide or land slippage along the route. Careful consideration will be required to ensure appropriate road design to avoid landslides, slope failure and erosion.
10	Is the project site within or adjacent to any areas of historical, religious, traditional or cultural significance?	There are 2 religious, 4 school and 1 health centre are found besides the road alignment. So far such historical and cultural relics have not been found. In case of chance find during construction will be reported according to the rules of the government. Continuous public consultation and stake holder discussion can throw some more light.
11	Will the project operation disturb any traditional activity on adjoining or nearby properties?	The hilly population in the project area very scanty and unlike plane lands. Most tribal community is away from the project area with some exception of villages and market place. It will not disturb any traditional activity of tribal people
12	Preservation of land use/Impact of adjoining users	Preservation of land use will have an impact on adjoining users.
13	Is the project area zoned for the intended use?	Not yet. However whole forest in many way controlled by government and tribal people has little access to forest products.
14	Will the sub-project affect existing land uses around the site during operation?	There are 2 bridge or culverts are exist and required to be remodeled. More than 93 km earthen road should be constructing. The construction of the road will definitely affect the farmland and forest around the project site with runoff coming from construction activities.
15	Will nearby activities in surrounding areas adversely	During construction and operation, noise and vibration will be

	affect the sub-project (for instance, noise, run-off, air/exhaust emissions from surrounding land uses)?	generated from construction equipment, equipment will generate emissions and during operation, air pollutants from traffic will be generated in the ambient air.
16	Will the new road significantly increase access to areas/resources that were once largely inaccessible to the general public?	The project area is nearly inaccessible. If the project is successful then the road significantly increases the accessibility of different forest and mineral resources. It also increase the business between Bangladesh and India
17	Is this increase access likely to place pressure on local natural resources and wildlife?	It may create pressure on local resources like forest and its habitat. Govt. will take appropriate measure.
18	Is the new road likely to cause an increased demand for new permanent residence and businesses in the community?	The 97.171 km road may increase the demand of business and new permanent resident in the surrounding communities. Trans-boundary business will increase and as such demand for facilities for business and living will increase.
19	Is the presence of the new road likely to cause an influx of visitors/tourists into the community?	The scenic beauty, tribal population and their cultural activities attracted visitors and tourist both nationally and internationally.
20	Will the new road affect community cohesion?	No. Rather community will enjoy better communication facility in the area and better access to the facilities of the government like health care, schooling for the children
21	Will the new road result in the use of vehicles with excess tonnage?	The road connected between the Chittagong sea port to interior of CHT and across the border. Increased number of vehicles and excess tonnage are expected.
22	Is the diversion likely to have an adverse impact on local users (e.g. loss of irrigation water for farmers in dry season)?	More than 23 Charas and river are the main sources of water for farmers. The diversion of these sources has an adverse effect on irrigation and household works.
23	Is the sub-project site part of a protected or environmentally sensitive area?	The protected or environmentally sensitive area is far away from the project site.
24	Loss of bottom habitat and fishery resources are also significant problem included in this category?	More than 23 Charas and river crossing need to dredging or pilling. Dredging and pilling foundation for bridge construction may lead to loss of bottom habitat and fishery resources in the project area. If dredging is required for navigation purpose that can create more problem in the area.
25	Does the sub-project encroach on tropical rain forests, wetland, mangrove forests, coral reefs, coastal zone or other vulnerable areas?	The project is located in tribal and pristine area. Water bodies at Kaptaii lake and forest surrounded by woodlands. Total road sections are passing through the mountainous terrain, where road safety, landslide, and slope stability will be of concerns. Approximately 69% of total land use area is forest land.
26	Does the sub-project involve significant removal of vegetation cover?	The project will need 150 m ROW for construction of road. If forest and vegetation may need to be cleared for the construction however it does not involve significant removal of vegetation in the area.
27	Will the project require sourcing of significant quantities of aggregate material?	No. There is no such significant amount of aggregate available and need to be transported to the project area by road or by waterways.
28	Is the sub-project right-of-way/route/corridor likely to bisect or cross a protected area or environmentally sensitive area?	No. It will not bisect or cross a protected area or environmentally sensitive area The protected or environmentally sensitive area is far away from the project site.
29	Is the sub-project's right-of-way/route/corridor likely to affect:	
	-the habitats of fish?	Total 3635.069 m long Chara and river crossing existed on the alignment. The diversion of those Chara, rivers, dredging, constructing bridges and culverts will affect the habitats of fish.
	-habitats of wildlife species including endangered species?	The habitats of wildlife species including endangered species are not on the road alignment or nearby though it is passing through the forest.
	-wildlife or livestock movement/crossing patterns?	As stated this will not happen in the project area.
30	Will the seasonal flow create conditions of stagnant water?	During construction proper drainage system must be built otherwise seasonal flow creates conditions of stagnant water. There are 23 Charas and rivers existed on the alignment.
31	Is the new drain likely to change the normal flow of	Proper design should take care for the drainage system.

	water run-off	
32	Will the construction work generate significant amounts of dust, odor or noxious gases that are likely to disturb local residents (reproductive and informal activities) and businesses?	The construction work will generate dust, odor or noxious gases that are likely to disturb local resident. Measures will be taken to reduce the effect.
33	Will the construction work cause a noise nuisance due to the operation of heavy machinery and other on-site activities?	The construction work will causes of noise due to the operation of heavy machinery on the site. Necessary steps should taken to reduce the effect
34	Will the construction work produce significant amount of run-off, change drainage patterns and/or erosion?	Construction work produce significant amount of run-off, and may change drainage patterns and/or erosion
35	Will the construction work disrupt traffic (pedestrian and vehicular)?	The percentage of settlement is 1.71% of total land use needed. That means population density is very low along the project areas. The disruption of traffic (pedestrian and vehicular) will be minimal.
36	Will the construction of the sub-project affect access to existing land uses?	Heavy machinery for construction may causes will the movement and location of heavy equipment, trenching, etc. for rural roads, large drains, interfere with access to private property.
37	Will construction worker be provided with hard hats and boots, and be required to wear them?	Comply with all types of health and safety issues. It will be part of bid document.
38	Will visitors to the sub-project construction site be provided with hard hats?	Comply with all types of health and safety issues. It will be part of bid document.
39	Will the site be secured during construction to prevent unimpeded public access and protect area users?	Comply with all types of health and safety issues. It will be part of bid document.
40	Will precautions be put in place during construction to protect area users (e.g. barriers, lighting and signage)?	Comply with all types of health and safety issues. It will be part of bid document.
41	Are construction workers trained and equipped with the required personal protective equipment (PPE) to undertake the tasks assigned to them?	Comply with all types of health and safety issues. It will be part of bid document.
42	Does the Contractor convene regular health and safety meeting with workers?	Comply with all types of health and safety issues. It will be part of bid document.
43	Are there separate washroom facilities, adequate restroom/eating areas and first aid kit on site, and are these freely accessible to workers when needed?	Comply with all types of health and safety issues. It will be part of bid document.
44	Are any development activities within a legally protected area (e.g. natural reserve, national park) for the protection or conservation of biodiversity?	The protected or environmentally sensitive area is far away from the project site.
45	Does the project involve significant extraction, diversion or containment of surface or ground water?	No. Extraction, diversion or containment of surface or ground water and will be limited to the construction requirements only.
46	Does the project pose a risk of degrading soils?	A huge quantity of cutting and filling can take place. Project may pose a risk of degrading soils & need mitigation.
47	Would the propose project result in the release of pollutants to the environment due to routine or non-routine circumstances with the potential for adverse local, regional and trans boundary impacts?	Instead of road from Chotohorina to Thegamukh, if waterway is planned, international water bodies will be affected. The project will be located close to Kaptaii Lake and tribal communities. Extensive tribal community consultation and engagement will be required for smooth implementation of the project.
48	Would the proposed project result in the generation of waste that cannot be recovered, reused or disposed of in an environmentally and socially sound manner?	Waste generated during construction will be disposed of in safe way. The contractor will be instructed and it will be part of bid documents.
49	Is the proposed project likely to directly or indirectly increase environmental and social vulnerability to climate change now or in the future (also known as maladaptive practices)?	Though road is passing through forest land/ Greenfield but it will create minimal harm to the community. It will not directly or indirectly increase environmental and social vulnerability to climate change now or in the future
50	Is the project likely to result in a substantial influx of people into the affected community (ies)?	The scenic beauty, tribal population and their cultural activities attracted visitors and tourist. There is enormous possibility in the development of tourism and project aiming at financing tourism infrastructure in the mounting.
51	Will the proposed project result in physical interventions (during construction or implementation) that would affect areas that have known physical or cultural significance to Tribal groups and other	Project will not make any physical interventions (during construction or operation) that would affect areas that have known physical or cultural significance to Tribal groups. Public consultation and focus group discussion is continuing to

	communities with settled recognized cultural claims?	understand the situation.
52	Would the proposed project be susceptible to or lead to increased vulnerability to earthquakes, subsidence and landslide, erosion, flooding or extreme climatic conditions?	There is high risk of earthquakes, subsidence, landslide, erosion, flooding or extreme climatic conditions as risk of the mountainous road alignment. Proper slope protection and drainage infrastructure will be required.
53	Will the project result in increased health risks as a result of a change in living and working conditions? In particular, will it have the potential to lead to an increase in HIV/AIDS infection?	India is heavily affected by HIV/AIDS. The connectivity may create a threat for increase in HIV/AIDS in Bangladesh. All precaution will be taken in the labor camp for construction workers to meet such health hazards.
54	Will the proposed project required additional health services including testing?	The connectivity will give more access to the health services into the area which is inaccessible before.
55	Is the proposed project location subject to currently approved land use plans (e.g. roads, settlements) which could affect the environmental and social sustainability of the project?	The area was inaccessible before. Government may have future plans for urban growth, industrial development, if the transportation infrastructure (road construction) is complete. There is no land use plan at the moment.
56	Would the proposed project result in secondary or consequential development which could lead to environmental and social effects, or would it have potential to generate cumulative impacts with other known existing or planned activities in the area?	New road through forested land will generate direct environmental and social impacts through the cutting of forest and earthwork associated with construction and potential relocation of inhabitants. Approximately 66.2% of total land use area should be removed. These are direct impacts. In addition, however, the new road would likely also bring new commercial and domestic development (houses, shops, businesses). In turn, these will generate indirect impacts.
	Multimodal	
57	Habitat (especially fish spawning areas) from dredging operations;	Dredging operation will cause damage of fish habitat.
58	Impacts to terrestrial flora/fauna and natural habitats at site of on-land disposal of dredged material (especially if dredged material is contaminated);	An ecological survey will be required in the project area including in the Kaptaii lake. The presence of sensitive species needs to be further verified during the feasibility study.
59	Impact critical habitats, potentially including but not limited to legally designate protected areas.	An ecological survey will be required in the project area including in Kaptaii lake. The presence of sensitive species needs to be further verified during the feasibility study. The road alignment is not proposed through designated protected area.
60	Open water disposal of dredging materials should be avoided wherever possible given its tremendous benthic effects.	Proper disposal of riverbed material will be required. Where no other alternatives to open water disposal exist, a benthic survey will be required. Evaluation of environmental issues related to selection and management of areas for disposal of dredging material on land will be required. Feasibility study will further quarry these.
61	Community participation in the management of dredging materials	Stake holder meeting and community consultation has been undertaken and management of the dredged materials will be done through this process.
62	Land acquisition is likely to be required for on-land disposal of dredging material, access roads or river port development activities	Disposal of dredging materials can be matched with fill section of the road. About 90% of the dredged material will be generated the section of navigational channel. The dredged material can be used for the road construction provided the dredged materials are suitable for road embankment.
63	River bed, coastline and on-shore habitats which may be impacted by disposal of dredged material and/or other on-land activities, as well as critical habitat (including but not limited to legally designated protected areas)	This will be taken care during dredging of the proposed navigational channel. Further investigation will be made during detailed feasibility study.

ANNEXURES IV

Table 4D: Route -4. Bangchara(Kaptai)-Chitmaram-Chakuwapara-Bhangamurapara-Bilaichari-Silchari-Mitingapara (Jurichari)-Barkal-Chotohrina-Thegamukh (Proposed Route Length 106.125 km)

	Initial Issues Identification Questions	**Initial Findings**
	Is the site vulnerable to major natural or induced hazards such as:	
1	Landslides	106.125 Km Proposed project areas may be affected by landslide. Steep slope and heavy rainfall may create landslide. The landslide in Bandarban is a regular feature during rainy season. More information about geological formation, soil condition and rainfall trend will be collected during feasibility study.
2	Flooding	Flash flood is very common in hilly area and in the Charas. Protection needed when such situation needed
	Storm Surge	Storm surge and cyclones is more frequent in the coastal region of Bangladesh but the area of influence also crosses over Chittagong Hill Tract.
3	Sever wind damage (associated with hurricanes, tropical storms or weather system)	Seasonal storm known as Nor'westers (kalboishakhi) is common in the month April and May.
4	Is the site vulnerable to major natural or induced hazards such as:	
5	Fire	People set fire on hill vegetation for cultivation of Jhum (burn and slash method) for nutrient of the crop.
6	Explosion	Transportation of different explosive chemical can causes explosion; safety in transportation will be required.
7	Chemical or Oil spill	Transportation of different chemical and oil can be cause of spill and contaminated the project area; safety in transportation will be required.
8	Is the road gradient likely to be very steep?	The project area is a hilly zone, have many fold and the construction of road is likely to be very steep but not unreachable for motor vehicle.
9	Is there any past record of landslides, or land slippage along the route?	Some location along the route may affected by landslide. There is a scarcity of information about the landslide or land slippage along the route. Careful consideration will be required to ensure appropriate road design to avoid landslides, slope failure and erosion.
10	Is the project site within or adjacent to any areas of historical, religious, traditional or cultural significance?	There are 10 religious, 12 school and 2 health centre are found besides the road alignment. So far such historical and cultural relics have not been found. In case of chance find during construction will be reported according to the rules of the government. Continuous public consultation and stake holder discussion can throw some more light.
11	Will the project operation disturb any traditional activity on adjoining or nearby properties?	The hilly population in the project area very scanty and unlike plane lands. Most tribal communities are away from the project area with some exception of villages and market place. It will not disturb any traditional activity of tribal people
12	Preservation of land use/Impact of adjoining users	Preservation of land use will have an impact on adjoining users.
13	Is the project area zoned for the intended use?	Not yet. However whole forest in many way controlled by government and tribal people has little access to forest products.
14	Will the sub-project affect existing land uses around the site during operation?	There are 42 bridge and culverts are exist and required to be remodeled. More than 87.9 km earthen road should be constructing. The construction of the road will definitely affect the farmland around the project site with runoff coming from construction activities.
15	Will nearby activities in surrounding areas adversely affect the sub-project (for instance, noise, run-off, air/exhaust emissions from surrounding land uses)?	During construction and operation, noise and vibration will be generated from construction equipment, equipment will generate emissions and during operation, air pollutants from traffic will be generated in the ambient air.

16	Will the new road significantly increase access to areas/resources that were once largely inaccessible to the general public?	The project area is nearly inaccessible. If the project is successful then the road significantly increases the accessibility of different forest and mineral resources. It also increase the business between Bangladesh and India
17	Is this increase access likely to place pressure on local natural resources and wildlife?	It may create pressure on local resources like forest and its habitat. Govt. will take appropriate measure.
18	Is the new road likely to cause an increased demand for new permanent residence and businesses in the community?	The 106.125 km road may increase the demand of business and new permanent resident in the surrounding communities. Huge transportation will take place between Chittagong port and the interior area of CHT. Trans-boundary business will increase and as such demand for facilities for business and living will increase.
19	Is the presence of the new road likely to cause an influx of visitors/tourists into the community?	The scenic beauty, tribal population and their cultural activities attracted visitors and tourist both nationally and internationally.
20	Will the new road affect community cohesion?	No. Rather community will enjoy better communication facility in the area and better access to the facilities of the government like health care, schooling for the children
21	Will the new road result in the use of vehicles with excess tonnage?	The road connected between the Chittagong sea port to interior of CHT and across the border. Increased number of vehicles and excess tonnage are expected.
22	Is the diversion likely to have an adverse impact on local users (e.g. loss of irrigation water for farmers in dry season)?	More than 30 Charas and River are the main sources of water for farmers. The diversion of these sources has an adverse effect on irrigation and household works.
23	Is the sub-project site part of a protected or environmentally sensitive area?	The protected or environmentally sensitive area is far away from the project site.
24	Loss of bottom habitat and fishery resources are also significant problem included in this category?	More than 30 Charas and river crossing need to dredging or pilling. Dredging and pilling foundation for bridge construction may lead to loss of bottom habitat and fishery resources in the project area. If dredging is required for navigation purpose that can create more problem in the area.
25	Does the sub-project encroach on tropical rain forests, wetland, mangrove forests, coral reefs, coastal zone or other vulnerable areas?	The project is located in tribal and pristine area. Water bodies at Kaptaii lake and forest surrounded by woodlands. Approximately 124 Km road sections are passing through several upazilas of Rangamati district in the mountainous terrain, where road safety, landslide, and slope stability will be of concerns. Approximately 69% of total land use area is forest land.
26	Does the sub-project involve significant removal of vegetation cover?	The project will need 150m ROW for construction of road. If forest and vegetation may need to be cleared for the construction however it does not involve significant removal of vegetation in the area.
27	Will the project require sourcing of significant quantities of aggregate material?	No. There is no such significant amount of aggregate available and need to be transported to the project area by road or by waterways.
28	Is the sub-project right-of-way/route/corridor likely to bisect or cross a protected area or environmentally sensitive area?	No. It will not bisect or cross a protected area or environmentally sensitive area The protected or environmentally sensitive area is far away from the project site.
29	Is the sub-project's right-of-way/route/corridor likely to affect:	
	-the habitats of fish?	About 2794.874 m long Chara and River crossing existed on the alignment. The diversion of those Chara, Rivers, dredging, constructing bridges and culverts will affect the habitats of fish.
	-habitats of wildlife species including endangered species?	The habitats of wildlife species including endangered species are not on the road alignment or nearby though it is passing through the forest.
	-wildlife or livestock movement/crossing patterns?	As stated this will not happen in the project area.
30	Will the seasonal flow create conditions of stagnant water?	During construction proper drainage system must be built otherwise seasonal flow creates conditions of stagnant water. There are more than 30 Charas and Rivers existed on the alignment.

31	Is the new drain likely to change the normal flow of water run-off	Proper design should take care for the drainage system.
32	Will the construction work generate significant amounts of dust, odor or noxious gases that are likely to disturb local residents (reproductive and informal activities) and businesses?	The construction work will generate dust, odor or noxious gases that are likely to disturb local resident. Measures will be taken to reduce the effect.
33	Will the construction work cause a noise nuisance due to the operation of heavy machinery and other on-site activities?	The construction work will causes of noise due to the operation of heavy machinery on the site. Necessary steps should taken to reduce the effect
34	Will the construction work produce significant amount of run-off, change drainage patterns and/or erosion?	Construction work produce significant amount of run-off, and may change drainage patterns and/or erosion
35	Will the construction work disrupt traffic (pedestrian and vehicular)?	The percentage of settlement is 4.6% of total land use needed. That means population density is very low along the project areas. The disruption of traffic (pedestrian and vehicular) will be minimal.
36	Will the construction of the sub-project affect access to existing land uses?	Heavy machinery for construction may causes will the movement and location of heavy equipment, trenching, etc. for rural roads, large drains, interfere with access to private property.
37	Will construction worker be provided with hard hats and boots, and be required to wear them?	Comply with all types of health and safety issues. It will be part of bid document.
38	Will visitors to the sub-project construction site be provided with hard hats?	Comply with all types of health and safety issues. It will be part of bid document.
39	Will the site be secured during construction to prevent unimpeded public access and protect area users?	Comply with all types of health and safety issues. It will be part of bid document.
40	Will precautions be put in place during construction to protect area users (e.g. barriers, lighting, signage)?	Comply with all types of health and safety issues. It will be part of bid document.
41	Are construction workers trained and equipped with the required personal protective equipment (PPE) to undertake the tasks assigned to them?	Comply with all types of health and safety issues. It will be part of bid document.
42	Does the Contractor convene regular health and safety meeting with workers?	Comply with all types of health and safety issues. It will be part of bid document.
43	Are there separate washroom facilities, adequate restroom/eating areas and first aid kit on site, and are these freely accessible to workers when needed?	Comply with all types of health and safety issues. It will be part of bid document.
44	Are any development activities within a legally protected area (e.g. natural reserve, national park) for the protection or conservation of biodiversity?	The protected or environmentally sensitive area is far away from the project site.
45	Does the project involve significant extraction, diversion or containment of surface or ground water?	No. Extraction, diversion or containment of surface or ground water and will be limited to the construction requirements only.
46	Does the project pose a risk of degrading soils?	A huge quantity of cutting and filling can take place. Project may pose a risk of degrading soils & need mitigation.
47	Would the propose project result in the release of pollutants to the environment due to routine or non-routine circumstances with the potential for adverse local, regional and trans boundary impacts?	Instead of road from Chotohorina to Thegamukh, if waterway is planned, international water bodies will be affected. The project will be located close to Kaptaii Lake and tribal communities. Extensive tribal community consultation and engagement will be required for smooth implementation of the project.
48	Would the proposed project result in the generation of waste that cannot be recovered, reused or disposed of in an environmentally and socially sound manner?	Waste generated during construction will be disposed of in safe way. The contractor will be instructed and it will be part of bid documents.
49	Is the proposed project likely to directly or indirectly increase environmental and social vulnerability to climate change now or in the future (also known as maladaptive practices)?	Though road is passing through forest land/ Greenfield but it will create minimal harm to the community. It will not directly or indirectly increase environmental and social vulnerability to climate change now or in the future
50	Is the project likely to result in a substantial influx of people into the affected community (ies)?	The scenic beauty, tribal population and their cultural activities attracted visitors and tourist. There is enormous possibility in the development of tourism and project aiming at financing tourism infrastructure in the mounting.
51	Will the proposed project result in physical interventions (during construction or implementation) that would affect areas that have known physical or	Project will not make any physical interventions (during construction or operation) that would affect areas that have known physical or cultural significance to Tribal groups. Public

	cultural significance to Tribal groups and other communities with settled recognized cultural claims?	consultation and focus group discussion is continuing to understand the situation.
52	Would the proposed project be susceptible to or lead to increased vulnerability to earthquakes, subsidence and landslide, erosion, flooding or extreme climatic conditions?	There is high risk of earthquakes, subsidence, landslide, erosion, flooding or extreme climatic conditions as risk of the mountainous road alignment. Proper slope protection and drainage infrastructure will be required.
53	Will the project result in increased health risks as a result of a change in living and working conditions? In particular, will it have the potential to lead to an increase in HIV/AIDS infection?	India is heavily affected by HIV/AIDS. The connectivity may create a threat for increase in HIV/AIDS in Bangladesh. All precaution will be taken in the labor camp for construction workers to meet such health hazards.
54	Will the proposed project required additional health services including testing?	The connectivity will give more access to the health services into the area which is inaccessible before.
55	Is the proposed project location subject to currently approved land use plans (e.g. roads, settlements) which could affect the environmental and social sustainability of the project?	The area was inaccessible before. Government may have future plans for urban growth, industrial development, if the transportation infrastructure (road construction) is complete. There is no land use plan at the moment.
56	Would the proposed project result in secondary or consequential development which could lead to environmental and social effects, or would it have potential to generate cumulative impacts with other known existing or planned activities in the area?	New road through forested land will generate direct environmental and social impacts through the cutting of forest and earthwork associated with construction and potential relocation of inhabitants. Approximately 65.7% of total land use area should be removed. These are direct impacts. In addition, however, the new road would likely also bring new commercial and domestic development (houses, shops, businesses). In turn, these will generate indirect impacts.
	Multimodal	
57	Habitat (especially fish spawning areas) from dredging operations;	Dredging operation will cause damage of fish habitat.
58	Impacts to terrestrial flora/fauna and natural habitats at site of on-land disposal of dredged material (especially if dredged material is contaminated);	An ecological survey will be required in the project area including in the Kaptaii lake. The presence of sensitive species needs to be further verified during the feasibility study.
59	Impact critical habitats, potentially including but not limited to legally designate protected areas.	An ecological survey will be required in the project area including in Kaptaii lake. The presence of sensitive species needs to be further verified during the feasibility study. The road alignment is not proposed through designated protected area.
60	Open water disposal of dredging materials should be avoided wherever possible given its tremendous benthic effects.	Proper disposal of riverbed material will be required. Where no other alternatives to open water disposal exist, a benthic survey will be required. Evaluation of environmental issues related to selection and management of areas for disposal of dredging material on land will be required. Feasibility study will further quarry these.
61	Community participation in the management of dredging materials	Stake holder meeting and community consultation has been undertaken and management of the dredged materials will be done through this process.
62	Land acquisition is likely to be required for on-land disposal of dredging material, access roads or river port development activities	Disposal of dredging materials can be matched with fill section of the road between Barkal and Chotohorina. About 90% of the dredged material will be generated in this section of navigational channel. The dredged material can be used for the road construction provided the dredged materials are suitable for road embankment.
63	River bed, coastline and on-shore habitats which may be impacted by disposal of dredged material and/or other on-land activities, as well as critical habitat (including but not limited to legally designated protected areas)	This will be taken care during dredging of the proposed navigational channel. Further investigation will be made during detailed feasibility study.

ANNEXURES IV

Table 4E: Multimodal Route-1. Rangamati-Chhotoharina (63 km) connected by waterway and Chotohorina-Thegamukh (7.987 km) by road.

	Initial Issues Identification Questions	**Initial Findings**
	Is the site vulnerable to major natural or induced hazards such as:	
1	Flooding	63 Km navigational channel for plying of vessel will be constructed on the present channel of Karnafuli River. The channel is being submerged during flood season. Flash flood is very common in hilly area and may associate with silt and erosion. Quick rise of water may damage the navigational channel and other infrastructural facilities on the bank of the channel like landing berthing, pontoon etc.
2	Storm Surge	Storm surge and cyclones is more frequent in the coastal region of Bangladesh but the area of influence also well over Chittagong Hill Tract. Navigation in the channel will be disrupted during such cyclonic storm particularly during wet season when the depth of water is high.
3	Sever wind damage (associated with hurricanes, tropical storms or weather system)	Seasonal storm known as Nor'westers (kalboishakhi) is common in the month April and May. The strong wind and hurricane can capsize the vessel and it is happening in many navigational channels around Bangladesh including Chittagong Hill Tract.
4	Explosion	Transportation of different explosive chemical in the channel corridor can be cause of explosion, safety in transportation will be required.
5	Chemical or Oil spill	Transportation of different chemical and oil can be cause spill and contaminated the channel area, safety transportation will be required.
6	Will the project operation disturb any traditional activity on adjoining or nearby properties?	Hilly population now relocated on the fringe of Kaptaii Lake after submergence of the area. They said channel is passing through the lake and it is likely the populations are disturbed during dredging for excavation and operation of vessels for transportation.
7	Will nearby activities in surrounding areas adversely affect the sub-project (for instance, noise, run-off, air/exhaust emissions from surrounding land uses)?	Approximately 8.26 M m^3 of dredged materials should be removed from the navigational route. Dredging for excavation of channel for construction of navigational route will adversely affect the population with noise, run-off, air/exhaust emissions The operation of vessel also create those nuisance throughout the project life.
8	Will the new road/corridor significantly increase access to areas/resources that were once largely inaccessible to the general public?	The project area is nearly inaccessible by road. After construction of the reservoir these remote place became accessible for the local population but does not have proper navigational facility. With development of the navigational route/ corridor better communication in the remote area of Chittagong Hill Tract and also trans-boundary traffic will generate.
9	Is the sub-project site part of a protected or environmentally sensitive area?	No. The protected or environmentally sensitive area is far away from the project site.

10	Loss of bottom habitat and fishery resources are also significant problem included in this category?	Dredging for construction of navigational route (63 Km) will disturb the fish habitat. Dredging should be planned to be confined within the channel width and disposal of the dredged material will be outside the channel and lake water. Combination can be made to construct the road which has been proposed between Chotohorina-Thegamukh (7.987 km) under Route Option 1. However there will be appreciable loss of bottom habitat and fishery resources in the project area (approx. 70m width over 63 Km long channel. The detail of ecological survey will be done during Feasibility study.
	Is the sub-project's right-of-way/route/corridor likely to affect:	
11	The habitats of fish?	Yes, it needs further ecological study along the navigational route during feasibility study and will be reflected in TOR of ESIA.
12	Habitats of wildlife species including endangered species?	No. The habitats of wildlife species including endangered species are not on the corridor alignment or nearby.
13	Wildlife or livestock movement/crossing patterns?	Not Applicable.
14	Will the construction work cause a noise nuisance due to the operation of dredger/ heavy machinery and other on-site activities?	During dredging/construction and operation, noise and vibration will be generated from dredgers, construction equipment and vessel operation.
15	Will the dredger/ construction work disrupt traffic (fisher man/ boat navigation)?	The population density is very low along the navigational corridor. The disruption of boat, traffic and fishing is likely.
16	Will dredger/ construction worker be provided with hard hats, life jacket and boots, and be required to wear them?	Comply with all types of health and safety issues. It will be part of bid document.
17	Will the site be secured during Excavation/construction to prevent unimpeded public access and protect area users?	Comply with all types of health and safety issues. It will be part of bid document. The site will be fully secured to avoid unimpeded public access and protected area users and protected area users.
18	Will precautions be put in place during dredging /construction to protect area users (e.g. barriers, lighting and signage)?	Comply with all types of marking, fencing the area with lighting and signage will be made.
19	Are dredging /construction workers trained and equipped with the required personal protective equipment (PPE) to undertake the tasks assigned to them?	Comply with all rules and regulation documented in safety manual of dredging. It will be part of bid document. Hard hats, life jacket, fire-fighting equipment will be provided.
20	Does the operator of dredging /Contractor convene regular health and safety meeting with workers?	Comply with all types of training and demonstration before the workers can be involved in such work. Health and safety meeting is part of the work.
21	Are there separate washroom facilities, adequate restroom/eating areas and first aid kit on site, and are these freely accessible to workers when needed?	Comply with all types of health and safety issues of dredging operation. It will be part of bid document.
22	Does the project pose a risk of degrading tremendous benthic organism?	Approximately 8.26 M m^3 of dredge materials should be removed from the channel. Dredging will be taken up and removal of bottom material will happen. Sampling and testing will be made in the ecological survey during feasibility study.
23	Would the propose project result in the release of pollutants to the environment due to routine or non-routine circumstances with the potential for adverse local, regional and trans boundary impacts?	Instead of road from Chotohorina to Thegamukh, if waterway is planned, international water bodies will be affected. The project will be located close to Kaptaii Lake and tribal communities. Extensive tribal community consultation and engagement will be required for smooth implementation of the project.
24	Would the proposed project result in the generation of waste that cannot be recovered, reused or disposed of in an environmentally and socially sound manner?	Yes, waste generated during dredging of riverbed and disposal of dredged material (about 8.26 million m^3) will be required. New construction of 7.987 km road in green field. The dredged material will be reused or disposed of in an environmentally and socially sound manner. The contractor will be instructed and it will part of bid documents.
25	Is the project likely to result in a substantial influx of people into the affected community (ies)?	The scenic beauty, tribal population and their cultural activities attracted visitors and tourist. There is enormous possibility in the

		development of tourism and project aiming at financing tourism infrastructure in the mounting.
26	Would the proposed project be susceptible to or lead to increased vulnerability to earthquakes, subsidence and landslide, erosion, flooding or extreme climatic conditions?	This is a high risk of earthquakes, subsidence, landslide, erosion, flooding or extreme climatic conditions. The project should be well planned to avoid erosion in the erosion in navigation channel during on rush of flood from hills of Mizoram.
27	Will the project result in increased health risks as a result of a change in living and working conditions? In particular, will it have the potential to lead to an increase in HIV/AIDS infection?	India is heavily affected by HIV/AIDS. The connectivity may create a threat for increase in HIV/AIDS in Bangladesh. Dredging and allied works need concentration of working people and health risk should be covered for the workers.
28	Would the proposed project result in secondary or consequential development which could lead to environmental and social effects, or would it have potential to generate cumulative impacts with other known existing or planned activities in the area?	New road through forested land will generate direct environmental and social impacts through the cutting of forest and earthwork associated with construction and potential relocation of inhabitants. These are direct impacts. In addition, however, the new road would likely also bring new commercial and domestic development (houses, shops, businesses). In turn, these will generate indirect impacts.
29	Habitat (especially fish spawning areas) from dredging operations;	Dredging operation will damage the habitat of fish particularly spawning area.
30	Impacts to terrestrial flora/fauna and natural habitats at site of on-land disposal of dredged material (especially if dredged material is contaminated);	The dredged material will be disposed off or reused for the project. The flora / fauna and natural habitat is likely to be affected. Survey of ecological elements during feasibility study will be taken up. The contaminated dredged material will need further care before depositing on the fringe of Kaptaii lake.
31	Noise and air emissions from equipment and machinery;	During construction and operation, noise and vibration will be generated from dredgers, construction equipment and launch operation.
32	Impact critical habitats, potentially including but not limited to legally designate protected areas.	An ecological survey will be required in the project area including in Kaptaii lake. The presences of sensitive species need to be verified further during the feasibility study. The navigational alignment is not proposed through designated protected area.
33	Open water disposal of dredging materials should be avoided wherever possible given its tremendous benthic effects.	Proper disposal of riverbed material will be required. Where no other alternatives to open water disposal exist, a benthic survey will be required. Evaluation of environmental issues related to selection and management of areas for disposal of dredging material on land will be required. IWTA guideline will be followed.
34	Community participation in the management of dredging materials	Stake holder meeting and community consultation has been undertaken and management of the dredged materials will be done through this process. If any community interested in using dredged materials.
35	Land acquisition is likely to be required for on-land disposal of dredging material, access roads or river port development activities	There will be about 8.26 M m^3 of dredging materials will be required to disposed off or reuse if not contaminated. The huge amount of the material will need some land acquisition if it cannot be reused. Moreover land acquisition is likely to be required for access roads or river port development activities.
36	River bed, coastline and on-shore habitats which may be impacted by disposal of dredged material and/or other on-land activities, as well as critical habitat (including but not limited to legally designated protected areas)	Ecological survey during feasibility will give proper direction in disposal of dredged material and/or other on-land activities, as well as critical habitat .This will be taken care during dredging of the proposed navigational channel.
37	Are there existing land uses on or around the location e.g. homes, gardens, other private property, industry, commerce, recreation, public open space, community facilities, agriculture, forestry, tourism, mining or quarrying which could be affected by the project?	Popular for tourism. Waterways will be partially affected during dredging. About 25 Chakma families will be affected due to the land customs station development.
38	Are there any areas or features of historic or cultural importance on or around the location which could be affected by the project?	Subolong union is famous for waterfalls. In addition, Kaptaii lake and Kaptaii hydropower plant will be close to the project alignment.

Table 4F: Multimodal Route-2. Rangamati-Barkal waterway (37.5 km) and then Barkal-Thegamukh (29.307 km) by road

	Initial Issues Identification Questions	Initial Findings
	Is the site vulnerable to major natural or induced hazards such as:	
1	Flooding	37.5 Km navigational channel for plying of vessel will be constructed on the present channel of Karnafuli River. The channel is being submerged during flood season. Flash flood is very common in hilly area and may associate with silt and erosion. Quick rise of water may damage the navigational channel and other infrastructural facilities on the bank of the channel like landing berthing, pontoon etc.
2	Storm Surge	Storm surge and cyclones is more frequent in the coastal region of Bangladesh but the area of influence also well over Chittagong Hill Tract. Navigation in the channel will be disrupted during such cyclonic storm particularly during wet season when the depth of water is high.
3	Sever wind damage (associated with hurricanes, tropical storms or weather system)	Seasonal storm known as Nor'westers (kalboishakhi) is common in the month April and May. The strong wind and hurricane can capsize the vessel and it is happening in many navigational channels around Bangladesh including Chittagong Hill Tract.
4	Explosion	Transportation of different explosive chemical in the channel corridor can be cause of explosion, safety in transportation will be required.
5	Chemical or Oil spill	Transportation of different chemical and oil can be cause spill and contaminated the channel area, safety transportation will be required.
6	Will the project operation disturb any traditional activity on adjoining or nearby properties?	Hilly population now relocated on the fringe of Kaptaii Lake after submergence of the area. They said channel is passing through the lake and it is likely the populations are disturbed during dredging for excavation and operation of vessels for transportation.
7	Will nearby activities in surrounding areas adversely affect the sub-project (for instance, noise, run-off, air/exhaust emissions from surrounding land uses)?	Dredging for excavation of channel for construction of navigational route will adversely affect the population with noise, run-off, air/exhaust emissions The operation of vessel also create those nuisance throughout the project life.
8	Will the new road/corridor significantly increase access to areas/resources that were once largely inaccessible to the general public?	The project area is nearly inaccessible by road. After construction of the reservoir these remote place became accessible for the local population but does not have proper navigational facility. With development of the navigational route/ corridor better communication in the remote area of Chittagong Hill Tract and also trans-boundary traffic will generate.
9	Is the sub-project site part of a protected or environmentally sensitive area?	No. The protected or environmentally sensitive area is far away from the project site.
10	Loss of bottom habitat and fishery resources are also significant problem included in this category ?	Dredging for construction of navigational route (37.5 Km) will disturb the fish habitat. Dredging should be planned to be confined within the channel width and disposal of the dredged material will be outside the channel and lake water. Combination can be made to construct the road which has been proposed between Barkal-Thegamukh (29.307 km) under Route Option 1. However there will be appreciable loss of bottom habitat and fishery resources in the project area (approx. 70m width over 37.5 Km long channel. The detail of ecological survey will be done during Feasibility study.
	Is the sub-project's right-of-way/route/corridor likely to affect:	

11	The habitats of fish?	Yes, it needs further ecological study along the navigational route during feasibility study and will be reflected in TOR of ESIA.
12	Habitats of wildlife species including endangered species?	No. The habitats of wildlife species including endangered species are not on the corridor alignment or nearby.
13	Wildlife or livestock movement/crossing patterns?	Not Applicable.
14	Will the construction work cause a noise nuisance due to the operation of dredger/ heavy machinery and other on-site activities?	During dredging/construction and operation, noise and vibration will be generated from dredgers, construction equipment and vessel operation.
15	Will the dredger/ construction work disrupt traffic (fisher man/ boat navigation)?	The population density is very low along the navigational corridor. The disruption of boat, traffic and fishing is likely.
16	Will dredger/ construction worker be provided with hard hats, life jacket and boots, and be required to wear them?	Comply with all types of health and safety issues. It will be part of bid document.
17	Will the site be secured during Excavation/construction to prevent unimpeded public access and protect area users?	Comply with all types of health and safety issues. It will be part of bid document. The site will be fully secured to avoid unimpeded public access and protected area users and protected area users.
18	Will precautions be put in place during dredging /construction to protect area users (e.g. barriers, lighting and signage)?	Comply with all types of marking, fencing the area with lighting and signage will be made.
19	Are dredging /construction workers trained and equipped with the required personal protective equipment (PPE) to undertake the tasks assigned to them?	Comply with all rules and regulation documented in safety manual of dredging. It will be part of bid document. Hard hats, life jacket, fire-fighting equipment will be provided.
20	Does the operator of dredging /Contractor convene regular health and safety meeting with workers?	Comply with all types of training and demonstration before the workers can be involved in such work. Health and safety meeting is part of the work.
21	Are there separate washroom facilities, adequate restroom/eating areas and first aid kit on site, and are these freely accessible to workers when needed?	Comply with all types of health and safety issues of dredging operation. It will be part of bid document.
22	Does the project pose a risk of degrading tremendous benthic organism?	A huge quantity of dredging will be taken up and removal of bottom material will happen. Sampling and testing will be made in the ecological survey during feasibility study.
23	Would the propose project result in the release of pollutants to the environment due to routine or non-routine circumstances with the potential for adverse local, regional and trans boundary impacts?	Instead of road from Chotohorina to Thegamukh, if waterway is planned, international water bodies will be affected. The project will be located close to Kaptaii Lake and tribal communities. Extensive tribal community consultation and engagement will be required for smooth implementation of the project.
24	Would the proposed project result in the generation of waste that cannot be recovered, reused or disposed of in an environmentally and socially sound manner?	Yes, waste generated during dredging of riverbed and disposal of dredged material will be required. New construction of 29.307 km road in green field. The dredged material will be reused or disposed of in an environmentally and socially sound manner. The contractor will be instructed and it will part of bid documents.
25	Is the project likely to result in a substantial influx of people into the affected community (ies)?	The scenic beauty, tribal population and their cultural activities attracted visitors and tourist. There is enormous possibility in the development of tourism and project aiming at financing tourism infrastructure in the mounting.
26	Would the proposed project be susceptible to or lead to increased vulnerability to earthquakes, subsidence and landslide, erosion, flooding or extreme climatic conditions?	This is a high risk of earthquakes, subsidence, landslide, erosion, flooding or extreme climatic conditions. The project should be well planned to avoid erosion in the erosion in navigation channel during on rush of flood from hills of Mizoram.
27	Will the project result in increased health risks as a result of a change in living and working conditions? In particular, will it have the potential to lead to an increase in HIV/AIDS infection?	India is heavily affected by HIV/AIDS. The connectivity may create a threat for increase in HIV/AIDS in Bangladesh. Dredging and allied works need concentration of working people and health risk should be covered for the workers.
28	Would the proposed project result in secondary or	New road through forested land will generate direct

	consequential development which could lead to environmental and social effects, or would it have potential to generate cumulative impacts with other known existing or planned activities in the area?	environmental and social impacts through the cutting of forest and earthwork associated with construction and potential relocation of inhabitants. These are direct impacts. In addition, however, the new road would likely also bring new commercial and domestic development (houses, shops, businesses). In turn, these will generate indirect impacts.
29	Habitat (especially fish spawning areas) from dredging operations;	Dredging operation will damage the habitat of fish particularly spawning area.
30	Impacts to terrestrial flora/fauna and natural habitats at site of on-land disposal of dredged material (especially if dredged material is contaminated);	The dredged material will be disposed off or reused for the project. The flora / fauna and natural habitat is likely to be affected. Survey of ecological elements during feasibility study will be taken up. The contaminated dredged material will need further care before depositing on the fringe of Kaptaii lake.
31	Noise and air emissions from equipment and machinery;	During construction and operation, noise and vibration will be generated from dredgers, construction equipment and launch operation.
32	Impact critical habitats, potentially including but not limited to legally designate protected areas.	An ecological survey will be required in the project area including in Kaptaii lake. The presences of sensitive species need to be verified further during the feasibility study. The navigational alignment is not proposed through designated protected area.
33	Open water disposal of dredging materials should be avoided wherever possible given its tremendous benthic effects.	Proper disposal of riverbed material will be required. Where no other alternatives to open water disposal exist, a benthic survey will be required. Evaluation of environmental issues related to selection and management of areas for disposal of dredging material on land will be required. IWTA guideline will be followed.
34	Community participation in the management of dredging materials	Stake holder meeting and community consultation has been undertaken and management of the dredged materials will be done through this process. If any community interested in using dredged materials.
35	Land acquisition is likely to be required for on-land disposal of dredging material, access roads or river port development activities	There will be about 8.26 M m^3 of dredging materials will be required to disposed off or reuse if not contaminated. The huge amount of the material will need some land acquisition if it cannot be reused. Moreover land acquisition is likely to be required for access roads or river port development activities.
36	River bed, coastline and on-shore habitats which may be impacted by disposal of dredged material and/or other on-land activities, as well as critical habitat (including but not limited to legally designated protected areas)	Ecological survey during feasibility will give proper direction in disposal of dredged material and/or other on-land activities, as well as critical habitat .This will be taken care during dredging of the proposed navigational channel.
37	Are there existing land uses on or around the location e.g. homes, gardens, other private property, industry, commerce, recreation, public open space, community facilities, agriculture, forestry, tourism, mining or quarrying which could be affected by the project?	Popular for tourism. Waterways will be partially affected during dredging. About 25 Chakma families will be affected due to the land customs station development.
38	Are there any areas or features of historic or cultural importance on or around the location which could be affected by the project?	Subholong union is famous for waterfalls. In addition, Kaptaii lake and Kaptaii hydropower plant will be close to the project alignment.

ANNEXURES IV

Table 4G: Multimodal Route 3: Kaptaii-Barkal (64.81 km) waterway and Barkal-Thegamukh (29.307 km) by road

	Initial Issues Identification Questions	**Initial Findings**
	Is the site vulnerable to major natural or induced hazards such as:	
1	Flooding	64.81 Km navigational channel for plying of vessel will be constructed on the present channel of Karnafuli River. The channel is being submerged during flood season. Flash flood is very common in hilly area and may associate with silt and erosion. Quick rise of water may damage the navigational channel and other infrastructural facilities on the bank of the channel like landing berthing, pontoon etc.
2	Storm Surge	Storm surge and cyclones is more frequent in the coastal region of Bangladesh but the area of influence also well over Chittagong Hill Tract. Navigation in the channel will be disrupted during such cyclonic storm particularly during wet season when the depth of water is high.
3	Sever wind damage (associated with hurricanes, tropical storms or weather system)	Seasonal storm known as Nor'westers (kalboishakhi) is common in the month April and May. The strong wind and hurricane can capsize the vessel and it is happening in many navigational channels around Bangladesh including Chittagong Hill Tract.
4	Explosion	Transportation of different explosive chemical in the channel corridor can be cause of explosion, safety in transportation will be required.
5	Chemical or Oil spill	Transportation of different chemical and oil can be cause spill and contaminated the channel area, safety transportation will be required.
6	Will the project operation disturb any traditional activity on adjoining or nearby properties?	Hilly population now relocated on the fringe of Kaptaii Lake after submergence of the area. They said channel is passing through the lake and it is likely the populations are disturbed during dredging for excavation and operation of vessels for transportation.
7	Will nearby activities in surrounding areas adversely affect the sub-project (for instance, noise, run-off, air/exhaust emissions from surrounding land uses)?	Dredging for excavation of channel for construction of navigational route will adversely affect the population with noise, run-off, air/exhaust emissions The operation of vessel also create those nuisance throughout the project life.
8	Will the new road/corridor significantly increase access to areas/resources that were once largely inaccessible to the general public?	The project area is nearly inaccessible by road. After construction of the reservoir these remote place became accessible for the local population but does not have proper navigational facility. With development of the navigational route/ corridor better communication in the remote area of Chittagong Hill Tract and also trans-boundary traffic will generate.
9	Is the sub-project site part of a protected or environmentally sensitive area?	No. The protected or environmentally sensitive area is far away from the project site.
10	Loss of bottom habitat and fishery resources are also significant problem included in this category ?	Dredging for construction of navigational route (64.81 Km) will disturb the fish habitat. Dredging should be planned to be confined within the channel width and disposal of the dredged material will be outside the channel and lake water. Combination can be made to construct the road which has been proposed between Barkal-Thegamukh (29.307 km). However there will be appreciable loss of bottom habitat and fishery resources in the project area (approx. 70m width over 64.81 Km long channel. The detail of ecological survey will be done during Feasibility study.
	Is the sub-project's right-of-way/route/corridor likely to affect:	
11	The habitats of fish?	Yes, it needs further ecological study along the navigational

		route during feasibility study and will be reflected in TOR of ESIA.
12	Habitats of wildlife species including endangered species?	No. The habitats of wildlife species including endangered species are not on the corridor alignment or nearby.
13	Wildlife or livestock movement/crossing patterns?	Not Applicable.
14	Will the construction work cause a noise nuisance due to the operation of dredger/ heavy machinery and other on-site activities?	During dredging/construction and operation, noise and vibration will be generated from dredgers, construction equipment and vessel operation.
15	Will the dredger/ construction work disrupt traffic (fisher man/ boat navigation)?	The population density is very low along the navigational corridor. The disruption of boat, traffic and fishing is likely.
16	Will dredger/ construction worker be provided with hard hats, life jacket and boots, and be required to wear them?	Comply with all types of health and safety issues. It will be part of bid document.
17	Will the site be secured during Excavation/construction to prevent unimpeded public access and protect area users?	Comply with all types of health and safety issues. It will be part of bid document. The site will be fully secured to avoid unimpeded public access and protected area users and protected area users.
18	Will precautions be put in place during dredging /construction to protect area users (e.g. barriers, lighting, signage)?	Comply with all types of marking, fencing the area with lighting and signage will be made.
19	Are dredging /construction workers trained and equipped with the required personal protective equipment (PPE) to undertake the tasks assigned to them?	Comply with all rules and regulation documented in safety manual of dredging. It will be part of bid document. Hard hats, life jacket, fire-fighting equipment will be provided.
20	Does the operator of dredging /Contractor convene regular health and safety meeting with workers?	Comply with all types of training and demonstration before the workers can be involved in such work. Health and safety meeting is part of the work.
21	Are there separate washroom facilities, adequate restroom/eating areas and first aid kit on site, and are these freely accessible to workers when needed?	Comply with all types of health and safety issues of dredging operation. It will be part of bid document.
22	Does the project pose a risk of degrading tremendous benthic organism?	A huge quantity of dredging will be taken up and removal of bottom material will happen. Sampling and testing will be made in the ecological survey during feasibility study.
23	Would the propose project result in the release of pollutants to the environment due to routine or non-routine circumstances with the potential for adverse local, regional and trans boundary impacts?	Instead of road from Chotohorina to Thegamukh, if waterway is planned, international water bodies will be affected. The project will be located close to Kaptaii Lake and tribal communities. Extensive tribal community consultation and engagement will be required for smooth implementation of the project.
24	Would the proposed project result in the generation of waste that cannot be recovered, reused or disposed of in an environmentally and socially sound manner?	Yes, waste generated during dredging of riverbed and disposal of dredged material will be required. New construction of 29.307 km road in green field. The dredged material will be reused or disposed of in an environmentally and socially sound manner. The contractor will be instructed and it will part of bid documents
25	Is the project likely to result in a substantial influx of people into the affected community (ies)?	The scenic beauty, tribal population and their cultural activities attracted visitors and tourist. There is enormous possibility in the development of tourism and project aiming at financing tourism infrastructure in the mounting.
26	Would the proposed project be susceptible to or lead to increased vulnerability to earthquakes, subsidence and landslide, erosion, flooding or extreme climatic conditions?	This is a high risk of earthquakes, subsidence, landslide, erosion, flooding or extreme climatic conditions. The project should be well planned to avoid erosion in the erosion in navigation channel during on rush of flood from hills of Mizoram.
27	Will the project result in increased health risks as a result of a change in living and working conditions? In particular, will it have the potential to lead to an increase in HIV/AIDS infection?	India is heavily affected by HIV/AIDS. The connectivity may create a threat for increase in HIV/AIDS in Bangladesh. Dredging and allied works need concentration of working people and health risk should be covered for the workers.
28	Would the proposed project result in secondary or consequential development which could lead to environmental and social effects, or would it have	New road through forested land will generate direct environmental and social impacts through the cutting of forest and earthwork associated with construction and potential

	potential to generate cumulative impacts with other known existing or planned activities in the area?	relocation of inhabitants. These are direct impacts. In addition, however, the new road would likely also bring new commercial and domestic development (houses, shops, businesses). In turn, these will generate indirect impacts.
29	Habitat (especially fish spawning areas) from dredging operations;	Dredging operation will damage the habitat of fish particularly spawning area.
30	Impacts to terrestrial flora/fauna and natural habitats at site of on-land disposal of dredged material (especially if dredged material is contaminated);	The dredged material will be disposed off or reused for the project. The flora / fauna and natural habitat is likely to be affected. Survey of ecological elements during feasibility study will be taken up. The contaminated dredged material will need further care before depositing on the fringe of Kaptaii lake.
31	Noise and air emissions from equipment and machinery;	During construction and operation, noise and vibration will be generated from dredgers, construction equipment and launch operation.
32	Impact critical habitats, potentially including but not limited to legally designate protected areas.	An ecological survey will be required in the project area including in Kaptaii lake. The presences of sensitive species need to be verified further during the feasibility study. The navigational alignment is not proposed through designated protected area.
33	Open water disposal of dredging materials should be avoided wherever possible given its tremendous benthic effects.	Proper disposal of riverbed material will be required. Where no other alternatives to open water disposal exist, a benthic survey will be required. Evaluation of environmental issues related to selection and management of areas for disposal of dredging material on land will be required. IWTA guideline will be followed.
34	Community participation in the management of dredging materials	Stake holder meeting and community consultation has been undertaken and management of the dredged materials will be done through this process. If any community interested in using dredged materials.
35	Land acquisition is likely to be required for on-land disposal of dredging material, access roads or river port development activities	There will be about 8.26 M m^3 of dredging materials will be required to disposed off or reuse if not contaminated. The huge amount of the material will need some land acquisition if it cannot be reused. Moreover land acquisition is likely to be required for access roads or river port development activities.
36	River bed, coastline and on-shore habitats which may be impacted by disposal of dredged material and/or other on-land activities, as well as critical habitat (including but not limited to legally designated protected areas)	Ecological survey during feasibility will give proper direction in disposal of dredged material and/or other on-land activities, as well as critical habitat .This will be taken care during dredging of the proposed navigational channel.
37	Are there existing land uses on or around the location e.g. homes, gardens, other private property, industry, commerce, recreation, public open space, community facilities, agriculture, forestry, tourism, mining or quarrying which could be affected by the project?	Popular for tourism. Waterways will be partially affected during dredging. About 25 Chakma families will be affected due to the land customs station development.
38	Are there any areas or features of historic or cultural importance on or around the location which could be affected by the project?	Subholong union is famous for waterfalls. In addition, Kaptaii lake and Kaptaii hydropower plant will be close to the project alignment.

ANNEXURES IV

Table 4H: Multimodal Route-4: Kaptaii-Rangamat-Barkal-Chotoharina by waterway (89.62 Km) and Chotohorina-Thegamukh by road (7.987 Km).

	Initial Issues Identification Questions	**Initial Findings**
	Is the site vulnerable to major natural or induced hazards such as:	
1	Flooding	89.62 Km navigational channel for plying of vessel will be constructed on the present channel of Karnafuli River. The channel is being submerged during flood season. Flash flood is very common in hilly area and may associate with silt and erosion. Quick rise of water may damage the navigational channel and other infrastructural facilities on the bank of the channel like landing berthing, pontoon etc.
2	Storm Surge	Storm surge and cyclones is more frequent in the coastal region of Bangladesh but the area of influence also well over Chittagong Hill Tract. Navigation in the channel will be disrupted during such cyclonic storm particularly during wet season when the depth of water is high.
3	Sever wind damage (associated with hurricanes, tropical storms or weather system)	Seasonal storm known as Nor'westers (kalboishakhi) is common in the month April and May. The strong wind and hurricane can capsize the vessel and it is happening in many navigational channels around Bangladesh including Chittagong Hill Tract.
4	Explosion	Transportation of different explosive chemical in the channel corridor can be cause of explosion, safety in transportation will be required.
5	Chemical or Oil spill	Transportation of different chemical and oil can be cause spill and contaminated the channel area, safety transportation will be required.
6	Will the project operation disturb any traditional activity on adjoining or nearby properties?	Hilly population now relocated on the fringe of Kaptaii Lake after submergence of the area. They said channel is passing through the lake and it is likely the populations are disturbed during dredging for excavation and operation of vessels for transportation.
7	Will nearby activities in surrounding areas adversely affect the sub-project (for instance, noise, run-off, air/exhaust emissions from surrounding land uses)?	Approximately 8.26 M m^3 of dredged materials should be removed from the navigational route. Dredging for excavation of channel for construction of navigational route will adversely affect the population with noise, run-off, air/exhaust emissions The operation of vessel also create those nuisance throughout the project life.
8	Will the new road/corridor significantly increase access to areas/resources that were once largely inaccessible to the general public?	The project area is nearly inaccessible by road. After construction of the reservoir these remote place became accessible for the local population but does not have proper navigational facility. With development of the navigational route/ corridor better communication in the remote area of Chittagong Hill Tract and also trans-boundary traffic will generate.
9	Is the sub-project site part of a protected or environmentally sensitive area?	No. The protected or environmentally sensitive area is far away from the project site.
10	Loss of bottom habitat and fishery resources are also significant problem included in this category ?	Dredging for construction of navigational route (89.62 Km) will disturb the fish habitat. Dredging should be planned to be confined within the channel width and disposal of the dredged material will be outside the channel and lake water. Combination can be made to construct the road which has been proposed between Chotohorinal-Thegamukh (7.987 km) under Route Option 1. However there will be appreciable loss of bottom habitat and fishery resources in the project area

		(approx. 70m width over 89.62 Km long channel. The detail of ecological survey will be done during Feasibility study.
	Is the sub-project's right-of-way/route/corridor likely to affect:	
11	The habitats of fish?	Yes, it needs further ecological study along the navigational route during feasibility study and will be reflected in TOR of ESIA.
12	Habitats of wildlife species including endangered species?	No. The habitats of wildlife species including endangered species are not on the corridor alignment or nearby.
13	Wildlife or livestock movement/crossing patterns?	Not Applicable.
14	Will the construction work cause a noise nuisance due to the operation of dredger/ heavy machinery and other on-site activities?	During dredging/construction and operation, noise and vibration will be generated from dredgers, construction equipment and vessel operation.
15	Will the dredger/ construction work disrupt traffic (fisher man/ boat navigation)?	The population density is very low along the navigational corridor. The disruption of boat, traffic and fishing is likely.
16	Will dredger/ construction worker be provided with hard hats, life jacket and boots, and be required to wear them?	Comply with all types of health and safety issues. It will be part of bid document.
17	Will the site be secured during Excavation/construction to prevent unimpeded public access and protect area users?	Comply with all types of health and safety issues. It will be part of bid document. The site will be fully secured to avoid unimpeded public access and protected area users and protected area users.
18	Will precautions be put in place during dredging /construction to protect area users (e.g. barriers, lighting and signage)?	Comply with all types of marking, fencing the area with lighting and signage will be made.
19	Are dredging /construction workers trained and equipped with the required personal protective equipment (PPE) to undertake the tasks assigned to them?	Comply with all rules and regulation documented in safety manual of dredging. It will be part of bid document. Hard hats, life jacket, fire-fighting equipment will be provided.
20	Does the operator of dredging /Contractor convene regular health and safety meeting with workers?	Comply with all types of training and demonstration before the workers can be involved in such work. Health and safety meeting is part of the work.
21	Are there separate washroom facilities, adequate restroom/eating areas and first aid kit on site, and are these freely accessible to workers when needed?	Comply with all types of health and safety issues of dredging operation. It will be part of bid document.
22	Does the project pose a risk of degrading tremendous benthic organism?	Approximately 8.26 M m^3 of dredge materials should be removed from the channel. Dredging will be taken up and removal of bottom material will happen. Sampling and testing will be made in the ecological survey during feasibility study.
23	Would the propose project result in the release of pollutants to the environment due to routine or non-routine circumstances with the potential for adverse local, regional and trans boundary impacts?	Instead of road from Chotohorina to Thegamukh, if waterway is planned, international water bodies will be affected. The project will be located close to Kaptaii Lake and tribal communities. Extensive tribal community consultation and engagement will be required for smooth implementation of the project.
24	Would the proposed project result in the generation of waste that cannot be recovered, reused or disposed of in an environmentally and socially sound manner?	Yes, waste generated during dredging of riverbed and disposal of dredged material (about 8.26 million m^3) will be required. New construction of 7.987 km road in green field. The dredged material will be reused or disposed of in an environmentally and socially sound manner. The contractor will be instructed and it will part of bid documents.
25	Is the project likely to result in a substantial influx of people into the affected community (ies)?	The scenic beauty, tribal population and their cultural activities attracted visitors and tourist. There is enormous possibility in the development of tourism and project aiming at financing tourism infrastructure in the mounting.
26	Would the proposed project be susceptible to or lead to increased vulnerability to earthquakes, subsidence and landslide, erosion, flooding or extreme climatic	This is a high risk of earthquakes, subsidence, landslide, erosion, flooding or extreme climatic conditions. The project should be well planned to avoid erosion in the erosion in

	conditions?	navigation channel during on rush of flood from hills of Mizoram.
27	Will the project result in increased health risks as a result of a change in living and working conditions? In particular, will it have the potential to lead to an increase in HIV/AIDS infection?	India is heavily affected by HIV/AIDS. The connectivity may create a threat for increase in HIV/AIDS in Bangladesh. Dredging and allied works need concentration of working people and health risk should be covered for the workers.
28	Would the proposed project result in secondary or consequential development which could lead to environmental and social effects, or would it have potential to generate cumulative impacts with other known existing or planned activities in the area?	New road through forested land will generate direct environmental and social impacts through the cutting of forest and earthwork associated with construction and potential relocation of inhabitants. These are direct impacts. In addition, however, the new road would likely also bring new commercial and domestic development (houses, shops, businesses). In turn, these will generate indirect impacts.
29	Habitat (especially fish spawning areas) from dredging operations;	Dredging operation will damage the habitat of fish particularly spawning area.
30	Impacts to terrestrial flora/fauna and natural habitats at site of on-land disposal of dredged material (especially if dredged material is contaminated);	The dredged material will be disposed off or reused for the project. The flora / fauna and natural habitat is likely to be affected. Survey of ecological elements during feasibility study will be taken up. The contaminated dredged material will need further care before depositing on the fringe of Kaptaii lake.
31	Noise and air emissions from equipment and machinery;	During construction and operation, noise and vibration will be generated from dredgers, construction equipment and launch operation.
32	Impact critical habitats, potentially including but not limited to legally designate protected areas.	An ecological survey will be required in the project area including in Kaptaii lake. The presences of sensitive species need to be verified further during the feasibility study. The navigational alignment is not proposed through designated protected area.
33	Open water disposal of dredging materials should be avoided wherever possible given its tremendous benthic effects.	Proper disposal of riverbed material will be required. Where no other alternatives to open water disposal exist, a benthic survey will be required. Evaluation of environmental issues related to selection and management of areas for disposal of dredging material on land will be required. IWTA guideline will be followed.
34	Community participation in the management of dredging materials	Stake holder meeting and community consultation has been undertaken and management of the dredged materials will be done through this process. If any community interested in using dredged materials.
35	Land acquisition is likely to be required for on-land disposal of dredging material, access roads or river port development activities	There will be about 8.26 M m^3 of dredging materials will be required to disposed off or reuse if not contaminated. The huge amount of the material will need some land acquisition if it cannot be reused. Moreover land acquisition is likely to be required for access roads or river port development activities.
36	River bed, coastline and on-shore habitats which may be impacted by disposal of dredged material and/or other on-land activities, as well as critical habitat (including but not limited to legally designated protected areas)	Ecological survey during feasibility will give proper direction in disposal of dredged material and/or other on-land activities, as well as critical habitat .This will be taken care during dredging of the proposed navigational channel.
37	Are there existing land uses on or around the location e.g. homes, gardens, other private property, industry, commerce, recreation, public open space, community facilities, agriculture, forestry, tourism, mining or quarrying which could be affected by the project?	Popular for tourism. Waterways will be partially affected during dredging. About 25 Chakma families will be affected due to the land customs station development.
38	Are there any areas or features of historic or cultural importance on or around the location which could be affected by the project?	Subholong union is famous for waterfalls. In addition, Kaptaii lake and Kaptaii hydropower plant will be close to the project alignment.

ANNEXURE II:

Environmental Sampling and Assessment

Volume IC:
Environmental Screening and Scoping Report

FINAL

GOVERNMENT OF THE PEOPLE'S REPUBLIC OF BANGLADESH

Consultancy Services for Feasibility, Detailed Survey and Design of Chittagong Hill Tracts Connectivity Connecting Thegamukh and Chittagong Port

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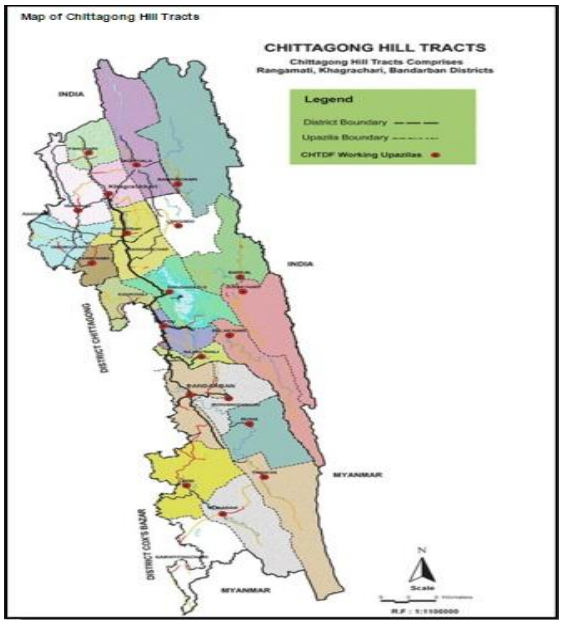

ENVIRONMENTAL SCREENING AND SCOPING REPORT – VOLUME IC OF IV

JUNE 2016

LOCAL GOVERNMENT ENGINEERING DEPARTMENT (LGED)

SAI Consulting Engineers Pvt.Ltd.,
SAI House, Satyam Corporate Square
B/hRajpath Club, Bodakdev
Ahmedabad–380059,INDIA

In association with

BETS Consulting Services Ltd.,
House-10,Road-135,Gulshan-1,
Dhaka-1212
Bangladesh

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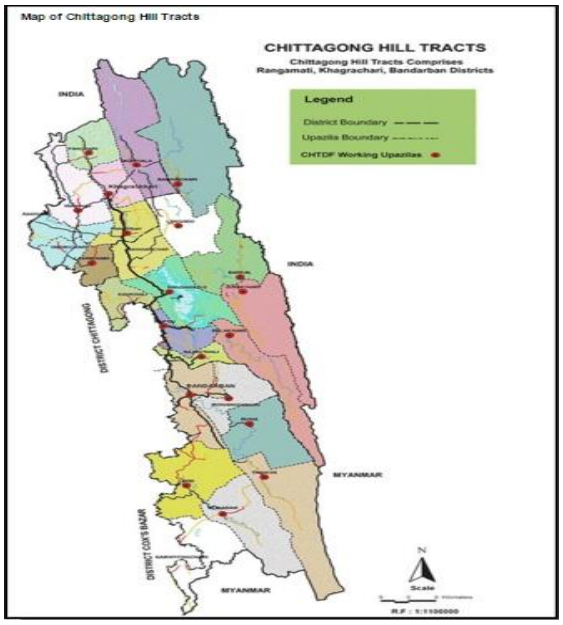

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SAI Consulting Engineers Pvt.Ltd.,
SAI House, Satyam Corporate Square
B/hRajpath Club, Bodakdev
Ahmedabad–380059,INDIA

In association with

BETS Consulting Services Ltd.,
House-10,Road-135,Gulshan-1,
Dhaka-1212
Bangladesh

Project: Consultancy services for Feasibility, Detailed Survey and Design of Chittagong Hill Tracts (CHT) Connectivity Connecting Thegamukh and Chittagong Port.

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Executive Summary

As per desire of the Government of the People's Republic of Bangladesh, for developing effective connectivity from Thegamukh to Chittagong Port, a study was carried out for selecting two alignments, one road alignment from among 4 road alignment options and one multimodal alignment from among 4 road-water alignment options.

Finally, using those selection criteria, from among the road alignments, road no.1 from Rajosthali-Bilaichari-Juraichari-Barkal-Thegamukh scored the highest 67.68. And from among the multimodal M-1Rangamati-Chhotoharina connected by waterway and Thegamukh by road have got highest scores of 64.93 have been selected. In view of having highest weight these two routes have been selected for further feasibility study.

The feasibility study has been carried out through Community Consultation in regard to social aspect and issues throughout and along the selected route alignments in order to carry out in-depth assessment for starting the actual construction works. Public Consultation along the selected alignments was carried out with different stakeholders to assess different opportunities, threats and cost effectiveness for re-settlements works. And also was conducted to gather knowledge and experience of local people relevant to identifying social and environmental issues and to find out appropriateness of selected alignments.

The selected road Alignment-1 that starts from Rajosthali has the connectivity with approach road with surrounding districts which are Chittagong, Banderban, Coxes Bazar, Khagrachari, etc., and easily can establish connectivity with the Upazilas thereof. It has road connection with some Upazilas of Rangamati district and can be connected with other Upazilas and network of whole CHT area. Rajosthali would ease the communication problem of Farua, Belaichari, Juraichari, Barkal and Thegamukh which was long awaited desire of the local people and if the project is materialized properly then entire Rangamati District including the remote places of it will be developed considerably. Besides that this route would be less risky compared to other alignment options. Multimodal-1 is suitable for inter-Upazila connectivity.

The field facilitators conducted the public consultation and FGDs where they covered the Upazila Officials, Upazila Chairmen, Headman, Karbaries, etc., including the common people along the alignments. Following the same method they also carried out the Multimodal selected route no.1, starting from Rangamati – Chotohorina along waterway and land up to Thegamukh. The field team conducted 52 public consultations covering all Upazila Headquarters throughout the road alignment and carried out 36 public consultations in and along multimodal alignment. The facilitators prepared the list of the respondents with detailed address, phone numbers and key responses.A stakeholder consultation meeting was organized by the project at Rangamati where 67 participants from different professional groups attended the meeting. Among the participants there were World Bank representatives, Additional Police Super, UNO-Barkal, Director, Chamber of commerce, Journalists, NGO representatives, UP Chairmen, Headman, Karbai and representatives of different business communities. The meeting was lively and participatory one.

From the public consultation it was found that for Road Alignment -1, land acquisition has to be done roughly of 114 acres, cost of which would be around BDT: 80.00 million. As such in 1 km land acquisition will be approximately 1 acre/km and the cost of which would be around BDT: 0.55 million/km. Study reveals that around 564 HHs will be affected due to implementation of the Road Alignment-1. All of them will need to be re-settled to another suitable place so that they can live there comfortably as before. Some 157 HHs will lose business structures, 241 HHs will lose

gardens (mainly Teak), and a suitable compensation plan has to be prepared to recover loss of the affected persons. The Resettlement Action Plan (RAP) and the work will be done following the World Banks OP-4.12, and OP/BP 4.10 since there will be some involuntary resettlement and impacts to some indigenous people.

Under social assessment gender issues were given due consideration.From public consultation, it revealed that if communication facilities are improved women would have access to all sorts of facilities like-education, health services, job opportunities, etc.

Settlement pattern has serious implications for resettlement. Since the area is a hilly terrain settlement pattern is completely different from the rest part of Bangladesh. Tribal people follow three types of settlement pattern in that area where some people live in the bottom of the hill,another group live in the middle of the hill and one more group live in the top of the hill. Again, some tribal like Tripura live one family in one hill, Chakma live one or more than one in one hill and Marma also live one family in one hill. The reason for such pattern of settlement is related to their water use and livelihood pattern as reported by them. Tribals who are using water extensively in the everyday life used to live very close to their water source mainly at the bottom of the hill. They also used to rear cattle for which they prefer to live close the river or stream or lake. In total eleven ethnic minorities will be impacted which include Chakma, Marma, Tanchangya, Tripua, Pankua, Lushi, Khiang, Murang, Rakhain, Chak, Bowm, and Khumi.

Hot Spots in 2 selected alignments have been identified and shown in a tabular form in the report.

From the respondents of the consultation it was revealed that average poverty situation of the area has been reducing considerably compared to BBS data of 2010. As a proof of their observation they mentioned some criteria like living standard, food intake, use of luxury items, electricity, etc.

CHAPTER 1
Overall Condition of CHT Area

1.1 Local Government in the Region

Large number of institutions is there in the region, apart from many Government Departments and other agencies operating in the region as in the rest of the country. Institutions which are special to the area include CHTD Board, Hill District Councils and Regional Council. The MoCHT Affairs and Regional Council are the latest addition in the scenario. The HD Councils have also undergone substantial transformation following the historic Peace Agreement.

There are very old and traditional institutions like the Circle Chief-Headmen-Karbari network. The web of local government is distinctive in the CHT. With the existence of many organizations in the region an over-lap in functioning and confusion about the activities of some of the institutions occurs frequently.

New Institutions Creation of a new Ministry for CHTA is an evidence of the appreciation by the Government of giving special importance to socio-economic development of the people of the region. The Government is now in a position to take up intensive care of the problems and needs of the people of the region. It is also enabling increasing the resource allocation for the region through the various agencies.

Establishment of RC is a positive step towards strengthening local self-Government in the region. The RC can strengthen its mandatory functions of supervision and coordination of development activities of the region with the support of the Government. Experts feel that RC needs support with proper manpower, logistics and financial resources. Increased mutual trust and confidence between the RC and the Government is considered essential for effectiveness functioning of the RC.

Like other parts of Bangladesh various line Departments and other autonomous corporations and agencies of the Government have their district level offices in the three districts of CHT. These offices generally follow their highly centralized guidelines given from Dhaka. Top-down thinking prevails there but what is needed is a participatory approach to be followed for solving local level problem.

The traditional institution of Circle Chiefs (Rajas) and Headmen is important in the region. Effectiveness of Headman is gradually declining because of inadequate facilities. They may discharge their functions related to land management and local revenue administration better if they are given enhanced incentives.

1.2 Political Development in CHT Area

Indigenous people of CHT have a long history of struggle for realizing their some demands for improving their objectives economic conditions and some rights. Following that line of thought they had a long arms struggle in the CHT region. The struggle was ceased upon signing a peace accord in December 1997 what is called CHT Accord which was hailed by all. Both national and international community considered that as a breakthrough in resolving the decades-long conflicts in the region. It brought widespread optimism among all that the region will finally see peace and stability, giving a chance to pursue socio-economic development. However, the subsequent years produced a far-more complicated situation for the region. The Accord, almost immediately after its signing found itself embroiled into polemics with the two signatory parties – the government

and the PCJSS – both accusing each other over the status of its implementation. At present, nearly after two decades of its signing, if one takes stock of things, the outcome is decidedly mixed. The government has been truthful in setting up the decentralized institutional framework in the region. The 3 Hill District Councils (HDCs) have been set up by separate acts of parliaments with expanded mandate. The Regional Council has been similarly set up, as also the Land Dispute Resolution Commission and as well as the Refugee Task Force.

Despite all those good initiatives, none witness their logical conclusion. The HDCs are yet to be empowered with their full authority as envisaged in their respective acts and Accord. The CHTRC remains a weak institution devoid of any real authority as outcome of the government's steady attempt to fully handing over its power. The Land Commission is still to be fully functional. Similarly, the CHT Refugee Task Force also could not achieve anything significant due to disagreement over the identification of the internally displaced persons. Finally, the CHT Development Board continues to function as a parallel institution, out of the domain of the CHT Regional Council.

The Accord has yet to achieve much-coveted full peace and stability in the region. Immediately after the signing of the Peace Accord, a faction of the PCJSS rejected it, claiming the Accord as not fulfilling the aspirations of the CHT peoples. They later formed a separate political party, called United Peoples' Democratic Front (UPDF) to press their demands. However, from the very beginning having conflicting view over the accord issue, the two parties remain at loggerhead, regularly clashing one against another. Further, during the past Caretaker Government period, the PCJSS split into two factions where one group formed another political party, known as PCJSS-MN Larma. The three groups now fight each other often with fatal outcomes.

The region also experienced intensification of the settlers where they too consider the CHT Accord as hostile to the interests of the Bengalee residents of the region. With that view, they grouped under an organizational platform, ostensibly called 'Sama Odhikar Andolan' (Equal Rights Movement), demanding more rehabilitation of settlers and annulment of the Peace Accord. The ERM, in recent years have appeared as a formidable force in support of the settlers lobby, and often accused of creating communalism in the region, sparking several communal riots in the recent years. Meantime, the withdrawal of the armed forces also has not happen as envisaged. Therefore, a mixed political situation is there where some mistrust and political unrest is still persisting there despite on-going efforts for establishing full peace in the region.

1.3 Land Rights of Indigenous People

Landownership is more complex issue as many villagers used to have customary rights to land. Originally IP settled wherever they found enough land but gradually the land area reduced over the last century. Land of the region was divided into private property, Khas land, Reserve Forests, Protected Forests and Unclassified State Forests (USF). Initially in USF the IP were allowed to practice Juming and to extract forest produce to meet their requirements. With the elapse of time, more and more people settled there where land were occupied by private persons for agriculture and horticulture, making those as private property. A study reveals that a Bengali or a Tripura household owns 1.5 acres of land while a Chakma household owns 2 acres and Mro and Marma owns to 3 acres. Only about 40% of the indigenous peoples have some sort of land titles, (either deposited to the Headmen and not registered with the Land Record Office under the DC or registered formally).

Although people have even land rights in reserve and protected forests, these are not normally recorded and claimed as IPs are not aware of the procedure of the government office. People in

such situations enjoy land use but not be able to do or claim anything in case the land is confiscated for other government use. In case of Reserve Forest locally residing people can become forest labourers or can plant trees and also do their Jum crops. However, in the case of any extraction of forest products they face serious legal consequences.

A broad institutional set up is there who are involved in the land administration such as Headman, Karbari and Circle Chief. In addition to that Deputy Commissioner along with ADC and the Land Record Office also do other land record management works. However, with the establishment of the HDCs in late 1980s particularly with the resulting administrative and governance framework of the Peace Accord, they currently enjoy a reduced power. Nevertheless, they still are the 'final authority' with regard to acquisition, sale or transfer of land titles/ownership.

There are different types of land which include Reserve Forests (24% of the region); Protected Forests (1% of the region) and Unclassed State Forests (no accurate statics are available but this category of land constitute the major chunks and also are the most contentions; claimed as 'khas land' by the government where as the region's indigenous peoples counter-claiming these as their 'common/communal lands'

1.4 Issues Related to Gender

Gender is an important issue in the CHT area where it was observed that the women are more active and hardworking compared to their counterpart male partners. They carry out most of the domestic works and also get involved in farm production activities. Among the ethnic minorities women have no decision-making role in household affairs. They have no parental rights over their children. The male also allow their women to go out to work more often. The family norms are patriarchal. During public consultation impacts of the project on the women population were investigated.

With the increased communication facilities women will get the following benefits:

- Increase access to education
- Increase access to health Services
- Increase job opportunity
- Increase empowerment
- Improve Livelihood situation
- Maternal mortality rate will reduce
- Reduce work load of women
- Pregnant mothers will get health services
- Get fare price of their products
- Women will get all sorts of other benefits
- Reduce infant and child mortality

Indeed, women folk of remote CHT areas are deprived from above facilities and services. Deprivation of those occurred due to lack of effective communication facilities within the districts and Upazilas. If the internal Upazila connectivity/communication system is improved then the above problems will be reduced considerably.

It was also observed that the tribal women are poverty stricken and are vulnerable to their basic needs compared to others. Women carry their farm production to market places for selling and purchase household commodities for consumption of the families. Along with their domestic works, they get involved in cultivation, production of food and non food crops such as rice, potato, corn, mustard seed, cotton, mango, jackfruit, banana, pineapple, litchi, black berry, etc.

CHAPTER 2
Community Consultation for Feasibility Study for Road Alignment-1

2.1 Community Consultation for Feasibility Study for Road Alignment-1

2.1.1 Introduction:

This Feasibility study has been carried out through Community Consultation in regard to Social Aspect and issues throughout and along the selected route alignments in order to carry out in-depth assessment for the feasibility of the alignments before starting the actual construction works. For the feasibility survey, a well-structured questionnaire/checklist was prepared by the concerned authority to follow it as guideline for Public Consultation. And a 5-membered team was formed for conducting the field level Survey. In the checklist there was scope of writing four respondents' names and address. The Government of Bangladesh has the aim to develop remote areas of Chittagong Hill Districts and make trade connectivity from Chittagong Port to Thegamukh to Eastern states of India and other countries of eastern Asia and for the purpose initial pre-feasibility studies on 4 proposed Road Alignments and 4 Multimodal Alignments were held in order to select 1 Road Alignment and 1 Multimodal Alignment from among the proposed routes. From the pre-feasibility survey-ratings Road Alignment -1 and Multimodal Route Alignment-1 was tentatively selected. And as part -2 of the Phase 1, feasibility study through effective Public Consultation along the selected alignments was carried out with different stakeholders to assess different opportunities, threats and cost effectiveness for re-settlements works. And Public Consultations also was conducted to gather knowledge and experience of local people's opinion relevant to identifying social and environmental issues and ensuring the appropriateness and viability of selected alignments.

2.1.2 Objectives:

The objective of the consulting service is to carry out the study to identify most viable transportation routes from Chittagong Port to remote area of Chittagong Hill Tracts Districts of Bangladesh that may lead to the development of cross-border transit corridors to North Easter states of India, particularly through Thegamukh. The routes will be selected in consideration of quick benefits achieved in the short-term and sustainable project effectiveness in the longer-term for designed life cycle cost of the project. The identification of the routes shall be based on technical, environmental and social screening of the probable routes in order to select the preferred road alignment, and combination waterways and roads, leading to the detailed feasibility study of one road option and one multimodal option. The identified two best options will then be further reviewed for preferred connectivity and decided through a national level consultation workshop.

Once the preferred route is selected for further investment based on the findings of the detailed feasibility study, the employer may activate or contract for Phase II of the consulting service to carry out a survey, detailed engineering design, cost estimating and preparation of bid documents for the construction of the selected road.

Selected route alignments:

Road Alignment-1:

Rajosthali ----Belaichhari---Juraichhari---Barkal---Thegamukh—114.750 km

Multimodal Alignment-1:

Rangamati---Chotohorina--- Thegamukh---70.987= 63 waterway+7.987 land.

2.1.3 Justification:

Among the 4 land Road Alignments, Alignment-1: Rajosthali ----Belaichhari---Juraichhari---Barkal---Thegamukh was selected considering different socio-technical critera and ratings. Among the 4 road alignment options, Alignment-1 that starts from Rajosthali has the connectivity with approach road with surrounding districts which are Chittagong, Banderban, Coxes Bazar, Khagrachari, etc., and easily can establish connectivity with the Upazilas thereof. It has road connection with some Upazilas of Rangamati district and can be connected with other Upazilas and network connectivity would take place with the whole CHT area. Rajostholi would ease the communication problem of Farua, Belaichari, Juraichari, Barkal and Thegamukh which was long awaited desire of the local people and if the project is materialized properly then entire Rangamati District including the remote places of it will be developed considerably. Besides that this route would be less risky compared to other options.

2.1.4 Methodology:

For feasibility study of Road Alignment-1 and Multimodal Alignment -1, a 5- member team was formed with one team leader and 4 field Investigators. The team was engaged to carry out the task of Public Consultation along the alignments. Four investigators were divided into two sub-groups and started field level Public Consultation and data collection from different areas of the Alignments. The responsibility of the Team Leader was monitoring and supervision of survey team works and data collection of the public consultation to keep the task on the right tract. The Public Consultation was done on the purposive selection basis along the selected 123.546 km long road alignment. The field team conducted 52 Public Consultations throughout the road alignment. The team adopted participatory assessment method for both the alignments. The investigators conducted the public consultation and FGDs where they covered the Upazila Officials, Upazila Chairmen, Headmen, Karbaries, etc., including the common people along the alignment. No. of consultations were different at different places of the alignments because of the density of the population and problems of movement at different places, mainly for forests and hills tracts. For passing through the Road Alignment, the investigators sometimes had to hire boat, motorcycle and Guide to make out and figure out the Alignment and conduct PC where they found people in and around. Following the same method they also carried out the Multimodal selected route no.1, starting from Rangamati – Cotohorina along waterway and land up to Thegamukh. The investigators carried out 36 Public Consultation in and along that alignment.

Road Alignment followed by Investigators:

The Road Alignment that followed by the investigators from Rajosthali - Thegamukh and the places that they touched; and conducted the Public Consultation most of which have been mentioned below:

Rajostholi - Gainda – Amcharapara - Ghilachhari - Naraichhari – Mitengachhari - Agapara - 5 No Bolypara - Farua - Amkatachhra - Jambil - Aguchachari - Guainchhari - Taktanala - Downbridge – Bilaichhari – Belaicharibazar - Banggalkata – Moinpara – Duggachar – Nalchari - Fakirachhara – Hanjachari – Shilchari Bazar –Gilatali – Samirapara – Jurachari Bazar – Moshachari- Jameschari – Samiramukh – Barkal - Dhamaipara – Bamapanchari – Danapanchari – Aimachara – Sakrachari – Bhudchara – Latibashchara – Sukripatachara – Bairagipara – Kalabuniapara – Goroshan – Arabuniabazar – Bhushancharabazar – Chotohorinabazar - Amtala – Dhanubag – Nangol Abdu – Gongadhanchara – Thegamukh.

Constraints and problems faced during survey:

- The Alignment was not demarcated clearly in the route maps supplied, so, it was troublesome to locate the exact location of the Alignment.

- Mouza map would be helpful if available for identification of route alignment and locating other necessary point for land demarcation. And mouza also would help to move along the routes.
- On 02/12/12015 ethnic minorities celebrated the 18 year of Peace Agreement Act and Public Consultation could not be done properly on that Day.
- On weekly Hat Day /Bazar Day, it was difficult to find people for the purpose of Public Consultation.
- It was difficult to pass through deep forest and high hills by walking and find desired number and categories of people for Public Consultation.
- Some people have been living in forest owned land for years together, they have occupation rights, some took lease for living purpose, making of houses and gardens on the land and some are living on the recorded lands, verification of which is very much time consuming.

2.2 Upgrading Key Poverty Situation and Social Impacts and Mitigation Measures:

The average poverty situation of the Upazilas through which the alignments pass, has been compiled here. That poverty data was generated by BBS in 2010. Average poverty situation of 2010 by alignments has been noted below[1]:

Alignment no.	Upazila, the alignment passed through	% of extreme poor (lower poverty line)	% of poor (upper poverty line)
Road Alignment no.1	Rajasthali, JuraiChhari,BelaiChhari and Barkal	9.1	25.1
Multimodal Alignment no.1	Rangarnati-Chhotoharina connected by waterway (63 Km) and Thegamukh by road (about 7.987 km) Total: 70.987 Km	3.3	16.9

But, 5 years later, during the feasibility study carried out from 29/11/2015 to 15/12/2015 in all 52 public consultations along road alignment-1 and 36 public consultations of Multimodal alignment-1, the respondents reported that the poverty situation has considerably **reduced** during the 5 years period. Following parameters have been observed during Feasibility study:

1. Rate of education increased and enrolment in schools has also been increased
2. Condition of living house structure improved
3. Increased use of sanitary latrines
4. Food intake in terms of quantity and quality has improved
5. Using solar panel, some Upazila got electricity connection
6. Use of TV, mobile and motorbike increased
7. Movement to other districts increased
8. Job opportunity increased
9. Increased employment in local government offices
10. Increased entrepreneurship

2.3 Issues Related to Ethnic Minority People:

From the Public Consultation, it came out that 90% of the affected people are Ethnic Minority at Road Alignment-1. Upazila wise their positions have been given below:

[1]Poverty data for last five years were not available from any Government or non-government organizations/ offices in the proposed project area.

Ethnic MinorityPeople living along the Alignmet-1

Name of Alignment	Name of Upazila	% of Ethnic Minoritypeople	% of Bangalees
Road Alignment-1: Rajosthali ----Belaichhari---Juraichhari---Barkal---Thegamukh—123.546 km	Rajostholi	80%	20%
	Belaichari	100%	00
	Juraichari	100%	00
	Barkal	70%	30%

Most of the potential affected Ethnic Minority households were involved in fruit and timber gardening, producing turmeric and ginger, livestock rearing, trading, fishing and operating boat on rent basis.

In the PC, it came out that the affected Ethnic Minoritypopulation need to be re-settled in their own original profession, which they consider would be the best option for them. Besides that they are also interested in Income Generating activities (IGA), Alternative Livelihood Options (ALO) and Small & Medium Enterprises (SMEs). Some of them mentioned about training on motor driving.

However, it was found that they were interested both for financial and technical support. Options for support they mentioned include:

- Support for making fruit garden;
- Support for buying boat for fishing;
- Support for starting small business;
- Arrange well-resourced IGA training;

They tentatively estimated BDT 50,000 for IGA for each affected Ethnic Minorityhousehold.

Land use pattern of Road Alignment-1

Alignment	Alignments	Land use pattern		
1	Rajosthali-Bilaichari-Juraichari-Barkal-Thegamukh- 114.750 km	Class Name	Area in Sq	Area in Ac
		Dense forest	1133.592	0.28
		Fallow/Agriculture/Jhum	244587.597	60.439
		Low dense forest	1602750.321	396.048
		Medium dense forest	123866.743	30.608
		Road Network	286091.427	70.695
		Settlement	305166.563	75.408
		Waterbody	90654.943	22.401
		Total	**2654251.186**	**655.879**

Participation in Land Route Construction Work:

During Public Consultation people opined that if the road construction is done with the help of machine that would be better instead of doing it manually. They also informed that 100% cooperation will be available from the local people in all respect in regard to implementation of the road. Ethnic Minoritywomen as labour force for construction work may not be available at all the sites of the alignment.

2.4 Key Socio –economic Findings:

Following Table highlighted the Socio-economic findings of the Road Alignment-1
Road Alignment-1: Road Alignmen1; Rajosthali ----Belaichhari---Juraichhari---Barkal---Thegamukh—114.750 km

Length Covered	Chain age	N0. 0f public-consultation	land to acquire (approx) in acres	Amount reqd. in BDT(in crores)	No. of household affected	Cost of household in BDT	No. of Commercial structure	Cost of Commercial structure (BDT.)	Agri-affected*[1]	Cultural Structure Affected*[2]	Water bodies Affected*[2]
Rajosth-ali to Naraichar Agapara = 8.40 km	Ch 8400	6	8	4	16 HH	8 lac	36	36 lac	19 gardens	1 mosque 1 temples	3 ponds
Naraichari Agapara to Beplaichari= 40 km	Ch 48400	11	10	1	135HH	68 lac	12	12 lac	88 gardens	2 school 1 temple	1 pond
Bilaichari to Mondirachara = 15.7 km	Ch 64100m	6	15	0.5	20 HH	10 lac	2	2 lac	15 gardens	00 school	1 pond
Mondiracha to Juraichai= 14.4 km	Ch 78500m	14	25	1.25	105 HH	52 lac	10	10 lac	64 gardens	1 school	16 pond
Juraichai to Chotohorin = 28.25 km	Ch 106750m	10	40	0.75	251 HH	125 lac	75	75 lac	35 gardens	1 school 2 mosque 1 temple	10 pond
Chotohorina To Thegamukh 8km	Ch 114750m	5	16	0.5	37 HH	18 lac	22	22 lac	20 gardens	00	1 pond
Total = 114.75km		52	114 acres	8.00 crore	564 HH	2.81crore	157	1.57 crore	241	3mosque 3temples 4schools	32 ponds
Per km			1acre/km	552868/km	5HH/km	194194/km		136878/km	2/km		

Note 1: *Compensation for mosque and temple has not been included here as that can be avoided though designs and if not that has to be replaced by the constructing the same at site.*

Note 2: *During PC, they told that one garden may lose 30 trees, and one tree will cost at least Tk. 10,000, so 2 gardens in one km will cost Tk. 6, 00,000.*

2.5 Land Acquisition and Re-settlement:

So, for 1 Km. Total re-settlement rough estimated cost would be as follows:

Name of item/km	Rough estimated cost for re-settlement/km in BDT
Land acquisition	5,52,868
HH re-settlement	1,94,194
Commercial structure	1,36,878
Agri, affected (Trees)	6,00,000
Total	BDT/km = 14,83,940

From the Public Consultation and feasibility study data, it was found that for Road Alignment -1, Land Acquisition has to be done roughly 114 acres. The cost of which would be around BDT: 8.00 Crores. As such in 1 km Land Acquisition will be approximately 1 acre/km and the cost of which would be around BDT: 5.5 lac/km. And from the Feasibility Study Data, it reveals that around 564 HHs will be affected due to implementation of the Road Alignment-1. All of them will need to be re-settled to another suitable place so that they can live there comfortably as before. Some 157 HHs will lose business structures, 241 HHs will lose gardens (mainly Teak), and a suitable plan has to be made to recover their loss through paying properly calculated compensation to the affected persons.

2.6 Hot Spot

Following places have been considered as Hot Spot

1 **:** a place of more than usual interest, activity, or popularity

2 **:** a place in the upper mantle of the earth at which hot magma from the lower mantle upwells to melt through the crust usually in the interior of a tectonic plate to form a volcanic feature; *also*: a place in the crust overlying a hot spot

3 **:** an area of political, military, or civil unrest usually considered dangerous

Hotspot Location (For Social and Environmental Aspect): Road Alignment-1:

Route 1: Rajosthali-Bilaichari-Juraichari-Barkal-Thegamukh (114.751 Km)(Existing)

Chainage (Existing)	Location	Infrastructure					Agriculture/ Aquaculture	Forest (Reserve/Protected area)
		Building	Bridge/ Culvert	Sharp Turn	Vertical Slope/ Longitudinal gradient	Water Structure		
0-200	Rajosthali Bazar	Houses, Buildings. Shop Shed	Culvert		-	-	Pond	-
263-310				Sharp Turn				
410-434				Sharp Turn				
500-800	-	Mosque, House, Buildings, Shops, Buddhist Temple,	-	Sharp Turn	-	-	Pond	-
800-1000	-	House, Buildings, Shops, Buddhist Temple,	-		-	-	-	Forest
1000-2000	-	Houses	-		-	-	-	Forest
2000-3400	-	-	-		-	-	-	Forest
3400-5000	Ghilamukh	Houses, Shop Shed	-		Avg. Gradient Upto 8%	-	Chhara	-
5000-6000	Mubachhara	Houses, Shop Shed, School	Bridge		Avg Gradient Upto 8%		Chhara	Forest
6000-8000	Chabochhara	Houses, Buddhist Temple,	-		Avg. Gradient Upto 8%	-	-	-
8000-9000	Naraicori Agapara	Houses	Bridge	8000-8100 (sharp Turn)	Avg Gradient greater than 8%		Chhara	Forest
9000-11700	-	-	-		Avg Gradient greater than 8%	-	-	Forest
11700-14000	Mitingachhary	Houses	Bridge		Avg Gradient greater than 8%	-	Chhara	Forest
14000-16000	-	-	-		Avg Gradient greater than 8%	-	-	Forest
16000-18200	-	-	-	17741-18041(sharp Turn)	Avg Gradient greater than 8%	-	-	Forest

Chainage (Existing)	Location	Infrastructure					Agriculture/ Aquaculture	Forest (Reserve/Protected area)
		Building	Bridge/ Culvert	Sharp Turn	Vertical Slope/ Longitudinal gradient	Water Structure		
18200-19000	Angaboshura	-	-		-	-	Paddy Field	Forest
19000-20000	Angaboshura	Houses	Culvert		-	-	Chhara	Forest
20000-20800	-	Houses	-		-	-	Paddy Field	Forest
20800-21100	-	-	Culvert		-	-	-	-
21100-21800	-	-	Culvert		-	-	Paddy Field, Chhara	Forest
21800-22700	-	Houses	-		Avg Gradient Upto 8%	-	Paddy Field	Forest
22700-23500	Laittochhary	Houses, School	Culvert		Avg Gradient Upto 8%	-	Paddy Field, Chhara	Forest
23500-25000	-	-	-		Avg Gradient Upto 8%	-	-	Forest
25000-26200	-	-	-	25631-25836(sharp Turn)	Avg Gradient Upto 8%	-	-	Forest
26200-27000	-	House	-		-	-	-	Forest
27000-27800	Taktanala	Taktanala Tample,Shed,School,House	-		Avg Gradient Upto 8%	-	Paddy Field	Forest
27800-30000	-	-	-	29000-29100 (sharp Turn/zigzag road)	-	-	-	Forest
30000-33300	-	-	-	30500-30600 (sharp Turn) 31500-32500 (sharp Turn/zigzag road)	Avg Gradient Upto 8%	-	-	Forest
33300-35000	Alikhong	House	Bridge		-	-	Paddy Field, Chhara	Forest
35000-39400	-	-	-	38000-38200(sharp Turn) 38300-38400(sharp Turn)	Avg Gradient greater than 8%	-	Paddy Field	Forest
39400-41000	-	Houses, Buddhist Temple,	Bridge		-	-	Ditch	Forest
41000-43200	-	-	-	41100-41600 (sharp Turn/zigzag road)	Avg Gradient up to 8%	-	Jhum Cultivation	Forest

Chainage (Existing)	Location	Infrastructure					Agriculture/ Aquaculture	Forest (Reserve/Protected area)
		Building	Bridge/ Culvert	Sharp Turn	Vertical Slope/ Longitudinal gradient	Water Structure		
				42300-42900 (sharp Turn/zigzag road)				
43200-43400	-	-	-		Avg Gradient up to 8%	-	Jhum Cultivation	Forest
43400-46600	-	-	-		-	-	-	Forest
46600-48000	Degholchari	Primary School,House	Bridge	46900-47100 (sharp turn) 47500-48200 (sharp Turn/zigzag road)	-	-	Raaing khong river	Forest
48000-48600	Bilaichhari	Upazila Parishad,House	Bridge		Avg Gradient up to 8%	-	Raaing khong river	Forest
48600-50000	Bilaichhari	Upazila Bhaban,House	-		Avg Gradient up to 8%	-	-	Forest
50000-57000	-	House shed	Culvert Bridge	51000-54000 (sharp Turn/zigzag road) 52500-53200 (sharp Turn/zigzag road)	Avg Gradient greater than 8%	-	Chhara,Paddy Field	Forest
57000-60900	-	House shed,Jameshari Boiddho Bihar	Culvert		Avg Gradient up to 8%	-	Paddy Field Chhara	Forest
60900-62100	-	House,Hazachari Temple	-		-	-	Ditch	Forest
62100-62800	-	House	Culvert		-	-	Paddy Field Chhara	Forest
62800-64000	-	House	Culvert		-	-	Paddy Field Chhara	Forest
64000-64700	-	House,School	Culvert		Avg Gradient up to 8%	-	Paddy Field Chhara	Forest
64700-65300	-	House,Brick Field	-		-	Water Tank,Pucca Drain	Paddy Field Chhara	Forest
65300-66700	Barabaine	House	Culvert Bridge	65400-65900 (sharp Turn/zigzag road)	Avg Gradient up to 8%	-	Paddy Field Chhara	Forest
66700-68800	-	House	Culvert		-	-	Paddy Field	Forest

Chainage (Existing)	Location	Infrastructure					Agriculture/ Aquaculture	Forest (Reserve/Protected area)
		Building	Bridge/ Culvert	Sharp Turn	Vertical Slope/ Longitudinal gradient	Water Structure		
68800-70100	-	House	Bridge	69100-69500 (sharp Turn/zigzag road)	Avg Gradient up to 8%	-	Paddy Field Chhara	Forest
70100-72200	-	House	Culvert	70000-72700 (sharp Turn/zigzag road)	-	-	Paddy Field Chhara	Forest
72200-77000	-	House	Bridge	73700-737509(Sharp turn) 75700-75900(sharp turn)	Avg Gradient up to 8%	-	Paddy Field Chhara	Forest
77000-77200	-	-	Culvert		Avg Gradient up to 8%	-	Chhara	-
77200-77900	Juraichhari	House,Building ,School	Bridge		Avg Gradient up to 8%		Paddy Field,Pond	-
77900-78800	-	House,Food Godown,Post office,Mosque	Culvert		Avg Gradient up to 8%	-	Paddy Field,Pond, Chhara	-
78800-81000	-	Shed	Culvert Bridge Bridge Bridge	79400-81000 (sharp Turn/zigzag road)	Avg Gradient greater than 8%	-	Paddy Field, Chhara	Forest
81000-84500	-	Shed	Bridge	82000-82500 (sharp Turn/zigzag road)	Avg Gradient up to 8%	-	Chhara	Forest
84500-85100	-	Building	Bridge		-	-	Paddy Field, Chhara	-
85100-86000	Barkal	-	Bridge		-	-	Karnofuli, river,Paddy field	Forest
86000-86800	-	Shed House	-		-	-	Paddy field	Forest
86800-88000	-	-	Culvert		-	-	Paddy Field, Chhara	-
88000-90000	-	-	Culvert Bridge Bridge		-	-	Karnofuli river,Paddy field	-
90000-92200	-	-	Culvert Bridge Bridge Bridge		-	-	Chhara	-

Chainage (Existing)	Location	Infrastructure					Agriculture/ Aquaculture	Forest (Reserve/Protected area)
		Building	Bridge/ Culvert	Sharp Turn	Vertical Slope/ Longitudinal gradient	Water Structure		
			Bridge					
92200-94000	-	House	-		-	-	Paddy field	Forest
94000-95000	Kalabunia	Shed,Mosque,School,Graveyard,Primary School	-		-	-	Kalabunia Chhara	Forest
95000-97200	Bamland	Shed House, Health Complex,School,Mosque	Bridge Bridge Bridge		-	-	Paddy Field	-
97200-101500	Arabunia	School,Community Hospital,House	Bridge Bridge	100200-100400 (sharp turn)	Avg Gradient up to 8%	-	Karnofuli river,Paddy field,Pond	-
101500-104500	Bhusonchhara	Madrasha,House,Mosque	Bridge Bridge Bridge Bridge Bridge	102100-103200 (sharp Turn/zigzag road)	Avg Gradient up to 8%	-	Pond, Paddy Field, Chhara	-
104500-105500	-	House,	Culvert Bridge		-	-	Paddy Field, Chhara	-
105500-106700	Amtala	House,Mosque	Bridge	105600-106500(sharp turn)	Avg Gradient up to 8%	-	Paddy Field	-
106700-108200	Chotoharona	Shop,Shed House,School.Buddhist Temple	Bridge		-	-	addy Field, Chhara	Forest
108200-110600	-	-	-		-	-	Chhara	Forest
110600-114751	Thegamukh	House,Sheed,BGB Camp,Community Clinic,School	Bridge Bridge		-	-	Ditch, Paddy Field	Forest

Some Suggestions from the PAPs:

- In the PC people opined that the Road Construction should be done by the LGED or other similar organization.
- The present proposed Road alignment is supposed to pass through Jurachuri Sadar, then it would need to remove all establishments of Upazila and oher buildings. So, the people opined that the alignment should be changed to save those establishments. They proposed that if the route passes by the Upazila Police station-LabourPara–Kalika Para-Barkal then the upazila establishments will be saved and road length would be shortened by 4-5 km.
- If the Road Alignment follows the old KPM road that passes through Farua, Akuzzapara, Taktanala, and Alikhong to downbridge, then it would be cost effective and a lot of houses and buildings would be saved from acquisition.
- For preparing Road Alignment Maps, important locations should be demarcated on the maps. And at the same time during consultation, investigators should be advised to use Mouza Maps to find out the exact alignment locations and would easily point out the position of the possession to locate.
- It would be very much fruitful, if there would be one day small workshop for review of the design and alignment in each of the four Upazilas, through which the road alignment has been passing with the presence of Headmen, Karbari, UNO, UP Chairmen, UP members, Upazila Chairman, Vice-Chairman, etc. These workshops would help the project to do re-settlement works easily.

CHAPTER 3
Community Consultation for Feasibility Study for Multimodal Alignment

3.1 Community Consultation for Feasibility Study for Multimodal alignment-1

Multimodal route Alignment-1:
Rangamati---Chotohorina--- Thegamukh---70.987= 63 waterway+7.987 lands

3.1.1 Introduction:

This Feasibility study of the Multimodal Alignment has been carried out through Community Consultation in regard to Social Aspect and issues throughout and along the selected connectivity alignment route in order to further in depth assessing the feasibility of the alignment before starting the operational activities. Feasibility study of the selected Multimodal Alignment was done by the same team of the Road Alignment. Feasibility survey was done following same guideline as prepared by the concerned authority. The GoB has the aim to develop remote areas of Chittagong Hill Districts and make trade connectivity from Chittagong Port to Eastern states of India and other countries and for the purpose during pre-feasibility studies one Multimodal Route was selected considering the ratings as done for selecting Road Alignment -1 comparing to other options. And as a part -2 of phase 1 of the pre-feasibility studies, this Public Consultation was conducted to assess different opportunities, threats and cost effectiveness of different aspects taking in account the public opinion on the selection alignment compared to other options.

3.1.2 Objectives:

The objective of this study is:

- To ascertain the viability of the Multimodal Alignment compared to other Multimodal options;
- To involve local people and public representatives to gain ownership with the Multimodal Alignment like the Road Alignment;
- To learn necessity of resettlement of the people at Multimodal Alignment area;
- To know the necessity of Dredging at the Multimodal Alignment and where to drop the soil of dredging;

3.1.3 Methodology:

Feasibility study of Multimodal Alignment route -1 was done by sub-group-2. The team adopted participatory assessment method for the alignments. The investigators conducted the public consultation where they covered the unions, bazaar, etc., situated on the lake and the with the people who have been living at coastal areas along and around the route. The Public Consultations was done with Upazila Officials, Upazila Chairmen, Headmen, Karbaries, etc., including the general public along the alignment. No. of consultations were different at different place of the alignments because of the density of the population and movement problems at different place. mainly for forests and hills. For passing through the Multimodal Alignment, the investigators to hire engine boat for movements.

Name of the places where the investigators conducted the PC at Kaptai lake area and Karnafuli river along Multimodal Alignment-1 from Rangamati to Chotohorina.

Rangamati Reseve Bazar Launchghat—Rangamali Fishariesghat—1st point of Barkal Upazila—Shubhalong College Para—Chilardhak Dokanghat—Kiching Para Balukhali—Bagachala

Nadirpar Barkal—Beganachari Schoolghat Barkal—BRDB Officers' office—Barkal UP Office—Barkal Upazila—Nolbunia Schoolghat—Natunbazar Maischari—Shunhalong—Shunhalong Bazar—Shunhalong Launchghat—Barkal Bazar—Barkal BDR Camp—Bhudchara Nadirpar—Latibshchara Mandir—Baratalipar Barkal—Aimachara Nadirpar—Kalabunia Bazar—Gorosthan Bazar—Arabunia Bazar—Bhushanchara Nadirghat—Chotoharina Nadirghat—Chotoharina Bazar

3.2 Upgrading Key Poverty Situation and Social Impacts and Mitigation Measures:

The poverty situation previously was considered by alignment taking up average data of the Upazila, through which the alignment passes. The source of the data was provided by BBS in 2010. Average poverty situation of Multimodal Alignment-1 at that time was as follows:

Alignment no.	Upazila, the alignment passed through	% of extreme poor (lower poverty line)	% of poor (upper poverty line)
Multimodal Alignment no.1	Rangarnati-Chhotoharina connected by waterway (63 Km) and Thegamukh by road (about 7.987 km) Total: 70.987 Km	3.3	16.9

During the recent feasibility study conducted from 29/11/2015 to 15/12/2015, through 36 public consultations from Multimodal-1 alignment, all respondents told that the poverty has **reduced** considerably during the last 5 years period. Following indicators they indicaded during the survey period and those are almost same as the Road Alignment:

1. Rate of education increased and enrolment in schools has increased;
2. Condition of living house improved;
3. Using sanitary latrines increased;
4. Food intake quantity increased and quality improved;
5. Using Solar panel, Some Upazila got electricity;
6. Use of TV, Mobile increased;
7. Mobility to other districts, country increased;
8. Job Opportunity increased;

Land Use Pattern of Multimodal Alignment-1:

Alignment	Alignnment route length	Land Use Pattern	
		Landuse type	**Area(acr)**
Multimodal Alignment-1	Rangamati-Chhotoharina connected by waterway and Thegamukh by road-70.987.	Agriculture	22.83026835
		Education	0.152654
		Forest	21.34024284
		Religious	0.017299828
		Road Network	0.568949403
		Settlement	1.91346366
		Waterbody	1.20716395
		Total	**48.03004203**

3.3 Issues Related to Ethnic MinorityPeople:

In Multimodal Alignment-1, Ethnic Minorityfamilies have been living scatteredly on the hills of the lake. They are involved in fruit gardening, agriculture for producing Turmeric, Ginger,

Livestock rearing, etc., some are involved in making local garments; some are involved in Fishing and boat renting business. The people living nearer to this alignment will not be affected as learned from the Public Consultation. If the route is in operation then the income of the people of the area will increase as their business of the farming items will be enhanced.

3.4 Hotspots:

Multimodal Alignment-1
Route 1: Rangamati to Chhotohorina waterway (63Km) and Chhotohorina to Thegamukh Road way (8.089Km).ExistingRangamati to Chhotohorina waterway (63Km) (Hotspot)

Location
Rangamati Sadar
Shovolong
Barkal
Chottohorina

Chhotohorina to Thegamukh Road way (8.089Km) (Hotspot)

Chainage (Existing)	Location	Infrastructure					Agriculture/ Aquaculture	Forest Type Reserve/ VCF
		Building	Bridge/ Culvert	Sharp Turn/Zigzag Road	Vertical Slope/ Longitudinal gradient	Water Structure		
0-1000	Chhotohorina Bazar	House,Sheed,BGB Camp,Community Clinic,School,Buddhist Temple	-		Avg L.Gradient greater than 8%	-	Ditch, Paddy Field	Forest
1000-2000	-	-	-	Zigzag Road	-	-	-	Forest
2000-3000	-	-	-		-	-	-	Forest
3000-4000	-	-	-	Zigzag Road	Avg L.Gradient up to 8%	-	-	Forest
4000-5000		Sheed	-		-	-	-	Forest
5000-6000	Morathega	-	-		-	-	Paddy field.Chara	Forest
6000-7000	-	-	Bidge		-	-	Paddy field.Chara	Forest
7000-8089	Thegamukh	House,Sheed,BGB Camp,Community Clinic,School	Bidge				Paddy field.Chara	Forest

Landing Facilities/Water Structures

From Rangamati to Chottohorina via Barkal the places of traffic importance are:

(i) Rangamatisadar
(ii) Shovolong
(iii) Barkal
(iv) Chottohorina
(v)Thagamukh

(I)Rangamatisadar (i) One R.C.C Jetty (straight 30 m+ sloping 43.55 m)

	(ii) One 19.50 m Pontoon (iii) 2 Steel spuds (iv) One Tertminal Building (v) One Transit shed of 10m * 5 m (vi)Tube-well (vii) Electric Connection
(II) Shovolong	(i) One14.60 m Pontoon including 2 wooden planks
(III) Barkal	(i) One R.C.C Jetty (straight 30 m+ sloping 43.55 m) (ii) One 19.50 m Pontoon (iii) 2 Steel spuds (iv) One Tertminal Building (v) One Transit shed of 10m * 5 m (vi) Tube-well vii) Electric Connection
(IV) Chottohorina	(i) One R.C.C Jetty (straight 30 m+ sloping 43.55 m) (ii) One 19.50 m Pontoon (iii) 2 Steel spuds (iv) One Tertminal Building (v) One Transit shed of 10m * 5 m (vi) Tube-well vii) Electric Connection
(V) Thegamukh	Land customs will build the necessary structures under their project

Besides the above important launch stations, there are also some launch stations namely:

1. Bhushionchara, 2. Arabunia, 3.Bamland, 4. Kala bunia,
5.SouthKalabunia, 6. Bhutchara, 7.Baraitala, 8. Nutun Bazar.

In each of the landing stations, at least one 14.63 m pontoon may be provided with supply of two wooden planks as shore connection from pontoon to shore.

Other 8 Stations: (i) 8 pontoons

Typical drawing of R.C.C jetty, Pontoon, Spud, are provided in volume III. Details will be worked out during detailed design phase.

Survey duration: 29-11-2015 to 15-12-1015

3.5 Key Socio –economic Findings:

Multimodal Alignment-1: Rangamati---Chotohorina--- Thegamukh---70.987= 63 waterway+7.987 lands

Length Covered	No. of Public con sultation	Land to acquire	Amount for Acquisition	No. of families affected	Amount for Re-settlement	Business Structure affected	Tentative Expenses for shops	Agri-affected	Cultural Structure affected	Water bodies affected
Rangamati to Sbhalong Beganachari = 20 km	11	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Barkal to Sbhalong = 22 km	09	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Length Covered	No. of Public con sultation	Land to acquire	Amount for Acquisition	No. of families affected	Amount for Re-settlement	Business Structure affected	Tentative Expenses for shops	Agri-affected	Cultural Structure affected	Water bodies affected
Barkal to Chotohorina = 21km	16	N/A	N/A	N/A	N/A		N/A	N/A	N/A	N/A
Chotohorina to Thegamukh=7.987	The land part has been done along with the Road Alignment	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Total = 70.987 km	**36**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**

3.6 Land Acquisition and Re-settlement:

In Multimodal Alignment -1, 63Km are waterway that starts from Rangamati to Chotohorina, this part will not need any land acquisition and would not need any Re-settlement. Chotohorina to Thegamukh is about 8km is a land way and this part will be needed to acquire about 4 acres of land and some re-settlement may require. But, this land part has been counted with Road Alignment as this part: Chotohorina to Thegamukh is common to both Road and Multimodal Alignments. So we shall not repeat counting this land part along with the Multimodal Alignment -1 for land acquisition, re-settlement and other social aspects. ForLand Acquisition and Re-settlement directives of World Bank and Bangladesh has to be followed.

Dredging of Alignment:

During Public Consultation for feasibility assessment, on a question regarding the dredging of the Multimodal Alignment-1, the respondents told that this was their long awaited desire so that during the whole year boats can ply on the lake and that would help their travelling and business. They also told that none would be affected during dredging. They also told that there are lots of suitable spaces for dropping the soil of dredging.

CHAPTER-4
The Details of Stakeholders' Meeting

4.1 The details of Stakeholder Meeting on proposed alignment

4.1.1 Public consultation

Public consultationis a regulatory process by which the public's input on matters affecting them is sought. Its main goals are improving the efficiency, transparency and public involvement in large-scale projects or laws and policies. It usually involves consultation (a two-way flow of information and opinion exchange) as well as participation. It is a commonly used tool of social assessment for understanding different levels of community participation in consultation.

4.1.2 Methodology:

For feasibility study of Road Alignment-1 and Multimodal Alignment-1, a 5- member team was formed with one team leader and 4 field Investigators. The team was engaged to carry out the task of Public Consultation along the alignments. Four investigators were divided into two sub-groups for quickening and easy performance of work, and started field level Public Consultation and data collection from different areas of the Alignments. The responsibility of the Team Leader was monitoring and supervision of survey team works and data collection of the public consultation to keep the task on the right tract. The Public Consultation was done on the purposive selection basis along the selected 114.751 km long road alignment. The field team conducted 52 Public Consultations throughout the road alignment. The team adopted participatory assessment method for both the alignments. The investigators conducted the public consultation and FGDs where they covered the Upazila Officials, Upazila Chairmen, Headmen, Karbaries, etc., including the common people along the alignment. Number of consultations was different at different places of the alignments because of the density of the population and problems of movement at different places, mainly for forests and hills. For passing through the Road Alignment, the investigators sometimes had to hire boat, motorcycle and Guide to make out and figure out the Alignment and conduct PC where they found people in and around. Following the same method they also carried out the Multimodal selected route no.1, starting from Rangamati – Chotohorina along waterway and land up to Thegamukh. The investigators carried out 36 Public Consultations in and along that alignment. Public Consultations and KII were done initially for screening, later on for feasibility study.

A brief description covering all information of public consultation with the names of the facilitators, consultation dates and locations, address of the respondents with their comments in short have been stated below:

4.1.3 Public Consultations of Road Alignment-1:

SL	Date	Interview location	Name of the respondents	Profession/designation	Facilitator	Participants				Key issues discussed (Bullets)
						Tribal		Non-Tribal		
						Male	Female	Male	Female	
01	01-12-2015	Sadar Upazila, Rajosthali	Md. HannanKhandakar, Ahammad Hossain, Md. Ali Akbar Milon and Varatmoni Tripura	Contractor, LGED job, farmer.	Md. Shahadat, Hossain	**1**		**3**		01. They demand tk. 100000 for acquisition of 1.0 decimal land and for their rehabilitation they demanded tk. 100000. 02. For economic development of Ethnic Minority people the project should create tree garden because of Ethnic minority people. For creating a 60 decimal garden it needs tk. 50000. 03. All people will be benefited by the project
02	01-12-2015	UP Chairman Office, Rajosthali	UthinsinMarma, Rupomoy Tongchuna, Haradhan Karmakar,	UP chairman, Karbari Journalist,	Md. Shahadat, Hossain	**4**				01. Business opportunities for affected people will be created. The affected people demand tk. 100000 for starting a business. 02. By using modern machineries the project work should be done. 03. It is better to work by using latest machineries rather than using local worker.

03	01-12-2015	Ghilachori Union Parishd, Rajosthali	DipomoyTalukdar, Sekh Aahammad, Mongai Marma and UdoyTongchonga.	Local leader, Farmer, Business.	Md. Shahadat, Hossain	**3**		**1**		01. 1 tank may be damaged by Project work. 02. It is better to work by using latest machineries rather than using local worker. 03. People of every sector will support this project.
04	02-12-2015	Gilamukh, Rajosthali	Ratrimohon Tongchunga, Chobi Kumar, Joy mala and Jothsna tongchunga	Farmer and Business.	Md. Shahadat, Hossain	**2**	**2**			01. It will be better to use latest machineries rather than to use local labor. 02. Businessman will be more benefited by this project. 03. Ethnic Minorityman and women will work in this project.
05	02-12-2015	Gilamukh Rajosthali	Adi Chandra Tongchunga, Dharma Raj Tongchunga, RajjochenTongchunga	Farmer	Md. Shahadat, Hossain	**3**				01. Business opportunities for affected people will be created. The affected people demand tk. 100000 for starting a business. 02. For their economic development fruit garden may be made for them. 03. Ethnic Minoritypeople are largely affected by this project.

06	02-12-2015	Naraychori, Rajosthali	KishoreTongchunga Suponto Tongchonga RonchonaTongchonga	Farmer	Md. Shahadat, Hossain	**2**	**1**			01. The price of 1.5 decimal land in Gialmukh is tk. 6000 only. 02. Compensation will must be provided to the affected people. To make a 60 decimal garden needs tk. 50000 only. 03. Some Ethnic Minoritypeople will be affected by this project.
07	03-12-2015	Mitingachori, Rajosthali	Purnachandra Tripura, Baromoni Tripura, MonjuTongchunga, Purno Chandra	Karbari Business, Farmer Farmar	Md. Shahadat, Hossain	**4**				01. Hill land price is tk.8000 per 1.5 decimal and cultivable land price is tk.5000 per 1.5 decimal in Naraychori to Mitingachori. 02. Ethnic Minoritypeople will be more affected by this project. 03. People will be economically benefitted by this project.
08.	03-12-2015	Bolipara, Rajosthali	Khudiram, Purnoram Tripura, Shadhu Chandra Tripura, Mohon Tripura.	Farmer, Farmer UP Member Farmer		**4**				01. Hill land price is 6000 taka per 1.5 decimal and cultivable land price is 5000 taka per 1.5 decimal in Mitingachori to Bolipara. 02. For rehabilitation of every affected people need 50000 taka only. 03. Ethnic Minoritypeople will be economically benefited by this project.

09	03-12-2015	Amkatachora, Bilaichari	Ultafu, Sukramon Chakam, Sujjo Kumar Tonchunga, Ratan Karbari	Headman, Farmer Farmer Karbari	Md. Shahadat, Hossain	**4**				01. The land price is tk.5000 only from Bolipara to Amkathachora. 02. No home will be affected in this area by this project. 03. Poverty rate decreased in last 5 years in this project area.
10	03-12-2015	Jambil Para Bilaichari	Ranjoy Chakma, Ronjit Chakma, RanguTongchunga, Sommo Kumar Tongchunga	Farmer Farmer Farmer Farmer	Md. Shahadat, Hossain	**4**				01. The land price is tk. 5000 only from Amkathachora to Jambil. 02. 180 decimal land accusation for project in Amkathachora to Jambil will require. 03. Probably 85% people will cooperate in this project.
11	04-12-2015	AgujjaChori Para, Belaichari	Jibon BikasTangchunga SumullaTangchunga, Ratan Kumar tangchunga, Sumita Devi Tangchunga	UP Member, Headman Karbari UP Member	Md. Shahadat, Hossain	**3**	**1**			01. For development of affected people, job, business and farm must be created by the project. 02. Their living condition has been developed during last 5 years but not sufficient for education and health. 03. 22 shops, 2-3 fruit gardens will be affected by the project in this area.

12	04-12-2015	Farua Bazar, Bilaichari	PrioRanjonTanchunga, Shubrato Tongchunga, Su-mullaTangchunga, Diponkar Chanda	Headman UP Member Headman Karbari	Md. Shahadat, Hossain	**4**				01. The land price is tk.5000 only per 1.5 decimal land from Jambil to Agujachori 02. The Ethnic Minoritypeople do like gardening. The affected people demand tk. 5 lakh for starting a business, and tk. 5-6 lakh for making fruit garden. 03. 95% Ethnic Minoritypeople of this area will be affected by this project.
13	04-12-2015	Head man house, ToktanalaDokhin para. Belaichari	Ching Begaiu Marma, Din ChokraTongchunga, Udhar joy Tongchunga, Jubo Kumar Tongchonga	UP Member, Head man, Farmer Farmer	Md. Shahadat, Hossain	**4**				01. The land price is tk.7000 only per 1.5 decimal land from Agujachori to Toktanala. 02. 3-4.5 acre garden land will be affected by this project. 03. It will be better to use latest machineries rather than to use local labor.
14	05-12-2015	DownbridgePara Bilaichari	Roma kanto, Anil Karbari, Liloy Pankua, Sundar RanjanTongchunga	Headman Farmer UP Member Farmer	Md. Shahadat, Hossain	**4**				01. The land price is tk.5000 only per 1.5 decimal land from Toktanala to Daun Bridge. 02. It will be better to use latest machineries rather than to use local labor. 03. 7 gardens will be affected by this project in this area. The compensation for each garden is tk. 300000 only.

15	05-12-2015	UNO office, Bilaichari	ShuvoMongal Chakma, SujonChowdhuri, TejendrolalTongchong	Upazila Chairman, UNO Belaichari	Md. Shahadat, Hossain	**2**		**1**		01. Hill land price is tk. 10000-15000 per 1.5 decimal and Upazila land price is tk. 50000 per 1.5 decimal from Bilaychori to Daun Bridge. 02. Poverty rate has been decreased during last 5 years. 03. 3% Ethnic Minoritypeople will be affected by this project in this area.
16	05-12-2015	Upozila Bazar, Belaichari	Uttam Kumar Tongchunga, Tarun Kanti Tongchunga, Aungsupru Maram.	Ex-upazila vice-chairman Headman Karbari	Md. Shahadat, Hossain	**3**				01. 30 business shops will be affected in this area. 02. 2% Ethnic Minoritypeople may be affected by this project. 03. People of this area will be benefited by this project.
17	05-12-2015	Upozila Health Complex. Belaichari	Progga Joyti Chakma, Arjun Moni Chakma, Vhodrosen Chakma.	Gov. Jjob Service UP Member	Md. Shahadat, Hossain	**3**				01. 30 houses and 25 shops will be affected by this project. The potential victim people demanded tk. 50000 for each house and 1-2 lakh taka for each shop. 02. 25 businessmen of this area will be affected by this project. 03. 99% people of this area participated in this project.

18	06-12-2015	Dupachar, Bilaichari	Tui Pru Marma, Ratna Marma, Sui Chi Mong Marma, AungmaChingMarma.	Karbai Farmer Farmer Farmer	Shimul Chakma and HasanSelim	**4**				01. People will get transportation benefits. 02. 30 families of this area will lose their accommodation. 03. Chakma and Marma people of this area will mostly be affected by this project.
19	06-12-2015	Belaichori Post Office,Belaichari	Abdul Aziz, Kajol Barua, Md. Harun, Eton Chakma	Business, Farmer Business, Business,	Shimul Chakma and HasanSelim	**2**		**2**		01. The project will be benefited for businessman. 02. No man will be affected by the project in this area. 03. 30 trees of this area may be affected by this project.
20	06-12-2015	Rajdhon Chora Belaichori	NiharKanti Chakma, Sumoti Ronjon Chakma, Shukro Raj Chakma, Tri sankar Chakma	Business, farmer	Shimul Chakma and HasanSelim	**4**				01. Poverty rate has decreased during last 5 years. 02. The farmer will get the proper price for their goods. 03. 25 Ethnic Minorityfamilies of this area will be affected by this project.
21	07-12-2015	Bangal para Belaichari	Geda Chakma, Dhonmoni Chakma, Chimbodhon Chakma, Champa Chakma	Farmer, Business Business, Business,	Shimul Chakma and HasanSelim	**3**	**1**			01. People's educational condition will improve. 02. The income of general people will increase. 03. It will be better to use latest machineries rather than to use local labor.

22	07-12-2015	Bangalkata, Belaichari	Satta Kumar Talukdar, Probhat Chandra chakma, Milon Santi Chakma, Sudulal Tanchunga.	Farmer Farmer Farmer Karbari	Shimul Chakma and HasanSelim	**4**				01. Transportation system, educational system and health condition will be developed by this project. 02. Poverty rate has decreased in last 5 years. 03. 5 gardens may be affected by the project in this area.
23	07-12-2015	Fokir Chora, Jurachori	Ratan Jit Chakma, Doyal Kanti Chakma, Biganda Chakma, Supayan Chakma.	Farmer Farmer Farmer Farmer	Shimul Chakma and HasanSelim	**4**				01. Development will take place in education and health sectors. 02. Ethnic Minoritypeople of this area will be affected. 03. All people in this area will support the project work.
24	08-12-2015	FokiraChora Bazar, Jurachori	Somrat Chakma, Sunil Bihari Chakma, DoyaMohon Chakma, Kalu Nanda Chakma.	Headman, Farmer Farmer Farmer	Shimul Chakma HasanSelin	**4**				01. People will get proper prize for their goods. 02. To reduce the loss of affected people different types of technical measures may be taken up. 03. Economic development of local people will be made by this project.

25	08-12-2015	FokiraChora Bazar, Jurachori	Dhononjoy Chakma, Jugol Chandra Chakma, Meya Ram Chakma, DayaDhon Chakma.	Farmer Farmer Farmer Farmer	Shimul Chakma HasanSelin	**4**				01. For the development of transport system the income level of the people will be increased. 02. Nobody will be affected by this project. 03. It will be better to use latest machineries rather than to use local labor.
26	08-12-2015	FokiraChora Bazar, Jurachori	SadhonaNanda Chakma, TridibKarbari, Dhononjoy Chakma, Pores Chakma.	Head man, Farmer Farmer Farmer	Shimul Chakma HasanSelin	**3**	**1**			01. Economic and educational condition of the project area people will improve due to this project. 02. Nobody of this area will be affected by this project. 03. 5 garden of this area will be affected by this project.
27	09-12-2015	FokiraChora Bazar, Jurachori	Kinadhon Chakma, Rupendu Chakam, BijoyJit Chakma, Ananda Chakma.	Farmer Farmer Farmer Farmer	Shimul Chakma HasanSelin	**4**				01. The income level of the project area people will improve due to this project. 02. 10 families' income may decrease due to this project in this area. 03. It will be better to use latest machineries rather than to use local labor.

28	09-12-2015	Hajachori Para, Jurachori	Chichimoni Chakma, AggolalChakma, Chirojib Chakma, Amar Bikas Chakma.	Farmer Farmer Farmer Farmer	Shimul Chakma HasanSelin	**3**	**1**			01. Poverty rate of this area has been decreased in the last 5 years. 02. Technical steps may reduce the loss. 03. Ethnic Minoritymale and female will work for this project.
29	09-12-2015	Shilchori Bazar, Jurachori	Dhononjoy Chakma, CharuBikas Chakma, Nakko Chakma, Amrito Chakma.	Farmer Farmer Farmer Farmer	Shimul Chakma HasanSelin	**3**	**1**			01. Income level of local people will increase due to this project. 02. They will get all transport benefits. 03. To solve all problems which will be created by the project may be solved by taking up some measures: Income generating activities and expansion of working opportunities.
30	10-12-2015	Shilchori, Jurachori	Chigon Morot karbari Bijoy Chandra Chakma Bijumoni Chakma Chigon Chan Chakma	Karbari Farmer, Business Farmer	Shimul Chakma HasanSelin	**4**				01. Poverty rate will decrease. 02. For the development of transport system the income level of the people will increase. 03. Ethnic Minoritypeople may be affected by this project.

31	10-12-2015	Gilatoli, Jurachori	Santos Dewan, Kaladhon Chakma, Monoskor Dewan, Protap Dewan	Headman Farmer Farmer Farmer	Shimul Chakma HasanSelin	**4**				01. Transportation system, educational system and health condition will be devolved by this project. 02. Poverty rate decreased in last 5 years. 03. It will be better to use latest machineries rather than to use local labor.
32	10-12-2015	Samira Para, Jurachari	Nibaron Chakma, Sadhon Kumar Chakma, Jibon Chakma, RidoyChakam	UP Member Farmer Farmer Farmer	Shimul Chakma HasanSelin	**4**				01. The project will be benefited for businessman. 02. No man will be affected by the project in this area. 03. Economic condition of general people will be improved by this project.
33	10-12-2015	Durachori UP office, Jurachari	Menon Chakma, Mollika Chakma, Anil Raman Chakma, LokhindraChkma	UP Chairman\	Shimul Chakma HasanSelin	**3**	**1**			01. Transportation system, education system and health condition will improve due to this project. 02. Poverty rate decreased in last 5 years. 03. 3-4 gardens may be affected by the project in this area.

34	10-12-2015	Dhamai Para Bihar, Jurachari	Binod Kumar karbari, Birongalal Chakma, KaminiRanjon Chakma, LokhiMoni Chakma	Karbari Farmer UP Member UP Member	Shimul Chakma HasanSelin	**2**	**2**			01. The income level of the project area people will increase due to this project. 02. 10 families' income may decrease for this project. 03. It will be better to use latest machineries rather than to use local labor.
35	11-12-2015	BamePanchori, Jurachai	Dhonmohon Chakma, Mui Chakma, Ronika Chakma, Monira Chakma	Farmer Farmer Farmer Farmer	Shimul Chakma HasanSelin	**2**	**2**			01. People's educational condition will develop. 02. The income of general people will increase. 03. It will be better to use latest machineries rather than to use local labor.
36	11-12-2015	Choto Pan Chori, Jurachori	Gunodhon Chakma, Nibaron Chakma, Santimoy Chakma, Aoshini Kumar Chakma	Farmer	Shimul Chakma HasanSelin	**3**	**1**			01. For development of affected people, job opportunities, business opportunities and farms must be created by the project. 02. Their living condition improved during the last 5 years but not sufficiently developed in the education and health sectors. 03. 5 Shegun gardens will be affected by the project in this area.

37	11-12-2015	Barkal Bazar, Barkal	Bhubanesher Chakma, Dhonratan Chakma, Sujon Chakma, Monobhadro Chakma	Business, Farmer Farmer Farmer	Shimul Chakma HasanSelin	**4**				01. Economic condition of general people will be improved by this project. 02. For the development of transport system the income level of the people will increase. 03. No man will be affected by the project in this area.
38	11-12-2015	Barkal Bazar, Barkal	Chandilal Chakma, BinoyKrisno Chakma, Anurudro Chakma, Priomoy Chakma	Farmer, Business Farmer Farmer	Shimul Chakma HasanSelin	**4**				01. People will get transportation benefits. 02. 30 families of this area will lose their home in this area. 03. Chakma and Marma people of this area will mostly be affected by this project.
39	11-12-2015	Bhushanchara, Barkal	Monni Bikas Chakma, Laxmijan Chakma, PaddaShova Chakma, Tarabanu Chakma.	Farmer Farmer Farmer Farmer	Shimul Chakma HasanSelin	**1**	**3**			01. All people will be economically benefited. 02. Poverty rate decreased in the last 5 years. 03. It will be better to use latest machineries rather than to use local labor.

40	12-12-2015	Bhushanchara, Barkal	Guanlal Chakma, Surjoy Chakma, Jibito Chakma, Shawpan Chakma	Farmer Farmer Farmer Farmer	Shimul Chakma HasanSelin	**4**				01. Development will take place in education and health sectors. 02. Ethnic Minoritypeople of this area will be affected. 03. All people in this area will help in the project work.
41	12-12-2015	ShukripataChora Bhushanchara, Barkal,	Ratan Chakma, Behola Chakma, Sunika Chakma, Sumit Chakma	Farmer	Shimul Chakma HasanSelin	**3**	**1**			01. Socioeconomic development will be seen in this area. 02. People of this area will get all transportation benefits. 03. 3 Garden of this area may be affected by this project.
42	12-12-2015	Kolabunia Bazar Barkal	Sunder Kanto Chakma, Binoy Chakma, Alabi Chakma, Kalindi Rani Chakma.	Farmer Farmer Farmer Farmer	Shimul Chakma HasanSelin	**3**	**1**			01. Economic and educational condition of the project area people will be improved by this project. 02. Nobody of this area will be affected by this project. 03. 4 garden of this area will be affected by this project.
43	12-12-2015	Kolabunia Bazar Barkal	Md. Abu Saleh, Md. Fayzur Gazi, Md. Nazim Uddin, Md. Ali Hossain	UP Member Business, Business Business,	Shimul Chakma HasanSelin			**4**		01. People's educational condition will develop. 02. The income of general people will increase. 03.It will be better to use latest machineries rather than to use local labor.

44	12-12-2015	Kolabunia Bazar	Md. Nurul Haque, Md. Alam Jamader, Md. Robiul Islam, Md. Jurmat Morol	Ex-up chairman Business, Farmer Ex-upmember	Shimul Chakma HasanSelin			**4**		01. The income level of general people will increase due to this project. 02. Bangalee people of this area will be more affected by this project. 03. It will be better to use latest machineries rather than to use local labor.
45	13-12-2015	Erabunia Bazar, Barkal	Md. Emdadul Haque, Md. Edris Ali, Md. Ahat Sheik, Md. Monir Hossain	Business, Farmer Business, Business,	Shimul Chakma HasanSelin			**4**		01. The project will be beneficial to the businessman. 02. Bengali people of this area will be more affected due to this project. 03. The income of general people will increase.
46	13-12-2015	Bhushanchora Bazar, Barkal	Abdu Mojid, Md. Abu Salek, Md. Rafikul Islam, Md. Ajmol Hossain	Ex up member, Business Business Business	Shimul Chakma HasanSelin			**4**		01. Bengali people of this area will be more affected by this project. 02. The income level of the project area people will increase. 03. Transportation system, education system and health condition will improve due to this project.

47	13-12-2015	Bhushanchora , Barkal	Md. Badruzzaman Md. Mostofa Kamal, Md. Abdul Karim, KAbir leader	Business Business Business Member	Shimul Chakma HasanSelin			**4**		01. Poverty rate will decrease. 02. For the development of transport system the income level of the people will increase. 03. 100% Bengali people will be affected due to this project
48	14-12-2015	Dhonu Bagpara Barkal	Santi Kumar Chakma, Kesoerilal Chakma, Mrigosita Chakma, JotonMoni Chakma.	Farmer Farmer Farmer Farmer	Shimul Chakma HasanSelin	**3**	**1**			01. Development will take place in education and health sectors. 02. Ethnic Minoritypeople of this area will be affected. 03. It will be better to use latest machineries rather than to use local labor.
49	14-12-2015	Naggel Adam, Bhushanchora , Barkal	Deuti Ranjon Chakma, PunnoDhon Chakma, Chidong Chkma, Birching Chakma.	Farmer Farmer Farmer Farmer	Shimul Chakma HasanSelin	**4**				01. Transportation system, education system and health condition will improve due to this project. 02. The farmer will get proper price for their goods. 03. 100% Ethnic Minoritypeople will be affected by this project.

50	14-12-2015	Bhushanchora , Barkal	Shuprio Chakma, Anil Chakma, Badi Chakam, Dalim Chakma	Farmer Farmer Farmer Farmer	Shimul Chakma HasanSelin	**4**				01. Income level of local people will increase due to this project. 02. They will get all transport benefits. 03. Income generating activities and work opportunity will increase
51	14-12-2015	Tega Bazar Bhushanchora , Barkal	RatanBikas Chakma, KolpoRanjon Chakma, Suniti Chakma, Kala Tukendu Chakma	Farmer	Shimul Chakma HasanSelin	**4**				01. People will get proper price of their products. 02. To reduce the loss of affected people different types of technical measures may be take up. 03. Economic development of local people will take place due to this project.
52	14-12-2015	Bhushanchora, , Barkal	Md. Masum Hasan Md. Lalchand Hossain Md. Delwar Hossain Md. Hanif	Business Business Business Business						

4.1.4 Public Consultations of Multimodal alignment-1

Number of Public Consultation Respondents
Chittagong Port to Thegamukh Project

Public Consultations of Multimodal Alignment-1

SL	Date	Interview location	Name of the respondents	Profession/designation	Facilitator	Participants				Key issues discussed (Bullets)
						Tribal		Non-Tribal		
						Male	Female	Male	Female	
01	01-12-2015	Riserv Bazar Lonch Ghat, Rangamati	Md. Kamrul Islam, Ashraful Islam, Md. Jewel Rana, Md. Nurul Islam	Student, Business	Md. Shahadat Hossain			**4**		01. All people will be benefited by this project. 02. Income source will increase due to this project. 03. Ethnic Minoritypeople will not be affected by this project.
02	01-12-2015	Rangamati Fishsarighat, Rangamati	Md. Azizul Haque, Md. Ajgor Ali, Abdul Roshid	Business, Road man	Md. Shahadat Hossain			**3**		01. Personal land will not be affected by this project. 02. Bengali and Ethnic Minorityboth people will be affected by this project. 03. Dredged soil may be kept outside the town.
03	01-12-2015	Fishari Ghat, Rangamati	Md. Jafar Iqbal, Md. Jasim Uddin, Md. Azad, Md. MasudurRasid	Fish Trader Business Business Business	Md. Shahadat Hossain			**4**		01. Poverty rate will decrease. 02. For the development of transport system income of the people will increase. 03. 100% Bengali people will be affected by this project
04	02-12-2015	Shuvolong, Barkal Upazila	BadsaFoysal, Bimol Chakma, Harun, Md.	Business, Business Business	Md. Shahadat Hossain	**2**		**2**		01. Economic condition of general people will improve due to this project.

			MonirMollik.	Labor						02. For the development of transport system income level of the people will increase. 03. No man will be affected by the project in this area.
05	02-12-2015	Headman House College Para,, Barkal	Rabindralal Chakma, Dijendralal Chakma, Elora Chakma, Porno Kumar Chakma.	Headman, Farmer housewife, Farmer	Md. Shahadat Hossain	**3**	**1**			01. Robbery, theft may increase in this area. 02. All people in this area may be affected by this project. 03. Dredge soil may be kept beneath the mountain.
06	02-12-2015	ChilarDhakDokan Ghat, Barkal	Jogonath Chakma, Chitto Ronjon Chakma, BimolKranti Chakma, Lokhi Debi Chakma.	Fisherman, Farmer, business Farmer	Md. Shahadat Hossain	**3**	**1**			01. Fisherman, Farmers may be affected by this project. 02. 95% people of this area will participate in this project. 03. The proposed project does not have any long term negative effect on local community.
07	03-12-2015	Kiching Para, Rangamati	Bishawnath Chakma, Karbari Chakma, Aroti Chakma, ChondraMoni Chakma.	Karbari Farmer Housewife,	Md. Shahadat Hossain	**3**	**1**			01. There will be no negative effect on local community. 02. All people will be benefited by this project. 03. Poverty rate decreased in the last 5 years
08	03-12-2015	Bagachola river, Barkal	Prodip Kumar Chakma, Edris Mia, Mohibi Marma, SujonTalukdar	Farmer, Business Farmer, Farmer,	Md. Shahadat Hossain	**2**		**2**		01. All people will be benefited by this project. 02. Income source will increase. 03. Ethnic Minoritypeople will not be affected by this project.
09	03-12-2015	Bagachola river, Barkal	SamBikasTalukdar, TonotnaBiakas Chakma, Jinkumi Chakma, BodiPrio Chakma	Fisherman Fisherman Fisherman Fisherman	Md. Shahadat Hossain	**4**				01. Development will take place in education and health sectors. 02. Ethnic Minoritypeople of this area will be affected. 03. All people in this area will

										support the project work.
10	04-12-2015	Beganachori School, Barkal	Biju Chakma, Himel Dewan , Siku Chakma, Kripon Chakma	Farmer Farmer Farmer Farmer	Md. Shahadat Hossain	**4**				01. The project will be useful for businessman. 02. No man will be affected by the project in this area. 03. Economic condition of general people will improve due to this project.
11	04-12-2015	Beganachori School, Barkal	Ridoy Ronjon Chakma, Shusonka Chakma, Rupayn Chakma, Dukkokinkor Chakma	Farmer Farmer Farmer Farmer	Md. Shahadat Hossain	**4**				01. Personal land will not be affected by this project. 02. Bengali and Ethnic Minorityboth people will be affected by this project. 03. Dredge soil may be kept outside of the town.
12	05-12-2015	Bhushanchara Barkal	TapanBikas Chakma, Lendu Chakma, Sujit Krisa	Local leader, business, Service	Md. Shahadat Hossain	**3**				01. Bengali people of this area will be more affected by this project. 02. The income level of the project area people will increase. 03. Transportation system, education system and health condition will improve.
13	05-12-2015	BRDB office, Barkal	Md. MohiuddinSharif, Prodip Chandra Chakma, Md. Imran Ali, Pakhir Dewan	BRDB Officer, Service Service Service	Md. Shahadat Hossain	**1**		**3**		01. The project will be useful to the businessman. 02. Bengali people of this area will be more affected by this project. 03. The income of general people will increase.
14	05-12-2015	Borokal UP office, Barkal	Provat Kumar Chakma, Shusil Jibon Chakma, Putul Chakma	UP Chairman,, Headman, Karbari	Md. Shahadat Hossain	**2**	**1**			01. Robbery, theft may increase in this area. 02. All people in this area may be affected. 03. Dredge soil may be kept beneath the hill.

15	06-12-2015	Bhushanchara,Barkal	Lolini Kumar Chakma, RatnaRani, Sur lal Chakma	Karbari Ex-member Farmer	Md. Shahadat Hossain	**2**	**1**			01. Fisherman, Boat Owner may be affected by this project. 02. 1500 boatmen and 1000 fishermen may be affected by this project of this area. 03. 95% people of this area will support the project work.
16	06-12-2015	Nolbunia School, Barkal	Nilmohon Chakma, Suniti Bikash Chakma, Binanda Chakma, Doyamoy Chakma.	Business, Farmer Farmer Farmer	Md. Shahadat Hossain	**4**				01. Personal land will not be affected by this project. 02. Bengali and Ethnic Minorityboth people will be affected by this project. 03. Dredged soil may be kept outside of the town.
17	06-12-2015	Natun Bazar Barkal	Bindumoy Chakma, Joshi Kusum, Nomita Chakma, Sumitra Chakma	School Teacher, Farmer, Housewife, Business	Md. Shahadat Hossain	**4**				01. Many people will lose their farming land. 02. 100-150 business men may be affected by this project. 03. 80% Ethnic Minoritypeople may be affected by this project.
18	07-12-2015	Shuvolong' Barkal	Torun Joti Chakma, Dr.SujonShil, BidurBorua	UP Chairman,Shuvalong, Physician, Bbusiness	Md. Shahadat Hossain	**2**		**1**		01. Fishermen, Farmers may be affected by this project. 02. 98% people of this area will participate in this project. 03. The proposed project will not have any long term negative effect on local community.
19	07-12-2015	Shuvolong Bazar, Barkal	Santimoy Chakma, Md. Abul Hossain, Suchitra Chakma	Business, Fishbusiness Businessr	Md. Shahadat Hossain	**2**	**1**			01. Economic condition of general people will improve by this project. 02. For the development of transport system the income level of the people will increase. 03. No man will be affected by the project in this area.

20	08-12-2015	Suvolong , Barkal	Md. Didar Alam, Md. Atar Ali, Md .Moslem Ali, Md. Mojammel Haque	Business Business Business Business	Md. Shahadat Hossain			**4**		01. The project will be beneficial to the businessmen. 02. Bengali people of this area will be more affected by this project. 03. The income of general people will increase.
21	08-12-2015	Barkal Bazar Barkal	Bhubonesher Chakma, Dhono Ronjon Chakma, Sumon Chakma, Mono Bhodra Chakma.	Business, Farmer Farmer Farmer	Md. Shahadat Hossain	**4**				01. Income of general people will increase but boatmen and fishermen may be affected by this project. 02. Boatmen and Ethnic Minoritypeople will be more affected by this project. 03. Dredged soil may be kept outside of the town.
22	08-12-2015	Borokal Bazar (BDR camp) Barkal	Protimoy Chakma, Chandrilal Chakma, Anurudro Chakma, Priomoy Chakma	Teacher Farmer Farmer Farme	Md. Shahadat Hossain	**4**				01. Robbery, theft may increase in this area. 02. All people in this area may be affected by this project. 03. Dredged soil may be kept beneath the hill.
23	09-12-2015	Bhudchora Barkal	Monirika Chakma, Lokhi Jan Chakma, PaddoShova Chakma, Tara Banu Chakma.	Student, Farmer Farmer Housewife	Md. Shahadat Hossain		**4**			01. Bengali people of this area will be more affected by this project. 02. The income level of the project area people will increase. 03. Transportation system, education system and health condition will develop due to this project.
24	09-12-2015	Loti BaschoraMondir, Barkal	SurojoyChakma, Anit Chakma, GanolalChakma, JibitChakma	Farmer Farmer Farmer Farmer	Md. Shahadat Hossain	**4**				01. Poverty rate will decrease. 02. For the development of transport system the income level of the people will increase. 03. 100% Bengali people will be

										affected by this project
25	10-12-2015	Borotoli Para	Sunil Kanti Chakma, LokhidebiChakma, Kinki Chakma	Farmer, Farmer, Housewife	Md. Shahadat Hossain	**1**	**2**			01. People's educational condition will develop. 02. The income of general people will increase. 03. It will be better to use latest machineries rather than to use local labor.
26	10-12-2015	Aimachora, Barkal	Md. Riaz Uddin, Md. Nojrul Islam, Krisno Joy Chakma	UP Member Boat man, Business. Farmer	Md. Shahadat Hossain	**1**		**2**		01. For the development of transport system the income level of the people will increase. 02. Nobody will be affected by this project. 03. It will be better to use latest machineries rather than to use local labor.
27	11-12-2015	Boraigipara River wharf	Md. Mostofa, Hori NarayonDhor, Shymol Chandra Das, Md. Kobirhossain	Farmer Business, Farmer	Md. Shahadat Hossain			**4**		01. Fisherman, Boat Owner may be affected by this project. 02. 100% Bengali people will be affected by this project. 03. Income of general people will be increase but boatmen and fishermen may be affected by this project.
28	11-12-2015	Kalabunia Bazar, Barkal	Md. Nurul Haque, Md. Abu sale, Md. Golam Rosul, Md. Robiul Islam	Ex-up chairman, UP-Member Business. Farmer	Md. Shahadat Hossain			**4**		01. Development will take place in education and health sectors. 02. Ethnic Minoritypeople of this area will be affected. 03. All people in this area will help in project work.
29	12-12-2015	Kalabunia Bazar, Barkal	Md. Moniruzaman, Md, Jahangir Alam, Md. Sohidul Islam, Md. Josim	Farmer, Business Business Business	Md. Shahadat Hossain			**4**		01. Bengali people will be more affected by this project rather than Ethnic Minoritypeople of this area.

			Uddin							02. Economic condition of general people will improve by this project. 03. For the development of transport system the income level of the people will increase.
30	12-12-2015	Kalabunia Bazar, Barkal	Md. Hamid ali, PolasChakma, NilumoniChakma, Md. Sogir	Fisherman, Farmer Business	Md. Shahadat Hossain	**1**		**3**		01. The project will be beneficial to businessman. 02. Bengali people of this area will be more affected by this project. 03. The income of general people will increase.
31	13-12-2015	Gurusthan Barkal	Mos. Nurunnahar, Md. Delowar Hossain, Md. Lal Chad Hossain, Md.MamunHasan	Housewife, Farmer Farmer Farmer	Md. Shahadat Hossain			**3**	**1**	01. Economic and educational condition of the project area people will improve by this project. 02. Nobody of this area will be affected by this project. 03. It will be better to use latest machineries rather than to use local labor.
32	13-12-2015	Erabunia bazaar Barkal	Md. Abdul Motaleb, Abdul AwalSikdar, Md,.Sohidul Islam, Md. Hasan	UP Member, Business, Farmer Business	Md. Shahadat Hossain			**4**		01. Economic condition of general people will be improved by this project. 02. For the development of transport system the income level of the people will increase. 03. No man will be affected by the project in this area.
33	13-12-2015	Bhusonchora Barkal	Abdul Aziz, Md. Rofikul Islam, Md. Ajmol Hossain, Md. Abu Salhe Islam	UP Member Business Business Business	Md. Shahadat Hossain			**4**		01. Robbery, theft may increase in this area. 02. All people in this area may be affected by this project. 03. Dredged soil may be kept beneath the bill.

34	14-12-2015	ChotoHorina Barkal	Md. SofiulAlam, PritiChakma, Md. SofiulAlam, MitulChakma	Business, Business Business\ Business	Md. Shahadat Hossain		**2**	**2**		01. The project will be useful to businessman. 02. Bengali people of this area will be more affected by this project. 03. The income of general people will increase.
35	14-12-2015	ChotoHorina Bazar, Barkal	Md. Mustofa Mohiuddin, Md. Nasir, \ Md. Anwar Hossain	Business, Business Business Business	Md. ShahadatHossain	**1**		**3**		01. There will be no negative effect on local community by this project. 02. All people will be benefited by this project. 03. Poverty rate decreased in the last 5 years
36	14-12-2015	ChotoHorina Bazar, Barkal	Md. Korban Uddin, Ibrahim Khan, Hazi Md. Alamgir, SolemanSowdagor	Bazar Committee Member, Chotohorina Business Business	Md. Shahadat Hossain			**4**		01. The project will be useful to businessman. 02. Bengali people of this area will be more affected by this project. 03. The income of general people will increase.

List of Key Infromants Interviewed

01.	Mr. Runel Chakma	Director	Small Ethnic Groups Cultural Institute	01556704045
02.	Mr. Kamal Hossain	TNO	TNO, Sadar	0155176176
03.	Mr. Shamsul Azam	CFO	Forest Department	01761494656
04.	Mr. Yahia Mahmud	Scientific Officer	Bangladesh Fisheries Research Institute, Rangamati.	
05.	Mr. AKM Saiful Islam	Scientific Officer	Bangladesh Fisheries Research Institute, Rangamati	
06.	Mr. Atish Kumar Barua	Director	CHT Development Authority	01712-768192
07.	Mr. Adnan Aktarul Alam	XEN, LGED	LGED, Rnagamati	01818-216629
08.	Md. Liakat Ali	UNO	Juraichori Upazila, Rangamati	01717-123978
09	Mr. Lal Pankua	Executive Director	Green Hill	01730-086303

Relevant Photographs of Public Consultationare given bellow:

Venue: Barkal, District: Rangamati

Program: Public Consultation, Date 29-11-2015

Venue : Bilaichari, District: Rangamati

Program: Public Consultation, Date: 01-12-2015

Venue : Rangamati, District: Rangamati

Program: Public Consultation, Date: 04-12-2015

Venue:Department of Forest,CFO office,Rangamati

Program: Public Consultation, Date: 27-12-2015

Location: Chief Analyst, BFRI, Rangamati

Program: Public Consultation, Date: 27-12-2015

Location: CHTDB, Rangamati

Program: Public Consultation, Date: 27-12-2015

4.2 Stakeholders Consultation Meeting held at Rangamati

4.2.1 Stakeholders' Mapping

	Stakeholder	Involvement
A	**Government Departments:**	
1.	Local government Engineering Department (LGED)	LGED is responsible provide technical support to the rural and the urban local government institutions (LGIs), planning and implementation of infrastructure development projects in the rural and urban areas like road, markets, river jetties, etc. to improve communication and transport network.
2.	Bangladesh Inland Water Transport Authority (BIWTA)	**BIWTA** is the authority who controls the inland water transport in Bangladesh. It is also responsible for managing development and maintenance of inland water transport system.

3.	Bangladesh Land Port Authority (BLPA)	The Bangladesh Land Port Authority (BLPA) is to facilitate export-import of the country through land routes. It is responsible for infrastructure development, efficient cargo handling, improvement of storage facilities, fostering public-private partnership for effective and better service delivery.
4.	Department of Forest (FD)	The Forest Department (FD) is responsible for taking care of the total forest land of about 1.48 million hectares (ha) that covers both natural and plantation forests. About 0.72 million ha of land are designated as unclassified state forests under the control of the Ministry of Land. Actual forest cover is approximately only 6% of the total land area.The forest, concentrated in CHT, covers about 0.72 m ha of land, which is about 29% of the total forest land of Bangladesh.
5.	Department of Fisheries (DoF)	The Department of Fisheries is responsible for the formulation and implementation of policies that promote best practice in the case of conservation and utilization of fishery resources. The department drives this through coordination, consultation and in partnership with resource owners, communities, private sector, government agencies, Non-Governmental Organizations, Regional and International Agencies.
6.	Road and Highways (RHD)	RHD is responsible for communication and maintenance of the major road and bridge network of Bangladesh. It has to provide a safe, cost effective and well maintained road network. Currently the department has to maintain a network of 21,302.08 Km.
7.	Police, BGB, and Army	The police force is responsible to enforce laws, control crimes and protect property in the country. The Border Guard Bangladesh (BGB) is the paramilitary force in the country which is responsible for ensuring boarder security of the country. The Bangladesh Armyis responsible for national security and defense of the nation's territorial integrity against external attack. In addition to that the Army is also constitutionally obligated to assist the civilian government during times of national emergency.
8.	Administrative Department (DC, ADCs, AC Land, TNO)	Execute all administrative aspects in their Jurisdiction including land record management, transfer of land, land revenue collection, acquisition and requisition of land, etc. Also look after law and order in their administrative area on behalf of the central government.
B.	**Local Government Authority**	
1.	Local Government Authority (Zila Parishad, Upazila Parishad)	Local government is of three tiers: (i) Zila Paishad; (ii) Upazila Parishad; (iii) Union Parishad. Local Governments are responsible for a wide range of services for their local communities which include waste disposal, road development and maintenance, water supply and sanitation, recreation and parklands, etc.
C.	**Other Bodies**	
1.	NGOs (Green Hill, Tagya, CIPD, SAS, Shining Hill, CCDR, Haimanti, etc	Most of the NGOs provide services for the have-nots group where they work for socio-economic development of the poor and marginalized groups. Mostly NGOs supplement and compliment the government development programs. Many of them are also involved in micro-credit services with a reasonable service-charge.
2.	Local press	Used to collect information and news which they arrange to publish

		through different print and electronic media.
3.	Launch, Bus, Cargo, Truck owners associations	Launch, Bus, Cargo, and Truck Owners Association are the important actors for land and water transport of the country. They are main road and water way network users of the country.
4.	Launch, Bus, Cargo, and Truck operators	Launch, Bus, Cargo, and Truck Operators are also important actors in the transport operation system. They are mainly the operators and the loading –unloading labour of those transports.
5.	Headman, Karbari	Headman is the chief of a mouza in the CHT area. Apart from her/his role as revenue collector within the Mouza ,he/she also plays vital roles in matters related to customary laws, resolving local level disputes and maintaining of law and order inside the Mouza. Karbari operates at the bottom level of the tier who is the head of a village/community. S/he assists the Headman in all relevant matters. S/he also arbitrates (along with other village leaders) disputes among the communities.
6.	Local Business organization	Local businesspersons are also involved in business where they undertake commercial or industrial activities for the purpose of generating cash flow and sales.
7.	Regional, District, Local Councils, institutions	These are the organizations and institutions which look after the welfare of the local people, local environment and advocate for the welfare of CHT area. They also plan and implement some development programs in the area.
8.	School, College teachers	They are also road and water way users. Also aware of communication problems of the area.
9.	Bangladesh Legal Aid and Services Trust (BLAST)	BLAST works on making the legal services accessible to the poor and the marginalized groups. It works for ensuring the rule of law where every individual, including the poor, marginalized and excluded, in particular women, children, peoples with disabilities, adivasis, and dalits, have access to justice and in which their human rights are respected and protected.
10.	Religious Leaders	Looks after the interest of the religious institutions during the implementation of the project and also see that no religious properties are damaged by any development work and can assist to think alternatives of that.

4.2.2 Preparation and Mobilization:

The Stakeholders Consultation Meeting was organized at Rangamati which was held on 16/05/2016 at Ashika Conference Room, New Market. For the conference all the pre-listed stakeholders were invited with a formal letter containing date and place of workshop and a short note on feasibility study covering social and environmental findings. This was a pre-informed workshop organized as per requirement of the project. Two persons from the consultants' team worked for one week to organize the workshop where they not only distributed the invitation but also physically visited to the stakeholders as maximum as possible to make them understand about the importance of the consultation meeting.

4.2.3 Methodology:

The invitees of the consultation meeting were of different level of stakeholders and professional group, who were very much concerned with communication and connectivity of the CHT districts and can provide feedbacks on the feasibility findings on the selected alignments. The selection of participants was done on a purposive basis. The selected invitees were from NGOs, Local Journalists, GoB officials, representatives from businessmen, UP Chairman, Members, Upazila

Chairman, Vice-chairman, Headmen and Karbaries including women. All necessary equipments for recording the presentations and feedbacks were ready from the organizers' side.

4.2.4 List of Stakeholders Invited in the Meeting

Sl.No.	Stakeholders	No of Participants
1	**NGO Representatives (Male & Female)**	
	UNDP	1
	SAS	1
	tangya	1
	Green Hill	1
	CIPD	1
	CCDR	1
	Himawanti	1
	Maleya Foundation	1
	PAHRA	1
	Shining Hill	1
2	Launch owners association (Male)	1
3	Truck owners association (Male)	3
4	Bus owners association (Male)	2
5	Fishers Association (Male)	2
6	Transport Operator Association	2
7	Journalists (Male & Female)	4
8	Forest Department	1
9	Roads & Highway Department (R&HD)	1
10	Department of Fisheries(DoF)	1
11	Local Government Engineering Department, LGED	9
12	Rangamati Hill District Council	1
13	CHT Regional Council	1
14	Chittagong Hill Tract Development Board (CHTDB)	1
15	Rangamati Culture Center	1
16	Rangamati Chamber of Commerce & Industries	1
17	Upazila Chairmen	4
18	UNO	4
19	Chakma Royal Kingdom	2
20	Rangamati Bar Council	1
21	Bangladesh Legal Aid and Services Trust (BLAST)	1
22	Headmen (Male & Female)	10
23	Karbari (Male & Female)	7
24	College Principal (Male & Female)	3
25	Headmaster / Headmistress	2
26	College and School Teachers (Male & Female)	3
27	Local Businessman	5
28	Hill Women Federation	1
29	UP Chairman	5
30	UP Members	4

Sl.No.	Stakeholders	No of Participants
31	Religious persons	2
32	CHTRDP II Representative	1
33	DC OFFICE, Rangamati	
	ADC General	1
	ADC Revenue	1
	ADM	1
34	Additional SP	1
35	Prakriti Ranjan Chakma X-Deputy Secretary	1
36	Saktipada Tripura Prsident ,CHT Headmen Network	1
37	Professor Mongshanu Chhowdhury	1
38	Santi Bijay Dewan General Secretary, CHT Headmen Network	1
39	Thowaiwary Marma Headmen	1
40	Goutam Dewan President,CHT Movement for the Conservation of Land and Forests	1
	Total	**106**
**	**Consultant Team**	**6**
	Grand Total	**112**

Out of estimated 112 invitees 67 attended the consultation meeting. The list of the participants with their designations, address, and telephone numbers were recorded properly and attached as annexure.

4.2.5 List of Stakeholders Attended the Meeting

Sl. No.	Name of stakeholder	Designation	Address	Mobile No.
1	Momin Mojibul Haq Shamaji	Project Director	LGED Head Office	01711-976061
2	Adnan Aktarul Alam	Executive Engineer	LGED Rangamati	01818-216629
3	Kirti Nishan Chakma	Consultant World Bank	Dhaka	01755578273
4	Dr. Mostofa M. Kamal	Environment Specialist	BETS, Dhaka	01819143666
5	Abdul Quayum Khandakar	Sociologist	BETS, Dhaka	01916158148
6	Tuku Talukder	Executive Director, Himawanti	Champak Nagar, Rangamati	01558883127
7	Shimul Chakma	BETS, Rangamati	South Kalindipur, Rangamati	01556541219
8	Satrang Chakma	Staff Reporter, Dainik Samakal	Banarupa, Rangamati	01550608276
9	Adv. Jwel Dewan	Coordinator, BLAST	Rangamati	01550608276
10	Jagatjoti rmoy	Businessman	Thegamukh Bazar	01875117122
11	Sakka Mitra Tanchunga	Businessman	Rajasthali	01557434097
12	Nanda Kumar Talukder	Headmen	Barkal	01820305061

ANNEXURES

Sl. No.	Name of stakeholder	Designation	Address	Mobile No.
13	Jadu Chandra Tripura	Member	Rajasthali	01859764807
14	Udayan Tanchunga	Member	Rajasthali	01557585377
15	Taktachan Tanchunga	Karbari	Rajasthali	01557344794
16	Md. Golam Rasul	Sub-Assistant Engineer, LGED	Juraichori, Rangamati	01867063599
17	Md. Moniruzzaman	Work Assistant, LGED	Jurachori, Rangamati	01557794712
18	Gan Talukder	Businessman	Master Para, Barkal Sadar, Rangamati	01553756896
19	Upanabda Das	Principal	Rajasthali, Rangamati	01820041485
20	Susmita Chakma	CHT Nagorik Committee, Rangamati	Bonorupa, Rangamati	01715752898
21	Santi Bijoy Chakma	Headmen, 124 Naraichori	Bilaichori Upazila	01820302154
22	Monghulamant	PC (CHTWCA) Project	Chakma Circle,Roy Bari, Rangamati	01558455631
23	Shushil Bikash Chakma	Field Coordinator, CHTWCA Project	Chakma Circle, Rajbari	01556778470
24	Thoai Aung Marma	Headmen& Joint Secretary	119 Kaptai, Rangamati District Headmen Association	01819616045 01556980715
25	Dipen Dewan	Headmen	4 Bhushanchora, Chotohorina, Barkal	01813666997
26	Bablu Chakma	Information Officer Maleeya Foundation	Rajbari Road, Rangamati	01554332624
27	Dipujjal Khisha	Coordinator, Maleeya Foundation	Rajbari Road, Rangamati	01826162707
28	Lalit K. Chakma	ED-SAS	Kallanpur, Rangamati	01712276408
29	Himel Chakma	Journalist	Rangamati Sadar	01755624583
30	Biplob Chakma	Executive Director	Taungya, Kalyanpur	01732921151
31	Barun Talukder	3 Up Chairman, Jurachuri	Jurachori, Rangamati	01553123898
32	Mayananda Dewan	Headmam, Jurachori	145 Kushumchori, Jurachori	01553249895
33	Deepomoy Talukder	Chairman Up 1no. Gilachori, Rajostholi	Rajostholi, Rangamati	01811460777
34	Haji Zahir Ahmed Saudagar	Businessman	Tabalchori, Rangamati	0155060751
35	Kaygm Bancee	Sub-Asstt Eng, LGED Rangamati	Rajosthali, Rangamati	01550601818
36	Kasaf Chakma	Up Member	Barkal Sadar	01851940832
37	Provat Bindu Chakma	Headmaster, Barkal Model High School	Barkal Master para	01552371769
38	Sayam Ratan Chakma	Up Chairman, Aimachara	Barkal	01553292711
39	Adv, Vobotosh Dewan	Headmen, 106 Kabilachori	106 Kabilachori, Rangamati Sadar	01732350652
40	Santimoy Chakma	Asst, Teacher, Bhuban Joy Gov. High School	Jurachori	01556558852
41	Md. Abdus Shobur	Sub Division Engineer	Road Division- 2, Rangamati	01913429334
42	M M Mahbubur Rahman	Upazila Engineer	Borkol, Rangamati	01720458303

Sl. No.	Name of stakeholder	Designation	Address	Mobile No.
43	Md. Ashraful Islam Bhuiyan	Upazila Engineer	Bilaicchori, Rangamati	01734766777
44	Hari Kishor	Staff Correspondent	Rangamati	01550609304
45	Hitler Dewan	Headmen	105 no, jibtali,mouja, Rangamati	01556549547
46	Moni Chakma	Chairman	Borkol upazila parishad	01556534231
47	Shuvo Madal Chakma	Chairman	Upazila Parishad	01550605517
48	Prokriti Ranjan Chakma	Ret. Sub Secretary	Ram bahadur road, Rangamati	01825027876
49	Uday Joy Chakma	Chairman	Upazila parishad, Juracchori	01553117532
50	Shaktipad Tripura	Vice Chairman	Rangamati	0184335857
51	Ranjan Chakma	Karbory, 158 No. Vosoncchora, Moja	Vusonchhora	01851364932
52	Munindra Lal Talukder	Headmen	Aimachara	01557069465
53	Riko Khisa	Program Co-Ordinator, Green Hill	Rangamati	01730086360
54	Md. Mainuddin	Upazila Engineer	Juracchari , Rangamati	01557889712
55	Onuching Marma	Vice Chairman, Upazila Parishad	Rajasthali	01832156606
56	Muhammad Subedar Islam	Division Forest	Jhum controller division, banrupa, rangamati	01712221004
57	Md. Kabir Hossain Asu	Corpo,,		01718977779
58	Md. Shaid Ullah			01730336137, 01730336139
59	Md. Jahidul Alam	Executive Director CCDR	Swarnatilla	01733072484
60	Iqbal Ahmed	Environment Specialist	World bank	
61	Abbas Uddin Chowdhury	ED PARA	Kathaltuli	01876085700
62	Kamrul Hassan	Jr. Engineer	BETS, Dhaka	01723251490
63	M Azam Ali	Office Secretary, Truck Mini-Truck 0wners' Association	Pouro Truck Terminal	01814401759
64	Mohammad Mahabub Alam	UNO Barkal	UNO Office Barkal	01721835904
65	Mohammad Moniruzzaman Mohshin	Director, Rangamati Chamber of Commerce&Industry	Rangamati	01715163160
66	Rabindranath Mondal	UFO Naniar Char, Rangamati	District Fisheries Department	01723523847
67	Arifur Rahman	LGED Rangamati	TNT Area,Rangamati	01556603055

4.2.6 Start of Stakeholders' Consultation meeting:

The meeting started at 10:00 am in an informal way. At the beginning the participants introduced themselves to the house. After formal introduction, the Project Director, Mr. Momin Mojibul Haq Shamaji welcomed all the participants in the Consultation meeting. He also facilitated very

enthusiastically the whole meeting from the beginning to the end. During the welcome address he elaborated the background, purpose and objective of the stakeholder Consultation meeting. He added that the professionals' presentation would highlight the findings of the feasibility study so far have been progressed and ask for their opinion, feedback and suggestions. He informed the house that the two alignments have been selected through comparative study with specific criteria analysis: The alignments are:

Selected route alignments:
Road Alignment-1:
Rajosthali ----Belaichhari---Juraichhari---Barkal---Thegamukh—114.546 km

Multimodal Alignment-1:
Rangamati---Chotohorina--- Thegamukh---70.987= 63 waterway+7.987 lands.

How the alignments were selected through multi-criteria analysis have been shown in the following table:

Proposed Route									
Sl No	**Criteria**	**No of Points**	**Road Route**				**Multimodal Route**			
			R-1 (Length =123.54 Km)	**R-2 (Length=50.25 Km)**	**R-3 (Length=97.17 Km)**	**R-4 (Length=106.12 Km)**	**M-1 (Length=70.98 Km)**	**M-2 (Length=66.80 Km)**	**M-3 (Length=94.11 Km)**	**M-4 (Length=97.60 Km)**
1	Technical and Engineering Feasibility	10	6.81	7.92	7.37	6.95	7.25	6.26	6.66	7.26
2	Adverse Environmental Impact	10	4.5	3.5	1.25	4.25	6.75	5.75	5.75	6.75
3	Social Impact	10	1.5	3	5.5	2.75	5.5	2.75	3	5.25
4	Poverty	10	7.5	10	7.5	5	5	5	5	5
5	Present Inaccessibility to reach the road head	10	9.37	9.49	9.63	9.74	7.13	2.15	1.83	6.82
6	**Travel time saving after construction from origin of proposed Route to Thegamukh**	5	4.5	4.41	4.38	4.5	1.24	3.15	2.59	0.95
7	Less improvement required to existing road to Chittagong	10	8.22	6.59	6.42	8.77	7.79	7.79	7.21	7.21
8	Less time of travel between Chittagong to Thegamukh	10	3.28	2.16	0	4.43	1.97	3.69	1.67	0
9	Population served per Km of connectivity within zone of Influence	5	2	5	3	4	5	5	2	2
10	Length of the road covered by spending US$ 1 million project	10	10	4.37	6.98	9.30	7.30	6.18	8.67	10
11	Disliking for the Project	10	10	3	3	3	10	10	10	10
	Total Score	100	67.68	59.44	55.03	62.69	64.93	57.72	54.38	61.24

Above noted findings reveal that from among the road alignments, road no.1 that goes from Rajosthali-Bilaichari-Juraichari-Barkal-Thegamukh scored the highest 67.68 marks. And from

among the multimodal routes, the route M-1Rangamati-Chhotoharina connected by waterway and Thegamukh by road have got highest marks of 64.93. In view of having highest weight these two routes are selected for further feasibility study.

These two alignments have been selected through a multi-criteria analysis- that includes a matrix of 11 points and the following judgments:

- Technical judgment
- Social Judgment
- Environment Judgment; and
- Economic Judgment

He also informed the participants that the purposes of selection of these two alignments are:

1. Maximum people will get benefit out of it
2. Social and environmental affect will be minimum
3. Minimum people will be affected and need resettlement
4. Minimum properties will be damaged.

He added that the objective of the Consultation Meeting was to have feedback from the participants on the alignments and on the findings of the Professionals and incorporate the addressable feedbacks in the engineering design which was in a preliminary stage.

Then he asked the Professionals to present their findings to the audience.

Presentation of Consultants:

Before presentation, the consultants distributed printed copies of their presentations to the participants, so that they can know about findings well ahead. This was given for their feedbacks and suggestions.

The Environment Specialist, Dr. Mostafa Kamal presented his environmental findings on the alignments. He detailed all aspects of environment that have to be taken care of during construction of the selected road. He also clarified the questions raised by the participants.

Then the Sociologist, Khandakar Abdul Quayum who was physically involved in conducting whole social assessment at the field level, presented the paper in the house and highlighted the major findings of the feasibility study on social aspects. It was aimed to getting feedback and suggestions from the participants that might be incorporated in the final feasibility report.

After the presentations of the professionals, question- answer session started. Many questions were raised by the participants where most of them were answered by the Project Director and by the relevant consultants. Some participants tried to raise questions at the time of presentation, but they were requested to ask questions at the end of presentation.

Questions and Answer session:

Issue: Alignments selection process

Ans: The alignments have been selected through a procedure approved by the World Bank. They have been shown a matrix with 11 points, based on the matrix, parameter and a

multi-criteria analysis. The alignment that got the highest score was selected. Before going for implementation and construction of the road an environment management plan would be made. It will follow the World Bank safeguard policies and criteria so that environment was saved considerably. In this project LGED shall strictly follow the World Bank's involuntary resettlement operation policy strictly.

Issue: Safeguard policy of the World Bank for indigenous people

Ans: For indigenous people World Bank has separate resettlement policy, it is detailed in OP 4.10, where it is mentioned that if for constructing a project loss of shelter, loss of property, loss of income or any other loss occurs that have to be compensated. In addition to that an Indigenous People Development Plan (IPDP) to be made.

Issue: Safeguard for whom

Ans: Safeguard for all. Safeguard policy for best practices for the people.

Issue: World Bank changed its safeguard policy or not

Ans: The World Bank has changed its safeguard policy that incorporated future safeguard including participation and transparency of the affected people.

Issue: Monitoring process of the project

Ans: Our assessment is in a very preliminary stage. We have selected the alignment where no big change will be needed. When we shall for detail assessment we shall engage one team for Social assessment, one team for environment assessment, government has a policy for that and World Bank has 10 operation policies. Besides that government and World Bank will have separate team to oversee the work.

Issue: All positive things came out from your presentation, you should also highlight the negative aspects like-increase of trafficking, stones from the roadside will be taken away. What would be the impact on the religious and cultural aspects?

Ans: Obviously we shall highlight the negative points during our next study and incorporate safeguard to get rid of those problems in order to do away with those negative aspects.

Issue: The three districts have regional council, in policy making whether they have any participation

Ans: Hill District Council people were invited, perhaps somehow they could not manage time for this meeting. However, we shall invite them in our next program and obviously we shall get their feedback at that time.

Issue: The affected people for the Kaptai Lake were not resettled properly; whether this time

for this project the affected people will be taken care of for resettlement as per policy?

Ans: We have to discard the bitter experience of Kaptai Lake, we shall take care all important issues so that such thing doesn't happen again and that is why this consultation meeting with you people to have to get your feedback.

Issue: In October-November Kaptai lake gets filled up with water hyacinth which affects movement of the people.

Ans: If that route is developed under this project, then we have to take care of it.

Issue: If dredging is done where shall you deposit soil, if soil is deposited on the hills, it will come down to lake during rainy seasons, what measure would you like to take?

Ans: When we shall work on multimodal route, we shall consult with the experts and go for a detail feasibility study.

Issue: Instead of making new road, if existing roads are renovated, that will be better for movement for local people.

Ans: Actually we are doing that, the alignments selected, that is on the existing road and maximum people will be benefitted from that.

Issue: We have the observation that when there is a new road or new connectivity, environment is damaged in different ways, forest is damaged, if this happens for your alignment, what would be the measure?

Ans: In order to save the environment and biodiversity, we shall make an environment management plan and following the environment safeguard policy of World Bank we shall go ahead.

Issue: Before starting construction, if you consult with the local institutions, that would be better.

Ans: Yes, we shall go for that during our next meeting.

Issue: How and with whom the public consultation was done?

Ans: Public consultation was done in an informal way. The facilitation team moved along the selected alignment, where they got some people, they did consultation, they recorded the names, address and phone numbers of the people they consulted. They were UP Chairmen, Headmen, Karbari and general people in those consultation meetings.

Conclusion:

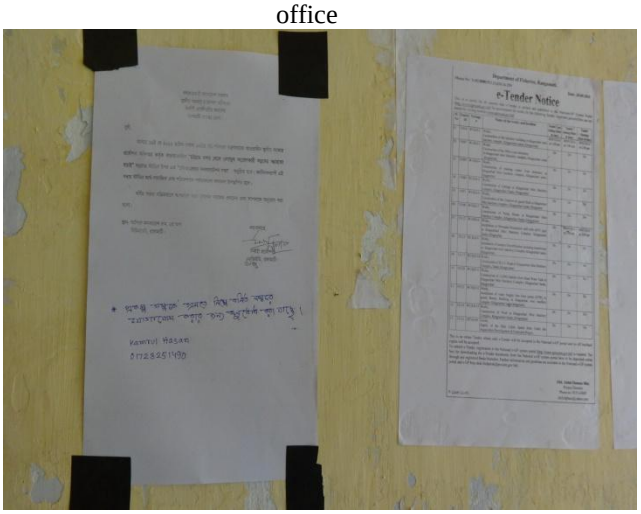
The consultation meeting was attended by a lot of respected persons. They were thanked for giving their valuable time and made the meeting successful. For a road construction this type of consultation meeting is a rare incident and for the first time it has taken place in that area. The stakeholder consultation meeting was also attended by the World Bank representatives, Additional Police Super, UNO-Barkal, Director, Chamber of commerce, Journalists, NGO representatives, UP Chairmen, Headmen, Karbai and representatives of different business communities. The meeting was concluded at 1:30pm.

Stakeholder Consultation Meeting Video Program, Photograph & Attendence Sheet are presented in Compact Disk (7 Set) in Volume IV

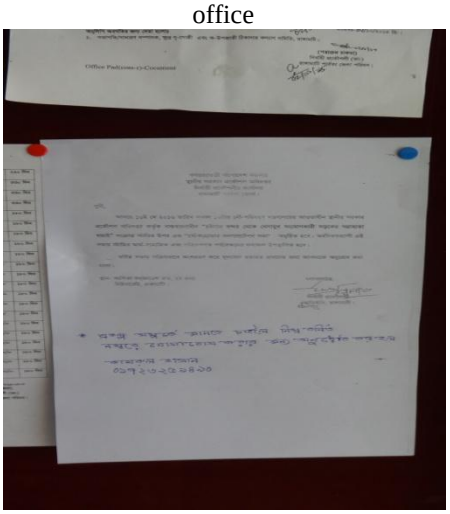
Stakeholder Consultation Meeting photographs are given bellow:

Invitation letter hanging on Chakma Royal Kingdom office

Invitation letter hanging on CHT Hill District Council office



Invitation letter hanging on Department of Fisheeries



Invitation letter hanging on CHT Hill District Council office

Venue:Asika Conference Room ,Rangamati

Program: Stakeholder Consultation Meeting, Date: 16-05-2016

CHAPTER 5
Terms of Reference (TOR) forResettlement Action Plan (RAP)

I. INTRODUCTION AND OBJECTIVES

1. The Government of Peoples Republic of Bangladesh is in the process of developing transport Corridor Connectivity Routes from Chittagong Port to Thegamukh through improving Road and Multimodal Alignments of the District of Rangamati. The aim of the project is to improve remote areas of CHT transport networks by improving road conditions and capacity and waterway upto Thegamukh that would work as corridor for bi-lateral trade activities between Bangladesh and India.
2. Based on the results of the techno-economic feasibility studies together with environmental and Social Impact Assessments, final selection of two connectivity routes were determined. The selection was done based on detailed rankings and required criteria, GOB has selected one road alignment: Rajostholi to Bilaichari to Juraichari to Barkal to Chottohorina to Thegamukh: 114.751Km and one multimodal alignment-1, Rangamati-Chottohorina-Thegamukh to materialize the connectivity project.
3. Where the project will necessitate acquisition of land, structures and other assets, and/or cause displacement or loss of assets within the public Right Of Way (ROW), the section on Relocation in the Government of Bangladesh's Environmental Guidelines for Rail/Road/Highway projects applies. The project is under consideration for World Bank financing, and must therefore be in compliance with the World Bank's policy on Involuntary Resettlement as described in OP 4.12and OP 4.20 on Gender.
4. It is the responsibility of the Borrower to prepare a plan which complies with the Government of Bangladesh and the World Bank's policy guidelines and directives on land acquisition and involuntary resettlement. This plan is referred to as a Resettlement and Rehabilitation Action Plan (RAP). Presentation of a RAP satisfactory to the Government of Bangladesh and the World Bank is a pre-condition for Bank appraisal of the project. The RAP will be prepared in two phases. The Government of Bangladesh and the World Bank will first agree on an appropriate Entitlement Framework, on the basis of which a detailed RAP will be developed.
5. The RAP has three main objectives:
   (a) to present the project area and the impacts of land acquisition for project civil works on the people who own properties to be acquired; live on the land to be acquired; and/or derive their income from the land or enterprises operating on the land to be acquired;
   (b) to present the entitlement policy for compensation and assistance to people affected by the project;
   (c) to present an action plan for delivery of the compensation and assistance outlined in the policy, to the persons identified as entitled to such assistance.
6. Government of Bangladesh and World Bank policy is based on the principle that the population affected by the project should receive benefits from it, or at the very least not be worse off than before. Acquisition of land and other assets, both of private holdings and within the ROW, are integral parts of project design and implementation. Undertaking a social impact assessment and preparing a RAP should be incorporated as part of the project design from the start, and undertaken in close coordination with the Environmental Analysis, the Environmental Action Plan, and the engineering designs and implementation.
7. The World Bank policy emphasizes that involuntary resettlement should be avoided or minimized where possible by exploring other alternative project designs. Therefore, the

initial screening for social and environmental impacts should be part of the feasibility studies to determine the final selection of roads to be included in the project.

8. In cases where displacement, loss of assets, or other negative impacts on people are unavoidable, the project should assist the Project Affected Persons (PAPs) with the means to improve their former living standards, income earning capacities, production levels or at least maintain the previous standards of living of those suffering losses.
9. Since a key principle is that no civil works should be undertaken on any stretch of road before land acquisition has been completed and compensation or assistance carried out according to the RAP, it is essential that the planning and implementation of civil works be coordinated with the RAP.
10. Preparation of a RAP requires thorough understanding of social, economic and cultural factors influencing the lives of the adversely affected people. Detailed baseline studies need to be conducted, and a participatory approach through consultation with potentially affected persons and other stakeholders such as local NGOs, municipal authorities, etc. is essential. Appropriate skills and experience to coordinate and implement this must be available within the responsible agencies.
11. In cases of impacts on indigenous communities, the World Bank's Operational Directive 4.20 also applies. In such cases, the TOR requires the consultants to prepare the plans mandated by this directive, in addition to the other elements of the RAP. This planning will specifically include consultation with and informed participation of the Ethnic Minoritypopulation. The outcome of the consultation process should be the formulation of either an Indigenous People's Development Plan (IPDP) or a specific strategy to ensure that the affected Ethnic Minoritypopulation benefits from the project activities. In the case of an IPDP, the information guidelines mandated by OD 4.20 should be followed.
12. The Terms of Reference for the work undertaken may be modified according to local contexts, subject to approval by the Bangladesh Government and the World Bank.

II. SCOPE OF WORK

A. Social Impact Assessment

13. The objectives of the Social Impact Assessments are:
    (a) to provide information on social impacts of the selected road and muti-modal;
    (b) to verify the legal boundaries of the Right of Way, document existing structures, land plots, and other physical assets within the ROW to establish a cut-off date for entitlements in accordance with the policy to be developed;
    (c) to provide the socio-economic baseline information required for preparation of the entitlement framework.
14. Preliminary Screening. The consultants shall make initial visits to all the different stretches of road(s) under consideration for the project. An assessment shall be made of the potential magnitude of social impacts. Any major social impact issue such as large scale resettlement, dense urban clusters, and Ethnic Minoritypopulations shall be identified. Stretches with no or minor social impacts shall be identified, and given priority in the selection of roads to be improved.
15. Following the selection of road stretches to be included in the project, undertake a verification exercise. The verification shall establish the legal boundaries of the Right of Way, and identify current usage of the land in terms of squatters, land encroachments, fixed and movable structures, trees and ponds, etc. This shall be jointly verified by the representatives from Roads and Highways/LGED, department of forest / agriculture extension, PWD and the Department of Revenue of the Government of Bangladesh in the field. The information gathered should be reflected in maps and records, jointly verified by

signatures of the responsible senior RBD and Revenue officials. The following guidelines shall be followed:

(a) Where it is likely that dislocation of people will be required, suitable resettlement sites of government owned land in close proximity to the current locations of the affected persons should be recorded;

(b) All encroachments within the Public Right of Way, as well as private holdings of land and other assets in areas where it is probable that the corridor of impact will go (see below) shall be documented;

(d) Assets both within and outside of the ROW such as structures, land holdings, trees and ponds, etc. shall be recorded on strip maps, and be numbered in each named settlement and administrative unit;

(e) The information gathered shall be recorded on strip maps, and if possible computerized. Photography and/or video recordings should be used to document existing structures and land holdings, and circumstances for identification and planning. The use of aerial photography should be considered, if approval can be obtained from the relevant authorities;

16. Following this a public notification of the intent to undertake a project shall be issued, in accordance with the legal requirements of the country. This represents the cut-off date for entitlements under the project. Only those people with land or other assets identified as existing prior to this date will be entitled to support under the project. This is to prevent land invasions, erection of new structures for speculation purposes, and other attempts at false claims. The consultants shall assist the appropriate authorities in undertaking this work.

17. Socio-economic baseline information. This will be collected by means of a sample socio-economic survey, of the pre-selected road. The survey shall gather information on the various categories of losses and other adverse impacts likely to take place under the project. The losses shall be categorized according to types. These losses will vary based on the local context. They may include but not be limited to:

(a) loss of land and other productive resources such as trees
(b) loss of structures, temporary or fixed, within or outside the ROW
(c) loss of access to public services (roads, water supply, schools, medical facilities, shops)
(d) loss of customers and supplies
(e) loss of fishing, grazing, or forest areas
(f) loss of access to common property resources
(g) disruption of social, cultural, religious, or economic ties and networks

18. Furthermore, the sample socio-economic survey shall identify potentially affected populations, with special attention to vulnerable groups such as Ethnic Minoritypopulations, scheduled castes, Dalits, landless households, and women-headed households. It shall include but not be limited to:

(a) demographic characteristics (age, sex, numbers, and categories of affected people);
(b) ethnic/caste composition of the population, and settlement pattern by ethnic/caste groups;
(c) main forms of livelihood including specification of the resource base, seasonal and permanent use of resources including land based or salaried employment for different household members; labor mobility; the importance of informal networks and labor exchange patterns and the potential impact of disrupting these patterns;
(d) if any persons have already been displaced, information on them should be collected for two time periods: at the time of displacement, and at present.

19. As part of the sample socio-economic survey, an assessment shall also be made of what the likely replacement value of the various assets lost is, based on the following considerations:

(a) entitlements to affected persons shall be based on replacement value rather than registered land prices, etc, which tend to be undervalued;
(b) this assessment is also important as a means of preventing inflated claims to compensation;
(c) as part of this assessment, consultations and discussions shall be held with a representative number of the different categories of affected persons, to assess their views on what constitutes fair compensation or assistance, their preferences for resettlement actions, and reactions towards the project;
(d) a suitable methodology shall be develop to classify different types of assets, and the measurements taken to determine quantities of losses, i.e. different types of land, trees, crops, structures, businesses, etc., and the unit of measurement such as area of land, number of trees, floor area or other measurements for houses, etc.

20. The sample survey shall form the basis for the full baseline socio-economic survey to be undertaken subsequently of all PAPs. By conducting it first for a sample population, it may be modified and improved prior to undertaking the full survey.
21. Reporting. The findings from the Social Impact Assessment shall be presented in a report. This shall include:
(a) assessment of current land acquisition practices, their appropriateness and potential impacts for this project;
(b) estimates of the types of losses expected as a result of the project, broken up in categories of cultivated, homestead, enumeration of structures, trees, and other assets;
(c) identification of the categories of affected persons, based on the identified losses, and estimates of their numbers;
(d) it is important to analyze the data in such a way that the report captures the likelihood that some persons may lose different kinds of assets. Therefore, the numbers under each category are not mutually exclusive, and in identifying different persons' losses and entitlements, provisions must be made for recording and compensating for more than one kind of loss;
(e) the status of squatters and encroachers within the public Right of Way.
22. Based on this information, the consultants shall prepare a Draft Entitlement Framework, which will form part of the agreement between the Government of Bangladesh and the Bank. The following considerations are essential:
(a) the framework will be adopted as policy for this project, and will have as an objective to provide a basis for development of a more general, sectoral policy for social impacts and resettlement within the state highway sector;
(b) the entitlement framework shall be prepared by the consultants. However, it is essential that this will be done in close consultation with the agencies responsible for the subsequent implementation of the Resettlement Action Plan, to ensure full understanding and agreement on the issues;
(c) the framework should be placed within the legal context of Bangladesh and CHT, and the Bank's Operational Directive 4.30 must be adhered to. If there is a divergence between domestic law and practice, and the World Bank's Directives, this should be clearly identified and analyzed before the framework is finalized. If necessary, consultations between the Bank and the Bangladesh authorities should be held to arrive at a framework acceptable to both;
(d) a key consideration should be to develop a methodology to document to what extent the objectives are achieved. Indicators should be developed which can be used for systematic monitoring and comparison with the baseline data over time;

(e) as a general principle, there ought to be more than one option offered to PAPs within each category of impact. The entitlement framework should analyze these options, the risks and benefits of each, and how to implement the various programs in a transparent manner;

(f) wherever possible, land for land ought to be a priority. Cash compensation should only be undertaken when it can be clearly documented that land for land or other types of assistance are not available. Experience shows that cash compensation is rarely effective in restoring livelihoods or lost assets. If cash payments are made, special arrangements should be made to assist the most vulnerable in making productive use of the money. The entitlement framework should also describe how payments can be made in a transparent manner, for example, by doing it publicly with independent verification;

(g) the entitlement framework shall specify the period of notification about acquisition of assets, and establish that no civil works may start on a stretch of road before the Resettlement Action Plan has been implemented there. This is a key principle, and must be taken into account of when awarding contracts for civil works. Improper or delayed implementation of the RAP may lead to costly delays in civil works. Because the project will work in different areas at different times, the framework and RAP should be prepared in such a way that people's assets are not acquired many months or years before actual work starts. The framework should, therefore, also contain provisions for how the compensation and assistance levels may be re-evaluated and adjusted in case of price increases. Such reassessment should be done at least on an annual, ideally on a six-monthly basis.

23. The framework shall be presented in a tabular form:

Typer of loss	Entitled person	Entitlement	Implementation issues/ Gudelines	Organizations Responsible

B. Preparation of Resettlement Action Plan

24. The information collected during the Social Impact Assessment shall form the basis for preparing a Resettlement and Rehabilitation Action Plan. The RAP should contain at a minimum the following sections:

(a) summary findings from the Social Impact Assessment
(b) entitlement framework
(c) data on expected impacts and numbers and categories of affected persons
(c) development of resettlement sites, if required
(d) institutional arrangements
(e) implementation procedures
(f) consultation and participation arrangements, of PAPs and other stakeholders, including grievance procedures
(g) budget and costs
(h) timetable of activities, with Gantt charts showing the various elements of the plan, coordination of land acquisition with road design, contracting, and construction
(i) monitoring and evaluation of land acquisition and resettlement.

25. In preparing the RAP, the likely alignment and corridor of impact for the roads to be improved shall be determined. This shall be done as a joint exercise, coordinating the various design aspects of the project (engineering, environmental, socio-economic). The corridor of impact is defined as the width required for the improved road and the civil works

necessary to construct it, including the new pavements, shoulders, support slopes, and necessary safety zone. People who live or have assets outside of this corridor of impact and who will not be affected by the project, will not be considered as PAPs, and will not be entitled to compensation or other forms of assistance. The following considerations are important:

(a) The identification of the corridor of impact shall be undertaken as a joint exercise between the planners responsible for engineering design, environmental assessment, and social impact and R&R planning;
(b) Public consultation shall be undertaken, to determine what local people consider to be the best alignment for the improved road;
(c) The corridor of impact will normally fall within the existing Right of Way, but the study shall assess where private land acquisition may be required;
(d) It is likely that the exact road alignment and therefore the corridor of impact may shift following detailed engineering designs. The purpose of this early estimate is to get as complete a picture as possible of the expected scope of land acquisition required, number of PAPs, categories and entitlements, and budgets and timeframe required for the implementation of the Resettlement Action Plan. However, this shall be updated and corrected as required, following the final engineering designs;
(e) Along with engineering, economic, and environmental considerations, the principle of avoiding resettlement or loss of assets to people shall be used in determining the corridor of impact. In minimizing land acquisition, the following measures should be considered:
    (i) the land acquired should be the minimum needed to improve and upgrade the existing road alignments to the defined technical standard;
    (ii) lower value land should be acquired where possible;
    (iii) wherever possible, the alignment should be designed so as to avoid acquiring buildings in which permanent businesses operate;
    (iv) re-alignments should only be done where it is necessary for safety reasons or when it is preferable for environmental reasons or because it has less asset acquisition impact.

26. Based on the agreed-upon entitlement framework, the full baseline socio-economic survey and a joint on-site verification shall take place for the total length of highways to be improved. The baseline socio-economic survey shall be conducted within the corridor of impact.
27. The survey shall be a full census of all entitled persons and a baseline socio-economic survey. It shall uniquely identify all entitled persons under the policy. The survey shall use the methodology developed for the sample survey undertaken earlier, and provide the data for an overall estimate of total numbers of people affected, assets to be acquired by the project, and scope of resettlement and rehabilitation measures to be taken. The joint on-site verification will determine the precise nature and quantity of assets to be acquired and the losses to be compensated.
28. Both can take place concurrently. The consultants shall advise the project authorities about the best way to coordinate this. The following considerations are important:
    (a) the survey and verification should be done jointly by representatives of the project authorities and the PAPs, and other authorities such as local revenue officials, as appropriate based on local rules;
    (b) during this survey, the PAPs shall be explained the likely impact of the project, and presented with a copy of the entitlement framework in his/her local language;

(c) the assets to be acquired shall be tabulated, bearing in mind that each PAP may have losses in more than one category. The compensation or assistance he/she is entitled to shall be clearly explained, as well as the likely timetable for when the acquisition is likely to take place;

(d) Where different options have been developed, these shall be explained along with the likely risks involved. Wherever possible, the principle of high vulnerability / low risk should be followed; i.e. those among the PAPs identified as particularly vulnerable should be encouraged to choose the assistance or compensation that offers the least risk. This choice shall not be made on the spot. Provision should be made in the RAP for further consultation, and sufficient time should be given to the PAPs to make their choices. Where possible, provision should also be made to allow people to change their mind about the entitlements opted for, within reason;

(e) the table of likely losses and types of entitlements shall be verified by the three parties present, and signed by each of them. The PAP shall be given a copy. This will serve as proof of his status as PAP, and each PAP should be given a unique identification code. Other measures such as identity cards may be considered if necessary;

(f) this information should be coded and computerized, and updated as required following finalization of the data. Developing a database to track PAPs, entitlements, and compensation or assistance given should be considered to ensure accurate and efficient implementation of the RAP;

(g) it should be made clear to the PAP that if the final road design and the choice of alignment mean that he/she is no longer within the corridor of impact, no compensation will be given;

(h) the PAP shall be explained that in the cases of cash or kind compensation, or resettlement to a new site, such compensation shall take place before the project authorities acquire the assets;

(i) the PAP shall also be informed about the mechanism set up for grievance procedures;

(j) provision should be made for how missing data can be collected later, and other mechanisms for information sharing and local participation should also be developed;

(k) undertaking this baseline socio-economic survey and joint verification is a time-consuming exercise. People are not always available, and it may be difficult to coordinate the movements of local government officials with the project authorities. It is, therefore, essential to allow sufficient time for the survey and verification before any civil works starts, and to coordinate the planning of different project components;

(l) summary information shall be tabulated based on districts, with length of road, land to be acquired (cultivated and homestead listed separately), temporary and permanent buildings, and number of households and total persons affected (broken down by gender and other relevant categories such as majors/minors, tribals, etc.).

29. Institutional Arrangements. Responsibilities for implementation of various parts of the RAP should be clearly delineated:

(a) while elements of the plan may be undertaken by other institutions (for example, by contracting with NGOs to undertake income-generating activities, or local consultants to develop a tracking database for PAPs and entitlements), the overall coordination and capacity to monitor the project should be maintained by the main responsible agency, RBD.

(b) for tasks involving coordination among different agencies of government or community organizations, appropriate mechanisms should be identified and established. The organizational structure and type of skills required should be specified. The possibility of setting up an environmental and social cell, and of creating a joint task force or

steering committee with representatives of different agencies involved as well as from local government and representatives of the PAPs, should be explored.

(c) appropriate monitoring and evaluation arrangements should be developed. It should be the responsibility of the implementing agency to systematically monitor the progress of the RAP, and analyze and report on its impacts compared with the baseline data. Suitable indicators should be developed for this. Independent evaluation or supervision should be provided for, and guidelines prepared for how this is to be undertaken.

(d) a grievances and appeals mechanism should be evolved.

(e) it is essential to document the institutional capacity of the agency or agencies responsible for implementing the RAP. Where institutional capacity is yet to be developed or identified, a realistic plan shall be presented for how this is to be achieved, bearing in mind likely constraints and delays.

30. Assessment of institutional capacity will be a key factor in the appraisal of the RAP.

31. Reporting. In addition to the reports described in paragraphs 20 and 21, and the RAP itself, the consultants shall submit the following reports:

(a) An inception report presenting the initial findings and detailed plan of activities within 30 days from commencement. This should contain a Gantt chart showing the estimated start and end dates for the different activities, as well as responsibility for implementation.

(b) Monthly progress report for each calendar month outlining the details of various activities undertaken.

(c) Following agreement on an entitlement framework, a summary publication with project description, estimates of land acquisition losses and entitlements, both in English and local languages. This is to be distributed among the local communities and to other stakeholders.

III. QUALIFICATIONS AND REQUIRED SKILLS

32. The assignment is to be carried out for the Government of Bangladesh by the Project Coordinating Consultants (PCC) engaged for the overall preparation of the proposed Connectivity Project, using available resources as local consultants. These consultants may be from social science institutes, NGOs, and/or individuals or consulting firms with appropriate prior experience of this type of socio-economic context. Experience in participatory planning and consultation with various stakeholders is essential, as is good analytical skills and experience in working in multi-disciplinary settings. For the socio-economic surveys, the consultants should be familiar with collection and analysis of both quantitative and qualitative data.

33. The PCC will hire, supervise, and manage the local consultants engaged in the preparation of the Land Acquisition Assessment, Baseline Socio-Economic Survey, and the RAP proposals, and the PCC will be responsible for preparation of the final reports and the draft plan.

CHAPTER 6
Terms of Reference (TOR) for Ethnic Minority/Indigenous People's Development Plan (IPDP)

6.1 Introduction and Background

The Government of People's Republic of Bangladesh is in the process of developing transport Corridor Connectivity Routes from Chittagong Port to Thegamukh through improving Multimodal and Road Alignments in the District of Rangamati. The aim of the project is to improve remote areas of CHT transport networks by improving road conditions and capacity and waterway up to Thegamukh that would work as corridor for trade activities between Bangladesh and North Eastern States of India. These interventions are also expected to facilitate domestic trade, international trade with third countries as well as regional trade with neighboring countries including India, Nepal and Myanmar.

6.2 Area to work with

Based on the results of the techno-economic feasibility studies together with environmental and Social Impact Assessments, final selection of two connectivity routes were determined. The selection was done based on detailed rankings and required criteria, GOB has selected one road alignment and one multimodal alignment to materialize the connectivity project. The road alignment that was selected for connectivity was from: Rajosthali ----Belaichhari----Juraichhari---Barkal---Thegamukh—123.546 km. most of the affected households are indigenous where 90% of them from ethnic minority. In selected multimodal alignment no household will be affected in 63 km at water part, and the land part has been included along with the Road Alignment.

To materialize the road connectivity of the project, approximately 611 acres of land will require and of which about 121 acres are private land that have to be acquired. For that 513 affected households will have to be re-settled with their assets, business structures, trees, agricultural land, etc., with proper compensation and resettlement following World Bank guidelines OP 4.12 and 4.10 and Bangladesh Ethnic Minoritypolicy guidelines.

6.3 Objectives of the Project

1. To identify each and every persons affected by the project.
2. To estimate all assets, land, crops, business structures, water bodies, etc. of the Ethnic Minoritypeople that would be affected by the project
3. To formulate a framework to re-locate/re-settle the affected persons to a nearer safe place
4. To formulate a development plan for the affected ethnic minority households that should be more upgraded than they lived before.

6.4 Preparation of Indigenous People's Development Plan (IPDP)

In cases of impacts on erthnic minority communities, the project requires the consultants to prepare the plans mandated under this directive, in addition to the other elements of the RAP. This planning will specifically include consultation with and informed participation of the Ethnic Minoritypopulation. The outcome of the consultation process should be the formulation of either an Indigenous People's Development Plan (IPDP) or a specific

strategy to ensure that the affected Ethnic Minoritypopulation benefits from the project activities. In the case of an IPDP, the information guidelines mandated by OD 4.20 should be followed.

6.5 Scope of Work

(i) The sample socio-economic survey shall identify potentially affected indigenous/Ethnic Minoritypopulations, scheduled castes, landless households, and women-headed households. It shall include but not be limited to:
   (a) demographic characteristics (age, sex, numbers, and categories of affected people);
   (b) ethnic/tribal/caste composition of the population, and settlement pattern by ethnic/tribal/caste groups;
   © main forms of livelihood including specification of the resource base, seasonal and permanent use of resources including land based or salaried employment for different household members of the affected population;
   (d) if any persons have already been displaced, information on them should be collected for two time periods: at the time of displacement, and at present;
   (e) Develop a monitoring and evaluation methodology and develop a conflict resolution mechanism.

(ii) As part of the sample socio-economic survey, an assessment shall also be made of what the likely replacement value of the various assets lost is, based on the following considerations:
   (a) entitlements to affected persons shall be based on replacement value rather than registered land prices, etc, which tend to be undervalued;
   (b) this assessment is also important as a means of preventing inflated claims to compensation;
   © as part of this assessment, consultations and discussions shall be held with a representative number of the different categories of affected persons, to assess their views on what constitutes fair compensation or assistance, their preferences for resettlement actions, and reactions towards the project;

6.6 Methodology:

A suitable methodology shall be developed to classify different types of assets, and the measurements taken to determine quantities of losses, i.e. different types of land, trees, crops, structures, businesses, etc., and the unit of measurement such as area of land, number of trees, floor area or other measurements for houses, etc.

6.7 Qualifications and Required Skills

The assignment is to be carried out for the Government of Bangladesh by the Project Coordinating Consultants (PCC) engaged for the overall preparation of the proposed Connectivity Project, using available Bangladesh resources as local consultants. These consultants may be from social sciences NGOs, and/or individuals or consulting firms with appropriate prior experience of this type of socio-economic context. Experience in participatory planning and consultation with various stakeholders is essential, as is good analytical skills and experience in working in multi-disciplinary settings. For the socio-economic surveys, the consultants should be familiar with collection and analysis of both quantitative and qualitative data. The PCC will hire, supervise, and manage the local consultants engaged in the preparation of the Land Acquisition Assessment, Baseline Socio-

Economic Survey, Indigenous People's Development Expertise and the RAP proposals, and the PCC will be responsible for preparation of the final reports and the draft plan.

Volume ID:

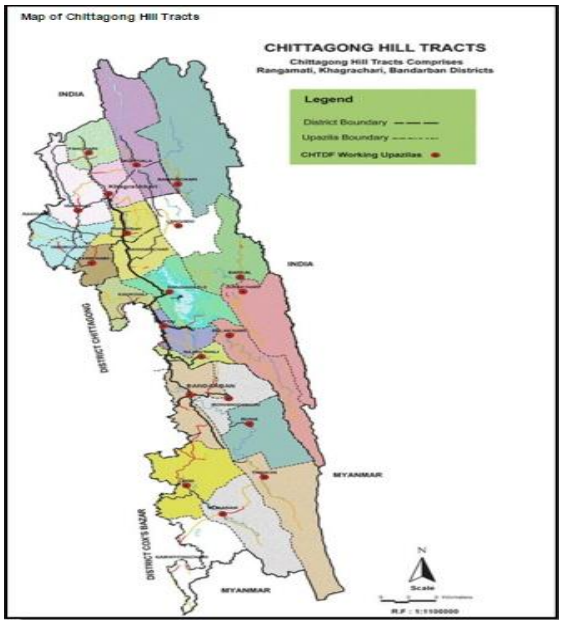
Social Screening and Scoping Report

FINAL

GOVERNMENT OF THE PEOPLE'S REPUBLIC OF BANGLADESH

Consultancy Services for Feasibility, Detailed Survey and Design of Chittagong Hill Tracts Connectivity Connecting Thegamukh and Chittagong Port

CONTRACT PACKAGE NO. MOS-S4



FEASIBILITY REPORT (COST ESTIMATES) – VOLUME II OF IV

JUNE 2016

LOCAL GOVERNMENT ENGINEERING DEPARTMENT (LGED)

SAI Consulting Engineers Pvt.Ltd.,
SAI House, Satyam Corporate Square
B/hRajpath Club, Bodakdev
Ahmedabad–380059,INDIA

In association with

BETS Consulting Services Ltd.,
House-10,Road-135,Gulshan-1,
Dhaka-1212
Bangladesh

VOLUME II: COST ESTIMATES

Project: Consultancy services for Feasibility, Detailed Survey and Design of Chittagong Hills Tract (CHT) Connectivity Connecting Thegamukh and Chittagong Port.

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Volume II A: Cost Estimates for Road Route
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Volume II A: Cost Estimates for Road Route

i). Cost for Improvement of Existing Road (Chittagong Port to Rajosthali)

ii). Cost for Construction of New Proposed Road (Rajosthali to Thegamukh)

iii) Environmental Management Action Plan Cost

i). Cost for Improvement of Existing Road (Chittagong Port to Rajosthali)

Consultancy Services for Feasibility, Detailed Survey and Design of Chittagong Hill Tracts (CHT) Connectivity Connecting Thegamukh and Chittagong Port.

Development/Rehabilitation Required on existing roads (Road Route) i.e.Chittagong to Rajosthali (75.302km)

Summary of Cost Estimation for all Division

SL. No	Name of Component	Division as per RHD & LGED	Total Taka (Including VAT & TAX)	Remarks
1	**2**	**3**	**4**	**5**
1	General	Division-1	N/A	
2	Road Pavement	Division-2	84403936.75	
		Division-3	838946249.00	
3	Bridges (PSC & RCC)	Division-2	2254500.00	
		Division-4	73195440.50	
		Division-5	252355837.30	
4	Box Culvert	Division-2	N/A	
		Division-5	N/A	
5	RCC Retaining wall	Division-2,3,5 & 6	N/A	
6	Drain	Division-2 & 5	N/A	
7	Incidental	Division-6	N/A	
		Grand total=	**1,251,155,963.55**	
			1,251.16	**Million Taka**
			16.21	**Million US$**

Consultancy Services for Feasibility, Detailed Survey and Design of Chittagong Hill Tracts (CHT) Connectivity Connecting Thegamukh and Chittagong Port.

Development/Rehabilitation Required on existing roads (Road Route) i.e. Chittagong to Rajosthali.

Cost Estimation for Existing Roads (Road Route) Pavement (75.302 km)

Division 2- Earthwork **(All Prices in BDT)**

SL. No	Item Code	Item Description	Unit	Total Unit Price with TAX & VAT	Quantity	Total	Remarks
1	2	3	4	5	6	7	8
1	02/01/01	Clearing and Grubbing	sq. meter	45.00	3100.00	139,500.00	RHD Schedule of Rates, August 2015
3	02/02/02	Roadway Excavation in Suitable Soil	cu. meter	171.00	360323.00	61,615,233.00	RHD Schedule of Rates, August 2015
13	02/06/01(a)	Embankment Fill from Excavation on site	cu. meter	245.00	90080.75	22,069,783.75	RHD Schedule of Rates, August 2015
26	02/12/01	Subgrade Drain	lin. Meter	270.00	2146.00	579,420.00	RHD Schedule of Rates, August 2015
Sub-total =						**84,403,936.75**	

Division 3 - Pavement works

SL. No	Item Code	Item Description	Unit	Total Unit Price with TAX & VAT	Quantity	Total	Remarks
1	2	3	4	5	6	7	8
3	03/02/01	Sub-Base	cu. meter	4,361.00	45074.00	196,567,714.00	RHD Schedule of Rates, August 2015
4	03/03/01	Aggregate Base Type l	cu. meter	6,566.00	39715.00	260,768,690.00	RHD Schedule of Rates, August 2015
6	03/06/01(a)	Bituminous Prime Coat (Plant placed)	sq. meter	123.00	207733.00	25,551,159.00	RHD Schedule of Rates, August 2015
9	03/07/01(b)	Bituminous Tack Coat (Labour intensive Work)	sq. meter	44.00	200275.00	8,812,100.00	RHD Schedule of Rates, August 2015

18	03/10/01(b)	Dense Bituminous Surfacing-Base Course (Plant Method) (Bitumen Grade 60/70)	cu. meter	19,906.00	9348.00	186,081,288.00	RHD Schedule of Rates, August 2015
20	03/10/02(b)	Dense Bituminous Surfacing-Wearing Course (Plant Method) (Bitumen Grade 60/70)	cu. meter	20,118.00	8011.00	161,165,298.00	RHD Schedule of Rates, August 2015
Sub-total =						**838,946,249.00**	
Existing Road Route= 75.302 Km					**Grand Total=**	**923,350,185.75**	

Consultancy Services for Feasibility, Detailed Survey and Design of Chittagong Hill Tracts (CHT) Connectivity Connecting Thegamukh and Chittagong Port.

Development/Rehabilitation Required on existing roads (Road Route) i.e. Chittagong to Rajosthali.

Summary of Cost (PSC & RCC Bridge)

SL. No	Size of Bridge in Meter	No of Bridge	TK/Bridge	Total Amount in BDT	Remarks
1	**2**	**3**	**4**	**5**	**6**
1	1x25	1	23,366,095.42	23,366,095.42	RCC BRIDGE
2	3x21	1	42,570,152.27	42,570,152.27	RCC BRIDGE
3	9x35	1	261,869,530.12	261,869,530.12	PSC.BRIDGE
Grand Total Taka(All RCC & PSC Bridge **)=**				**327,805,777.80**	

Consultancy Services for Feasibility, Detailed Survey and Design of Chittagong Hill Tracts (CHT) Connectivity Connecting Thegamukh and Chittagong Port.

Development/Rehabilitation Required on existing roads (Road Route) i.e. Chittagong to Rajosthali.

SUMMARY OF COST ESTIAMTION FOR ALL RCC & PSC BRIDGE

Division 2 –Earthwork **(All Prices in BDT)**

SL. No.	Item Code	Item Description	Unit	Total Unit Price with TAX & VAT	Quantity	Total	Remarks
1	**2**	**3**	**4**	**5**	**6**	**7**	8
1	02/01/01	Clearing and Grubbing	sq. meter	45.00	1208.00	54,360.00	RHD Schedule of Rates, August 2015
10	02/05/01	Excavation and backfill for Structures	cu. Meter	360.00	6111.50	2,200,140.00	RHD Schedule of Rates, August 2015
Sub-total =						2,254,500.00	

Division 4 – Foundation works

SL. No.	Item Code	Item Description	Unit	Total Unit Price with TAX & VAT	Quantity	Total	Remarks
1	**2**	**3**	**4**	**5**	**6**	**7**	8
2	04/01/01(b)	Bored Cast in Place Piles (Dia. 600mm)	lin. Meter	4,595.00	1823.50	8,378,982.50	RHD Schedule of Rates, August 2015
4	04/01/01(d)	Bored pile cast in place piles (dia 900mm)	lin. Meter	10,651.00	3,415.00	36,373,165.00	RHD Schedule of Rates, August 2015
8	04/01/04	High yield Deformed Steel Reinforcing Bars	Tonne	95,236.00	290.00	27,618,440.00	Pile Rebar, RHD Schedule of Rates, August 2015

29	04/04/01 I	Load test on crst in place pile (For 200 Ton)	Number	274,951.00	3.00	824,853.00	RHD Schedule of Rates, August 2015
				Sub-total =		73,195,440.50	

Division 5 –Structures **(All Prices in BDT)**

Sl. No.	Item Code	Item Description	Unit	Total Unit Price With TAX & VAT	Quantity	Total	Remarks
1	**2**	**3**	**4**	**5**	**6**	**7**	8
1	05/01/01	Single Layer Brick Flat Soling	sq.metre	468.00	1207.00	564,876.00	RHD Schedule of Rates, August 2015
2	05/01/02 (a)	Concrete class as Detailed on Drawings (class 10) (Concrete Mixer)	cu.metre	8,466.00	76.00	643,416.00	RHD Schedule of Rates, August 2015
7	05/01/02 (f)	Concrete class-20 (rail & post)(concrete Mixer)	cu.metre	16,862.00	130.50	2,200,491.00	RHD Schedule of Rates, August 2015
8	05/01/02 (g)	Concrete class -25 (Foundation) (Concrete Mixer)	cu.metre	12,379.00	1322.00	16,365,038.00	RHD Schedule of Rates, August 2015
9	05/01/02 (h)	Concrete class -25 (Vertical member col, pier, abutmentment/ wing wall, Culvert etc) (Concrete Mixer	cu.metre	14,224.00	1402.50	19,949,160.00	RHD Schedule of Rates, August 2015
10	05/01/02 (i)	Concrete class-25 (Deck, Curb, Approach slab and Parapet etc) (Concrete mixer)	cu.metre	16,581.00	357.00	5,919,417.00	RHD Schedule of Rates, August 2015
12	05/01/02 (k)	Concrete class-30 (Deck slab, side walk, wheel guard, curb etc (Concrete Mixer)	cu.metre	15,526.00	932.50	14,477,995.00	RHD Schedule of Rates, August 2015
14	05/01/02 (m)	Concrete class-40 (pre-stressed Girder) (Concrete Mixer)	cu.metre	24,558.00	1612.00	39,587,496.00	RHD Schedule of Rates, August 2015
28	05/02/02	High Yield Reinforcrmrnt Bars	Tonne	95,236.00	939.00	89,426,604.00	RHD Schedule of Rates, August 2015

30	05/03/01	Prestressing Wire or Strand	Tonne	273,590.00	77.50	21,203,225.00	RHD Schedule of Rates, August 2015
49	**05/08/01	Expansion joint complete as detailed on the Drawings in the location described in the BoQ. (Updated with new drawing/ 2014	lin. Metre	10,500.00	158.00	1,659,000.00	RHD Schedule of Rates, August 2015
58	05/13/01 (b)	Neoprene rubber bearing or Elastomeric bearing supplying & fitting fixting, etc.	Number	19,334.00	130.00	2,513,420.00	RHD Schedule of Rates, August 2015
66	LGED.4.3.22	Weep Hole	Number	330.13	372.00	122,808.36	LGED Schedule of Rates, July 2014
67	LGED.7.08.01.03	75 mm dia Rain Water Down Pipe	lin. Metre	322.85	111.00	35,836.35	LGED Schedule of Rates, July 2014
68	LGED.4.3.14	450 mm Thick Cotinuous Back Drain(Filter Materials)	cu. Metre	1,655.51	289.00	478,442.39	LGED Schedule of Rates, July 2014
69	LGED.4.01.02	Making Earthen Ring/Cross bundth of required height	Lump sum	1.00	20138609.00	20,138,609.00	LGED Schedule of Rates, July 2014
70	LGED.5.32.01.01,3.11.08.09,3.12.02	Embankmenk protection (RCC Pile & CC Block)	Lump sum	1.00	4065216.00	4,065,216.00	LGED Schedule of Rates, July 2014
71	LGED.4.01.22.06	M.S Pipe 900 mm dia & 8 mm Thick wall	lin. Metre	20,319.98	640.00	13,004,787.20	LGED Schedule of Rates, July 2014
Sub-total =						252,355,837.30	
Grand Total (All RCC & PSC Bridge)=						**327,805,777.80**	

ii). Cost for Construction of New Proposed Road (Rajosthali to Thegamukh)

Consultancy Services for Feasibility, Detailed Survey and Design of Chittagong Hill Tracts (CHT) Connectivity Connecting Thegamukh and Chittagong Port.

Rajosthali to Thegamukh = 109.670 km

Summary of Cost Estimation for all Division

SL. No	Name of Component	Division as per RHD & LGED	Total Taka (Including VAT & TAX)	Remarks
1	**2**	**3**	**4**	**5**
1	General	Division-1	23038941.00	
2	Road Pavement	Division-2	12822660852.20	
		Division-3	4574709695.42	
3	Bridges (PSC & RCC)	Division-2	25950037.50	
		Division-4	591471751.50	
		Division-5	1422988043.69	
4	Box Culvert	Division-2	3388589.70	
		Division-5	147101221.92	
5	Incidental	Division-6	44456650.00	
6	Drain	Division-2 & 5	307070451.35	
7	RCC Retaining wall	Division-2,3,5 & 6	1435825378.10	
		Grand total=	**21,398,661,612.38**	
			21,398.66	**Million Taka**
			277.18	**Million US$**

Consultancy Services for Feasibility, Detailed Survey and Design of Chittagong Hill Tracts (CHT) Connectivity Connecting Thegamukh and Chittagong Port.

Rajosthali to Thegamukh = 109.670 km

Cost Estimation for Road Pavement (109.670 km)

Division 1 -General & Facilities **(All Prices in BDT)**

SL. No	Item Code	Item Description	Unit	Total Unit Price with TAX & VAT	Quantity	Total	Remarks
1	2	3	4	5	6	7	8
1	01/01/01	Maintenance and Protection of Traffic	Lump Sum	80,257.00	1	80,257.00	RHD Schedule of Rates, August 2015
2	01/01/02	Maintain Temp.Structures & Equipment for the Maintenance of Traffic	Day	1,913.00	1095	2,094,735.00	RHD Schedule of Rates, August 2015
3	01/02/01	Suply Erect and Remove Field Office for Engineers	Lump Sum	249,497.00	1	249,497.00	RHD Schedule of Rates, August 2015
4	01/02/02	Maintenance, Staffing, Security and Clearing of the field office for the Engineers	Month	11,000.00	36	396,000.00	RHD Schedule of Rates, August 2015
5	01/02/03	Provision of Office Equipment and Consumables	Month	7,700.00	36	277,200.00	RHD Schedule of Rates, August 2015
6	01/02/04	Provision, Maintenance and Removal of Sign Boards	Lump Sum	8,849.00	1	8,849.00	RHD Schedule of Rates, August 2015
7	01/02/05	Provision and Maintenance of Survey Equipment	Month	897.00	36	32,292.00	RHD Schedule of Rates, August 2015
8	01/02/07	Progress Photographs	Month	1,000.00	36	36,000.00	RHD Schedule of Rates, August 2015
9	01/03/01	Provide and Remove Site Laboratory & Equipment	Lump Sum	331,843.00	36	11,946,348.00	RHD Schedule of Rates, August 2015
10	01/03/02	Maintain Site Laboartory	Month	7,699.00	1	7,699.00	RHD Schedule of Rates, August 2015
12	01/04/01	Saloon Car 12000cc Capacity	Month	55,000.00	36	1,980,000.00	RHD Schedule of Rates, August 2015
13	01/04/02	Pick-up (Double Cab)	Month	66,000.00	36	2,376,000.00	RHD Schedule of Rates, August 2015

14	01/04/03	Four Wheel Drive Vehicle Min. 6 seats	Month	77,799.00	36	2,800,764.00	RHD Schedule of Rates, August 2015
15	01/04/04	Motor Cycle 125cc	Month	4,425.00	36	159,300.00	RHD Schedule of Rates, August 2015
16	01/04/05	Motor Boat min. 5m length	Month	16,500.00	36	594,000.00	RHD Schedule of Rates, August 2015
Sub-total =						23,038,941.00	
Rajosthali to Thegamukh (109.670km)					**Grand Total**	**23,038,941.00**	

Consultancy Services for Feasibility, Detailed Survey and Design of Chittagong Hill Tracts (CHT) Connectivity Connecting Thegamukh and Chittagong Port.

Rajosthali to Thegamukh = 109.670 km

Cost Estimation for Road Pavement (Ch.0+000 to 109+670 km)

Division 2- Earthwork **(All Prices in BDT)**

SL. No	Item Code	Item Description	Unit	Total Unit Price with TAX & VAT	Quantity	Total	Remarks
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
1	02/01/01	Clearing and Grubbing	sq. meter	45.00	1483980.16	66,779,107.20	RHD Schedule of Rates, August 2015
3	02/02/02	Roadway Excavation in Suitable Soil	cu. meter	171.00	71747810.00	12,268,875,510.00	RHD Schedule of Rates, August 2015
13	02/06/01(a)	Embankment Fill from Excavation on site	cu. meter	245.00	1986781.00	486,761,345.00	RHD Schedule of Rates, August 2015
26	02/12/01	Subgrade Drain	lin. Meter	270.00	907.00	244,890.00	RHD Schedule of Rates, August 2015
				Sub-total =		**12,822,660,852.20**	

Division 3 - Pavement works **(All Prices in BDT)**

SL. No	Item Code	Item Description	Unit	Total Unit Price with TAX & VAT	Quantity	Total	Remarks
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
3	03/02/01	Sub-Base	cu. meter	4,361.00	206318.15	899,753,458.15	RHD Schedule of Rates, August 2015
4	03/03/01	Aggregate Base Type l	cu. meter	6,566.00	219098.22	1,438,598,885.10	RHD Schedule of Rates, August 2015
6	03/06/01(a)	Bituminous Prime Coat (Plant placed)	sq. meter	123.00	1148244.90	141,234,122.70	RHD Schedule of Rates, August 2015
9	03/07/01(b)	Bituminous Tack Coat (Labour intensive Work)	sq. meter	44.00	1138374.60	50,088,482.40	RHD Schedule of Rates, August 2015
14	03/09/02(b)	Double Bituminous Surface Treatment -20mm nominal size aggregate followed by 10mm (Machine Method) (Bituminous Grade 60/70)	sq. meter	407.00	321681.00	130,924,167.00	RHD Schedule of Rates, August 2015
18	03/10/01(b)	Dense Bituminous Surfacing-Base Course (Plant Method) (Bitumen Grade 60/70)	cu. meter	19,906.00	50314.88	1,001,567,917.65	RHD Schedule of Rates, August 2015
20	03/10/02(b)	Dense Bituminous Surfacing-Wering Course (Plant Method) (Bitumen Grade 60/70)	cu. meter	20,118.00	45359.51	912,542,662.42	RHD Schedule of Rates, August 2015
				Sub-total =		**4,574,709,695.42**	
Ch.0+000 to 109+670 km					**Grand Total**	**17,397,370,547.62**	

Consultancy Services for Feasibility, Detailed Survey and Design of Chittagong Hill Tracts (CHT) Connectivity Connecting Thegamukh and Chittagong Port.

Rajosthali to Thegamukh =109.670km

Summary of Cost (PSC & RCC Bridge)

SL. No	Size of Bridge in Meter	No of Bridge	TK/Bridge	Total Amount in BDT	Remarks
1	**2**	**3**	**4**	**5**	**6**
1	1x15	7	20,250,421.72	141,752,952.01	RCC BRIDGE
2	1x20	4	21,535,090.77	86,140,363.06	RCC BRIDGE
3	1x25	2	23,366,095.42	46,732,190.83	RCC BRIDGE
4	1x30	7	34,497,118.51	241,479,829.57	PSC.BRIDGE
5	1x35	7	42,087,232.41	294,610,626.87	PSC.BRIDGE
6	3x15	3	36,957,702.87	110,873,108.60	RCC BRIDGE
7	3x21	1	42,570,152.27	42,570,152.27	RCC BRIDGE
8	5x26	1	111,771,421.78	111,771,421.78	PSC.BRIDGE
9	3x30	1	71,248,067.53	71,248,067.53	PSC.BRIDGE
10	9x32	1	194,544,518.93	194,544,518.93	PSC.BRIDGE
11	3x38	1	93,809,026.73	93,809,026.73	PSC.BRIDGE
12	7x33	1	179,169,724.71	179,169,724.71	PSC.BRIDGE
13	5x32	1	142,678,516.23	142,678,516.23	PSC.BRIDGE
14	5x35	1	145,701,396.23	145,701,396.23	PSC.BRIDGE
15	3x30+2x26	1	137,327,937.35	137,327,937.35	PSC.BRIDGE
	Total Taka=			**2,040,409,832.69**	

Consultancy Services for Feasibility, Detailed Survey and Design of Chittagong Hill Tracts (CHT) Connectivity Connecting Thegamukh and Chittagong Port.

Rajosthali to Thegamukh =109.670km

Summary of Cost Estiamtion For All RCC & PSC Bridge

Division 2 -Earthwork **(All Prices in BDT)**

SL. No	Item Code	Item Description	Unit	Total Unit Price with TAX & VAT	Quantity	Total	Remarks
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
1	02/01/01	Clearing and Grubbing	sq. meter	45.00	11299.50	508,477.50	RHD Schedule of Rates, August 2015
10	02/05/01	Excavation and backfill for Structures	cu. meter	360.00	70671.00	25,441,560.00	RHD Schedule of Rates, August 2015
Sub-total =						25,950,037.50	

Division 4 - Foundation works

SL. No	Item Code	Item Description	Unit	Total Unit Price with TAX & VAT	Quantity	Total	Remarks
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
2	04/01/01(b)	Bored Cast in Place Piles (Dia. 600mm)	lin. Meter	4,595.00	13508.50	62,071,557.50	RHD Schedule of Rates, August 2015
4	04/01/01(c)	Bored pile cast in place piles (dia 750mm)	lin. Meter	7,214.00	9,538.00	68,807,132.00	RHD Schedule of Rates, August 2015
4	04/01/01(d)	Bored pile cast in place piles (dia 900mm)	lin. Meter	10,651.00	20,201.00	215,160,851.00	RHD Schedule of Rates, August 2015
8	04/01/04	High yield Deformed Steel Reinforcing Bars	Tonne	95,236.00	2,464.50	234,709,122.00	Pile Rebar

29	04/04/01 (c)	Load test on crst in place pile (For 200 Ton)	Number	274,951.00	39.00	10,723,089.00	RHD Schedule of Rates, August 2015
Sub-total =						591,471,751.50	

Division 5 –Structures **(All Prices in BDT)**

Sl. No.	Item Code	Item Description	Unit	Total Unit Price With TAX & VAT	Quantity	Total	Remarks
1	**2**	**3**	**4**	**5**	**6**	**7**	8
1	05/01/01	Single Layer Brick Flat Soling	sq.metre	468.00	9079.50	4,249,206.00	RHD Schedule of Rates, August 2015
2	05/01/02 (a)	Concrete class as Detailed on Drawings (class 10) (Concrete Mixer)	cu.metre	8,466.00	659.25	5,581,210.50	RHD Schedule of Rates, August 2015
7	05/01/02 (f)	Concrete class-20 (rail & post)(concrete Mixer)	cu.metre	16,862.00	890.50	15,015,611.00	RHD Schedule of Rates, August 2015
8	05/01/02 (g)	Concrete class -25 (Foundation) (Concrete Mixer)	cu.metre	12,379.00	10356.00	128,196,924.00	RHD Schedule of Rates, August 2015
9	05/01/02 (h)	Concrete class -25 (Vertical member col, pier, abutmentment/ wing wall, Culvert etc) (Concrete Mixer	cu.metre	14,224.00	9870.00	140,390,880.00	RHD Schedule of Rates, August 2015
10	05/01/02 (i)	Concrete class-25 (Deck, Curb, Approach slab and Parapet etc) (Concrete mixer)	cu.metre	16,581.00	1498.50	24,846,628.50	RHD Schedule of Rates, August 2015
12	05/01/02 (k)	Concrete class-30 (Deck slab, side walk, wheel guard, curb etc (Concrete Mixer)	cu.metre	15,526.00	5145.00	79,881,270.00	RHD Schedule of Rates, August 2015
14	05/01/02 (m)	Concrete class-40 (pre-stressed Girder) (Concrete Mixer)	cu.metre	24,558.00	9271.20	227,682,129.60	RHD Schedule of Rates, August 2015
28	05/02/02	High Yield Reinforcrmrnt Bars	Tonne	95,236.00	4664.45	444,223,560.20	RHD Schedule of Rates, August 2015

30	05/03/01	Prestressing Wire or Strand	Tonne	273,590.00	403.21	110,313,676.72	RHD Schedule of Rates, August 2015
49	**05/08/01	Expansion joint complete as detailed on the Drawings in the location described in the BoQ. (Updated with new drawing/ 2014	lin. Metre	10,500.00	1191.50	12,510,750.00	RHD Schedule of Rates, August 2015
58	05/13/01 (b)	Neoprene rubber bearing or Elastomeric bearing supplying & fitting fixting, etc.	Number	19,334.00	810.00	15,660,540.00	RHD Schedule of Rates, August 2015
66	LGED.4.3.22	Weep Hole	Number	330.13	4836.00	1,596,508.68	LGED Schedule of Rates, July 2014
67	LGED.7.08.01.03	75 mm dia Rain Water Down Pipe	lin. Metre	322.85	656.00	211,789.60	LGED Schedule of Rates, July 2014
68	LGED.4.3.14	450 mm Thick Cotinuous Back Drain(Filter Materials)	cu. metre	1,655.51	4003.50	6,627,834.29	LGED Schedule of Rates, July 2014
69	LGED.4.01.02	Making Earthen Ring/Cross bundth of required height	Lump sum	1.00	138521331.00	138,521,331.00	LGED Schedule of Rates, July 2014
70	LGED.5.32.01.01,3.11.08.09,3.12.02	Embankmenk protection (RCC Pile & CC Block)	Lump sum	1.00	52847808.00	52,847,808.00	LGED Schedule of Rates, July 2014
71	LGED.4.01.22.06	M.S Pipe 900 mm dia & 8 mm Thick wall	lin. Metre	20,319.98	720.00	14,630,385.60	LGED Schedule of Rates, July 2014
Sub-total =						1,422,988,043.69	
Grand Total (All RCC & PSC Bridge)=						**2,040,409,832.69**	

Consultancy Services for Feasibility, Detailed Survey and Design of Chittagong Hill Tracts (CHT) Connectivity Connecting Thegamukh and Chittagong Port.

Rajosthali to Thegamukh =109.670km

Summary of Cost For All RCC Box Culvert

Division 2 - Earthwork **(All Prices in BDT)**

SL. No	Item Code	Item Description	Unit	Total Unit Price with TAX & VAT	Quantity	Total	Remarks
1	2	3	4	5	6	7	8
1	02/01/01	Clearing and Grubbing	sq. meter	45.00	3424.50	154,102.50	RHD Schedule of Rates, August 2015
10	02/05/01	Excavation and backfill for Structures	cu. meter	360.00	4269.12	1,536,883.20	RHD Schedule of Rates, August 2015
12	02/05/03	Sand Backfill for Structure	cu. meter	1,174.00	1446.00	1,697,604.00	RHD Schedule of Rates, August 2015
Sub-total =						3,388,589.70	

Division 5 -Structures

Sl. No.	Item Code	Item Description	Unit	Total Unit Price With TAX & VAT	Quantity	Total	Remarks
1	2	3	4	5	6	7	8
1	05/01/01	Single Layer Brick Flat Soling	sq.metre	468.00	4686.75	2,193,399.00	RHD Schedule of Rates, August 2015
2	05/01/02 (a)	Concrete class as Detailed on Drawings (class 10) (Concrete Mixer)	cu.metre	8,466.00	580.40	4,913,666.40	RHD Schedule of Rates, August 2015
9	05/01/02 (h)	Concrete class -25 (Vertical member col, pier, abutmentment/ wing wall, Culvert etc) (Concrete Mixer	cu.metre	14,224.00	4990.75	70,988,428.00	RHD Schedule of Rates, August 2015
28	05/02/02	High Yield Reinforcrmrnt Bars	Tonne	95,236.00	593.65	56,536,851.40	RHD Schedule of Rates, August 2015
66	LGED-7.09.1.10	50 mm Dia G.I Pipe	lin. Metre	992.85	422.50	419,479.13	LGED Schedule of Rates, July 2014

67	LGED-3.4.14	500 mm Thick Filter Materials	cu. metre	1,655.51	1719.60	2,846,815.00	LGED Schedule of Rates, July 2014
68	LGED.4.01.02	Making Earthen Ring/Cross bundth of required height (Bypass Road)	Lump sum	1.00	9202583.00	9,202,583.00	LGED Schedule of Rates, July 2014
Sub-total =						147,101,221.92	
Grand Total (All RCC Box Culvert)=						**150,489,811.62**	

Consultancy Services for Feasibility, Detailed Survey and Design of Chittagong Hill Tracts (CHT) Connectivity Connecting Thegamukh and Chittagong Port.

Rajosthali to Thegamukh = 109.670 km

Cost Estimation for Road Pavement (109.670 km)

Division 6 –Incidental **(All Prices in BDT)**

Sl. No.	Item Code	Item Description	Unit	Total Unit Price With TAX & VAT	Quantity	Total	Remarks
1	**2**	**3**	**4**	**5**		**7**	**8**
1	06/01/01	Grouted Riprap Pavement	sq. metre	2,178.00	1510.00	3,288,780.00	RHD Schedule of Rates, August 2015
2	06/01/02	Concrete slope Protection	sq. metre	1,499.00	2200.00	3,297,800.00	RHD Schedule of Rates, August 2015
3	06/01/03	Loose stone Riprap Protection	cu. Metre	5,309.00	730.00	3,875,570.00	RHD Schedule of Rates, August 2015
14	06/05/02	Road Marking-Road marking paint	sq. metre	412.00	5370.00	2,212,440.00	RHD Schedule of Rates, August 2015
15	06/05/03	Reflecting Road studs	Number	897.00	450.00	403,650.00	RHD Schedule of Rates, August 2015
20	*06/08/01	Guardrail	lin. Metre	8,656.00	2950.00	25,535,200.00	RHD Schedule of Rates, August 2015
23	06/10/01	Traffic Sign	Number	6,901.00	350.00	2,415,350.00	RHD Schedule of Rates, August 2015

24	06/10/02	Sign post	Number	3,073.00	560.00	1,720,880.00	RHD Schedule of Rates, August 2015
32	06/15/01	Concrete Guide post (1.6 m long, 200mm dia)	No.	2,068.00	365.00	754,820.00	RHD Schedule of Rates, August 2015
33	06/16/01	Concrete Kilometre post (As per drawing)	No.	8,656.00	110.00	952,160.00	RHD Schedule of Rates, August 2015
Sub-total =						44,456,650.00	
Rajoshtoli to Thegamukh (109.670km)					**Grand Total**	**44,456,650.00**	

Consultancy Services for Feasibility, Detailed Survey and Design of Chittagong Hill Tracts (CHT) Connectivity Connecting Thegamukh and Chittagong Port.

Rajosthali to Thegamukh = 109.670 km

Cost Estimation for Standard Drain Type - D6.U Drain

Division 2 – Earthwork **(All Prices in BDT)**

Sl. No.	Item Code	Item Description	Unit	Total Unit Price with TAX & VAT	Quantity	Total	Remarks
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
1	02/01/01	Clearing and Grubbing	sq. meter	45.00	1.00	45.00	RHD Schedule of Rates, August 2015
10	02/05/01	Excavation and backfill for Structures	cu. meter	360.00	0.650	234.00	RHD Schedule of Rates, August 2015
Sub-total =						279.00	

Division 5 –Structures

Sl. No.	Item Code	Item Description	Unit	Total Unit Price With TAX & VAT	Quantity	Total	Remarks
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
37	05/05/01	New and Extended Brickwork Joints	cu. metre	7,408.00	0.240	1,777.92	RHD Schedule of Rates, August 2015
71	LGED.5.12.01	12 mm thick plaster with NCF	sq. metre	236.13	1.400	330.58	LGED Schedule of Rates, July 2014
Sub-total =						2,108.50	
Standard drain Type -D6.U Drain					**(Per 1.00M)**	**2,387.50**	
Grand Total					**For 67950.00**	**162,230,760.90**	

Consultancy Services for Feasibility, Detailed Survey and Design of Chittagong Hill Tracts (CHT) Connectivity Connecting Thegamukh and Chittagong Port.

Rajosthali to Thegamukh = 109.670 km

Cost Estimation for Standard Drain Type - D5(V)

Division 2 – Earthwork **(All Prices in BDT)**

SL. No	Item Code	Item Description	Unit	Total Unit Price with TAX & VAT	Quantity	Total	Remarks
1	**2**	**3**	**4**	**5**	**6**	**7**	8
1	02/01/01	Clearing and Grubbing	sq. meter	45.00	0.40	18.00	RHD Schedule of Rates, August 2015
10	02/05/01	Excavation and backfill for Structures	cu. meter	360.00	0.308	110.88	RHD Schedule of Rates, August 2015
				Sub-total =		128.88	

Division 5 –Structures **(All Prices in BDT)**

Sl. No.	Item Code	Item Description	Unit	Total Unit Price With TAX & VAT	Quantity	Total	Remarks
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
3	05/01/02 (b)	Concrete class-20)Foundation) (Concrete Mixer)	cu.metre	11,925.00	0.129	1,538.33	RHD Schedule of Rates, August 2015
37	05/05/01	New and Extended Brickwork Joints	cu. metre	7,408.00	0.075	555.60	RHD Schedule of Rates, August 2015
71	LGED.5.12.01	12 mm thick plaster with NCF	sq. metre	236.13	1.744	411.81	LGED Schedule of Rates, July 2014
Sub-total =						2,505.74	
Standard drain Type V.-D5(A)				**(Per 1.00M)**		**2,634.62**	
Grand Total				**For 30550.00 M**		**80,487,510.25**	

Consultancy Services for Feasibility, Detailed Survey and Design of Chittagong Hill Tracts (CHT) Connectivity Connecting Thegamukh and Chittagong Port.

Rajosthali to Thegamukh = 109.670 km

Cost Estimation for Standard Drain Type - D6.U Drain with Cover Slab

Division 2 – Earthwork **(All Prices in BDT)**

SL. No	Item Code	Item Description	Unit	Total Unit Price with TAX & VAT	Quantity	Total	Remarks
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
1	02/01/01	Clearing and Grubbing	sq. meter	45.00	1.00	45.00	RHD Schedule of Rates, August 2015
10	02/05/01	Excavation and backfill for Structures	cu. meter	360.00	0.650	234.00	RHD Schedule of Rates, August 2015
Sub-total =						279.00	

Division 5 -Structures

Sl. No.	Item Code	Item Description	Unit	Total Unit Price With TAX & VAT	Quantity	Total	Remarks
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
6	05/01/02 (e)	Concrete class-20 (Deck slab, side walk, wheel guard, curb etc (Concrete Mixer)	cu.metre	14,177.00	0.25	3,544.25	RHD Schedule of Rates, August 2015
9	05/01/02 (h)	Concrete class -25 (Vertical member col, pier, abutmentment/ wing wall, Culvert etc) (Concrete Mixer	cu.metre	14,224.00	0.150	2,133.60	RHD Schedule of Rates, August 2015
28	05/02/02	High Yield Reinforcrmrnt Bars	Tonne	95,236.00	0.027	2,571.37	RHD Schedule of Rates, August 2015
37	05/05/01	New and Extended Brickwork Joints	cu. metre	7,408.00	0.240	1,777.92	RHD Schedule of Rates, August 2015
71	LGED.5.12.01	12 mm thick plaster with NCF	sq. metre	236.13	1.400	330.58	LGED Schedule of Rates, July 2014
Sub-total =						10,357.72	
Standard drain Type -D6.U Drain with Cover Slab				**(Per 1.00M)**		**10,636.72**	
Grand Total				**For 6050.00M**		**64,352,180.20**	

Consultancy Services for Feasibility, Detailed Survey and Design of Chittagong Hill Tracts (CHT) Connectivity Connecting Thegamukh and Chittagong Port.

Rajosthali to Thegamukh = 109.670 km

Cost Estimation for all RCC Retaining wall

SL. No	Height of wall	Length of wall in Meter	Taka	Total Taka	Remarks
1	**2**	**3**	**4**	**5**	**6**
1	3.00m	100.00	3,907,410.50	3,907,410.50	
2	4.00m	1200.00	75,988,980.00	75,988,980.00	
3	5.00m	350.00	31,856,845.65	31,856,845.65	
4	6.00m	650.00	83,516,239.30	83,516,239.30	
5	7.00m	850.00	173,681,994.30	173,681,994.30	
6	8.00m	250.00	58,367,636.25	58,367,636.25	
7	9.00m	1650.00	604,793,656.50	604,793,656.50	
8	10.00m	950.00	403,712,615.60	403,712,615.60	
Grand Total				**1,435,825,378.10**	

Consultancy Services for Feasibility, Detailed Survey and Design of Chittagong Hill Tracts (CHT) Connectivity Connecting Thegamukh and Chittagong Port.

Rajosthali to Thegamukh = 109.670 km

Cost Estimation for RCC Retaining wall.Height =3.00 m (Length considering = 1m)

Division 2 – Earthwork **(All Prices in BDT)**

SL. No	Item Code	Item Description	Unit	Total Unit Price with TAX & VAT	Quantity	Total	Remarks
1	2	3	4	5	6	7	8
1	02/01/01	Clearing and Grubbing	sq. meter	45.00	1.95	87.75	RHD Schedule of Rates, August 2015
3	02/02/02	Roadway Excavation in Suitable Soil	cu. meter	171.00	4.00	684.00	RHD Schedule of Rates, August 2015
12	02/05/03	Sand Backfill for Structure	cu. meter	1,174.00	0.585	686.79	RHD Schedule of Rates, August 2015
13	02/06/01(a)	Embankment Fill from Excavation on site	cu. meter	245.00	1.89	463.05	RHD Schedule of Rates, August 2015
				Sub-total =		1,921.59	

Division 3 - Pavement works

SL. No	Item Code	Item Description	Unit	Total Unit Price with TAX & VAT	Quantity	Total	Remarks
5	03/03/02	Aggregate Base Type ll	cu. meter	4,732.00	2.50	11,830.00	RHD Schedule of Rates, August 2015
				Sub-total =		11,830.00	

Division 5 -Structures

Sl. No.	Item Code	Item Description	Unit	Total Unit Price With TAX & VAT	Quantity	Total	Remarks
1	2	3	4	5	6	7	8

1	05/01/01	Single Layer Brick Flat Soling	sq.metre	468.00	1.70	795.60	RHD Schedule of Rates, August 2015
2	05/01/02 (a)	Concrete class as Detailed on Drawings (class 10) (Concrete Mixer)	cu.metre	8,466.00	0.127	1,075.18	RHD Schedule of Rates, August 2015
8	05/01/02 (g)	Concrete class -25 (Foundation) (Concrete Mixer)	cu.metre	12,379.00	0.633	7,835.91	RHD Schedule of Rates, August 2015
9	05/01/02 (h)	Concrete class -25 (Vertical member col, pier, abutmentment/ wing wall, Culvert etc) (Concrete Mixer	cu.metre	14,224.00	0.472	6,713.73	RHD Schedule of Rates, August 2015
28	05/02/02	High Yield Reinforcrmrnt Bars	Tonne	95,236.00	0.078	7,428.41	RHD Schedule of Rates, August 2015
70	LGED.4.3.22	Weep Hole	Number	330.13	3.00	990.39	LGED Schedule of Rates, July 2014
				Sub-total =		24,839.22	

Division 6 -Incidental

Sl. No.	Item Code	Item Description	Unit	Total Unit Price With TAX & VAT	Quantity	Total	Remarks
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
27	06/12/01	Geotextile Filter Fabric (as detailed on the drawings)	sq. metre	179.00	2.70	483.30	RHD Schedule of Rates, August 2015
				Sub-total =		483.30	

RCC Retaining wall.H =3.00m (Length=1.00 m) **39,074.11**

For 100.00 m Grand Total 3,907,410.50

Consultancy Services for Feasibility, Detailed Survey and Design of Chittagong Hill Tracts (CHT) Connectivity Connecting Thegamukh and Chittagong Port.

Rajosthali to Thegamukh = 109.670 km

Cost Estimation for RCC Retaining wall.Height =4.00 m (Length considering = 1m)

Division 2 – Earthwork **(All Prices in BDT)**

SL. No	Item Code	Item Description	Unit	Total Unit Price with TAX & VAT	Quantity	Total	Remarks
1	2	3	4	5	6	7	8
1	02/01/01	Clearing and Grubbing	sq. meter	45.00	2.55	114.75	RHD Schedule of Rates, August 2015
3	02/02/02	Roadway Excavation in Suitable Soil	cu. meter	171.00	5.65	966.49	RHD Schedule of Rates, August 2015
12	02/05/03	Sand Backfill for Structure	cu. meter	1,174.00	0.686	805.36	RHD Schedule of Rates, August 2015
13	02/06/01(a)	Embankment Fill from Excavation on site	cu. meter	245.00	3.307	810.22	RHD Schedule of Rates, August 2015
				Sub-total =		2,696.82	

Division 3 - Pavement works

SL. No	Item Code	Item Description	Unit	Total Unit Price with TAX & VAT	Quantity	Total	Remarks
5	03/03/02	Aggregate Base Type ll	cu. meter	4,732.00	3.70	17,508.40	RHD Schedule of Rates, August 2015
				Sub-total =		17,508.40	

Division 5 –Structures **(All Prices in BDT)**

Sl. No.	Item Code	Item Description	Unit	Total Unit Price With TAX & VAT	Quantity	Total	Remarks
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
1	05/01/01	Single Layer Brick Flat Soling	sq.metre	468.00	2.05	959.40	RHD Schedule of Rates, August 2015
2	05/01/02 (a)	Concrete class as Detailed on Drawings (class 10) (Concrete Mixer)	cu.metre	8,466.00	0.153	1,295.30	RHD Schedule of Rates, August 2015
8	05/01/02 (g)	Concrete class -25 (Foundation) (Concrete Mixer)	cu.metre	12,379.00	0.971	12,020.01	RHD Schedule of Rates, August 2015
9	05/01/02 (h)	Concrete class -25 (Vertical member col, pier, abutmentment/ wing wall, Culvert etc) (Concrete Mixer	cu.metre	14,224.00	0.912	12,972.29	RHD Schedule of Rates, August 2015
28	05/02/02	High Yield Reinforcrmrnt Bars	Tonne	95,236.00	0.139	13,237.80	RHD Schedule of Rates, August 2015
70	LGED.4.3.22	Weep Hole	Number	330.13	6.00	1,980.78	LGED Schedule of Rates, July 2014
				Sub-total =		42,465.58	

Division 6 -Incidental

Sl. No.	Item Code	Item Description	Unit	Total Unite Price With TAX & VAT	Quantity	Total	Remarks
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
27	06/12/01	Geotextile Filter Fabric (as detailed on the drawings)	sq. metre	179.00	3.65	653.35	RHD Schedule of Rates, August 2015
				Sub-total =		653.35	

RCC Retaining wall.H =4.00m (Length=1.00 m) **63,324.15**

For 1200.00m Grand Total 75,988,980.00

Consultancy Services for Feasibility, Detailed Survey and Design of Chittagong Hill Tracts (CHT) Connectivity Connecting Thegamukh and Chittagong Port.

Rajosthali to Thegamukh = 109.670 km

Cost Estimation for RCC Retaining wall.Height =5.00 m (Length considering = 1m)

Division 2 – Earthwork **(All Prices in BDT)**

Sl. No	Item Code	Item Description	Unit	Total Unit Price with TAX & VAT	Quantity	Total	Remarks
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
1	02/01/01	Clearing and Grubbing	sq. meter	45.00	3.15	141.75	RHD Schedule of Rates, August 2015
3	02/02/02	Roadway Excavation in Suitable Soil	cu. meter	171.00	8.39	1,435.20	RHD Schedule of Rates, August 2015

12	02/05/03	Sand Backfill for Structure	cu. meter	1,174.00	0.855	1,003.77	RHD Schedule of Rates, August 2015
13	02/06/01(a)	Embankment Fill from Excavation on site	cu. meter	245.00	5.28	1,293.60	RHD Schedule of Rates, August 2015
				Sub-total =		3,874.32	

Division 3 - Pavement works

Sl. No	Item Code	Item Description	Unit	Total Unit Price with TAX & VAT	Quantity	Total	Remarks
5	03/03/02	Aggregate Base Type ll	cu. meter	4,732.00	4.90	23,186.80	RHD Schedule of Rates, August 2015
				Sub-total =		23,186.80	

Division 5 –Structures **(All Prices in BDT)**

Sl. No	Item Code	Item Description	Unit	Total Unit Price With TAX & VAT	Quantity	Total	Remarks
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
1	05/01/01	Single Layer Brick Flat Soling	sq.metre	468.00	2.60	1,216.80	RHD Schedule of Rates, August 2015
2	05/01/02 (a)	Concrete class as Detailed on Drawings (class 10) (Concrete Mixer)	cu.metre	8,466.00	0.195	1,650.87	RHD Schedule of Rates, August 2015
8	05/01/02 (g)	Concrete class -25 (Foundation) (Concrete Mixer)	cu.metre	12,379.00	1.35	16,711.65	RHD Schedule of Rates, August 2015
9	05/01/02 (h)	Concrete class -25 (Vertical member col, pier, abutmentment/ wing wall, Culvert etc) (Concrete Mixer	cu.metre	14,224.00	1.380	19,629.12	RHD Schedule of Rates, August 2015
28	05/02/02	High Yield Reinforcrmrnt Bars	Tonne	95,236.00	0.231	21,999.52	RHD Schedule of Rates, August 2015
70	LGED.4.3.22	Weep Hole	Number	330.13	6.00	1,980.78	LGED Schedule of Rates, July 2014
				Sub-total =		63,188.74	

Division 6 –Incidental **(All Prices in BDT)**

Sl. No.	Item Code	Item Description	Unit	Total Unit Price With TAX & VAT	Quantity	Total	Remarks
1	2	3	4	5	6	7	8
27	06/12/01	Geotextile Filter Fabric (as detailed on the drawings)	sq. metre	179.00	4.30	769.70	RHD Schedule of Rates, August 2015
				Sub-total =		769.70	

RCC Retaining wall.H =5.00m (Length=1.00 m) **91,019.56**

For 350.00m Grand Total 31,856,845.65

Consultancy Services for Feasibility, Detailed Survey and Design of Chittagong Hill Tracts (CHT) Connectivity Connecting Thegamukh and Chittagong Port.

Rajosthali to Thegamukh = 109.670 km

Cost Estimation for RCC Retaining wall.Height =6.00 m (Length considering = 1m)

Division 2 – Earthwork **(All Prices in BDT)**

Sl. No	Item Code	Item Description	Unit	Total Unit Price with TAX & VAT	Quantity	Total	Remarks
1	2	3	4	5	6	7	8
1	02/01/01	Clearing and Grubbing	sq. meter	45.00	3.65	164.25	RHD Schedule of Rates, August 2015
3	02/02/02	Roadway Excavation in Suitable Soil	cu. meter	171.00	10.69	1,827.82	RHD Schedule of Rates, August 2015
12	02/05/03	Sand Backfill for Structure	cu. meter	1,174.00	0.983	1,154.04	RHD Schedule of Rates, August 2015
13	02/06/01(a)	Embankment Fill from Excavation on site	cu. meter	245.00	7.29	1,786.05	RHD Schedule of Rates, August 2015
				Sub-total =		4,932.16	

Division 3 - Pavement works **(All Prices in BDT)**

Sl. No	Item Code	Item Description	Unit	Total Unit Price with TAX & VAT	Quantity	Total	Remarks
5	03/03/02	Aggregate Base Type ll	cu. meter	4,732.00	6.00	28,392.00	RHD Schedule of Rates, August 2015
				Sub-total =		28,392.00	

Division 5 –Structures **(All Prices in BDT)**

Sl. No.	Item Code	Item Description	Unit	Total Unit Price With TAX & VAT	Quantity	Total	Remarks
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
1	05/01/01	Single Layer Brick Flat Soling	sq.metre	468.00	3.15	1,474.20	RHD Schedule of Rates, August 2015
2	05/01/02 (a)	Concrete class as Detailed on Drawings (class 10) (Concrete Mixer)	cu.metre	8,466.00	0.235	1,989.51	RHD Schedule of Rates, August 2015
8	05/01/02 (g)	Concrete class -25 (Foundation) (Concrete Mixer)	cu.metre	12,379.00	1.937	23,978.12	RHD Schedule of Rates, August 2015
9	05/01/02 (h)	Concrete class -25 (Vertical member col, pier, abutmentment/ wing wall, Culvert etc) (Concrete Mixer	cu.metre	14,224.00	1.925	27,381.20	RHD Schedule of Rates, August 2015
28	05/02/02	High Yield Reinforcrmrnt Bars	Tonne	95,236.00	0.393	37,427.75	RHD Schedule of Rates, August 2015
70	LGED.4.3.22	Weep Hole	Number	330.13	6.00	1,980.78	LGED Schedule of Rates, July 2014
				Sub-total =		94,231.56	

Division 6 –Incidental **(All Prices in BDT)**

Sl. No.	Item Code	Item Description	Unit	Total Unit Price With TAX & VAT	Quantity	Total	Remarks
1	2	3	4	5	6	7	8
27	06/12/01	Geotextile Filter Fabric (as detailed on the drawings)	sq. metre	179.00	5.20	930.80	RHD Schedule of Rates, August 2015
				Sub-total =		930.80	

RCC Retaining wall.H =6.00m (Length=1.00 m) **128,486.52**

For 650.00m Grand Total 83,516,239.30

Consultancy Services for Feasibility, Detailed Survey and Design of Chittagong Hill Tracts (CHT) Connectivity Connecting Thegamukh and Chittagong Port.

Rajosthali to Thegamukh = 109.670 km

Cost Estimation for RCC Retaining wall.Height =7.00 m (Length considering = 1m)

Division 2 – Earthwork **(All Prices in BDT)**

SL. No	Item Code	Item Description	Unit	Total Unit Price with TAX & VAT	Quantity	Total	Remarks
1	2	3	4	5	6	7	8
1	02/01/01	Clearing and Grubbing	sq. meter	45.00	4.51	202.77	RHD Schedule of Rates, August 2015
3	02/02/02	Roadway Excavation in Suitable Soil	cu. meter	171.00	14.90	2,547.56	RHD Schedule of Rates, August 2015

12	02/05/03	Sand Backfill for Structure	cu. meter	1,174.00	1.351	1,586.07	RHD Schedule of Rates, August 2015
13	02/06/01(a)	Embankment Fill from Excavation on site	cu. meter	245.00	14.213	3,482.19	RHD Schedule of Rates, August 2015
				Sub-total =		7,818.59	

Division 3 - Pavement works

SL. No	Item Code	Item Description	Unit	Total Unit Price with TAX & VAT	Quantity	Total	Remarks
5	03/03/02	Aggregate Base Type ll	cu. meter	4,732.00	7.26	34,363.78	RHD Schedule of Rates, August 2015
				Sub-total =		34,363.78	

Division 5 –Structures **(All Prices in BDT)**

Sl. No.	Item Code	Item Description	Unit	Total Unit Price With TAX & VAT	Quantity	Total	Remarks
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
1	05/01/01	Single Layer Brick Flat Soling	sq.metre	468.00	3.28	1,532.70	RHD Schedule of Rates, August 2015
2	05/01/02 (a)	Concrete class as Detailed on Drawings (class 10) (Concrete Mixer)	cu.metre	8,466.00	0.275	2,328.15	RHD Schedule of Rates, August 2015
8	05/01/02 (g)	Concrete class -25 (Foundation) (Concrete Mixer)	cu.metre	12,379.00	3.5	43,326.50	RHD Schedule of Rates, August 2015
9	05/01/02 (h)	Concrete class -25 (Vertical member col, pier, abutmentment/ wing wall, Culvert etc) (Concrete Mixer	cu.metre	14,224.00	3.465	49,286.16	RHD Schedule of Rates, August 2015
28	05/02/02	High Yield Reinforcrmrnt Bars	Tonne	95,236.00	0.654	62,284.34	RHD Schedule of Rates, August 2015

70	LGED.4.3.22	Weep Hole	Number	330.13	7.00	2,310.91	LGED Schedule of Rates, July 2014
				Sub-total =		161,068.76	

Division 6 –Incidental **(All Prices in BDT)**

Sl. No.	Item Code	Item Description	Unit	Total Unit Price With TAX & VAT	Quantity	Total	Remarks
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
27	06/12/01	Geotextile Filter Fabric (as detailed on the drawings)	sq. metre	179.00	6.04	1,080.62	RHD Schedule of Rates, August 2015
				Sub-total =		1,080.62	

RCC Retaining wall.H =7.00m (Length=1.00 m) **204,331.76**

For 850.00 m **Grand Total** **173,681,994.30**

Consultancy Services for Feasibility, Detailed Survey and Design of Chittagong Hill Tracts (CHT) Connectivity Connecting Thegamukh and Chittagong Port.

Rajosthali to Thegamukh = 109.670 km

Cost Estimation for RCC Retaining wall.Height =8.00 m (Length considering = 1m)

Division 2 – Earthwork **(All Prices in BDT)**

SL. No	Item Code	Item Description	Unit	Total Unit Price with TAX & VAT	Quantity	Total	Remarks
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
1	02/01/01	Clearing and Grubbing	sq. meter	45.00	5.15	231.75	RHD Schedule of Rates, August 2015

3	02/02/02	Roadway Excavation in Suitable Soil	cu. meter	171.00	17.03	2,911.62	RHD Schedule of Rates, August 2015
12	02/05/03	Sand Backfill for Structure	cu. meter	1,174.00	1.545	1,813.83	RHD Schedule of Rates, August 2015
13	02/06/01(a)	Embankment Fill from Excavation on site	cu. meter	245.00	16.244	3,979.78	RHD Schedule of Rates, August 2015
				Sub-total =		8,936.98	

Division 3 - Pavement works **(All Prices in BDT)**

SL. No	Item Code	Item Description	Unit	Total Unit Price with TAX & VAT	Quantity	Total	Remarks
5	03/03/02	Aggregate Base Type ll	cu. meter	4,732.00	8.30	39,275.60	RHD Schedule of Rates, August 2015
				Sub-total =		39,275.60	

Division 5 –Structures **(All Prices in BDT)**

Sl. No.	Item Code	Item Description	Unit	Total Unit Price With TAX & VAT	Quantity	Total	Remarks
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
1	05/01/01	Single Layer Brick Flat Soling	sq.metre	468.00	4.20	1,965.60	RHD Schedule of Rates, August 2015
2	05/01/02 (a)	Concrete class as Detailed on Drawings (class 10) (Concrete Mixer)	cu.metre	8,466.00	0.315	2,666.79	RHD Schedule of Rates, August 2015
8	05/01/02 (g)	Concrete class -25 (Foundation) (Concrete Mixer)	cu.metre	12,379.00	4	49,516.00	RHD Schedule of Rates, August 2015
9	05/01/02 (h)	Concrete class -25 (Vertical member col, pier, abutmentment/ wing wall, Culvert etc) (Concrete Mixer	cu.metre	14,224.00	3.960	56,327.04	RHD Schedule of Rates, August 2015
28	05/02/02	High Yield Reinforcrmrnt Bars	Tonne	95,236.00	0.748	71,236.53	RHD Schedule of Rates, August 2015

70	LGED.4.3.22	Weep Hole	Number	330.13	7.00	2,310.91	LGED Schedule of Rates, July 2014
				Sub-total =		184,022.87	

Division 6 –Incidental **(All Prices in BDT)**

Sl. No.	Item Code	Item Description	Unit	Total Unit Price With TAX & VAT	Quantity	Total	Remarks
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
27	06/12/01	Geotextile Filter Fabric (as detailed on the drawings)	sq. metre	179.00	6.90	1,235.10	RHD Schedule of Rates, August 2015
				Sub-total =		1,235.10	

RCC Retaining wall.H =8.00m (Length=1.00 m) **233,470.55**

For 250.00m Grand Total 58,367,636.25

Consultancy Services for Feasibility, Detailed Survey and Design of Chittagong Hill Tracts (CHT) Connectivity Connecting Thegamukh and Chittagong Port.
Rajosthali to Thegamukh = 109.670 km

Cost Estimation for RCC Retaining wall.Height =9.00 m (Length considering = 1m)

Division 2 – Earthwork **(All Prices in BDT)**

SL. No	Item Code	Item Description	Unit	Total Unit Price with TAX & VAT	Quantity	Total	Remarks
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
1	02/01/01	Clearing and Grubbing	sq. meter	45.00	6.15	276.75	RHD Schedule of Rates, August 2015
3	02/02/02	Roadway Excavation in Suitable Soil	cu. meter	171.00	25.22	4,312.96	RHD Schedule of Rates, August 2015

12	02/05/03	Sand Backfill for Structure	cu. meter	1,174.00	1.629	1,912.45	RHD Schedule of Rates, August 2015
13	02/06/01(a)	Embankment Fill from Excavation on site	cu. meter	245.00	14.985	3,671.33	RHD Schedule of Rates, August 2015
				Sub-total =		10,173.48	

Division 3 - Pavement works **(All Prices in BDT)**

SL. No	Item Code	Item Description	Unit	Total Unit Price with TAX & VAT	Quantity	Total	Remarks
5	03/03/02	Aggregate Base Type ll	cu. meter	4,732.00	9.80	46,373.60	RHD Schedule of Rates, August 2015
				Sub-total =		46,373.60	

Division 5 –Structures **(All Prices in BDT)**

Sl. No.	Item Code	Item Description	Unit	Total Unit Price With TAX & VAT	Quantity	Total	Remarks
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
1	05/01/01	Single Layer Brick Flat Soling	sq.metre	468.00	5.25	2,457.00	RHD Schedule of Rates, August 2015
2	05/01/02 (a)	Concrete class as Detailed on Drawings (class 10) (Concrete Mixer)	cu.metre	8,466.00	0.393	3,327.14	RHD Schedule of Rates, August 2015
8	05/01/02 (g)	Concrete class -25 (Foundation) (Concrete Mixer)	cu.metre	12,379.00	5.615	69,508.09	RHD Schedule of Rates, August 2015
9	05/01/02 (h)	Concrete class -25 (Vertical member col, pier, abutmentment/ wing wall, Culvert etc) (Concrete Mixer	cu.metre	14,224.00	5.062	72,001.89	RHD Schedule of Rates, August 2015
28	05/02/02	High Yield Reinforcrmrnt Bars	Tonne	95,236.00	1.666	158,663.18	RHD Schedule of Rates, August 2015

70	LGED.4.3.22	Weep Hole	Number	330.13	8.00	2,641.04	LGED Schedule of Rates, July 2014
				Sub-total =		308,598.33	

Division 6 –Incidental **(All Prices in BDT)**

Sl. No.	Item Code	Item Description	Unit	Total Unit Price With TAX & VAT	Quantity	Total	Remarks
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
27	06/12/01	Geotextile Filter Fabric (as detailed on the drawings)	sq. metre	179.00	7.80	1,396.20	RHD Schedule of Rates, August 2015
				Sub-total =		1,396.20	

RCC Retaining wall.H =9.00m (Length=1.00 m) **366,541.61**

For 1650.00m Grand Total 604,793,656.50

Consultancy Services for Feasibility, Detailed Survey and Design of Chittagong Hill Tracts (CHT) Connectivity Connecting Thegamukh and Chittagong Port.
Rajosthali to Thegamukh = 109.670 km

Cost Estimation for RCC Retaining wall.Height =10.00 m (Length considering = 1m)

Division 2 – Earthwork **(All Prices in BDT)**

Sl. No	Item Code	Item Description	Unit	Total Unit Price with TAX & VAT	Quantity	Total	Remarks
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
1	02/01/01	Clearing and Grubbing	sq. meter	45.00	7.15	321.75	RHD Schedule of Rates, August 2015
3	02/02/02	Roadway Excavation in Suitable Soil	cu. meter	171.00	26.10	4,463.44	RHD Schedule of Rates, August 2015

12	02/05/03	Sand Backfill for Structure	cu. meter	1,174.00	1.873	2,198.90	RHD Schedule of Rates, August 2015
13	02/06/01(a)	Embankment Fill from Excavation on site	cu. meter	245.00	20.305	4,974.73	RHD Schedule of Rates, August 2015
				Sub-total =		11,958.82	

Division 3 - Pavement works **(All Prices in BDT)**

SL. No	Item Code	Item Description	Unit	Total Unit Price with TAX & VAT	Quantity	Total	Remarks
5	03/03/02	Aggregate Base Type ll	cu. meter	4,732.00	10.90	51,578.80	RHD Schedule of Rates, August 2015
				Sub-total =		51,578.80	

Division 5 –Structures **(All Prices in BDT)**

Sl. No.	Item Code	Item Description	Unit	Total Unit Price With TAX & VAT	Quantity	Total	Remarks
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
1	05/01/01	Single Layer Brick Flat Soling	sq.metre	468.00	5.80	2,714.40	RHD Schedule of Rates, August 2015
2	05/01/02 (a)	Concrete class as Detailed on Drawings (class 10) (Concrete Mixer)	cu.metre	8,466.00	0.435	3,682.71	RHD Schedule of Rates, August 2015
8	05/01/02 (g)	Concrete class -25 (Foundation) (Concrete Mixer)	cu.metre	12,379.00	8.671	107,338.31	RHD Schedule of Rates, August 2015
9	05/01/02 (h)	Concrete class -25 (Vertical member col, pier, abutmentment/ wing wall, Culvert etc) (Concrete Mixer	cu.metre	14,224.00	6.820	97,007.68	RHD Schedule of Rates, August 2015
28	05/02/02	High Yield Reinforcrmrnt Bars	Tonne	95,236.00	1.535	146,187.26	RHD Schedule of Rates, August 2015

70	LGED.4.3.22	Weep Hole	Number	330.13	9.00	2,971.17	LGED Schedule of Rates, July 2014
				Sub-total =		359,901.53	

Division 6 –Incidental **(All Prices in BDT)**

Sl. No.	Item Code	Item Description	Unit	Total Unit Price With TAX & VAT	Quantity	Total	Remarks
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
27	06/12/01	Geotextile Filter Fabric (as detailed on the drawings)	sq. metre	179.00	8.50	1,521.50	RHD Schedule of Rates, August 2015
Sub-total =						1,521.50	
RCC Retaining wall.H =10.00m				**(Length=1.00 m)**		**424,960.65**	
Grand Total				**For 950.00m**		**403,712,615.60**	

iii) Environmental Management Action Plan Cost

iii) Environmental Management Action Plan Cost

Environmental Attributes	Mitigation Measures	Responsible Organization	Tk. in Million
Diversion of traffic	• Appropriate traffic diversion schemes shall be implemented so as to avoid inconvenience due to project operations to present road users, particularly during nighttimes. • Proper diversion schemes will ensure smooth traffic flow minimizes accidents, traffic snarl ups, and commotion. • The diversion signs should be bold and clearly visible particularly at night.	Consultants and contractors	30
Construction Camp Sites	• The construction campsites shall be away from any local human settlements and preferably located on lands, which are not productive barren/waste lands presently. The camps shall have adequate water supply, sanitation and all requisite infrastructure facilities. This would minimize dependence of construction personnel on outside resources, presently being used by local populace and minimize undesirable social friction thereof. • The camps shall have septic tank/soak pitof adequate capacity so that it can function properly for the entire duration of its use. • All construction camps shall have rationing facilities particularly for kerosene/LPG so that dependence on firewood for cooking is avoided completely to the extent possible. • The construction camps shall have health care facilities particularly for kerosene/LPG so that dependence on firewood for cooking is avoided completely to the extent possible. • The camps shall have septic tank/soak pit of adequate capacity so that it can function properly for the entire duration of its use. • All construction camps shall have rationing facilities particularly for kerosene/LPG so that dependence on firewood for cooking is avoided completely to the extent possible. • The construction camps shall have health care facilities for adults, pregnant women and children. • All construction personnel shall be subjected to routine vaccinations and other	Supervising engineer with contractor Department of the Environment	60

Environmental Attributes	Mitigation Measures	Responsible Organization	Tk. in Million
	preventive/ healthcare measures. • The construction camps shall have in house community/common entertainment facilities. Dependence of local entertainment outlets by construction camps should be discouraged /prohibited to the extent possible		
Work sites	• All personnel in work sites shall have protective gears like helmets, boots etc. so that injuries to personnel are minimized. • Children and pregnant women shall not be allowed to work under any circumstances. • No personnel shall be allowed to work at site for more than 10 hours per day (8 hour makes one work shift). Personnel who are likely to exposed to noise levels beyond stipulated limits shall be provided with protective gears like ear plugs etc and regularly rotated. • Regular water sprinkling of water shall be ensured so that dust levels are kept to minimum	Design consultants Supervising engineer with contractor and DoE	20
Construction Equipment Vehicles	• All equipment/vehicles deployed for construction activities shall be regularly maintained and not older than 5 years. • Vehicles/equipment shall be regularly subjected for emission tests and shall have valid POLLUTION UNDER CONTROL certificates. Revalidation of certificates shall be done once in a month. • All vehicles deployed for material movement shall be spill proof to the extent possible. • In any case all material movement routes shall be inspected daily twice to clear off any accidental spills.	Design consultants Supervising engineer with contractor and DoE	50
Water resources & Drainage channels	• Thel road construction will also require construction of several cross drainage structures, minor and major bridges to facilitate development in accordance with design requirements and standards. • Impacts arising out of construction of drainage structures is not likely to impact drainage pattern since under the road design, pattern of flow and discharge capacities of all drainage structures are reviewed and designed to negate any heading up or flooding problems.	Design consultants Supervising engineer with contractor and DoE	150

Environmental Attributes	Mitigation Measures	Responsible Organization	Tk. in Million
	• Impacts on water quality are not significant or either negligible since construction activities to be scheduled to complete during dry months of year. • Adequate precaution is to be taken to prevent oil/lubricant/hydrocarbon contamination of channel beds. Spillage if any shall be immediately cleared with utmost caution to leave no traces. • Channel beds are to be cleaned up (50 m u/s & 50 m d/s sides of water courses) and restored to its previous state after completion of construction but prior to onset of monsoon.		
Borrow areas	• Borrow areas identified / suggested during project preparation are to be investigated for presence of ecologically sensitive areas if any and cleared thereof. • Within these locations, the actual extent of area/zones to be excavated areas is to be demarcated with signboards. All such operational areas are to be access controlled particularly for locals and for grazing cattle. • Through this project, the borrow areas/pits may be converted into surface/ponds wherever possible, as a derivative of development. Some of the ponds could serve as source of water for agriculture, a practice prevalent in some part of the country. • The top soil recovered from newly acquired land areas for road construction is preserved and used for turfing of embankment(s) of project highway.	Supervising engineer with contractor	100
Air Quality	• All operational areas under the road construction works are to be regularly monitored (atleast ONCE in a season) for air quality parameters such as SPM, RPM, SO2, NOx, HC, CO etc. • This will ensure identification of operations/ areas of concern with regard to air pollution. Operational areas include, work sites, haulage roads, hot mix plants, quarries, borrow sites, human settlement etc. mitigation measures such water sprinkling for dust suppression, permitting construction equipment/vehicles having POLLUTION UNDER CONTROL certificates will reduce work area concentration of air pollutants like RPM, SO2, NOx, HC, CO etc. does not exceed permissible limits and therefore does not	Supervising engineer with contractor and DoE	20

Environmental Attributes	Mitigation Measures	Responsible Organization	Tk. in Million
	contribute to build up of pollutants		
Removal of trees	The most of the alignment of the road along the reserve forest and vegetation. Appreciable number of trees to be removed and further forest to be regenerated to replace the trees felled.	Forest Dept, Supervising engineer with contractor	300
Soil erosion and conservation	• Along rural roads the widening activities will raise, extend and enlarge existing roadway/tracks all along the alignment therefore mitigation measures to contain erosion and drainage problems are essential along RoW • Measures to ensure embankment stabilization including selection of less erodable material, good compaction, re-vegetation, placement of gabions or any suitable measures around bridges and culverts etc. (in case required) are included in technical specification and contract documents. The engineering measures for countering soil erosion, slope protection, drainage wherever required considered for project highway and detailed project report. • Many of impacts on soil due to road construction can be significantly mitigated by some of the following measures a) Minimizing area of ground clearance only to the extent required. b) Balancing the filling and cutting of earth to the extent possible. c) Avoiding creation of cut slopes and embankment which are of an angle greater than natural angle of repose for locally available soil type. d) Replanting disturbed area(s) immediately after disturbance due to construction has stopped and NOT after construction has been completed.	Design consultants Supervising engineer with contractor	150
Hot Mix Plants	• Hot mix plants shall be at least 1.5 km away from any human settlements and preferably located on leeward side. • Hot mix plants/sites shall be located on barren/uncultivable lands. Diversion of cultivable/agricultural lands, even preferred by local people for economic gain shall not be allowed unless otherwise warranted by specific local conditions.	Design consultants Supervising engineer with contractor and DoE	20
Loss of Fertile soil	• Clearing operations within RoW and at all places of operational areas like borrow areas, work areas, labour camps, construction of new/upgradation of existing to new haulage roads, hot mix plants, storage areas etc. shall consider	Design consultants Supervising engineer with contractor and	100

Environmental Attributes	Mitigation Measures	Responsible Organization	Tk. in Million
	preservation of fertile soil . • As a first option, topsoil should be restored to its initial place after the specific activity is completed for which the area was vacated, or for enriching some other place like embankment slopes for turfing/erosion protective measure. • The topsoil can also be used for supporting re-plantation activities within RoW/median.	DoE NGOs, LGED	
Location of campsites, storage depots	• The location of campsites, storage depots shall preferably on unproductive/barren lands, away from forest areas (minimum 1.5 km). • Use of agricultural/ cultivable lands shall not be allowed under any circumstances. • All fuel loading, unloading, storage areas shall be spill proof, leakage proof and carried out on paved areas. • The sites shall have suitable system to drain storm water, sanitary facilities and shall not contaminate any near by water courses/drains. • The site shall also have a system for handling any emergency situation like fire, explosion etc.	Design consultants Supervising engineer with contractor and DoE , LGED	30
Storage of hazardous materials	• All areas intended for storage of hazardous materials shall be quarantined and provided with adequate facilities to combat emergency situations. • The personnel in charge of such areas shall be properly trained, licensed and with sufficient experience. • The areas shall be access controlled and entry shall be allowed only under authorization	Supervising engineer with contractor and DoE, LGED	20
Total			**1050**

Total Taka 1050.00 Million. It is about 5% of total project cost which need to be added up for project costing.

The detail mitigation cost can be calculated based on detail engineering design of infrastructure facilities of the project. The following need to be included:

Temporary excavation and embankment

- Silt fence,
- Seeding,
- Stream by-pass system,
- Air quality (dust prevention)
- Erosion control and planting,
- High-visibility fencing,
- Additional fencing
- Tire/Wheel wash area

Any alterations to the roadway design needed to avoid or minimize wetland impacts:

- Retaining walls,
- Altered roadway alignment,
- Steeper side slopes,
- Guardrail
- Bridges ,
- Culvert installation

Volume IIB: Cost Estimate for Multimodal Route

i). Cost for Improvement of Existing Road (Chittagong to Rangamati)

ii). Cost for Improvement of Waterway (Rangamati to Chottoharina)

iii). Cost for Construction of New Proposed Road (Chottoharina to Thegamukh)

iv)Environmental Management Action Plan Cost

i). Cost for Improvement of Existing Road (Chittagong to Rangamati)

Consultancy Services for Feasibility, Detailed Survey and Design of Chittagong Hill Tracts (CHT) Connectivity Connecting Thegamukh and Chittagong Port.

Development/Rehabilitation Required on existing roads (Multimodal route) i.e. Chittagong port to Rangamati (72.51km)

Summary of Cost Estimation for all Division

SL. No	Name of Component	Division as per RHD & LGED	Total Taka (Including VAT & TAX)	Remarks
1	**2**	**3**	**4**	**5**
1	General	Division-1	N/A	
2	Road Pavement	Division-2	11443992.75	
		Division-3	107501638.00	
3	Bridges (PSC & RCC)	Division-2	529449.50	
		Division-4	6352496.50	
		Division-5	16574266.42	
4	Box Culvert	Division-2	N/A	
		Division-5	N/A	
5	RCC Retaining wall	Division-2,3,5 & 6	N/A	
6	Drain	Division-2 & 5	N/A	
7	Incidental	Division-6	N/A	
		Grand total=	**142,401,843.17**	
			142.40	**Million Taka**
			1.84	**Million US$**

Consultancy Services for Feasibility, Detailed Survey and Design of Chittagong Hill Tracts (CHT) Connectivity Connecting Thegamukh and Chittagong Port.

Development/Rehabilitation Required on existing roads (Multimodal route) i.e. Chittagong port to Rangamati.

Cost Estimation for Existing Roads (Multimodal route) Pavement (72.51 km)

Division 2- Earthwork **(All Prices in BDT)**

SL. No	Item Code	Item Description	Unit	Total Unit Price with TAX & VAT	Quantity	Total	Remarks
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
1	02/01/01	Clearing and Grubbing	sq. Metre	45.00	3100.00	139,500.00	RHD Schedule of Rates, August 2015
3	02/02/02	Roadway Excavation in Suitable Soil	cu. Metre	171.00	46179.00	7,896,609.00	RHD Schedule of Rates, August 2015
13	02/06/01(a)	Embankment Fill from Excavation on site	cu. Metre	245.00	11544.75	2,828,463.75	RHD Schedule of Rates, August 2015
26	02/12/01	Sub grade Drain	lin. Metre	270.00	2146.00	579,420.00	RHD Schedule of Rates, August 2015
					Sub-total =	**11,443,992.75**	

Division 3 - Pavement works

SL. No	Item Code	Item Description	Unit	Total Unit Price with TAX & VAT	Quantity	Total	Remarks
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
3	03/02/01	Sub-Base	cu. Metre	4,361.00	5776.00	25,189,136.00	RHD Schedule of Rates, August 2015

4	03/03/01	Aggregate Base Type l	cu. Metre	6,566.00	5090.00	33,420,940.00	RHD Schedule of Rates, August 2015
6	03/06/01(a)	Bituminous Prime Coat (Plant placed)	sq. Metre	123.00	26622.00	3,274,506.00	RHD Schedule of Rates, August 2015
9	03/07/01(b)	Bituminous Tack Coat (Labor intensive Work)	sq. Metre	44.00	25650.00	1,128,600.00	RHD Schedule of Rates, August 2015
18	03/10/01(b)	Dense Bituminous Surfacing-Base Course (Plant Method) (Bitumen Grade 60/70)	cu. Metre	19,906.00	1198.00	23,847,388.00	RHD Schedule of Rates, August 2015
20	03/10/02(b)	Dense Bituminous Surfacing-Wearing Course (Plant Method) (Bitumen Grade 60/70)	cu. Metre	20,118.00	1026.00	20,641,068.00	RHD Schedule of Rates, August 2015
Sub-total =						**107,501,638.00**	
Existing Road route= 72.51 Km					**Grand Total**	**118,945,630.75**	

Consultancy Services for Feasibility, Detailed Survey and Design of Chittagong Hill Tracts (CHT) Connectivity Connecting Thegamukh and Chittagong Port.

Development/Rehabilitation Required on existing roads (Multimodal route) i.e. Chittagong port to Rangamati.

Cost of RCC Bridge & Box Culvert

SL. No	Size of Bridge/Culvert in Metre	No of Bridge	TK/Bridge	Total Amount in BDT	Remarks
1	**2**	**3**	**4**	**5**	**6**
1	1x15 (Bridge)	1	20,250,421.72	20,250,421.72	RCC BRIDGE
2	3x3 (Box Culvert)	1	3,217,704.91	3,217,704.91	RCC BOX CULVERT
Total Taka				**23,468,126.62**	
Grand Total (All RCC & PSC Bridge**)**				**23,468,126.62**	

Consultancy Services for Feasibility, Detailed Survey and Design of Chittagong Hill Tracts (CHT) Connectivity Connecting Thegamukh and Chittagong Port.

Development/Rehabilitation Required on existing roads (Multimodal route) i.e. Chittagong port to Rangamati.

Cost of Estimation For All RCC Bridge & Box Culvert

Division 2 -Earthwork **(All Prices in BDT)**

Sl. No	Item Code	Item Description	Unit	Total Unit Price with TAX & VAT	Quantity	Total	Remarks
1	2	3	4	5	6	7	8
1	02/01/01	Clearing and Grubbing	sq. Metre	45.00	293.50	13,207.50	RHD Schedule of Rates, August 2015
10	02/05/01	Excavation and backfill for Structures	cu. Metre	360.00	1359.00	489,240.00	RHD Schedule of Rates, August 2015
12	02/05/03	Sand Backfill for Structure	cu. Metre	1,174.00	23.00	27,002.00	RHD Schedule of Rates, August 2015
Sub-total =						529,449.50	

Division 4 - Foundation works

Sl. No	Item Code	Item Description	Unit	Total Unit Price with TAX & VAT	Quantity	Total	Remarks
1	2	3	4	5	6	7	8
2	04/01/01(b)	Bored Cast in Place Piles (Dia. 600mm)	lin. Metre	4,595.00	690.50	3,172,847.50	RHD Schedule of Rates, August 2015
4	04/01/01(c)	Bored pile cast in place piles (dia 750mm)	lin. Metre	7,214.00		-	RHD Schedule of Rates, August 2015
4	04/01/01(d)	Bored pile cast in place piles (dia 900mm)	lin. Metre	10,651.00		-	RHD Schedule of Rates, August 2015
8	04/01/04	High yield Deformed Steel Reinforcing Bars	Tone	95,236.00	30.50	2,904,698.00	Pile Rebar
29	04/04/01 (c)	Load test on cast in place pile (For 200 Ton)	Number	274,951.00	1.00	274,951.00	RHD Schedule of Rates, August 2015
Sub-total =						6,352,496.50	

Division 5 –Structures **(All Prices in BDT)**

Sl. No.	Item Code	Item Description	Unit	Total Unit Price With TAX & VAT	Quantity	Total	Remarks
1	2	3	4	5	6	7	8
1	05/01/01	Single Layer Brick Flat Soling	sq.Metre	468.00	209.50	98,046.00	RHD Schedule of Rates, August 2015
2	05/01/02 (a)	Concrete class as Detailed on Drawings (class 10) (Concrete Mixer)	cu.Metre	8,466.00	20.50	173,553.00	RHD Schedule of Rates, August 2015
7	05/01/02 (f)	Concrete class-20 (rail & post)(concrete Mixer)	cu.Metre	16,862.00	7.00	118,034.00	RHD Schedule of Rates, August 2015
8	05/01/02 (g)	Concrete class -25 (Foundation) (Concrete Mixer)	cu.Metre	12,379.00	184.00	2,277,736.00	RHD Schedule of Rates, August 2015
9	05/01/02 (h)	Concrete class -25 (Vertical member col, pier, abutment/ wing wall, Culvert etc) (Concrete Mixer	cu.Metre	14,224.00	234.00	3,328,416.00	RHD Schedule of Rates, August 2015
10	05/01/02 (i)	Concrete class-25 (Deck, Curb, Approach slab and Parapet etc) (Concrete mixer)	cu.Metre	16,581.00	47.50	787,597.50	RHD Schedule of Rates, August 2015
12	05/01/02 (k)	Concrete class-30 (Deck slab, side walk, wheel guard, curb etc (Concrete Mixer)	cu.Metre	15,526.00	35.00	543,410.00	RHD Schedule of Rates, August 2015
14	05/01/02 (m)	Concrete class-40 (pre-stressed Girder) (Concrete Mixer)	cu.Metre	24,558.00		-	RHD Schedule of Rates, August 2015
28	05/02/02	High Yield Reinforcement Bars	Tone	95,236.00	53.00	5,047,508.00	RHD Schedule of Rates, August 2015
30	05/03/01	Prestressing Wire or Strand	Tone	273,590.00		-	RHD Schedule of Rates, August 2015
49	**05/08/01	Expansion joint complete as detailed on the Drawings in the location described in the BoQ. (Updated with new drawing/ 2014	lin. Metre	10,500.00	20.00	210,000.00	RHD Schedule of Rates, August 2015
58	05/13/01 (b)	Neoprene rubber bearing or Elastomeric bearing supplying & fitting fixing, etc.	Number	19,334.00	10.00	193,340.00	RHD Schedule of Rates, August 2015

66	LGED.4.3.22	Weep Hole	Number	330.13	124.00	40,936.12	LGED Schedule of Rates, July 2014
67	LGED.7.08.01.03	75 mm dia Rain Water Down Pipe	lin. Metre	322.85	5.00	1,614.25	LGED Schedule of Rates, July 2014
68	LGED.4.3.14	450 mm Thick Continuous Back Drain(Filter Materials)	cu. Metre	1,655.51	105.00	173,828.55	LGED Schedule of Rates, July 2014
69	LGED.4.01.02	Making Earthen Ring/Cross bundth of required height	Lump sum	1.00	2225175.00	2,225,175.00	LGED Schedule of Rates, July 2014
70	LGED.5.32.01.01, 3.11.08.09,3.12.02	Embankment protection (RCC Pile & CC Block)	Lump sum	1.00	1355072.00	1,355,072.00	LGED Schedule of Rates, July 2014
72	LGED-7.09.1.10	50 mm Dia G.I Pipe	lin. Metre	992.85	12.00	11,914.20	LGED Schedule of Rates, July 2014
Sub-total =						16,574,266.42	
All RCC & PSC Bridge					**Grand Total**	**23,456,212.42**	

ii). Cost for Improvement of Waterway (Rangamati to Chottoharina)

Consultancy Services for Feasibility, Detailed Survey and Design of Chittagong Hill Tracts (CHT) Connectivity Connecting Thegamukh and Chittagong Port.

Cost for Multimodal Route from Rangamati to Chottoharina (Waterway & Chottoharina to Thegamukh by Road)

Cost of Waterway

Dredging Cost **(All Prices in BDT)**

SL. No.	Description	Unit	Quantity	Rate Taka (Including VAT and TAX)	Amount (Taka)
1	Dredging from Rangamati to Barkal	m^3	1180000	250	295000000.00
2	Dredging from Barkal to Chottoharina	m^3	7080000	250	1770000000.00
3	Cost of Maintenance Dredging	m^3	247800	250	61950000.00
				Sub Total	**2126950000.00**
			Cost of Landing Facilities		
1	R.C.C Jetty	No	3	9060000	27180000.00
2	Pontoon (Big)	No	3	7490000	22470000.00
3	Pontoon(Small)	No	9	5498000	49482000.00
4	Spud	No	6	757550	4545300.00
5	One Terminal Building	No	3	14949834	44849502
6	One Semi Pucca Transit shed	No	3	600000	1800000.00
7	Tube-well(shallow)	No	3	80000	240000.00
8	Electric Connection	No	3	20000	60000.00
				Sub Total	**150626802.00**
1	Bank protection work		L.S		7000000.00
2	Other ancillary work		L.S		7000000.00
				Total	**2291576802.00**
				Million Taka	**2291.577**
				Million US$	**29.68**

Table 6.8.2 A

R. C. C. JETTY- Length - Straight 30 m Steping 42.56 m

Pile Length- 40.00 Rm Dia- 500 mm / Span Length - 5.0 m

SL. No.	Code No.	Description	Unit	Quantity	Rate	Amount in TK
01	BIWTA- Chapter-IV. 8(b)	Boring and Casting R. C. C. cast in situ pile up to Required depth	Rm	291.9	3207	936,123.30
02	LGED A 4.1.22.02	Supply best quality M. S. pipe with 6 mm thick wall 500 mm dia	Rm	128.1	8368.51	1,072,006.13
03	BIWTA- Chapter-IV.10	Labor for breaking head of cast in situ bored pile	cum	1.099	1864	2,048.54
04	BIWTA- Chapter-IV.17	Remove of soils/ mud	cum	57.285	392	22,455.72
05	BIWTA- Chapter-IV.18	Cast in situ pile with R.C.C.	cum	12.501	11058	138,236.06
06	BIWTA- Chapter- Iv. 19	Conducting static load test	No.	1	84508	84,508.00
07	BIWTA- Chapter-XII-2	M.S work in Reinforcement in all kind of R. C. C. work	Ton	17.311	77000	1,332,947.00
08	BIWTA- Chapter-IV-5	R. C. C. work (B. JETTY)	Cum	52.61	12649	665,463.89
09	BIWTA- Chapter-XII-2	M. S work in Reinforcement in all kind of R. C. C. work	Ton	7.329	77000	564,333.00
10	BIWTA- Chapter-XI-12	Wood work in Jetty, Bridge / Culvert	Cum	3.375	78856	266,139.00
11	BIWTA- Chapter-IV. 8(b)	Boring and Casting R. C. C. cast in situ pile up to Required depth	Rm	208.5	3207	668,659.50

12	BIWTA- Chapter-IV.10	Dismantling R. C. C.	cum	0.785	1864	1,463.24
13	BIWTA- Chapter-IV.17	Remove of soils/ mud	cum	40.918	392	16,039.86
14	BIWTA- Chapter-IV.18	Cast in situ pile with R.C.C.	cum	8.929	11058	98,736.88
15	BIWTA- Chapter-XII-2	M. S work in Reinforcement in all kind of R. C. C. work	Ton	11.965	77000	921,305.00
16	BIWTA- Chapter-IV-5	R. C. C. work (B. JETTY)	Cum	100.886	12649	1,276,107.01
17	BIWTA- Chapter-XII-2	M. S work in Reinforcement in all kind of R. C. C. work	Ton	12.821	77000	987,217.00
18	BIWTA- Chapter-XII-23	S. F. F. 152 mm long bolts & nuts	Ton	40.738	150	6,110.70
Total						**9059899.827**
						Tk. 9.06 million
Source: Cost from BIWTA Schedule of Rates						

Table 6.8.2 B

Cost for Construction of Pontoon
Size: 19.52 x 8.23 x 1.52 m (Big One)

SL. No.	Code No.	Description	Unit	Quantity	Rate	Amount in TK
01	BIWTA-Chapter-XII.1	M. S Sheet 8 mm think	ton	53.332	82600	4405223.2
02		Post. Φ75*9 mm	rm	1.123	50000	56150
03		Double Bollard	No.	4	50000	200000
04		Single Bollard	No.	6	30000	180000
05		Hatch in each Hold Cover	No.	8	5000	40000
06		Plastic Chair	No.	23	500	11500
07		Railing	l.s	1	50000	50000
08		Post. Φ-100 mm	rm	40.5	400	16200
09		Rooting Sheet	sqm	87.63	763	66861.69
10		Partition wall	sqm	41.54	1000	41540
11		Door	no.	3	4500	13500
12		Floor tiles + wall	sqm	9.72	1809	17583.48
13		Capstan	no.	2	100000	200000
14		Window grill with shutter	sqm	2.4	2150	5160
15	Wooden fender CH-XI.2/e	e/ Garjen	cum	0.539	90357	48702.423
Total						**5352420.793**
Manufacturing cost (40%) of total cost			40%			**2140968.317**
Grand Total						**7493389.11**
						Tk. 7.49 million
Source: Cost from BIWTA Schedule of Rates						

Cost for Construction of Pontoon **Size: 14.63 x 7.32 x 1.22 m (Small One)**						
SL. No.	**Code No.**	**Description**	**Unit**	**Quantity**	**Rate**	**Amount in TK.**
01	BIWTA-Chapter-XII-1	Pontoon	ton	37.329	82600	3083375.4
02		Post 75 mm Φ qmm thick	m	0.8	5000	4000
03		Double Bollard	no	4	50000	200000
04		Single Bollard	no.	6	30000	180000
05		Hatch in each Hold cover	no.	6	5000	30000
06		Plastic Chair	no.	18	500	9000
07		Railing	l.s	1	40000	40000
08		100 mm q	rm	40.5	400	16200
09		Rooting sult	sqm	65.134	763	49697.242
10		Partition wall	sqm	38.79	1000	38790
11	Size: 75*2.10		no.	3	4500	13500
12		Floor + wall tiles	sqm	9.72	1809	17583.48
13		capstan	no.	2	100000	200000
14		Window grill + shutter	sqm	2.7	2150	5805
15	CH-XI. 2.e	Wooden fender	cum	0.439	90357	39666.723
Total						**3927617.845**
Manufacturing cost (40%) of total cost			40%			**1571047.138**
Grand Total						**5498664.983**
						Tk. 5.499 million
Source: Cost from BIWTA Schedule of Rates						

Table 6.8.2 C

Cost for Construction of SPUD (6 nos.) Length each 17m & 10 m

SL. No.	Code No.	Description	Unit	Quantity	Rate	Amount in TK
01	BIWTA-Chapter-XII.43	Construction of spud ring 1 Metre	no	12	42100	505200
02	BIWTA-53	Fabrication& supply 762 mm dia SPUD	m	3*2*27	19650	3183300
03	BIWTA-Chapter-XII.54	Driving 22" to 30" dia spud	m	3*2*17	8400	856800
Total						**4545300**
						Tk. 4.54 million

Source: Cost from BIWTA Schedule of Rates

Consultancy Services for Feasibility, Detailed Survey and Design of Chittagong Hill Tracts (CHT) Connectivity Connecting Thegamukh and Chittagong Port

SUMMARY OF DETAILED COST ESTIMATE OF TERMINAL BUILDING

Civil work						
Sl. No.	**Item Code (PWD)**	**Item Description**	**Unit**	**Quantity**	**Rate in Taka**	**Total Amount (Taka)**
1	02.1.1	Layout and marking	Sqm	160.06	11.00	1760.61
2	02.1.5	Earth work excavation	Cum	45.95	166.00	7627.21
3	02.10.1	Sand filling in Plinth	Cum	62.56	602.00	37659.23
4	02.16.4.1	Site Development	Cum	288.37	217.16	62623.34
5	02.13	Earth filling in foundation	Cum	17.35	114.00	1978.16
6	03.1	Single Layer BFS	Sqm	55.96	355.00	19867.15
7	03.4.1	Mass concreat (1:3:6)	Cum	0.54	6319.00	3433.31
8	03.7	Single Layer Polythine Sheet	Sqm	160.06	34.00	5441.89
9	09.12.3	Driving pre cast pile (300mm x 300mm size)	Sqm	914.63	584.00	534146.34
10	09.9.2	Pre cast pile RCC (300mm x 300mm size)	Rm	914.63	1176.00	1075609.76
11	09.4	Providing Point Welding	Point	16200.00	584.00	9460800.00
12	09.5	Providing Splice Welding	Rm	14.63	472.83	6919.46
13	08.1.2	Reinforcement (Pile)	Kg	1856.98	85.00	157843.51
14		**RCC Work**				
		(A) Pile Cap				
	07.7.1.1	a/ Concrete	Cum	26.07	10526.00	274412.82
	07.7.1.2	b/ Form work	Sqm	52.68		
		(B) Padestal				
	07.6.4	a/ Concrete	Cum	2.53	10626.00	26883.78
	07.4.1.2	b/ Form work	Sqm	21.00	412.00	8652.80
		C/ G. beam				
	07.6.3.1	a/ Concrete	Cum	7.10	10526.00	74692.48
	07.6.3.2	b/ Form work	Sqm	76.70	355.00	27227.01

		D/ Stair case/ slab & step				
	07.6.10.1	a/ Concrete	Cum	22.76	10794.00	245671.44
	07.6.10.2	b/ Form work	Sqm	26.41	381.00	10062.21
15	08.1.2	Reinforcement (Pile & others)	Kg	6860.74	85.00	583163.05
16		**RCC work**				0.00
		A/ Column				0.00
	07.6.4.1	a/ Concrete	Cum	6.40	10626.00	67960.89
	07.4.4.2	b/ Form work	Sqm	63.19	412.00	26033.15
		B/ Tie beam/ Lintel				0.00
	07.4.5.1	a/ Concrete	Cum	0.58	7722.00	4442.91
	07.4.5.2	b/ Form work	Sqm	12.00	394.00	4729.26
		C/ Tee beam/ Rectangular beam				0.00
	07.04.6.1	a/ Concrete	Cum	9.19	7319.00	67273.05
	07.04.6.2	b/ Form work	Sqm	101.60	485.00	49275.27
		D/ In floor and roof slab				0.00
	07.4.7.1	a/ Concrete	Cum	38.32	7319.00	280459.90
	07.4.7.2	b/ Form work	Sqm	282.48	559.00	157904.18
		E/ False seiling etc.				0.00
	07.4.9.1	a/ Concrete	Cum	0.53	7587.00	4039.20
	07.4.9.2	b/ Form work	Sqm	5.33	395.00	2106.97
17	8.1.2	S. F. & F. Reinforcement	Kg	29055.42	85.00	2469710.60
18	4.2	10" thick brick work	Cum	18.79	7637.00	143477.99
19	4.19	5" thick brick work	Sqm	60.79	1499.00	91124.06
20	15.4	1/2" thick plaster (inside)	Sqm	180.22	199.00	35863.42
21	15.4	1/2" thick plaster (Out side)	Sqm	96.26	199.00	19155.28
22	15.5	1/4" 6mm thick plaster (In side)	Sqm	367.15	186.00	68289.90
23	15.1	Drip course/ Nosing	Rm	66.62	91.00	6062.04
24	6.6	Glazed wall tiles	Sqm	35.66	1230.00	43861.05
25	6.8	Floor tiles	Sqm	154.40	1509.00	232987.31
26	11.1	Door window chowkat (Silkarai)	Cum	0.20	159093.00	32036.41
27	11.2	M.S. Flat bar	Nos.	24.00	86.00	2064.00
28	12.2	Door shutter (Gamari)	Sqm	6.56	5354.00	35140.45
29	14.6	Aluminium sliding window	Sqm	15.06	2620.00	39446.10
30	14.14.1	5mm thick clear glass	Sqm	15.06	1077.00	16215.06

31	12.22	S.F.F. Hydrolic door closer	Nos.	2.00	2521.00	5042.00
32	12.23.1	S.F.F Mortic lock	Nos.	4.00	1620.00	6480.00
33	12.23.1	S.F.F Pad lock	Nos.	4.00	550.00	2200.00
34	19.1.3	S.F.F Collapsible gate	Sqm	10.84	4876.00	52847.50
35	16.8.1	Plastic emulsion paint	Sqm	235.43	159.00	37433.23
36	16.4	Weather coat	Sqm	132.92	189.00	25121.05
37	16.1	White wash	Sqm	275.12	18.00	4952.14
38	16.6	Synthetic enamel paint	Sqm	27.10	183.00	4958.52
					Total Taka =	**13,284,554.17**
Sanitary work						
01	26.5.1.1	S.F.F Long pan	No.	2.00	1902.00	3804.00
02	26.7	S.F.F Plastic lawdown	No.	2.00	2017.00	4034.00
03	26.9.1.4	S.F.F Wash basin	No.	2.00	1997.69	3995.38
04	26.12.1	S.F.F Padestal	No.	2.00	1091.00	2182.00
05	26.18	S.F.F Mirror	No.	2.00	786.00	1572.00
06	26.2	S.F.F Glass self	No.	2.00	1258.00	2516.00
07	1074	S.F.F Towel rail	No.	2.00	537.00	1074.00
08	26.26.1	S.F.F Soap tray	No.	2.00	211.00	422.00
09	26.24.1	S.F.F Paper holder	No.	2.00	192.00	384.00
10	26.54.1	S.F.F Bib cock	No.	2.00	682.00	1364.00
11	26.55.1	S.F.F Piller cock	No.	2.00	840.00	1680.00
12	26.63.1	S.F.F Angle stop cock	No.	4.00	789.00	3156.00
13	26.36	100mm dia PVC soil pipe	Rm	9.15	739.00	6759.15
14	26.52.1	S.F.F uPVC Trap	No.	4.00	1109.00	4436.00
15		S.F.F 125mm floor gratings	No.			0.00
16		**S.F.F uPVC pressure pipe for water supply**				
	26.39.1	a/ 12mm dia	Rm	6.10	152.00	926.83
	26.39.3	b/ 25mm dia	Rm	4.57	214.00	978.66
17	26.48.3	G.I gate valve (A) 25mm dia	No.	1.00	617.00	617.00
18	26.43.2	S.F.F uPVC soil pipe (A) 150mm dia	Rm	9.15	724.00	6621.95
19	26.75.3	Inspection pit	No.	3.00	6882.00	20646.00
20	26.76.3	Inspection pit cover	No.	3.00	1734.00	5202.00

21	26.79.2	Septic tank (100 users)	No.	1.00	183339.00	183339.00
22	26.80.2	Soak well (100 users)	No.	1.00	67733.00	67733.00
23	26.67.1	S.F.F. Plastic over head water tank (1000 Liter)	No.	1.00	13381.00	13381.00
					Total Taka =	**336,823.97**
Electrical work						
		Total Civil work Amount Taka x 10%				**1,328,455.42**
					Grand Total =	**14,949,833.55**

iii). Cost for Construction of New Proposed Road (Chottoharina to Thegamukh)

Consultancy Services for Feasibility, Detailed Survey and Design of Chittagong Hill Tracts (CHT) Connectivity Connecting Thegamukh and Chittagong Port.

Chottoharina to Thegamukh = 7.370 km (Road Part of Multimodal Route)

Summary of Cost Estimation for all Division

SL. No	Name of Component	Division as per RHD & LGED	Total Taka (Including VAT & TAX)	Remarks
1	**2**	**3**	**4**	**5**
1	General	Division-1	21058941.00	
2	Road Pavement	Division-2	789628180.85	
		Division-3	312618255.29	
3	Bridges (PSC & RCC)	Division-2	1955857.50	
		Division-4	34362497.50	
		Division-5	61810356.69	
4	Box Culvert	Division-2	N/A	
		Division-5	N/A	
5	RCC Retaining wall	Division-2,3,5 & 6	219924966.00	
6	Drain	Division-2 & 5	31330639.92	
7	Incidental	Division-6	3063339.99	
Grand total			**1,475,753,034.74**	
			1,475.75	**Million Taka**
			19.12	**Million US$**

Consultancy Services for Feasibility, Detailed Survey and Design of Chittagong Hill Tracts (CHT) Connectivity Connecting Thegamukh and Chittagong Port.

Chottoharina to Thegamukh = 7.370 km

Cost Estimation for Road Pavement (7.370 km)

Division 1 -General & Facilities **(All Prices in BDT)**

SL. No	Item Code	Item Description	Unit	Total Unit Price with TAX & VAT	Quantity	Total	Remarks
1	2	3	4	5	6	7	8
1	01/01/01	Maintenance and Protection of Traffic	Lump Sum	80,257.00	1	80,257.00	RHD Schedule of Rates, August 2015
2	01/01/02	Maintain Temp.Structures& Equipment for the Maintenance of Traffic	Day	1,913.00	1095	2,094,735.00	RHD Schedule of Rates, August 2015
3	01/02/01	Supply Erect and Remove Field Office for Engineers	Lump Sum	249,497.00	1	249,497.00	RHD Schedule of Rates, August 2015
4	01/02/02	Maintenance, Staffing, Security and Clearing of the field office for the Engineers	Month	11,000.00	36	396,000.00	RHD Schedule of Rates, August 2015
5	01/02/03	Provision of Office Equipment and Consumables	Month	7,700.00	36	277,200.00	RHD Schedule of Rates, August 2015
6	01/02/04	Provision, Maintenance and Removal of Sign Boards	Lump Sum	8,849.00	1	8,849.00	RHD Schedule of Rates, August 2015
7	01/02/05	Provision and Maintenance of Survey Equipment	Month	897.00	36	32,292.00	RHD Schedule of Rates, August 2015
8	01/02/07	Progress Photographs	Month	1,000.00	36	36,000.00	RHD Schedule of Rates, August 2015
9	01/03/01	Provide and Remove Site Laboratory & Equipment	Lump Sum	331,843.00	36	11,946,348.00	RHD Schedule of Rates, August 2015
10	01/03/02	Maintain Site Laboratory	Month	7,699.00	1	7,699.00	RHD Schedule of Rates, August 2015
11	*01/03/03	Special or Additional Test	Pro. Sum	0	36	-	RHD Schedule of Rates, August 2015
12	01/04/01	Saloon Car 12000cc Capacity	Month	55,000.00		-	RHD Schedule of Rates, August 2015
13	01/04/02	Pick-up (Double Cab)	Month	66,000.00	36	2,376,000.00	RHD Schedule of Rates, August 2015

14	01/04/03	Four Wheel Drive Vehicle Min. 6 seats	Month	77,799.00	36	2,800,764.00	RHD Schedule of Rates, August 2015
15	01/04/04	Motor Cycle 125cc	Month	4,425.00	36	159,300.00	RHD Schedule of Rates, August 2015
16	01/04/05	Motor Boat min. 5m length	Month	16,500.00	36	594,000.00	RHD Schedule of Rates, August 2015
Sub-total =						21,058,941.00	
Harina to Thegamukh (7.370km)					**Grand Total**	**21,058,941.00**	

Consultancy Services for Feasibility, Detailed Survey and Design of Chittagong Hill Tracts (CHT) Connectivity Connecting Thegamukh and Chittagong Port.

Chottoharina to Thegamukh = 7.370 km

Cost Estimation for Road Pavement (7.370 km)

Division 2- Earthwork **(All Prices in BDT)**

SL. No	Item Code	Item Description	Unit	Total Unit Price with TAX & VAT	Quantity	Total	Remarks
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
1	02/01/01	Clearing and Grubbing	sq. Metre	45.00	102000.80	4,590,036.00	RHD Schedule of Rates, August 2015
3	02/02/02	Roadway Excavation in Suitable Soil	cu. Metre	171.00	4465326.87	763,570,893.92	RHD Schedule of Rates, August 2015
13	02/06/01(a)	Embankment Fill from Excavation on site	cu. Metre	245.00	87313.96	21,391,920.94	RHD Schedule of Rates, August 2015
26	02/12/01	Sub grade Drain	lin. Metre	270.00	479.00	129,330.00	RHD Schedule of Rates, August 2015
Sub-total =						**789,682,180.85**	

Division 3 - Pavement works

SL. No	Item Code	Item Description	Unit	Total Unit Price with TAX & VAT	Quantity	Total	Remarks
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
3	03/02/01	Sub-Base	cu. Metre	4,361.00	14180.80	61,842,474.25	RHD Schedule of Rates, August 2015
4	03/03/01	Aggregate Base Type l	cu. Metre	6,566.00	15059.21	98,878,769.18	RHD Schedule of Rates, August 2015
6	03/06/01(a)	Bituminous Prime Coat (Plant placed)	sq. Metre	123.00	77163.90	9,491,159.70	RHD Schedule of Rates, August 2015
9	03/07/01(b)	Bituminous Tack Coat (Labor intensive Work)	sq. Metre	44.00	76500.60	3,366,026.40	RHD Schedule of Rates, August 2015
14	03/09/02(b)	Double Bituminous Surface Treatment -20mm nominal size aggregate followed by 10mm (Machine Method) (Bituminous Grade 60/70)	sq. Metre	407.00	22110.00	8,998,770.00	RHD Schedule of Rates, August 2015
18	03/10/01(b)	Dense Bituminous Surfacing-Base Course (Plant Method) (Bitumen Grade 60/70)	cu. Metre	19,906.00	3456.53	68,805,686.18	RHD Schedule of Rates, August 2015
20	03/10/02(b)	Dense Bituminous Surfacing-Wearing Course (Plant Method) (Bitumen Grade 60/70)	cu. Metre	20,118.00	3043.81	61,235,369.58	RHD Schedule of Rates, August 2015
Sub-total =						**312,618,255.29**	
Chottoharina to Thegamukh (7.370 km)					**Grand Total**	**1,102,300,436.14**	

Consultancy Services for Feasibility, Detailed Survey and Design of Chittagong Hill Tracts (CHT) Connectivity Connecting Thegamukh and Chittagong Port.

Chottoharina to Thegamukh (7.370 km)

Summary of Cost Estimation For All RCC & PSC Bridge

Division 2 -Earthwork **(All Prices in BDT)**

Sl. No	Item Code	Item Description	Unit	Total Unit Price with TAX & VAT	Quantity	Total	Remarks
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
1	02/01/01	Clearing and Grubbing	sq. Metre	45.00	705.50	31,747.50	RHD Schedule of Rates, August 2015
10	02/05/01	Excavation and backfill for Structures	cu. Metre	360.00	5344.00	1,923,840.00	RHD Schedule of Rates, August 2015
Sub-total =						1,955,587.50	

Division 4 - Foundation works

Sl. No	Item Code	Item Description	Unit	Total Unit Price with TAX & VAT	Quantity	Total	Remarks
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
2	04/01/01(b)	Bored Cast in Place Piles (Dia. 600mm)	lin. Metre	4,595.00	690.50	3,172,847.50	RHD Schedule of Rates, August 2015
4	04/01/01(c)	Bored pile cast in place piles (dia 750mm)	lin. Metre	7,214.00	895.00	6,456,530.00	RHD Schedule of Rates, August 2015
4	04/01/01(d)	Bored pile cast in place piles (dia 900mm)	lin. Metre	10,651.00	899.00	9,575,249.00	RHD Schedule of Rates, August 2015

8	04/01/04	High yield Deformed Steel Reinforcing Bars	Tone	95,236.00	150.50	14,333,018.00	Pile Rebar, RHD Schedule of Rates, August 2015
29	04/04/01 (c)	Load test on crst in place pile (For 200 Ton)	Number	274,951.00	3.00	824,853.00	RHD Schedule of Rates, August 2015
Sub-total =						34,362,497.50	

Division 5 –Structures **(All Prices in BDT)**

Sl. No.	Item Code	Item Description	Unit	Total Unit Price With TAX & VAT	Quantity	Total	Remarks
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
1	05/01/01	Single Layer Brick Flat Soling	sq.Metre	468.00	504.50	236,106.00	RHD Schedule of Rates, August 2015
2	05/01/02 (a)	Concrete class as Detailed on Drawings (class 10) (Concrete Mixer)	cu.Metre	8,466.00	38.50	325,941.00	RHD Schedule of Rates, August 2015
7	05/01/02 (f)	Concrete class-20 (rail & post)(concrete Mixer)	cu.Metre	16,862.00	49.00	826,238.00	RHD Schedule of Rates, August 2015
8	05/01/02 (g)	Concrete class -25 (Foundation) (Concrete Mixer)	cu.Metre	12,379.00	552.00	6,833,208.00	RHD Schedule of Rates, August 2015
9	05/01/02 (h)	Concrete class -25 (Vertical member col, pier, abutment/ wing wall, Culvert etc) (Concrete Mixer	cu.Metre	14,224.00	520.50	7,403,592.00	RHD Schedule of Rates, August 2015
10	05/01/02 (i)	Concrete class-25 (Girder, Cross girder &diaphragm etc) (Concrete mixer)	cu.Metre	16,581.00	70.00	1,160,670.00	RHD Schedule of Rates, August 2015
12	05/01/02 (k)	Concrete class-30 (Deck slab, side walk, wheel guard, curb etc (Concrete Mixer)	cu.Metre	15,526.00	197.00	3,058,622.00	RHD Schedule of Rates, August 2015
14	05/01/02 (m)	Concrete class-40 (pre-stressed Girder) (Concrete Mixer)	cu.Metre	24,558.00	325.10	7,983,805.80	RHD Schedule of Rates, August 2015

28	05/02/02	High Yield Reinforcement Bars	Tone	95,236.00	183.10	17,437,711.60	RHD Schedule of Rates, August 2015
30	05/03/01	Prestressing Wire or Strand	Tone	273,590.00	14.55	3,981,828.86	RHD Schedule of Rates, August 2015
49	**05/08/01	Expansion joint complete as detailed on the Drawings in the location described in the BoQ. (Updated with new drawing/ 2014	lin. Metre	10,500.00	60.00	630,000.00	RHD Schedule of Rates, August 2015
58	05/13/01 (b)	Neoprene rubber bearing or Elastomeric bearing supplying & fitting fixing, etc.	Number	19,334.00	30.00	580,020.00	RHD Schedule of Rates, August 2015
66	LGED.4.3.22	Weep Hole	Number	330.13	372.00	122,808.36	LGED Schedule of Rates, July 2014
67	LGED.7.08.01.03	75 mm dia Rain Water Down Pipe	lin. Metre	322.85	30.00	9,685.50	LGED Schedule of Rates, July 2014
68	LGED.4.3.14	450 mm Thick Continuous Back Drain(Filter Materials)	cu. Metre	1,655.51	331.50	548,801.57	LGED Schedule of Rates, July 2014
69	LGED.4.01.02	Making Earthen Ring/Cross bundth of required height	Lump sum	1.00	6597102.00	6,597,102.00	LGED Schedule of Rates, July 2014
70	LGED.5.32.01.01, 3.11.08.09,3.12.02	Embankment protection (RCC Pile & CC Block)	Lump sum	1.00	4065216.00	4,065,216.00	LGED Schedule of Rates, July 2014
Sub-total =						61,801,356.69	

All RCC & PSC Bridge

Grand Total= 98,119,441.69

Consultancy Services for Feasibility, Detailed Survey and Design of Chittagong Hill Tracts (CHT) Connectivity Connecting Thegamukh and Chittagong Port.
Chottoharina to Thegamukh = 7.370 km

Cost Estimation for Road Pavement (7.370 km)

Division 6 –Incidental **(All Prices in BDT)**

Sl. No.	Item Code	Item Description	Unit	Total Unit Price With TAX & VAT	Quantity	Total	Remarks
1	2	3	4	5	6	7	8
1	06/01/01	Grouted Riprap Pavement	sq. Metre	2,178.00	103.90	226,292.20	RHD Schedule of Rates, August 2015
2	06/01/02	Concrete slope Protection	sq. Metre	1,499.00	151.38	226,912.84	RHD Schedule of Rates, August 2015
3	06/01/03	Loose stone Riprap Protection	cu. Metre	5,309.00	50.23	266,667.66	RHD Schedule of Rates, August 2015
14	06/05/02	Road Marking-Road marking paint	sq. Metre	412.00	369.50	152,232.11	RHD Schedule of Rates, August 2015
15	06/05/03	Reflecting Road studs	Number	897.00	31.00	27,807.00	RHD Schedule of Rates, August 2015
20	*06/08/01	Guardrail	lin. Metre	8,656.00	202.98	1,757,009.17	RHD Schedule of Rates, August 2015
23	06/10/01	Traffic Sign	Number	6,901.00	24.00	165,624.00	RHD Schedule of Rates, August 2015
24	06/10/02	Sign post	Number	3,073.00	39.00	119,847.00	RHD Schedule of Rates, August 2015
32	06/15/01	Concrete Guide post (1.6 m long, 200mm dia)	No.	2,068.00	25.00	51,700.00	RHD Schedule of Rates, August 2015

33	06/16/01	Concrete KiloMetre post (As per drawing)	No.	8,656.00	8.00	69,248.00	RHD Schedule of Rates, August 2015
Sub-total =						3,063,339.99	

Harina to Thegamukh (7.370km) ,**Grand Total =3,063,339.99**

Consultancy Services for Feasibility, Detailed Survey and Design of Chittagong Hill Tracts (CHT) Connectivity Connecting Thegamukh and Chittagong Port.

Chottoharina to Thegamukh = 7.370 km

Cost Estimation for all RCC Retaining wall

SL. No	Height of wall	Length of wall in Metre	Taka	Total Taka	Remarks
1	**2**	**3**	**4**	**5**	**6**
1	9.00m	1650.00	219,924,966.00	219,924,966.00	
Grand Total=				**219,924,966.00**	

Consultancy Services for Feasibility, Detailed Survey and Design of Chittagong Hill Tracts (CHT) Connectivity Connecting Thegamukh and Chittagong Port.
Chottoharina to Thegamukh = 7.370 km

Cost Estimation for RCC Retaining wall. Height =9.00 m (Length considering = 1m)

Division 2 – Earthwork **(All Prices in BDT)**

SL. No	Item Code	Item Description	Unit	Total Unit Price with TAX & VAT	Quantity	Total	Remarks
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
1	02/01/01	Clearing and Grubbing	sq. Metre	45.00	6.15	276.75	RHD Schedule of Rates, August 2015
3	02/02/02	Roadway Excavation in Suitable Soil	cu. Metre	171.00	25.22	4,312.96	RHD Schedule of Rates, August 2015
12	02/05/03	Sand Backfill for Structure	cu. Metre	1,174.00	1.629	1,912.45	RHD Schedule of Rates, August 2015
13	02/06/01(a)	Embankment Fill from Excavation on site	cu. Metre	245.00	14.985	3,671.33	RHD Schedule of Rates, August 2015
Sub-total =						10,173.48	

Division 3 - Pavement works

SL. No	Item Code	Item Description	Unit	Total Unit Price with TAX & VAT	Quantity	Total	Remarks
5	03/03/02	Aggregate Base Type ll	cu. Metre	4,732.00	9.80	46,373.60	RHD Schedule of Rates, August 2015
Sub-total =						46,373.60	

Division 5 –Structures **(All Prices in BDT)**

Sl. No.	Item Code	Item Description	Unit	Total Unit Price With TAX & VAT	Quantity	Total	Remarks
1	**2**	**3**	**4**	**5**	**6**	**7**	8
1	05/01/01	Single Layer Brick Flat Soling	sq. Metre	468.00	5.25	2,457.00	RHD Schedule of Rates, August 2015
2	05/01/02 (a)	Concrete class as Detailed on Drawings (class 10) (Concrete Mixer)	cu. Metre	8,466.00	0.393	3,327.14	RHD Schedule of Rates, August 2015
8	05/01/02 (g)	Concrete class -25 (Foundation) (Concrete Mixer)	cu. Metre	12,379.00	5.615	69,508.09	RHD Schedule of Rates, August 2015
9	05/01/02 (h)	Concrete class -25 (Vertical member col, pier, abutment/ wing wall, Culvert etc) (Concrete Mixer	cu. Metre	14,224.00	5.062	72,001.89	RHD Schedule of Rates, August 2015
28	05/02/02	High Yield Reinforcement Bars	Tone	95,236.00	1.666	158,663.18	RHD Schedule of Rates, August 2015
70	LGED.4.3.22	Weep Hole	Number	330.13	8.00	2,641.04	LGED Schedule of Rates, July 2014
Sub-total =						308,598.33	

Division 6 -Incidental

Sl. No.	Item Code	Item Description	Unit	Total Unit Price With TAX & VAT	Quantity	Total	Remarks
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
27	06/12/01	Geo-textile Filter Fabric (as detailed on the drawings)	sq. Metre	179.00	7.80	1,396.20	RHD Schedule of Rates, August 2015
Sub-total =						1,396.20	

RCC Retaining wall. H =9.00m (Length=1.00 m) **366,541.61**

For 600.00 Grand Total 219,924,966.00

Consultancy Services for Feasibility, Detailed Survey and Design of Chittagong Hill Tracts (CHT) Connectivity Connecting Thegamukh and Chittagong Port.

Chottoharina to Thegamukh (7.370 km)

Cost Estimation for Standard Drain Type - D5(V)

Division 2 -Earthwork **(All Prices in BDT)**

SL. No	Item Code	Item Description	Unit	Total Unit Price with TAX & VAT	Quantity	Total	Remarks
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
1	02/01/01	Clearing and Grubbing	sq. Metre	45.00	0.40	18.00	RHD Schedule of Rates, August 2015
10	02/05/01	Excavation and backfill for Structures	cu. Metre	360.00	0.308	110.88	RHD Schedule of Rates, August 2015
Sub-total =						128.88	

Division 5 -Structures

Sl. No.	Item Code	Item Description	Unit	Total Unit Price With TAX & VAT	Quantity	Total	Remarks
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
3	05/01/02 (b)	Concrete class-20)Foundation) (Concrete Mixer)	cu. Metre	11,925.00	0.129	1,538.33	RHD Schedule of Rates, August 2015
37	05/05/01	New and Extended Brickwork Joints	cu. Metre	7,408.00	0.075	555.60	RHD Schedule of Rates, August 2015
71	LGED.5.12.01	12 mm thick plaster with NCF	sq. Metre	236.13	1.744	411.81	LGED Schedule of Rates, July 2014
Sub-total =						2,505.74	

For,**300.00 Grand Total =790,384.72**

Consultancy Services for Feasibility, Detailed Survey and Design of Chittagong Hill Tracts (CHT) Connectivity Connecting Thegamukh and Chittagong Port.

Chottoharina to Thegamukh (7.370 km)

Cost Estimation for Standard Drain Type - D6.U Drain with Cover Slab

Division 2 -Earthwork **(All Prices in BDT)**

Sl. No	Item Code	Item Description	Unit	Total Unit Price with TAX & VAT	Quantity	Total	Remarks
1	2	3	4	5	6	7	8
1	02/01/01	Clearing and Grubbing	sq. Metre	45.00	1.00	45.00	RHD Schedule of Rates, August 2015
10	02/05/01	Excavation and backfill for Structures	cu. Metre	360.00	0.650	234.00	RHD Schedule of Rates, August 2015
Sub-total =						279.00	

Division 5 -Structures

Sl. No.	Item Code	Item Description	Unit	Total Unit Price With TAX & VAT	Quantity	Total	Remarks
6	05/01/02 (e)	Concrete class-20 (Deck slab, side walk, wheel guard, curb etc (Concrete Mixer)	cu.Metre	14,177.00	0.25	3,544.25	RHD Schedule of Rates, August 2015
9	05/01/02 (h)	Concrete class -25 (Vertical member col, pier, abutment/ wing wall, Culvert etc) (Concrete Mixer	cu.Metre	14,224.00	0.150	2,133.60	RHD Schedule of Rates, August 2015
28	05/02/02	High Yield Reinforcement Bars	Tone	95,236.00	0.027	2,571.37	RHD Schedule of Rates, August 2015
37	05/05/01	New and Extended Brickwork Joints	cu. Metre	7,408.00	0.240	1,777.92	RHD Schedule of Rates, August 2015
71	LGED.5.12.01	12 mm thick plaster with NCF	sq. Metre	236.13	1.400	330.58	LGED Schedule of Rates, July 2014
Sub-total =						10,357.72	

Standard drain Type -D6.U Drain with Cover Slab	**1.00 M**			**10,636.72**
	For	**1300.00**	**Grand Total**	**13,827,741.20**

Consultancy Services for Feasibility, Detailed Survey and Design of Chittagong Hill Tracts (CHT) Connectivity Connecting Thegamukh and Chittagong Port.

Chottoharina to Thegamukh (7.370 km)

Cost Estimation for Standard Drain Type - D6.U Drain

Division 2 -Earthwork **(All Prices in BDT)**

Sl. No	Item Code	Item Description	Unit	Total Unit Price with TAX & VAT	Quantity	Total	Remarks
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
1	02/01/01	Clearing and Grubbing	sq. Metre	45.00	1.00	45.00	RHD Schedule of Rates, August 2015
10	02/05/01	Excavation and backfill for Structures	cu. Metre	360.00	0.650	234.00	RHD Schedule of Rates, August 2015
Sub-total =						279.00	

Division 5 -Structures

Sl. No.	Item Code	Item Description	Unit	Total Unit Price With TAX & VAT	Quantity	Total	Remarks
37	05/05/01	New and Extended Brickwork Joints	cu. Metre	7,408.00	0.240	1,777.92	RHD Schedule of Rates, August 2015
71	LGED.5.12.01	12 mm thick plaster with NCF	sq. Metre	236.13	1.400	330.58	LGED Schedule of Rates, July 2014
Sub-total =						2,108.50	
Standard drain Type -D6.U Drain				**For 1.00 M**		**2,387.50**	
Grand Total				**For 7000.00M**		**16,712,514.00**	

iv) Environmental Management Action Plan Cost

iv) Environmental Management Action Plan Cost

EMP Cost Matrix: Environmental Management Action Plan for Pre-Construction & Construction Phases (Water Ways: Rangamati-Chhotoharina)

Environmental Attributes	Mitigation Measures	Responsible Organization	Tk. in Million
Diversion of traffic	• Appropriate traffic diversion schemes shall be implemented so as to avoid inconvenience due to project operations to present road users, particularly during nighttimes during dredging of navigational channel. • Proper diversion schemes will ensure smooth traffic flow minimizes accidents, traffic snarl ups, and commotion. • The diversion signs should be displayed and be clearly visible particularly at night.	Consultants and contractors	20
Dredge Material Disposal	• The disposed material to be in a convenient location so that does not return to the channel. Toxic material if found should be contained and dispose off with care and processing	Design consultants Supervising engineer with contractor	15
Dredging Work Sites	• The dredging camp sites shall be away from any local human settlements, Fishing area, and shelter of fish. The camps shall have adequate water supply, sanitation and all requisite infrastructure facilities. This would minimize dependence of construction personnel on outside resources, presently being used by local populace and minimize undesirable social friction thereof. • The work site shall have septic tank/soak pit of adequate capacity so that it can function properly for the entire duration of its use. • All sites have rationing facilities particularly for kerosene/LPG so that dependence on firewood for cooking is avoided completely to the extent possible. • The sites shall have health care facilities particularly for kerosene/LPG so that dependence on firewood for cooking is avoided completely to the extent possible. • The sites shall have health care facilities • All workers shall be subjected to routine vaccinations and other preventive/ healthcare measures. • The sites shall have in house community/common entertainment facilities. Dependence of local entertainment outlets by construction camps should be discouraged /prohibited to the extent possible	Supervising engineer with contractor Department of the Environment	35
Dredging Work sites	• All personnel in work sites shall have protective gears like helmets, boots etc. so	Design consultants	1

Environmental Attributes	Mitigation Measures	Responsible Organization	Tk. in Million
	that injuries to personnel are minimized. • Children and pregnant women shall not be allowed to work under any circumstances. • No personnel shall be allowed to work at site for more than 10 hours per day (8 hour makes one work shift). Personnel who are likely to exposed to noise levels beyond stipulated limits shall be provided with protective gears like ear plugs etc and regularly rotated. • Regular water sprinkling of water shall be ensured so that dust levels are kept to minimum	Supervising engineer with contractor and DoE	
Construction Equipment Vessel	• All equipment/vessel deployed for dredging activities shall be regularly maintained and not older than 5 years. • Vessel/equipment shall be regularly subjected for emission tests and shall have valid POLLUTION UNDER CONTROL certificates. Revalidation of certificates shall be done once in a month. • All vessels deployed for material movement shall be spill proof to the extent possible. • In any case all material movement navigation routes shall be inspected daily twice to clear off any accidental spills.	Design consultants Supervising engineer with contractor and DoE	3
Total			**74**

EMP Cost Matrix: Environmental Management Action Plan for Pre-Construction & Construction Phases (Road Route: Chhotoharina-Thegamukh)

Environmental Attributes	Mitigation Measures	Responsible Organization	Tk. in Million
Diversion of traffic	• Appropriate traffic diversion schemes shall be implemented so as to avoid inconvenience due to project operations to present road users, particularly during nighttimes during dredging of navigational channel.. • Proper diversion schemes will ensure smooth traffic flow minimizes accidents, traffic snarl ups, and commotion. • The diversion signs should be displayed and be clearly visible particularly at night.	Consultants and contractors	5

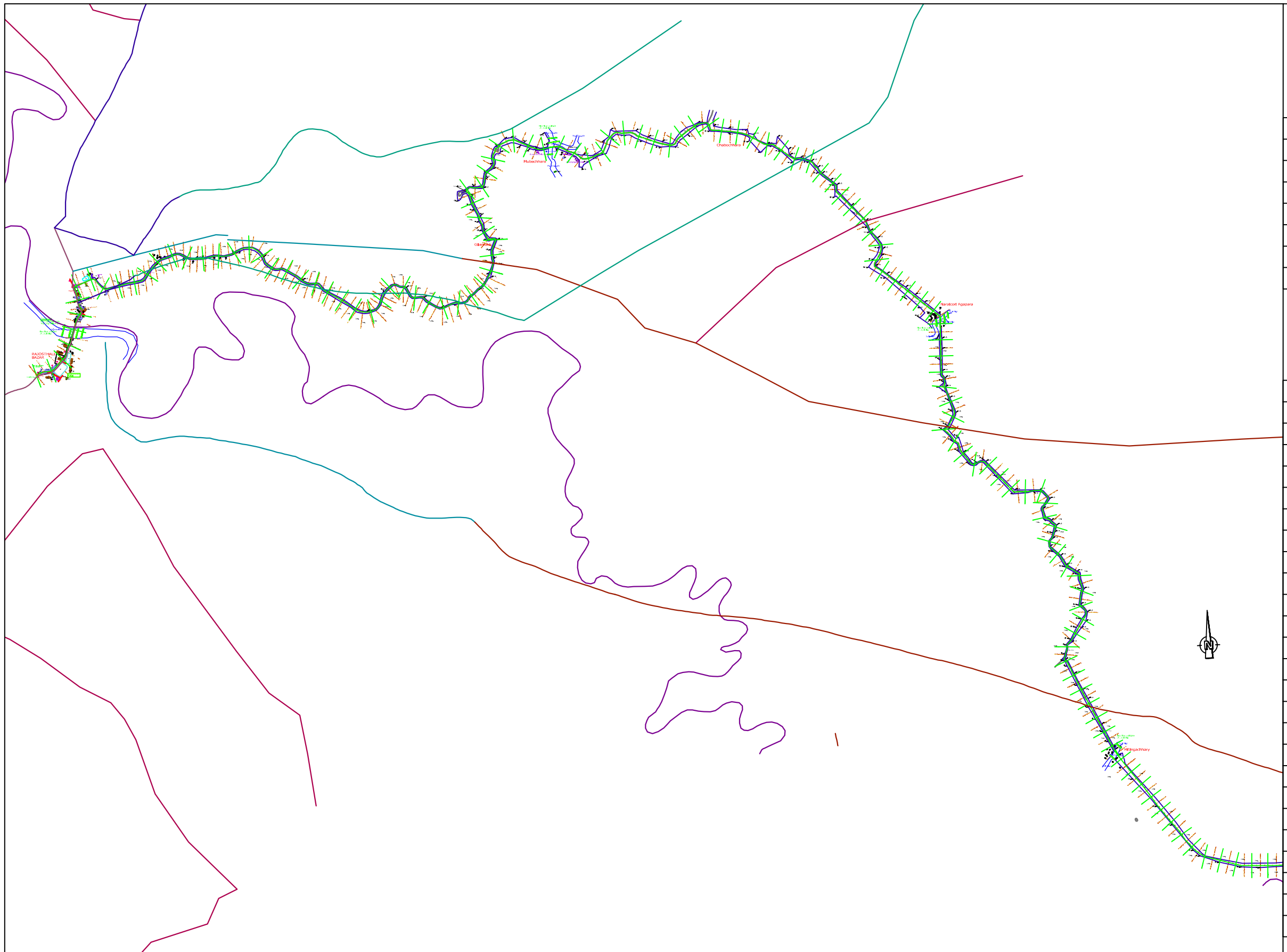
Environmental Attributes	Mitigation Measures	Responsible Organization	Tk. in Million
Construction Camp Sites	• The construction camp sites shall be away from any local human settlements and preferably located on lands, which are not productive barren/waste lands presently. The camps shall have adequate water supply, sanitation and all requisite infrastructure facilities. This would minimize dependence of construction personnel on outside resources, presently being used by local populace and minimize undesirable social friction thereof. • The camps shall have septic tank/soak pit of adequate capacity so that it can function properly for the entire duration of its use. • All construction camps shall have rationing facilities particularly for kerosene/LPG so that dependence on firewood for cooking is avoided completely to the extent possible. • The construction camps shall have health care facilities particularly for kerosene/LPG so that dependence on firewood for cooking is avoided completely to the extent possible. • The camps shall have septic tank/soak pit of adequate capacity so that it can function properly for the entire duration of its use. • All construction camps shall have rationing facilities particularly for kerosene/LPG so that dependence on firewood for cooking is avoided completely to the extent possible. • The construction camps shall have health care facilities • All construction personnel shall be subjected to routine vaccinations and other preventive/ healthcare measures. • The construction camps shall have in house community/common entertainment facilities. Dependence of local entertainment outlets by construction camps should be discouraged /prohibited to the extent possible	Supervising engineer with contractor Department of the Environment	5
Work sites	• All personnel in work sites shall have protective gears like helmets, boots etc. so that injuries to personnel are minimized. • Children and pregnant women shall not be allowed to work under any circumstances. • No personnel shall be allowed to work at site for more than 10 hours per day (8 hour makes one work shift). Personnel who are likely to exposed to noise levels beyond stipulated limits shall be provided with protective gears like ear plugs etc and regularly rotated.	Design consultants Supervising engineer with contractor and DoE	3

Environmental Attributes	Mitigation Measures	Responsible Organization	Tk. in Million
	• Regular water sprinkling of water shall be ensured so that dust levels are kept to minimum		
Construction Equipment Vehicles	• All equipment/vehicles deployed for construction activities shall be regularly maintained and not older than 5 years. • Vehicles/equipment shall be regularly subjected for emission tests and shall have valid POLLUTION UNDER CONTROL certificates. Revalidation of certificates shall be done once in a month. • All vehicles deployed for material movement shall be spill proof to the extent possible. • In any case all material movement routes shall be inspected daily twice to clear off any accidental spills.	Design consultants Supervising engineer with contractor and DoE	3
Water resources & Drainage channels	• The road construction will also require construction of several cross drainage structures, minor and major bridges to facilitate development in accordance with design requirements and standards. • Impacts arising out of construction of drainage structures is not likely to impact drainage pattern since under the road design, pattern of flow and discharge capacities of all drainage structures are reviewed and designed to negate any heading up or flooding problems. • Impacts on water quality are not significant or either negligible since construction activities to be scheduled to complete during dry months of year. • Adequate precaution is to be taken to prevent oil/lubricant/hydrocarbon contamination of channel beds. Spillage if any shall be immediately cleared with utmost caution to leave no traces. • Channel beds are to be cleaned up (50 m u/s & 50 m d/s sides of water courses) and restored to its previous state after completion of construction but prior to onset of monsoon.	Design consultants Supervising engineer with contractor and DoE	20
Borrow areas	• Borrow areas identified / suggested during project preparation are to be investigated for presence of ecologically sensitive areas if any and cleared thereof. • Within these locations, the actual extent of area/zones to be excavated areas is to be demarcated with signboards. All such operational areas are to be access controlled particularly for locals and for grazing cattle. • Through this project, the borrow areas/pits may be converted into surface/ponds wherever possible, as a derivative of development. Some of the ponds could serve as	Supervising engineer with contractor	10

Environmental Attributes	Mitigation Measures	Responsible Organization	Tk. in Million
	source of water for agriculture, a practice prevalent in some part of the country. • The top soil recovered from newly acquired land areas for road construction is preserved and used for turfing of embankment(s) of project highway.		
Removal of trees	• The most of the alignment of the road along the reserve forest and vegetation. Appreciable number of trees to be removed and further forest to be regenerated to replace the trees felled.	Forest Dept, Supervising engineer with contractor	20
Soil erosion and conservation	• Along rural roads the widening activities will raise, extend and enlarge existing roadway/tracks all along the alignment therefore mitigation measures to contain erosion and drainage problems are essential along RoW • Measures to ensure embankment stabilization including selection of less erodable material, good compaction, re-vegetation, placement of gabions or any suitable measures around bridges and culverts etc. (in case required) are included in technical specification and contract documents. The engineering measures for countering soil erosion, slope protection, drainage wherever required considered for project highway and detailed project report. • Many of impacts on soil due to road construction can be significantly mitigated by some of the following measures a) Minimizing area of ground clearance only to the extent required. b) Balancing the filling and cutting of earth to the extent possible. c) Avoiding creation of cut slopes and embankment which are of an angle greater than natural angle of repose for locally available soil type. d) Replanting disturbed area(s) immediately after disturbance due to construction has stopped and NOT after construction has been completed.	Design consultants Supervising engineer with contractor	10
Hot Mix Plants	• Hot mix plants shall be at least 1.5 km away from any human settlements and preferably located on leeward side. • Hot mix plants/sites shall be located on barren/uncultivable lands. Diversion of cultivable/agricultural lands, even preferred by local people for economic gain shall not be allowed unless otherwise warranted by specific local conditions.	Design consultants Supervising engineer with contractor and DoE	2
Loss of Fertile soil	• Clearing operations within RoW and at all places of operational areas like borrow areas, work areas, labour camps, construction of new/upgradation of existing to new haulage roads, hot mix plants, storage areas etc. shall consider preservation of fertile soil . • As a first option, topsoil should be restored to its initial place after the specific	Design consultants Supervising engineer with contractor and DoE NGOs, LGED	7

Environmental Attributes	Mitigation Measures	Responsible Organization	Tk. in Million
	activity is completed for which the area was vacated, or for enriching some other place like embankment slopes for turfing/erosion protective measure. • The topsoil can also be used for supporting re-plantation activities within RoW/median.		
Storage of hazardous materials	• All areas intended for storage of hazardous materials shall be quarantined and provided with adequate facilities to combat emergency situations. • The personnel in charge of such areas shall be properly trained, licensed and with sufficient experience. • The areas shall be access controlled and entry shall be allowed only under authorization	Supervising engineer with contractor and DoE, LGED	2
Total			**87**

Total Mitigation Cost: 74+87 = 161 Million Taka.



Legend (Existing Road)

Zila Road	
Upazila Road Pacca	
Upazila Road Katcha	
Union Road Pacca	
Union Road Katcha	
Regional Highway	
Village Road A Pacca	
Village Road A Katcha	

Legend (Proposed Alignmnet)

Primary Benchmarks	
Secondary/Temporary Benchmarks	
Bridge	
Building	
Semi-Pacca	
Shed	
Shop	
Shohidminar	
Chainage	CH-000.00m
Chhara	
Culvert	
Ditch	
Drain	
Electric Post	EP
Fence	
Gate	
Institution (School/Collage/Mosque/Temple Etc)	
Grave Yard	
Hill Toe	
Island	
Pond	
River	
Pacca Road	
Earthen Road	
RCC Road	
Herring Bond Bricks (HBB) Road	
Alignment Road Route 1	

NAME OF THE CLIENT :
GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH
LOCAL GOVERNMENT ENGINEERING DEPARTMENT

NAME OF THE PROJECT :
CONSULTANCY SERVICES FOR FEASIBILITY, DETAILED SURVEY AND DESIGN OF CHITTAGONG HILL TRACT CONNECTIVITY CONNECTING THEGAMUKH AND CHITTAGONG PORT.

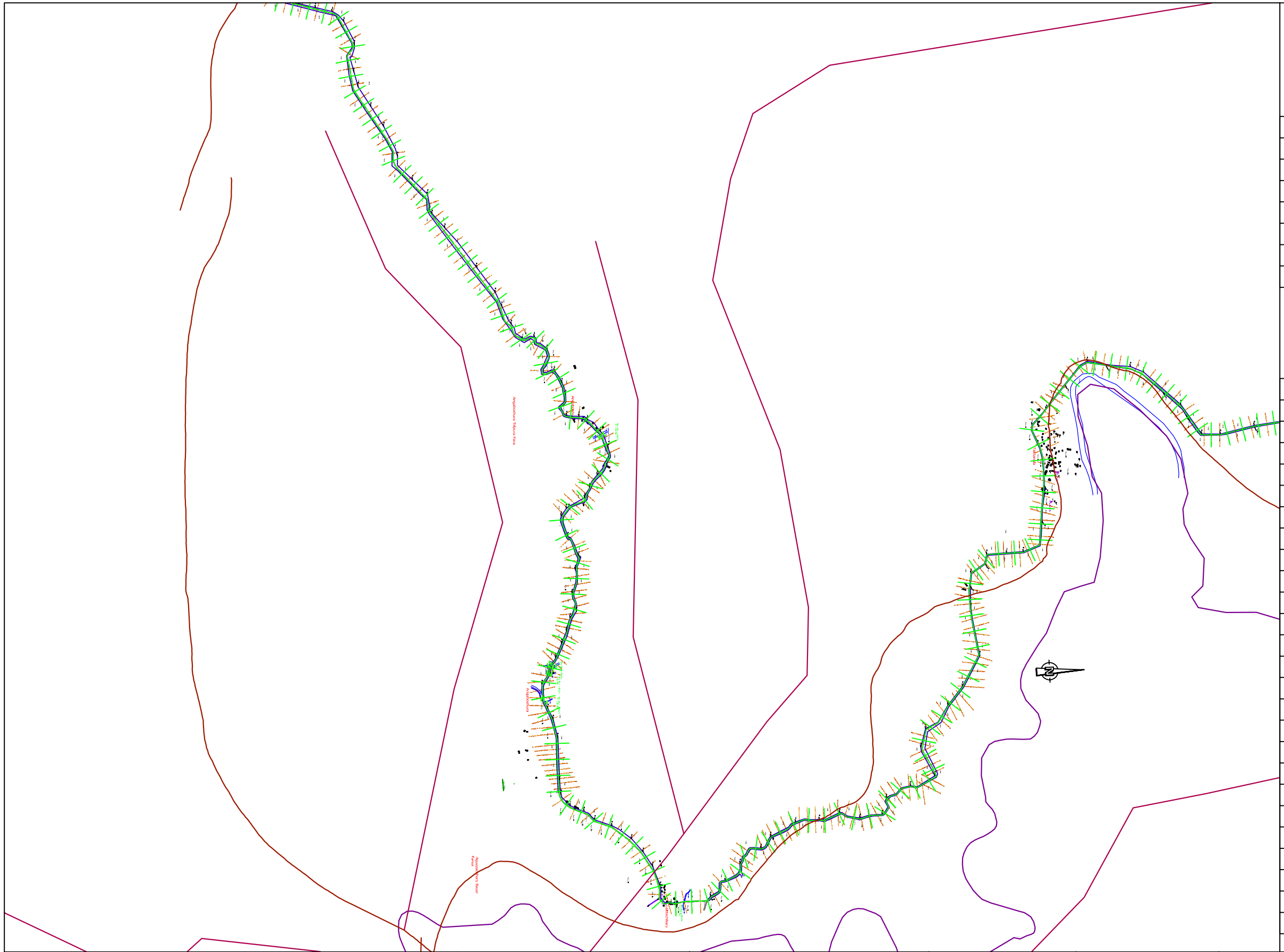
NAME OF THE CONSULTANTS :
SAI Consulting Engineers Pvt. Ltd, India.
in association with
BETS Consulting Services Ltd, Bangladesh

SURVEYED BY: SURVEY2000

DRAWING TITLE :
Topographic Survey Map

DRAWING NO : 1
Scale :1:25000

COORDINATED BY :	DRAWN BY :	CHECKED BY :	APPROVED BY :
Tanvir Ahmed GIS Expert	Alauddin-Al-Azad Surveyor	AFM Hamidul Haque Deputy Team Leader	Dr.Prabhat Shrivastava Team Leader



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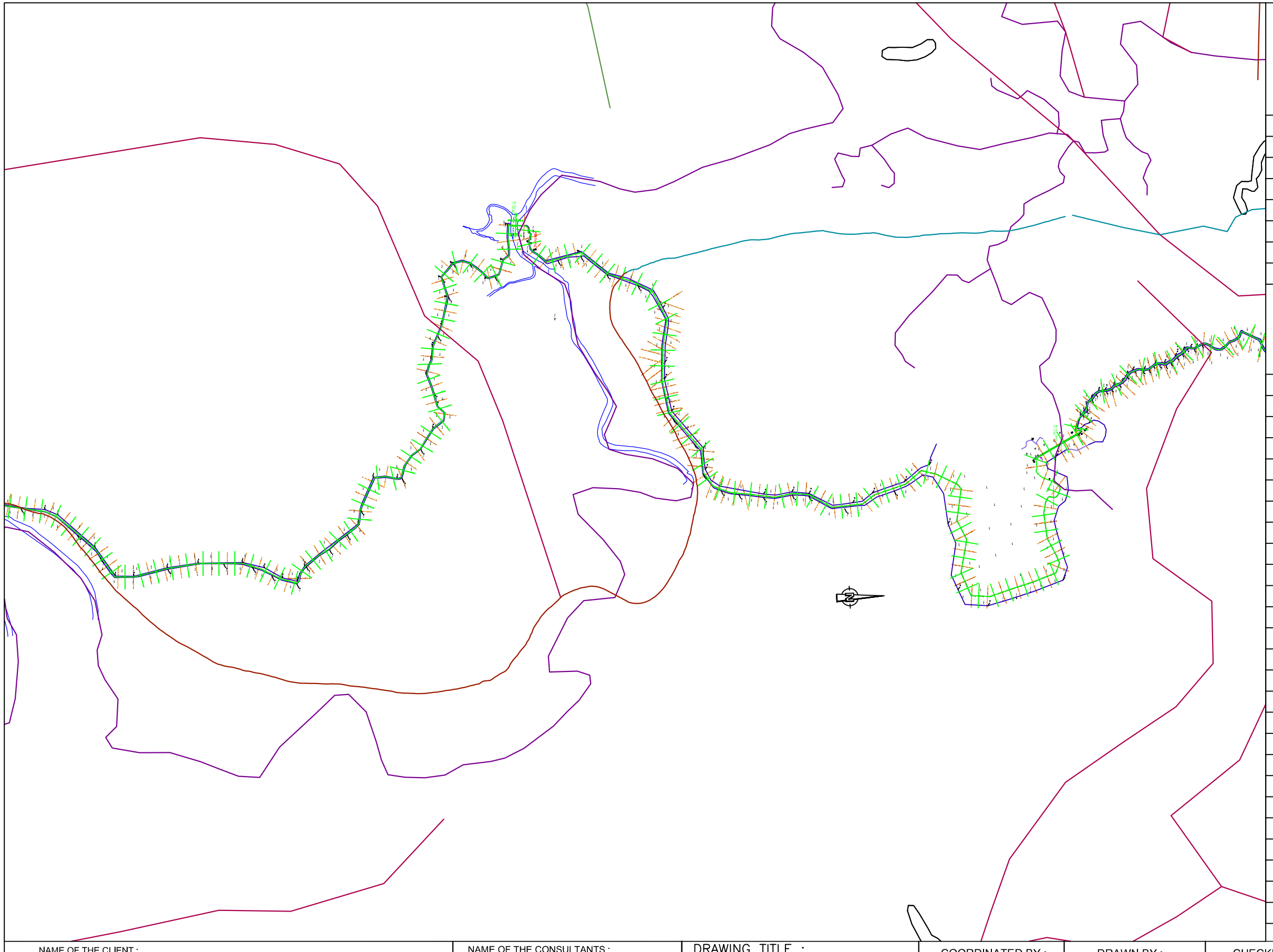
DRAWING TITLE :
Topographic Survey Map

DRAWING NO : 2
Scale :1:25000

COORDINATED BY :	DRAWN BY :	CHECKED BY :	APPROVED BY :
Tanvir Ahmed GIS Expert	Alauddin-Al-Azad Surveyor	AFM Hamidul Haque Deputy Team Leader	Dr.Prabhat Shrivastava Team Leader



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RCC Road	
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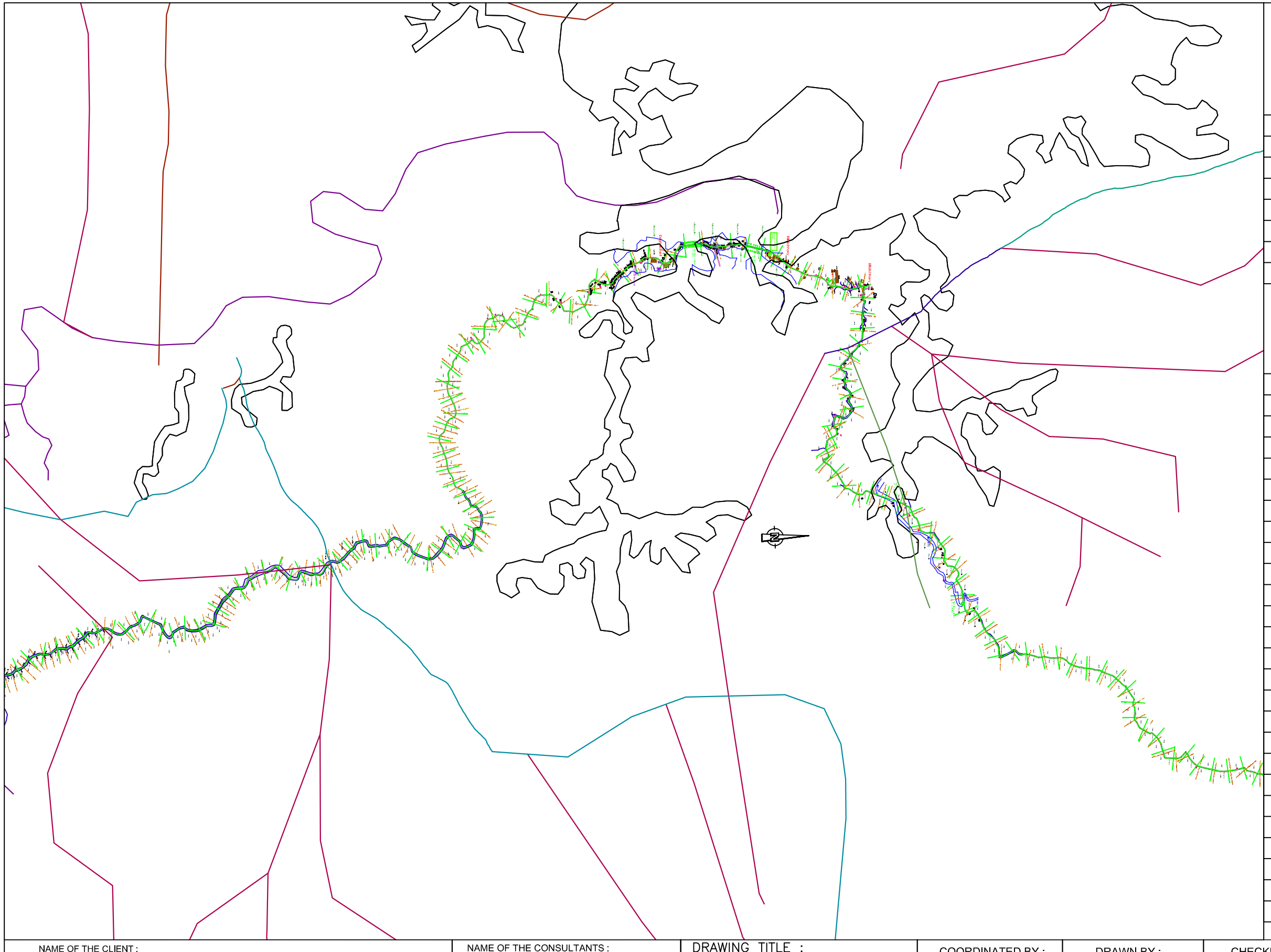
Scale :1:25000

COORDINATED BY :	DRAWN BY :	CHECKED BY :	APPROVED BY :
Tanvir Ahmed GIS Expert	Alauddin-Al-Azad Surveyor	AFM Hamidul Haque Deputy Team Leader	Dr.Prabhat Shrivastava Team Leader



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NAME OF THE CONSULTANTS :
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BETS Consulting Services Ltd, Bangladesh

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DRAWING TITLE :
Topographic Survey Map

DRAWING NO : 4

Scale :1:25000

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Tanvir Ahmed GIS Expert	Alauddin-Al-Azad Surveyor	AFM Hamidul Haque Deputy Team Leader	Dr.Prabhat Shrivastava Team Leader

Legend (Existing Road)

Zila Road	
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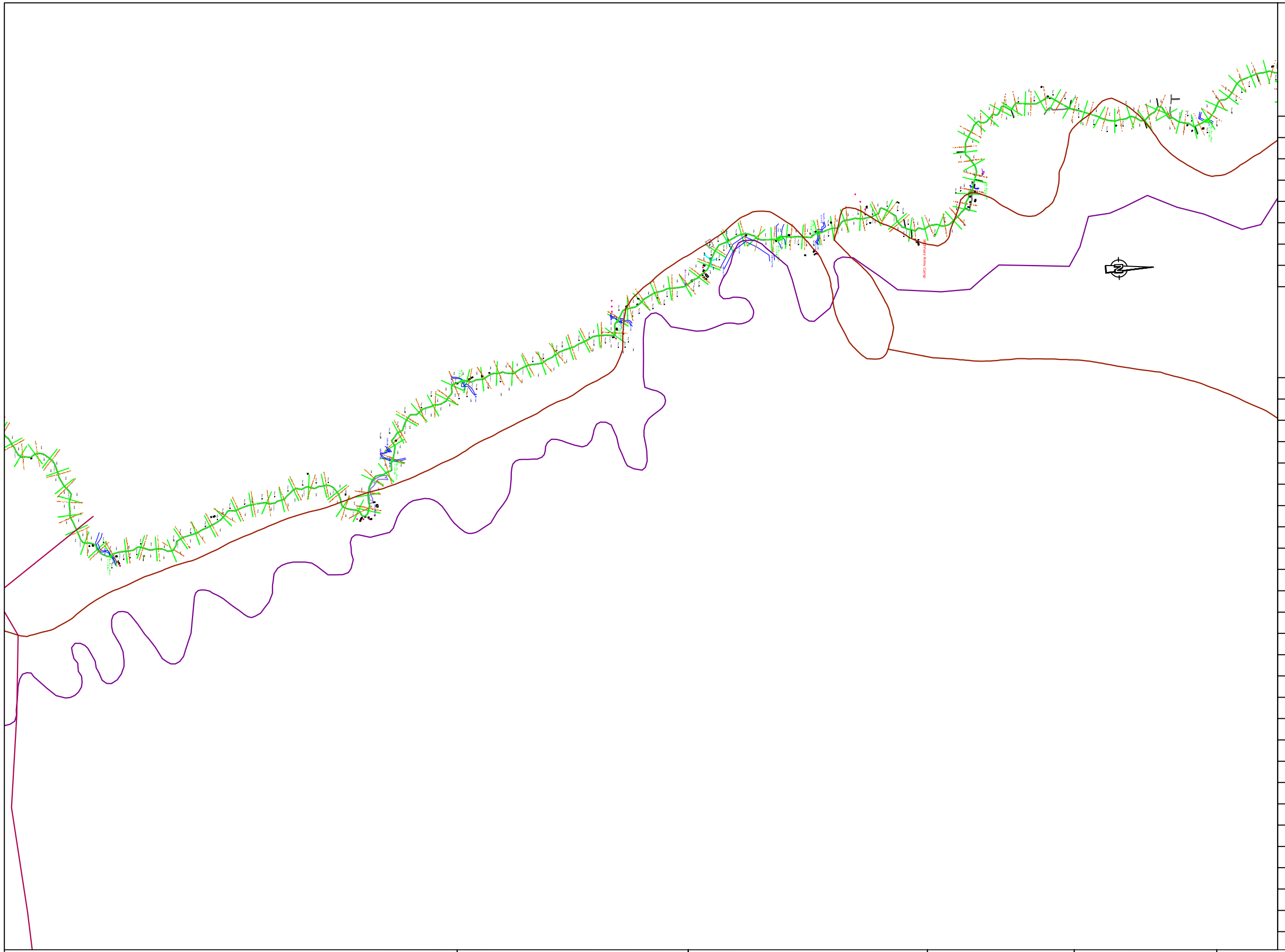
SURVEYED BY: SURVEY2000

DRAWING TITLE :
Topographic Survey Map

DRAWING NO : 5

Scale :1:25000

COORDINATED BY :	DRAWN BY :	CHECKED BY :	APPROVED BY :
Tanvir Ahmed GIS Expert	Alauddin-Al-Azad Surveyor	AFM Hamidul Haque Deputy Team Leader	Dr.Prabhat Shrivastava Team Leader



Legend (Existing Road)

Zila Road	
Upazila Road Pacca	
Upazila Road Katcha	
Union Road Pacca	
Union Road Katcha	
Regional Highway	
Village Road A Pacca	
Village Road A Katcha	

Legend (Proposed Alignmnet)

Primary Benchmarks	
Secondary/Temporary Benchmarks	
Bridge	
Building	
Semi-Pacca	
Shed	
Shop	
Shohidminar	
Chainage	CH-000.00m
Chhara	
Culvert	
Ditch	
Drain	
Electric Post	EP
Fence	
Gate	
Institution (School/Collage/Mosque/Temple Etc)	
Grave Yard	
Hill Toe	
Island	
Pond	
River	
Pacca Road	
Earthen Road	
RCC Road	
Herring Bond Bricks (HBB) Road	
Alignment Road Route 1	

NAME OF THE CLIENT :
GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH
LOCAL GOVERNMENT ENGINEERING DEPARTMENT

NAME OF THE PROJECT :
CONSULTANCY SERVICES FOR FEASIBILITY, DETAILED SURVEY AND DESIGN OF CHITTAGONG HILL TRACT CONNECTIVITY CONNECTING THEGAMUKH AND CHITTAGONG PORT.

NAME OF THE CONSULTANTS :
SAI Consulting Engineers Pvt. Ltd, India.
in association with
BETS Consulting Services Ltd, Bangladesh

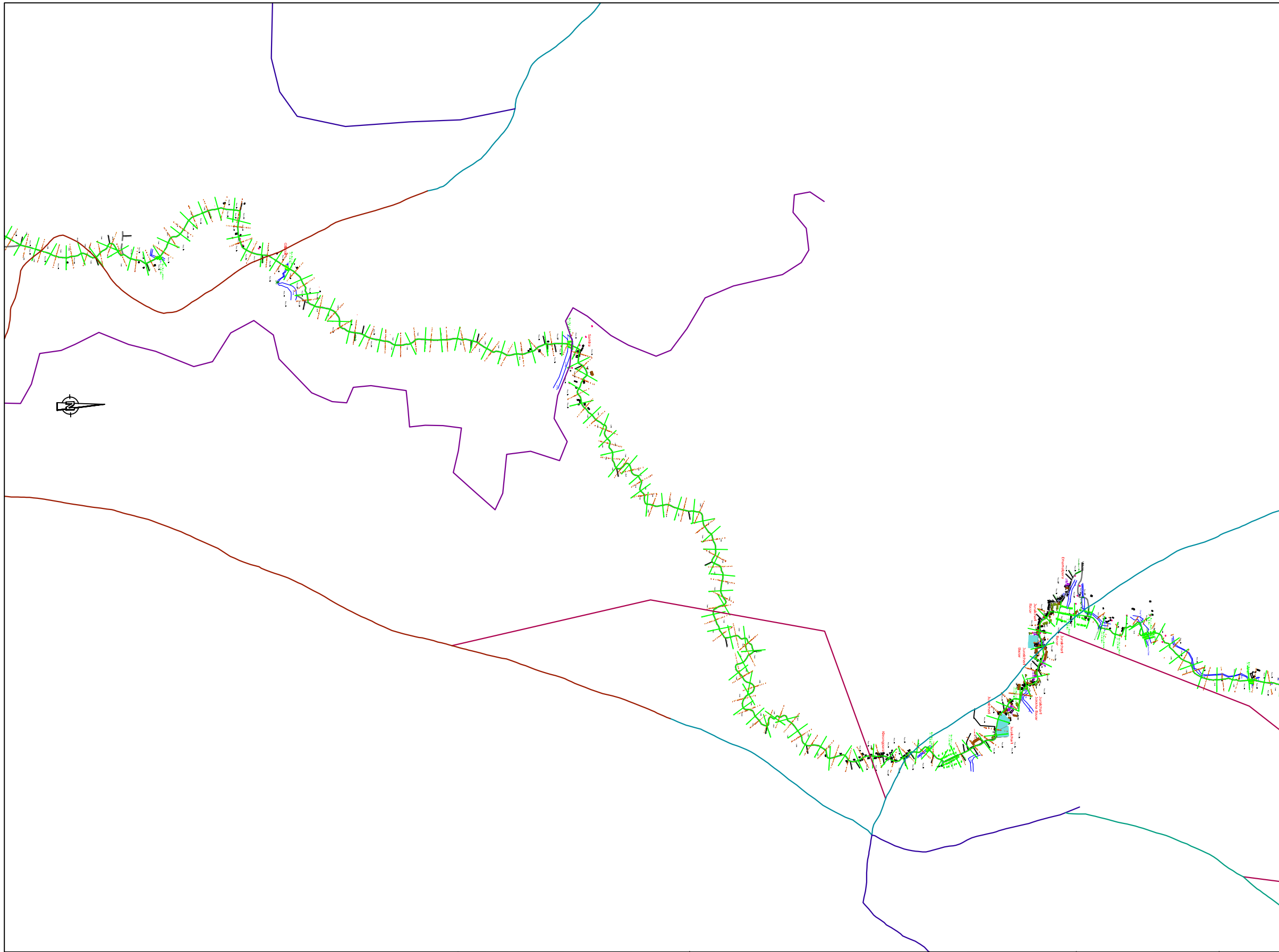
SURVEYED BY: SURVEY2000

DRAWING TITLE :
Topographic Survey Map

DRAWING NO : 6

Scale :1:25000

COORDINATED BY :	DRAWN BY :	CHECKED BY :	APPROVED BY :
Tanvir Ahmed GIS Expert	Alauddin-Al-Azad Surveyor	AFM Hamidul Haque Deputy Team Leader	Dr.Prabhat Shrivastava Team Leader



Legend (Existing Road)

Zila Road	
Upazila Road Pacca	
Upazila Road Katcha	
Union Road Pacca	
Union Road Katcha	
Regional Highway	
Village Road A Pacca	
Village Road A Katcha	

Legend (Proposed Alignmnet)

Primary Benchmarks	
Secondary/Temporary Benchmarks	
Bridge	
Building	
Semi-Pacca	
Shed	
Shop	
Shohidminar	
Chainage	CH-000.00m
Chhara	
Culvert	
Ditch	
Drain	
Electric Post	EP
Fence	
Gate	
Institution (School/Collage/Mosque/Temple Etc)	
Grave Yard	
Hill Toe	
Island	
Pond	
River	
Pacca Road	
Earthen Road	
RCC Road	
Herring Bond Bricks (HBB) Road	
Alignment Road Route 1	

NAME OF THE CLIENT :
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LOCAL GOVERNMENT ENGINEERING DEPARTMENT

NAME OF THE PROJECT :
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NAME OF THE CONSULTANTS :
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in association with
BETS Consulting Services Ltd, Bangladesh

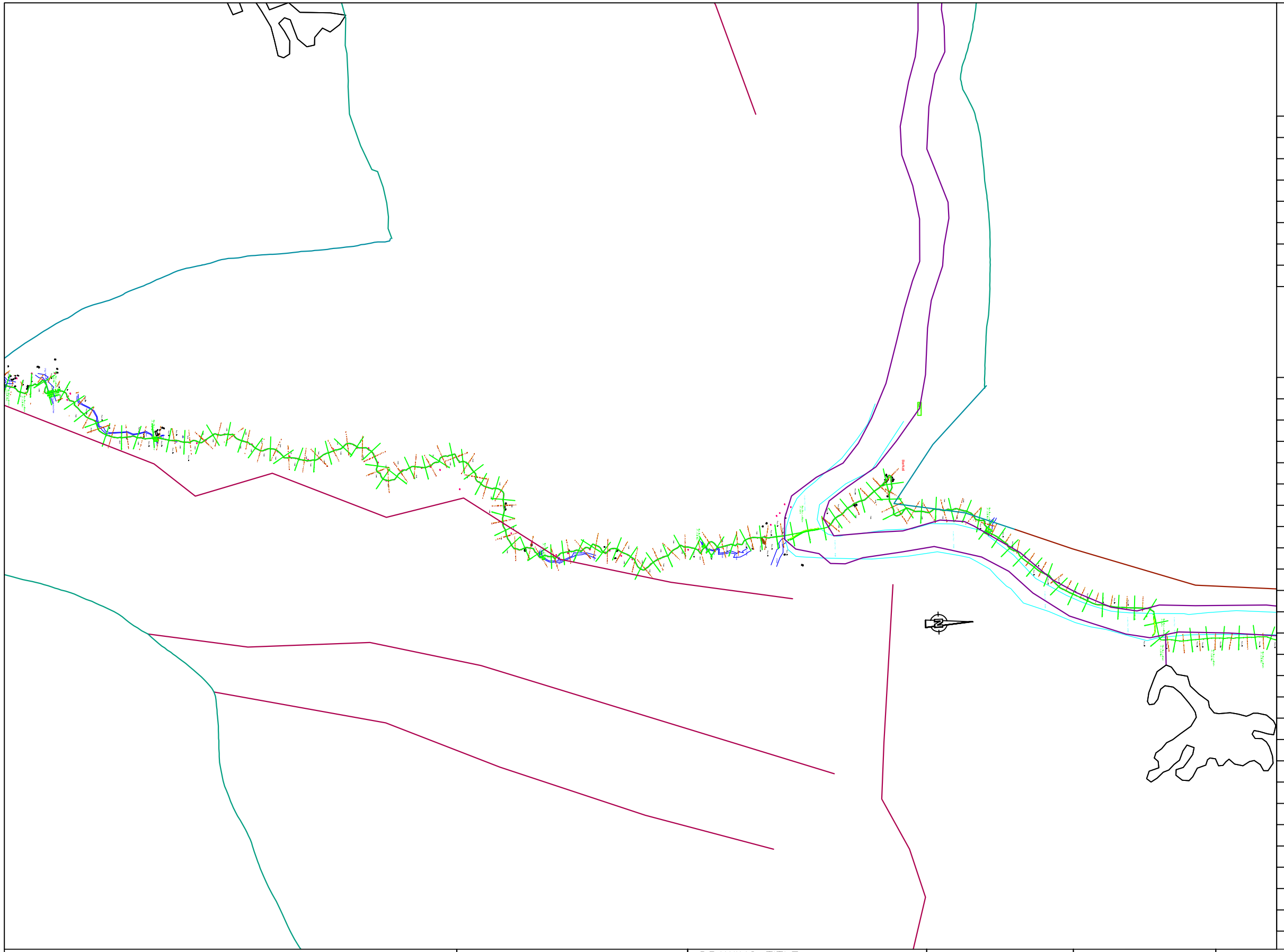
SURVEYED BY: SURVEY2000

DRAWING TITLE :
Topographic Survey Map

DRAWING NO : 7

Scale :1:25000

COORDINATED BY :	DRAWN BY :	CHECKED BY :	APPROVED BY :
Tanvir Ahmed GIS Expert	Alauddin-Al-Azad Surveyor	AFM Hamidul Haque Deputy Team Leader	Dr.Prabhat Shrivastava Team Leader



Legend (Existing Road)

Zila Road	
Upazila Road Pacca	
Upazila Road Katcha	
Union Road Pacca	
Union Road Katcha	
Regional Highway	
Village Road A Pacca	
Village Road A Katcha	

Legend (Proposed Alignmnet)

Primary Benchmarks	
Secondary/Temporary Benchmarks	
Bridge	
Building	
Semi-Pacca	
Shed	
Shop	
Shohidminar	
Chainage	CH-000.00m
Chhara	
Culvert	
Ditch	
Drain	
Electric Post	EP
Fence	
Gate	
Institution (School/Collage/Mosque/Temple Etc)	
Grave Yard	
Hill Toe	
Island	
Pond	
River	
Pacca Road	
Earthen Road	
RCC Road	
Herring Bond Bricks (HBB) Road	
Alignment Road Route 1	

NAME OF THE CLIENT :
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LOCAL GOVERNMENT ENGINEERING DEPARTMENT

NAME OF THE PROJECT :
CONSULTANCY SERVICES FOR FEASIBILITY, DETAILED SURVEY AND DESIGN OF CHITTAGONG HILL TRACT CONNECTIVITY CONNECTING THEGAMUKH AND CHITTAGONG PORT.

NAME OF THE CONSULTANTS :
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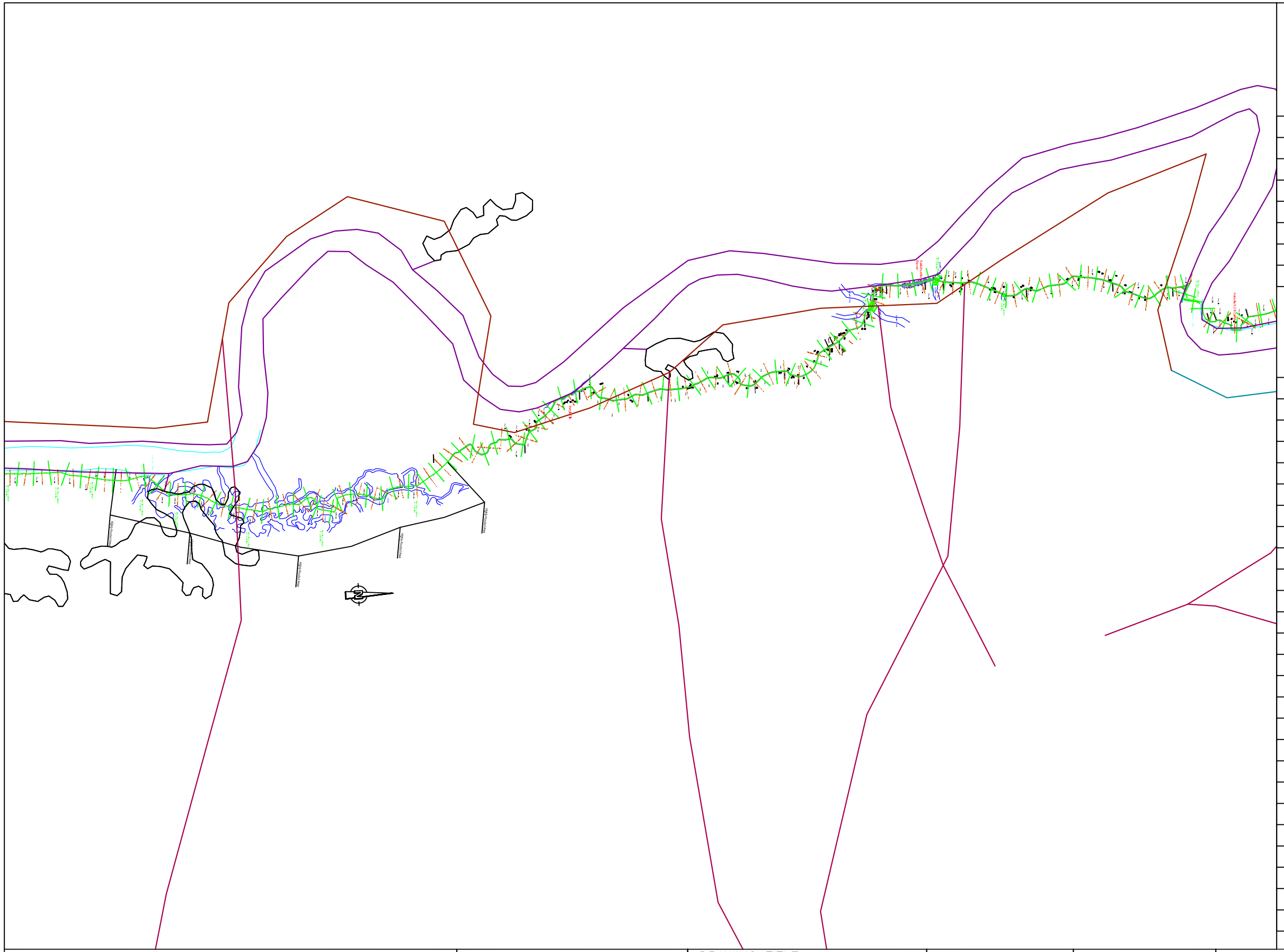
in association with
BETS Consulting Services Ltd, Bangladesh

SURVEYED BY: SURVEY2000

DRAWING TITLE :
Topographic Survey Map

DRAWING NO : 8
Scale :1:25000

COORDINATED BY :	DRAWN BY :	CHECKED BY :	APPROVED BY :
Tanvir Ahmed GIS Expert	Alauddin-Al-Azad Surveyor	AFM Hamidul Haque Deputy Team Leader	Dr.Prabhat Shrivastava Team Leader



Legend (Existing Road)

Zila Road	
Upazila Road Pacca	
Upazila Road Katcha	
Union Road Pacca	
Union Road Katcha	
Regional Highway	
Village Road A Pacca	
Village Road A Katcha	

Legend (Proposed Alignmnet)

Primary Benchmarks	
Secondary/Temporary Benchmarks	
Bridge	
Building	
Semi-Pacca	
Shed	
Shop	
Shohidminar	
Chainage	CH-000.00m
Chhara	
Culvert	
Ditch	
Drain	
Electric Post	EP
Fence	
Gate	
Institution (School/Collage/Mosque/Temple Etc)	
Grave Yard	
Hill Toe	
Island	
Pond	
River	
Pacca Road	
Earthen Road	
RCC Road	
Herring Bond Bricks (HBB) Road	
Alignment Road Route 1	

NAME OF THE CLIENT :
GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH
LOCAL GOVERNMENT ENGINEERING DEPARTMENT

NAME OF THE PROJECT :
CONSULTANCY SERVICES FOR FEASIBILITY, DETAILED SURVEY AND DESIGN OF CHITTAGONG HILL TRACT CONNECTIVITY CONNECTING THEGAMUKH AND CHITTAGONG PORT.

NAME OF THE CONSULTANTS :
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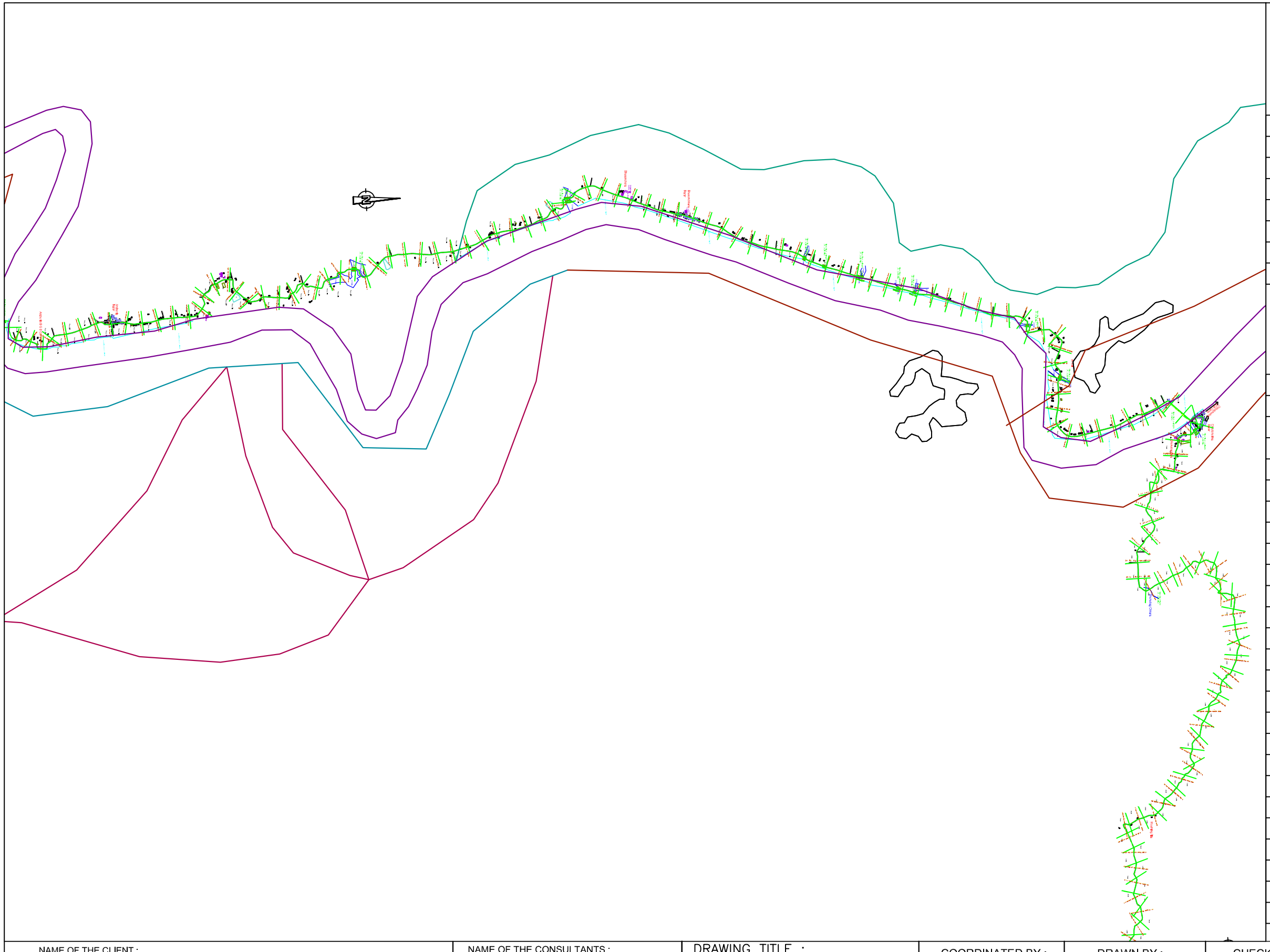
SURVEYED BY: SURVEY2000

DRAWING TITLE :
Topographic Survey Map

DRAWING NO : 9
Scale :1:25000

COORDINATED BY :	DRAWN BY :	CHECKED BY :	APPROVED BY :
Tanvir Ahmed GIS Expert	Alauddin-Al-Azad Surveyor	AFM Hamidul Haque Deputy Team Leader	Dr.Prabhat Shrivastava Team Leader



Legend (Existing Road)

Zila Road	
Upazila Road Pacca	
Upazila Road Katcha	
Union Road Pacca	
Union Road Katcha	
Regional Highway	
Village Road A Pacca	
Village Road A Katcha	

Legend (Proposed Alignmnet)

Primary Benchmarks	
Secondary/Temporary Benchmarks	
Bridge	
Building	
Semi-Pacca	
Shed	
Shop	
Shohidminar	
Chainage	CH-000.00m
Chhara	
Culvert	
Ditch	
Drain	
Electric Post	EP
Fence	
Gate	
Institution (School/Collage/Mosque/Temple Etc)	
Grave Yard	
Hill Toe	
Island	
Pond	
River	
Pacca Road	
Earthen Road	
RCC Road	
Herring Bond Bricks (HBB) Road	
Alignment Road Route 1	

NAME OF THE CLIENT :
GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH
LOCAL GOVERNMENT ENGINEERING DEPARTMENT

NAME OF THE PROJECT :
CONSULTANCY SERVICES FOR FEASIBILITY, DETAILED SURVEY AND DESIGN OF CHITTAGONG HILL TRACT CONNECTIVITY CONNECTING THEGAMUKH AND CHITTAGONG PORT.

NAME OF THE CONSULTANTS :
SAI Consulting Engineers Pvt. Ltd, India.
in association with
BETS Consulting Services Ltd, Bangladesh

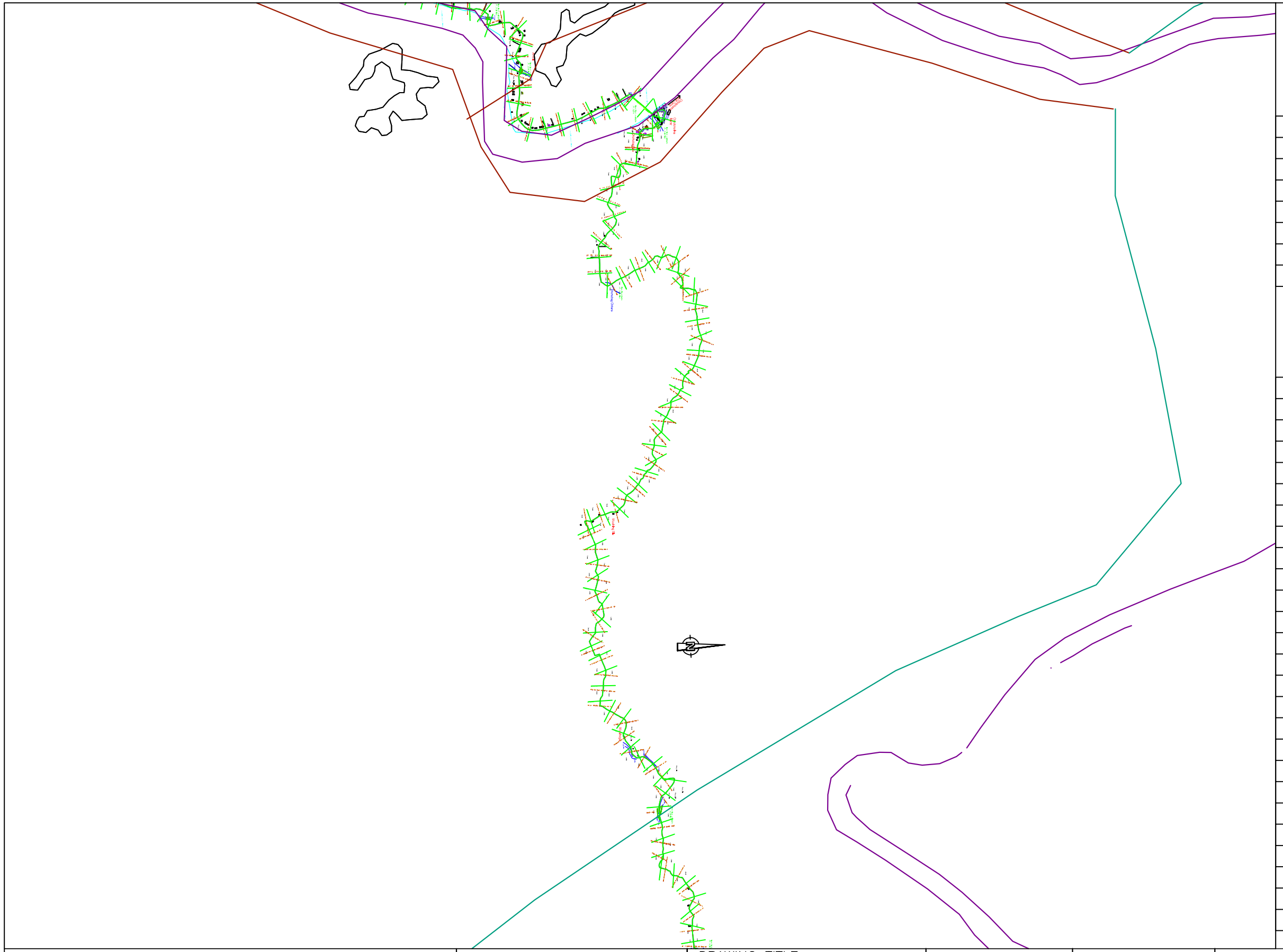
SURVEYED BY: SURVEY2000

DRAWING TITLE :
Topographic Survey Map

DRAWING NO : 10

Scale :1:25000

COORDINATED BY :	DRAWN BY :	CHECKED BY :	APPROVED BY :
Tanvir Ahmed GIS Expert	Alauddin-Al-Azad Surveyor	AFM Hamidul Haque Deputy Team Leader	Dr.Prabhat Shrivastava Team Leader



Legend (Existing Road)

Zila Road	
Upazila Road Pacca	
Upazila Road Katcha	
Union Road Pacca	
Union Road Katcha	
Regional Highway	
Village Road A Pacca	
Village Road A Katcha	

Legend (Proposed Alignmnet)

Primary Benchmarks	
Secondary/Temporary Benchmarks	
Bridge	
Building	
Semi-Pacca	
Shed	
Shop	
Shohidminar	
Chainage	CH-000.00m
Chhara	
Culvert	
Ditch	
Drain	
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Fence	
Gate	
Institution (School/Collage/Mosque/Temple Etc)	
Grave Yard	
Hill Toe	
Island	
Pond	
River	
Pacca Road	
Earthen Road	
RCC Road	
Herring Bond Bricks (HBB) Road	
Alignment Road Route 1	

NAME OF THE CLIENT :
GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH
LOCAL GOVERNMENT ENGINEERING DEPARTMENT

NAME OF THE PROJECT :
CONSULTANCY SERVICES FOR FEASIBILITY, DETAILED SURVEY AND DESIGN OF CHITTAGONG HILL TRACT CONNECTIVITY CONNECTING THEGAMUKH AND CHITTAGONG PORT.

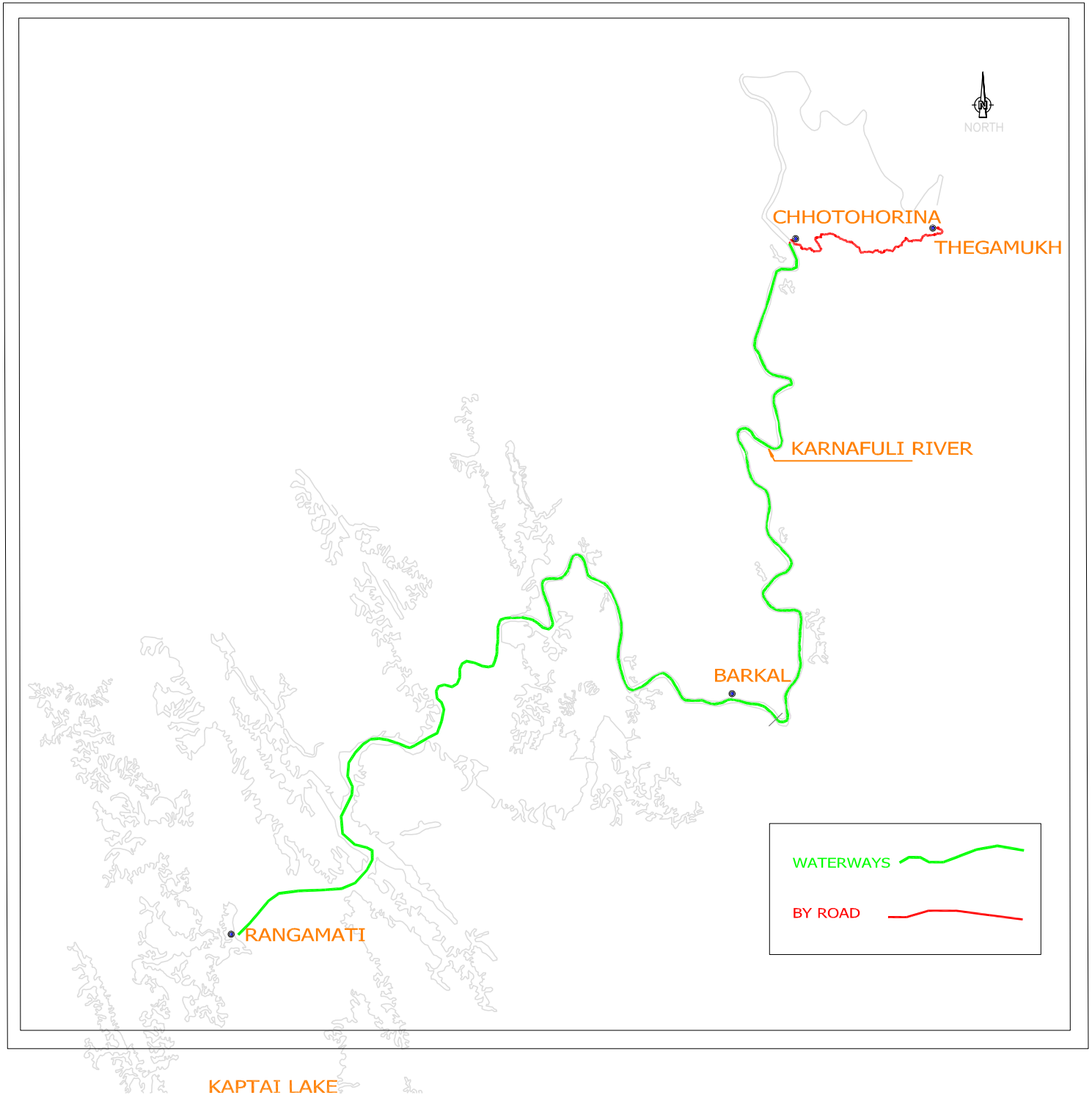
NAME OF THE CONSULTANTS :
SAI Consulting Engineers Pvt. Ltd, India.
in association with
BETS Consulting Services Ltd, Bangladesh

SURVEYED BY: SURVEY2000

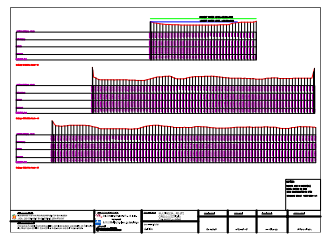
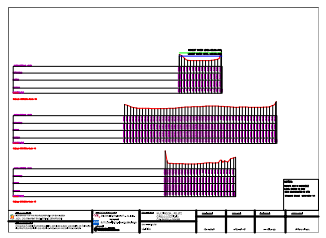
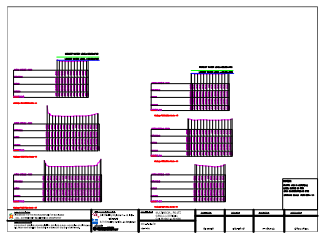
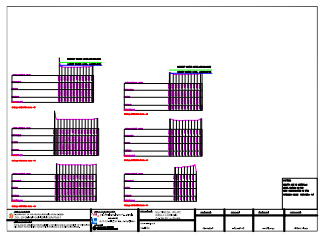
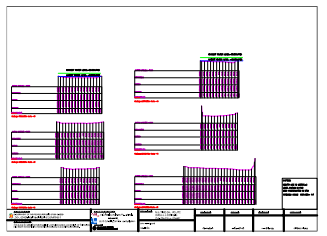
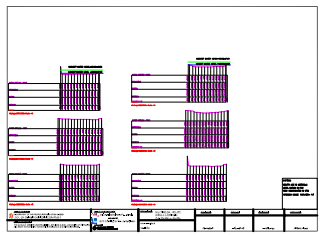
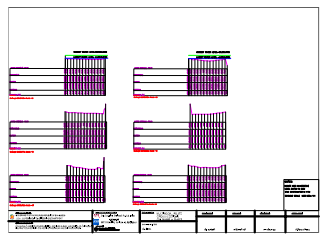
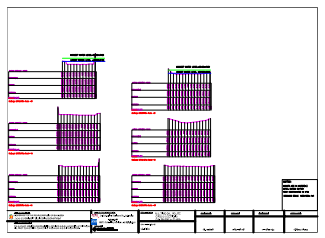
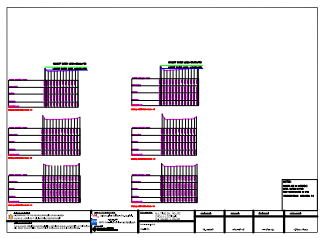
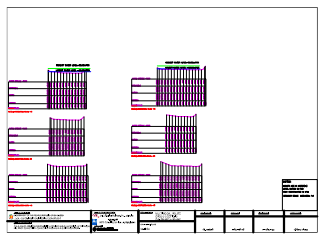
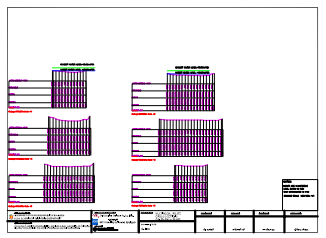
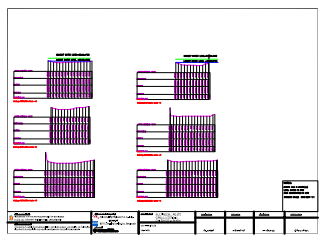
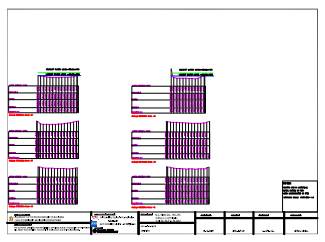
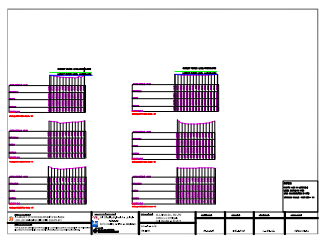
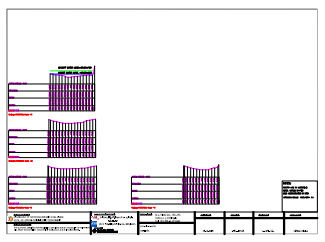
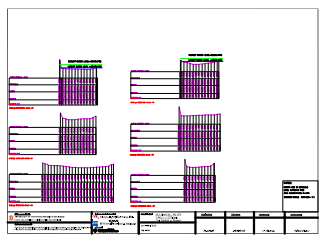
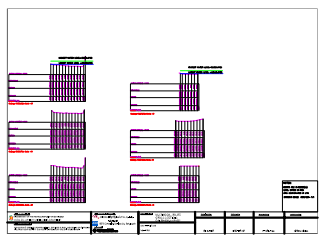
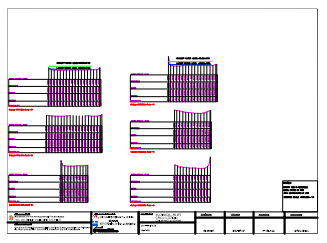
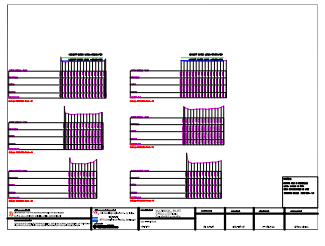
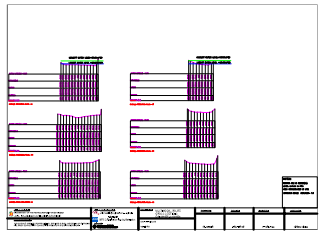
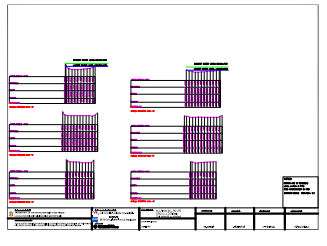
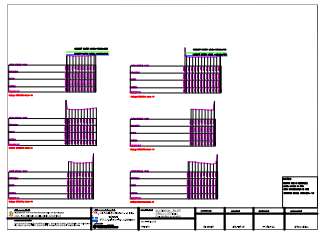
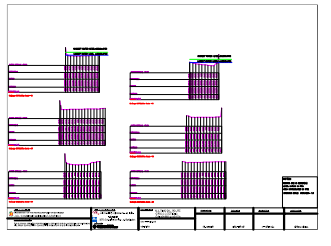
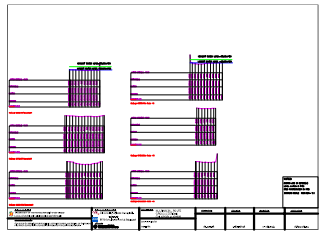
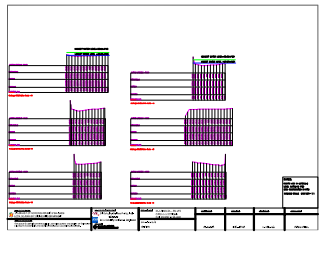
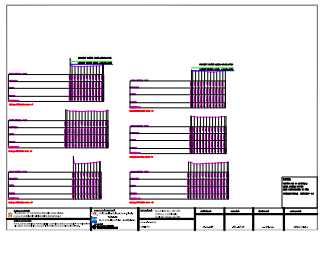
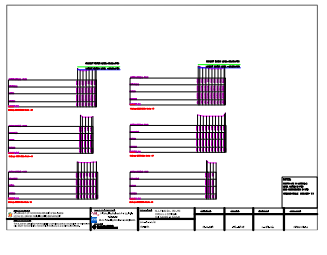
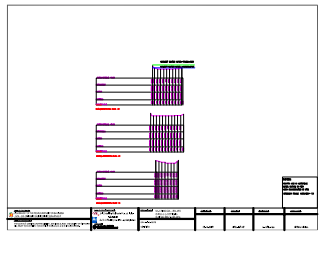
DRAWING TITLE :
Topographic Survey Map

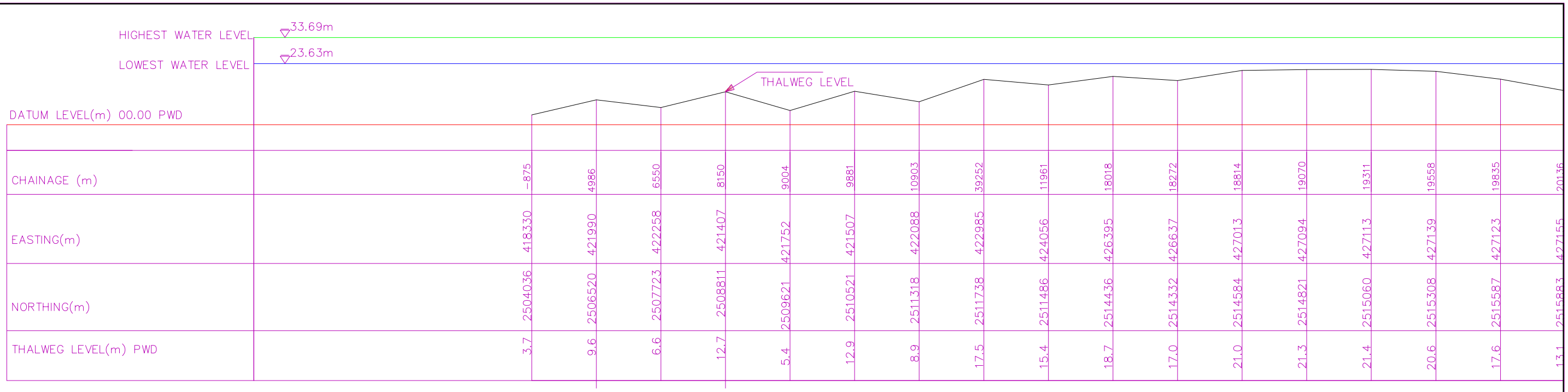
DRAWING NO : 11
Scale :1:25000

COORDINATED BY :	DRAWN BY :	CHECKED BY :	APPROVED BY :
Tanvir Ahmed GIS Expert	Alauddin-Al-Azad Surveyor	AFM Hamidul Haque Deputy Team Leader	Dr.Prabhat Shrivastava Team Leader


NORTH
CHHOTOHORINA
THEGAMUKH
KARNAFULI RIVER
BARKAL
RANGAMATI
KAPTAI LAKE
WATERWAYS
BY ROAD

RANGAMATI TO BARKAL TO CHHOTOHARINA



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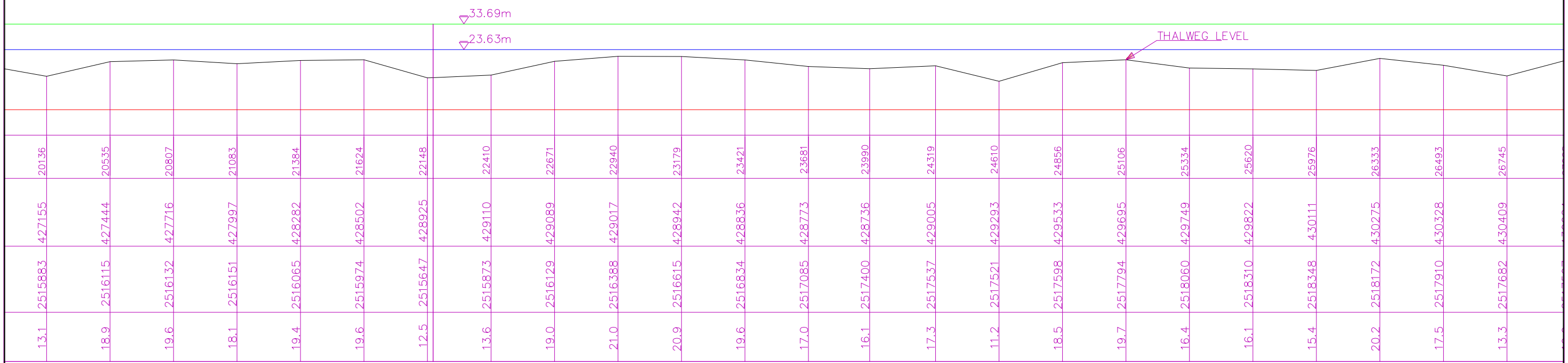


HORIZONTAL MEASUREMENT NOT IN SCALE

NAME OF THE CLIENT :
GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH
LOCAL GOVERNMENT ENGINEERING DEPARTMENT

NAME OF THE PROJECT :
CONSULTANCY SERVICES FOR FEASIBILITY, DETAILED SURVEY AND DESIGN OF CHITTAGONG HILL TRACT CONNECTIVITY CONNECTING THEGAMUKH AND CHITTAGONG PORT.

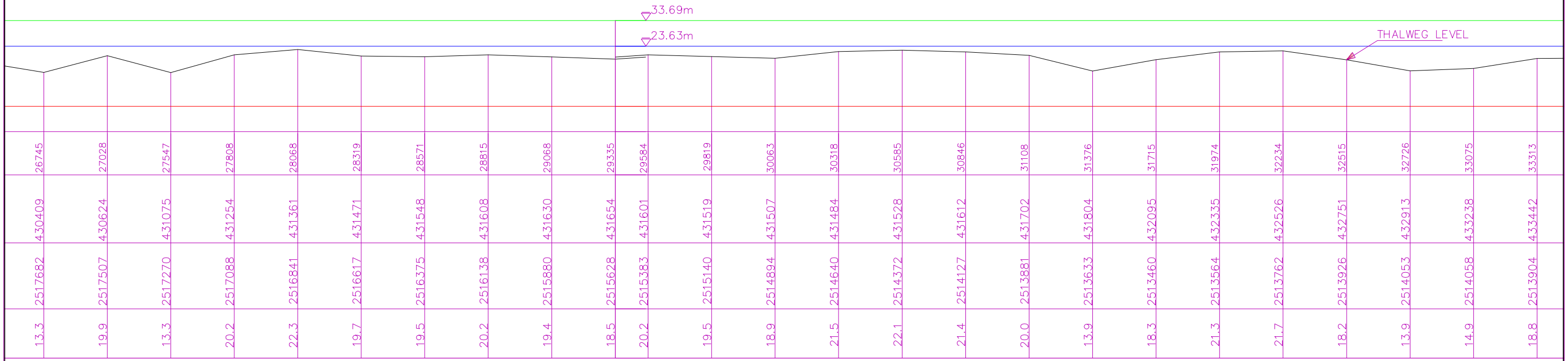
NAME OF THE CONSULTANTS :
SAI Consulting Engineers Pvt. Ltd, India.
in association with
BETS Consulting Services Ltd, Bangladesh
Surveyed by:
SURVEY 9000

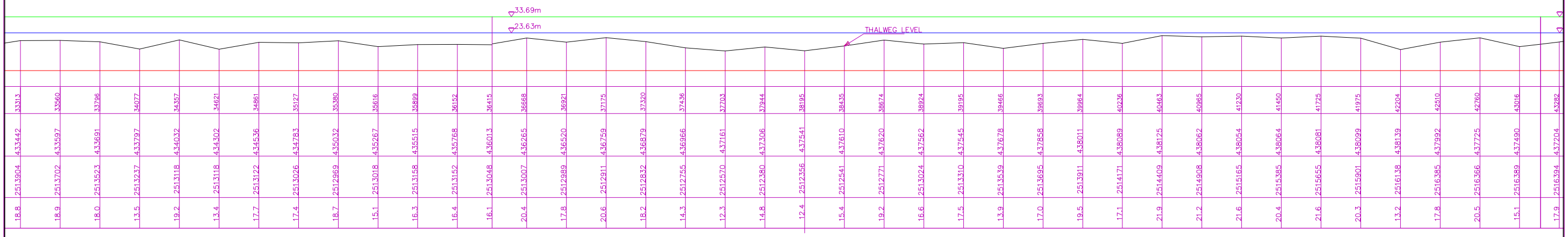
DRAWING TITLE : MULTIMODAL ROUTE LONG SECTION (THALWLEG)

DRAWING NO : 1 of 3

Scale :1:25000

DESIGNED BY :	DRAWN BY :	CHECKED BY :	APPROVED BY :
Eng. Abul Qasem	Ashraful Islam Khan	AFM Hamidul Haque	Dr.Prabhat Shrivastava





HORIZONTAL MEASUREMENT NOT IN SCALE

NAME OF THE CLIENT :

GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH

LOCAL GOVERNMENT ENGINEERING DEPARTMENT

NAME OF THE PROJECT :

CONSULTANCY SERVICES FOR FEASIBILITY, DETAILED SURVEY AND DESIGN OF CHITTAGONG HILL TRACT CONNECTIVITY CONNECTING THEGAMUKH AND CHITTAGONG PORT.

NAME OF THE CONSULTANTS :

SAI Consulting Engineers Pvt. Ltd, India.

in association with

BETS Consulting Services Ltd, Bangladesh

Surveyed by:

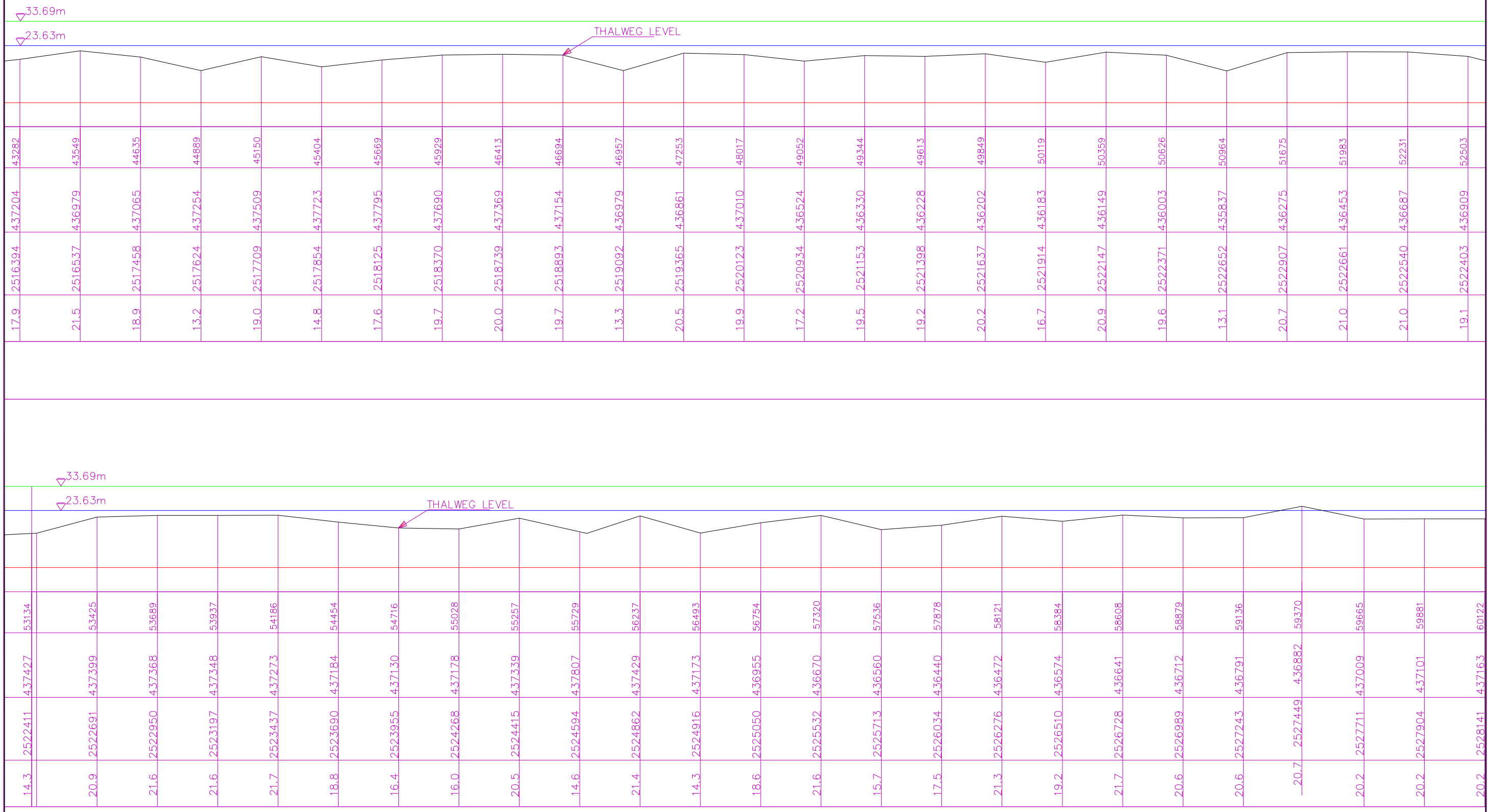
SURVEY 2000

DRAWING TITLE : MULTIMODAL ROUTE LONG SECTION (THALWLEG)

DRAWING NO : 2 of 3

Scale :1:25000

DESIGNED BY :	DRAWN BY :	CHECKED BY :	APPROVED BY :
Eng. Abul Qasem	Ashraful Islam Khan	AFM Hamidul Haque	Dr.Prabhat Shrivastava



HORIZONTAL MEASUREMENT NOT IN SCALE

NAME OF THE CLIENT :

GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH

LOCAL GOVERNMENT ENGINEERING DEPARTMENT

NAME OF THE PROJECT :

CONSULTANCY SERVICES FOR FEASIBILITY, DETAILED SURVEY AND DESIGN OF CHITTAGONG HILL TRACT CONNECTIVITY CONNECTING THEGAMUKH AND CHITTAGONG PORT.

NAME OF THE CONSULTANTS :

SAI Consulting Engineers Pvt. Ltd, India.

in association with

BETS Consulting Services Ltd, Bangladesh

Surveyed by:

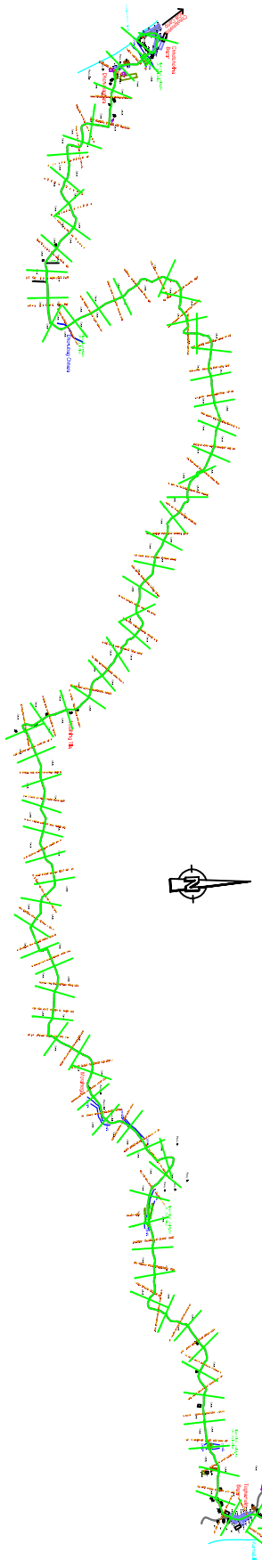
SURVEY 2000

DRAWING TITLE : MULTIMODAL ROUTE LONG SECTION (THALWLEG)

DRAWING NO : 3 of 3

Scale :1:25000

DESIGNED BY :	DRAWN BY :	CHECKED BY :	APPROVED BY :
Eng. Abul Qasem	Ashraful Islam Khan	AFM Hamidul Haque	Dr.Prabhat Shrivastava



Legend (Existing Road)

Zila Road	
Upazila Road Pacca	
Upazila Road Katcha	
Union Road Pacca	
Union Road Katcha	
Regional Highway	
Village Road A Pacca	
Village Road A Katcha	

Legend (Proposed Alignmnet)

Primary Benchmarks	
Secondary/Temporary Benchmarks	
Bridge	
Building	
Semi-Pacca	
Shed	
Shop	
Shohidminar	
Chainage	CH-000.00m
Chhara	
Culvert	
Ditch	
Drain	
Electric Post	EP
Fence	
Gate	
Institution (School/Collage/Mosque/Temple Etc)	
Grave Yard	
Hill Toe	
Island	
Pond	
River	
Pacca Road	
Earthen Road	
RCC Road	
Herring Bond Bricks (HBB) Road	
Alignment Road Route 1	

NAME OF THE CLIENT :
GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH
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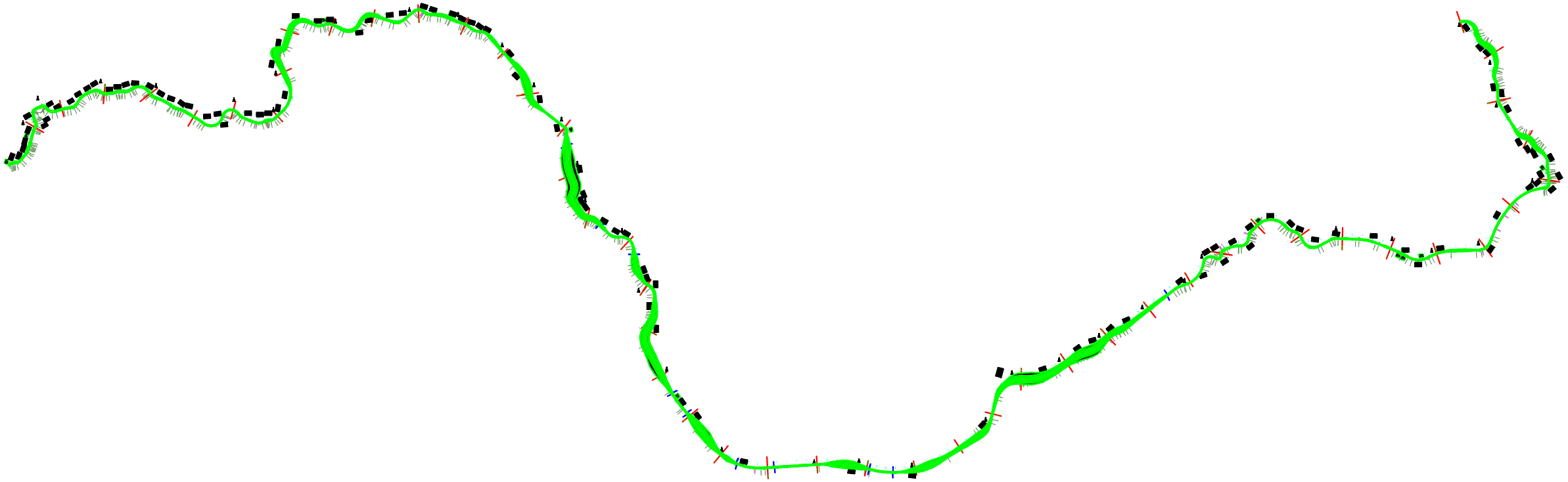
NAME OF THE CONSULTANTS :
SAI Consulting Engineers Pvt. Ltd, India.
in association with
BETS Consulting Services Ltd, Bangladesh

SURVEYED BY: SURVEY2000

DRAWING TITLE :
Multimodal Route-1: Topographic Survey Map

DRAWING NO : 1
Scale :1:25000

COORDINATED BY :	DRAWN BY :	CHECKED BY :	APPROVED BY :
Tanvir Ahmed GIS Expert	Alauddin-Al-Azad Surveyor	AFM Hamidul Haque Deputy Team Leader	Dr.Prabhat Shrivastava Team Leader



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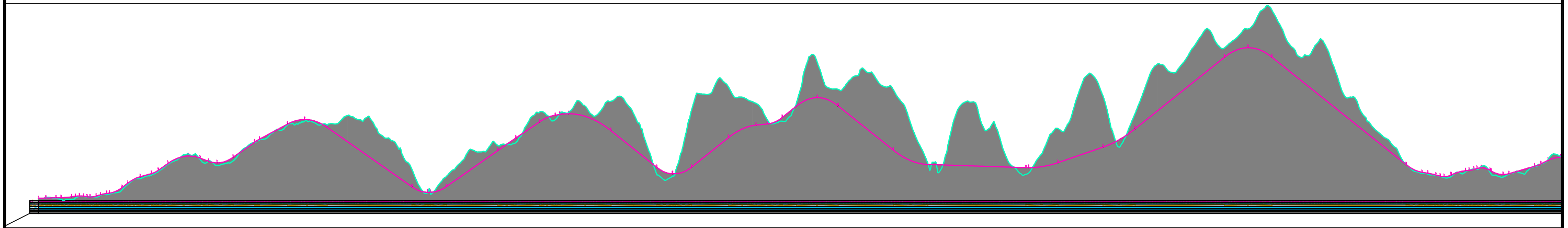

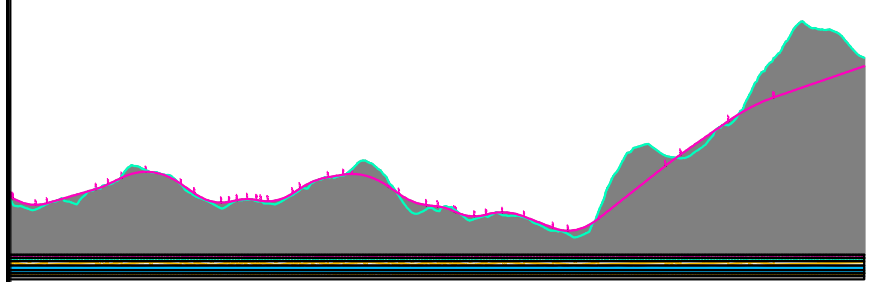

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NAME OF THE CONSULTANTS :

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in association with

BETS Consulting Services Ltd, Bangladesh

SURVEYED BY: SURVEY2000

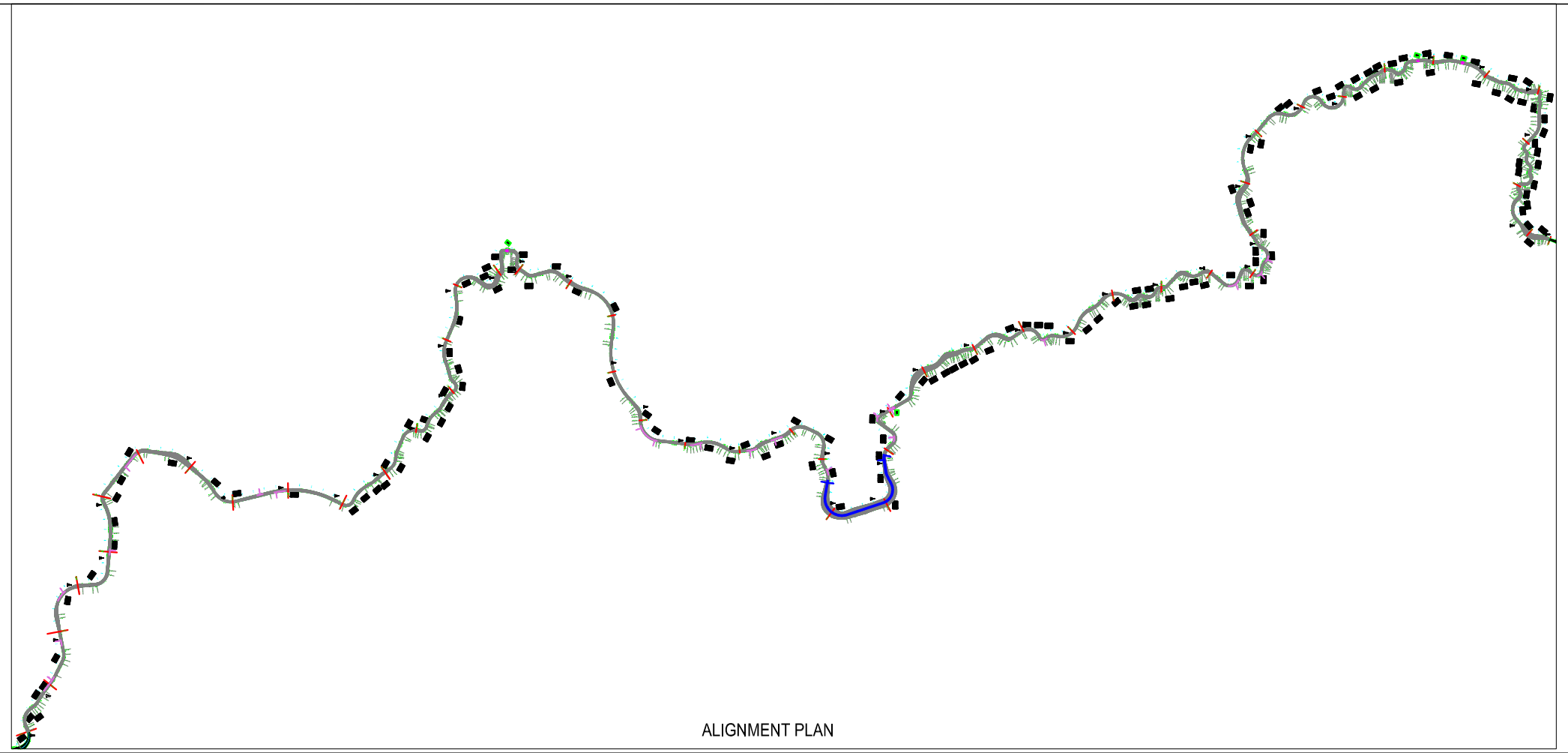
DRAWING TITLE :

ROAD PLAN & PROFILE
CH.0+000 TO CH.24+000

DRAWING NO : 01

Scale : Vertical1:5000
Horizontal1:50000

DESIGNED BY :	DRAWN BY :	CHECKED BY :	APPROVED BY :
Mahavir Chopra Design Eng.	Ashraful Islam Khan CAD Operator	AFM Hamidul Haque Deputy Team Leader	Dr.Prabhat Shrivastava Team Leader



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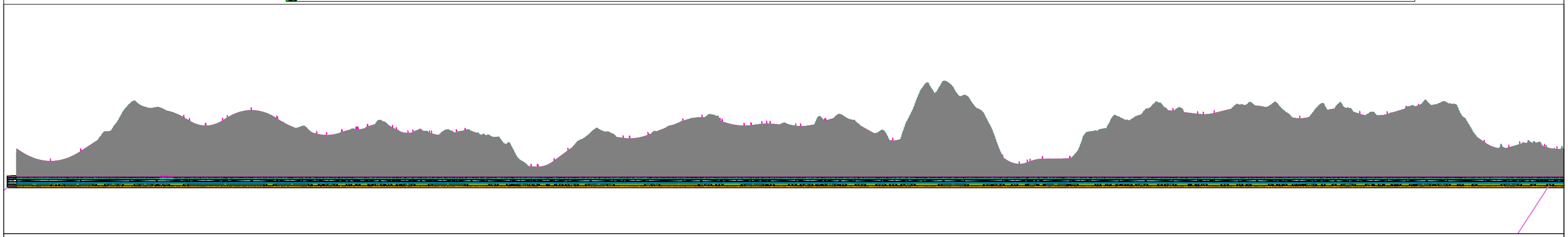

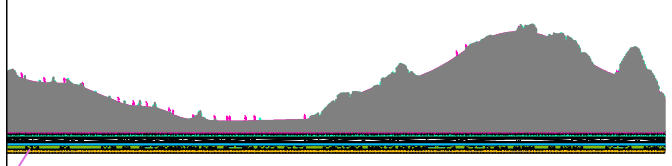

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LOCAL GOVERNMENT ENGINEERING DEPARTMENT

NAME OF THE PROJECT :

CONSULTANCY SERVICES FOR FEASIBILITY, DETAILED SURVEY AND DESIGN OF CHITTAGONG HILL TRACT CONNECTIVITY CONNECTING THEGAMUKH AND CHITTAGONG PORT.

NAME OF THE CONSULTANTS :

SAI Consulting Engineers Pvt. Ltd, India.

in association with

BETS Consulting Services Ltd, Bangladesh

SURVEYED BY: SURVEY2000

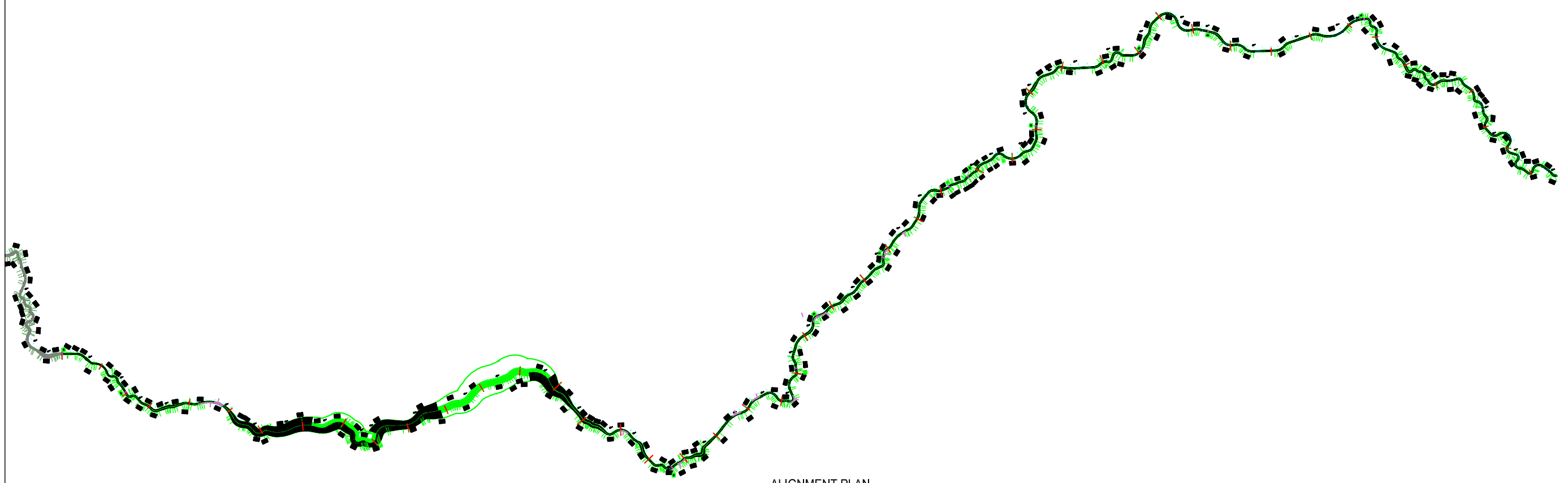
DRAWING TITLE :

ROAD PLAN & PROFILE
CH.24+000 TO CH.48+700

DRAWING NO : 2

Scale : Vertical 1:5000
Horizontal 1:50000

DESIGNED BY :	DRAWN BY :	CHECKED BY :	APPROVED BY :
Mahavir Chopra Designed Eng.	Ashraful Islam Khan CAD Operator	AFM Hamidul Haque Deputy Team Leader	Dr.Prabhat Shrivastava Team Leader



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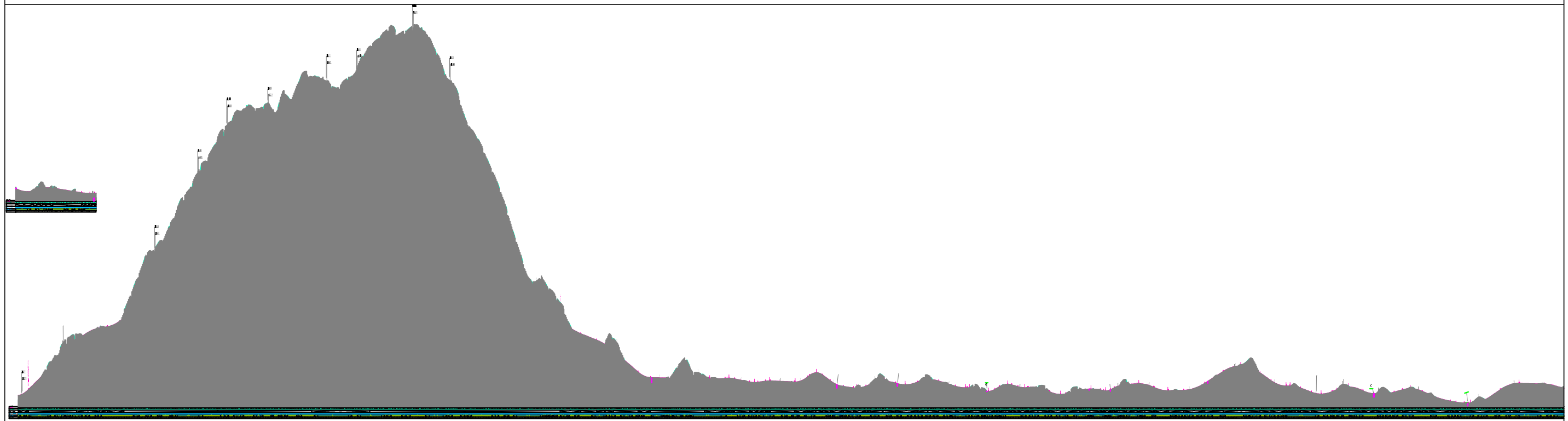


ALIGNMENT PROFILE

NAME OF THE CLIENT :

GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH

LOCAL GOVERNMENT ENGINEERING DEPARTMENT

NAME OF THE PROJECT :

CONSULTANCY SERVICES FOR FEASIBILITY, DETAILED SURVEY AND DESIGN OF CHITTAGONG HILL TRACT CONNECTIVITY CONNECTING THEGAMUKH AND CHITTAGONG PORT.

NAME OF THE CONSULTANTS :

SAI Consulting Engineers Pvt. Ltd, India.

in association with

BETS Consulting Services Ltd, Bangladesh

SURVEYED BY: SURVEY2000

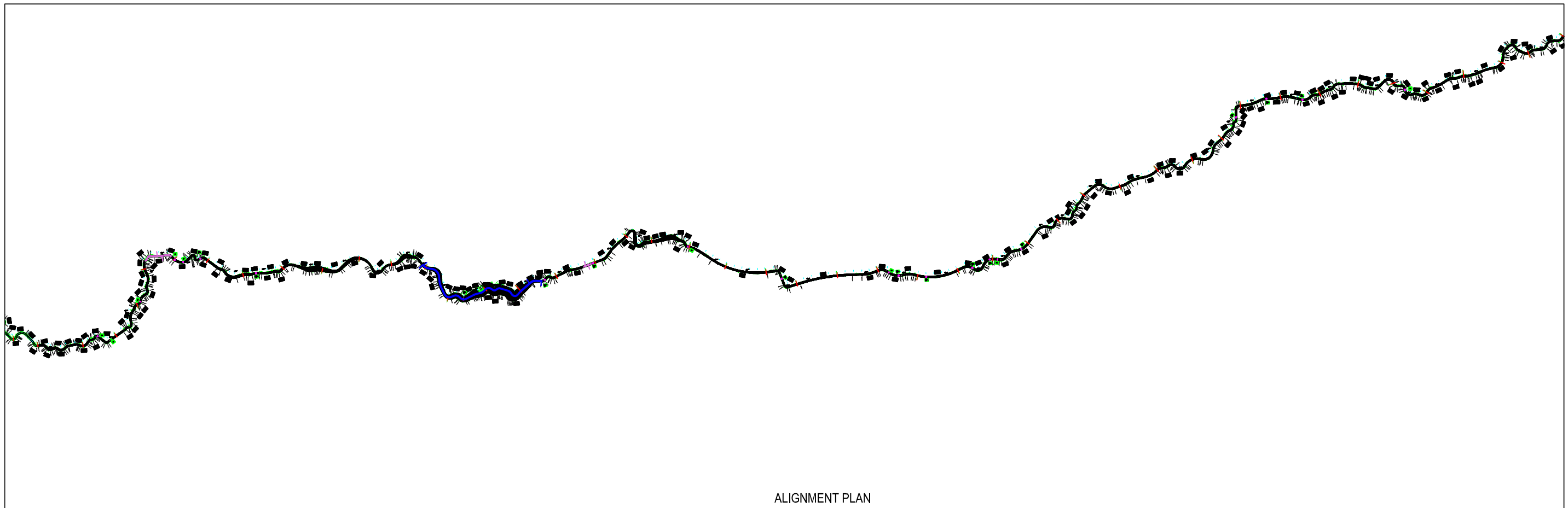
DRAWING TITLE :

ROAD PLAN & PROFILE
CH.48+700 TO CH.72+000

DRAWING NO : 3

Scale : Vertical 1:5000
Horizontal 1:50000

DESIGNED BY :	DRAWN BY :	CHECKED BY :	APPROVED BY :
Mahavir Chopra Design Eng.	Ashraful Islam Khan CAD Operator	AFM Hamidul Haque Deputy Team Leader	Dr.Prabhat Shrivastava Team Leader



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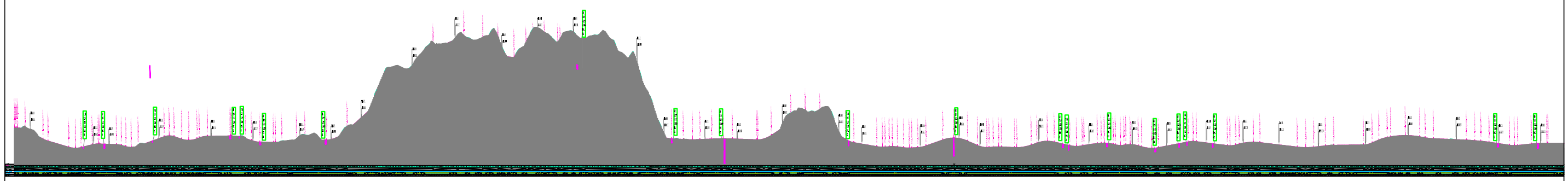
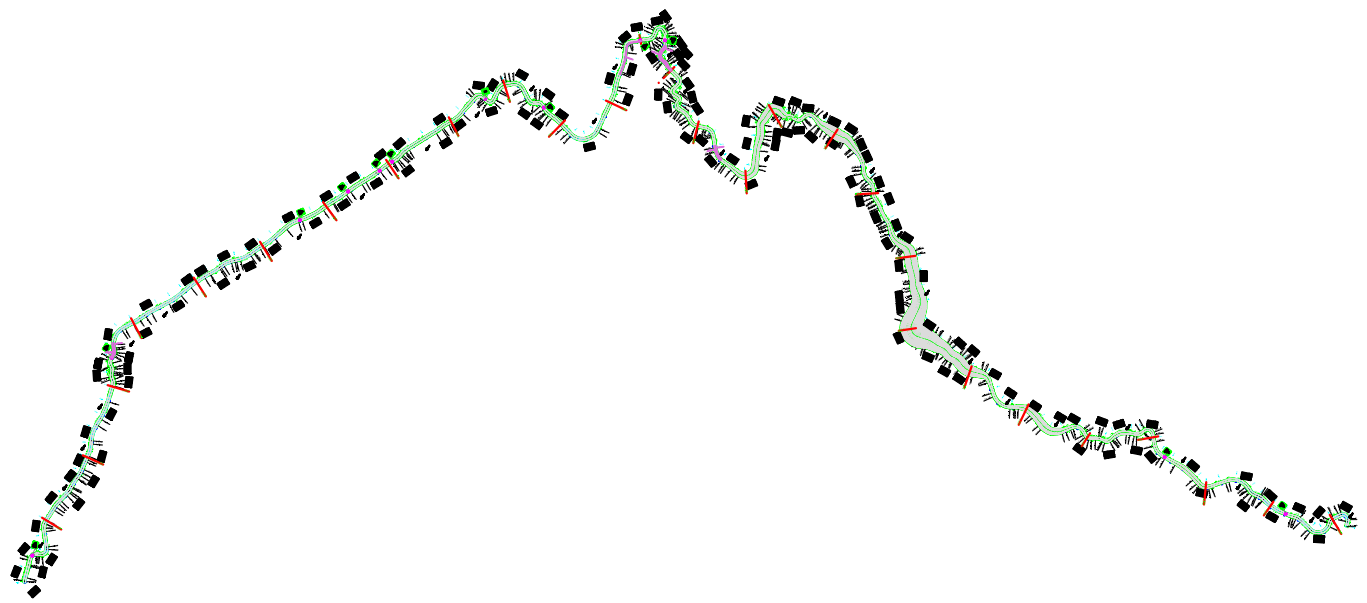


ALIGNMENT PROFILE

NAME OF THE CLIENT : GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH LOCAL GOVERNMENT ENGINEERING DEPARTMENT	NAME OF THE CONSULTANTS : SAI Consulting Engineers Pvt. Ltd, India. in association with BETS Consulting Services Ltd, Bangladesh	DRAWING TITLE : ROAD PLAN & PROFILE CH.72+900 TO CH.95+500	DESIGNED BY : Mahavir Chopra Design Eng.	DRAWN BY : Ashraful Islam Khan CAD Operator	CHECKED BY : AFM Hamidul Haque Deputy Team Leader	APPROVED BY : Dr.Prabhat Shrivastava Team Leader
NAME OF THE PROJECT : CONSULTANCY SERVICES FOR FEASIBILITY, DETAILED SURVEY AND DESIGN OF CHITTAGONG HILL TRACT CONNECTIVITY CONNECTING THEGAMUKH AND CHITTAGONG PORT.	SURVEYED BY: SURVEY2000	DRAWING NO : 4 Scale : Vertical 1:5000 Horizontal 1:50000				



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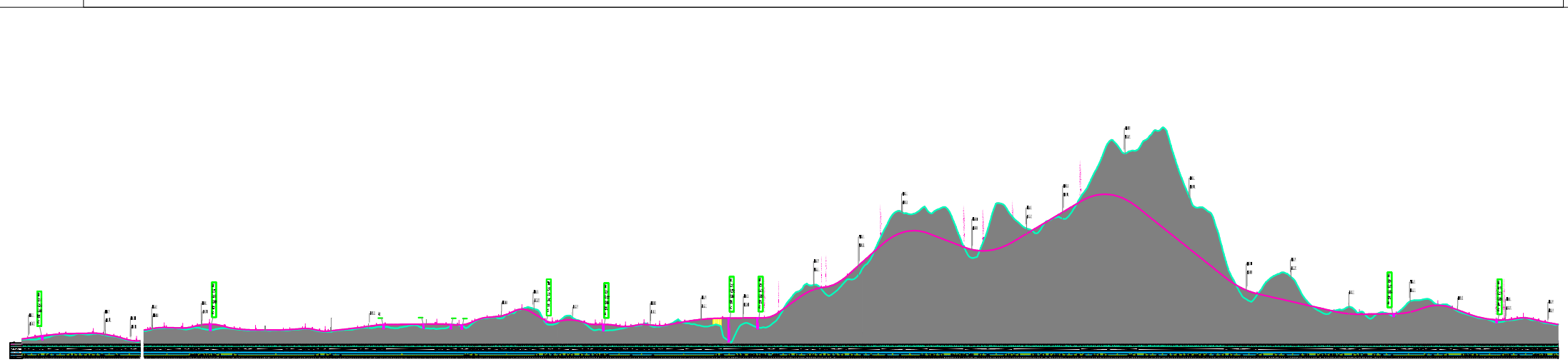


ALIGNMENT PROFILE

NAME OF THE CLIENT :

GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH

LOCAL GOVERNMENT ENGINEERING DEPARTMENT

NAME OF THE PROJECT :

CONSULTANCY SERVICES FOR FEASIBILITY, DETAILED SURVEY AND DESIGN OF CHITTAGONG HILL TRACT CONNECTIVITY CONNECTING THEGAMUKH AND CHITTAGONG PORT.

NAME OF THE CONSULTANTS :

SAI Consulting Engineers Pvt. Ltd, India.

in association with

BETS Consulting Services Ltd, Bangladesh

SURVEYED BY:

SURVEY2000

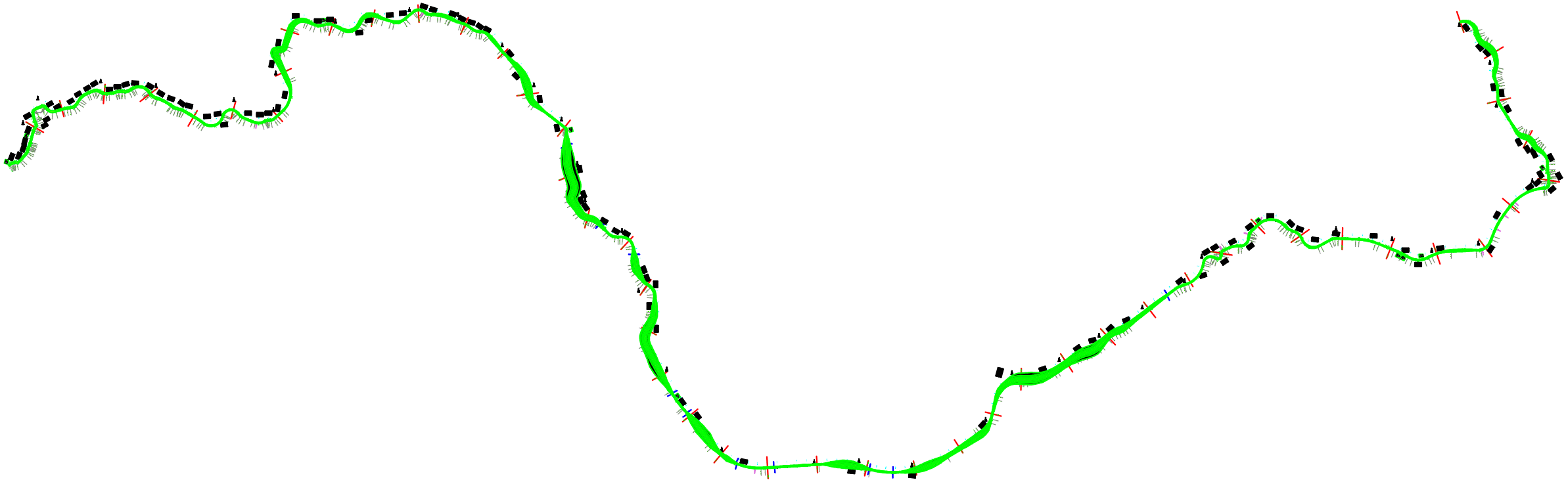
DRAWING TITLE :

ROAD PLAN & PROFILE
CH.95+500 TO CH.109+675

DRAWING NO : 5

Scale : Vertical 1:5000
Horizontal 1:50000

DESIGNED BY :	DRAWN BY :	CHECKED BY :	APPROVED BY :
Mahavir Chopra Design Eng.	Md. Siddiqur Rahman CAD operator	AFM Hamidul Haque Deputy Team Leader	Dr.Prabhat Shrivastava Team Leader



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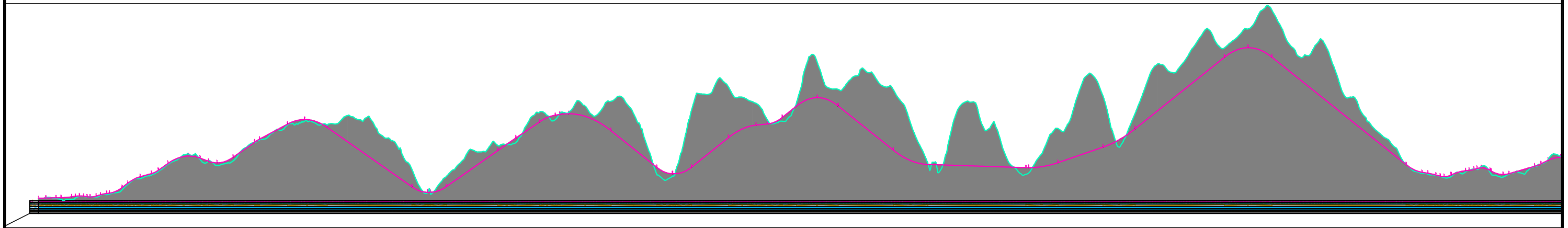
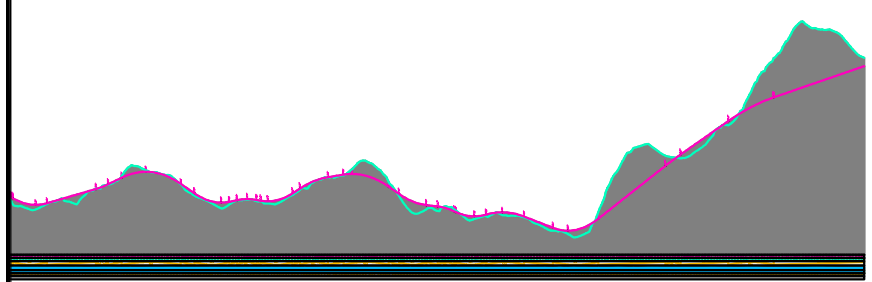




ALIGNMENT PROFILE

NAME OF THE CLIENT :

GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH

LOCAL GOVERNMENT ENGINEERING DEPARTMENT

NAME OF THE PROJECT :

CONSULTANCY SERVICES FOR FEASIBILITY, DETAILED SURVEY AND DESIGN OF CHITTAGONG HILL TRACT CONNECTIVITY CONNECTING THEGAMUKH AND CHITTAGONG PORT.

NAME OF THE CONSULTANTS :

SAI Consulting Engineers Pvt. Ltd, India.

in association with

BETS Consulting Services Ltd, Bangladesh

SURVEYED BY: SURVEY2000

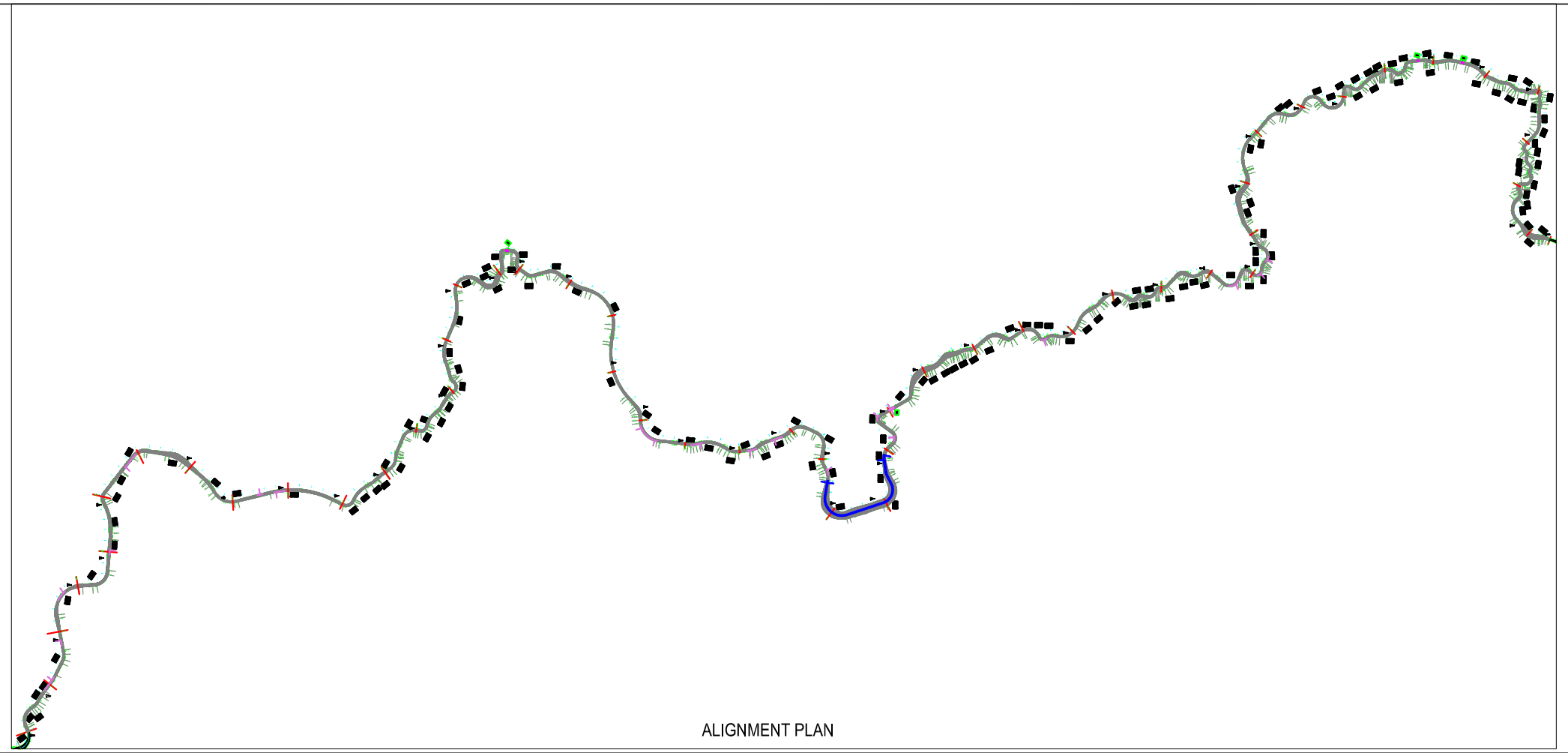
DRAWING TITLE :

ROAD PLAN & PROFILE
CH.0+000 TO CH.24+000

DRAWING NO : 01

Scale : Vertical1:5000
Horizontal1:50000

DESIGNED BY :	DRAWN BY :	CHECKED BY :	APPROVED BY :
Mahavir Chopra Design Eng.	Ashraful Islam Khan CAD Operator	AFM Hamidul Haque Deputy Team Leader	Dr.Prabhat Shrivastava Team Leader



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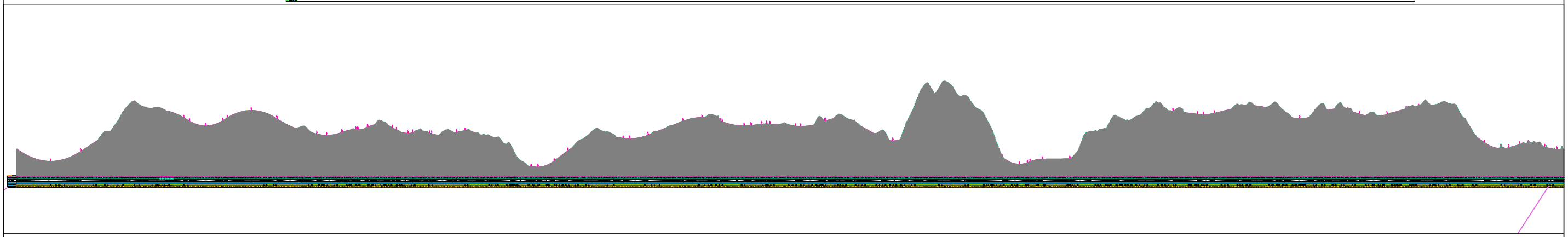
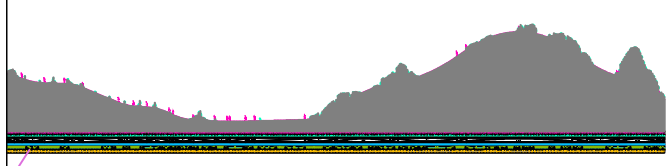




ALIGNMENT PROFILE

NAME OF THE CLIENT :

GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH

LOCAL GOVERNMENT ENGINEERING DEPARTMENT

NAME OF THE PROJECT :

CONSULTANCY SERVICES FOR FEASIBILITY, DETAILED SURVEY AND DESIGN OF CHITTAGONG HILL TRACT CONNECTIVITY CONNECTING THEGAMUKH AND CHITTAGONG PORT.

NAME OF THE CONSULTANTS :

SAI Consulting Engineers Pvt. Ltd, India.

in association with

BETS Consulting Services Ltd, Bangladesh

SURVEYED BY: SURVEY2000

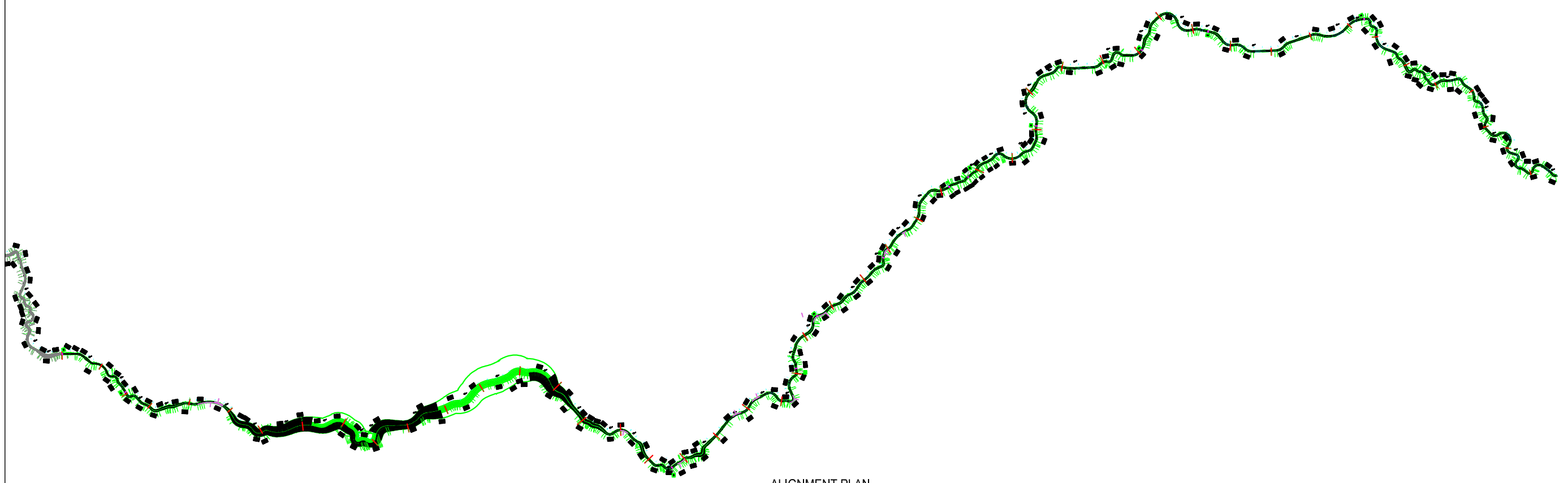
DRAWING TITLE :

ROAD PLAN & PROFILE
CH.24+000 TO CH.48+700

DRAWING NO : 2

Scale : Vertical 1:5000
Horizontal 1:50000

DESIGNED BY :	DRAWN BY :	CHECKED BY :	APPROVED BY :
Mahavir Chopra Designed Eng.	Ashraful Islam Khan CAD Operator	AFM Hamidul Haque Deputy Team Leader	Dr.Prabhat Shrivastava Team Leader



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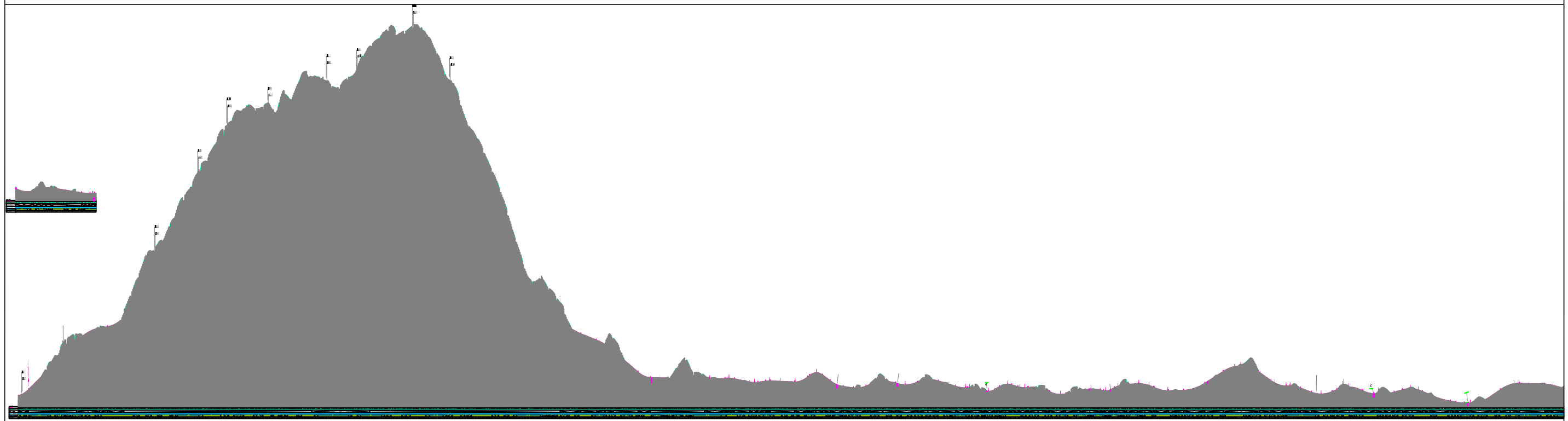

ALIGNMENT PROFILE

NAME OF THE CLIENT :

GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH

LOCAL GOVERNMENT ENGINEERING DEPARTMENT

NAME OF THE PROJECT :

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NAME OF THE CONSULTANTS :

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in association with

BETS Consulting Services Ltd, Bangladesh

SURVEYED BY: SURVEY2000

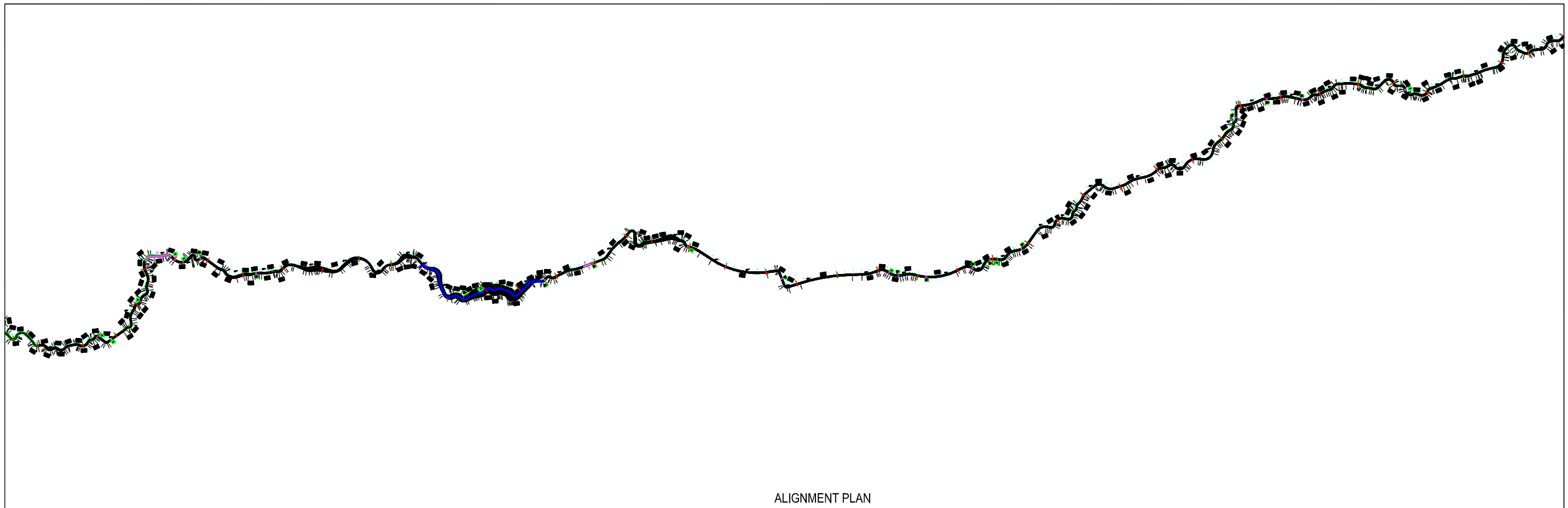
DRAWING TITLE :

ROAD PLAN & PROFILE
CH.48+700 TO CH.72+000

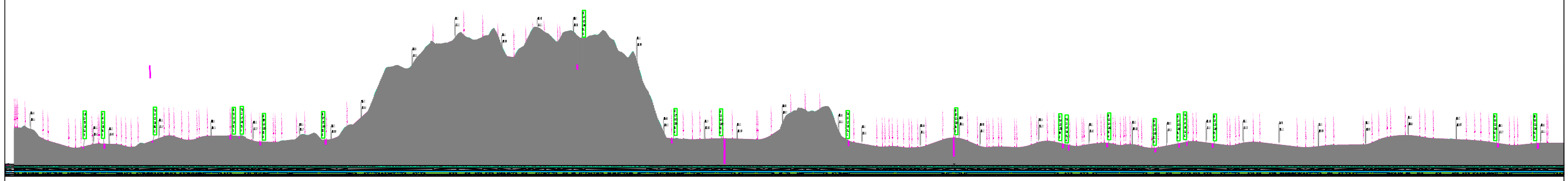
DRAWING NO : 3

Scale : Vertical 1:5000
Horizontal 1:50000

DESIGNED BY :	DRAWN BY :	CHECKED BY :	APPROVED BY :
Mahavir Chopra Design Eng.	Ashraful Islam Khan CAD Operator	AFM Hamidul Haque Deputy Team Leader	Dr.Prabhat Shrivastava Team Leader

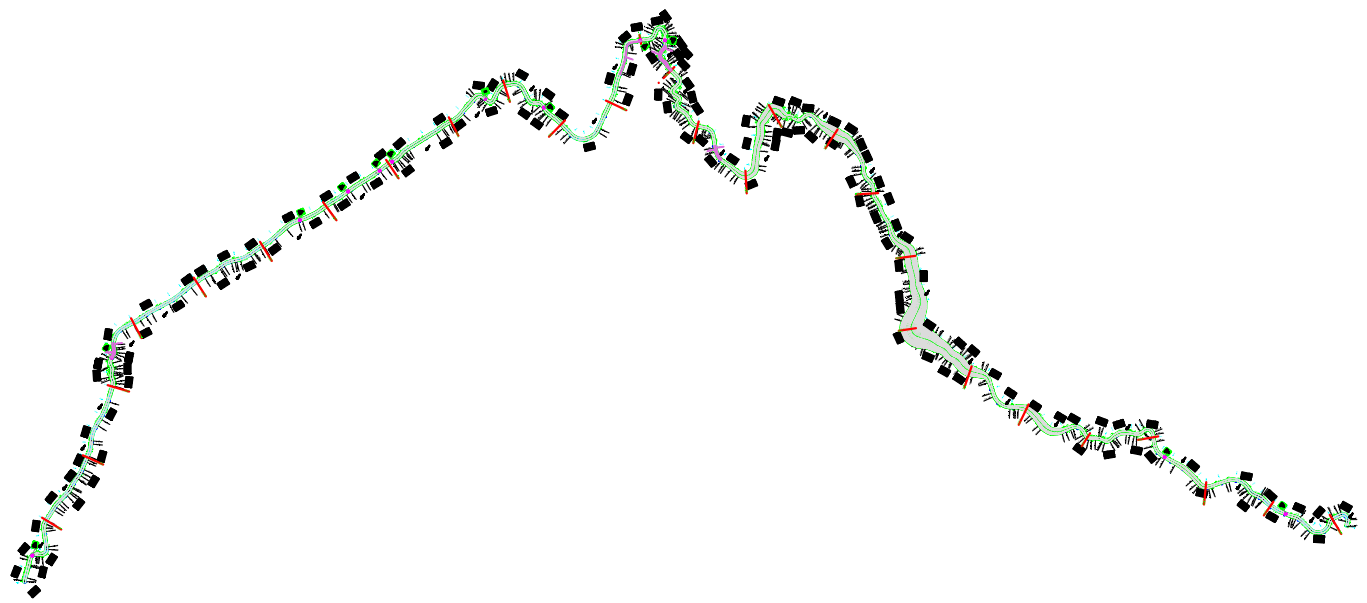


ALIGNMENT PLAN

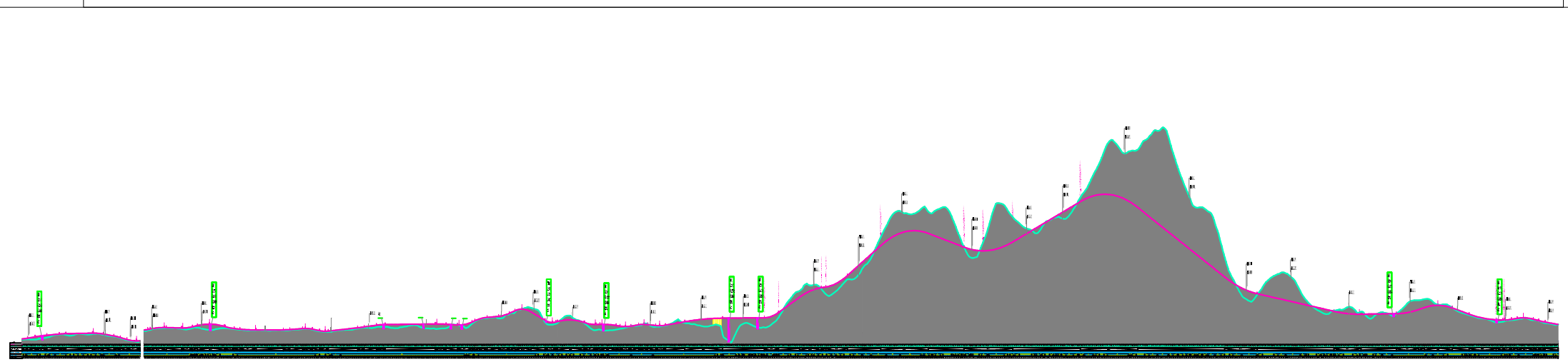


ALIGNMENT PROFILE

NAME OF THE CLIENT : GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH LOCAL GOVERNMENT ENGINEERING DEPARTMENT	NAME OF THE CONSULTANTS : SAI Consulting Engineers Pvt. Ltd, India. in association with BETS Consulting Services Ltd, Bangladesh	DRAWING TITLE : ROAD PLAN & PROFILE CH.72+900 TO CH.95+500	DESIGNED BY : Mahavir Chopra Design Eng.	DRAWN BY : Ashraful Islam Khan CAD Operator	CHECKED BY : AFM Hamidul Haque Deputy Team Leader	APPROVED BY : Dr.Prabhat Shrivastava Team Leader
NAME OF THE PROJECT : CONSULTANCY SERVICES FOR FEASIBILITY, DETAILED SURVEY AND DESIGN OF CHITTAGONG HILL TRACT CONNECTIVITY CONNECTING THEGAMUKH AND CHITTAGONG PORT.	SURVEYED BY: SURVEY2000	DRAWING NO : 4 Scale : Vertical 1:5000 Horizontal 1:50000				



ALIGNMENT PLAN



ALIGNMENT PROFILE

NAME OF THE CLIENT :

GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH

LOCAL GOVERNMENT ENGINEERING DEPARTMENT

NAME OF THE PROJECT :

CONSULTANCY SERVICES FOR FEASIBILITY, DETAILED SURVEY AND DESIGN OF CHITTAGONG HILL TRACT CONNECTIVITY CONNECTING THEGAMUKH AND CHITTAGONG PORT.

NAME OF THE CONSULTANTS :

SAI Consulting Engineers Pvt. Ltd, India.

in association with

BETS Consulting Services Ltd, Bangladesh

SURVEYED BY:

SURVEY2000

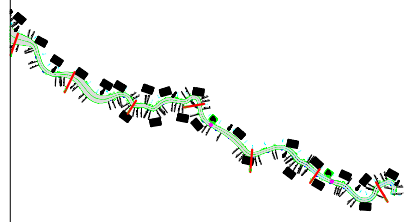
DRAWING TITLE :

ROAD PLAN & PROFILE
CH.95+500 TO CH.109+675

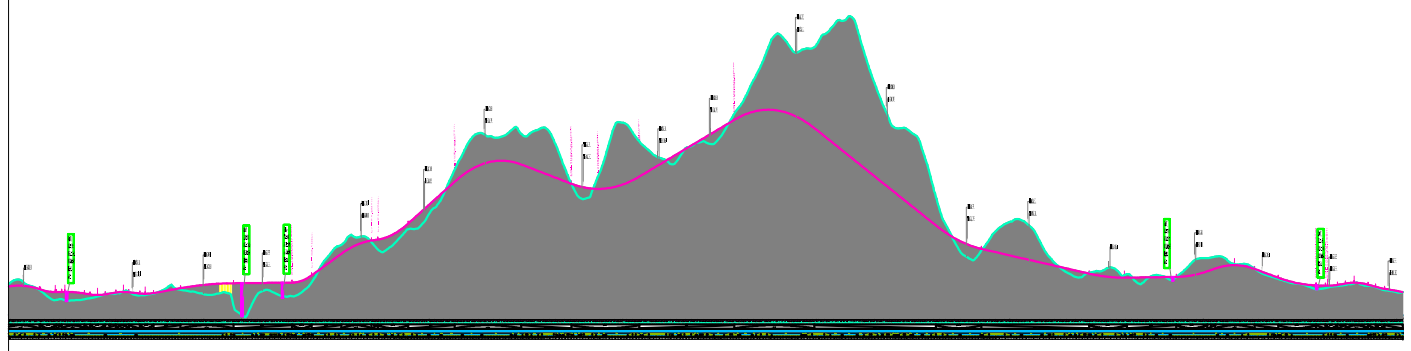
DRAWING NO : 5

Scale : Vertical 1:5000
Horizontal 1:50000

DESIGNED BY :	DRAWN BY :	CHECKED BY :	APPROVED BY :
Mahavir Chopra Design Eng.	Md. Siddiqur Rahman CAD operator	AFM Hamidul Haque Deputy Team Leader	Dr.Prabhat Shrivastava Team Leader



ALIGNMENT PLAN



ALIGNMENT PROFILE

NAME OF THE CLIENT :

GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH

LOCAL GOVERNMENT ENGINEERING DEPARTMENT

NAME OF THE PROJECT :

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NAME OF THE CONSULTANTS :

SAI Consulting Engineers Pvt. Ltd, India.

in association with

BETS Consulting Services Ltd, Bangladesh

SURVEYED BY:

SURVEY2000

DRAWING TITLE :

MULTIMODAL ROAD PART

DRAWING NO : 1

Scale : Vertical 1:5000
Horizontal 1:50000

DESIGNED BY :	DRAWN BY :	CHECKED BY :	APPROVED BY :
Mahavir Chopra Design Eng.	Md. Siddiqur Rahman CAD operator	AFM Hamidul Haque Deputy Team Leader	Dr.Prabhat Shrivastava Team Leader

GENERAL NOTES & SPECIFICATION FOR CONSTRUCTION OF RCC GIRDER BRIDGE

1. DESIGN STANDARD : AASHTO LRFD Bridge Design Specification-2007
2. DESIGN LOADING : AASHTO; HL-93
3. CEMENT : Ordinary Portland Cement Type - BDS-EN-197-1 (CEM-1)

A) SETTING TIME :

Initial Setting Time : Not Less Than 45 Minutes
Final Setting Time : Not More Than 8 Hours

B) STRENGTH :

Compressive Strength 50mm Cube Specimen As per ASTM-C150-86
07 Days Strength :19.30 Mpa (2800psi)

4. REINFORCEMENT :

A) STRENGTH :

Yield Strength (fy) of M.S Deformed Bar shall not be less then 413 N/mm² (60000 psi). The steel should conform ASTM-A615-88 & Equivalent.

B) SPLICES IN REINFORCEMENT :

Splices In Reinforcement if necessary shall be made only as approved by the Engineer-In- Charge
Splices In Reinforcement of maximum stress in Deck and Girders should be avoided.

C) LAP LENGTH :

(a) Not more than 33% of reinforcement shall be lapped at any one section.
(b) For closely spaced bars lapping may be avoided by providing suitable mechanical anchorage (with prior approval).
(c) Splices shall be staggered at least 600mm.
(d) Minimum lap length of bar shall conform to AASHTO LRFD.
Unless otherwise specified, length of the lap splice shall be:

Bar Dia, mm	Lap Splice, mm (Deformed bar)
10	300
12	360
16	480
20	800
22	880
25	1000
32	1280

D. MINIMUM CLEAR COVER TO MAIN REINFORCEMENT :

Clear concrete cover to reinforcing bar shall be maintained as follows unless otherwise shown in the drawings or as directed by the Engineer.

Concrete Element	Clear Cover (mm)	
	Normal Exposure	Saline Water
Abutment, wing wall		
(a) Contact with earth	60	75
(b) Exposed to weather and water	50	60
(c) Abutment base and cut-off wall	75	75
Piles		
(a) Cast-in-place bored	75	75
(b) pre-cast	40	50
Beam, Girder, Column & bracing.	50	60
Pier cap	50	60
Deck slab (bottom layer)	40	40
Deck slab (top layer)	50	50
Railing	25	25

5. CONCRETE :

i): Concrete shall have 28 days standard Cylinder Crushing strength f'c = 25 N/mm² (3600psi) , for all Components.

(ii) The minimum suggested mix shall be 1:1$\frac{1}{2}$:3 for class 25 concrete or a richer mix to attain the specified strength. Mixing ratio shall be confirmed by mix design and trial mix.

6. Water

Water to be used in concreting and curing shall conform to ASHTO LRFD.

7. All Dimensions are in mm unless otherwise mentioned
8. Slump for Cast-In-Situ pile shall be :150 to 200mm, for other Components: 50 to 75mm
9. Coarse Aggregate : 20mm down graded Crushed Stone Chips in Accordance With BS882 Or Equivalent
10. All RCC work must be fair faced (form finished).
11. ***FM of sand*** shall be ***2.5*** (Minimum) for all R.C.C Works whatever mentioned in other places.
12. All RCC casting work must be carried out in steel Form Work of Appropriate size & thickness.
13. Form work with Scaffolding details shall be submitted by the contractor for approval
14. Welding of reinforcement bars shall not be permitted, unless approved by the Engineer in charge
15. Supporting Reinforcing chairs of 16mm diameter for main reinforcement shall be provided at suitable intervals.
16. Construction Joint:
    (a) The location and provision of construction joints shall be approved by the Engineer-in-charge. The concreting operation shall be carried out continuously up to the construction joint.
    (b) The preparation of construction joint shall conform to AASHTO LRFD.

NAME OF THE CLIENT :
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NAME OF THE PROJECT :
CONSULTANCY SERVICES FOR FEASIBILITY, DETAILED SURVEY AND DESIGN OF CHITTAGONG HILL TRACT CONNECTIVITY CONNECTING THEGAMUKH AND CHITTAGONG PORT.

NAME OF THE CONSULTANTS :
SAI Consulting Engineers Pvt. Ltd, India.
in association with
BETS Consulting Services Ltd, Bangladesh
Project office :
Tahmid Mahmood Palace
Flat # 9A, House # 77, Road # 4, Block-C,
Banani. Dhaka-1213. Banaladesh.

DRAWING TITLE :
GENERAL NOTES & SPECIFICATION FOR CONSTRUCTION OF RCC GIRDER BRIDGE

DRAWING NO : GEN/RC-01
Scale :As shown
Date : 28-01-16

DESIGNED BY :	DRAWN BY :	CHECKED BY :	APPROVED BY :
MD. TAZUDDIN	MD. TAZUDDIN	AFM HAMIDUL HAQUE	DR. PRABHAT SHRIVASTAVA

REV.	DESCRIPTION	DATE

GENERAL NOTES & SPECIFICATION FOR THE CONSTRUCTION OF PC GIRDER

A. MATERIAL STRENGTH

01. CONCRETE SHALL HAVE SPECIFIED CHARACTERISTIC COMPRESSIVE STRENGTH OF STANDARD CYLINDER OR CUBE (15 cm) AT 28 DAYS, ARE AS FOLLOWS:

    a) STANDARAD CYLINDER CRUSHING STRENGTH, f'c = 35 N/mm^2

    b) STANDARD CUBE CRUSHING STRENGTH, fcu = 43 N/mm^2

02. REINFORCING STEEL SHALL CONFORM TO ASTM A615-88 GRADE 60 DEFORMED BARS (MARKED 'Y') HAVING MINIMUM YEILD STRENGTH Fy = 413 N/mm^2.

03. PRESTRESSING STEEL SHALL BE OF 12.7mm DIA. 7 PLY UNCOATED LOW RELAXATION STRAND CONFORMING TO AASHTO-M203 (GRADE-270) OR EQUIVALENT HAVING THE FOLLOWING STRENGTH:

    (a) MINIMUM ULTIMATE TENSILE STRENGTH (UTS) f's = 1861 N/mm^2 (183.7 KN PER STRAND)
    (b) MINIMUM YIELD STRENGTH f'y = 1674 N/mm^2 (165.3 KN PER STRAND)

03. PRESTRESSING CABLE SHALL CONSISTS OF 12 NOS.12.7mm DIA. STRAND (12T13) IN A SHEATHING/DUCT

B. PRESTRESSING ACCESSORIES

01. THE DETAILS OF ANCHORAGES, DUCTS, CABLE SPACINGS AND END BLOCK REINFORCEMENT SHOWN ON THE DRAWINGS ARE BASED ON FREYSSINET 12T13 MULTI-STRAND ANCHORAGE SYSTEM.

02. THE SHEATHING/DUCTS FOR THE 12T13 PRESTRESSING CABLES SHALL BE FORMED FROM 75mm INTERNAL DIA. (ID) CORRUGATED STEEL SHEATHS OF GALVANIZED METAL HAVING MINIMUM THICKNESS 0.40mm. THE OUTSIDE DIA. (OD) OF THE SHEATH SHOULD BE ABOUT 6mm LARGER THAN THE ID. THE CONNECTING SLEEVES FOR SHEATH SHOULD HAVE A DIAMETER ABOUT 3.1mm GREATER.

03. FOLLOWING PROPERTIES HAVE BEEN CONSIDERED IN THE DESIGN
    AREA OF STRAND = 98.7 mm^2
    AREA OF CABLE = 1184.4 mm^2
    MODULLES OF ELASTICITY OF STRAND =1.97x10^5(N/mm^2)
    AVERAGE SLIP = 6mm
    JACKING FORCE IN EACH CABLE = 1680 KN.

C. WORKMANSHIP DETAILING

01. AFTER SATISFACTORY COMPLETION OF TENSIONING THE CABLES SHALL BE GROUTED AS PER STANDARED SPECIFICATION. BESIDES THE GROUT HOLES AT STRESSING END EXTRA GROUT VENT MAY ALSO BE PROVIDED AT LOWEST POINT OF EACH CABLE, IF REQUIRED.

02. EXTRA LENGTH OF CABLE REQUIRED FOR FIXING FREYSSINET JACK IS APPROX. 750mm. HOWEVER FOR OTHER ANCHORAGE SYSTEM EXTRA TENDON LENGTH FOR GRIPPING WITH JACK SHALL BE KEPT AS PER MANUFACTURER'S RECOMMENDATION.

03. THE CABLE MUST BE PLACED STRAIGHT AND CO-AXIAL WITH THE ANCHORAGE AT RECESS END FOR A DISTANCE OF AT LEAST 900mm.

04. THE PROFILE OF LONGITUDINAL PRESTRESSING DUCTS SHALL BE MAINTAINED BY PROVIDING 10mm DIA. U-SHAPED MS WELDED SADDLES ATTACHED TO ONE BRANCH OF THE STIRRUPS @ 1000mm C/C APPROX.

05. NON-PRESTRESSED REINFORCEMENT IS TO BE ADJUSTED TO THE SATISFACTION OF THE EINGINNER, IF OBSTRUCTON TO CABLE DUCT OCCURS.

D. CLEAR COVER TO PRESTRESSING AND REINFORCING STEEL

01. MINIMUM CLEAR COVER TO PRESTRESSING DUCTS AND REINFORCING STEEL SHALL BE 40mm.

E. PRESTRESSING AND GROUTING OPERATION

01. THE PRESTRESSING FORCE IN EACH CABLE AT ANCHORAGE DURING STRESSING PRIOR TO LOCK OFF (JACKING FORCE) SHALL BE 1680 KN.

02. EACH CABLE SHALL BE SIMULTENOUSLY STRESSED FROM BOTH END OF PC GIRDER BY USING FREYSSINET/OR EUIVALENT MULTISTRAND JACK.

03. THE STRESSING SEQUENCE OF THE CABLES AND CONCRETE STRENGTH f'ci AT DIFFERENT STAGES HAVE BEEN SHOWN ON SHEET S-11 OF THE DRAWING SERIES OF THE PC GIRDER.

04. THE APPLIED PRESTRESSING FORCES ON THE CABLES SHALL BE MEASURED ON THE RECENTLY CALIBRATED JACKS & GAUGE ACCOMPANIED BY ELONGATION MEASUREMENT IN PRESENCE OF THE ENGINEER OR HIS DESIGNATED REPRESENTATIVE. PROPER RECORDS OF THE ABOVE SHALL BE MAINTAINED.

05. ALL DUCTS SHALL BE GROUTED FOLLOWING STRANDARD SPECIFICATION AFTER SATISFACTORY COMPLETION OF THE STRESSING OPERATIONS AND APPROVAL OF THE ENGINEER.

06. FOR ALL STRESSING AND GROUTING OPERATIONS, THE PROCEDURE GIVEN IN THE GUIDE FOR FREYSSINET OR EQUIVALENT METHODS SHALL BE USED.

F. INSTALLATION DETAILS

01. THE PC GIRDERS SHALL BE MOVED AT LEAST AFTER COMPLETION OF THE 1ST STAGE STRESSING OF THE CABLES AND GROUTING OF THE CABLE DUCTS ONLY.

02. THE PC GIRDERS SHALL BE LIFTED BY PROIVIDING SUPPORTS IN THE VICINITY OF THE CENTER LINE OF BEARINGS ONLY.

03. LATERAL SUPPORTS TO THE PRECAST PC GIRDER SHALL BE PROVIDED DURING MOVEMENT OPERATION OF THE SAME AND CONCRETING OF THE CAST-IN-SITU DECK.

G. MISCELLANEOUS

01. THE SURFACE OF THE TOP FLANGE OF THE PC GIRDER SHALL BE INTENTIONALLY ROUGHENED EXPOSING ABOUT 1/4TH HEIGHT OF THE COARSE AGGREGATE BREAKING THEM TO DEVELOP COMPOSITE ACTION BETWEEN THE PC GIRDER AND CAST-IN-SITU DECK CONCRETE.

02. PRECAMBER TO THE GIRDER SHALL BE PROVIDED AT THE GIRDER SOFFIT BEFORE CASTING OF GIRDER

03. ALL LAP LENGTHS SHALL BE PROVIDED AT LEAST 40 x BAR DIA. AND SHALL BE STAGGERED BY +/- 50% UNLESS OTHERWISE SHOWN.

H. SPECIAL NOTE FOR PRESTRESSING

01. (i) IF THE CALCULATED ELONGATION IS REACHED BEFORE THE CALCULATED GUAGE PRESSURE IS OBTAINED, CONTINUE TENTIONING TILL ATTAINING THE CALCULATED GAUGE PRESSURE, PROVIDED THE ELONGATION DOES NOT EXCEED 1.05 TIMES THE CALCULATED ELONGATION. IF THIS ELONGATION IS ACHIEVED BEFORE THE CALCULATED GUAGE PRESSURE IS ATTAINED, STOP STRESSING AND INFORM THE ENGINEER.

    (ii) IF THE CALCULATED ELONGATION HAS NOT BEEN REACHED CONTINUE TENSIONING BY INTERVALS OF 5 Kg/Sq.CM UNTIL THE CALCULATED ELONGATION IS REACHED PROVIDED THE GAUGE PRESSURE DOES NOT EXCEED 1.05 TIMES THE CALCULATED GUAGE PRESSURE.

    (iii) IF THE ELONGATION AT 1.05 TIMES THE CALCULATED GAUGE PRESSURE IS LESS THAN 0.95 TIMES THE CALCULATED ELONGATION, THE FOLLOWING MEASURES MUST BE TAKEN, IN SUCCESSION,TO DEFINE THE CAUSE OF THIS LACK OF ELONGATION.

    - RECALIBRATE THE PRESSURE GUAGE
    - CHECK THE CORRECT FUNCTIONING OF THE JACK. PUMP AND LEADS.
    - DE-TENSION THE CABLE, SLIDE IT IN ITS DUCT TO CHECK THAT IT IS NOT BLOCKED BY MORTAR WHICH HAS ENTERED THROUGH HOLES IN THE SHEATH. RE-TENSION THE CABLE IF FREE. IF THE REQUIRED ELONGATION IS NOT OBTAINED. FURTHER FINISHING OPERATIONS SUCH AS CUTTING OR SEALING SHOULD NOT BE UNDERTAKEN WITHOUT THE APPROVAL OF THE ENGINEER.

02. ELONGATION SHOWN IN THE DRAWINGS SHALL BE CORRECTED FOR THE ACTUAL 'A' AND 'E' VALUE OF STRANDS OBTAINED FROM THE TEST RESULT .
    CORRECTED ELONGATION = ELONGATION SHOWN IN THE DRAWINGS x A.E/A1.E1
    A, E ARE THE DESIGN AREA AND MODULUS OF ELASTICITY OF STRANDS.
    A1,E1 ARE ACTUAL AREA AND MODULUS OF ELASTICITY OF STRANDS.

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GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH
LOCAL GOVERNMENT ENGINEERING DEPARTMENT

NAME OF THE PROJECT :
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NAME OF THE CONSULTANTS :
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Project office :
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Flat # 9A, House # 77, Road # 4, Block-C,
Banani, Dhaka-1213, Bangladesh.

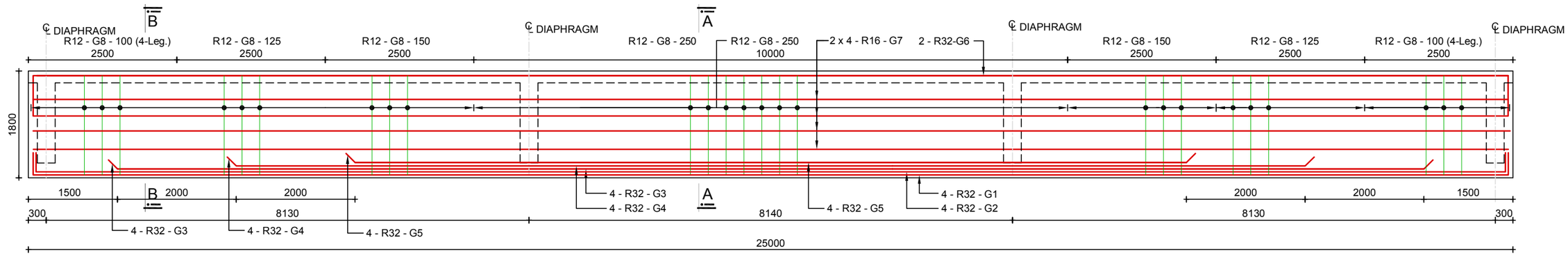
DRAWING TITLE :
GENERAL NOTES & SPECIFICATION FOR CONSTRUCTION OF PC GIRDER BRIDGE

DRAWING NO : GEN/PC-02

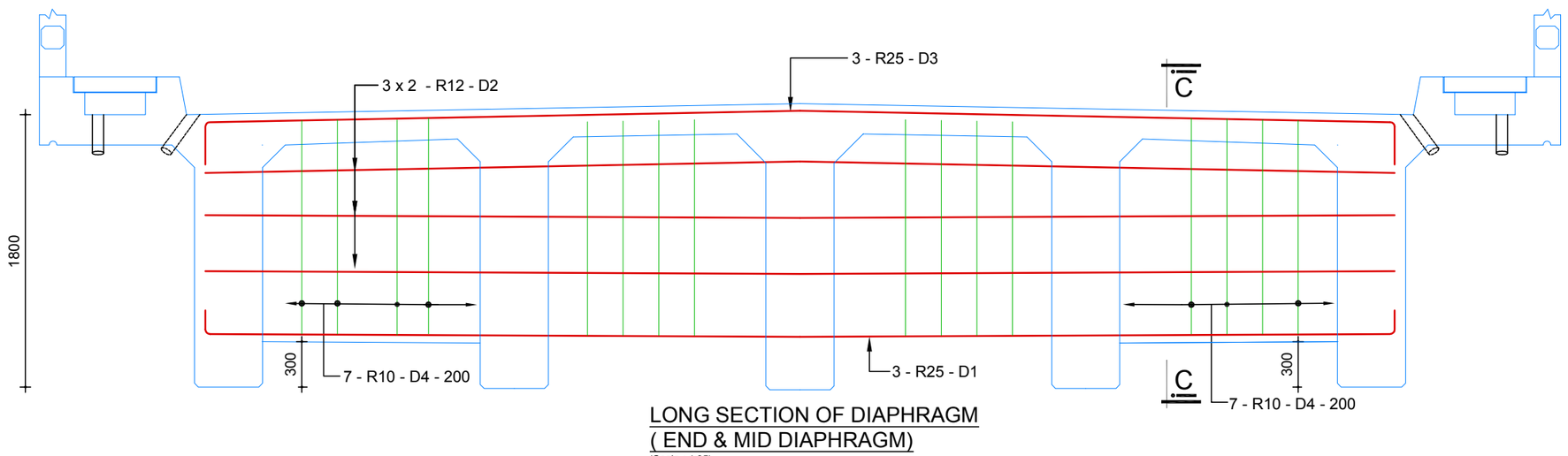
Scale :As shown Date : 28-01-16

DESIGNED BY :	DRAWN BY :	CHECKED BY :	APPROVED BY :
MD. TAZUDDIN	MD. TAZUDDIN	AFM HAMIDUL HAQUE	DR. PRABHAT SHRIVASTAVA

REV.	DESCRIPTION	DATE



LONG SECTION OF GIRDER



LONG SECTION OF DIAPHRAGM
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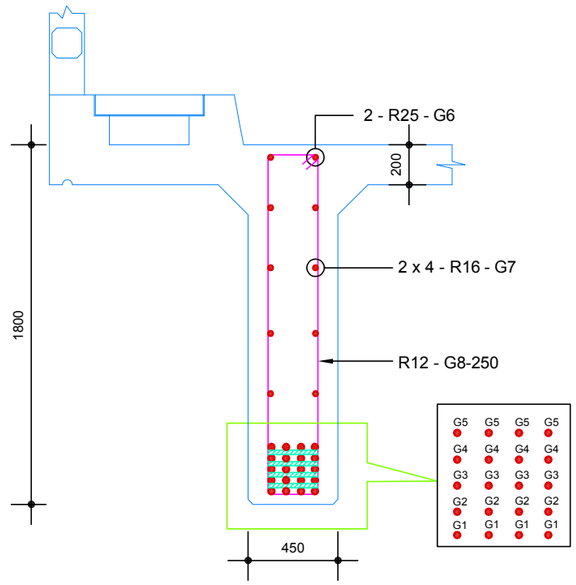
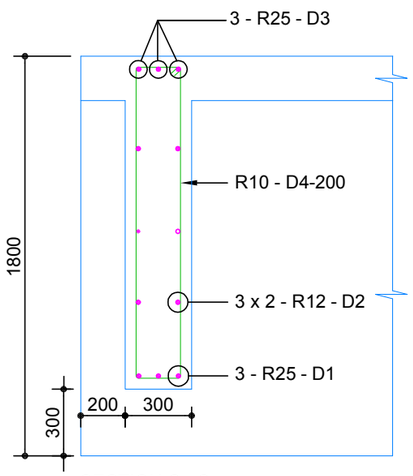


SECTION A - A
Exterior girder



SECTION C - C
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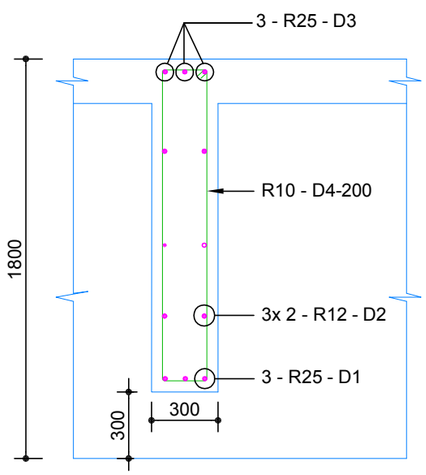
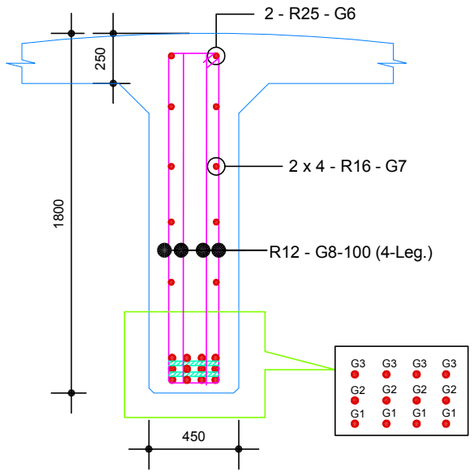
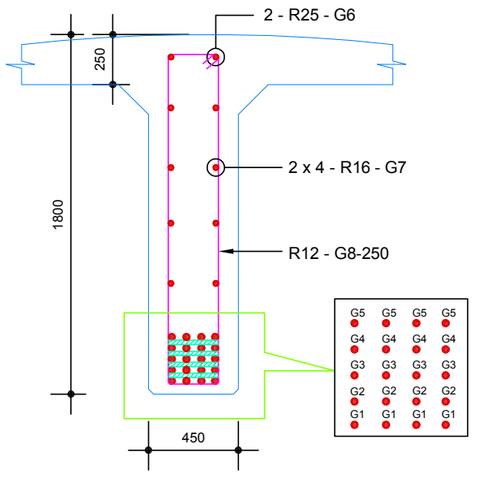


SECTION C - C
MID DIAPHRAGM

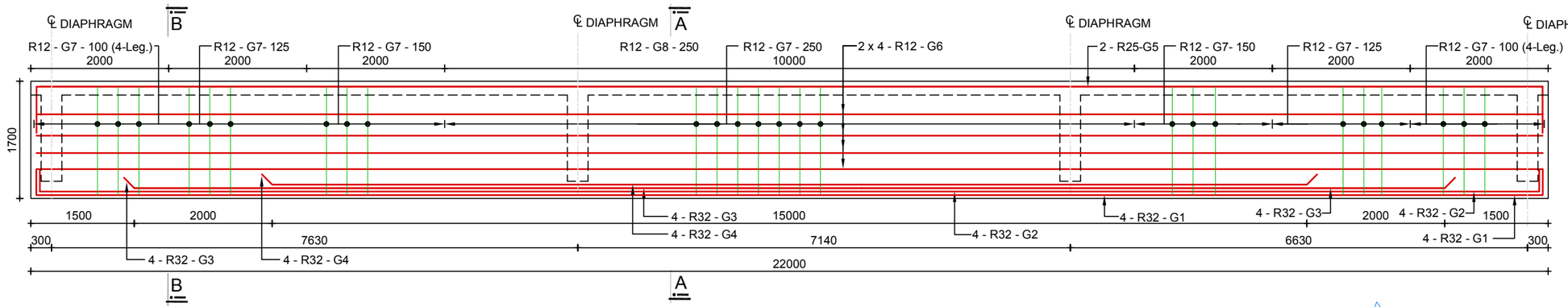


SECTION B-B
Interior girder



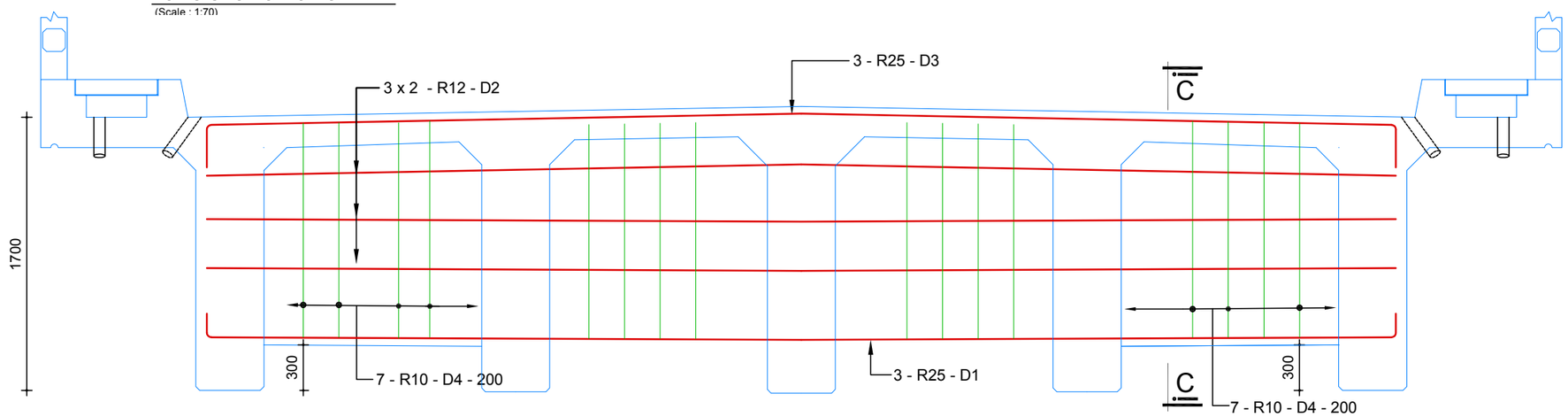
SECTION A-A
Interior girder

NAME OF THE CLIENT : GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH **LOCAL GOVERNMENT ENGINEERING DEPARTMENT**	NAME OF THE CONSULTANTS : **SAI Consulting Engineers Pvt. Ltd, India.** in association with **BETS Consulting Services Ltd, Bangladesh** Project office : Tahmid Mahmood Palace Flat # 9A, House # 77, Road # 4, Block-C,	DRAWING TITLE : REINF. DETAILS OF 25.0m LONG RCC GIRDER	DESIGNED BY : MD. TAZUDDIN	DRAWN BY : MD. TAZUDDIN	CHECKED BY : AFM HAMIDUL HAQUE	APPROVED BY : DR. PRABHAT SHRIVASTAVA	REV. / DESCRIPTION / DATE
NAME OF THE PROJECT : CONSULTANCY SERVICES FOR FEASIBILITY, DETAILED SURVEY AND DESIGN OF CHITTAGONG HILL TRACT CONNECTIVITY CONNECTING THEGAMUKH AND CHITTAGONG PORT.		DRAWING NO : LGED/D-25/RCG-01 Scale :As shown Date : 28-01-16					

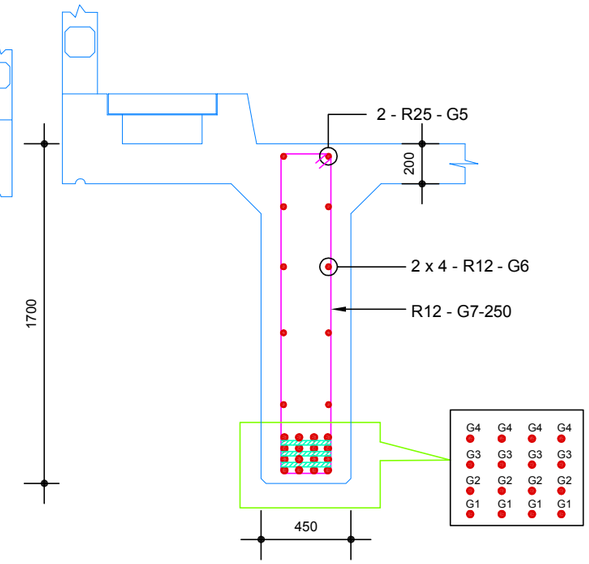


LONG SECTION OF GIRDER

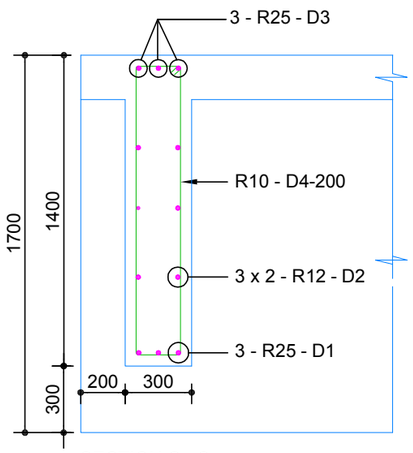
(Scale : 1:70)



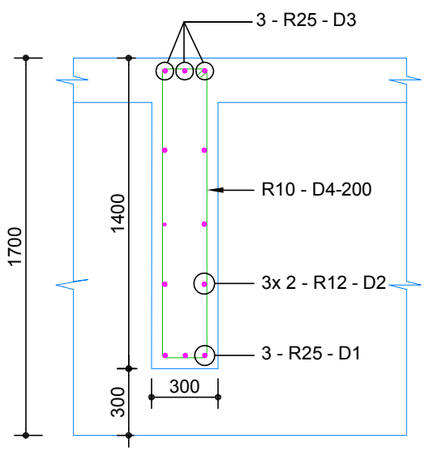
LONG SECTION OF DIAPHRAGM
(END & MID DIAPHRAGM)



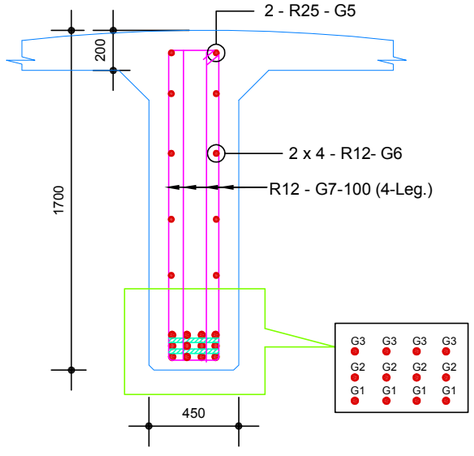
SECTION A - A
Exterior girder



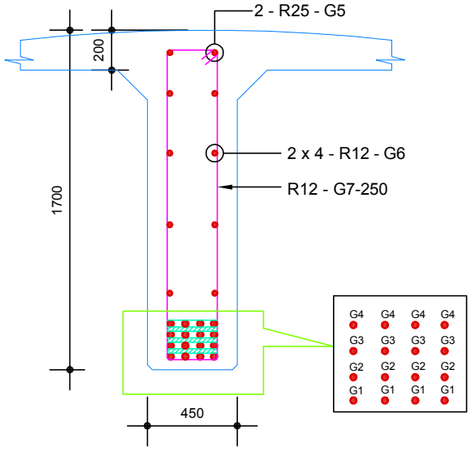
SECTION C - C
END DIAPHRAGM



SECTION C - C
MID DIAPHRAGM

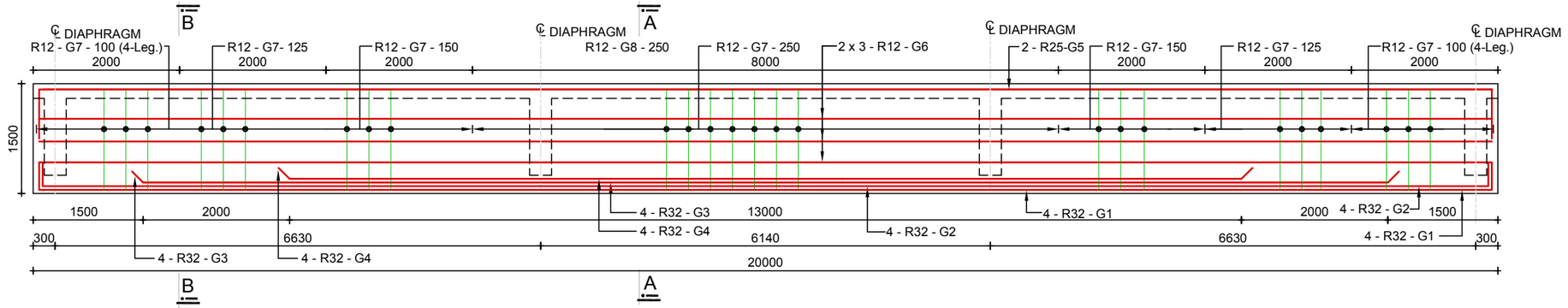


SECTION B-B
Interior girder

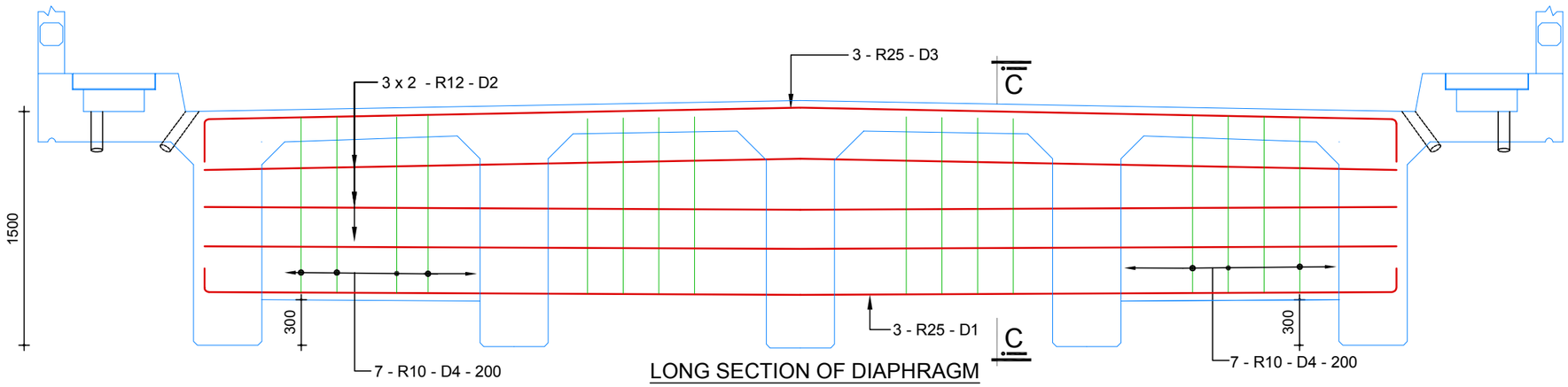


SECTION A-A
Interior girder

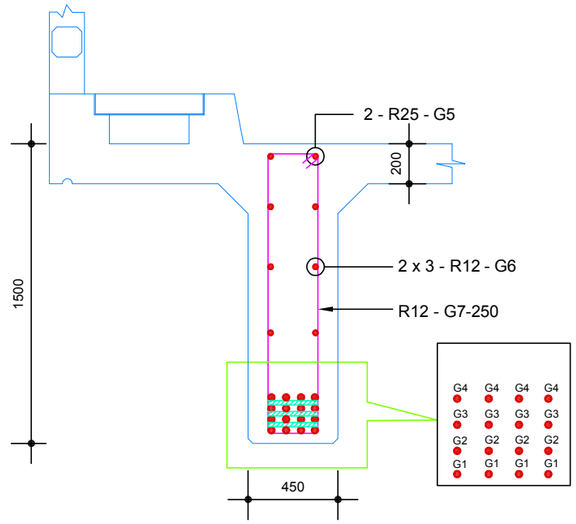
NAME OF THE CLIENT : GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH **LOCAL GOVERNMENT ENGINEERING DEPARTMENT**	NAME OF THE CONSULTANTS : **SAI Consulting Engineers Pvt. Ltd, India.** in association with **BETS Consulting Services Ltd, Bangladesh** Project office : Tahmid Mahmood Palace Flat # 9A, House # 77, Road # 4, Block-C,	DRAWING TITLE : REINF. DETAILS OF 22.0m LONG RCC GIRDER	DESIGNED BY : MD. TAZUDDIN	DRAWN BY : MD. TAZUDDIN	CHECKED BY : AFM HAMIDUL HAQUE	APPROVED BY : DR. PRABHAT SHRIVASTAVA	REV.	DESCRIPTION	DATE
NAME OF THE PROJECT : CONSULTANCY SERVICES FOR FEASIBILITY, DETAILED SURVEY AND DESIGN OF CHITTAGONG HILL TRACT CONNECTIVITY CONNECTING THEGAMUKH AND CHITTAGONG PORT.		DRAWING NO : LGED/D-22/RCG-01 Scale :As shown Date : 28-01-16							



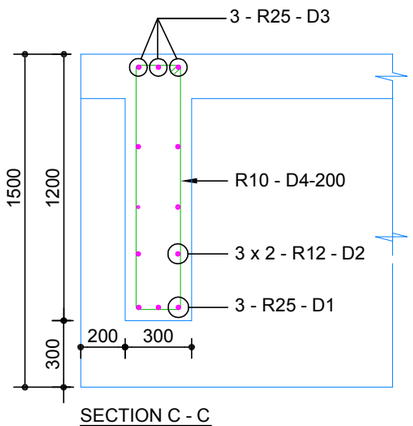
LONG SECTION OF GIRDER



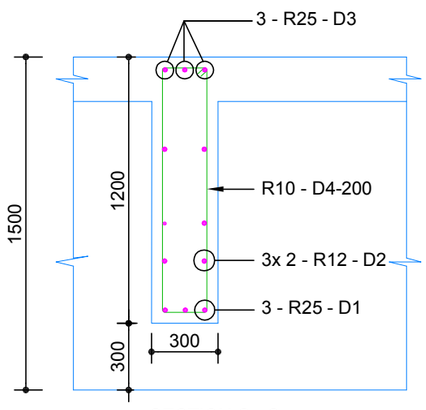
LONG SECTION OF DIAPHRAGM
(END & MID DIAPHRAGM)
(Scale : 1:35)



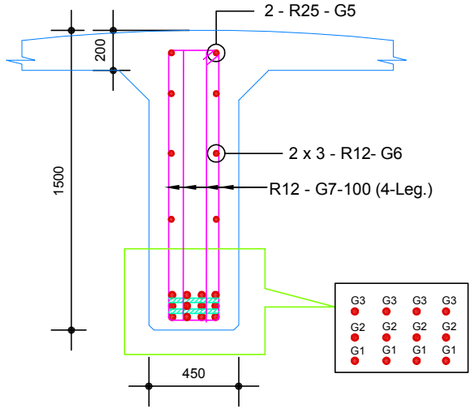
SECTION A - A
Exterior girder



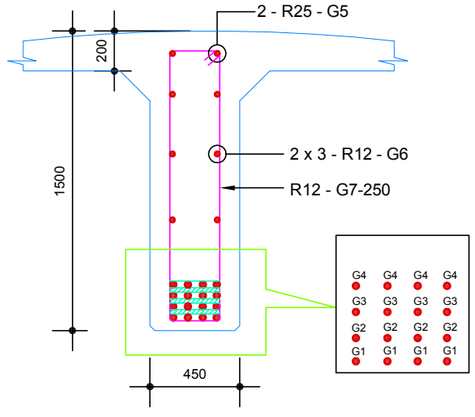
SECTION C - C
END DIAPHRAGM



SECTION C - C
MID DIAPHRAGM



SECTION B-B
Interior girder



SECTION A-A
Interior girder

NAME OF THE CLIENT :
GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH
LOCAL GOVERNMENT ENGINEERING DEPARTMENT

NAME OF THE PROJECT :
CONSULTANCY SERVICES FOR FEASIBILITY, DETAILED SURVEY AND DESIGN OF CHITTAGONG HILL TRACT CONNECTIVITY CONNECTING THEGAMUKH AND CHITTAGONG PORT.

NAME OF THE CONSULTANTS :
SAI Consulting Engineers Pvt. Ltd, India.
in association with
BETS Consulting Services Ltd, Bangladesh
Project office :
Tahmid Mahmood Palace
Flat # 9A, House # 77, Road # 4, Block-C,

DRAWING TITLE :
REINF. DETAILS OF 20.0m LONG RCC GIRDER

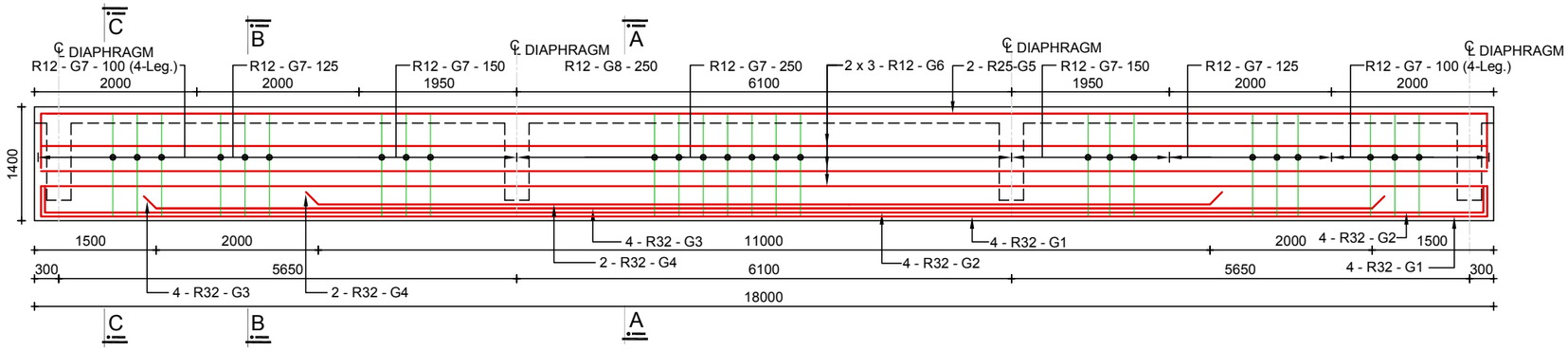
DRAWING NO : LGED/D-20/RCG-01

Scale :As shown

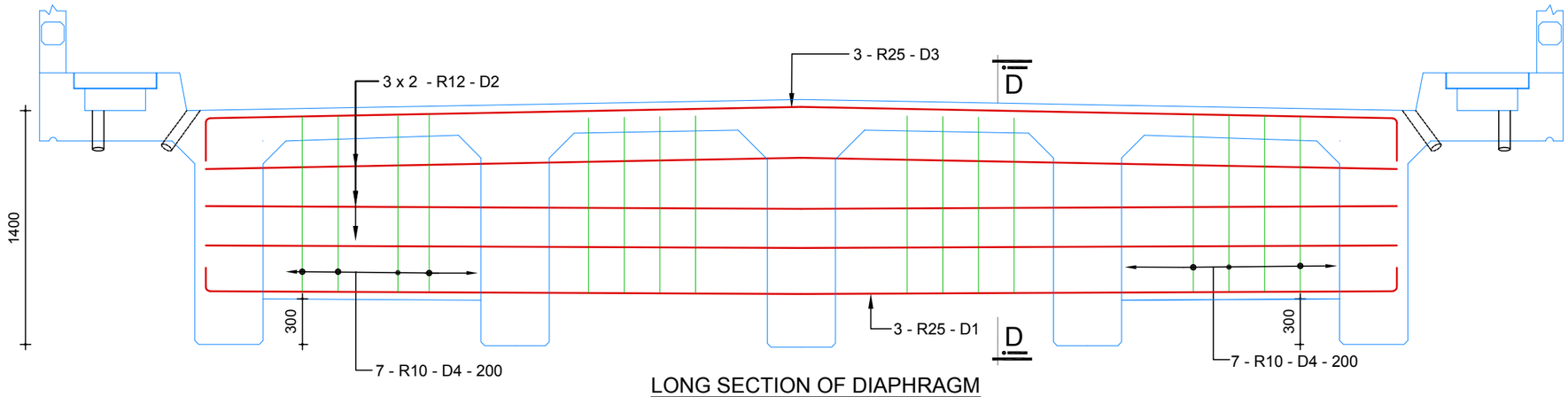
Date : 28-01-16

DESIGNED BY :	DRAWN BY :	CHECKED BY :	APPROVED BY :
MD. TAZUDDIN	MD. TAZUDDIN	AFM HAMIDUL HAQUE	DR. PRABHAT SHRIVASTAVA

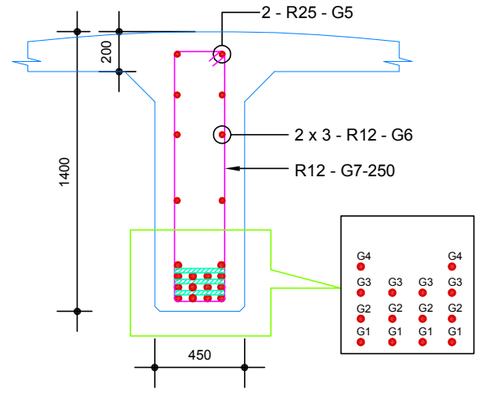
REV.	DESCRIPTION	DATE



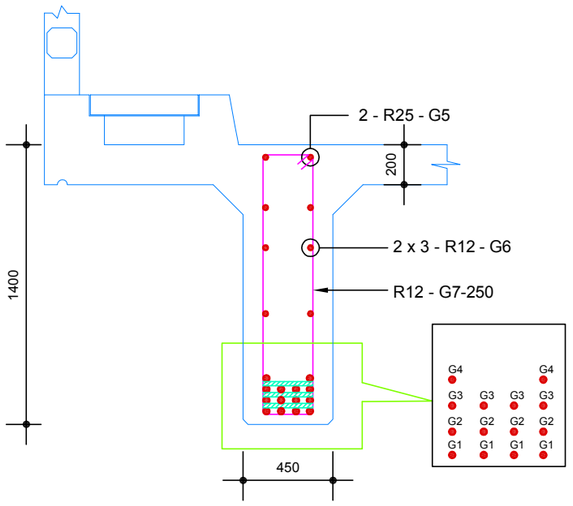
LONG SECTION OF GIRDER
(Scale : 1:70)



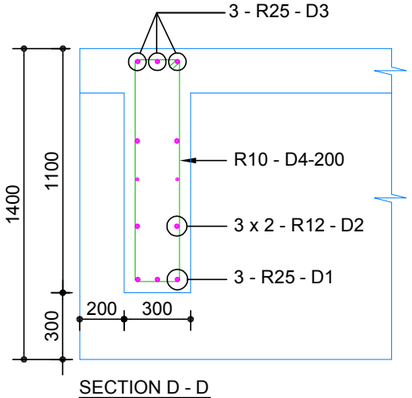
LONG SECTION OF DIAPHRAGM
(END & MID DIAPHRAGM)
(Scale : 1:35)



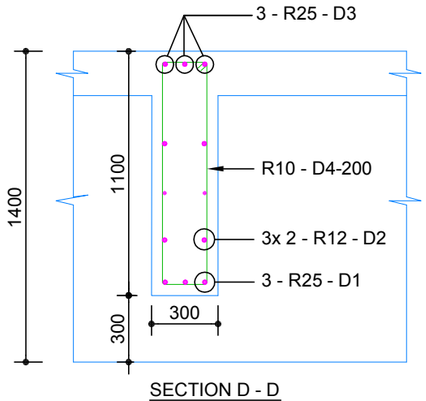
SECTION A-A
Interior girder



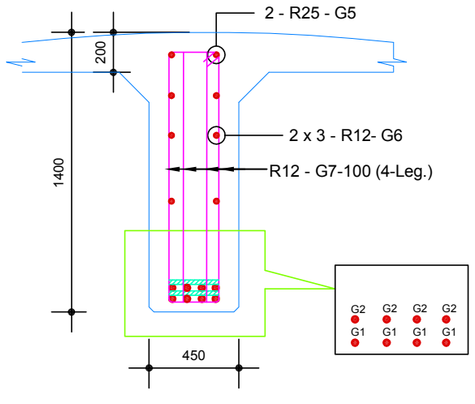
SECTION A - A
Exterior girder



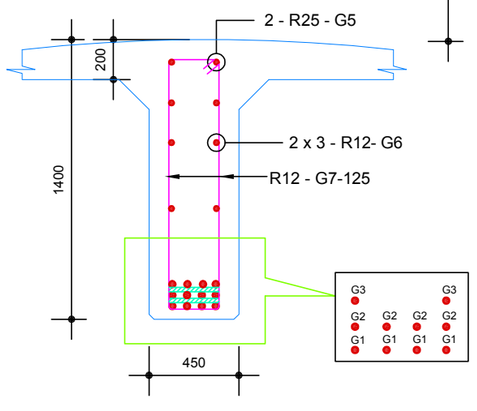
SECTION D - D
END DIAPHRAGM



SECTION D - D
MID DIAPHRAGM

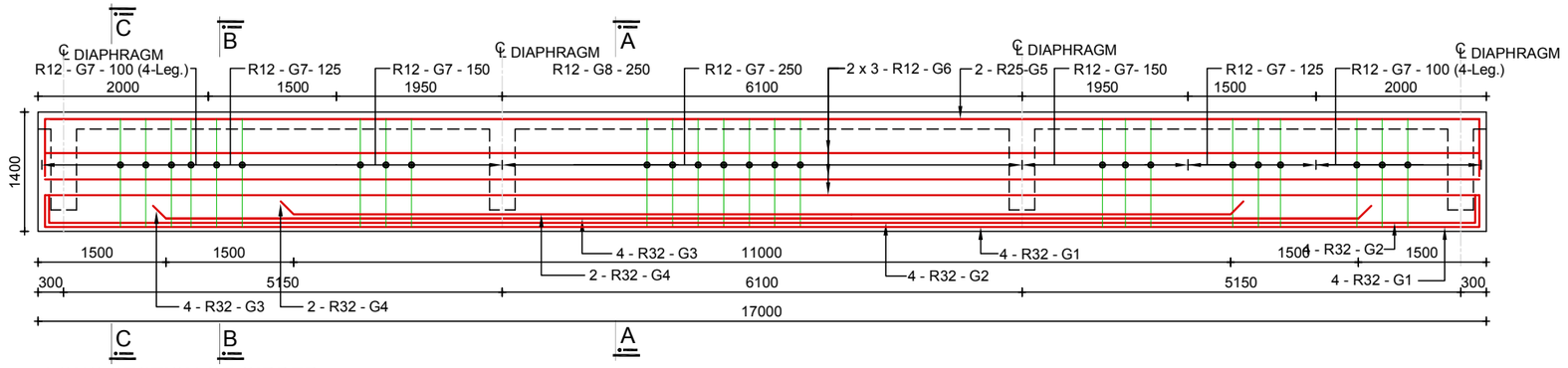


SECTION C-C
Interior girder



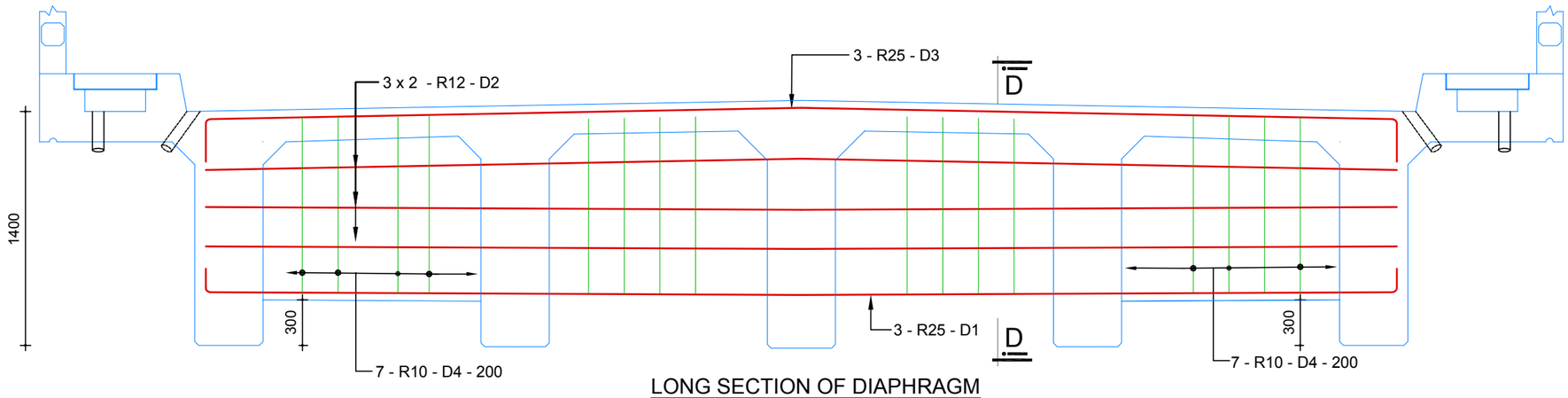
SECTION B-B
Interior girder

NAME OF THE CLIENT : GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH **LOCAL GOVERNMENT ENGINEERING DEPARTMENT**	NAME OF THE CONSULTANTS : **SAI Consulting Engineers Pvt. Ltd, India.** in association with **BETS Consulting Services Ltd, Bangladesh** Project office : Tahmid Mahmood Palace Flat # 9A, House # 77, Road # 4, Block-C,	DRAWING TITLE : REINF. DETAILS OF 18.0m LONG RCC GIRDER	DESIGNED BY : MD. TAZUDDIN	DRAWN BY : MD. TAZUDDIN	CHECKED BY : AFM HAMIDUL HAQUE	APPROVED BY : DR. PRABHAT SHRIVASTAVA	REV.	DESCRIPTION	DATE
NAME OF THE PROJECT : CONSULTANCY SERVICES FOR FEASIBILITY, DETAILED SURVEY AND DESIGN OF CHITTAGONG HILL TRACT CONNECTIVITY CONNECTING THEGAMUKH AND CHITTAGONG PORT.		DRAWING NO : LGED/D-18/RCG-01 Scale :As shown Date : 28-01-16							



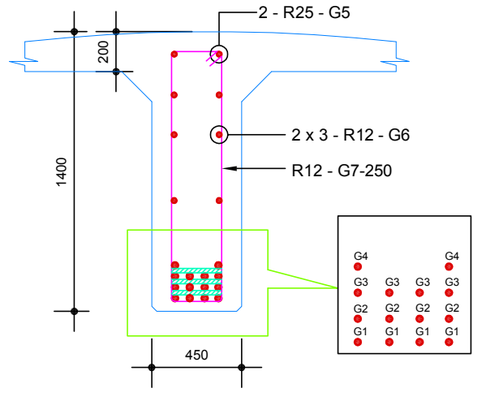
LONG SECTION OF GIRDER

(Scale : 1:70)

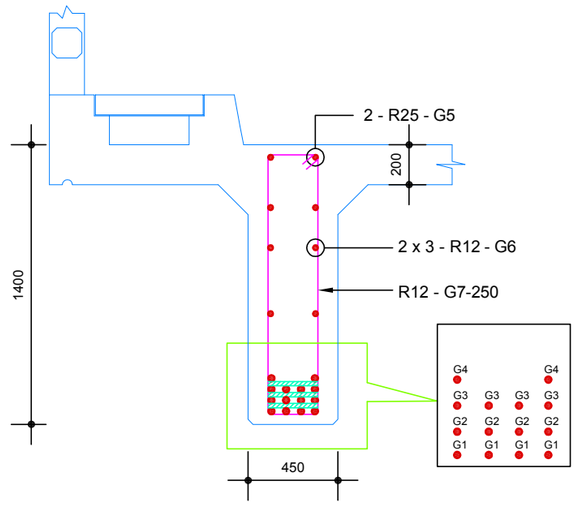


LONG SECTION OF DIAPHRAGM
(END & MID DIAPHRAGM)

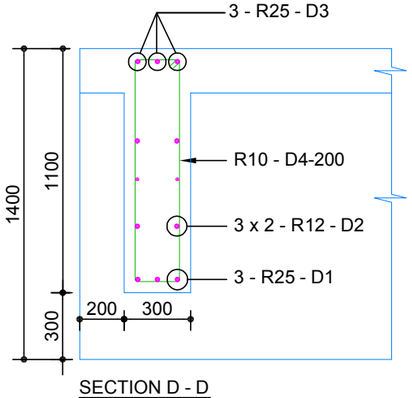
(Scale : 1:35)



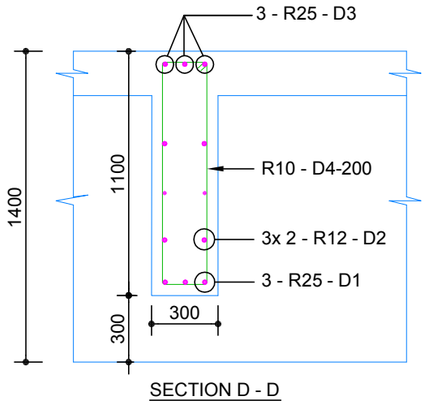
SECTION A-A
Interior girder



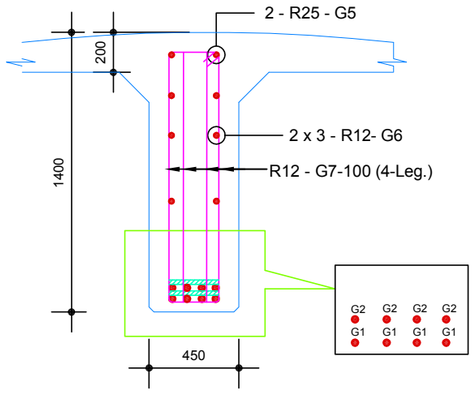
SECTION A - A
Exterior girder



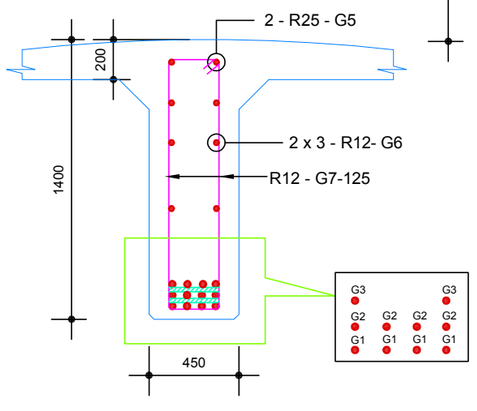
SECTION D - D
END DIAPHRAGM



SECTION D - D
MID DIAPHRAGM

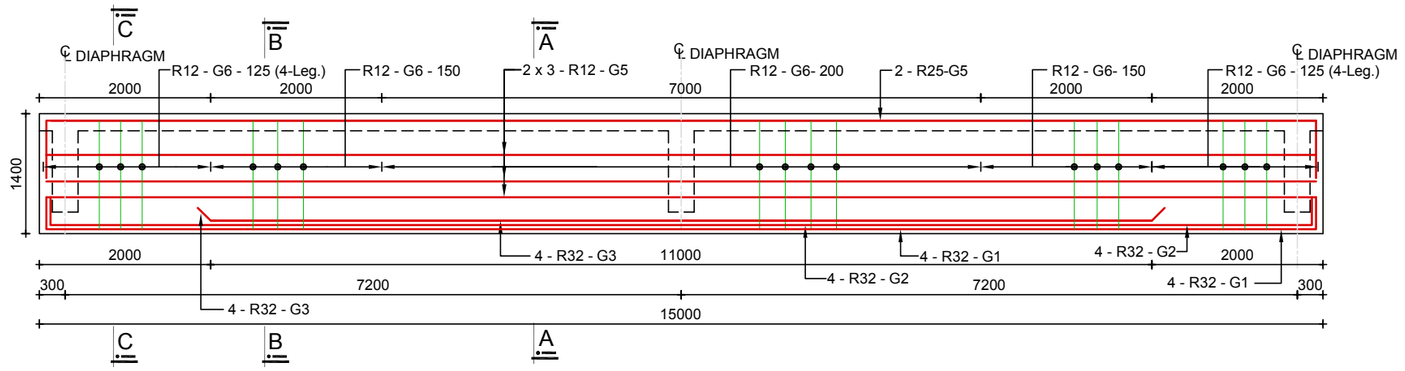


SECTION C-C
Interior girder

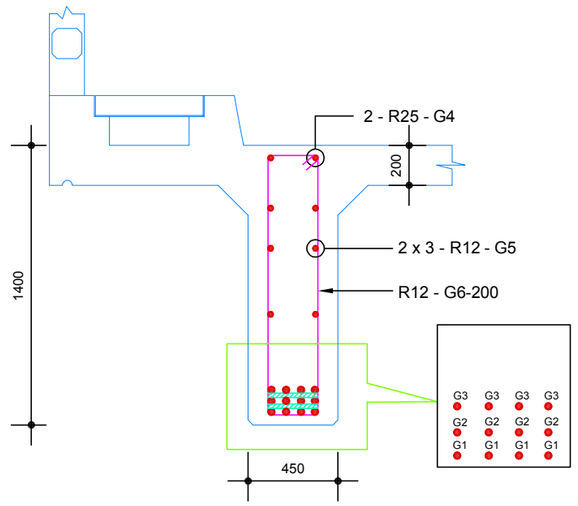


SECTION B-B
Interior girder

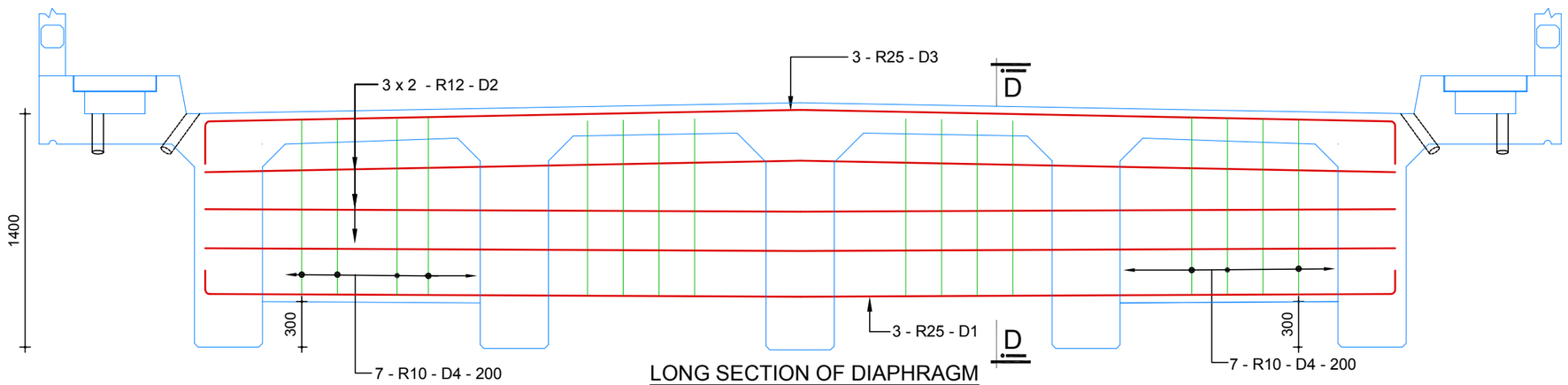
NAME OF THE CLIENT : GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH **LOCAL GOVERNMENT ENGINEERING DEPARTMENT** NAME OF THE PROJECT : CONSULTANCY SERVICES FOR FEASIBILITY, DETAILED SURVEY AND DESIGN OF CHITTAGONG HILL TRACT CONNECTIVITY CONNECTING THEGAMUKH AND CHITTAGONG PORT.	NAME OF THE CONSULTANTS : **SAI Consulting Engineers Pvt. Ltd, India.** in association with **BETS Consulting Services Ltd, Bangladesh** Project office : Tahmid Mahmood Palace Flat # 9A, House # 77, Road # 4, Block-C,	DRAWING TITLE : REINF. DETAILS OF 17.0m LONG RCC GIRDER DRAWING NO : LGED/D-17/RCG-01 Scale :As shown Date : 28-01-16	DESIGNED BY : MD. TAZUDDIN	DRAWN BY : MD. TAZUDDIN	CHECKED BY : AFM HAMIDUL HAQUE	APPROVED BY : DR. PRABHAT SHRIVASTAVA	REV.	DESCRIPTION	DATE



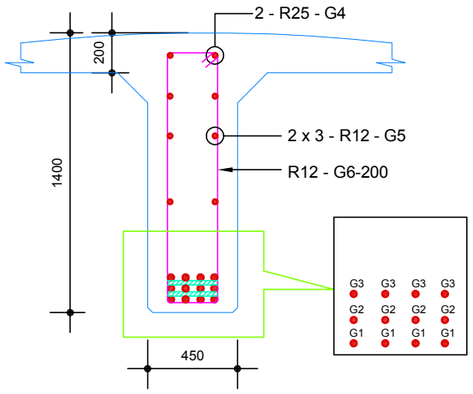
LONG SECTION OF GIRDER
(Scale : 1:70)



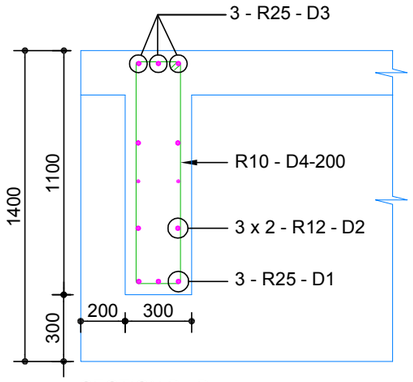
SECTION A - A
Exterior girder



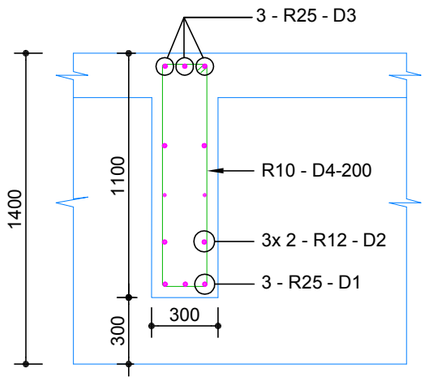
LONG SECTION OF DIAPHRAGM
(END & MID DIAPHRAGM)



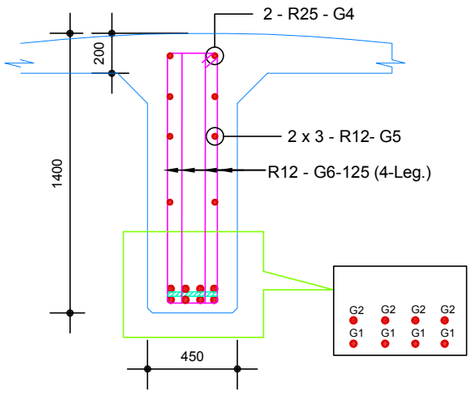
SECTION A-A
Interior girder



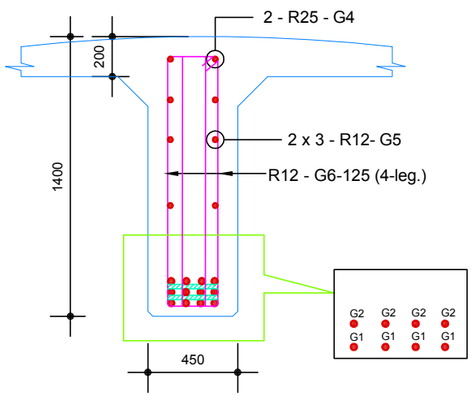
SECTION D - D
END DIAPHRAGM



SECTION D - D
MID DIAPHRAGM

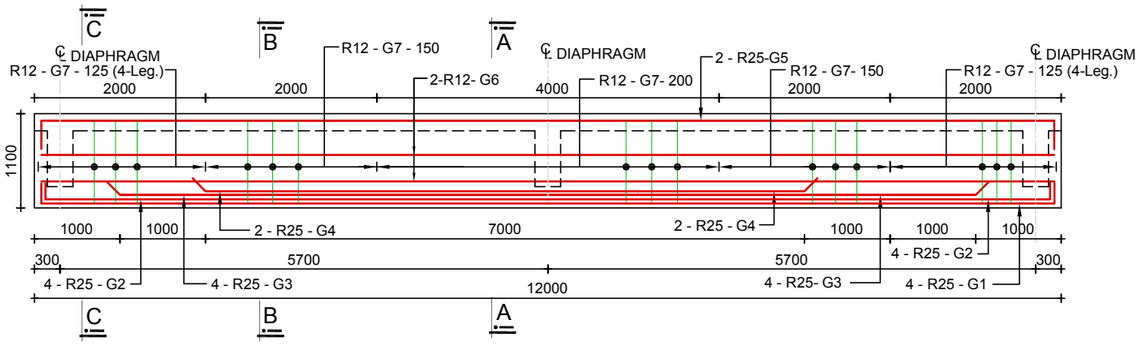


SECTION C-C
Interior girder

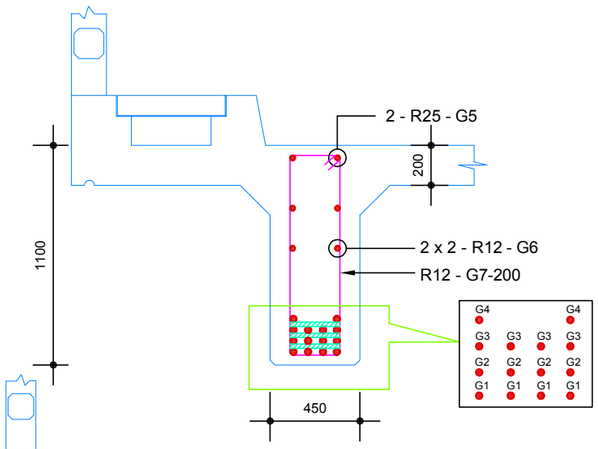


SECTION B-B
Interior girder

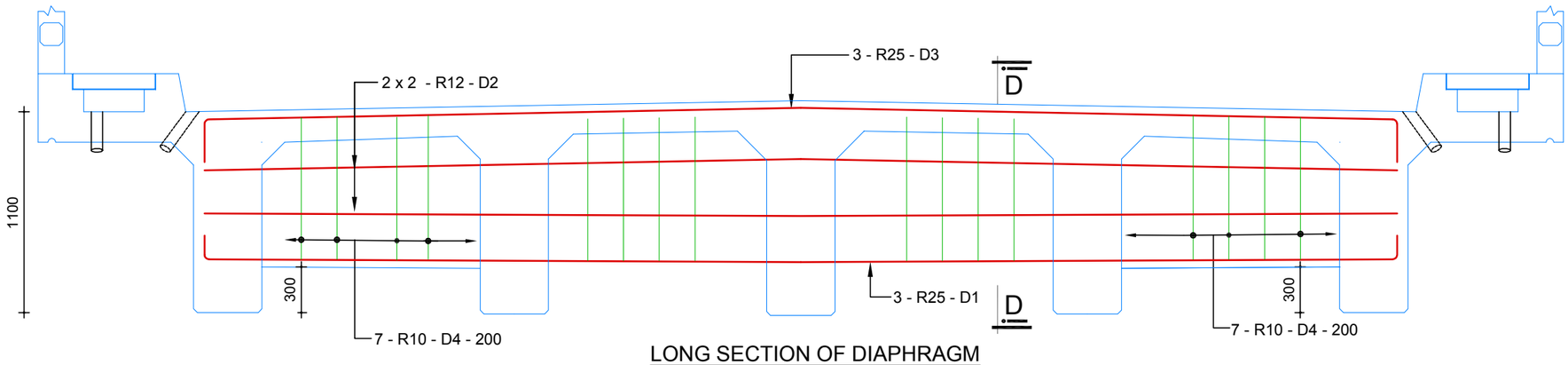
NAME OF THE CLIENT : GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH **LOCAL GOVERNMENT ENGINEERING DEPARTMENT** NAME OF THE PROJECT : CONSULTANCY SERVICES FOR FEASIBILITY, DETAILED SURVEY AND DESIGN OF CHITTAGONG HILL TRACT CONNECTIVITY CONNECTING THEGAMUKH AND CHITTAGONG PORT.	NAME OF THE CONSULTANTS : **SAI Consulting Engineers Pvt. Ltd, India.** in association with **BETS Consulting Services Ltd, Bangladesh** Project office : Tahmid Mahmood Palace Flat # 9A, House # 77, Road # 4, Block-C,	DRAWING TITLE : REINF. DETAILS OF 15.0m LONG RCC GIRDER DRAWING NO : LGED/D-15/RCG-01 Scale :As shown Date : 28-01-16	DESIGNED BY : MD. TAZUDDIN	DRAWN BY : MD. TAZUDDIN	CHECKED BY : AFM HAMIDUL HAQUE	APPROVED BY : DR. PRABHAT SHRIVASTAVA	REV.	DESCRIPTION	DATE



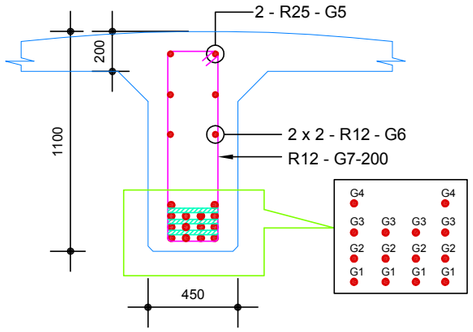
LONG SECTION OF GIRDER
(Scale : 1:70)



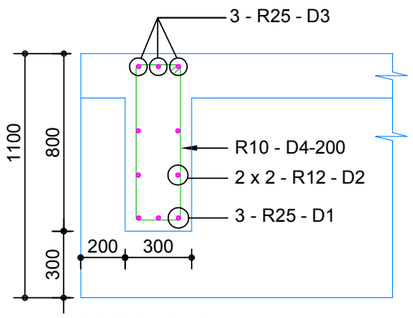
SECTION A - A
Exterior girder



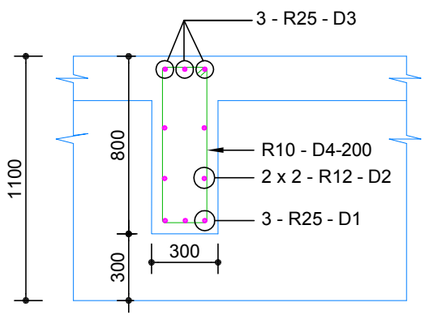
LONG SECTION OF DIAPHRAGM
(END & MID DIAPHRAGM)
(Scale : 1:35)



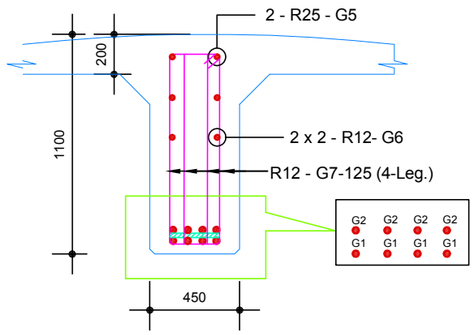
SECTION A-A
Interior girder



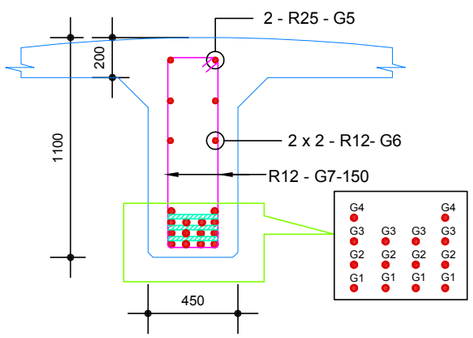
SECTION D - D
END DIAPHRAGM



SECTION D - D
MID DIAPHRAGM



SECTION C-C
Interior girder

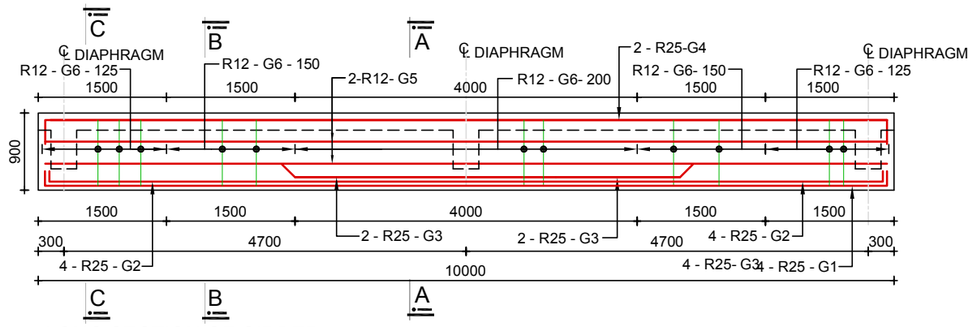


SECTION B-B
Interior girder

NAME OF THE CLIENT : GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH **LOCAL GOVERNMENT ENGINEERING DEPARTMENT**	NAME OF THE CONSULTANTS : **SAI Consulting Engineers Pvt. Ltd, India.** in association with **BETS Consulting Services Ltd, Bangladesh** Project office : Tahmid Mahmood Palace Flat # 9A, House # 77, Road # 4, Block-C,	DRAWING TITLE : REINF. DETAILS OF 12.0m LONG RCC GIRDER
NAME OF THE PROJECT : CONSULTANCY SERVICES FOR FEASIBILITY, DETAILED SURVEY AND DESIGN OF CHITTAGONG HILL TRACT CONNECTIVITY CONNECTING THEGAMUKH AND CHITTAGONG PORT.		DRAWING NO : LGED/D-12/RCG-01
		Scale :As shown Date : 28-01-16

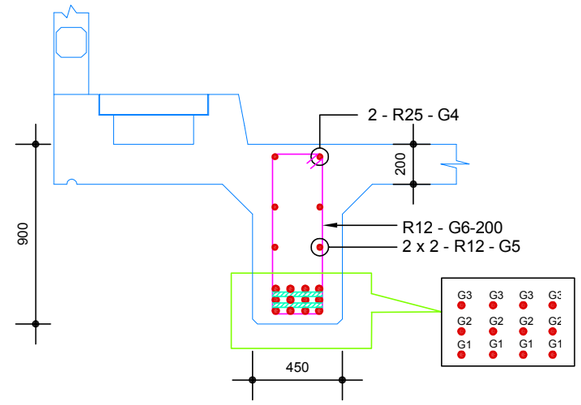
DESIGNED BY :	DRAWN BY :	CHECKED BY :	APPROVED BY :
MD. TAZUDDIN	MD. TAZUDDIN	AFM HAMIDUL HAQUE	DR. PRABHAT SHRIVASTAVA

REV.	DESCRIPTION	DATE



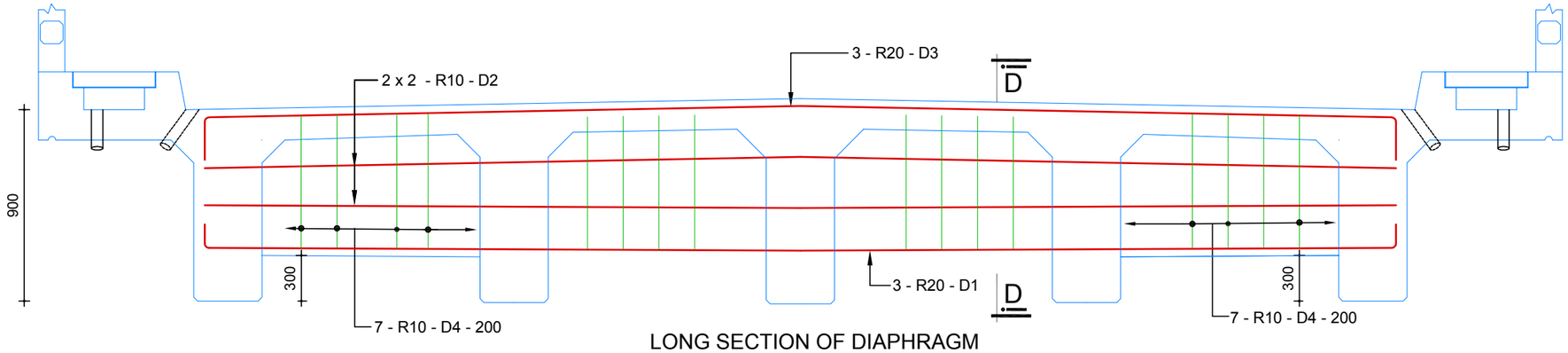
LONG SECTION OF GIRDER

(Scale : 1:70)



SECTION A - A

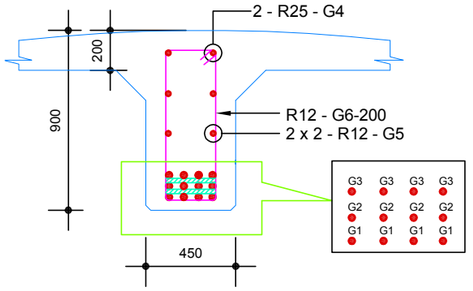
Exterior girder



LONG SECTION OF DIAPHRAGM

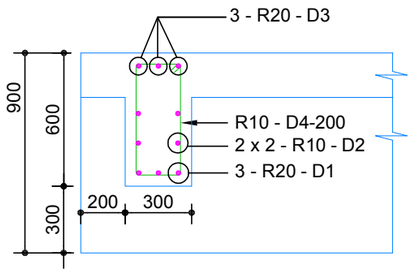
(END & MID DIAPHRAGM)

(Scale : 1:35)



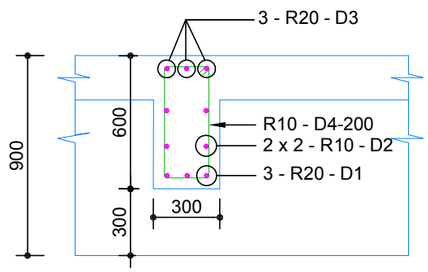
SECTION A-A

Interior girder



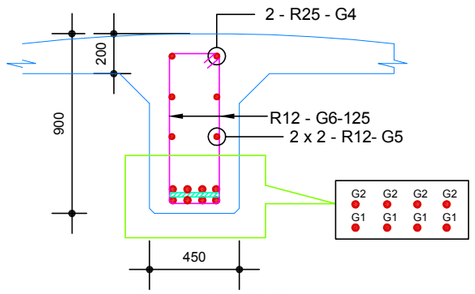
SECTION D - D

END DIAPHRAGM



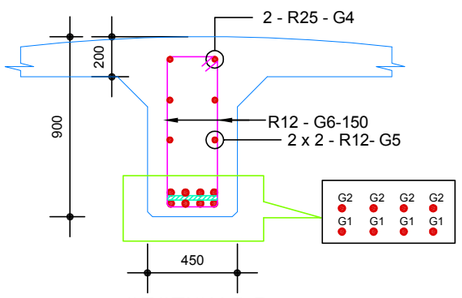
SECTION D - D

MID DIAPHRAGM



SECTION C-C

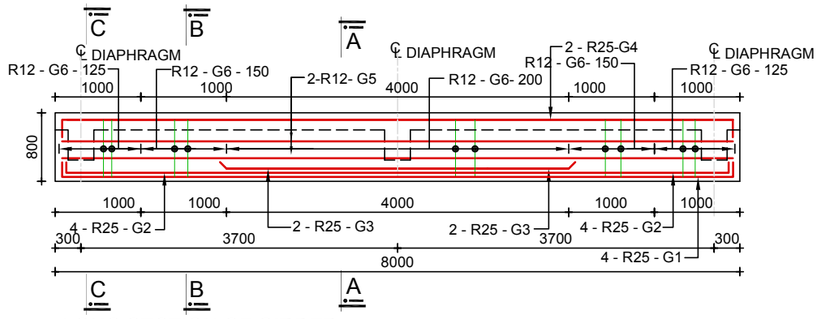
Interior girder



SECTION B-B

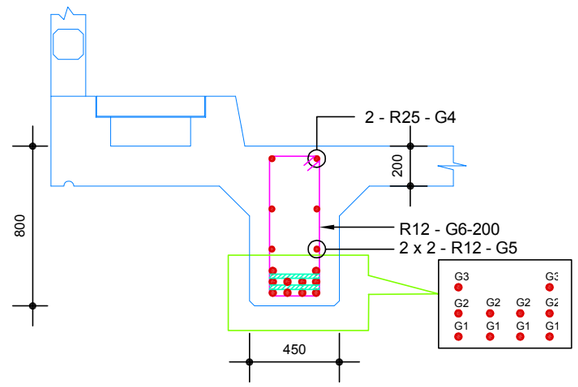
Interior girder

NAME OF THE CLIENT : GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH **LOCAL GOVERNMENT ENGINEERING DEPARTMENT**	NAME OF THE CONSULTANTS : **SAI Consulting Engineers Pvt. Ltd, India.** in association with **BETS Consulting Services Ltd, Bangladesh** Project office : Tahmid Mahmood Palace Flat # 9A, House # 77, Road # 4, Block-C,	DRAWING TITLE : REINF. DETAILS OF 10.0m LONG RCC GIRDER	DESIGNED BY : MD. TAZUDDIN	DRAWN BY : MD. TAZUDDIN	CHECKED BY : AFM HAMIDUL HAQUE	APPROVED BY : DR. PRABHAT SHRIVASTAVA	REV.	DESCRIPTION	DATE
NAME OF THE PROJECT : CONSULTANCY SERVICES FOR FEASIBILITY, DETAILED SURVEY AND DESIGN OF CHITTAGONG HILL TRACT CONNECTIVITY CONNECTING THEGAMUKH AND CHITTAGONG PORT.		DRAWING NO : LGED/D-10/RCG-01 Scale :As shown Date : 28-01-16							



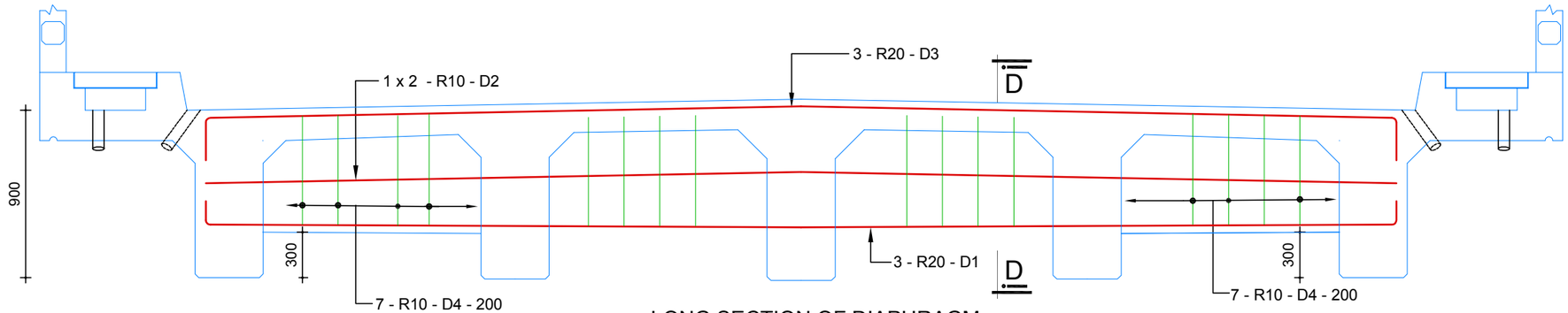
LONG SECTION OF GIRDER

(Scale : 1:70)



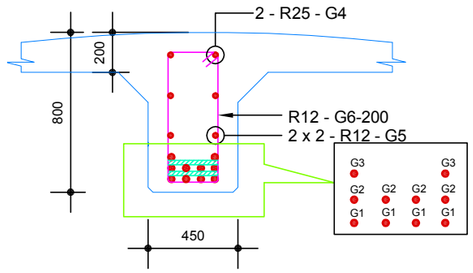
SECTION A - A

Exterior girder



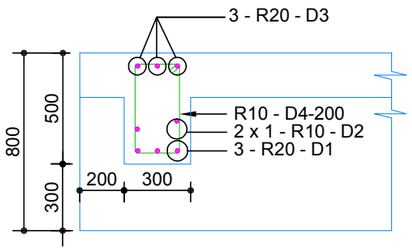
LONG SECTION OF DIAPHRAGM

(END & MID DIAPHRAGM)



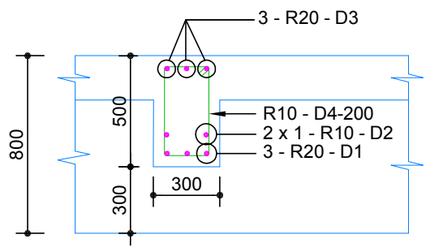
SECTION A-A

Interior girder



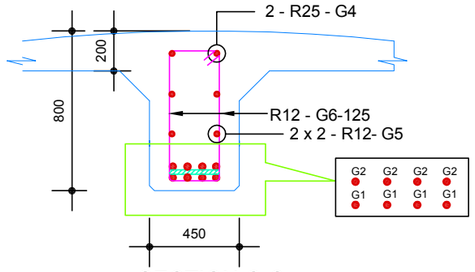
SECTION D - D

END DIAPHRAGM



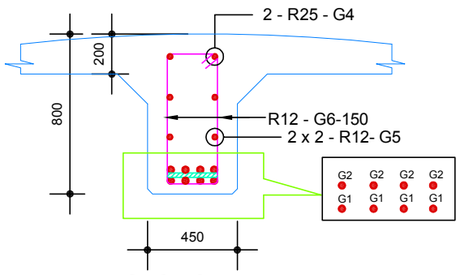
SECTION D - D

MID DIAPHRAGM



SECTION C-C

Interior girder



SECTION B-B

Interior girder

NAME OF THE CLIENT :

GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH

LOCAL GOVERNMENT ENGINEERING DEPARTMENT

NAME OF THE PROJECT :

CONSULTANCY SERVICES FOR FEASIBILITY, DETAILED SURVEY AND DESIGN OF CHITTAGONG HILL TRACT CONNECTIVITY CONNECTING THEGAMUKH AND CHITTAGONG PORT.

NAME OF THE CONSULTANTS :

SAI Consulting Engineers Pvt. Ltd, India.

in association with

BETS Consulting Services Ltd, Bangladesh

Project office :

Tahmid Mahmood Palace

Flat # 9A, House # 77, Road # 4, Block-C,

DRAWING TITLE :

REINF. DETAILS OF 8.0m LONG RCC GIRDER

DRAWING NO : LGED/D-8/RCG-01

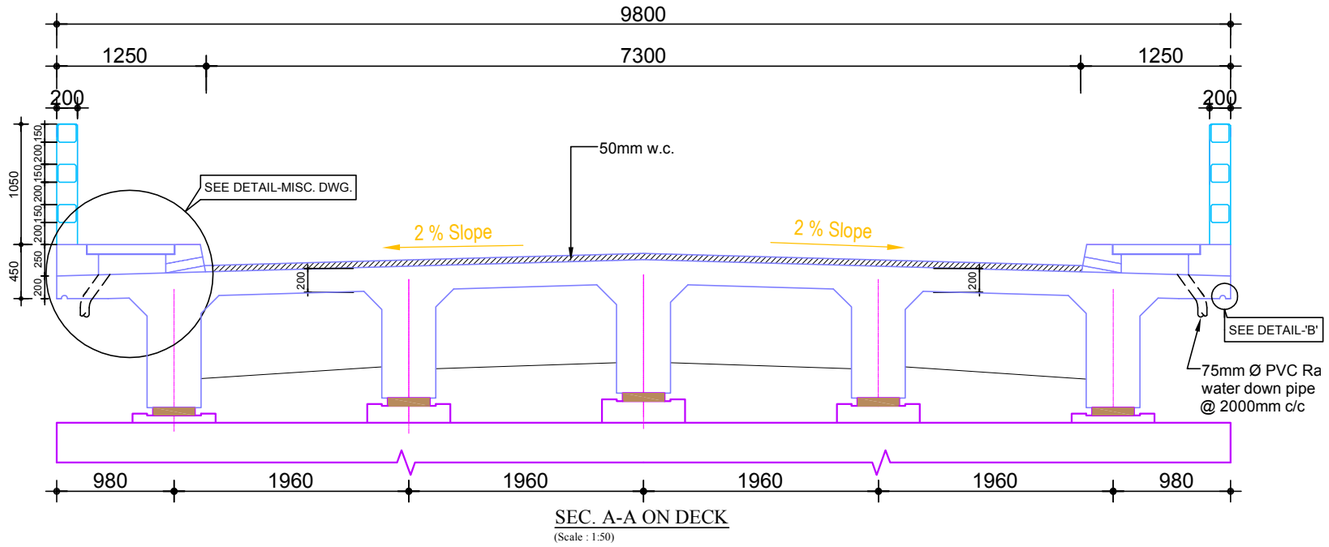
Scale :As shown

Date : 28-01-16

DESIGNED BY :	DRAWN BY :	CHECKED BY :	APPROVED BY :
MD. TAZUDDIN	MD. TAZUDDIN	AFM HAMIDUL HAQUE	DR. PRABHAT SHRIVASTAVA

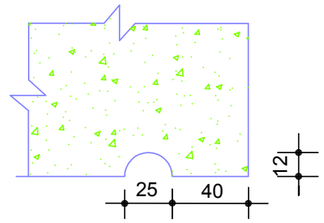
REV.	DESCRIPTION	DATE

TYPICAL RCC GIRDER

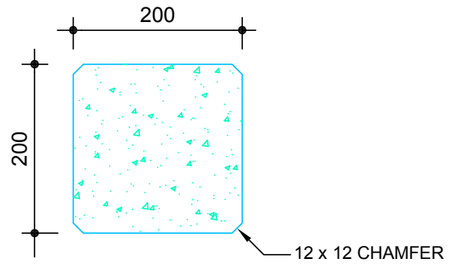


SEC. A-A ON DECK

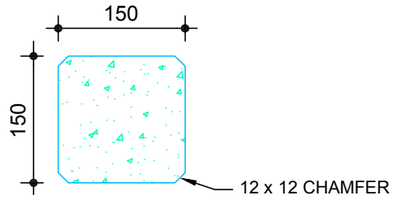
(Scale : 1:50)



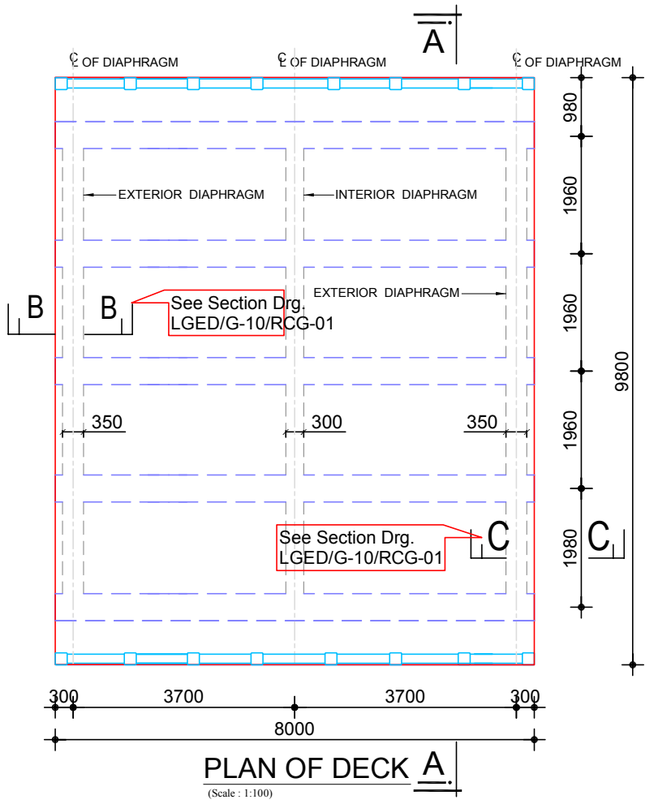
DETAIL "B"



CROSS SECTION
RAIL POST



CROSS SECTION
RAIL BAR



PLAN OF DECK A

(Scale : 1:100)

NOTES:

1. All dimensions are in milimeters unless othrwise mentioned.
2. Rain water down pipe shall be projected minimum 50mm from the bottom of slab.

NAME OF THE CLIENT :

GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH

LOCAL GOVERNMENT ENGINEERING DEPARTMENT

NAME OF THE PROJECT :

CONSULTANCY SERVICES FOR FEASIBILITY, DETAILED SURVEY AND DESIGN OF CHITTAGONG HILL TRACT CONNECTIVITY CONNECTING THEGAMUKH AND CHITTAGONG PORT.

NAME OF THE CONSULTANTS :

SAI Consulting Engineers Pvt. Ltd, India.

in association with

BETS Consulting Services Ltd, Bangladesh

Project office :

Tahmid Mahmood Palace
Flat # 9A, House # 77, Road # 4, Block-C,
Banani, Dhaka-1213, Bangladesh.

DRAWING TITLE :

DETAILS OF DECK SLAB (S-8.0m)

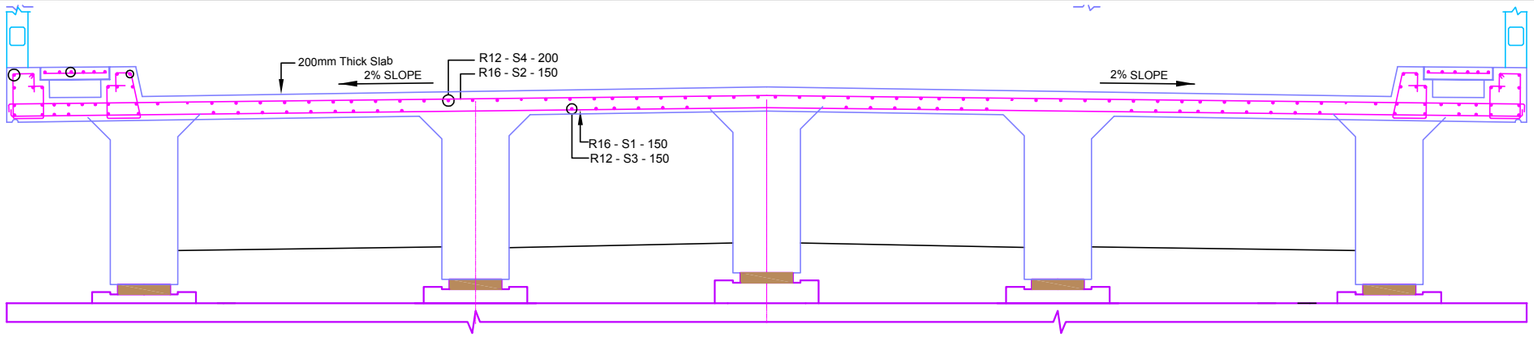
DRAWING NO : LGED/DK-8/C-01

Scale :As shown

Date : 28-01-16

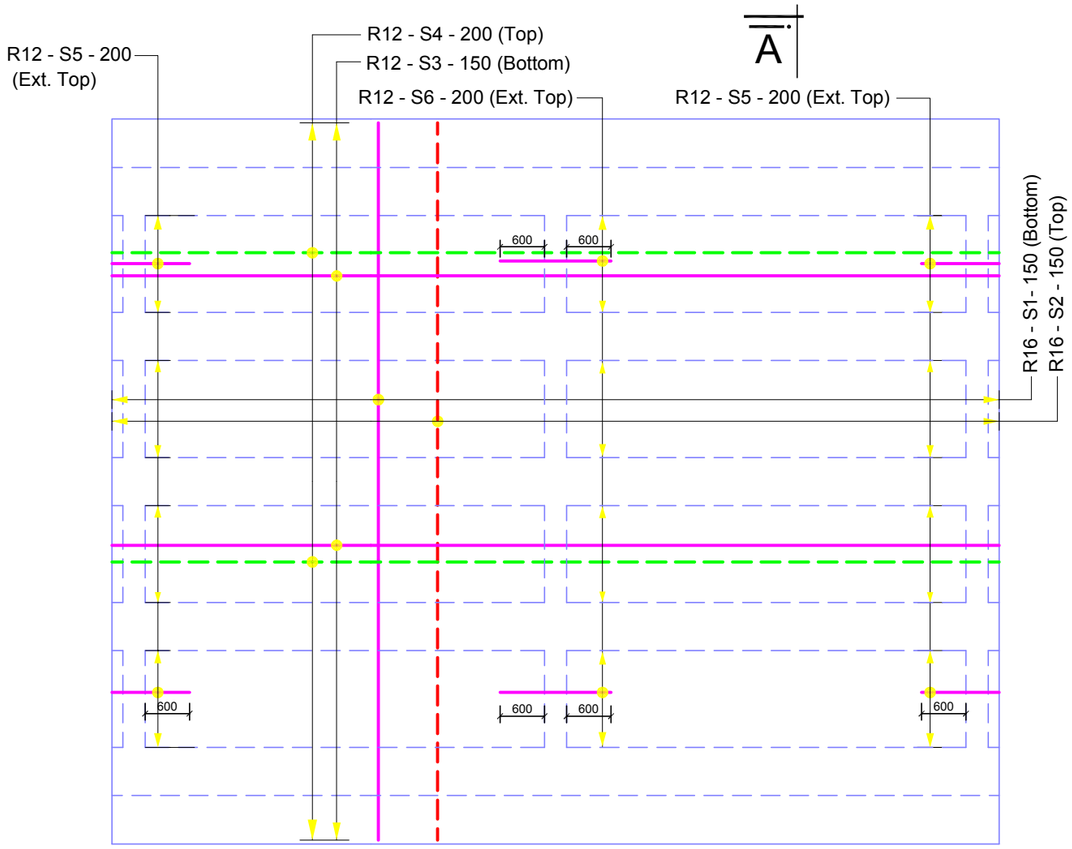
DESIGNED BY :	DRAWN BY :	CHECKED BY :	APPROVED BY :
MD. TAZUDDIN	MD. TAZUDDIN	AFM HAMIDUL HAQUE	DR. PRABHAT SHRIVASTAVA

REV.	DESCRIPTION	DATE



SEC. A-A ON DECK

(Scale : 1:40)



REINF. PLAN OF DECK A

(Scale : 1:80)

NAME OF THE CLIENT :
GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH
LOCAL GOVERNMENT ENGINEERING DEPARTMENT

NAME OF THE PROJECT :
CONSULTANCY SERVICES FOR FEASIBILITY, DETAILED SURVEY AND DESIGN OF CHITTAGONG HILL TRACT CONNECTIVITY CONNECTING THEGAMUKH AND CHITTAGONG PORT.

NAME OF THE CONSULTANTS :
SAI Consulting Engineers Pvt. Ltd, India.
in association with
BETS Consulting Services Ltd, Bangladesh
Project office :
Tahmid Mahmood Palace
Flat # 9A, House # 77, Road # 4, Block-C,
Banani, Dhaka-1213, Bangladesh.

DRAWING TITLE :
REINF. DETAILS OF DECK SLAB (S-8.0m)

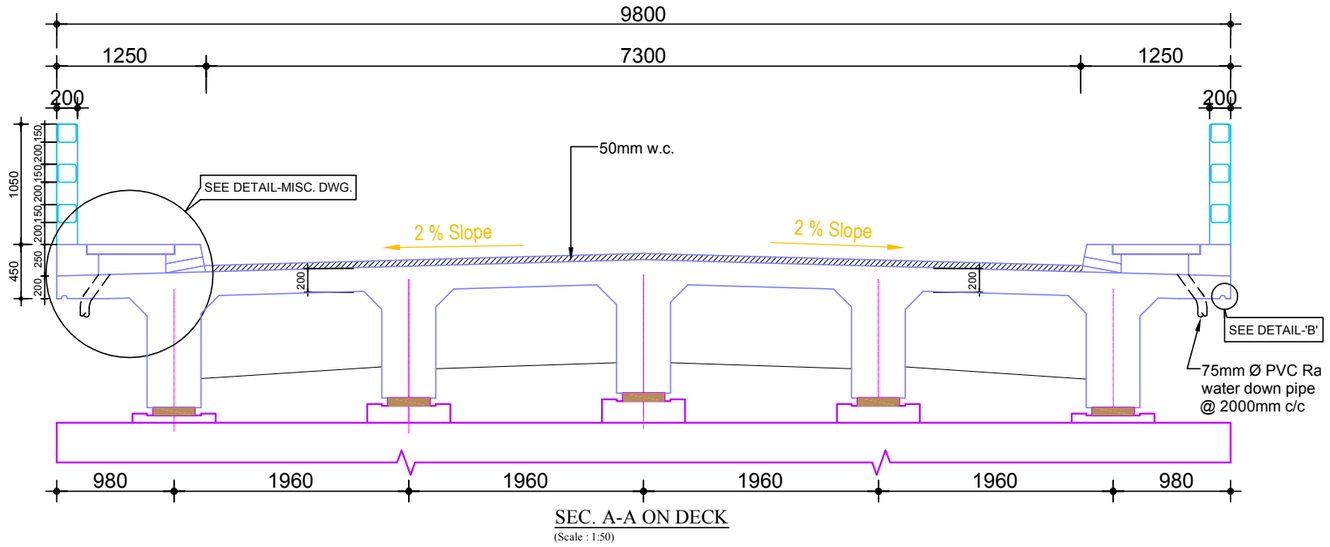
DRAWING NO : LGED/DK-8/RNF.-02

Scale :As shown

Date : 28-01-16

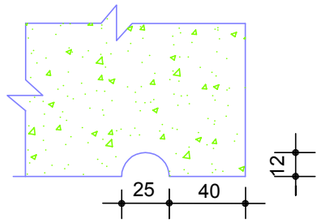
DESIGNED BY :	DRAWN BY :	CHECKED BY :	APPROVED BY :
MD. TAZUDDIN	MD. TAZUDDIN	AFM HAMIDUL HAQUE	DR. PRABHAT SHRIVASTAVA

REV.	DESCRIPTION	DATE

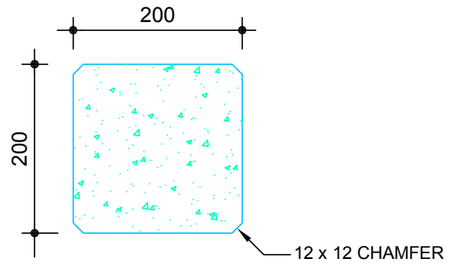


SEC. A-A ON DECK

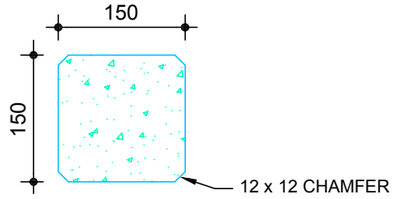
(Scale : 1:50)



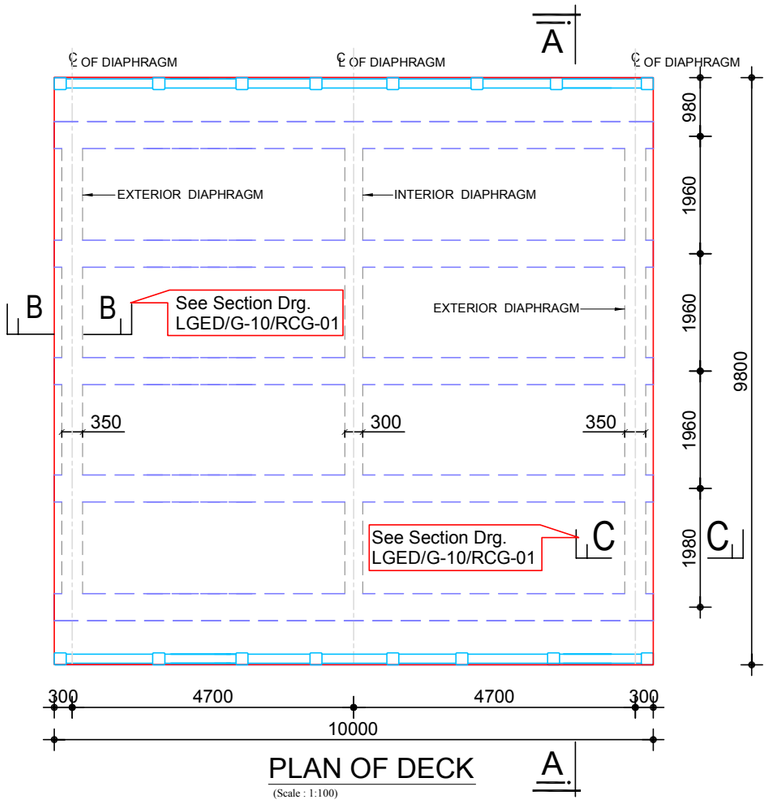
DETAIL "B"



CROSS SECTION
RAIL POST



CROSS SECTION
RAIL BAR



PLAN OF DECK

(Scale : 1:100)

NOTES:

1. All dimensions are in milimeters unless othrwise mentioned.
2. Rain water down pipe shall be projected minimum 50mm from the bottom of slab.

NAME OF THE CLIENT :

GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH

LOCAL GOVERNMENT ENGINEERING DEPARTMENT

NAME OF THE PROJECT :

CONSULTANCY SERVICES FOR FEASIBILITY, DETAILED SURVEY AND DESIGN OF CHITTAGONG HILL TRACT CONNECTIVITY CONNECTING THEGAMUKH AND CHITTAGONG PORT.

NAME OF THE CONSULTANTS :

SAI Consulting Engineers Pvt. Ltd, India.

in association with

BETS Consulting Services Ltd, Bangladesh

Project office :

Tahmid Mahmood Palace
Flat # 9A, House # 77, Road # 4, Block-C,
Banani, Dhaka-1213, Bangladesh.

DRAWING TITLE :

DETAILS OF DECK SLAB (S-10.0m)

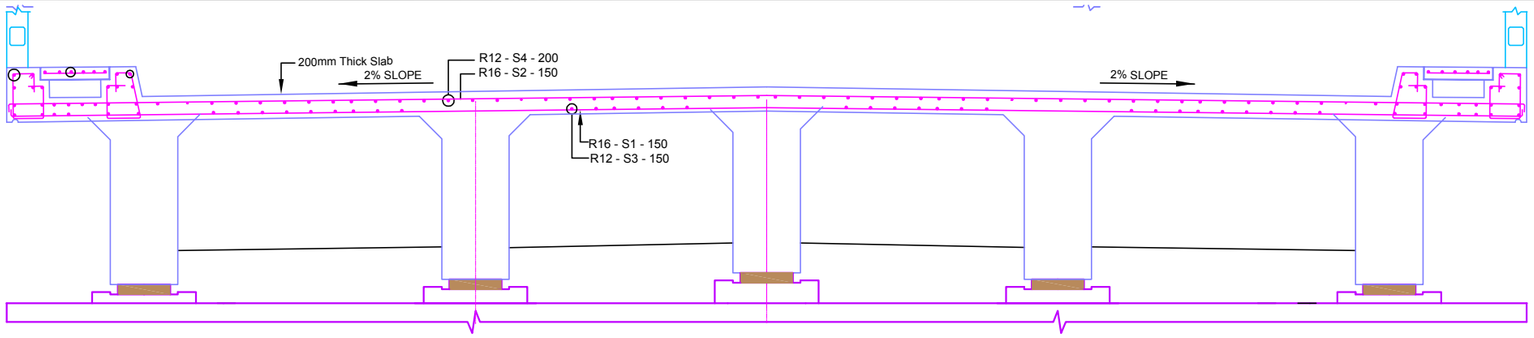
DRAWING NO : LGED/DK-10/C-01

Scale :As shown

Date : 28-01-16

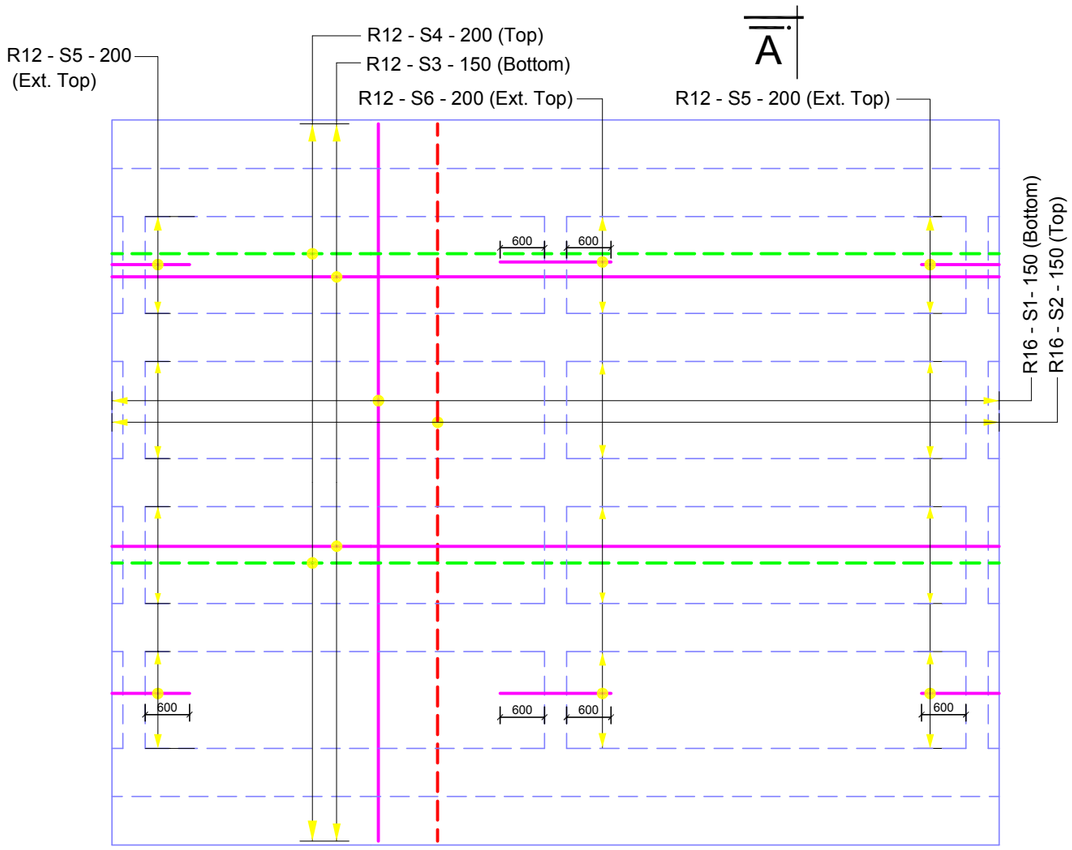
DESIGNED BY :	DRAWN BY :	CHECKED BY :	APPROVED BY :
MD. TAZUDDIN	MD. TAZUDDIN	AFM HAMIDUL HAQUE	DR. PRABHAT SHRIVASTAVA

REV.	DESCRIPTION	DATE



SEC. A-A ON DECK

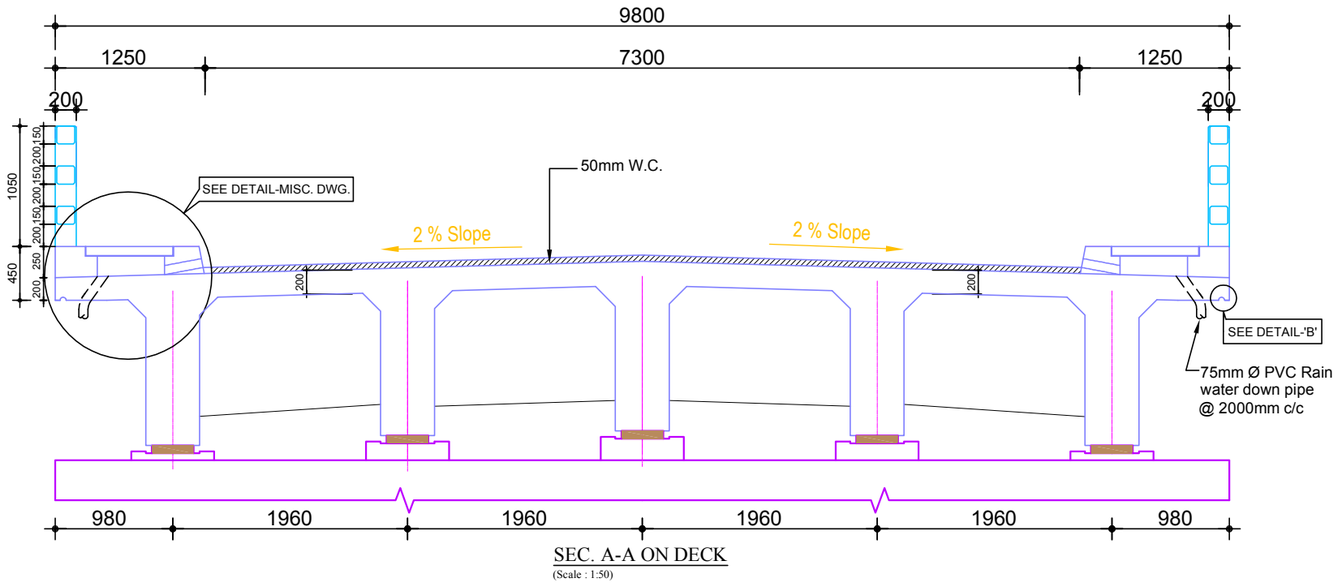
(Scale : 1:40)



REINF. PLAN OF DECK A

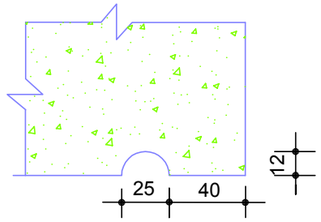
(Scale : 1:80)

NAME OF THE CLIENT : GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH **LOCAL GOVERNMENT ENGINEERING DEPARTMENT** NAME OF THE PROJECT : CONSULTANCY SERVICES FOR FEASIBILITY, DETAILED SURVEY AND DESIGN OF CHITTAGONG HILL TRACT CONNECTIVITY CONNECTING THEGAMUKH AND CHITTAGONG PORT.	NAME OF THE CONSULTANTS : **SAI Consulting Engineers Pvt. Ltd, India.** in association with **BETS Consulting Services Ltd, Bangladesh** Project office : Tahmid Mahmood Palace Flat # 9A, House # 77, Road # 4, Block-C, Banani, Dhaka-1213, Bangladesh.	DRAWING TITLE : REINF. DETAILS OF DECK SLAB (S-10.0m) DRAWING NO : LGED/DK-10/RNF.-02 Scale :As shown Date : 28-01-16	DESIGNED BY : MD. TAZUDDIN	DRAWN BY : MD. TAZUDDIN	CHECKED BY : AFM HAMIDUL HAQUE	APPROVED BY : DR. PRABHAT SHRIVASTAVA	REV.	DESCRIPTION	DATE

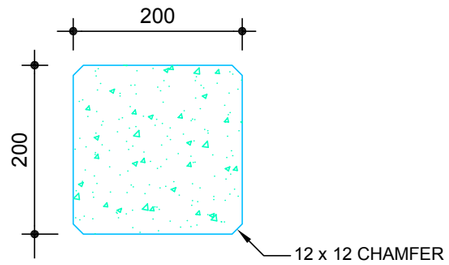


SEC. A-A ON DECK

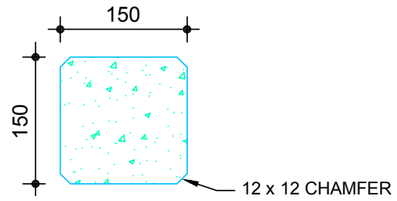
(Scale : 1:50)



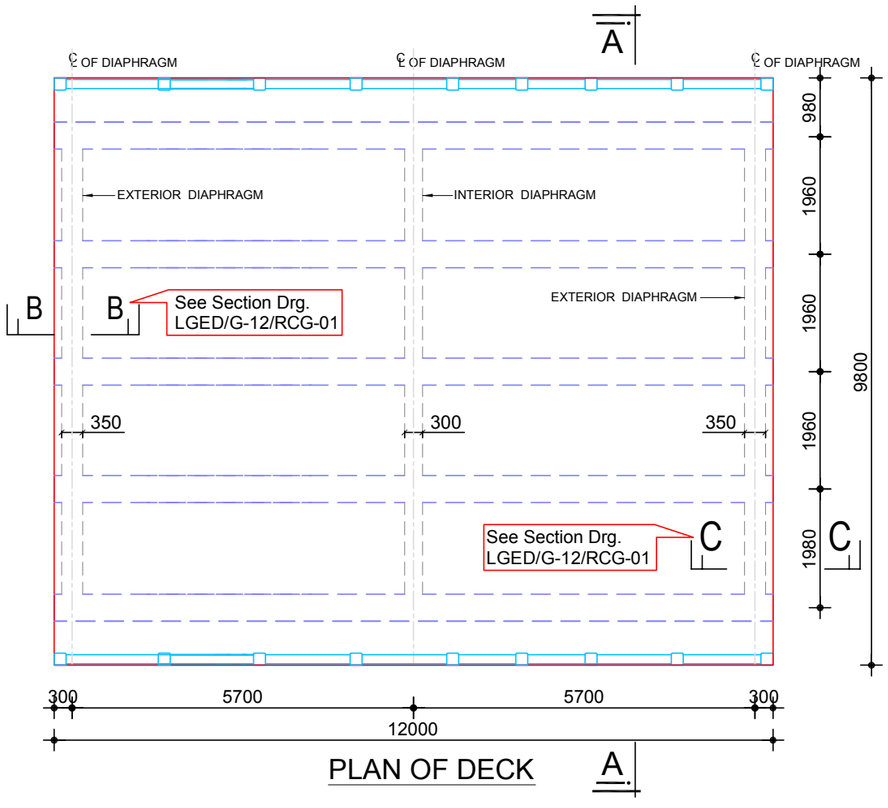
DETAIL "B"



CROSS SECTION
RAIL POST



CROSS SECTION
RAIL BAR



PLAN OF DECK

NOTES:

1. All dimensions are in milimeters unless othrwise mentioned.
2. Rain water down pipe shall be projected minimum 50mm from the bottom of slab.

NAME OF THE CLIENT :

GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH

LOCAL GOVERNMENT ENGINEERING DEPARTMENT

NAME OF THE PROJECT :

CONSULTANCY SERVICES FOR FEASIBILITY, DETAILED SURVEY AND DESIGN OF CHITTAGONG HILL TRACT CONNECTIVITY CONNECTING THEGAMUKH AND CHITTAGONG PORT.

NAME OF THE CONSULTANTS :

SAI Consulting Engineers Pvt. Ltd, India.

in association with

BETS Consulting Services Ltd, Bangladesh

Project office :

Tahmid Mahmood Palace
Flat # 9A, House # 77, Road # 4, Block-C,
Banani, Dhaka-1213, Bangladesh.

DRAWING TITLE :

DETAILS OF DECK SLAB (S-12.0m)

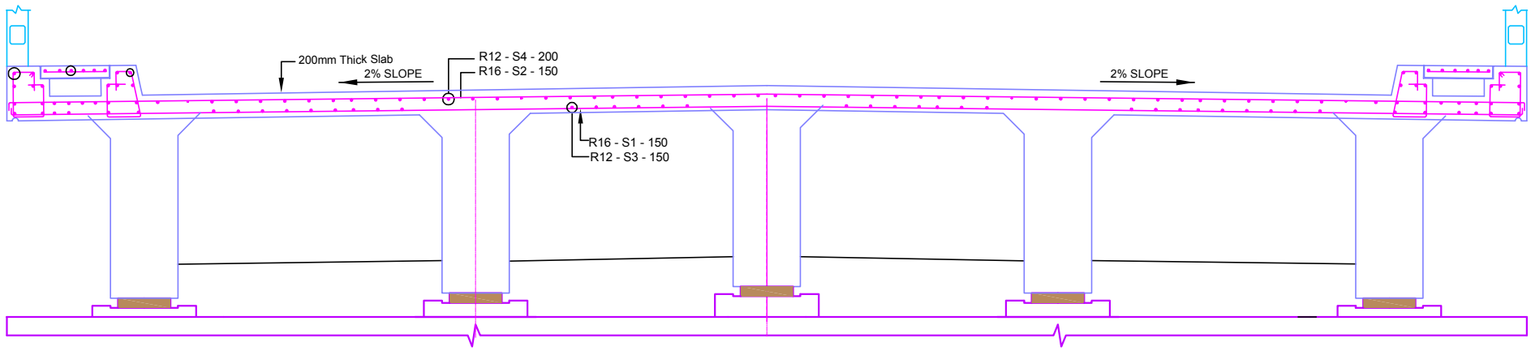
DRAWING NO : LGED/DK-12/C-01

Scale :As shown

Date : 28-01-16

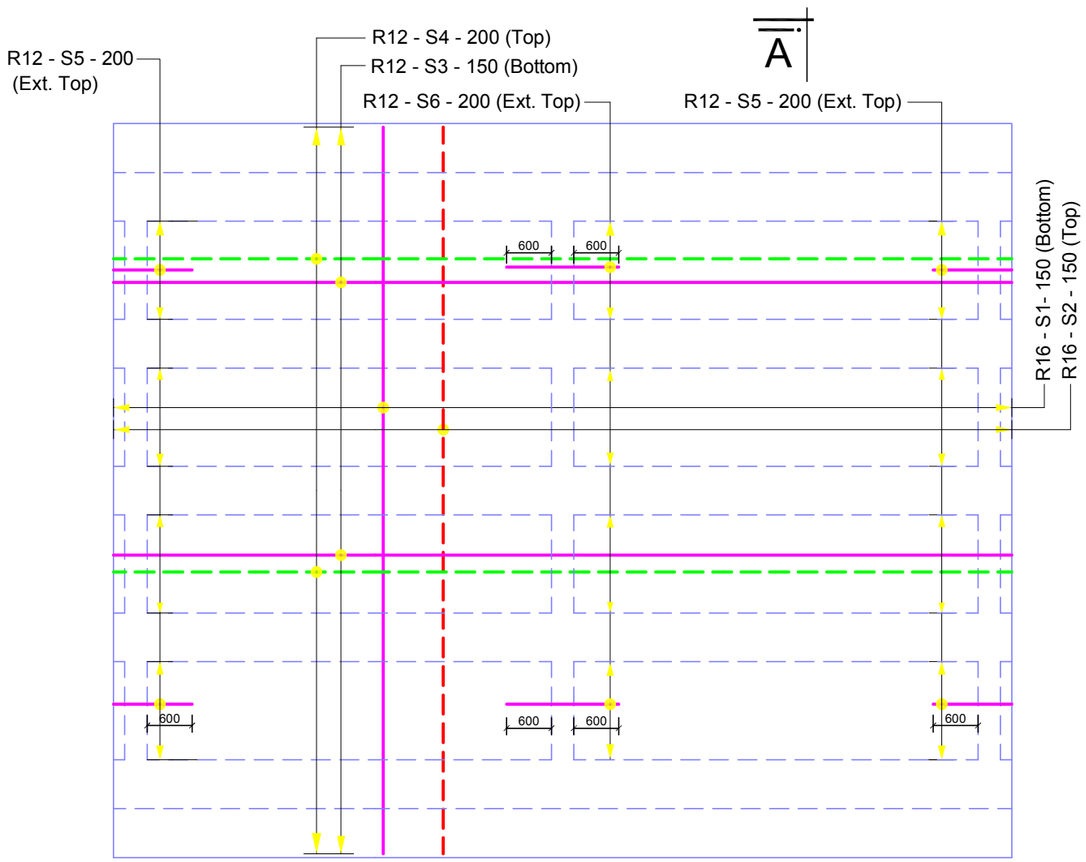
DESIGNED BY :	DRAWN BY :	CHECKED BY :	APPROVED BY :
MD. TAZUDDIN	MD. TAZUDDIN	AFM HAMIDUL HAQUE	DR. PRABHAT SHRIVASTAVA

REV.	DESCRIPTION	DATE



SEC. A-A ON DECK

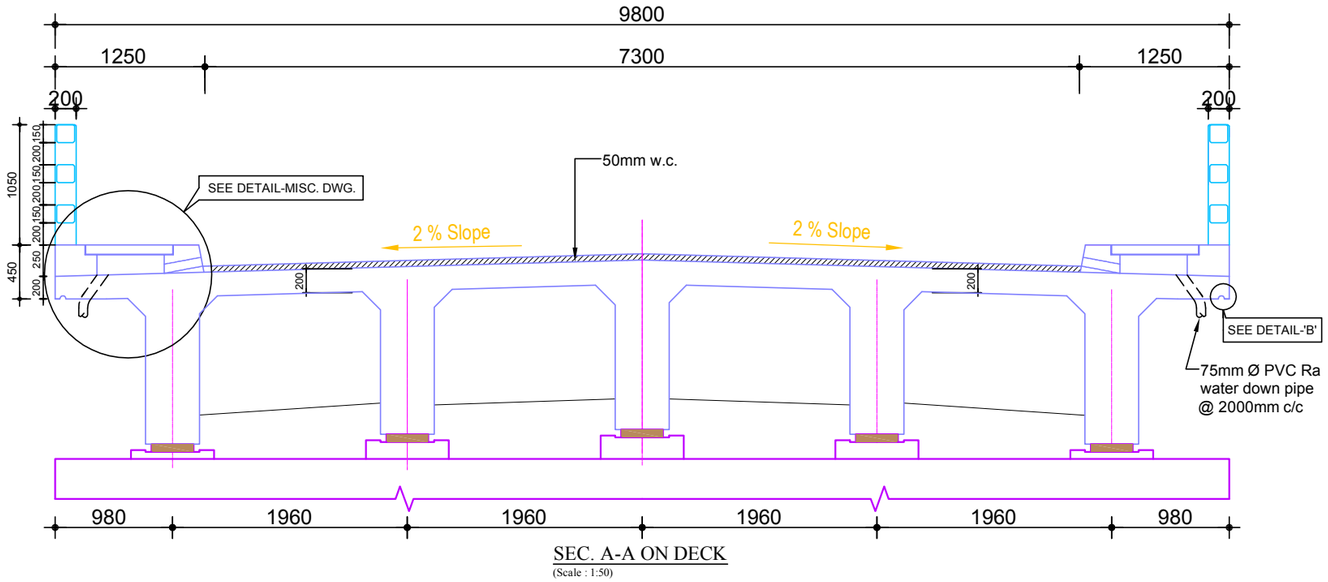
(Scale : 1:40)



REINF. PLAN OF DECK A

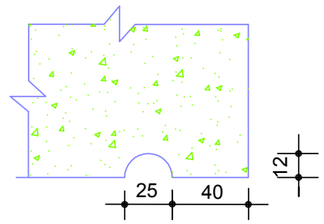
(Scale : 1:80)

NAME OF THE CLIENT : GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH **LOCAL GOVERNMENT ENGINEERING DEPARTMENT** NAME OF THE PROJECT : CONSULTANCY SERVICES FOR FEASIBILITY, DETAILED SURVEY AND DESIGN OF CHITTAGONG HILL TRACT CONNECTIVITY CONNECTING THEGAMUKH AND CHITTAGONG PORT.	NAME OF THE CONSULTANTS : **SAI Consulting Engineers Pvt. Ltd, India.** in association with **BETS Consulting Services Ltd, Bangladesh** Project office : Tahmid Mahmood Palace Flat # 9A, House # 77, Road # 4, Block-C, Banani, Dhaka-1213, Bangladesh.	DRAWING TITLE : REINF. DETAILS OF DECK SLAB (S-12.0m) DRAWING NO : LGED/DK-12/RNF.-02 Scale :As shown Date : 28-01-16	DESIGNED BY : MD. TAZUDDIN	DRAWN BY : MD. TAZUDDIN	CHECKED BY : AFM HAMIDUL HAQUE	APPROVED BY : DR. PRABHAT SHRIVASTAVA	REV.	DESCRIPTION	DATE

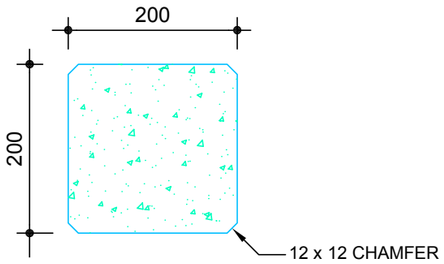


SEC. A-A ON DECK

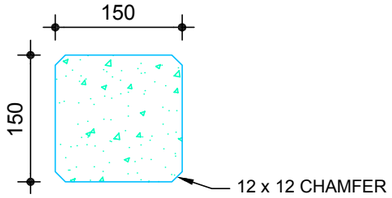
(Scale : 1:50)



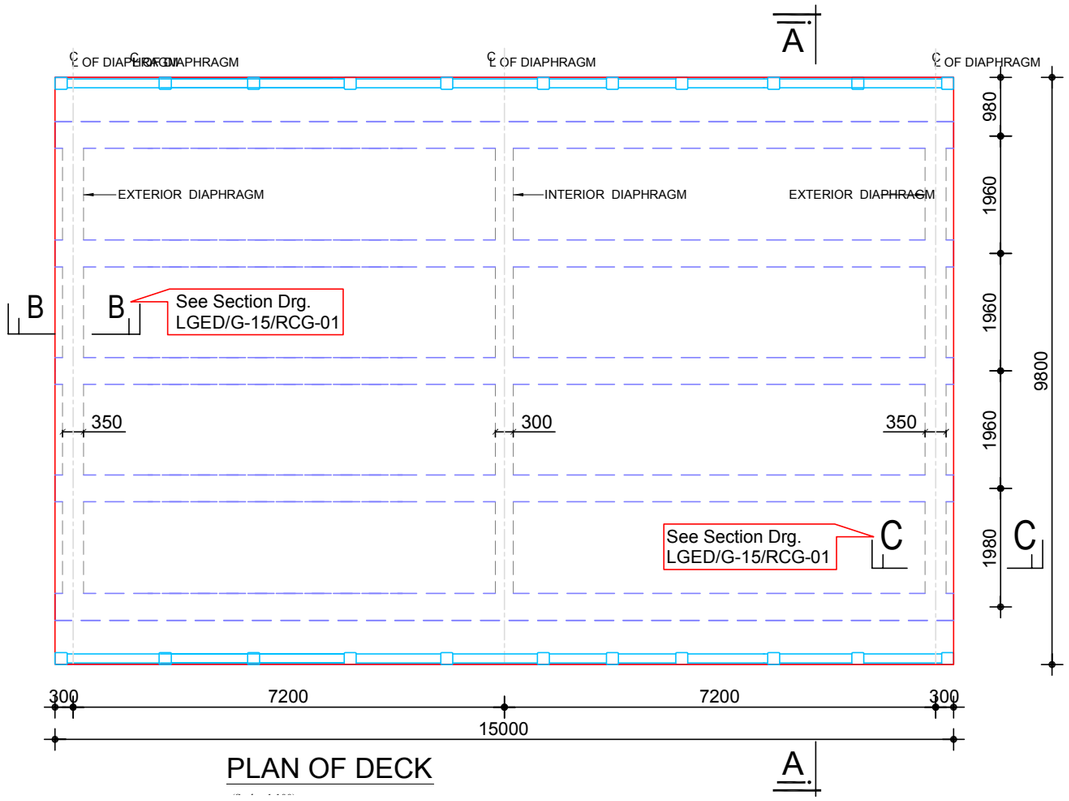
DETAIL "B"



CROSS SECTION
RAIL POST



CROSS SECTION
RAIL BAR



PLAN OF DECK

NOTES:

1. All dimensions are in milimeters unless othrwise mentioned.
2. Rain water down pipe shall be projected minimum 50mm from the bottom of slab.

NAME OF THE CLIENT :

GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH

LOCAL GOVERNMENT ENGINEERING DEPARTMENT

NAME OF THE PROJECT :

CONSULTANCY SERVICES FOR FEASIBILITY, DETAILED SURVEY AND DESIGN OF CHITTAGONG HILL TRACT CONNECTIVITY CONNECTING THEGAMUKH AND CHITTAGONG PORT.

NAME OF THE CONSULTANTS :

SAI Consulting Engineers Pvt. Ltd, India.

in association with

BETS Consulting Services Ltd, Bangladesh

Project office :

Tahmid Mahmood Palace
Flat # 9A, House # 77, Road # 4, Block-C,
Banani, Dhaka-1213, Bangladesh.

DRAWING TITLE :

DETAILS OF DECK SLAB (S-15.0m)

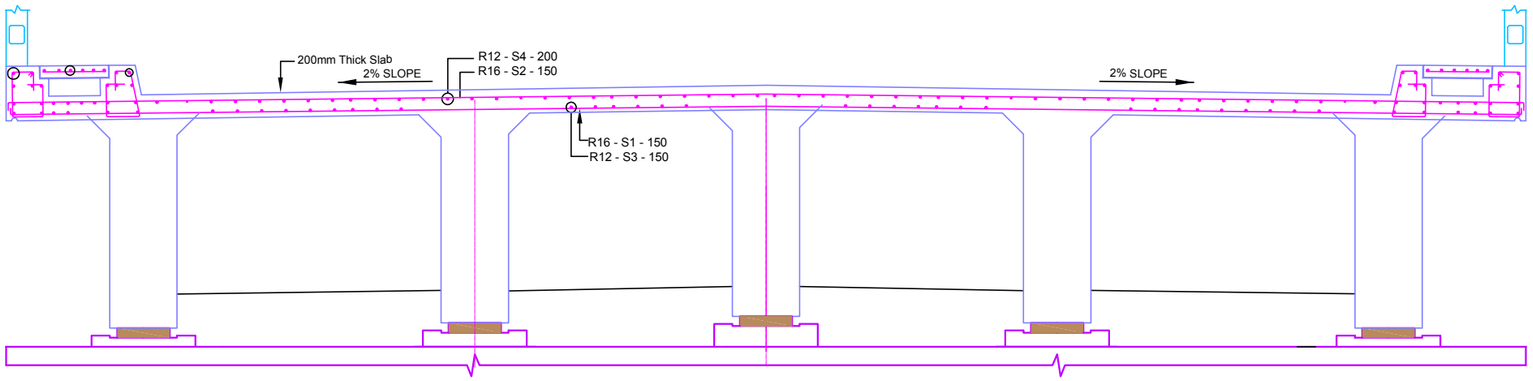
DRAWING NO : LGED/DK-15/C-01

Scale :As shown

Date : 28-01-16

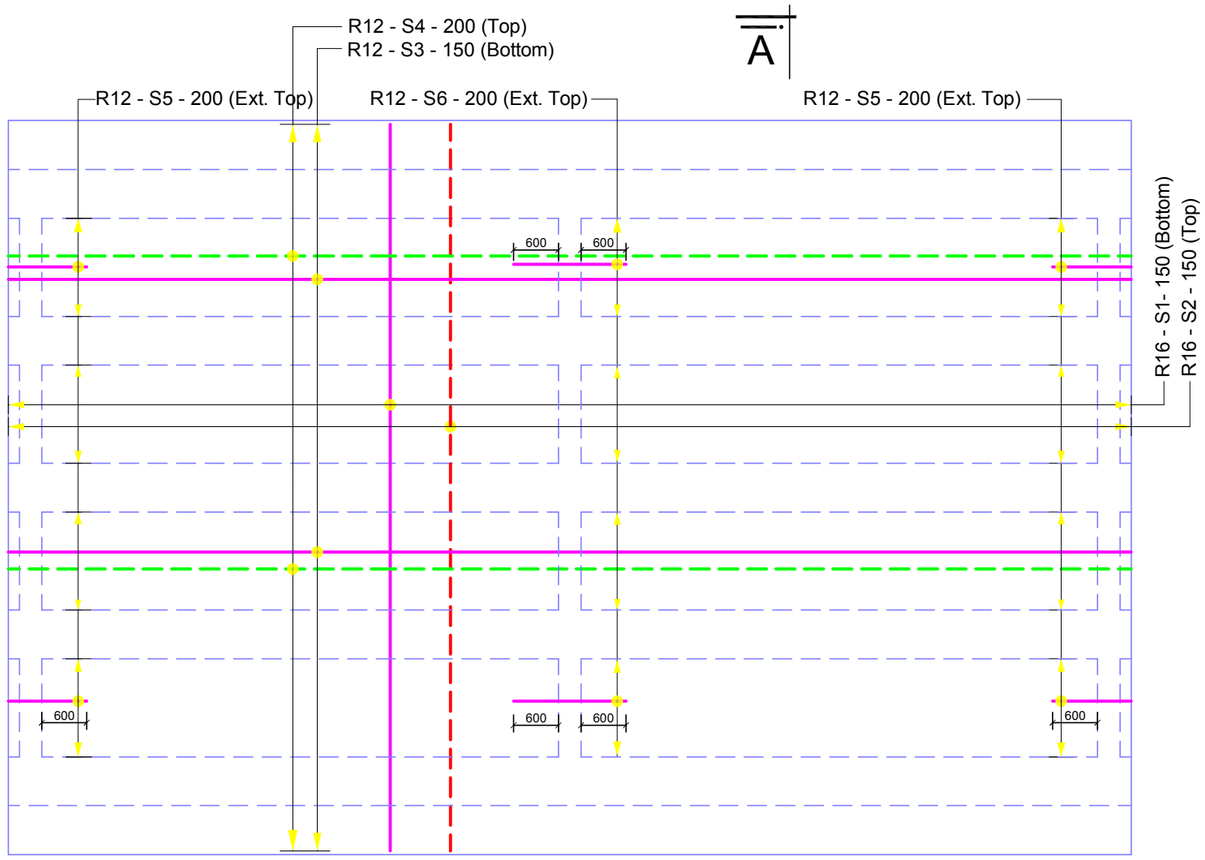
DESIGNED BY :	DRAWN BY :	CHECKED BY :	APPROVED BY :
MD. TAZUDDIN	MD. TAZUDDIN	AFM HAMIDUL HAQUE	DR. PRABHAT SHRIVASTAVA

REV.	DESCRIPTION	DATE



SEC. A-A ON DECK

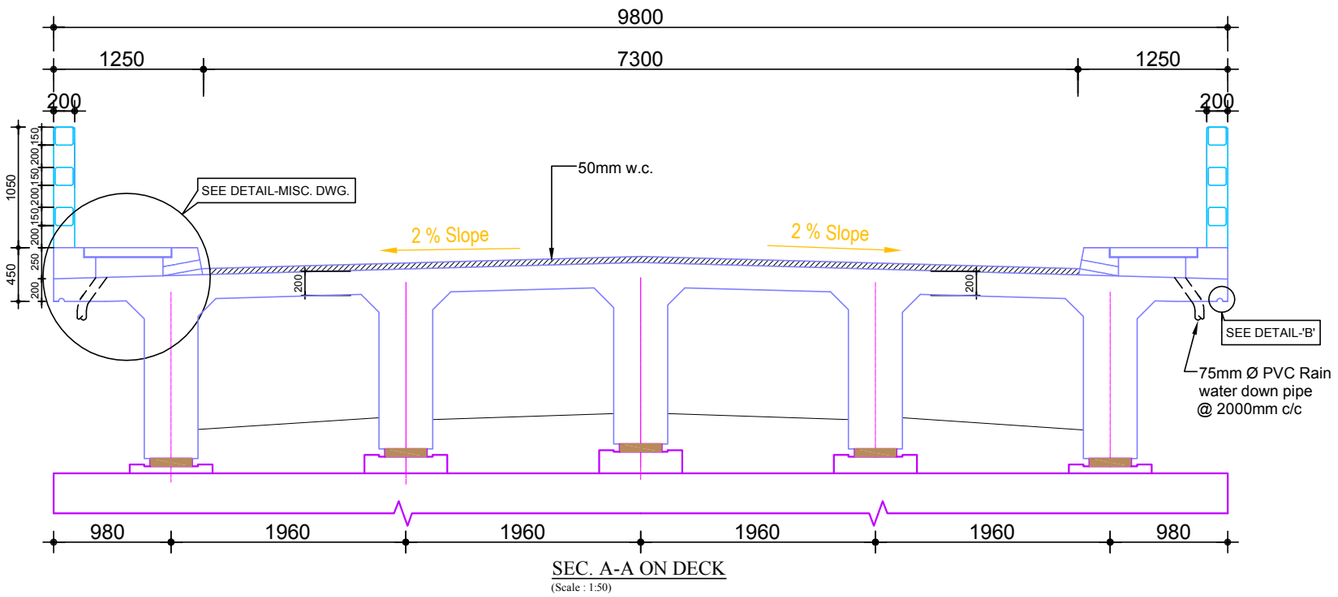
(Scale : 1:40)



REINF. PLAN OF DECK A

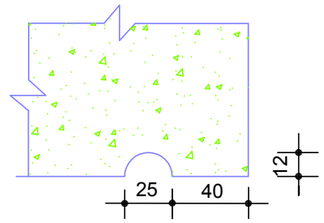
(Scale : 1:80)

NAME OF THE CLIENT : GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH **LOCAL GOVERNMENT ENGINEERING DEPARTMENT** NAME OF THE PROJECT : CONSULTANCY SERVICES FOR FEASIBILITY, DETAILED SURVEY AND DESIGN OF CHITTAGONG HILL TRACT CONNECTIVITY CONNECTING THEGAMUKH AND CHITTAGONG PORT.	NAME OF THE CONSULTANTS : **SAI Consulting Engineers Pvt. Ltd, India.** in association with **BETS Consulting Services Ltd, Bangladesh** Project office : Tahmid Mahmood Palace Flat # 9A, House # 77, Road # 4, Block-C, Banani, Dhaka-1213, Bangladesh.	DRAWING TITLE : REINF. DETAILS OF DECK SLAB (S-15.0m) DRAWING NO : LGED/DK-15/RNF.-02 Scale :As shown Date : 28-01-16	DESIGNED BY : MD. TAZUDDIN	DRAWN BY : MD. TAZUDDIN	CHECKED BY : AFM HAMIDUL HAQUE	APPROVED BY : DR. PRABHAT SHRIVASTAVA	REV.	DESCRIPTION	DATE

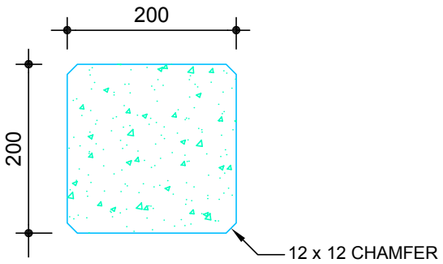


SEC. A-A ON DECK

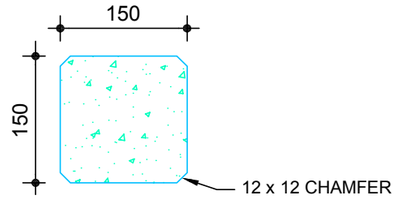
(Scale : 1:50)



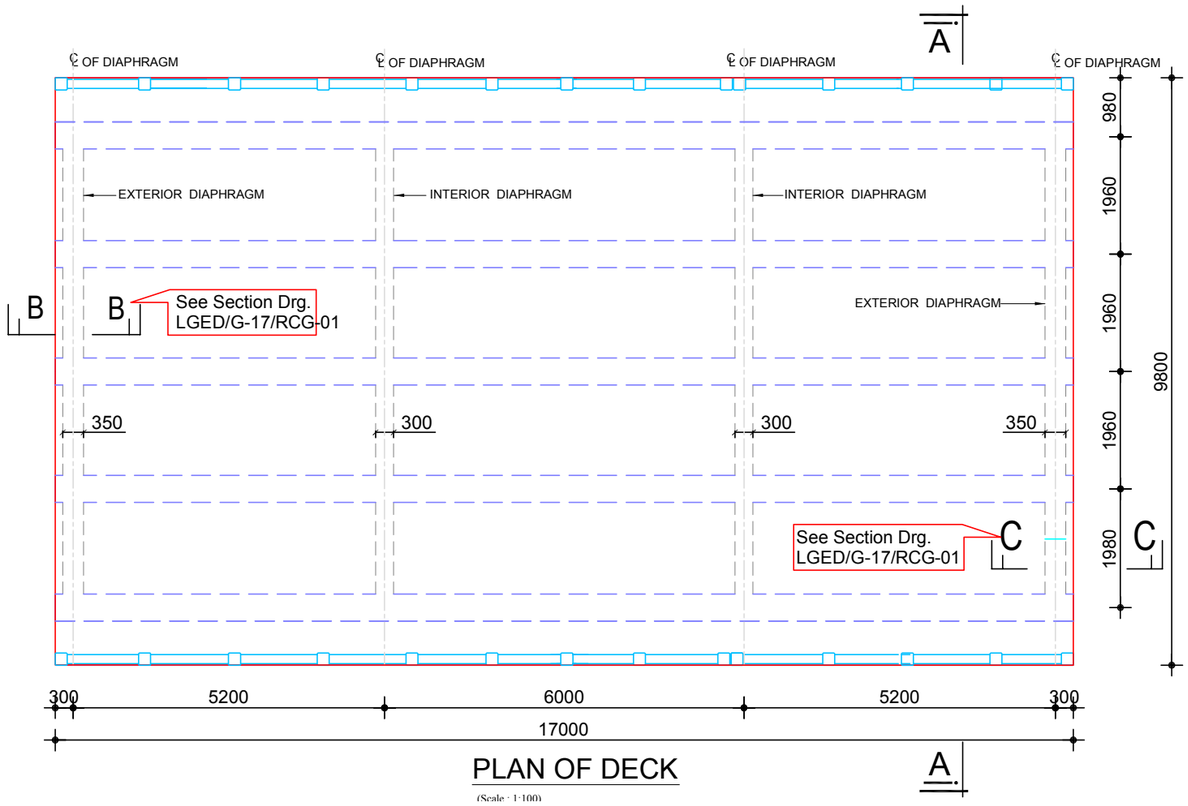
DETAIL "B"



CROSS SECTION
RAIL POST



CROSS SECTION
RAIL BAR



PLAN OF DECK

(Scale : 1:100)

NOTES:

1. All dimensions are in milimeters unless othrwise mentioned.
2. Rain water down pipe shall be projected minimum 50mm from the bottom of slab.

REV.	DESCRIPTION	DATE

NAME OF THE CLIENT :

GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH

LOCAL GOVERNMENT ENGINEERING DEPARTMENT

NAME OF THE PROJECT :

CONSULTANCY SERVICES FOR FEASIBILITY, DETAILED SURVEY AND DESIGN OF CHITTAGONG HILL TRACT CONNECTIVITY CONNECTING THEGAMUKH AND CHITTAGONG PORT.

NAME OF THE CONSULTANTS :

SAI Consulting Engineers Pvt. Ltd, India.

in association with

BETS Consulting Services Ltd, Bangladesh

Project office :

Tahmid Mahmood Palace
Flat # 9A, House # 77, Road # 4, Block-C,
Banani, Dhaka-1213, Bangladesh.

DRAWING TITLE :

DETAILS OF DECK SLAB (S-17.0m)

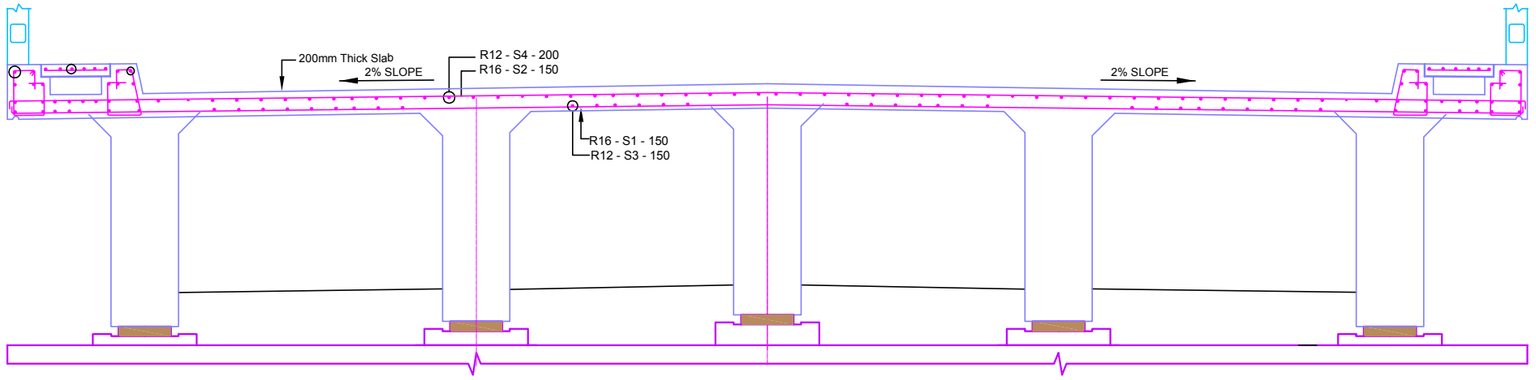
DRAWING NO : LGED/DK-17/C-01

Scale :As shown

Date : 28-01-16

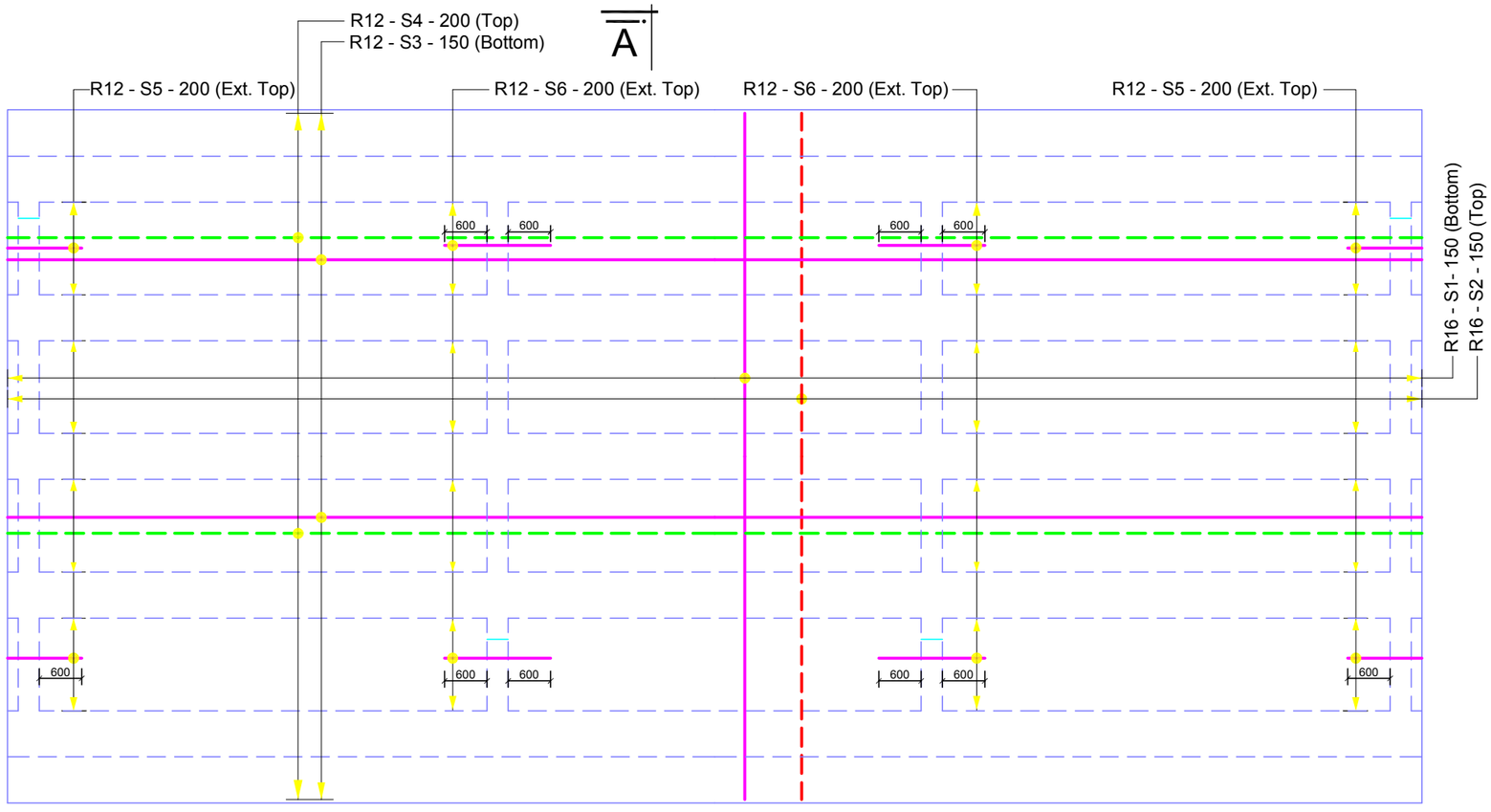
DESIGNED BY :	DRAWN BY :	CHECKED BY :	APPROVED BY :
MD. TAZUDDIN	MD. TAZUDDIN	AFM HAMIDUL HAQUE	DR. PRABHAT SHRIVASTAVA

REV.	DESCRIPTION	DATE



SEC. A-A ON DECK

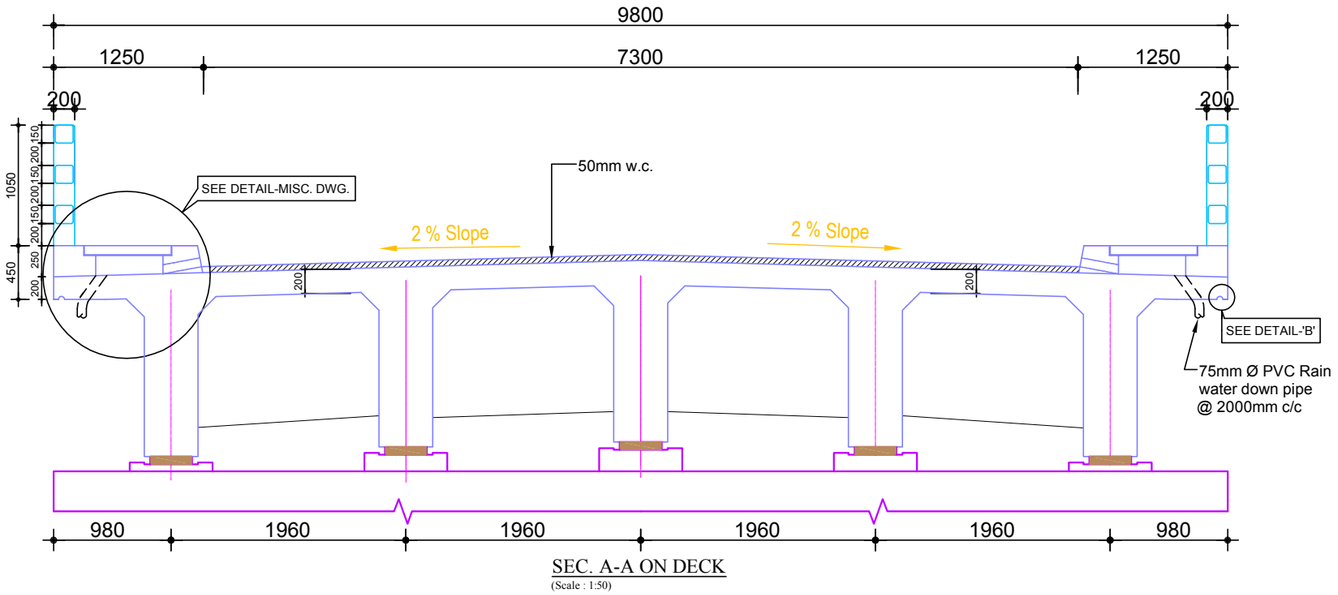
(Scale : 1:40)



A REINF. PLAN OF DECK

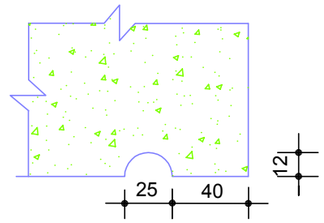
(Scale : 1:80)

NAME OF THE CLIENT : GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH **LOCAL GOVERNMENT ENGINEERING DEPARTMENT** NAME OF THE PROJECT : CONSULTANCY SERVICES FOR FEASIBILITY, DETAILED SURVEY AND DESIGN OF CHITTAGONG HILL TRACT CONNECTIVITY CONNECTING THEGAMUKH AND CHITTAGONG PORT.	NAME OF THE CONSULTANTS : **SAI Consulting Engineers Pvt. Ltd, India.** in association with **BETS Consulting Services Ltd, Bangladesh** Project office : Tahmid Mahmood Palace Flat # 9A, House # 77, Road # 4, Block-C, Banani, Dhaka-1213, Bangladesh.	DRAWING TITLE : REINF. DETAILS OF DECK SLAB (S-17.0m) DRAWING NO : LGED/DK-17/RNF.-02 Scale :As shown Date : 28-01-16	DESIGNED BY : MD. TAZUDDIN	DRAWN BY : MD. TAZUDDIN	CHECKED BY : AFM HAMIDUL HAQUE	APPROVED BY : DR. PRABHAT SHRIVASTAVA	REV.	DESCRIPTION	DATE

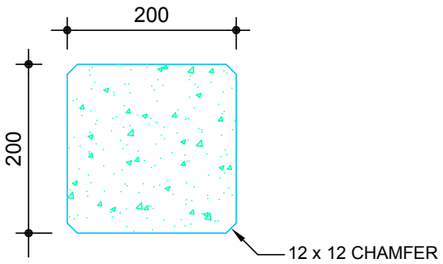


SEC. A-A ON DECK

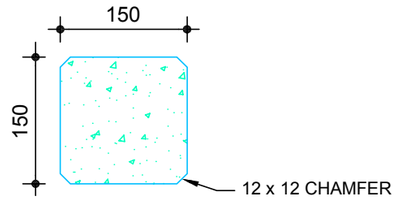
(Scale : 1:50)



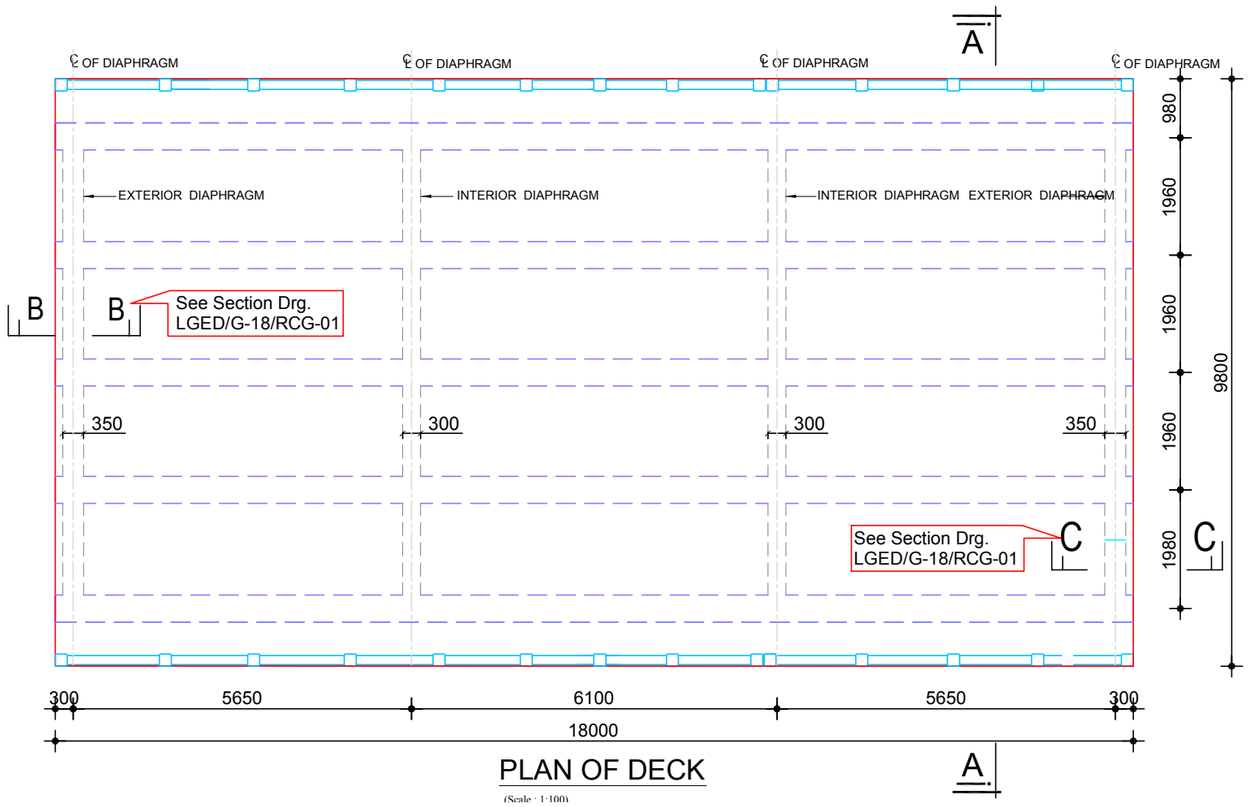
DETAIL "B"



CROSS SECTION
RAIL POST



CROSS SECTION
RAIL BAR



PLAN OF DECK

(Scale : 1:100)

NOTES:

1. All dimensions are in milimeters unless othrwise mentioned.
2. Rain water down pipe shall be projected minimum 50mm from the bottom of slab.

REV.	DESCRIPTION	DATE

NAME OF THE CLIENT :

GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH

LOCAL GOVERNMENT ENGINEERING DEPARTMENT

NAME OF THE PROJECT :

CONSULTANCY SERVICES FOR FEASIBILITY, DETAILED SURVEY AND DESIGN OF CHITTAGONG HILL TRACT CONNECTIVITY CONNECTING THEGAMUKH AND CHITTAGONG PORT.

NAME OF THE CONSULTANTS :

SAI Consulting Engineers Pvt. Ltd, India.

in association with

BETS Consulting Services Ltd, Bangladesh

Project office :

Tahmid Mahmood Palace
Flat # 9A, House # 77, Road # 4, Block-C,
Banani, Dhaka-1213, Bangladesh.

DRAWING TITLE :

DETAILS OF DECK SLAB (S-18.0m)

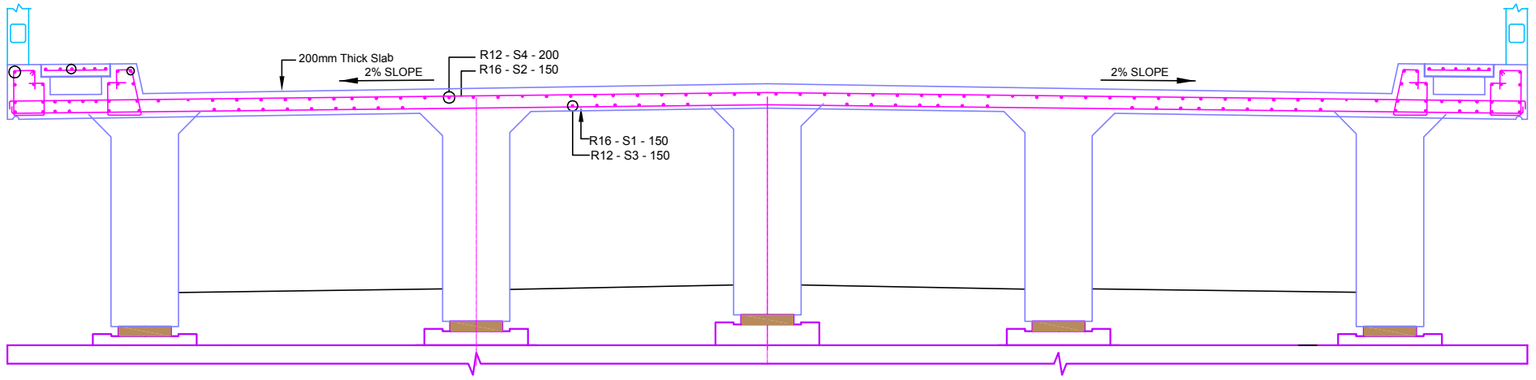
DRAWING NO : LGED/DK-18/C-01

Scale :As shown

Date : 28-01-16

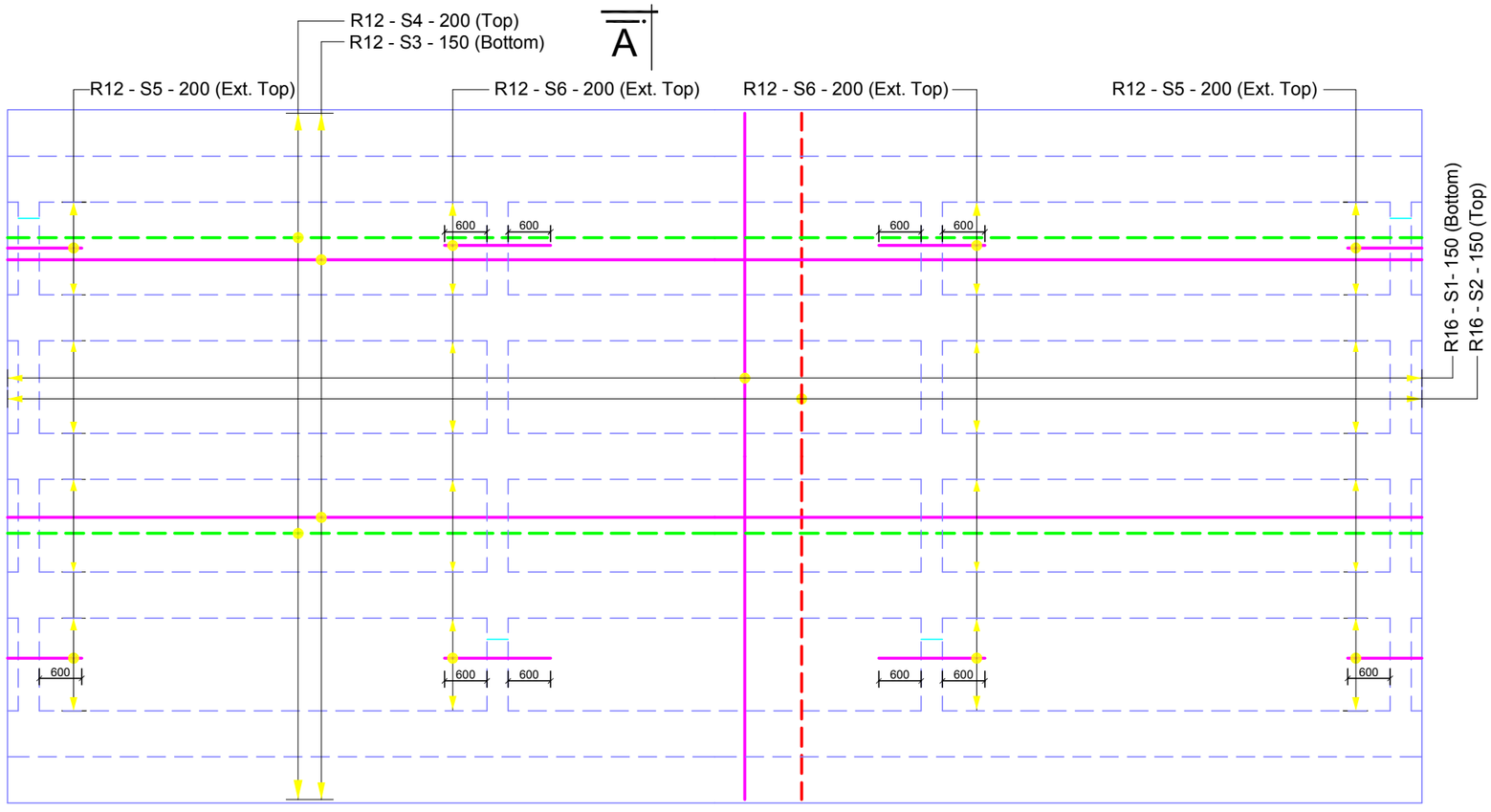
DESIGNED BY :	DRAWN BY :	CHECKED BY :	APPROVED BY :
MD. TAZUDDIN	MD. TAZUDDIN	AFM HAMIDUL HAQUE	DR. PRABHAT SHRIVASTAVA

REV.	DESCRIPTION	DATE



SEC. A-A ON DECK

(Scale : 1:40)



A REINF. PLAN OF DECK

(Scale : 1:80)

NAME OF THE CLIENT :

GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH

LOCAL GOVERNMENT ENGINEERING DEPARTMENT

NAME OF THE PROJECT :

CONSULTANCY SERVICES FOR FEASIBILITY, DETAILED SURVEY AND DESIGN OF CHITTAGONG HILL TRACT CONNECTIVITY CONNECTING THEGAMUKH AND CHITTAGONG PORT.

NAME OF THE CONSULTANTS :

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Project office :

Tahmid Mahmood Palace
Flat # 9A, House # 77, Road # 4, Block-C,
Banani, Dhaka-1213, Bangladesh.

DRAWING TITLE :

REINF. DETAILS OF DECK SLAB (S-18.0m)

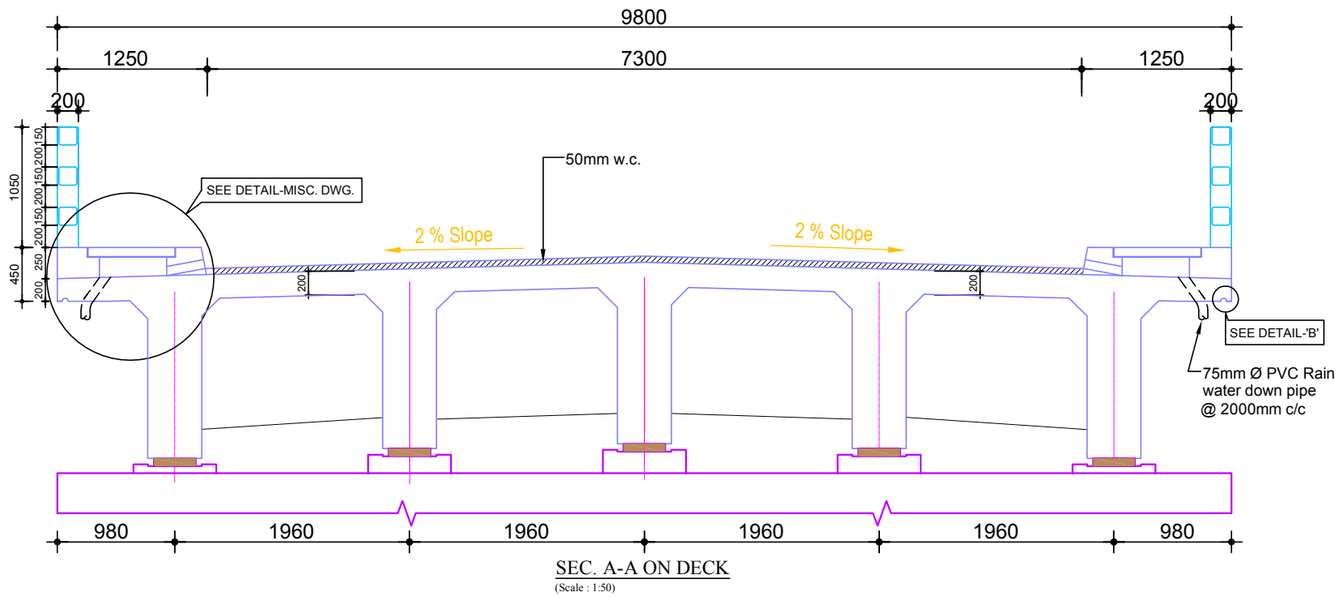
DRAWING NO : LGED/DK-18/RNF.-02

Scale :As shown

Date : 28-01-16

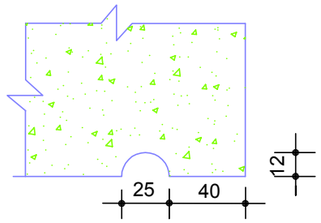
DESIGNED BY :	DRAWN BY :	CHECKED BY :	APPROVED BY :
MD. TAZUDDIN	MD. TAZUDDIN	AFM HAMIDUL HAQUE	DR. PRABHAT SHRIVASTAVA

REV.	DESCRIPTION	DATE

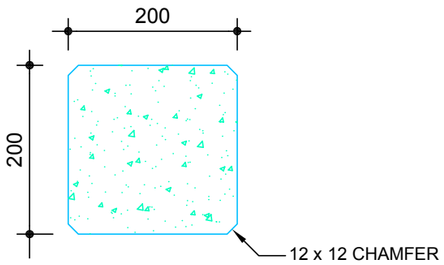


SEC. A-A ON DECK

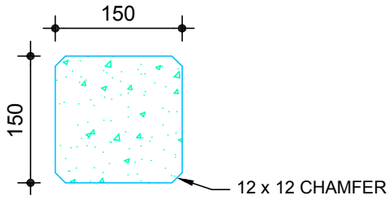
(Scale : 1:50)



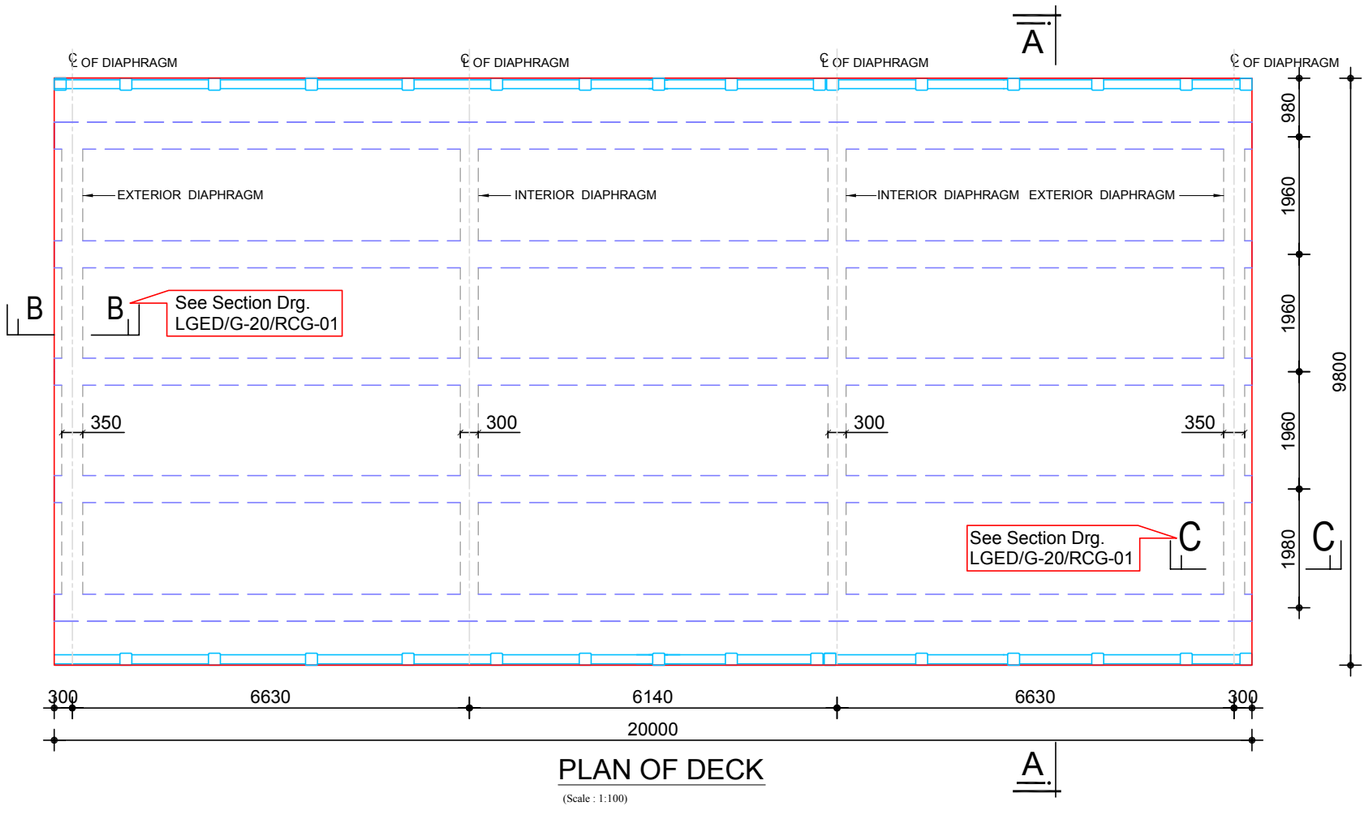
DETAIL "B"



CROSS SECTION
RAIL POST



CROSS SECTION
RAIL BAR



PLAN OF DECK

(Scale : 1:100)

NOTES:

1. All dimensions are in milimeters unless othrwise mentioned.
2. Rain water down pipe shall be projected minimum 50mm from the bottom of slab.

NAME OF THE CLIENT :

GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH

LOCAL GOVERNMENT ENGINEERING DEPARTMENT

NAME OF THE PROJECT :

CONSULTANCY SERVICES FOR FEASIBILITY, DETAILED SURVEY AND DESIGN OF CHITTAGONG HILL TRACT CONNECTIVITY CONNECTING THEGAMUKH AND CHITTAGONG PORT.

NAME OF THE CONSULTANTS :

SAI Consulting Engineers Pvt. Ltd, India.

in association with

BETS Consulting Services Ltd, Bangladesh

Project office :

Tahmid Mahmood Palace
Flat # 9A, House # 77, Road # 4, Block-C,
Banani, Dhaka-1213, Bangladesh.

DRAWING TITLE : DETAILS OF DECK SLAB (S-20.0m)

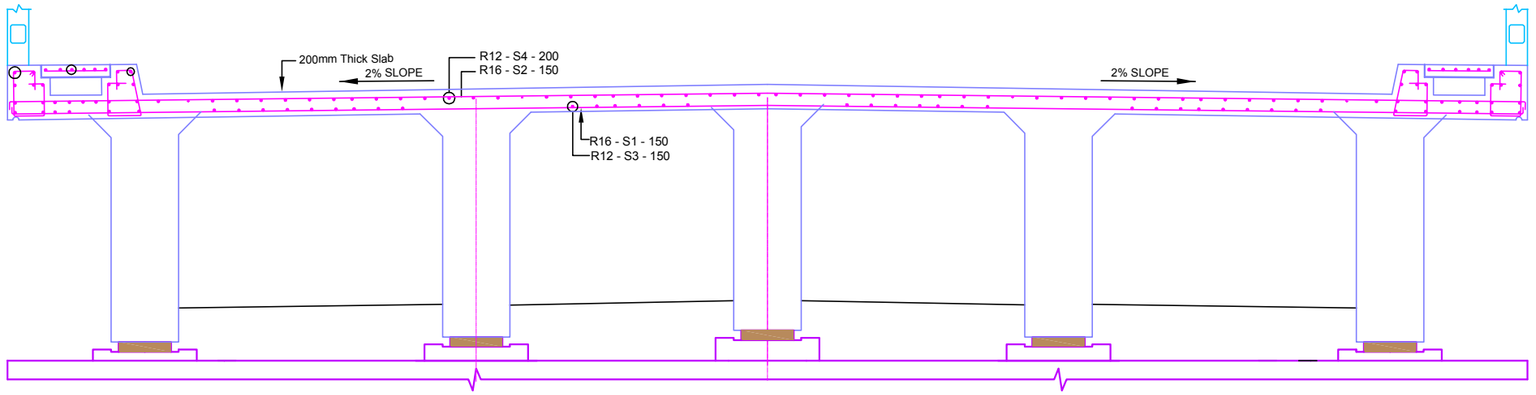
DRAWING NO : LGED/DK-20/C-01

Scale :As shown

Date : 28-01-16

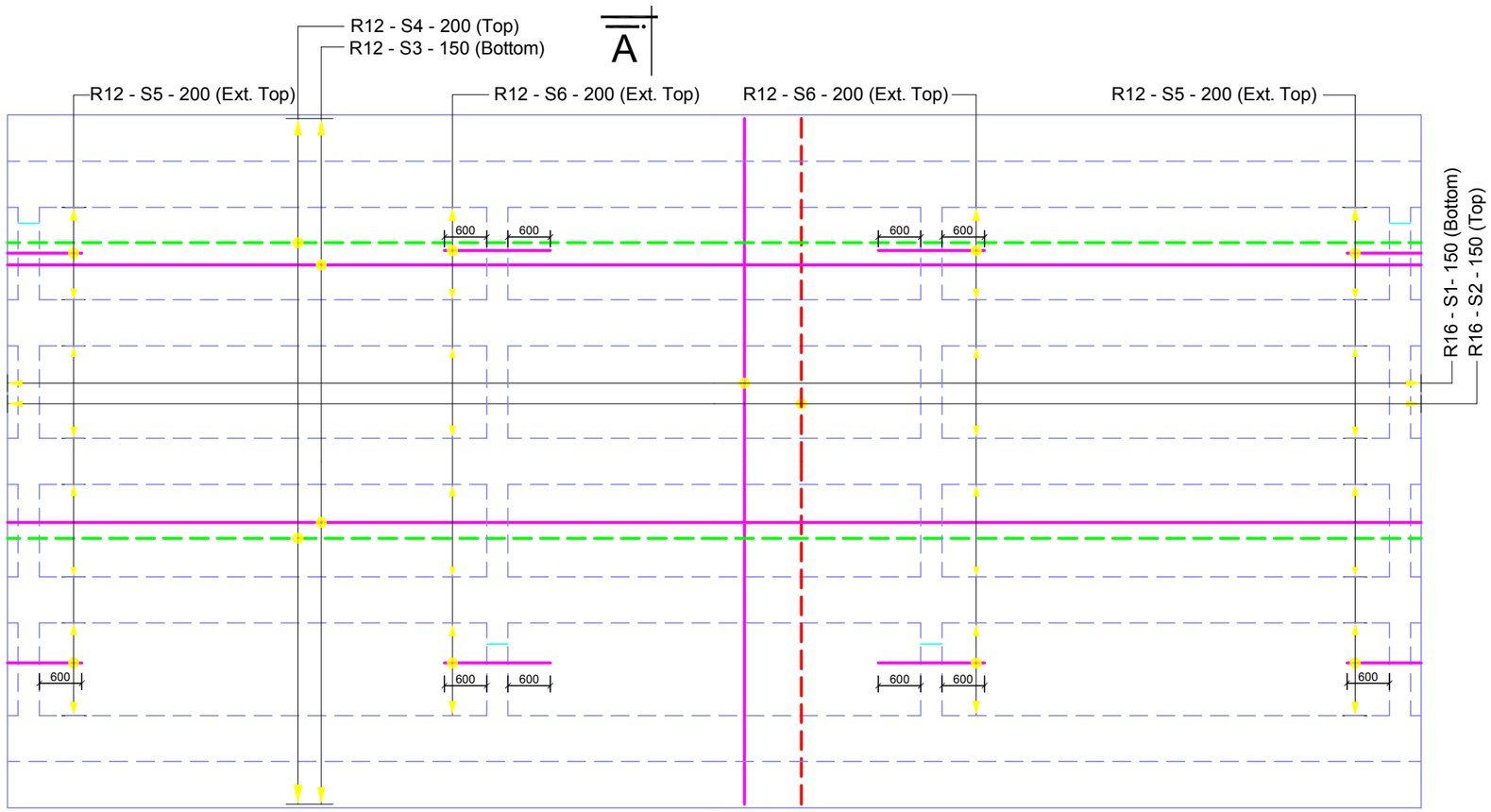
DESIGNED BY :	DRAWN BY :	CHECKED BY :	APPROVED BY :
MD. TAZUDDIN	MD. TAZUDDIN	AFM HAMIDUL HAQUE	DR. PRABHAT SHRIVASTAVA

REV.	DESCRIPTION	DATE



SEC. A-A ON DECK

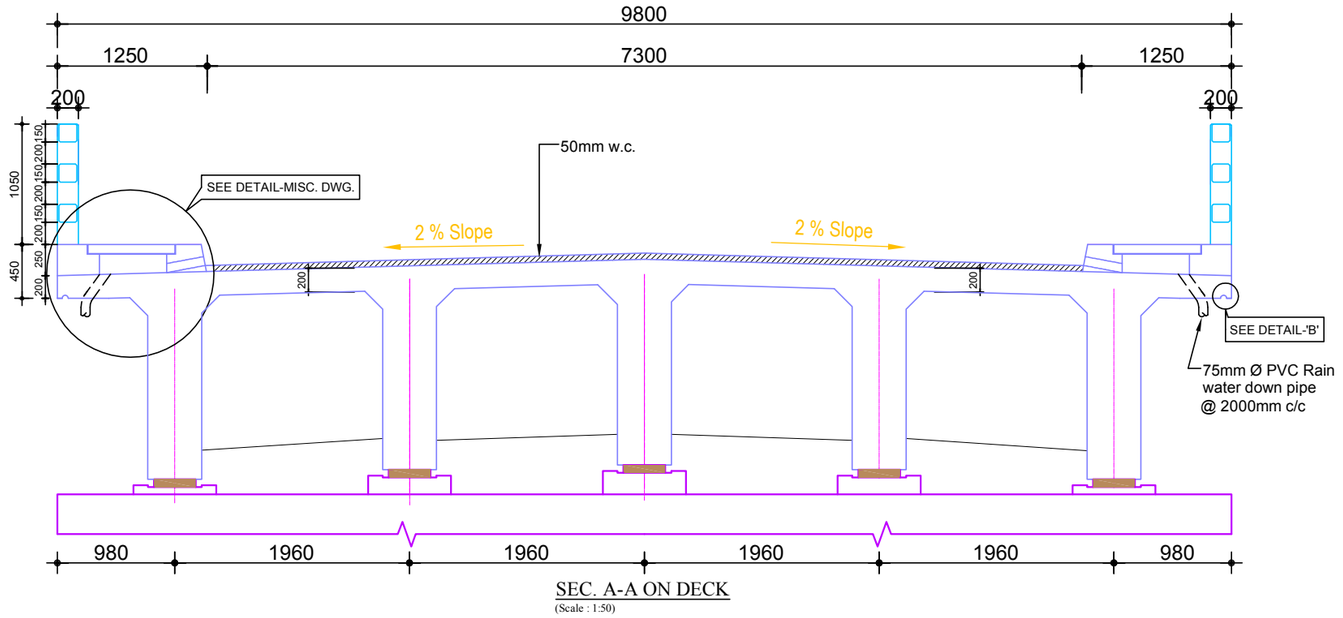
(Scale : 1:40)



A REINF. PLAN OF DECK

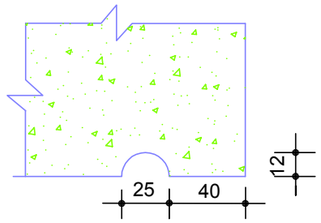
(Scale : 1:80)

NAME OF THE CLIENT : GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH **LOCAL GOVERNMENT ENGINEERING DEPARTMENT** NAME OF THE PROJECT : CONSULTANCY SERVICES FOR FEASIBILITY, DETAILED SURVEY AND DESIGN OF CHITTAGONG HILL TRACT CONNECTIVITY CONNECTING THEGAMUKH AND CHITTAGONG PORT.	NAME OF THE CONSULTANTS : **SAI Consulting Engineers Pvt. Ltd, India.** in association with **BETS Consulting Services Ltd, Bangladesh** Project office : Tahmid Mahmood Palace Flat # 9A, House # 77, Road # 4, Block-C, Banani, Dhaka-1213, Bangladesh.	DRAWING TITLE : REINF. DETAILS OF DECK SLAB (S-20.0m) DRAWING NO : LGED/DK-20/RNFR.-01 Scale :As shown Date : 28-01-16	DESIGNED BY : MD. TAZUDDIN	DRAWN BY : MD. TAZUDDIN	CHECKED BY : AFM HAMIDUL HAQUE	APPROVED BY : DR. PRABHAT SHRIVASTAVA	REV.	DESCRIPTION	DATE

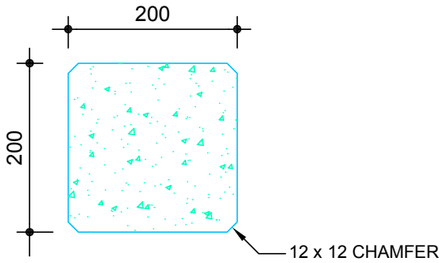


SEC. A-A ON DECK

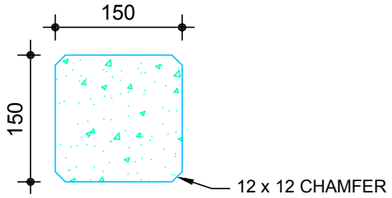
(Scale : 1:50)



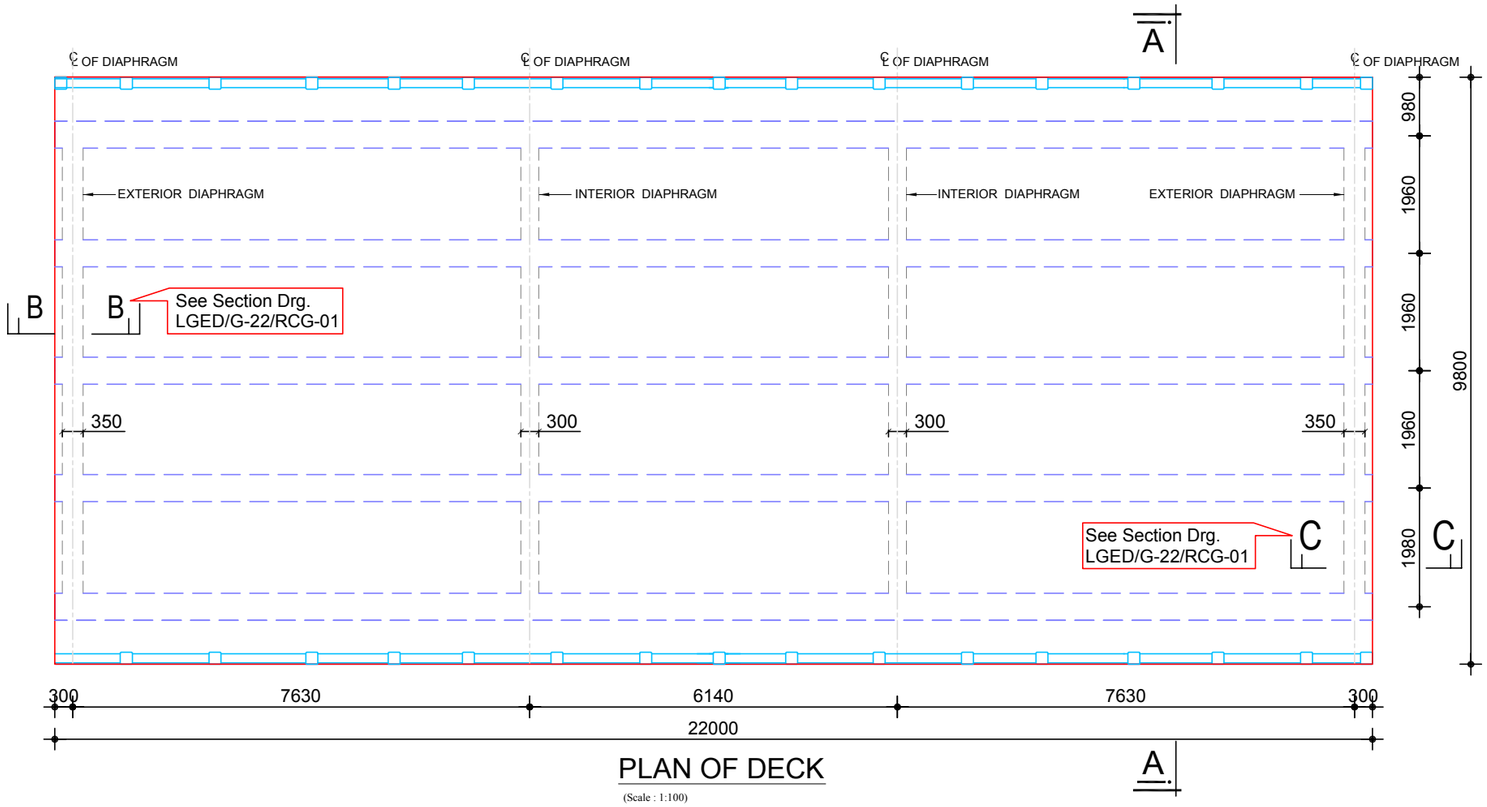
DETAIL "B"



CROSS SECTION
RAIL POST



CROSS SECTION
RAIL BAR



PLAN OF DECK

(Scale : 1:100)

NOTES:

1. All dimensions are in milimeters unless othrwise mentioned.
2. Rain water down pipe shall be projected minimum 50mm from the bottom of slab.

NAME OF THE CLIENT :
GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH
LOCAL GOVERNMENT ENGINEERING DEPARTMENT

NAME OF THE PROJECT :
CONSULTANCY SERVICES FOR FEASIBILITY, DETAILED SURVEY AND DESIGN OF CHITTAGONG HILL TRACT CONNECTIVITY CONNECTING THEGAMUKH AND CHITTAGONG PORT.

NAME OF THE CONSULTANTS :
SAI Consulting Engineers Pvt. Ltd, India.
in association with
BETS Consulting Services Ltd, Bangladesh
Project office :
Tahmid Mahmood Palace
Flat # 9A, House # 77, Road # 4, Block-C,
Banani, Dhaka-1213, Bangladesh.

DRAWING TITLE :
DETAILS OF DECK SLAB (S-22.0m)

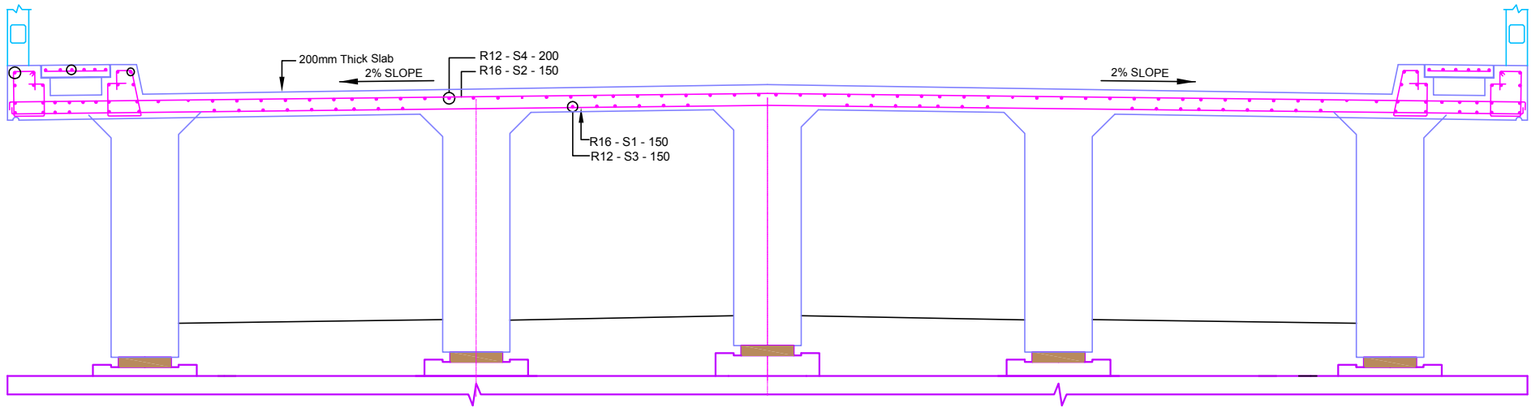
DRAWING NO : LGED/DK-22/C-01

Scale :As shown

Date : 28-01-16

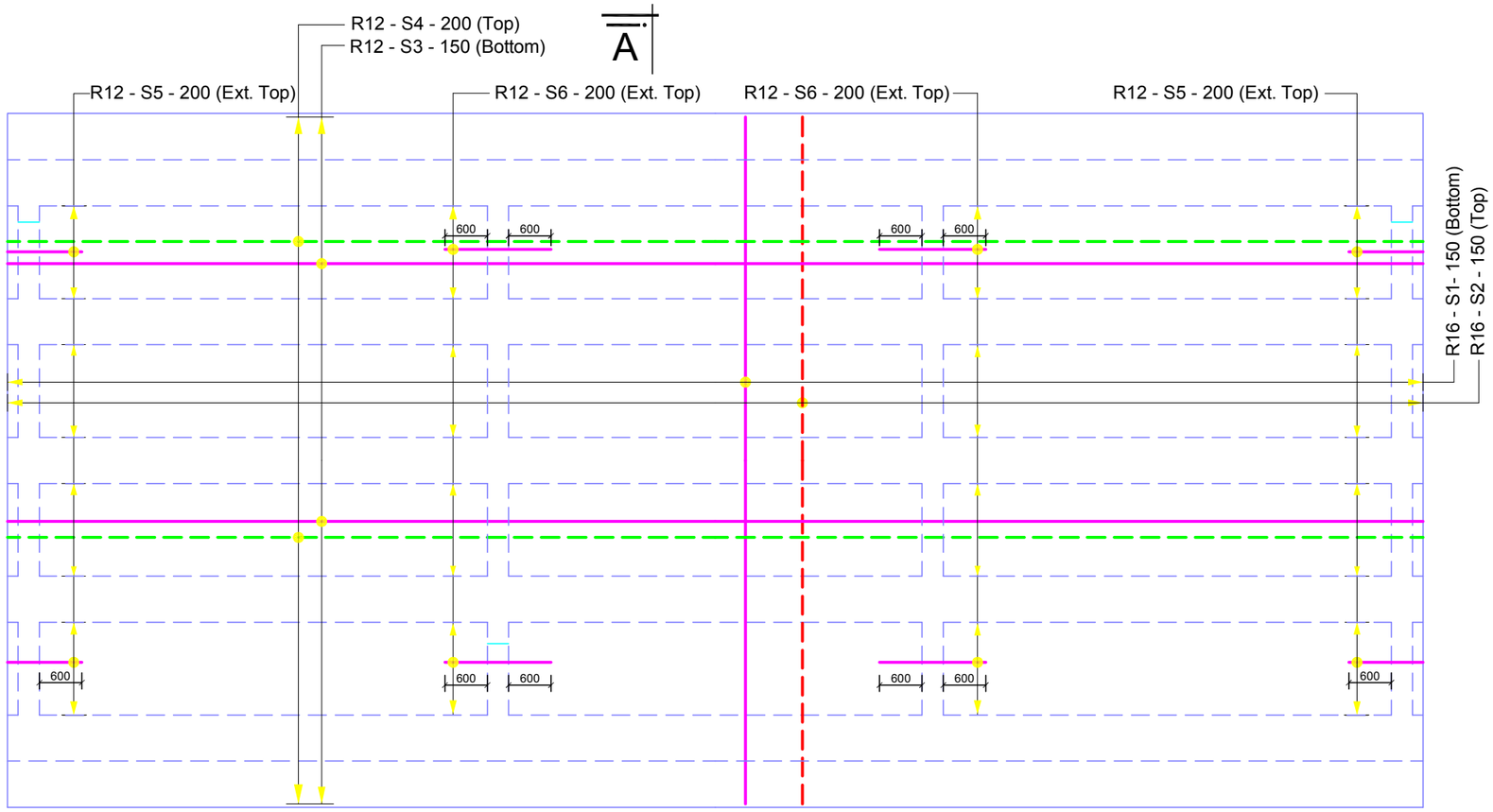
DESIGNED BY :	DRAWN BY :	CHECKED BY :	APPROVED BY :
MD. TAZUDDIN	MD. TAZUDDIN	AFM HAMIDUL HAQUE	DR. PRABHAT SHRIVASTAVA

REV.	DESCRIPTION	DATE



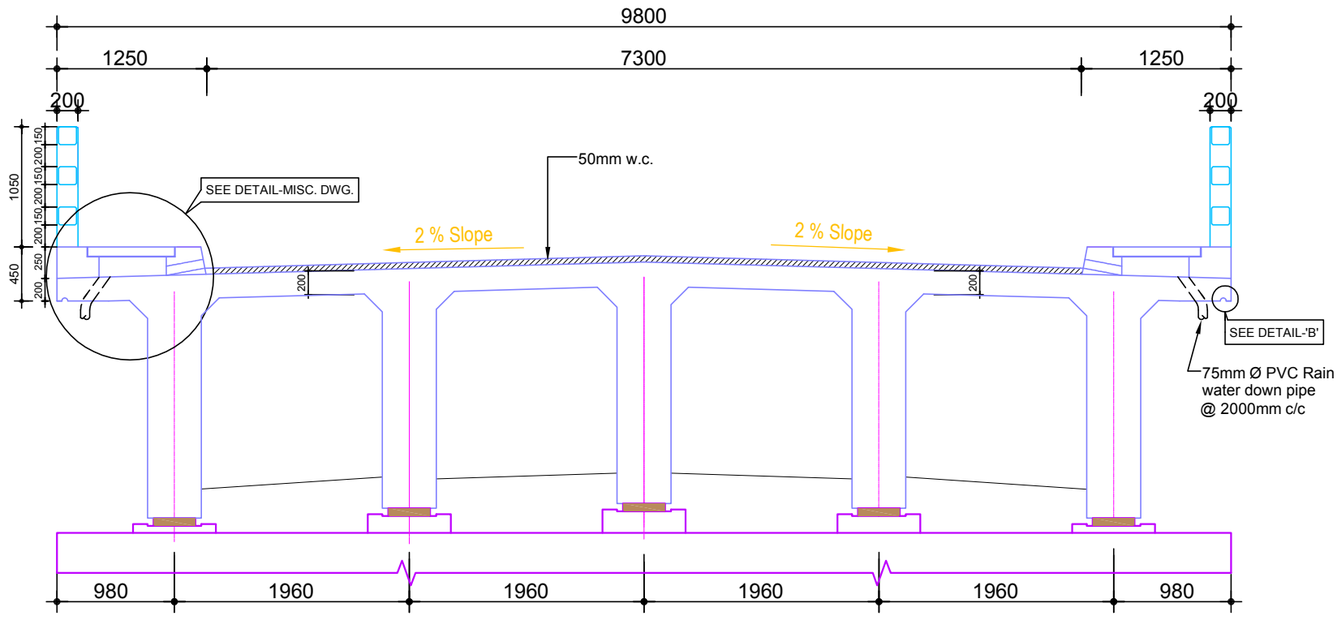
SEC. A-A ON DECK

(Scale : 1:40)

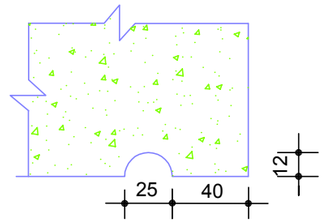


A REINF. PLAN OF DECK

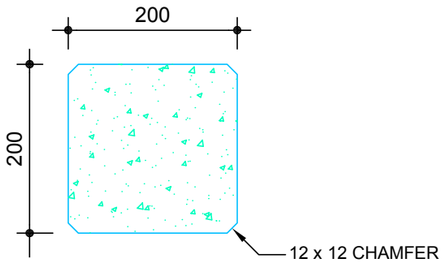
NAME OF THE CLIENT : GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH **LOCAL GOVERNMENT ENGINEERING DEPARTMENT** NAME OF THE PROJECT : CONSULTANCY SERVICES FOR FEASIBILITY, DETAILED SURVEY AND DESIGN OF CHITTAGONG HILL TRACT CONNECTIVITY CONNECTING THEGAMUKH AND CHITTAGONG PORT.	NAME OF THE CONSULTANTS : **SAI Consulting Engineers Pvt. Ltd, India.** in association with **BETS Consulting Services Ltd, Bangladesh** Project office : Tahmid Mahmood Palace Flat # 9A, House # 77, Road # 4, Block-C, Banani, Dhaka-1213, Bangladesh.	DRAWING TITLE : REINF. DETAILS OF DECK SLAB (S-22.0m) DRAWING NO : LGED/DK-22/RNF.-02 Scale :As shown Date : 28-01-16	DESIGNED BY : MD. TAZUDDIN	DRAWN BY : MD. TAZUDDIN	CHECKED BY : AFM HAMIDUL HAQUE	APPROVED BY : DR. PRABHAT SHRIVASTAVA	REV.	DESCRIPTION	DATE



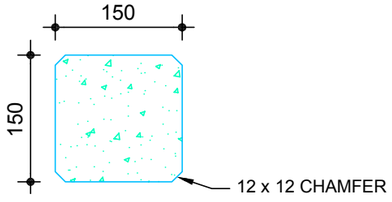
SEC. A-A ON DECK



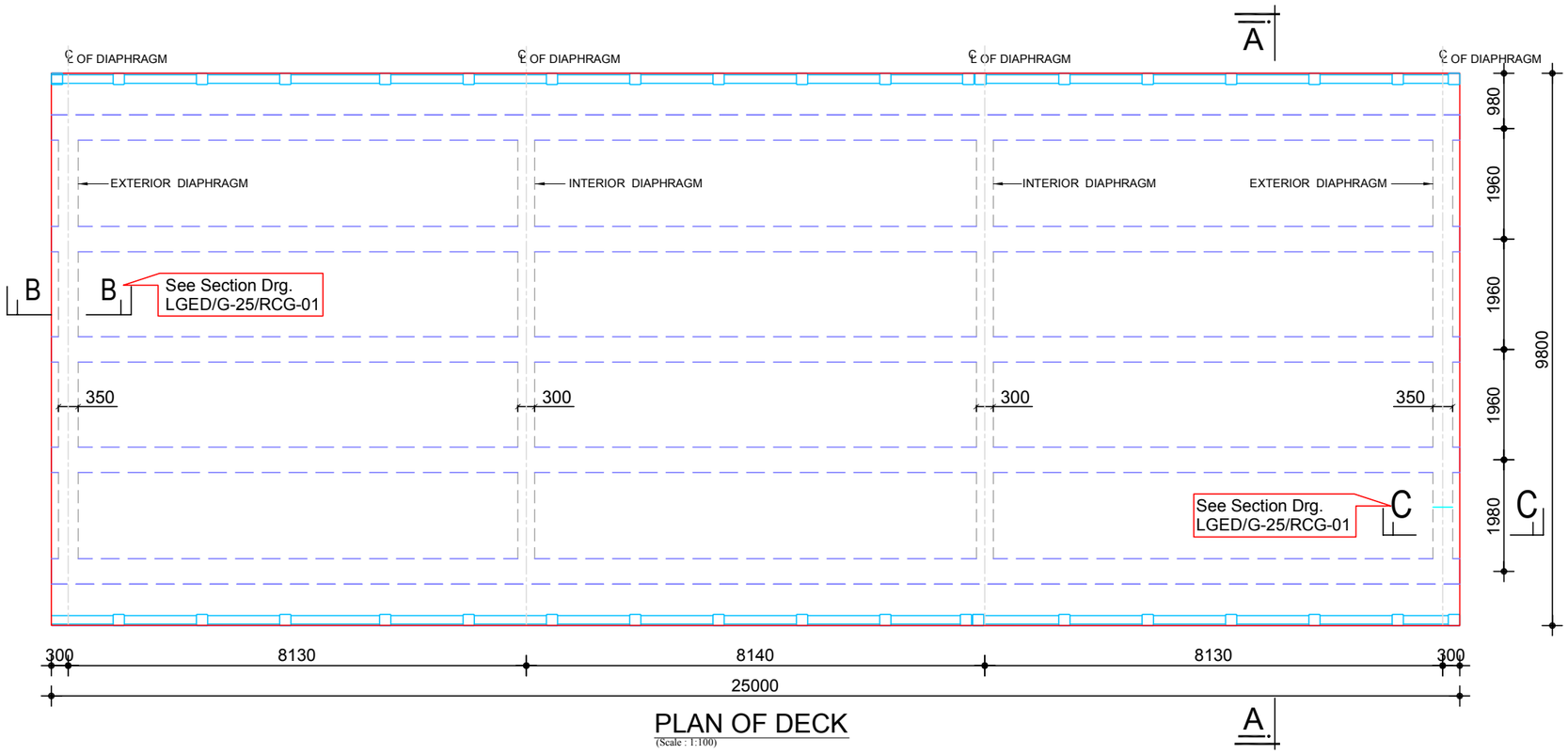
DETAIL "B"



CROSS SECTION
RAIL POST



CROSS SECTION
RAIL BAR



PLAN OF DECK
(Scale : 1:100)

NOTES:

1. All dimensions are in milimeters unless othrwise mentioned.
2. Rain water down pipe shall be projected minimum 50mm from the bottom of slab.

NAME OF THE CLIENT :
GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH
LOCAL GOVERNMENT ENGINEERING DEPARTMENT

NAME OF THE PROJECT :
CONSULTANCY SERVICES FOR FEASIBILITY, DETAILED SURVEY AND DESIGN OF CHITTAGONG HILL TRACT CONNECTIVITY CONNECTING THEGAMUKH AND CHITTAGONG PORT.

NAME OF THE CONSULTANTS :
SAI Consulting Engineers Pvt. Ltd, India.
in association with
BETS Consulting Services Ltd, Bangladesh
Project office :
Tahmid Mahmood Palace
Flat # 9A, House # 77, Road # 4, Block-C,
Banani, Dhaka-1213, Bangladesh.

DRAWING TITLE :
DETAILS OF DECK SLAB (S-25.0m)

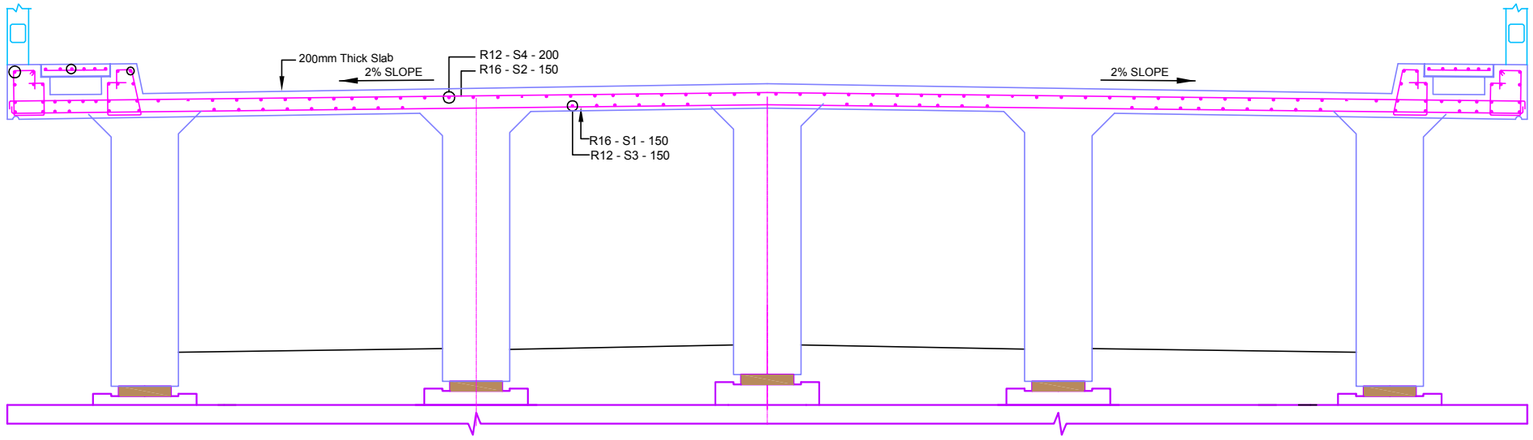
DRAWING NO : LGED/DK-25/C-01

Scale :As shown

Date : 28-01-16

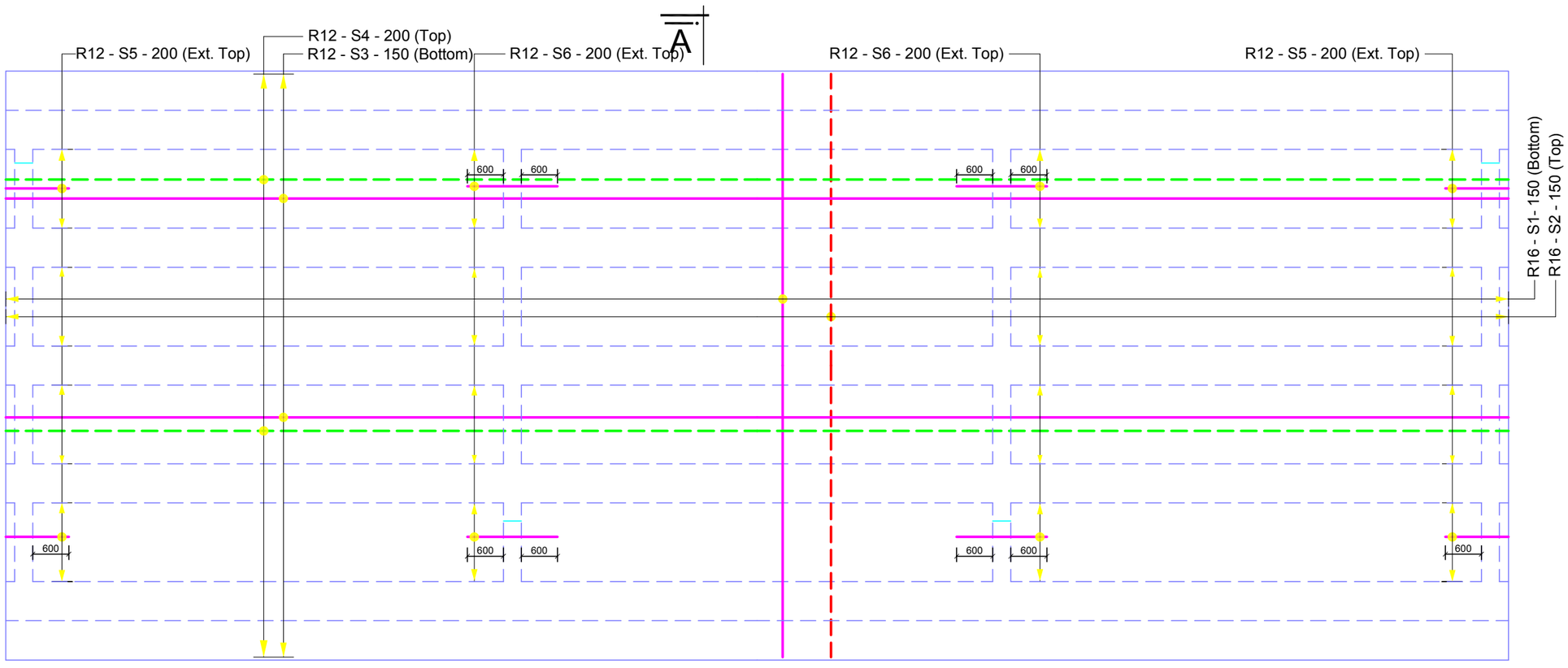
DESIGNED BY :	DRAWN BY :	CHECKED BY :	APPROVED BY :
MD. TAZUDDIN	MD. TAZUDDIN	AFM HAMIDUL HAQUE	DR. PRABHAT SHRIVASTAVA

REV.	DESCRIPTION	DATE



SEC. A-A ON DECK

(Scale : 1:40)



A. REINF. PLAN OF DECK

(Scale : 1:80)

REV.	DESCRIPTION	DATE

NAME OF THE CLIENT :

GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH

LOCAL GOVERNMENT ENGINEERING DEPARTMENT

NAME OF THE PROJECT :

CONSULTANCY SERVICES FOR FEASIBILITY, DETAILED SURVEY AND DESIGN OF CHITTAGONG HILL TRACT CONNECTIVITY CONNECTING THEGAMUKH AND CHITTAGONG PORT.

NAME OF THE CONSULTANTS :

SAI Consulting Engineers Pvt. Ltd, India.

in association with

BETS Consulting Services Ltd, Bangladesh

Project office :

Tahmid Mahmood Palace
Flat # 9A, House # 77, Road # 4, Block-C,
Banani, Dhaka-1213, Bangladesh.

DRAWING TITLE :

REINF. DETAILS OF DECK SLAB (S-25.0m)

DRAWING NO : LGED/DK-25/RNF.-02

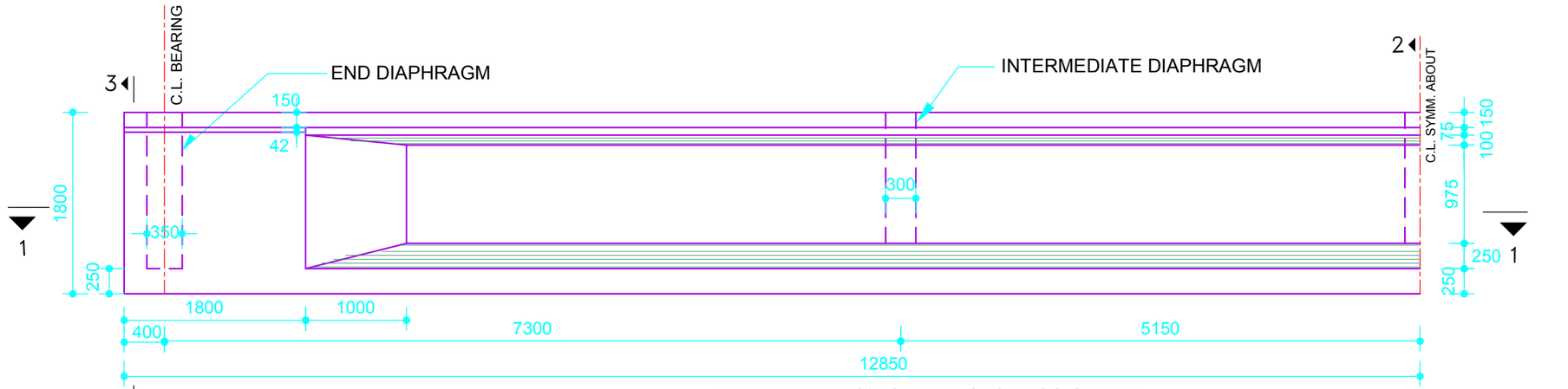
Scale :As shown

Date : 28-01-16

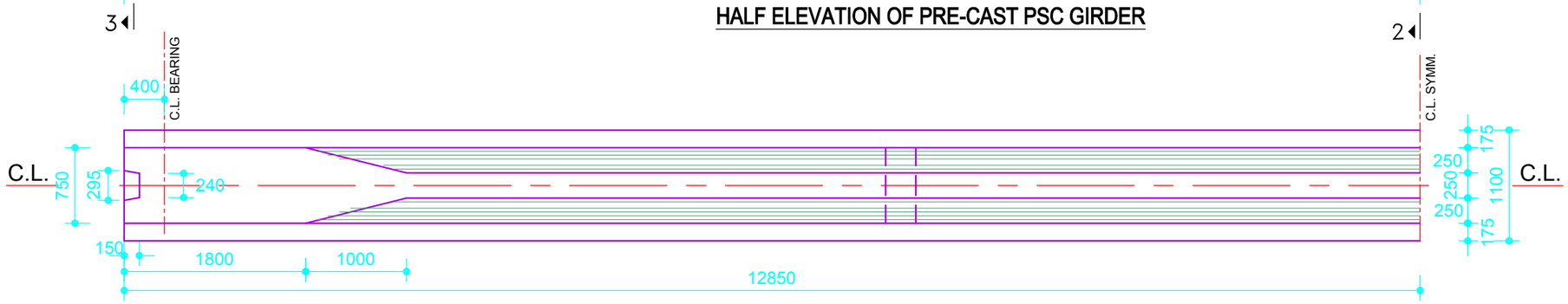
DESIGNED BY :	DRAWN BY :	CHECKED BY :	APPROVED BY :
MD. TAZUDDIN	MD. TAZUDDIN	AFM HAMIDUL HAQUE	DR. PRABHAT SHRIVASTAVA

REV.	DESCRIPTION	DATE

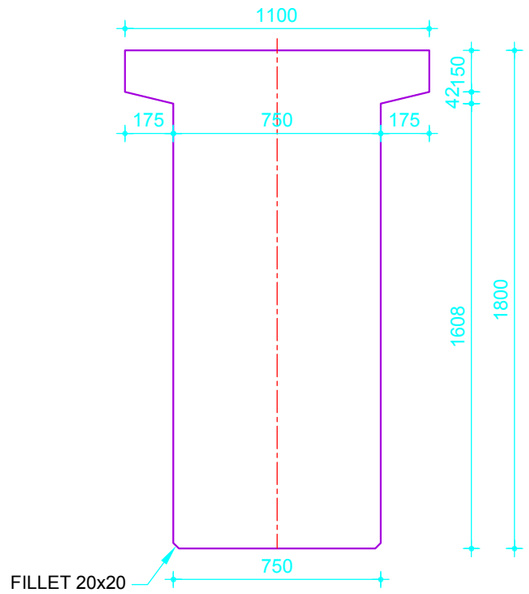
TYPICAL DECK SLAB FOR RCC GIRDER



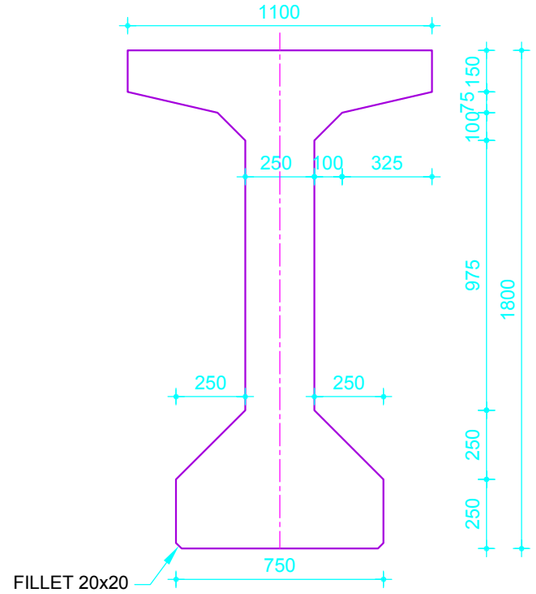
HALF ELEVATION OF PRE-CAST PSC GIRDER



SECTIONAL VIEW OF PRE-CAST PSC GIRDER (SECTION 1-1)



SECTION 3-3 AT END



SECTION 2-2 AT MIDDLE

NOTES:

1. CONCRETE SHALL HAVE SPECIFIED CHARACTERISTIC COMPRESSIVE STRENGTH OF STANDARD CYLINDER OR CUBE (15 cm) AT 28 DAYS, ARE AS FOLLOWS(15 cm) AT 28 DAYS, ARE AS FOLLOWS:
   a) STANDARD CYLINDER CRUSHING STRENGTH, f'c = 35 N/mm²
   b) STANDARD CUBE CRUSHING STRENGTH, fcu = 43 N/mm²
2. REINFORCING STEEL SHALL CONFORM TO ASTM A615-87 GRADE 6 DEFORMED BARS (MARKED 'Y') HAVING MINIMUM YEILD STRENGT Fy = 413 N/mm²
3. PRESTRESSING STEEL SHALL BE OF 12.7mm DIA. 7 PLY UNCOATE LOW RELAXATION STRAND CONFORMING TO AASHTO-M203 (GRADE-270) OR EQUIVALENT HAVING THE FOLLOWING STRENGTH:
   (a) MINIMUM ULTIMATE TENSILE STRENGTH (UTS) f 's = 1861 N/mm (183.7 KN PER STRAND)
   (b) MINIMUM YIELD STRENGTH f 'y = 1674 N/mm² (165.3 KN PER STRAND)
4. PPRESTRESSING CABLE SHALL CONSISTS OF 12 NOS.12.7mm DIA. STRAND (12T13) IN A SHEATHING/DUCT
5. FOLLOWING PROPERTIES HAVE BEEN CONSIDERED IN THE DESIGN
   AREA OF STRAND = 98.7 mm²
   AREA OF CABLE = 1184.4 mm²
   MODULLES OF ELASTICITY OF STRAND =1.97x10 ^{5} (N/mm ^{2})
   AVERAGE SLIP = 6mm
   JACKING FORCE IN EACH CABLE = 16 80 KN.

NAME OF THE CLIENT :
GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH
LOCAL GOVERNMENT ENGINEERING DEPARTMENT

NAME OF THE PROJECT :
CONSULTANCY SERVICES FOR FEASIBILITY, DETAILED SURVEY AND DESIGN OF CHITTAGONG HILL TRACT CONNECTIVITY CONNECTING THEGAMUKH AND CHITTAGONG PORT.

NAME OF THE CONSULTANTS :
SAI Consulting Engineers Pvt. Ltd, India.
in association with
BETS Consulting Services Ltd, Bangladesh
Project office :
Tahmid Mahmood Palace
Flat # 9A, House # 77, Road # 4, Block-C,
Banani, Dhaka-1213, Bangladesh.

DRAWING TITLE :
26.0m LONG PC GIRDER CONCRETE OUTLINE DETAILS

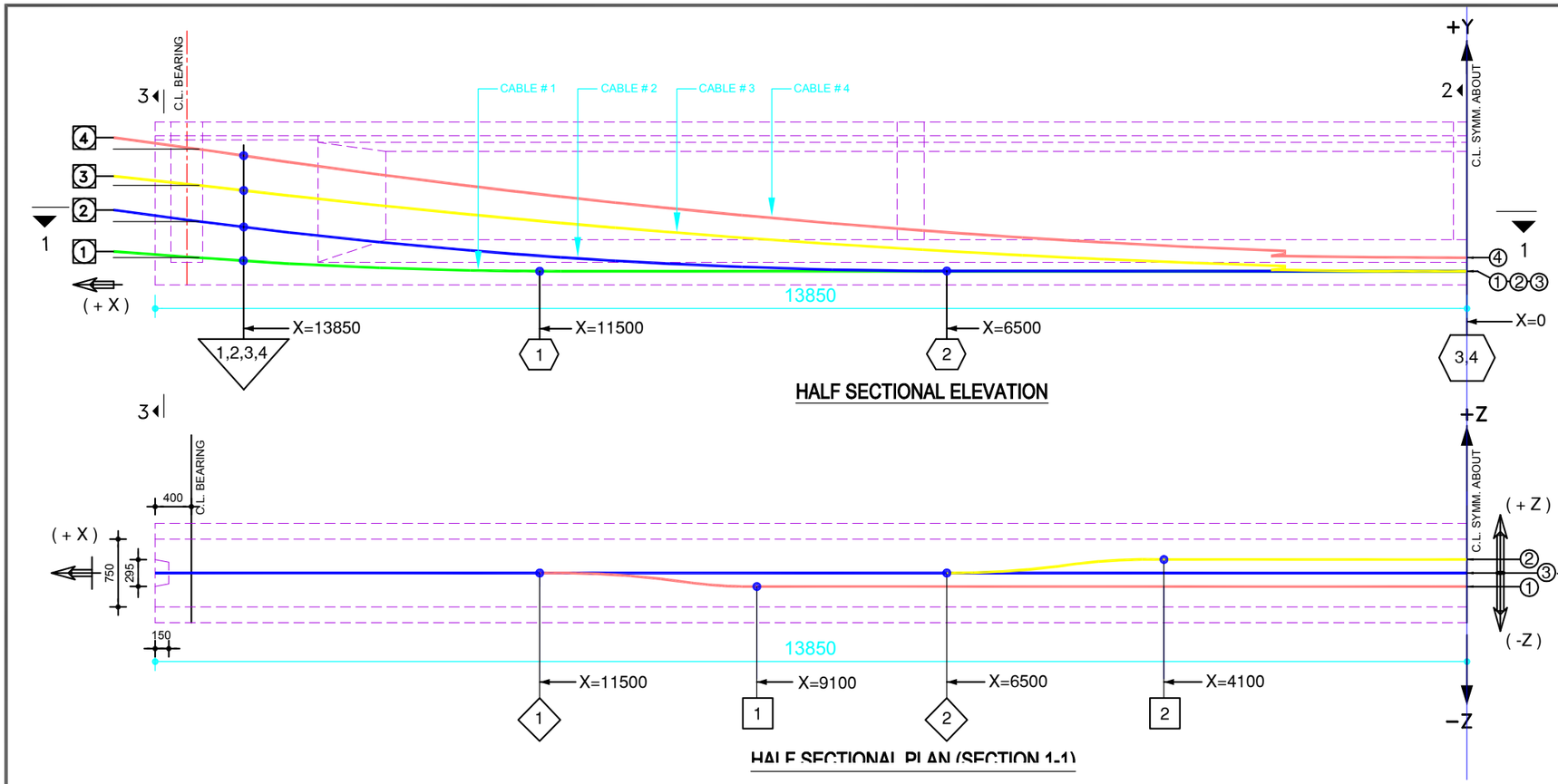
DRAWING NO : LGED/PCG-26/CON-01

Scale :As shown

Date : 28-01-16

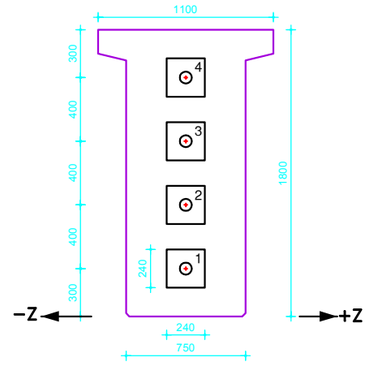
DESIGNED BY :	DRAWN BY :	CHECKED BY :	APPROVED BY :
MD. TAZUDDIN	MD. TAZUDDIN	AFM HAMIDUL HAQUE	DR. PRABHAT SHRIVASTAVA

REV.	DESCRIPTION	DATE

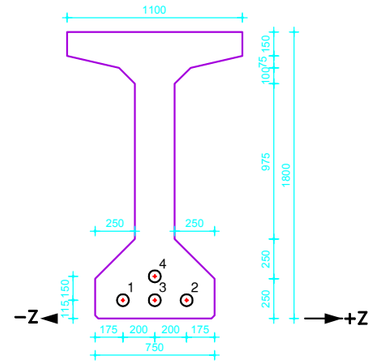


HALF SECTIONAL ELEVATION

HALF SECTIONAL PLAN (SECTION 1-1)



SECTION 3-3
(END SECTION)



SECTION 2-2
(MID SECTION)

Cable No.	ORDINATE AT DISTANCE X FROM CENTER																				Extension at each jecking end	Emergence angle
	12850		12500		12500		12000		11750		11500		10300		9100		8500		8000		7500			
	Y	Z	Y	Z	Y	Z	Y	Z	Y	Z	Y	Z	Y	Z	Y	Z	Y	Z	Y	Z	Y	Z		
1	300		259		211		177		157		150		150		150		150		150		150		96.69	1.24
2	700		649		580		517		458		405		297		219		191		173		160		97.06	4.53
3	1100		1053		987		924		863		805		675		560		508		467		429		97.87	7.76
4	1500		1440		1357		1277		1201		1127		964		818		752		700		652		98.59	9.73
1		0		0		0		0		0		0		-75.0		-150		-150		-150		-150		
2		0		0		0		0		0				0		0		0		0		0		

Cable No.																					Extension at each jecking end	Emergence angle
	7000		6500		5300		4100		3500		3000		2500		2000		1500		1000		0			
	Y	Z	Y	Z	Y	Z	Y	Z	Y	Z	Y	Z	Y	Z	Y	Z	Y	Z	Y	Z	Y	Z		
1	150		150		150		150		150		150		150		150		150		150		150		96.69	1.24
2	153		150		150		150		150		150		150		150		150		150		150		97.06	4.53
3	393		359		289		233		211		195		181		170		161		155		150		97.87	7.76
4	607		564		476		405		377		356		339		325		314		306		300		98.59	9.73
1		-150		-150		-150		-150		-150		-150		-150		-150		-150		-150		-150		
2		0		0		75.0		150		150		150		150		150		150		150		150		

LEGEND:

- INDICATES START OF CURVE IN ELEVATION
- INDICATES END OF CURVE IN ELEVATION
- INDICATES START OF CURVE IN PLAN
- INDICATES END OF CURVE IN PLAN
- INDICATES END OF CABLE
- INDICATES CABLE NUMBER

NAME OF THE CLIENT :
GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH
LOCAL GOVERNMENT ENGINEERING DEPARTMENT

NAME OF THE PROJECT :
CONSULTANCY SERVICES FOR FEASIBILITY, DETAILED SURVEY AND DESIGN OF CHITTAGONG HILL TRACT CONNECTIVITY CONNECTING THEGAMUKH AND CHITTAGONG PORT.

NAME OF THE CONSULTANTS :
SAI Consulting Engineers Pvt. Ltd, India.
in association with
BETS Consulting Services Ltd, Bangladesh
Project office :
Tahmid Mahmood Palace
Flat # 9A, House # 77, Road # 4, Block-C,

DRAWING TITLE :
26.0m LONG PC GIRDER PRE-STRESSING CABLE DETAILS

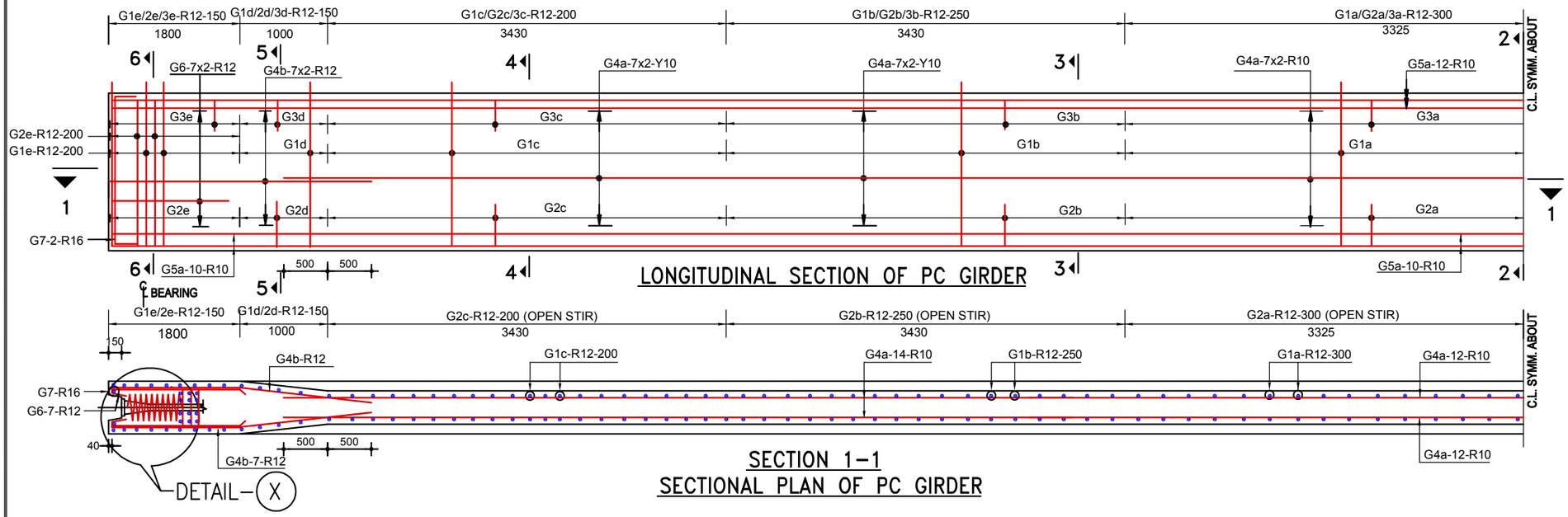
DRAWING NO : LGED/PCG-26/CAB-02

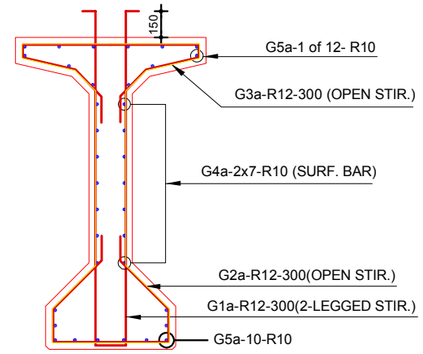
Scale :As shown

Date : 28-01-16

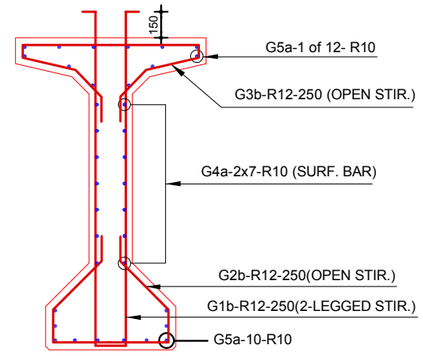
DESIGNED BY :	DESIGNED BY :	DRAWN BY :	CHECKED BY :	APPROVED BY :
MD. TAZUDDIN		MD. TAZUDDIN	AFM HAMIDUL HAQUE	DR. PRABHAT SHRIVASTAVA

REV.	DESCRIPTION	DATE



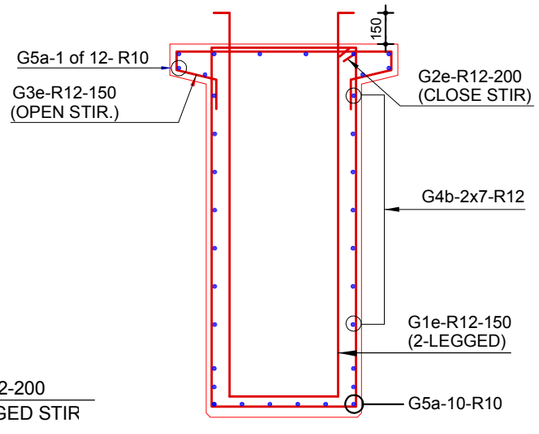


SECTION 2-2
(MID SECTION)

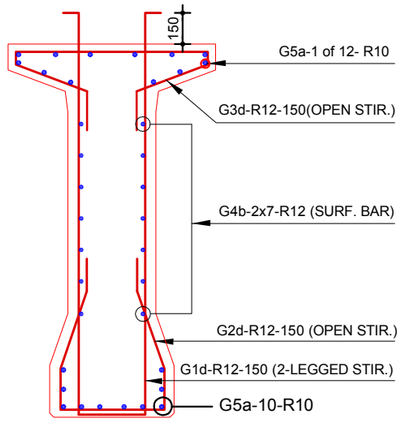


SECTION 3-3
(MID SECTION)

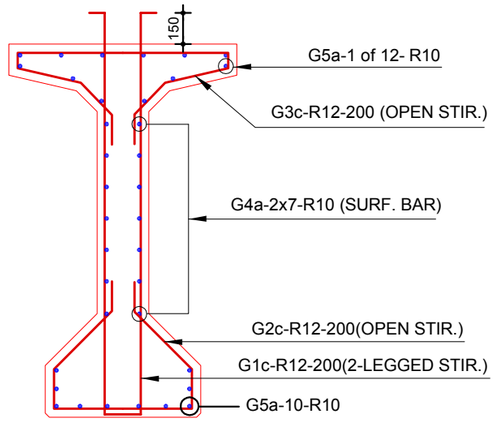
ELEV. SHOWING END BLOCK REINF. DETAILS



SECTION 6-6
(END SECTION)



SECTION 5-5
(MID SECTION)



SECTION 4-4
(MID SECTION)

NAME OF THE CLIENT :
GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH
LOCAL GOVERNMENT ENGINEERING DEPARTMENT

NAME OF THE PROJECT :
CONSULTANCY SERVICES FOR FEASIBILITY, DETAILED SURVEY AND DESIGN OF CHITTAGONG HILL TRACT CONNECTIVITY CONNECTING THEGAMUKH AND CHITTAGONG PORT.

NAME OF THE CONSULTANTS :
SAI Consulting Engineers Pvt. Ltd, India.
in association with
BETS Consulting Services Ltd, Bangladesh
Project office :
Tahmid Mahmood Palace
Flat # 9A, House # 77, Road # 4, Block-C,

DRAWING TITLE :
26.0m LONG PC GIRDER NON-PRE STRESSING REINFORCEMENT

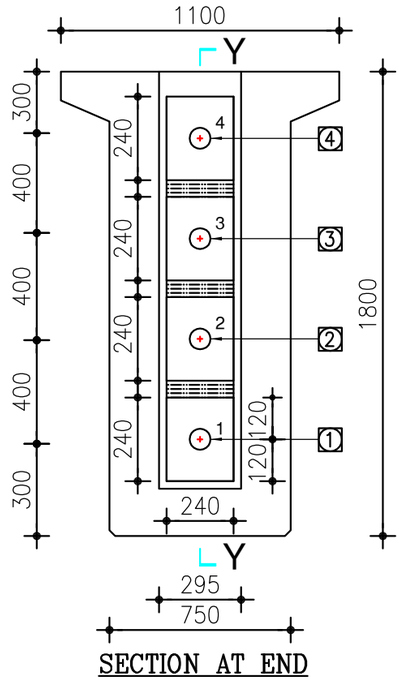
DRAWING NO : LGED/PCG-26/RNF.-03

Scale :As shown

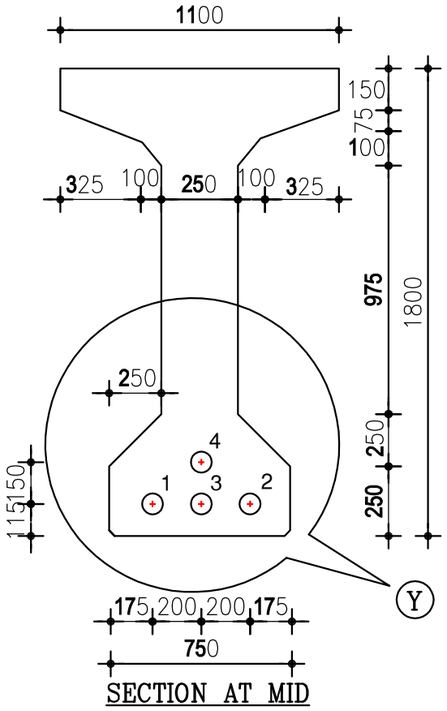
Date : 28-01-16

DESIGNED BY :	DESIGNED BY :	CHECKED BY :	APPROVED BY :
MD. TAZUDDIN	MD. TAZUDDIN	AFM HAMIDUL HAQUE	DR. PRABHAT SHRIVASTAVA

REV.	DESCRIPTION	DATE



SECTION AT END

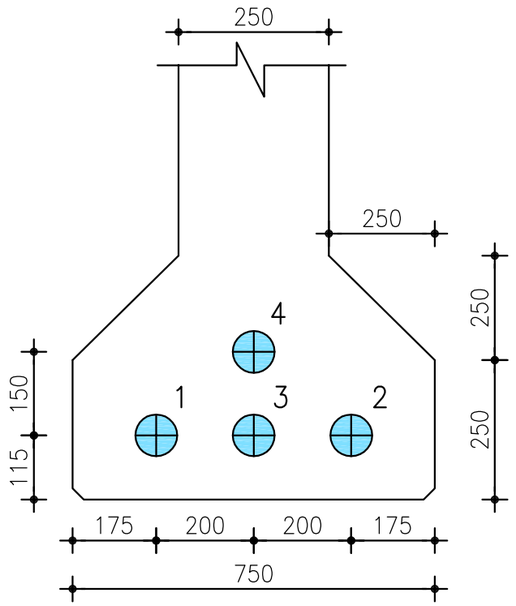


SECTION AT MID

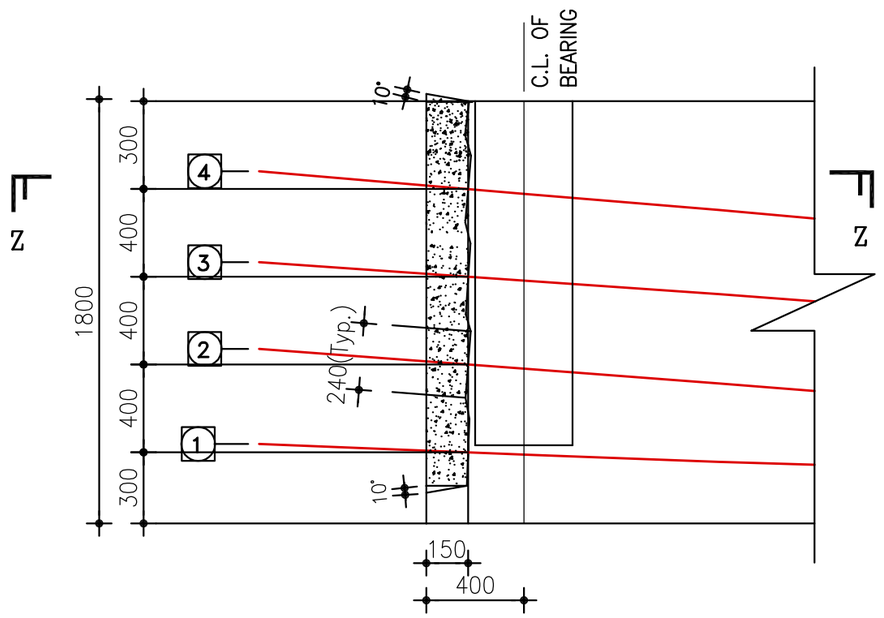
NOTES:

STAGES AND SEQUENCE OF PRESTRESSING

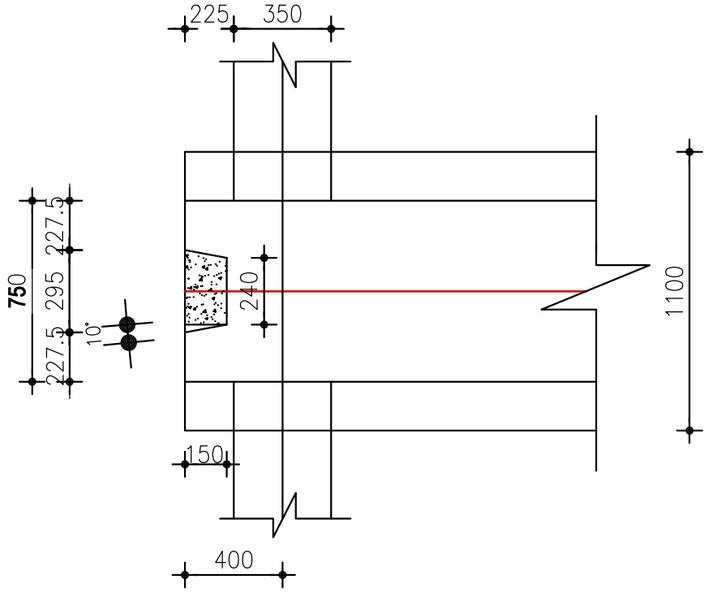
1. EACH CABLE SHALL BE STRESSED SIMULTANEOUSLY FROM BOTH ENDS. THE JACKING FORCE IN EACH CABLE SHALL BE 1680 KN TO BE IMPARTED SIMULTANEOUSLY AT BOTH ENDS.
2. THE SEQUENCE OF STRESSING OF PRESTRESSING CABLES SHALL BE AS FOLLOWS: 3, 2,1 & 4
3. STRESSING OF CABLES SHALL BE DONE MINIMUM AFTER 14 DAYS OR CONCRETE STRENGTH NOT LESS THAN 26N/mm^2 WHICHEVER IS LATER.
4. THE EXTENSION SHOWN IN THE TABLE IS FOR THE PORTION OF CABLES LYING BETWEEN MID SPAN AND RECESS FACE OF THE GIRDER. ADDITIONAL ELONGATION FOR GRIPPING LENGTH MUST BE ADDED DURING TENSIONING.
5. EACH CABLES CONSISTS OF 12 NOS. 12.7mm DIA. (12T13) 7-PLY UNCOATED LOW RELAXATION STRANDS
6. FOR OTHER REQUIREMENTS REFER GENERAL NOTES FOR PC GIRDER : S-02
7. THE CONTRACTOR SHALL SUBMIT DETAILS SHOP DRAWING FOR PC GIRDER'S FORMWORK AND SCAFFOLDING SYSTEM AND GET IT APPROVED BY CONCERNED XEN.
8. THE FORMWORK OF PC GIRDER MUST BE MADE OF M.S. SHEET HAVING THICKNESS 12BWG WITH NECESSARY BRACING.



DETAIL Ⓨ



DETAILS OF END BLOCK

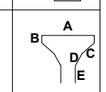
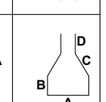
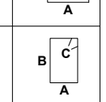
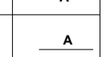
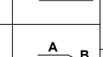
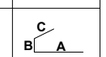
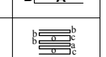


SECTION Z–Z

NAME OF THE CLIENT : GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH **LOCAL GOVERNMENT ENGINEERING DEPARTMENT**	NAME OF THE CONSULTANTS : **SAI Consulting Engineers Pvt. Ltd, India.** in association with **BETS Consulting Services Ltd, Bangladesh** Project office : Tahmid Mahmood Palace Flat # 9A, House # 77, Road # 4, Block-C,	DRAWING TITLE : END BLOCK DETAILS OF 26.0m LONG PC GIRDER	DESIGNED BY : MD. TAZUDDIN	DRAWN BY : MD. TAZUDDIN	CHECKED BY : AFM HAMIDUL HAQUE
NAME OF THE PROJECT : CONSULTANCY SERVICES FOR FEASIBILITY, DETAILED SURVEY AND DESIGN OF CHITTAGONG HILL TRACT CONNECTIVITY CONNECTING THEGAMUKH AND CHITTAGONG PORT.		DRAWING NO : LGED/PCG-26/EBL-04 Scale :As shown Date : 28-01-16			APPROVED BY : DR. PRABHAT SHRIVASTAVA

REV.	DESCRIPTION	DATE

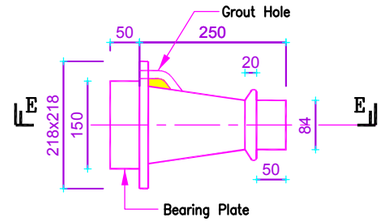
BAR BENDING SCHEDULE OF NON-PRESTRESSED REINF. (FOR ONE GIRDER, 28.0m)

SHAP CODE	BAR SHAPE	ITEM	NO.	BAR MARK	BAR TYPE & DIA (mm)	NO. OF BAR	SHAPE CODE	BENDING DIMENSIONS(MM) A	B	C	D	E	F	G	CUT LENGTH(MM)	TOTAL NO. OF BARS	TOTAL LENGTH(M)	UNIT WT. OF BAR(Kg/M)	TOTAL WT.(Kg)
1		PC GIRDER	45	G1a	R 12	26	1	170	1910	200					4350	26	113.100	0.888	100.41
				G1b	R 12	30	1	170	1910	200					4350	30	130.500	0.888	115.86
				G1c	R 12	38	1	170	1910	200					4560	38	173.280	0.888	153.84
2				G1d	R 12	14	1	420	1910	200					4640	14	64.960	0.888	57.67
				G1e	R 12	24	1	670	1910	200					4890	24	117.360	0.888	104.19
				G2a	R 12	26	2A	670	197	400	200				2264	26	58.864	0.888	52.26
				G3a	R 12	26	2	1020	78	313	216	200			2634	26	68.480	0.888	60.80
2A				G2b	R 12	30	2A	670	197	400	200				2264	30	67.920	0.888	60.30
				G3b	R 12	30	2	1020	78	313	216	200			2234	30	67.020	0.888	59.50
				G2c	R 12	38	2A	670	197	400	200				2264	38	86.020	0.888	76.38
				G3c	R 12	38	2	1020	78	313	216	200			2234	38	84.892	0.888	75.37
				G2d	R 12	14	2A	670	197	400	200				2269	14	31.766	0.888	28.20
				G3d	R 12	14	2	1020	78	313	216	200			2234	14	31.276	0.888	27.77
3				G2e	R 12	24	3	670	1720	200					5180	24	124.320	0.888	110.37
				G3e	R 12	36	2	1020	78	313	216				2234	36	80.424	0.888	71.40
				G4a	R 10	14	4	23370							23370	14	327.180	0.617	201.72
				G4b	R 12	28	5	1700	1521						3221	28	90.179	0.888	80.06
4				G5a	R 10	12	4	27270							27270	12	335.664	0.617	206.95
				G5a	R 10	10	4	27270							27270	10	279.720	0.617	172.46
				G6	R 12	28	6	1700	150						3700	28	103.600	0.888	91.98
5				G7	R 16	4	7	1720	100						1920	4	7.680	1.578	12.12
		MESH	45	m1	R 12	6	8	9900	450	7560	1350				19260	6	115.560	0.888	102.60
6				m2	R 8	2	8	3000	450	3000	450				6900	2	13.800	0.395	5.45
		Spiral	45	S1	R 12	2	03	7295							7295	2	14.590	0.888	12.95
7																			
8																			

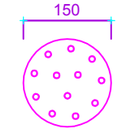
NB : BARBENDING SCHEDULE SHOULD BE CHECKED AT SITE BEFORE FABRICATION.

TOTAL WT.OF STEEL-Y16 (M.TON) = 0.01
TOTAL WT.OF STEEL-Y12 (M.TON) = 1.44
TOTAL WT.OF STEEL-Y10 (M.TON) = 0.58
TOTAL WT.OF STEEL-Y8 (M.TON) = 0.01

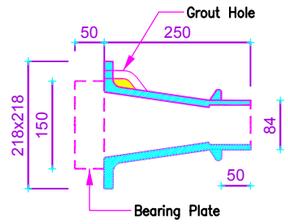
TOTAL WT. OF STEEL(M.TON) FOR ONE GIRDER = 2.04



Freyssinet Branded 12T13 Anchorage



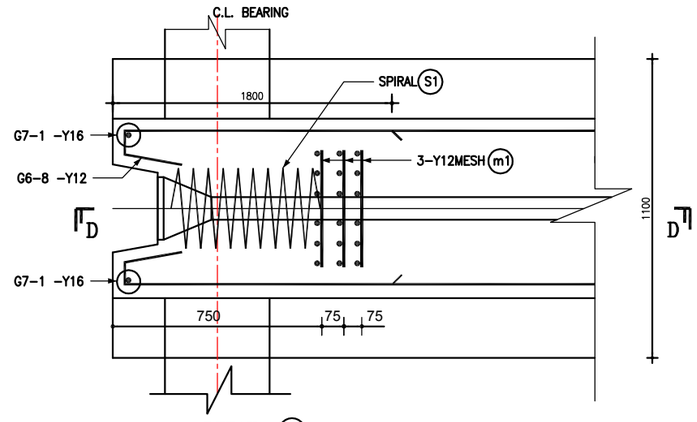
Bearing Plate



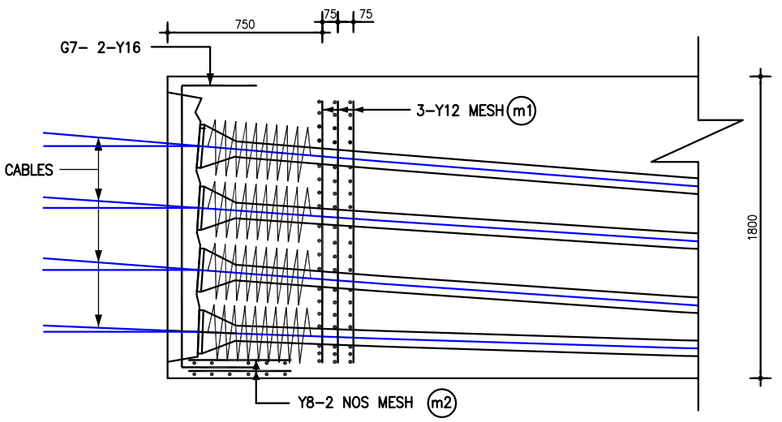
Section E-E

NOTES:

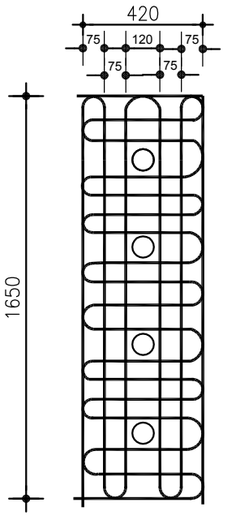
1. ANCHORAGE MUST BE TESTED TO CONFIRM ITS CAPACITY APPLYING 95% OF ULTIMATE LOAD (2205 KN) AS PER STANDARD SPECIFICATION PRIOR TO USE
2. HYDRAULIC JACKS FOR TENSIONING OPERATION MUST BE OF SAME BRANDED OF ANCHORAGE SYSTEM HAVING RECENT CALIBRATION
3. TENSIONING OPERATION SHALL BE CARRIED OUT IN PRESENCE OF AN EXPERIENCED ENGINEER OR AS DIRECTED BY THE DESIGN UNIT, LGED
4. THE PRE-STRESSING PARTY, IF SUBCONTRACTED, SHALL BE SELECTED TAKING PRIOR APPROVAL OF CONCERNED EXECUTIVE ENGINEER OR AS APPROVED BY DESIGN UNIT, LGED



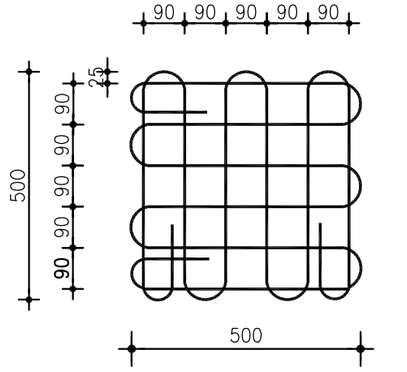
DETAIL- X



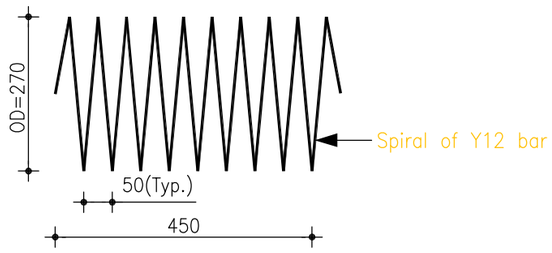
SECTION D-D



Y12 MESH REINFORCEMENT m1



Y8 MESH REINF. ABOVE BEARINGS m2

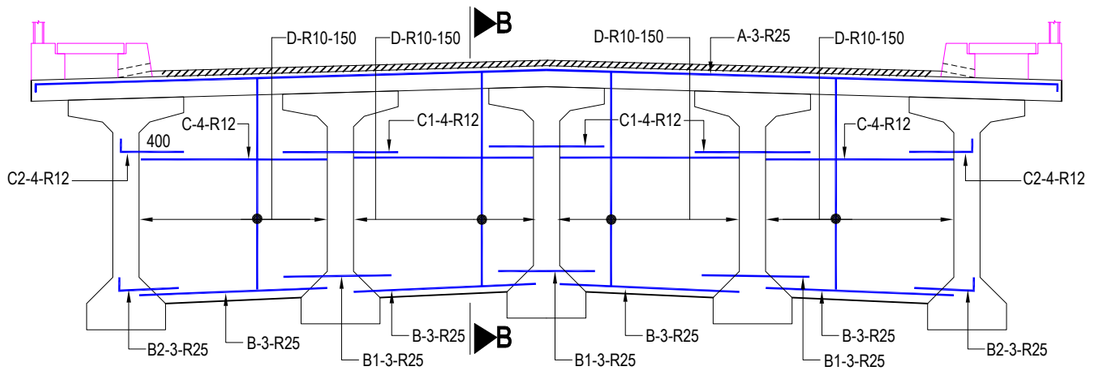


DETAILS OF SPIRAL S1

NAME OF THE CLIENT : GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH **LOCAL GOVERNMENT ENGINEERING DEPARTMENT**	NAME OF THE CONSULTANTS : **SAI Consulting Engineers Pvt. Ltd, India.** in association with **BETS Consulting Services Ltd, Bangladesh** Project office : Tahmid Mahmood Palace Flat # 9A, House # 77, Road # 4, Block-C,	DRAWING TITLE : TYPICAL PRE-STRESSING ANCHORAGE DETAILS FOR 26.0m LONG GIRDER	DESIGNED BY : MD. TAZUDDIN	DRAWN BY : MD. TAZUDDIN	CHECKED BY : AFM HAMIDUL HAQUE	APPROVED BY : DR. PRABHAT SHRIVASTAVA
NAME OF THE PROJECT : CONSULTANCY SERVICES FOR FEASIBILITY, DETAILED SURVEY AND DESIGN OF CHITTAGONG HILL TRACT CONNECTIVITY CONNECTING THEGAMUKH AND CHITTAGONG PORT.		DRAWING NO : LGED/PCG-26/ANC-05 Scale :As shown Date : 28-01-16				

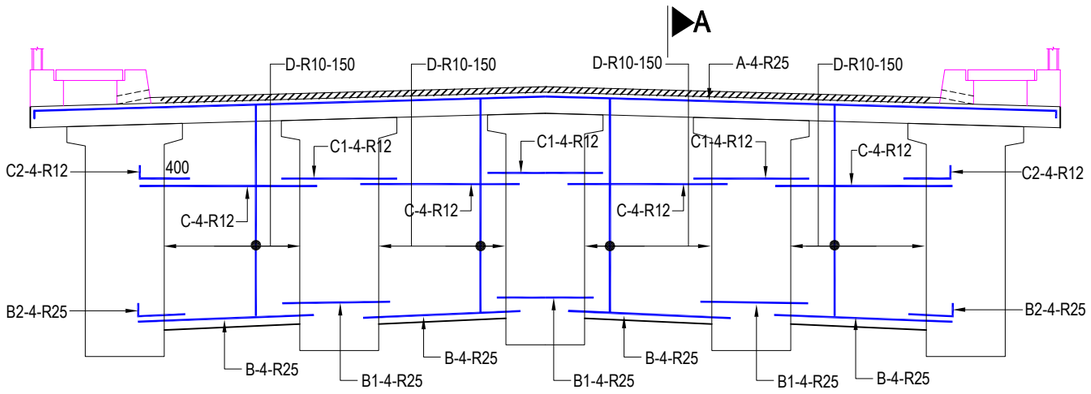
DESIGNED BY

REV.	DESCRIPTION	DATE



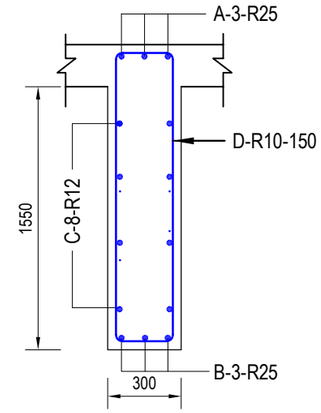
REINF. DETAILS OF INTER-MEDIATE X-GIRDER

(Scale : 1:60)



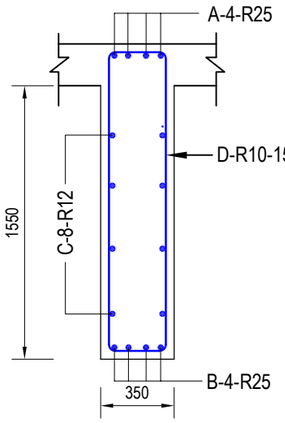
REINF. DETAILS OF END X-GIRDER

(Scale : 1:60)



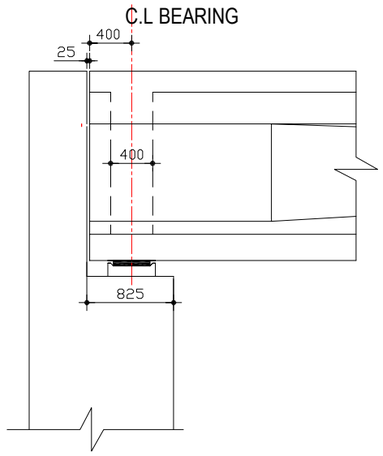
SEC. B-B (INTERMEDIATE X-GIRDER)

(Scale : 1:30)



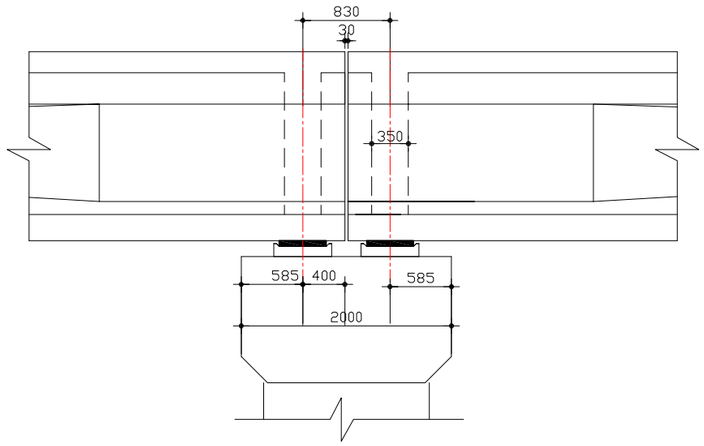
SEC. A-A (END X-GIRDER)

(Scale : 1:30)



SEC. B-B AT ABUTMENT END

(Scale : 1:75)



SEC. C-C AT COLUMN TYPE PIER END

(Scale : 1:75)

BAR BENDING SCHEDULE FOR INTERMEDIATE & END X-GIRDERE (33.00, whole span)

ITEM	NO.	BAR MARK	BAR TYPE & DIA (mm)	NO. OF BAR	SHAPE CODE	BENDING DIMENSIONS(MM) A	B	C	D	E	CUT LENGTH(MM)	TOTAL NO. OF BARS	TOTAL LENGTH(M)	UNIT WT. OF BAR(Kg/M)	TOTAL WT.(Kg)
INTERME - DIATE X-GIRDER	1	A	R 25	3	2A	9720	75				9870	3	29.610	3.853	114.08
		B	R 25	12	01	2010					2010	12	24.120	3.853	92.93
		B1	R 25	9	01	1050					1050	9	9.450	3.853	36.41
		B2	R 25	6	03	475	200				675	6	4.050	3.853	15.60
		C	R 12	32	01	1710					1710	32	54.720	0.888	48.59
		C1	R 12	24	01	1050					1050	24	25.200	0.888	22.38
		C2	R 12	16	03	525	200				725	16	11.600	0.888	10.30
		D	R 10	48	04	1650	220	150			3990	48	191.52	0.617	118.17
											Sub-Total of Intermediate X-girder				458.46
END X-GIRDER	1	A	R 25	4	2A	9720	75				9870	4	39.480	3.853	152.12
		B	R 25	16	01	2010					2010	16	32.160	3.853	123.91
		B1	R 25	12	01	1550					1550	12	18.600	3.853	71.67
		B2	R 25	8	03	725	200				925	8	7.400	3.853	28.51
		C	R 12	32	01	1210					1210	32	38.720	0.888	34.38
		C1	R 12	24	01	1550					1550	24	37.200	0.888	33.03
		C2	R 12	16	03	725	300				1025	16	16.400	0.888	14.56
		D	R 10	36	04	1700	270	75			4015	36	144.54	0.617	89.18
											Sub-Total of End X-girder				547.36

TOTAL WT. OF STEEL(M.TON) FOR ONE END & ONE MID GIRDER = 1.00

SHAPE CODE	01	01A	02	02A	02B	03	04	05	06
SHAPE OF BARS	a	b a	b a	c b a	b a	a b	b a	b c a	a c b

NAME OF THE CLIENT :
GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH
LOCAL GOVERNMENT ENGINEERING DEPARTMENT

NAME OF THE PROJECT :
CONSULTANCY SERVICES FOR FEASIBILITY, DETAILED SURVEY AND DESIGN OF CHITTAGONG HILL TRACT CONNECTIVITY CONNECTING THEGAMUKH AND CHITTAGONG PORT.

NAME OF THE CONSULTANTS :
SAI Consulting Engineers Pvt. Ltd, India.
in association with
BETS Consulting Services Ltd, Bangladesh
Project office :
Tahmid Mahmood Palace
Flat # 9A, House # 77, Road # 4, Block-C,

DRAWING TITLE :
REINF. DETAILS OF X-GIRDER FOR 26.0m SPAN

DRAWING NO : LGED/PCG-26/XG-06

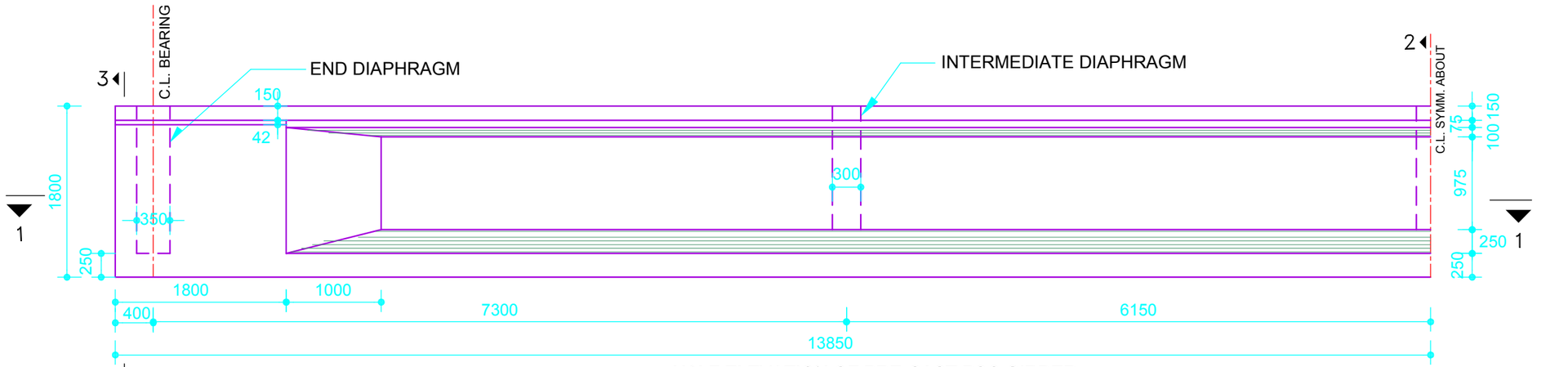
Scale :As shown

Date : 28-01-16

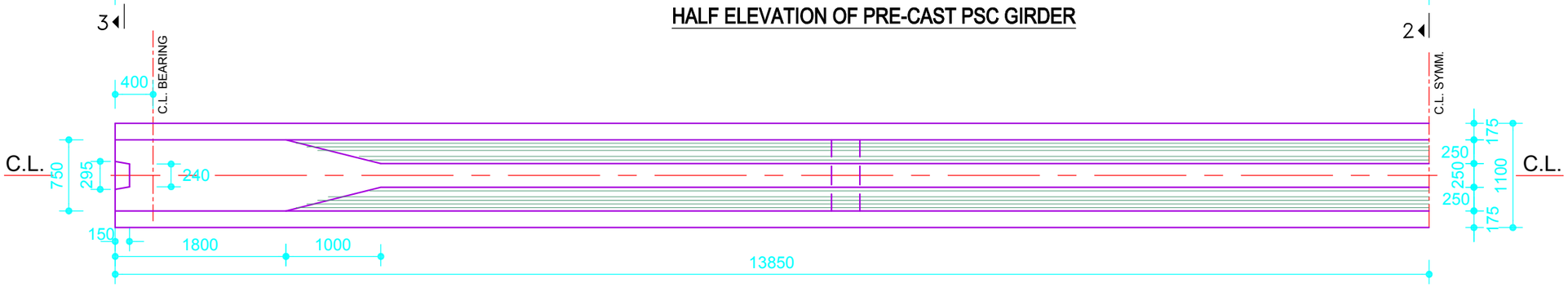
DESIGNED BY :	DESIGNED BY :	CHECKED BY :	APPROVED BY :
MD. TAZUDDIN	MD. TAZUDDIN	AFM HAMIDUL HAQUE	DR. PRABHAT SHRIVASTAVA

REV.	DESCRIPTION	DAT

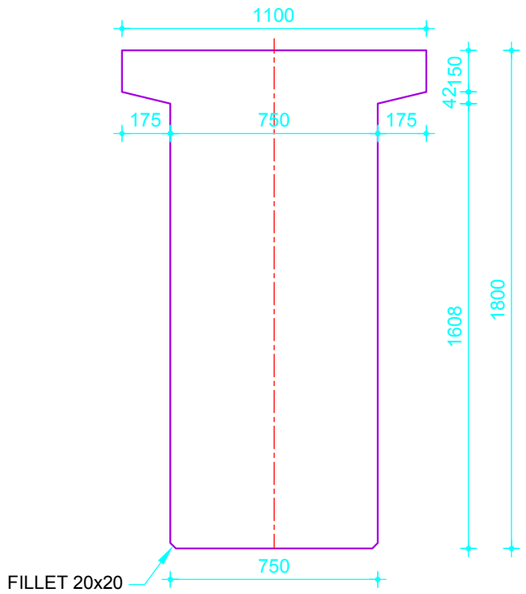
TYPICAL PSC GIRDER



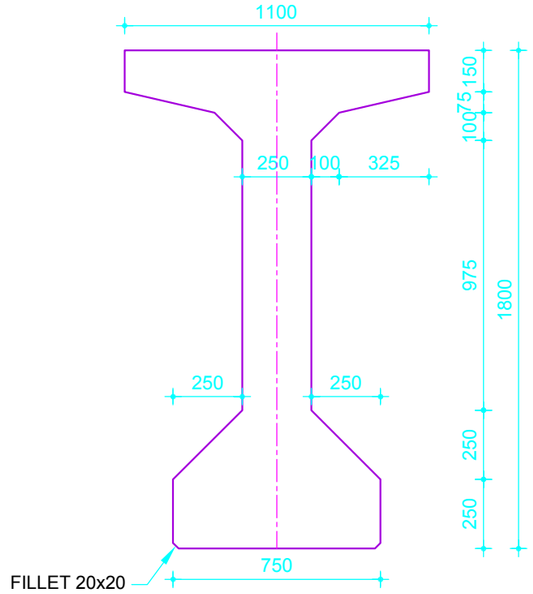
HALF ELEVATION OF PRE-CAST PSC GIRDER



SECTIONAL VIEW OF PRE-CAST PSC GIRDER (SECTION 1-1)



SECTION 3-3 AT END



SECTION 2-2 AT MIDDLE

NOTES:

1. CONCRETE SHALL HAVE SPECIFIED CHARACTERISTIC COMPRESSIVE STRENGTH OF STANDARD CYLINDER OR CUBE (15 cm) AT 28 DAYS, ARE AS FOLLOWS(15 cm) AT 28 DAYS, ARE AS FOLLOWS:
   a) STANDARD CYLINDER CRUSHING STRENGTH, f'c = 35 N/mm²
   b) STANDARD CUBE CRUSHING STRENGTH, fcu = 43 N/mm²
2. REINFORCING STEEL SHALL CONFORM TO ASTM A615-87 GRADE 6 DEFORMED BARS (MARKED 'Y') HAVING MINIMUM YEILD STRENGT Fy = 413 N/mm²
3. PRESTRESSING STEEL SHALL BE OF 12.7mm DIA. 7 PLY UNCOATE LOW RELAXATION STRAND CONFORMING TO AASHTO-M203 (GRADE-270) OR EQUIVALENT HAVING THE FOLLOWING STRENGTH:
   (a) MINIMUM ULTIMATE TENSILE STRENGTH (UTS) f 's = 1861 N/mm (183.7 KN PER STRAND)
   (b) MINIMUM YIELD STRENGTH f 'y = 1674 N/mm² (165.3 KN PER STRAND)
4. PPRESTRESSING CABLE SHALL CONSISTS OF 12 NOS.12.7mm DIA. STRAND (12T13) IN A SHEATHING/DUCT
5. FOLLOWING PROPERTIES HAVE BEEN CONSIDERED IN THE DESIGN
   AREA OF STRAND = 98.7 mm²
   AREA OF CABLE = 1184.4 mm²
   MODULLES OF ELASTICITY OF STRAND =1.97x10 ^{5} (N/mm ^{2})
   AVERAGE SLIP = 6mm
   JACKING FORCE IN EACH CABLE = 1680 KN.

NAME OF THE CLIENT :
GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH
LOCAL GOVERNMENT ENGINEERING DEPARTMENT

NAME OF THE PROJECT :
CONSULTANCY SERVICES FOR FEASIBILITY, DETAILED SURVEY AND DESIGN OF CHITTAGONG HILL TRACT CONNECTIVITY CONNECTING THEGAMUKH AND CHITTAGONG PORT.

NAME OF THE CONSULTANTS :
SAI Consulting Engineers Pvt. Ltd, India.
in association with
BETS Consulting Services Ltd, Bangladesh
Project office :
Tahmid Mahmood Palace
Flat # 9A, House # 77, Road # 4, Block-C,
Banani, Dhaka-1213, Bangladesh.

DRAWING TITLE :
28.0m LONG PC GIRDER CONCRETE OUTLINE DETAILS

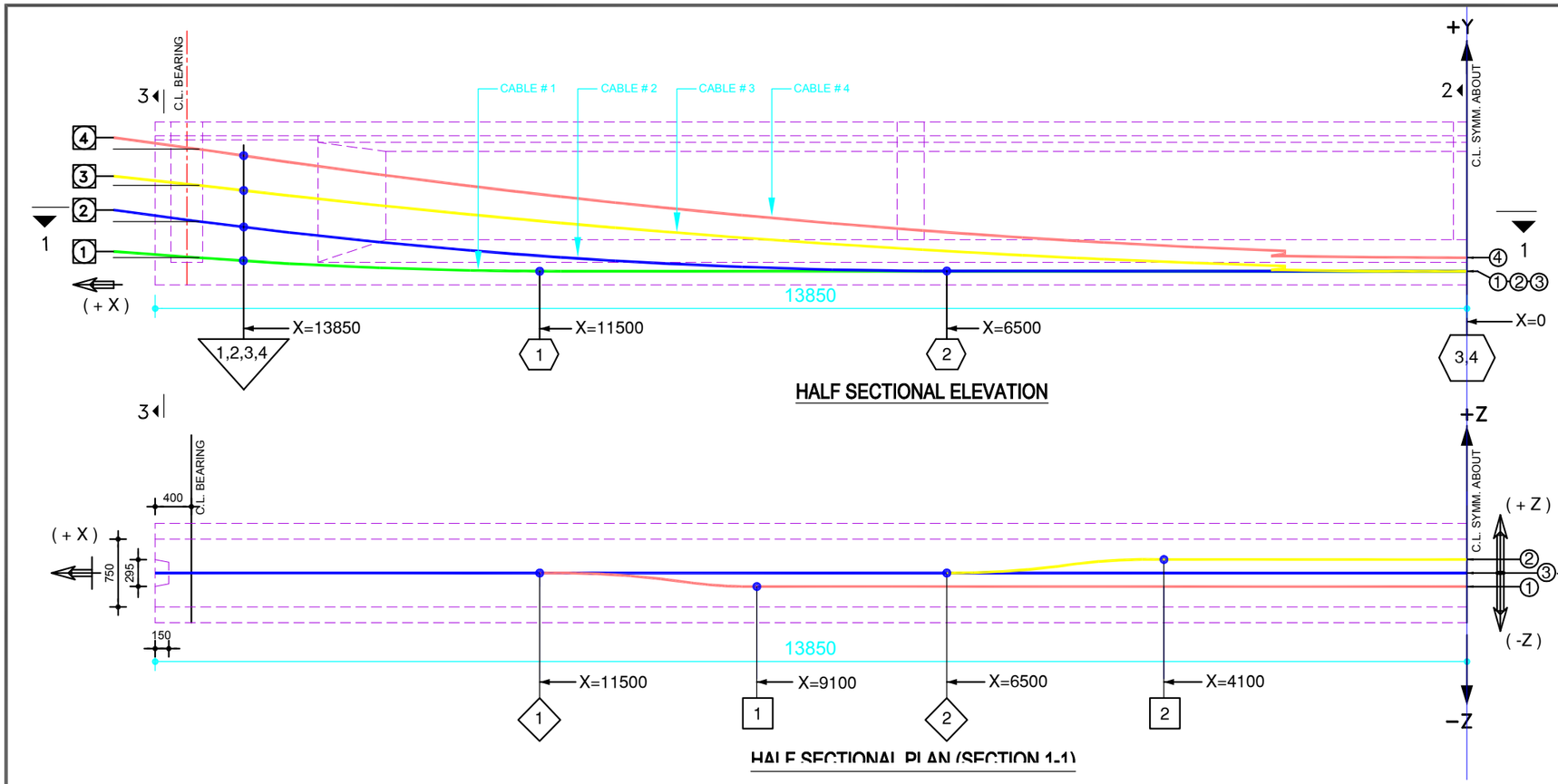
DRAWING NO : LGED/PCG-28/CON-01

Scale :As shown

Date : 28-01-16

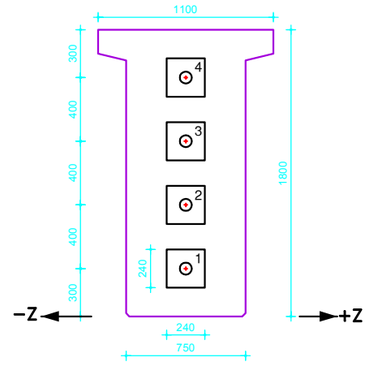
DESIGNED BY :	DRAWN BY :	CHECKED BY :	APPROVED BY :
MD. TAZUDDIN	MD. TAZUDDIN	AFM HAMIDUL HAQUE	DR. PRABHAT SHRIVASTAVA

REV.	DESCRIPTION	DATE

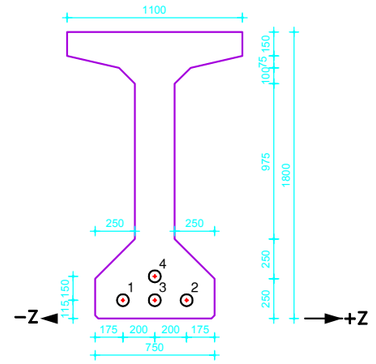


HALF SECTIONAL ELEVATION

HALF SECTIONAL PLAN (SECTION 1-1)



SECTION 3-3
(END SECTION)



SECTION 2-2
(MID SECTION)

Cable No.	ORDINATE AT DISTANCE X FROM CENTER																				Extension at each jecking end	Emergence angle
	13850		13500		13000		12500		12000		11500		10300		9100		8500		8000		7500			
	Y	Z	Y	Z	Y	Z	Y	Z	Y	Z	Y	Z	Y	Z	Y	Z	Y	Z	Y	Z	Y	Z		
1	300		259		211		177		157		150		150		150		150		150		150		96.69	1.24
2	700		649		580		517		458		405		297		219		191		173		160		97.06	4.53
3	1100		1053		987		924		863		805		675		560		508		467		429		97.87	7.76
4	1500		1440		1357		1277		1201		1127		964		818		752		700		652		98.59	9.73
1		0		0		0		0		0		0		-75.0		-150		-150		-150		-150		
2		0		0		0		0		0				0		0		0		0		0		

Cable No.																						Extension at each jecking end	Emergence angle
	7000		6500		5300		4100		3500		3000		2500		2000		1500		1000		0			
	Y	Z	Y	Z	Y	Z	Y	Z	Y	Z	Y	Z	Y	Z	Y	Z	Y	Z	Y	Z	Y	Z		
1	150		150		150		150		150		150		150		150		150		150		150		96.69	1.24
2	153		150		150		150		150		150		150		150		150		150		150		97.06	4.53
3	393		359		289		233		211		195		181		170		161		155		150		97.87	7.76
4	607		564		476		405		377		356		339		325		314		306		300		98.59	9.73
1		-150		-150		-150		-150		-150		-150		-150		-150		-150		-150		-150		
2		0		0		75.0		150		150		150		150		150		150		150		150		

LEGEND:

- INDICATES START OF CURVE IN ELEVATION
- INDICATES END OF CURVE IN ELEVATION
- INDICATES START OF CURVE IN PLAN
- INDICATES END OF CURVE IN PLAN
- INDICATES END OF CABLE
- INDICATES CABLE NUMBER

NAME OF THE CLIENT :
GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH
LOCAL GOVERNMENT ENGINEERING DEPARTMENT

NAME OF THE PROJECT :
CONSULTANCY SERVICES FOR FEASIBILITY, DETAILED SURVEY AND DESIGN OF CHITTAGONG HILL TRACT CONNECTIVITY CONNECTING THEGAMUKH AND CHITTAGONG PORT.

NAME OF THE CONSULTANTS :
SAI Consulting Engineers Pvt. Ltd, India.
in association with
BETS Consulting Services Ltd, Bangladesh
Project office :
Tahmid Mahmood Palace
Flat # 9A, House # 77, Road # 4, Block-C,

DRAWING TITLE :
28.0m LONG PC GIRDER PRE-STRESSING CABLE DETAILS

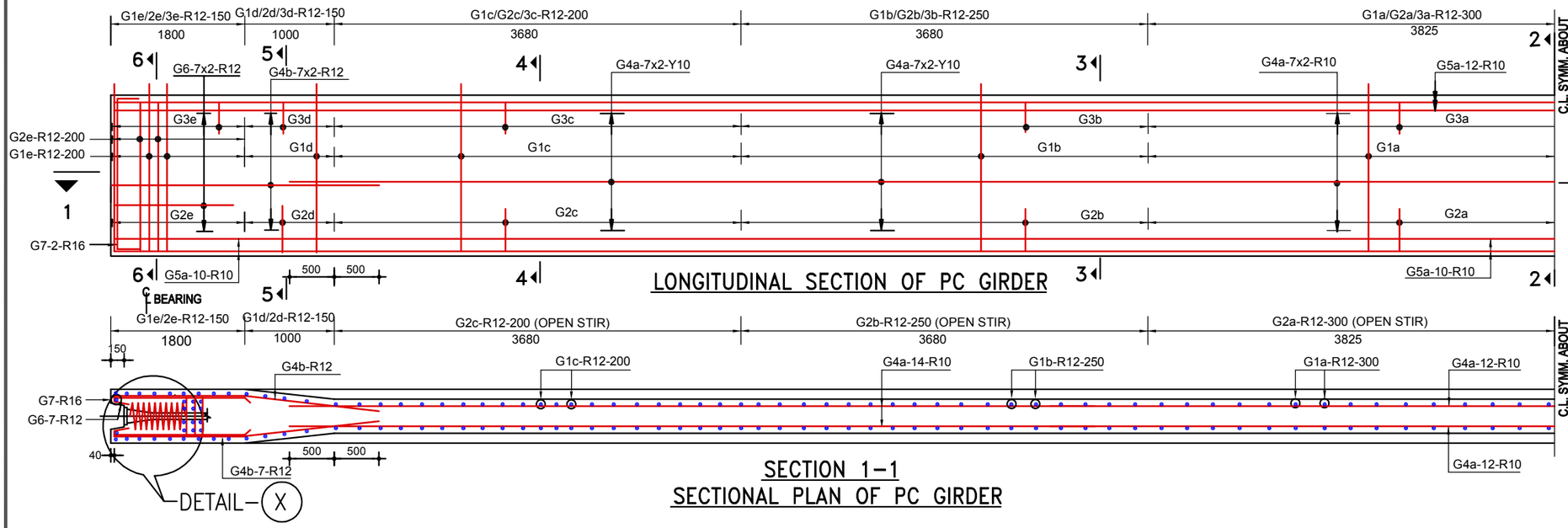
DRAWING NO : LGED/PCG-28/CAB-02

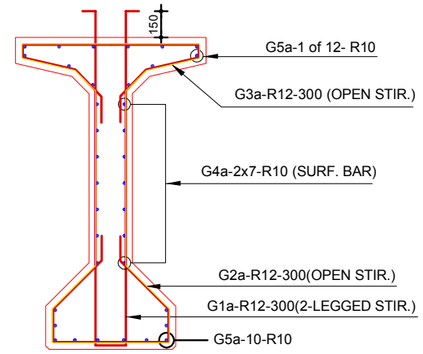
Scale :As shown

Date : 28-01-16

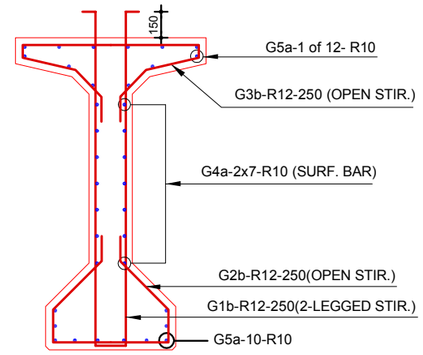
DESIGNED BY :	DRAWN BY :	CHECKED BY :	APPROVED BY :
MD. TAZUDDIN	MD. TAZUDDIN	AFM HAMIDUL HAQUE	DR. PRABHAT SHRIVASTAVA

REV.	DESCRIPTION	DATE





SECTION 2-2
(MID SECTION)



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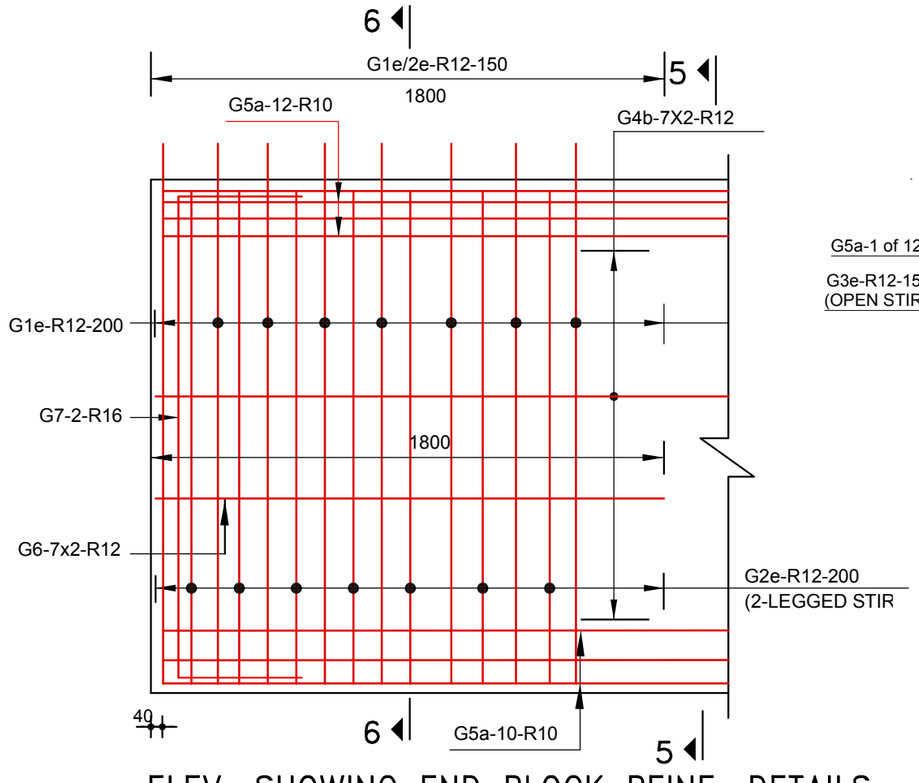
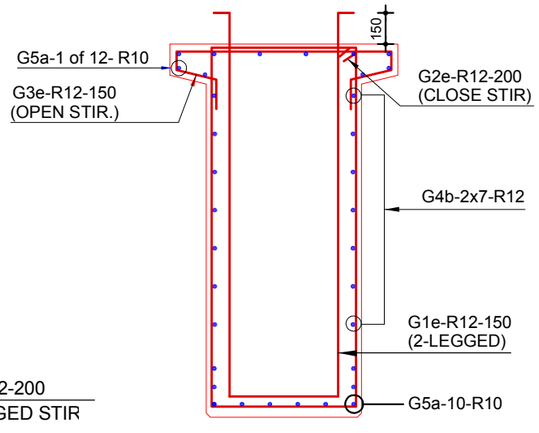


ELEV. SHOWING END BLOCK REINF. DETAILS



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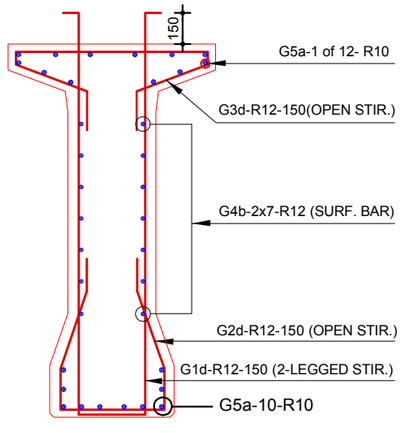

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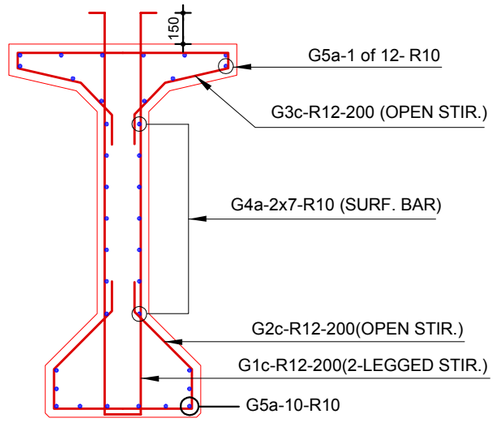


SECTION 4-4
(MID SECTION)

NAME OF THE CLIENT :
GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH
LOCAL GOVERNMENT ENGINEERING DEPARTMENT

NAME OF THE PROJECT :
CONSULTANCY SERVICES FOR FEASIBILITY, DETAILED SURVEY AND DESIGN OF CHITTAGONG HILL TRACT CONNECTIVITY CONNECTING THEGAMUKH AND CHITTAGONG PORT.

NAME OF THE CONSULTANTS :
SAI Consulting Engineers Pvt. Ltd, India.
in association with
BETS Consulting Services Ltd, Bangladesh
Project office :
Tahmid Mahmood Palace
Flat # 9A, House # 77, Road # 4, Block-C,

DRAWING TITLE :
28.0m LONG PC GIRDER NON-PRE STRESSING REINFORCEMENT

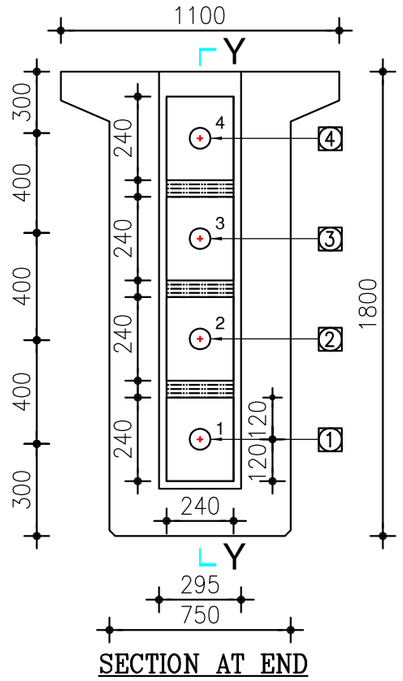
DRAWING NO : LGED/PCG-28/RNF.-03

Scale :As shown

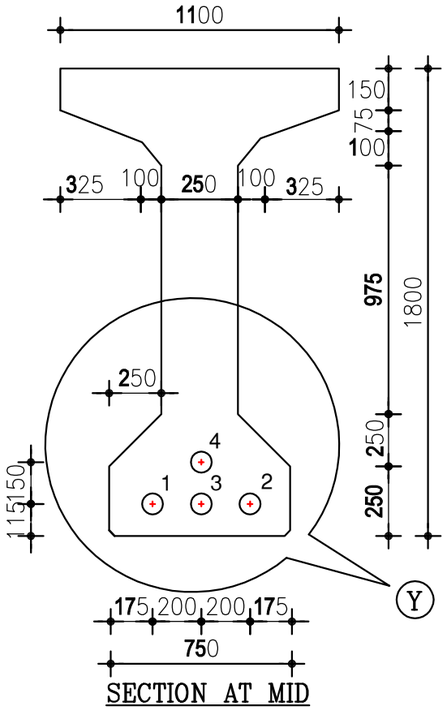
Date : 28-01-16

DESIGNED BY :	DRAWN BY :	CHECKED BY :	APPROVED BY :
MD. TAZUDDIN	MD. TAZUDDIN	AFM HAMIDUL HAQUE	DR. PRABHAT SHRIVASTAVA

REV.	DESCRIPTION	DATE



SECTION AT END

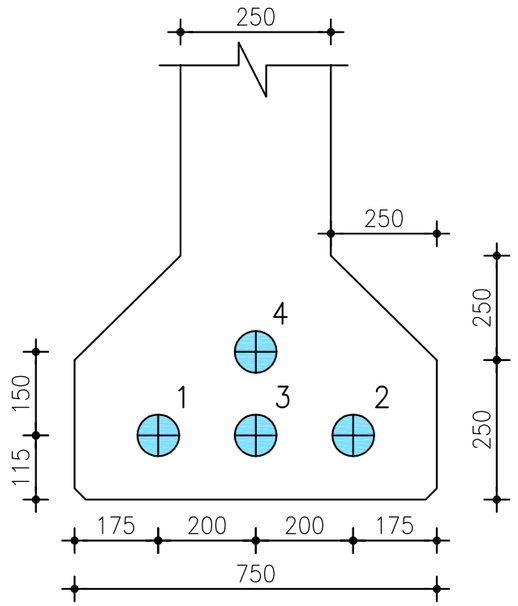


SECTION AT MID

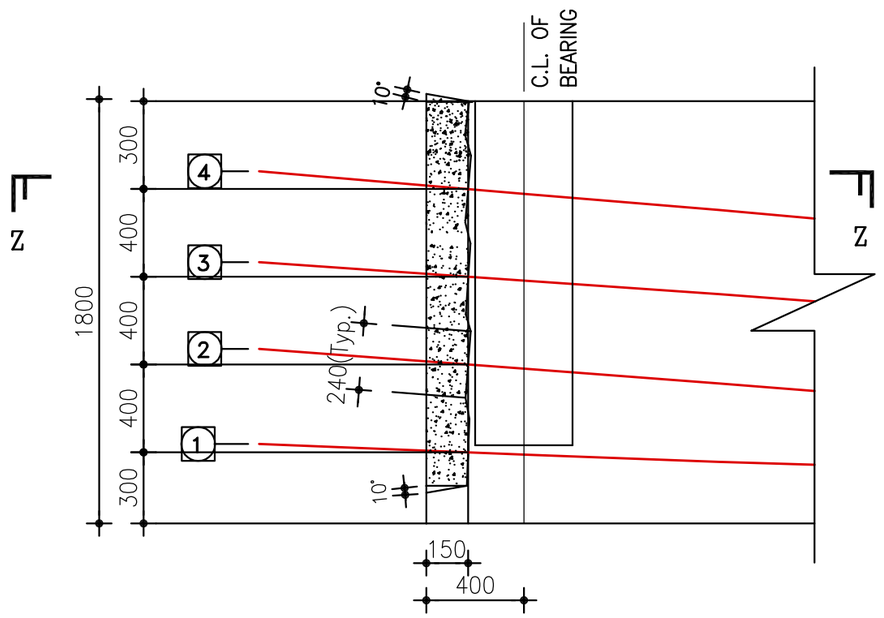
NOTES:

STAGES AND SEQUENCE OF PRESTRESSING

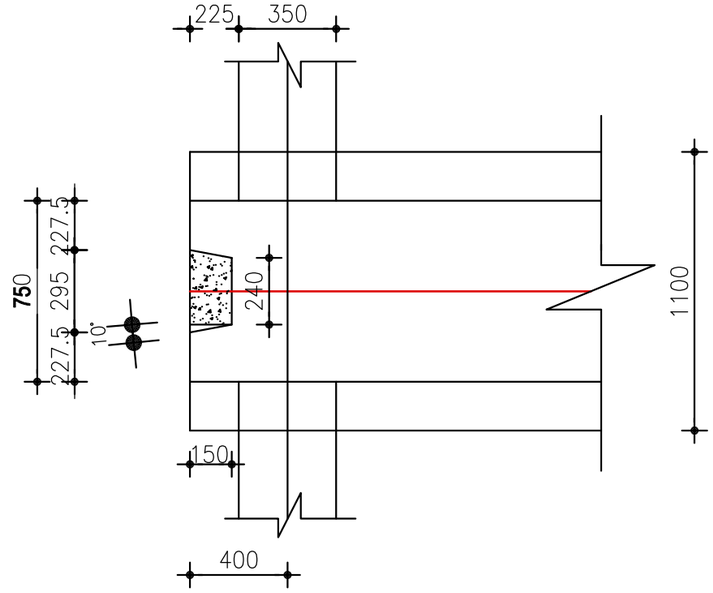
1. EACH CABLE SHALL BE STRESSED SIMULTANEOUSLY FROM BOTH ENDS. THE JACKING FORCE IN EACH CABLE SHALL BE 1680 KN TO BE IMPARTED SIMULTANEOUSLY AT BOTH ENDS.
2. THE SEQUENCE OF STRESSING OF PRESTRESSING CABLES SHALL BE AS FOLLOWS: 3, 2,1 & 4
3. STRESSING OF CABLES SHALL BE DONE MINIMUM AFTER 14 DAYS OR CONCRETE STRENGTH NOT LESS THAN 26N/mm^2 WHICHEVER IS LATER.
4. THE EXTENSION SHOWN IN THE TABLE IS FOR THE PORTION OF CABLES LYING BETWEEN MID SPAN AND RECESS FACE OF THE GIRDER. ADDITIONAL ELONGATION FOR GRIPPING LENGTH MUST BE ADDED DURING TENSIONING.
5. EACH CABLES CONSISTS OF 12 NOS. 12.7mm DIA. (12T13) 7-PLY UNCOATED LOW RELAXATION STRANDS.
6. FOR OTHER REQUIREMENTS REFER GENERAL NOTES FOR PC GIRDER : S-02
7. THE CONTRACTOR SHALL SUBMIT DETAILS SHOP DRAWING FOR PC GIRDER'S FORMWORK AND SCAFFOLDING SYSTEM AND GET IT APPROVED BY CONCERNED XEN.
8. THE FORMWORK OF PC GIRDER MUST BE MADE OF M.S. SHEET HAVING THICKNESS 12BWG WITH NECESSARY BRACING.



DETAIL Ⓨ



DETAILS OF END BLOCK

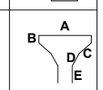
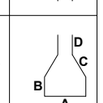
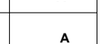
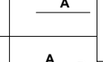
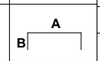
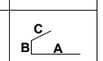
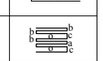


SECTION Z–Z

NAME OF THE CLIENT : GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH **LOCAL GOVERNMENT ENGINEERING DEPARTMENT**	NAME OF THE CONSULTANTS : **SAI Consulting Engineers Pvt. Ltd, India.** in association with **BETS Consulting Services Ltd, Bangladesh** Project office : Tahmid Mahmood Palace Flat # 9A, House # 77, Road # 4, Block-C,	DRAWING TITLE : END BLOCK DETAILS OF 28.0m LONG PC GIRDER	DESIGNED BY : MD. TAZUDDIN	DRAWN BY : MD. TAZUDDIN
NAME OF THE PROJECT : CONSULTANCY SERVICES FOR FEASIBILITY, DETAILED SURVEY AND DESIGN OF CHITTAGONG HILL TRACT CONNECTIVITY CONNECTING THEGAMUKH AND CHITTAGONG PORT.		DRAWING NO : LGED/PCG-28/EBL-04 Scale :As shown Date : 28-01-16	CHECKED BY : AFM HAMIDUL HAQUE	APPROVED BY : DR. PRABHAT SHRIVASTAVA

REV.	DESCRIPTION	DATE

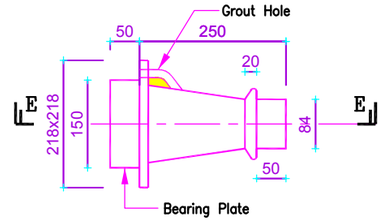
BAR BENDING SCHEDULE OF NON-PRESTRESSED REINF. (FOR ONE GIRDER, 28.0m)

SHAP CODE	BAR SHAPE	ITEM	NO.	BAR MARK	BAR TYPE & DIA (mm)	NO. OF BAR	SHAPE CODE	BENDING DIMENSIONS(MM) A	B	C	D	E	F	G	CUT LENGTH(MM)	TOTAL NO. OF BARS	TOTAL LENGTH(M)	UNIT WT. OF BAR(Kg/M)	TOTAL WT.(Kg)
1		PC GIRDER	45	G1a	R 12	26	1	170	1910	200					4350	26	113.100	0.888	100.41
				G1b	R 12	30	1	170	1910	200					4350	30	130.500	0.888	115.86
				G1c	R 12	38	1	170	1910	200					4560	38	173.280	0.888	153.84
2				G1d	R 12	14	1	420	1910	200					4640	14	64.960	0.888	57.67
				G1e	R 12	24	1	670	1910	200					4890	24	117.360	0.888	104.19
				G2a	R 12	26	2A	670	197	400	200				2264	26	58.864	0.888	52.26
				G3a	R 12	26	2	1020	78	313	216	200			2634	26	68.480	0.888	60.80
2A				G2b	R 12	30	2A	670	197	400	200				2264	30	67.920	0.888	60.30
				G3b	R 12	30	2	1020	78	313	216	200			2234	30	67.020	0.888	59.50
				G2c	R 12	38	2A	670	197	400	200				2264	38	86.020	0.888	76.38
				G3c	R 12	38	2	1020	78	313	216	200			2234	38	84.892	0.888	75.37
				G2d	R 12	14	2A	670	197	400	200				2269	14	31.766	0.888	28.20
				G3d	R 12	14	2	1020	78	313	216	200			2234	14	31.276	0.888	27.77
3				G2e	R 12	24	3	670	1720	200					5180	24	124.320	0.888	110.37
				G3e	R 12	36	2	1020	78	313	216				2234	36	80.424	0.888	71.40
				G4a	R 10	14	4	23370							23370	14	327.180	0.617	201.72
				G4b	R 12	28	5	1700	1521						3221	28	90.179	0.888	80.06
4				G5a	R 10	12	4	27270							27270	12	335.664	0.617	206.95
				G5a	R 10	10	4	27270							27270	10	279.720	0.617	172.46
				G6	R 12	28	6	1700	150						3700	28	103.600	0.888	91.98
5				G7	R 16	4	7	1720	100						1920	4	7.680	1.578	12.12
		MESH	45	m1	R 12	6	8	9900	450	7560	1350				19260	6	115.560	0.888	102.60
6				m2	R 8	2	8	3000	450	3000	450				6900	2	13.800	0.395	5.45
		Spiral	45	S1	R 12	2	03	7295							7295	2	14.590	0.888	12.95
7																			
8																			

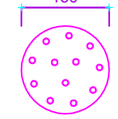
NB : BARBENDING SCHEDULE SHOULD BE CHECKED AT SITE BEFORE FABRICATION.

TOTAL WT.OF STEEL-Y16 (M.TON) = 0.01
TOTAL WT.OF STEEL-Y12 (M.TON) = 1.44
TOTAL WT.OF STEEL-Y10 (M.TON) = 0.58
TOTAL WT.OF STEEL-Y8 (M.TON) = 0.01

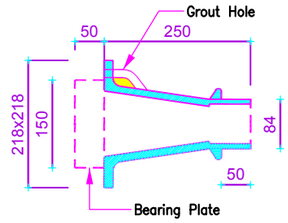
TOTAL WT. OF STEEL(M.TON) FOR ONE GIRDER = 2.04



Freyssinet Branded 12T13 Anchorage



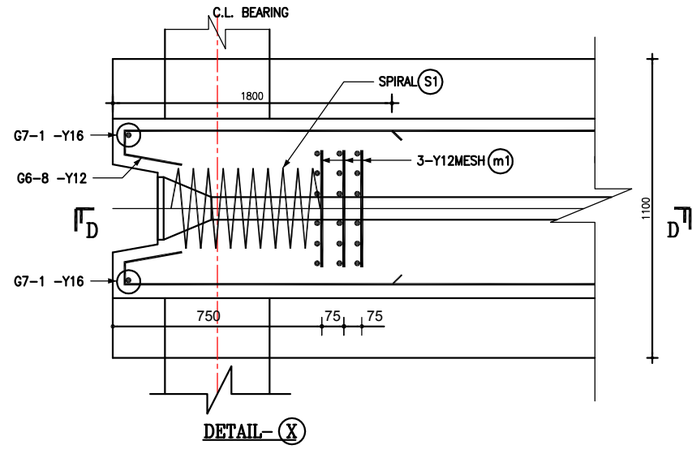
Bearing Plate



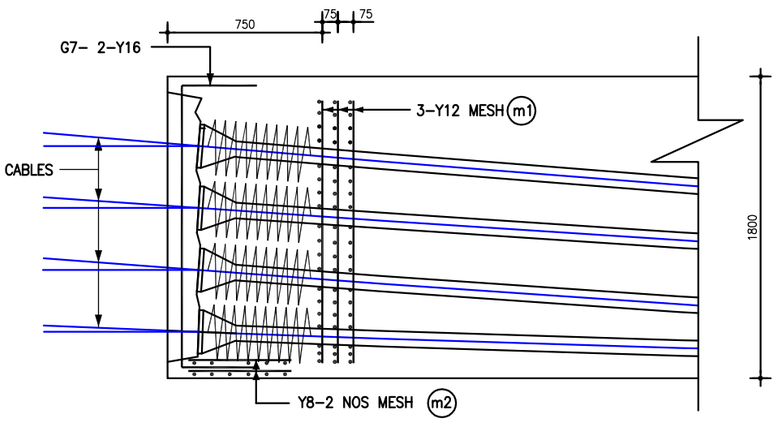
Section E-E

NOTES:

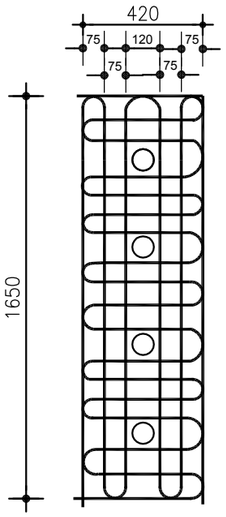
1. ANCHORAGE MUST BE TESTED TO CONFIRM ITS CAPACITY APPLYING 95% OF ULTIMATE LOAD (2205 KN) AS PER STANDARD SPECIFICATION PRIOR TO USE
2. HYDRAULIC JACKS FOR TENSIONING OPERATION MUST BE OF SAME BRANDED OF ANCHORAGE SYSTEM HAVING RECENT CALIBRATION
3. TENSIONING OPERATION SHALL BE CARRIED OUT IN PRESENCE OF AN EXPERIENCED ENGINEER OR AS DIRECTED BY THE DESIGN UNIT, LGED
4. THE PRE-STRESSING PARTY, IF SUBCONTRACTED, SHALL BE SELECTED TAKING PRIOR APPROVAL OF CONCERNED EXECUTIVE ENGINEER OR AS APPROVED BY DESIGN UNIT, LGED



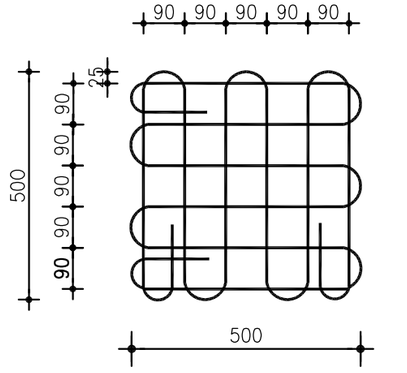
DETAIL- X



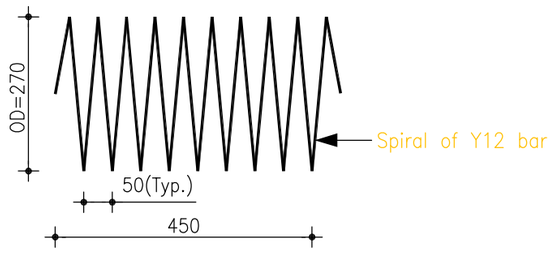
SECTION D-D



Y12 MESH REINFORCEMENT m1



Y8 MESH REINF. ABOVE BEARINGS m2

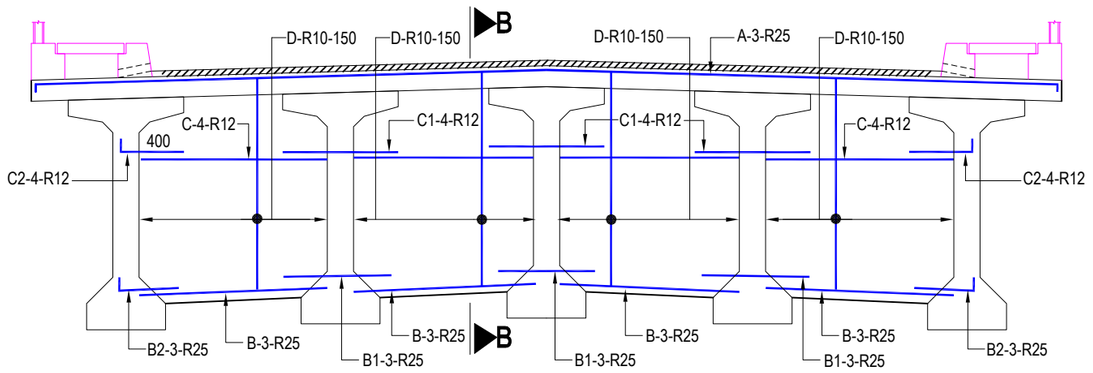


DETAILS OF SPIRAL S1

NAME OF THE CLIENT : GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH **LOCAL GOVERNMENT ENGINEERING DEPARTMENT**	NAME OF THE CONSULTANTS : **SAI Consulting Engineers Pvt. Ltd, India.** in association with **BETS Consulting Services Ltd, Bangladesh** Project office : Tahmid Mahmood Palace Flat # 9A, House # 77, Road # 4, Block-C,	DRAWING TITLE : TYPICAL PRE-STRESSING ANCHORAGE DETAILS FOR 28.0m LONG GIRDER	DESIGNED BY : MD. TAZUDDIN	DRAWN BY : MD. TAZUDDIN	CHECKED BY : AFM HAMIDUL HAQUE	APPROVED BY : DR. PRABHAT SHRIVASTAVA
NAME OF THE PROJECT : CONSULTANCY SERVICES FOR FEASIBILITY, DETAILED SURVEY AND DESIGN OF CHITTAGONG HILL TRACT CONNECTIVITY CONNECTING THEGAMUKH AND CHITTAGONG PORT.		DRAWING NO : LGED/PCG-28/ANC-05 Scale :As shown Date : 28-01-16				

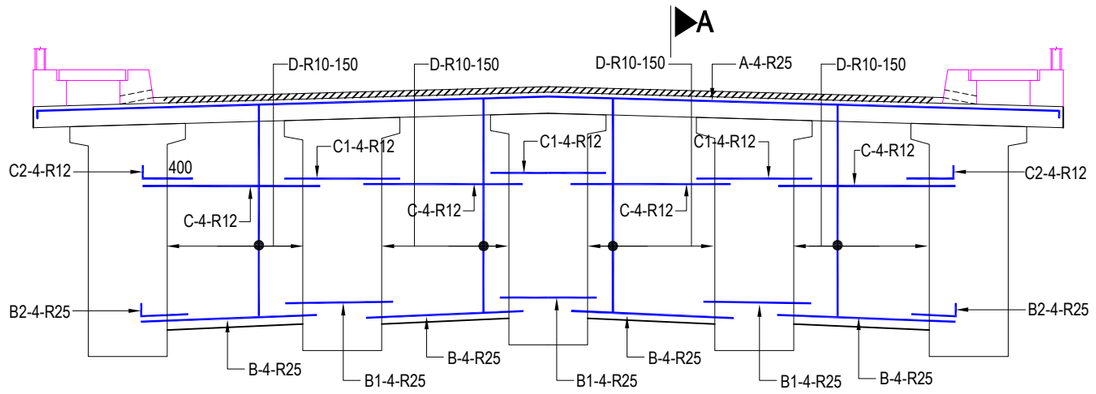
DESIGNED BY

REV.	DESCRIPTION	DATE



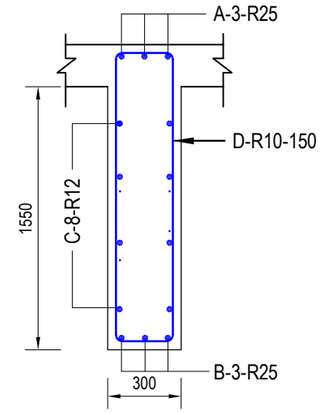
REINF. DETAILS OF INTER-MEDIATE X-GIRDER

(Scale : 1:60)



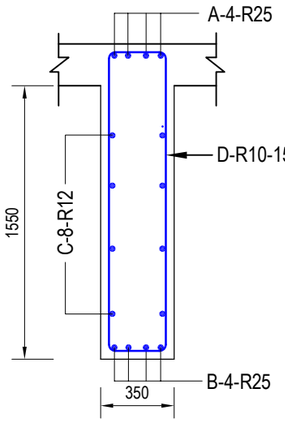
REINF. DETAILS OF END X-GIRDER

(Scale : 1:60)



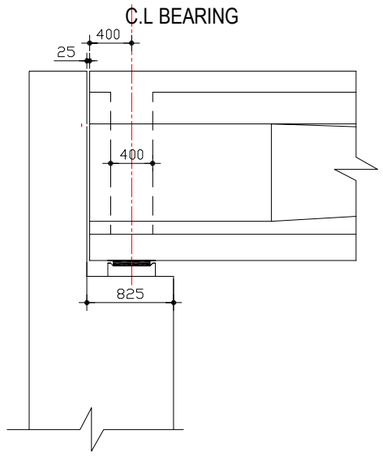
SEC. B-B (INTERMEDIATE X-GIRDER)

(Scale : 1:30)



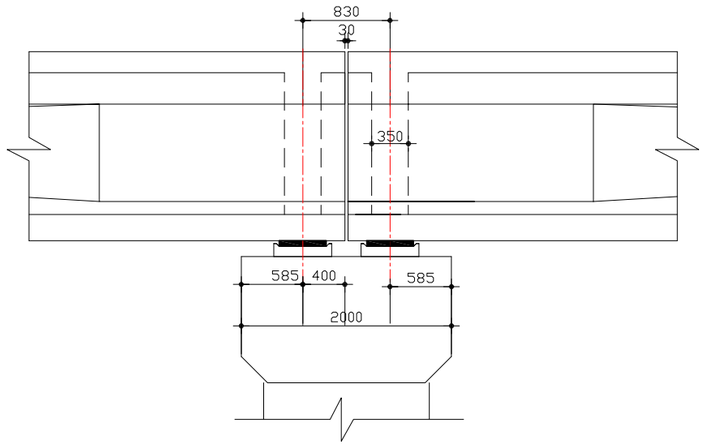
SEC. A-A (END X-GIRDER)

(Scale : 1:30)



SEC. B-B AT ABUTMENT END

(Scale : 1:75)



SEC. C-C AT COLUMN TYPE PIER END

(Scale : 1:75)

BAR BENDING SCHEDULE FOR INTERMEDIATE & END X-GIRDERE (33.00, whole span)

ITEM	NO.	BAR MARK	BAR TYPE & DIA (mm)	NO. OF BAR	SHAPE CODE	BENDING DIMENSIONS(MM) A	B	C	D	E	CUT LENGTH(MM)	TOTAL NO. OF BARS	TOTAL LENGTH(M)	UNIT WT. OF BAR(Kg/M)	TOTAL WT.(Kg)
INTERME - DIATE X-GIRDER	1	A	R 25	3	2A	9720	75				9870	3	29.610	3.853	114.08
		B	R 25	12	01	2010					2010	12	24.120	3.853	92.93
		B1	R 25	9	01	1050					1050	9	9.450	3.853	36.41
		B2	R 25	6	03	475	200				675	6	4.050	3.853	15.60
		C	R 12	32	01	1710					1710	32	54.720	0.888	48.59
		C1	R 12	24	01	1050					1050	24	25.200	0.888	22.38
		C2	R 12	16	03	525	200				725	16	11.600	0.888	10.30
		D	R 10	48	04	1650	220	150			3990	48	191.52	0.617	118.17
											Sub-Total of Intermediate X-girder				458.46
END X-GIRDER	1	A	R 25	4	2A	9720	75				9870	4	39.480	3.853	152.12
		B	R 25	16	01	2010					2010	16	32.160	3.853	123.91
		B1	R 25	12	01	1550					1550	12	18.600	3.853	71.67
		B2	R 25	8	03	725	200				925	8	7.400	3.853	28.51
		C	R 12	32	01	1210					1210	32	38.720	0.888	34.38
		C1	R 12	24	01	1550					1550	24	37.200	0.888	33.03
		C2	R 12	16	03	725	300				1025	16	16.400	0.888	14.56
		D	R 10	36	04	1700	270	75			4015	36	144.54	0.617	89.18
											Sub-Total of End X-girder				547.36

TOTAL WT. OF STEEL(M.TON) FOR ONE END & ONE MID GIRDER = 1.00

SHAPE CODE	01	01A	02	02A	02B	03	04	05	06
SHAPE OF BARS	a	b a	b a	c b a	b a	a b	b a	b c a	a c b

NAME OF THE CLIENT :
GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH
LOCAL GOVERNMENT ENGINEERING DEPARTMENT

NAME OF THE PROJECT :
CONSULTANCY SERVICES FOR FEASIBILITY, DETAILED SURVEY AND DESIGN OF CHITTAGONG HILL TRACT CONNECTIVITY CONNECTING THEGAMUKH AND CHITTAGONG PORT.

NAME OF THE CONSULTANTS :
SAI Consulting Engineers Pvt. Ltd, India.
in association with
BETS Consulting Services Ltd, Bangladesh
Project office :
Tahmid Mahmood Palace
Flat # 9A, House # 77, Road # 4, Block-C,

DRAWING TITLE :
REINF. DETAILS OF X-GIRDER FOR 28.0m SPAN

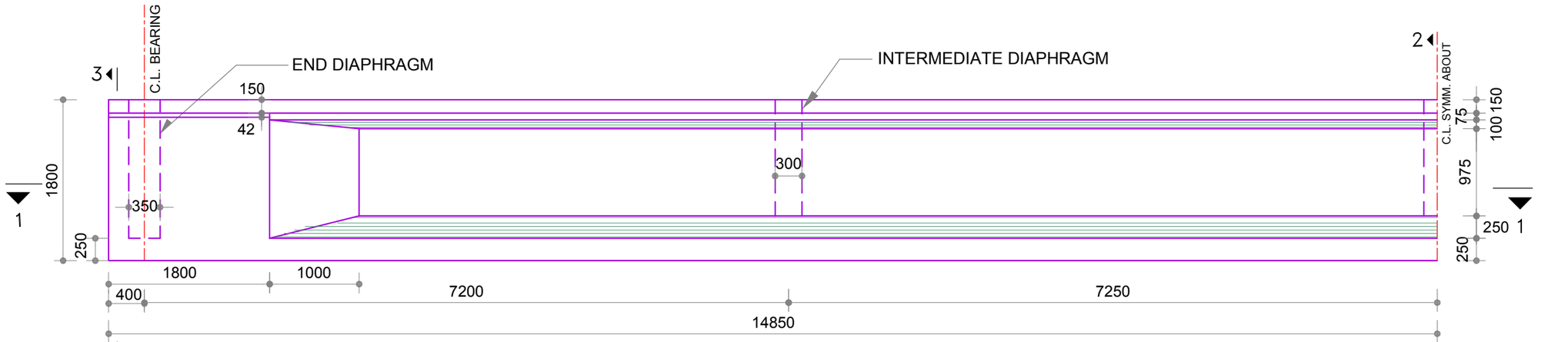
DRAWING NO : LGED/PCG-28/XG-06

Scale :As shown

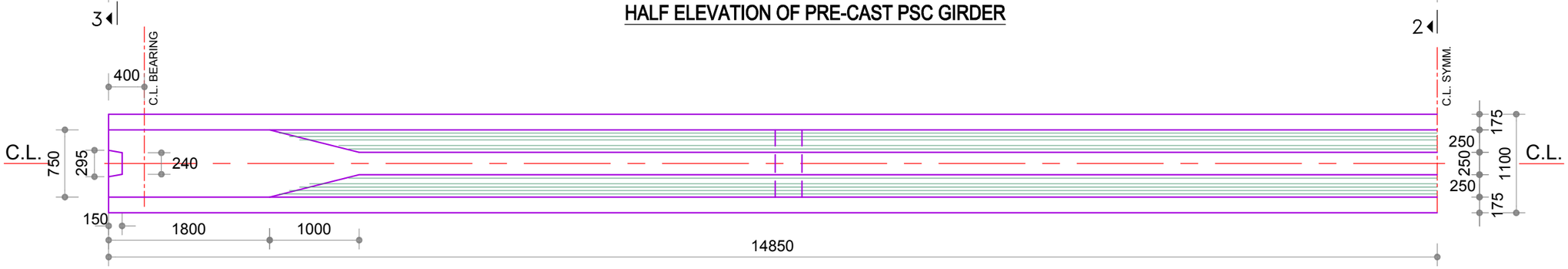
Date : 28-01-16

DESIGNED BY :	DESIGNED BY :	DRAWN BY :	CHECKED BY :	APPROVED BY :
MD. TAZUDDIN		MD. TAZUDDIN	AFM HAMIDUL HAQUE	DR. PRABHAT SHRIVASTAVA

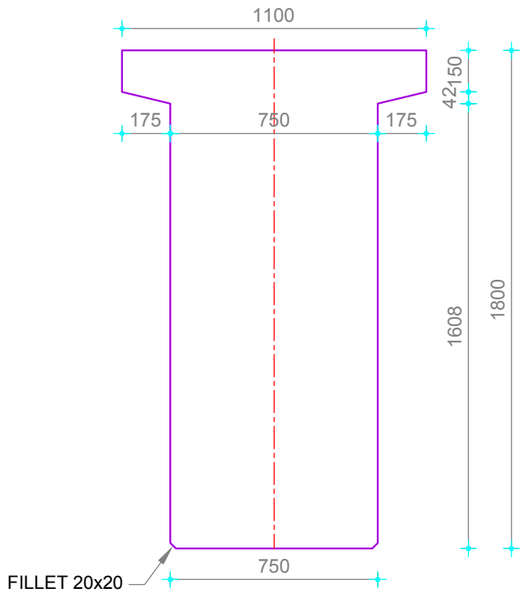
REV.	DESCRIPTION	DAT



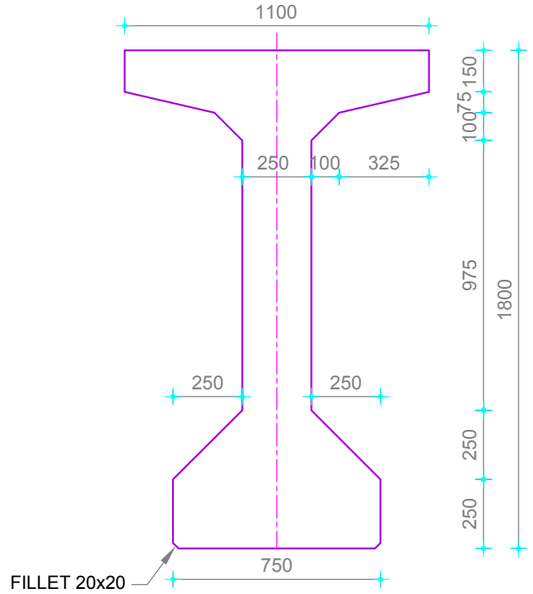
HALF ELEVATION OF PRE-CAST PSC GIRDER



SECTIONAL VIEW OF PRE-CAST PSC GIRDER (SECTION 1-1)



SECTION 3-3 AT END



SECTION 2-2 AT MIDDLE

NOTES:

1. CONCRETE SHALL HAVE SPECIFIED CHARACTERISTIC COMPRESSIVE STRENGTH OF STANDARD CYLINDER OR CUBE (15 cm) AT 28 DAYS, ARE AS FOLLOWS(15 cm) AT 28 DAYS, ARE AS FOLLOWS:
   a) STANDARD CYLINDER CRUSHING STRENGTH, f'c = 35 N/mm²
   b) STANDARD CUBE CRUSHING STRENGTH, fcu = 43 N/mm²
2. REINFORCING STEEL SHALL CONFORM TO ASTM A615-87 GRADE 6 DEFORMED BARS (MARKED 'Y') HAVING MINIMUM YEILD STRENGT Fy = 413 N/mm²
3. PRESTRESSING STEEL SHALL BE OF 12.7mm DIA. 7 PLY UNCOATE LOW RELAXATION STRAND CONFORMING TO AASHTO-M203 (GRADE-270) OR EQUIVALENT HAVING THE FOLLOWING STRENGTH:
   (a) MINIMUM ULTIMATE TENSILE STRENGTH (UTS) f 's = 1861 N/mm (183.7 KN PER STRAND)
   (b) MINIMUM YIELD STRENGTH f 'y = 1674 N/mm² (165.3 KN PER STRAND)
4. PPRESTRESSING CABLE SHALL CONSISTS OF 12 NOS.12.7mm DIA. STRAND (12T13) IN A SHEATHING/DUCT
5. FOLLOWING PROPERTIES HAVE BEEN CONSIDERED IN THE DESIGN
   AREA OF STRAND = 98.7 mm²
   AREA OF CABLE = 1184.4 mm²
   MODULLES OF ELASTICITY OF STRAND =1.97x10 ^{5} (N/mm ^{2})
   AVERAGE SLIP = 6mm
   JACKING FORCE IN EACH CABLE = 1680 KN.

NAME OF THE CLIENT :
GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH
LOCAL GOVERNMENT ENGINEERING DEPARTMENT

NAME OF THE PROJECT :
CONSULTANCY SERVICES FOR FEASIBILITY, DETAILED SURVEY AND DESIGN OF CHITTAGONG HILL TRACT CONNECTIVITY CONNECTING THEGAMUKH AND CHITTAGONG PORT.

NAME OF THE CONSULTANTS :
SAI Consulting Engineers Pvt. Ltd, India.
in association with
BETS Consulting Services Ltd, Bangladesh
Project office :
Tahmid Mahmood Palace
Flat # 9A, House # 77, Road # 4, Block-C,
Banani, Dhaka-1213, Bangladesh.

DRAWING TITLE :
30.0m LONG PC GIRDER CONCRETE OUTLINE DETAILS

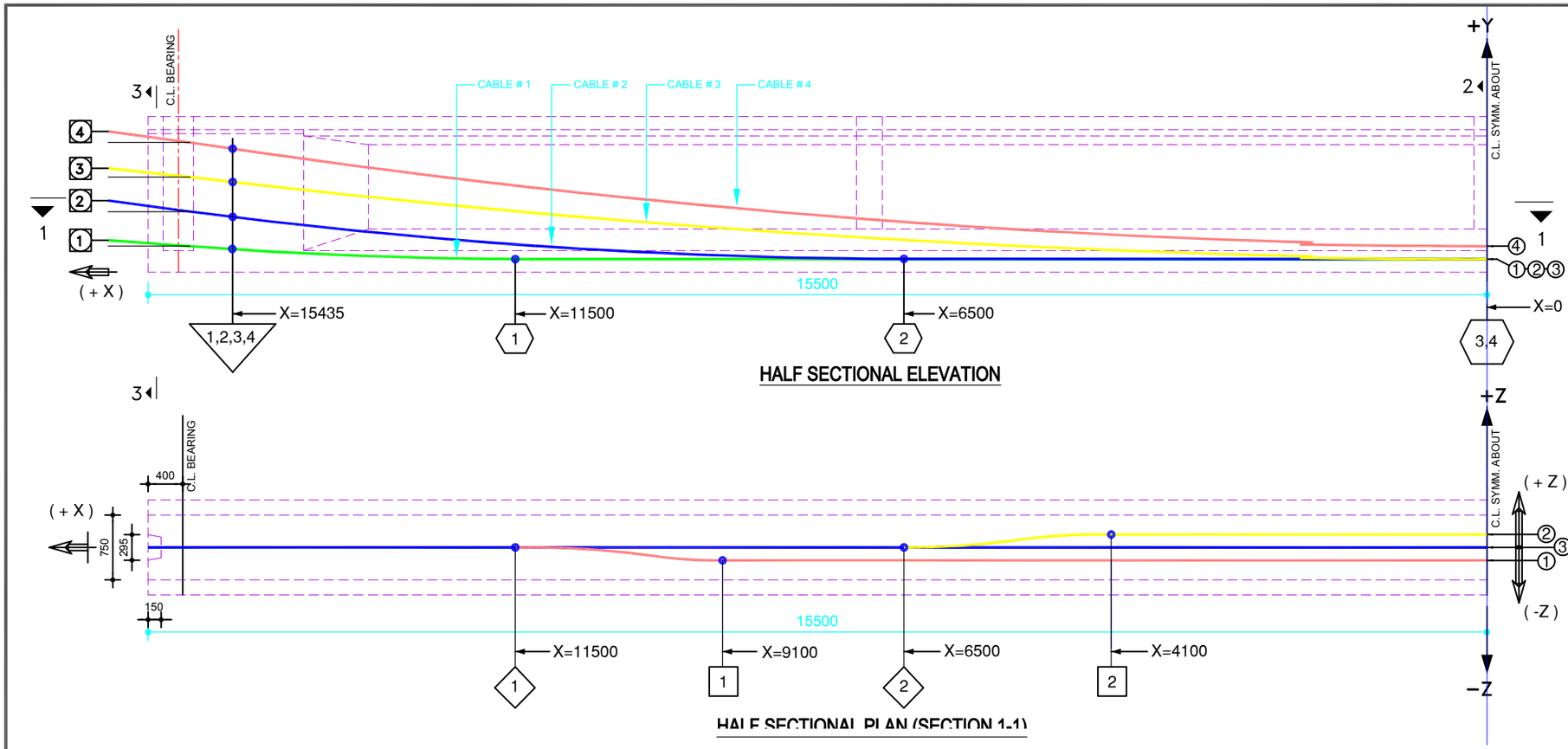
DRAWING NO : LGED/PCG-30/CON-01

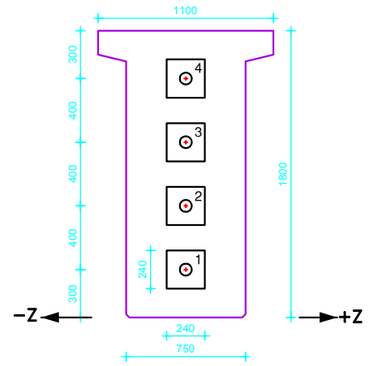
Scale :As shown

Date : 28-01-16

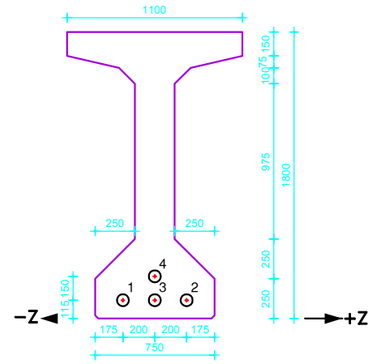
DESIGNED BY :	DESIGNED BY :	CHECKED BY :	APPROVED BY :
MD. TAZUDDIN	MD. TAZUDDIN	AFM HAMIDUL HAQUE	DR. PRABHAT SHRIVASTAVA

REV.	DESCRIPTION	DATE





SECTION 3-3
(END SECTION)



SECTION 2-2
(MID SECTION)

Cable No.	ORDINATE AT DISTANCE X FROM CENTER																				Extension at each jecking end	Emergence angle
	14850		13500		13000		12500		12000		11500		10300		9100		8500		8000		7500			
	Y	Z	Y	Z	Y	Z	Y	Z	Y	Z	Y	Z	Y	Z	Y	Z	Y	Z	Y	Z	Y	Z		
1	300		203		180		163		153		150		150		150		150		150		150		103.66	1.16
2	700		537		483		434		389		347		264		203		182		168		158		104.01	4.23
3	1100		935		878		823		770		720		607		507		461		426		392		104.77	7.25
4	1500		1292		1220		1150		1084		1020		877		751		693		648		606		105.44	9.10
1		0		0		0		0		0		0		-75.0		-150		-150		-150		-150		
2		0		0		0		0		0				0		0		0		0		0		

Cable No.																					Extension at each jecking end	Emergence angle
	7000		6500		5300		4100		3500		3000		2500		2000		1500		1000		0			
	Y	Z	Y	Z	Y	Z	Y	Z	Y	Z	Y	Z	Y	Z	Y	Z	Y	Z	Y	Z	Y	Z		
1	150		150		150		150		150		150		150		150		150		150		150		103.66	1.16
2	152		150		150		150		150		150		150		150		150		150		150		104.01	4.23
3	363		332		271		222		203		189		177		167		160		154		150		104.77	7.25
4	567		530		453		391		367		349		334		322		312		305		300		105.44	9.10
1		-150		-150		-150		-150		-150		-150		-150		-150		-150		-150		-150		
2		0		0		75.0		150		150		150		150		150		150		150		150		

LEGEND:

- INDICATES START OF CURVE IN ELEVATION
- INDICATES END OF CURVE IN ELEVATION
- INDICATES START OF CURVE IN PLAN
- INDICATES END OF CURVE IN PLAN
- INDICATES END OF CABLE
- INDICATES CABLE NUMBER

NAME OF THE CLIENT :
GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH
LOCAL GOVERNMENT ENGINEERING DEPARTMENT

NAME OF THE PROJECT :
CONSULTANCY SERVICES FOR FEASIBILITY, DETAILED SURVEY AND DESIGN OF CHITTAGONG HILL TRACT CONNECTIVITY CONNECTING THEGAMUKH AND CHITTAGONG PORT.

NAME OF THE CONSULTANTS :
SAI Consulting Engineers Pvt. Ltd, India.
in association with
BETS Consulting Services Ltd, Bangladesh
Project office :
Tahmid Mahmood Palace
Flat # 9A, House # 77, Road # 4, Block-C,

DRAWING TITLE :
30.0m LONG PC GIRDER PRE-STRESSING CABLE DETAILS

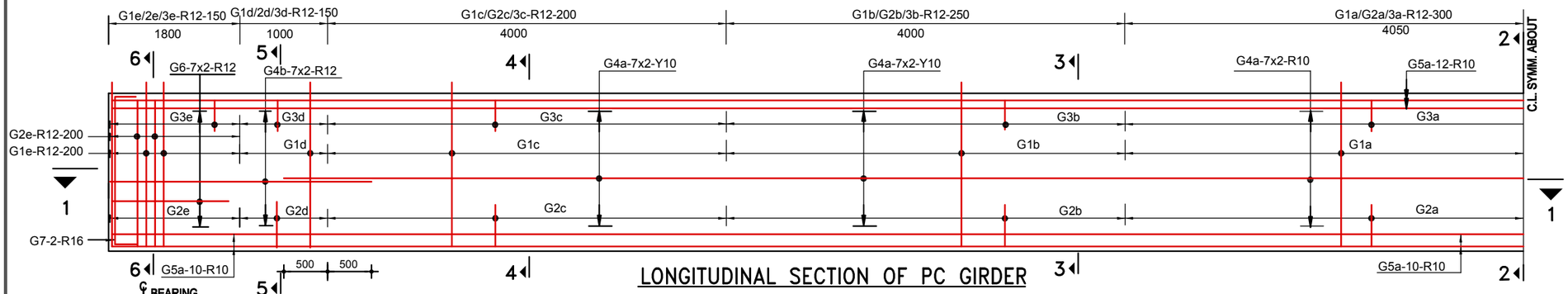
DRAWING NO : LGED/PCG-30/CAB-02

Scale :As shown

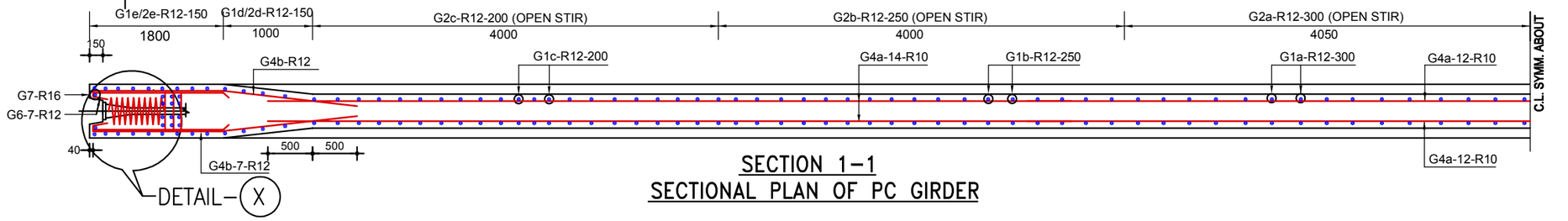
Date : 28-01-16

DESIGNED BY :	DESIGNED BY :	DRAWN BY :	CHECKED BY :	APPROVED BY :
MD. TAZUDDIN		MD. TAZUDDIN	AFM HAMIDUL HAQUE	DR. PRABHAT SHRIVASTAVA

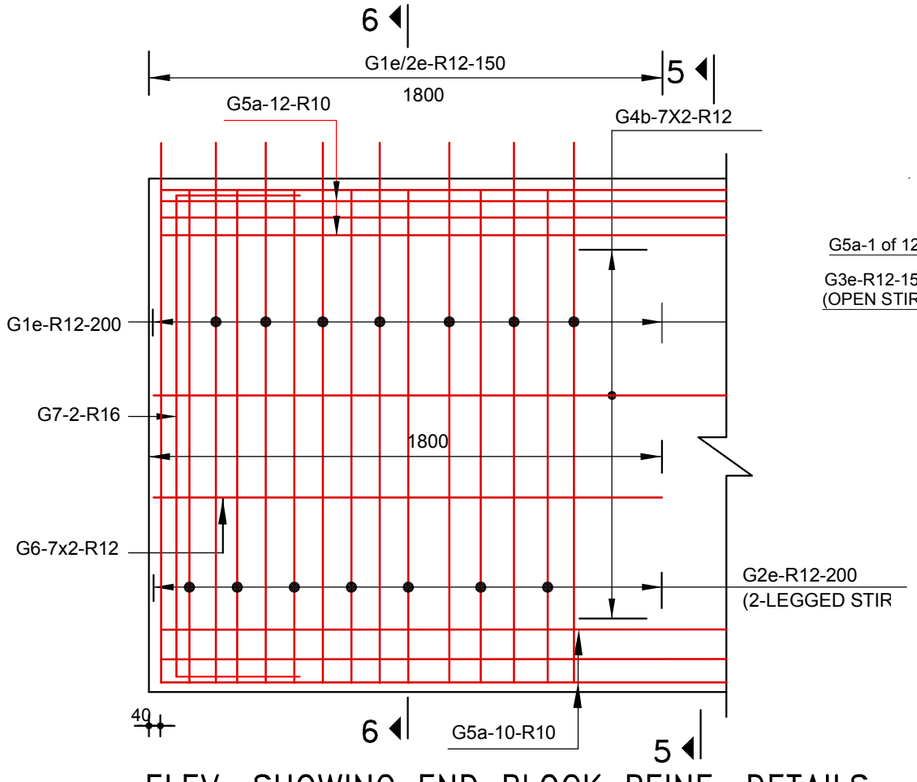
REV.	DESCRIPTION	DATE



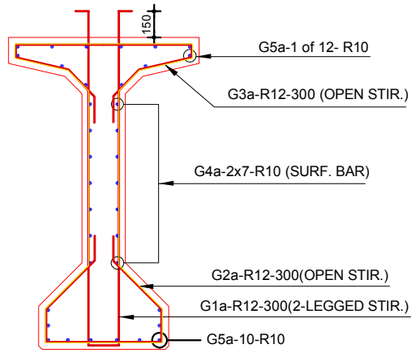
LONGITUDINAL SECTION OF PC GIRDER



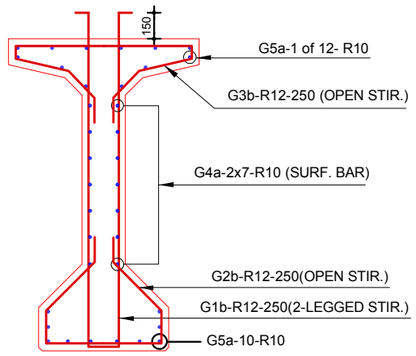
SECTION 1–1
SECTIONAL PLAN OF PC GIRDER



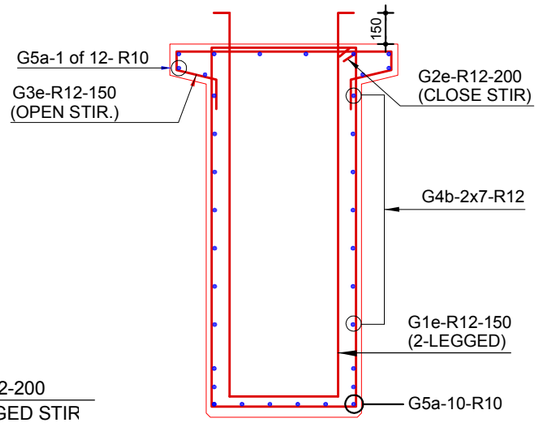
ELEV. SHOWING END BLOCK REINF. DETAILS



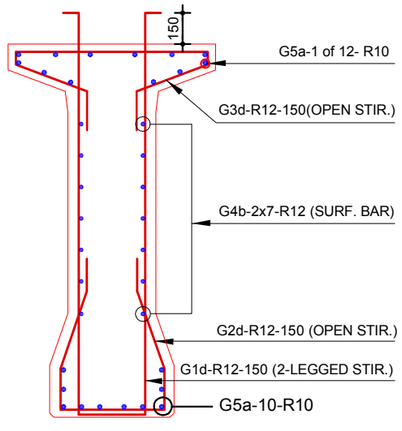
SECTION 2-2
(MID SECTION)



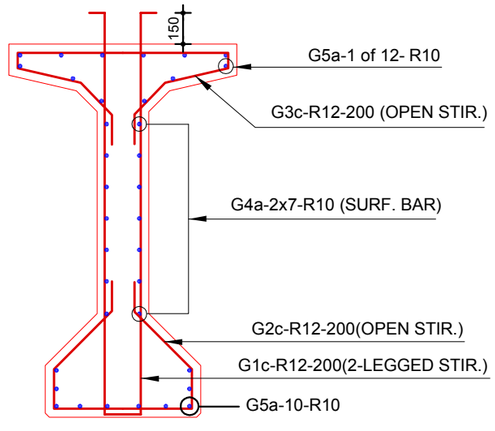
SECTION 3-3
(MID SECTION)



SECTION 6-6
(END SECTION)



SECTION 5-5
(MID SECTION)



SECTION 4-4
(MID SECTION)

NAME OF THE CLIENT :
GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH
LOCAL GOVERNMENT ENGINEERING DEPARTMENT

NAME OF THE PROJECT :
CONSULTANCY SERVICES FOR FEASIBILITY, DETAILED SURVEY AND DESIGN OF CHITTAGONG HILL TRACT CONNECTIVITY CONNECTING THEGAMUKH AND CHITTAGONG PORT.

NAME OF THE CONSULTANTS :
SAI Consulting Engineers Pvt. Ltd, India.
in association with
BETS Consulting Services Ltd, Bangladesh
Project office :
Tahmid Mahmood Palace
Flat # 9A, House # 77, Road # 4, Block-C,

DRAWING TITLE :
30.0m LONG PC GIRDER NON-PRE STRESSING REINFORCEMENT

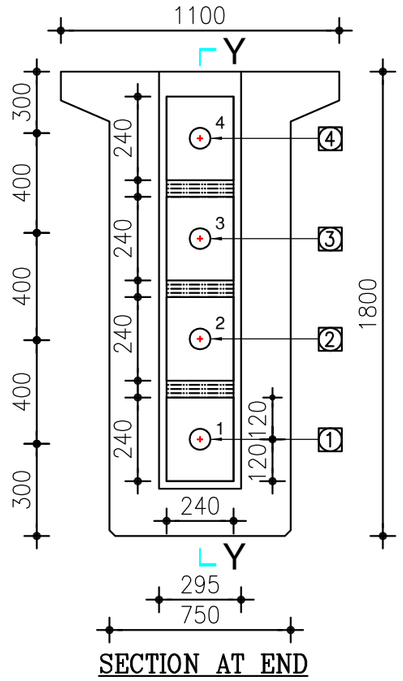
DRAWING NO : LGED/PCG-30/RNF.-03

Scale :As shown

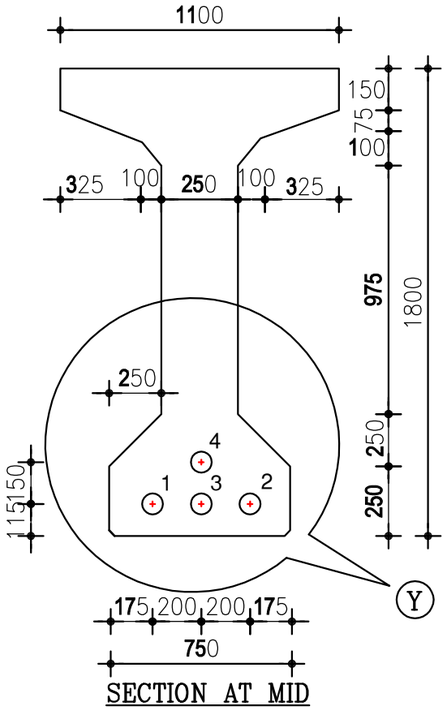
Date : 28-01-16

DESIGNED BY :	DRAWN BY :	CHECKED BY :	APPROVED BY :
MD. TAZUDDIN	MD. TAZUDDIN	AFM HAMIDUL HAQUE	DR. PRABHAT SHRIVASTAVA

REV.	DESCRIPTION	DATE



SECTION AT END

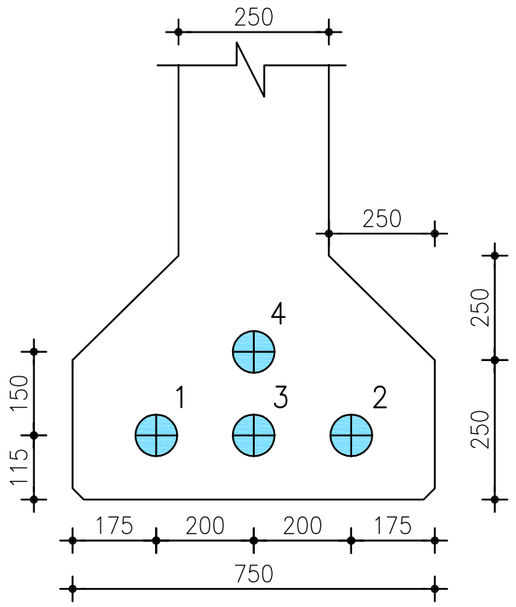


SECTION AT MID

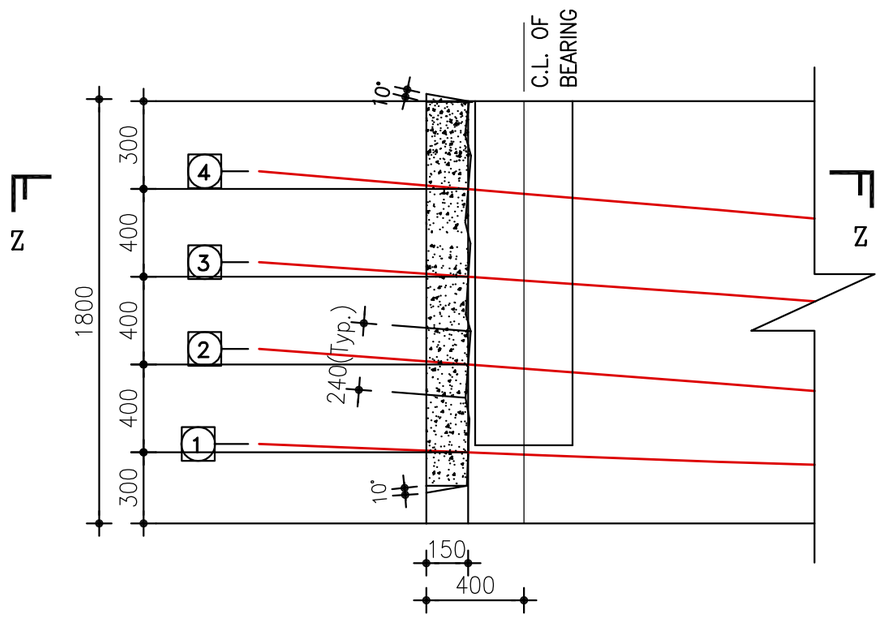
NOTES:

STAGES AND SEQUENCE OF PRESTRESSING

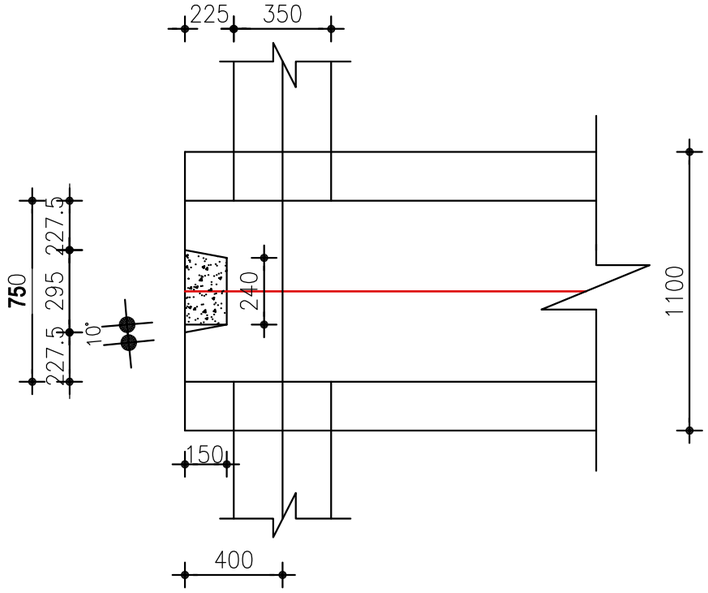
1. EACH CABLE SHALL BE STRESSED SIMULTANEOUSLY FROM BOTH ENDS. THE JACKING FORCE IN EACH CABLE SHALL BE 1680 KN TO BE IMPARTED SIMULTANEOUSLY AT BOTH ENDS.
2. THE SEQUENCE OF STRESSING OF PRESTRESSING CABLES SHALL BE AS FOLLOWS: 3, 2,1 & 4
3. STRESSING OF CABLES SHALL BE DONE MINIMUM AFTER 14 DAYS OR CONCRETE STRENGTH NOT LESS THAN 26N/mm^2 WHICHEVER IS LATER.
4. THE EXTENSION SHOWN IN THE TABLE IS FOR THE PORTION OF CABLES LYING BETWEEN MID SPAN AND RECESS FACE OF THE GIRDER. ADDITIONAL ELONGATION FOR GRIPPING LENGTH MUST BE ADDED DURING TENSIONING.
5. EACH CABLES CONSISTS OF 12 NOS. 12.7mm DIA. (12T13) 7-PLY UNCOATED LOW RELAXATION STRANDS
6. FOR OTHER REQUIREMENTS REFER GENERAL NOTES FOR PC GIRDER : S-02
7. THE CONTRACTOR SHALL SUBMIT DETAILS SHOP DRAWING FOR PC GIRDER'S FORMWORK AND SCAFFOLDING SYSTEM AND GET IT APPROVED BY CONCERNED XEN.
8. THE FORMWORK OF PC GIRDER MUST BE MADE OF M.S. SHEET HAVING THICKNESS 12BWG WITH NECESSARY BRACING.



DETAIL Ⓨ



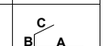
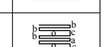
DETAILS OF END BLOCK



SECTION Z–Z

NAME OF THE CLIENT : GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH **LOCAL GOVERNMENT ENGINEERING DEPARTMENT** NAME OF THE PROJECT : CONSULTANCY SERVICES FOR FEASIBILITY, DETAILED SURVEY AND DESIGN OF CHITTAGONG HILL TRACT CONNECTIVITY CONNECTING THEGAMUKH AND CHITTAGONG PORT.	NAME OF THE CONSULTANTS : **SAI Consulting Engineers Pvt. Ltd, India.** in association with **BETS Consulting Services Ltd, Bangladesh** Project office : Tahmid Mahmood Palace Flat # 9A, House # 77, Road # 4, Block-C,	DRAWING TITLE : END BLOCK DETAILS BOF 30.0m LONG PC GIRDER DRAWING NO : LGED/PCG-30/EBL-04 Scale :As shown Date : 28-01-16	DESIGNED BY : MD. TAZUDDIN	DRAWN BY : MD. TAZUDDIN
CHECKED BY : AFM HAMIDUL HAQUE	APPROVED BY : DR. PRABHAT SHRIVASTAVA	REV.	DESCRIPTION	DATE

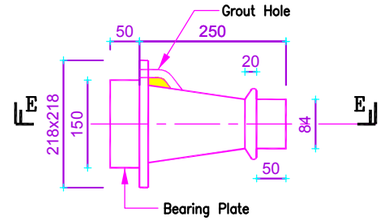
BAR BENDING SCHEDULE OF NON-PRESTRESSED REINF. (FOR ONE GIRDER, 30.0m)

SHAP CODE	BAR SHAPE	ITEM	NO.	BAR MARK	BAR TYPE & DIA (mm)	NO. OF BAR	SHAPE CODE	BENDING DIMENSIONS(MM) A	B	C	D	E	F	G	CUT LENGTH(MM)	TOTAL NO. OF BARS	TOTAL LENGTH(M)	UNIT WT. OF BAR(Kg/M)	TOTAL WT.(Kg)
1		PC GIRDER	1	G1a	R 12	28	1	170	1910	200					4350	28	121.800	0.888	108.14
				G1b	R 12	32	1	170	1910	200					4350	32	139.200	0.888	123.58
				G1c	R 12	40	1	170	1910	200					4560	40	182.400	0.888	161.94
2				G1d	R 12	14	1	420	1910	200					4640	14	64.960	0.888	57.67
				G1e	R 12	24	1	670	1910	200					4890	24	117.360	0.888	104.19
				G2a	R 12	28	2A	670	197	400	200				2264	28	63.392	0.888	56.28
				G3a	R 12	28	2	1020	78	313	216	200			2634	28	73.750	0.888	65.48
2A				G2b	R 12	32	2A	670	197	400	200				2264	32	72.448	0.888	64.32
				G3b	R 12	32	2	1020	78	313	216	200			2234	32	71.488	0.888	63.47
				G2c	R 12	40	2A	670	197	400	200				2264	40	90.560	0.888	80.40
				G3c	R 12	40	2	1020	78	313	216	200			2234	40	89.360	0.888	79.34
				G2d	R 12	14	2A	670	197	400	200				2269	14	31.766	0.888	28.20
3				G3d	R 12	14	2	1020	78	313	216	200			2234	14	21.276	0.888	27.77
				G2e	R 12	24	3	670	1720	200					5180	24	124.320	0.888	110.37
				G3e	R 12	36	2	1020	78	313	216				2234	36	80.424	0.888	71.40
4				G4a	R 10	14	4	25100							25100	14	351.400	0.617	216.65
				G4b	R 12	28	5	1700	1521						3221	28	90.179	0.888	80.06
				G5a	R 10	12	4	29870							29870	12	358.464	0.617	221.01
5				G5a	R 10	10	4	29870							29870	10	298.720	0.617	184.17
				G6	R 12	28	6	1700	150						3700	28	103.600	0.888	91.98
				G7	R 16	4	7	1720	100						1920	4	7.680	1.578	12.12
		MESH	1	m1	R 12	6	8	9900	450	7560	1350				19260	6	115.560	0.888	102.60
6				m2	R 8	2	8	3000	450	3000	450				6900	2	13.800	0.395	5.45
		Spiral	1	S1	R 12	2	03	7295							7295	2	14.590	0.888	12.95
7																			
8																			

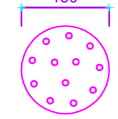
NB : BARBENDING SCHEDULE SHOULD BE CHECKED AT SITE BEFORE FABRICATION.

TOTAL WT.OF STEEL-Y16 (M.TON) = 0.01
TOTAL WT.OF STEEL-Y12 (M.TON) = 1.49
TOTAL WT.OF STEEL-Y10 (M.TON) = 0.62
TOTAL WT.OF STEEL-Y8 (M.TON) = 0.01

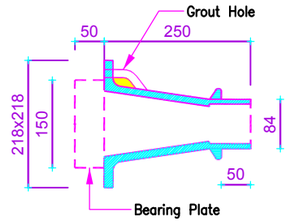
TOTAL WT. OF STEEL(M.TON) FOR ONE GIRDER = 2.13



Freyssinet Branded 12T13 Anchorage



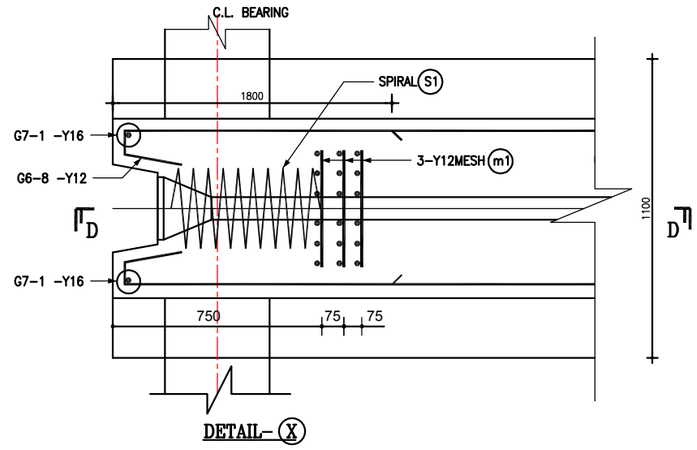
Bearing Plate



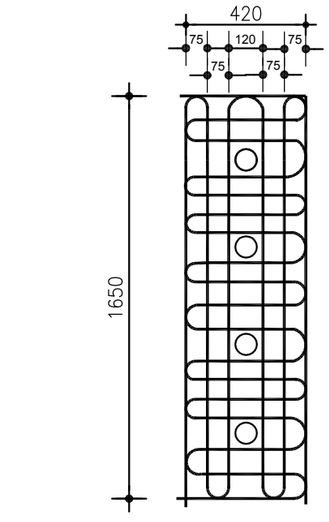
Section E-E

NOTES:

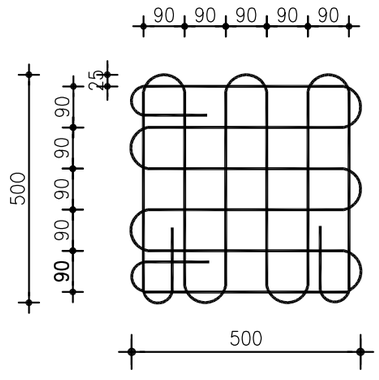
1. ANCHORAGE MUST BE TESTED TO CONFIRM ITS CAPACITY APPLYING 95% OF ULTIMATE LOAD (2205 KN) AS PER STANDARD SPECIFICATION PRIOR TO USE
2. HYDRAULIC JACKS FOR TENSIONING OPERATION MUST BE OF SAME BRANDED OF ANCHORAGE SYSTEM HAVING RECENT CALIBRATION
3. TENSIONING OPERATION SHALL BE CARRIED OUT IN PRESENCE OF AN EXPERIENCED ENGINEER OR AS DIRECTED BY THE DESIGN UNIT, LGED
4. THE PRE-STRESSING PARTY, IF SUBCONTRACTED, SHALL BE SELECTED TAKING PRIOR APPROVAL OF CONCERNED EXECUTIVE ENGINEER OR AS APPROVED BY DESIGN UNIT, LGED



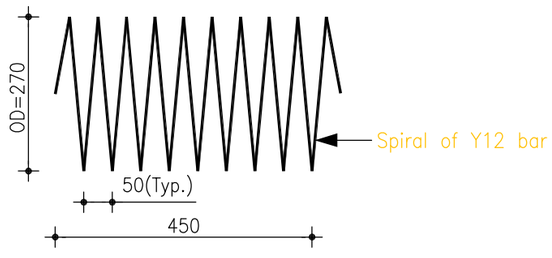
DETAIL- (X)



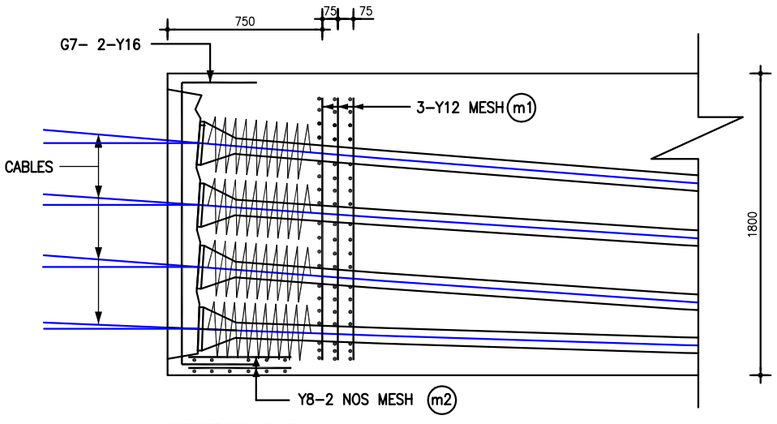
Y12 MESH REINFORCEMENT (m1)



Y8 MESH REINF. ABOVE BEARINGS (m2)



DETAILS OF SPIRAL S1

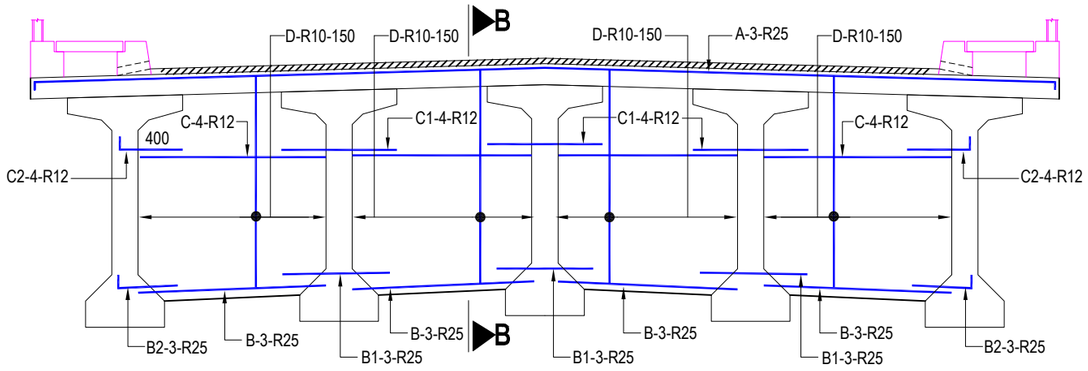


SECTION D-D

NAME OF THE CLIENT : GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH **LOCAL GOVERNMENT ENGINEERING DEPARTMENT**	NAME OF THE CONSULTANTS : **SAI Consulting Engineers Pvt. Ltd, India.** in association with **BETS Consulting Services Ltd, Bangladesh** Project office : Tahmid Mahmood Palace Flat # 9A, House # 77, Road # 4, Block-C,	DRAWING TITLE : TYPICAL PRE-STRESSING ANCHORAGE DETAILS FOR 30.0m LONG GIRDER	DESIGNED BY : MD. TAZUDDIN	DRAWN BY : MD. TAZUDDIN	CHECKED BY : AFM HAMIDUL HAQUE	APPROVED BY : DR. PRABHAT SHRIVASTAVA
NAME OF THE PROJECT : CONSULTANCY SERVICES FOR FEASIBILITY, DETAILED SURVEY AND DESIGN OF CHITTAGONG HILL TRACT CONNECTIVITY CONNECTING THEGAMUKH AND CHITTAGONG PORT.		DRAWING NO : LGED/PCG-30/ANC-05 Scale :As shown Date : 28-01-16				

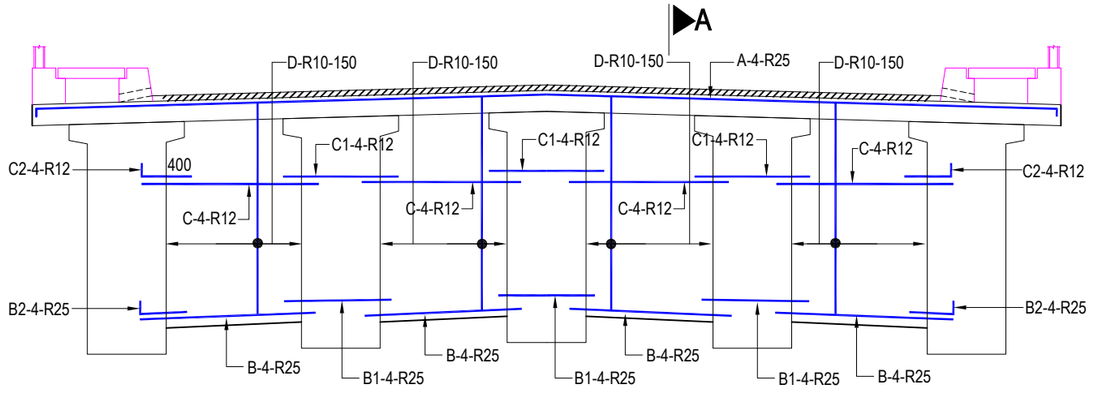
DESIGNED BY

REV.	DESCRIPTION	DATE



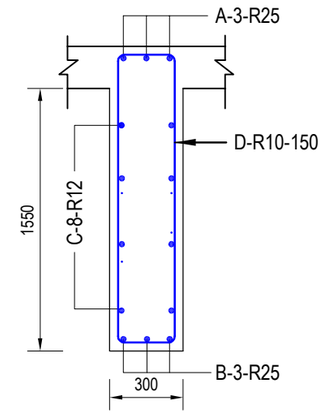
REINF. DETAILS OF INTER-MEDIATE X-GIRDER

(Scale : 1:60)



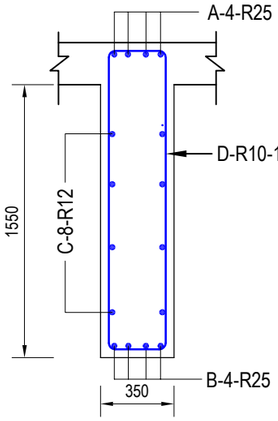
REINF. DETAILS OF END X-GIRDER

(Scale : 1:60)



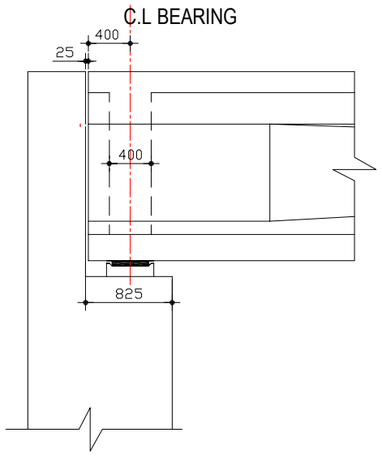
SEC. B-B (INTERMEDIATE X-GIRDER)

(Scale : 1:30)



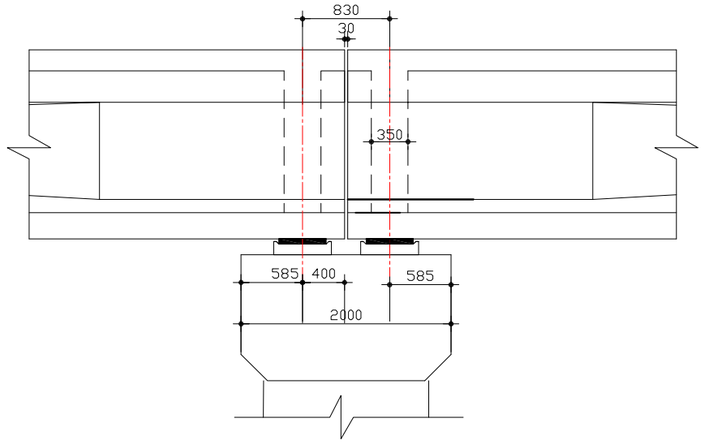
SEC. A-A (END X-GIRDER)

(Scale : 1:30)



SEC. B-B AT ABUTMENT END

(Scale : 1:75)



SEC. C-C AT COLUMN TYPE PIER END

(Scale : 1:75)

BAR BENDING SCHEDULE FOR INTERMEDIATE & END X-GIRDERE (33.00, whole span)

ITEM	NO.	BAR MARK	BAR TYPE & DIA (mm)	NO. OF BAR	SHAPE CODE	BENDING DIMENSIONS(MM) A	B	C	D	E	CUT LENGTH(MM)	TOTAL NO. OF BARS	TOTAL LENGTH(M)	UNIT WT. OF BAR(Kg/M)	TOTAL WT.(Kg)
INTERME - DIATE X-GIRDER	1	A	R 25	3	2A	9720	75				9870	3	29.610	3.853	114.08
		B	R 25	12	01	2010					2010	12	24.120	3.853	92.93
		B1	R 25	9	01	1050					1050	9	9.450	3.853	36.41
		B2	R 25	6	03	475	200				675	6	4.050	3.853	15.60
		C	R 12	32	01	1710					1710	32	54.720	0.888	48.59
		C1	R 12	24	01	1050					1050	24	25.200	0.888	22.38
		C2	R 12	16	03	525	200				725	16	11.600	0.888	10.30
		D	R 10	48	04	1650	220	150			3990	48	191.52	0.617	118.17
											Sub-Total of Intermediate X-girder				458.46
END X-GIRDER	1	A	R 25	4	2A	9720	75				9870	4	39.480	3.853	152.12
		B	R 25	16	01	2010					2010	16	32.160	3.853	123.91
		B1	R 25	12	01	1550					1550	12	18.600	3.853	71.67
		B2	R 25	8	03	725	200				925	8	7.400	3.853	28.51
		C	R 12	32	01	1210					1210	32	38.720	0.888	34.38
		C1	R 12	24	01	1550					1550	24	37.200	0.888	33.03
		C2	R 12	16	03	725	300				1025	16	16.400	0.888	14.56
		D	R 10	36	04	1700	270	75			4015	36	144.54	0.617	89.18
											Sub-Total of End X-girder				547.36

TOTAL WT. OF STEEL(M.TON) FOR ONE END & ONE MID GIRDER = 1.00

SHAPE CODE	01	01A	02	02A	02B	03	04	05	06
SHAPE OF BARS	a	b a	b a	c b a	b a	a b	b a	b c a	a c b

NAME OF THE CLIENT :
GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH
LOCAL GOVERNMENT ENGINEERING DEPARTMENT

NAME OF THE PROJECT :
CONSULTANCY SERVICES FOR FEASIBILITY, DETAILED SURVEY AND DESIGN OF CHITTAGONG HILL TRACT CONNECTIVITY CONNECTING THEGAMUKH AND CHITTAGONG PORT.

NAME OF THE CONSULTANTS :
SAI Consulting Engineers Pvt. Ltd, India.
in association with
BETS Consulting Services Ltd, Bangladesh
Project office :
Tahmid Mahmood Palace
Flat # 9A, House # 77, Road # 4, Block-C,

DRAWING TITLE :
REINF. DETAILS OF X-GIRDER FOR 30.0m SPAN

DRAWING NO : LGED/PCG-30/XG-06

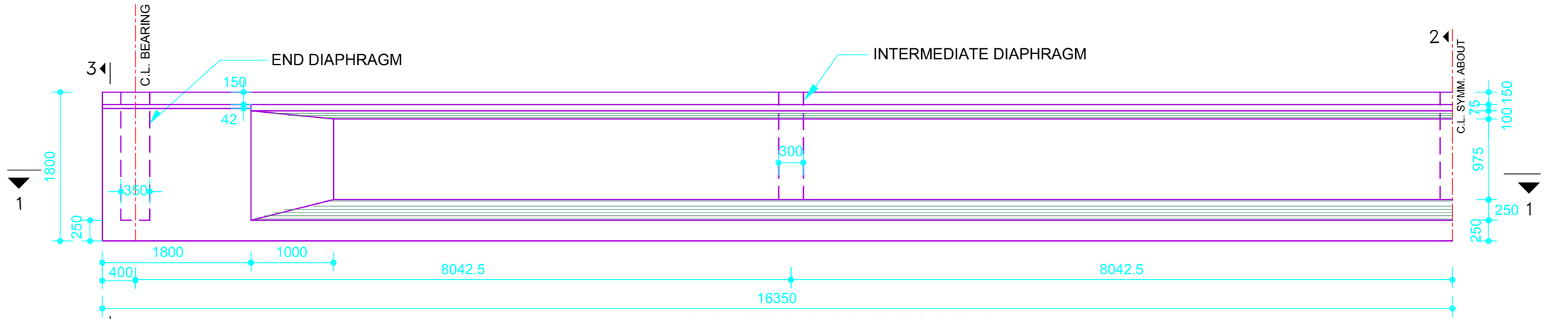
Scale :As shown

Date : 28-01-16

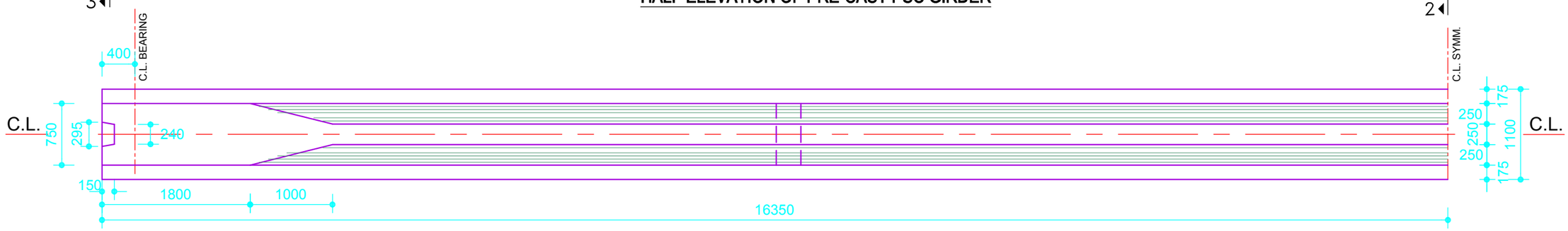
DESIGNED BY :	DRAWN BY :	CHECKED BY :	APPROVED BY :
MD. TAZUDDIN	MD. TAZUDDIN	AFM HAMIDUL HAQUE	DR. PRABHAT SHRIVASTAVA

DESIGNED BY:

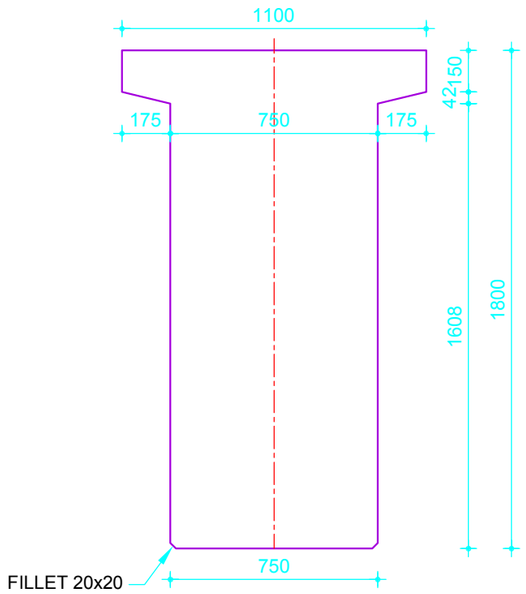
REV.	DESCRIPTION	DATE



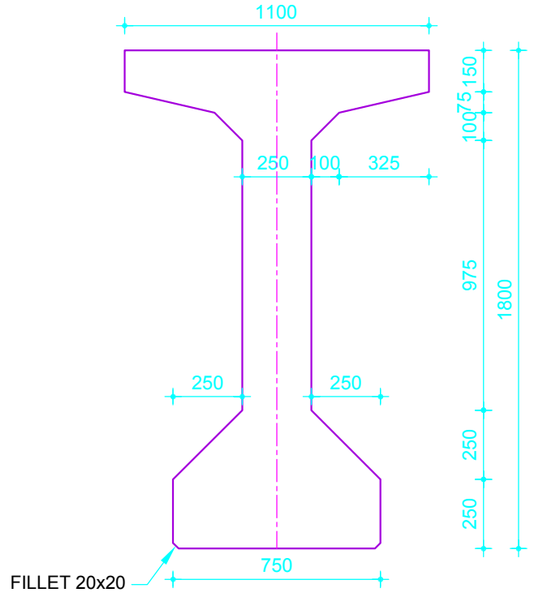
HALF ELEVATION OF PRE-CAST PSC GIRDER



SECTIONAL VIEW OF PRE-CAST PSC GIRDER (SECTION 1-1)



SECTION 3-3 AT END



SECTION 2-2 AT MIDDLE

NOTES:

1. CONCRETE SHALL HAVE SPECIFIED CHARACTERISTIC COMPRESSIVE STRENGTH OF STANDARD CYLINDER OR CUBE (15 cm) AT 28 DAYS, ARE AS FOLLOWS(15 cm) AT 28 DAYS, ARE AS FOLLOWS:
   a) STANDARD CYLINDER CRUSHING STRENGTH, f'c = 35 N/mm²
   b) STANDARD CUBE CRUSHING STRENGTH, fcu = 43 N/mm²
2. REINFORCING STEEL SHALL CONFORM TO ASTM A615-87 GRADE 6 DEFORMED BARS (MARKED 'Y') HAVING MINIMUM YEILD STRENGT Fy = 413 N/mm²
3. PRESTRESSING STEEL SHALL BE OF 12.7mm DIA. 7 PLY UNCOATE LOW RELAXATION STRAND CONFORMING TO AASHTO-M203 (GRADE-270) OR EQUIVALENT HAVING THE FOLLOWING STRENGTH:
   (a) MINIMUM ULTIMATE TENSILE STRENGTH (UTS) f 's = 1861 N/mm (183.7 KN PER STRAND)
   (b) MINIMUM YIELD STRENGTH f 'y = 1674 N/mm² (165.3 KN PER STRAND)
4. PPRESTRESSING CABLE SHALL CONSISTS OF 12 NOS.12.7mm DIA. STRAND (12T13) IN A SHEATHING/DUCT
5. FOLLOWING PROPERTIES HAVE BEEN CONSIDERED IN THE DESIGN
   AREA OF STRAND = 98.7 mm²
   AREA OF CABLE = 1184.4 mm²
   MODULLES OF ELASTICITY OF STRAND =1.97x10 ^{5} (N/mm ^{2})
   AVERAGE SLIP = 6mm
   JACKING FORCE IN EACH CABLE = 1680 KN.

NAME OF THE CLIENT :
GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH
LOCAL GOVERNMENT ENGINEERING DEPARTMENT

NAME OF THE PROJECT :
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NAME OF THE CONSULTANTS :
SAI Consulting Engineers Pvt. Ltd, India.
in association with
BETS Consulting Services Ltd, Bangladesh
Project office :
Tahmid Mahmood Palace
Flat # 9A, House # 77, Road # 4, Block-C,
Banani, Dhaka-1213, Bangladesh.

DRAWING TITLE :
33.0m LONG PC GIRDER CONCRETE OUTLINE DETAILS

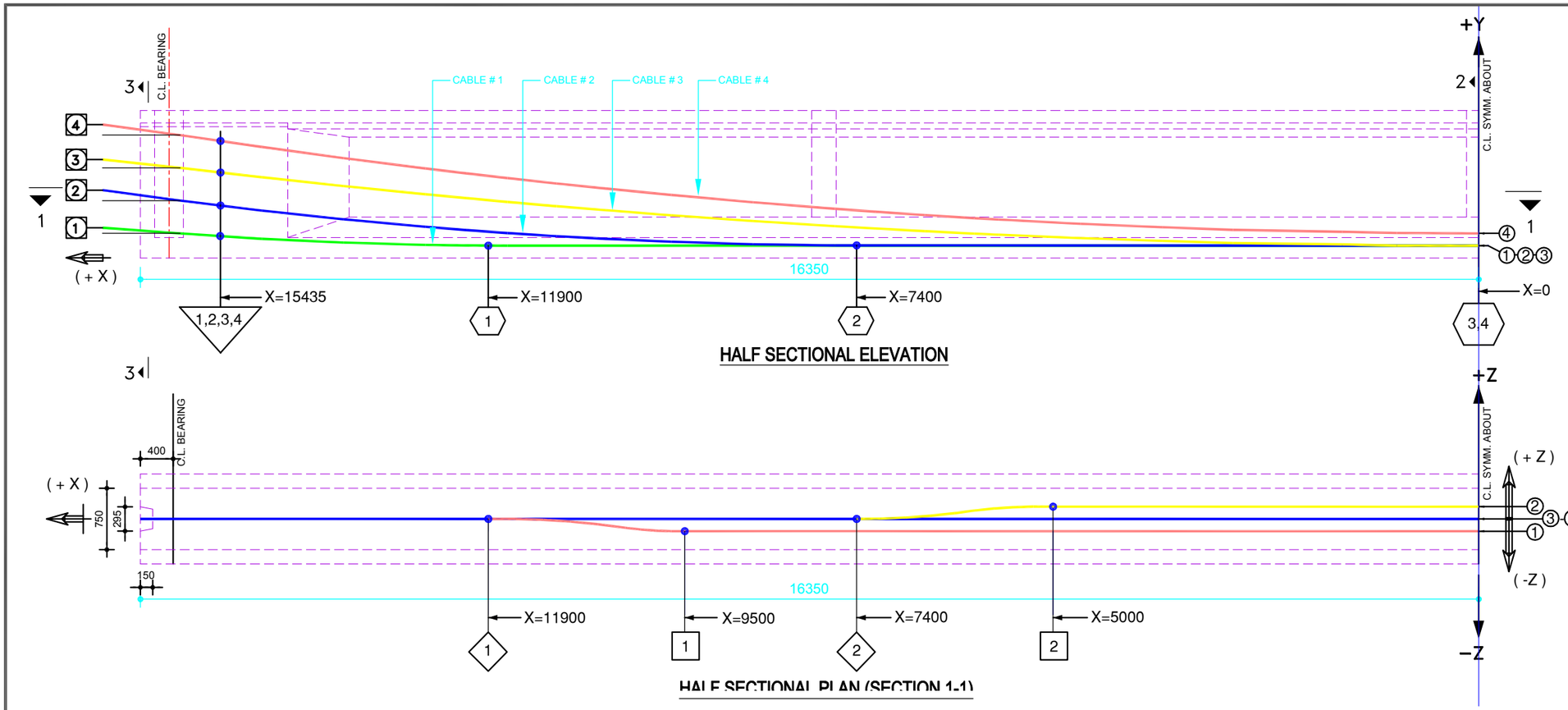
DRAWING NO : LGED/PCG-33/CON-01

Scale :As shown

Date : 28-01-16

DESIGNED BY :	DRAWN BY :	CHECKED BY :	APPROVED BY :
MD. TAZUDDIN	MD. TAZUDDIN	AFM HAMIDUL HAQUE	DR. PRABHAT SHRIVASTAVA

REV.	DESCRIPTION	DATE



Cable No.	ORDINATE AT DISTANCE X FROM CENTER																				Extension at each jecking end	Emergence angle
	16350		15000		14000		13000		12000		11500		10300		9100		8500		8000		7500			
	Y	Z	Y	Z	Y	Z	Y	Z	Y	Z	Y	Z	Y	Z	Y	Z	Y	Z	Y	Z	Y	Z		
1	300		228		190		164		152		150		150		150		150		150		150		114.13	1.05
2	700		560		469		390		321		292		232		188		173		163		156		114.45	3.84
3	1100		950		847		751		662		620		527		444		407		377		350		115.13	6.60
4	1500		1310		1180		1053		946		894		776		672		624		587		553		115.74	8.29
1		0		0		0		0		0		0		-75.0		-150		-150		-150		-150		
2		0		0		0		0		0				0		0		0		0		0		

Cable No.																					Extension at each jecking end	Emergence angle
	7000		6500		5300		4100		3500		3000		2500		2000		1500		1000		0			
	Y	Z	Y	Z	Y	Z	Y	Z	Y	Z	Y	Z	Y	Z	Y	Z	Y	Z	Y	Z	Y	Z		
1	150		150		150		150		150		150		150		150		150		150		150		114.13	1.05
2	151		150		150		150		150		150		150		150		150		150		150		114.45	3.84
3	324		300		250		210		194		182		172		164		158		154		150		115.13	6.60
4	520		490		426		375		355		340		328		318		310		305		300		115.74	8.29
1		-150		-150		-150		-150		-150		-150		-150		-150		-150		-150		-150		
2		0		0		75.0		150		150		150		150		150		150		150		150		

LEGEND:

- INDICATES START OF CURVE IN ELEVATION
- INDICATES END OF CURVE IN ELEVATION
- INDICATES START OF CURVE IN PLAN
- INDICATES END OF CURVE IN PLAN
- INDICATES END OF CABLE
- INDICATES CABLE NUMBER

NAME OF THE CLIENT :
GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH
LOCAL GOVERNMENT ENGINEERING DEPARTMENT

NAME OF THE PROJECT :
CONSULTANCY SERVICES FOR FEASIBILITY, DETAILED SURVEY AND DESIGN OF CHITTAGONG HILL TRACT CONNECTIVITY CONNECTING THEGAMUKH AND CHITTAGONG PORT.

NAME OF THE CONSULTANTS :
SAI Consulting Engineers Pvt. Ltd, India.
in association with
BETS Consulting Services Ltd, Bangladesh
Project office :
Tahmid Mahmood Palace
Flat # 9A, House # 77, Road # 4, Block-C,
Banani, Dhaka-1213, Bangladesh.

DRAWING TITLE :
33.0m LONG PC GIRDER PRE-STRESSING CABLE DETAILS

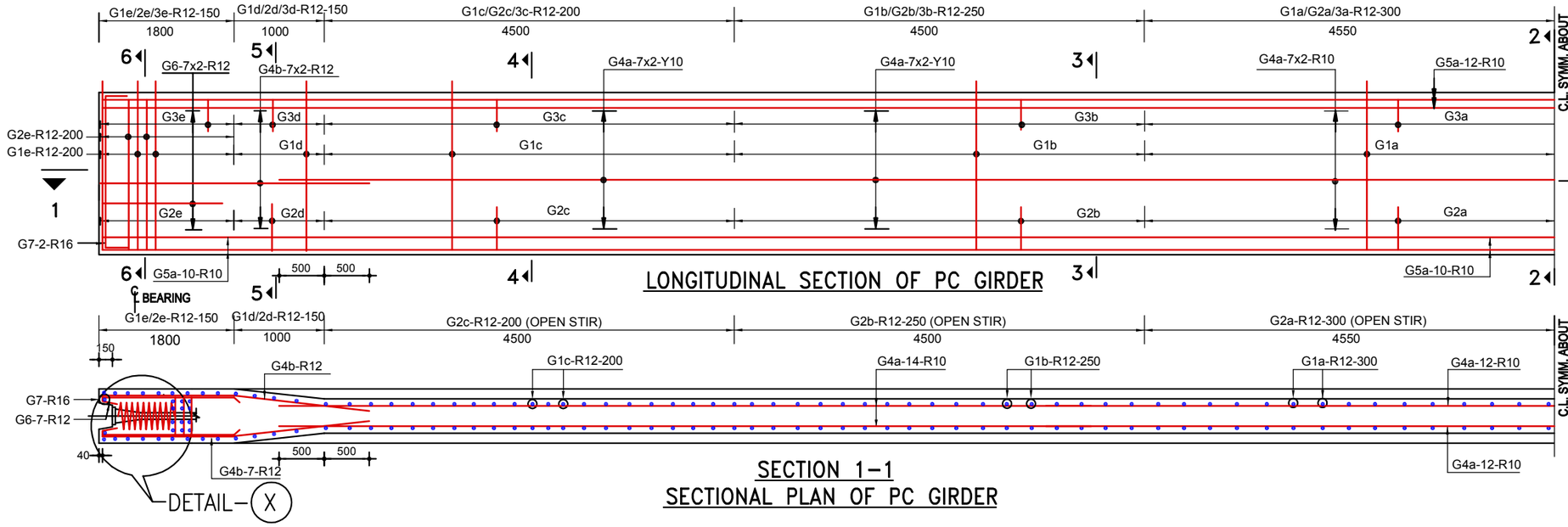
DRAWING NO : LGED/PCG-33/CAB-02

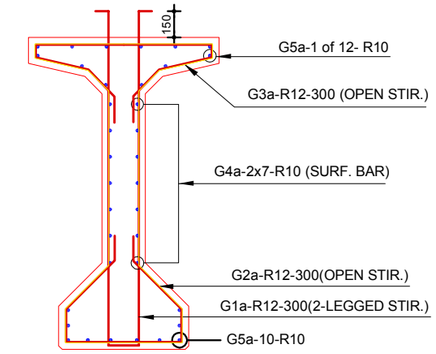
Scale :As shown

Date : 28-01-16

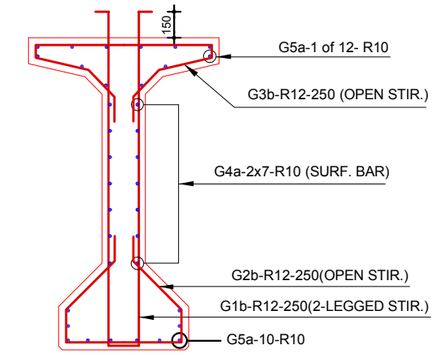
DESIGNED BY :	DRAWN BY :	CHECKED BY :	APPROVED BY :
MD. TAZUDDIN	MD. TAZUDDIN	AFM HAMIDUL HAQUE	DR. PRABHAT SHRIVASTAVA

REV.	DESCRIPTION	DATE



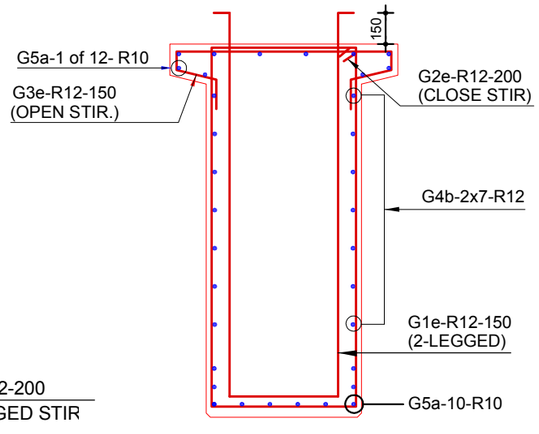


SECTION 2-2
(MID SECTION)

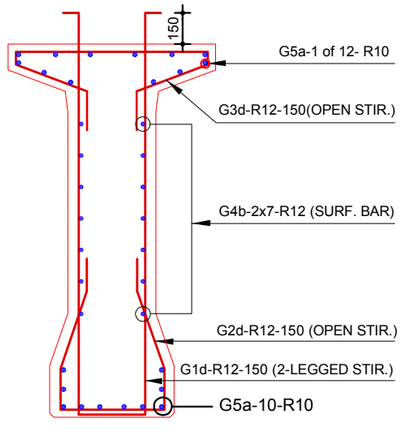


SECTION 3-3
(MID SECTION)

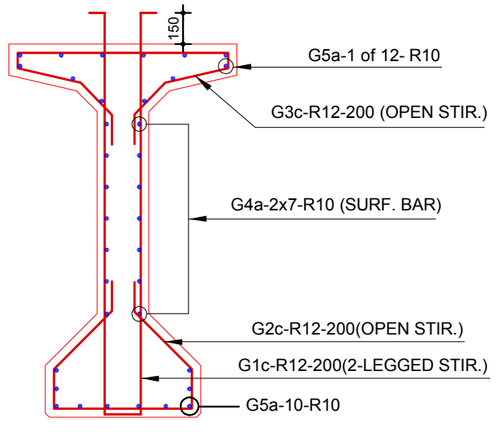
ELEV. SHOWING END BLOCK REINF. DETAILS



SECTION 6-6
(END SECTION)



SECTION 5-5
(MID SECTION)



SECTION 4-4
(MID SECTION)

NAME OF THE CLIENT :
GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH
LOCAL GOVERNMENT ENGINEERING DEPARTMENT

NAME OF THE PROJECT :
CONSULTANCY SERVICES FOR FEASIBILITY, DETAILED SURVEY AND DESIGN OF CHITTAGONG HILL TRACT CONNECTIVITY CONNECTING THEGAMUKH AND CHITTAGONG PORT.

NAME OF THE CONSULTANTS :
SAI Consulting Engineers Pvt. Ltd, India.
in association with
BETS Consulting Services Ltd, Bangladesh
Project office :
Tahmid Mahmood Palace
Flat # 9A, House # 77, Road # 4, Block-C,
Banani, Dhaka-1213, Bangladesh.

DRAWING TITLE :
33.0m LONG PC GIRDER NON-PRE STRESSING REINF. DETAILS

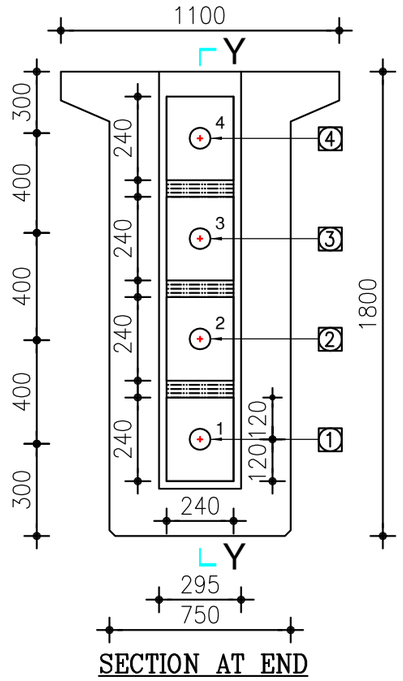
DRAWING NO : LGED/PCG-33/REINF.-03

Scale :As shown

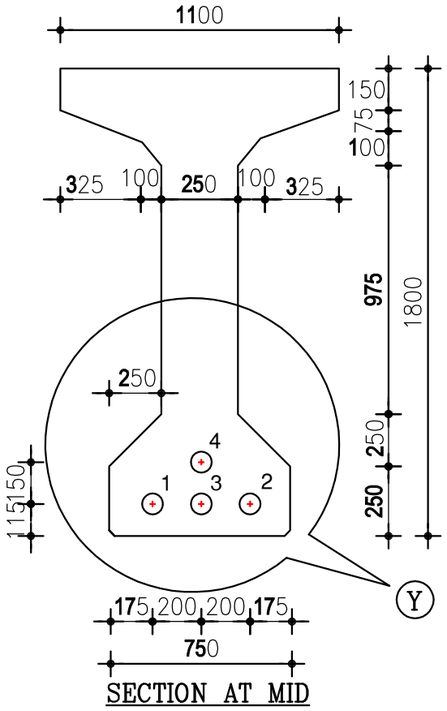
Date : 28-01-16

DESIGNED BY :	DRAWN BY :	CHECKED BY :	APPROVED BY :
MD. TAZUDDIN	MD. TAZUDDIN	AFM HAMIDUL HAQUE	DR. PRABHAT SHRIVASTAVA

REV.	DESCRIPTION	DATE



SECTION AT END

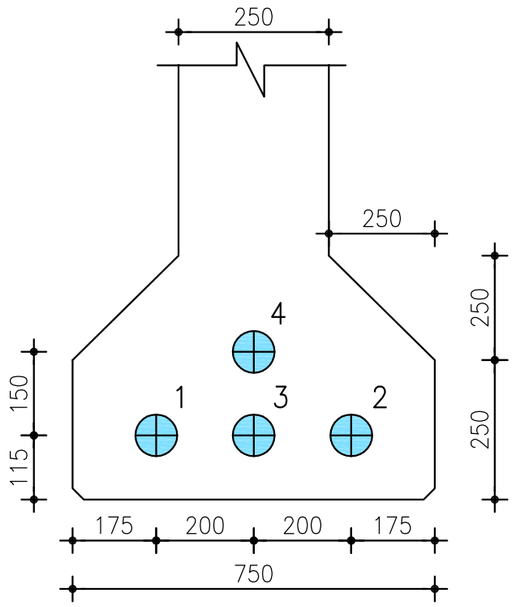


SECTION AT MID

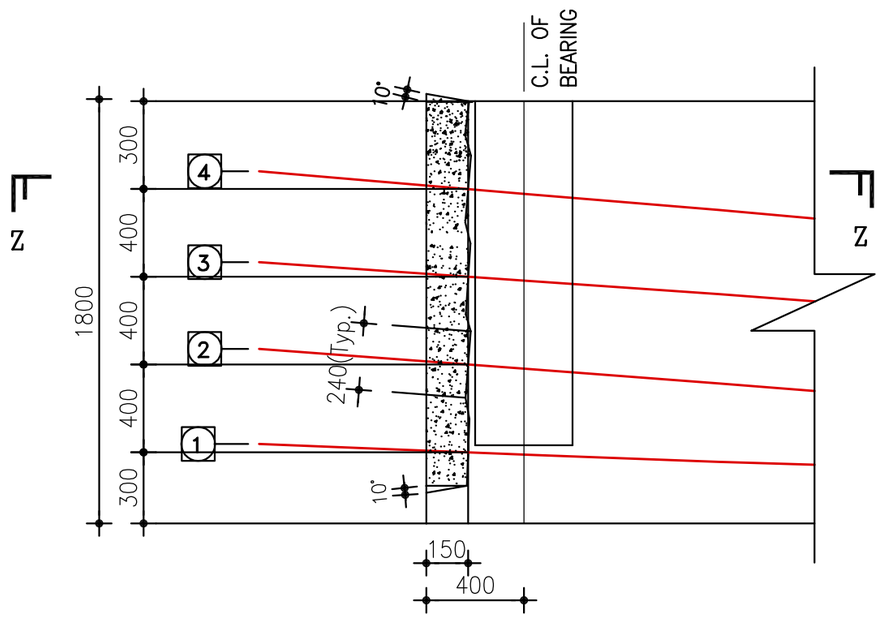
NOTES:

STAGES AND SEQUENCE OF PRESTRESSING

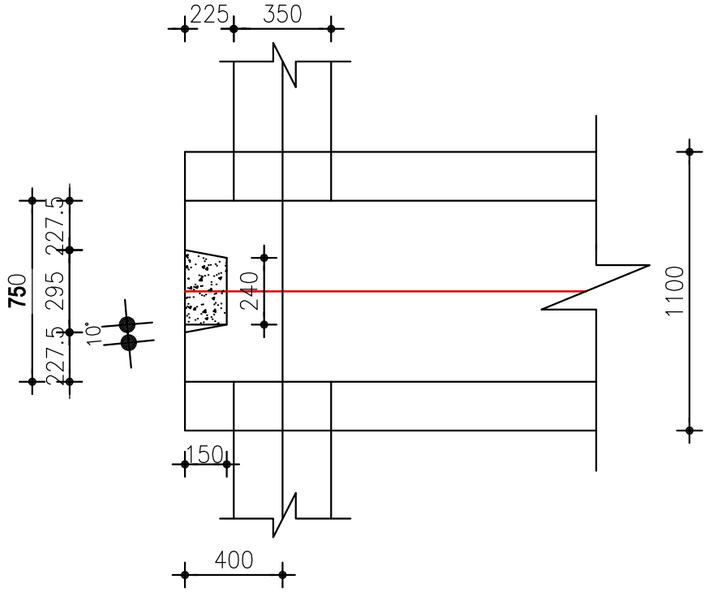
1. EACH CABLE SHALL BE STRESSED SIMULTANEOUSLY FROM BOTH ENDS. THE JACKING FORCE IN EACH CABLE SHALL BE 1680 KN TO BE IMPARTED SIMULTANEOUSLY AT BOTH ENDS.
2. THE SEQUENCE OF STRESSING OF PRESTRESSING CABLES SHALL BE AS FOLLOWS: 3, 2,1 & 4
3. STRESSING OF CABLES SHALL BE DONE MINIMUM AFTER 14 DAYS OR CONCRETE STRENGTH NOT LESS THAN 26N/mm^2 WHICHEVER IS LATER.
4. THE EXTENSION SHOWN IN THE TABLE IS FOR THE PORTION OF CABLES LYING BETWEEN MID SPAN AND RECESS FACE OF THE GIRDER. ADDITIONAL ELONGATION FOR GRIPPING LENGTH MUST BE ADDED DURING TENSIONING.
5. EACH CABLES CONSISTS OF 12 NOS. 12.7mm DIA. (12T13) 7-PLY UNCOATED LOW RELAXATION STRANDS
6. FOR OTHER REQUIREMENTS REFER GENERAL NOTES FOR PC GIRDER : S-02
7. THE CONTRACTOR SHALL SUBMIT DETAILS SHOP DRAWING FOR PC GIRDER'S FORMWORK AND SCAFFOLDING SYSTEM AND GET IT APPROVED BY CONCERNED XEN.
8. THE FORMWORK OF PC GIRDER MUST BE MADE OF M.S. SHEET HAVING THICKNESS 12BWG WITH NECESSARY BRACING.



DETAIL Ⓨ



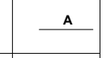
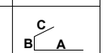
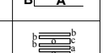
DETAILS OF END BLOCK



SECTION Z–Z

NAME OF THE CLIENT : GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH **LOCAL GOVERNMENT ENGINEERING DEPARTMENT**	NAME OF THE CONSULTANTS : **SAI Consulting Engineers Pvt. Ltd, India.** in association with **BETS Consulting Services Ltd, Bangladesh** Project office : Tahmid Mahmood Palace Flat # 9A, House # 77, Road # 4, Block-C, Banani, Dhaka-1213, Bangladesh.	DRAWING TITLE : END BLOCK DETAILS OF 33.0m LONG PC GIRDER	DESIGNED BY : MD. TAZUDDIN	DRAWN BY : MD. TAZUDDIN	CHECKED BY : AFM HAMIDUL HAQUE	APPROVED BY : DR. PRABHAT SHRIVASTAVA	REV.	DESCRIPTION	DATE
NAME OF THE PROJECT : CONSULTANCY SERVICES FOR FEASIBILITY, DETAILED SURVEY AND DESIGN OF CHITTAGONG HILL TRACT CONNECTIVITY CONNECTING THEGAMUKH AND CHITTAGONG PORT.		DRAWING NO : LGED/PCG-33/EBL-04 Scale :As shown Date : 28-01-16							

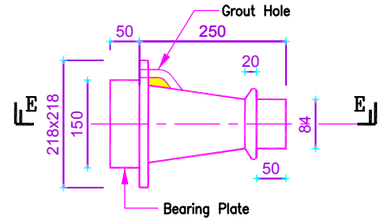
BAR BENDING SCHEDULE OF NON-PRESTRESSED REINF. (FOR ONE GIRDER, 33.0m)

SHAP CODE	BAR SHAPE	ITEM	NO.	BAR MARK	BAR TYPE & DIA (mm)	NO. OF BAR	SHAPE CODE	BENDING DIMENSIONS(MM) A	B	C	D	E	F	G	CUT LENGTH(MM)	TOTAL NO. OF BARS	TOTAL LENGTH(M)	UNIT WT. OF BAR(Kg/M)	TOTAL WT.(Kg)
1		PC GIRDER	1	G1a	R 12	32	1	170	1910	200					4350	32	139.200	0.888	123.58
				G1b	R 12	36	1	170	1910	200					4350	36	156.600	0.888	139.03
				G1c	R 12	46	1	170	1910	200					4560	46	209.76	0.888	186.23
2				G1d	R 12	14	1	420	1910	200					4640	14	64.96	0.888	57.67
				G1e	R 12	24	1	670	1910	200					4890	24	117.36	0.888	104.19
				G2a	R 12	32	2A	670	197	400	200				2264	32	72.448	0.888	64.32
				G3a	R 12	32	2	1020	78	313	216	200			2634	32	84.29	0.888	74.83
2A				G2b	R 12	36	2A	670	197	400	200				2264	36	81.504	0.888	72.36
				G3b	R 12	36	2	1020	78	313	216	200			2234	36	80.424	0.888	71.40
				G2c	R 12	46	2A	670	197	400	200				2264	46	104.144	0.888	92.46
				G3c	R 12	46	2	1020	78	313	216	200			2234	46	102.764	0.888	91.24
				G2d	R 12	14	2A	670	197	400	200				2269	14	31.766	0.888	28.20
				G3d	R 12	14	2	1020	78	313	216	200			2234	14	31.276	0.888	27.77
3				G2e	R 12	24	3	670	1720	200					5180	24	124.32	0.888	110.37
				G3e	R 12	36	2	1020	78	313	216				2234	36	80.424	0.888	71.40
				G4a	R 10	14	4	28100							28100	14	393.400	0.617	242.55
4				G4b	R 12	28	5	1700	1521						3221	28	90.179	0.888	80.06
				G5a	R 10	12	4	33700							33700	12	404.424	0.617	249.34
				G5a	R 10	10	4	33700							33700	10	337.020	0.617	207.79
				G6	R 12	28	6	1700	150						3700	28	103.600	0.888	91.98
5				G7	R 16	4	7	1720	100						1920	4	7.680	1.578	12.12
		MESH	1	m1	R 12	6	8	9900	450	7560	1350				19260	6	115.560	0.888	102.60
6				m2	R 8	2	8	3000	450	3000	450				6900	2	13.800	0.395	5.45
		Spiral	1	S1	R 12	2	03	7295							7295	2	14.590	0.888	12.95
7																			
8																			

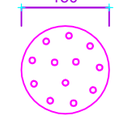
NB : BARBENDING SCHEDULE SHOULD BE CHECKED AT SITE BEFORE FABRICATION.

TOTAL WT.OF STEEL-Y16 (M.TON) = 0.01
TOTAL WT.OF STEEL-Y12 (M.TON) = 1.60
TOTAL WT.OF STEEL-Y10 (M.TON) = 0.70
TOTAL WT.OF STEEL-Y8 (M.TON) = 0.01

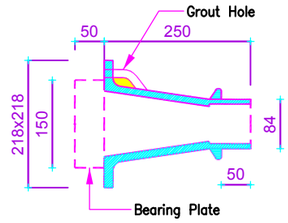
TOTAL WT. OF STEEL(M.TON) FOR ONE GIRDER = 2.32



Freyssinet Branded 12T13 Anchorage



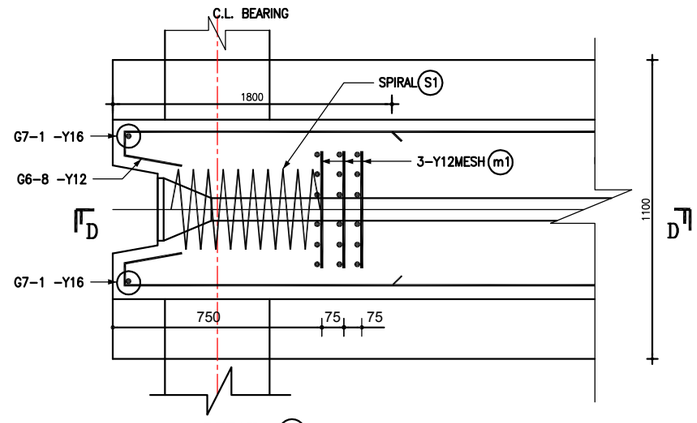
Bearing Plate



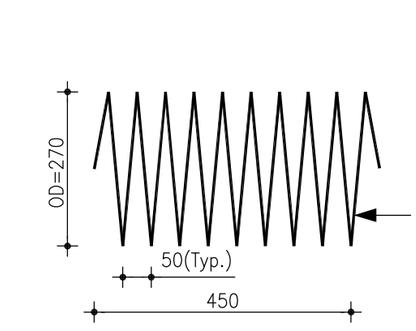
Section E-E

NOTES:

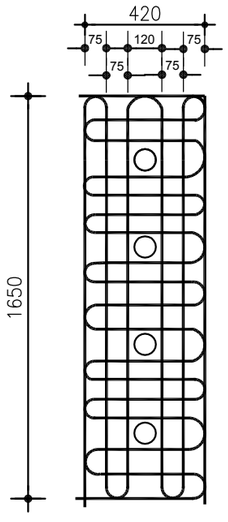
1. ANCHORAGE MUST BE TESTED TO CONFIRM ITS CAPACITY APPLYING 95% OF ULTIMATE LOAD (2205 KN) AS PER STANDARD SPECIFICATION PRIOR TO USE
2. HYDRAULIC JACKS FOR TENSIONING OPERATION MUST BE OF SAME BRANDED OF ANCHORAGE SYSTEM HAVING RECENT CALIBRATION
3. TENSIONING OPERATION SHALL BE CARRIED OUT IN PRESENCE OF AN EXPERIENCED ENGINEER OR AS DIRECTED BY THE DESIGN UNIT, LGED
4. THE PRE-STRESSING PARTY, IF SUBCONTRACTED, SHALL BE SELECTED TAKING PRIOR APPROVAL OF CONCERNED EXECUTIVE ENGINEER OR AS APPROVED BY DESIGN UNIT, LGED



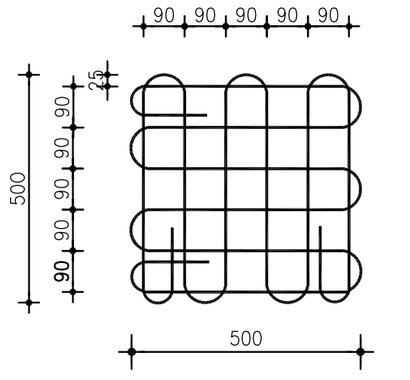
DETAIL- X



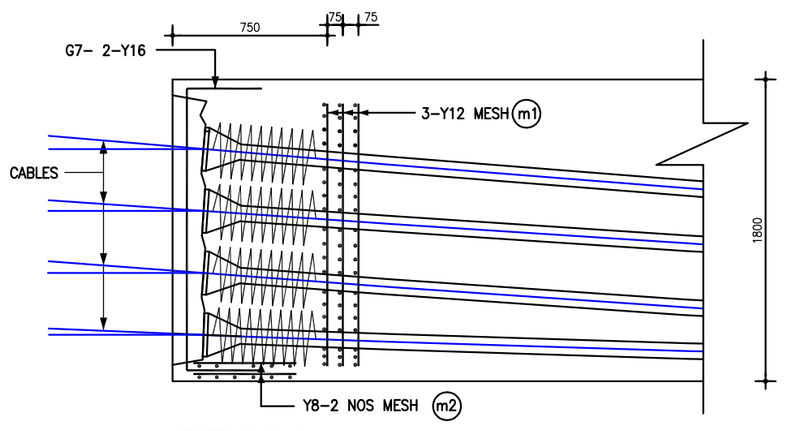
DETAILS OF SPIRAL S1



Y12 MESH REINFORCEMENT (m1)



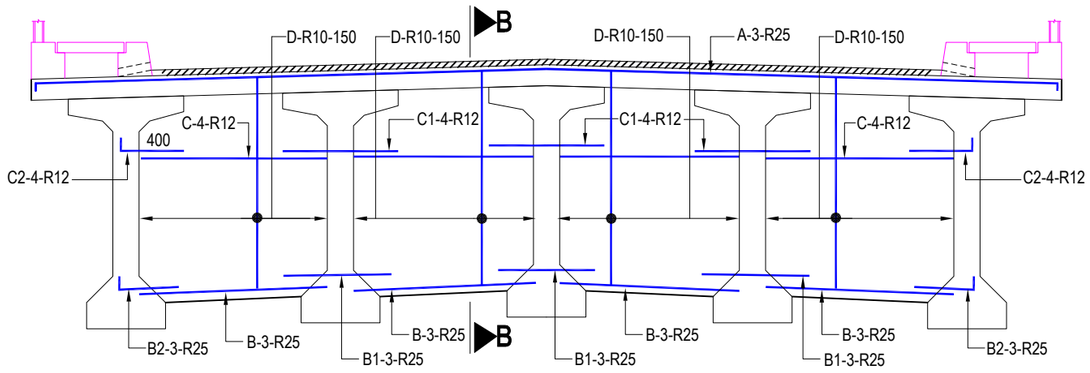
Y8 MESH REINF. ABOVE BEARINGS (m2)



SECTION D-D

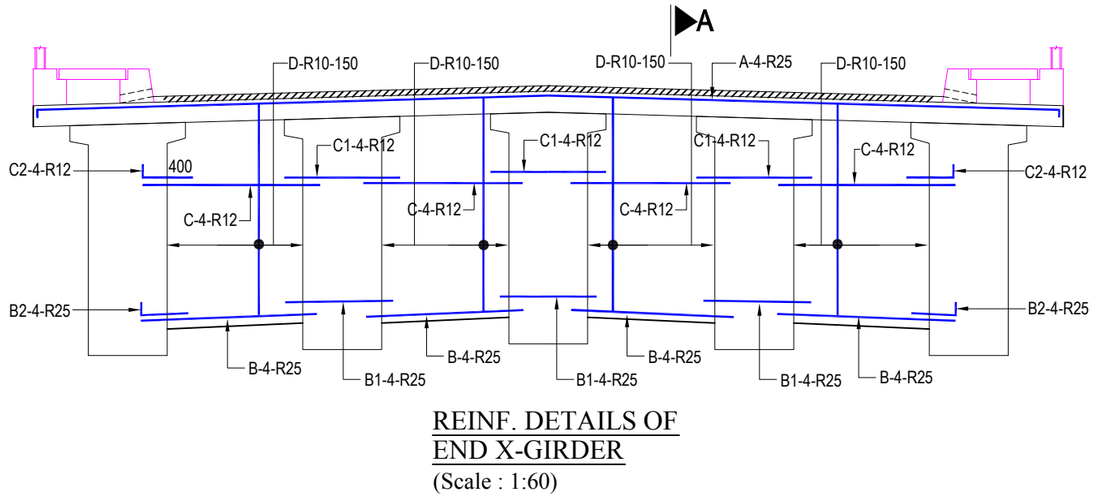
NAME OF THE CLIENT : GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH **LOCAL GOVERNMENT ENGINEERING DEPARTMENT**	NAME OF THE CONSULTANTS : **SAI Consulting Engineers Pvt. Ltd, India.** in association with **BETS Consulting Services Ltd, Bangladesh** Project office : Tahmid Mahmood Palace Flat # 9A, House # 77, Road # 4, Block-C, Banani, Dhaka-1213, Bangladesh.	DRAWING TITLE : TYPICAL PRE-STRESSING ANCHORAGE DETAILS FOR 33.0m LONG PC GIRDER DRAWING NO : LGED/PCG-33/ANC.-05 Scale :As shown Date : 28-01-16	DESIGNED BY : MD. TAZUDDIN	DRAWN BY : MD. TAZUDDIN
NAME OF THE PROJECT : CONSULTANCY SERVICES FOR FEASIBILITY, DETAILED SURVEY AND DESIGN OF CHITTAGONG HILL TRACT CONNECTIVITY CONNECTING THEGAMUKH AND CHITTAGONG PORT.			CHECKED BY : AFM HAMIDUL HAQUE	APPROVED BY : DR. PRABHAT SHRIVASTAVA

REV.	DESCRIPTION	DATE



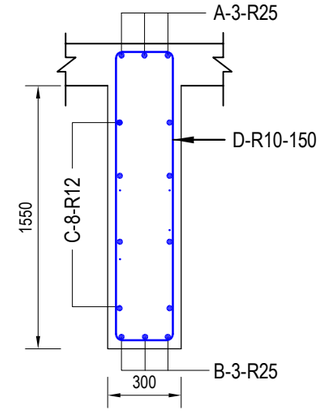
REINF. DETAILS OF INTER-MEDIATE X-GIRDER

(Scale : 1:60)



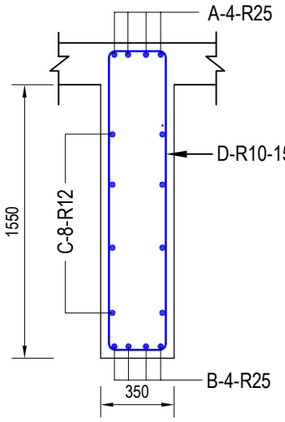
REINF. DETAILS OF END X-GIRDER

(Scale : 1:60)



SEC. B-B (INTERMEDIATE X-GIRDER)

(Scale : 1:30)



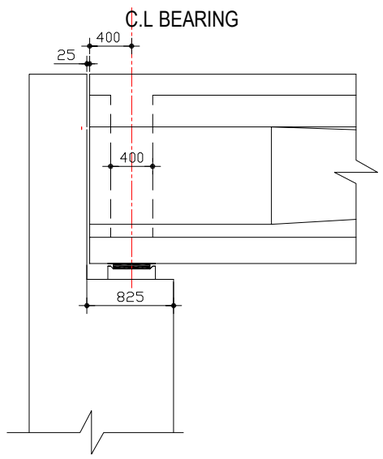
SEC. A-A (END X-GIRDER)

(Scale : 1:30)

BAR BENDING SCHEDULE FOR INTERMEDIATE & END X-GIRDERE (33.00, whole span)

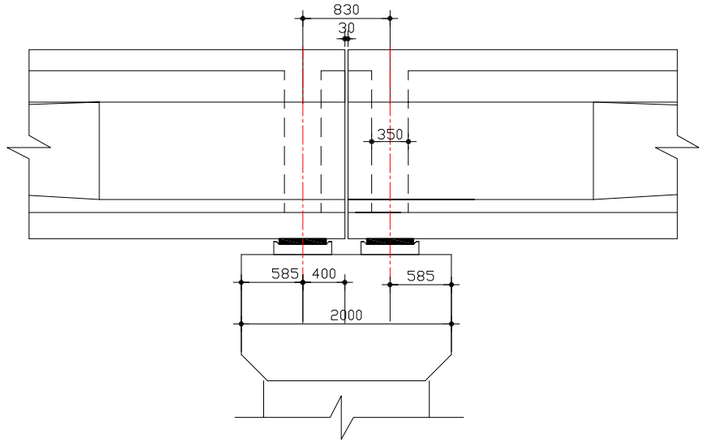
ITEM	NO.	BAR MARK	BAR TYPE & DIA (mm)	NO. OF BAR	SHAPE CODE	BENDING DIMENSIONS(MM) A	B	C	D	E	CUT LENGTH(MM)	TOTAL NO. OF BARS	TOTAL LENGTH(M)	UNIT WT. OF BAR(Kg/M)	TOTAL WT. (Kg)
INTERME - DIATE X-GIRDER	1	A	R 25	3	2A	9720	75				9870	3	29.610	3.853	114.08
		B	R 25	12	01	2010					2010	12	24.120	3.853	92.93
		B1	R 25	9	01	1050					1050	9	9.450	3.853	36.41
		B2	R 25	6	03	475	200				675	6	4.050	3.853	15.60
		C	R 12	32	01	1710					1710	32	54.720	0.888	48.59
		C1	R 12	24	01	1050					1050	24	25.200	0.888	22.38
		C2	R 12	16	03	525	200				725	16	11.600	0.888	10.30
		D	R 10	48	04	1650	220	150			3990	48	191.52	0.617	118.17
											Sub-Total of Intermediate X-girder				458.46
END X-GIRDER	1	A	R 25	4	2A	9720	75				9870	4	39.480	3.853	152.12
		B	R 25	16	01	2010					2010	16	32.160	3.853	123.91
		B1	R 25	12	01	1550					1550	12	18.600	3.853	71.67
		B2	R 25	8	03	725	200				925	8	7.400	3.853	28.51
		C	R 12	32	01	1210					1210	32	38.720	0.888	34.38
		C1	R 12	24	01	1550					1550	24	37.200	0.888	33.03
		C2	R 12	16	03	725	300				1025	16	16.400	0.888	14.56
		D	R 10	36	04	1700	270	75			4015	36	144.54	0.617	89.18
											Sub-Total of End X-girder				547.36

TOTAL WT. OF STEEL(M.TON) FOR ONE END & ONE MID GIRDER = 1.00



SEC. B-B AT ABUTMENT END

(Scale : 1:75)



SEC. C-C AT COLUMN TYPE PIER END

(Scale : 1:75)

SHAPE CODE	01	01A	02	02A	02B	03	04	05	06
SHAPE OF BARS	a	b a	b a	c b a	b a	a b	b a	b c a	a c b

NAME OF THE CLIENT :
GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH
LOCAL GOVERNMENT ENGINEERING DEPARTMENT

NAME OF THE PROJECT :
CONSULTANCY SERVICES FOR FEASIBILITY, DETAILED SURVEY AND DESIGN OF CHITTAGONG HILL TRACT CONNECTIVITY CONNECTING THEGAMUKH AND CHITTAGONG PORT.

NAME OF THE CONSULTANTS :
SAI Consulting Engineers Pvt. Ltd, India.
in association with
BETS Consulting Services Ltd, Bangladesh
Project office :
Tahmid Mahmood Palace
Flat # 9A, House # 77, Road # 4, Block-C,

DRAWING TITLE :
REINF. DETAILS OF X-GIRDER FOR 33.0m SPAN

DRAWING NO : LGED/PCG-33/XG-06

Scale :As shown

Date : 28-01-16

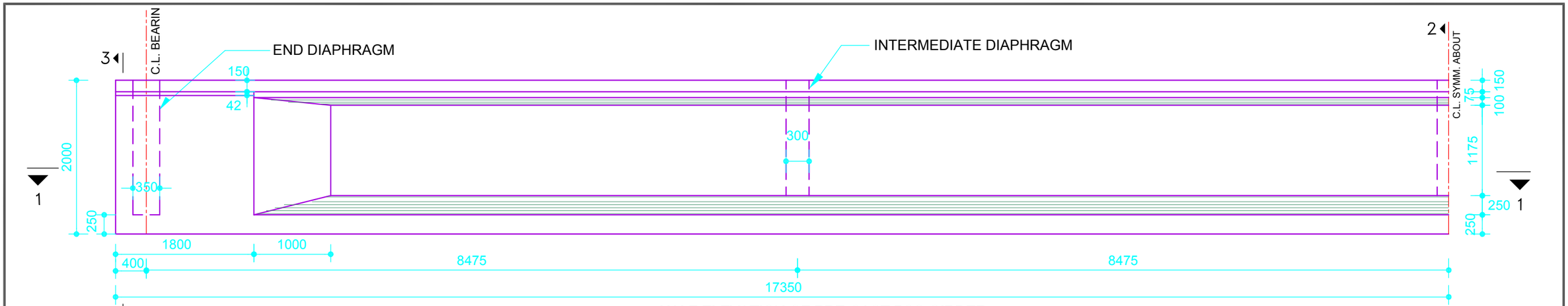
DESIGNED BY : MD. TAZUDDIN

DESIGNED BY : MD. TAZUDDIN

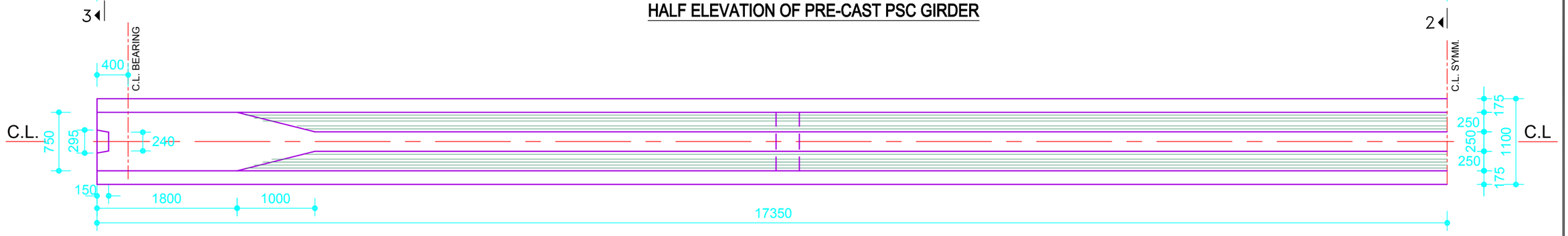
CHECKED BY : AFM HAMIDUL HAQUE

APPROVED BY : DR. PRABHAT SHRIVASTAVA

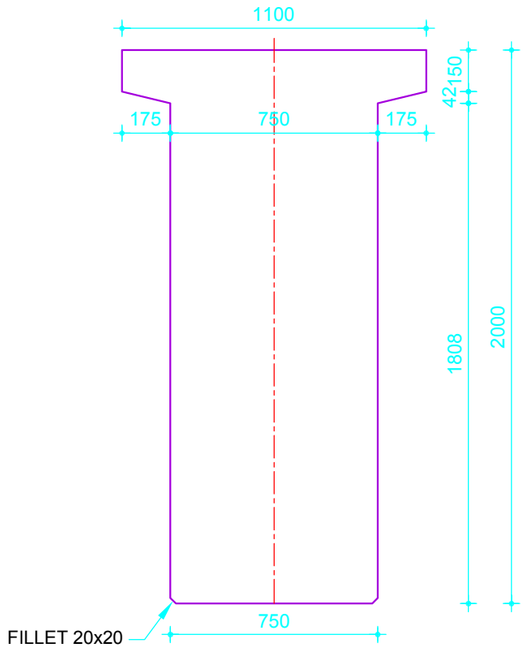
REV.	DESCRIPTION	DAT



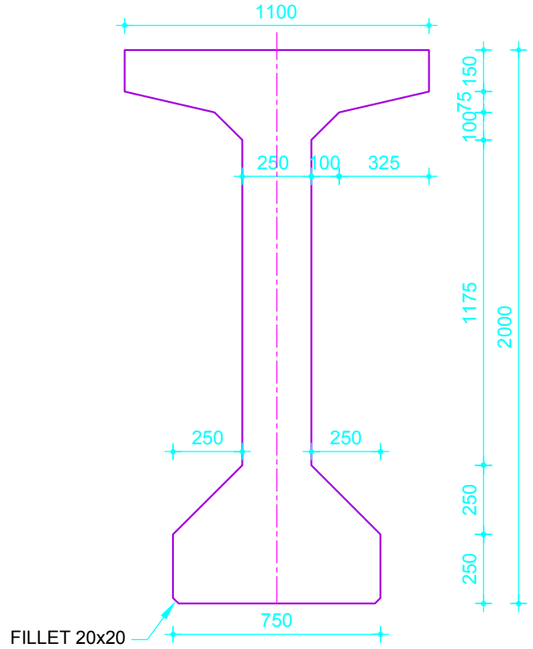
HALF ELEVATION OF PRE-CAST PSC GIRDER



SECTIONAL VIEW OF PRE-CAST PSC GIRDER (SECTION 1-1)



SECTION 3-3 AT END



SECTION 2-2 AT MIDDLE

NOTES:

1. CONCRETE SHALL HAVE SPECIFIED CHARACTERISTIC COMPRESSIVE STRENGTH OF STANDARD CYLINDER OR CUBE (15 cm) AT 28 DAYS, ARE AS FOLLOWS(15 cm) AT 28 DAYS, ARE AS FOLLOWS:
   a) STANDARD CYLINDER CRUSHING STRENGTH, f'c = 35 N/mm²
   b) STANDARD CUBE CRUSHING STRENGTH, fcu = 43 N/mm²
2. REINFORCING STEEL SHALL CONFORM TO ASTM A615-87 GRADE 6 DEFORMED BARS (MARKED 'Y') HAVING MINIMUM YEILD STRENGT Fy = 413 N/mm²
3. PRESTRESSING STEEL SHALL BE OF 12.7mm DIA. 7 PLY UNCOATE LOW RELAXATION STRAND CONFORMING TO AASHTO-M203 (GRADE-270) OR EQUIVALENT HAVING THE FOLLOWING STRENGTH:
   (a) MINIMUM ULTIMATE TENSILE STRENGTH (UTS) f 's = 1861 N/mm (183.7 KN PER STRAND)
   (b) MINIMUM YIELD STRENGTH f 'y = 1674 N/mm² (165.3 KN PER STRAND)
4. PPRESTRESSING CABLE SHALL CONSISTS OF 12 NOS.12.7mm DIA. STRAND (12T13) IN A SHEATHING/DUCT
5. FOLLOWING PROPERTIES HAVE BEEN CONSIDERED IN THE DESIGN
   AREA OF STRAND = 98.7 mm²
   AREA OF CABLE = 1184.4 mm²
   MODULLES OF ELASTICITY OF STRAND =1.97x10 ^{5} (N/mm ^{2})
   AVERAGE SLIP = 6mm
   JACKING FORCE IN EACH CABLE = 16 80 KN.

NAME OF THE CLIENT :
GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH
LOCAL GOVERNMENT ENGINEERING DEPARTMENT

NAME OF THE PROJECT :
CONSULTANCY SERVICES FOR FEASIBILITY, DETAILED SURVEY AND DESIGN OF CHITTAGONG HILL TRACT CONNECTIVITY CONNECTING THEGAMUKH AND CHITTAGONG PORT.

NAME OF THE CONSULTANTS :
SAI Consulting Engineers Pvt. Ltd, India.
in association with
BETS Consulting Services Ltd, Bangladesh
Project office :
Tahmid Mahmood Palace
Flat # 9A, House # 77, Road # 4, Block-C,
Banani, Dhaka-1213, Bangladesh.

DRAWING TITLE :
35.0m LONG PC GIRDER CONCRETE OUTLINE DETAILS

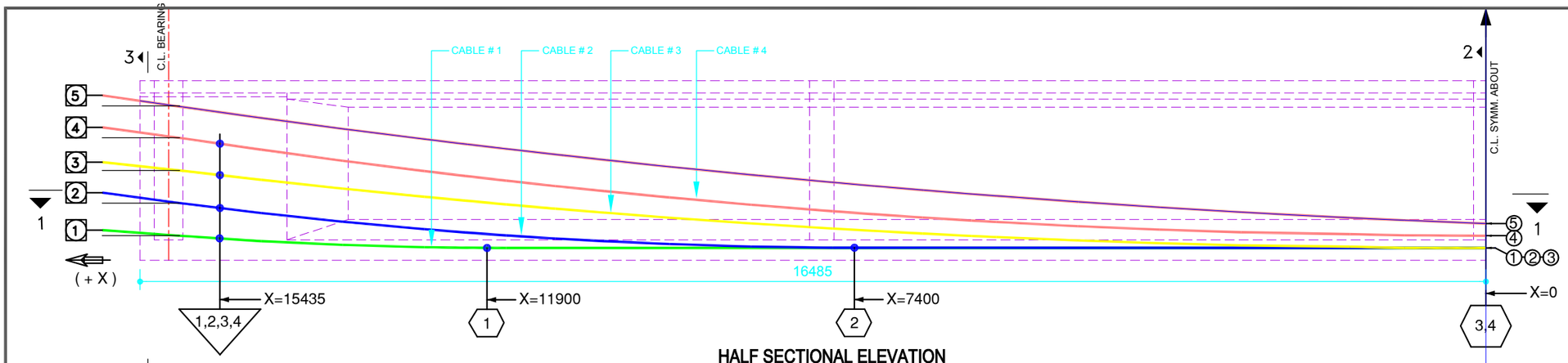
DRAWING NO : LGED/PCG-35/CON-01

Scale :As shown

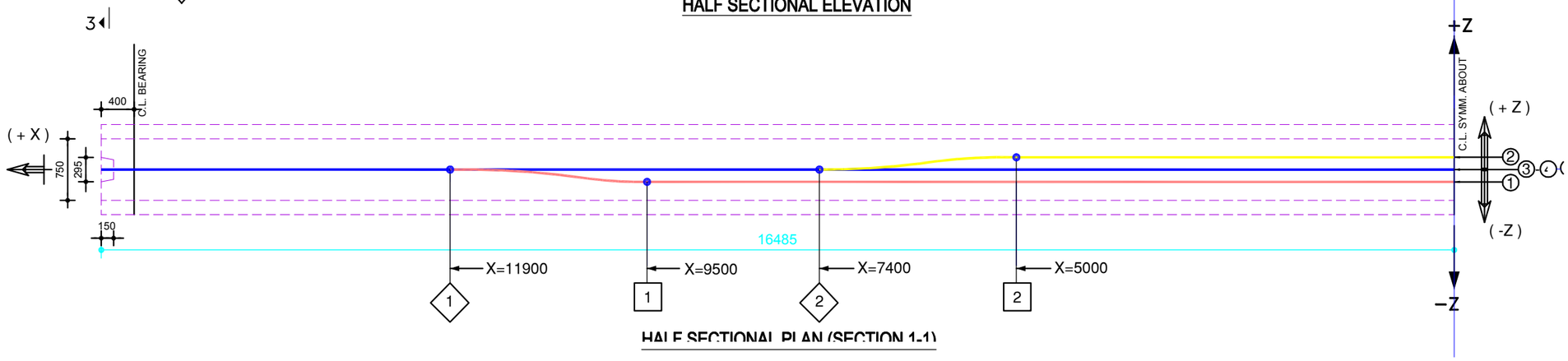
Date : 28-01-16

DESIGNED BY :	DRAWN BY :	CHECKED BY :	APPROVED BY :
MD. TAZUDDIN	MD. TAZUDDIN	AFM HAMIDUL HAQUE	DR. PRABHAT SHRIVASTAVA

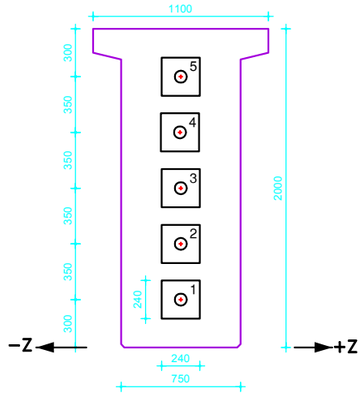
REV.	DESCRIPTION	DATE



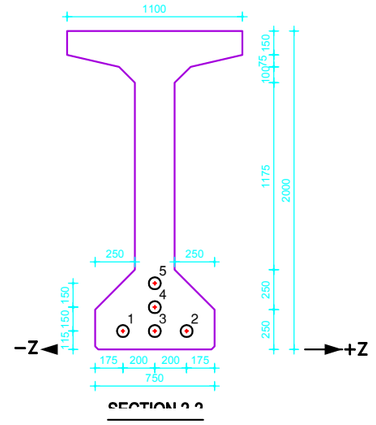
HALF SECTIONAL ELEVATION



HALF SECTIONAL PLAN (SECTION 1-1)



SECTION 3-3
(END SECTION)



SECTION 2-2

Cable No.	ORDINATE AT DISTANCE X FROM CENTER																				Extension at each jecking end	Emergence angle
	17350		15000		14000		13000		12000		11500		1030		9100		8500		8000		7500			
	Y	Z	Y	Z	Y	Z	Y	Z	Y	Z	Y	Z	Y	Z	Y	Z	Y	Z	Y	Z	Y	Z		
1	300		204		177		160		151		150		150		150		150		150		150		121.11	0.99
2	650		457		389		329		278		256		211		179		167		160		154		121.35	3.30
3	1000		785		703		627		557		523		450		384		354		331		309		121.86	5.58
4	1350		1085		984		889		802		761		670		589		552		523		496		122.26	6.87
5	1700		1384		1264		1152		1048		999		891		794		750		716		684		122.76	8.14
1		0		0		0		0		0		0		-75.0		-150		-150		-150		-150		
2		0		0		0		0		0				0		0		0		0		0		

Cable No.																					Extension at each jecking end	Emergence angle
	7000		6500		5300		4100		3500		3000		2500		2000		1500		1000		0			
	Y	Z	Y	Z	Y	Z	Y	Z	Y	Z	Y	Z	Y	Z	Y	Z	Y	Z	Y	Z	Y	Z		
1	150		150		150		150		150		150		150		150		150		150		150		121.11	0.99
2	151		150		150		150		150		150		150		150		150		150		150		121.35	3.30
3	288		269		229		197		185		175		168		161		156		153		150		121.86	5.58
4	471		447		398		359		331		331		322		314		308		303		300		122.26	6.87
5	653		625		567		520		501		487		476		467		459		454		450		122.76	8.14
1		-150		-150		-150		-150		-150		-150		-150		-150		-150		-150		-150		
2		0		0		75.0		150		150		150		150		150		150		150		150		

LEGEND:

- INDICATES START OF CURVE IN ELEVATION
- INDICATES END OF CURVE IN ELEVATION
- INDICATES START OF CURVE IN PLAN
- INDICATES END OF CURVE IN PLAN
- INDICATES END OF CABLE
- INDICATES CABLE NUMBER

NAME OF THE CLIENT :
GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH
LOCAL GOVERNMENT ENGINEERING DEPARTMENT

NAME OF THE PROJECT :
CONSULTANCY SERVICES FOR FEASIBILITY, DETAILED SURVEY AND DESIGN OF CHITTAGONG HILL TRACT CONNECTIVITY CONNECTING THEGAMUKH AND CHITTAGONG PORT.

NAME OF THE CONSULTANTS :
SAI Consulting Engineers Pvt. Ltd, India.
in association with
BETS Consulting Services Ltd, Bangladesh
Project office :
Tahmid Mahmood Palace
Flat # 9A, House # 77, Road # 4, Block-C,
Banani, Dhaka-1213, Bangladesh.

DRAWING TITLE :
35.0m LONG PC GIRDER PRE-STRESSING CABLE DETAILS

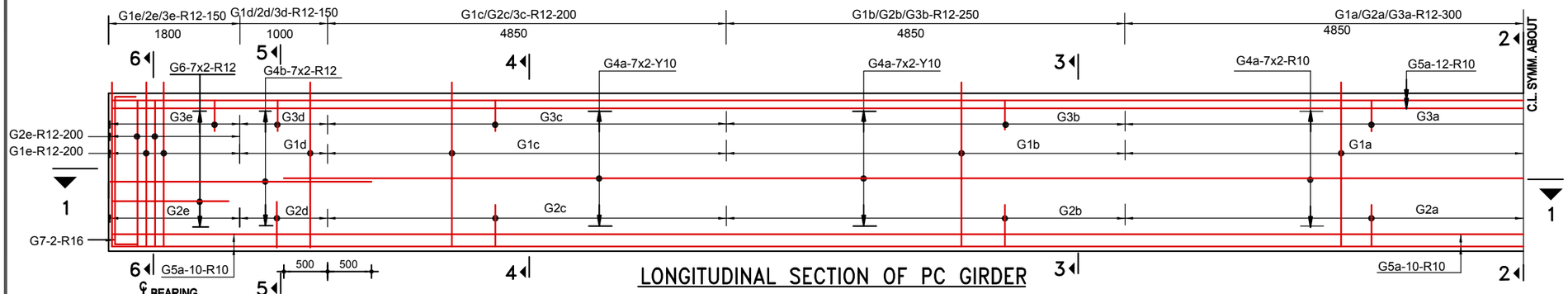
DRAWING NO : LGED/PCG-35/CON-02

Scale :As shown

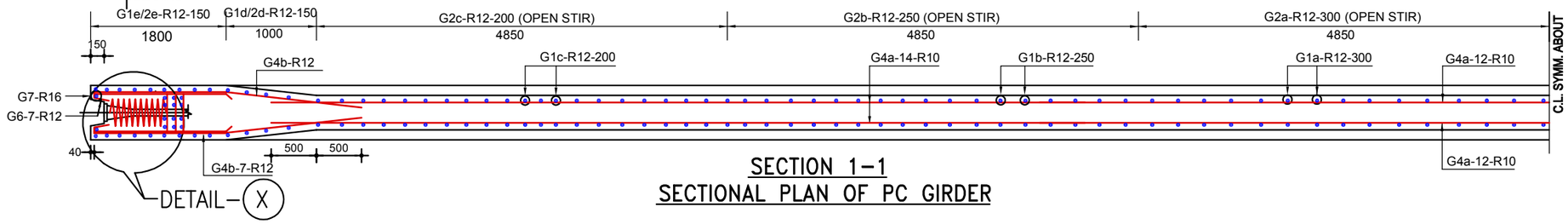
Date : 28-01-16

DESIGNED BY :	DRAWN BY :	CHECKED BY :	APPROVED BY :
MD. TAZUDDIN	MD. TAZUDDIN	AFM HAMIDUL HAQUE	DR. PRABHAT SHRIVASTAVA

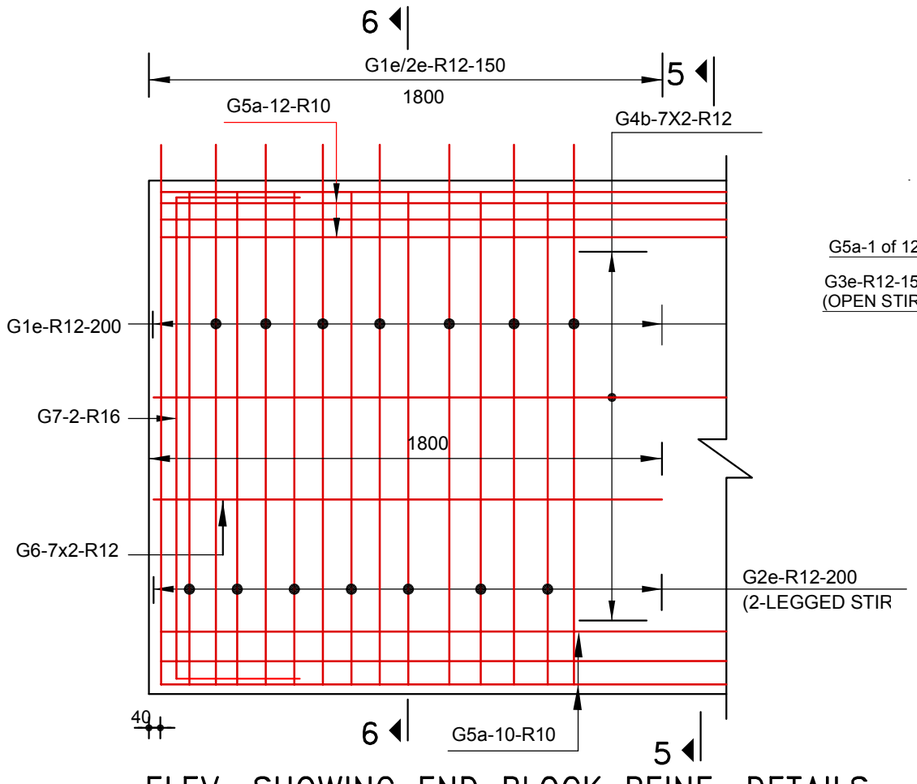
REV.	DESCRIPTION	DATE



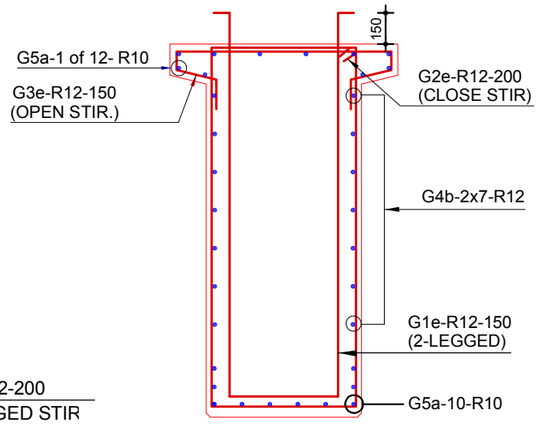
LONGITUDINAL SECTION OF PC GIRDER



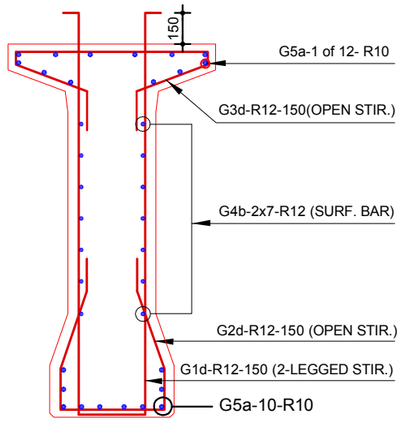
SECTION 1–1
SECTIONAL PLAN OF PC GIRDER



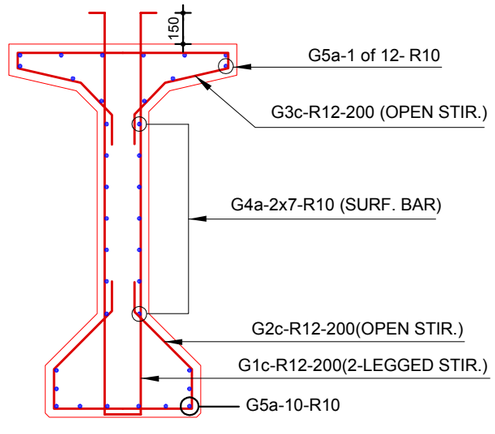
ELEV. SHOWING END BLOCK REINF. DETAILS



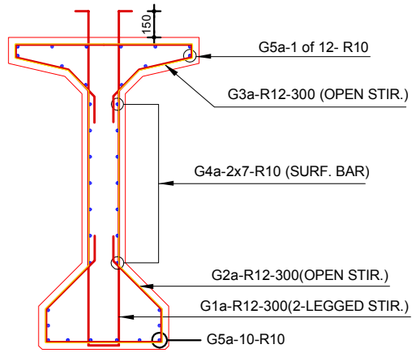
SECTION 6-6
(END SECTION)



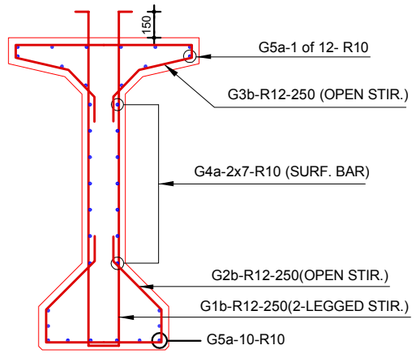
SECTION 5-5
(MID SECTION)



SECTION 4-4
(MID SECTION)



SECTION 2-2
(MID SECTION)



SECTION 3-3
(MID SECTION)

NAME OF THE CLIENT :
GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH
LOCAL GOVERNMENT ENGINEERING DEPARTMENT

NAME OF THE PROJECT :
CONSULTANCY SERVICES FOR FEASIBILITY, DETAILED SURVEY AND DESIGN OF CHITTAGONG HILL TRACT CONNECTIVITY CONNECTING THEGAMUKH AND CHITTAGONG PORT.

NAME OF THE CONSULTANTS :
SAI Consulting Engineers Pvt. Ltd, India.
in association with
BETS Consulting Services Ltd, Bangladesh
Project office :
Tahmid Mahmood Palace
Flat # 9A, House # 77, Road # 4, Block-C,
Banani, Dhaka-1213, Bangladesh.

DRAWING TITLE :
35.0m LONG PC GIRDER NON-PRE STRESSING REINF. DETAILS

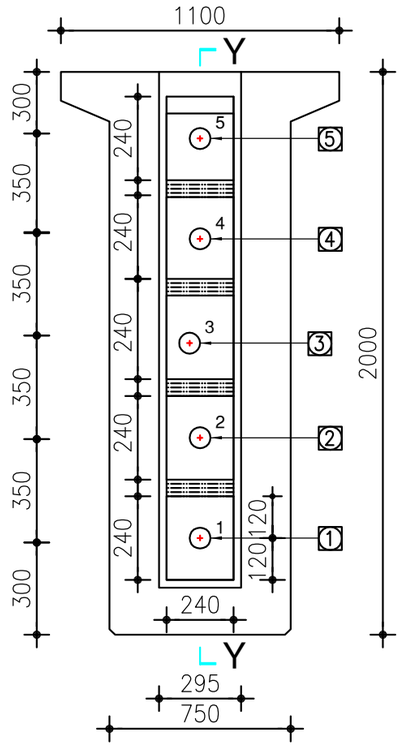
DRAWING NO : LGED/PCG-35/REINF.-03

Scale :As shown

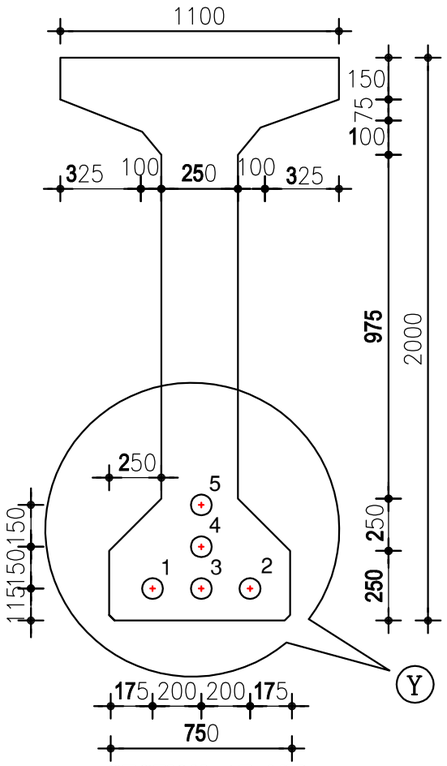
Date : 28-01-16

DESIGNED BY :	DRAWN BY :	CHECKED BY :	APPROVED BY :
MD. TAZUDDIN	MD. TAZUDDIN	AFM HAMIDUL HAQUE	DR. PRABHAT SHRIVASTAVA

REV.	DESCRIPTION	DATE



SECTION AT END

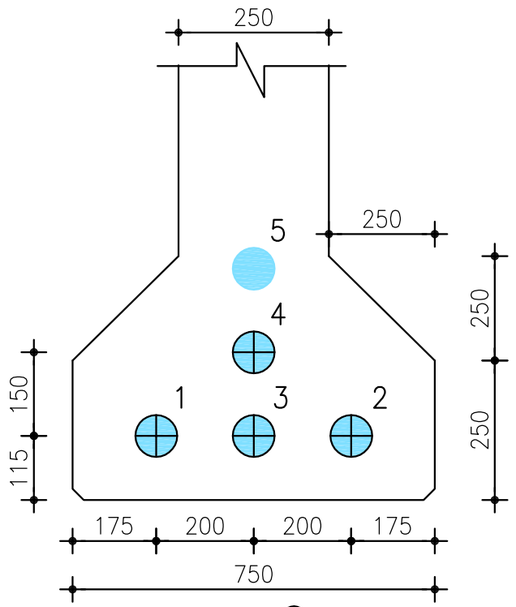


SECTION AT MID

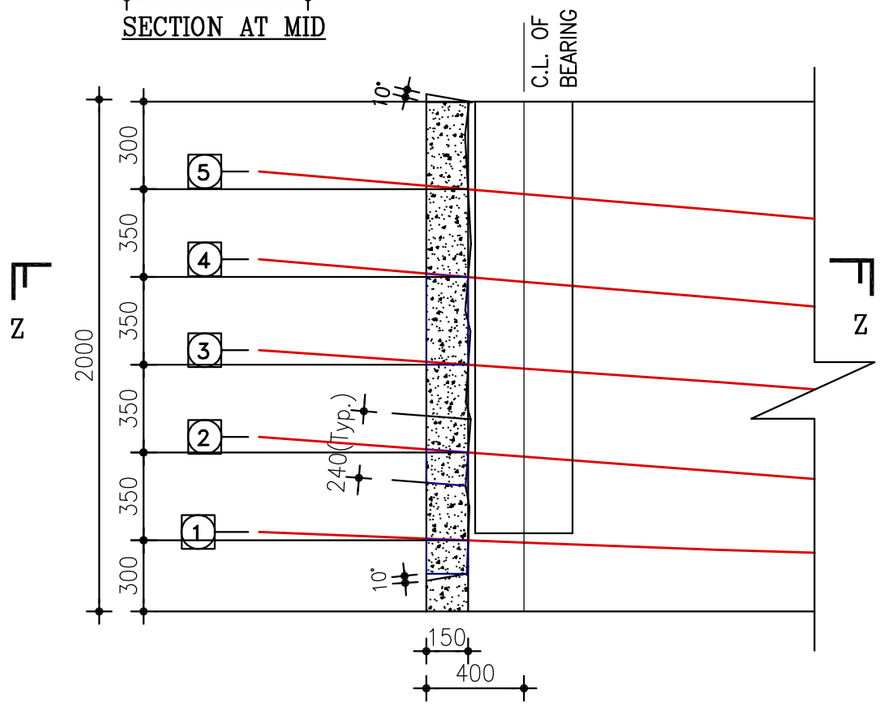
NOTES:

STAGES AND SEQUENCE OF PRESTRESSING

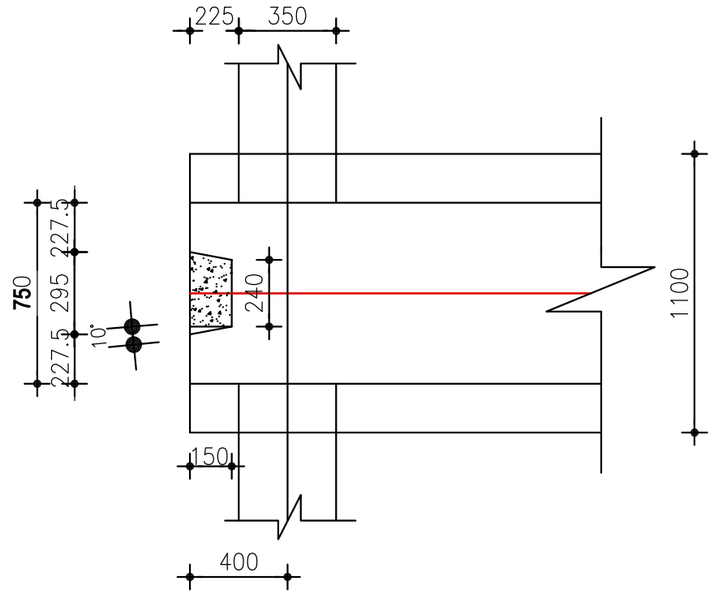
1. EACH CABLE SHALL BE STRESSED SIMULTANEOUSLY FROM BOTH ENDS. THE JACKING FORCE IN EACH CABLE SHALL BE 1680 KN TO BE IMPARTED SIMULTANEOUSLY AT BOTH ENDS.
2. THE SEQUENCE OF STRESSING OF PRESTRESSING CABLES SHALL BE AS FOLLOWS: 3, 2,1, 4 & 5
3. STRESSING OF CABLES SHALL BE DONE MINIMUM AFTER 14 DAYS OR CONCRETE STRENGTH NOT LESS THAN 26N/mm^2 WHICHEVER IS LATER.
4. THE EXTENSION SHOWN IN THE TABLE IS FOR THE PORTION OF CABLES LYING BETWEEN MID SPAN AND RECESS FACE OF THE GIRDER. ADDITIONAL ELONGATION FOR GRIPPING LENGTH MUST BE ADDED DURING TENSIONING.
5. EACH CABLES CONSISTS OF 12 NOS. 12.7mm DIA. (12T13) 7-PLY UNCOATED LOW RELAXATION STRANDS
6. FOR OTHER REQUIREMENTS REFER GENERAL NOTES FOR PC GIRDER : S-02
7. THE CONTRACTOR SHALL SUBMIT DETAILS SHOP DRAWING FOR PC GIRDER'S FORMWORK AND SCAFFOLDING SYSTEM AND GET IT APPROVED BY CONCERNED XEN.
8. THE FORMWORK OF PC GIRDER MUST BE MADE OF M.S. SHEET HAVING THICKNESS 12BWG WITH NECESSARY BRACING.



DETAIL Ⓨ



DETAILS OF END BLOCK

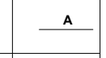
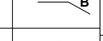
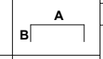
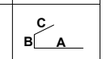
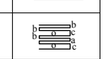


SECTION Z–Z

NAME OF THE CLIENT : GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH **LOCAL GOVERNMENT ENGINEERING DEPARTMENT**	NAME OF THE CONSULTANTS : **SAI Consulting Engineers Pvt. Ltd, India.** in association with **BETS Consulting Services Ltd, Bangladesh** Project office : Tahmid Mahmood Palace Flat # 9A, House # 77, Road # 4, Block-C, Banani, Dhaka-1213, Bangladesh.	DRAWING TITLE : END BLOCK DETAILS OF 35.0m LONG PC GIRDER DRAWING NO : LGED/PCG-35/EBL-04 Scale :As shown Date : 28-01-16	DESIGNED BY : MD. TAZUDDIN	DRAWN BY : MD. TAZUDDIN	CHECKED BY : AFM HAMIDUL HAQUE	APPROVED BY : DR. PRABHAT SHRIVASTAVA	REV.	DESCRIPTION	DATE

NAME OF THE PROJECT : CONSULTANCY SERVICES FOR FEASIBILITY, DETAILED SURVEY AND DESIGN OF CHITTAGONG HILL TRACT CONNECTIVITY CONNECTING THEGAMUKH AND CHITTAGONG PORT.

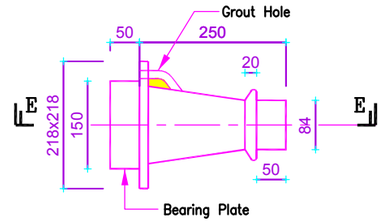
BAR BENDING SCHEDULE OF NON-PRESTRESSED REINF. (FOR ONE GIRDER, 35.0m)

SHAP CODE	BAR SHAPE	ITEM	NO.	BAR MARK	BAR TYPE & DIA (mm)	NO. OF BAR	SHAPE CODE	BENDING DIMENSIONS(MM) A	B	C	D	E	F	G	CUT LENGTH(MM)	TOTAL NO. OF BARS	TOTAL LENGTH(M)	UNIT WT. OF BAR(Kg/M)	TOTAL WT.(Kg)
1		PC GIRDER	1	G1a	R 12	34	1	170	1910	200					4350	34	147.900	0.888	131.31
				G1b	R 12	40	1	170	1910	200					4350	40	174.000	0.888	154.48
				G1c	R 12	50	1	170	1910	200					4560	50	228.000	0.888	202.42
2				G1d	R 12	14	1	420	1910	200					4640	14	64.960	0.888	57.67
				G1e	R 12	24	1	670	1910	200					4890	24	117.360	0.888	104.19
				G2a	R 12	34	2A	670	197	400	200				2264	34	76.976	0.888	68.34
				G3a	R 12	34	2	1020	78	313	216	200			2634	34	89.560	0.888	79.51
2A				G2b	R 12	40	2A	670	197	400	200				2264	40	90.560	0.888	80.40
				G3b	R 12	40	2	1020	78	313	216	200			2234	40	89.360	0.888	79.34
				G2c	R 12	50	2A	670	197	400	200				2264	50	113.200	0.888	100.50
				G3c	R 12	50	2	1020	78	313	216	200			2234	50	111.700	0.888	99.17
				G2d	R 12	14	2A	670	197	400	200				2269	14	31.766	0.888	28.20
				G3d	R 12	14	2	1020	78	313	216	200			2234	14	31.276	0.888	27.77
3				G2e	R 12	24	3	670	1720	200					5180	24	124.320	0.888	110.37
				G3e	R 12	36	2	1020	78	313	216				2234	36	80.424	0.888	71.40
				G4a	R 10	14	4	30400							30400	14	425.600	0.617	262.40
4				G4b	R 12	28	5	1700	1521						3221	28	90.179	0.888	80.06
				G5a	R 10	12	4	35700							35700	12	428.424	0.617	264.14
				G5a	R 10	10	4	35700							35700	10	357.020	0.617	220.12
				G6	R 12	28	6	1700	150						3700	28	103.600	0.888	91.98
5				G7	R 16	4	7	1720	100						1920	4	7.680	1.578	12.12
		MESH	1	m1	R 12	6	8	9900	450	7560	1350				19260	6	115.56	0.888	102.60
6				m2	R 8	2	8	3000	450	3000	450				6900	2	13.800	0.395	5.45
		Spiral	1	S1	R 12	2	03	7295							7295	2	14.590	0.888	12.95
7																			
8																			

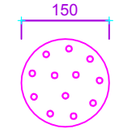
NB : BARBENDING SCHEDULE SHOULD BE CHECKED AT SITE BEFORE FABRICATION.

TOTAL WT.OF STEEL-Y16 (M.TON) = 0.01
TOTAL WT.OF STEEL-Y12 (M.TON) = 1.68
TOTAL WT.OF STEEL-Y10 (M.TON) = 0.75
TOTAL WT.OF STEEL-Y8 (M.TON) = 0.01

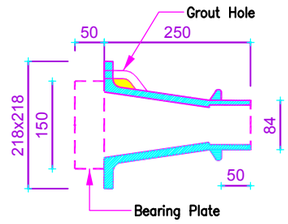
TOTAL WT. OF STEEL(M.TON) FOR ONE GIRDE = 2.45



Freyssinet Branded 12T13 Anchorage



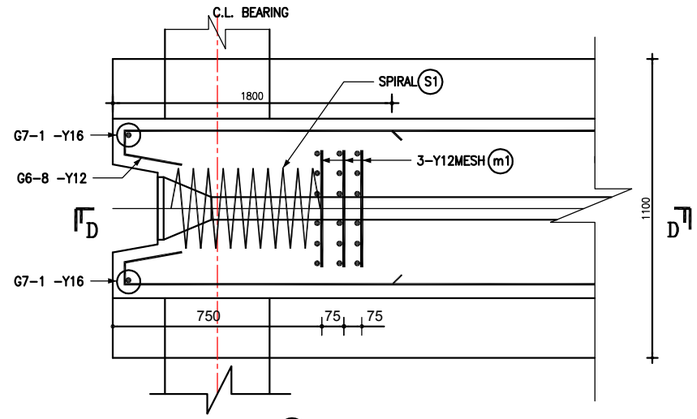
Bearing Plate



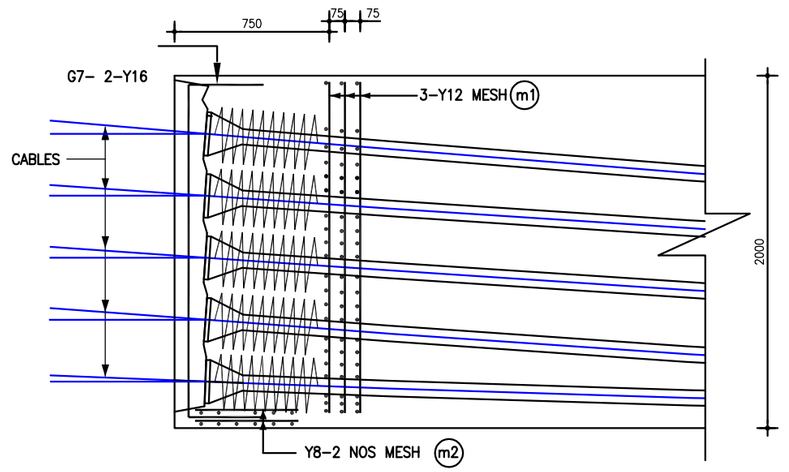
Section E-E

NOTES:

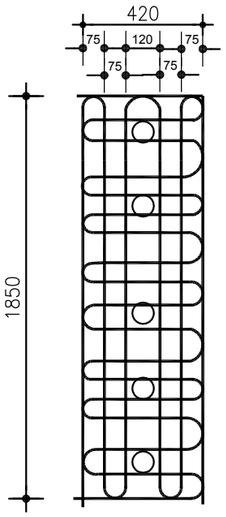
1. ANCHORAGE MUST BE TESTED TO CONFIRM ITS CAPACITY APPLYING 95% OF ULTIMATE LOAD (2205 KN) AS PER STANDARD SPECIFICATION PRIOR TO USE
2. HYDRAULIC JACKS FOR TENSIONING OPERATION MUST BE OF SAME BRANDED OF ANCHORAGE SYSTEM HAVING RECENT CALIBRATION
3. TENSIONING OPERATION SHALL BE CARRIED OUT IN PRESENCE OF AN EXPERIENCED ENGINEER OR AS DIRECTED BY THE DESIGN UNIT, LGED
4. THE PRE-STRESSING PARTY, IF SUBCONTRACTED, SHALL BE SELECTED TAKING PRIOR APPROVAL OF CONCERNED EXECUTIVE ENGINEER OR AS APPROVED BY DESIGN UNIT, LGED



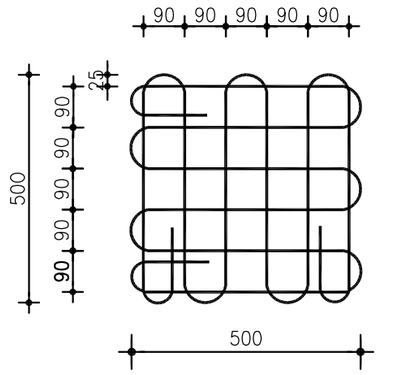
DETAIL– X



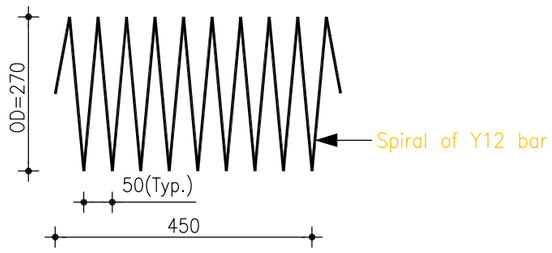
SECTION D–D



Y12 MESH REINFORCEMENT m1



Y8 MESH REINF. ABOVE BEARINGS m2

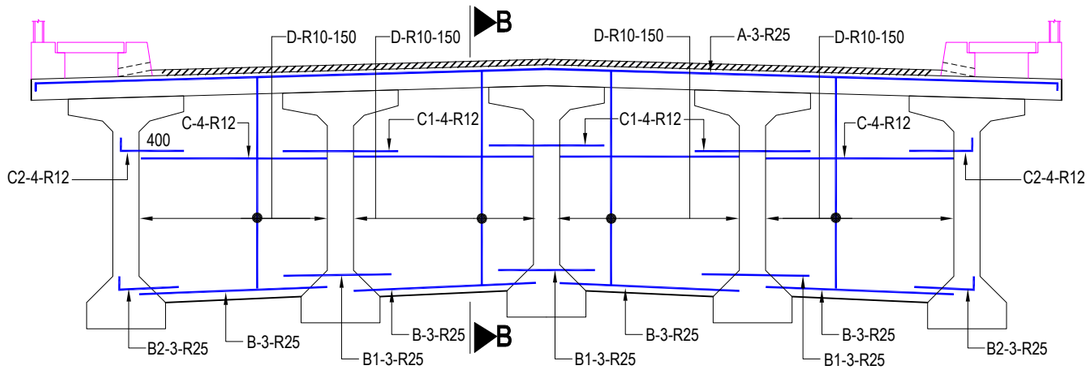


DETAILS OF SPIRAL S1

NAME OF THE CLIENT : GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH **LOCAL GOVERNMENT ENGINEERING DEPARTMENT**	NAME OF THE CONSULTANTS : **SAI Consulting Engineers Pvt. Ltd, India.** in association with **BETS Consulting Services Ltd, Bangladesh** Project office : Tahmid Mahmood Palace Flat # 9A, House # 77, Road # 4, Block-C, Banani, Dhaka-1213, Bangladesh.	DRAWING TITLE : TYPICAL PRE-STRESSING ANCHORAGE DETAILS FOR 35.0m LONG PC GIRDER DRAWING NO : LGED/PCG-35/ANC.-05 Scale :As shown Date : 28-01-16	DESIGNED BY : MD. TAZUDDIN	DRAWN BY : MD. TAZUDDIN	CHECKED BY : AFM HAMIDUL HAQUE	APPROVED BY : DR. PRABHAT SHRIVASTAVA

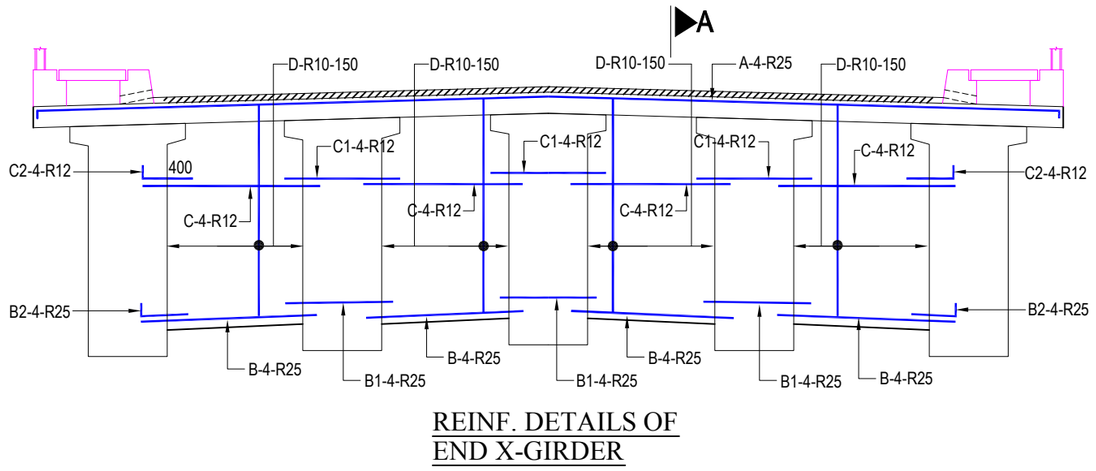
NAME OF THE PROJECT : CONSULTANCY SERVICES FOR FEASIBILITY, DETAILED SURVEY AND DESIGN OF CHITTAGONG HILL TRACT CONNECTIVITY CONNECTING THEGAMUKH AND CHITTAGONG PORT.

REV.	DESCRIPTION	DATE



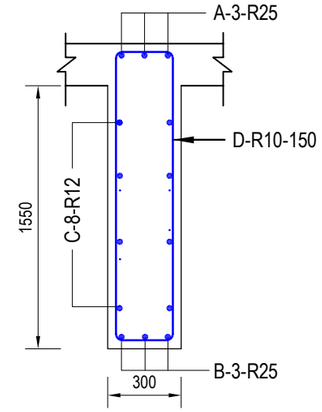
REINF. DETAILS OF INTER-MEDIATE X-GIRDER

(Scale : 1:60)



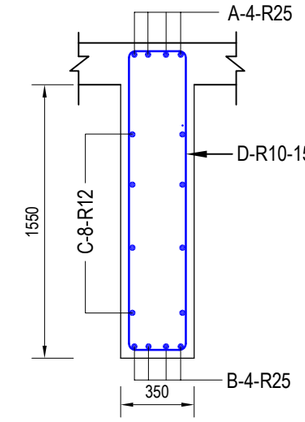
REINF. DETAILS OF END X-GIRDER

(Scale : 1:60)



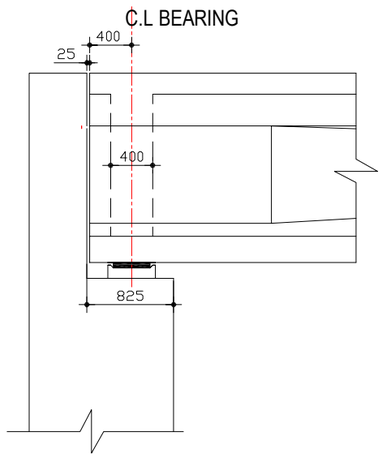
SEC. B-B (INTERMEDIATE X-GIRDER)

(Scale : 1:30)



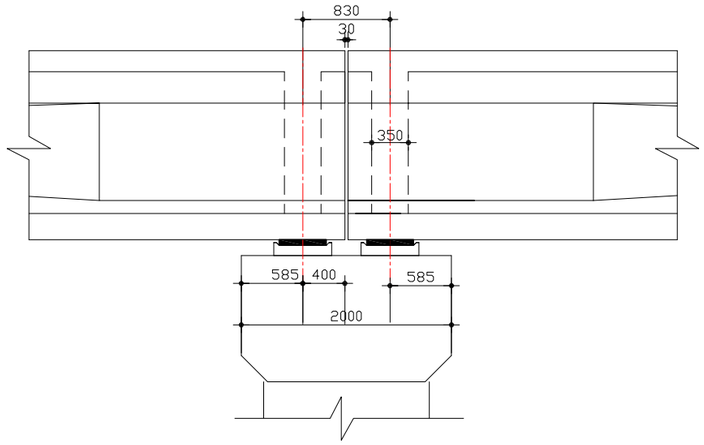
SEC. A-A (END X-GIRDER)

(Scale : 1:30)



SEC. B-B AT ABUTMENT END

(Scale : 1:75)



SEC. C-C AT COLUMN TYPE PIER END

(Scale : 1:75)

BAR BENDING SCHEDULE FOR INTERMEDIATE & END X-GIRDERE (ONE MID & ONE END X-GIRDER)

ITEM	NO.	BAR MARK	BAR TYPE & DIA (mm)	NO. OF BAR	SHAPE CODE	BENDING DIMENSIONS(MM) A	B	C	D	E	CUT LENGTH(MM)	TOTAL NO. OF BARS	TOTAL LENGTH(M)	UNIT WT. OF BAR(Kg/M)	TOTAL WT.(Kg)
INTERME - DIATE X-GIRDER	1	A	R 25	3	2A	9720	75				9870	1	9.870	3.853	38.03
		B	R 25	12	01	2010					2010	12	24.120	3.853	92.93
		B1	R 25	9	01	1050					1050	9	9.450	3.853	36.41
		B2	R 25	6	03	475	200				675	6	4.050	3.853	15.60
		C	R 12	32	01	1710					1710	32	54.720	0.888	48.59
		C1	R 12	24	01	1050					1050	24	25.200	0.888	22.38
		C2	R 12	16	03	525	200				725	16	11.600	0.888	10.30
		D	R 10	48	04	1650	220	150			3990	48	191.52	0.617	117.21
											Sub-Total of Intermediate X-girder				381.45
END X-GIRDER	1	A	R 25	4	2A	9720	75				9870	4	39.480	3.853	152.12
		B	R 25	16	01	2010					2010	16	32.16	3.853	123.91
		B1	R 25	12	01	1550					1550	12	18.600	3.853	71.67
		B2	R 25	8	03	725	200				925	8	7.400	3.853	28.51
		C	R 12	32	01	1210					1210	32	38.72	0.888	34.38
		C1	R 12	24	01	1550					1550	24	37.200	0.888	33.03
		C2	R 12	16	03	725	300				1025	16	16.400	0.888	14.56
		D	R 10	36	04	1700	270	75			4015	36	144.520	0.617	89.18
											Sub-Total of End X-girder				547.36

TOTAL WT. OF STEEL(M.TON) FOR ONE END & ONE MID GIRDR = 0.93

SHAPE CODE	01	01A	02	02A	02B	03	04	05	06
SHAPE OF BARS	a	b a	b a	c b a	b a	a b	b a	b c a	a c b

NAME OF THE CLIENT :
GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH
LOCAL GOVERNMENT ENGINEERING DEPARTMENT

NAME OF THE PROJECT :
CONSULTANCY SERVICES FOR FEASIBILITY, DETAILED SURVEY AND DESIGN OF CHITTAGONG HILL TRACT CONNECTIVITY CONNECTING THEGAMUKH AND CHITTAGONG PORT.

NAME OF THE CONSULTANTS :
SAI Consulting Engineers Pvt. Ltd, India.
in association with
BETS Consulting Services Ltd, Bangladesh
Project office :
Tahmid Mahmood Palace
Flat # 9A, House # 77, Road # 4, Block-C,

DRAWING TITLE :
REINF. DETAILS OF X-GIRDER FOR 35.0m SPAN

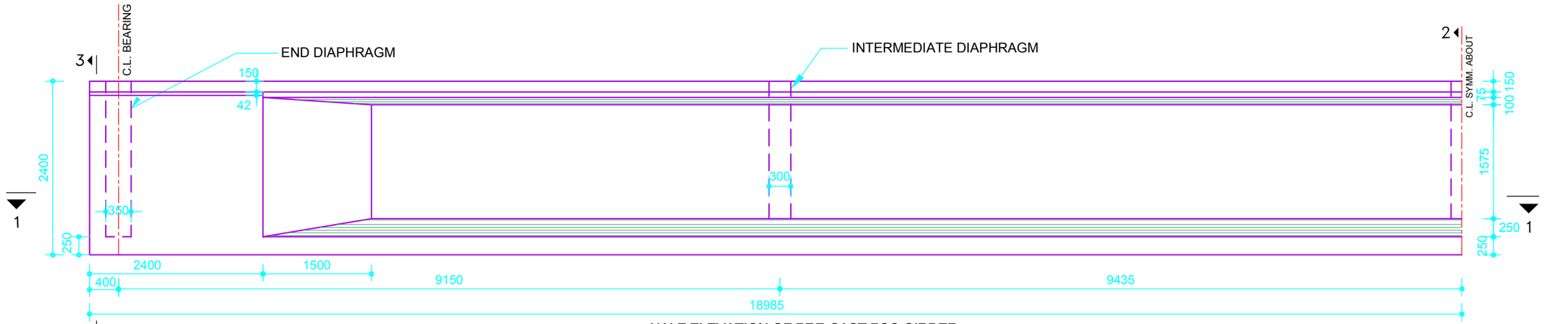
DRAWING NO : LGED/PCG-35/XG-06

Scale :As shown

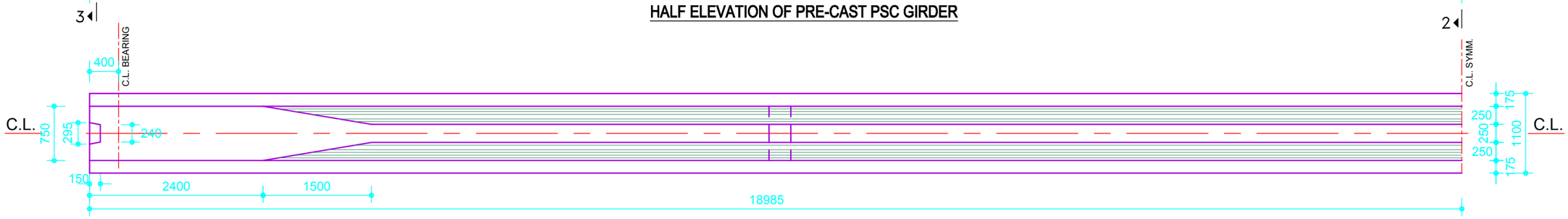
Date : 28-01-16

DESIGNED BY :	DESIGNED BY :	DRAWN BY :	CHECKED BY :	APPROVED BY :
	MD. TAZUDDIN	MD. TAZUDDIN	AFM HAMIDUL HAQUE	DR. PRABHAT SHRIVASTAVA

REV.	DESCRIPTION	DAT

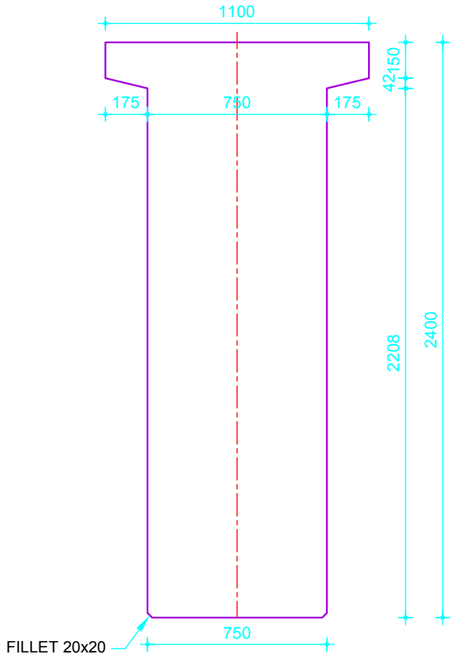


HALF ELEVATION OF PRE-CAST PSC GIRDER

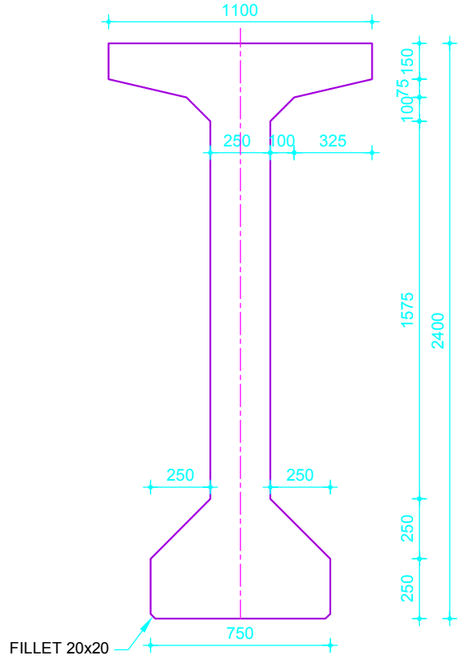


SECTIONAL VIEW OF PRE-CAST PSC GIRDER (SECTION 1-1)

(Scale : 1:60)



SECTION 3-3 AT END



SECTION 2-2 AT MIDDLE

NOTES:

1. CONCRETE SHALL HAVE SPECIFIED CHARACTERISTIC COMPRESSIVE STRENGTH OF STANDARD CYLINDER OR CUBE (15 cm) AT 28 DAYS, ARE AS FOLLOWS(15 cm) AT 28 DAYS, ARE AS FOLLOWS:
   a) STANDARD CYLINDER CRUSHING STRENGTH, f'c = 35 N/mm²
   b) STANDARD CUBE CRUSHING STRENGTH, fcu = 43 N/mm²
2. REINFORCING STEEL SHALL CONFORM TO ASTM A615-87 GRADE 6 DEFORMED BARS (MARKED 'Y') HAVING MINIMUM YEILD STRENGT Fy = 413 N/mm²
3. PRESTRESSING STEEL SHALL BE OF 12.7mm DIA. 7 PLY UNCOATE LOW RELAXATION STRAND CONFORMING TO AASHTO-M203 (GRADE-270) OR EQUIVALENT HAVING THE FOLLOWING STRENGTH:
   (a) MINIMUM ULTIMATE TENSILE STRENGTH (UTS) f 's = 1861 N/mm (183.7 KN PER STRAND)
   (b) MINIMUM YIELD STRENGTH f 'y = 1674 N/mm² (165.3 KN PER STRAND)
4. PPRESTRESSING CABLE SHALL CONSISTS OF 12 NOS.12.7mm DIA. STRAND (12T13) IN A SHEATHING/DUCT
5. FOLLOWING PROPERTIES HAVE BEEN CONSIDERED IN THE DESIGN
   AREA OF STRAND = 98.7 mm²
   AREA OF CABLE = 1184.4 mm²
   MODULLES OF ELASTICITY OF STRAND =1.97x10 ^{5} (N/mm ^{2})
   AVERAGE SLIP = 6mm
   JACKING FORCE IN EACH CABLE = 16 80 KN.

NAME OF THE CLIENT :
GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH
LOCAL GOVERNMENT ENGINEERING DEPARTMENT

NAME OF THE PROJECT :
CONSULTANCY SERVICES FOR FEASIBILITY, DETAILED SURVEY AND DESIGN OF CHITTAGONG HILL TRACT CONNECTIVITY CONNECTING THEGAMUKH AND CHITTAGONG PORT.

NAME OF THE CONSULTANTS :
SAI Consulting Engineers Pvt. Ltd, India.
in association with
BETS Consulting Services Ltd, Bangladesh
Project office :
Tahmid Mahmood Palace
Flat # 9A, House # 77, Road # 4, Block-C,
Banani, Dhaka-1213, Bangladesh.

DRAWING TITLE :
38.0m LONG PC GIRDER CONCRETE OUTLINE DETAILS

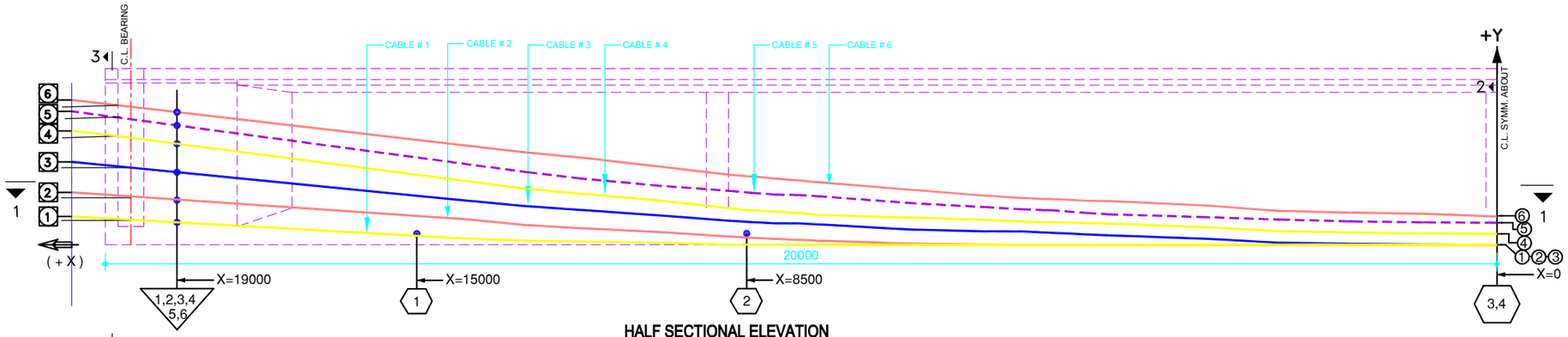
DRAWING NO : LGED/PCG-38/CON-01

Scale :As shown

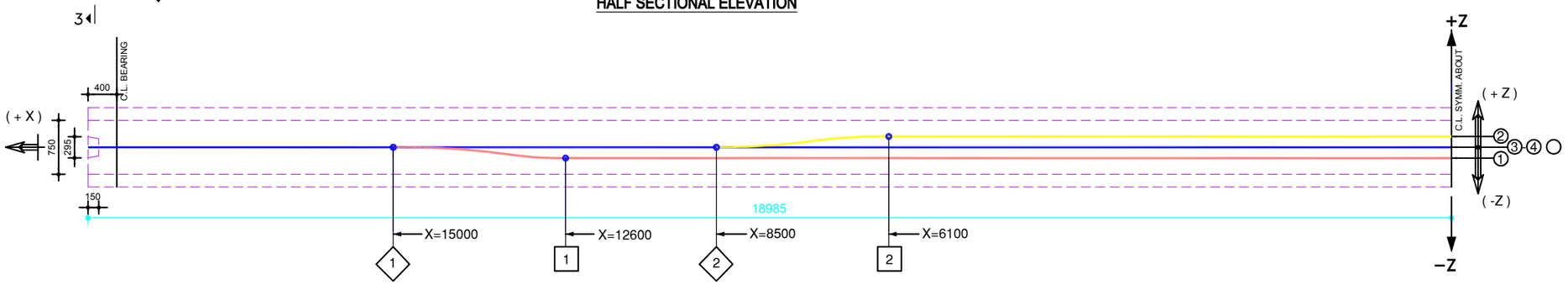
Date : 28-01-16

DESIGNED BY :	DRAWN BY :	CHECKED BY :	APPROVED BY :
MD. TAZUDDIN	MD. TAZUDDIN	AFM HAMIDUL HAQUE	DR. PRABHAT SHRIVASTAVA

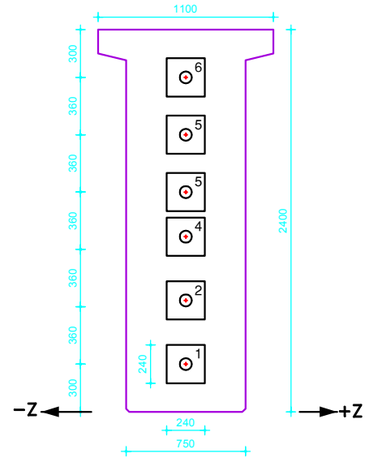
REV.	DESCRIPTION	DATE



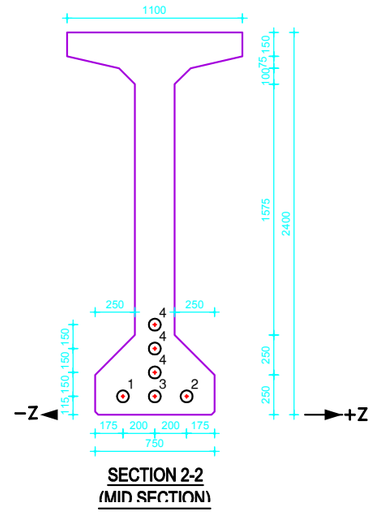
HALF SECTIONAL ELEVATION



HALF SECTIONAL PLAN (SECTION 1-1)



SECTION 3-3
(END SECTION)



SECTION 2-2
(MID SECTION)

Cable No.	ORDINATE AT DISTANCE X FROM CENTER																				Extension at each jecking end	Emergence angle
	18985		18500		18000		17000		16000		15000		13800		12600		12000		11000		10000			
	Y	Z	Y	Z	Y	Z	Y	Z	Y	Z	Y	Z	Y	Z	Y	Z	Y	Z	Y	Z	Y	Z		
1	300		247		204		174		156		150		150		150		150		150		150		139.49	0.86
2	660		576		499		429		367		313		259		215		197		174		159		139.71	2.92
3	1020		936		856		780		708		640		565		496		464		414		368		140.18	4.96
4	1380		1276		1176		1081		992		908		815		729		689		627		570		140.56	6.14
5	1740		1616		1496		1383		1277		1177		1065		963		915		841		773		141.02	7.32
6	2100		1956		1817		1685		1561		1445		1315		1196		1141		1054		976		141.56	8.47
1		0		0		0		0		0		0		-75.0		-150		-150		-150		-150		
2		0		0		0		0		0				0		0		0		0		0		

Cable No.																					Extension at each jecking end	Emergence angle
	9000		8500		7300		6100		5500		5000		4000		3000		2000		1000		0			
	Y	Z	Y	Z	Y	Z	Y	Z	Y	Z	Y	Z	Y	Z	Y	Z	Y	Z	Y	Z	Y	Z		
1	150		150		150		150		150		150		150		150		150		150		150		139.49	0.86
2	151		150		150		150		150		150		150		150		150		150		150		139.71	2.92
3	326		307		266		231		216		204		185		170		159		152		150		140.18	4.96
4	519		495		444		401		382		368		343		324		311		303		300		140.56	6.14
5	712		683		622		570		548		531		502		479		463		453		450		141.02	7.32
6	904		871		800		740		714		694		660		634		615		604		600		141.56	8.47

LEGEND:

- INDICATES START OF CURVE IN ELEVATION
- INDICATES END OF CURVE IN ELEVATION
- INDICATES START OF CURVE IN PLAN
- INDICATES END OF CURVE IN PLAN
- INDICATES END OF CABLE
- INDICATES CABLE NUMBER

NAME OF THE CLIENT :
GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH
LOCAL GOVERNMENT ENGINEERING DEPARTMENT

NAME OF THE PROJECT :
CONSULTANCY SERVICES FOR FEASIBILITY, DETAILED SURVEY AND DESIGN OF CHITTAGONG HILL TRACT CONNECTIVITY CONNECTING THEGAMUKH AND CHITTAGONG PORT.

NAME OF THE CONSULTANTS :
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in association with
BETS Consulting Services Ltd, Bangladesh
Project office :
Tahmid Mahmood Palace
Flat # 9A, House # 77, Road # 4, Block-C,
Banani, Dhaka-1213, Bangladesh.

DRAWING TITLE :
38.0m LONG PC GIRDER PRE-STRESSING CABLE DETAILS

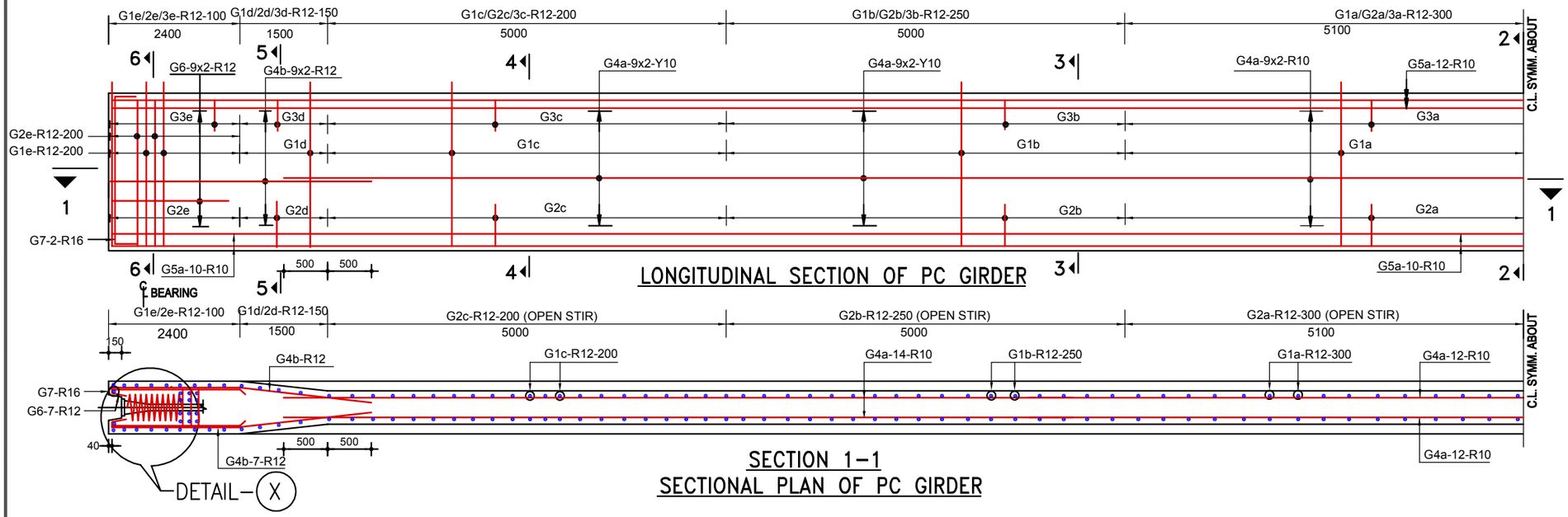
DRAWING NO : LGED/PCG-38/CAB-02

Scale :As shown

Date : 28-01-16

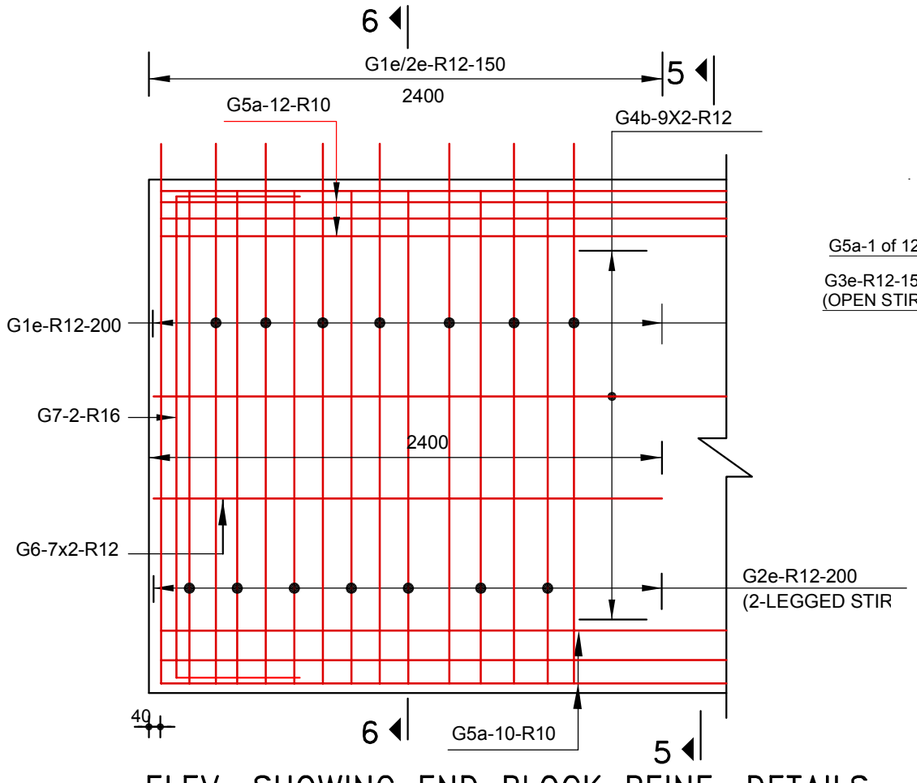
DESIGNED BY :	DRAWN BY :	CHECKED BY :	APPROVED BY :
MD. TAZUDDIN	MD. TAZUDDIN	AFM HAMIDUL HAQUE	DR. PRABHAT SHRIVASTAVA

REV.	DESCRIPTION	DATE

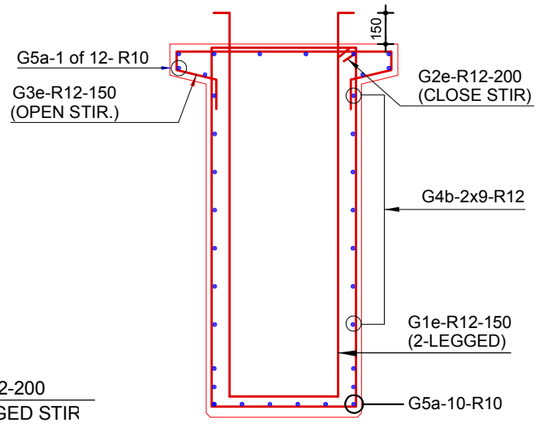


LONGITUDINAL SECTION OF PC GIRDER

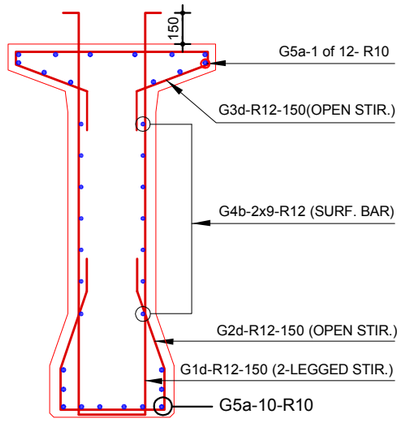
SECTION 1–1
SECTIONAL PLAN OF PC GIRDER



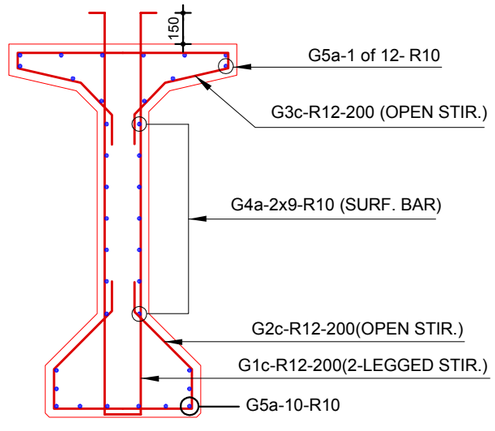
ELEV. SHOWING END BLOCK REINF. DETAILS



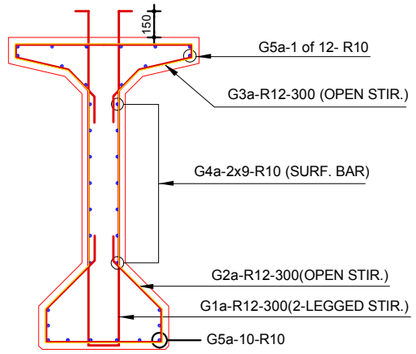
SECTION 6-6
(END SECTION)



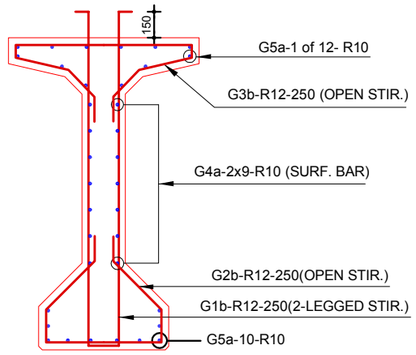
SECTION 5-5
(MID SECTION)



SECTION 4-4
(MID SECTION)



SECTION 2-2
(MID SECTION)



SECTION 3-3
(MID SECTION)

NAME OF THE CLIENT :
GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH
LOCAL GOVERNMENT ENGINEERING DEPARTMENT

NAME OF THE PROJECT :
CONSULTANCY SERVICES FOR FEASIBILITY, DETAILED SURVEY AND DESIGN OF CHITTAGONG HILL TRACT CONNECTIVITY CONNECTING THEGAMUKH AND CHITTAGONG PORT.

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in association with
BETS Consulting Services Ltd, Bangladesh
Project office :
Tahmid Mahmood Palace
Flat # 9A, House # 77, Road # 4, Block-C,
Banani, Dhaka-1213, Bangladesh.

DRAWING TITLE :
38.0m LONG PC GIRDER NON-PRE STRESSING REINF. DETAILS

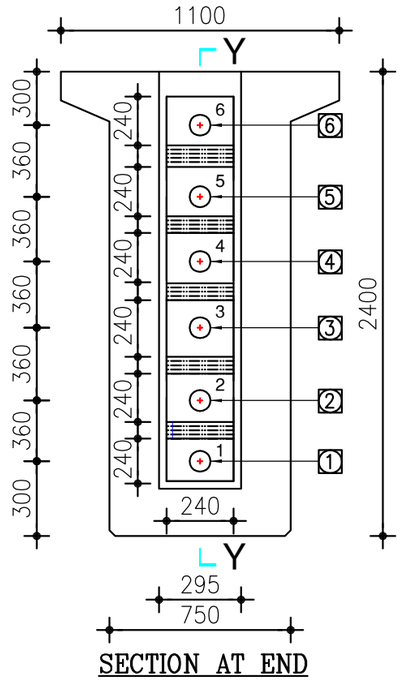
DRAWING NO : LGED/PCG-38/REINF.-03

Scale :As shown

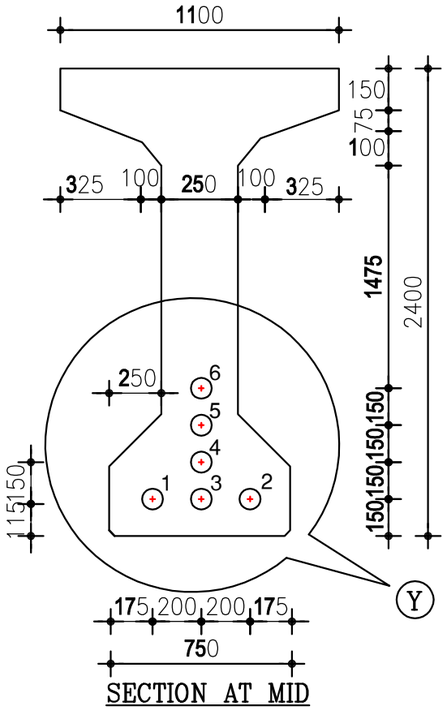
Date : 28-01-16

DESIGNED BY :	DRAWN BY :	CHECKED BY :	APPROVED BY :
MD. TAZUDDIN	MD. TAZUDDIN	AFM HAMIDUL HAQUE	DR. PRABHAT SHRIVASTAVA

REV.	DESCRIPTION	DATE



SECTION AT END

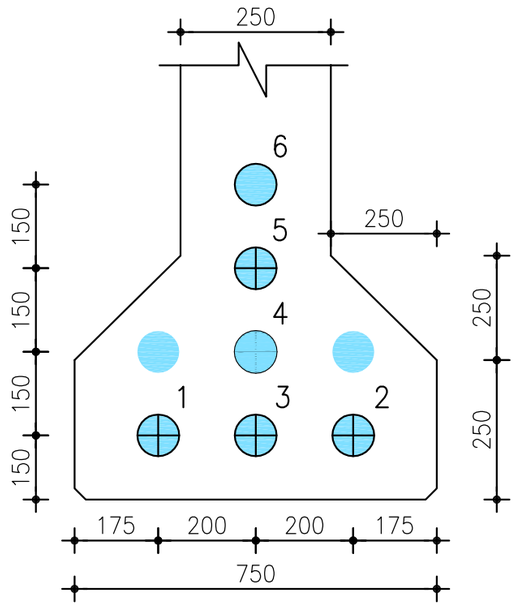


SECTION AT MID

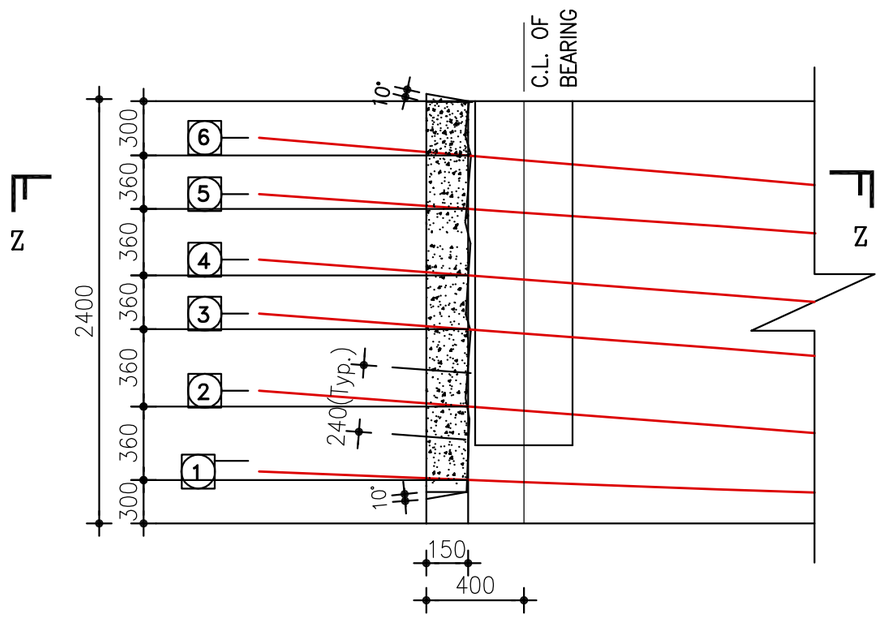
NOTES:

STAGES AND SEQUENCE OF PRESTRESSING

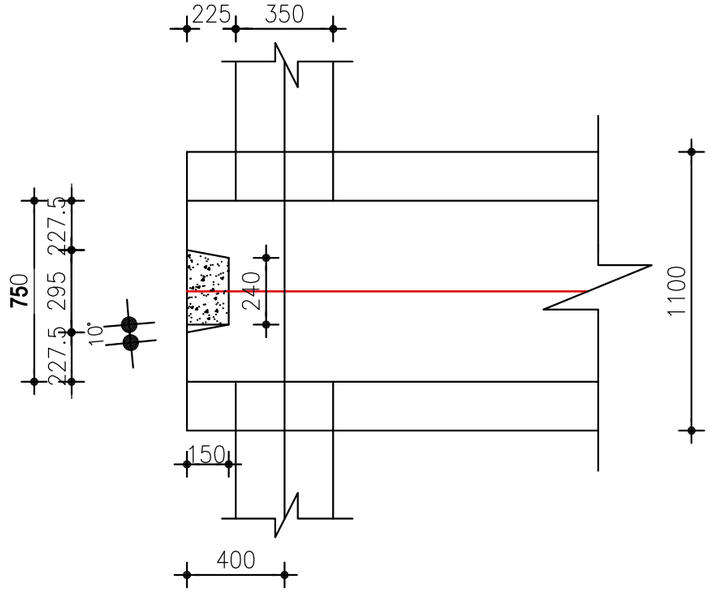
1. EACH CABLE SHALL BE STRESSED SIMULTANEOUSLY FROM BOTH ENDS. THE JACKING FORCE IN EACH CABLE SHALL BE 1680 KN TO BE IMPARTED SIMULTANEOUSLY AT BOTH ENDS.
2. THE SEQUENCE OF STRESSING OF PRESTRESSING CABLES SHALL BE AS FOLLOWS: 3, 2,1, 4, 5 & 6
3. STRESSING OF CABLES SHALL BE DONE MINIMUM AFTER 14 DAYS OR CONCRETE STRENGTH NOT LESS THAN 26N/mm^2 WHICHEVER IS LATER.
4. THE EXTENSION SHOWN IN THE TABLE IS FOR THE PORTION OF CABLES LYING BETWEEN MID SPAN AND RECESS FACE OF THE GIRDER. ADDITIONAL ELONGATION FOR GRIPPING LENGTH MUST BE ADDED DURING TENSIONING.
5. EACH CABLES CONSISTS OF 12 NOS. 12.7mm DIA. (12T13) 7-PLY UNCOATED LOW RELAXATION STRANDS
6. FOR OTHER REQUIREMENTS REFER GENERAL NOTES FOR PC GIRDER : S-02
7. THE CONTRACTOR SHALL SUBMIT DETAILS SHOP DRAWING FOR PC GIRDER'S FORMWORK AND SCAFFOLDING SYSTEM AND GET IT APPROVED BY CONCERNED XEN.
8. THE FORMWORK OF PC GIRDER MUST BE MADE OF M.S. SHEET HAVING THICKNESS 12BWG WITH NECESSARY BRACING.



DETAIL Ⓨ



DETAILS OF END BLOCK

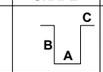
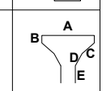
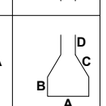
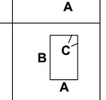
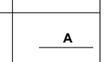
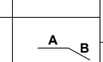
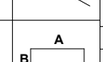
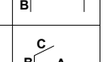
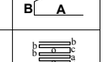


SECTION Z–Z

NAME OF THE CLIENT : GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH **LOCAL GOVERNMENT ENGINEERING DEPARTMENT**	NAME OF THE CONSULTANTS : **SAI Consulting Engineers Pvt. Ltd, India.** in association with **BETS Consulting Services Ltd, Bangladesh** Project office : Tahmid Mahmood Palace Flat # 9A, House # 77, Road # 4, Block-C,	DRAWING TITLE : END BLOCK DETAILS OF 38.0m LONG PC GIRDER	DESIGNED BY : MD. TAZUDDIN	DRAWN BY : MD. TAZUDDIN	CHECKED BY : AFM HAMIDUL HAQUE	APPROVED BY : DR. PRABHAT SHRIVASTAVA
NAME OF THE PROJECT : CONSULTANCY SERVICES FOR FEASIBILITY, DETAILED SURVEY AND DESIGN OF CHITTAGONG HILL TRACT CONNECTIVITY CONNECTING THEGAMUKH AND CHITTAGONG PORT.		DRAWING NO : LGED/PCG-38/EBL-04 Scale :As shown Date : 28-01-16				

REV.	DESCRIPTION	DATE

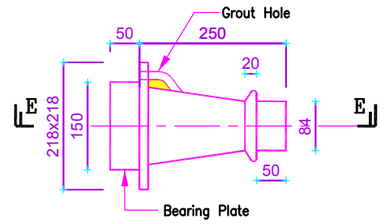
BAR BENDING SCHEDULE OF NON-PRESTRESSED REINF. (FOR ONE GIRDER, 40.0m)

SHAP CODE	BAR SHAPE	ITEM	NO.	BAR MARK	BAR TYPE & DIA (mm)	NO. OF BAR	SHAPE CODE	BENDING DIMENSIONS(MM) A	B	C	D	E	F	G	CUT LENGTH(MM)	TOTAL NO. OF BARS	TOTAL LENGTH(M)	UNIT WT. OF BAR(Kg/M)	TOTAL WT.(Kg)
1		PC GIRDER	1	G1a	R 12	36	1	170	2510	200					5550	36	199.800	0.888	177.39
				G1b	R 12	44	1	170	2510	200					5550	44	244.200	0.888	216.80
				G1c	R 12	54	1	170	2510	200					5760	54	311.040	0.888	276.15
				G1d	R 12	20	1	420	2510	200					5840	20	116.800	0.888	103.70
				G1e	R 12	46	1	670	2510	200					6090	46	280.14	0.888	248.71
2				G2a	R 12	36	2A	670	197	400	200				2264	36	81.504	0.888	72.36
				G3a	R 12	36	2	1020	78	313	216	200			2634	36	92.820	0.888	84.19
				G2b	R 12	44	2A	670	197	400	200				2264	44	99.616	0.888	88.44
				G3b	R 12	44	2	1020	78	313	216	200			2234	44	98.296	0.888	87.27
2A				G2c	R 12	54	2A	670	197	400	200				2264	54	122.256	0.888	108.54
				G3c	R 12	54	2	1020	78	313	216	200			2234	54	120.636	0.888	107.10
				G2d	R 12	20	2A	670	197	400	200				2269	20	45.380	0.888	20.29
				G3d	R 12	20	2	1020	78	313	216	200			2234	20	44.680	0.888	39.67
3				G2e	R 12	48	3	670	2320	200					6380	48	306.240	0.888	271.88
				G3e	R 12	48	2	1020	78	313	216				2234	48	107.232	0.888	95.20
				G4a	R 10	18	4	33170							33170	18	597.060	0.617	368.11
				G4b	R 12	36	5	2300	2016						4316	36	155.360	0.888	137.93
4				G5a	R 10	12	4	40700							40700	12	488.424	0.617	301.13
				G5a	R 10	10	4	40700							40700	10	407.020	0.617	250.92
				G6	R 12	28	6	2300	150						4900	28	137.200	0.888	121.81
5				G7	R 16	4	7	2320	100						2520	4	10.080	1.578	15.91
		MESH	1	m1	R 12	6	8	13500	450	7560	1350				22860	6	137.160	0.888	121.77
				m2	R 8	2	8	3000	450	3000	450				6900	2	13.800	0.395	5.45
6		Spiral	1	S1	R 12	2	03	7295							7295	2	14.590	0.888	12.95
7																			
8																			

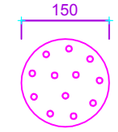
TOTAL WT.OF STEEL-Y16 (M.TON) = 0.02
TOTAL WT.OF STEEL-Y12 (M.TON) = 2.41
TOTAL WT.OF STEEL-Y10 (M.TON) = 0.92
TOTAL WT.OF STEEL-Y8 (M.TON) = 0.01

NB : BARBENDING SCHEDULE SHOULD BE CHECKED AT SITE BEFORE FABRICATION.

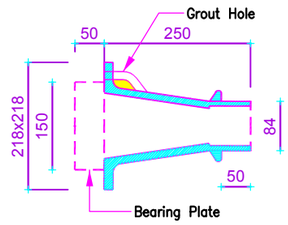
TOTAL WT. OF STEEL(M.TON) FOR ONE GIRDER = 3.35



Freyssinet Branded 12T13 Anchorage



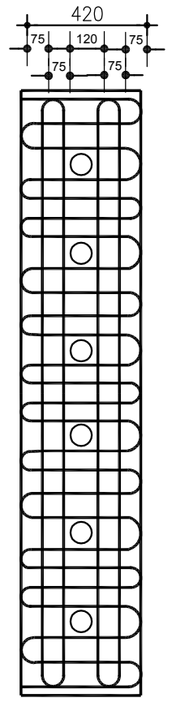
Bearing Plate



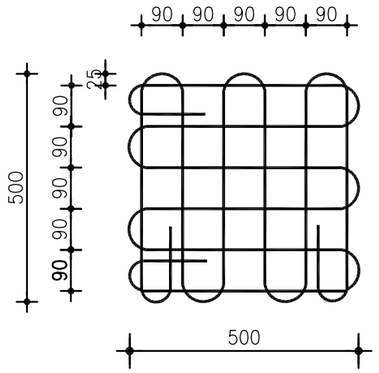
Section E-E

NOTES:

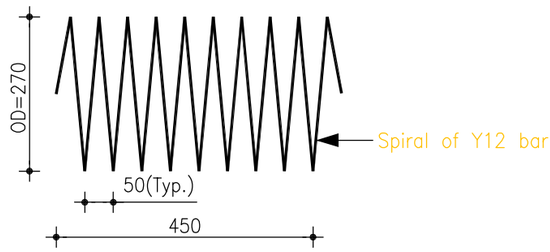
1. ANCHORAGE MUST BE TESTED TO CONFIRM ITS CAPACITY APPLYING 95% OF ULTIMATE LOAD (2205 KN) AS PER STANDARD SPECIFICATION PRIOR TO USE
2. HYDRAULIC JACKS FOR TENSIONING OPERATION MUST BE OF SAME BRANDED OF ANCHORAGE SYSTEM HAVING RECENT CALIBRATION
3. TENSIONING OPERATION SHALL BE CARRIED OUT IN PRESENCE OF AN EXPERIENCED ENGINEER OR AS DIRECTED BY THE DESIGN UNIT, LGED
4. THE PRE-STRESSING PARTY, IF SUBCONTRACTED, SHALL BE SELECTED TAKING PRIOR APPROVAL OF CONCERNED EXECUTIVE ENGINEER OR AS APPROVED BY DESIGN UNIT, LGED



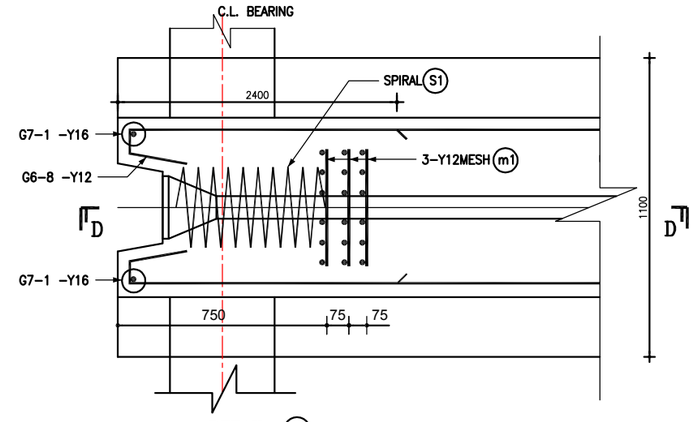
Y12 MESH REINFORCEMENT (m1)



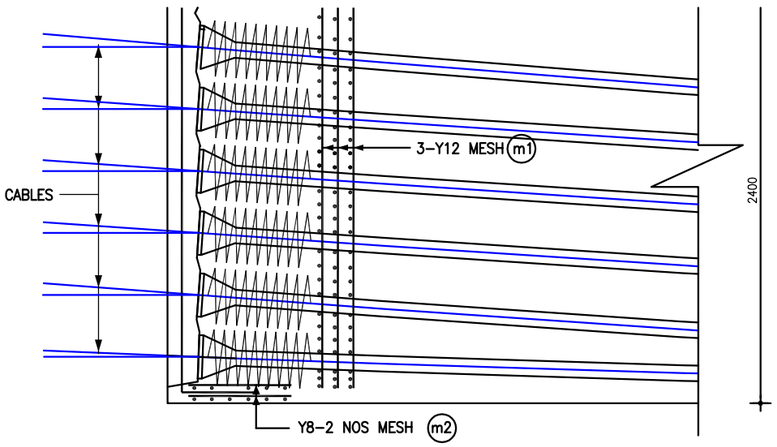
Y8 MESH REINF. (m2) ABOVE BEARINGS



DETAILS OF SPIRAL S1



DETAIL- (X)



SECTION D-D

NAME OF THE CLIENT :
GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH
LOCAL GOVERNMENT ENGINEERING DEPARTMENT

NAME OF THE PROJECT :
CONSULTANCY SERVICES FOR FEASIBILITY, DETAILED SURVEY AND DESIGN OF CHITTAGONG HILL TRACT CONNECTIVITY CONNECTING THEGAMUKH AND CHITTAGONG PORT.

NAME OF THE CONSULTANTS :
SAI Consulting Engineers Pvt. Ltd, India.
in association with
BETS Consulting Services Ltd, Bangladesh
Project office :
Tahmid Mahmood Palace
Flat # 9A, House # 77, Road # 4, Block-C,

DRAWING TITLE :
TYPICAL PRE-STRESSING ANCHORAGE DETAILS FOR 38.0m LONG PC GIRDER

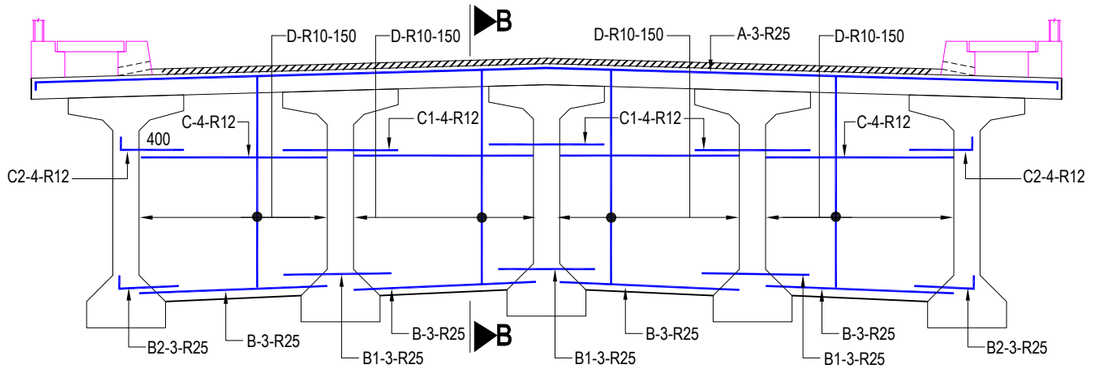
DRAWING NO : LGED/PCG-38/ANC.-05

Scale :As shown

Date : 28-01-16

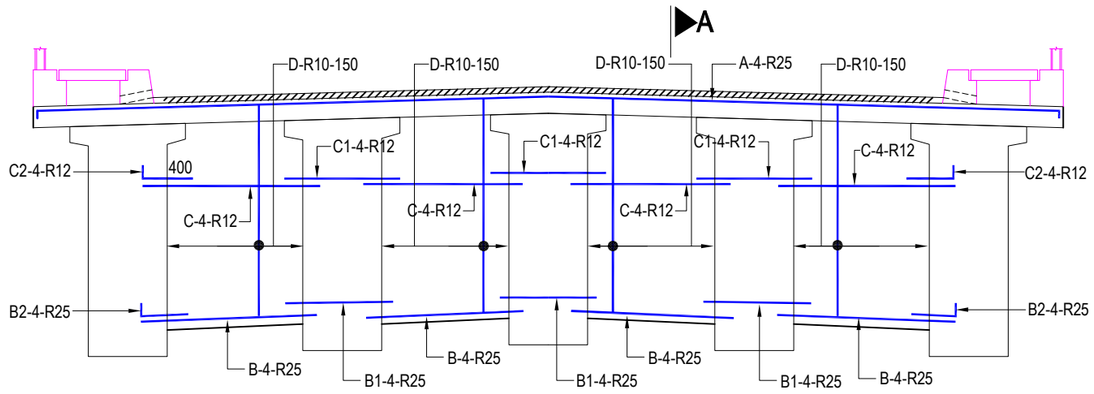
DESIGNED BY :	DRAWN BY :	CHECKED BY :	APPROVED BY :
MD. TAZUDDIN	MD. TAZUDDIN	AFM HAMIDUL HAQUE	DR. PRABHAT SHRIVASTAVA

REV.	DESCRIPTION	DATE



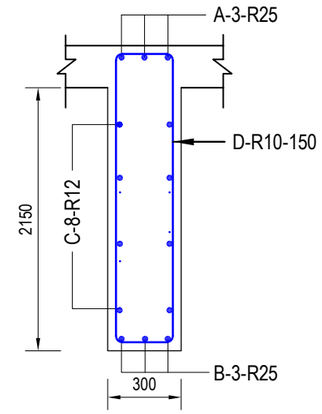
REINF. DETAILS OF INTER-MEDIATE X-GIRDER

(Scale : 1:60)



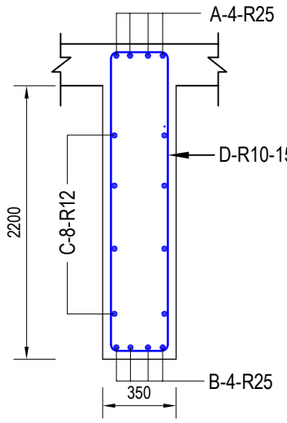
REINF. DETAILS OF END X-GIRDER

(Scale : 1:60)



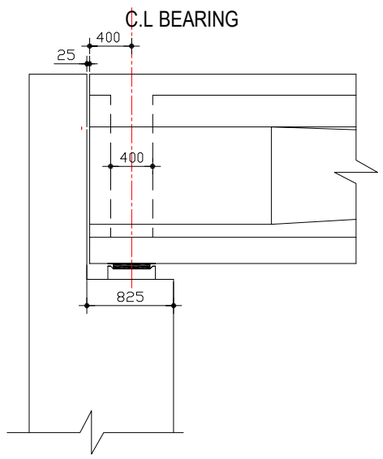
SEC. B-B (INTERMEDIATE X-GIRDER)

(Scale : 1:30)



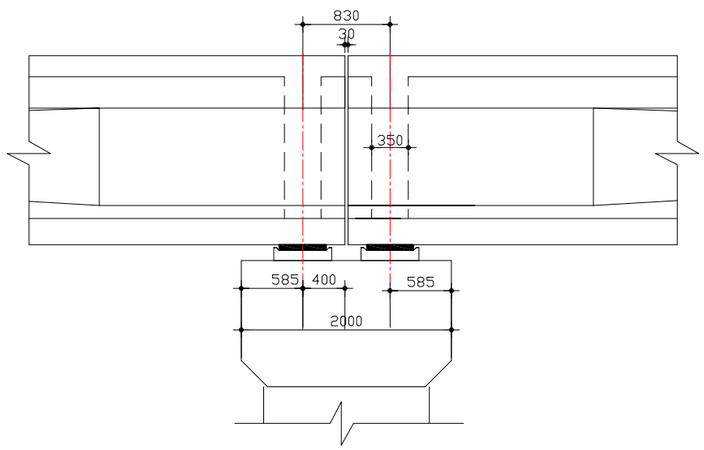
SEC. A-A (END X-GIRDER)

(Scale : 1:30)



SEC. B-B AT ABUTMENT END

(Scale : 1:75)



SEC. C-C AT COLUMN TYPE PIER END

(Scale : 1:75)

BAR BENDING SCHEDULE FOR INTERMEDIATE & END X-GIRDERE (38.00, One X-Girder each)

ITEM	NO.	BAR MARK	BAR TYPE & DIA (mm)	NO. OF BAR	SHAPE CODE	BENDING DIMENSIONS(MM) A	B	C	D	E	CUT LENGTH(MM)	TOTAL NO. OF BARS	TOTAL LENGTH(M)	UNIT WT. OF BAR(Kg/M)	TOTAL WT.(Kg)
INTERME - DIATE X-GIRDER	1	A	R 25	3	2A	9720	75				9870	3	29.600	3.853	114.12
		B	R 25	12	01	2010					2010	12	24.120	3.853	92.94
		B1	R 25	9	01	1050					1050	9	9.450	3.853	36.41
		B2	R 25	6	03	475	200				675	6	4.050	3.853	15.61
		C	R 12	32	01	1710					1710	30	54.720	0.888	48.58
		C1	R 12	24	01	1050					1050	24	25.200	0.888	22.37
		C2	R 12	16	03	525	200				725	16	11.600	0.888	10.30
		D	R 10	48	04	2250	220	150			4490	48	249.120	0.617	153.59
											Sub-Total of Intermediate X-girder				493.91
END X-GIRDER	1	A	R 25	4	2A	9720	75				9870	4	39.480	3.853	152.13
		B	R 25	16	01	2010					2010	16	32.160	3.853	123.92
		B1	R 25	12	01	1550	200				1550	12	18.600	3.853	71.67
		B2	R 25	8	03	725	200				925	8	7.400	3.853	28.51
		C	R 12	32	01	1210					1210	32	38.720	0.888	34.38
		C1	R 12	24	01	1550					1550	24	37.200	0.888	33.03
		C2	R 12	16	03	725	300				1025	16	16.400	0.888	14.56
		D	R 10	36	04	2300	270	75			5215	36	187.740	0.617	115.75
											Sub-Total of End X-girder				573.95

TOTAL WT.OF STEEL-R25 (M.TON) = 0.64
TOTAL WT.OF STEEL-R16 (M.TON) = 0.00
TOTAL WT.OF STEEL-R12 (M.TON) = 0.16
TOTAL WT.OF STEEL-R10 (M.TON) = 0.27
TOTAL WT.OF STEEL-R8 (M.TON) = 0.00

TOTAL WT. OF STEEL(M.TON) FOR ONE END & ONE MID GIRDER= 1.07

SHAPE CODE	01	01A	02	02A	02B	03	04	05	06
SHAPE OF BARS	a	b, a	b, a	c, b, a	b, a	a, b	b, a	b, c, a	a, c, b

NAME OF THE CLIENT :
GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH
LOCAL GOVERNMENT ENGINEERING DEPARTMENT

NAME OF THE PROJECT :
CONSULTANCY SERVICES FOR FEASIBILITY, DETAILED SURVEY AND DESIGN OF CHITTAGONG HILL TRACT CONNECTIVITY CONNECTING THEGAMUKH AND CHITTAGONG PORT.

NAME OF THE CONSULTANTS :
SAI Consulting Engineers Pvt. Ltd, India.
in association with
BETS Consulting Services Ltd, Bangladesh
Project office :
Tahmid Mahmood Palace
Flat # 9A, House # 77, Road # 4, Block-C,

DRAWING TITLE :
REINF. DETAILS OF X-GIRDER FOR 38.0m SPAN

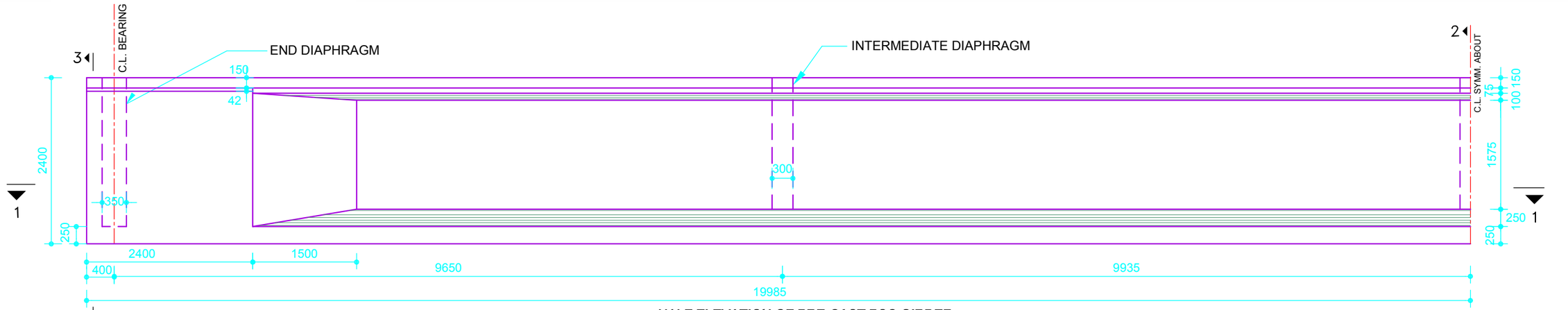
DRAWING NO : LGED/PCG-40/XG-06

Scale :As shown

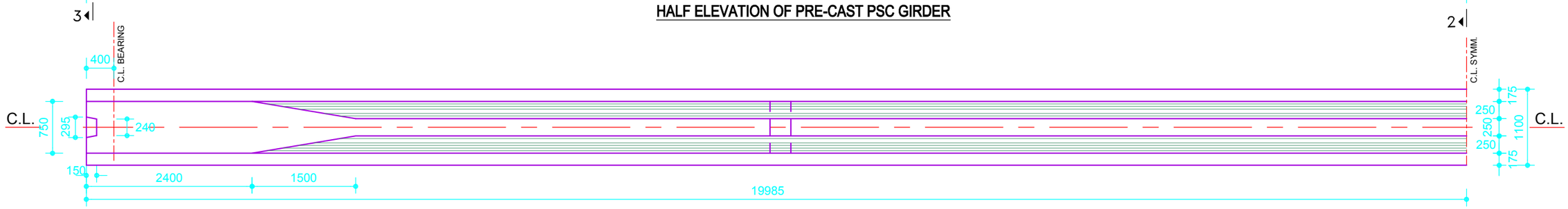
Date : 28-01-16

DESIGNED BY :	DRAWN BY :	CHECKED BY :	APPROVED BY :
MD. TAZUDDIN	MD. TAZUDDIN	AFM HAMIDUL HAQUE	DR. PRABHAT SHRIVASTAVA

REV.	DESCRIPTION	DAT

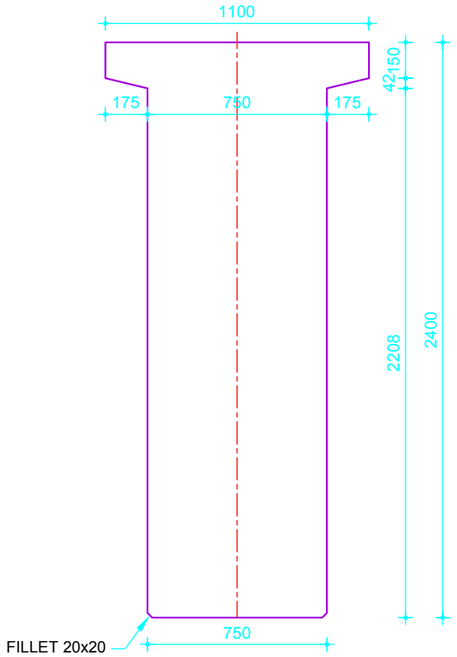


HALF ELEVATION OF PRE-CAST PSC GIRDER

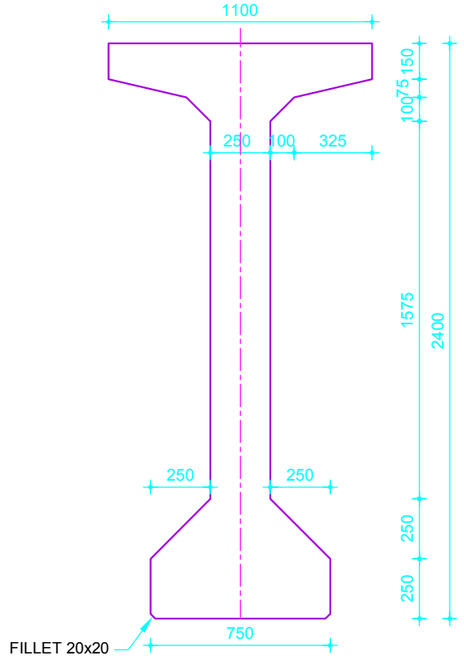


SECTIONAL VIEW OF PRE-CAST PSC GIRDER (SECTION 1-1)

(Scale : 1:60)



SECTION 3-3 AT END



SECTION 2-2 AT MIDDLE

NOTES:

1. CONCRETE SHALL HAVE SPECIFIED CHARACTERISTIC COMPRESSIVE STRENGTH OF STANDARD CYLINDER OR CUBE (15 cm) AT 28 DAYS, ARE AS FOLLOWS(15 cm) AT 28 DAYS, ARE AS FOLLOWS:
   a) STANDARD CYLINDER CRUSHING STRENGTH, f'c = 35 N/mm²
   b) STANDARD CUBE CRUSHING STRENGTH, fcu = 43 N/mm²
2. REINFORCING STEEL SHALL CONFORM TO ASTM A615-87 GRADE 6 DEFORMED BARS (MARKED 'Y') HAVING MINIMUM YEILD STRENGT Fy = 413 N/mm²
3. PRESTRESSING STEEL SHALL BE OF 12.7mm DIA. 7 PLY UNCOATE LOW RELAXATION STRAND CONFORMING TO AASHTO-M203 (GRADE-270) OR EQUIVALENT HAVING THE FOLLOWING STRENGTH:
   (a) MINIMUM ULTIMATE TENSILE STRENGTH (UTS) f 's = 1861 N/mm (183.7 KN PER STRAND)
   (b) MINIMUM YIELD STRENGTH f 'y = 1674 N/mm² (165.3 KN PER STRAND)
4. PPRESTRESSING CABLE SHALL CONSISTS OF 12 NOS.12.7mm DIA. STRAND (12T13) IN A SHEATHING/DUCT
5. FOLLOWING PROPERTIES HAVE BEEN CONSIDERED IN THE DESIGN
   AREA OF STRAND = 98.7 mm²
   AREA OF CABLE = 1184.4 mm²
   MODULLES OF ELASTICITY OF STRAND =1.97×10^5 (N/mm^2)
   AVERAGE SLIP = 6mm
   JACKING FORCE IN EACH CABLE = 16 80 KN.

NAME OF THE CLIENT :
GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH
LOCAL GOVERNMENT ENGINEERING DEPARTMENT

NAME OF THE PROJECT :
CONSULTANCY SERVICES FOR FEASIBILITY, DETAILED SURVEY AND DESIGN OF CHITTAGONG HILL TRACT CONNECTIVITY CONNECTING THEGAMUKH AND CHITTAGONG PORT.

NAME OF THE CONSULTANTS :
SAI Consulting Engineers Pvt. Ltd, India.
in association with
BETS Consulting Services Ltd, Bangladesh
Project office :
Tahmid Mahmood Palace
Flat # 9A, House # 77, Road # 4, Block-C,
Banani, Dhaka-1213, Bangladesh.

DRAWING TITLE :
40.0m LONG PC GIRDER CONCRETE OUTLINE DETAILS

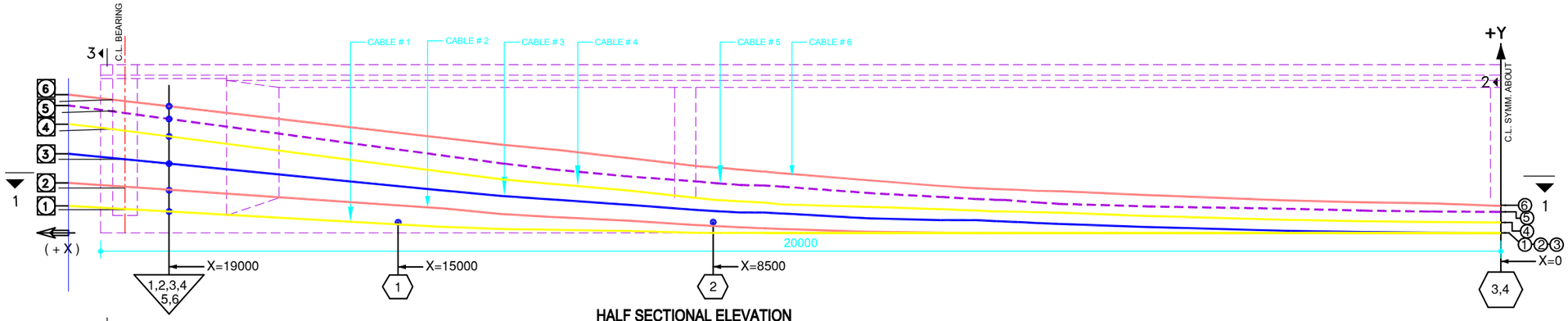
DRAWING NO : LGED/PCG-40/CON-01

Scale :As shown

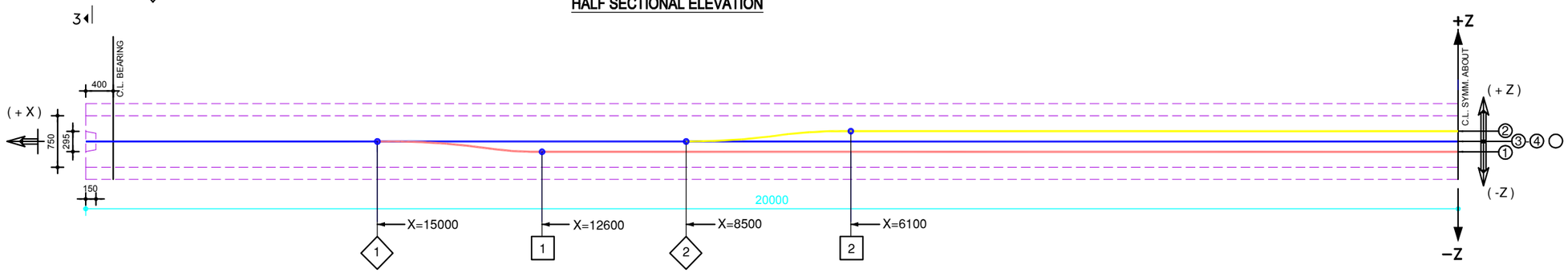
Date : 28-01-16

DESIGNED BY :	DRAWN BY :	CHECKED BY :	APPROVED BY :
MD. TAZUDDIN	MD. TAZUDDIN	AFM HAMIDUL HAQUE	DR. PRABHAT SHRIVASTAVA

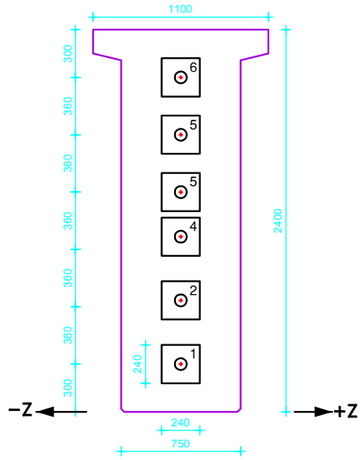
REV.	DESCRIPTION	DATE



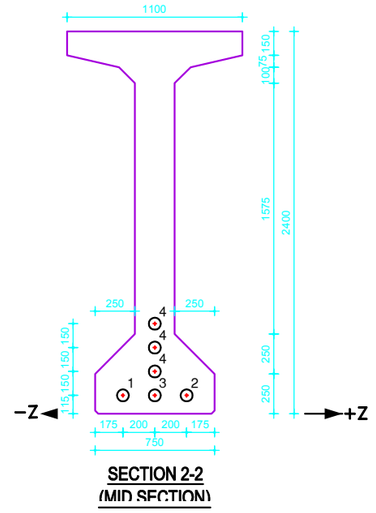
HALF SECTIONAL ELEVATION



HALF SECTIONAL PLAN (SECTION 1-1)



SECTION 3-3
(END SECTION)



SECTION 2-2
(MID SECTION)

Cable No.	ORDINATE AT DISTANCE X FROM CENTER																				Extension at each jecking end	Emergence angle
	19985		19000		18000		17000		16000		15000		13800		12600		12000		11000		10000			
	Y	Z	Y	Z	Y	Z	Y	Z	Y	Z	Y	Z	Y	Z	Y	Z	Y	Z	Y	Z	Y	Z		
1	300		247		204		174		156		150		150		150		150		150		150		139.49	0.86
2	660		576		499		429		367		313		259		215		197		174		159		139.71	2.92
3	1020		936		856		780		708		640		565		496		464		414		368		140.18	4.96
4	1380		1276		1176		1081		992		908		815		729		689		627		570		140.56	6.14
5	1740		1616		1496		1383		1277		1177		1065		963		915		841		773		141.02	7.32
6	2100		1956		1817		1685		1561		1445		1315		1196		1141		1054		976		141.56	8.47
1		0		0		0		0		0		0		-75.0		-150		-150		-150		-150		
2		0		0		0		0		0				0		0		0		0		0		

Cable No.																					Extension at each jecking end	Emergence angle
	9000		8500		7300		6100		5500		5000		4000		3000		2000		1000		0			
	Y	Z	Y	Z	Y	Z	Y	Z	Y	Z	Y	Z	Y	Z	Y	Z	Y	Z	Y	Z	Y	Z		
1	150		150		150		150		150		150		150		150		150		150		150		139.49	0.86
2	151		150		150		150		150		150		150		150		150		150		150		139.71	2.92
3	326		307		266		231		216		204		185		170		159		152		150		140.18	4.96
4	519		495		444		401		382		368		343		324		311		303		300		140.56	6.14
5	712		683		622		570		548		531		502		479		463		453		450		141.02	7.32
6	904		871		800		740		714		694		660		634		615		604		600		141.56	8.47

LEGEND:

- INDICATES START OF CURVE IN ELEVATION
- INDICATES END OF CURVE IN ELEVATION
- INDICATES START OF CURVE IN PLAN
- INDICATES END OF CURVE IN PLAN
- INDICATES END OF CABLE
- INDICATES CABLE NUMBER

NAME OF THE CLIENT :
GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH
LOCAL GOVERNMENT ENGINEERING DEPARTMENT

NAME OF THE PROJECT :
CONSULTANCY SERVICES FOR FEASIBILITY, DETAILED SURVEY AND DESIGN OF CHITTAGONG HILL TRACT CONNECTIVITY CONNECTING THEGAMUKH AND CHITTAGONG PORT.

NAME OF THE CONSULTANTS :
SAI Consulting Engineers Pvt. Ltd, India.
in association with
BETS Consulting Services Ltd, Bangladesh
Project office :
Tahmid Mahmood Palace
Flat # 9A, House # 77, Road # 4, Block-C,
Banani, Dhaka-1213, Bangladesh.

DRAWING TITLE :
40.0m LONG PC GIRDER PRE-STRESSING CABLE DETAILS

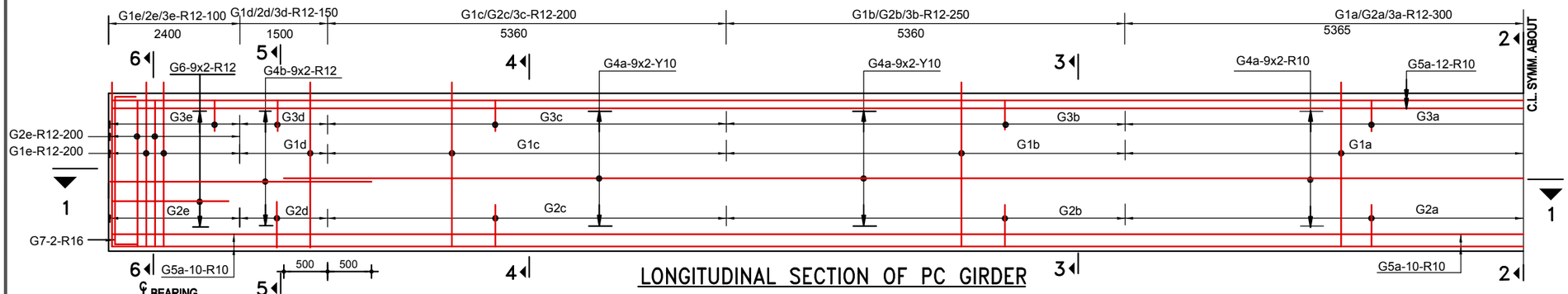
DRAWING NO : LGED/PCG-40/CAB-02

Scale :As shown

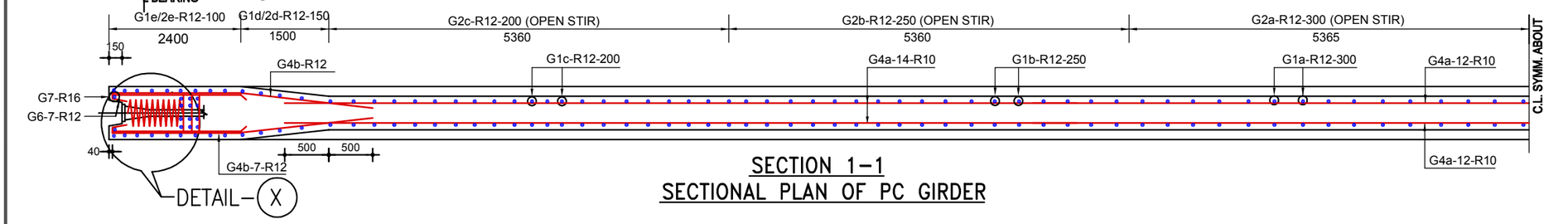
Date : 28-01-16

DESIGNED BY :	DRAWN BY :	CHECKED BY :	APPROVED BY :
MD. TAZUDDIN	MD. TAZUDDIN	AFM HAMIDUL HAQUE	DR. PRABHAT SHRIVASTAVA

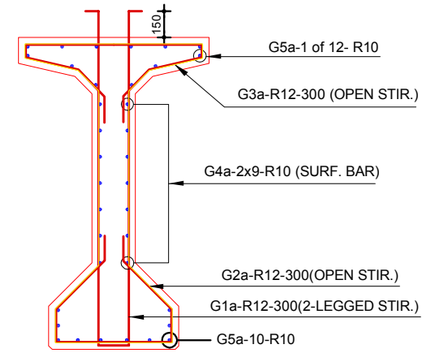
REV.	DESCRIPTION	DATE



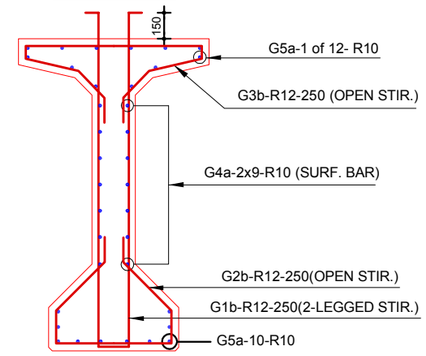
LONGITUDINAL SECTION OF PC GIRDER



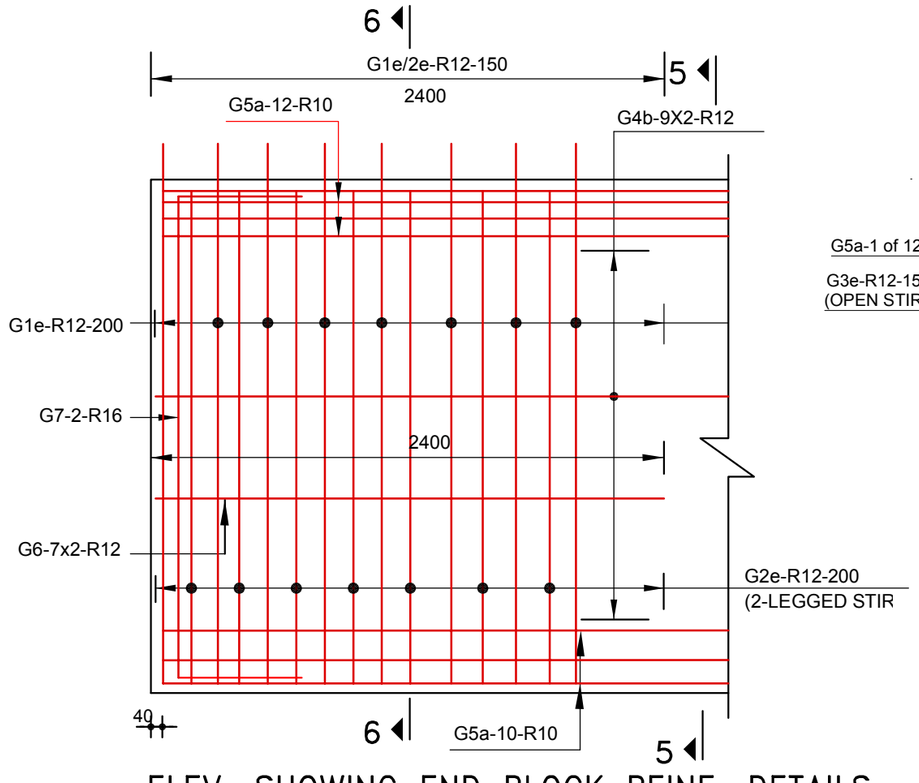
SECTION 1–1
SECTIONAL PLAN OF PC GIRDER



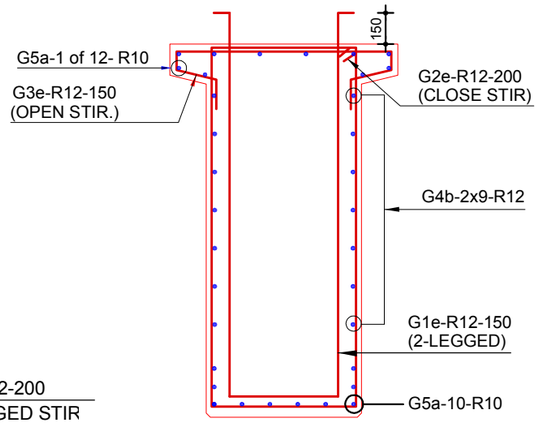
SECTION 2-2
(MID SECTION)



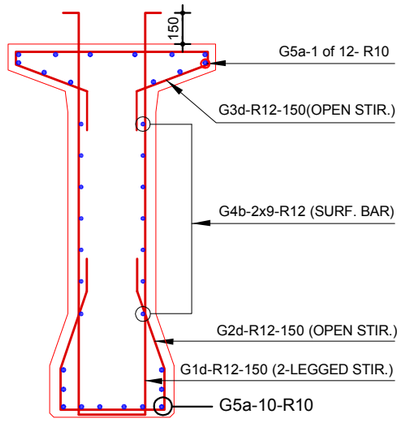
SECTION 3-3
(MID SECTION)



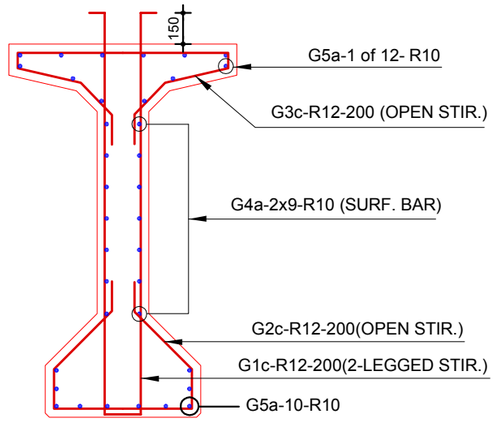
ELEV. SHOWING END BLOCK REINF. DETAILS



SECTION 6-6
(END SECTION)



SECTION 5-5
(MID SECTION)



SECTION 4-4
(MID SECTION)

NAME OF THE CLIENT :
GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH
LOCAL GOVERNMENT ENGINEERING DEPARTMENT

NAME OF THE PROJECT :
CONSULTANCY SERVICES FOR FEASIBILITY, DETAILED SURVEY AND DESIGN OF CHITTAGONG HILL TRACT CONNECTIVITY CONNECTING THEGAMUKH AND CHITTAGONG PORT.

NAME OF THE CONSULTANTS :
SAI Consulting Engineers Pvt. Ltd, India.
in association with
BETS Consulting Services Ltd, Bangladesh
Project office :
Tahmid Mahmood Palace
Flat # 9A, House # 77, Road # 4, Block-C,
Banani, Dhaka-1213, Bangladesh.

DRAWING TITLE :
40.0m LONG PC GIRDER NON-PRE STRESSING REINF. DETAILS

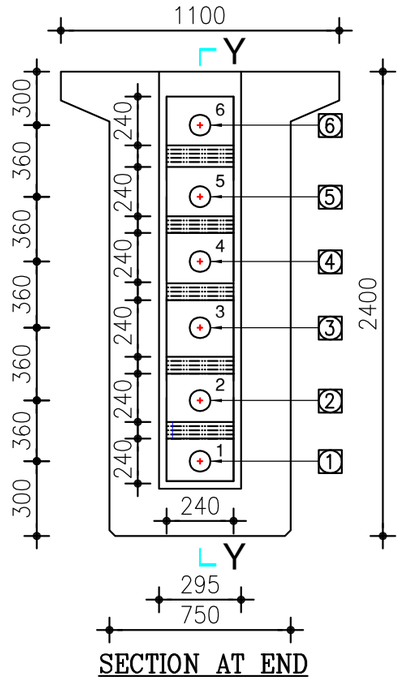
DRAWING NO : LGED/PCG-40/REINF.-03

Scale :As shown

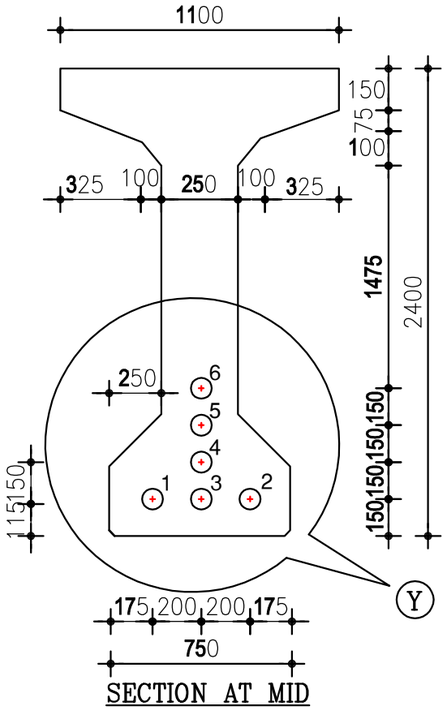
Date : 28-01-16

DESIGNED BY :	DRAWN BY :	CHECKED BY :	APPROVED BY :
MD. TAZUDDIN	MD. TAZUDDIN	AFM HAMIDUL HAQUE	DR. PRABHAT SHRIVASTAVA

REV.	DESCRIPTION	DATE



SECTION AT END

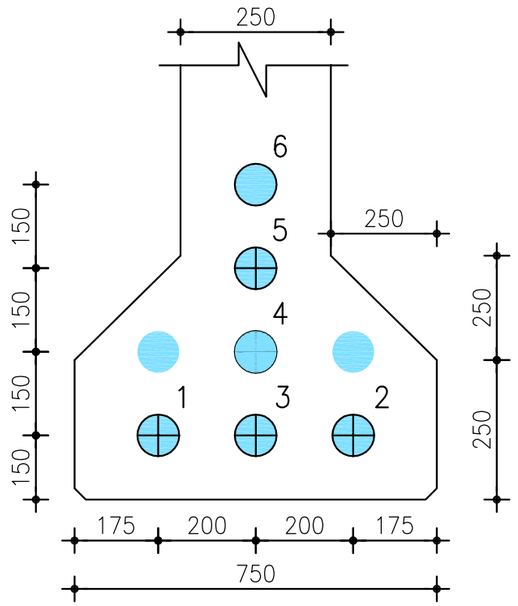


SECTION AT MID

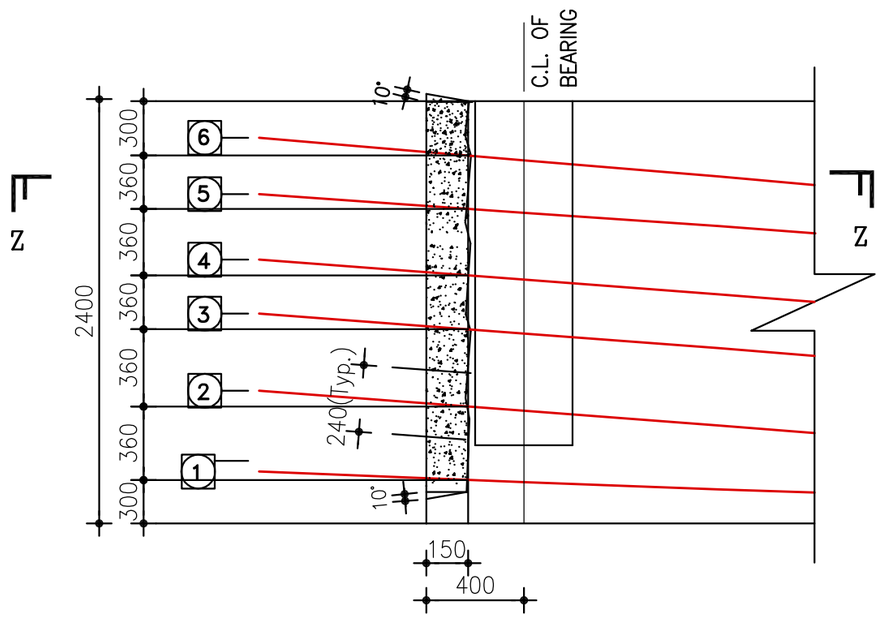
NOTES:

STAGES AND SEQUENCE OF PRESTRESSING

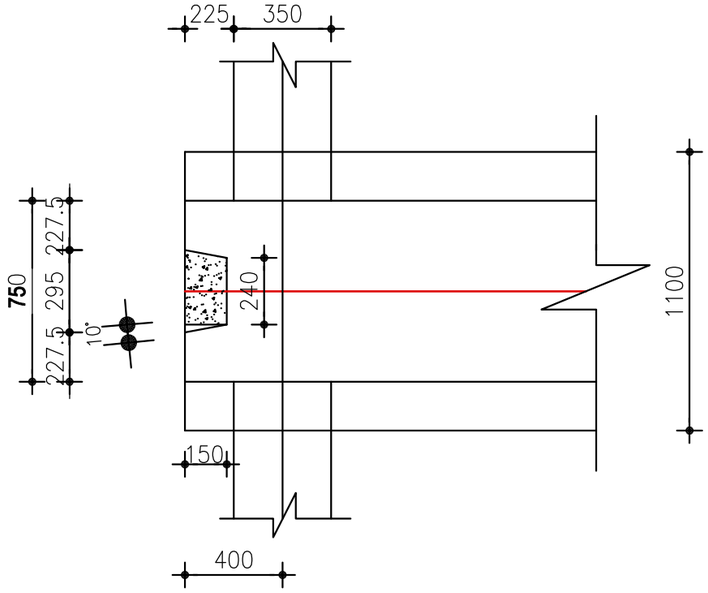
1. EACH CABLE SHALL BE STRESSED SIMULTANEOUSLY FROM BOTH ENDS. THE JACKING FORCE IN EACH CABLE SHALL BE 1680 KN TO BE IMPARTED SIMULTANEOUSLY AT BOTH ENDS.
2. THE SEQUENCE OF STRESSING OF PRESTRESSING CABLES SHALL BE AS FOLLOWS: 3, 2,1, 4, 5 & 6
3. STRESSING OF CABLES SHALL BE DONE MINIMUM AFTER 14 DAYS OR CONCRETE STRENGTH NOT LESS THAN 26N/mm^2 WHICHEVER IS LATER.
4. THE EXTENSION SHOWN IN THE TABLE IS FOR THE PORTION OF CABLES LYING BETWEEN MID SPAN AND RECESS FACE OF THE GIRDER. ADDITIONAL ELONGATION FOR GRIPPING LENGTH MUST BE ADDED DURING TENSIONING.
5. EACH CABLES CONSISTS OF 12 NOS. 12.7mm DIA. (12T13) 7-PLY UNCOATED LOW RELAXATION STRANDS
6. FOR OTHER REQUIREMENTS REFER GENERAL NOTES FOR PC GIRDER : S-02
7. THE CONTRACTOR SHALL SUBMIT DETAILS SHOP DRAWING FOR PC GIRDER'S FORMWORK AND SCAFFOLDING SYSTEM AND GET IT APPROVED BY CONCERNED XEN.
8. THE FORMWORK OF PC GIRDER MUST BE MADE OF M.S. SHEET HAVING THICKNESS 12BWG WITH NECESSARY BRACING.



DETAIL Ⓨ



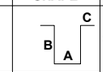
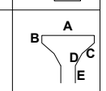
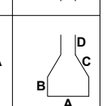
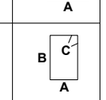
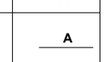
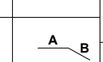
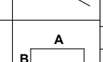
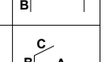
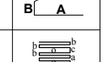
DETAILS OF END BLOCK



SECTION Z–Z

NAME OF THE CLIENT : GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH **LOCAL GOVERNMENT ENGINEERING DEPARTMENT**	NAME OF THE CONSULTANTS : **SAI Consulting Engineers Pvt. Ltd, India.** in association with **BETS Consulting Services Ltd, Bangladesh** Project office : Tahmid Mahmood Palace Flat # 9A, House # 77, Road # 4, Block-C,	DRAWING TITLE : END BLOCK DETAILS OF 40.0m LONG PC GIRDER	DESIGNED BY : MD. TAZUDDIN	DRAWN BY : MD. TAZUDDIN	CHECKED BY : AFM HAMIDUL HAQUE	APPROVED BY : DR. PRABHAT SHRIVASTAVA	REV.	DESCRIPTION	DATE
NAME OF THE PROJECT : CONSULTANCY SERVICES FOR FEASIBILITY, DETAILED SURVEY AND DESIGN OF CHITTAGONG HILL TRACT CONNECTIVITY CONNECTING THEGAMUKH AND CHITTAGONG PORT.		DRAWING NO : LGED/PCG-40/EBL-04 Scale :As shown Date : 28-01-16							

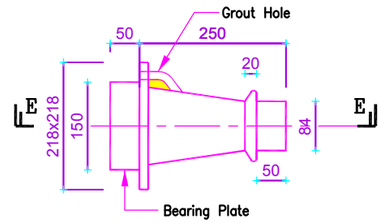
BAR BENDING SCHEDULE OF NON-PRESTRESSED REINF. (FOR ONE GIRDER, 40.0m)

SHAP CODE	BAR SHAPE	ITEM	NO.	BAR MARK	BAR TYPE & DIA (mm)	NO. OF BAR	SHAPE CODE	BENDING DIMENSIONS(MM) A	B	C	D	E	F	G	CUT LENGTH(MM)	TOTAL NO. OF BARS	TOTAL LENGTH(M)	UNIT WT. OF BAR(Kg/M)	TOTAL WT.(Kg)
1		PC GIRDER	1	G1a	R 12	36	1	170	2510	200					5550	36	199.800	0.888	177.39
				G1b	R 12	44	1	170	2510	200					5550	44	244.200	0.888	216.80
				G1c	R 12	54	1	170	2510	200					5760	54	311.040	0.888	276.15
				G1d	R 12	20	1	420	2510	200					5840	20	116.800	0.888	103.70
				G1e	R 12	46	1	670	2510	200					6090	46	280.14	0.888	248.71
2				G2a	R 12	36	2A	670	197	400	200				2264	36	81.504	0.888	72.36
				G3a	R 12	36	2	1020	78	313	216	200			2634	36	92.820	0.888	84.19
				G2b	R 12	44	2A	670	197	400	200				2264	44	99.616	0.888	88.44
				G3b	R 12	44	2	1020	78	313	216	200			2234	44	98.296	0.888	87.27
2A				G2c	R 12	54	2A	670	197	400	200				2264	54	122.256	0.888	108.54
				G3c	R 12	54	2	1020	78	313	216	200			2234	54	120.636	0.888	107.10
				G2d	R 12	20	2A	670	197	400	200				2269	20	45.380	0.888	20.29
				G3d	R 12	20	2	1020	78	313	216	200			2234	20	44.680	0.888	39.67
3				G2e	R 12	48	3	670	2320	200					6380	48	306.240	0.888	271.88
				G3e	R 12	48	2	1020	78	313	216				2234	48	107.232	0.888	95.20
				G4a	R 10	18	4	33170							33170	18	597.060	0.617	368.11
				G4b	R 12	36	5	2300	2016						4316	36	155.360	0.888	137.93
4				G5a	R 10	12	4	40700							40700	12	488.424	0.617	301.13
				G5a	R 10	10	4	40700							40700	10	407.020	0.617	250.92
				G6	R 12	28	6	2300	150						4900	28	137.200	0.888	121.81
5				G7	R 16	4	7	2320	100						2520	4	10.080	1.578	15.91
		MESH	1	m1	R 12	6	8	13500	450	7560	1350				22860	6	137.160	0.888	121.77
				m2	R 8	2	8	3000	450	3000	450				6900	2	13.800	0.395	5.45
6		Spiral	1	S1	R 12	2	03	7295							7295	2	14.590	0.888	12.95
7																			
8																			

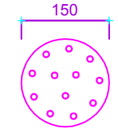
TOTAL WT.OF STEEL-Y16 (M.TON) = 0.02
TOTAL WT.OF STEEL-Y12 (M.TON) = 2.41
TOTAL WT.OF STEEL-Y10 (M.TON) = 0.92
TOTAL WT.OF STEEL-Y8 (M.TON) = 0.01

NB : BARBENDING SCHEDULE SHOULD BE CHECKED AT SITE BEFORE FABRICATION.

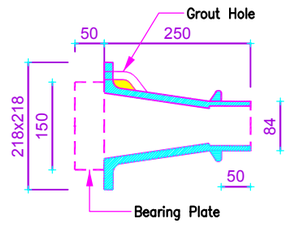
TOTAL WT. OF STEEL(M.TON) FOR ONE GIRDER = 3.35



Freyssinet Branded 12T13 Anchorage



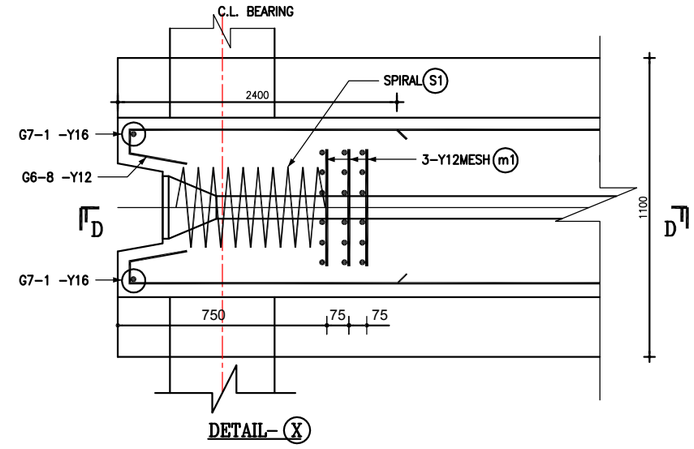
Bearing Plate



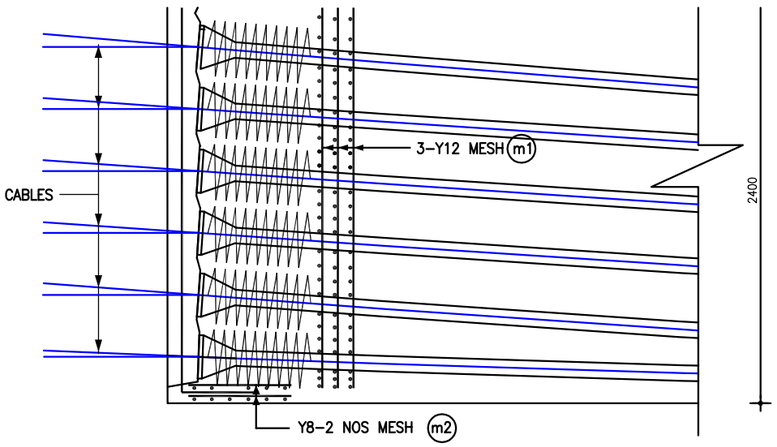
Section E-E

NOTES:

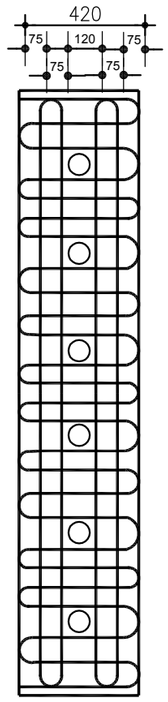
1. ANCHORAGE MUST BE TESTED TO CONFIRM ITS CAPACITY APPLYING 95% OF ULTIMATE LOAD (2205 KN) AS PER STANDARD SPECIFICATION PRIOR TO USE
2. HYDRAULIC JACKS FOR TENSIONING OPERATION MUST BE OF SAME BRANDED OF ANCHORAGE SYSTEM HAVING RECENT CALIBRATION
3. TENSIONING OPERATION SHALL BE CARRIED OUT IN PRESENCE OF AN EXPERIENCED ENGINEER OR AS DIRECTED BY THE DESIGN UNIT, LGED
4. THE PRE-STRESSING PARTY, IF SUBCONTRACTED, SHALL BE SELECTED TAKING PRIOR APPROVAL OF CONCERNED EXECUTIVE ENGINEER OR AS APPROVED BY DESIGN UNIT, LGED



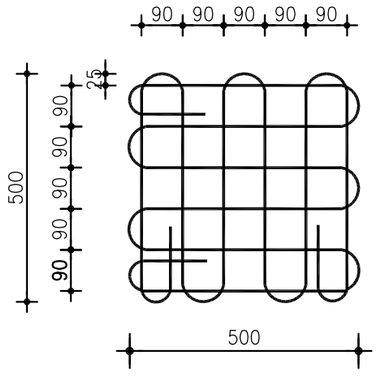
DETAIL- X



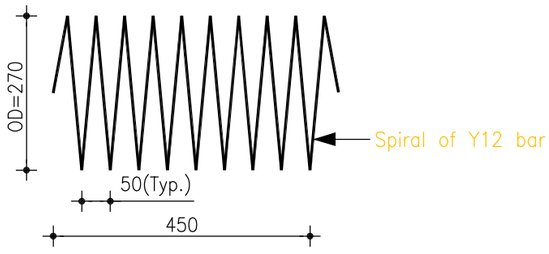
SECTION D-D



Y12 MESH REINFORCEMENT m1



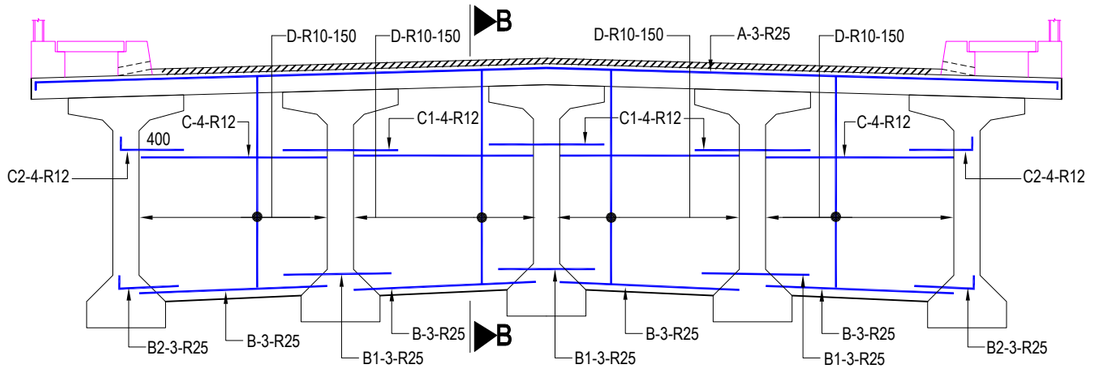
Y8 MESH REINF. ABOVE BEARINGS m2



DETAILS OF SPIRAL S1

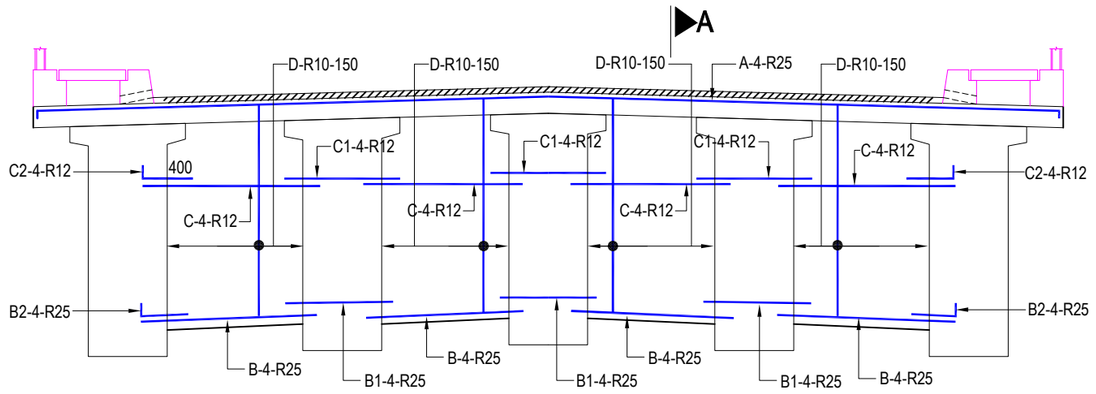
NAME OF THE CLIENT : GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH, LOCAL GOVERNMENT ENGINEERING DEPARTMENT	NAME OF THE CONSULTANTS : SAI Consulting Engineers Pvt. Ltd, India. in association with BETS Consulting Services Ltd, Bangladesh, Project office : Tahmid Mahmood Palace, Flat # 9A, House # 77, Road # 4, Block-C,	DRAWING TITLE : TYPICAL PRE-STRESSING ANCHORAGE DETAILS FOR 40.0m LONG PC GIRDER; DRAWING NO : LGED/PCG-40/ANC.-05; Scale :As shown; Date : 28-01-16	DESIGNED BY : MD. TAZUDDIN	DRAWN BY : MD. TAZUDDIN	CHECKED BY : AFM HAMIDUL HAQUE	APPROVED BY : DR. PRABHAT SHRIVASTAVA	REV.	DESCRIPTION	DATE

NAME OF THE PROJECT : CONSULTANCY SERVICES FOR FEASIBILITY, DETAILED SURVEY AND DESIGN OF CHITTAGONG HILL TRACT CONNECTIVITY CONNECTING THEGAMUKH AND CHITTAGONG PORT.



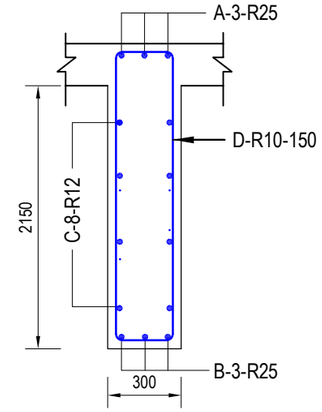
REINF. DETAILS OF INTER-MEDIATE X-GIRDER

(Scale : 1:60)



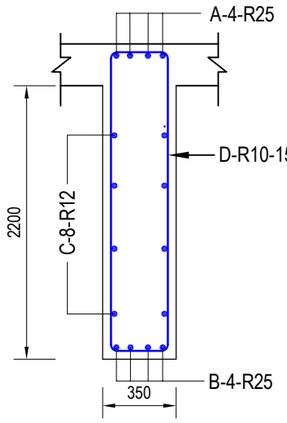
REINF. DETAILS OF END X-GIRDER

(Scale : 1:60)



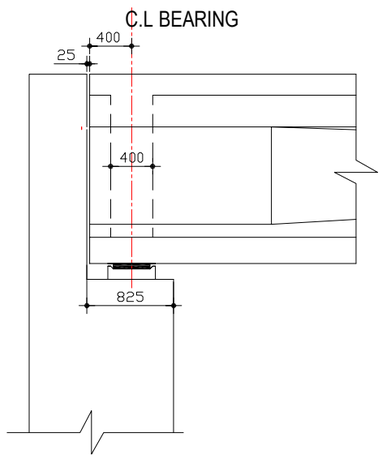
SEC. B-B (INTERMEDIATE X-GIRDER)

(Scale : 1:30)



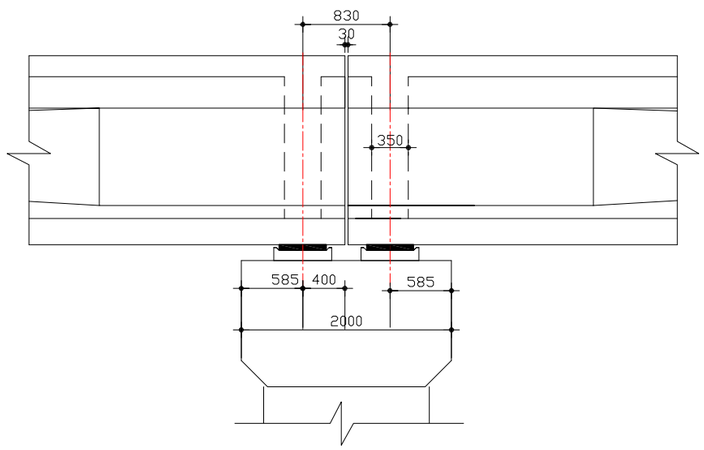
SEC. A-A (END X-GIRDER)

(Scale : 1:30)



SEC. B-B AT ABUTMENT END

(Scale : 1:75)



SEC. C-C AT COLUMN TYPE PIER END

(Scale : 1:75)

BAR BENDING SCHEDULE FOR INTERMEDIATE & END X-GIRDERE (40.00, one X-Girder each)

ITEM	NO.	BAR MARK	BAR TYPE & DIA (mm)	NO. OF BAR	SHAPE CODE	BENDING DIMENSIONS(MM) A	B	C	D	E	CUT LENGTH(MM)	TOTAL NO. OF BARS	TOTAL LENGTH(M)	UNIT WT. OF BAR(Kg/M)	TOTAL WT.(Kg)
INTERME - DIATE X-GIRDER	1	A	R 25	3	2A	9720	75				9870	3	29.600	3.853	114.12
		B	R 25	12	01	2010					2010	12	24.120	3.853	92.94
		B1	R 25	9	01	1050					1050	9	9.450	3.853	36.41
		B2	R 25	6	03	475	200				675	6	4.050	3.853	15.61
		C	R 12	32	01	1710					1710	30	54.720	0.888	48.58
		C1	R 12	24	01	1050					1050	24	25.200	0.888	22.37
		C2	R 12	16	03	525	200				725	16	11.600	0.888	10.30
		D	R 10	48	04	2250	220	150			4490	48	249.120	0.617	153.59
											Sub-Total of Intermediate X-girder				493.91
END X-GIRDER	1	A	R 25	4	2A	9720	75				9870	4	39.480	3.853	152.13
		B	R 25	16	01	2010					2010	16	32.160	3.853	123.92
		B1	R 25	12	01	1550					1550	12	18.600	3.853	71.67
		B2	R 25	8	03	725	200				925	8	7.400	3.853	28.51
		C	R 12	32	01	1210					1210	32	38.720	0.888	34.38
		C1	R 12	24	01	1550					1550	24	37.200	0.888	33.03
		C2	R 12	16	03	725	300				1025	16	16.400	0.888	14.56
		D	R 10	36	04	2300	270	75			5215	36	187.740	0.617	115.75
											Sub-Total of End X-girder				573.95

TOTAL WT.OF STEEL-R25 (M.TON) = 0.64
TOTAL WT.OF STEEL-R16 (M.TON) = 0.00
TOTAL WT.OF STEEL-R12 (M.TON) = 0.16
TOTAL WT.OF STEEL-R10 (M.TON) = 0.27
TOTAL WT.OF STEEL-R8 (M.TON) = 0.00

TOTAL WT. OF STEEL(M.TON) FOR ONE END & ONE MID GIRDER= 1.07

SHAPE CODE	01	01A	02	02A	02B	03	04	05	06
SHAPE OF BARS	a	b, a	b, a	c, b, a	b, a	a, b	b, a	b, c, a	a, c, b

NAME OF THE CLIENT :
GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH
LOCAL GOVERNMENT ENGINEERING DEPARTMENT

NAME OF THE PROJECT :
CONSULTANCY SERVICES FOR FEASIBILITY, DETAILED SURVEY AND DESIGN OF CHITTAGONG HILL TRACT CONNECTIVITY CONNECTING THEGAMUKH AND CHITTAGONG PORT.

NAME OF THE CONSULTANTS :
SAI Consulting Engineers Pvt. Ltd, India.
in association with
BETS Consulting Services Ltd, Bangladesh
Project office :
Tahmid Mahmood Palace
Flat # 9A, House # 77, Road # 4, Block-C,

DRAWING TITLE :
REINF. DETAILS OF X-GIRDER FOR 40.0m SPAN

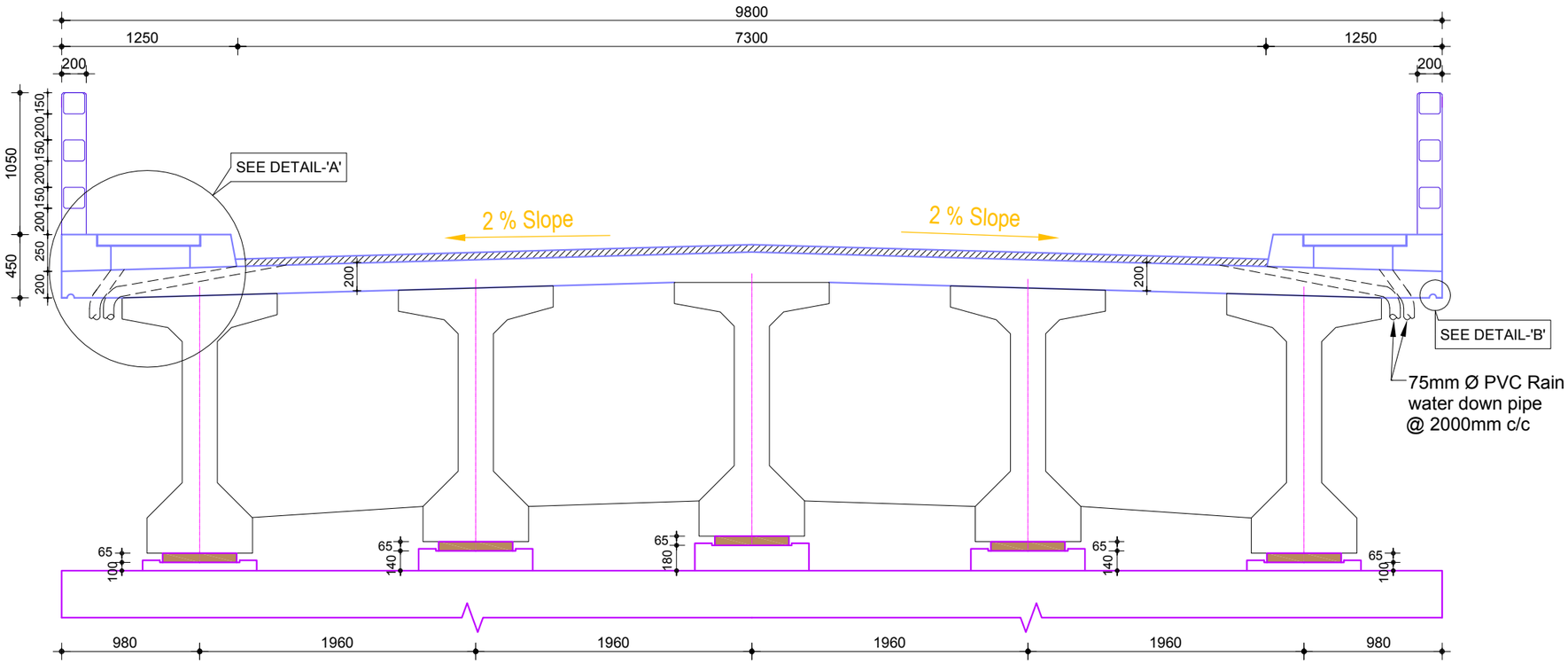
DRAWING NO : LGED/PCG-40/XG-06

Scale :As shown

Date : 28-01-16

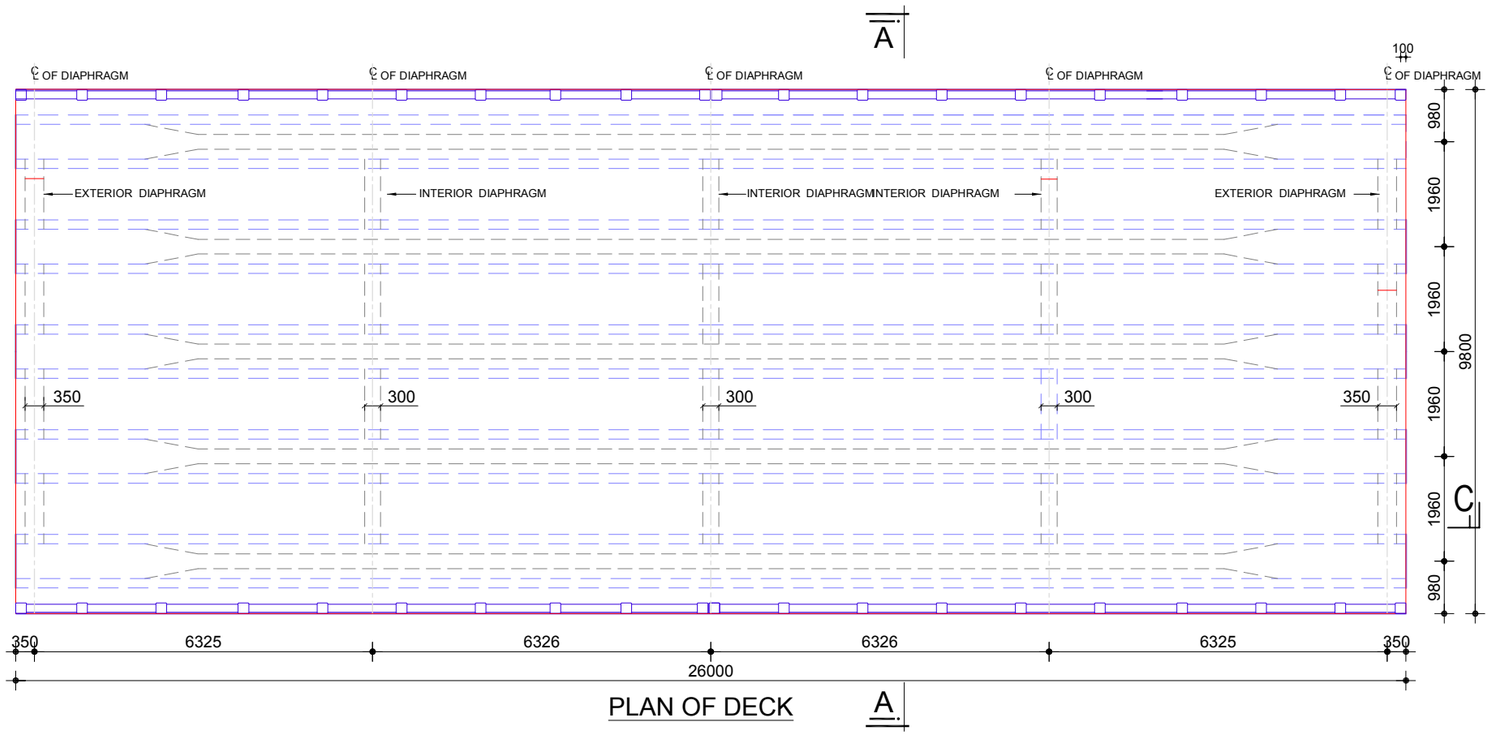
DESIGNED BY :	DRAWN BY :	CHECKED BY :	APPROVED BY :
MD. TAZUDDIN	MD. TAZUDDIN	AFM HAMIDUL HAQUE	DR. PRABHAT SHRIVASTAVA

REV.	DESCRIPTION	DAT

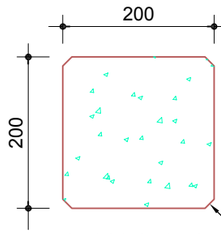


SEC. A-A ON DECK

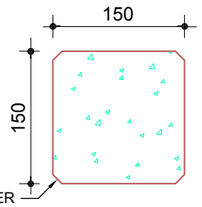
(Scale : 1:50)



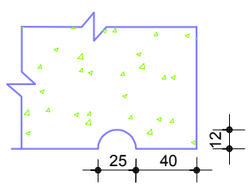
PLAN OF DECK



CROSS SECTION RAIL POST



CROSS SECTION RAIL BAR



DETAIL "B"

NOTES:

1. All dimensions are in milimeters unless othrwise mentioned.

NAME OF THE CLIENT :

GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH

LOCAL GOVERNMENT ENGINEERING DEPARTMENT

NAME OF THE PROJECT :

CONSULTANCY SERVICES FOR FEASIBILITY, DETAILED SURVEY AND DESIGN OF CHITTAGONG HILL TRACT CONNECTIVITY CONNECTING THEGAMUKH AND CHITTAGONG PORT.

NAME OF THE CONSULTANTS :

SAI Consulting Engineers Pvt. Ltd, India.

in association with

BETS Consulting Services Ltd, Bangladesh

Project office :

Tahmid Mahmood Palace
Flat # 9A, House # 77, Road # 4, Block-C,

DRAWING TITLE :

DETAILS OF DECK SLAB (S-26.0m)

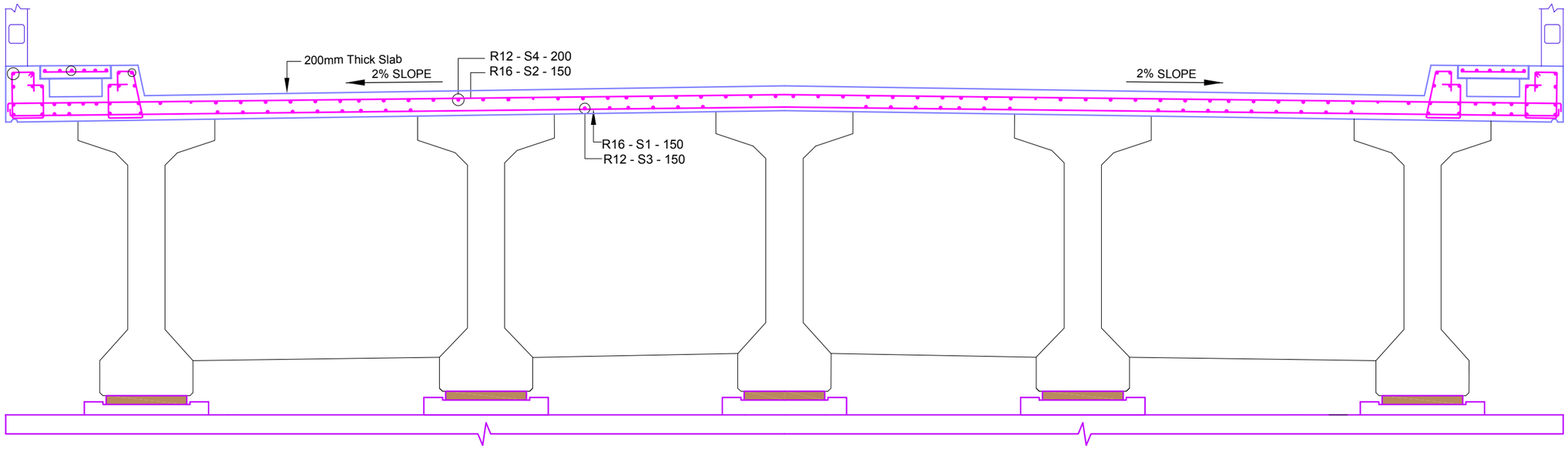
DRAWING NO : LGED/DK-26/C-01

Scale :As shown

Date : 28-01-16

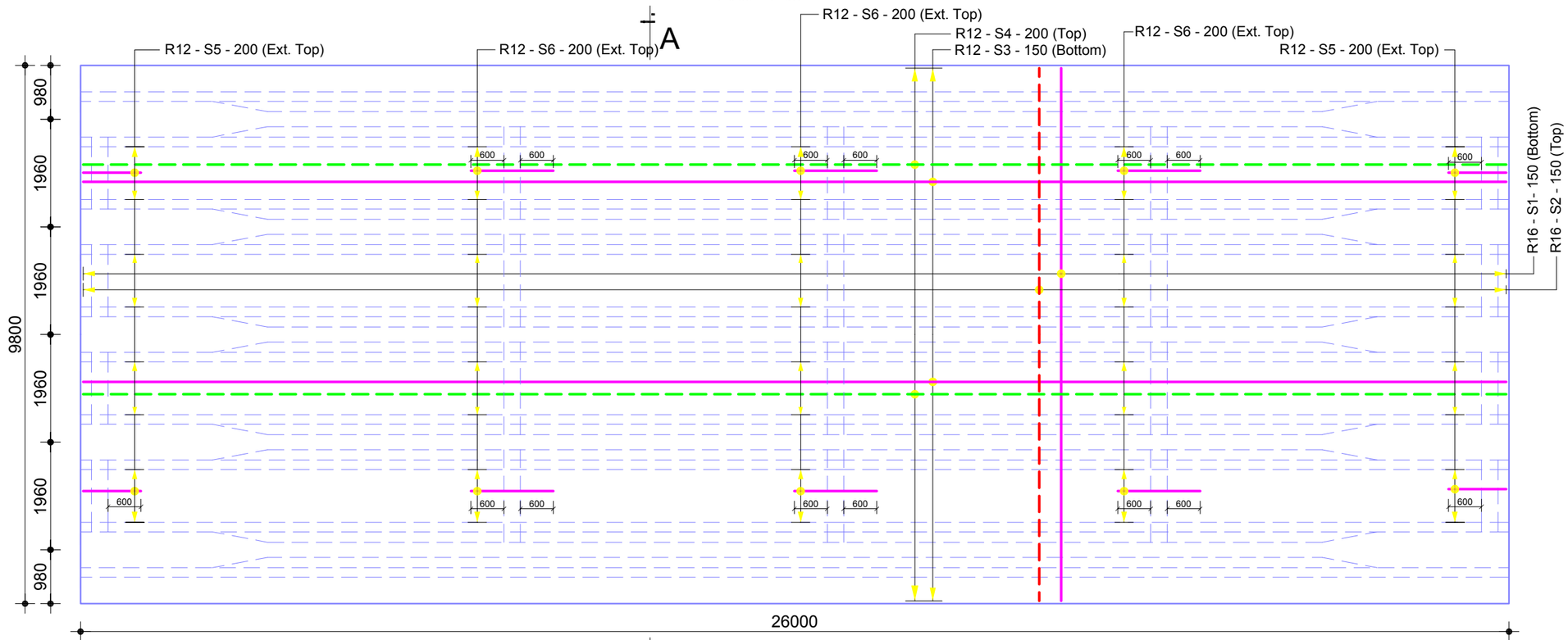
DESIGNED BY :	DRAWN BY :	CHECKED BY :	APPROVED BY :
MD. TAZUDDIN	MD. TAZUDDIN	AFM HAMIDUL HAQUE	DR. PRABHAT SHRIVASTAVA

REV.	DESCRIPTION	DATE



SEC. A-A ON DECK

(Scale : 1:50)



A REINF. PLAN OF DECK

NAME OF THE CLIENT :

GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH

LOCAL GOVERNMENT ENGINEERING DEPARTMENT

NAME OF THE PROJECT :

CONSULTANCY SERVICES FOR FEASIBILITY, DETAILED SURVEY AND DESIGN OF CHITTAGONG HILL TRACT CONNECTIVITY CONNECTING THEGAMUKH AND CHITTAGONG PORT.

NAME OF THE CONSULTANTS :

SAI Consulting Engineers Pvt. Ltd, India.

in association with

BETS Consulting Services Ltd, Bangladesh

Project office :

Tahmid Mahmood Palace
Flat # 9A, House # 77, Road # 4, Block-C,
Banani, Dhaka-1213, Bangladesh.

DRAWING TITLE : REINF. DETAILS OF DECK SLAB (S-26)

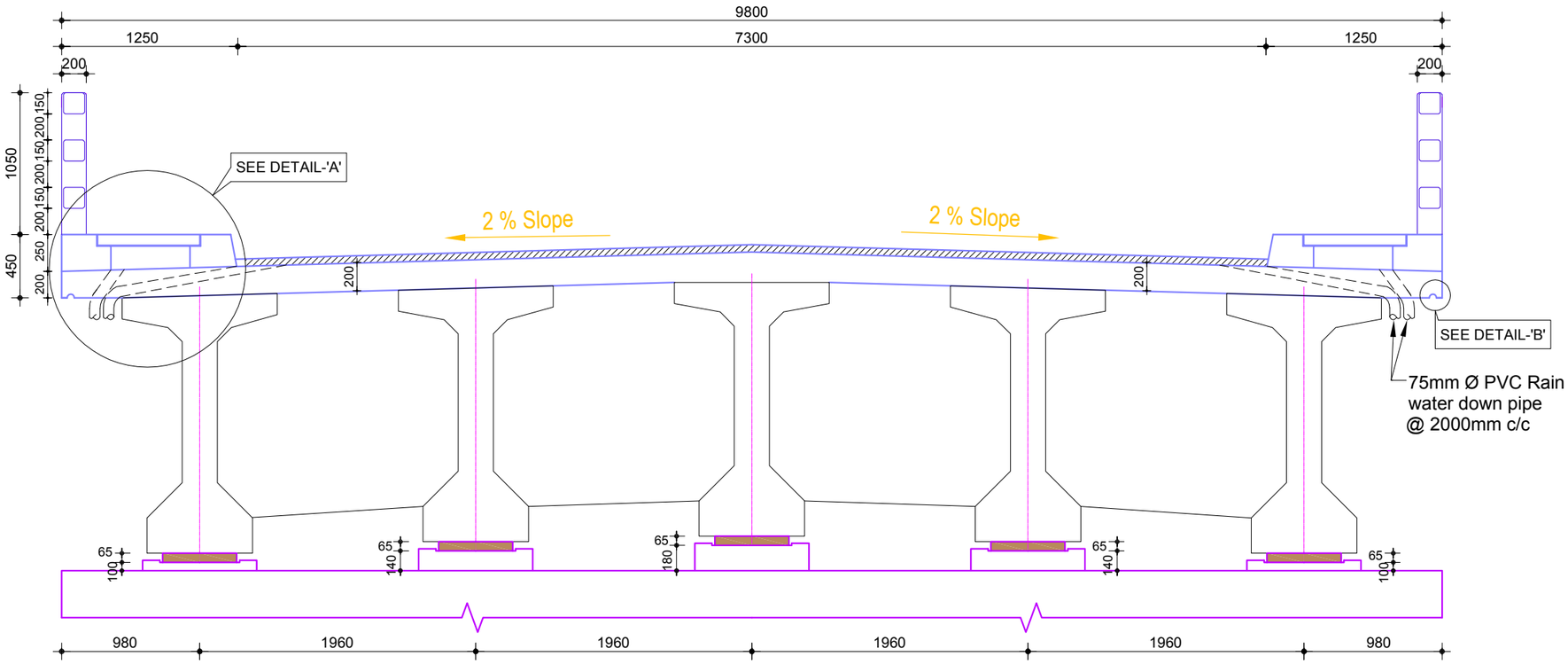
DRAWING NO : LGED/DK-26/RNF.-02

Scale :As shown

Date : 28-01-16

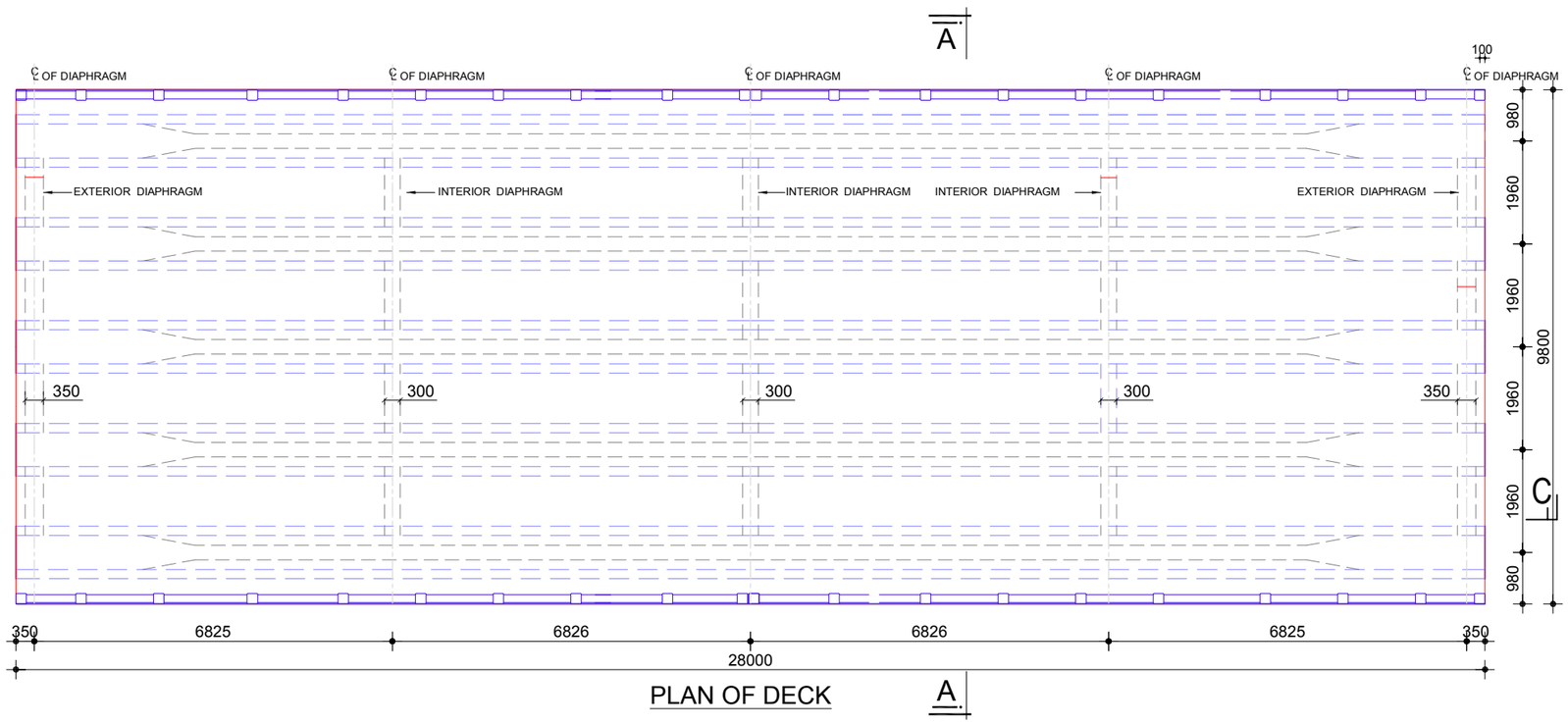
DESIGNED BY :	DRAWN BY :	CHECKED BY :	APPROVED BY :
MD. TAZUDDIN	MD. TAZUDDIN	AFM HAMIDUL HAQUE	DR. PRABHAT SHRIVASTAVA

REV.	DESCRIPTION	DATE

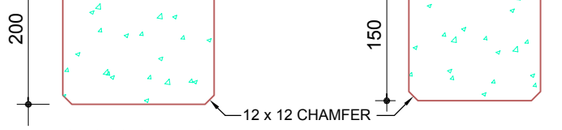


SEC. A-A ON DECK

(Scale : 1:50)

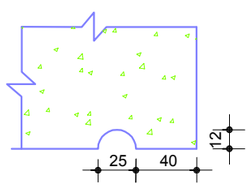


PLAN OF DECK



CROSS SECTION RAIL POST

CROSS SECTION RAIL BAR



DETAIL "B"

NOTES:

1. All dimensions are in milimeters unless othrwise mentioned.

NAME OF THE CLIENT :

GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH

LOCAL GOVERNMENT ENGINEERING DEPARTMENT

NAME OF THE PROJECT :

CONSULTANCY SERVICES FOR FEASIBILITY, DETAILED SURVEY AND DESIGN OF CHITTAGONG HILL TRACT CONNECTIVITY CONNECTING THEGAMUKH AND CHITTAGONG PORT.

NAME OF THE CONSULTANTS :

SAI Consulting Engineers Pvt. Ltd, India.

in association with

BETS Consulting Services Ltd, Bangladesh

Project office :

Tahmid Mahmood Palace
Flat # 9A, House # 77, Road # 4, Block-C,

DRAWING TITLE : DETAILS OF DECK SLAB (S-28.0m)

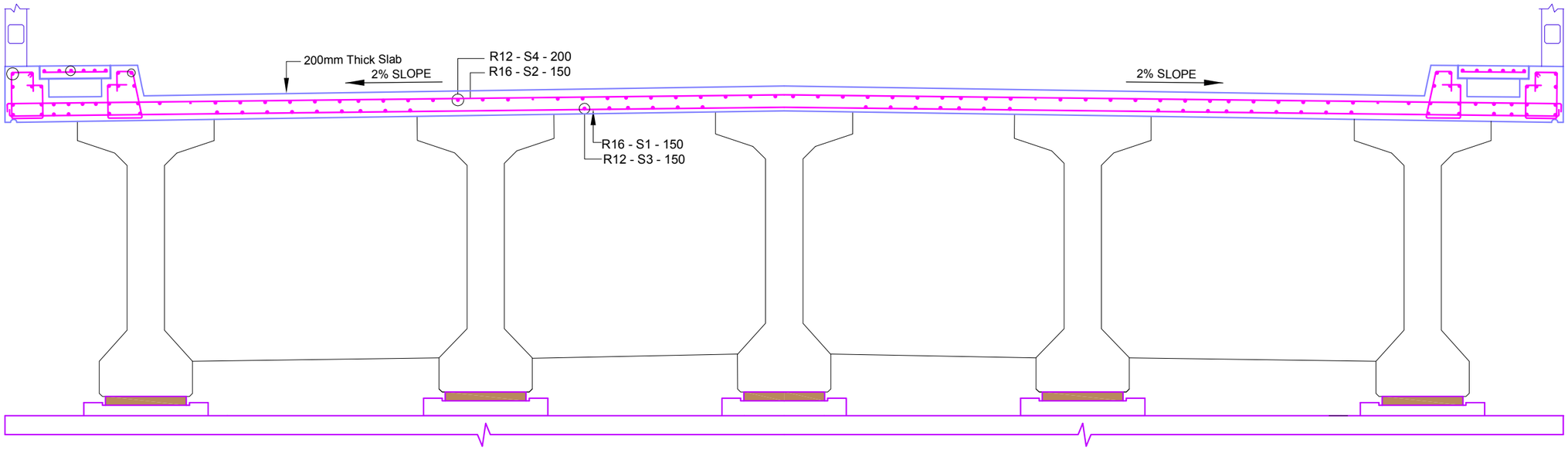
DRAWING NO : LGED/DK-28/C-01

Scale :As shown

Date : 28-01-16

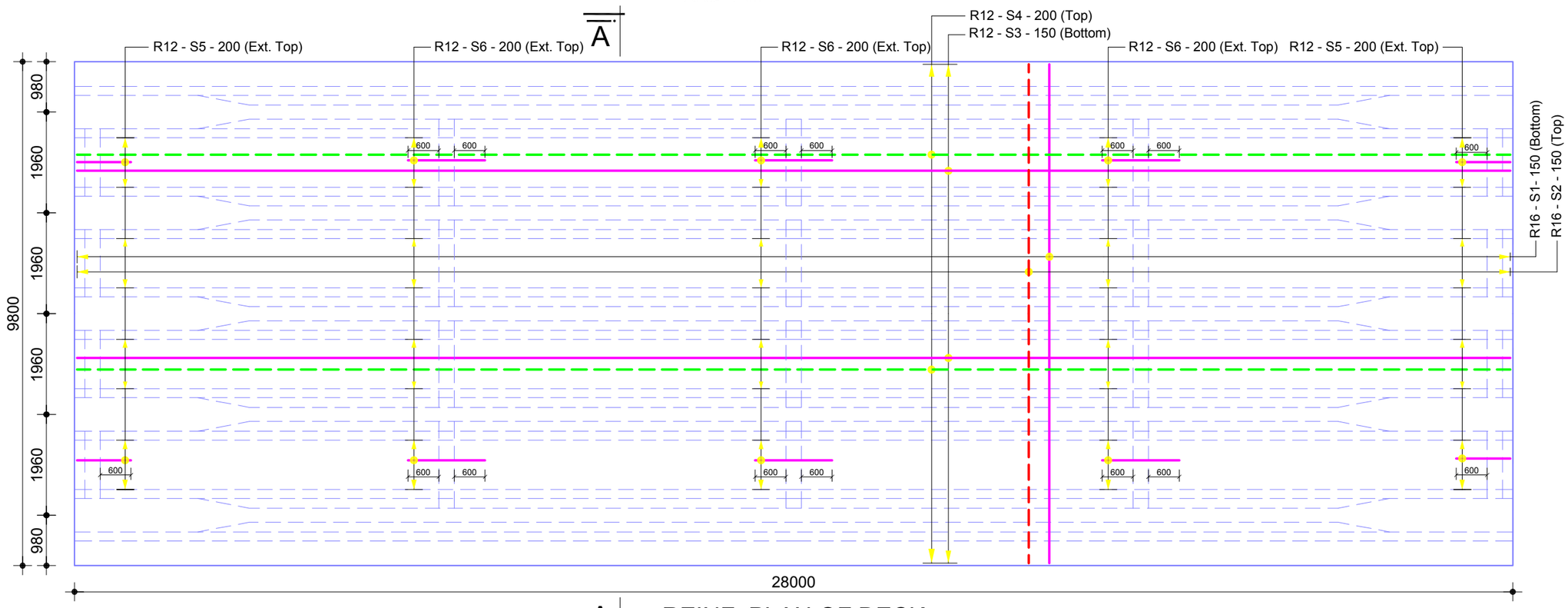
DESIGNED BY :	DRAWN BY :	CHECKED BY :	APPROVED BY :
MD. TAZUDDIN	MD. TAZUDDIN	AFM HAMIDUL HAQUE	DR. PRABHAT SHRIVASTAVA

REV.	DESCRIPTION	DATE



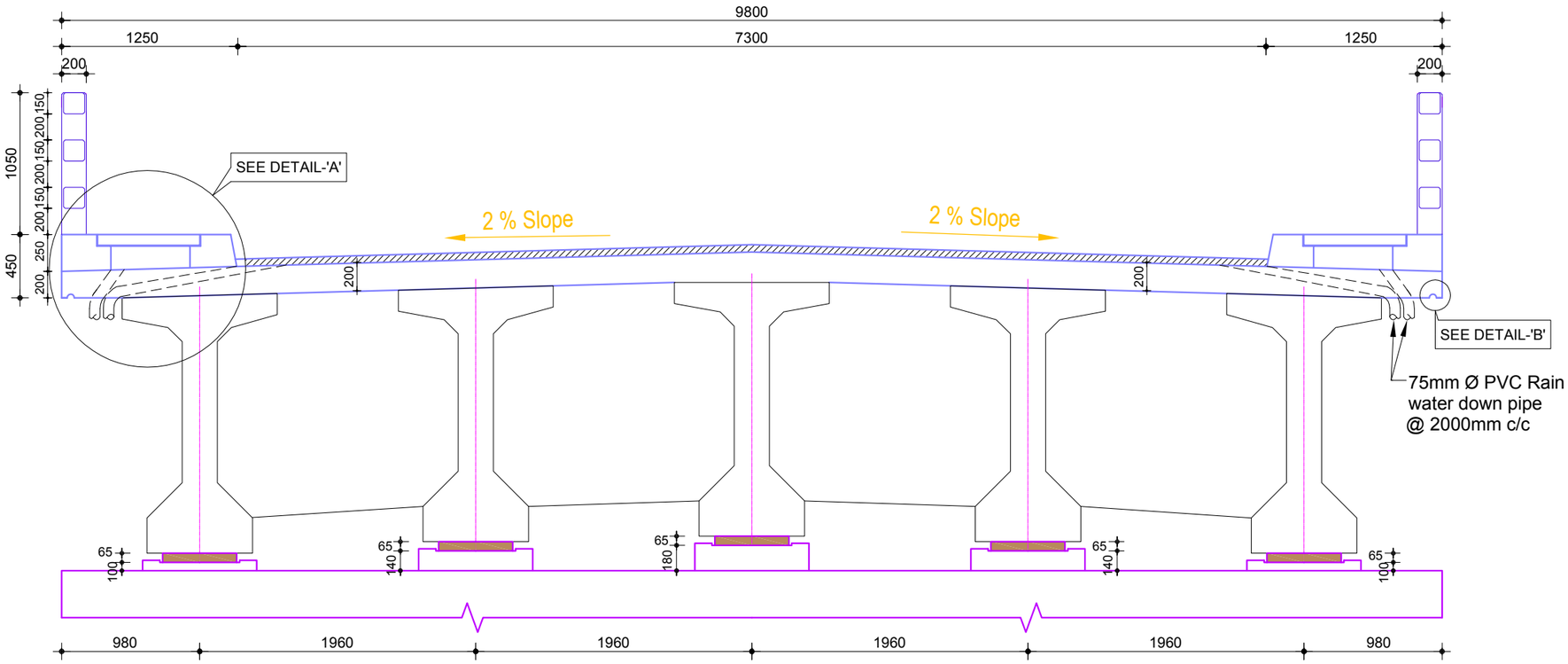
SEC. A-A ON DECK

(Scale : 1:50)



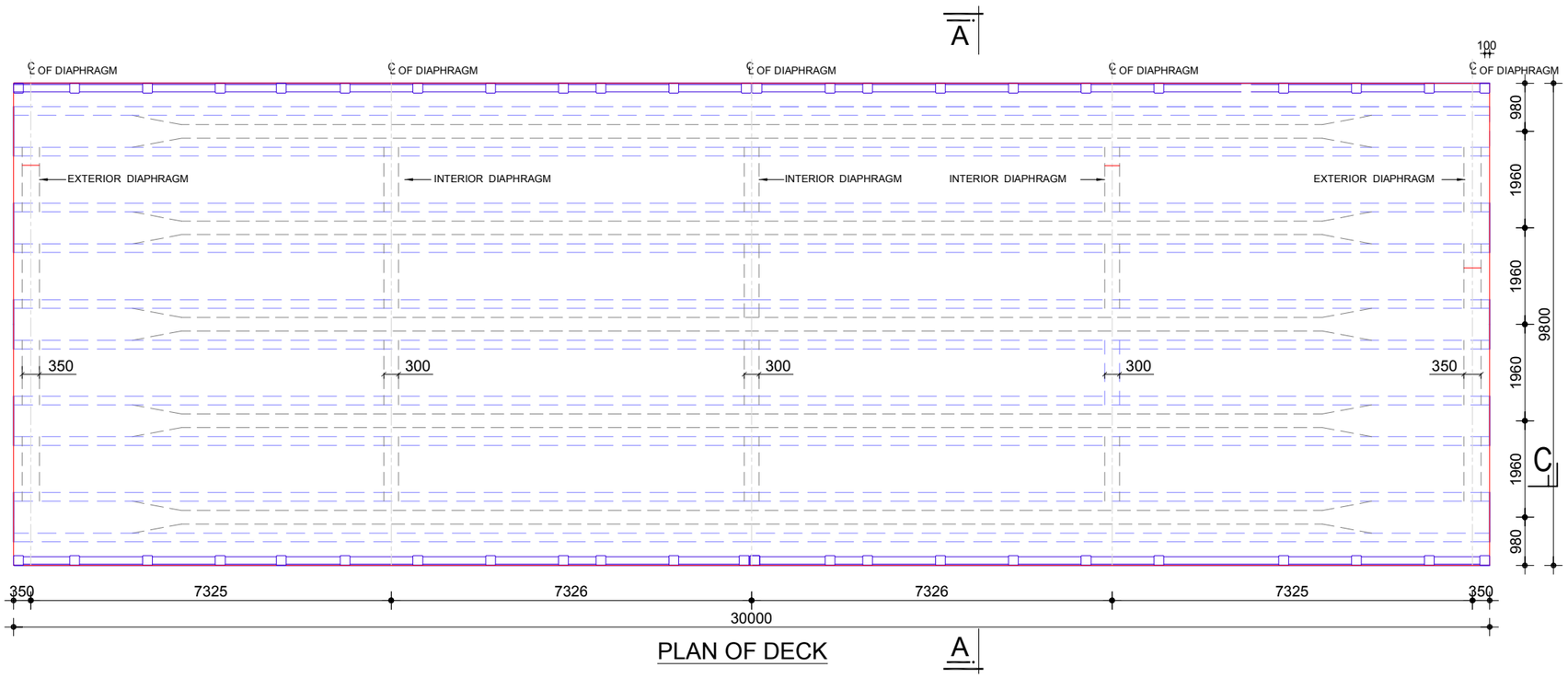
A REINF. PLAN OF DECK

NAME OF THE CLIENT : GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH **LOCAL GOVERNMENT ENGINEERING DEPARTMENT** NAME OF THE PROJECT : CONSULTANCY SERVICES FOR FEASIBILITY, DETAILED SURVEY AND DESIGN OF CHITTAGONG HILL TRACT CONNECTIVITY CONNECTING THEGAMUKH AND CHITTAGONG PORT.	NAME OF THE CONSULTANTS : **SAI Consulting Engineers Pvt. Ltd, India.** in association with **BETS Consulting Services Ltd, Bangladesh** Project office : Tahmid Mahmood Palace Flat # 9A, House # 77, Road # 4, Block-C, Banani, Dhaka-1213, Bangladesh.	DRAWING TITLE : REINF. DETAILS OF DECK SLAB (S-28) DRAWING NO : LGED/DK-28/RNF.-02 Scale :As shown Date : 28-01-16	DESIGNED BY : MD. TAZUDDIN	DRAWN BY : MD. TAZUDDIN	CHECKED BY : AFM HAMIDUL HAQUE	APPROVED BY : DR. PRABHAT SHRIVASTAVA	REV.	DESCRIPTION	DATE

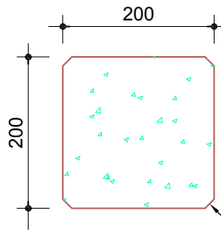


SEC. A-A ON DECK

(Scale : 1:50)



PLAN OF DECK



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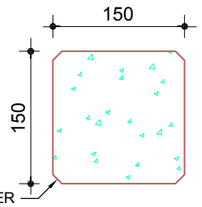

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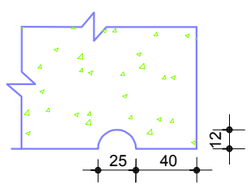


DETAIL "B"

NOTES:

1. All dimensions are in milimeters unless othrwise mentioned.

NAME OF THE CLIENT :

GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH

LOCAL GOVERNMENT ENGINEERING DEPARTMENT

NAME OF THE PROJECT :

CONSULTANCY SERVICES FOR FEASIBILITY, DETAILED SURVEY AND DESIGN OF CHITTAGONG HILL TRACT CONNECTIVITY CONNECTING THEGAMUKH AND CHITTAGONG PORT.

NAME OF THE CONSULTANTS :

SAI Consulting Engineers Pvt. Ltd, India.

in association with

BETS Consulting Services Ltd, Bangladesh

Project office :

Tahmid Mahmood Palace
Flat # 9A, House # 77, Road # 4, Block-C,

DRAWING TITLE :

DETAILS OF DECK SLAB (S-30.0m)

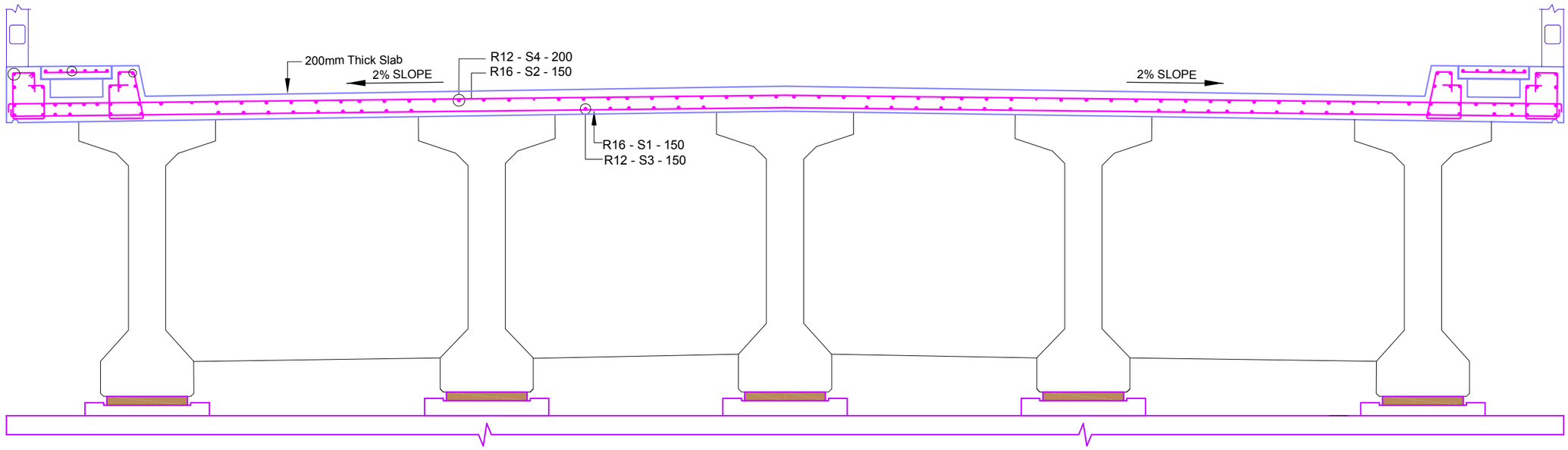
DRAWING NO : LGED/DK-30/C-01

Scale :As shown

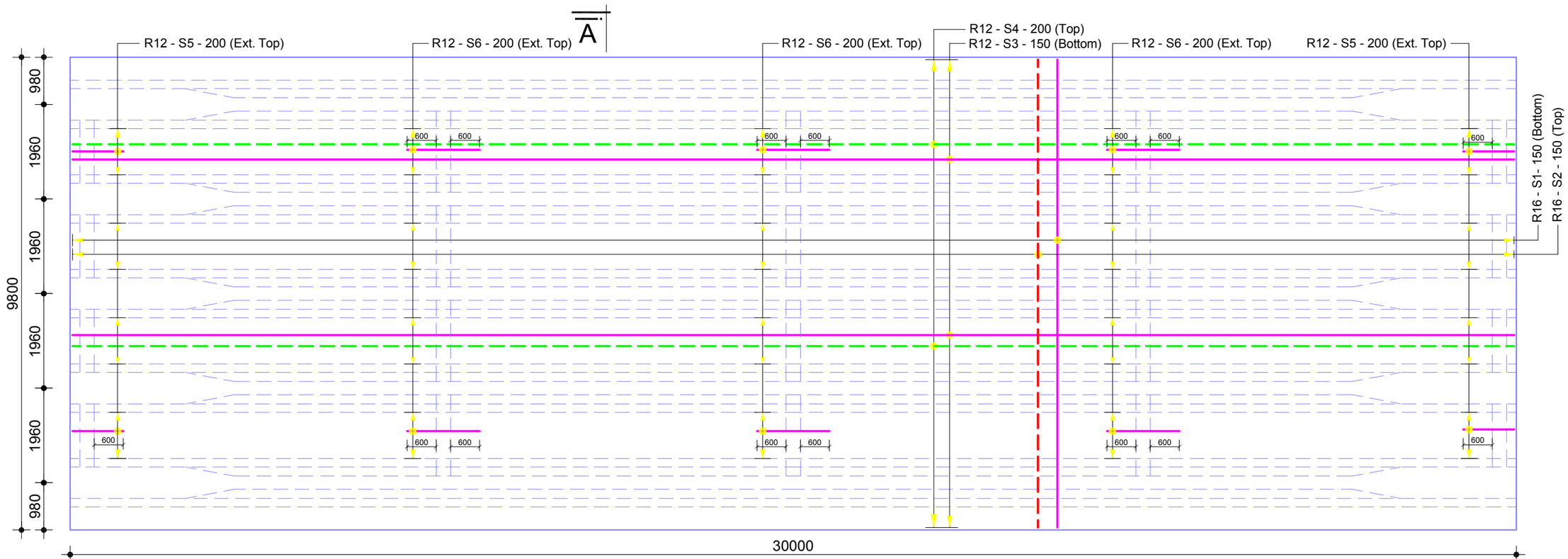
Date : 28-01-16

DESIGNED BY :	DRAWN BY :	CHECKED BY :	APPROVED BY :
MD. TAZUDDIN	MD. TAZUDDIN	AFM HAMIDUL HAQUE	DR. PRABHAT SHRIVASTAVA

REV.	DESCRIPTION	DATE

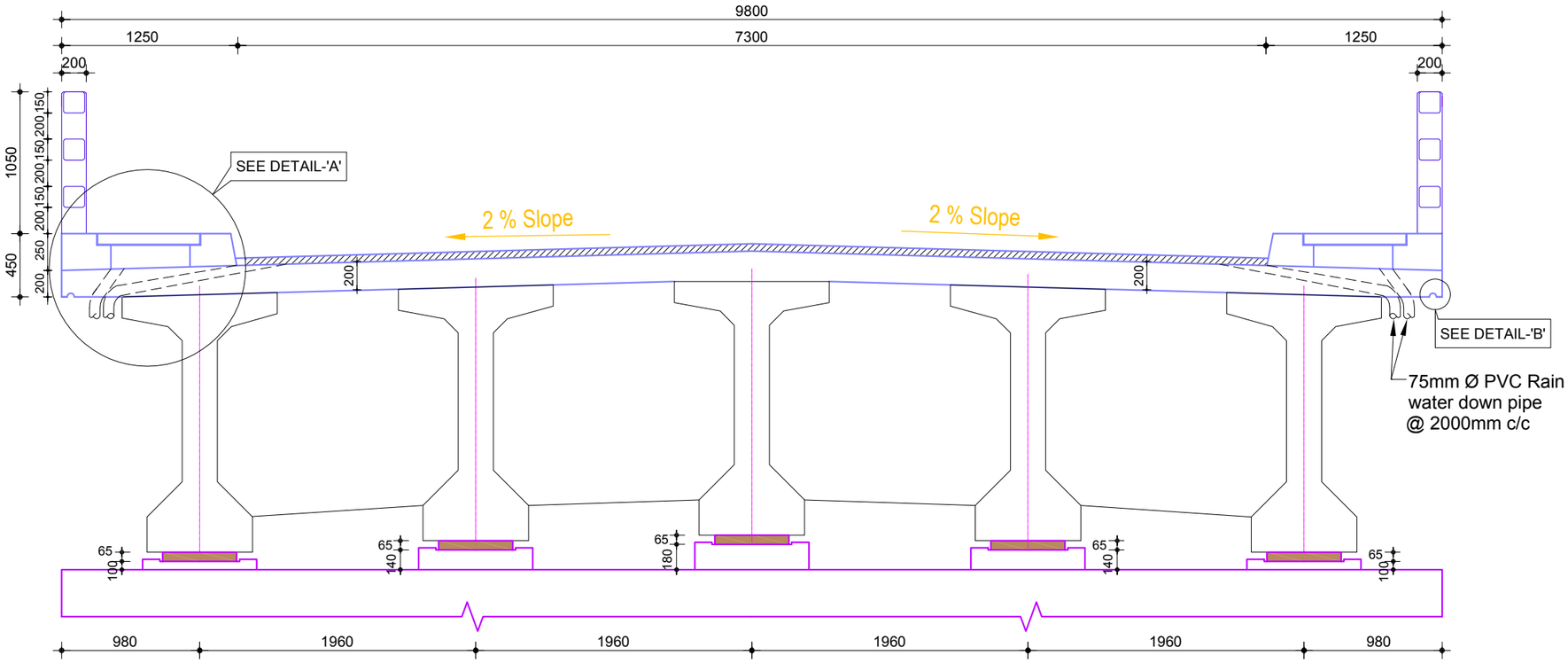


SEC. A-A ON DECK



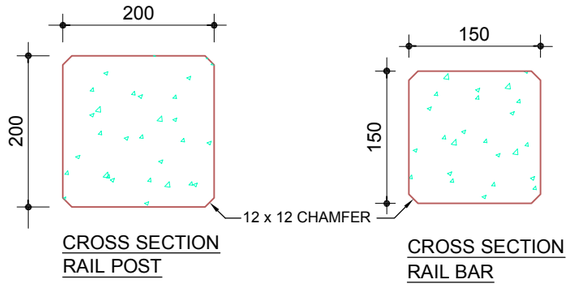
A REINF. PLAN OF DECK

NAME OF THE CLIENT : GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH **LOCAL GOVERNMENT ENGINEERING DEPARTMENT** NAME OF THE PROJECT : CONSULTANCY SERVICES FOR FEASIBILITY, DETAILED SURVEY AND DESIGN OF CHITTAGONG HILL TRACT CONNECTIVITY CONNECTING THEGAMUKH AND CHITTAGONG PORT.	NAME OF THE CONSULTANTS : **SAI Consulting Engineers Pvt. Ltd, India.** in association with **BETS Consulting Services Ltd, Bangladesh** Project office : Tahmid Mahmood Palace Flat # 9A, House # 77, Road # 4, Block-C, Banani, Dhaka-1213, Bangladesh.	DRAWING TITLE : REINF. DETAILS OF DECK SLAB (S-30) DRAWING NO : LGED/DK-30/RNF.-02 Scale :As shown Date : 28-01-16	DESIGNED BY : MD. TAZUDDIN	DRAWN BY : MD. TAZUDDIN	CHECKED BY : AFM HAMIDUL HAQUE	APPROVED BY : DR. PRABHAT SHRIVASTAVA	REV.	DESCRIPTION	DATE



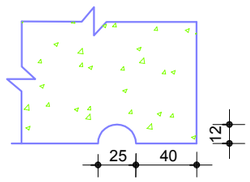
SEC. A-A ON DECK

(Scale : 1:50)



CROSS SECTION RAIL POST

CROSS SECTION RAIL BAR



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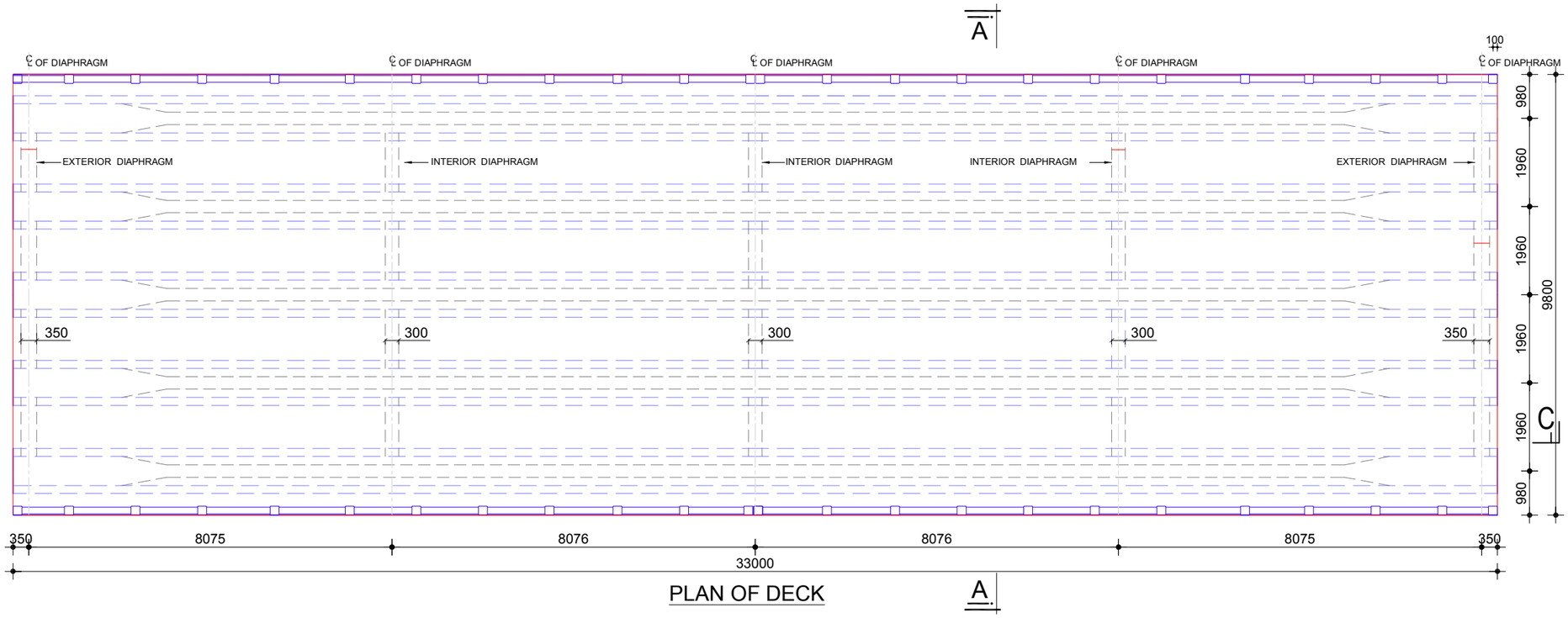


PLAN OF DECK

NOTES:

1. All dimensions are in milimeters unless othrwise mentioned.

NAME OF THE CLIENT :
GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH
LOCAL GOVERNMENT ENGINEERING DEPARTMENT

NAME OF THE PROJECT :
CONSULTANCY SERVICES FOR FEASIBILITY, DETAILED SURVEY AND DESIGN OF CHITTAGONG HILL TRACT CONNECTIVITY CONNECTING THEGAMUKH AND CHITTAGONG PORT.

NAME OF THE CONSULTANTS :
SAI Consulting Engineers Pvt. Ltd, India.
in association with
BETS Consulting Services Ltd, Bangladesh
Project office :
Tahmid Mahmood Palace
Flat # 9A, House # 77, Road # 4, Block-C,

DRAWING TITLE : DETAILS OF DECK SLAB (S-33.0m)

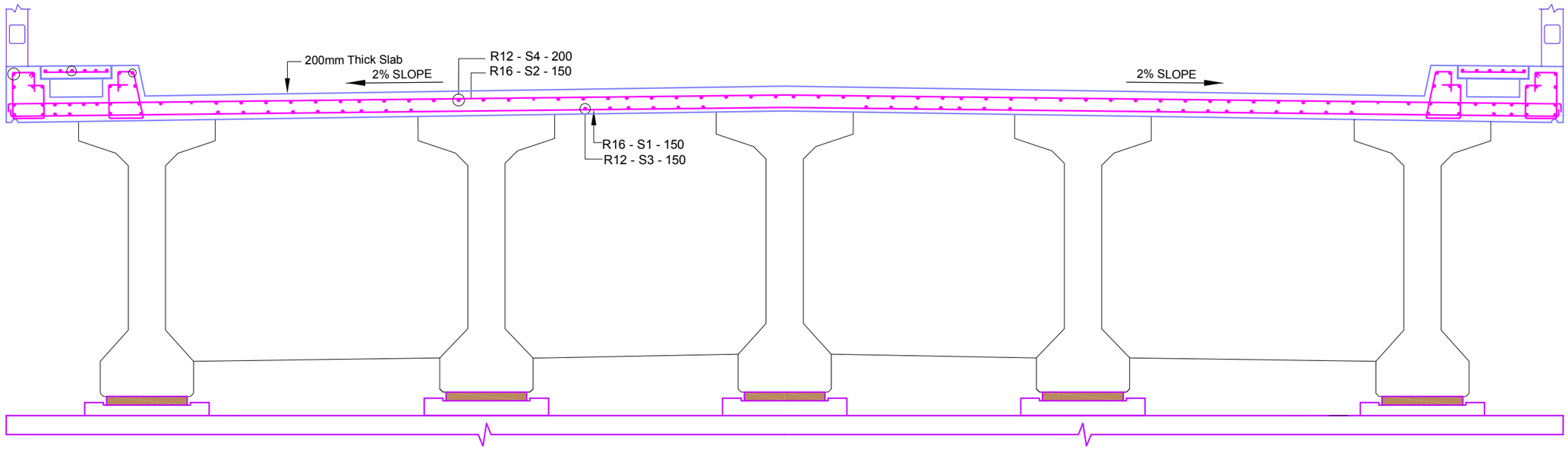
DRAWING NO : LGED/DK-33/C-01

Scale :As shown

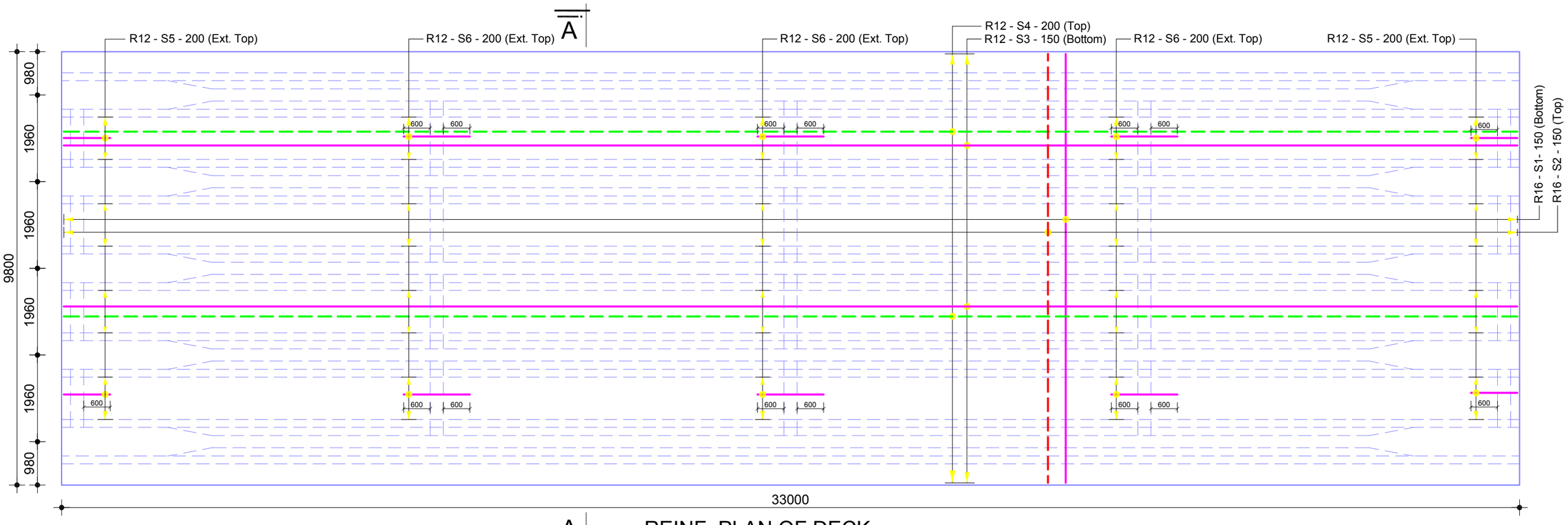
Date : 28-01-16

DESIGNED BY :	DRAWN BY :	CHECKED BY :	APPROVED BY :
MD. TAZUDDIN	MD. TAZUDDIN	AFM HAMIDUL HAQUE	DR. PRABHAT SHRIVASTAVA

REV.	DESCRIPTION	DATE



SEC. A-A ON DECK



A REINF. PLAN OF DECK

NAME OF THE CLIENT :
GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH
LOCAL GOVERNMENT ENGINEERING DEPARTMENT

NAME OF THE PROJECT :
CONSULTANCY SERVICES FOR FEASIBILITY, DETAILED SURVEY AND DESIGN OF CHITTAGONG HILL TRACT CONNECTIVITY CONNECTING THEGAMUKH AND CHITTAGONG PORT.

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BETS Consulting Services Ltd, Bangladesh
Project office :
Tahmid Mahmood Palace
Flat # 9A, House # 77, Road # 4, Block-C,
Banani, Dhaka-1213, Bangladesh.

DRAWING TITLE : REINF. DETAILS OF DECK SLAB (S-33)

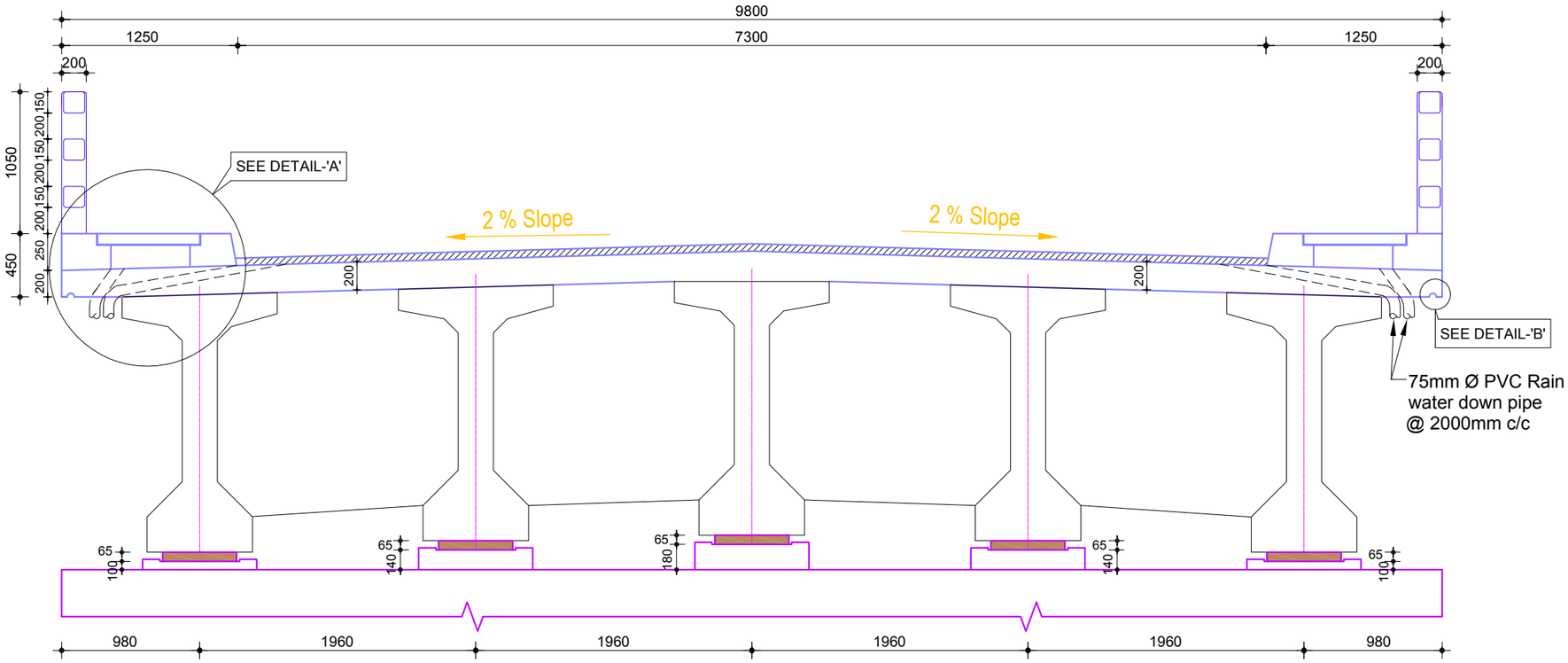
DRAWING NO : LGED/DK-33/RNF.-02

Scale :As shown

Date : 28-01-16

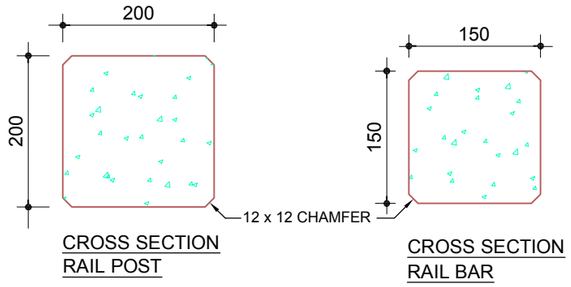
DESIGNED BY :	DRAWN BY :	CHECKED BY :	APPROVED BY :
MD. TAZUDDIN	MD. TAZUDDIN	AFM HAMIDUL HAQUE	DR. PRABHAT SHRIVASTAVA

REV.	DESCRIPTION	DATE



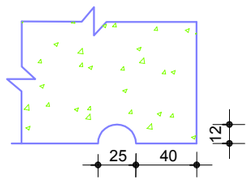
SEC. A-A ON DECK

(Scale : 1:50)

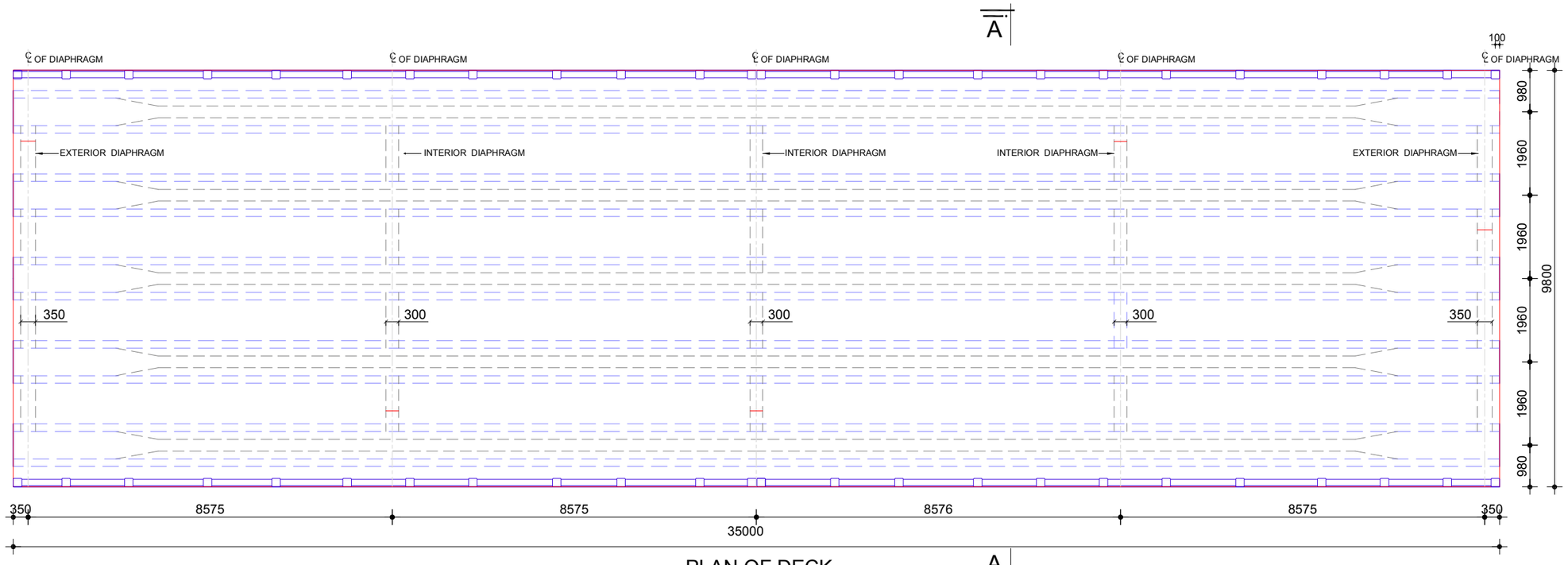


CROSS SECTION RAIL POST

CROSS SECTION RAIL BAR



DETAIL "B"



PLAN OF DECK

NOTES:

1. All dimensions are in milimeters unless othrwise mentioned.

NAME OF THE CLIENT :

GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH

LOCAL GOVERNMENT ENGINEERING DEPARTMENT

NAME OF THE PROJECT :

CONSULTANCY SERVICES FOR FEASIBILITY, DETAILED SURVEY AND DESIGN OF CHITTAGONG HILL TRACT CONNECTIVITY CONNECTING THEGAMUKH AND CHITTAGONG PORT.

NAME OF THE CONSULTANTS :

SAI Consulting Engineers Pvt. Ltd, India.

in association with

BETS Consulting Services Ltd, Bangladesh

Project office :

Tahmid Mahmood Palace
Flat # 9A, House # 77, Road # 4, Block-C,

DRAWING TITLE : DETAILS OF DECK SLAB (S-35.0m)

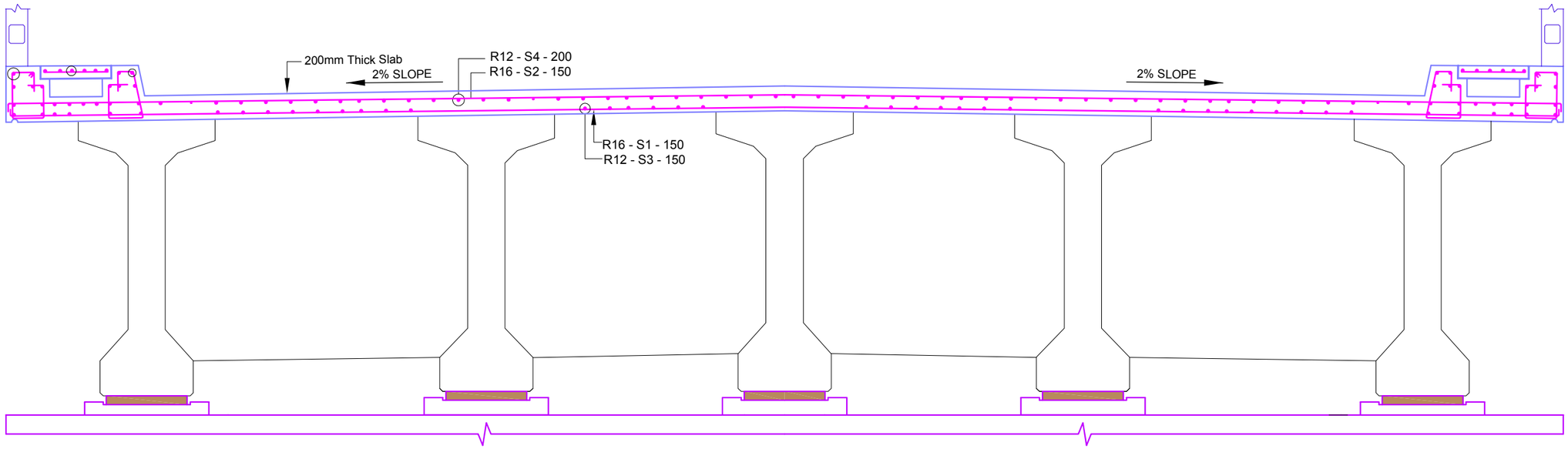
DRAWING NO : LGED/DK-35/C-01

Scale :As shown

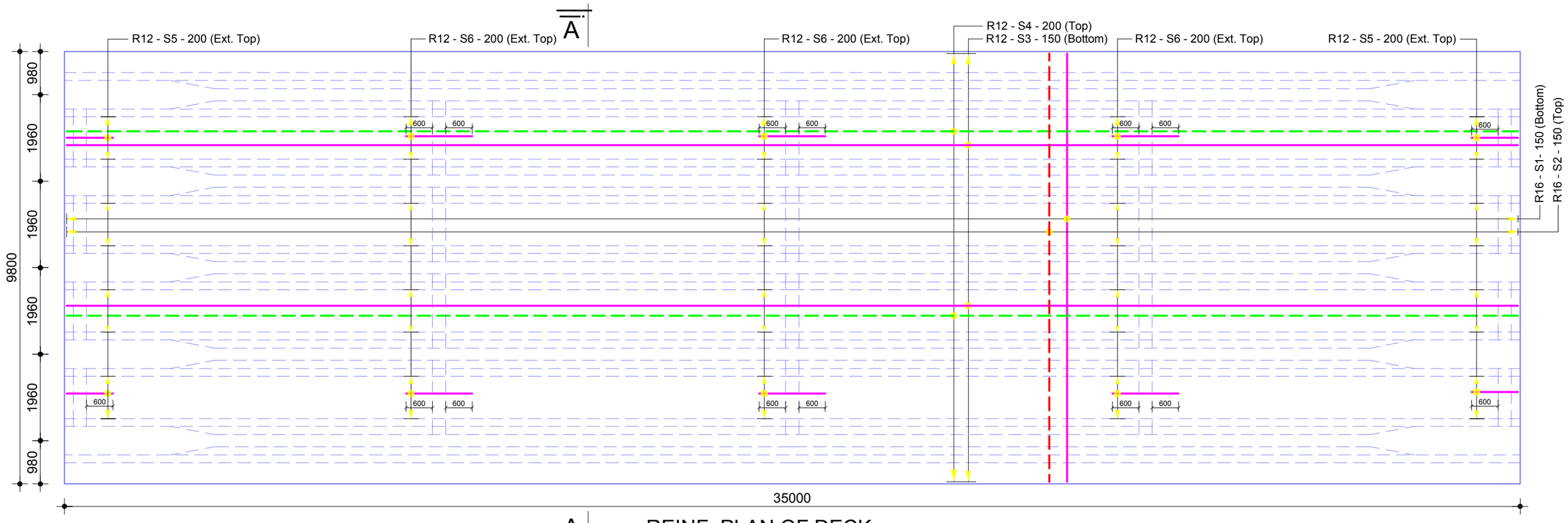
Date : 28-01-16

DESIGNED BY :	DRAWN BY :	CHECKED BY :	APPROVED BY :
MD. TAZUDDIN	MD. TAZUDDIN	AFM HAMIDUL HAQUE	DR. PRABHAT SHRIVASTAVA

REV.	DESCRIPTION	DATE



SEC. A-A ON DECK



A. REINF. PLAN OF DECK

NAME OF THE CLIENT :
GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH
LOCAL GOVERNMENT ENGINEERING DEPARTMENT

NAME OF THE PROJECT :
CONSULTANCY SERVICES FOR FEASIBILITY, DETAILED SURVEY AND DESIGN OF CHITTAGONG HILL TRACT CONNECTIVITY CONNECTING THEGAMUKH AND CHITTAGONG PORT.

NAME OF THE CONSULTANTS :
SAI Consulting Engineers Pvt. Ltd, India.
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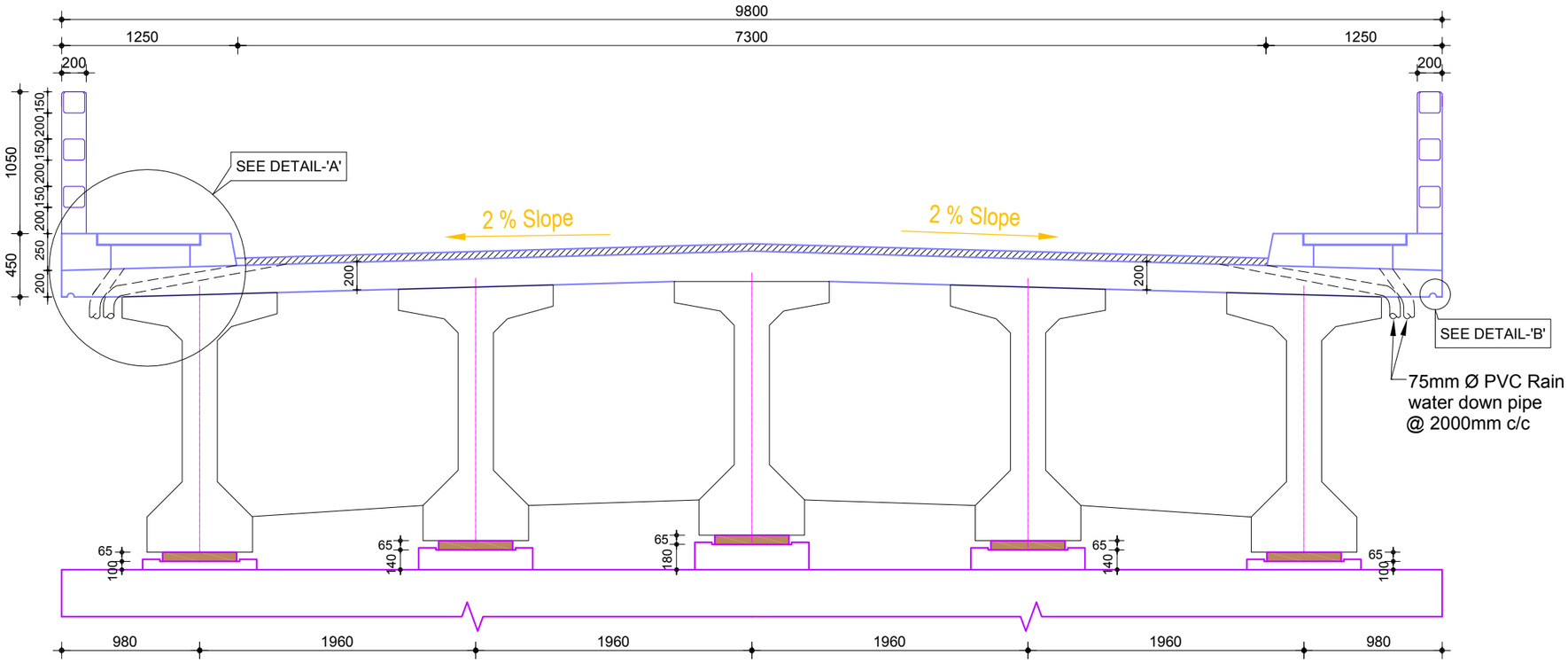
BETS Consulting Services Ltd, Bangladesh
Project office :
Tahmid Mahmood Palace
Flat # 9A, House # 77, Road # 4, Block-C,
Banani, Dhaka-1213, Bangladesh.

DRAWING TITLE : REINF. DETAILS OF DECK SLAB (S-35)
DRAWING NO : LGED/DK-35/RNF.-02
Scale :As shown
Date : 28-01-16

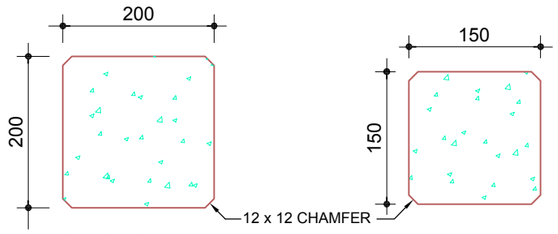
DESIGNED BY :	DRAWN BY :	CHECKED BY :	APPROVED BY :
MD. TAZUDDIN	MD. TAZUDDIN	AFM HAMIDUL HAQUE	DR. PRABHAT SHRIVASTAVA

REV.	DESCRIPTION	DATE



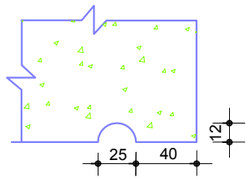
SEC. A-A ON DECK

(Scale : 1:50)



CROSS SECTION RAIL POST

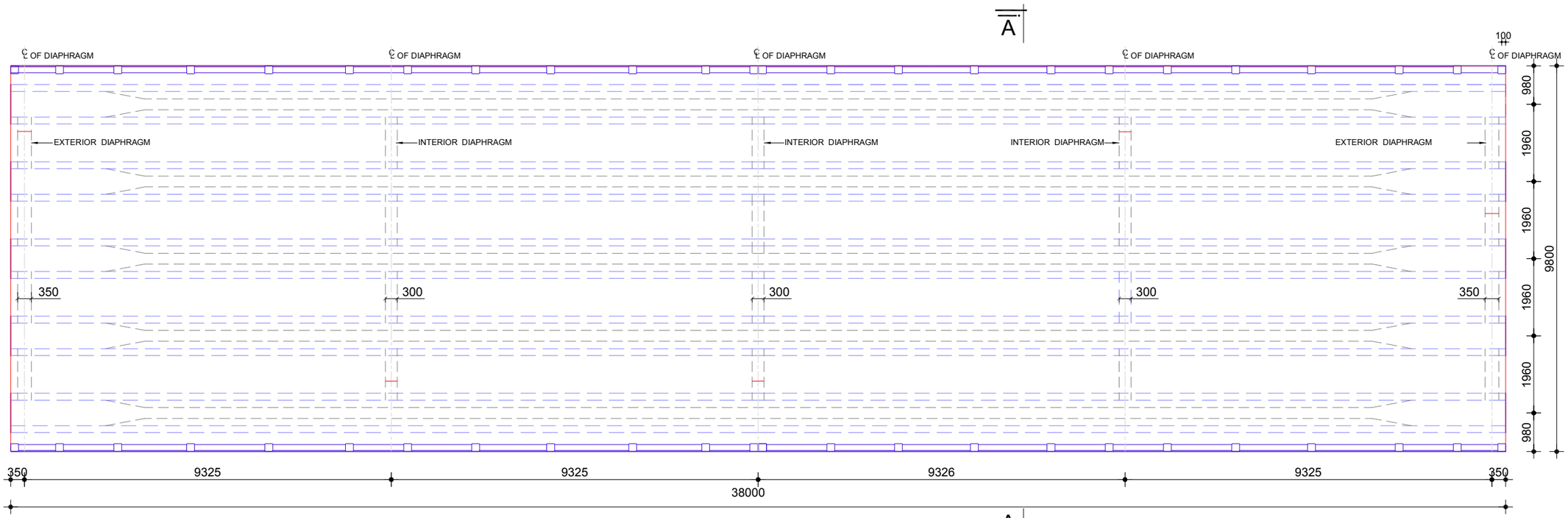
CROSS SECTION RAIL BAR



DETAIL "B"

NOTES:

1. All dimensions are in milimeters unless othrwise mentioned.



PLAN OF DECK

NAME OF THE CLIENT :

GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH

LOCAL GOVERNMENT ENGINEERING DEPARTMENT

NAME OF THE PROJECT :

CONSULTANCY SERVICES FOR FEASIBILITY, DETAILED SURVEY AND DESIGN OF CHITTAGONG HILL TRACT CONNECTIVITY CONNECTING THEGAMUKH AND CHITTAGONG PORT.

NAME OF THE CONSULTANTS :

SAI Consulting Engineers Pvt. Ltd, India.

in association with

BETS Consulting Services Ltd, Bangladesh

Project office :

Tahmid Mahmood Palace
Flat # 9A, House # 77, Road # 4, Block-C,

DRAWING TITLE : DETAILS OF DECK SLAB (S-38.0m)

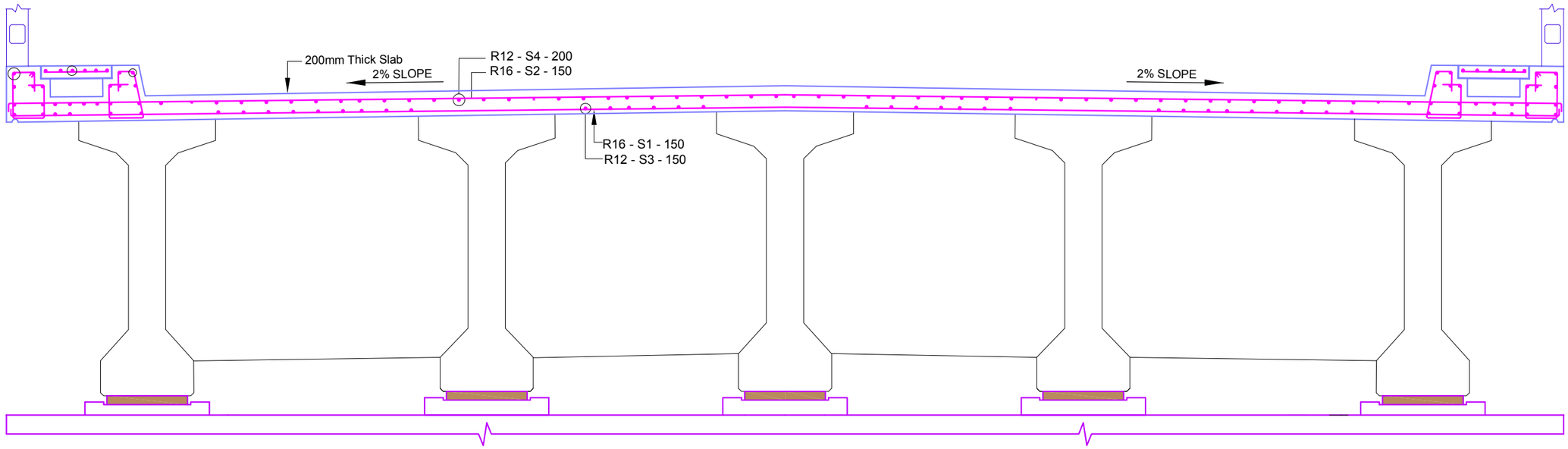
DRAWING NO : LGED/DK-38/C-01

Scale :As shown

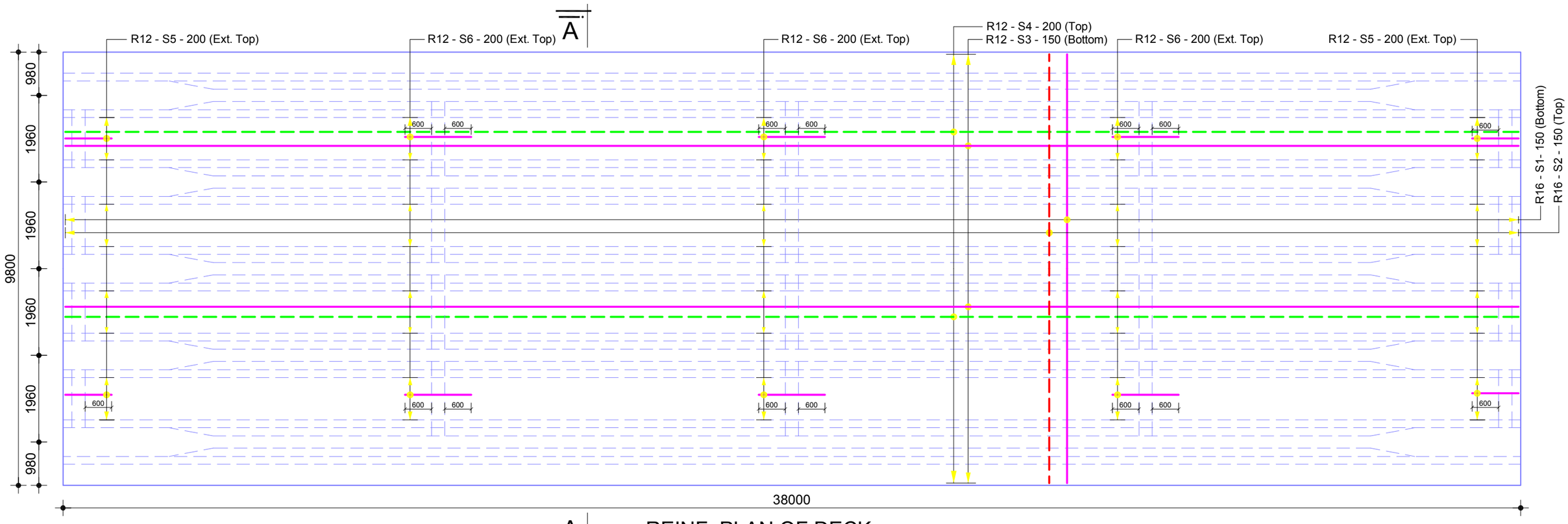
Date : 28-01-16

DESIGNED BY :	DRAWN BY :	CHECKED BY :	APPROVED BY :
MD. TAZUDDIN	MD. TAZUDDIN	AFM HAMIDUL HAQUE	DR. PRABHAT SHRIVASTAVA

REV.	DESCRIPTION	DATE



SEC. A-A ON DECK



A REINF. PLAN OF DECK

NAME OF THE CLIENT :
GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH
LOCAL GOVERNMENT ENGINEERING DEPARTMENT

NAME OF THE PROJECT :
CONSULTANCY SERVICES FOR FEASIBILITY, DETAILED SURVEY AND DESIGN OF CHITTAGONG HILL TRACT CONNECTIVITY CONNECTING THEGAMUKH AND CHITTAGONG PORT.

NAME OF THE CONSULTANTS :
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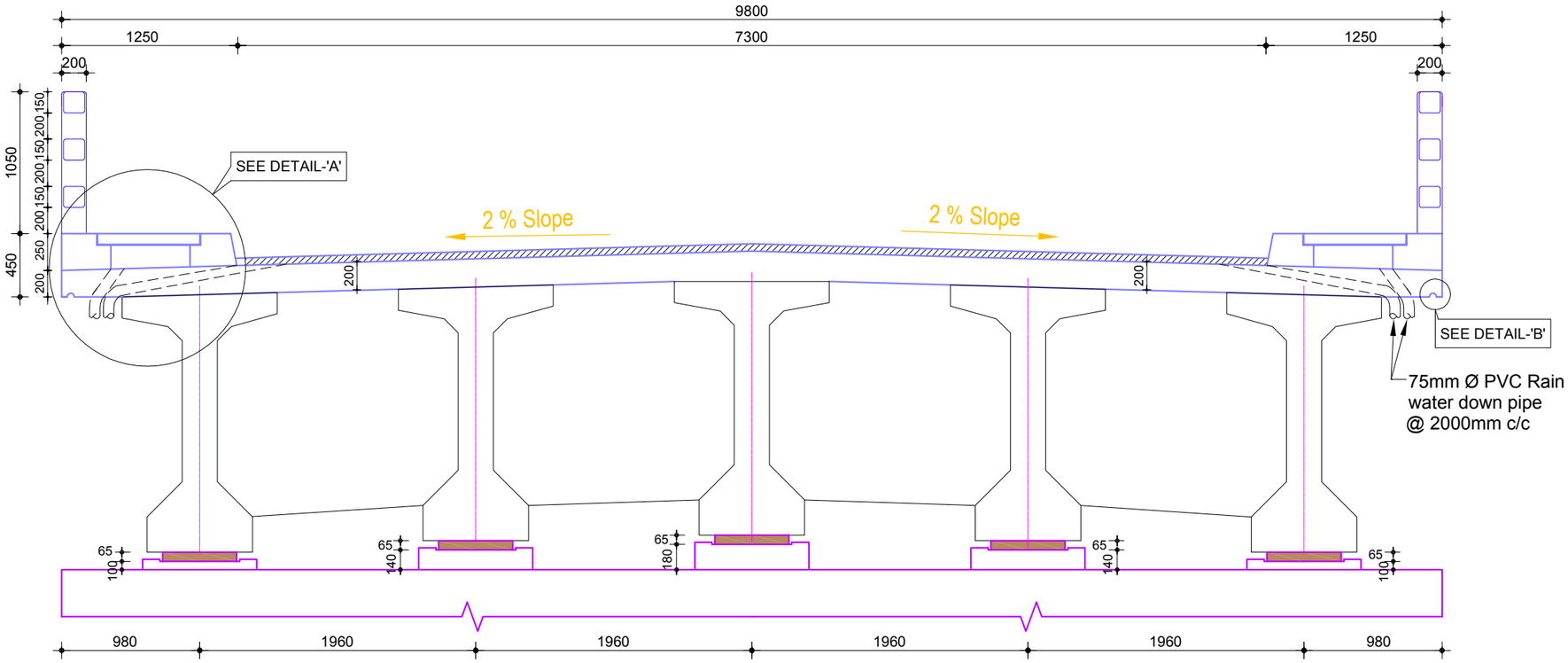
BETS Consulting Services Ltd, Bangladesh
Project office :
Tahmid Mahmood Palace
Flat # 9A, House # 77, Road # 4, Block-C,
Banani, Dhaka-1213, Bangladesh.

DRAWING TITLE : REINF. DETAILS OF DECK SLAB (S-38)
DRAWING NO : LGED/DK-38/RNF.-02
Scale :As shown
Date : 28-01-16

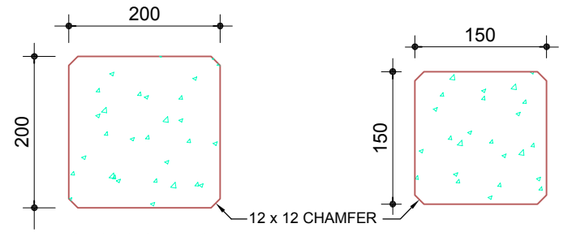
DESIGNED BY :	DRAWN BY :	CHECKED BY :	APPROVED BY :
MD. TAZUDDIN	MD. TAZUDDIN	AFM HAMIDUL HAQUE	DR. PRABHAT SHRIVASTAVA

REV.	DESCRIPTION	DATE



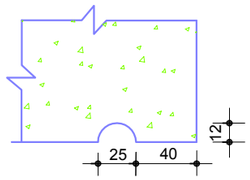
SEC. A-A ON DECK

(Scale : 1:50)



CROSS SECTION RAIL POST

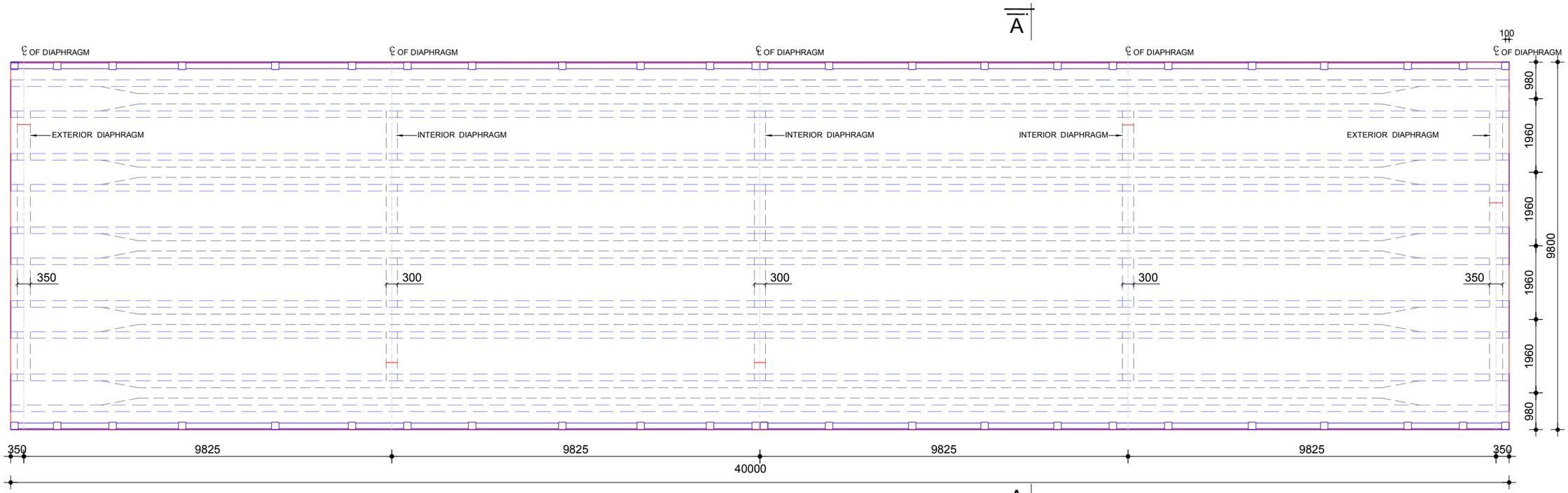
CROSS SECTION RAIL BAR



DETAIL "B"

NOTES:

1. All dimensions are in milimeters unless othrwise mentioned.



PLAN OF DECK

A

NAME OF THE CLIENT :

GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH

LOCAL GOVERNMENT ENGINEERING DEPARTMENT

NAME OF THE PROJECT :

CONSULTANCY SERVICES FOR FEASIBILITY, DETAILED SURVEY AND DESIGN OF CHITTAGONG HILL TRACT CONNECTIVITY CONNECTING THEGAMUKH AND CHITTAGONG PORT.

NAME OF THE CONSULTANTS :

SAI Consulting Engineers Pvt. Ltd, India.

in association with

BETS Consulting Services Ltd, Bangladesh

Project office :

Tahmid Mahmood Palace
Flat # 9A, House # 77, Road # 4, Block-C,

DRAWING TITLE : DETAILS OF DECK SLAB (S-40.0m)

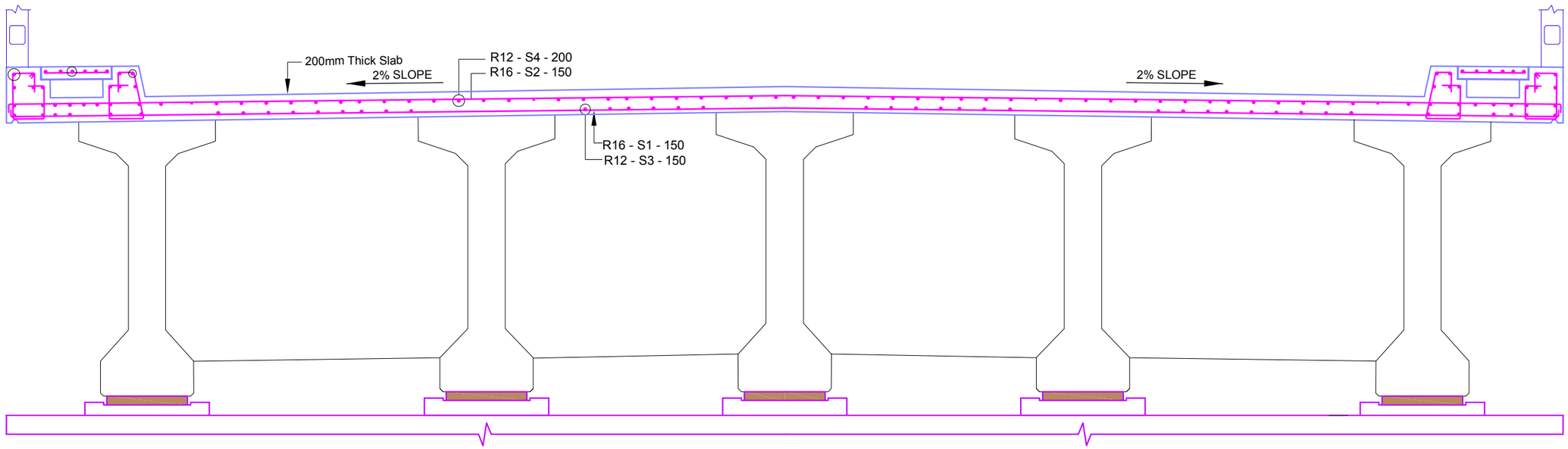
DRAWING NO : LGED/DK-40/C-01

Scale :As shown

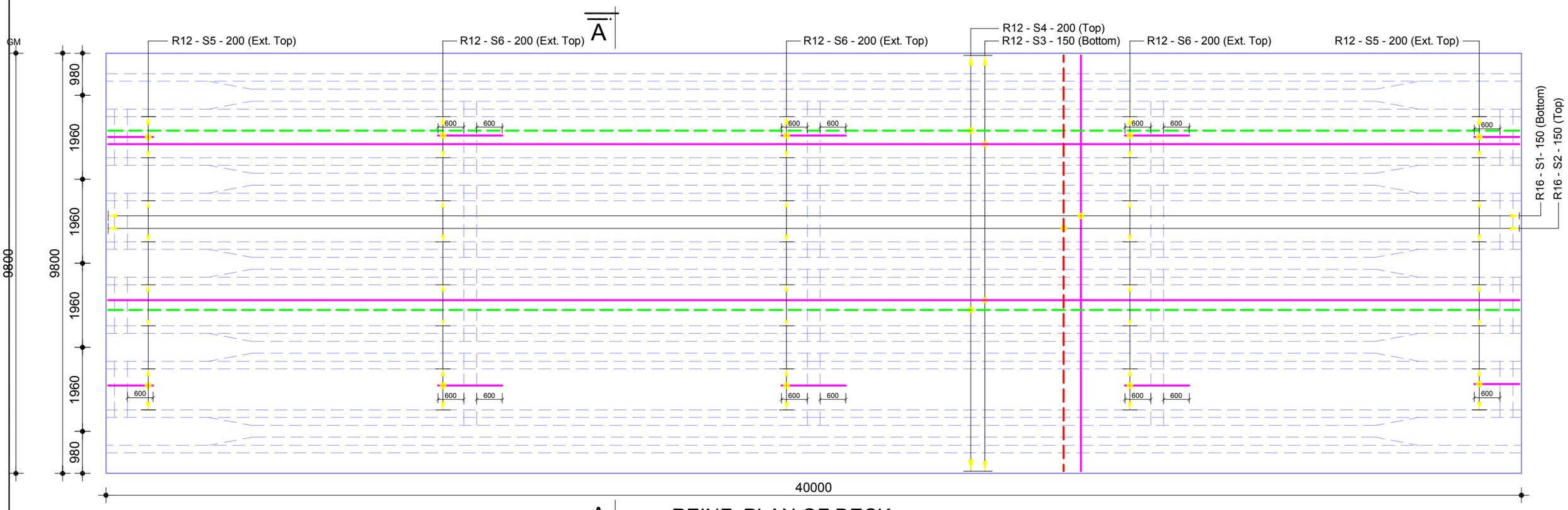
Date : 28-01-16

DESIGNED BY :	DRAWN BY :	CHECKED BY :	APPROVED BY :
MD. TAZUDDIN	MD. TAZUDDIN	AFM HAMIDUL HAQUE	DR. PRABHAT SHRIVASTAVA

REV.	DESCRIPTION	DATE



SEC. A-A ON DECK



A REINF. PLAN OF DECK

NAME OF THE CLIENT :
GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH
LOCAL GOVERNMENT ENGINEERING DEPARTMENT

NAME OF THE PROJECT :
CONSULTANCY SERVICES FOR FEASIBILITY, DETAILED SURVEY AND DESIGN OF CHITTAGONG HILL TRACT CONNECTIVITY CONNECTING THEGAMUKH AND CHITTAGONG PORT.

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BETS Consulting Services Ltd, Bangladesh
Project office :
Tahmid Mahmood Palace
Flat # 9A, House # 77, Road # 4, Block-C,
Banani, Dhaka-1213, Bangladesh.

DRAWING TITLE : REINF. DETAILS OF DECK SLAB (S-40)

DRAWING NO : LGED/DK-40/RNF.-02

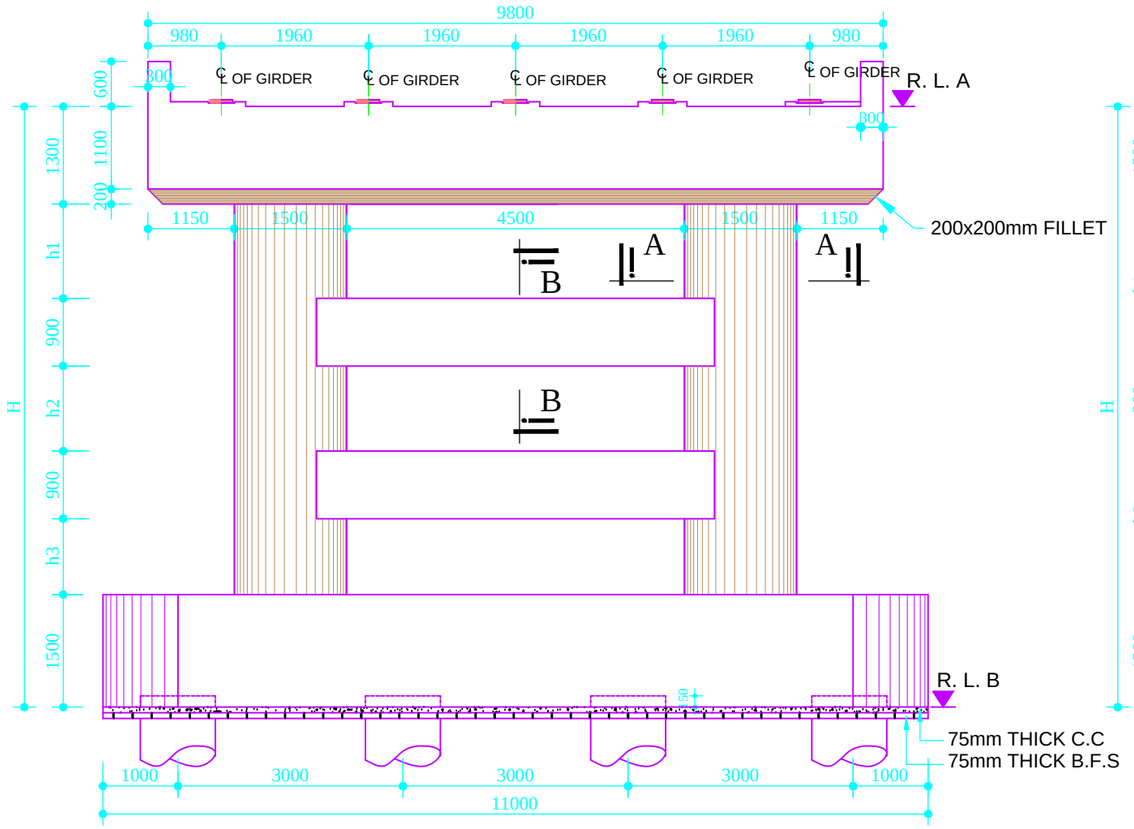
Scale :As shown

Date : 28-01-16

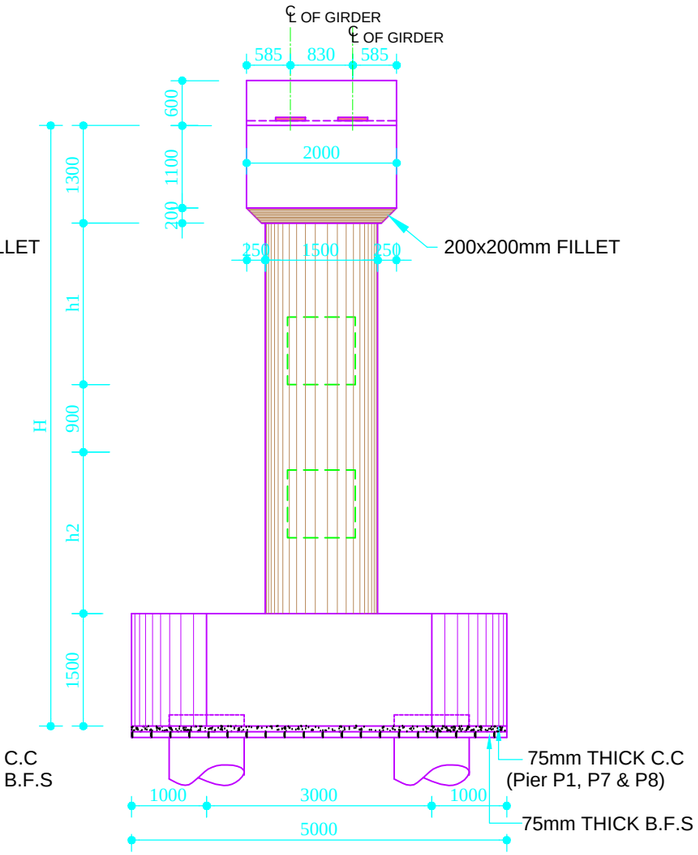
DESIGNED BY :	DRAWN BY :	CHECKED BY :	APPROVED BY :
MD. TAZUDDIN	MD. TAZUDDIN	AFM HAMIDUL HAQUE	DR. PRABHAT SHRIVASTAVA

REV.	DESCRIPTION	DATE

TYPICAL DECK SLAB FOR PC GIRDER



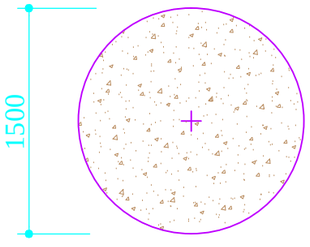
FRONT ELEVATION OF PIER & PIER CAP



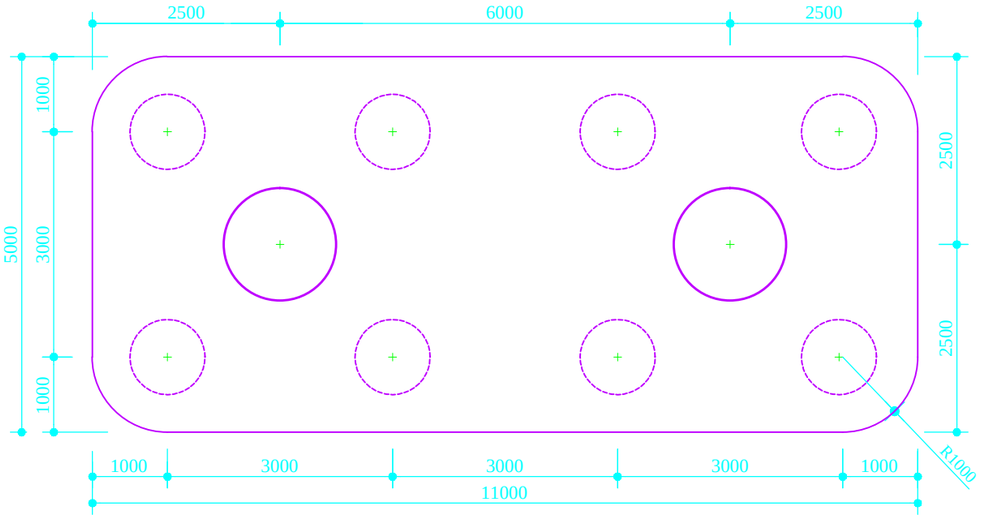
SIDE ELEVATION OF PIER & PIER CAP

PIER SCHEDULE :

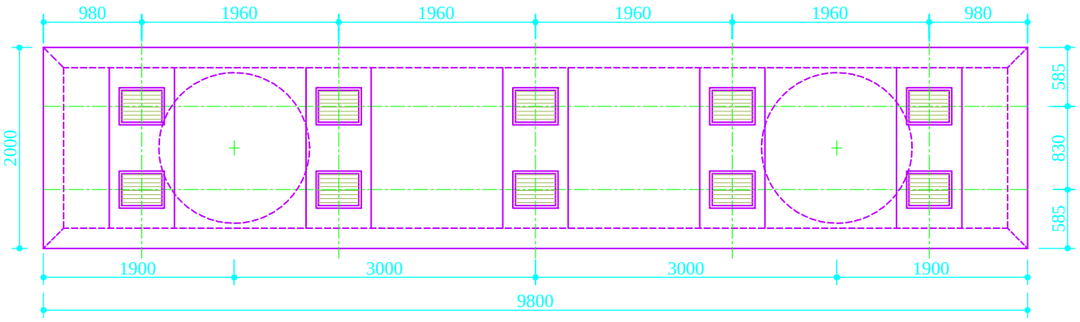
Pier Name	RL in m.		Height in mm		
	A	B	H	h1	h2
Pier - P1	12.109	4.609	7500	1900	1900
Pier - P7	13.209	5.009	8200	2250	2250
Pier - P8	12.109	6.409	5700	1000	1000



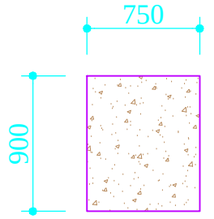
SEC. A-A



PILE LAY-OUT PLAN



TOP PLAN OF PIER CAP



SEC. B-B

NAME OF THE CLIENT :
GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH
LOCAL GOVERNMENT ENGINEERING DEPARTMENT

NAME OF THE PROJECT :
CONSULTANCY SERVICES FOR FEASIBILITY, DETAILED SURVEY AND DESIGN OF CHITTAGONG HILL TRACT CONNECTIVITY CONNECTING THEGAMUKH AND CHITTAGONG PORT.

NAME OF THE CONSULTANTS :
SAI Consulting Engineers Pvt. Ltd, India.
in association with
BETS Consulting Services Ltd, Bangladesh
Project office :
Tahmid Mahmood Palace
Flat # 9A, House # 77, Road # 4, Block-C,
Banani, Dhaka-1213, Bangladesh.

DRAWING TITLE :
DETAILS OF PIER (P1 ~ P6)
SPAN (30.0m ~ 40.0m), TYP-I

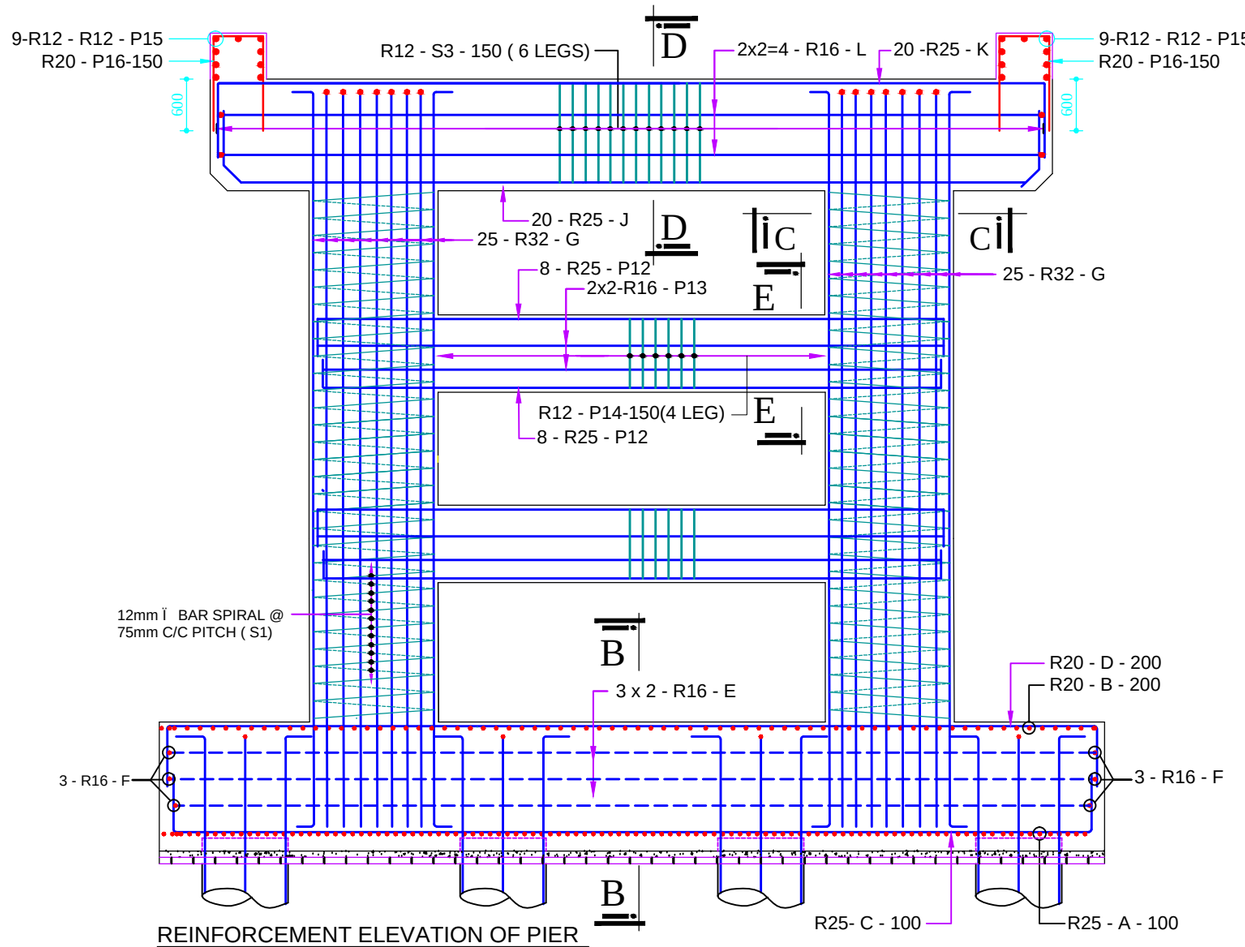
DRAWING NO : LGED/PR-I/C-01

Scale :As shown

Date : 28-01-16

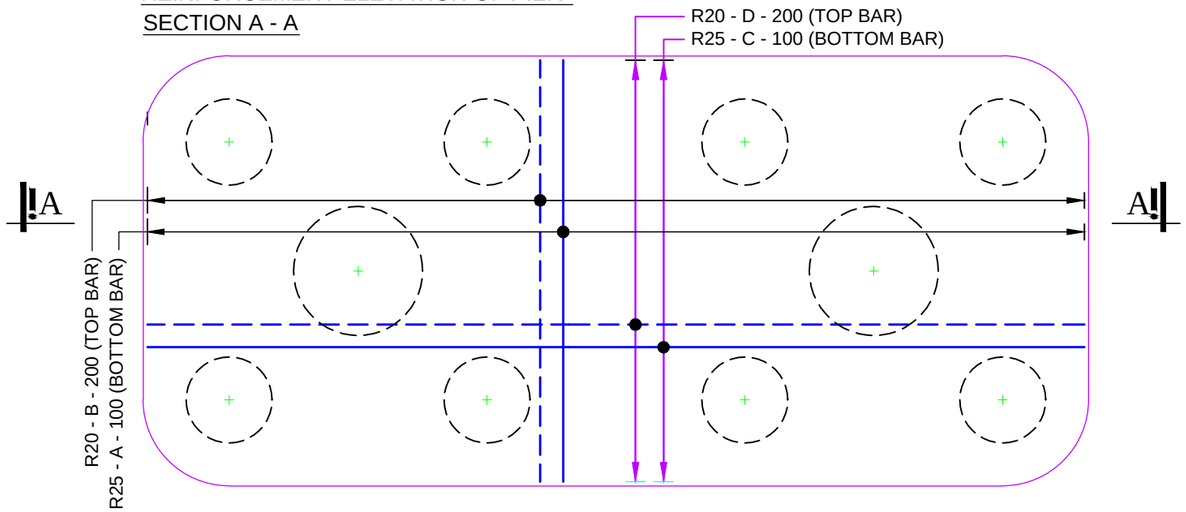
DESIGNED BY :	DRAWN BY :	CHECKED BY :	APPROVED BY :
MD. TAZUDDIN	MD. TAZUDDIN	AFM HAMIDUL HAQUE	DR. PRAVAT SHRIVESTAVA

REV.	DESCRIPTION	DATE

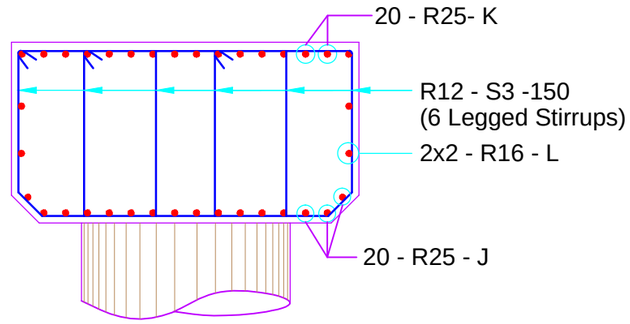


REINFORCEMENT ELEVATION OF PIER

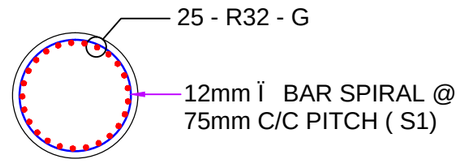
SECTION A - A



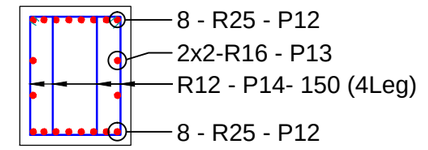
REINFORCEMENT PLAN OF PILE CAP



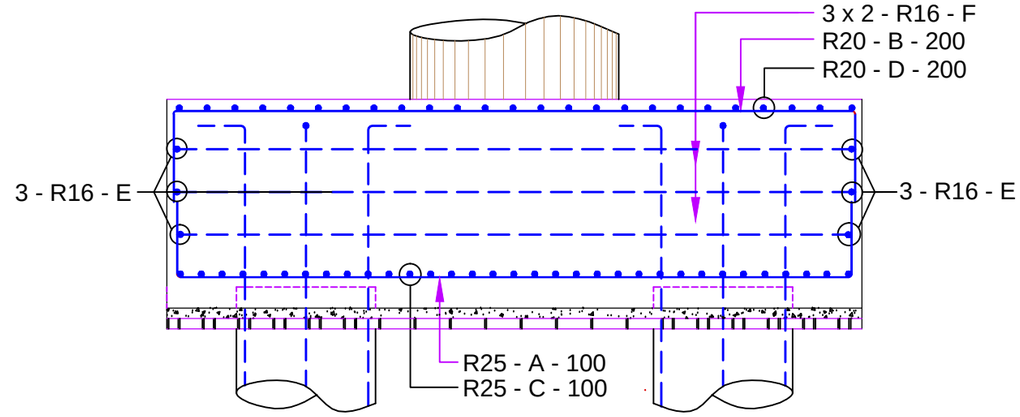
SEC. D-D



SEC. C-C



SEC. E - E



SECTION B-B

NOTES:

1. 28 DAYS STANDERD CYLINDER STRENGTH OF CONCRETE: f 'c = 25.0N/mm^2(3600 PSI)
2. YIELD STRENGTH OF M.S DEFORMED fy = 413 N/mm^2 (60000 PSI)
3. CLEAR COVER TO MAIN REINFORCEMENT BAR IS TO 50mm UNLESS OTHERWISE MENTIONED.
4. ALL DIMENSIONS ARE IN MILIMETERS UNLESS OTHRWISE MENTIONED.

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LOCAL GOVERNMENT ENGINEERING DEPARTMENT

NAME OF THE PROJECT :
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in association with
BETS Consulting Services Ltd, Bangladesh
Project office :
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Flat # 9A, House # 77, Road # 4, Block-C,
Banani, Dhaka-1213, Bangladesh.

DRAWING TITLE :
REINF. DETAILS OF PIER (P1 ~ P6)
SPAN (30.0m ~ 40.0m), TYP-I

DRAWING NO : LGED/PR-I/REINF.-02

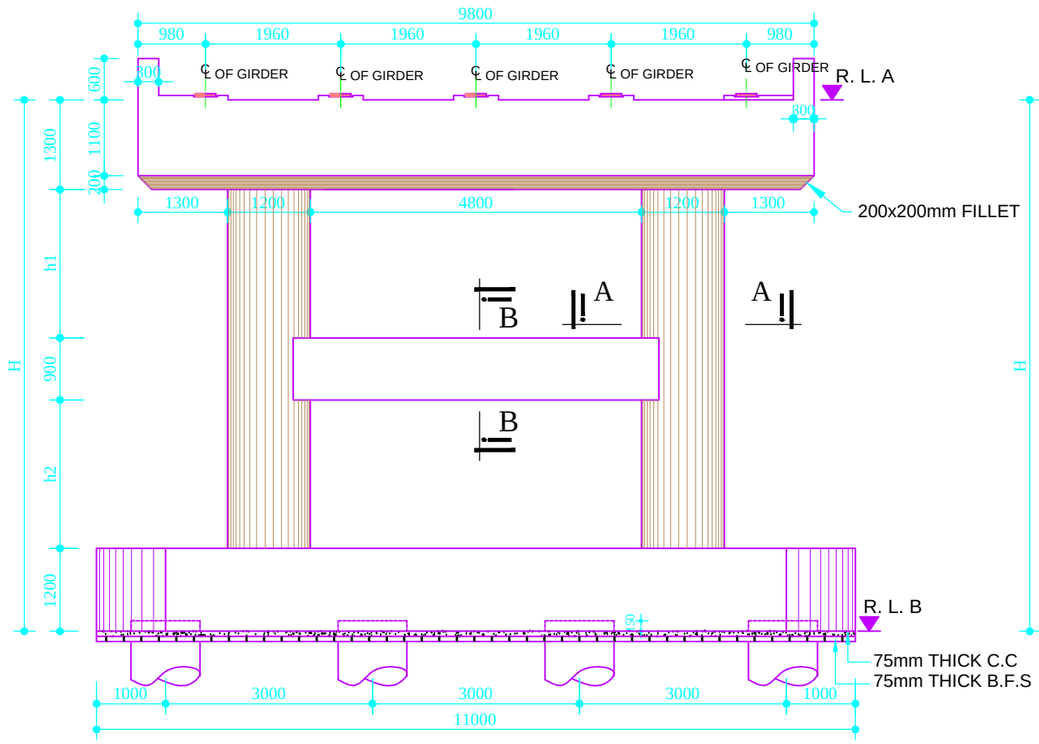
Scale :As shown

Date : 28-01-16

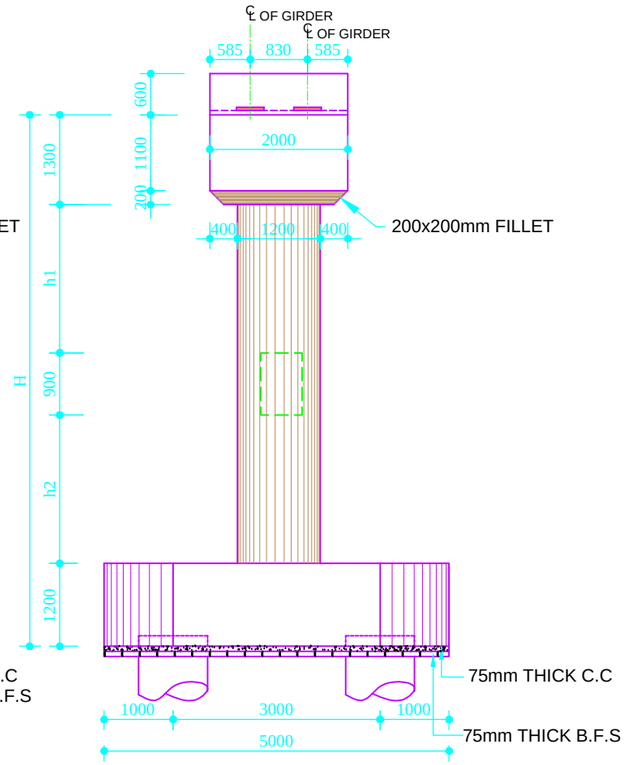
DESIGNED BY :	DRAWN BY :	CHECKED BY :	APPROVED BY :
MD. TAZUDDIN	MD. TAZUDDIN	AFM HAMIDUL HAQUE	DR. PRAVAT SHRIVESTAVA

REV.	DESCRIPTION	DATE

TYPICAL DRAWING OF PIER



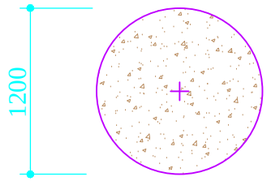
FRONT ELEVATION OF PIER & PIER CAP



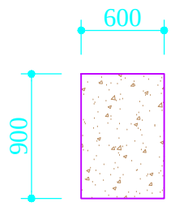
SIDE ELEVATION OF PIER & PIER CAP

PIER SCHEDULE :

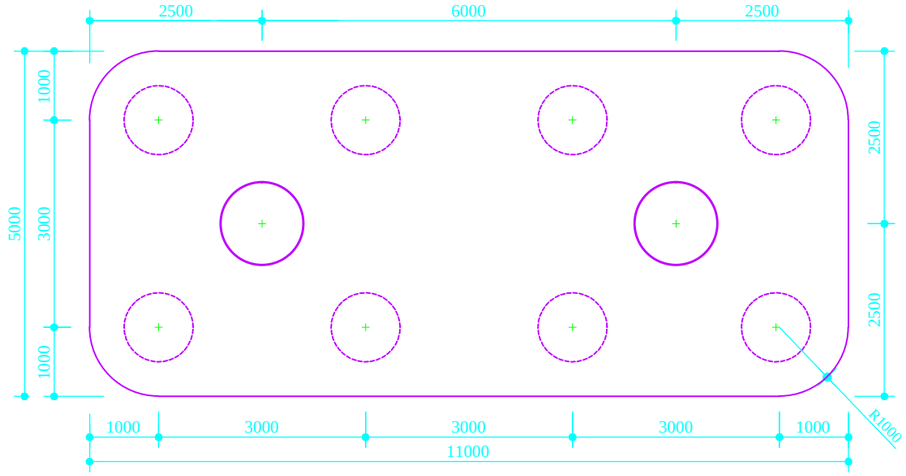
Pier Name	RL in m.		Height in mm		
	A	B	H	h1	h2
Pier - P1	12.109	4.609	7500	1900	1900
Pier - P7	13.209	5.009	8200	2250	2250
Pier - P8	12.109	6.409	5700	1000	1000



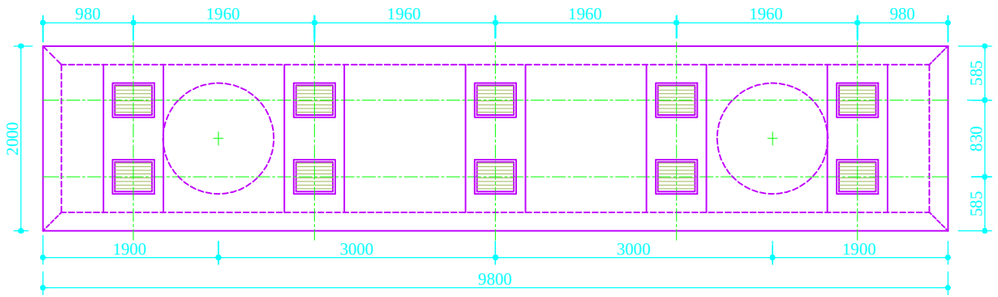
SEC. A-A



SEC. B-B



PILE LAY-OUT PLAN



TOP PLAN OF PIER CAP

NAME OF THE CLIENT :

GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH

LOCAL GOVERNMENT ENGINEERING DEPARTMENT

NAME OF THE PROJECT :

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in association with

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Flat # 9A, House # 77, Road # 4, Block-C,
Banani, Dhaka-1213, Bangladesh.

DRAWING TITLE :

DETAILS OF PIER (P1 ~ Pn)
SPAN (18.0m ~ 28.0m), TYP-II

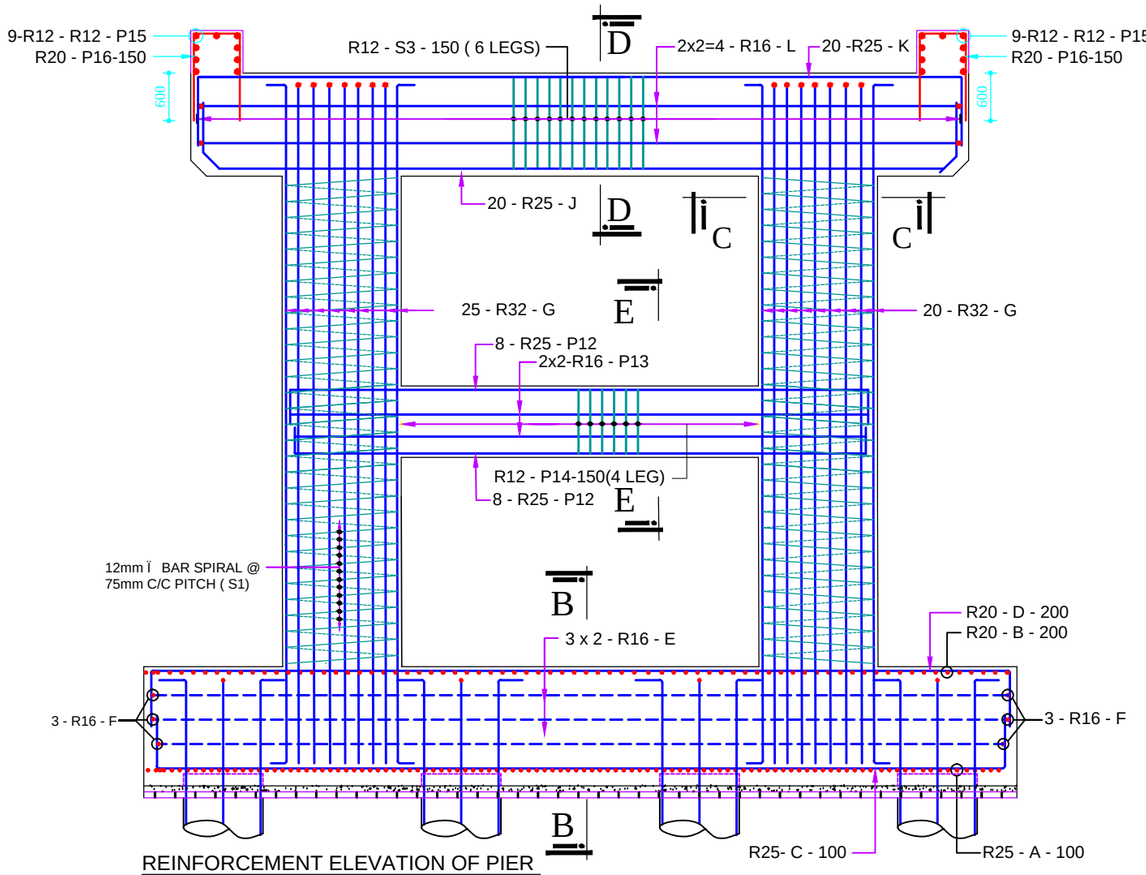
DRAWING NO : LGED/PR-II/C-01

Scale :As shown

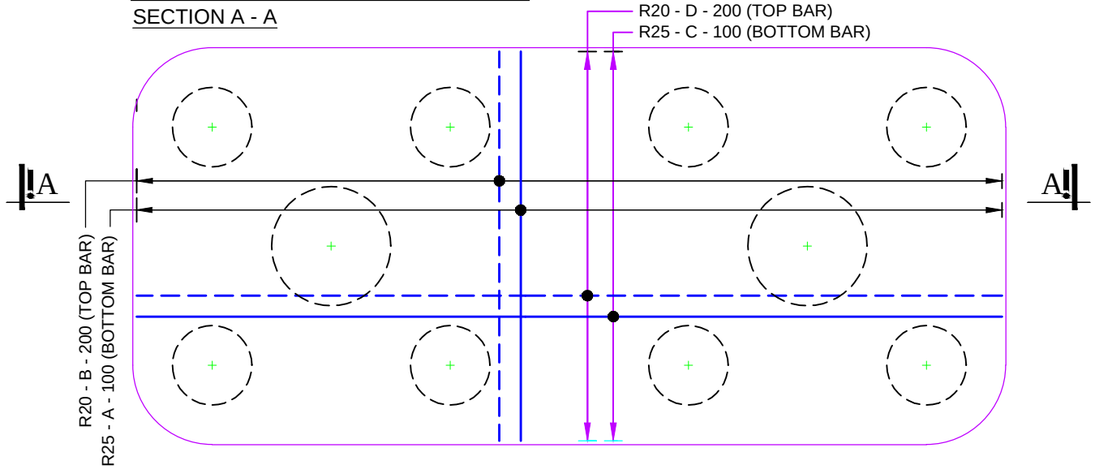
Date : 28-01-16

DESIGNED BY :	DRAWN BY :	CHECKED BY :	APPROVED BY :
MD. TAZUDDIN	MD. TAZUDDIN	AFM HAMIDUL HAQUE	DR. PRABHAT SHRIVASTAVA

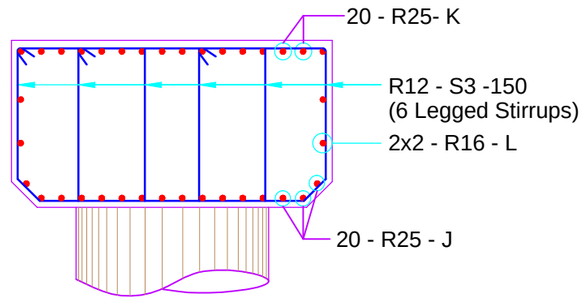
REV.	DESCRIPTION	DATE



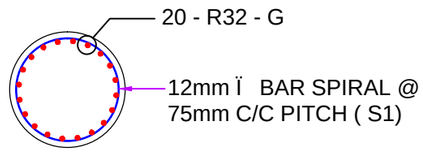
REINFORCEMENT ELEVATION OF PIER
SECTION A - A



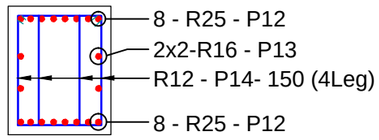
REINFORCEMENT PLAN OF PILE CAP



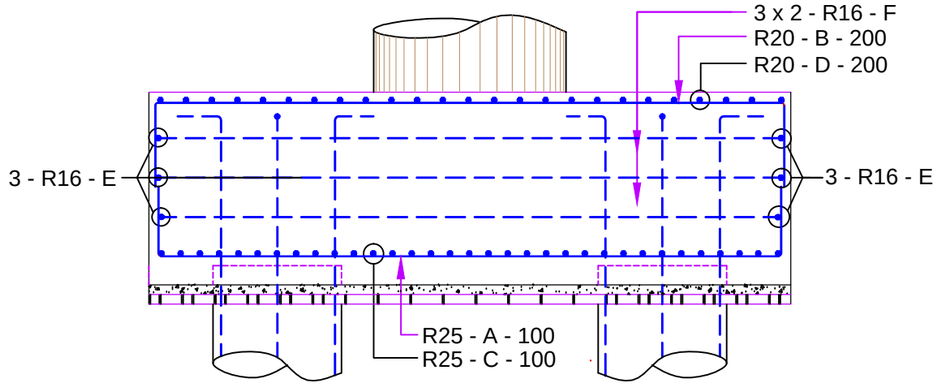
SEC. D-D



SEC. C-C



SEC. E - E



SECTION B-B

NOTES:

1. 28 DAYS STANDERD CYLINDER STRENGTH OF CONCRETE:
   f 'c = 25.0N/mm^2(3600 PSI)
2. YIELD STRENGTH OF M.S DEFORMED fy = 413 N/mm ^{2}(60000 PSI)
3. CLEAR COVER TO MAIN REINFORCEMENT BAR IS TO 50mm
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LOCAL GOVERNMENT ENGINEERING DEPARTMENT

NAME OF THE PROJECT :
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Project office :
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Flat # 9A, House # 77, Road # 4, Block-C,
Banani, Dhaka-1213, Bangladesh.

DRAWING TITLE :
REINF. DETAILS OF PIER (P1 ~ Pn)
SPAN (18.0m ~28.0m), TYP-II

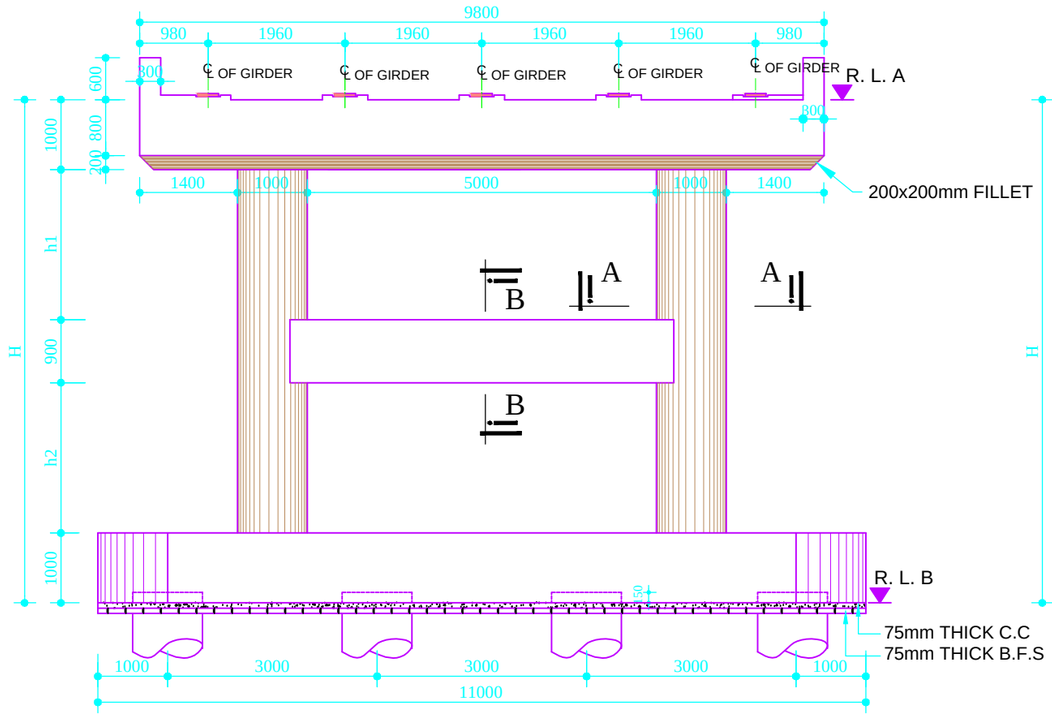
DRAWING NO : LGED/PR-II/REINF.-02

Scale :As shown

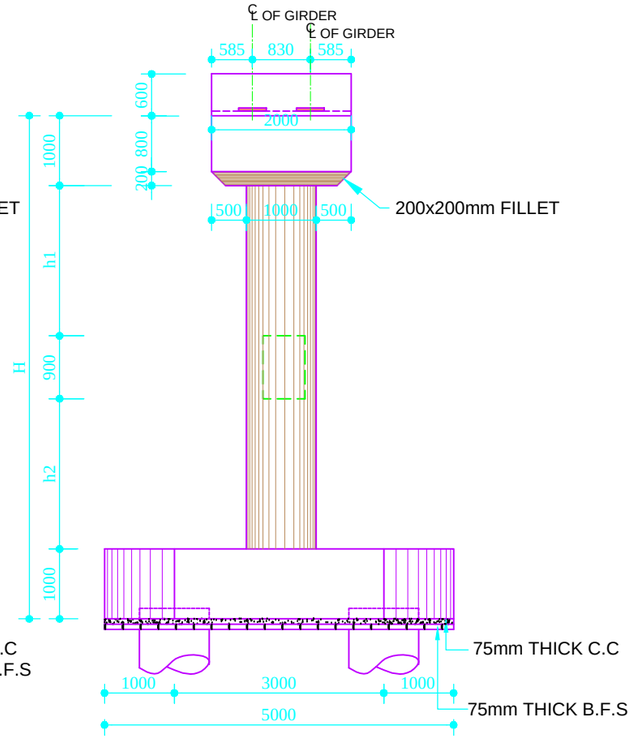
Date : 28-01-16

DESIGNED BY :	DRAWN BY :	CHECKED BY :	APPROVED BY :
MD. TAZUDDIN	MD. TAZUDDIN	AFM HAMIDUL HAQUE	DR. PRABHAT SHRIVASTAVA

REV.	DESCRIPTION	DATE



FRONT ELEVATION OF PIER & PIER CAP



SIDE ELEVATION OF PIER & PIER CAP

PIER SCHEDULE :

Pier Name	RL in m.		Height in mm		
	A	B	H	h1	h2
Pier - P1	12.109	4.609	7500	1900	1900
Pier - P7	13.209	5.009	8200	2250	2250
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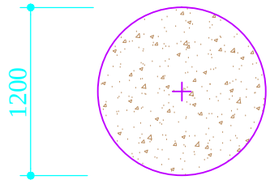
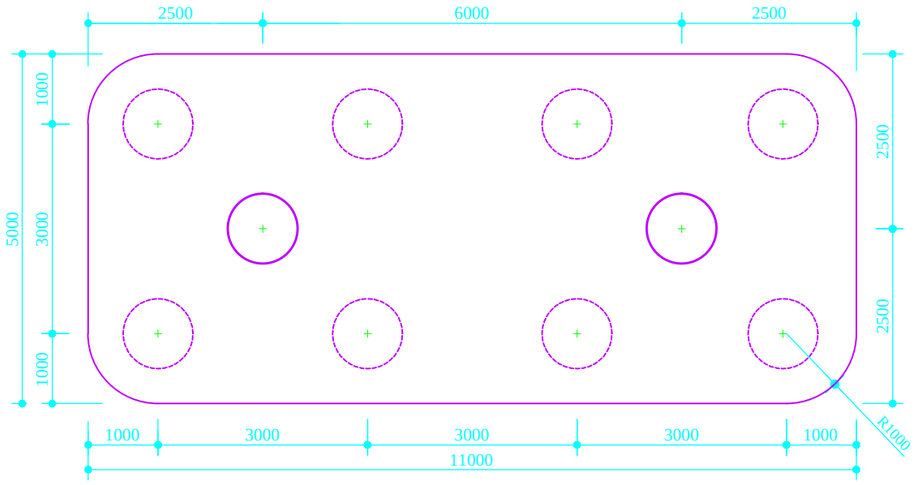
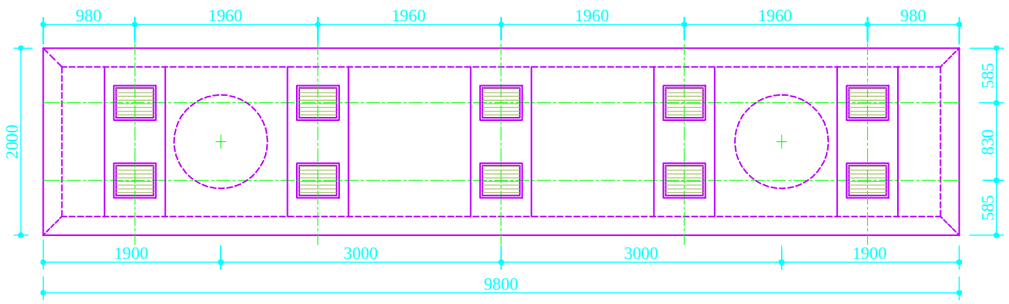


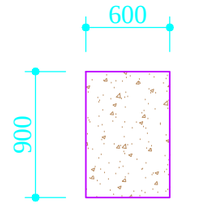
SEC. A-A



PILE LAY-OUT PLAN



TOP PLAN OF PIER CAP



SEC. B-B

NAME OF THE CLIENT :
GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH
LOCAL GOVERNMENT ENGINEERING DEPARTMENT

NAME OF THE PROJECT :
CONSULTANCY SERVICES FOR FEASIBILITY, DETAILED SURVEY AND DESIGN OF CHITTAGONG HILL TRACT CONNECTIVITY CONNECTING THEGAMUKH AND CHITTAGONG PORT.

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Project office :
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Flat # 9A, House # 77, Road # 4, Block-C,
Banani, Dhaka-1213, Bangladesh.

DRAWING TITLE :
DETAILS OF PIER (P1 ~ Pn)
SPAN (10.0m ~ 16.0m), TYP-III

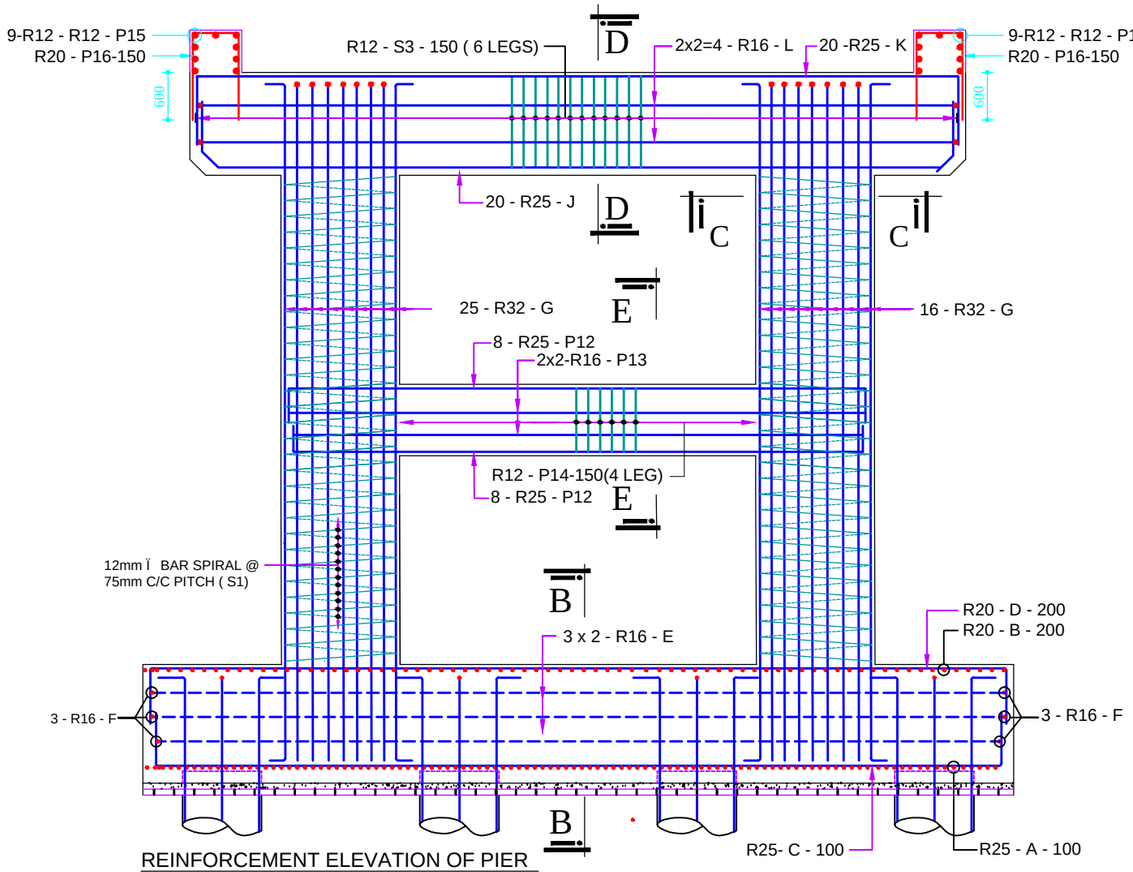
DRAWING NO : LGED/PR-III/C-01

Scale :As shown

Date : 28-01-16

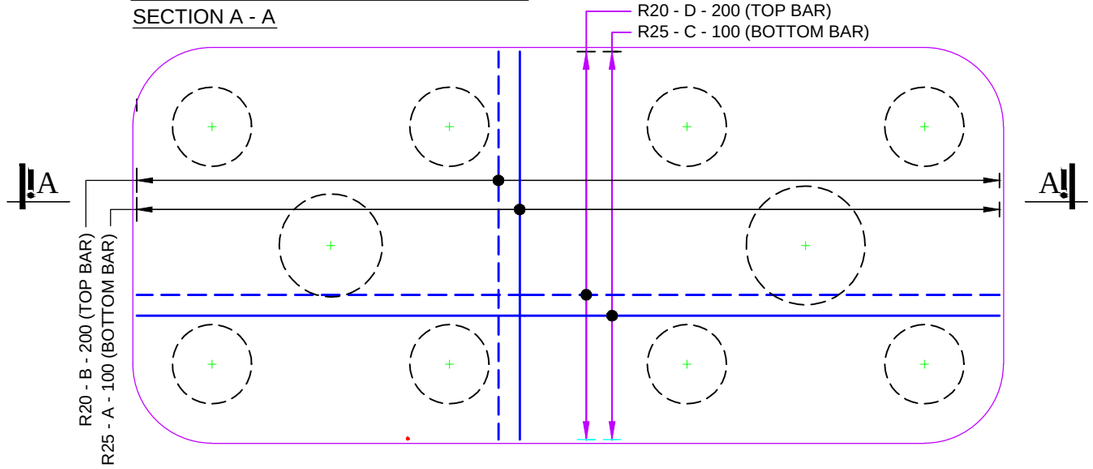
DESIGNED BY :	DRAWN BY :	CHECKED BY :	APPROVED BY :
MD. TAZUDDIN	MD. TAZUDDIN	AFM HAMIDUL HAQUE	DR. PRABHAT SHRIVASTAVA

REV.	DESCRIPTION	DATE

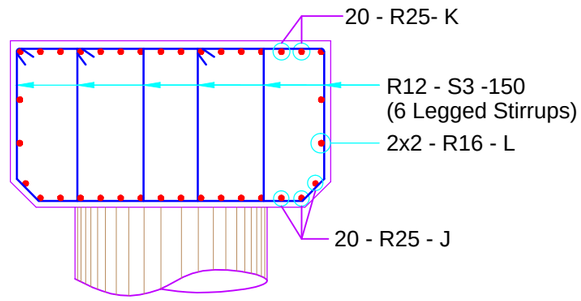


REINFORCEMENT ELEVATION OF PIER

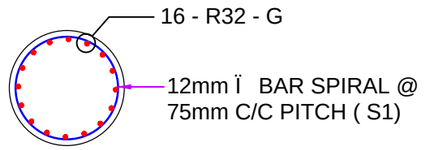
SECTION A - A



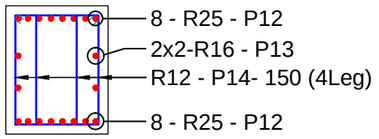
REINFORCEMENT PLAN OF PILE CAP



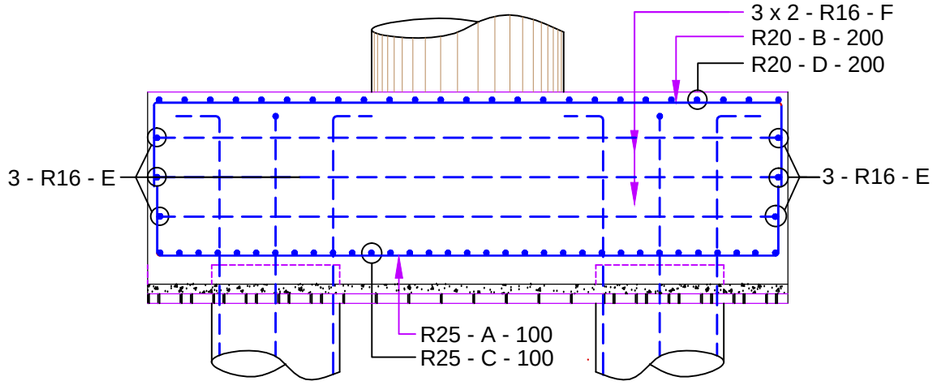
SEC. D-D



SEC. C-C



SEC. E - E



SECTION B-B

NOTES:

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   f 'c = 25.0N/mm^2(3600 PSI)
2. YIELD STRENGTH OF M.S DEFORMED fy = 413 N/mm ^{2}(60000 PSI)
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LOCAL GOVERNMENT ENGINEERING DEPARTMENT

NAME OF THE PROJECT :
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DRAWING TITLE :
REINF. DETAILS OF PIER (P1 ~ Pn)
SPAN (10.0m ~16.0m), TYP-III

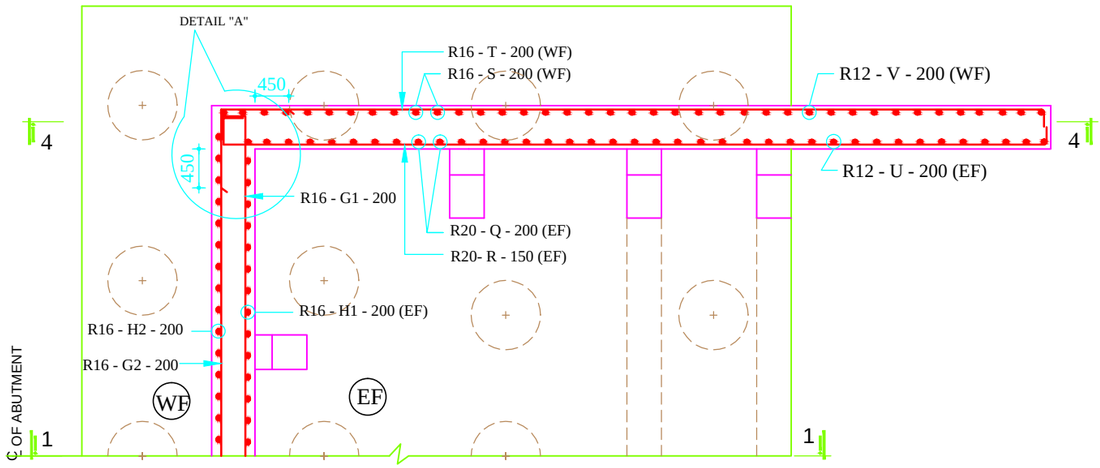
DRAWING NO : LGED/PR-III/REINF.-02

Scale :As shown

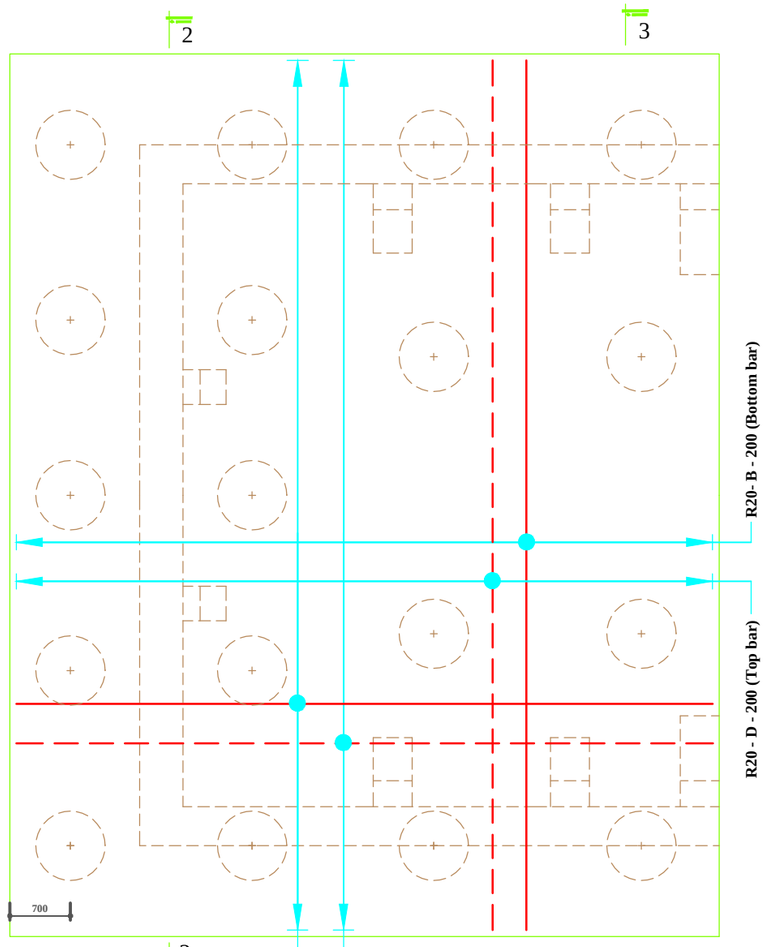
Date : 28-01-16

DESIGNED BY :	DRAWN BY :	CHECKED BY :	APPROVED BY :
MD. TAZUDDIN	MD. TAZUDDIN	AFM HAMIDUL HAQUE	DR. PRABHAT SHRIVASTAVA

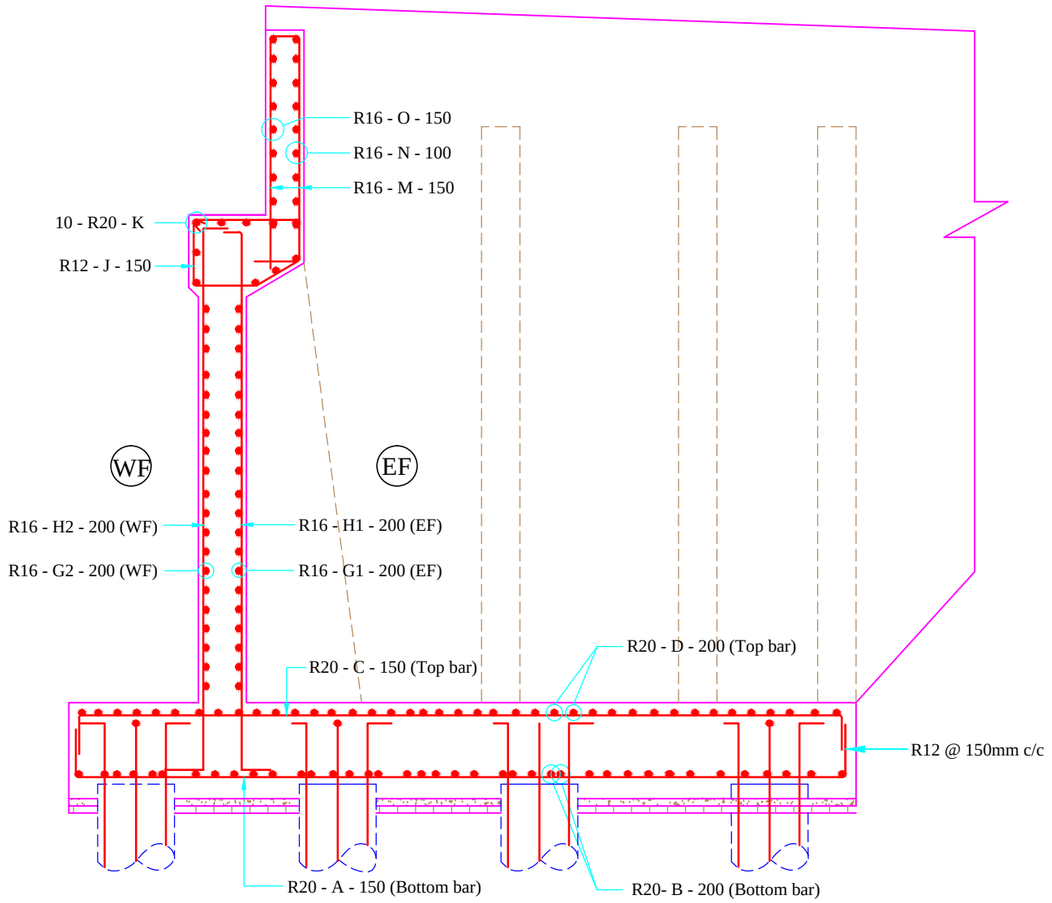
REV.	DESCRIPTION	DATE



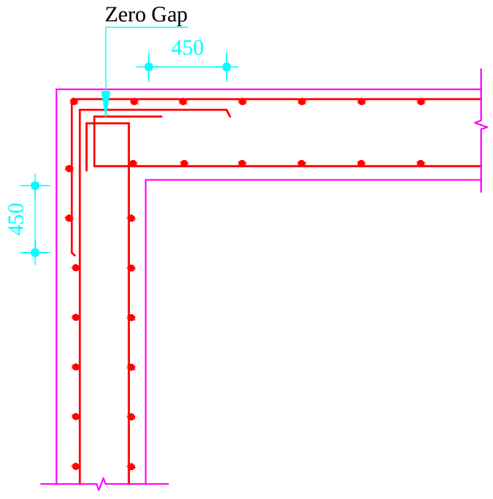
PLAN OF ABUTMENT & WING WALL (HALF)



PLAN OF PILE CAP
SHOWING REINFORCEMENT



CROSS SECTION OF ABUTMENT (SECTION 1-1)
SHOWING REINFORCEMENT DETAILS.



DETAIL "A"

NOTES:

1. **Clear cover to main reinforcement bar is to be 50mm. unless otherwise mentioned.**
2. **28 days cylinder strength of concrete: f 'c = 25.0N/mm (3600 psi)**
3. **Yield strength of mild steel deformed bar fy = 413N/mm (60000psi)**
4. **EF = Earth Face**
   WF = Water Face

NAME OF THE CLIENT :
GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH
LOCAL GOVERNMENT ENGINEERING DEPARTMENT

NAME OF THE PROJECT :
CONSULTANCY SERVICES FOR FEASIBILITY, DETAILED SURVEY AND DESIGN OF CHITTAGONG HILL TRACT CONNECTIVITY CONNECTING THEGAMUKH AND CHITTAGONG PORT.

NAME OF THE CONSULTANTS :
SAI Consulting Engineers Pvt. Ltd, India.
in association with
BETS Consulting Services Ltd, Bangladesh
Project office :
Tahmid Mahmood Palace
Flat # 9A, House # 77, Road # 4, Block-C,

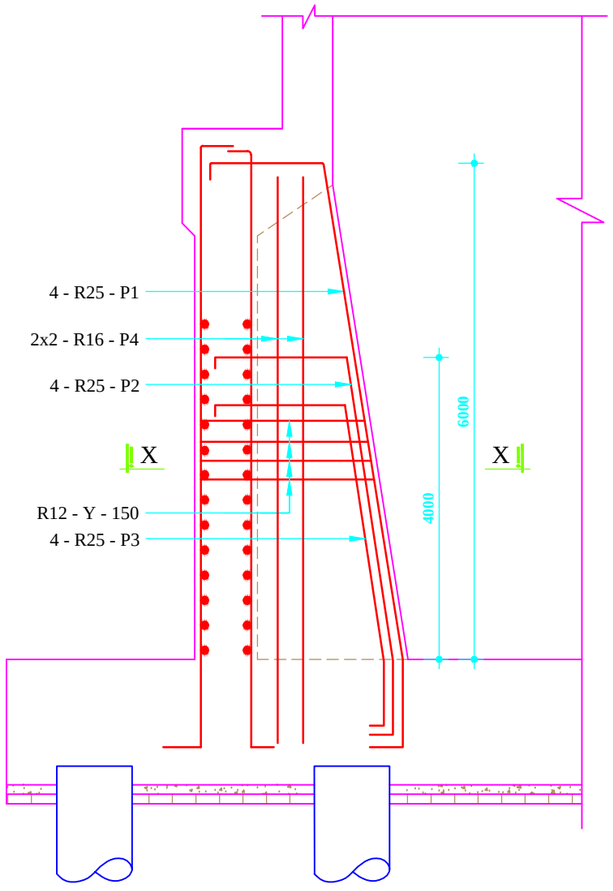
DRAWING TITLE :
REINF. DETAILS OF ABUTMENT PILE CAP (HEIGHT, HT. = 10.0m), TYP-I

DRAWING NO : LGED/AB-10(I)/RNF.-02

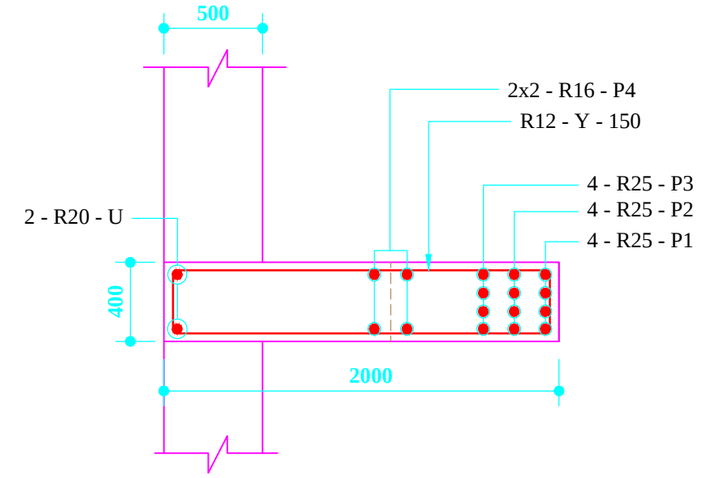
Scale :As shown Date : 28-01-16

DESIGNED BY :	DRAWN BY :	CHECKED BY :	APPROVED BY :
MD. TAZUDDIN	MD. TAZUDDIN	AFM HAMIDUL HAQUE	DR. PRABHAT SHRIVASTAVA

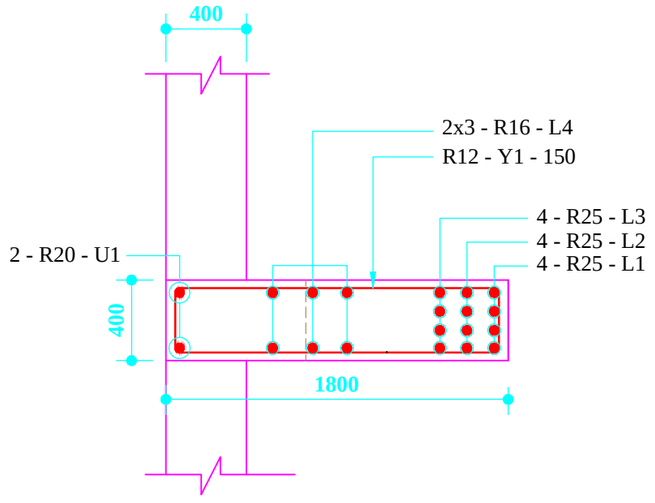
REV.	DESCRIPTION	DATE



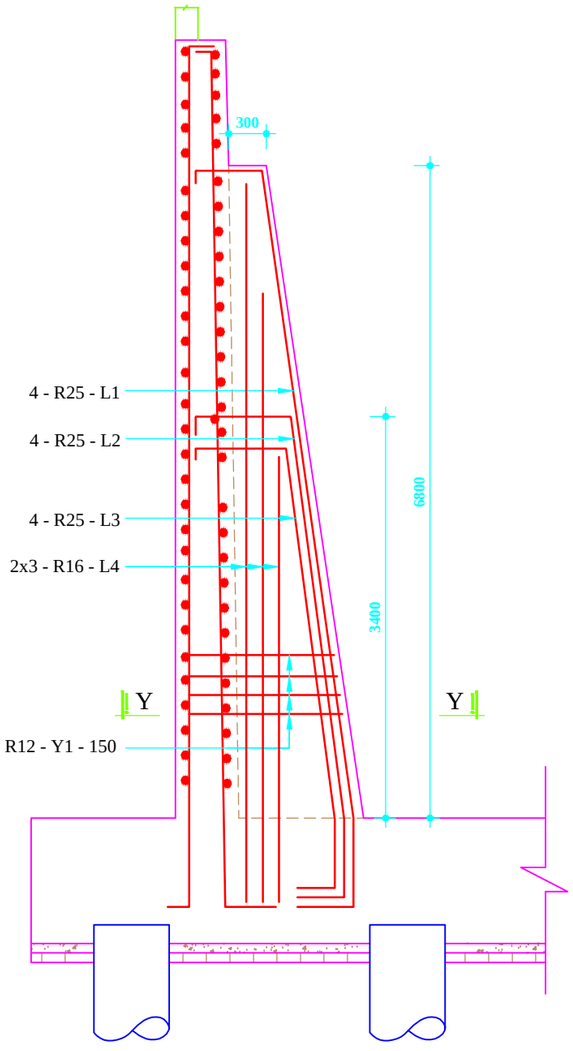
REINF. DETAILS OF ABUTMENT COUNTERFORT (C2)



SECTION X -X (C2)



SECTION Y -Y (C1)

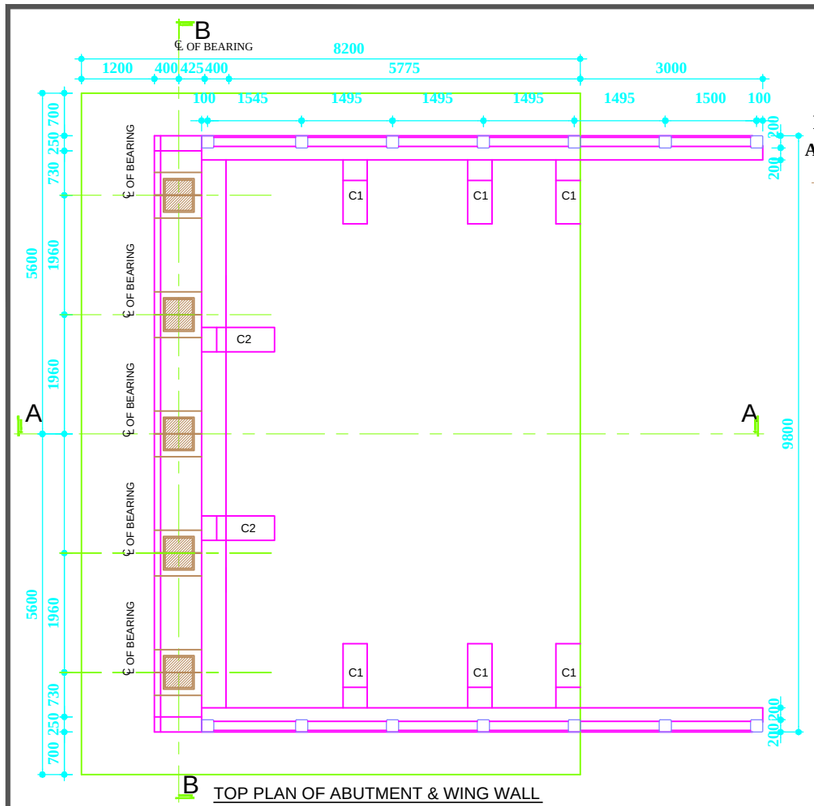


REINF. DETAILS OF WINGWALL COUNTERFORT (C1)

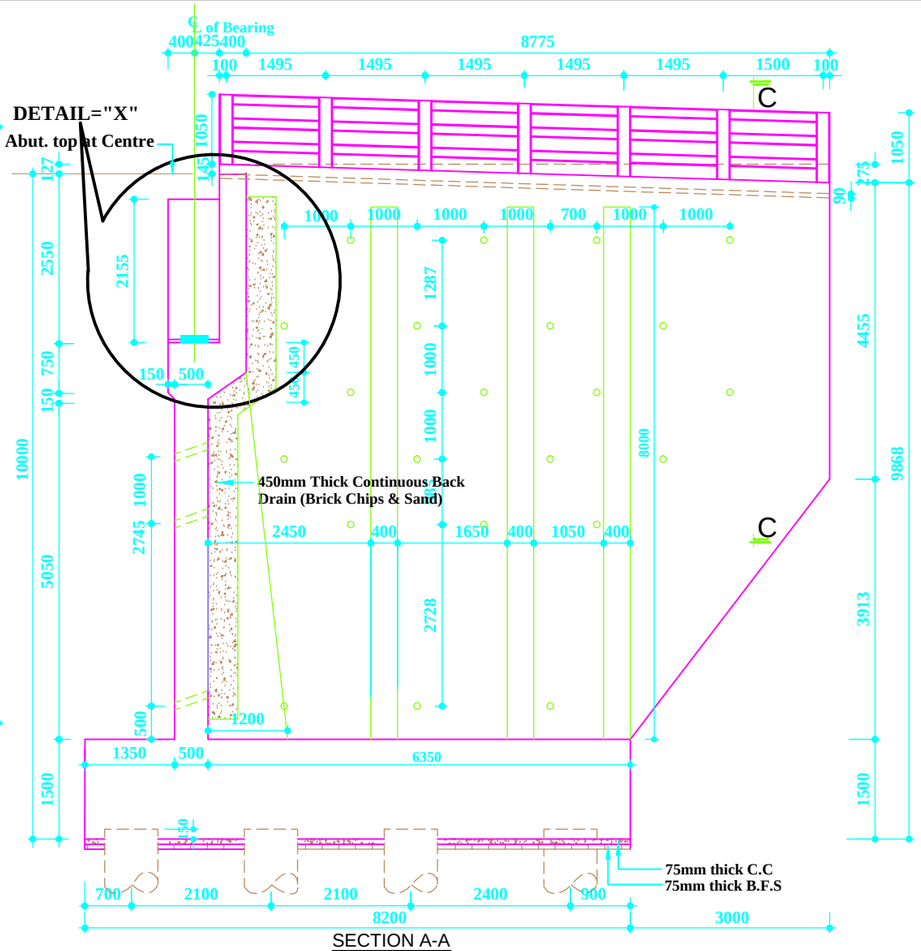
NOTES:

1. **Clear cover to main reinforcement bar is to be 50mm. unless otherwise mentioned.**
2. **28 days cylinder strength of concrete: f 'c = 25.0N/mm (3600 psi)**
3. **Yield strength of mild steel deformed bar fy = 413N/mm (60000psi)**
4. **EF = Earth Face**
   WF = Water Face

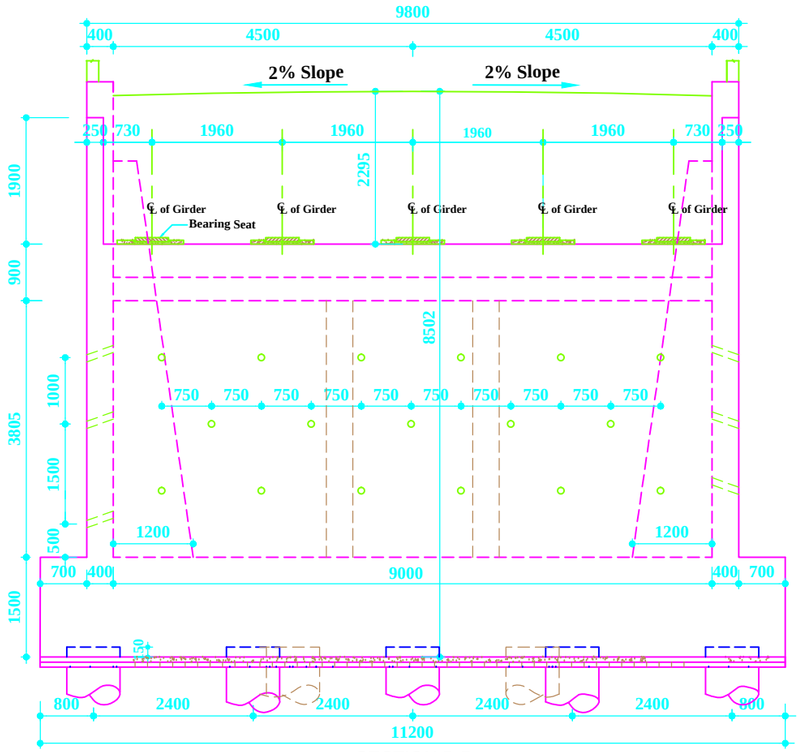
NAME OF THE CLIENT : GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH LOCAL GOVERNMENT ENGINEERING DEPARTMENT NAME OF THE PROJECT : CONSULTANCY SERVICES FOR FEASIBILITY, DETAILED SURVEY AND DESIGN OF CHITTAGONG HILL TRACT CONNECTIVITY CONNECTING THEGAMUKH AND CHITTAGONG PORT.	NAME OF THE CONSULTANTS : SAI Consulting Engineers Pvt. Ltd, India. in association with BETS Consulting Services Ltd, Bangladesh Project office : Tahmid Mahmood Palace Flat # 9A, House # 77, Road # 4, Block-C,	DRAWING TITLE : DETAILS OF COUNTERFORT (ABUT. HT. = 10.0m), TYP-I DRAWING NO : LGED/AB-10(I)/COUNT.-04 Scale :As shown Date : 28-01-16	DESIGNED BY : MD. TAZUDDIN	DRAWN BY : MD. TAZUDDIN	CHECKED BY : AFM HAMIDUL HAQUE	APPROVED BY : DR. PRABHAT SHRIVASTAVA	REV.	DESCRIPTION	DATE



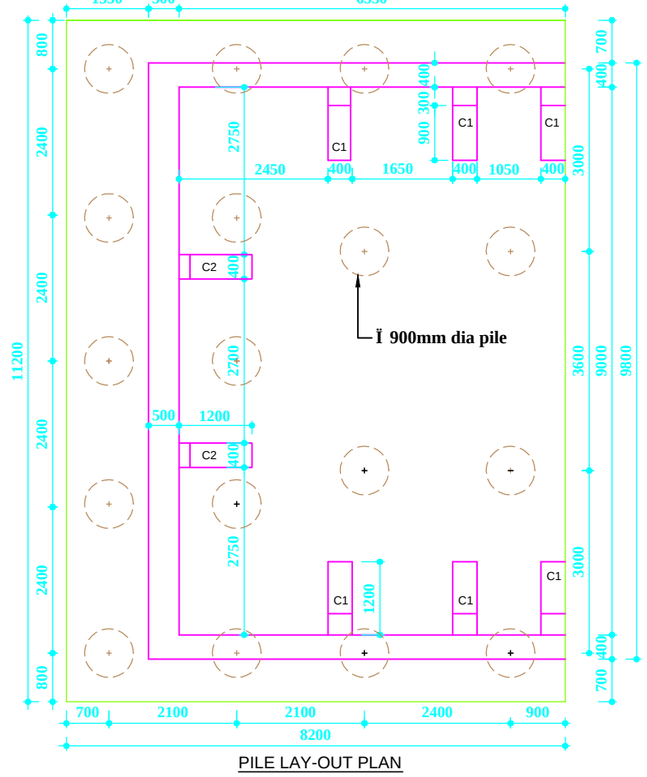
TOP PLAN OF ABUTMENT & WING WALL



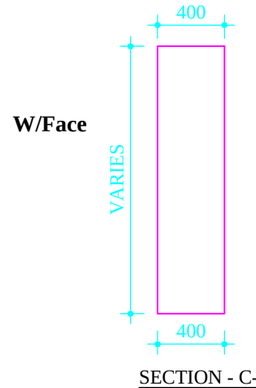
SECTION A-A



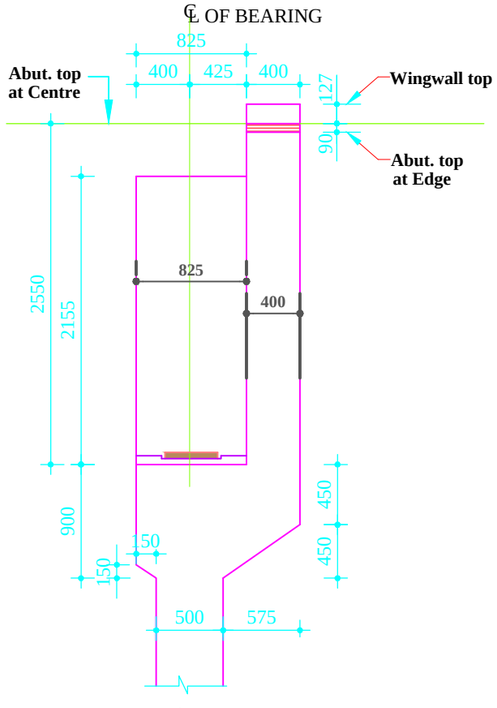
SECTION B-B



PILE LAY-OUT PLAN

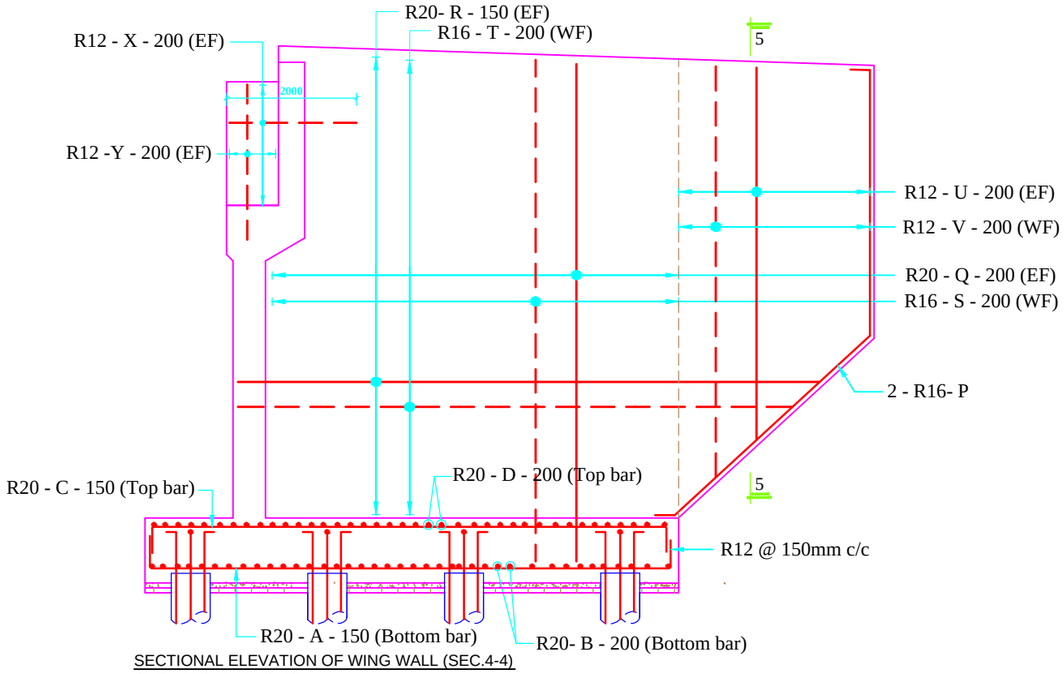


SECTION - C-C

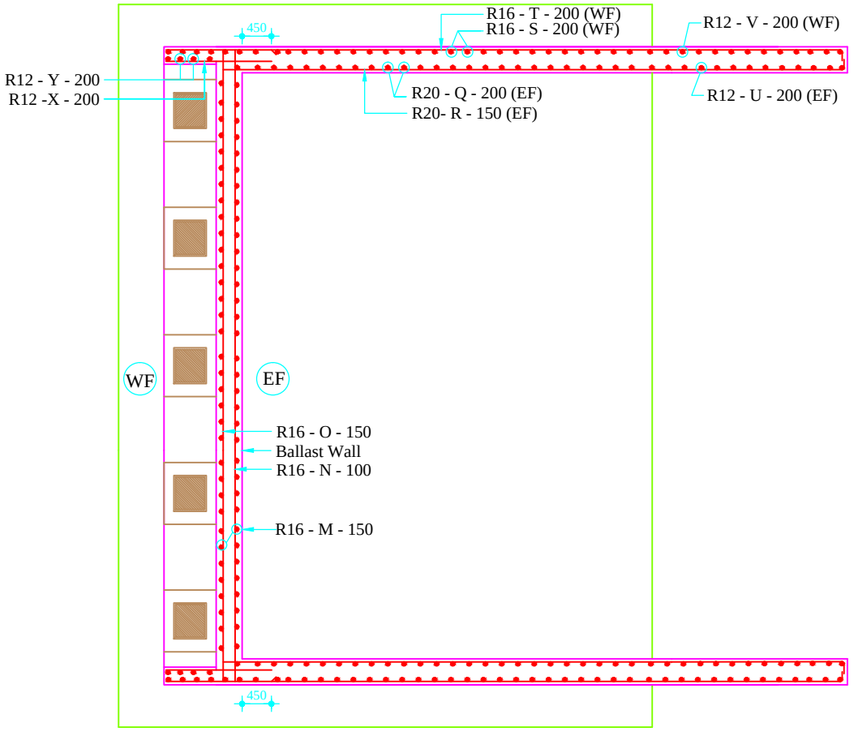


DETAIL -'X'

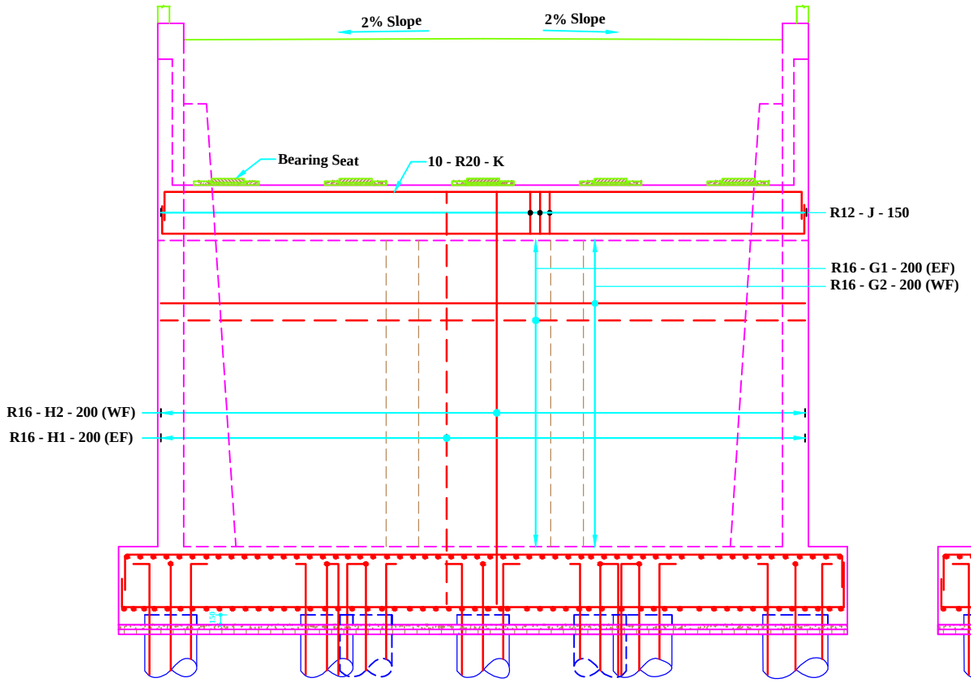
NAME OF THE CLIENT : GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH LOCAL GOVERNMENT ENGINEERING DEPARTMENT	NAME OF THE CONSULTANTS : SAI Consulting Engineers Pvt. Ltd, India. in association with BETS Consulting Services Ltd, Bangladesh Project office : Tahmid Mahmood Palace Flat # 9A, House # 77, Road # 4, Block-C,	DRAWING TITLE : DIMENSION DETAILS OF ABUTMENT (ABUTMENT HT, H = 10.0m), TYP-I DRAWING NO : LGED/AB-10(I)/C-01 Scale :As shown Date : 28-01-16	DESIGNED BY : MD. TAZUDDIN	DRAWN BY : MD. TAZUDDIN	CHECKED BY : AFM HAMIDUL HAQUE	APPROVED BY : DR. PRABHAT SHRIVASTAVA
NAME OF THE PROJECT : CONSULTANCY SERVICES FOR FEASIBILITY, DETAILED SURVEY AND DESIGN OF CHITTAGONG HILL TRACT CONNECTIVITY CONNECTING THEGAMUKH AND CHITTAGONG PORT.						REV. / DESCRIPTION / DATE



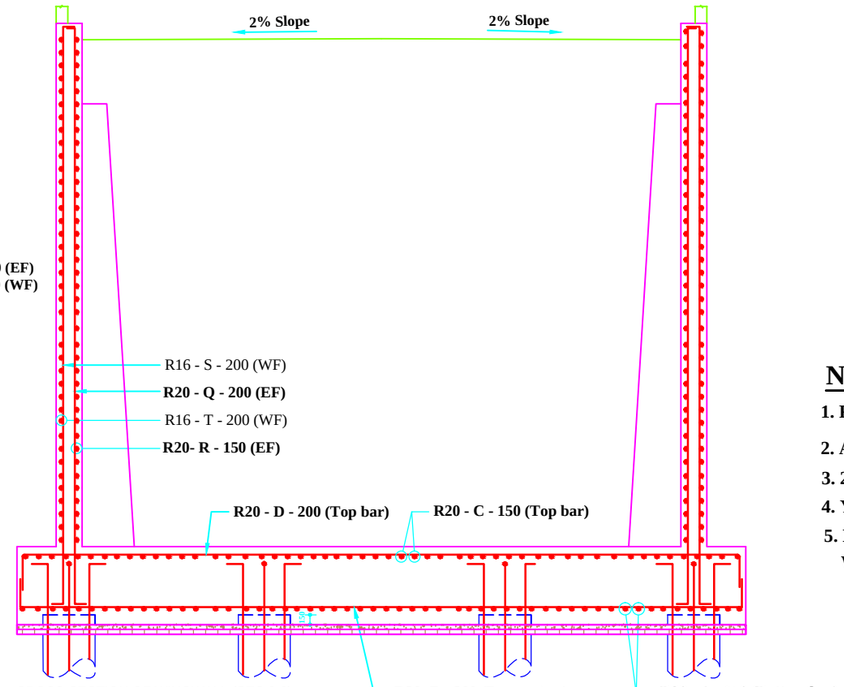
SECTIONAL ELEVATION OF WING WALL (SEC.4-4)
SHOWING REINFORCEMENT



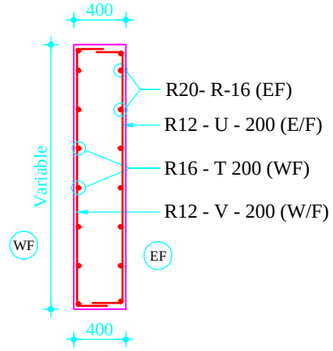
TOP PLAN OF BALLASTWALL & WINGWALL
SHOWING TOP REINFORCEMENT



SECTIONAL FRONT ELEVATION OF ABUTMENT (SECTION 2-2)
SHOWING REINFORCEMENT



CROSS-SECTION OF WINGWALL (SEC.3-3)
SHOWING REINFORCEMENT



SEC. 5 - 5

NOTES:

1. **For plan of section 4 - 4 See Sheet No. 13**
2. **All dimensions are in millimeter unless otherwise mentioned.**
3. **28 days cylinder strength of concrete: f 'c = 25.0N/mm^2 (3600 psi)**
4. **Yield strength of mild steel deformed bar fy = 413N/mm^2 (60000psi)**
5. **EF = Earth Face**
   WF = Water Face

NAME OF THE CLIENT :
GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH
LOCAL GOVERNMENT ENGINEERING DEPARTMENT

NAME OF THE PROJECT :
CONSULTANCY SERVICES FOR FEASIBILITY, DETAILED SURVEY AND DESIGN OF CHITTAGONG HILL TRACT CONNECTIVITY CONNECTING THEGAMUKH AND CHITTAGONG PORT.

NAME OF THE CONSULTANTS :
SAI Consulting Engineers Pvt. Ltd, India.
in association with
BETS Consulting Services Ltd, Bangladesh
Project office :
Tahmid Mahmood Palace
Flat # 9A, House # 77, Road # 4, Block-C,

DRAWING TITLE :
SECTIONAL REINF. OF ABUTMENT & BALLAST WALL (HT, H =10.0m), TYP-I

DRAWING NO : LGED/AB-10(I)/RNF.-03

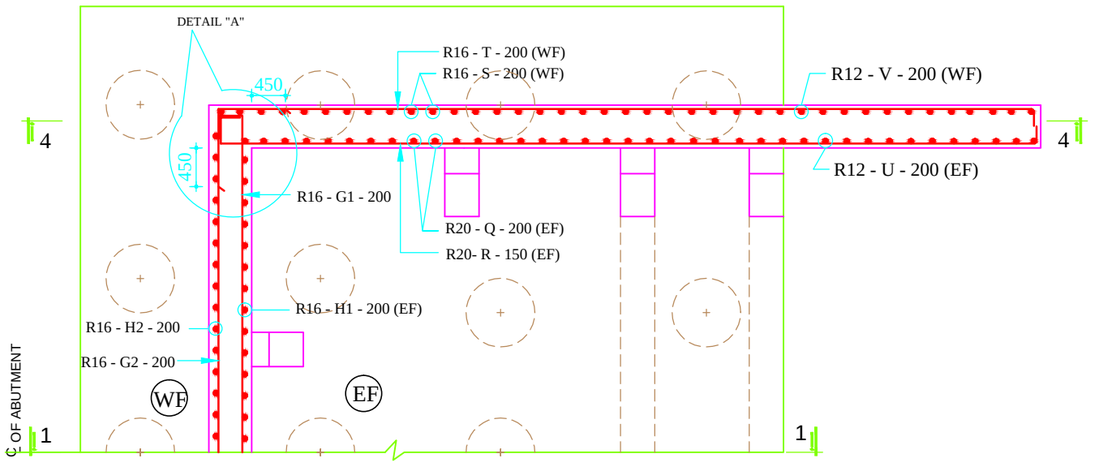
Scale :As shown

Date : 28-01-16

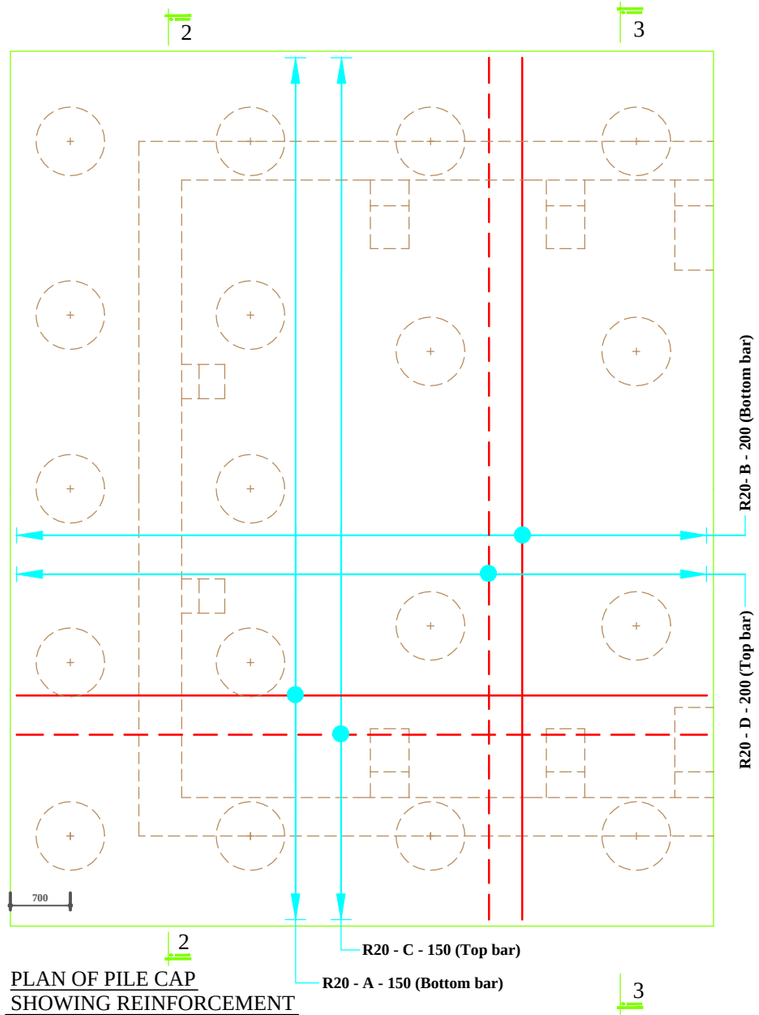
DESIGNED BY :	DRAWN BY :	CHECKED BY :	APPROVED BY :
MD. TAZUDDIN	MD. TAZUDDIN	AFM HAMIDUL HAQUE	DR. PRABHAT SHRIVASTAVA

REV.	DESCRIPTION	DATE

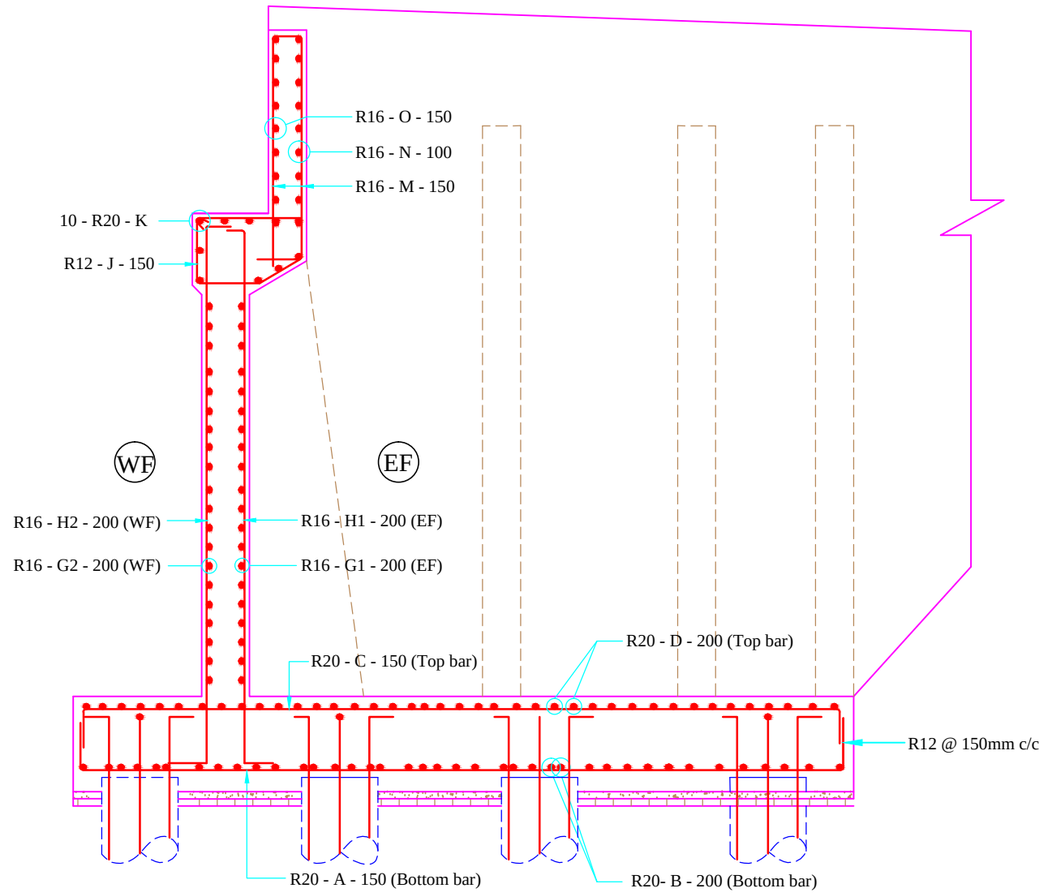
TYPICAL DRAWING OF ABUTMENT



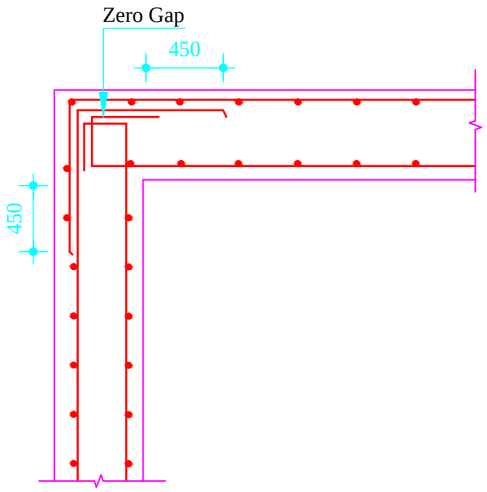
PLAN OF ABUTMENT & WING WALL (HALF)



PLAN OF PILE CAP
SHOWING REINFORCEMENT



CROSS SECTION OF ABUTMENT (SECTION 1-1)
SHOWING REINFORCEMENT DETAILS.



DETAIL "A"

NOTES:

1. **Clear cover to main reinforcement bar is to be 50mm. unless otherwise mentioned.**
2. **28 days cylinder strength of concrete: f 'c = 25.0N/mm (3600 psi)**
3. **Yield strength of mild steel deformed bar fy = 413N/mm (60000psi)**
4. **EF = Earth Face**
   WF = Water Face

NAME OF THE CLIENT :
GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH
LOCAL GOVERNMENT ENGINEERING DEPARTMENT

NAME OF THE PROJECT :
CONSULTANCY SERVICES FOR FEASIBILITY, DETAILED SURVEY AND DESIGN OF CHITTAGONG HILL TRACT CONNECTIVITY CONNECTING THEGAMUKH AND CHITTAGONG PORT.

NAME OF THE CONSULTANTS :
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in association with
BETS Consulting Services Ltd, Bangladesh
Project office :
Tahmid Mahmood Palace
Flat # 9A, House # 77, Road # 4, Block-C,

DRAWING TITLE :
REINF. DETAILS OF ABUTMENT PILE CAP (HEIGHT, HT. = 7.0m), TYP-II

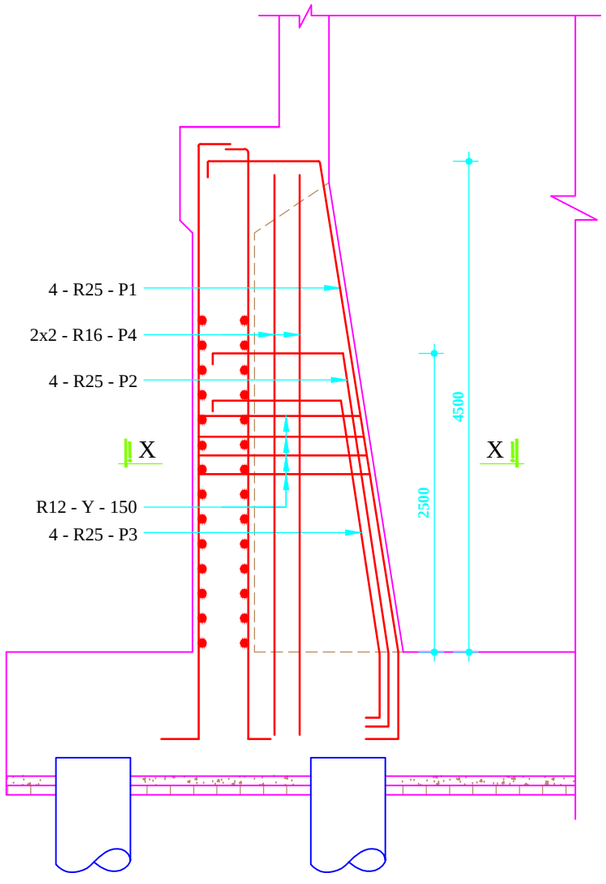
DRAWING NO : LGED/AB-7 (II)/RNF.-02

Scale :As shown

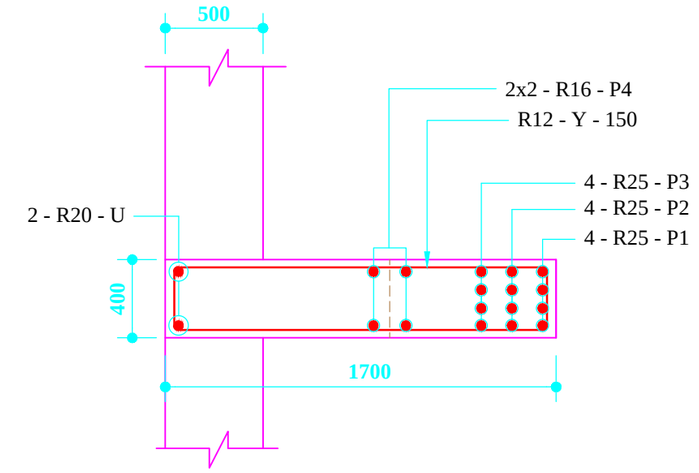
Date : 28-01-16

DESIGNED BY :	DRAWN BY :	CHECKED BY :	APPROVED BY :
MD. TAZUDDIN	MD. TAZUDDIN	AFM HAMIDUL HAQUE	DR. PRABHAT SHRIVASTAVA

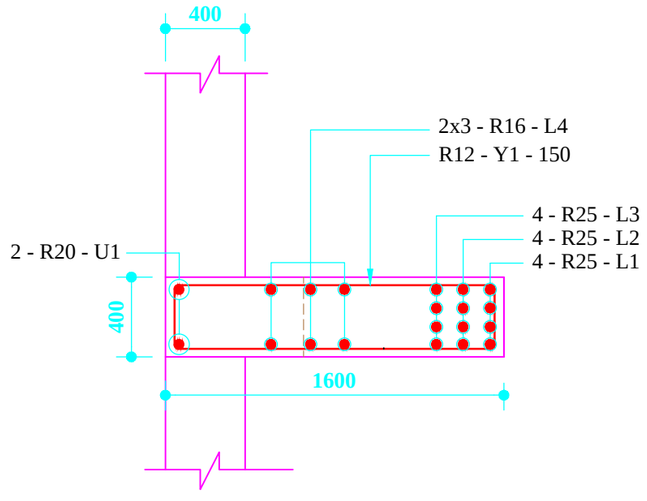
REV.	DESCRIPTION	DATE



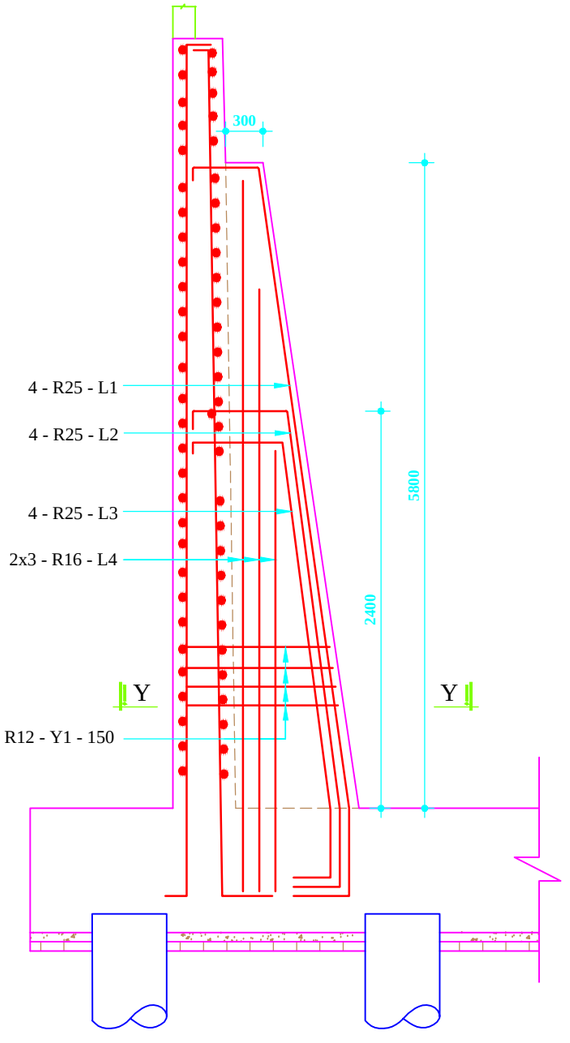
REINF. DETAILS OF ABUTMENT COUNTERFORT (C2)



SECTION X -X (C2)



SECTION Y -Y (C1)



REINF. DETAILS OF WINGWALL COUNTERFORT (C1)

NOTES:

1. **Clear cover to main reinforcement bar is to be 50mm. unless otherwise mentioned.**
2. **28 days cylinder strength of concrete: f 'c = 25.0N/mm (3600 psi)**
3. **Yield strength of mild steel deformed bar fy = 413N/mm (60000psi)**
4. **EF = Earth Face**
   WF = Water Face

NAME OF THE CLIENT :
GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH
LOCAL GOVERNMENT ENGINEERING DEPARTMENT

NAME OF THE PROJECT :
CONSULTANCY SERVICES FOR FEASIBILITY, DETAILED SURVEY AND DESIGN OF CHITTAGONG HILL TRACT CONNECTIVITY CONNECTING THEGAMUKH AND CHITTAGONG PORT.

NAME OF THE CONSULTANTS :
SAI Consulting Engineers Pvt. Ltd, India.
in association with
BETS Consulting Services Ltd, Bangladesh
Project office :
Tahmid Mahmood Palace
Flat # 9A, House # 77, Road # 4, Block-C,

DRAWING TITLE :
DETAILS OF COUNTERFORT (ABUT. HT. = 7.0m), TYP-II

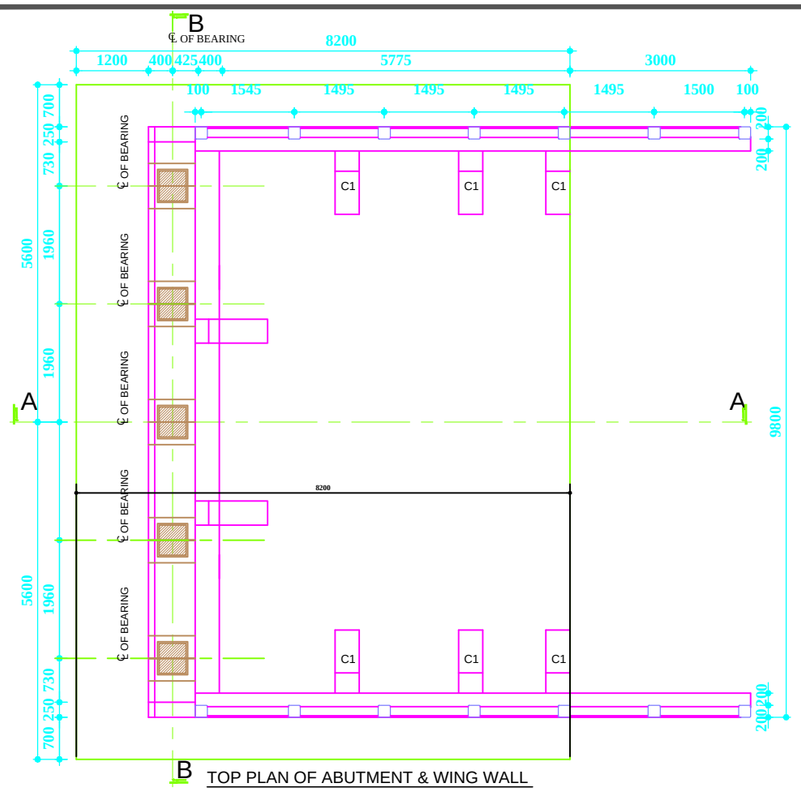
DRAWING NO : LGED/AB-7 (II)/COUNT.-04

Scale :As shown

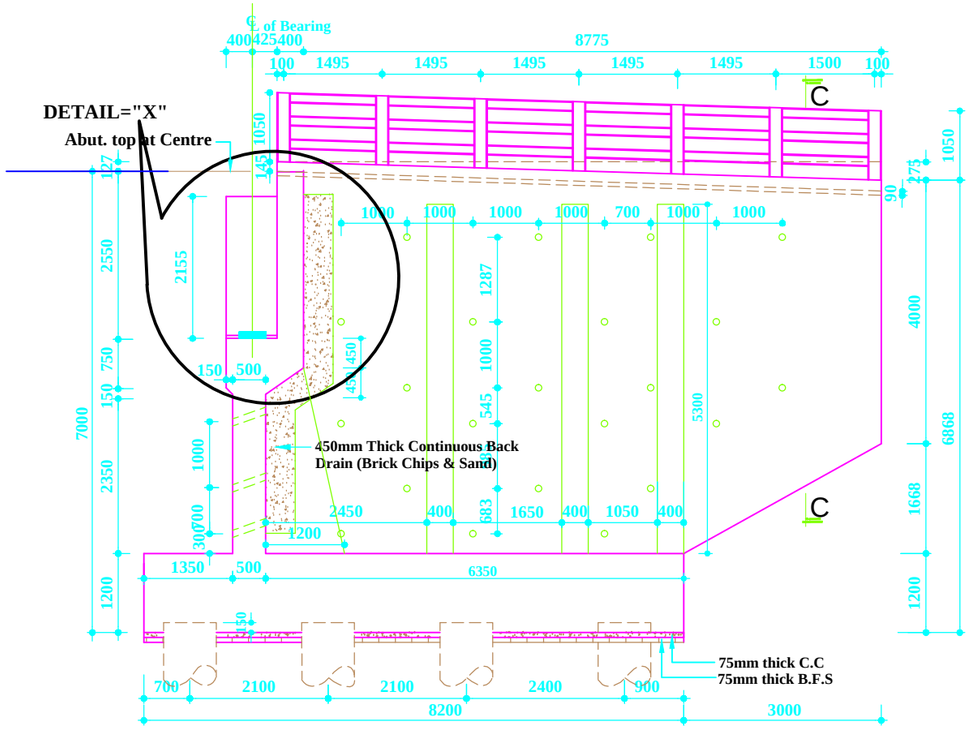
Date : 28-01-16

DESIGNED BY :	DRAWN BY :	CHECKED BY :	APPROVED BY :
MD. TAZUDDIN	MD. TAZUDDIN	AFM HAMIDUL HAQUE	DR. PRAVAT SHRIVESTAVA

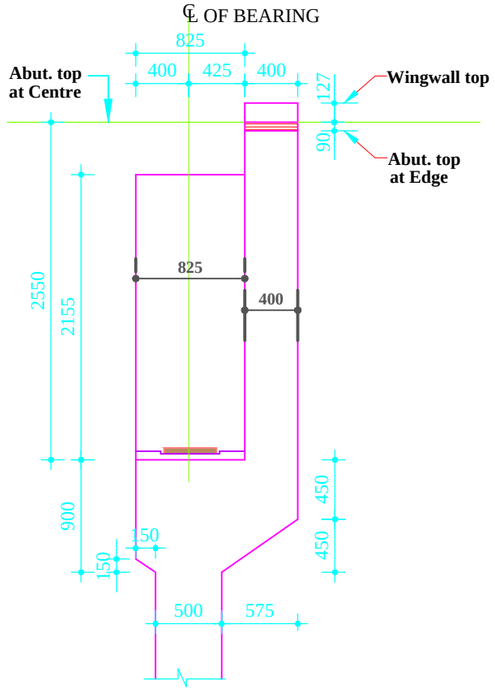
REV.	DESCRIPTION	DATE



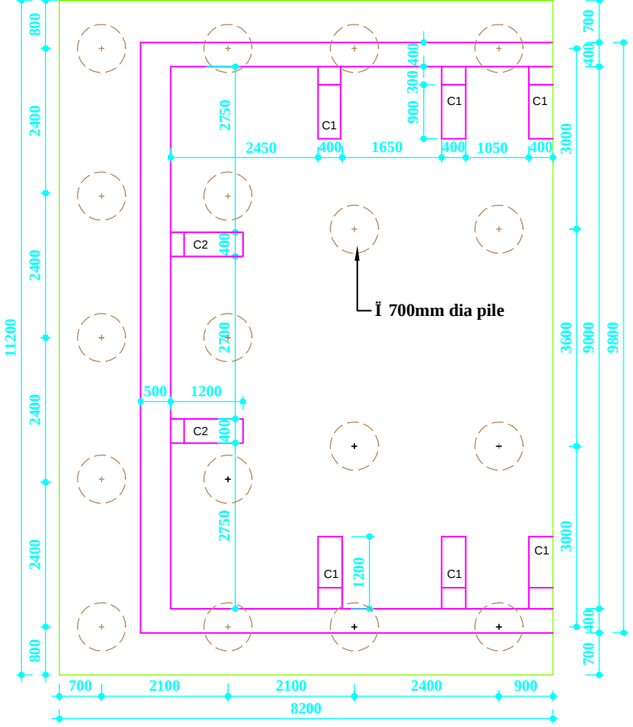
TOP PLAN OF ABUTMENT & WING WALL



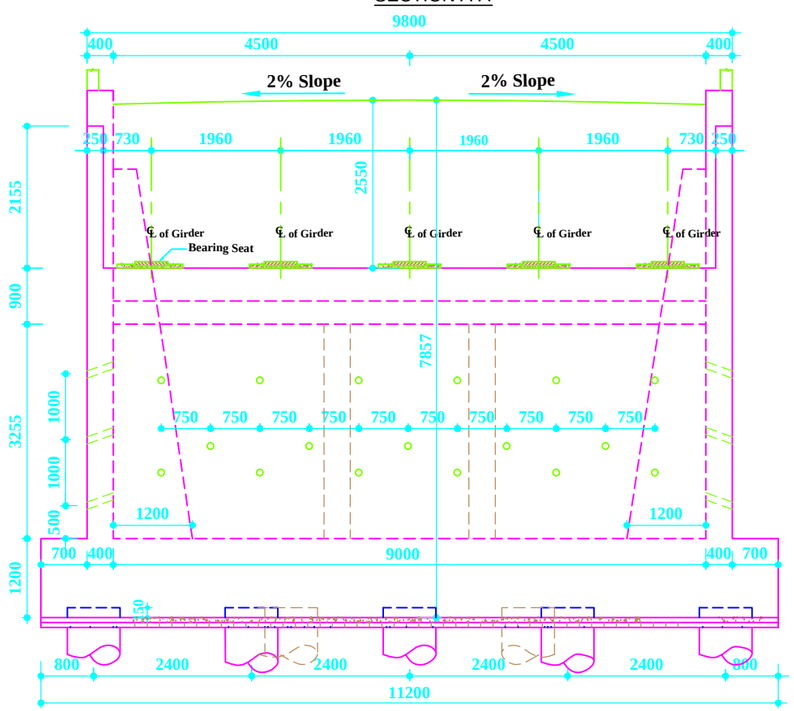
SECTION A-A



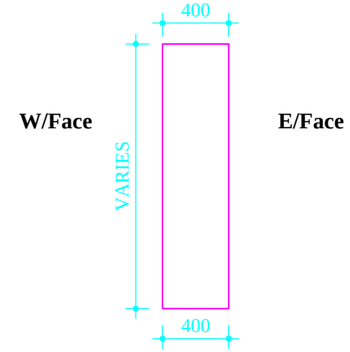
DETAIL -'X'



PILE LAY-OUT PLAN

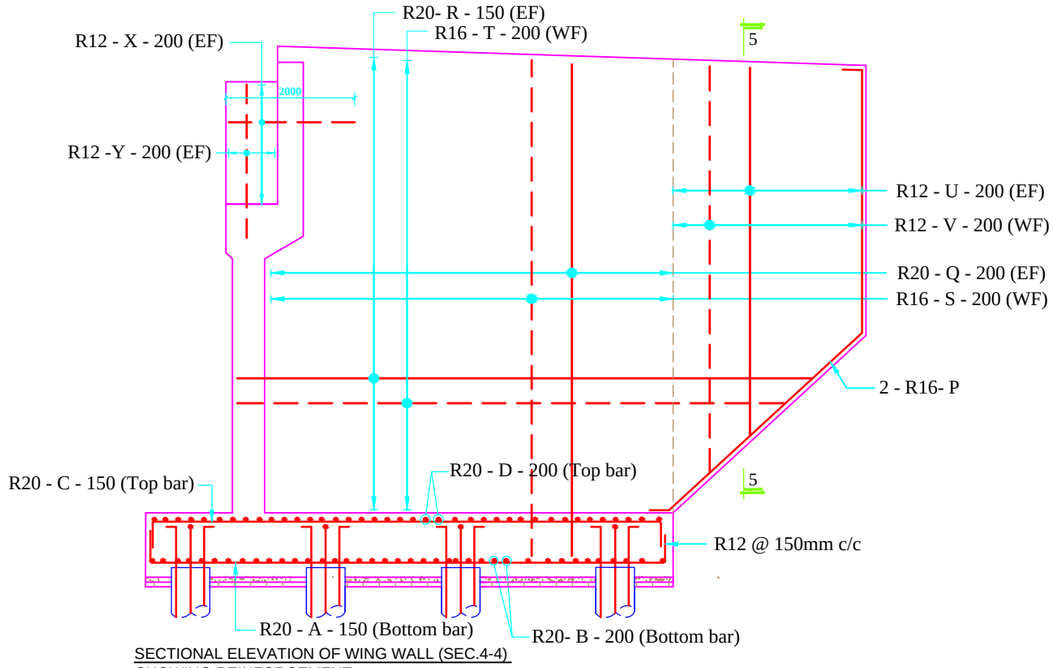


SECTION B-B

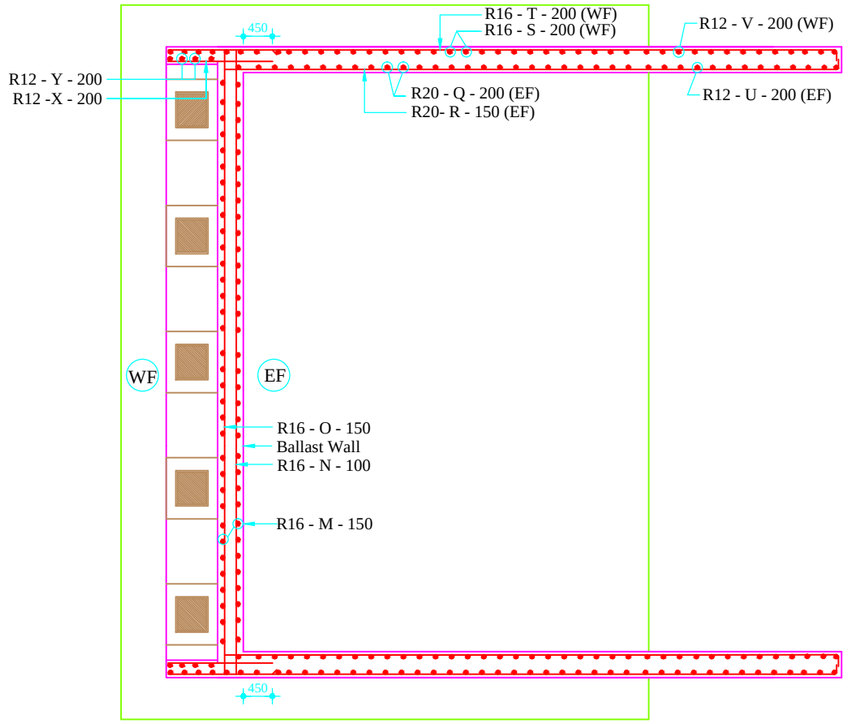


SECTION - C-C

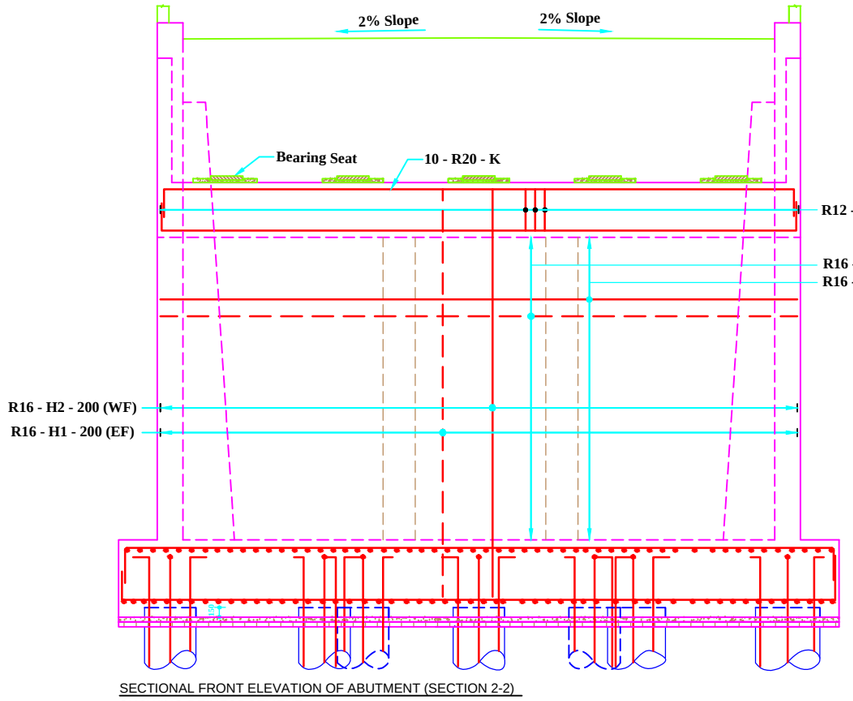
NAME OF THE CLIENT : GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH LOCAL GOVERNMENT ENGINEERING DEPARTMENT NAME OF THE PROJECT : CONSULTANCY SERVICES FOR FEASIBILITY, DETAILED SURVEY AND DESIGN OF CHITTAGONG HILL TRACT CONNECTIVITY CONNECTING THEGAMUKH AND CHITTAGONG PORT.	NAME OF THE CONSULTANTS : SAI Consulting Engineers Pvt. Ltd, India. in association with BETS Consulting Services Ltd, Bangladesh Project office : Tahmid Mahmood Palace Flat # 9A, House # 77, Road # 4, Block-C,	DRAWING TITLE : DIMENSION DETAILS OF ABUTMENT (ABUTMENT HT, H = 7.0m), TYP-II DRAWING NO : LGED/AB-7(II)/C-01 Scale :As shown Date : 28-01-16	DESIGNED BY : MD. TAZUDDIN	DRAWN BY : MD. TAZUDDIN	CHECKED BY : AFM HAMIDUL HAQUE	APPROVED BY : DR. PRABHAT SHRIVASTAVA	REV.	DESCRIPTION	DATE



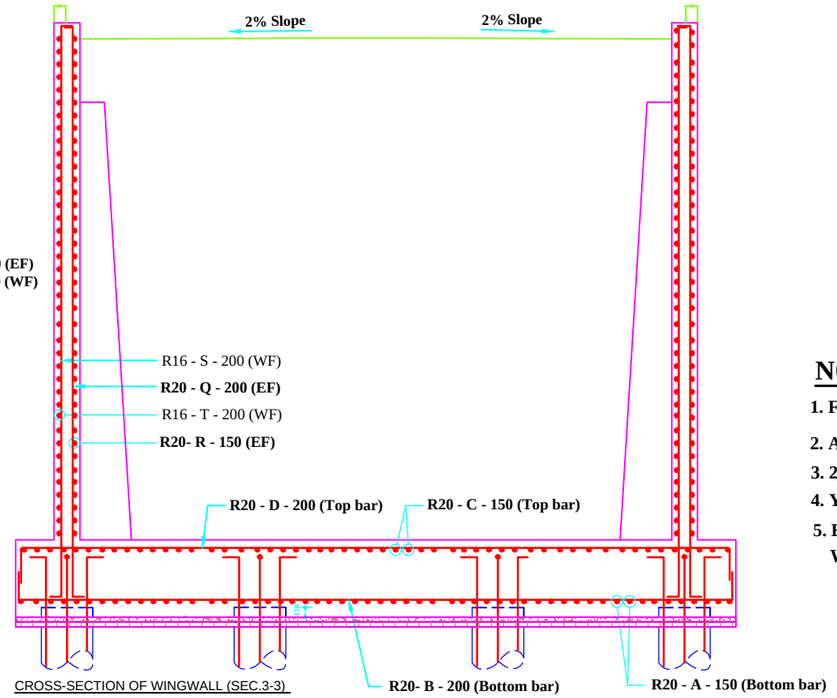
SECTIONAL ELEVATION OF WING WALL (SEC.4-4)
SHOWING REINFORCEMENT



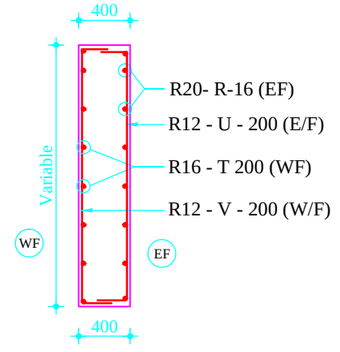
TOP PLAN OF BALLASTWALL & WINGWALL
SHOWING TOP REINFORCEMENT



SECTIONAL FRONT ELEVATION OF ABUTMENT (SECTION 2-2)
SHOWING REINFORCEMENT



CROSS-SECTION OF WINGWALL (SEC.3-3)
SHOWING REINFORCEMENT



SEC. 5 - 5

NOTES:

1. For plan of section 4 - 4 See Sheet No. 13
2. All dimensions are in millimeter unless otherwise mentioned.
3. 28 days cylinder strength of concrete: f 'c = 25.0N/mm^2 (3600 psi)
4. Yield strength of mild steel deformed bar fy = 413N/mm^2 (60000psi)
5. EF = Earth Face
   WF = Water Face

NAME OF THE CLIENT :
GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH
LOCAL GOVERNMENT ENGINEERING DEPARTMENT

NAME OF THE PROJECT :
CONSULTANCY SERVICES FOR FEASIBILITY, DETAILED SURVEY AND DESIGN OF CHITTAGONG HILL TRACT CONNECTIVITY CONNECTING THEGAMUKH AND CHITTAGONG PORT.

NAME OF THE CONSULTANTS :
SAI Consulting Engineers Pvt. Ltd, India.
in association with
BETS Consulting Services Ltd, Bangladesh
Project office :
Tahmid Mahmood Palace
Flat # 9A, House # 77, Road # 4, Block-C,

DRAWING TITLE :
REINF. DETAILS OF ABUTMENT & BALLAST WALL (HT, H = 7.0m), TY-II

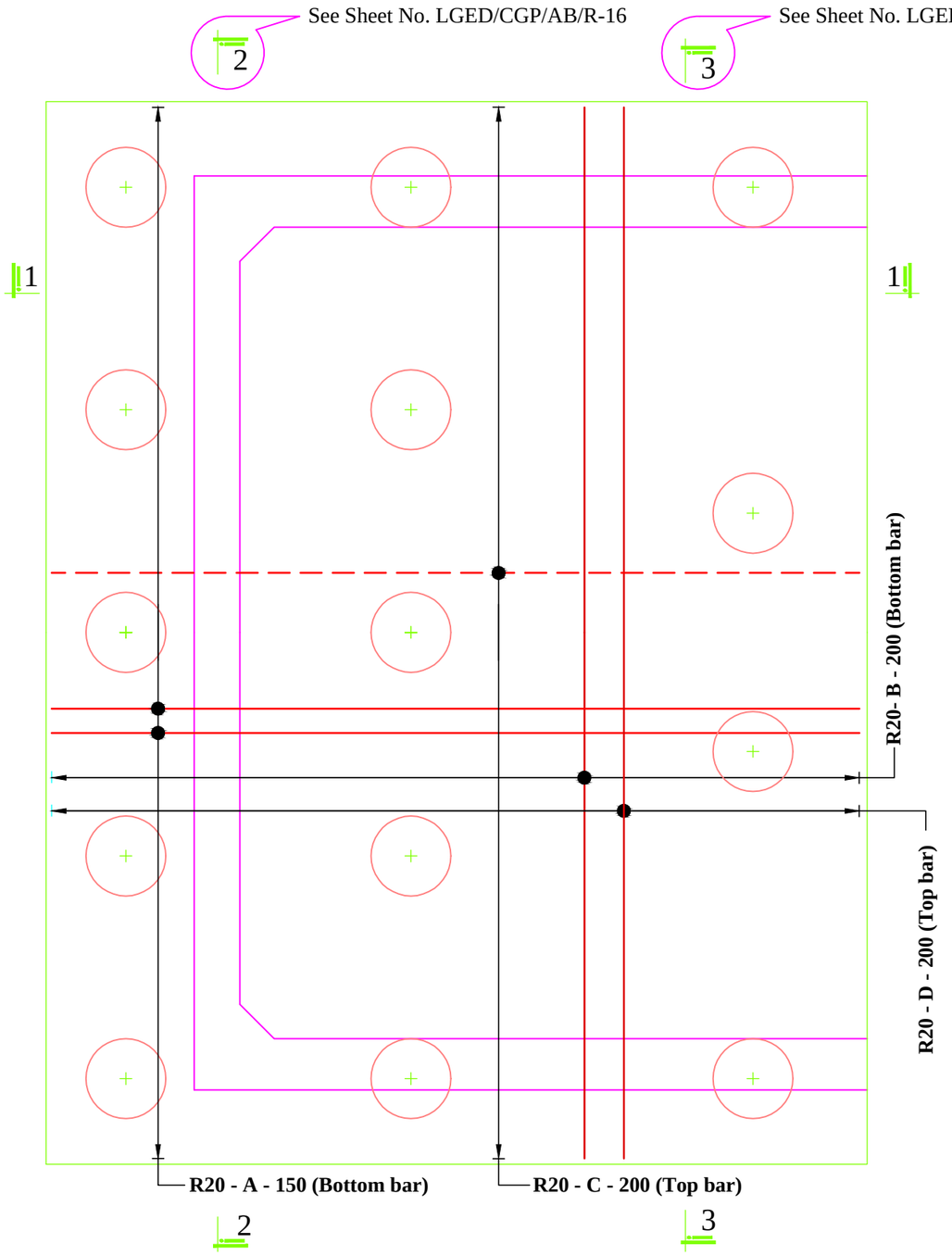
DRAWING NO : LGED/AB-7 (II)/RNF.-03

Scale :As shown

Date : 28-01-16

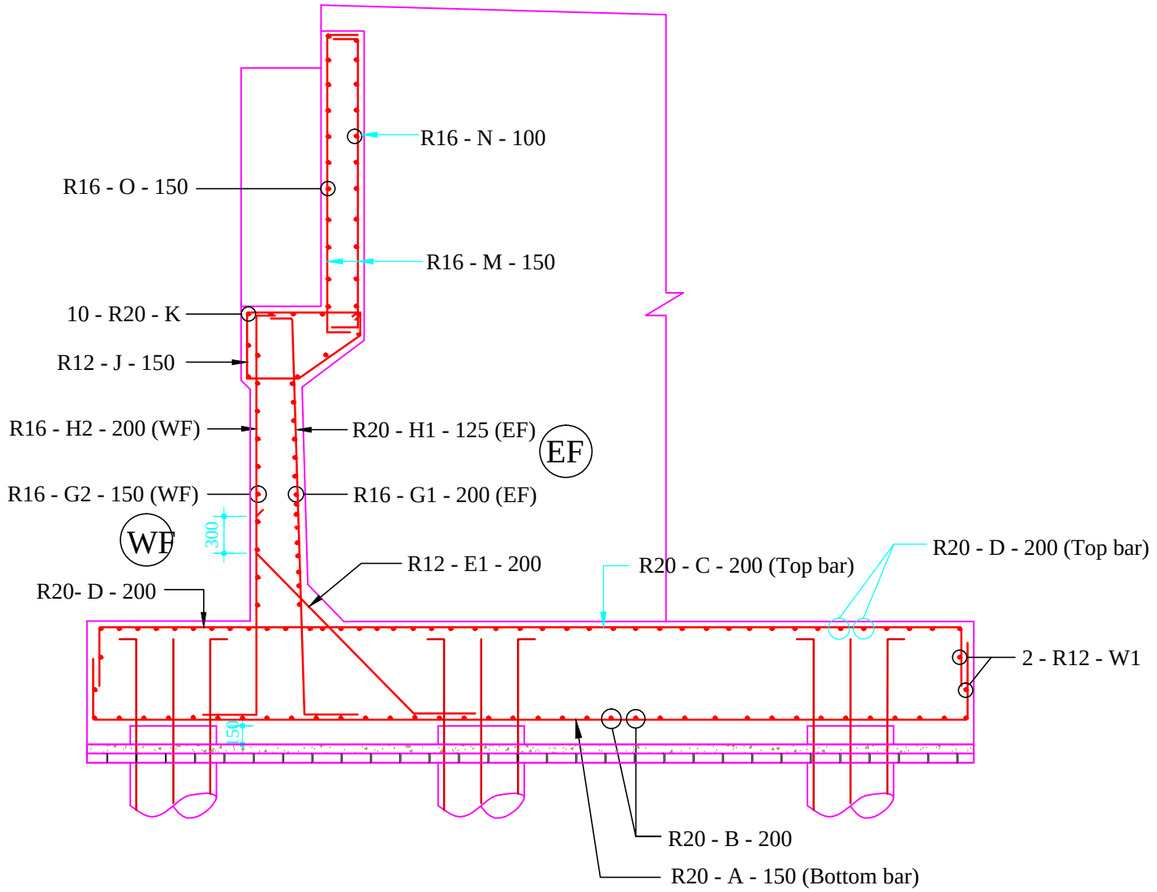
DESIGNED BY :	DRAWN BY :	CHECKED BY :	APPROVED BY :
MD. TAZUDDIN	MD. TAZUDDIN	AFM HAMIDUL HAQUE	DR. PRABHAT SHRIVASTAVA

REV.	DESCRIPTION	DATE



REINFORCEMENT PLAN OF PILE CAP

(Scale : 1:50)



REINF. SECTION OF ABUTMENT (SECTION 1-1)

LEGEND :

E/F : Earth face
W/F : Water face
R/F : River face

NOTES:

1. **Clear cover to main reinforcement bar is to be 50mm. unless otherwise mentioned.**
2. **28 days cylinder strength of concrete: f 'c = 25.0N/mm (3600 psi)**
3. **Yield strength of mild steel deformed bar fy = 413N/mm (60000psi)**

NAME OF THE CLIENT :
GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH
LOCAL GOVERNMENT ENGINEERING DEPARTMENT

NAME OF THE PROJECT :
CONSULTANCY SERVICES FOR FEASIBILITY, DETAILED SURVEY AND DESIGN OF CHITTAGONG HILL TRACT CONNECTIVITY CONNECTING THEGAMUKH AND CHITTAGONG PORT.

NAME OF THE CONSULTANTS :
SAI Consulting Engineers Pvt. Ltd, India.
in association with
BETS Consulting Services Ltd, Bangladesh
Project office :
Tahmid Mahmood Palace
Flat # 9A, House # 77, Road # 4, Block-C,

DRAWING TITLE :
REINF. DETAILS OF ABUTMENT PILE CAP (HEIGHT, HT. = 6.0m), TYP-III

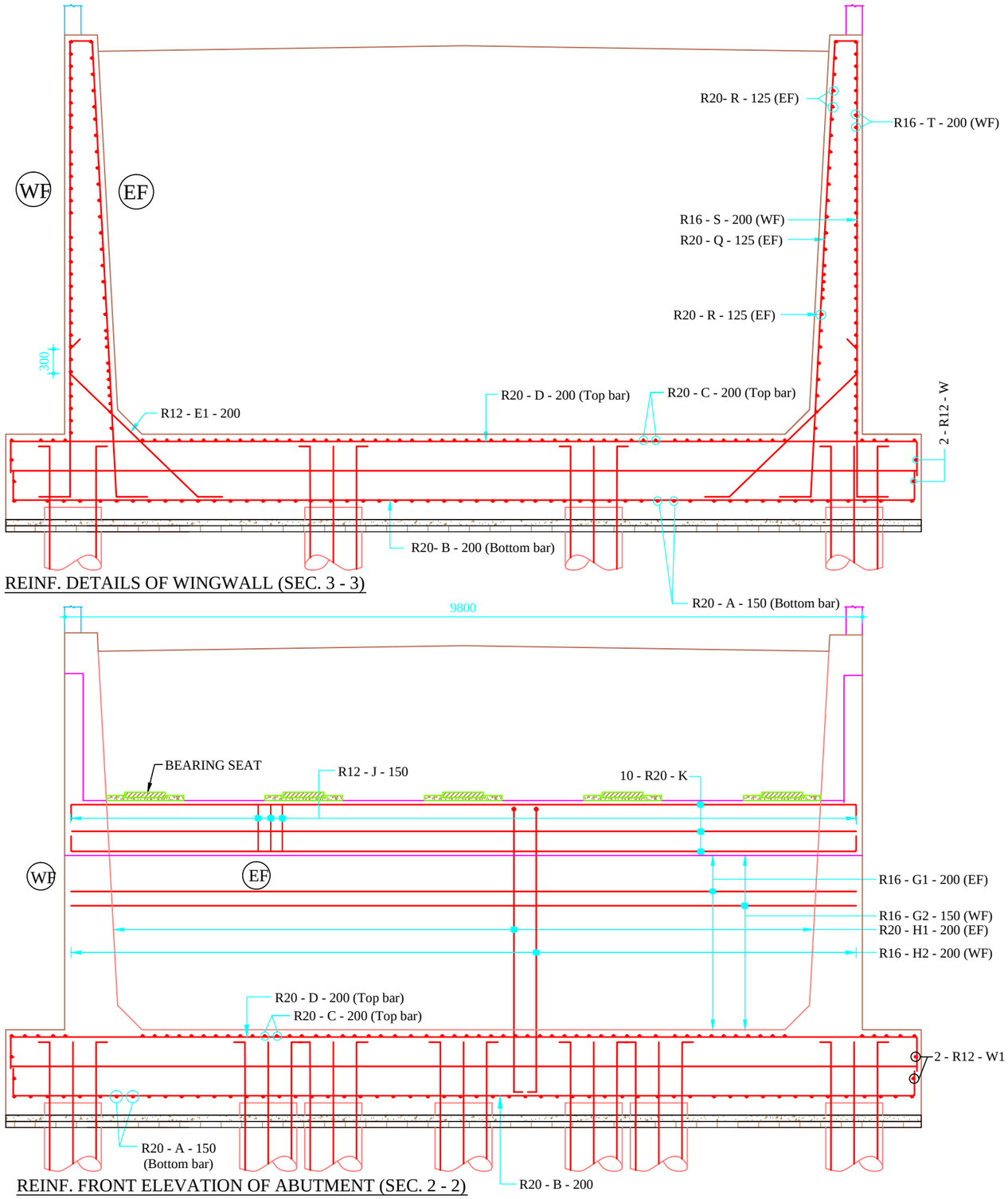
DRAWING NO : LGED/AB-6 (III)/RNF.-02

Scale :As shown

Date : 28-01-16

DESIGNED BY :	DRAWN BY :	CHECKED BY :	APPROVED BY :
MD. TAZUDDIN	MD. TAZUDDIN	AFM HAMIDUL HAQUE	DR. PRABHAT SHRIVASTAVA

REV.	DESCRIPTION	DATE



REINF. DETAILS OF WINGWALL (SEC. 3 - 3)

REINF. FRONT ELEVATION OF ABUTMENT (SEC. 2 - 2)

NOTES:

1. **Clear cover to main reinforcement bar is to be 50mm. unless otherwise mentioned.**
2. **28 days cylinder strength of concrete: f 'c = 25.0N/mm (3600 psi)**
3. **Yield strength of mild steel deformed bar fy = 413N/mm (60000psi)**
4. **EF = Earth Face**
   WF = Water Face

NAME OF THE CLIENT :
GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH
LOCAL GOVERNMENT ENGINEERING DEPARTMENT

NAME OF THE PROJECT :
CONSULTANCY SERVICES FOR FEASIBILITY, DETAILED SURVEY AND DESIGN OF CHITTAGONG HILL TRACT CONNECTIVITY CONNECTING THEGAMUKH AND CHITTAGONG PORT.

NAME OF THE CONSULTANTS :
SAI Consulting Engineers Pvt. Ltd, India.
in association with
BETS Consulting Services Ltd, Bangladesh
Project office :
Tahmid Mahmood Palace
Flat # 9A, House # 77, Road # 4, Block-C,

DRAWING TITLE :
SECTIONAL REINF. DETAILS OF ABUTMENT (HT = 6.0m)

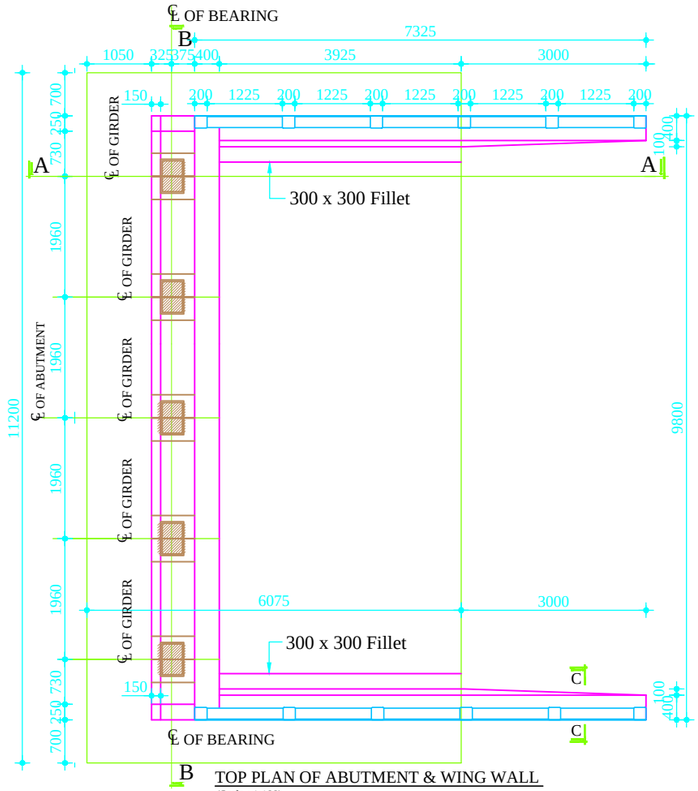
DRAWING NO : LGED/AB-6.0/REINF.-04

Scale :As shown

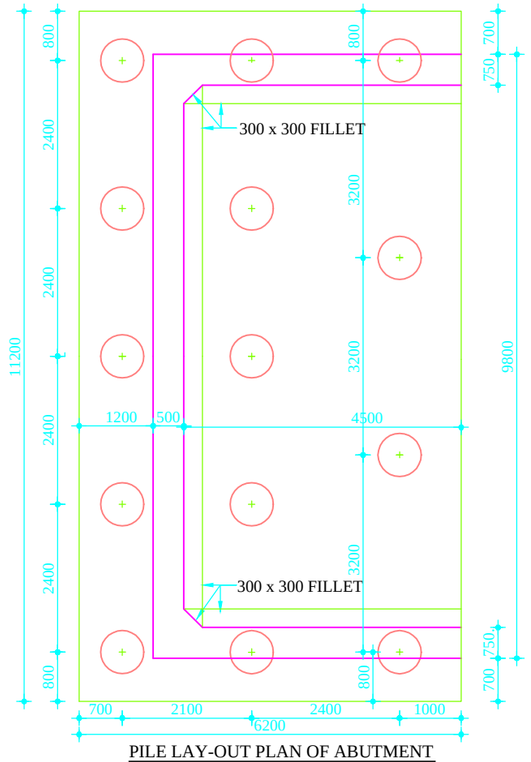
Date : 28-01-16

DESIGNED BY :	DRAWN BY :	CHECKED BY :	APPROVED BY :
MD. TAZUDDIN	MD. TAZUDDIN	AFM HAMIDUL HAQUE	DR. PRABHAT SHRIVASTAVA

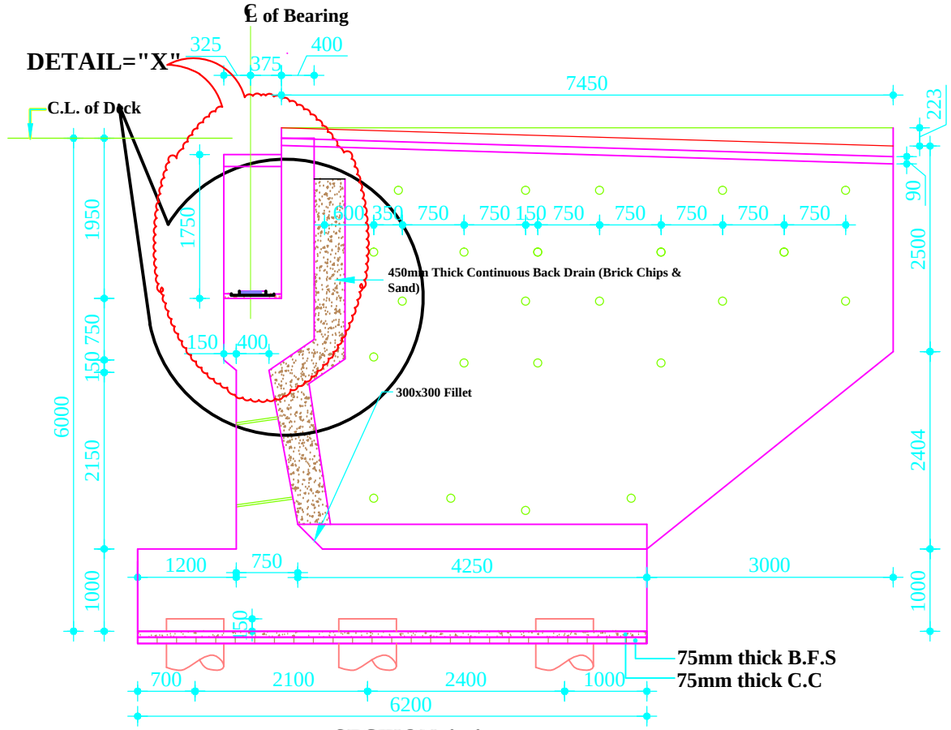
REV.	DESCRIPTION	DATE



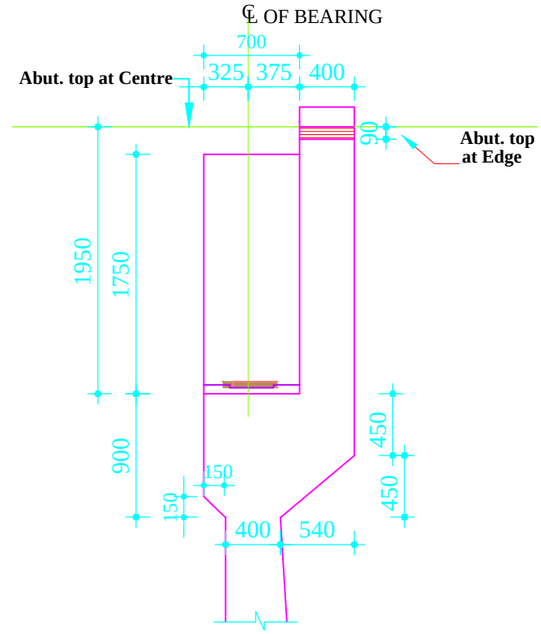
TOP PLAN OF ABUTMENT & WING WALL
(Scale : 1:100)



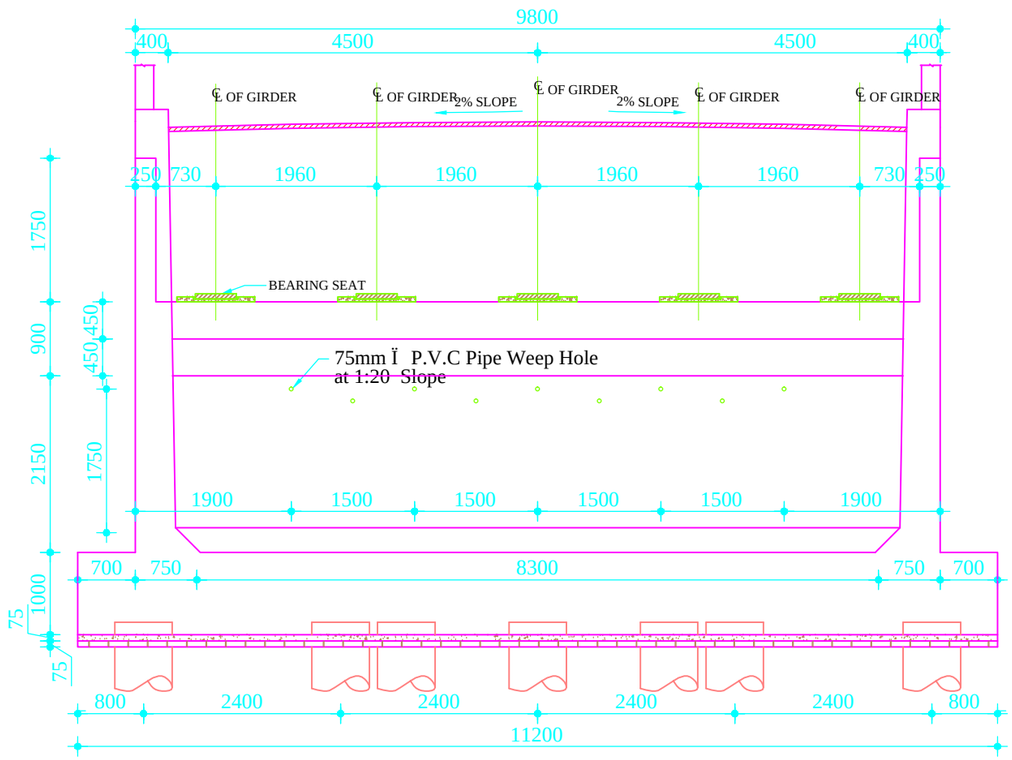
PILE LAY-OUT PLAN OF ABUTMENT
(Scale : 1:100)

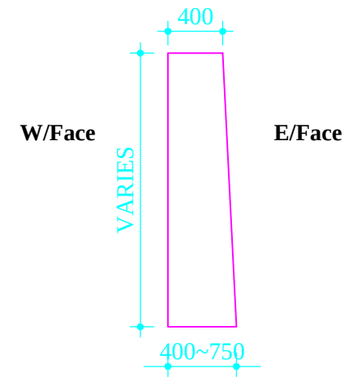


SECTION A-A
(Scale : 1:75)



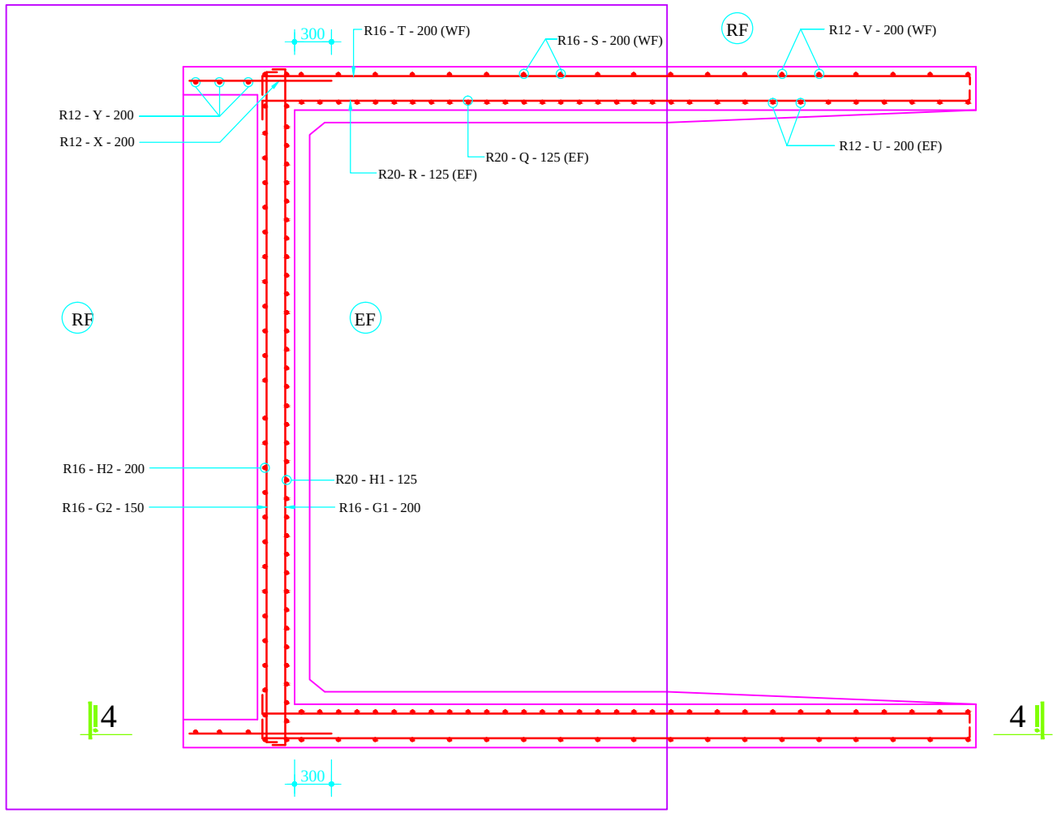
DETAIL -'X'
(Scale : 1:45)



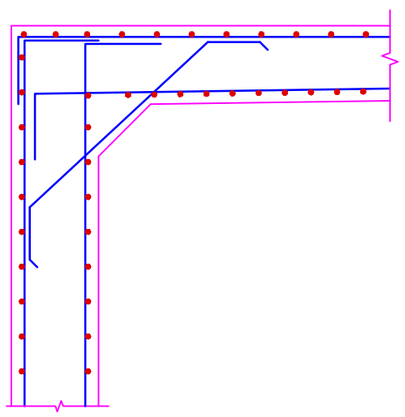


SECTION - C-C
(Scale : 1:45)

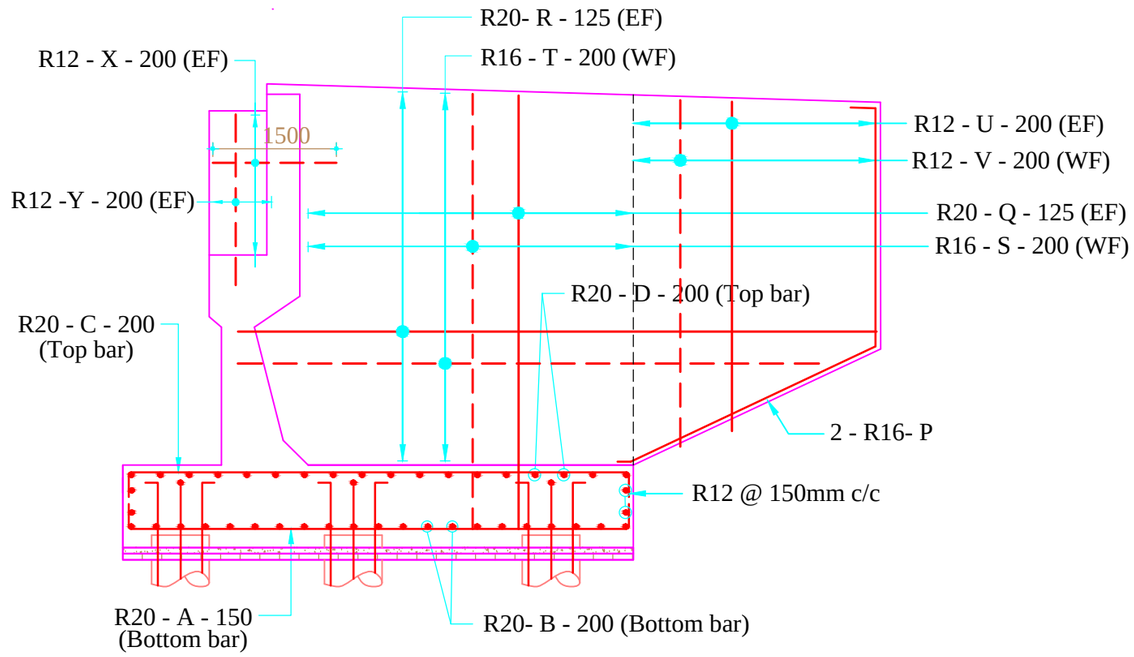
NAME OF THE CLIENT : GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH LOCAL GOVERNMENT ENGINEERING DEPARTMENT NAME OF THE PROJECT : CONSULTANCY SERVICES FOR FEASIBILITY, DETAILED SURVEY AND DESIGN OF CHITTAGONG HILL TRACT CONNECTIVITY CONNECTING THEGAMUKH AND CHITTAGONG PORT.	NAME OF THE CONSULTANTS : SAI Consulting Engineers Pvt. Ltd, India. in association with BETS Consulting Services Ltd, Bangladesh Project office : Tahmid Mahmood Palace Flat # 9A, House # 77, Road # 4, Block-C,	DRAWING TITLE : DIMENSION DETAILS OF ABUTMENT (ABUTMENT HT, H = 6.0m), TYP-III DRAWING NO : LGED/AB-6 (III)/C-01 Scale :As shown Date : 28-01-16	DESIGNED BY : MD. TAZUDDIN	DRAWN BY : MD. TAZUDDIN	CHECKED BY : AFM HAMIDUL HAQUE	APPROVED BY : DR. PRABHAT SHRIVASTAVA	REV.	DESCRIPTION	DATE



TOP PLAN OF WALL & WINGWALL
SHOWING TOP REINFORCEMENT
(DScale : 1:50)



DETAIL "A"



SECTIONAL ELEVATION OF WING WALL (SEC.4-4)
SHOWING REINFORCEMENT
(DScale : 1:75)

LEGEND :

E/F : Earth face
W/F : Water face
R/F : River face

NOTES:

1. Clear cover to reinforcement bar is to be 50mm. unless otherwise mentioned.
2. 28 days cylinder strength of concrete: fc' = 25.0N/mm (3600 psi)
3. Yield strength of mild steel deformed bar fy = 413N/mm (60000psi)

NAME OF THE CLIENT :
GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH
LOCAL GOVERNMENT ENGINEERING DEPARTMENT

NAME OF THE PROJECT :
CONSULTANCY SERVICES FOR FEASIBILITY, DETAILED SURVEY AND DESIGN OF CHITTAGONG HILL TRACT CONNECTIVITY CONNECTING THEGAMUKH AND CHITTAGONG PORT.

NAME OF THE CONSULTANTS :
SAI Consulting Engineers Pvt. Ltd, India.
in association with
BETS Consulting Services Ltd, Bangladesh
Project office :
Tahmid Mahmood Palace
Flat # 9A, House # 77, Road # 4, Block-C,

DRAWING TITLE :
REINF. DETAILS OF ABUTMENT & BALLAST WALL (HT, H =6.0m), TYP-III

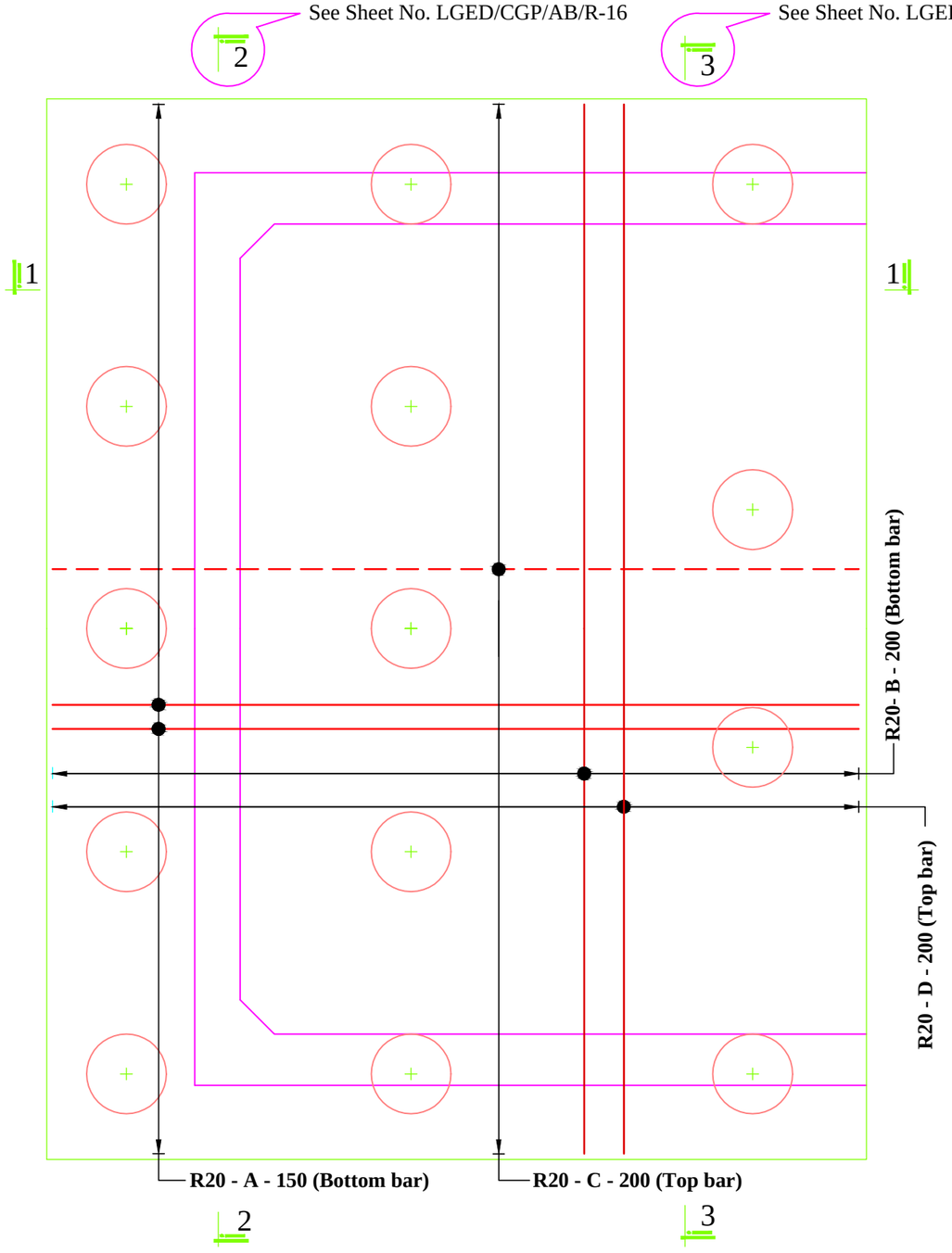
DRAWING NO : LGED/AB-6 (III)/RNF.-03

Scale :As shown

Date : 28-01-16

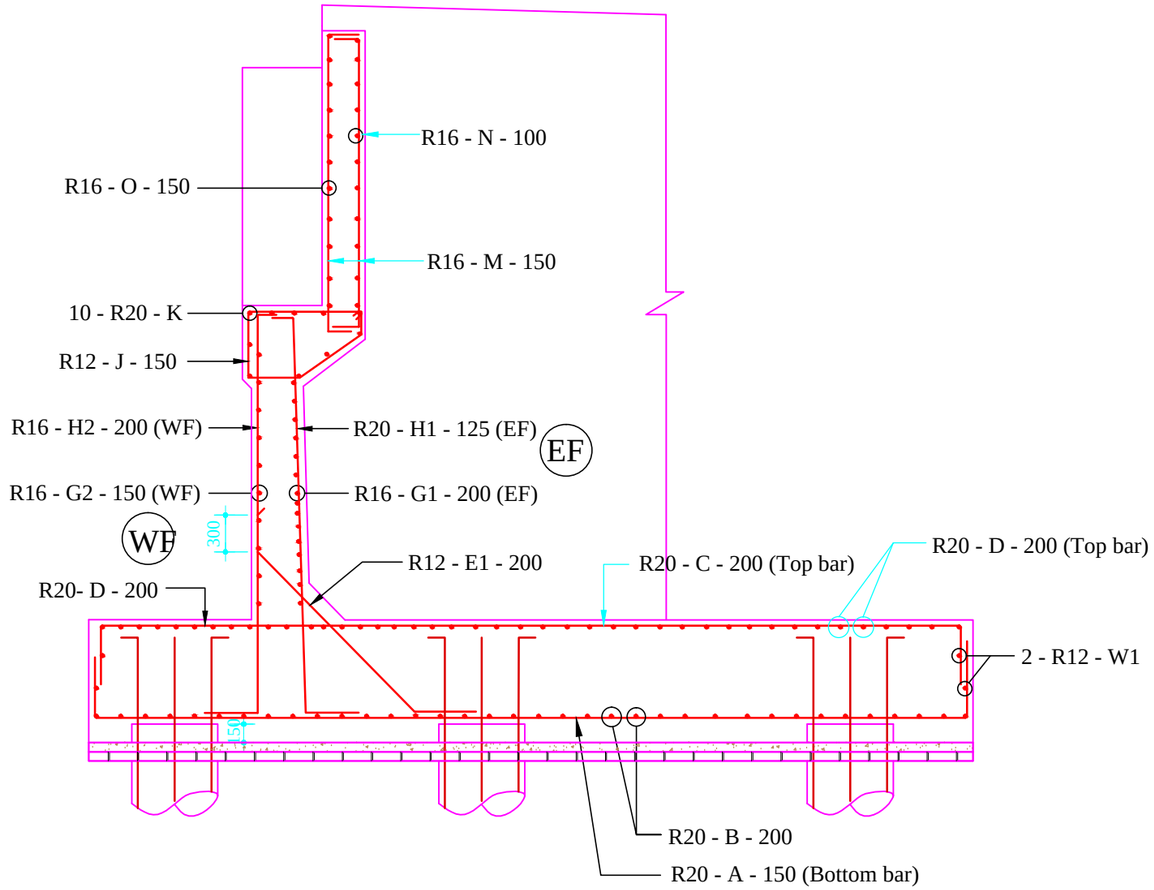
DESIGNED BY :	DRAWN BY :	CHECKED BY :	APPROVED BY :
MD. TAZUDDIN	MD. TAZUDDIN	AFM HAMIDUL HAQUE	DR. PRABHAT SHRIVASTAVA

REV.	DESCRIPTION	DATE



REINFORCEMENT PLAN OF PILE CAP

(Scale : 1:50)



REINF. SECTION OF ABUTMENT (SECTION 1-1)

LEGEND :

E/F : Earth face
W/F : Water face
R/F : River face

NOTES:

1. **Clear cover to main reinforcement bar is to be 50mm. unless otherwise mentioned.**
2. **28 days cylinder strength of concrete: f 'c = 25.0N/mm (3600 psi)**
3. **Yield strength of mild steel deformed bar fy = 413N/mm (60000psi)**

NAME OF THE CLIENT :
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LOCAL GOVERNMENT ENGINEERING DEPARTMENT

NAME OF THE PROJECT :
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NAME OF THE CONSULTANTS :
SAI Consulting Engineers Pvt. Ltd, India.
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BETS Consulting Services Ltd, Bangladesh
Project office :
Tahmid Mahmood Palace
Flat # 9A, House # 77, Road # 4, Block-C,

DRAWING TITLE :
REINF. DETAILS OF ABUTMENT PILE CAP (HEIGHT, HT. = 5.0m), TYP-IV

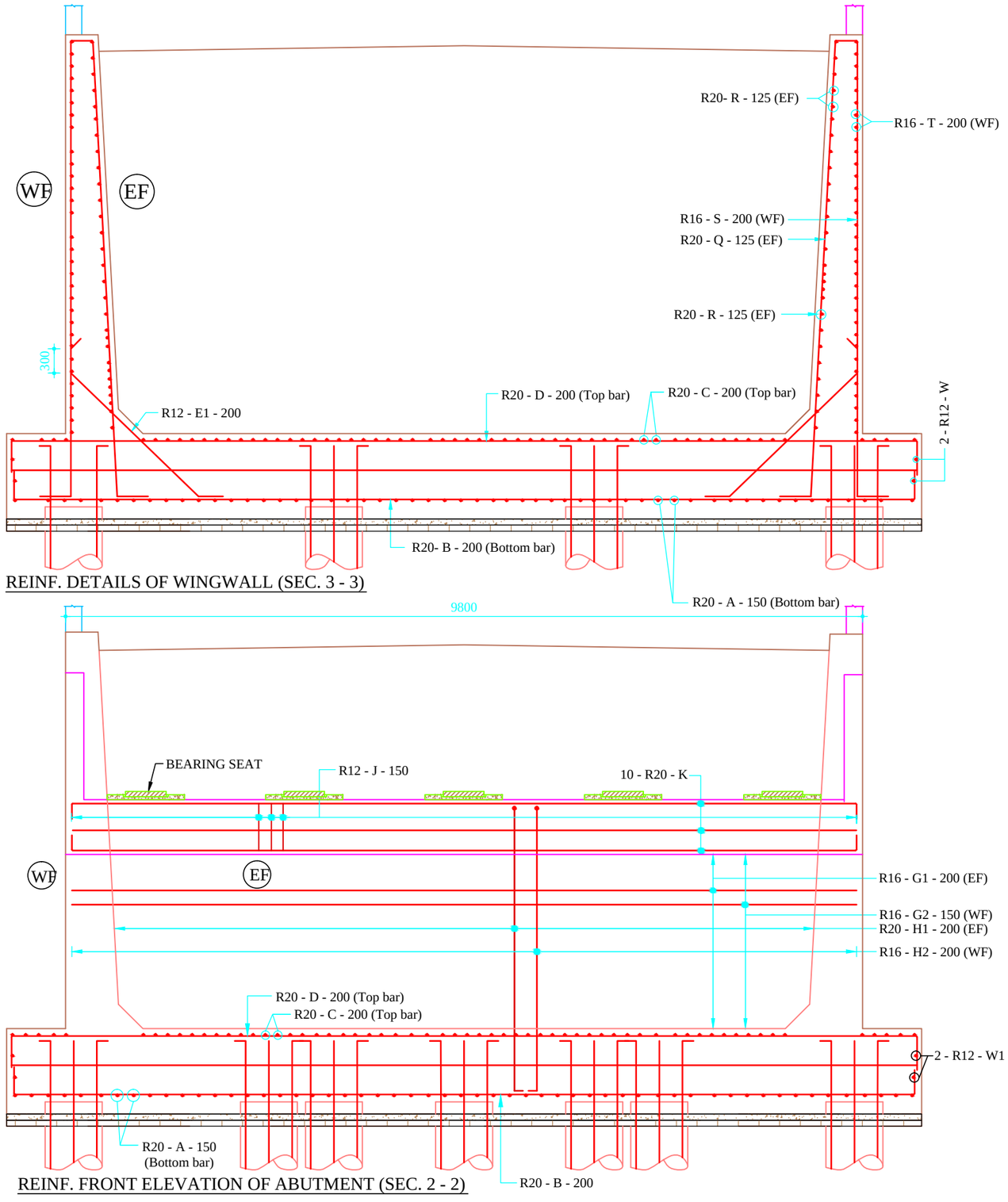
DRAWING NO : LGED/AB-5 (IV)/RNF.-02

Scale :As shown

Date : 28-01-16

DESIGNED BY :	DRAWN BY :	CHECKED BY :	APPROVED BY :
MD. TAZUDDIN	MD. TAZUDDIN	AFM HAMIDUL HAQUE	DR. PRABHAT SHRIVASTAVA

REV.	DESCRIPTION	DATE



REINF. DETAILS OF WINGWALL (SEC. 3 - 3)

REINF. FRONT ELEVATION OF ABUTMENT (SEC. 2 - 2)

NOTES:

1. **Clear cover to main reinforcement bar is to be 50mm. unless otherwise mentioned.**
2. **28 days cylinder strength of concrete: f 'c = 25.0N/mm (3600 psi)**
3. **Yield strength of mild steel deformed bar fy = 413N/mm (60000psi)**
4. **EF = Earth Face**
   WF = Water Face

NAME OF THE CLIENT :
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LOCAL GOVERNMENT ENGINEERING DEPARTMENT

NAME OF THE PROJECT :
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NAME OF THE CONSULTANTS :
SAI Consulting Engineers Pvt. Ltd, India.
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BETS Consulting Services Ltd, Bangladesh
Project office :
Tahmid Mahmood Palace
Flat # 9A, House # 77, Road # 4, Block-C,

DRAWING TITLE :
SECTIONAL REINF. DETAILS OF ABUTMENT (ABUT. HT. = 5.0m), TYP-IV

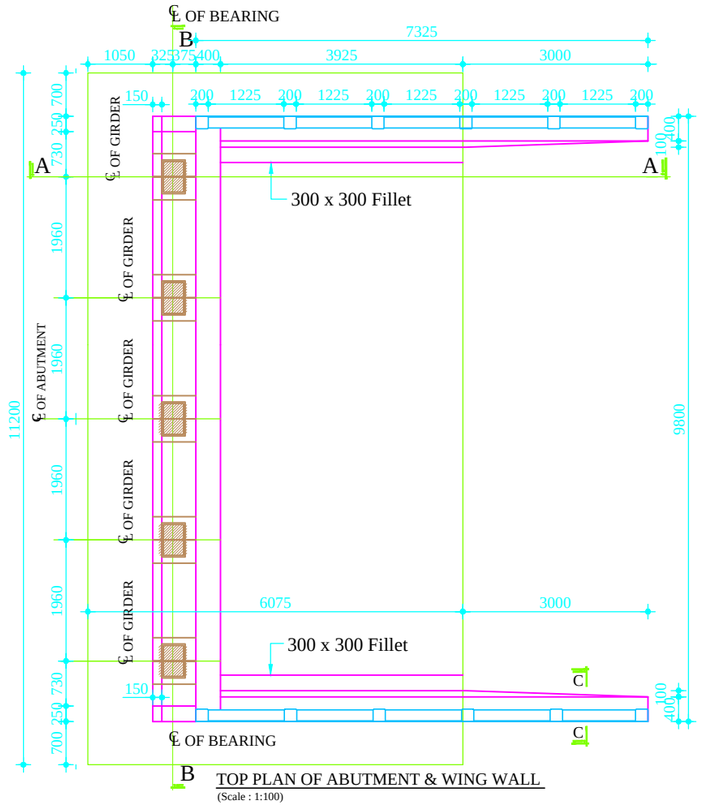
DRAWING NO : LGED/AB-5 (IV)/RNF.-04

Scale :As shown

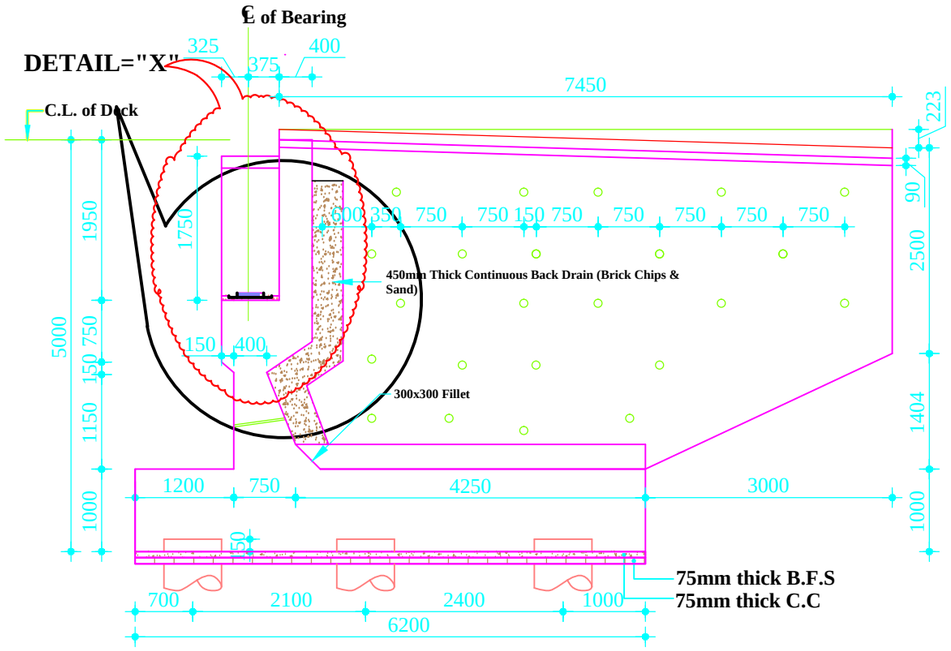
Date : 28-01-16

DESIGNED BY :	DRAWN BY :	CHECKED BY :	APPROVED BY :
MD. TAZUDDIN	MD. TAZUDDIN	AFM HAMIDUL HAQUE	DR. PRABHAT SHRIVASTAVA

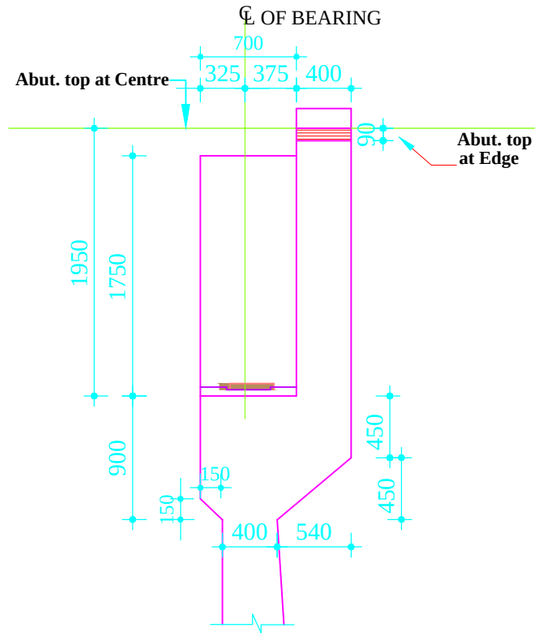
REV.	DESCRIPTION	DATE



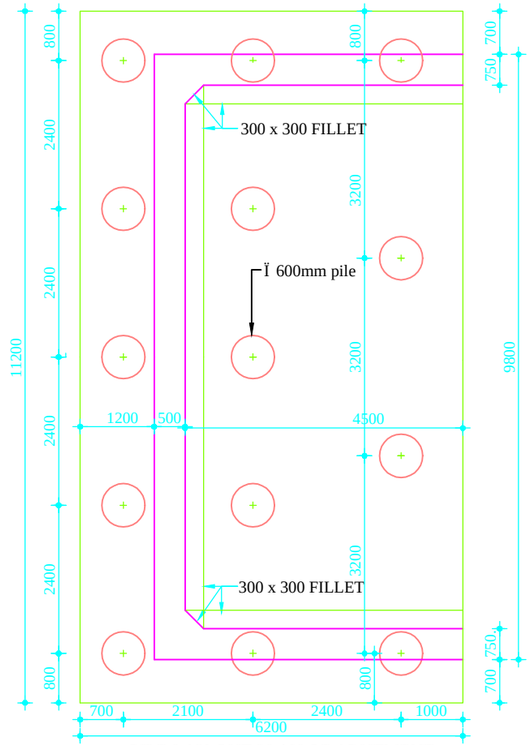
TOP PLAN OF ABUTMENT & WING WALL
(Scale : 1:100)



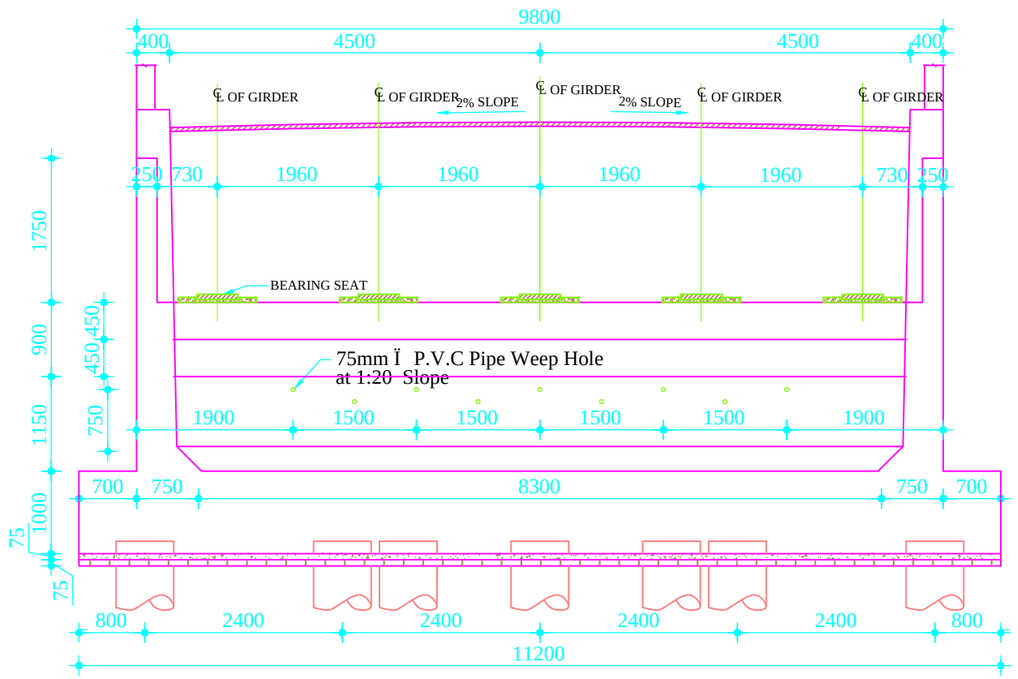
SECTION A-A
(Scale : 1:75)



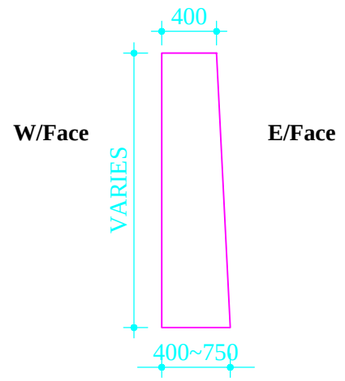
DETAIL -'X'
(Scale : 1:45)



PILE LAY-OUT PLAN OF ABUTMENT
(Scale : 1:100)

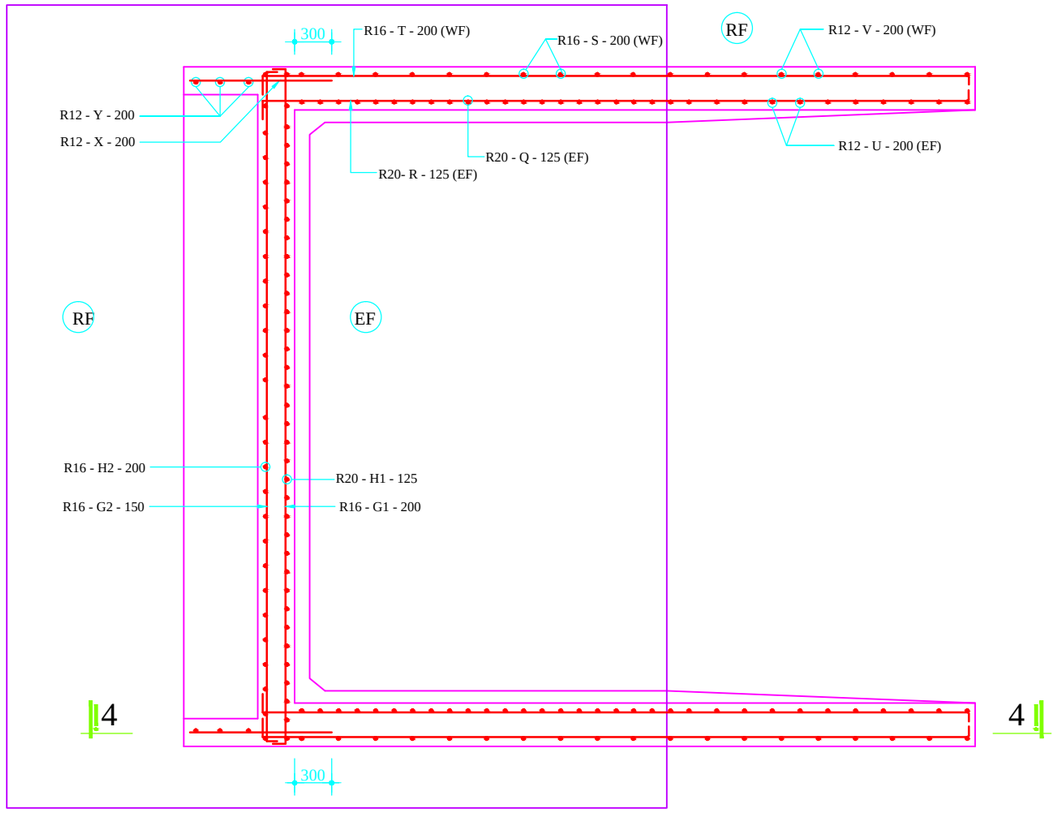


SECTION B - B
(Scale : 1:75)

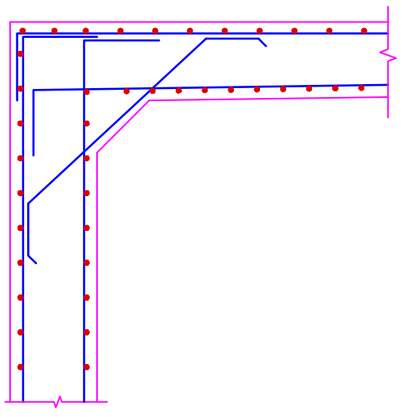


SECTION - C-C
(Scale : 1:45)

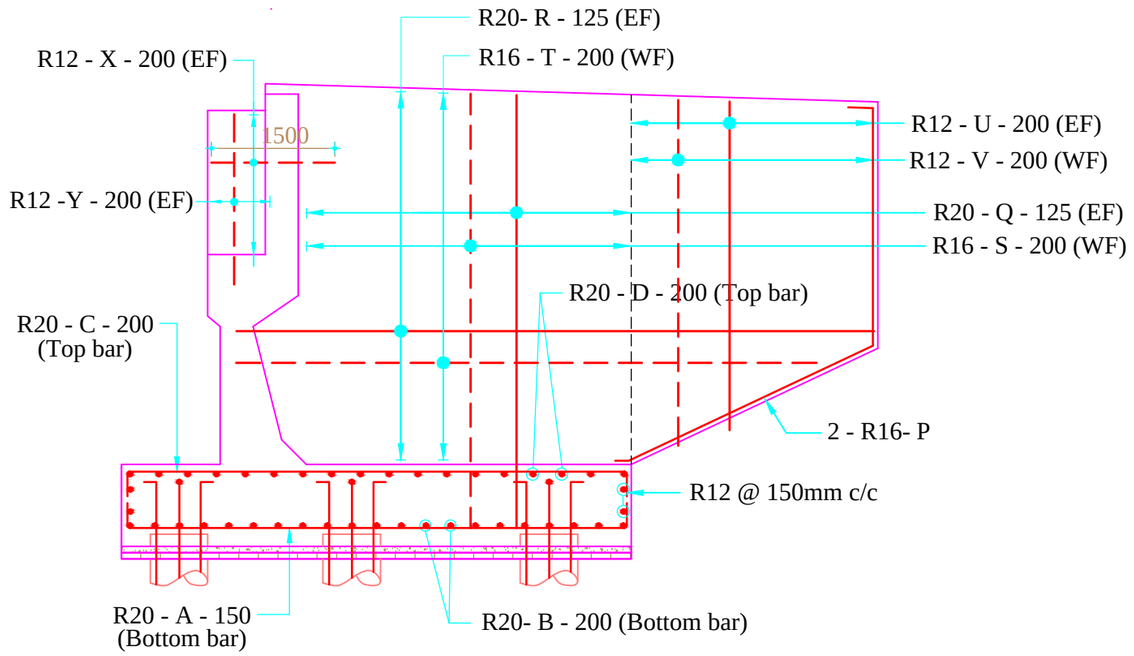
NAME OF THE CLIENT : GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH LOCAL GOVERNMENT ENGINEERING DEPARTMENT NAME OF THE PROJECT : CONSULTANCY SERVICES FOR FEASIBILITY, DETAILED SURVEY AND DESIGN OF CHITTAGONG HILL TRACT CONNECTIVITY CONNECTING THEGAMUKH AND CHITTAGONG PORT.	NAME OF THE CONSULTANTS : SAI Consulting Engineers Pvt. Ltd, India. in association with BETS Consulting Services Ltd, Bangladesh Project office : Tahmid Mahmood Palace Flat # 9A, House # 77, Road # 4, Block-C,	DRAWING TITLE : DIMENSION DETAILS OF ABUTMENT (ABUTMENT HT, H = 5.0m), TYP-IV DRAWING NO : LGED/AB-5 (IV)/C-01 Scale :As shown Date : 28-01-16	DESIGNED BY : MD. TAZUDDIN	DRAWN BY : MD. TAZUDDIN	CHECKED BY : AFM HAMIDUL HAQUE	APPROVED BY : DR. PRABHAT SHRIVASTAVA	REV.	DESCRIPTION	DATE



TOP PLAN OF WALL & WINGWALL
SHOWING TOP REINFORCEMENT
(DScale : 1:50)



DETAIL "A"



SECTIONAL ELEVATION OF WING WALL (SEC.4-4)
SHOWING REINFORCEMENT
(DScale : 1:75)

LEGEND :

E/F : Earth face
W/F : Water face
R/F : River face

NOTES:

1. Clear cover to reinforcement bar is to be 50mm. unless otherwise mentioned.
2. 28 days cylinder strength of concrete: fc' = 25.0N/mm (3600 psi)
3. Yield strength of mild steel deformed bar fy = 413N/mm (60000psi)

NAME OF THE CLIENT :
GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH
LOCAL GOVERNMENT ENGINEERING DEPARTMENT

NAME OF THE PROJECT :
CONSULTANCY SERVICES FOR FEASIBILITY, DETAILED SURVEY AND DESIGN OF CHITTAGONG HILL TRACT CONNECTIVITY CONNECTING THEGAMUKH AND CHITTAGONG PORT.

NAME OF THE CONSULTANTS :
SAI Consulting Engineers Pvt. Ltd, India.
in association with
BETS Consulting Services Ltd, Bangladesh
Project office :
Tahmid Mahmood Palace
Flat # 9A, House # 77, Road # 4, Block-C,

DRAWING TITLE :
REINF. DETAILS OF ABUTMENT & BALLAST WALL (HT, H =5.0m), TYP-IV

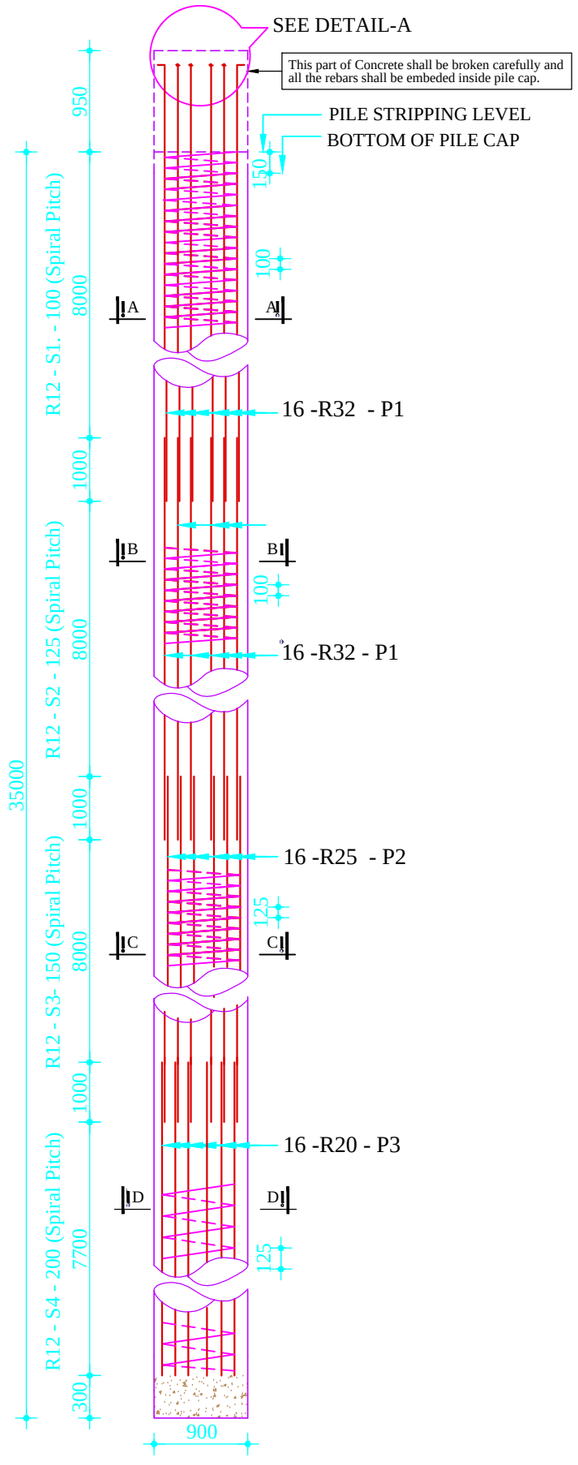
DRAWING NO : LGED/AB-5 (IV)/RNF.-03

Scale :As shown

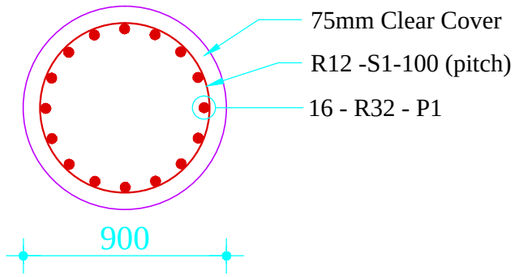
Date : 28-01-16

DESIGNED BY :	DRAWN BY :	CHECKED BY :	APPROVED BY :
MD. TAZUDDIN	MD. TAZUDDIN	AFM HAMIDUL HAQUE	DR. PRABHAT SHRIVASTAVA

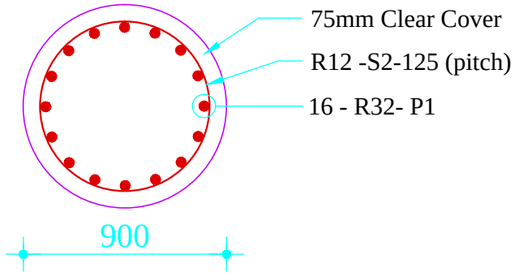
REV.	DESCRIPTION	DATE



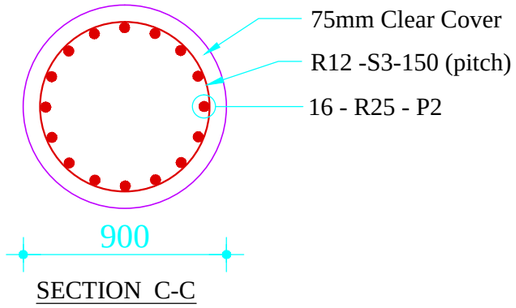
REINF. DETAILS OF ABUTMENT PILE
CAST-IN-SITU PILE DETAILS



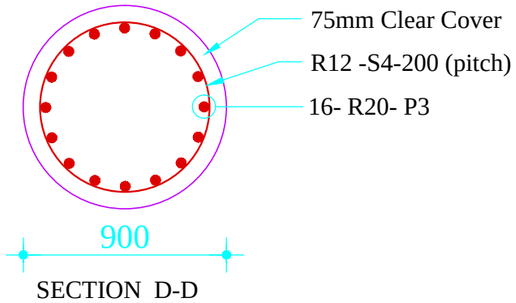
SECTION A-A



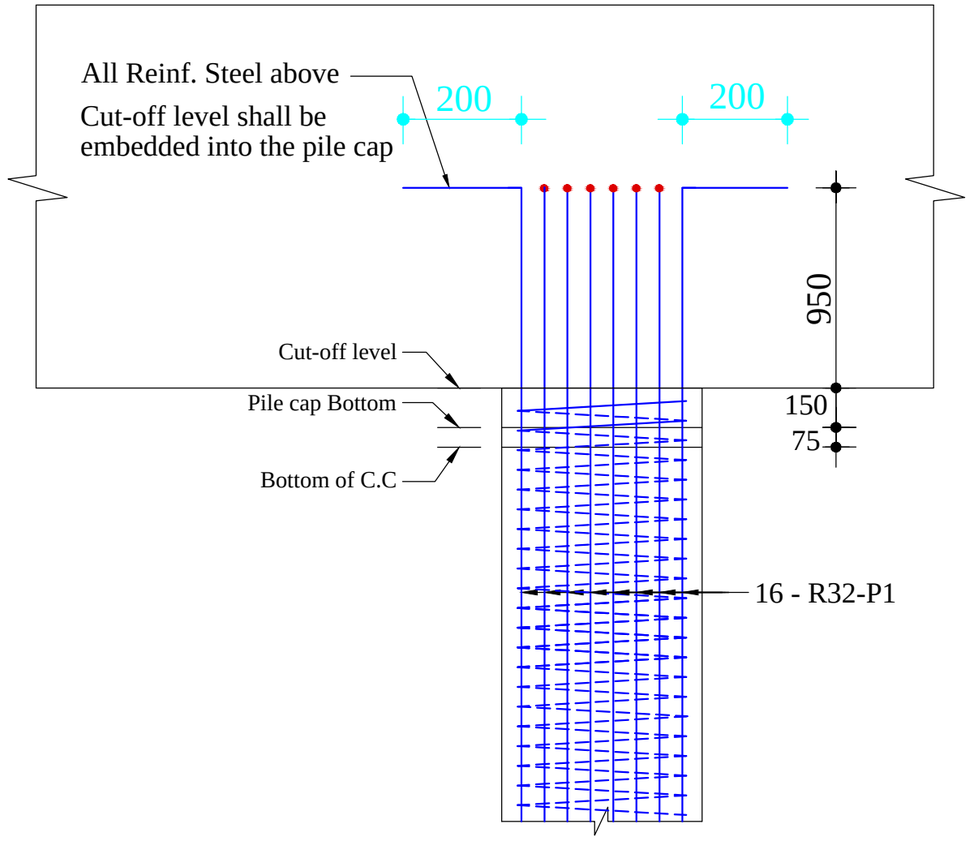
SECTION B-B



SECTION C-C



SECTION D-D



DETAIL-A

NOTES:

Cast-in-situ Pile:

1. All dimensions are in millimeters unless otherwise mentioned .
2. 28 days cylinder crushing strength of concrete f'c= 25 N/mm ^{2} (3500 psi)
3. Yield strength of M.S deformed reinforcement bar fy = 413 N/mm ^{2} (60000 psi)
4. Clear Cover to main reinforcement bar is to be 75mm. unless otherwise mentioned.
5. When concreting at the top of Pile one batch of concrete must be over flown to ensure fresh concrete at Pile head.
6. The spiral reinforcement should preferably be tack welded to the main Reinforceing bars.
7. The lapping portion of main reinforcement shall be joint welded .
8. Design load of Pile under service load condition is 200.0 M. T. for Pier Pile.
9. Test load shall be 400.0 Ton on service Pile.
10. Pile capacity is to be confirmed by static pile load test.

NAME OF THE CLIENT :
GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH
LOCAL GOVERNMENT ENGINEERING DEPARTMENT

NAME OF THE PROJECT :
CONSULTANCY SERVICES FOR FEASIBILITY, DETAILED SURVEY AND DESIGN OF CHITTAGONG HILL TRACT CONNECTIVITY CONNECTING THEGAMUKH AND CHITTAGONG PORT.

NAME OF THE CONSULTANTS :
SAI Consulting Engineers Pvt. Ltd, India.
in association with
BETS Consulting Services Ltd, Bangladesh
Project office :
Tahmid Mahmood Palace
Flat # 9A, House # 77, Road # 4, Block-C,
Banani, Dhaka-1213, Bangladesh.

DRAWING TITLE :
DETAILS OF PIER PILE (TYP-I)
(SPAN : 33.0m ~ 40.0m)

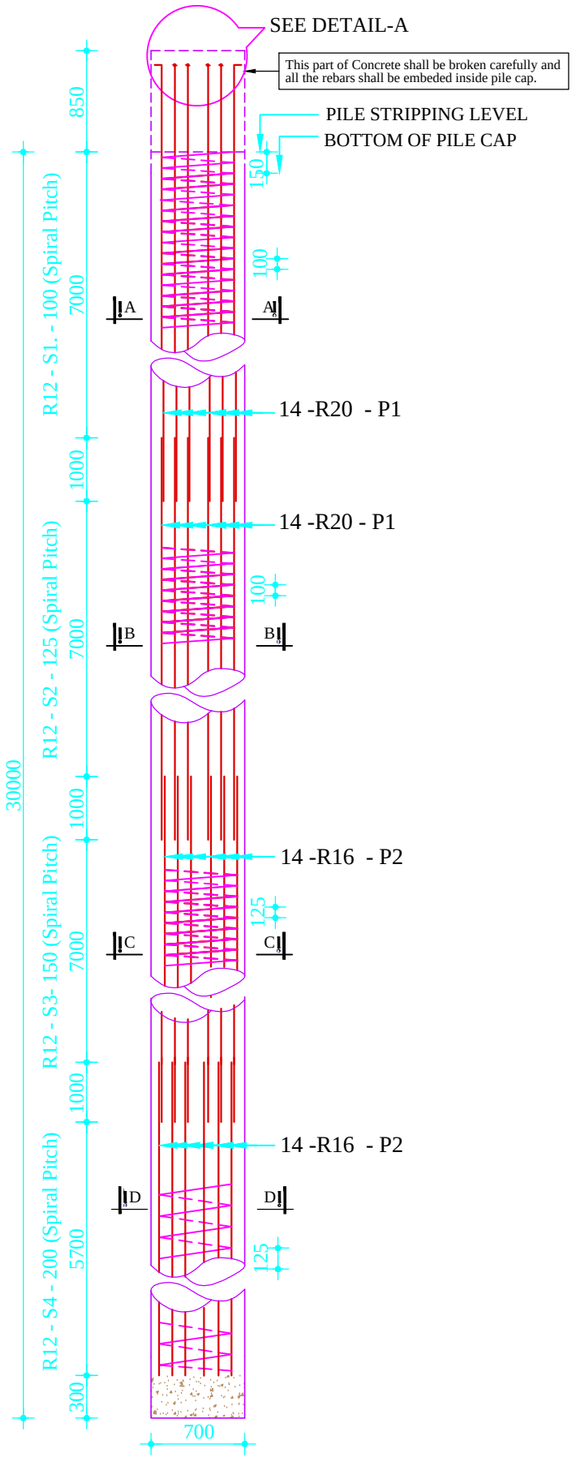
DRAWING NO : LGED/PR/TYP-I/PL-01

Scale :As shown

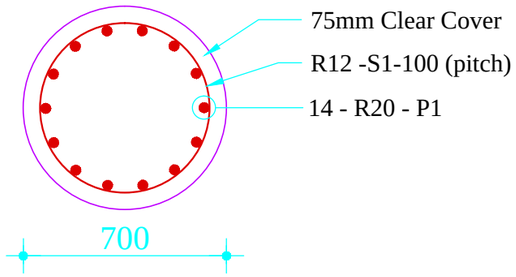
Date : 28-01-16

DESIGNED BY :	DRAWN BY :	CHECKED BY :	APPROVED BY :
MD. TAZUDDIN	MD. TAZUDDIN	AFM HAMIDUL HAQUE	DR. PRABHAT SHRIVASTAVA

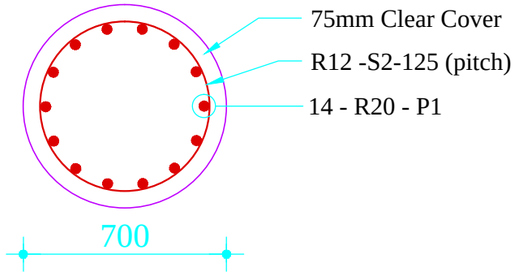
REV.	DESCRIPTION	DATE



REINF. DETAILS OF ABUTMENT PILE
CAST-IN-SITU PILE DETAILS



SECTION A-A



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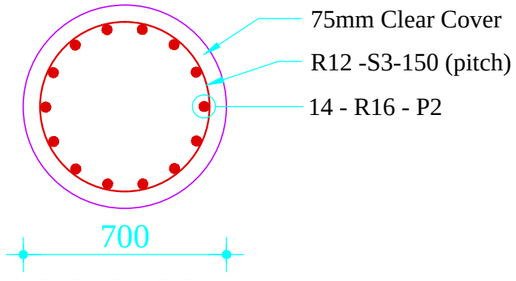
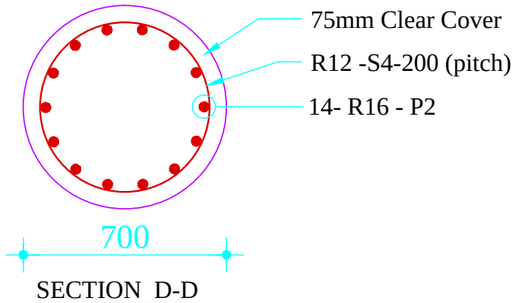
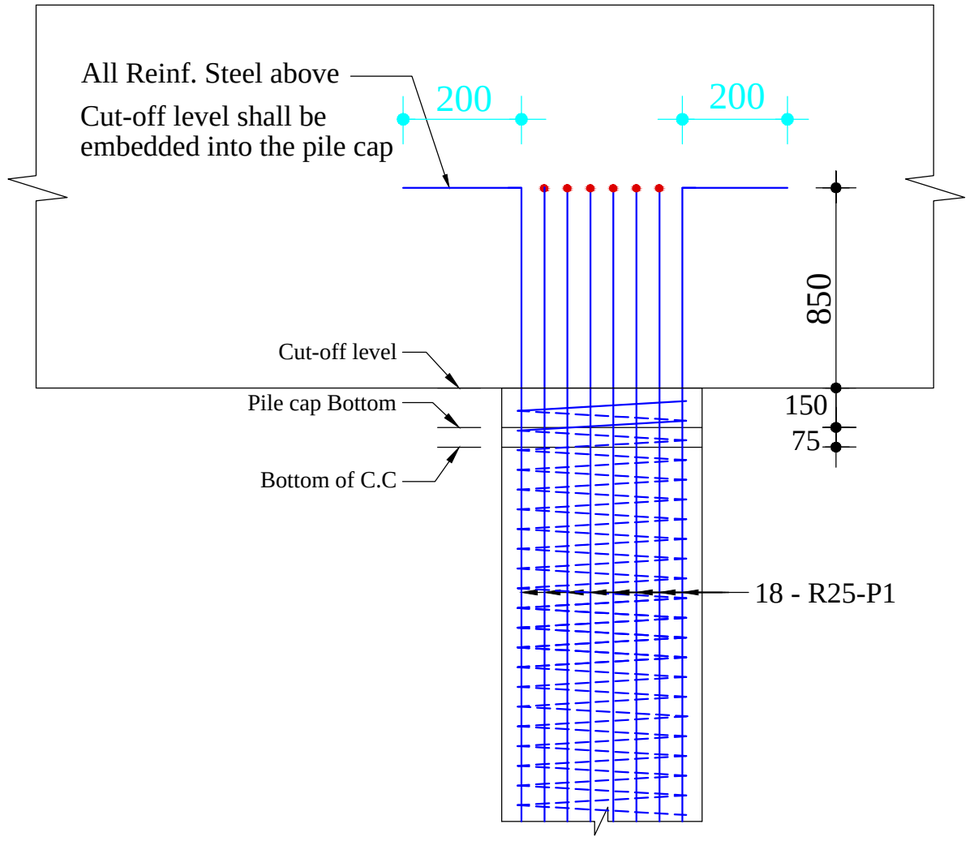


SECTION C-C



SECTION D-D



DETAIL-A

NOTES:

Cast-in-situ Pile:

1. All dimensions are in millimeters unless otherwise mentioned .
2. 28 days cylinder crushing strength of concrete f'c= 25 N/mm ^{2} (3500 psi)
3. Yield strength of M.S deformed reinforcement bar fy = 413 N/mm ^{2} (60000 psi)
4. Clear Cover to main reinforcement bar is to be 75mm. unless otherwise mentioned.
5. When concreting at the top of Pile one batch of concrete must be over flown to ensure fresh concrete at Pile head.
6. The spiral reinforcement should preferably be tack welded to the main Reinforceing bars.
7. The lapping portion of main reinforcement shall be joint welded .
8. Design load of Pile under service load condition is 160.0 M. T. for Pier Pile.
9. Test load shall be 320.0 Ton on service Pile.
10. Pile capacity is to be confirmed by static pile load test.

NAME OF THE CLIENT :
GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH
LOCAL GOVERNMENT ENGINEERING DEPARTMENT

NAME OF THE PROJECT :
CONSULTANCY SERVICES FOR FEASIBILITY, DETAILED SURVEY AND DESIGN OF CHITTAGONG HILL TRACT CONNECTIVITY CONNECTING THEGAMUKH AND CHITTAGONG PORT.

NAME OF THE CONSULTANTS :
SAI Consulting Engineers Pvt. Ltd, India.
in association with
BETS Consulting Services Ltd, Bangladesh
Project office :
Tahmid Mahmood Palace
Flat # 9A, House # 77, Road # 4, Block-C,
Banani, Dhaka-1213, Bangladesh.

DRAWING TITLE :
DETAILS OF PIER PILE (TYP-II)
(SPAN : 18.0m ~ 30.0m)

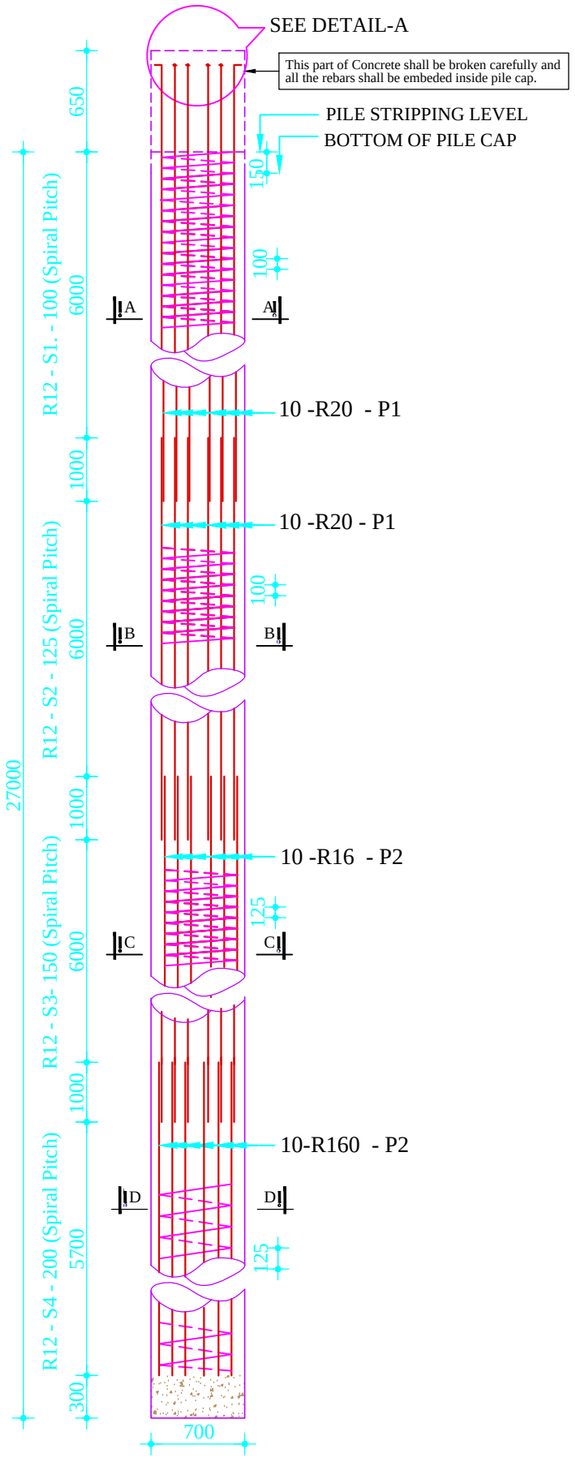
DRAWING NO : LGED/PR/TYP-II/PL-02

Scale :As shown

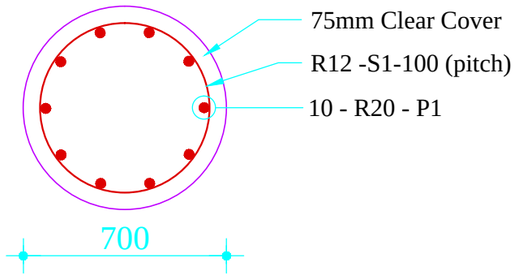
Date : 28-01-16

DESIGNED BY :	DRAWN BY :	CHECKED BY :	APPROVED BY :
MD. TAZUDDIN	MD. TAZUDDIN	AFM HAMIDUL HAQUE	DR. PRABHAT SHRIVASTAVA

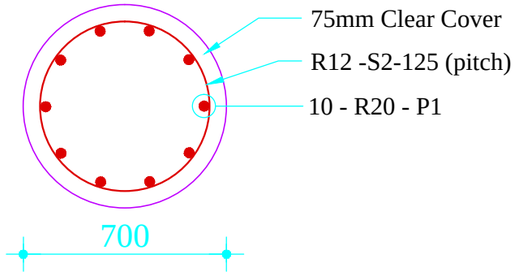
REV.	DESCRIPTION	DATE



REINF. DETAILS OF ABUTMENT PILE
CAST-IN-SITU PILE DETAILS



SECTION A-A



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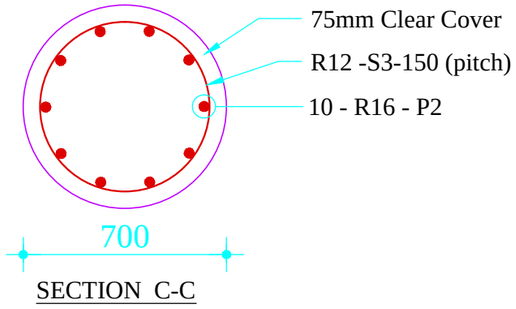
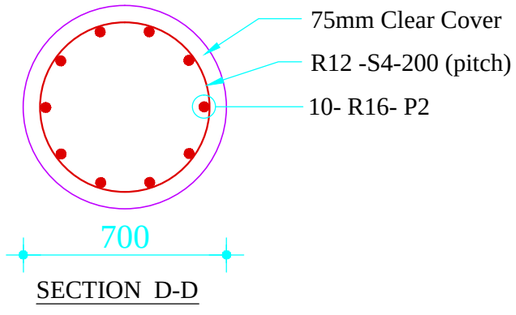
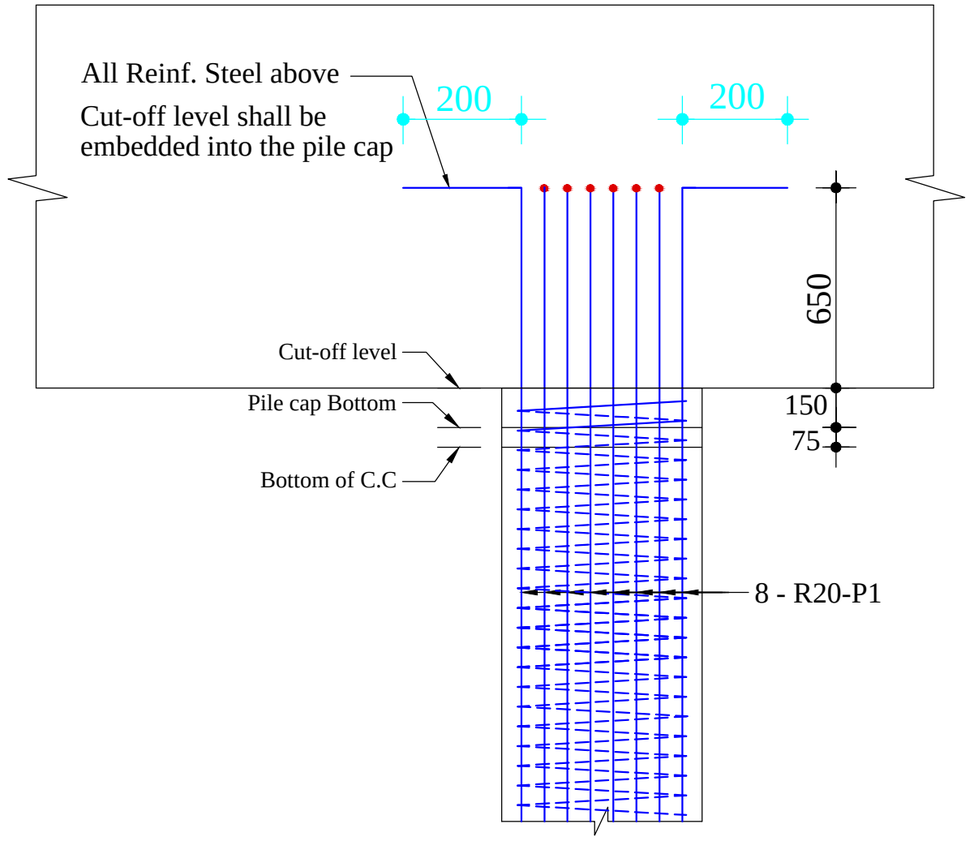


SECTION C-C



SECTION D-D



DETAIL-A

NOTES:

Cast-in-situ Pile:

1. All dimensions are in millimeters unless otherwise mentioned .
2. 28 days cylinder crushing strength of concrete f'c= 25 N/mm ^{2} (3500 psi)
3. Yield strength of M.S deformed reinforcement bar fy = 413 N/mm ^{2} (60000 psi)
4. Clear Cover to main reinforcement bar is to be 75mm. unless otherwise mentioned.
5. When concreting at the top of Pile one batch of concrete must be over flown to ensure fresh concrete at Pile head.
6. The spiral reinforcement should preferably be tack welded to the main Reinforceing bars.
7. The lapping portion of main reinforcement shall be joint welded .
8. Design load of Pile under service load condition is 120.0 M. T. forPier Pile.
9. Test load shall be 240.0 Ton on service Pile.
10. Pile capacity is to be confirmed by static pile load test.

NAME OF THE CLIENT :
GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH
LOCAL GOVERNMENT ENGINEERING DEPARTMENT

NAME OF THE PROJECT :
CONSULTANCY SERVICES FOR FEASIBILITY, DETAILED SURVEY AND DESIGN OF CHITTAGONG HILL TRACT CONNECTIVITY CONNECTING THEGAMUKH AND CHITTAGONG PORT.

NAME OF THE CONSULTANTS :
SAI Consulting Engineers Pvt. Ltd, India.
in association with
BETS Consulting Services Ltd, Bangladesh
Project office :
Tahmid Mahmood Palace
Flat # 9A, House # 77, Road # 4, Block-C,
Banani, Dhaka-1213, Bangladesh.

DRAWING TITLE :
DETAILS OF PIER PILE (TYP-III)
(SPAN : 8.0m ~ 17.0m)

DRAWING NO : LGED/PR/TYP-III/PL-03

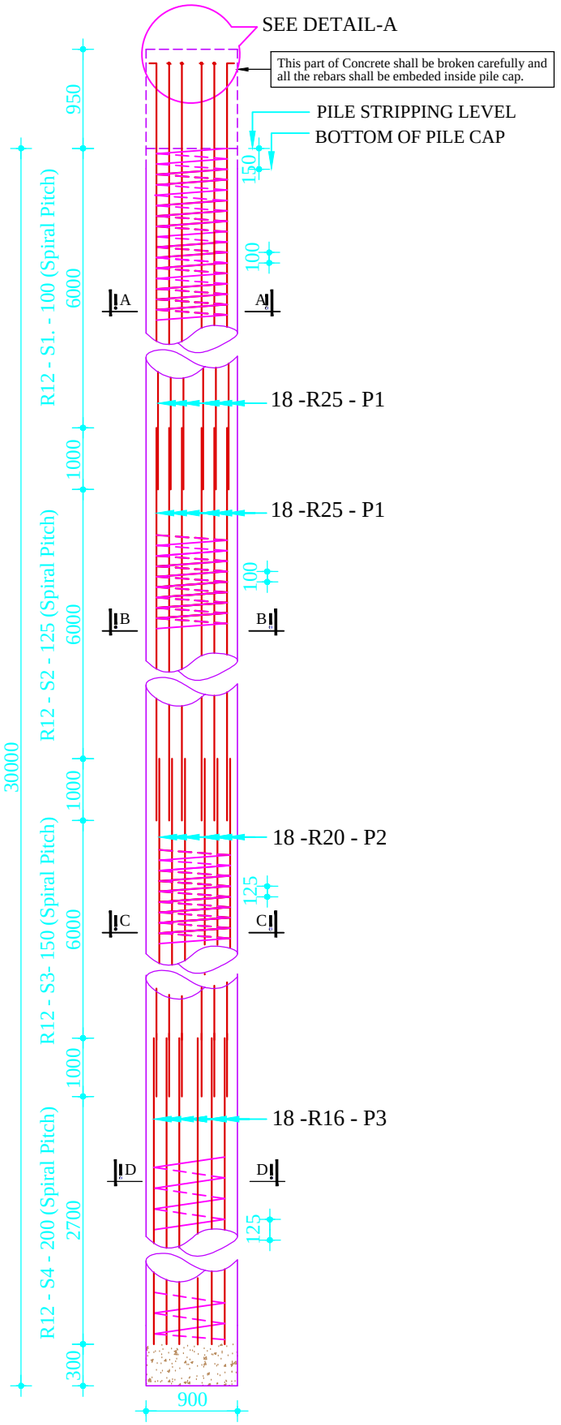
Scale :As shown

Date : 28-01-16

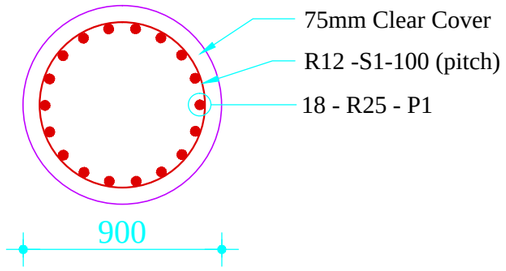
DESIGNED BY :	DRAWN BY :	CHECKED BY :	APPROVED BY :
MD. TAZUDDIN	MD. TAZUDDIN	AFM HAMIDUL HAQUE	DR. PRABHAT SHRIVASTAVA

REV.	DESCRIPTION	DATE

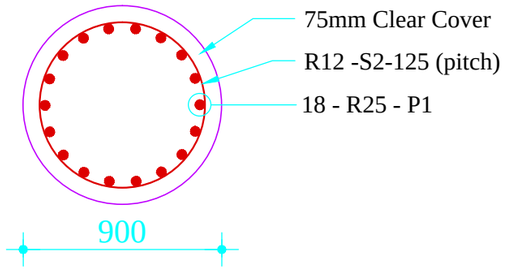
TYPICAL DRAWING OF PIER PILE



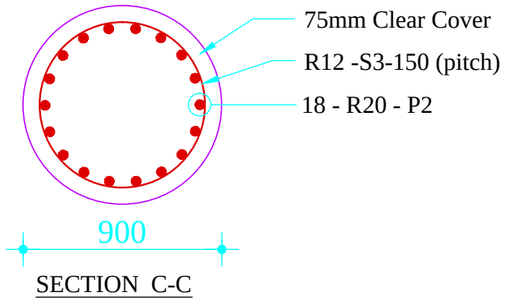
REINF. DETAILS OF ABUTMENT PILE
CAST-IN-SITU PILE DETAILS



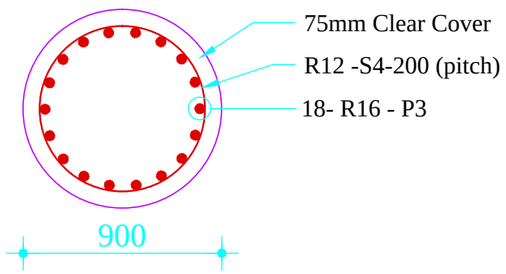
SECTION A-A



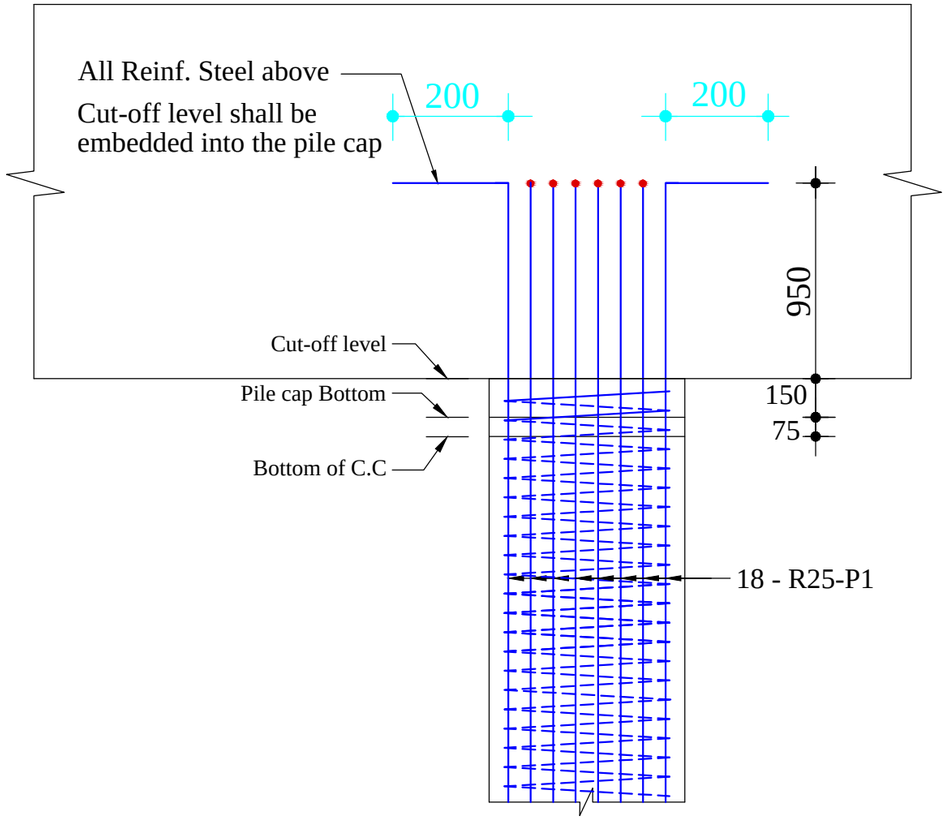
SECTION B-B



SECTION C-C



SECTION D-D



DETAIL-A

NOTES:

Cast-in-situ Pile:

1. All dimensions are in millimeters unless otherwise mentioned .
2. 28 days cylinder crushing strength of concrete f'c= 25 N/mm^2 (3500 psi)
3. Yield strength of M.S deformed reinforcement bar fy = 413 N/mm^2 (60000 psi)
4. Clear Cover to main reinforcement bar is to be 75mm. unless otherwise mentioned.
5. When concreting at the top of Pile one batch of concrete must be over flown to ensure fresh concrete at Pile head.
6. The spiral reinforcement should preferably be tack welded to the main Reinforceing bars.
7. The lapping portion of main reinforcement shall be joint welded .
8. Design load of Pile under service load condition is 160.0 M. T. for Abutment Pile.
9. Test load shall be 320.0 Ton on service Pile.
10. Pile capacity is to be confirmed by static pile load test.

NAME OF THE CLIENT :
GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH
LOCAL GOVERNMENT ENGINEERING DEPARTMENT

NAME OF THE PROJECT :
CONSULTANCY SERVICES FOR FEASIBILITY, DETAILED SURVEY AND DESIGN OF CHITTAGONG HILL TRACT CONNECTIVITY CONNECTING THEGAMUKH AND CHITTAGONG PORT.

NAME OF THE CONSULTANTS :
SAI Consulting Engineers Pvt. Ltd, India.
in association with
BETS Consulting Services Ltd, Bangladesh
Project office :
Tahmid Mahmood Palace
Flat # 9A, House # 77, Road # 4, Block-C,
Banani, Dhaka-1213, Bangladesh.

DRAWING TITLE :
DETAILS OF ABUTMENT PILE, TYP-I(a)
(SPAN : 35.0m ~ 40.0m/ht=10.0m)

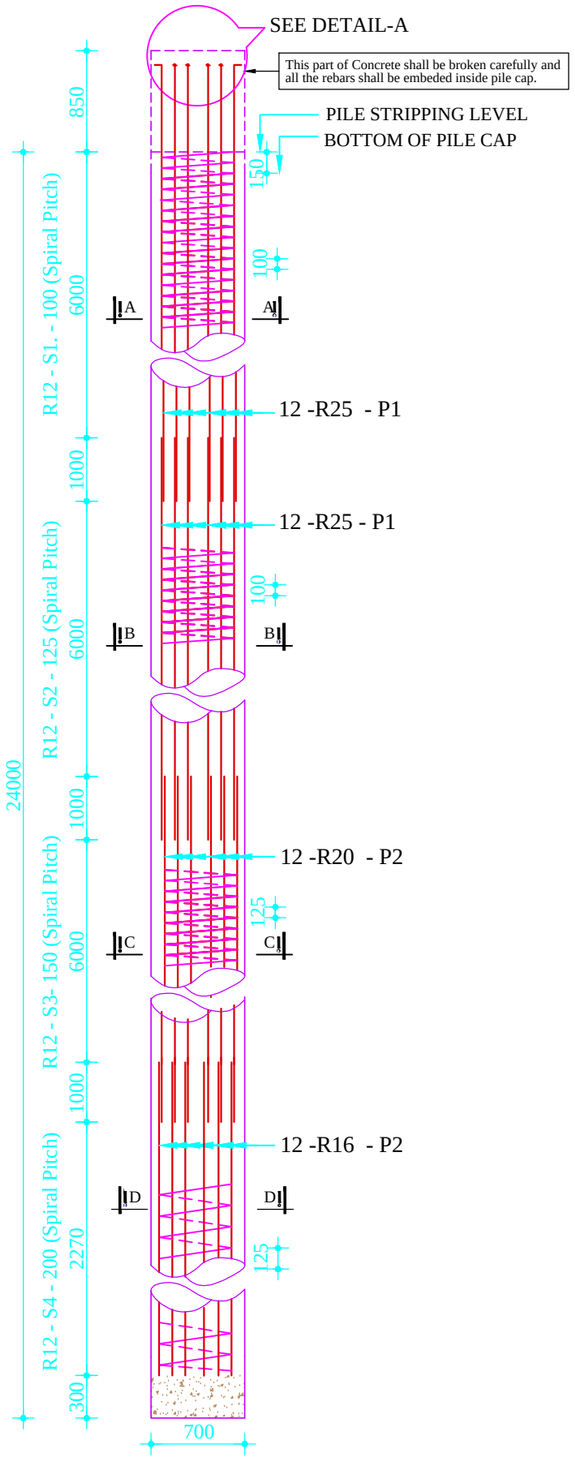
DRAWING NO : LGED/AB/TYP-I/PL-01

Scale :As shown

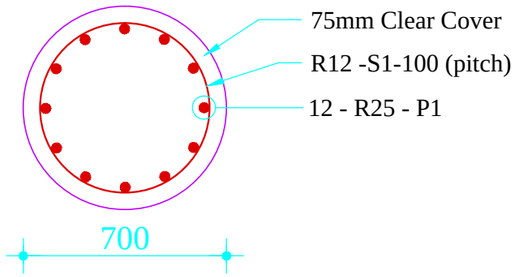
Date : 28-01-16

DESIGNED BY :	DRAWN BY :	CHECKED BY :	APPROVED BY :
MD. TAZUDDIN	MD. TAZUDDIN	AFM HAMIDUL HAQUE	DR. PRABHAT SHRIVASTAVA

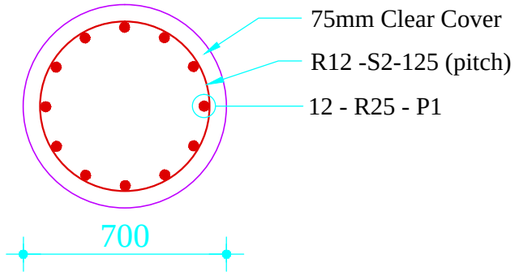
REV.	DESCRIPTION	DATE



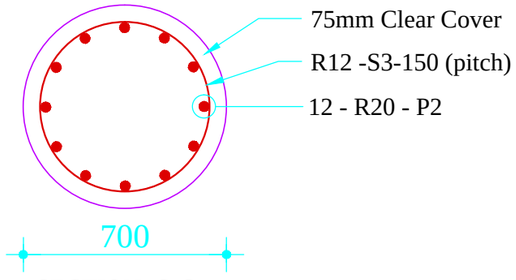
REINF. DETAILS OF ABUTMENT PILE
CAST-IN-SITU PILE DETAILS



SECTION A-A



SECTION B-B



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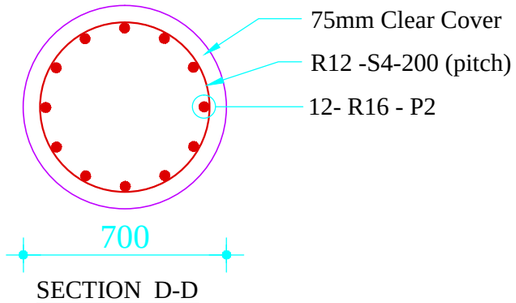
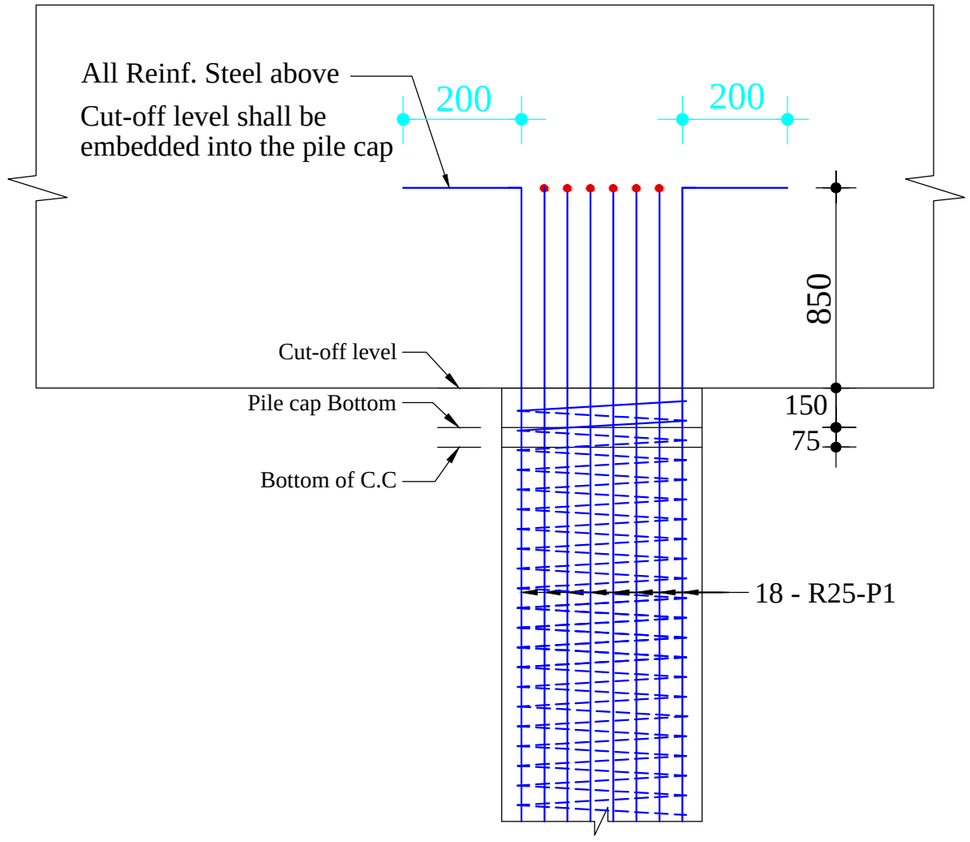


SECTION D-D



DETAIL-A

NOTES:

Cast-in-situ Pile:

1. All dimensions are in millimeters unless otherwise mentioned .
2. 28 days cylinder crushing strength of concrete f'c= 25 N/mm ^{2} (3500 psi)
3. Yield strength of M.S deformed reinforcement bar fy = 413 N/mm ^{2} (60000 psi)
4. Clear Cover to main reinforcement bar is to be 75mm. unless otherwise mentioned.
5. When concreting at the top of Pile one batch of concrete must be over flown to ensure fresh concrete at Pile head.
6. The spiral reinforcement should preferably be tack welded to the main Reinforceing bars.
7. The lapping portion of main reinforcement shall be joint welded .
8. Design load of Pile under service load condition is 140.0 M. T. for Abutment Pile.
9. Test load shall be 280.0 Ton on service Pile.
10. Pile capacity is to be confirmed by static pile load test.

NAME OF THE CLIENT :
GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH
LOCAL GOVERNMENT ENGINEERING DEPARTMENT

NAME OF THE PROJECT :
CONSULTANCY SERVICES FOR FEASIBILITY, DETAILED SURVEY AND DESIGN OF CHITTAGONG HILL TRACT CONNECTIVITY CONNECTING THEGAMUKH AND CHITTAGONG PORT.

NAME OF THE CONSULTANTS :
SAI Consulting Engineers Pvt. Ltd, India.
in association with
BETS Consulting Services Ltd, Bangladesh
Project office :
Tahmid Mahmood Palace
Flat # 9A, House # 77, Road # 4, Block-C,
Banani, Dhaka-1213, Bangladesh.

DRAWING TITLE :
DETAILS OF ABUTMENT PILE, TYP-II (b)
(SPAN : 33.0m ~ 35.0m/ ht = 8.0m)

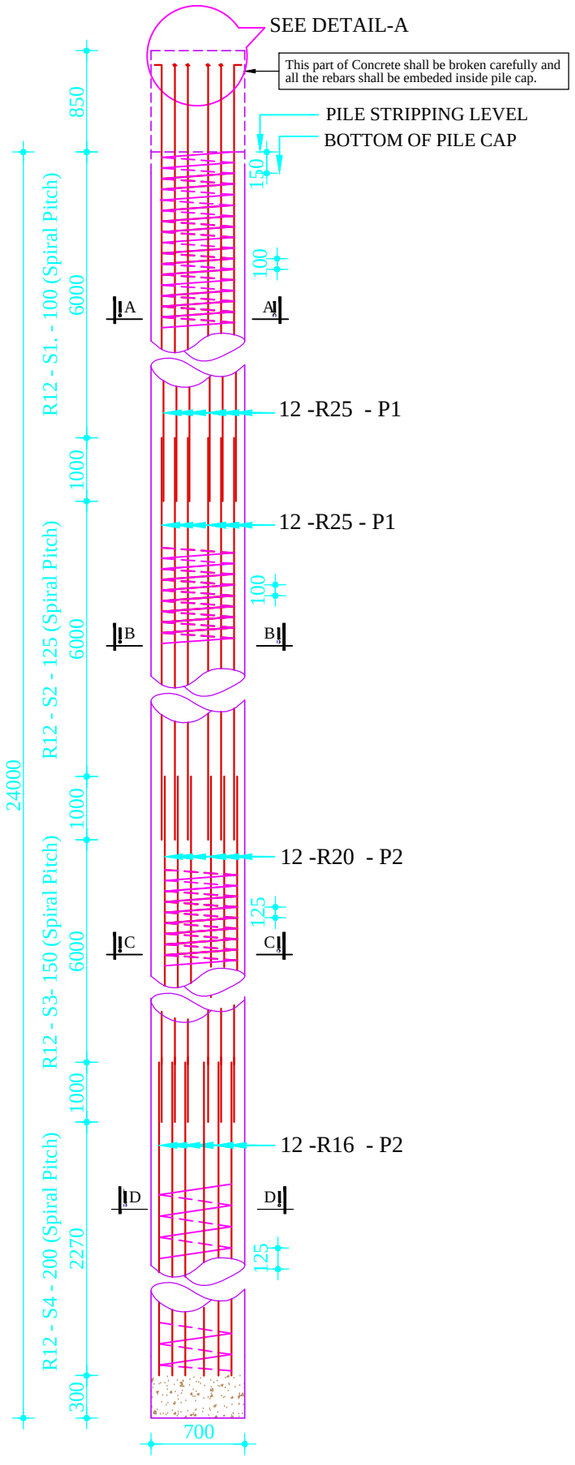
DRAWING NO : LGED/AB/TYP-II/PL-02

Scale :As shown

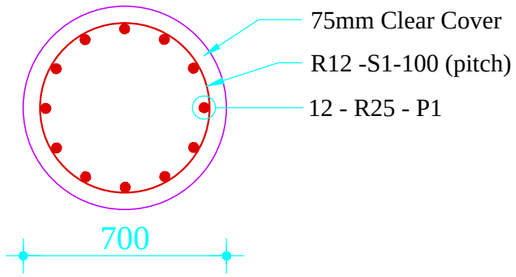
Date : 28-01-16

DESIGNED BY :	DRAWN BY :	CHECKED BY :	APPROVED BY :
MD. TAZUDDIN	MD. TAZUDDIN	AFM HAMIDUL HAQUE	DR. PRABHAT SHRIVASTAVA

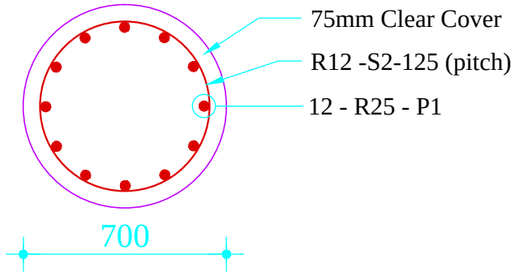
REV.	DESCRIPTION	DATE



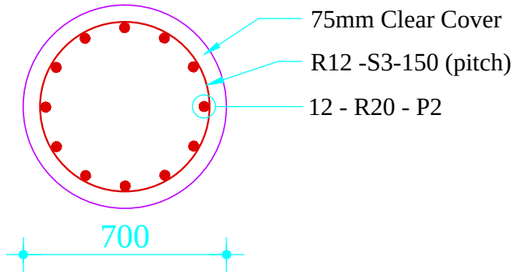
REINF. DETAILS OF ABUTMENT PILE
CAST-IN-SITU PILE DETAILS



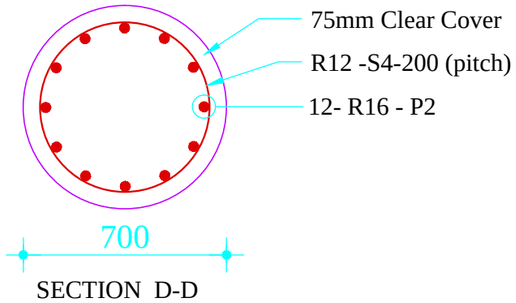
SECTION A-A



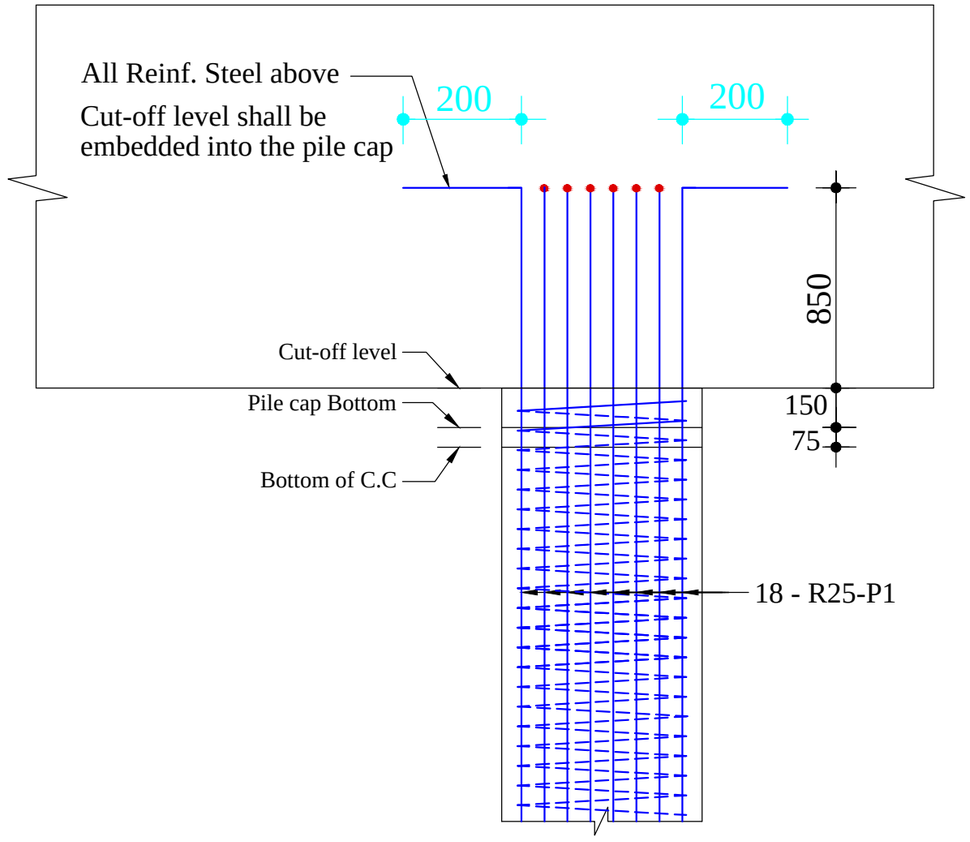
SECTION B-B



SECTION C-C



SECTION D-D



DETAIL-A

NOTES:

Cast-in-situ Pile:

1. All dimensions are in millimeters unless otherwise mentioned .
2. 28 days cylinder crushing strength of concrete f'c= 25 N/mm ^{2} (3500 psi)
3. Yield strength of M.S deformed reinforcement bar fy = 413 N/mm ^{2} (60000 psi)
4. Clear Cover to main reinforcement bar is to be 75mm. unless otherwise mentioned.
5. When concreting at the top of Pile one batch of concrete must be over flown to ensure fresh concrete at Pile head.
6. The spiral reinforcement should preferably be tack welded to the main Reinforceing bars.
7. The lapping portion of main reinforcement shall be joint welded .
8. Design load of Pile under service load condition is 125.0 M. T. for Abutment Pile.
9. Test load shall be 250.0 Ton on service Pile.
10. Pile capacity is to be confirmed by static pile load test.

NAME OF THE CLIENT :
GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH
LOCAL GOVERNMENT ENGINEERING DEPARTMENT

NAME OF THE PROJECT :
CONSULTANCY SERVICES FOR FEASIBILITY, DETAILED SURVEY AND DESIGN OF CHITTAGONG HILL TRACT CONNECTIVITY CONNECTING THEGAMUKH AND CHITTAGONG PORT.

NAME OF THE CONSULTANTS :
SAI Consulting Engineers Pvt. Ltd, India.
in association with
BETS Consulting Services Ltd, Bangladesh
Project office :
Tahmid Mahmood Palace
Flat # 9A, House # 77, Road # 4, Block-C,
Banani, Dhaka-1213, Bangladesh.

DRAWING TITLE :
DETAILS OF ABUTMENT PILE (TYP-II)
(SPAN : 18.0m ~ 30.0m/ ht = 6.0m)

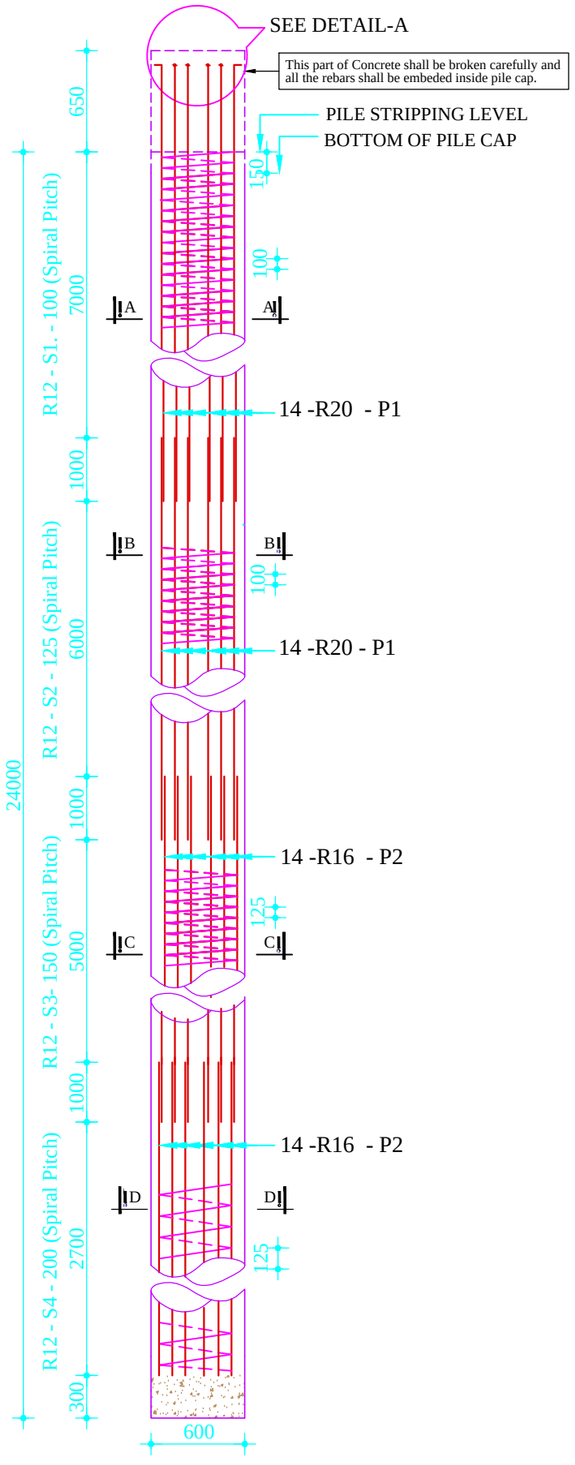
DRAWING NO : LGED/AB/TYP-II/PL-02

Scale :As shown

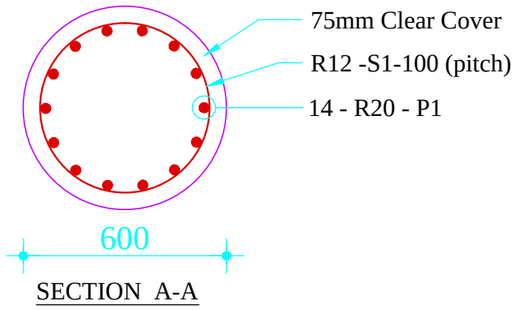
Date : 28-01-16

DESIGNED BY :	DRAWN BY :	CHECKED BY :	APPROVED BY :
MD. TAZUDDIN	MD. TAZUDDIN	AFM HAMIDUL HAQUE	DR. PRABHAT SHRIVASTAVA

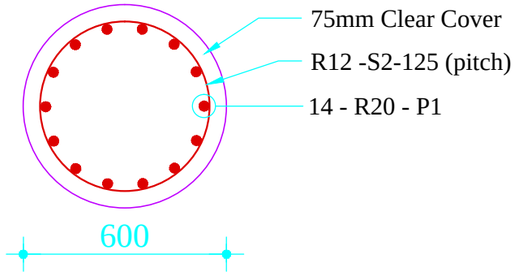
REV.	DESCRIPTION	DATE



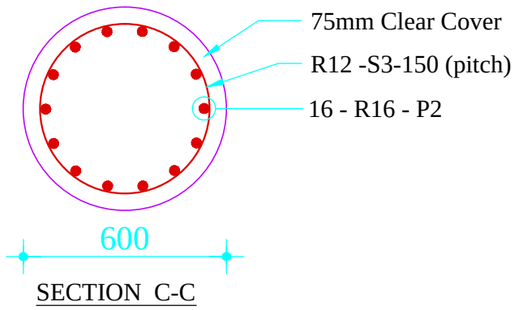
REINF. DETAILS OF ABUTMENT PILE
CAST-IN-SITU PILE DETAILS



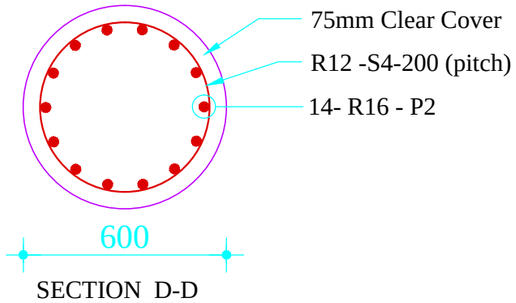
SECTION A-A



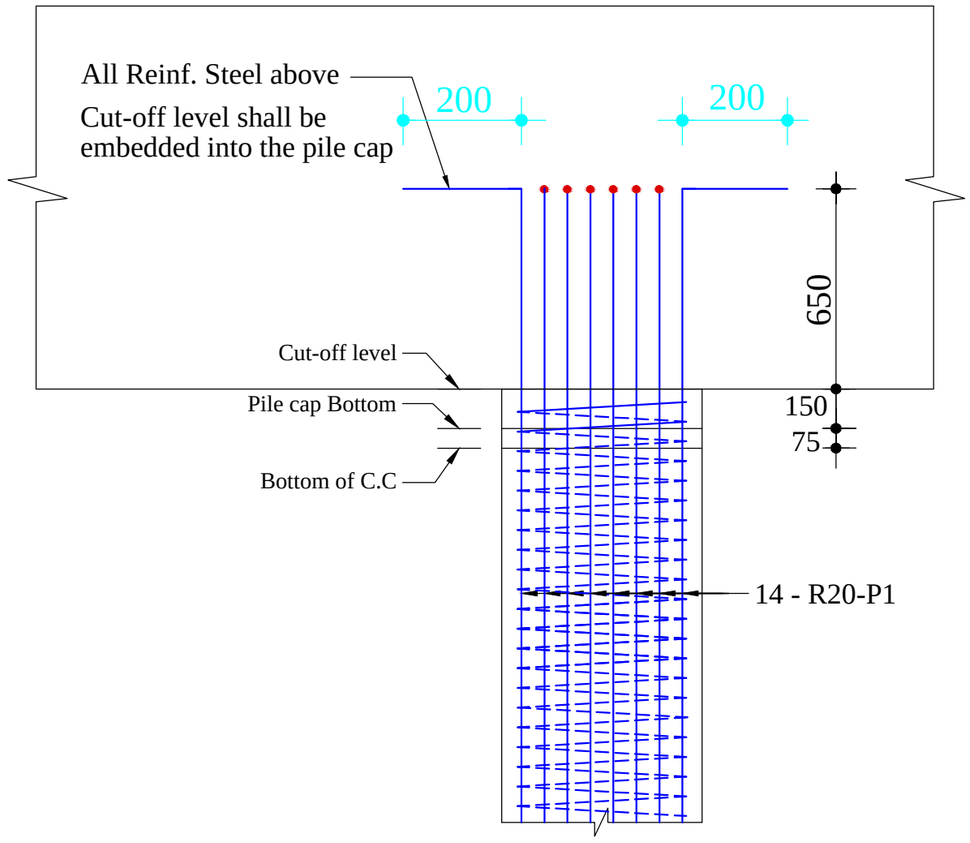
SECTION B-B



SECTION C-C



SECTION D-D



DETAIL-A

NOTES:

Cast-in-situ Pile:

1. All dimensions are in millimeters unless otherwise mentioned .
2. 28 days cylinder crushing strength of concrete f'c= 25 N/mm ^{2} (3500 psi)
3. Yield strength of M.S deformed reinforcement bar fy = 413 N/mm ^{2} (60000 psi)
4. Clear Cover to main reinforcement bar is to be 75mm. unless otherwise mentioned.
5. When concreting at the top of Pile one batch of concrete must be over flown to ensure fresh concrete at Pile head.
6. The spiral reinforcement should preferably be tack welded to the main Reinforceing bars.
7. The lapping portion of main reinforcement shall be joint welded .
8. Design load of Pile under service load condition is 110.0 M. T. for Abutment Pile.
9. Test load shall be 220.0 Ton on service Pile.
10. Pile capacity is to be confirmed by static pile load test.

NAME OF THE CLIENT :
GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH
LOCAL GOVERNMENT ENGINEERING DEPARTMENT

NAME OF THE PROJECT :
CONSULTANCY SERVICES FOR FEASIBILITY, DETAILED SURVEY AND DESIGN OF CHITTAGONG HILL TRACT CONNECTIVITY CONNECTING THEGAMUKH AND CHITTAGONG PORT.

NAME OF THE CONSULTANTS :
SAI Consulting Engineers Pvt. Ltd, India.
in association with
BETS Consulting Services Ltd, Bangladesh
Project office :
Tahmid Mahmood Palace
Flat # 9A, House # 77, Road # 4, Block-C,
Banani, Dhaka-1213, Bangladesh.

DRAWING TITLE :
DETAILS OF ABUTMENT PILE (TYP-III)
(SPAN : 8.0m ~ 17.0m/ ht = 6.0m)

DRAWING NO : LGED/AB/TYP-III/PL-03

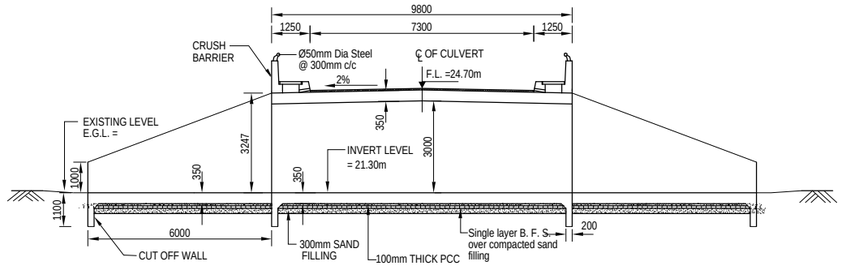
Scale :As shown

Date : 28-01-16

DESIGNED BY :	DRAWN BY :	CHECKED BY :	APPROVED BY :
MD. TAZUDDIN	MD. TAZUDDIN	AFM HAMIDUL HAQUE	DR. PRABHAT SHRIVASTAVA

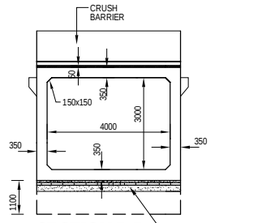
REV.	DESCRIPTION	DATE

TYPICAL DRAWING OF ABUTMENT PILE



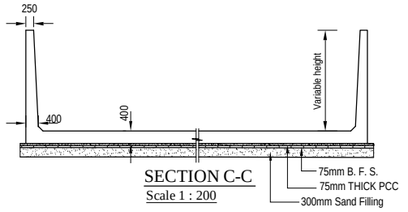
SECTION A-A

SCALE = 1:200



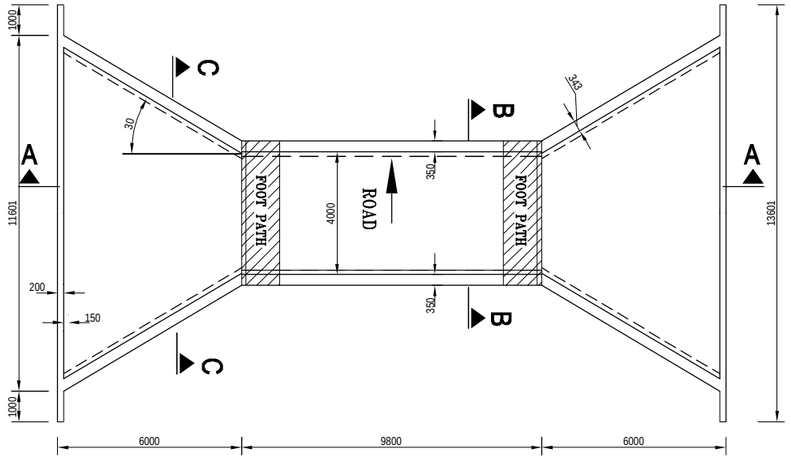
SECTION B-B

SCALE = 1:200



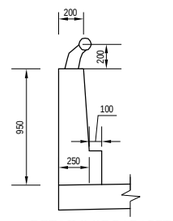
SECTION C-C

Scale 1 : 200



PLAN OF CULV

SCALE = 1:200



DETAILS OF PARAPET

Scale 1 : 50

NAME OF THE CLIENT :

GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH

LOCAL GOVERNMENT ENGINEERING DEPARTMENT

NAME OF THE PROJECT :

CONSULTANCY SERVICES FOR FEASIBILITY, DETAILED SURVEY AND DESIGN OF CHITTAGONG HILL TRACT CONNECTIVITY CONNECTING THEGAMUKH AND CHITTAGONG PORT.

NAME OF THE CONSULTANTS :

SAI Consulting Engineers Pvt. Ltd, India.

in association with

BETS Consulting Services Ltd, Bangladesh

Project office :

Tahmid Mahmood Palace
Flat # 9A, House # 77, Road # 4, Block-C,

DRAWING TITLE :

DIMENSION DETAILS OF 1x4.0x3.0 RCC BOX CULVERT AT CH. 0+025 kM.

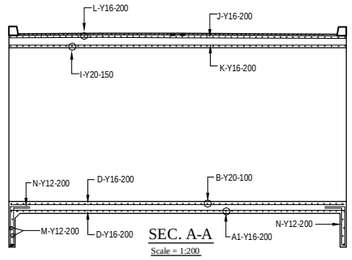
DRAWING NO : LGED/CUL-01/C-01

Scale :As shown

Date : 28-01-16

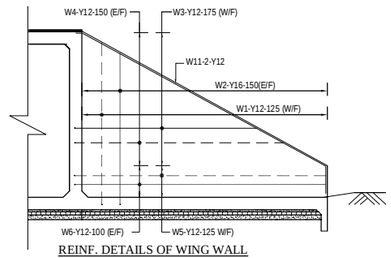
DESIGNED BY :	DRAWN BY :	CHECKED BY :	APPROVED BY :
MD. TAZUDDIN	MD. TAZUDDIN	AFM HAMIDUL HAQUE	DR. PRAVAT SHRIVESTAVA

REV.	DESCRIPTION	DATE



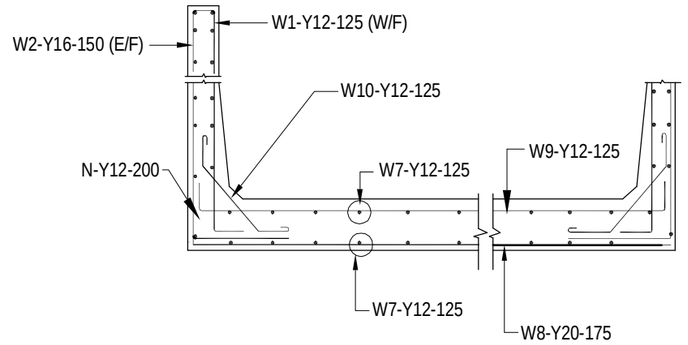
SEC. A-A

Scale = 1:200



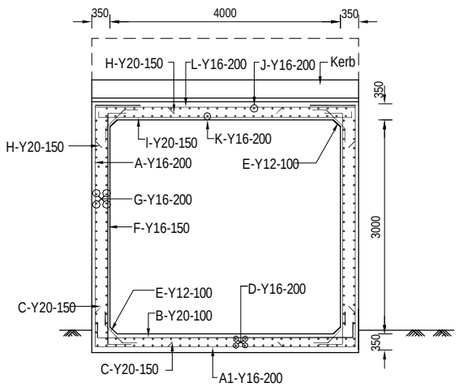
REINF. DETAILS OF WING WALL

Scale = 1:200



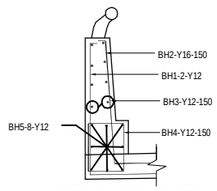
REINF. DETAILS OF WING WALL
SEC. C-C

Scale 1 : 75



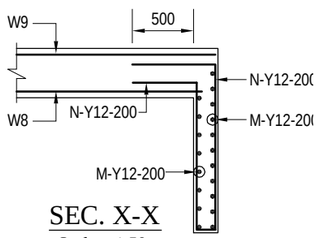
REINF. DETAILS OF BOX CULVERT

Scale = 1:200



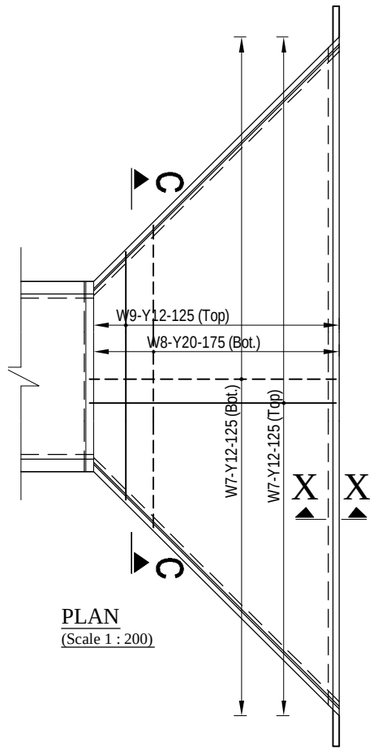
DETAILS OF PARAPET

Scale 1: 50



SEC. X-X

Scale = 1:50



PLAN

(Scale 1 : 200)

NOTE :

E/F : Earth face

W/F : Water fa

NAME OF THE CLIENT :

GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH

LOCAL GOVERNMENT ENGINEERING DEPARTMENT

NAME OF THE PROJECT :

CONSULTANCY SERVICES FOR FEASIBILITY, DETAILED SURVEY AND DESIGN OF CHITTAGONG HILL TRACT CONNECTIVITY CONNECTING THEGAMUKH AND CHITTAGONG PORT.

NAME OF THE CONSULTANTS :

SAI Consulting Engineers Pvt. Ltd, India.

in association with

BETS Consulting Services Ltd, Bangladesh

Project office :

Tahmid Mahmood Palace
Flat # 9A, House # 77, Road # 4, Block-C,

DRAWING TITLE :

REINF. DETAILS OF 1x4.0x3.0 RCC BOX CULVERT AT CH. 0+025 kM.

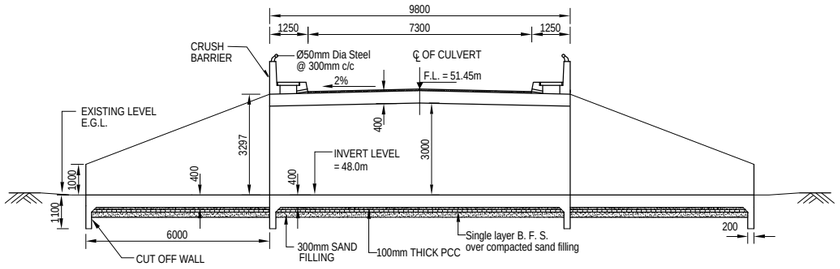
DRAWING NO : LGED/CUL-01/RNF.-02

Scale :As shown

Date : 28-01-16

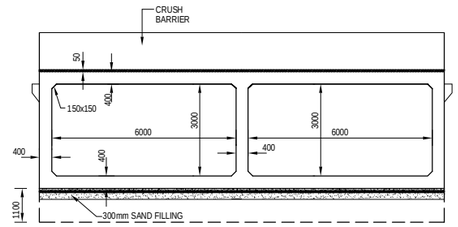
DESIGNED BY :	DRAWN BY :	CHECKED BY :	APPROVED BY :
MD. TAZUDDIN	MD. TAZUDDIN	AFM HAMIDUL HAQUE	DR. PRAVAT SHRIVESTAVA

REV.	DESCRIPTION	DATE



SECTION A-A

SCALE = 1:200



SECTION B-B

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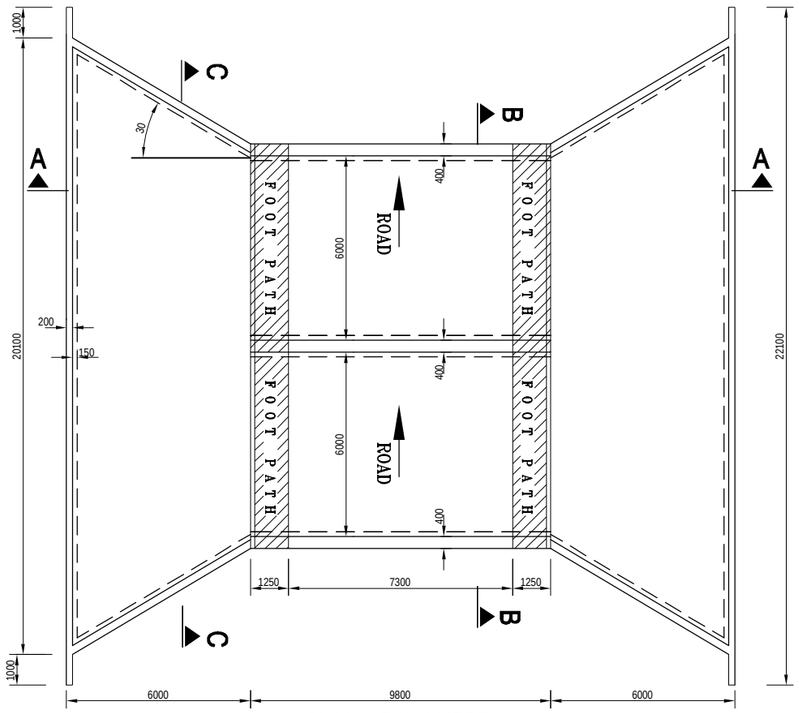
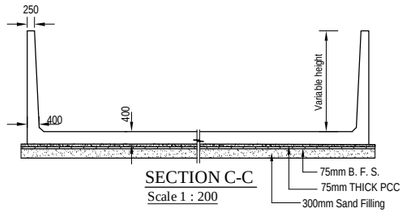


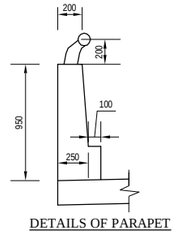
PLAN OF CULVERT

SCALE = 1:200



SECTION C-C

Scale 1 : 200



DETAILS OF PARAPET

Scale 1 : 50

NAME OF THE CLIENT :

GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH

LOCAL GOVERNMENT ENGINEERING DEPARTMENT

NAME OF THE PROJECT :

CONSULTANCY SERVICES FOR FEASIBILITY, DETAILED SURVEY AND DESIGN OF CHITTAGONG HILL TRACT CONNECTIVITY CONNECTING THEGAMUKH AND CHITTAGONG PORT.

NAME OF THE CONSULTANTS :

SAI Consulting Engineers Pvt. Ltd, India.

in association with

BETS Consulting Services Ltd, Bangladesh

Project office :

Tahmid Mahmood Palace
Flat # 9A, House # 77, Road # 4, Block-C,

DRAWING TITLE :

DIMENSION DETAILS OF 2x6.0x3.0 RCC BOX CULVERT AT CH.18+533 kM.

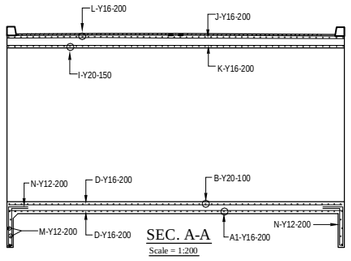
DRAWING NO : LGED/CUL-02/C-01

Scale :As shown

Date : 28-01-16

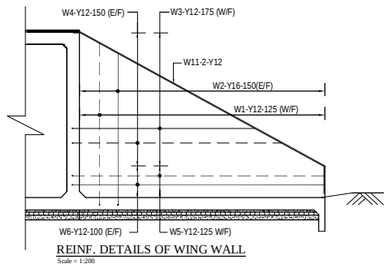
DESIGNED BY :	DRAWN BY :	CHECKED BY :	APPROVED BY :
MD. TAZUDDIN	MD. TAZUDDIN	AFM HAMIDUL HAQUE	DR. PRABHAT SHRIVASTAVA

REV.	DESCRIPTION	DATE



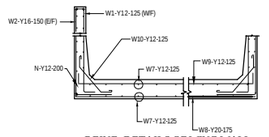
SEC. A-A

Scale = 1:200



REINF. DETAILS OF WING WALL

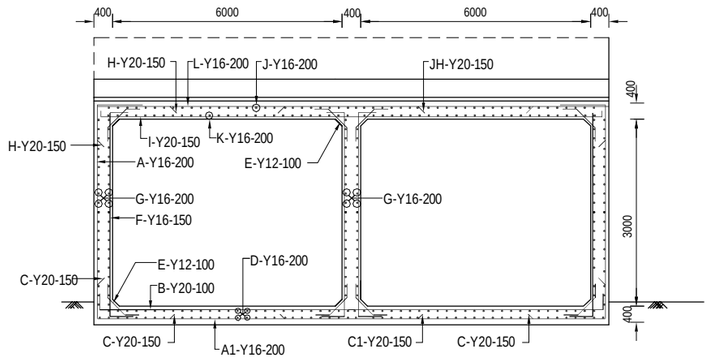
Scale = 1:200



REINF. DETAILS OF WING WALL

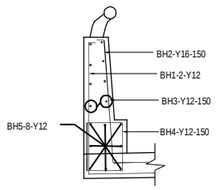
SEC. C-C

Scale 1 : 200



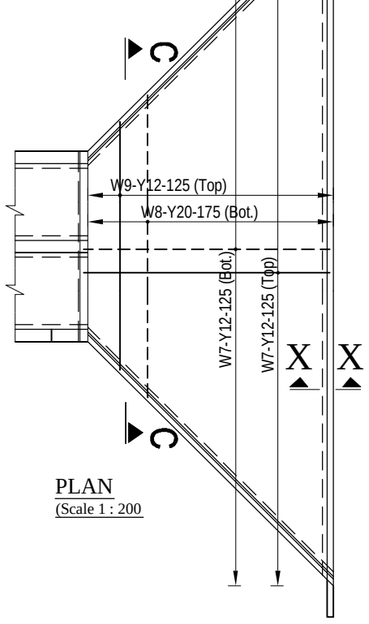
REINF. DETAILS OF BOX CULVERT

Scale = 1:200



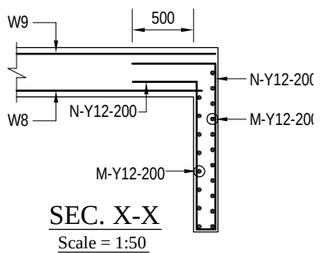
DETAILS OF PARAPET

Scale 1 : 50



PLAN

(Scale 1 : 200



SEC. X-X

Scale = 1:50

NOTE :

E/F : Earth face

W/F : Water fa

NAME OF THE CLIENT :

GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH

LOCAL GOVERNMENT ENGINEERING DEPARTMENT

NAME OF THE PROJECT :

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NAME OF THE CONSULTANTS :

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in association with

BETS Consulting Services Ltd, Bangladesh

Project office :

Tahmid Mahmood Palace

Flat # 9A, House # 77, Road # 4, Block-C,

DRAWING TITLE :

REINF. DETAILS OF 2x6.0x3.0 RCC BOX CULVERT AT CH. 18+533 kM.

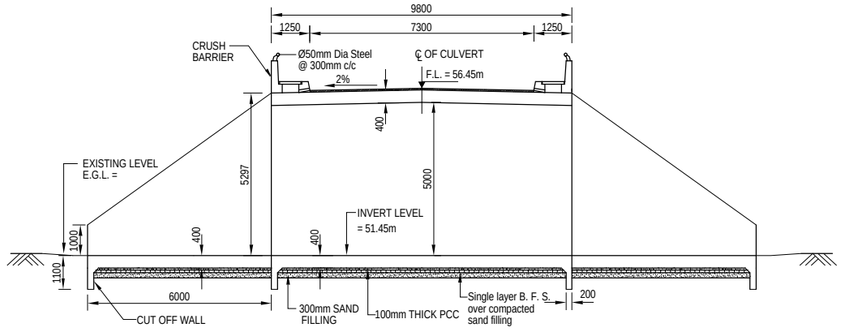
DRAWING NO : LGED/CUL-02/RNF.-02

Scale :As shown

Date : 28-01-16

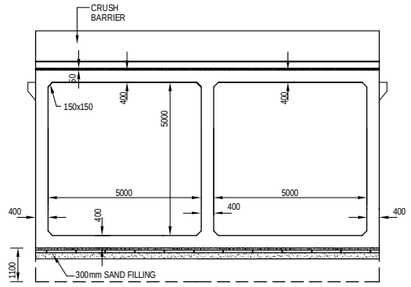
DESIGNED BY :	DRAWN BY :	CHECKED BY :	APPROVED BY :
MD. TAZUDDIN	MD. TAZUDDIN	AFM HAMIDUL HAQUE	DR. PRABHAT SHRIVASTAVA

REV.	DESCRIPTION	DATE



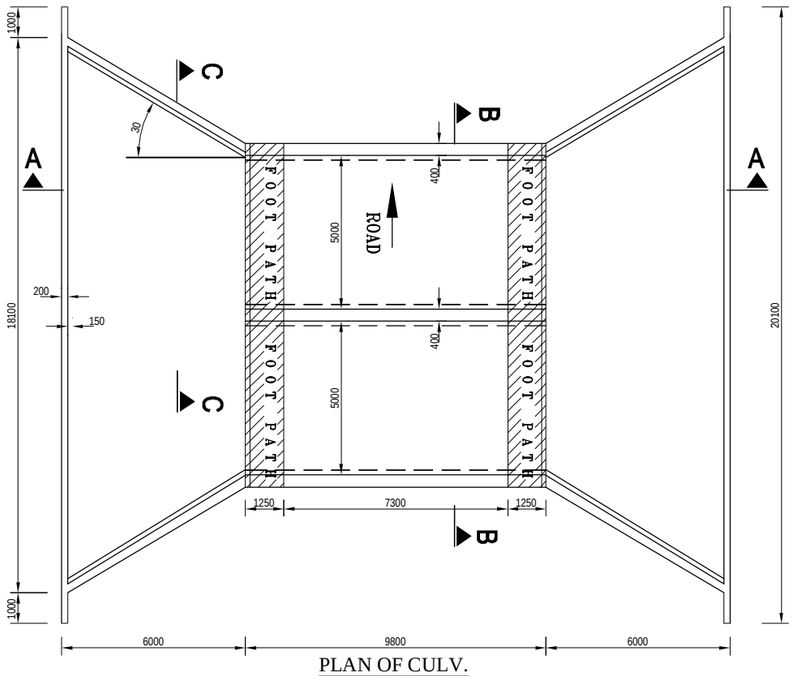
SECTION A-A

SCALE = 1:200



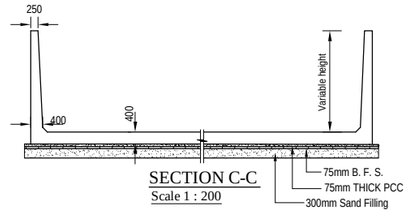
SECTION B-B

SCALE = 1:200



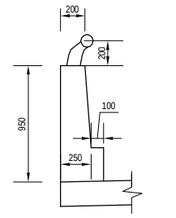
PLAN OF CULV.

SCALE = 1:200



SECTION C-C

Scale 1 : 200



DETAILS OF PARAPET

Scale 1: 50

NAME OF THE CLIENT :

GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH

LOCAL GOVERNMENT ENGINEERING DEPARTMENT

NAME OF THE PROJECT :

CONSULTANCY SERVICES FOR FEASIBILITY, DETAILED SURVEY AND DESIGN OF CHITTAGONG HILL TRACT CONNECTIVITY CONNECTING THEGAMUKH AND CHITTAGONG PORT.

NAME OF THE CONSULTANTS :

SAI Consulting Engineers Pvt. Ltd, India.

in association with

BETS Consulting Services Ltd, Bangladesh

Project office :

Tahmid Mahmood Palace
Flat # 9A, House # 77, Road # 4, Block-C,

DRAWING TITLE :

DIMENSION DETAILS OF 2x5.0x5.0 RCC BOX CULVERT AT CH. 20+119 kM.

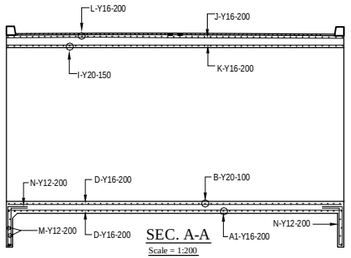
DRAWING NO : LGED/CUL-03/C-01

Scale :As shown

Date : 28-01-16

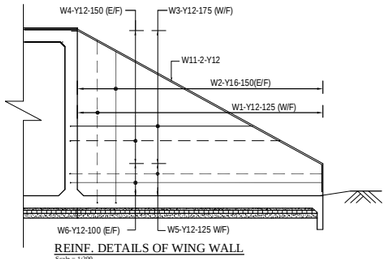
DESIGNED BY :	DRAWN BY :	CHECKED BY :	APPROVED BY :
MD. TAZUDDIN	MD. TAZUDDIN	AFM HAMIDUL HAQUE	DR. PRABHAT SHRIVASTAVA

REV.	DESCRIPTION	DATE



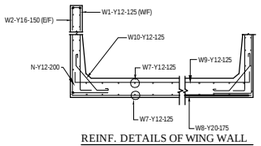
SEC. A-A

Scale = 1:200



REINF. DETAILS OF WING WALL

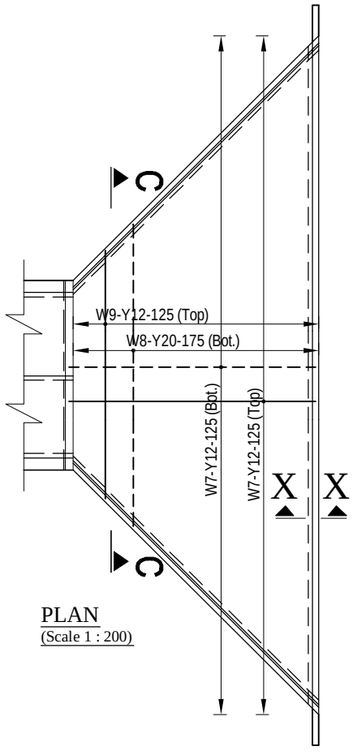
Scale = 1:200



REINF. DETAILS OF WING WALL

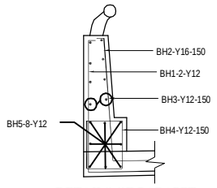
SEC. C-C

Scale 1 : 200



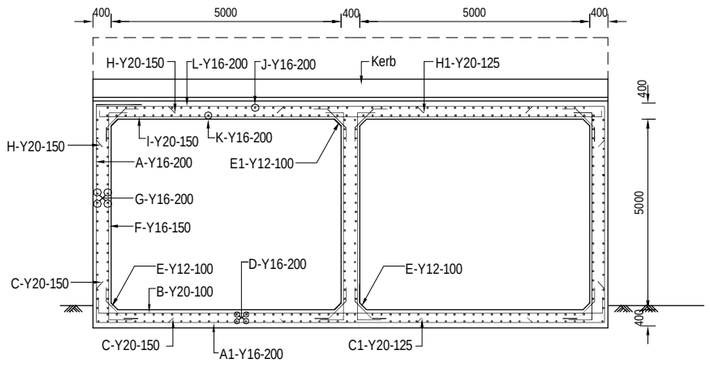
PLAN

(Scale 1 : 200)



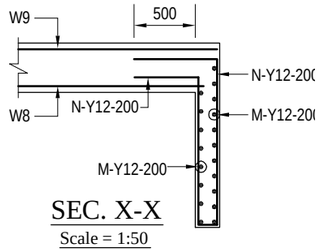
DETAILS OF PARAPET

Scale 1 : 50



REINF. DETAILS OF BOX CULVERT

Scale = 1:200



SEC. X-X

Scale = 1:50

NOTE :

E/F : Earth face

W/F : Water fa

NAME OF THE CLIENT :

GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH

LOCAL GOVERNMENT ENGINEERING DEPARTMENT

NAME OF THE PROJECT :

CONSULTANCY SERVICES FOR FEASIBILITY, DETAILED SURVEY AND DESIGN OF CHITTAGONG HILL TRACT CONNECTIVITY CONNECTING THEGAMUKH AND CHITTAGONG PORT.

NAME OF THE CONSULTANTS :

SAI Consulting Engineers Pvt. Ltd, India.

in association with

BETS Consulting Services Ltd, Bangladesh

Project office :

Tahmid Mahmood Palace
Flat # 9A, House # 77, Road # 4, Block-C,

DRAWING TITLE :

REINF. DETAILS OF 2x5.0x5.0 RCC BOX CULVERT AT CH. 20+119 kM.

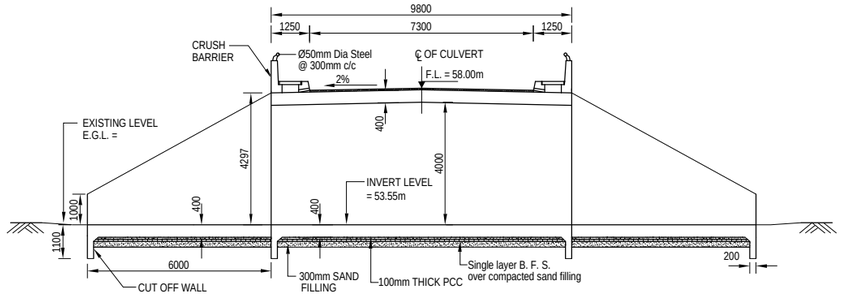
DRAWING NO : LGED/CUL-03/RNF.-02

Scale :As shown

Date : 28-01-16

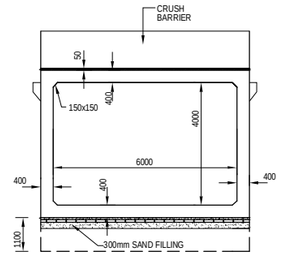
DESIGNED BY :	DRAWN BY :	CHECKED BY :	APPROVED BY :
MD. TAZUDDIN	MD. TAZUDDIN	AFM HAMIDUL HAQUE	DR. PRABHAT SHRIVASTAVA

REV.	DESCRIPTION	DATE



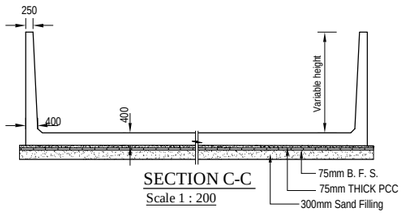
SECTION A-A

SCALE = 1:200



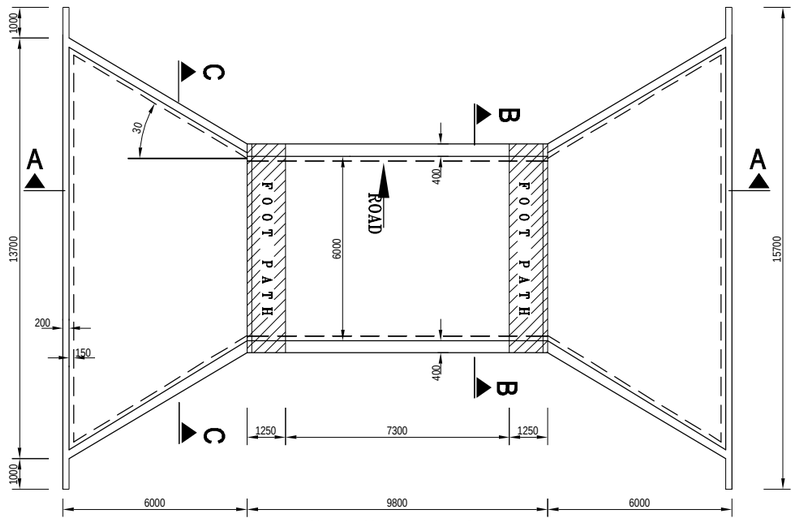
SECTION B-B

SCALE = 1:200



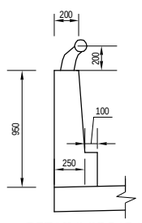
SECTION C-C

Scale 1 : 200



PLAN OF CULVERT

SCALE = 1:200



DETAILS OF PARAPET

Scale 1 : 50

NAME OF THE CLIENT :

GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH

LOCAL GOVERNMENT ENGINEERING DEPARTMENT

NAME OF THE PROJECT :

CONSULTANCY SERVICES FOR FEASIBILITY, DETAILED SURVEY AND DESIGN OF CHITTAGONG HILL TRACT CONNECTIVITY CONNECTING THEGAMUKH AND CHITTAGONG PORT.

NAME OF THE CONSULTANTS :

SAI Consulting Engineers Pvt. Ltd, India.

in association with

BETS Consulting Services Ltd, Bangladesh

Project office :

Tahmid Mahmood Palace
Flat # 9A, House # 77, Road # 4, Block-C,

DRAWING TITLE :

DIMENSION DETAILS OF 1x6.0x4.0 RCC BOX CULVERT AT CH. 20+175 kM.

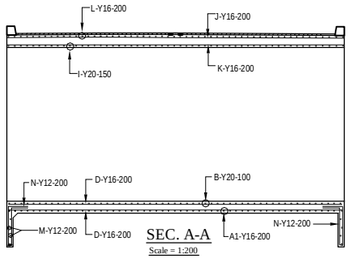
DRAWING NO : LGED/CUL-04/C-01

Scale :As shown

Date : 28-01-16

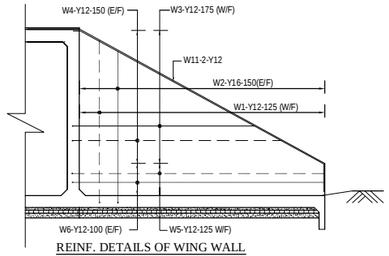
DESIGNED BY :	DRAWN BY :	CHECKED BY :	APPROVED BY :
MD. TAZUDDIN	MD. TAZUDDIN	AFM HAMIDUL HAQUE	DR. PRABHAT SHRIVASTAVA

REV.	DESCRIPTION	DATE



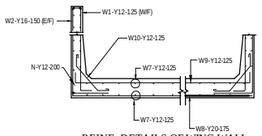
SEC. A-A

Scale = 1:200



REINF. DETAILS OF WING WALL

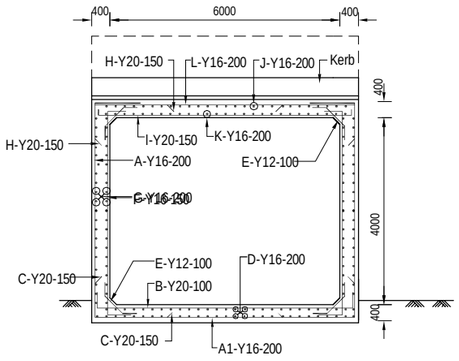
Scale = 1:200



REINF. DETAILS OF WING WALL

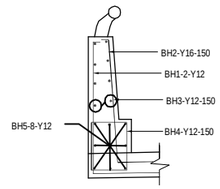
SEC. C-C

Scale 1 : 200



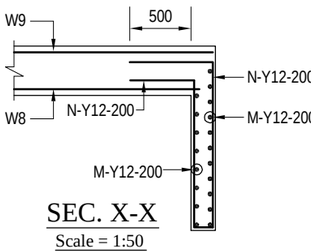
REINF. DETAILS OF BOX CULVERT

Scale = 1:200



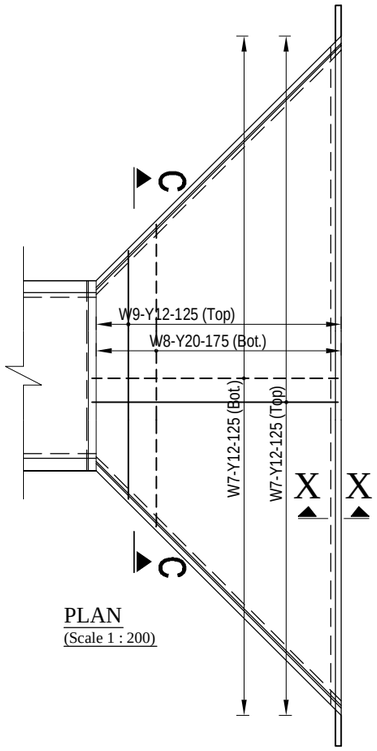
DETAILS OF PARAPET

Scale 1 : 50



SEC. X-X

Scale = 1:50



PLAN

(Scale 1 : 200)

NOTE :

E/F : Earth face

W/F : Water fa

NAME OF THE CLIENT :

GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH

LOCAL GOVERNMENT ENGINEERING DEPARTMENT

NAME OF THE PROJECT :

CONSULTANCY SERVICES FOR FEASIBILITY, DETAILED SURVEY AND DESIGN OF CHITTAGONG HILL TRACT CONNECTIVITY CONNECTING THEGAMUKH AND CHITTAGONG PORT.

NAME OF THE CONSULTANTS :

SAI Consulting Engineers Pvt. Ltd, India.

in association with

BETS Consulting Services Ltd, Bangladesh

Project office :

Tahmid Mahmood Palace
Flat # 9A, House # 77, Road # 4, Block-C,

DRAWING TITLE :

REINF. DETAILS OF 1x6.0x4.0 RCC BOX CULVERT AT CH. 20+175 kM.

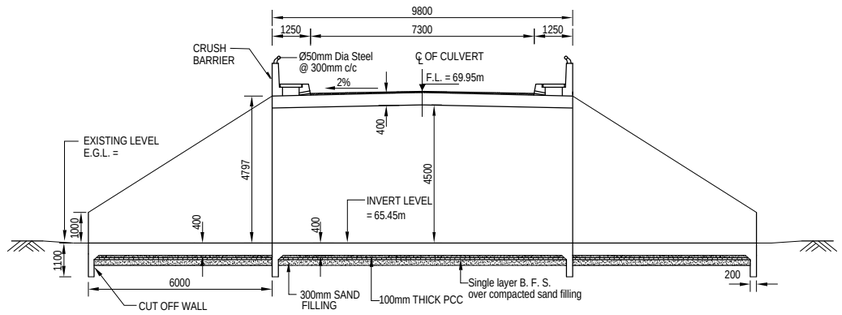
DRAWING NO : LGED/CUL-04/RNF.-02

Scale :As shown

Date : 28-01-16

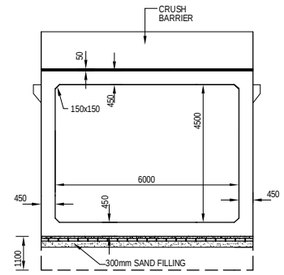
DESIGNED BY :	DRAWN BY :	CHECKED BY :	APPROVED BY :
MD. TAZUDDIN	MD. TAZUDDIN	AFM HAMIDUL HAQUE	DR. PRABHAT SHRIVASTAVA

REV.	DESCRIPTION	DATE



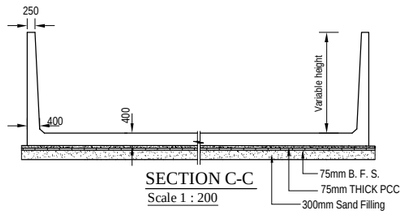
SECTION A-A

SCALE = 1:200



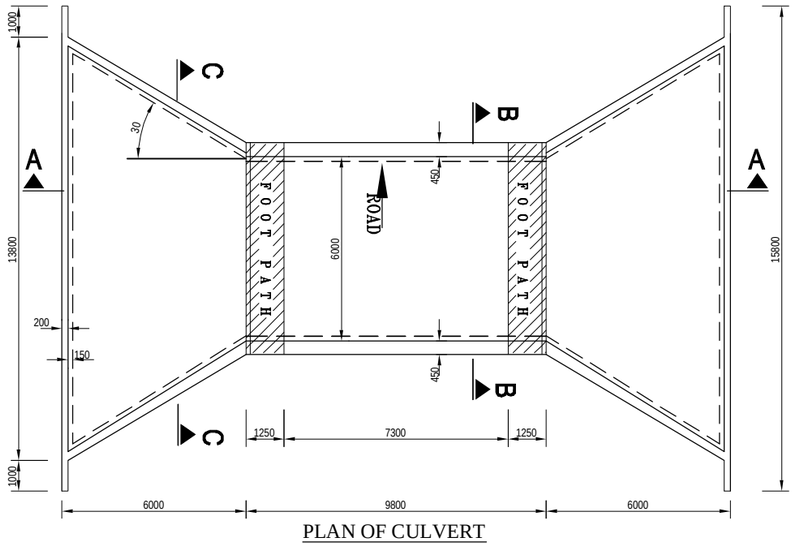
SECTION B-B

SCALE = 1:200



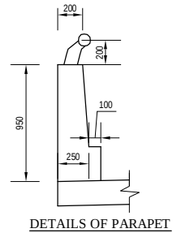
SECTION C-C

Scale 1 : 200



PLAN OF CULVERT

SCALE = 1:200

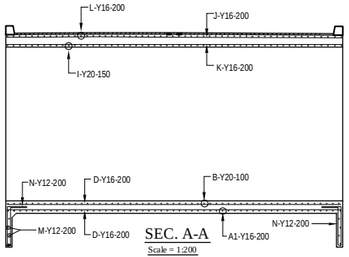


DETAILS OF PARAPET

Scale 1 : 50

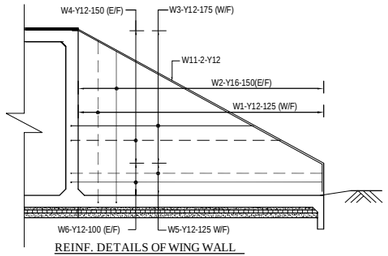
NAME OF THE CLIENT :	GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH **LOCAL GOVERNMENT ENGINEERING DEPARTMENT**
NAME OF THE PROJECT :	CONSULTANCY SERVICES FOR FEASIBILITY, DETAILED SURVEY AND DESIGN OF CHITTAGONG HILL TRACT CONNECTIVITY CONNECTING THEGAMUKH AND CHITTAGONG PORT.
NAME OF THE CONSULTANTS :	**SAI Consulting Engineers Pvt. Ltd, India.** in association with **BETS Consulting Services Ltd, Bangladesh** Project office : Tahmid Mahmood Palace Flat # 9A, House # 77, Road # 4, Block-C,
DRAWING TITLE :	DIMENSION DETAILS OF 1x6.0x4.5 RCC BOX CULVERT AT CH. 20+353 kM.
DRAWING NO :	LGED/CUL-05/C-01
Scale :As shown	Date : 28-01-16
DESIGNED BY :	MD. TAZUDDIN
DRAWN BY :	MD. TAZUDDIN
CHECKED BY :	AFM HAMIDUL HAQUE
APPROVED BY :	DR. PRABHAT SHRIVASTAVA

REV.	DESCRIPTION	DATE

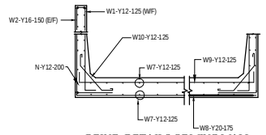


SEC. A-A

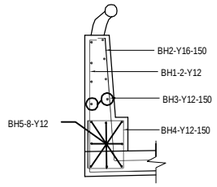
Scale = 1:200



REINF. DETAILS OF WING WALL

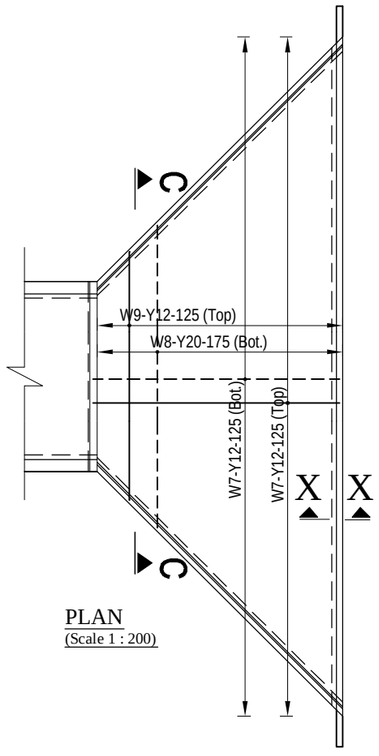


REINF. DETAILS OF WING WALL
SEC. C-C
Scale 1 : 200



DETAILS OF PARAPET

Scale 1 : 50

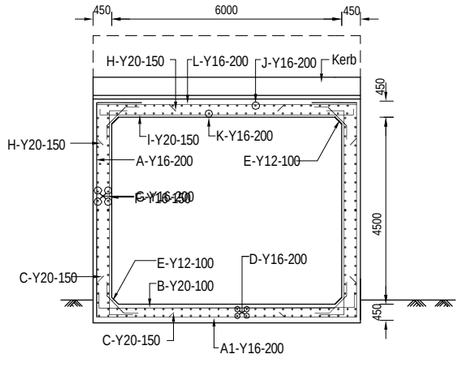


PLAN
(Scale 1 : 200)

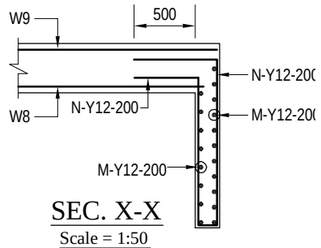
NOTE :

E/F : Earth face

W/F : Water fa



REINF. DETAILS OF BOX CULVERT
Scale = 1:200



SEC. X-X

Scale = 1:50

NAME OF THE CLIENT :

GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH

LOCAL GOVERNMENT ENGINEERING DEPARTMENT

NAME OF THE PROJECT :

CONSULTANCY SERVICES FOR FEASIBILITY, DETAILED SURVEY AND DESIGN OF CHITTAGONG HILL TRACT CONNECTIVITY CONNECTING THEGAMUKH AND CHITTAGONG PORT.

NAME OF THE CONSULTANTS :

SAI Consulting Engineers Pvt. Ltd, India.

in association with

BETS Consulting Services Ltd, Bangladesh

Project office :

Tahmid Mahmood Palace
Flat # 9A, House # 77, Road # 4, Block-C,

DRAWING TITLE :

REINF. DETAILS OF 1x6.0x4.0 RCC BOX CULVERT AT CH. 20+353 kM.

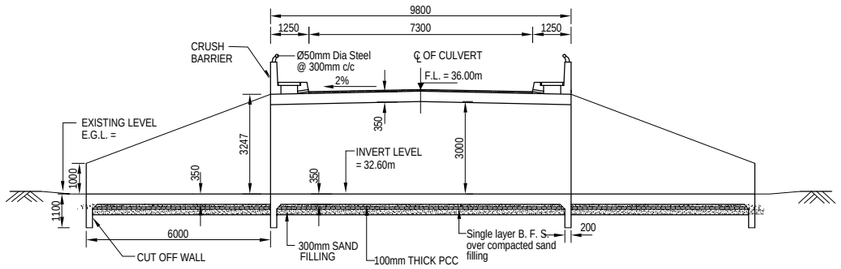
DRAWING NO : LGED/CUL-05/RNF.-02

Scale :As shown

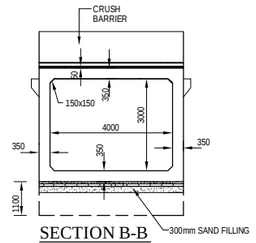
Date : 28-01-16

DESIGNED BY :	DRAWN BY :	CHECKED BY :	APPROVED BY :
MD. TAZUDDIN	MD. TAZUDDIN	AFM HAMIDUL HAQUE	DR. PRABHAT SHRIVASTAVA

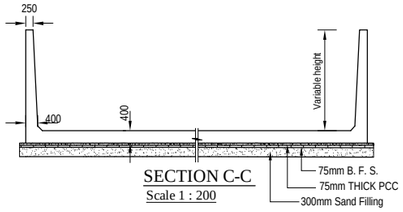
REV.	DESCRIPTION	DATE



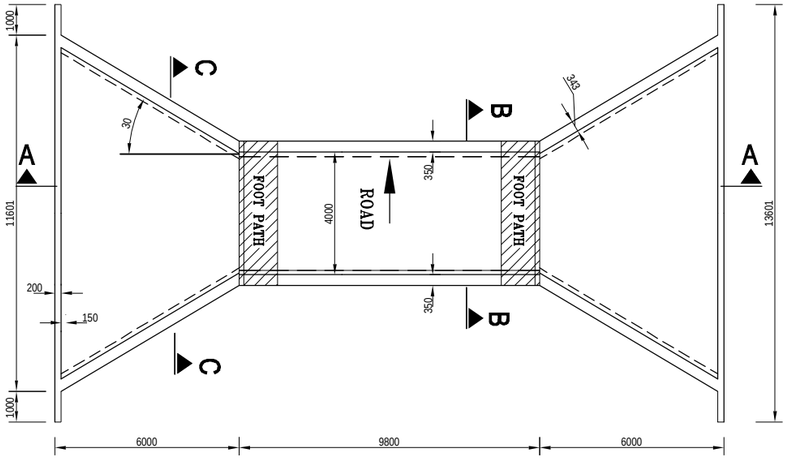
SECTION A-A
SCALE = 1:200



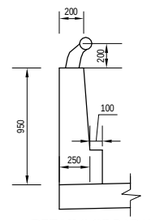
SECTION B-B
SCALE = 1:200



SECTION C-C
Scale 1 : 200



PLAN OF CULV
SCALE = 1:200



DETAILS OF PARAPET
Scale 1 : 50

NAME OF THE CLIENT :
GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH
LOCAL GOVERNMENT ENGINEERING DEPARTMENT

NAME OF THE PROJECT :
CONSULTANCY SERVICES FOR FEASIBILITY, DETAILED SURVEY AND DESIGN OF CHITTAGONG HILL TRACT CONNECTIVITY CONNECTING THEGAMUKH AND CHITTAGONG PORT.

NAME OF THE CONSULTANTS :
SAI Consulting Engineers Pvt. Ltd, India.
in association with
BETS Consulting Services Ltd, Bangladesh
Project office :
Tahmid Mahmood Palace
Flat # 9A, House # 77, Road # 4, Block-C,

DRAWING TITLE :
DIMENSION DETAILS OF 1x4.0x3.0 RCC BOX CULVERT AT CH. 22+079 kM.

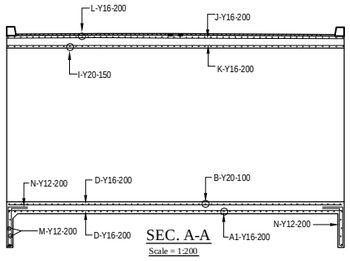
DRAWING NO : LGED/CUL-6/C-01

Scale :As shown

Date : 28-01-16

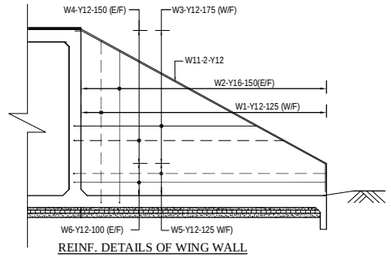
DESIGNED BY :	DRAWN BY :	CHECKED BY :	APPROVED BY :
MD. TAZUDDIN	MD. TAZUDDIN	AFM HAMIDUL HAQUE	DR. PRABHAT SHRIVASTAVA

REV.	DESCRIPTION	DATE



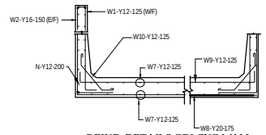
SEC. A-A

Scale = 1:200



REINF. DETAILS OF WING WALL

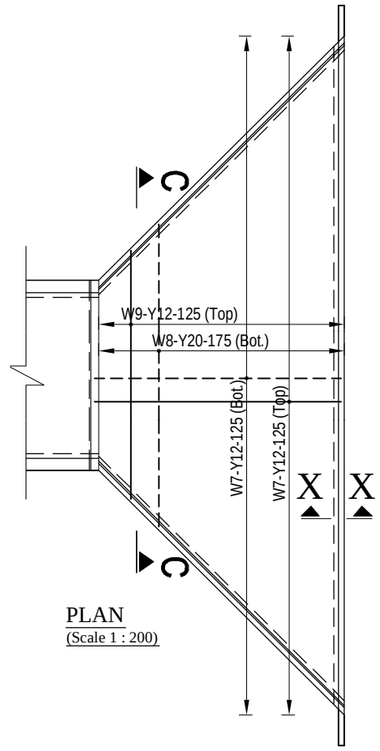
Scale = 1:200



REINF. DETAILS OF WING WALL

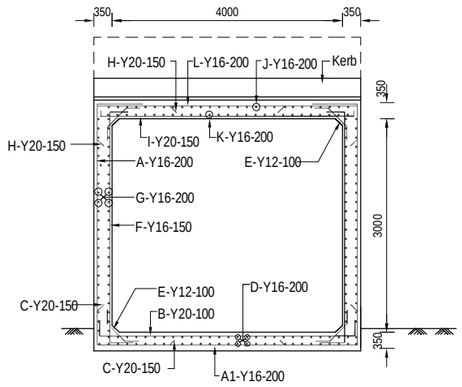
SEC. C-C

Scale 1 : 200



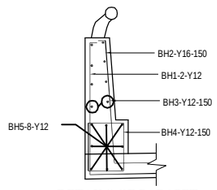
PLAN

(Scale 1 : 200)



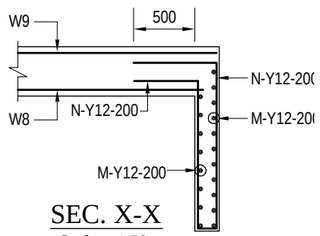
REINF. DETAILS OF BOX CULVERT

Scale = 1:200



DETAILS OF PARAPET

Scale 1 : 50



SEC. X-X

Scale = 1:50

NOTE :

E/F : Earth face

W/F : Water fa

NAME OF THE CLIENT :

GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH

LOCAL GOVERNMENT ENGINEERING DEPARTMENT

NAME OF THE PROJECT :

CONSULTANCY SERVICES FOR FEASIBILITY, DETAILED SURVEY AND DESIGN OF CHITTAGONG HILL TRACT CONNECTIVITY CONNECTING THEGAMUKH AND CHITTAGONG PORT.

NAME OF THE CONSULTANTS :

SAI Consulting Engineers Pvt. Ltd, India.

in association with

BETS Consulting Services Ltd, Bangladesh

Project office :

Tahmid Mahmood Palace
Flat # 9A, House # 77, Road # 4, Block-C,

DRAWING TITLE :

REINF. DETAILS OF 1x4.0x3.0 RCC BOX CULVERT AT CH. 22+079 kM.

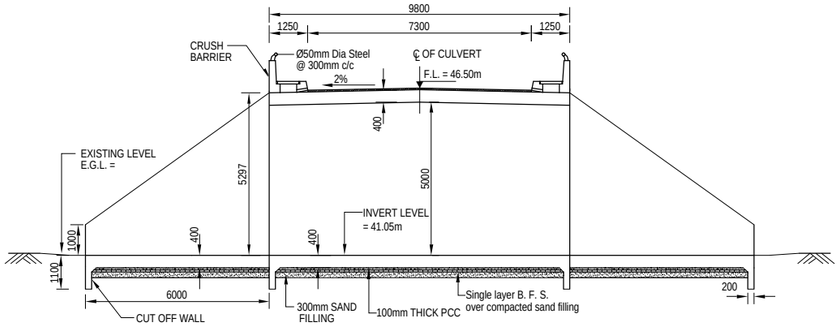
DRAWING NO : LGED/CUL-06/RNF.-02

Scale :As shown

Date : 28-01-16

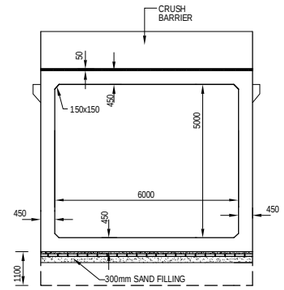
DESIGNED BY :	DRAWN BY :	CHECKED BY :	APPROVED BY :
MD. TAZUDDIN	MD. TAZUDDIN	AFM HAMIDUL HAQUE	DR. PRABHAT SHRIVASTAVA

REV.	DESCRIPTION	DATE



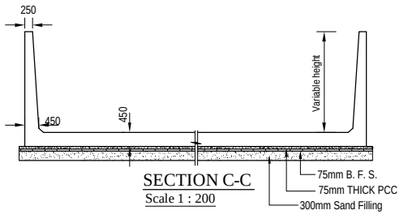
SECTION A-A

SCALE = 1:200



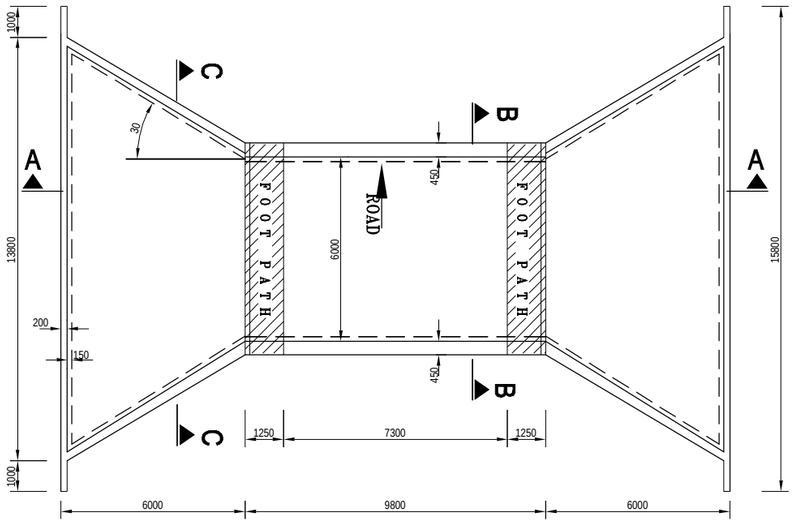
SECTION B-B

SCALE = 1:200



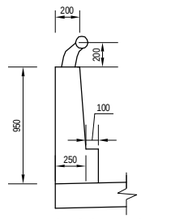
SECTION C-C

Scale 1 : 200



PLAN OF CULVERT

SCALE = 1:200



DETAILS OF PARAPET

Scale 1 : 50

NAME OF THE CLIENT :

GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH

LOCAL GOVERNMENT ENGINEERING DEPARTMENT

NAME OF THE PROJECT :

CONSULTANCY SERVICES FOR FEASIBILITY, DETAILED SURVEY AND DESIGN OF CHITTAGONG HILL TRACT CONNECTIVITY CONNECTING THEGAMUKH AND CHITTAGONG PORT.

NAME OF THE CONSULTANTS :

SAI Consulting Engineers Pvt. Ltd, India.

in association with

BETS Consulting Services Ltd, Bangladesh

Project office :

Tahmid Mahmood Palace
Flat # 9A, House # 77, Road # 4, Block-C,

DRAWING TITLE :

DIMENSION DETAILS OF 1x6.0x5.0 RCC BOX CULVERT AT CH. 48+705 kM.

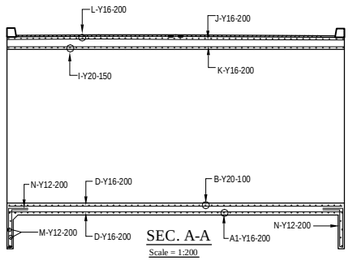
DRAWING NO : LGED/CUL-07/C-01

Scale :As shown

Date : 28-01-16

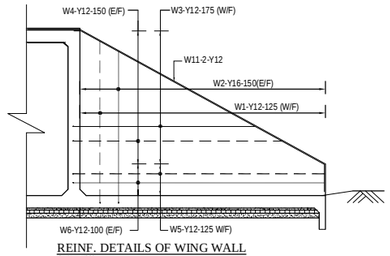
DESIGNED BY :	DRAWN BY :	CHECKED BY :	APPROVED BY :
MD. TAZUDDIN	MD. TAZUDDIN	AFM HAMIDUL HAQUE	DR. PRABHAT SHRIVASTAVA

REV.	DESCRIPTION	DATE



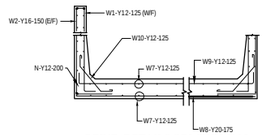
SEC. A-A

Scale = 1:200



REINF. DETAILS OF WING WALL

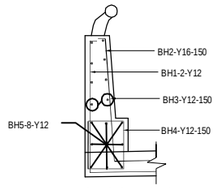
Scale = 1:200



REINF. DETAILS OF WING WALL

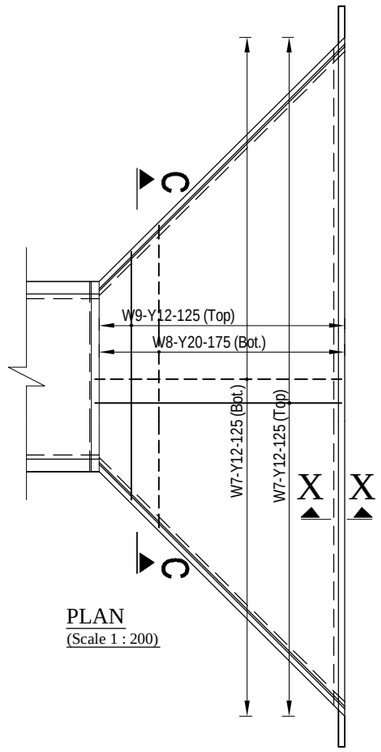
SEC. C-C

Scale 1 : 200



DETAILS OF PARAPET

Scale 1 : 50



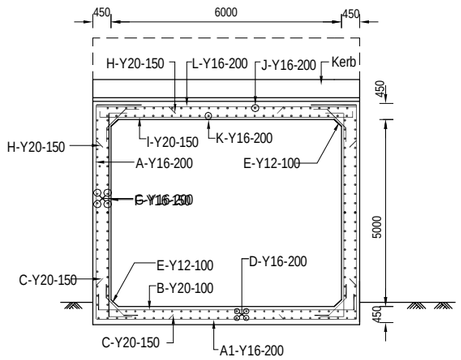
PLAN

(Scale 1 : 200)

NOTE :

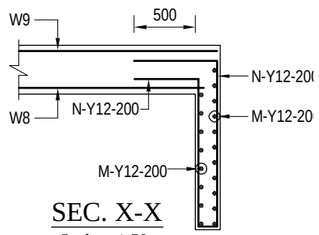
E/F : Earth face

W/F : Water fa



REINF. DETAILS OF BOX CULVERT

Scale = 1:200



SEC. X-X

Scale = 1:50

NAME OF THE CLIENT :

GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH

LOCAL GOVERNMENT ENGINEERING DEPARTMENT

NAME OF THE PROJECT :

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NAME OF THE CONSULTANTS :

SAI Consulting Engineers Pvt. Ltd, India.

in association with

BETS Consulting Services Ltd, Bangladesh

Project office :

Tahmid Mahmood Palace
Flat # 9A, House # 77, Road # 4, Block-C,

DRAWING TITLE :

REINF. DETAILS OF 1x6.0x5.0 RCC BOX CULVERT AT CH. 48+705 kM.

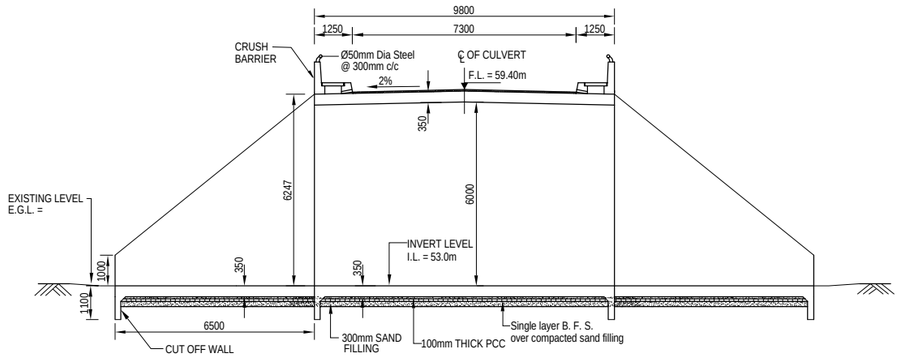
DRAWING NO : LGED/CUL-07/RNF.-02

Scale :As shown

Date : 28-01-16

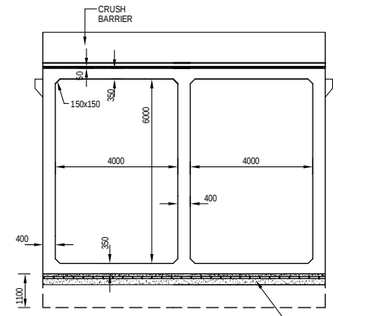
DESIGNED BY :	DRAWN BY :	CHECKED BY :	APPROVED BY :
MD. TAZUDDIN	MD. TAZUDDIN	AFM HAMIDUL HAQUE	DR. PRABHAT SHRIVASTAVA

REV.	DESCRIPTION	DATE



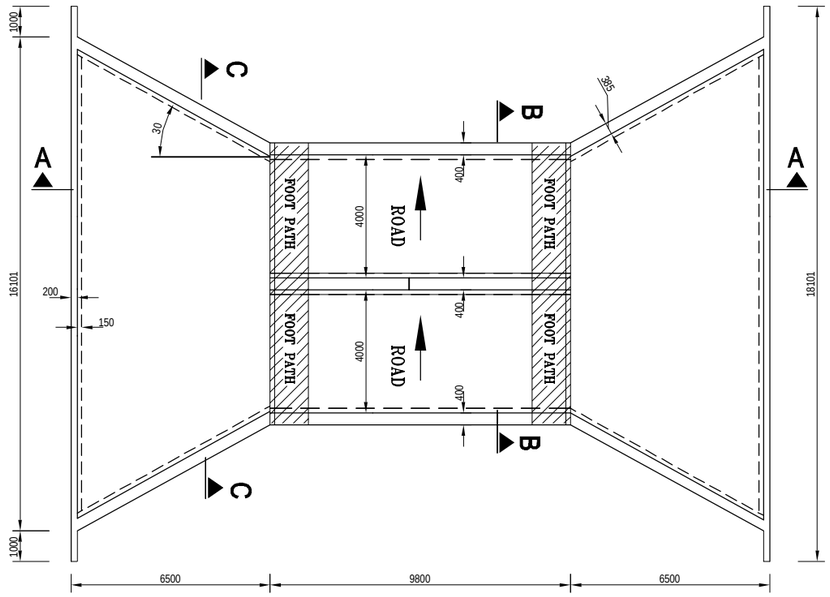
SECTION A-A (CULV. -06)

SCALE = 1:200



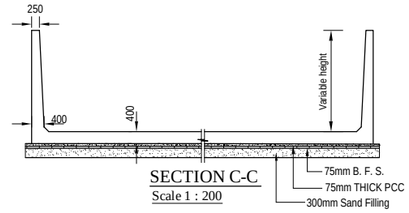
SECTION B-B

SCALE = 1:200



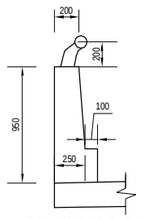
PLAN OF CULV.-06

SCALE = 1:200



SECTION C-C

Scale 1 : 200



DETAILS OF PARAPET

Scale 1: 50

NAME OF THE CLIENT :

GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH

LOCAL GOVERNMENT ENGINEERING DEPARTMENT

NAME OF THE PROJECT :

CONSULTANCY SERVICES FOR FEASIBILITY, DETAILED SURVEY AND DESIGN OF CHITTAGONG HILL TRACT CONNECTIVITY CONNECTING THEGAMUKH AND CHITTAGONG PORT.

NAME OF THE CONSULTANTS :

SAI Consulting Engineers Pvt. Ltd, India.

in association with

BETS Consulting Services Ltd, Bangladesh

Project office :

Tahmid Mahmood Palace
Flat # 9A, House # 77, Road # 4, Block-C,

DIMENSION DETAILS OF 2x4.0x6.0 RCC BOX CULVERT AT CH. 57+321 kM.

DRAWING NO : LGED/CUL-08/C-01

Scale :As shown

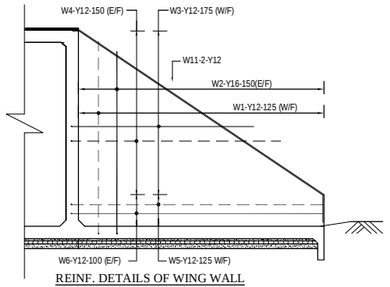
Date : 28-01-16

DESIGNED BY :	DRAWN BY :	CHECKED BY :	APPROVED BY :
MD. TAZUDDIN	MD. TAZUDDIN	AFM HAMIDUL HAQUE	DR. PRABHAT SHRIVASTAVA

REV.	DESCRIPTION	DATE

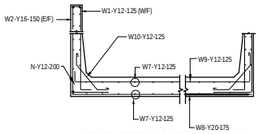
SEC. A-A

Scale = 1:200



REINF. DETAILS OF WING WALL

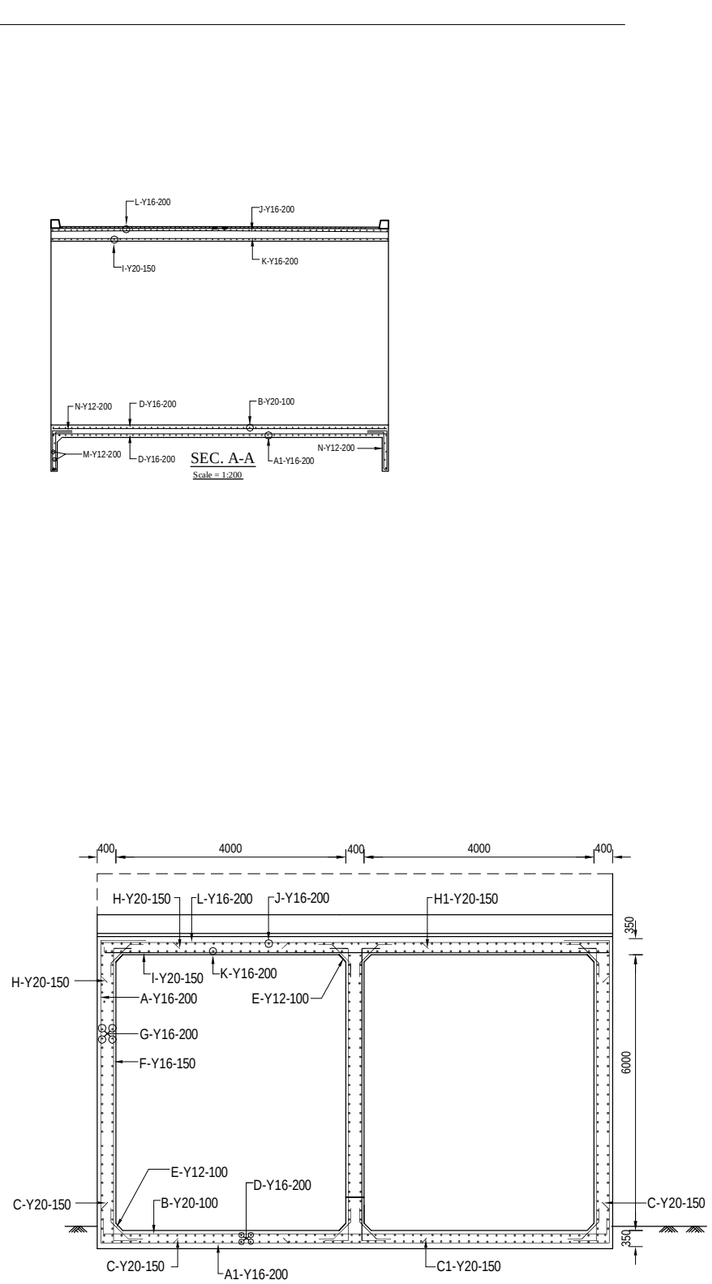
Scale = 1:200



REINF. DETAILS OF WING WALL

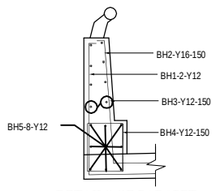
SEC. C-C

Scale 1 : 200



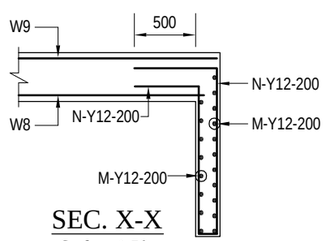
REINF. DETAILS OF BOX CULVERT

Scale = 1:200



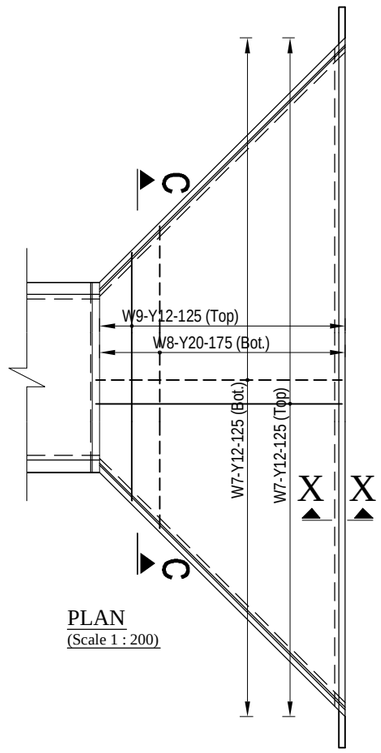
DETAILS OF PARAPET

Scale 1 : 50



SEC. X-X

Scale = 1:50



PLAN

(Scale 1 : 200)

NOTE :

E/F : Earth face

W/F : Water face

NAME OF THE CLIENT :

GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH

LOCAL GOVERNMENT ENGINEERING DEPARTMENT

NAME OF THE PROJECT :

CONSULTANCY SERVICES FOR FEASIBILITY, DETAILED SURVEY AND DESIGN OF CHITTAGONG HILL TRACT CONNECTIVITY CONNECTING THEGAMUKH AND CHITTAGONG PORT.

NAME OF THE CONSULTANTS :

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in association with

BETS Consulting Services Ltd, Bangladesh

Project office :

Tahmid Mahmood Palace
Flat # 9A, House # 77, Road # 4, Block-C,

REINF. DETAILS OF 2x4.0x6.0 RCC BOX CULVERT AT CH. 57+321 kM.

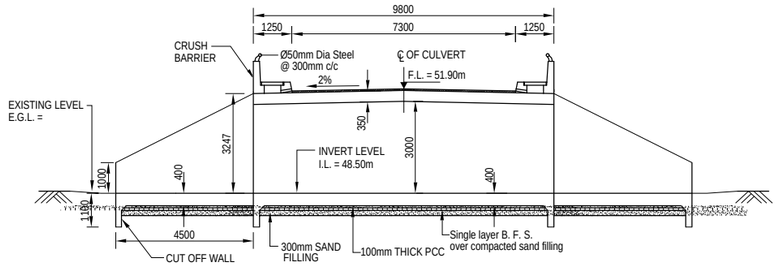
DRAWING NO : LGED/CUL-08/RNF.-02

Scale :As shown

Date : 28-01-16

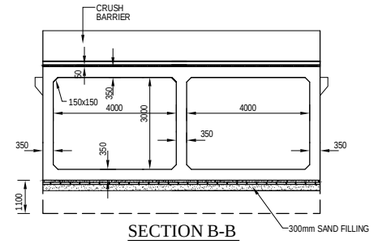
DESIGNED BY :	DRAWN BY :	CHECKED BY :	APPROVED BY :
MD. TAZUDDIN	MD. TAZUDDIN	AFM HAMIDUL HAQUE	DR. PRABHAT SHRIVASTAVA

REV.	DESCRIPTION	DATE



SECTION A-A (CULV. -06)

SCALE = 1:200



SECTION B-B

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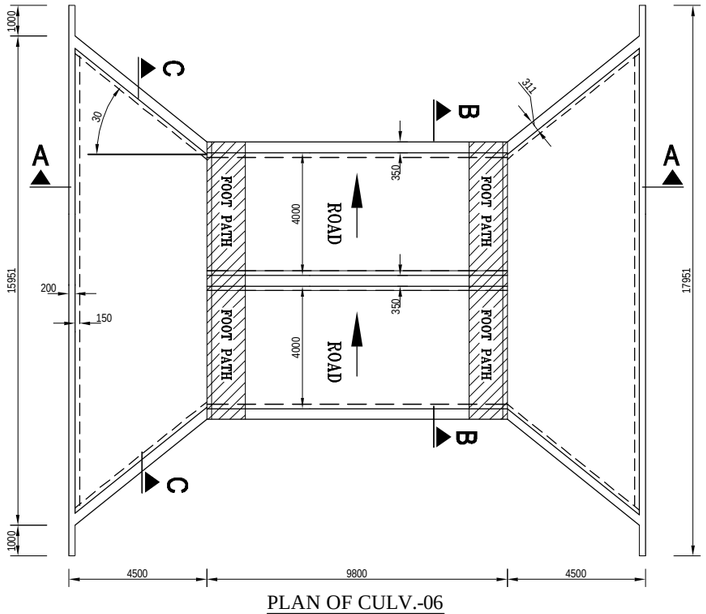
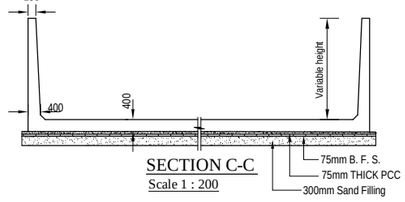


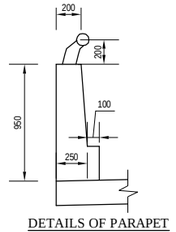
PLAN OF CULV.-06

SCALE = 1:200



SECTION C-C

Scale 1 : 200



DETAILS OF PARAPET

Scale 1:50

NAME OF THE CLIENT :

GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH

LOCAL GOVERNMENT ENGINEERING DEPARTMENT

NAME OF THE PROJECT :

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BETS Consulting Services Ltd, Bangladesh

Project office :

Tahmid Mahmood Palace
Flat # 9A, House # 77, Road # 4, Block-C,

DRAWING TITLE :

DIMENSION DETAILS OF 2x4.0x3.0 RCC BOX CULVERT AT CH. 59+560 kM.

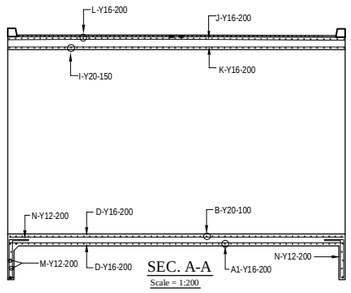
DRAWING NO : LGED/CUL-09/CON.-01

Scale :As shown

Date : 28-01-16

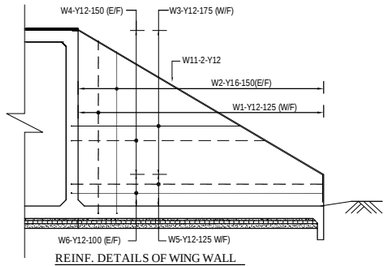
DESIGNED BY :	DRAWN BY :	CHECKED BY :	APPROVED BY :
MD. TAZUDDIN	MD. TAZUDDIN	AFM HAMIDUL HAQUE	DR. PRABHAT SHRIVASTAVA

REV.	DESCRIPTION	DATE



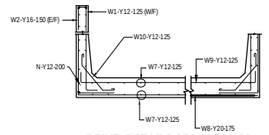
SEC. A-A

Scale = 1:200



REINF. DETAILS OF WING WALL

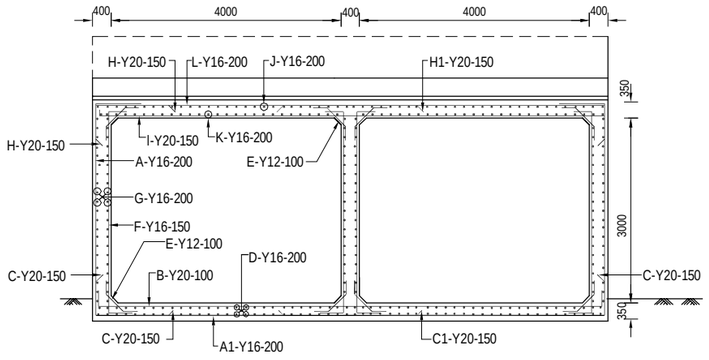
Scale = 1:200



REINF. DETAILS OF WING WALL

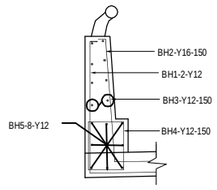
SEC. C-C

Scale 1 : 200



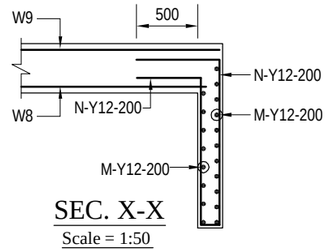
REINF. DETAILS OF BOX CULVERT

Scale = 1:200



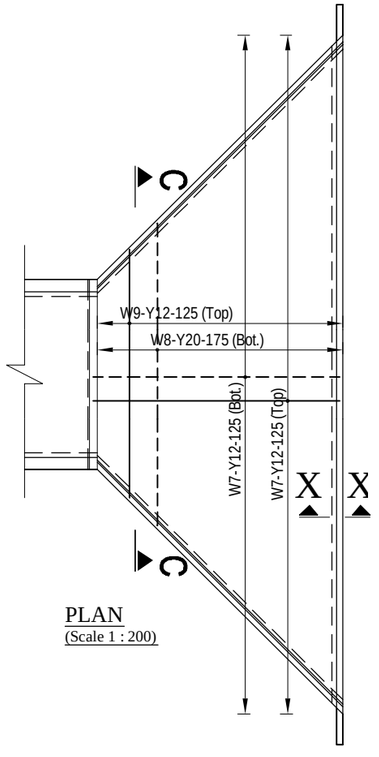
DETAILS OF PARAPET

Scale 1 : 50



SEC. X-X

Scale = 1:50



PLAN

(Scale 1 : 200)

NOTE :

E/F : Earth face
W/F : Water fa

NAME OF THE CLIENT :

GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH

LOCAL GOVERNMENT ENGINEERING DEPARTMENT

NAME OF THE PROJECT :

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in association with

BETS Consulting Services Ltd, Bangladesh

Project office :

Tahmid Mahmood Palace
Flat # 9A, House # 77, Road # 4, Block-C,

DRAWING TITLE :

REINF. DETAILS OF 2x4.0x3.0 RCC BOX CULVERT AT CH. 59+560 kM.

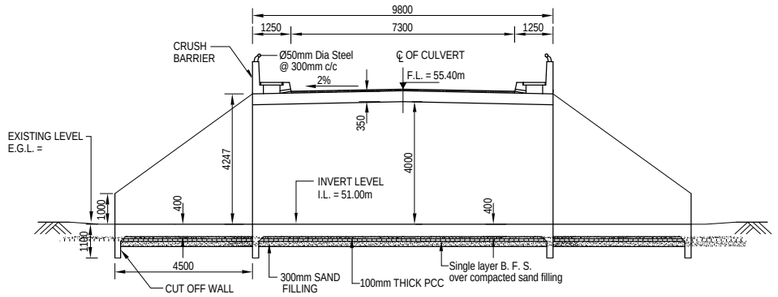
DRAWING NO : LGED/CUL-09/RNF.-02

Scale :As shown

Date : 28-01-16

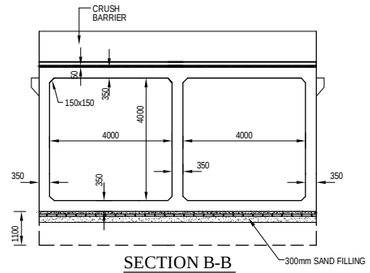
DESIGNED BY :	DRAWN BY :	CHECKED BY :	APPROVED BY :
MD. TAZUDDIN	MD. TAZUDDIN	AFM HAMIDUL HAQUE	DR. PRABHAT SHRIVASTAVA

REV.	DESCRIPTION	DATE



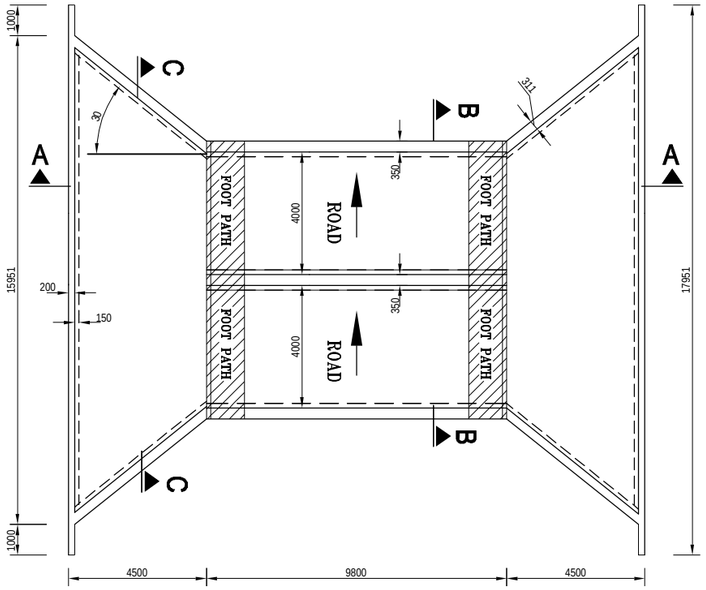
SECTION A-A (CULV. -06)

SCALE = 1:200



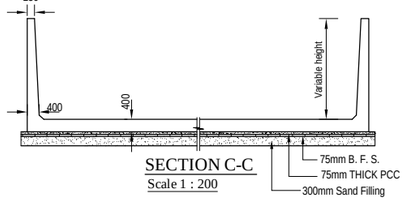
SECTION B-B

SCALE = 1:200



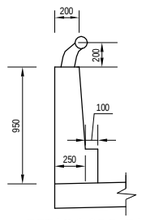
PLAN OF CULV.-06

SCALE = 1:200



SECTION C-C

Scale 1 : 200



DETAILS OF PARAPET

Scale 1 : 50

NAME OF THE CLIENT :

GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH

LOCAL GOVERNMENT ENGINEERING DEPARTMENT

NAME OF THE PROJECT :

CONSULTANCY SERVICES FOR FEASIBILITY, DETAILED SURVEY AND DESIGN OF CHITTAGONG HILL TRACT CONNECTIVITY CONNECTING THEGAMUKH AND CHITTAGONG PORT.

NAME OF THE CONSULTANTS :

SAI Consulting Engineers Pvt. Ltd, India.

in association with

BETS Consulting Services Ltd, Bangladesh

Project office :

Tahmid Mahmood Palace
Flat # 9A, House # 77, Road # 4, Block-C,

DRAWING TITLE :

DIMENSION DETAILS OF 2x4.0x4.0 RCC BOX CULVERT AT CH. 60+290 kM.

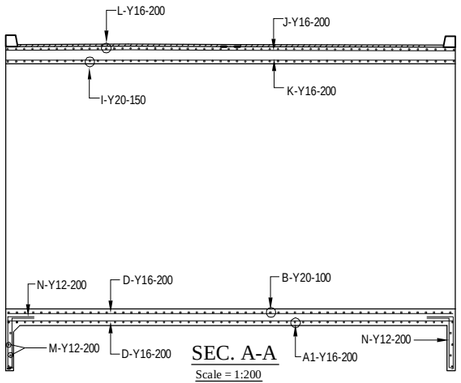
DRAWING NO : LGED/CUL-10/CON.-01

Scale :As shown

Date : 28-01-16

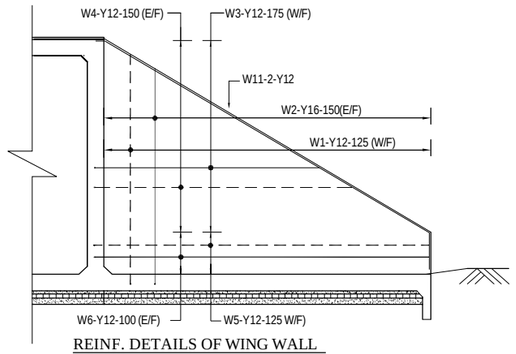
DESIGNED BY :	DRAWN BY :	CHECKED BY :	APPROVED BY :
MD. TAZUDDIN	MD. TAZUDDIN	AFM HAMIDUL HAQUE	DR. PRABHAT SHRIVASTAVA

REV.	DESCRIPTION	DATE



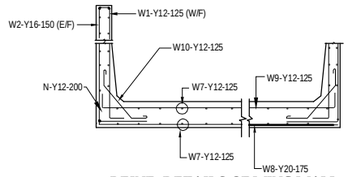
SEC. A-A

Scale = 1:200



REINF. DETAILS OF WING WALL

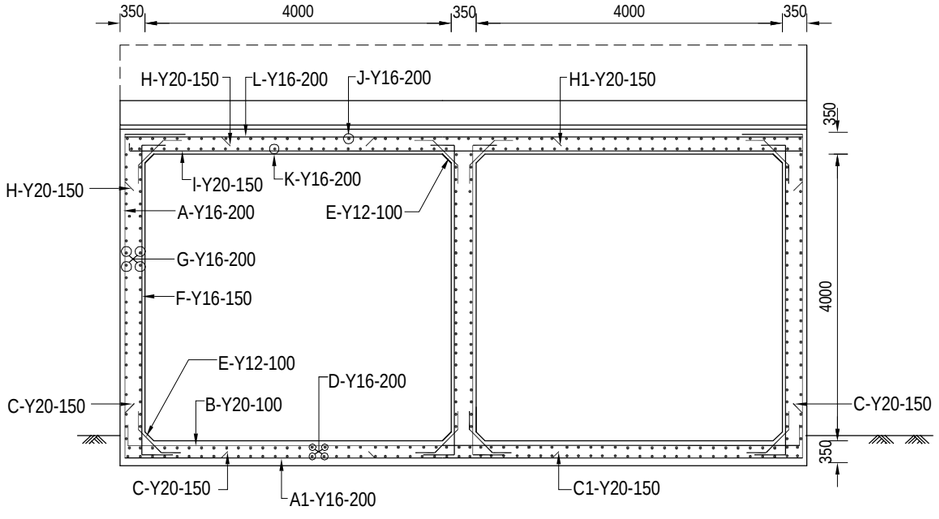
Scale = 1:200



REINF. DETAILS OF WING WALL

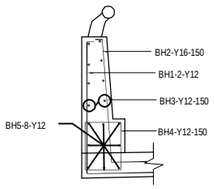
SEC. C-C

Scale = 1:200



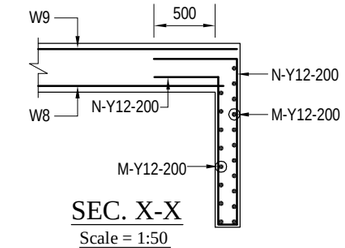
REINF. DETAILS OF BOX CULVERT

Scale = 1:200



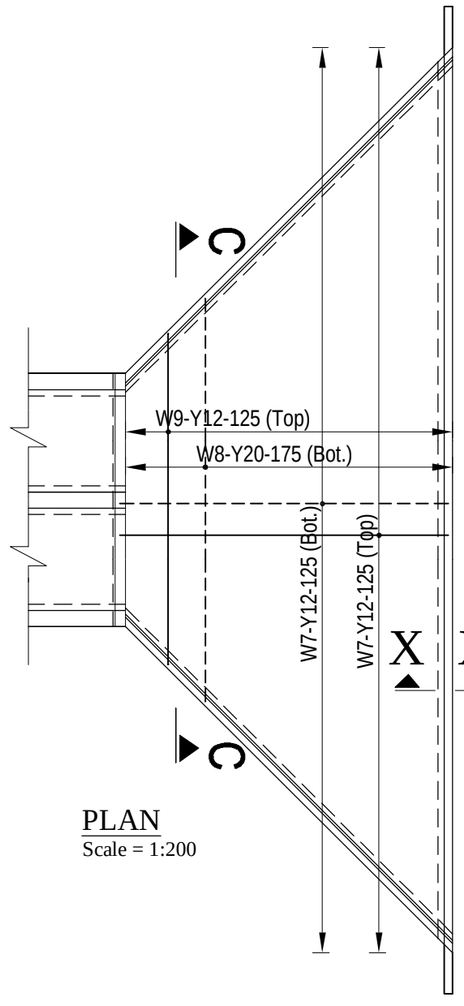
DETAILS OF PARAPET

Scale 1 : 50



SEC. X-X

Scale = 1:50



PLAN

Scale = 1:200

NOTE :

E/F : Earth face
W/F : Water fa

NAME OF THE CLIENT :

GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH

LOCAL GOVERNMENT ENGINEERING DEPARTMENT

NAME OF THE PROJECT :

CONSULTANCY SERVICES FOR FEASIBILITY, DETAILED SURVEY AND DESIGN OF CHITTAGONG HILL TRACT CONNECTIVITY CONNECTING THEGAMUKH AND CHITTAGONG PORT.

NAME OF THE CONSULTANTS :

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in association with

BETS Consulting Services Ltd, Bangladesh

Project office :

Tahmid Mahmood Palace
Flat # 9A, House # 77, Road # 4, Block-C,

DRAWING TITLE :

REINF. DETAILS OF 2x4.0x4.0 RCC BOX CULVERT AT CH. 60+290 kM.

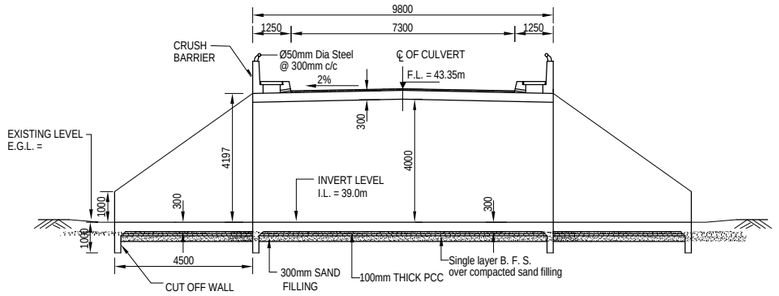
DRAWING NO : LGED/CUL-10RNF.-02

Scale :As shown

Date : 28-01-16

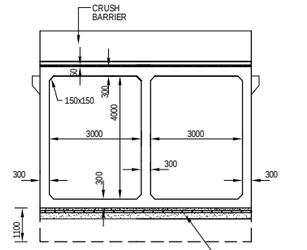
DESIGNED BY :	DRAWN BY :	CHECKED BY :	APPROVED BY :
MD. TAZUDDIN	MD. TAZUDDIN	AFM HAMIDUL HAQUE	DR. PRABHAT SHRIVASTAVA

REV.	DESCRIPTION	DATE



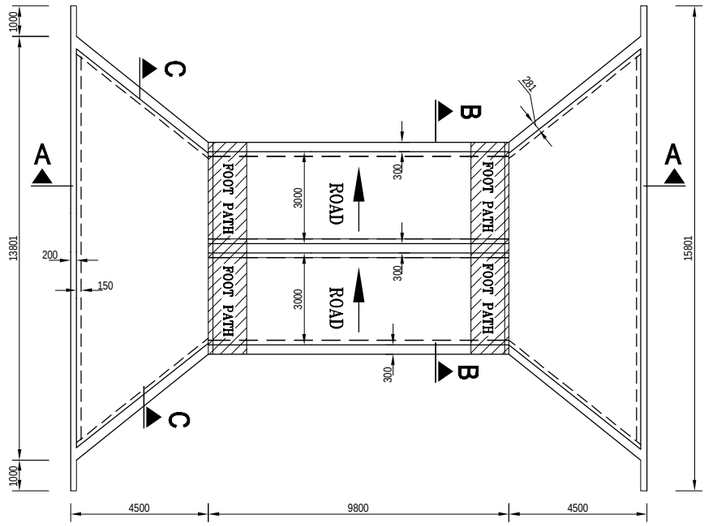
SECTION A-A (CULV. -06)

SCALE = 1:200



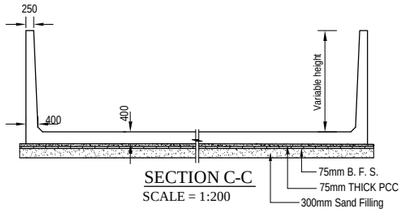
SECTION B-B

SCALE = 1:200



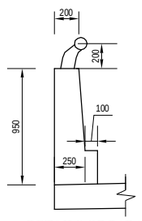
PLAN OF CULV.-06

SCALE = 1:200



SECTION C-C

SCALE = 1:200



DETAILS OF PARAPET

Scale 1: 50

NAME OF THE CLIENT :

GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH

LOCAL GOVERNMENT ENGINEERING DEPARTMENT

NAME OF THE PROJECT :

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in association with

BETS Consulting Services Ltd, Bangladesh

Project office :

Tahmid Mahmood Palace
Flat # 9A, House # 77, Road # 4, Block-C,

DRAWING TITLE :

DIMENSION DETAILS OF 2x3.0x4.0 RCC BOX CULVERT AT CH. 61+373 kM.

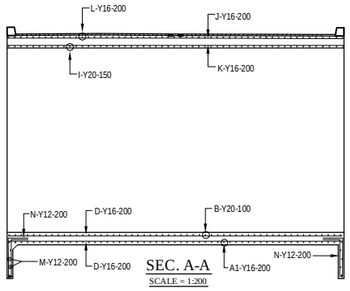
DRAWING NO : LGED/CUL-11/CON.-01

Scale :As shown

Date : 28-01-16

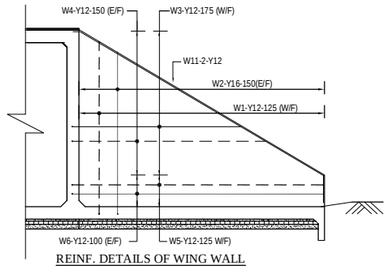
DESIGNED BY :	DRAWN BY :	CHECKED BY :	APPROVED BY :
MD. TAZUDDIN	MD. TAZUDDIN	AFM HAMIDUL HAQUE	DR. PRABHAT SHRIVASTAVA

REV.	DESCRIPTION	DATE



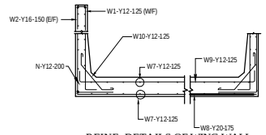
SEC. A-A

SCALE = 1:200



REINF. DETAILS OF WING WALL

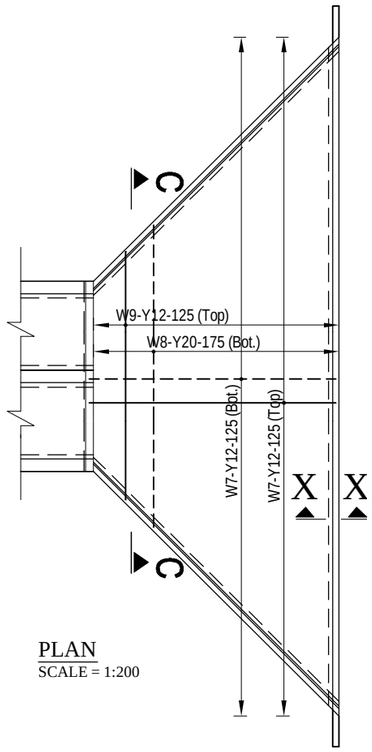
Scale = 1:100



REINF. DETAILS OF WING WALL

SEC. C-C

SCALE = 1:200



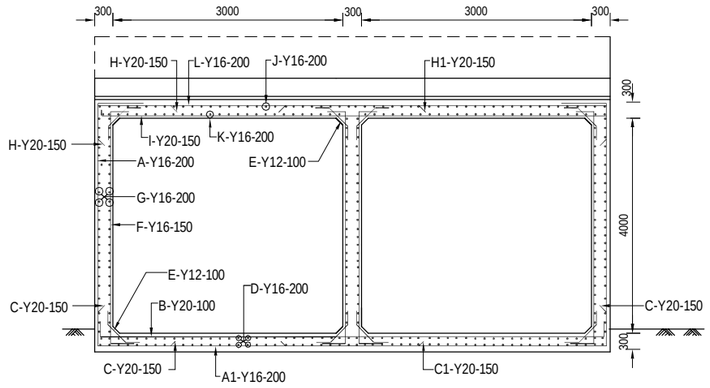
PLAN

SCALE = 1:200

NOTE :

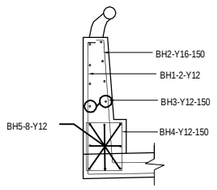
E/F : Earth face

W/F : Water fa



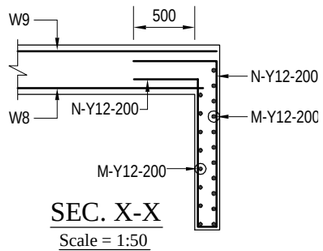
REINF. DETAILS OF BOX CULVERT

SCALE = 1:200



DETAILS OF PARAPET

Scale 1 : 50



SEC. X-X

Scale = 1:50

NAME OF THE CLIENT :

GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH

LOCAL GOVERNMENT ENGINEERING DEPARTMENT

NAME OF THE PROJECT :

CONSULTANCY SERVICES FOR FEASIBILITY, DETAILED SURVEY AND DESIGN OF CHITTAGONG HILL TRACT CONNECTIVITY CONNECTING THEGAMUKH AND CHITTAGONG PORT.

NAME OF THE CONSULTANTS :

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in association with

BETS Consulting Services Ltd, Bangladesh

Project office :

Tahmid Mahmood Palace
Flat # 9A, House # 77, Road # 4, Block-C,

DRAWING TITLE :

REINF. DETAILS OF 2x3.0x4.0 RCC BOX CULVERT AT CH. 61+373 kM.

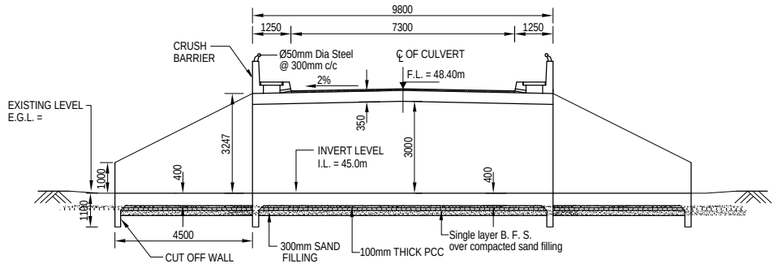
DRAWING NO : LGED/CUL-11/RNF.-02

Scale :As shown

Date : 28-01-16

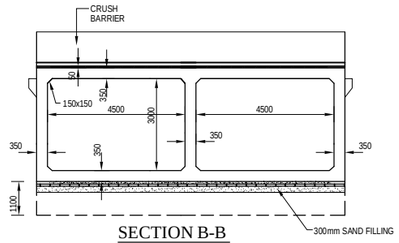
DESIGNED BY :	DRAWN BY :	CHECKED BY :	APPROVED BY :
MD. TAZUDDIN	MD. TAZUDDIN	AFM HAMIDUL HAQUE	DR. PRABHAT SHRIVASTAVA

REV.	DESCRIPTION	DATE



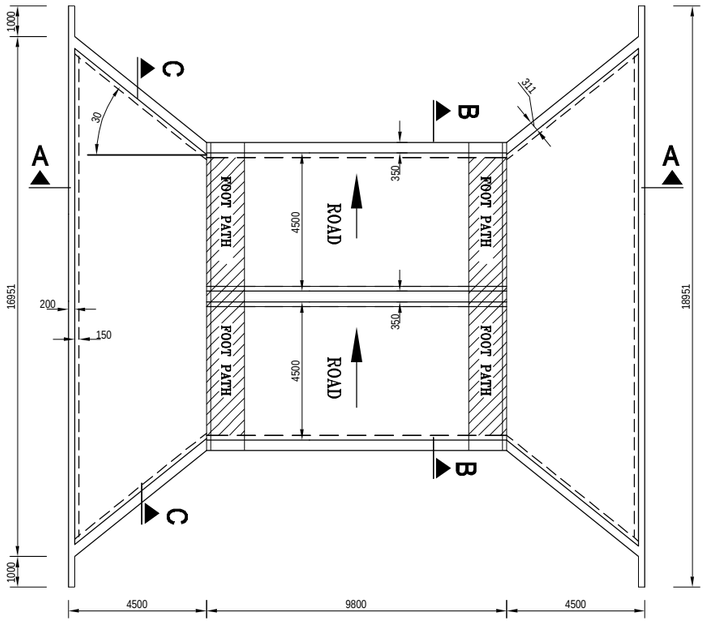
SECTION A-A (CULV. -06)

SCALE = 1:200



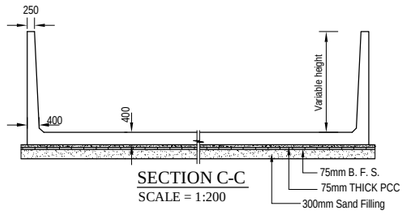
SECTION B-B

SCALE = 1:200



PLAN OF CULV.-06

SCALE = 1:200



SECTION C-C

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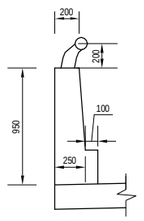

DETAILS OF PARAPET

Scale 1 : 50

NAME OF THE CLIENT :

GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH

LOCAL GOVERNMENT ENGINEERING DEPARTMENT

NAME OF THE PROJECT :

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BETS Consulting Services Ltd, Bangladesh

Project office :

Tahmid Mahmood Palace
Flat # 9A, House # 77, Road # 4, Block-C,

DRAWING TITLE :

REINF. DETAILS OF 2x4.5x3.0 RCC BOX CULVERT AT CH. 62+864 kM.

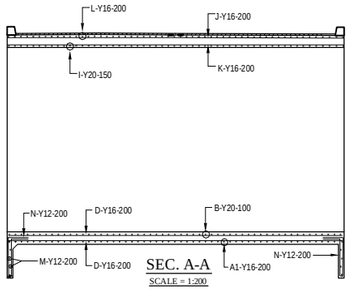
DRAWING NO : LGED/CUL-12/CON.-01

Scale :As shown

Date : 28-01-16

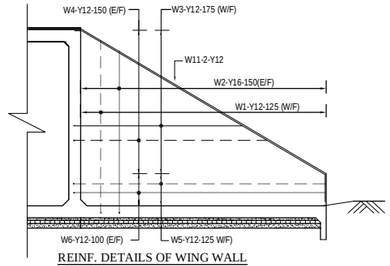
DESIGNED BY :	DRAWN BY :	CHECKED BY :	APPROVED BY :
MD. TAZUDDIN	MD. TAZUDDIN	AFM HAMIDUL HAQUE	DR. PRABHAT SHRIVASTAVA

REV.	DESCRIPTION	DATE



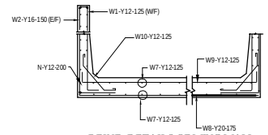
SEC. A-A

SCALE = 1:200



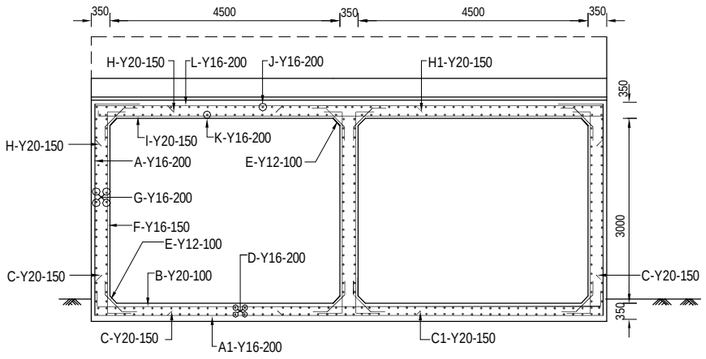
REINF. DETAILS OF WING WALL

SCALE = 1:200



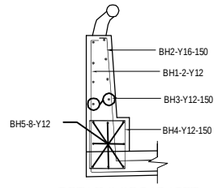
REINF. DETAILS OF WING WALL SEC. C-C

SCALE = 1:200



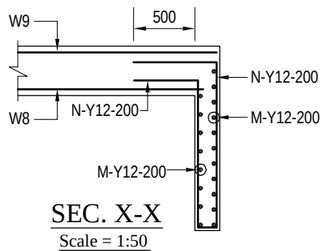
REINF. DETAILS OF BOX CULVERT

SCALE = 1:200



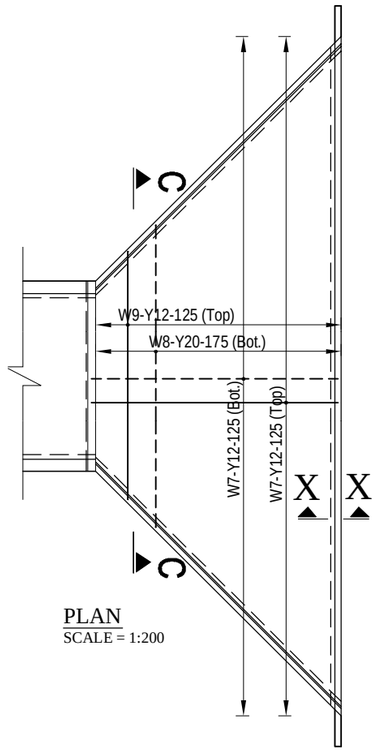
DETAILS OF PARAPET

Scale 1 :50



SEC. X-X

Scale = 1:50



PLAN

SCALE = 1:200

NOTE :

E/F : Earth face
W/F : Water fa

NAME OF THE CLIENT :

GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH

LOCAL GOVERNMENT ENGINEERING DEPARTMENT

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Flat # 9A, House # 77, Road # 4, Block-C,

DRAWING TITLE :

REINF. DETAILS OF 2x4.5x3.0 RCC BOX CULVERT AT CH. 62+864 kM.

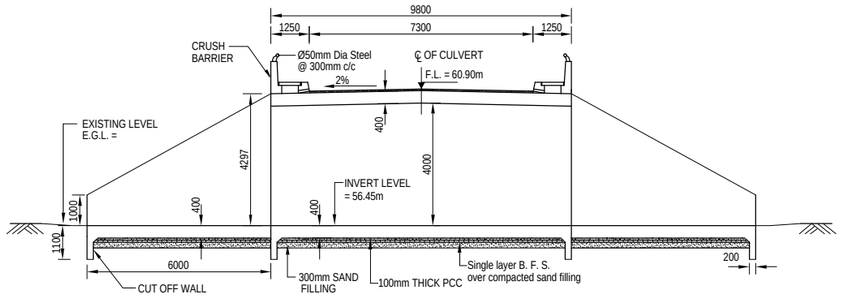
DRAWING NO : LGED/CUL-12/RNF.-02

Scale :As shown

Date : 28-01-16

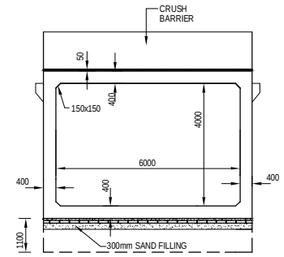
DESIGNED BY :	DRAWN BY :	CHECKED BY :	APPROVED BY :
MD. TAZUDDIN	MD. TAZUDDIN	AFM HAMIDUL HAQUE	DR. PRABHAT SHRIVASTAVA

REV.	DESCRIPTION	DATE



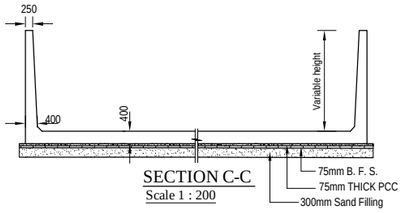
SECTION A-A

SCALE = 1:200



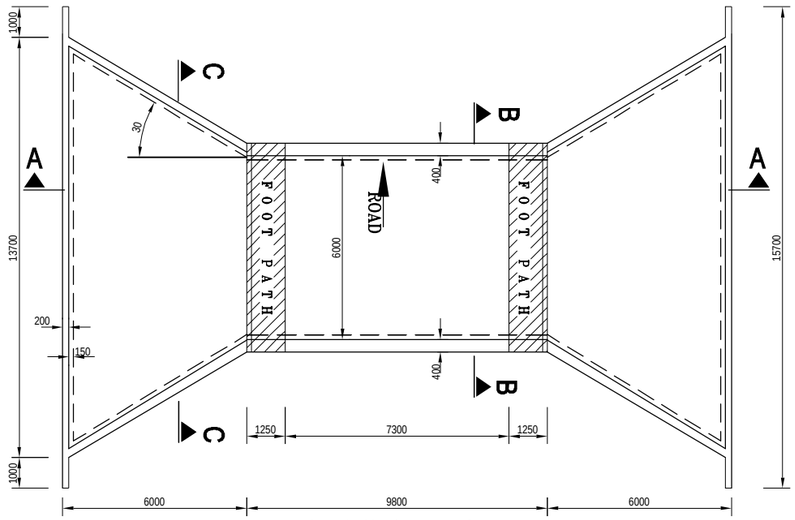
SECTION B-B

SCALE = 1:200



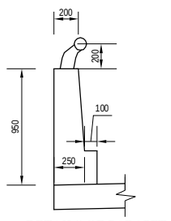
SECTION C-C

Scale 1 : 200



PLAN OF CULVERT

SCALE = 1:200



DETAILS OF PARAPET

Scale 1 :50

NAME OF THE CLIENT :

GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH

LOCAL GOVERNMENT ENGINEERING DEPARTMENT

NAME OF THE PROJECT :

CONSULTANCY SERVICES FOR FEASIBILITY, DETAILED SURVEY AND DESIGN OF CHITTAGONG HILL TRACT CONNECTIVITY CONNECTING THEGAMUKH AND CHITTAGONG PORT.

NAME OF THE CONSULTANTS :

SAI Consulting Engineers Pvt. Ltd, India.

in association with

BETS Consulting Services Ltd, Bangladesh

Project office :

Tahmid Mahmood Palace
Flat # 9A, House # 77, Road # 4, Block-C,

DRAWING TITLE :

DIMENSION DETAILS OF 1x6.0x4.5 RCC BOX CULVERT AT CH. 64+042 kM.

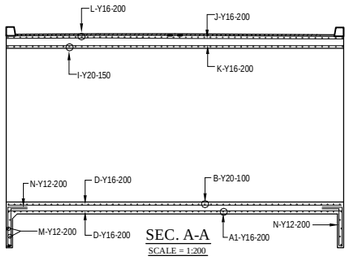
DRAWING NO : LGED/CUL-13/C-01

Scale :As shown

Date : 28-01-16

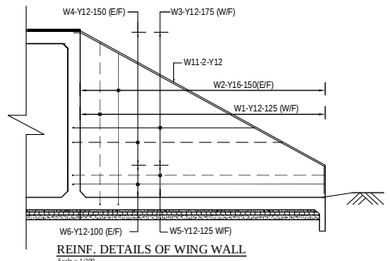
DESIGNED BY :	DRAWN BY :	CHECKED BY :	APPROVED BY :
MD. TAZUDDIN	MD. TAZUDDIN	AFM HAMIDUL HAQUE	DR. PRABHAT SHRIVASTAVA

REV.	DESCRIPTION	DATE



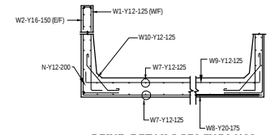
SEC. A-A

SCALE = 1:200



REINF. DETAILS OF WING WALL

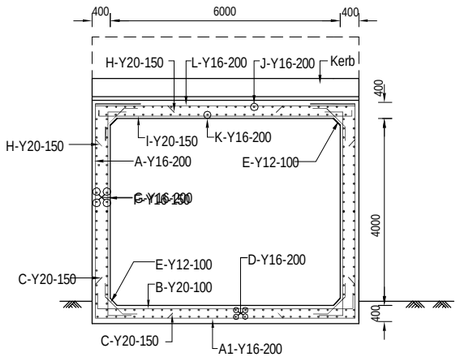
Scale = 1:200



REINF. DETAILS OF WING WALL

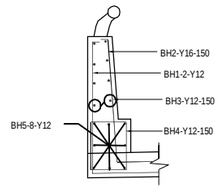
SEC. C-C

Scale 1 : 200



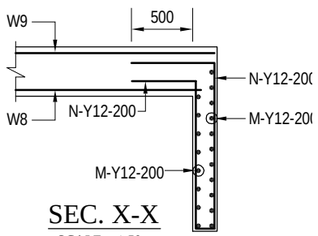
REINF. DETAILS OF BOX CULVERT

SCALE = 1:200



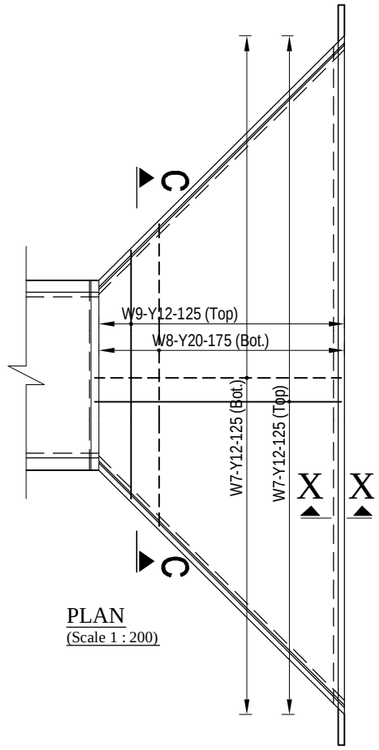
DETAILS OF PARAPET

Scale 1 : 50



SEC. X-X

SCALE = 1:50



PLAN

(Scale 1 : 200)

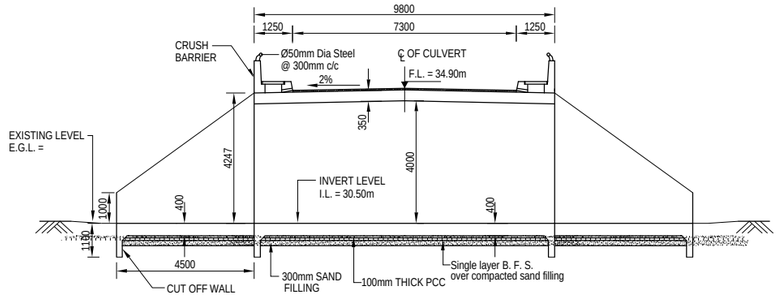
NOTE :

E/F : Earth face

W/F : Water fa

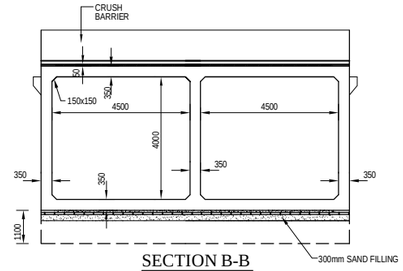
NAME OF THE CLIENT :	GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH **LOCAL GOVERNMENT ENGINEERING DEPARTMENT**
NAME OF THE PROJECT :	CONSULTANCY SERVICES FOR FEASIBILITY, DETAILED SURVEY AND DESIGN OF CHITTAGONG HILL TRACT CONNECTIVITY CONNECTING THEGAMUKH AND CHITTAGONG PORT.
NAME OF THE CONSULTANTS :	**SAI Consulting Engineers Pvt. Ltd, India.** in association with **BETS Consulting Services Ltd, Bangladesh** Project office : Tahmid Mahmood Palace Flat # 9A, House # 77, Road # 4, Block-C,
DRAWING TITLE :	REINF. DETAILS OF 1x6.0x4.5 RCC BOX CULVERT AT CH. 64+042 kM.
DRAWING NO :	LGED/CUL-13/RNF.-02
Scale :As shown	Date : 28-01-16
DESIGNED BY :	MD. TAZUDDIN
DRAWN BY :	MD. TAZUDDIN
CHECKED BY :	AFM HAMIDUL HAQUE
APPROVED BY :	DR. PRABHAT SHRIVASTAVA

REV.	DESCRIPTION	DATE



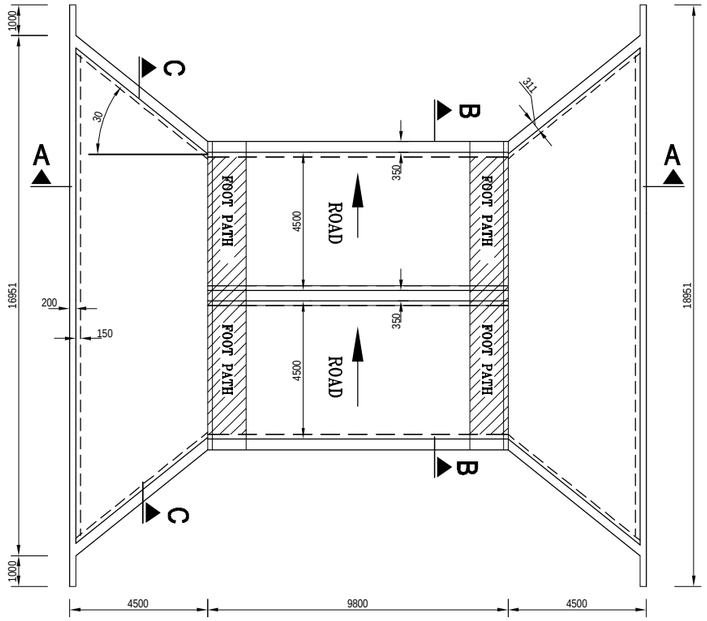
SECTION A-A (CULV. -06)

SCALE = 1:200



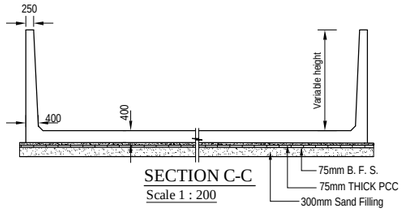
SECTION B-B

SCALE = 1:200



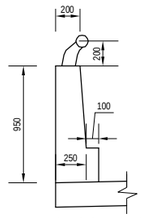
PLAN OF CULV.-06

SCALE = 1:200



SECTION C-C

Scale 1 : 200



DETAILS OF PARAPET

Scale 1 : 50

NAME OF THE CLIENT :

GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH

LOCAL GOVERNMENT ENGINEERING DEPARTMENT

NAME OF THE PROJECT :

CONSULTANCY SERVICES FOR FEASIBILITY, DETAILED SURVEY AND DESIGN OF CHITTAGONG HILL TRACT CONNECTIVITY CONNECTING THEGAMUKH AND CHITTAGONG PORT.

NAME OF THE CONSULTANTS :

SAI Consulting Engineers Pvt. Ltd, India.

in association with

BETS Consulting Services Ltd, Bangladesh

Project office :

Tahmid Mahmood Palace
Flat # 9A, House # 77, Road # 4, Block-C,

DRAWING TITLE :

DIMENSION DETAILS OF 2x4.5x4.0 RCC BOX CULVERT AT CH. 67+183 kM.

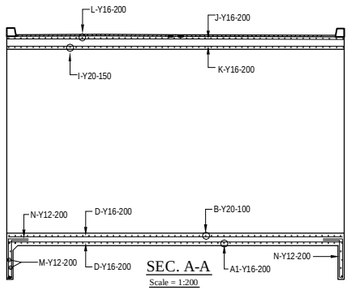
DRAWING NO : LGED/CUL-14/CO-01

Scale :As shown

Date : 28-01-16

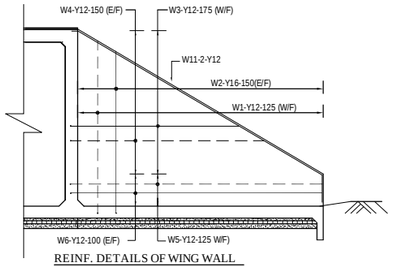
DESIGNED BY :	DRAWN BY :	CHECKED BY :	APPROVED BY :
MD. TAZUDDIN	MD. TAZUDDIN	AFM HAMIDUL HAQUE	DR. PRABHAT SHRIVASTAVA

REV.	DESCRIPTION	DATE



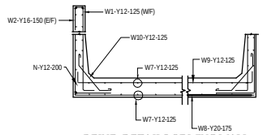
SEC. A-A

Scale = 1:200

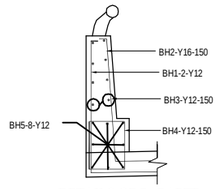


REINF. DETAILS OF WING WALL

Scale = 1:200

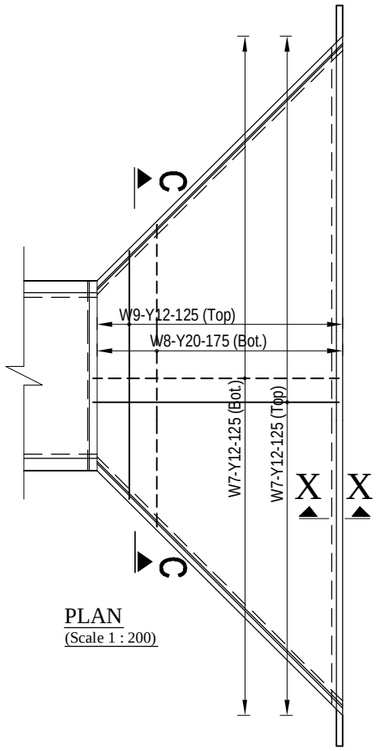


REINF. DETAILS OF WING WALL
SEC. C-C
Scale 1 : 200



DETAILS OF PARAPET

Scale 1 : 50

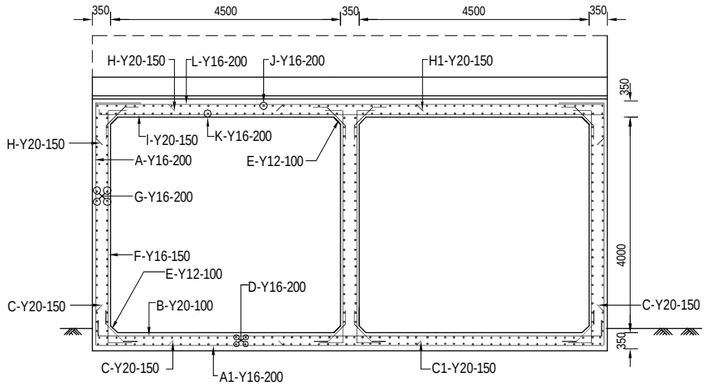


PLAN

(Scale 1 : 200)

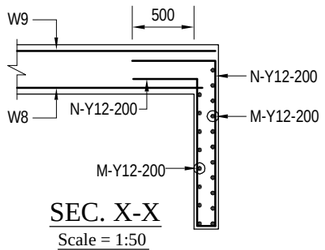
NOTE :

E/F : Earth face
W/F : Water fa



REINF. DETAILS OF BOX CULVERT

Scale = 1:200



SEC. X-X

Scale = 1:50

NAME OF THE CLIENT :

GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH

LOCAL GOVERNMENT ENGINEERING DEPARTMENT

NAME OF THE PROJECT :

CONSULTANCY SERVICES FOR FEASIBILITY, DETAILED SURVEY AND DESIGN OF CHITTAGONG HILL TRACT CONNECTIVITY CONNECTING THEGAMUKH AND CHITTAGONG PORT.

NAME OF THE CONSULTANTS :

SAI Consulting Engineers Pvt. Ltd, India.

in association with

BETS Consulting Services Ltd, Bangladesh

Project office :

Tahmid Mahmood Palace
Flat # 9A, House # 77, Road # 4, Block-C,

DRAWING TITLE :

REINF. DETAILS OF 2x4.5x4.0 RCC BOX CULVERT AT CH. 67+183 kM.

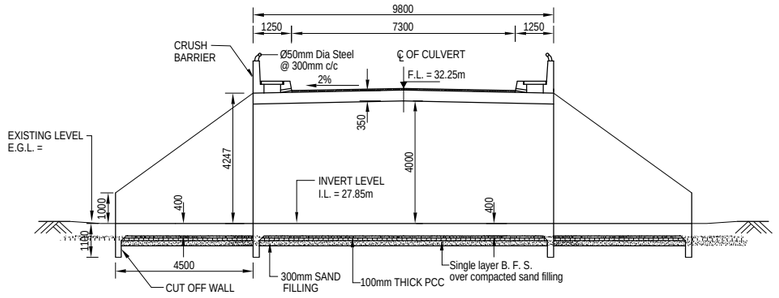
DRAWING NO : LGED/CUL-14/RNF.-02

Scale :As shown

Date : 28-01-16

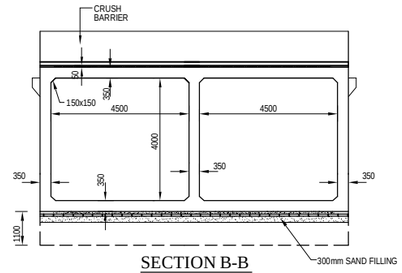
DESIGNED BY :	DRAWN BY :	CHECKED BY :	APPROVED BY :
MD. TAZUDDIN	MD. TAZUDDIN	AFM HAMIDUL HAQUE	DR. PRABHAT SHRIVASTAVA

REV.	DESCRIPTION	DATE



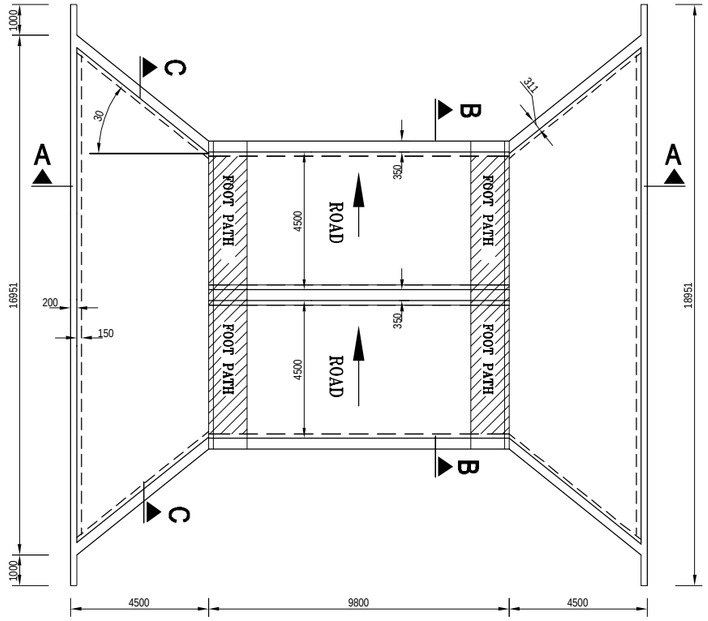
SECTION A-A (CULV. -06)

SCALE = 1:200



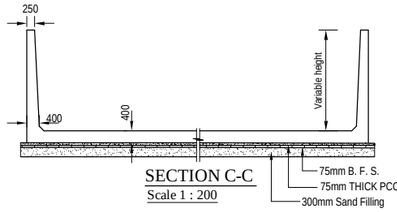
SECTION B-B

SCALE = 1:200



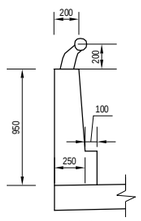
PLAN OF CULV.-06

SCALE = 1:200



SECTION C-C

Scale 1 : 200



DETAILS OF PARAPET

Scale 1 : 50

NAME OF THE CLIENT :

GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH

LOCAL GOVERNMENT ENGINEERING DEPARTMENT

NAME OF THE PROJECT :

CONSULTANCY SERVICES FOR FEASIBILITY, DETAILED SURVEY AND DESIGN OF CHITTAGONG HILL TRACT CONNECTIVITY CONNECTING THEGAMUKH AND CHITTAGONG PORT.

NAME OF THE CONSULTANTS :

SAI Consulting Engineers Pvt. Ltd, India.

in association with

BETS Consulting Services Ltd, Bangladesh

Project office :

Tahmid Mahmood Palace
Flat # 9A, House # 77, Road # 4, Block-C,

DRAWING TITLE :

DIMENSION DETAILS OF 2x4.5x4.0 RCC BOX CULVERT AT CH. 73+730 kM.

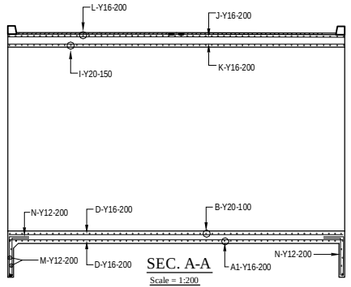
DRAWING NO : LGED/CUL-15/CON-01

Scale :As shown

Date : 28-01-16

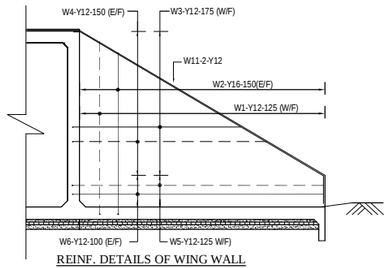
DESIGNED BY :	DRAWN BY :	CHECKED BY :	APPROVED BY :
MD. TAZUDDIN	MD. TAZUDDIN	AFM HAMIDUL HAQUE	DR. PRABHAT SHRIVASTAVA

REV.	DESCRIPTION	DATE



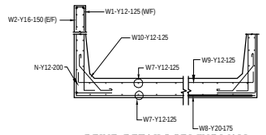
SEC. A-A

Scale = 1:200



REINF. DETAILS OF WING WALL

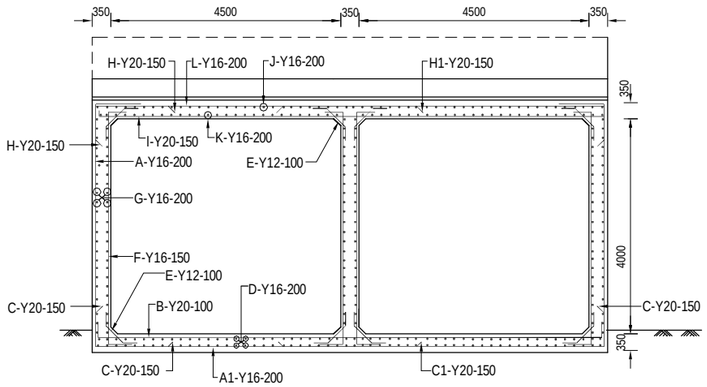
Scale = 1:200



REINF. DETAILS OF WING WALL

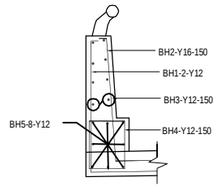
SEC. C-C

Scale 1 : 200



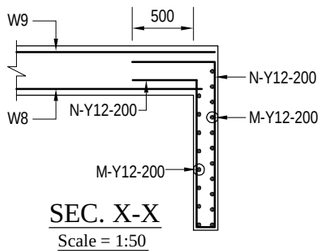
REINF. DETAILS OF BOX CULVERT

Scale = 1:200



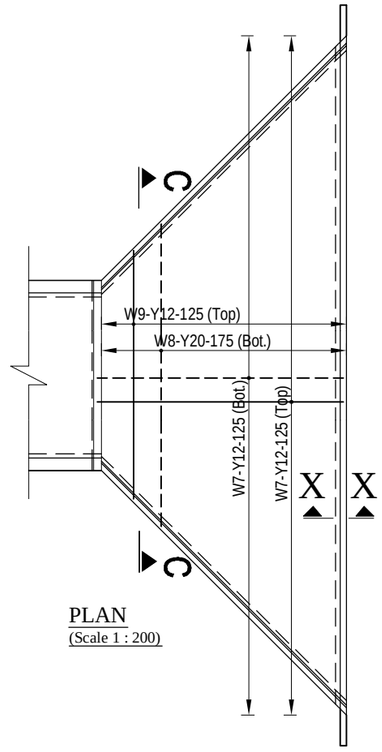
DETAILS OF PARAPET

Scale 1 : 50



SEC. X-X

Scale = 1:50



PLAN

(Scale 1 : 200)

NOTE :

E/F : Earth face

W/F : Water fa

NAME OF THE CLIENT :

GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH

LOCAL GOVERNMENT ENGINEERING DEPARTMENT

NAME OF THE PROJECT :

CONSULTANCY SERVICES FOR FEASIBILITY, DETAILED SURVEY AND DESIGN OF CHITTAGONG HILL TRACT CONNECTIVITY CONNECTING THEGAMUKH AND CHITTAGONG PORT.

NAME OF THE CONSULTANTS :

SAI Consulting Engineers Pvt. Ltd, India.

in association with

BETS Consulting Services Ltd, Bangladesh

Project office :

Tahmid Mahmood Palace
Flat # 9A, House # 77, Road # 4, Block-C,

DRAWING TITLE :

REINF. DETAILS OF 2x4.5x4.0 RCC BOX CULVERT AT CH. 73+730 kM.

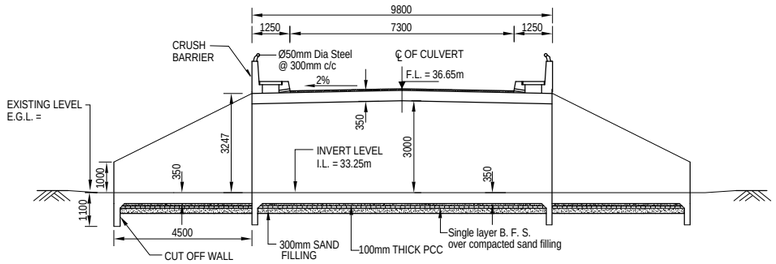
DRAWING NO : LGED/CUL-15/RNF.-02

Scale :As shown

Date : 28-01-16

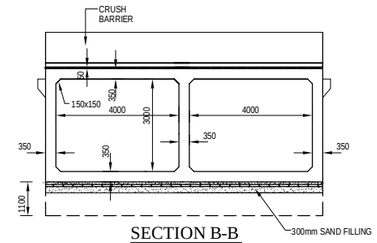
DESIGNED BY :	DRAWN BY :	CHECKED BY :	APPROVED BY :
MD. TAZUDDIN	MD. TAZUDDIN	AFM HAMIDUL HAQUE	DR. PRABHAT SHRIVASTAVA

REV.	DESCRIPTION	DATE



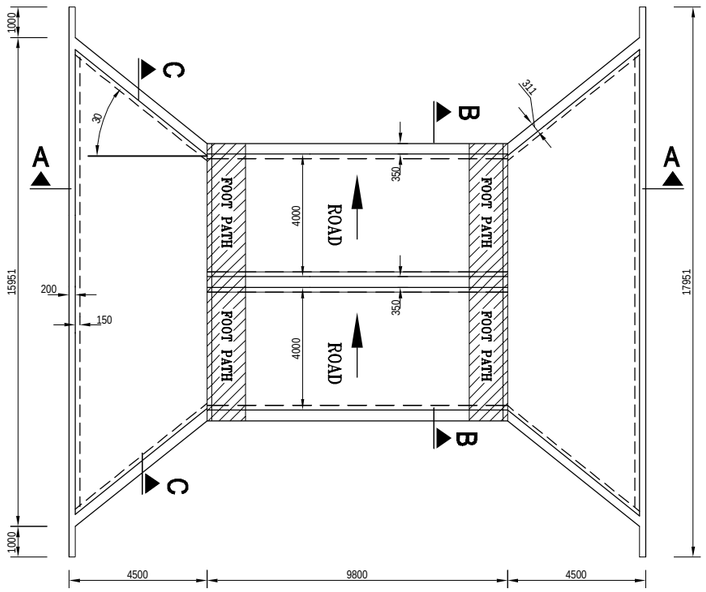
SECTION A-A (CULV. -06)

SCALE = 1:200



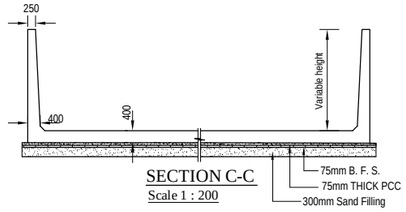
SECTION B-B

SCALE = 1:200



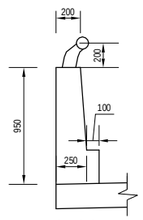
PLAN OF CULV.-06

SCALE = 1:200



SECTION C-C

Scale 1 : 200



DETAILS OF PARAPET

Scale 1 : 50

NAME OF THE CLIENT :

GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH

LOCAL GOVERNMENT ENGINEERING DEPARTMENT

NAME OF THE PROJECT :

CONSULTANCY SERVICES FOR FEASIBILITY, DETAILED SURVEY AND DESIGN OF CHITTAGONG HILL TRACT CONNECTIVITY CONNECTING THEGAMUKH AND CHITTAGONG PORT.

NAME OF THE CONSULTANTS :

SAI Consulting Engineers Pvt. Ltd, India.

in association with

BETS Consulting Services Ltd, Bangladesh

Project office :

Tahmid Mahmood Palace
Flat # 9A, House # 77, Road # 4, Block-C,

DRAWING TITLE :

DIMENSION DETAILS OF 2x4.0x3.0 RCC BOX CULVERT AT CH. 74+567 kM.

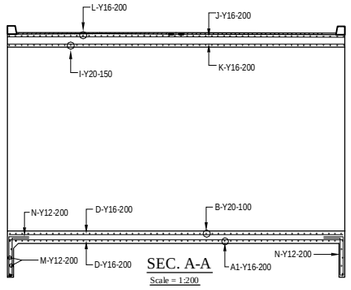
DRAWING NO : LGED/CUL-16/CON-01

Scale :As shown

Date : 28-01-16

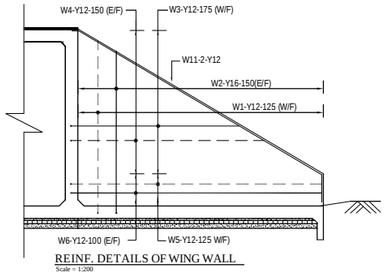
DESIGNED BY :	DRAWN BY :	CHECKED BY :	APPROVED BY :
MD. TAZUDDIN	MD. TAZUDDIN	AFM HAMIDUL HAQUE	DR. PRABHAT SHRIVASTAVA

REV.	DESCRIPTION	DATE



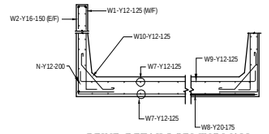
SEC. A-A

Scale = 1:200



REINF. DETAILS OF WING WALL

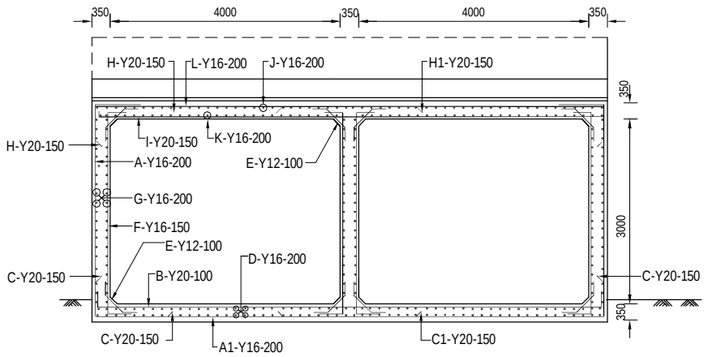
Scale = 1:200



REINF. DETAILS OF WING WALL

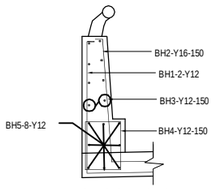
SEC. C-C

Scale 1 : 200



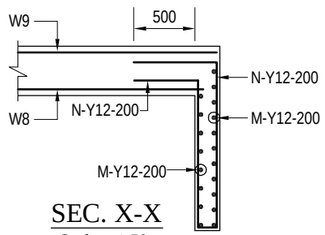
REINF. DETAILS OF BOX CULVERT

Scale = 1:200



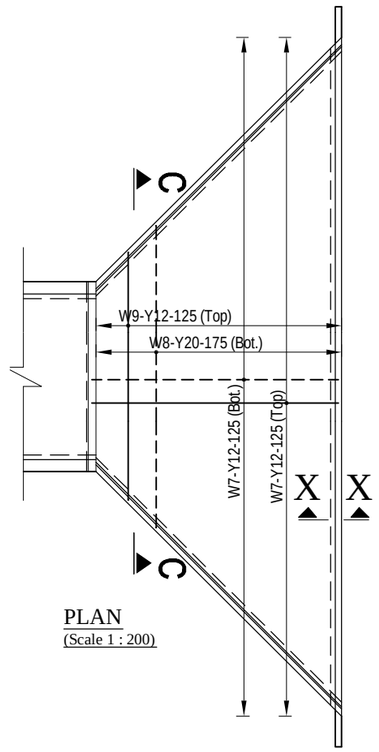
DETAILS OF PARAPET

Scale 1 : 50



SEC. X-X

Scale = 1:50



PLAN

(Scale 1 : 200)

NOTE :

E/F : Earth face

W/F : Water fa

NAME OF THE CLIENT :

GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH

LOCAL GOVERNMENT ENGINEERING DEPARTMENT

NAME OF THE PROJECT :

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in association with

BETS Consulting Services Ltd, Bangladesh

Project office :

Tahmid Mahmood Palace
Flat # 9A, House # 77, Road # 4, Block-C,

DRAWING TITLE :

REINF. DETAILS OF 2x4.0x3.0 RCC BOX CULVERT AT CH. 74+567 kM.

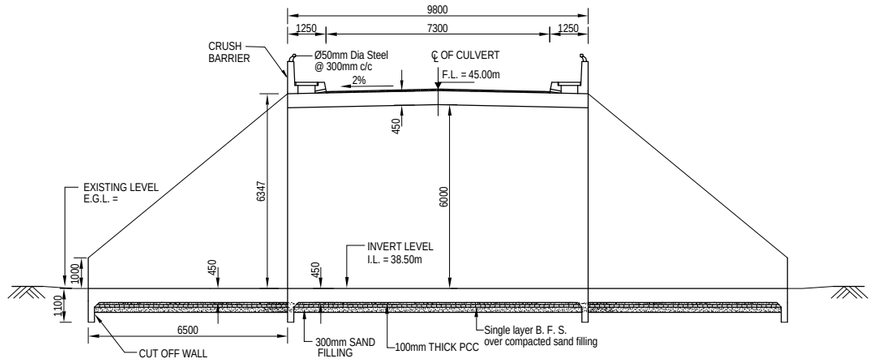
DRAWING NO : LGED/CUL-16/RNF.-02

Scale :As shown

Date : 28-01-16

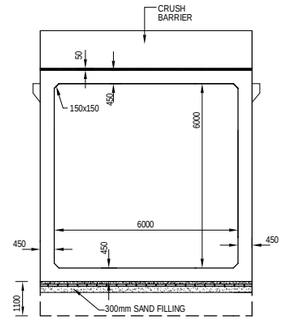
DESIGNED BY :	DRAWN BY :	CHECKED BY :	APPROVED BY :
MD. TAZUDDIN	MD. TAZUDDIN	AFM HAMIDUL HAQUE	DR. PRABHAT SHRIVASTAVA

REV.	DESCRIPTION	DATE



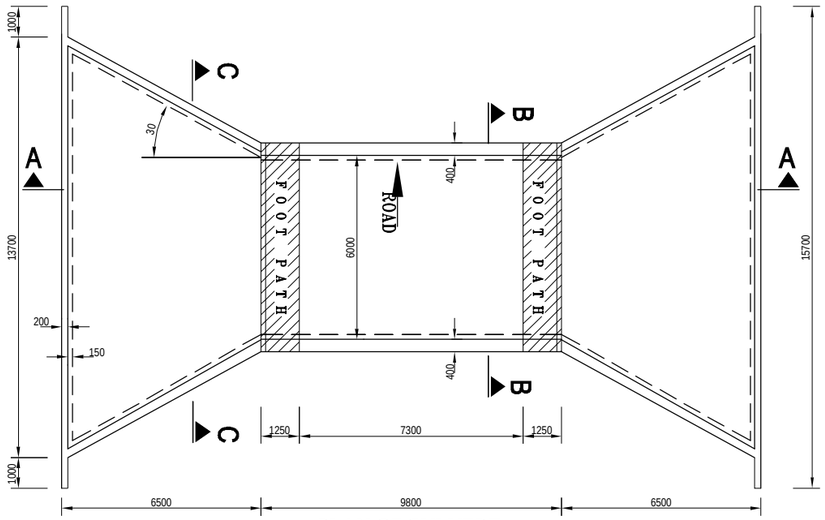
SECTION A-A

SCALE = 1:200



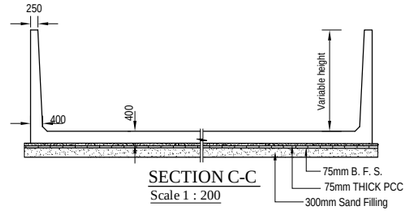
SECTION B-B

SCALE = 1:200



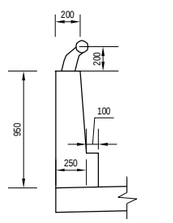
PLAN OF CULVERT

SCALE = 1:200



SECTION C-C

Scale 1 : 200



DETAILS OF PARAPET

Scale 1 : 50

NAME OF THE CLIENT :

GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH

LOCAL GOVERNMENT ENGINEERING DEPARTMENT

NAME OF THE PROJECT :

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in association with

BETS Consulting Services Ltd, Bangladesh

Project office :

Tahmid Mahmood Palace
Flat # 9A, House # 77, Road # 4, Block-C,

DRAWING TITLE :

DIMENSION DETAILS OF 1x6.0x6.0 RCC BOX CULVERT AT CH. 75+615 kM.

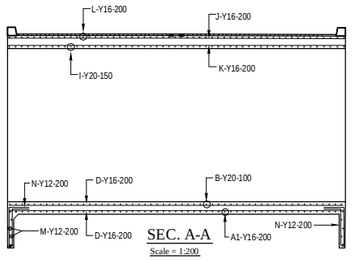
DRAWING NO : LGED/CUL-17/CON.-01

Scale :As shown

Date : 28-01-16

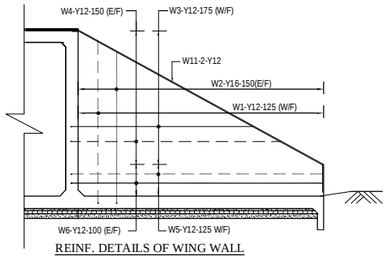
DESIGNED BY :	DRAWN BY :	CHECKED BY :	APPROVED BY :
MD. TAZUDDIN	MD. TAZUDDIN	AFM HAMIDUL HAQUE	DR. PRABHAT SHRIVASTAVA

REV.	DESCRIPTION	DATE



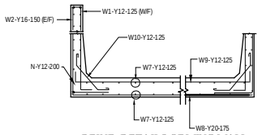
SEC. A-A

Scale = 1:200



REINF. DETAILS OF WING WALL

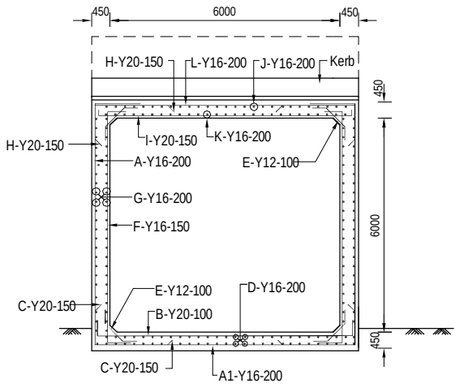
Scale = 1:200



REINF. DETAILS OF WING WALL

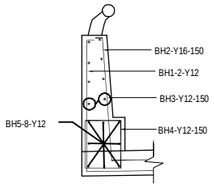
SEC. C-C

Scale 1 : 200



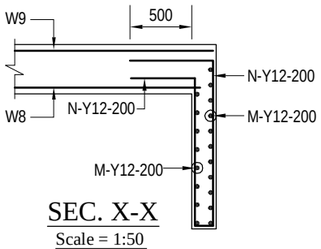
REINF. DETAILS OF BOX CULVERT

Scale = 1:200



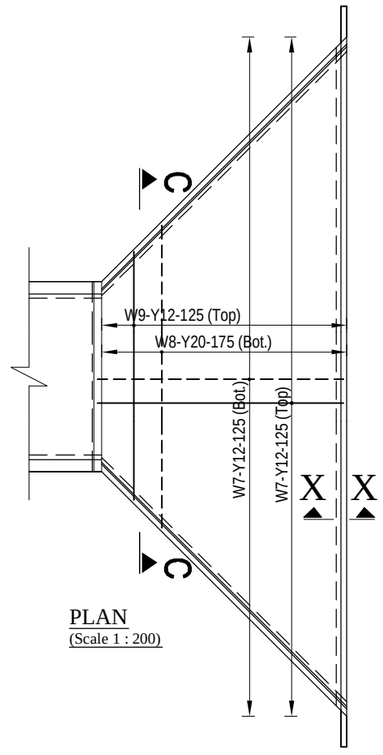
DETAILS OF PARAPET

Scale 1: 50



SEC. X-X

Scale = 1:50



PLAN

(Scale 1 : 200)

NOTE :

E/F : Earth face
W/F : Water fa

NAME OF THE CLIENT :

GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH

LOCAL GOVERNMENT ENGINEERING DEPARTMENT

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BETS Consulting Services Ltd, Bangladesh

Project office :

Tahmid Mahmood Palace
Flat # 9A, House # 77, Road # 4, Block-C,

DRAWING TITLE :

REINF. DETAILS OF 1x6.0x6.0 RCC BOX CULVERT AT CH. 75+615 kM.

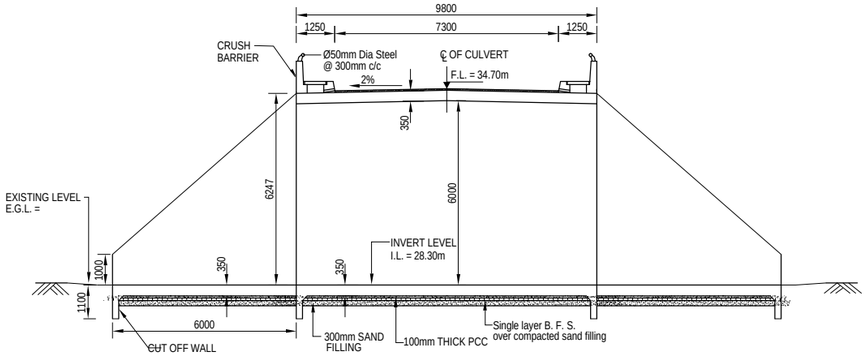
DRAWING NO : LGED/CUL-17/RNF.-02

Scale :As shown

Date : 28-01-16

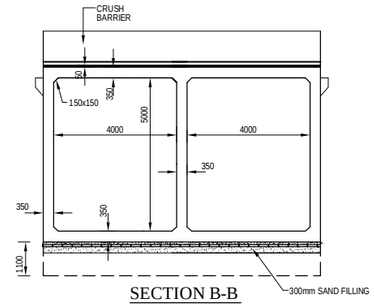
DESIGNED BY :	DRAWN BY :	CHECKED BY :	APPROVED BY :
MD. TAZUDDIN	MD. TAZUDDIN	AFM HAMIDUL HAQUE	DR. PRABHAT SHRIVASTAVA

REV.	DESCRIPTION	DATE



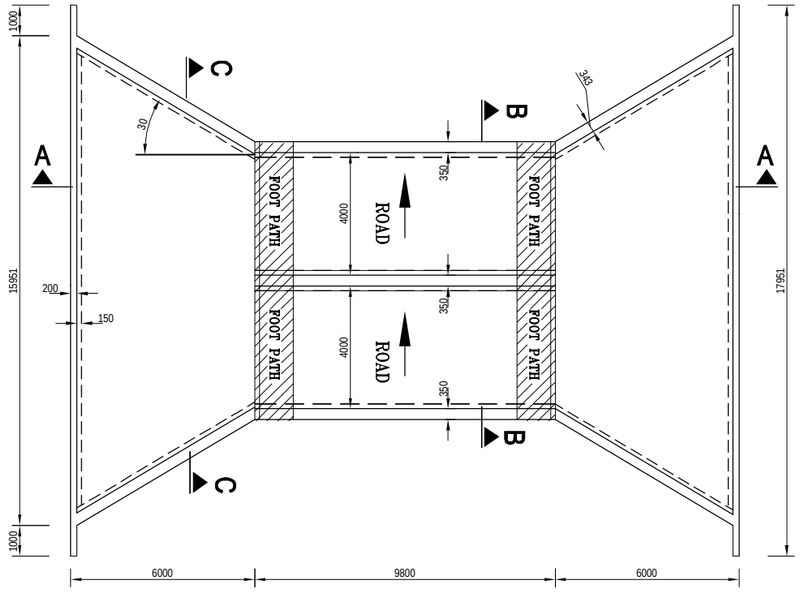
SECTION A-A (CULV. -06)

SCALE = 1:200



SECTION B-B

SCALE = 1:200



PLAN OF CULV.-06

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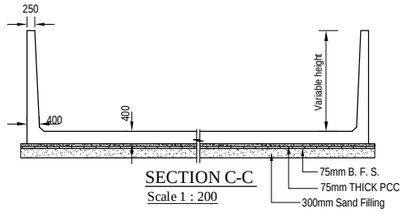
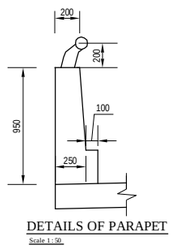


SECTION C-C

Scale 1 : 200



DETAILS OF PARAPET

Scale 1 : 50

NAME OF THE CLIENT :

GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH

LOCAL GOVERNMENT ENGINEERING DEPARTMENT

NAME OF THE PROJECT :

CONSULTANCY SERVICES FOR FEASIBILITY, DETAILED SURVEY AND DESIGN OF CHITTAGONG HILL TRACT CONNECTIVITY CONNECTING THEGAMUKH AND CHITTAGONG PORT.

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in association with

BETS Consulting Services Ltd, Bangladesh

Project office :

Tahmid Mahmood Palace
Flat # 9A, House # 77, Road # 4, Block-C,

DRAWING TITLE :

DIMENSION DETAILS OF 2x4.0x5.0 RCC BOX CULVERT AT CH. 82+980 kM.

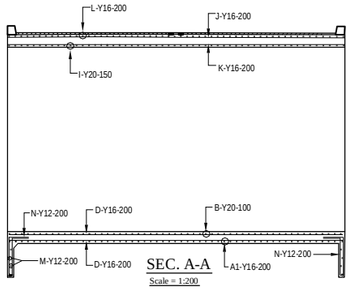
DRAWING NO : LGED/CUL-18/CON.-01

Scale :As shown

Date : 28-01-16

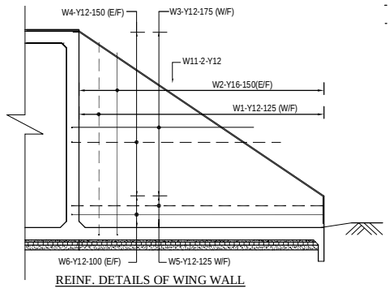
DESIGNED BY :	DRAWN BY :	CHECKED BY :	APPROVED BY :
MD. TAZUDDIN	MD. TAZUDDIN	AFM HAMIDUL HAQUE	DR. PRABHAT SHRIVASTAVA

REV.	DESCRIPTION	DATE



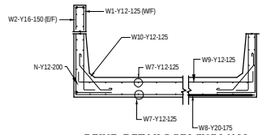
SEC. A-A

Scale = 1:200



REINF. DETAILS OF WING WALL

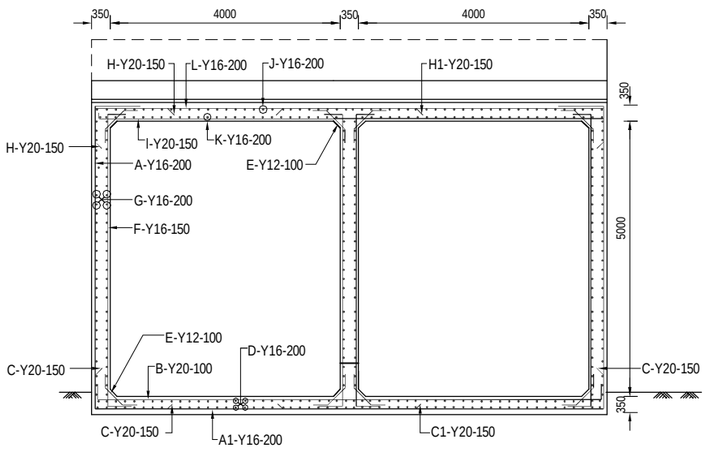
Scale = 1:200



REINF. DETAILS OF WING WALL

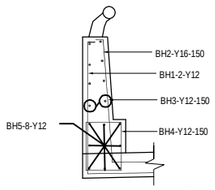
SEC. C-C

Scale 1 : 200



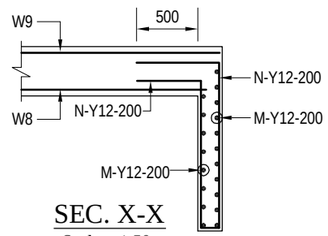
REINF. DETAILS OF BOX CULVERT

Scale = 1:200



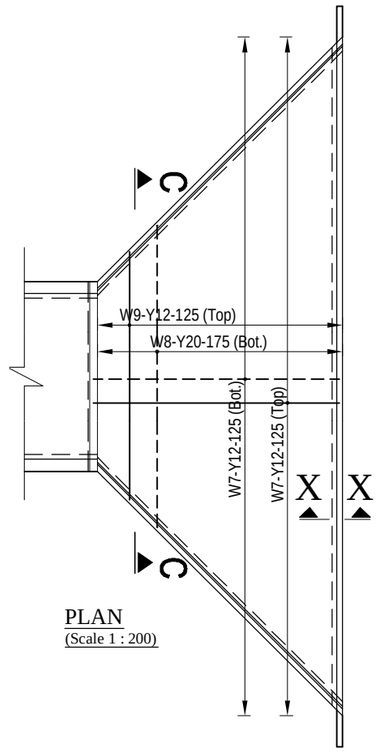
DETAILS OF PARAPET

Scale 1 : 50



SEC. X-X

Scale = 1:50



PLAN

(Scale 1 : 200)

NOTE :

E/F : Earth face

W/F : Water fa

NAME OF THE CLIENT :

GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH

LOCAL GOVERNMENT ENGINEERING DEPARTMENT

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DRAWING TITLE :

REINF. DETAILS OF 2x4.0x5.0 RCC BOX CULVERT AT CH. 82+980 kM.

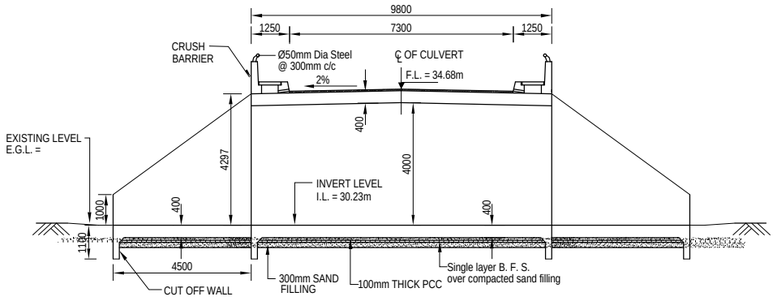
DRAWING NO : LGED/CUL-18/RNF.-02

Scale :As shown

Date : 28-01-16

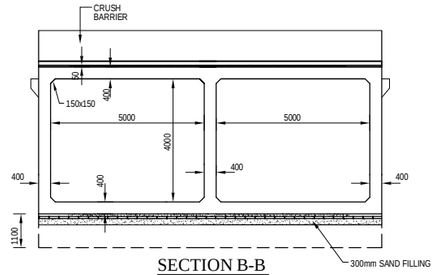
DESIGNED BY :	DRAWN BY :	CHECKED BY :	APPROVED BY :
MD. TAZUDDIN	MD. TAZUDDIN	AFM HAMIDUL HAQUE	DR. PRABHAT SHRIVASTAVA

REV.	DESCRIPTION	DATE



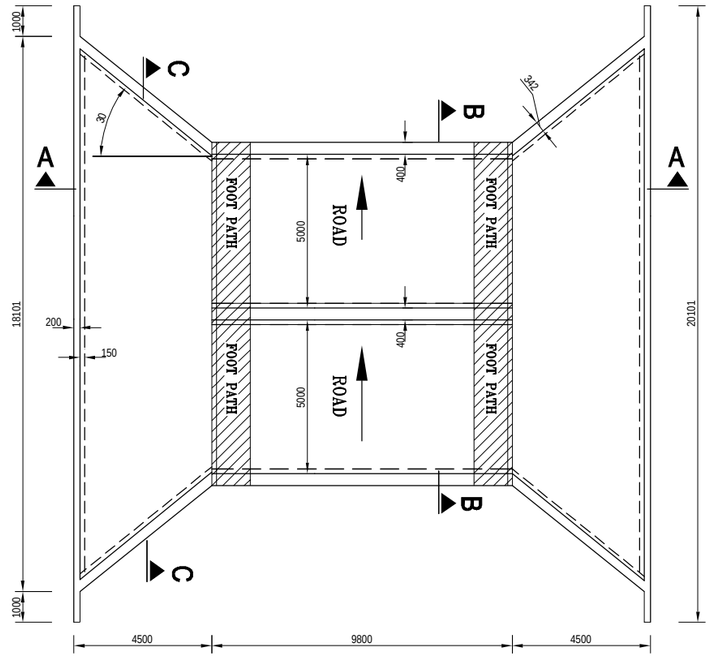
SECTION A-A (CULV. -06)

SCALE = 1:200



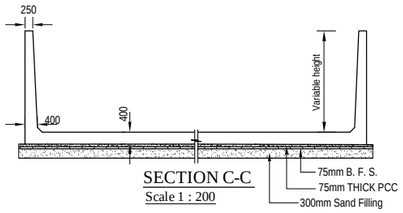
SECTION B-B

SCALE = 1:200



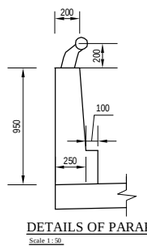
PLAN OF CULV.

SCALE = 1:200



SECTION C-C

Scale 1 : 200



DETAILS OF PARAPET

Scale 1 : 50

NAME OF THE CLIENT :

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Project office :

Tahmid Mahmood Palace
Flat # 9A, House # 77, Road # 4, Block-C,

DRAWING TITLE :

DIMENSION DETAILS OF 2x5.0x4.0 RCC BOX CULVERT AT CH. 85+638 kM.

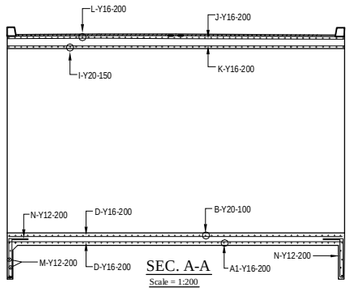
DRAWING NO : LGED/CUL-19/CON.-01

Scale :As shown

Date : 28-01-16

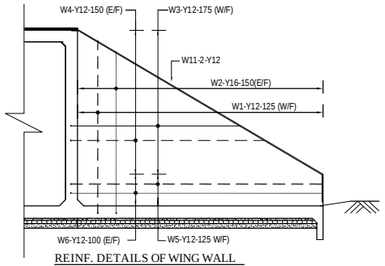
DESIGNED BY :	DRAWN BY :	CHECKED BY :	APPROVED BY :
MD. TAZUDDIN	MD. TAZUDDIN	AFM HAMIDUL HAQUE	DR. PRABHAT SHRIVASTAVA

REV.	DESCRIPTION	DATE



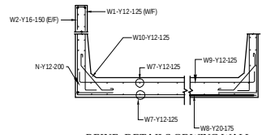
SEC. A-A

Scale = 1:200



REINF. DETAILS OF WING WALL

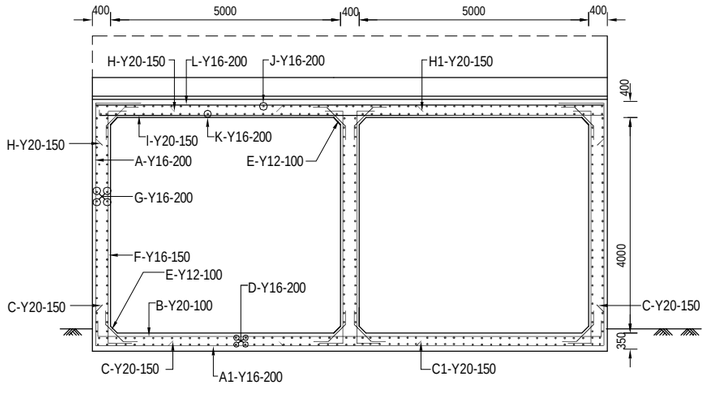
Scale = 1:200



REINF. DETAILS OF WING WALL

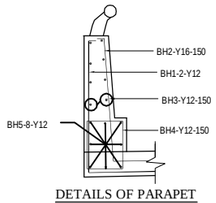
SEC. C-C

Scale 1 : 200



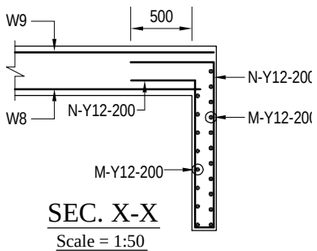
REINF. DETAILS OF BOX CULVERT

Scale = 1:200



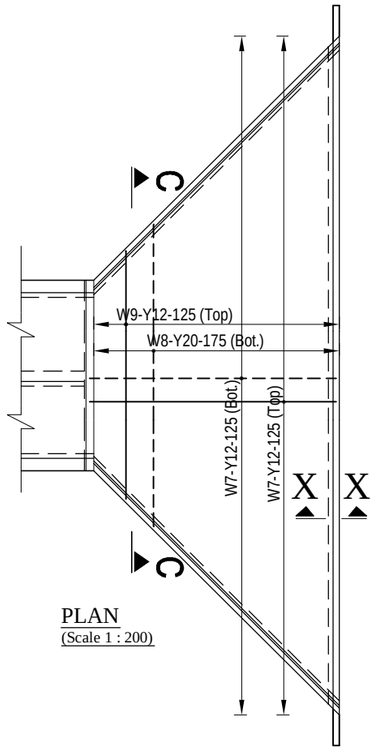
DETAILS OF PARAPET

Scale 1 : 50



SEC. X-X

Scale = 1:50



PLAN

(Scale 1 : 200)

NOTE :

E/F : Earth face

W/F : Water fa

NAME OF THE CLIENT :

GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH

LOCAL GOVERNMENT ENGINEERING DEPARTMENT

NAME OF THE PROJECT :

CONSULTANCY SERVICES FOR FEASIBILITY, DETAILED SURVEY AND DESIGN OF CHITTAGONG HILL TRACT CONNECTIVITY CONNECTING THEGAMUKH AND CHITTAGONG PORT.

NAME OF THE CONSULTANTS :

SAI Consulting Engineers Pvt. Ltd, India.

in association with

BETS Consulting Services Ltd, Bangladesh

Project office :

Tahmid Mahmood Palace

Flat # 9A, House # 77, Road # 4, Block-C,

DRAWING TITLE :

REINF. DETAILS OF 2x5.0x4.0 RCC BOX CULVERT AT CH. 85+638 kM.

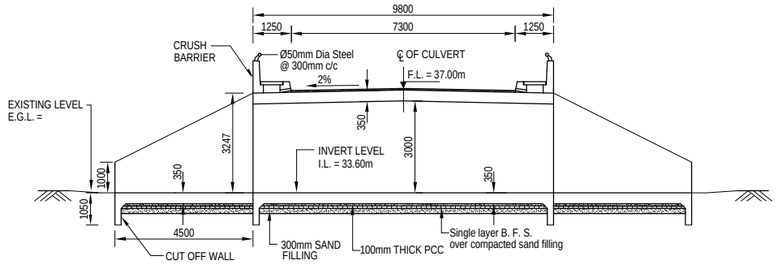
DRAWING NO : LGED/CUL-19/RNF.-02

Scale :As shown

Date : 28-01-16

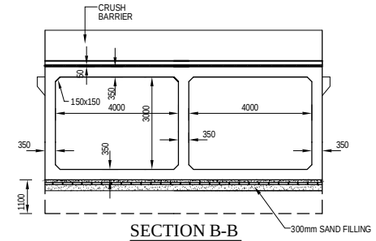
DESIGNED BY :	DRAWN BY :	CHECKED BY :	APPROVED BY :
MD. TAZUDDIN	MD. TAZUDDIN	AFM HAMIDUL HAQUE	DR. PRABHAT SHRIVASTAVA

REV.	DESCRIPTION	DATE



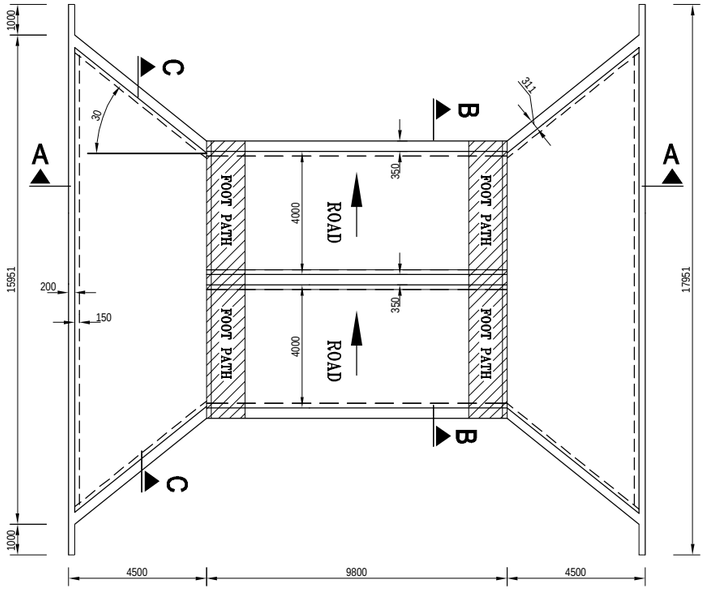
SECTION A-A (CULV. -06)

SCALE = 1:150



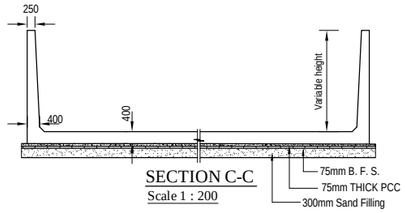
SECTION B-B

SCALE = 1:200



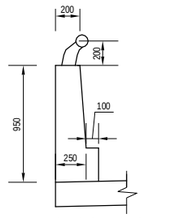
PLAN OF CULV.-06

SCALE = 1:150



SECTION C-C

Scale 1 : 200



DETAILS OF PARAPET

Scale 1 : 50

NAME OF THE CLIENT :

GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH

LOCAL GOVERNMENT ENGINEERING DEPARTMENT

NAME OF THE PROJECT :

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NAME OF THE CONSULTANTS :

SAI Consulting Engineers Pvt. Ltd, India.

in association with

BETS Consulting Services Ltd, Bangladesh

Project office :

Tahmid Mahmood Palace
Flat # 9A, House # 77, Road # 4, Block-C,

DRAWING TITLE :

DIMENSION DETAILS OF 2x4.0x3.0 RCC BOX CULVERT AT CH. 87+059 kM.

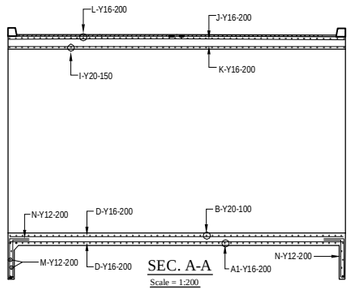
DRAWING NO : LGED/CUL-20/CON.-01

Scale :As shown

Date : 28-01-16

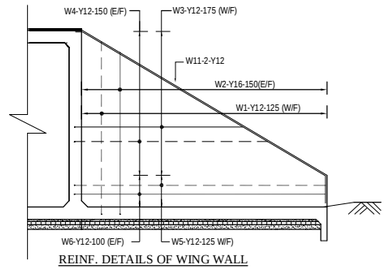
DESIGNED BY :	DRAWN BY :	CHECKED BY :	APPROVED BY :
MD. TAZUDDIN	MD. TAZUDDIN	AFM HAMIDUL HAQUE	DR. PRABHAT SHRIVASTAVA

REV.	DESCRIPTION	DATE

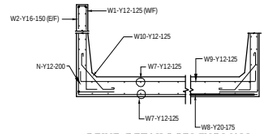


SEC. A-A

Scale = 1:200

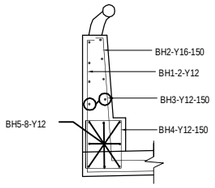


REINF. DETAILS OF WING WALL



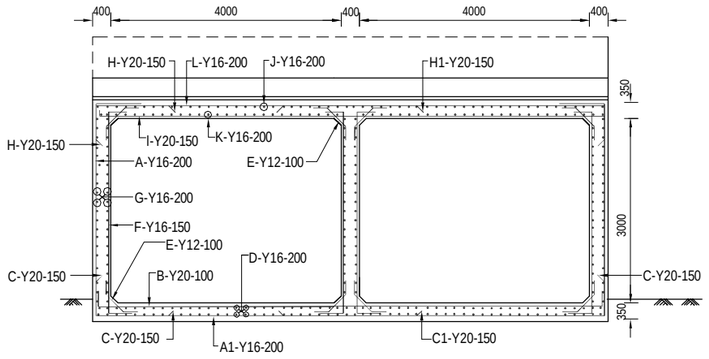
REINF. DETAILS OF WING WALL SEC. C-C

Scale 1 : 200



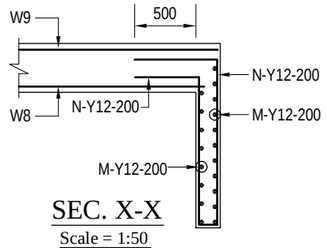
DETAILS OF PARAPET

Scale 1 : 50



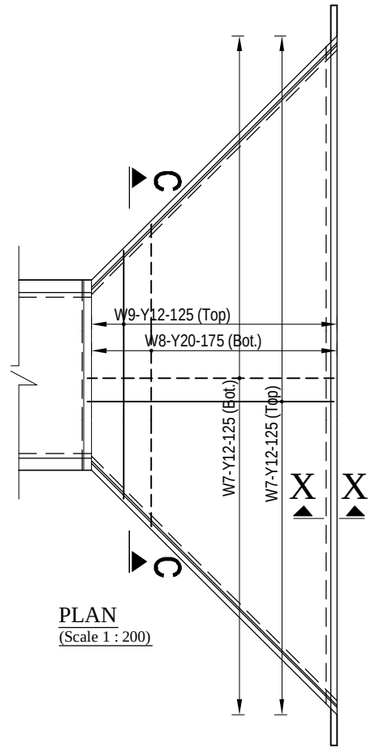
REINF. DETAILS OF BOX CULVERT

Scale = 1:200



SEC. X-X

Scale = 1:50



PLAN

(Scale 1 : 200)

NOTE :

E/F : Earth face

W/F : Water fa

NAME OF THE CLIENT :

GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH

LOCAL GOVERNMENT ENGINEERING DEPARTMENT

NAME OF THE PROJECT :

CONSULTANCY SERVICES FOR FEASIBILITY, DETAILED SURVEY AND DESIGN OF CHITTAGONG HILL TRACT CONNECTIVITY CONNECTING THEGAMUKH AND CHITTAGONG PORT.

NAME OF THE CONSULTANTS :

SAI Consulting Engineers Pvt. Ltd, India.

in association with

BETS Consulting Services Ltd, Bangladesh

Project office :

Tahmid Mahmood Palace

Flat # 9A, House # 77, Road # 4, Block-C,

DRAWING TITLE :

REINF. DETAILS OF 2x4.0x3.0 RCC BOX CULVERT AT CH. 87+059 kM.

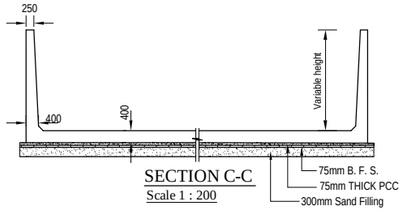
DRAWING NO : LGED/CUL-20/RNF.-02

Scale :As shown

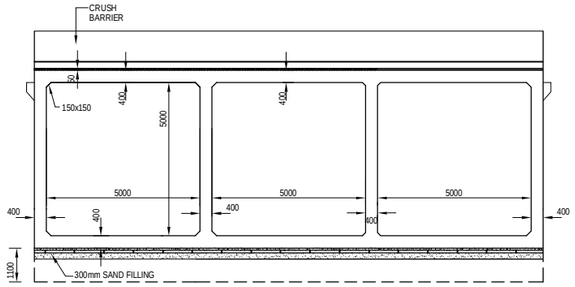
Date : 28-01-16

DESIGNED BY :	DRAWN BY :	CHECKED BY :	APPROVED BY :
MD. TAZUDDIN	MD. TAZUDDIN	AFM HAMIDUL HAQUE	DR. PRABHAT SHRIVASTAVA

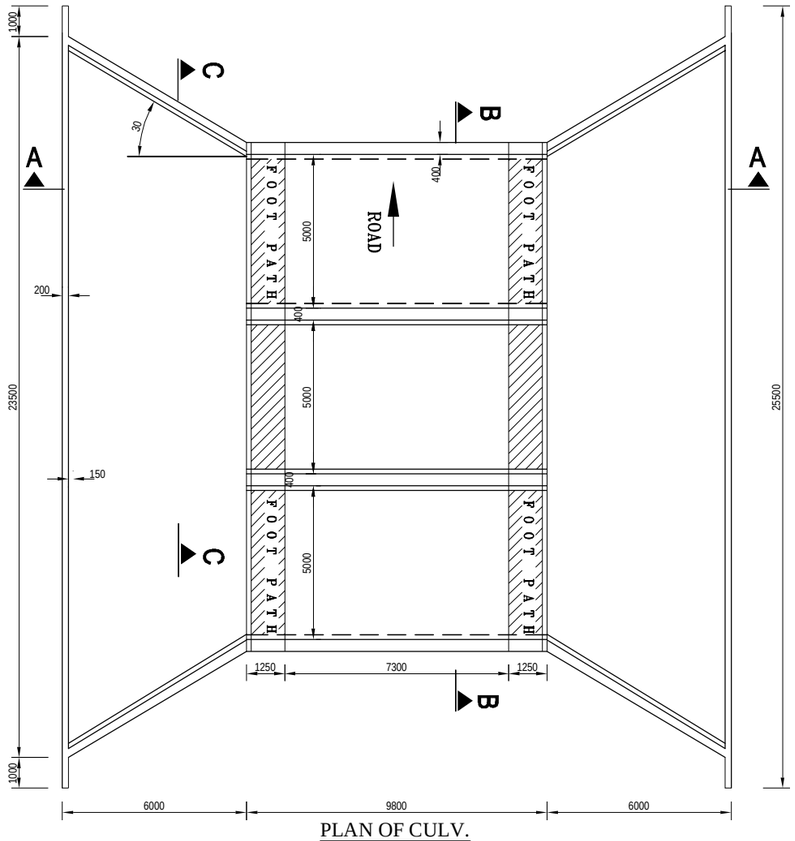
REV.	DESCRIPTION	DATE



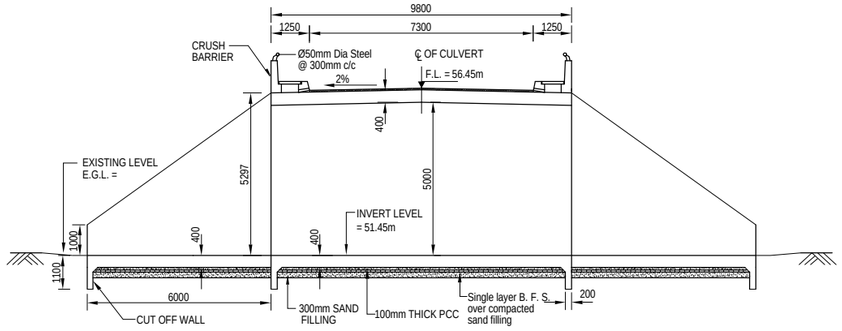
SECTION C-C
Scale 1 : 200



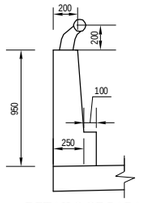
SECTION B-B
SCALE = 1:200



PLAN OF CULV.
SCALE = 1:200



SECTION A-A
SCALE = 1:200



DETAILS OF PARAPET
Scale 1 : 50

NAME OF THE CLIENT :
GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH
LOCAL GOVERNMENT ENGINEERING DEPARTMENT

NAME OF THE PROJECT :
CONSULTANCY SERVICES FOR FEASIBILITY, DETAILED SURVEY AND DESIGN OF CHITTAGONG HILL TRACT CONNECTIVITY CONNECTING THEGAMUKH AND CHITTAGONG PORT.

NAME OF THE CONSULTANTS :
SAI Consulting Engineers Pvt. Ltd, India.
in association with
BETS Consulting Services Ltd, Bangladesh
Project office :
Tahmid Mahmood Palace
Flat # 9A, House # 77, Road # 4, Block-C,

DRAWING TITLE :
DIMENSION DETAILS OF 3x5.0x5.0 RCC BOX CULVERT AT CH. 100+306 kM.

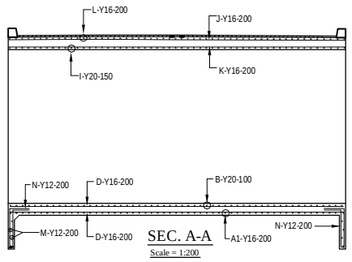
DRAWING NO : LGED/CUL-21/C-01

Scale :As shown

Date : 28-01-16

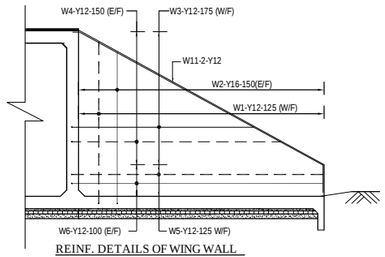
DESIGNED BY :	DRAWN BY :	CHECKED BY :	APPROVED BY :
MD. TAZUDDIN	MD. TAZUDDIN	AFM HAMIDUL HAQUE	DR. PRABHAT SHRIVASTAVA

REV.	DESCRIPTION	DATE



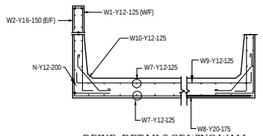
SEC. A-A

Scale = 1:200



REINF. DETAILS OF WING WALL

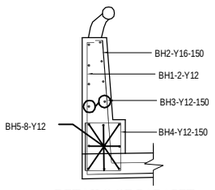
Scale = 1:200



REINF. DETAILS OF WING WALL

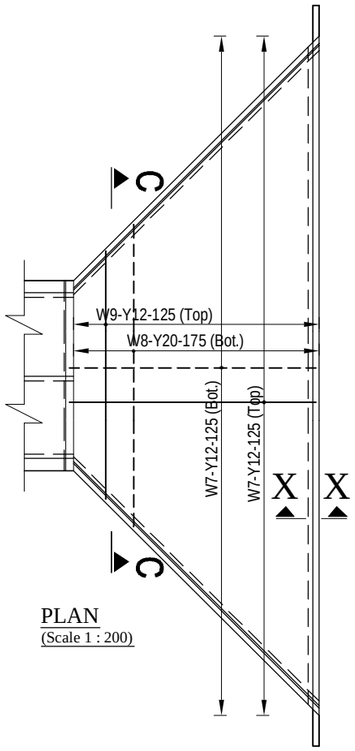
SEC. C-C

Scale 1 : 200



DETAILS OF PARAPET

Scale 1 : 50



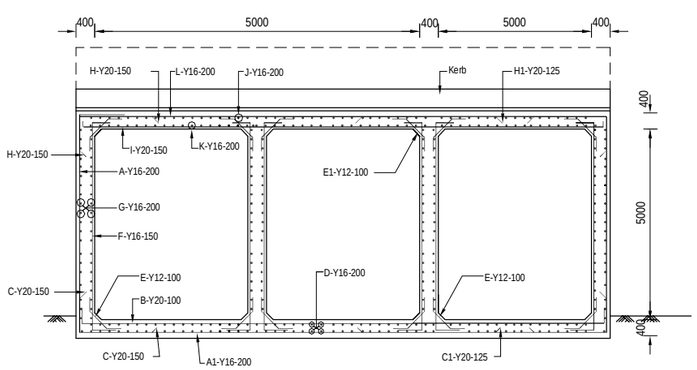
PLAN

(Scale 1 : 200)

NOTE :

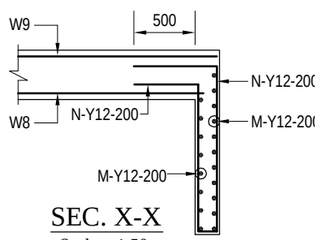
E/F : Earth face

W/F : Water fa



REINF. DETAILS OF BOX CULVERT

Scale = 1:200



SEC. X-X

Scale = 1:50

NAME OF THE CLIENT :

GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH

LOCAL GOVERNMENT ENGINEERING DEPARTMENT

NAME OF THE PROJECT :

CONSULTANCY SERVICES FOR FEASIBILITY, DETAILED SURVEY AND DESIGN OF CHITTAGONG HILL TRACT CONNECTIVITY CONNECTING THEGAMUKH AND CHITTAGONG PORT.

NAME OF THE CONSULTANTS :

SAI Consulting Engineers Pvt. Ltd, India.

in association with

BETS Consulting Services Ltd, Bangladesh

Project office :

Tahmid Mahmood Palace

Flat # 9A, House # 77, Road # 4, Block-C,

DRAWING TITLE :

REINF. DETAILS OF 3x5.0x5.0 RCC BOX CULVERT AT CH. 100+306 kM.

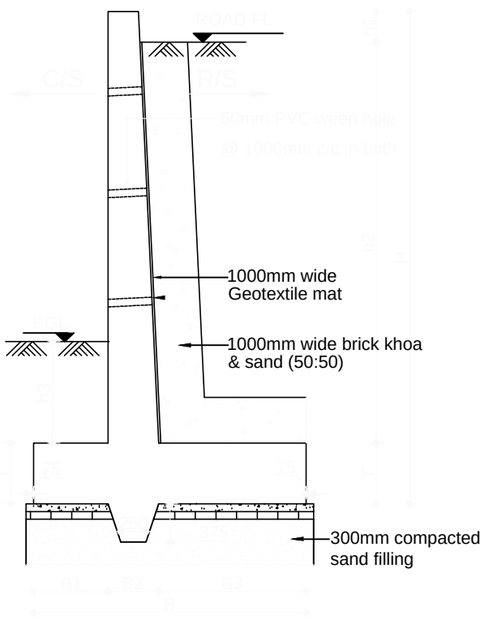
DRAWING NO : LGED/CUL-21/RNF.-02

Scale :As shown

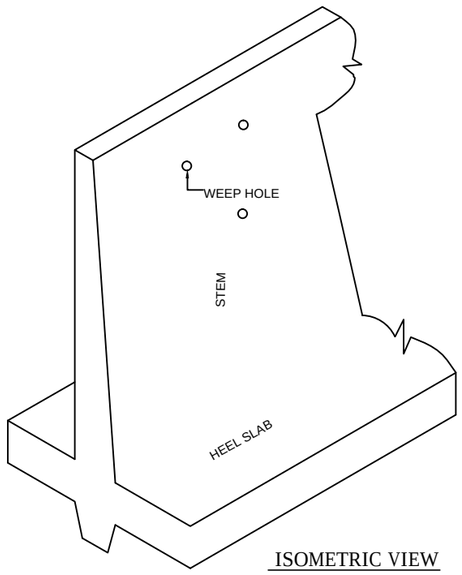
Date : 28-01-16

DESIGNED BY :	DRAWN BY :	CHECKED BY :	APPROVED BY :
MD. TAZUDDIN	MD. TAZUDDIN	AFM HAMIDUL HAQUE	DR. PRABHAT SHRIVASTAVA

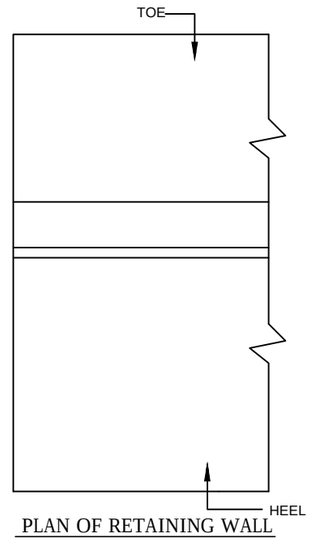
REV.	DESCRIPTION	DATE



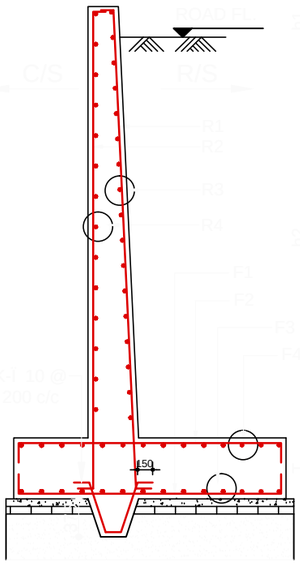
SECTIONAL ELEV. OF RCC RETAINING WALL (CONC.)
(Scale : 1:60)



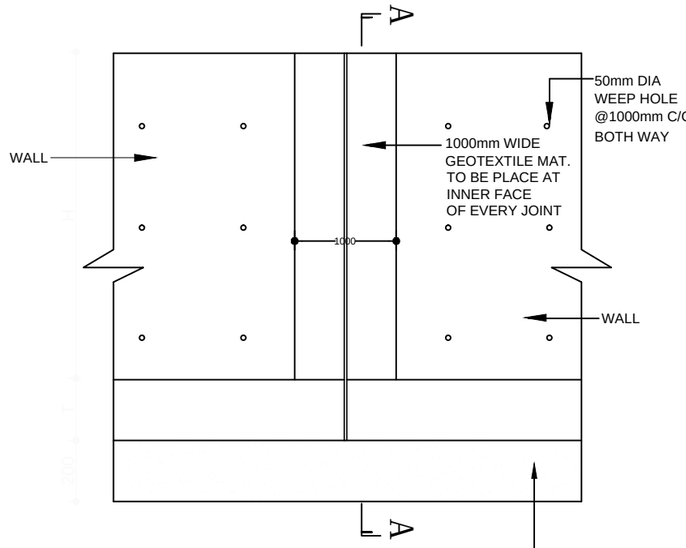
ISOMETRIC VIEW
(RETAINING WALL)



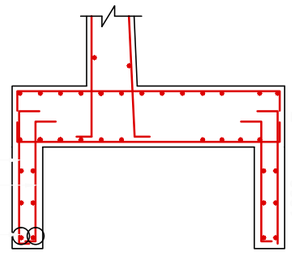
PLAN OF RETAINING WALL



SECTIONAL ELEV. OF RCC RETAINING WALL (REINF.)
(Scale : 1:60)



EARTH FACE ELEVATION OF WALL
(SHOWING JOINT)



(FOR ABOVE 6.0 TO 10.0m)
(Scale : 1:60)

NOTE :

1. FOR RETAINING WALL UPTO HEIGHT OF 6.0m SHEAR KEE TO BE PROVIDED.
2. FOR RETAINING WALL ABOVE 6.0m TO 10.0m CUTT-OFF WALL TO BE PROVIDED.

NOTE :

1. EXPANSION JOINT ON RETAINING WALL TO BE PROVIDED AT AN INTERVAL OF 27.5M
2. SAFE BEARING CAPACITY AT FOUNDATION LEVEL MUST BE MIN. 1.25 tsf FOR UPTO 7.0m HEIGHT.
   BUT FOR HEIGHT OF RETAINING WALL ABOVE 7.0m TO 10.0m BEARING CAPACITY REQD. MIN. 1.50 tsf.
3. IN THE HILL OR COUNTRY SIDE UP TO 6.0m HEIGHT SHALLOW FOUNDATION MAY BE PROVIDED.
4. IN THE RIVER SIDE ABOVE 6.0m HEIGHT PILE FOUNDATION MAY BE PROVIDED.
5. CONCRETE GRADE, f'c = 25 Mpa
6. FOR STEEL, fy = 410 Mpa

NAME OF THE CLIENT :
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NAME OF THE CONSULTANTS :
SAI Consulting Engineers Pvt. Ltd, India.
in association with
BETS Consulting Services Ltd, Bangladesh
Project office :
Tahmid Mahmood Palace
Flat # 9A, House # 77, Road # 4, Block-C,

DRAWING TITLE :
DETAILS OF RCC RETAINING WALL
(H = 3.0m TO 10.0m)

DRAWING NO : LGED/TYP-I/RW-01

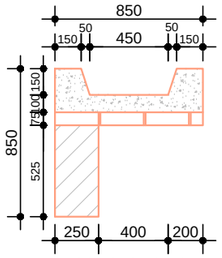
Scale :As shown

Date : 28-01-16

DESIGNED BY :	DRAWN BY :	CHECKED BY :	APPROVED BY :
MD. TAZUDDIN	MD. TAZUDDIN	AFM HAMIDUL HAQUE	DR. PRABHAT SHRIVASTAVA

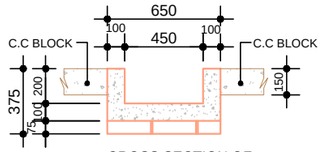
REV.	DESCRIPTION	DATE

TYPICAL DRAWING OF RETAINING WALL



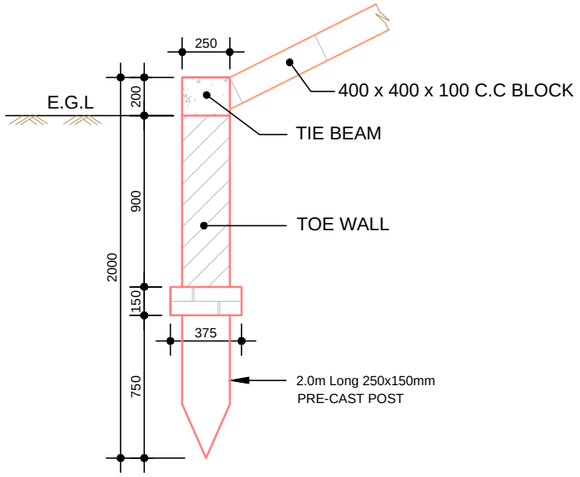
CROSS SECTION OF RAIN WATER SURFACE DRAIN

(Scale : 1 : 35)

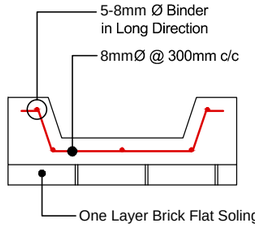


CROSS SECTION OF RAIN WATER OUTLET DRAIN

(Scale : 1 : 35)

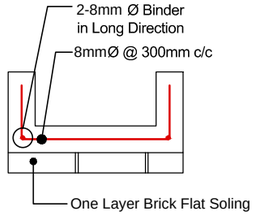


CROSS SECTION OF TOE WALL



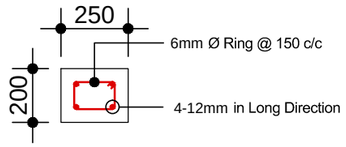
REINF. DETAIL OF RAIN WATER SURFACE DRAIN

(Scale : 1 : 20)



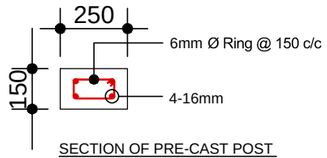
REINF. DETAIL OF RAIN WATER OUTLET DRAIN

(Scale : 1 : 20)



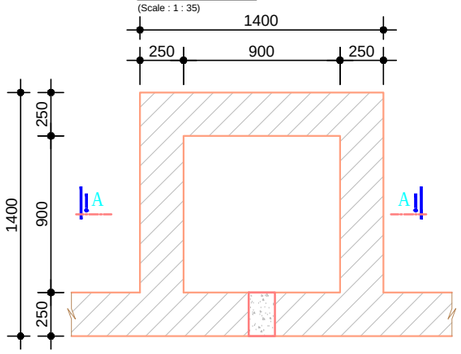
REIFO. DETAIL OF TIE BEAM

(Scale : 1 : 20)



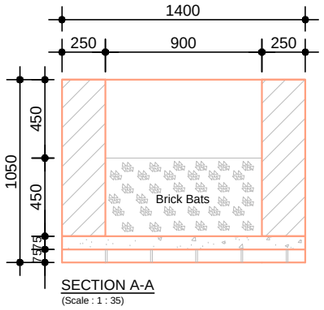
SECTION OF PRE-CAST POST

(Scale : 1 : 20)



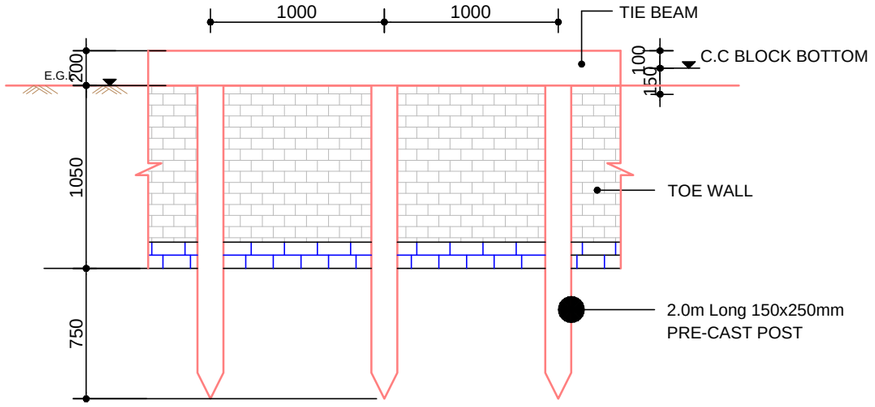
PLAN OF RAIN WATER OUTLET DRAIN PIT

(Scale : 1 : 35)

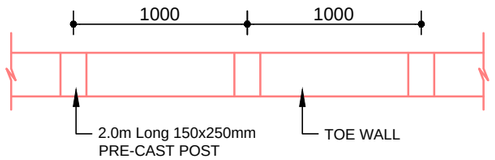


SECTION A-A

(Scale : 1 : 35)

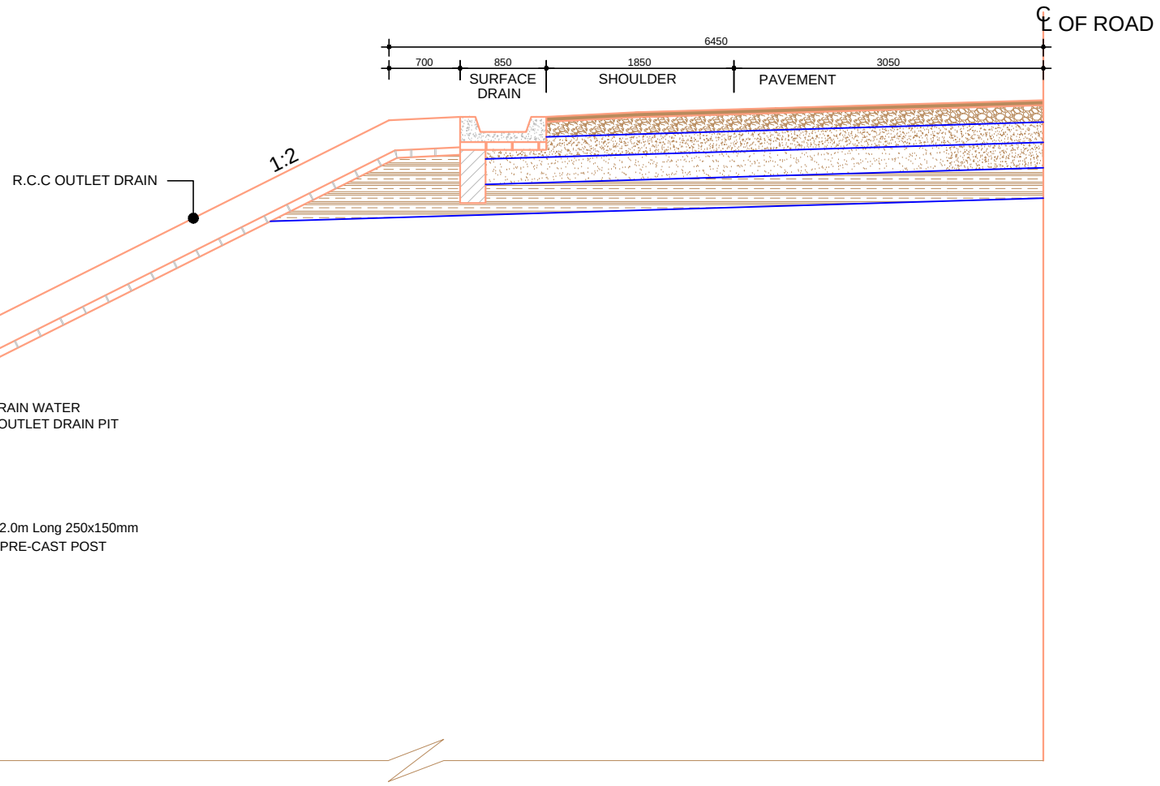


ELEVATION OF TOE WALL AND PRE-CAST POST



PLAN OF TOE WALL AND PRE-CAST POST

(Scale : 1 : 35)



HALF CROSS SECTION OF APPROACH ROAD OF BRIDGE (TYPICAL)

(Scale : 1 : 60)

NAME OF THE CLIENT :

GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH

LOCAL GOVERNMENT ENGINEERING DEPARTMENT

NAME OF THE PROJECT :

CONSULTANCY SERVICES FOR FEASIBILITY, DETAILED SURVEY AND DESIGN OF CHITTAGONG HILL TRACT CONNECTIVITY CONNECTING THEGAMUKH AND CHITTAGONG PORT.

NAME OF THE CONSULTANTS :

SAI Consulting Engineers Pvt. Ltd, India.

in association with

BETS Consulting Services Ltd, Bangladesh

Project office :

Tahmid Mahmood Palace
Flat # 9A, House # 77, Road # 4, Block-C,
Banani, Dhaka-1213, Bangladesh.

DRAWING TITLE : APPROACH ROAD SIDE DRAIN DETAILS

DRAWING NO. : LGED/TYP/AP./SUR_DR-01

Scale : As shown

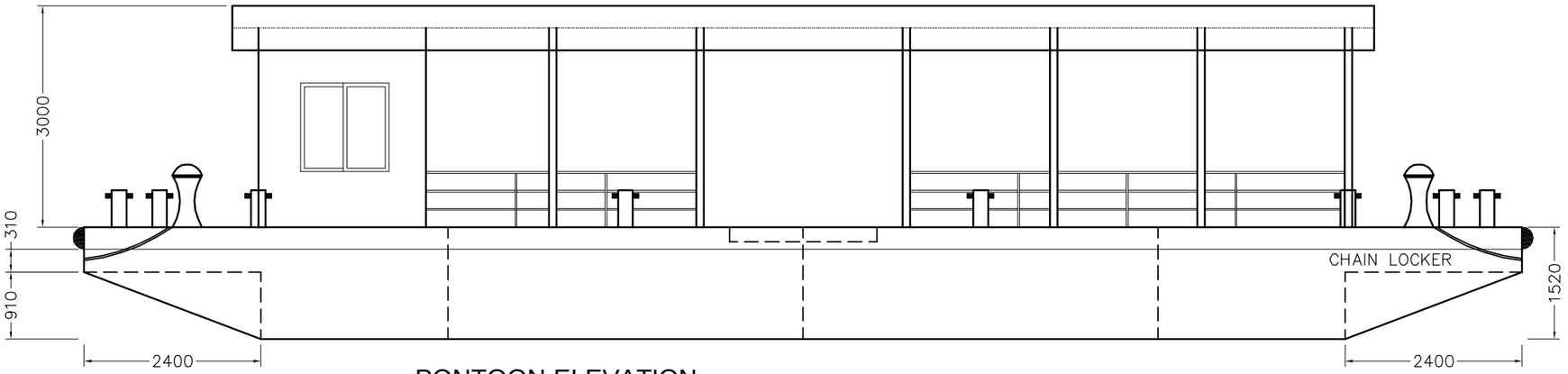
Date :28-01-16

DESIGNED BY :	DRAWN BY :	CHECKED BY :	APPROVED BY :
MD. TAZUDDIN		AFM HAMIDUL HAQUE	DR. PRABHAT SHRIVASTAVA

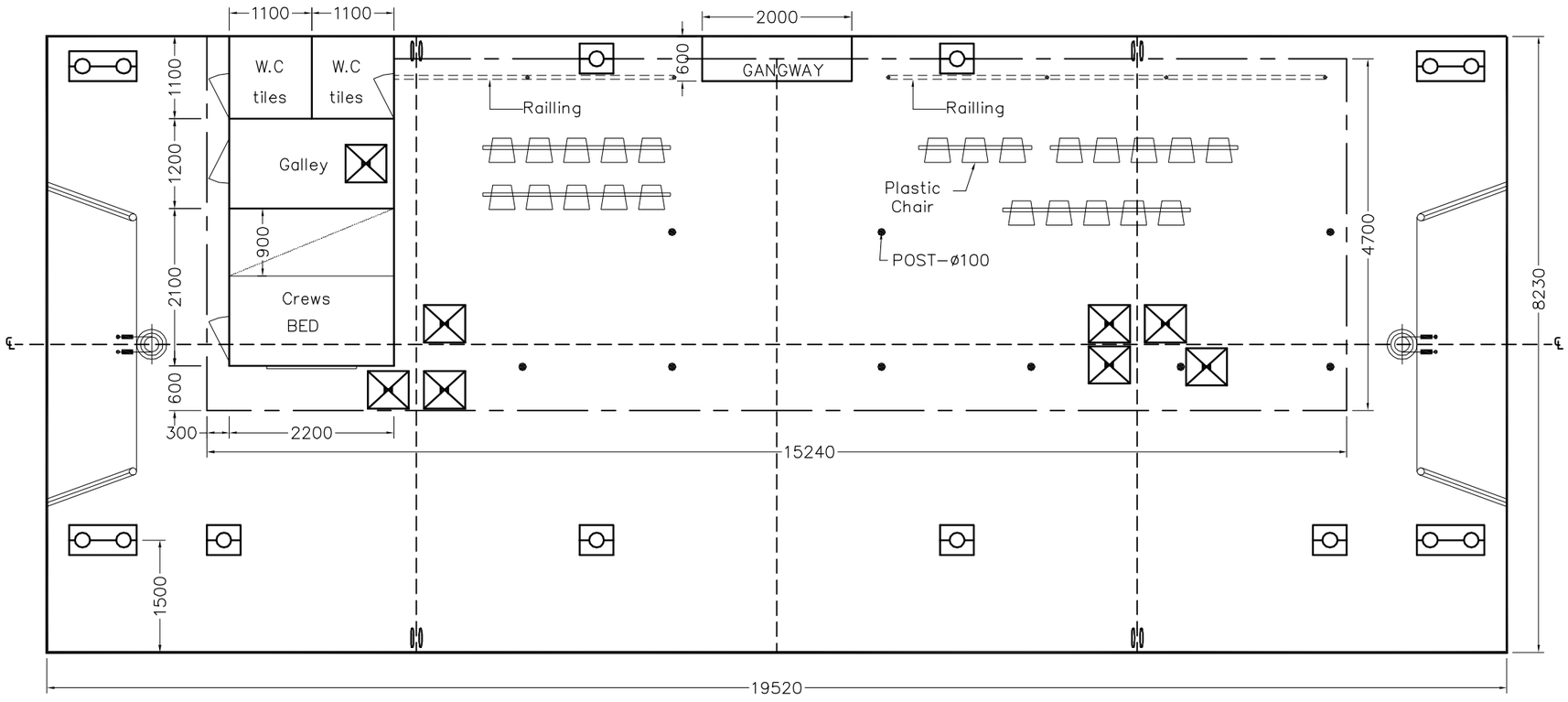
REV.	DESCRIPTION	DATE

TYPICAL APPROACH ROAD SIDE DRAIN

ALL DIMENSIONS ARE IN MILLIMETER UNLESS OTHERWISE SHOWN



PONTOON ELEVATION



PONTOON MAIN DECK PLAN
Scale 1:75

NAME OF THE CLIENT :
GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH
LOCAL GOVERNMENT ENGINEERING DEPARTMENT

NAME OF THE PROJECT :
CONSULTANCY SERVICES FOR FEASIBILITY, DETAILED SURVEY AND DESIGN OF CHITTAGONG HILL TRACT CONNECTIVITY CONNECTING THEGAMUKH AND CHITTAGONG PORT.

NAME OF THE CONSULTANTS :
SAI Consulting Engineers Pvt. Ltd, India.
in association with
BETS Consulting Services Ltd, Bangladesh
Tahmid Mahmood Palace Flat # 9A,
House # 77, Road # 4, Block-C, Banani,
Dhaka-1213, Bangladesh.

DRAWING TITLE : **GENERAL ARRANGEMENT PLAN**
PONTOON MAIN DECK PLAN
ELEVATION

DRAWING NO: 01

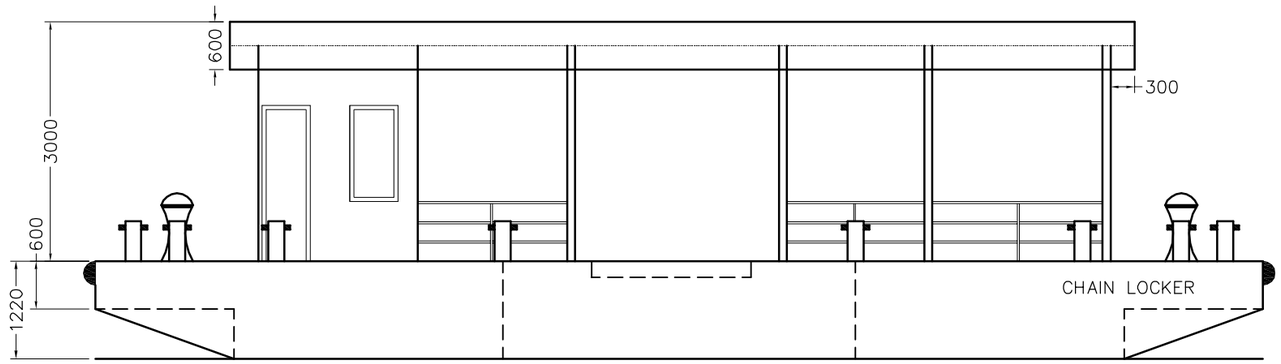
Scale :As shown

Date : 28-01-16

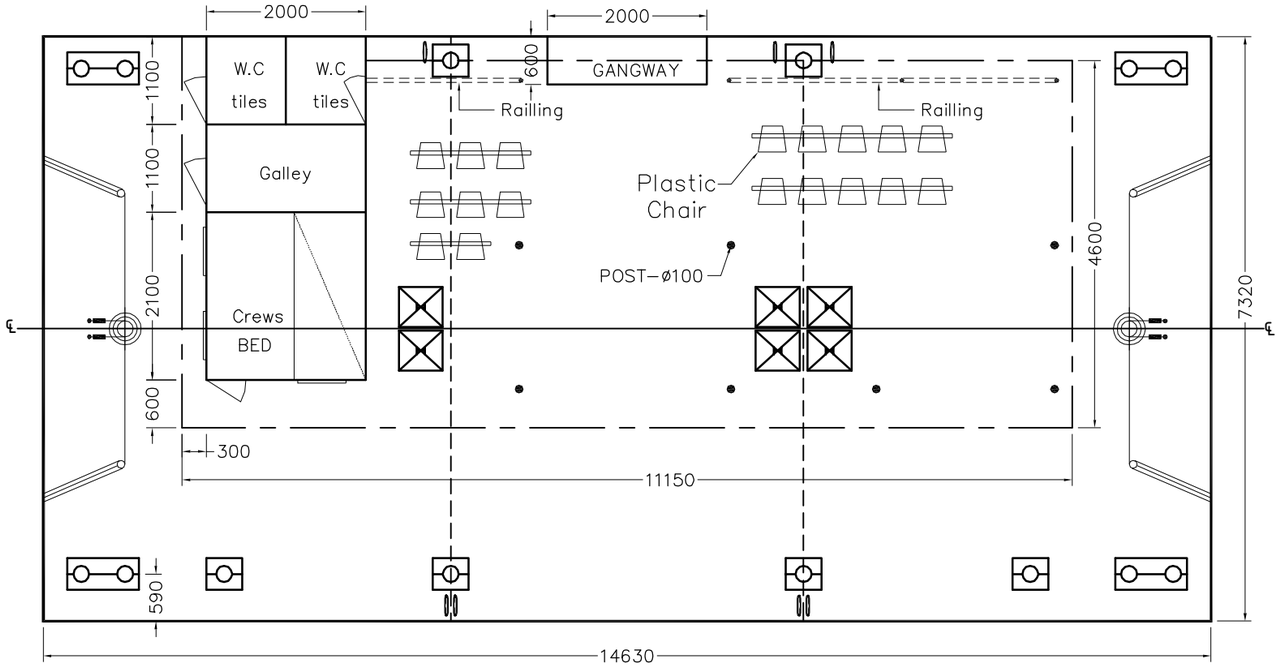
DESIGNED BY :	DRAWN BY :	CHECKED BY :	APPROVED BY :
Engr. Abul Qasem	Ashraful Islam Khan	AFM Hamidul Haque	DR. PRABHAT SHRIVASTAVA

REV.	DESCRIPTION	DATE

ALL DIMENSIONS ARE IN MILLIMETER UNLESS OTHERWISE SHOWN



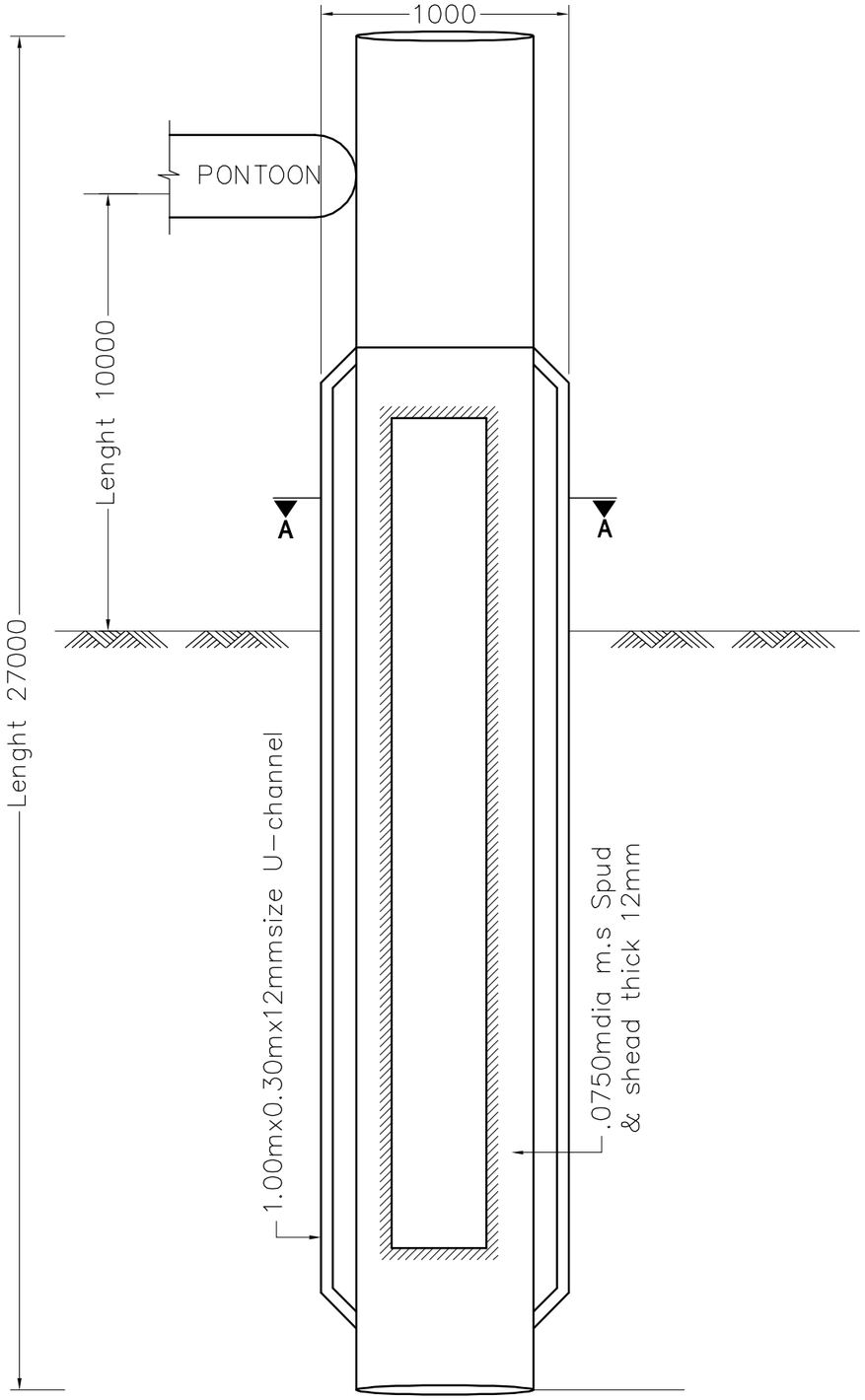
PONTOON ELEVATION



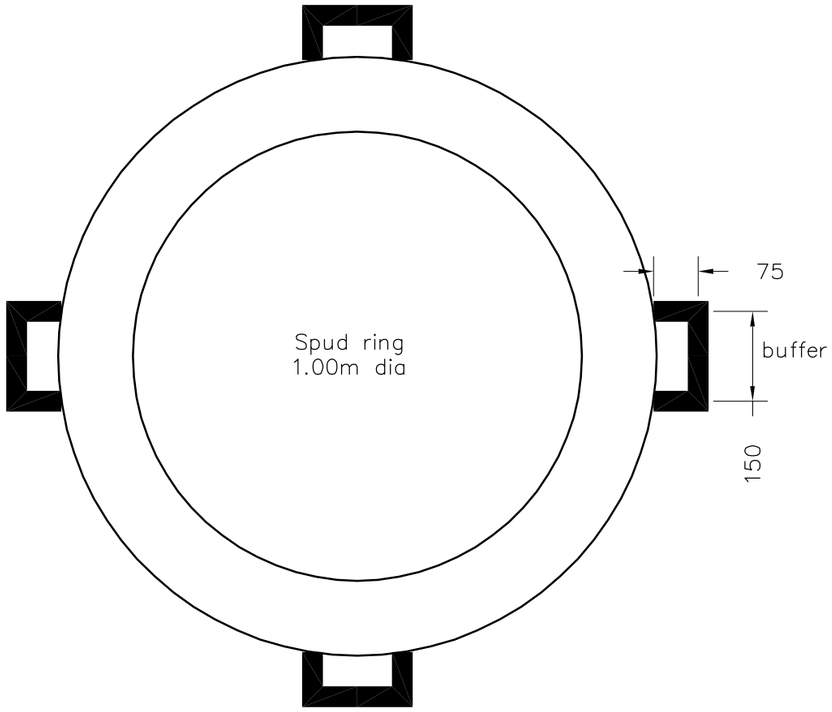
PONTOON MAIN DECK PLAN
Scale 1:75

NAME OF THE CLIENT : GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH **LOCAL GOVERNMENT ENGINEERING DEPARTMENT** NAME OF THE PROJECT : CONSULTANCY SERVICES FOR FEASIBILITY, DETAILED SURVEY AND DESIGN OF CHITTAGONG HILL TRACT CONNECTIVITY CONNECTING THEGAMUKH AND CHITTAGONG PORT.	NAME OF THE CONSULTANTS : **SAI Consulting Engineers Pvt. Ltd, India.** in association with **BETS Consulting Services Ltd, Bangladesh** Tahmid Mahmood Palace Flat # 9A, House # 77, Road # 4, Block-C, Banani, Dhaka-1213, Bangladesh.	DRAWING TITLE : **GENERAL ARRANGEMENT PLAN** **PONTOON MAIN DECK PLAN** **ELEVATION** DRAWING NO: 02 Scale :As shown Date : 28-01-16	DESIGNED BY : Engr. Abul Qasem	DRAWN BY : Ashraful Islam Khan	CHECKED BY : AFM Hamidul Haque	APPROVED BY : DR. PRABHAT SHRIVASTAVA	REV.	DESCRIPTION	DATE

ALL DIMENSIONS ARE IN MILLIMETER UNLESS OTHERWISE SHOWN



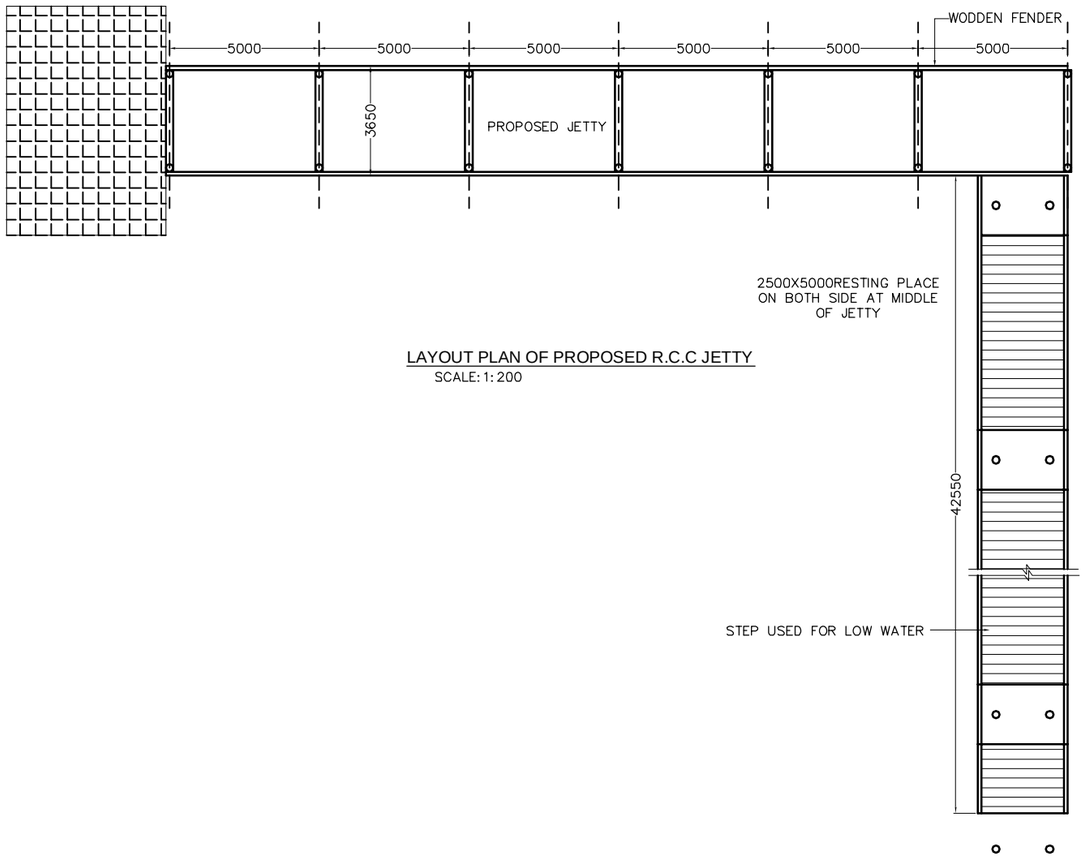
LONG SECTION OF MS SPUD
Scale 1:50



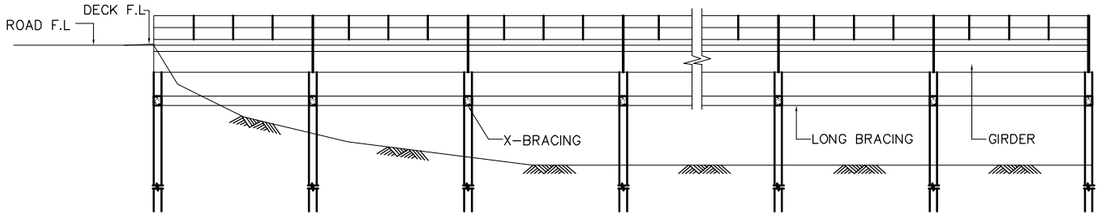
SECTION A-A
Scale 1:10

NAME OF THE CLIENT : GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH **LOCAL GOVERNMENT ENGINEERING DEPARTMENT** NAME OF THE PROJECT : CONSULTANCY SERVICES FOR FEASIBILITY, DETAILED SURVEY AND DESIGN OF CHITTAGONG HILL TRACT CONNECTIVITY CONNECTING THEGAMUKH AND CHITTAGONG PORT.	NAME OF THE CONSULTANTS : **SAI Consulting Engineers Pvt. Ltd, India.** in association with **BETS Consulting Services Ltd, Bangladesh** Tahmid Mahmood Palace Flat # 9A, House # 77, Road # 4, Block-C, Banani, Dhaka-1213, Bangladesh.	DRAWING TITLE : **LONG SECTION OF MS SPUD SECTION A-A** DRAWING NO: 03 Scale :As shown Date : 28-01-16	DESIGNED BY : Engr. Abul Qasem	DRAWN BY : Ashraful Islam Khan	CHECKED BY : AFM Hamidul Haque	APPROVED BY : DR. PRABHAT SHRIVASTAVA	REV.	DESCRIPTION	DATE

ALL DIMENSIONS ARE IN MILLIMETER UNLESS OTHERWISE SHOWN



LAYOUT PLAN OF PROPOSED R.C.C JETTY
SCALE: 1: 200



SECTIONAL ELEVATION OF PROPOSED R.C.C JETTY
SCALE: 1: 200

NAME OF THE CLIENT :
GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH
LOCAL GOVERNMENT ENGINEERING DEPARTMENT

NAME OF THE PROJECT :
CONSULTANCY SERVICES FOR FEASIBILITY, DETAILED SURVEY AND DESIGN OF CHITTAGONG HILL TRACT CONNECTIVITY CONNECTING THEGAMUKH AND CHITTAGONG PORT.

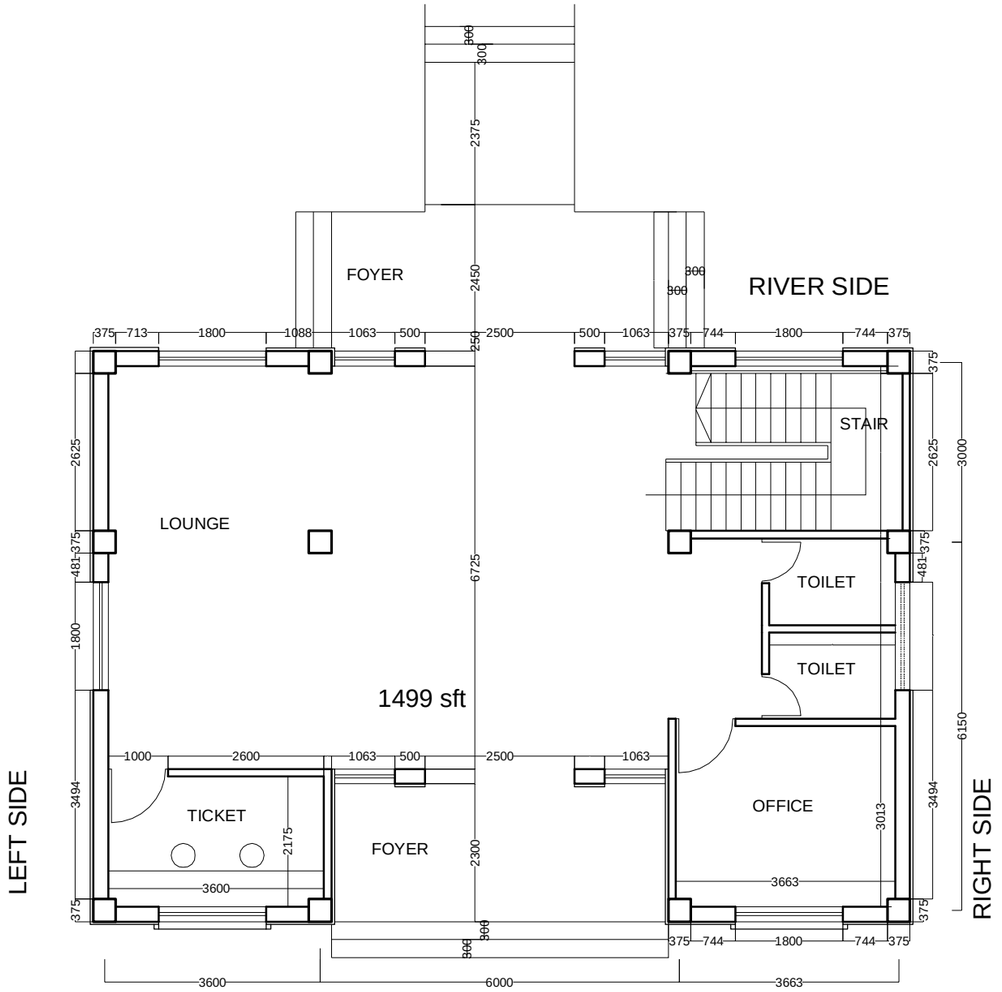
NAME OF THE CONSULTANTS :
SAI Consulting Engineers Pvt. Ltd, India.
in association with
BETS Consulting Services Ltd, Bangladesh
Tahmid Mahmood Palace Flat # 9A,
House # 77, Road # 4, Block-C, Banani,
Dhaka-1213, Bangladesh.

DRAWING TITLE : **LAYOUT PLAN OF PROPOSED R.C.C JETTY SECTIONAL ELEVATION**
DRAWING NO: 04
Scale :As shown
Date : 28-01-16

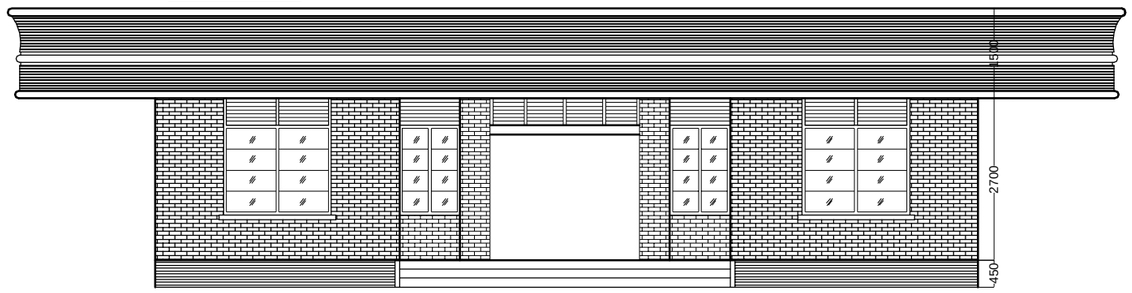
DESIGNED BY :	DRAWN BY :	CHECKED BY :	APPROVED BY :
Engr. Abul Qasem	Ashraful Islam Khan	AFM Hamidul Haque	DR. PRABHAT SHRIVASTAVA

REV.	DESCRIPTION	DATE

ALL DIMENSIONS ARE IN MILLIMETER UNLESS OTHERWISE SHOWN



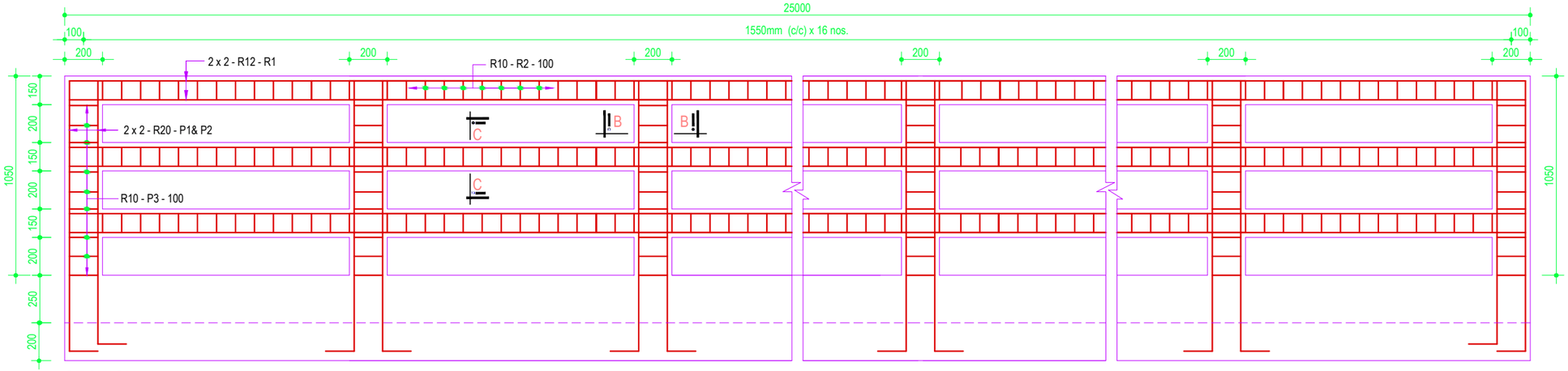
GROUND FLOOR PLAN
LANDING STATION (TYPE-B)
Scale 1:100



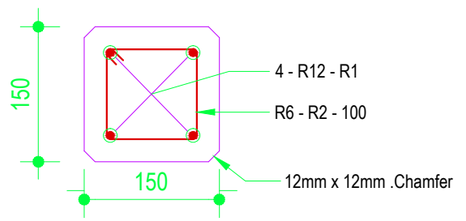
LAND SIDE ELEVATION
(TYPE-B) [Scale 1:100]

NAME OF THE CLIENT : GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH **LOCAL GOVERNMENT ENGINEERING DEPARTMENT** NAME OF THE PROJECT : CONSULTANCY SERVICES FOR FEASIBILITY, DETAILED SURVEY AND DESIGN OF CHITTAGONG HILL TRACT CONNECTIVITY CONNECTING THEGAMUKH AND CHITTAGONG PORT.	NAME OF THE CONSULTANTS : **SAI Consulting Engineers Pvt. Ltd, India.** in association with **BETS Consulting Services Ltd, Bangladesh** Tahmid Mahmood Palace Flat # 9A, House # 77, Road # 4, Block-C, Banani, Dhaka-1213, Bangladesh.	DRAWING TITLE : **Layout Plan of Proposed R.C.C Landing Station/Terminal Building** DRAWING NO: 05 Scale :As shown Date : 28-01-16	DESIGNED BY : Engr. Abul Qasem	DRAWN BY : Ashraful Islam Khan	CHECKED BY : AFM Hamidul Haque	APPROVED BY : DR. PRABHAT SHRIVASTAVA	REV.	DESCRIPTION	DATE

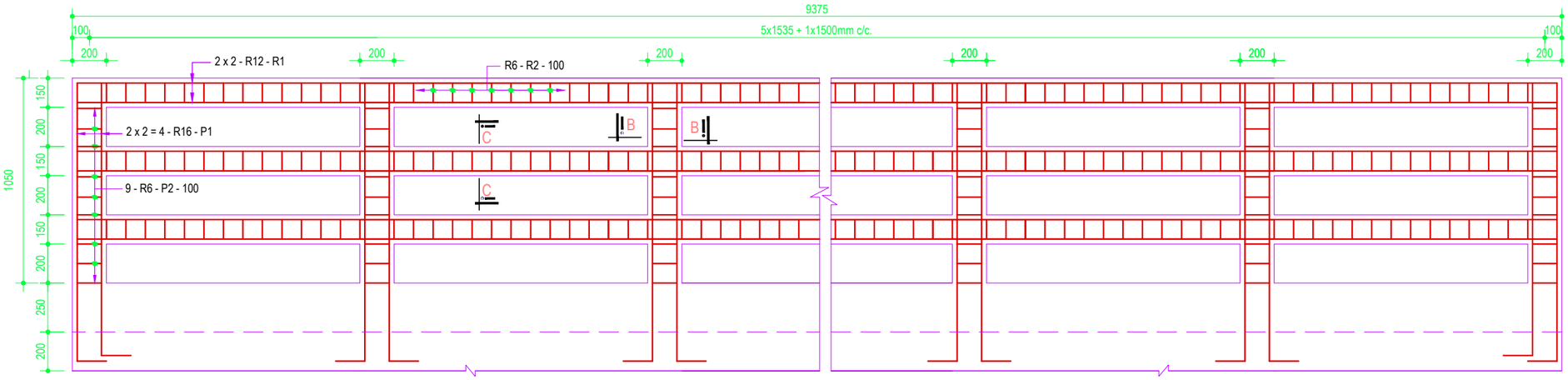
WATERWAY STRUCTURE DRAWINGS



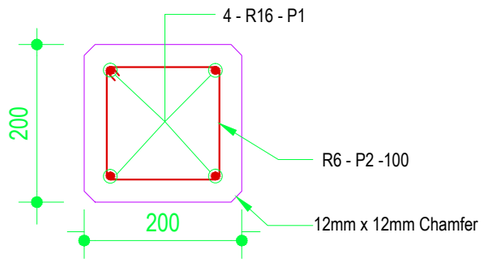
SECTION. A - A
LONG SECTION OF RAILING ON SIDEWALK



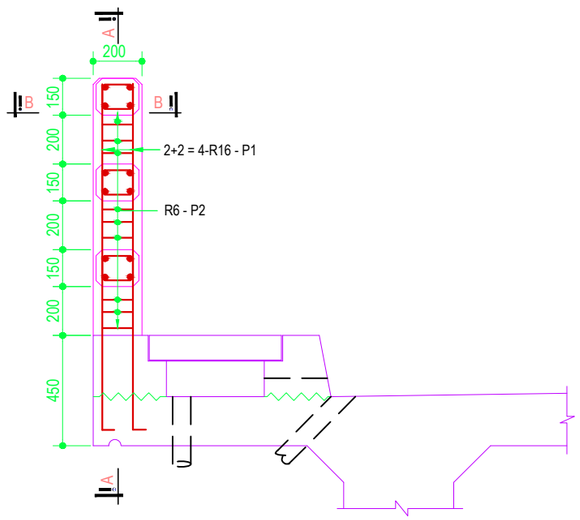
SECTION. C - C
HAND RAIL



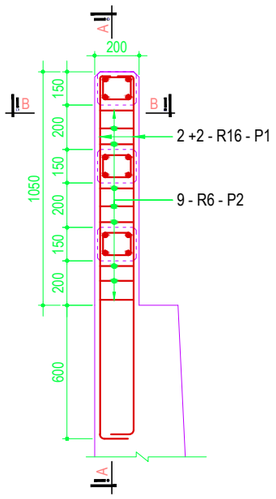
SECTION. A - A
LONG SECTION OF RAILING ON WINGWALL



SECTION. B - B
RAIL POST



REINF. DETAILS OF RAILING ON DECK



REINF. DETAILS OF RAILING ON WINGWALL

NAME OF THE CLIENT :
GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH
LOCAL GOVERNMENT ENGINEERING DEPARTMENT

NAME OF THE PROJECT :
CONSULTANCY SERVICES FOR FEASIBILITY, DETAILED SURVEY AND DESIGN OF CHITTAGONG HILL TRACT CONNECTIVITY CONNECTING THEGAMUKH AND CHITTAGONG PORT.

NAME OF THE CONSULTANTS :
SAI Consulting Engineers Pvt. Ltd, India.
in association with
BETS Consulting Services Ltd, Bangladesh
Project office :
Tahmid Mahmood Palace
Flat # 9A, House # 77, Road # 4, Block-C,
Banani, Dhaka-1213, Bangladesh.

DRAWING TITLE :
REINF. DETAILS OF RAILING ON DECK & WING WALL

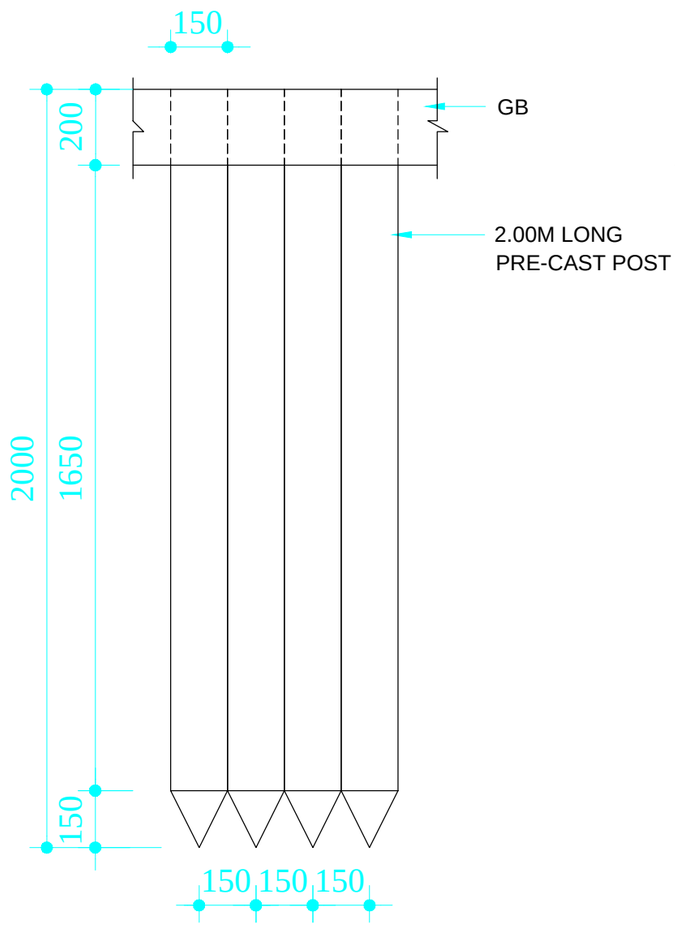
DRAWING NO : LGED/MISC./RL-01

Scale :As shown

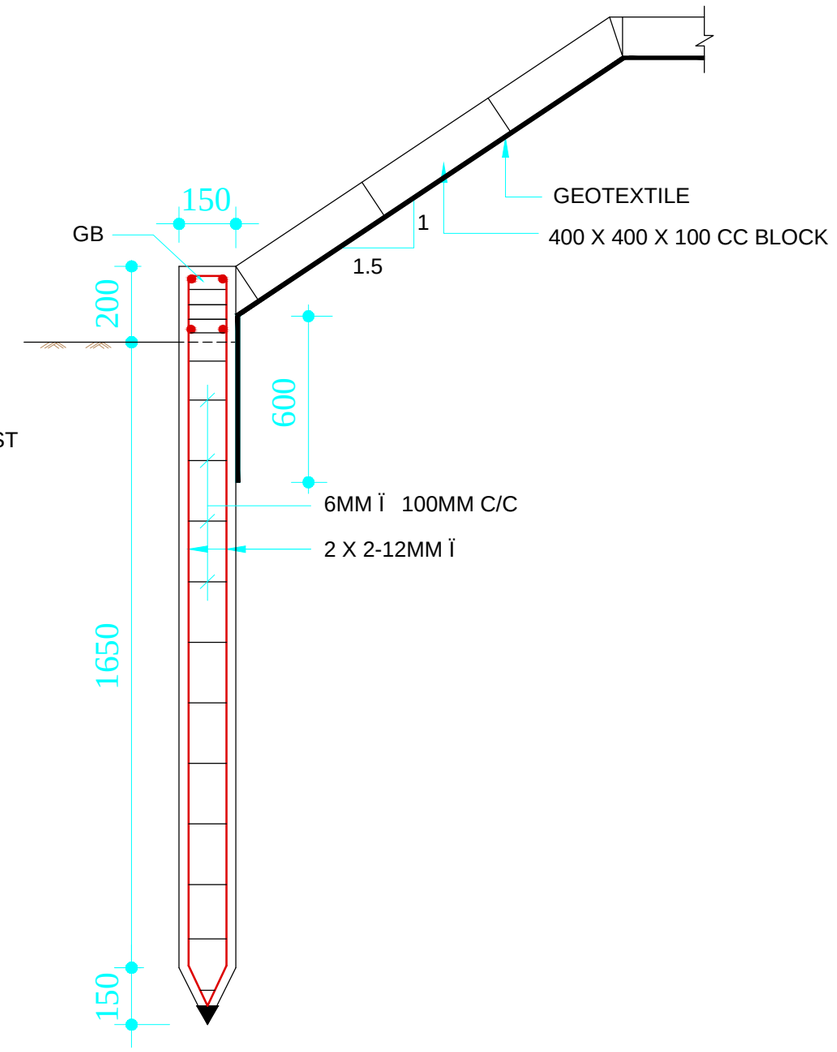
Date : 28-01-16

DESIGNED BY :	DRAWN BY :	CHECKED BY :	APPROVED BY :
MD. TAZUDDIN	MD. TAZUDDIN	AFM HAMIDUL HAQUE	DR. PRABHAT SHRIVASTAVA

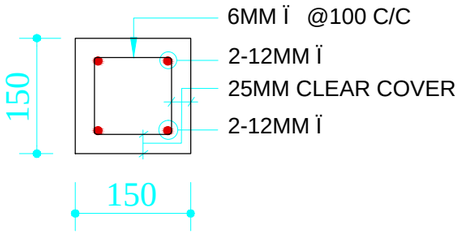
REV.	DESCRIPTION	DATE



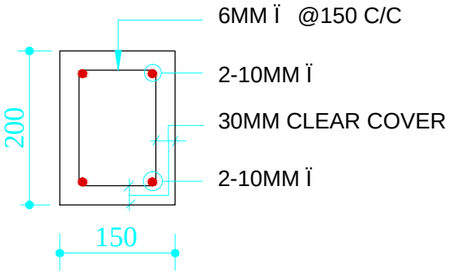
ELEVATION



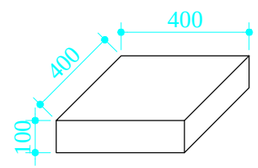
REINF. DETAILS OF 2.0M LONG PRE-CAST-POST



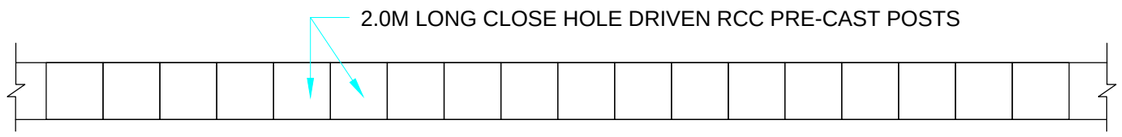
SEC OF PRE-CAST POST



SEC OF GRADE BEAM



C.C. BLOCK



PART PLAN OF PROTECTION WORK AROUND ABUTMENT

NAME OF THE CLIENT :
GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH
LOCAL GOVERNMENT ENGINEERING DEPARTMENT

NAME OF THE PROJECT :
CONSULTANCY SERVICES FOR FEASIBILITY, DETAILED SURVEY AND DESIGN OF CHITTAGONG HILL TRACT CONNECTIVITY CONNECTING THEGAMUKH AND CHITTAGONG PORT.

NAME OF THE CONSULTANTS :
SAI Consulting Engineers Pvt. Ltd, India.
in association with
BETS Consulting Services Ltd, Bangladesh
Project office :
Tahmid Mahmood Palace
Flat # 9A, House # 77, Road # 4, Block-C,
Banani, Dhaka-1213, Bangladesh.

DRAWING TITLE :
DETAILS OF SLOPE PROTECTION WORK

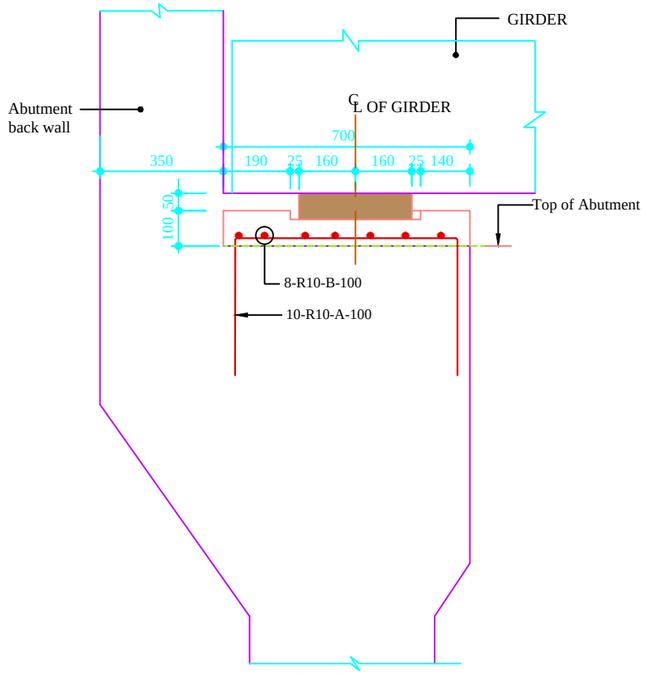
DRAWING NO : LGED/MISC/SLP-03

Scale :As shown

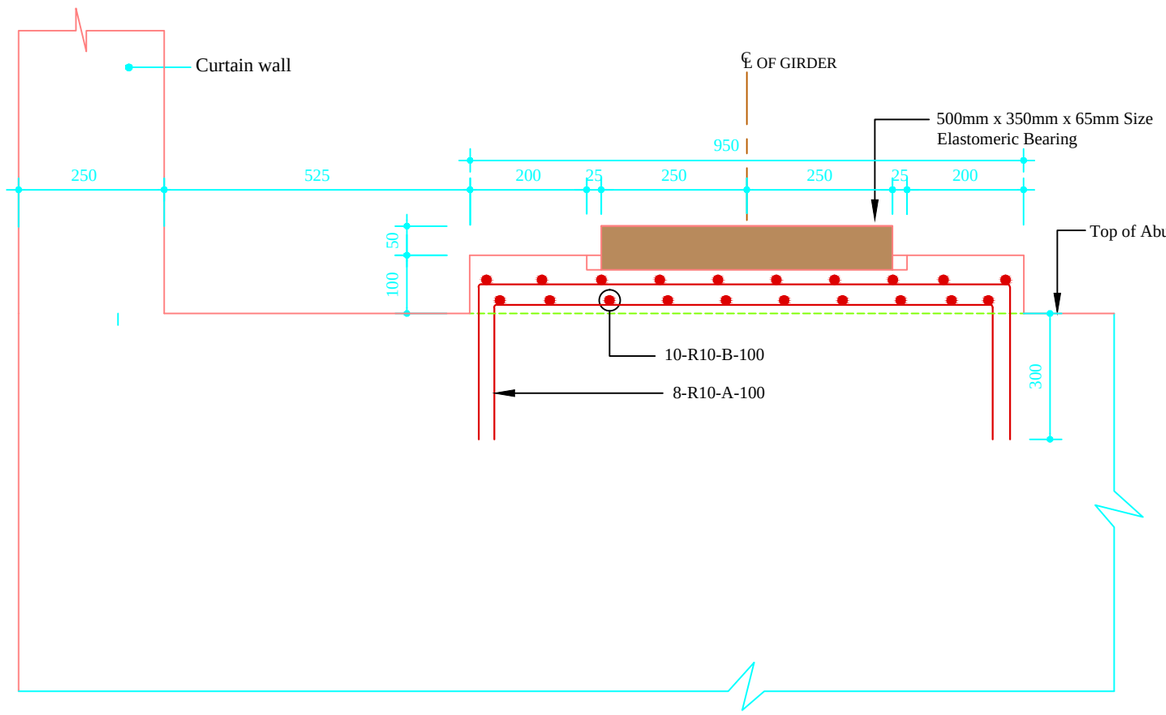
Date : 28-01-16

DESIGNED BY :	DRAWN BY :	CHECKED BY :	APPROVED BY :
MD. TAZUDDIN	MD. TAZUDDIN	AFM HAMIDUL HAQUE	DR. PRABHAT SHRIVASTAVA

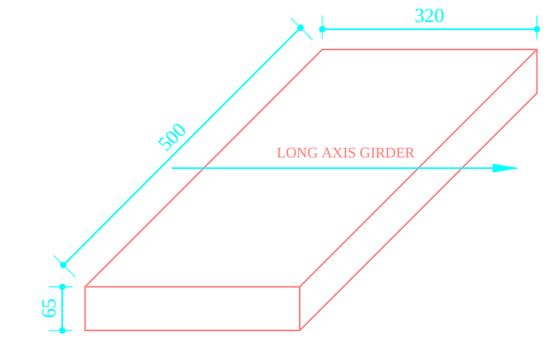
REV.	DESCRIPTION	DATE



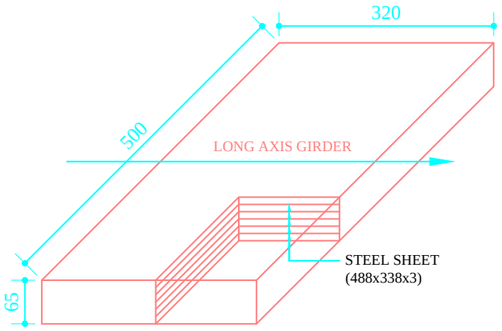
SECTION. A-A



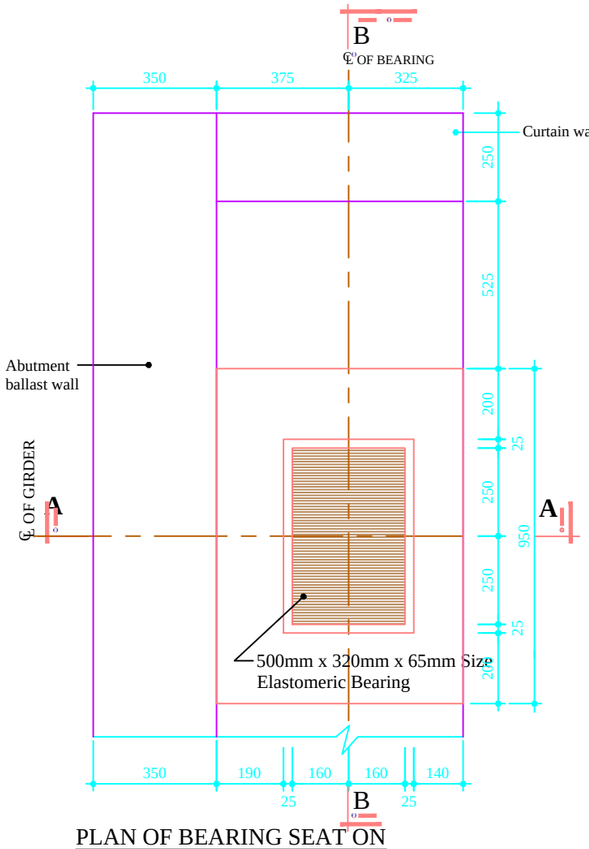
SECTION. B-B



ELASTOMERIC BEARING
ISOMERIC VIEW



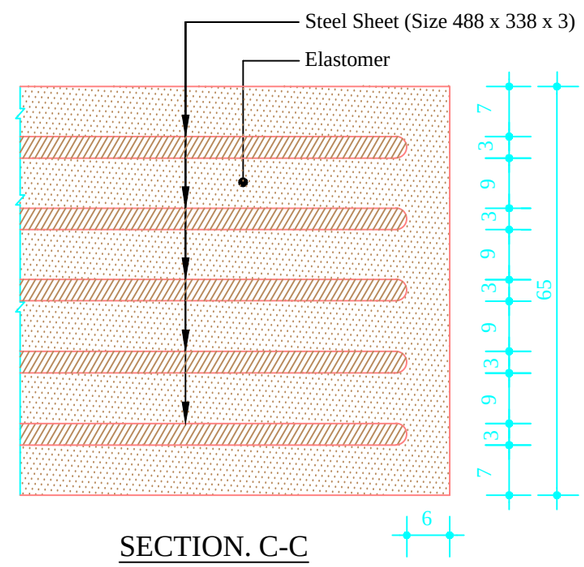
ELASTOMERIC (NEOPRENE) BEARING
SHOWING STEEL SHEET



PLAN OF BEARING SEAT ON
ABUTMENT (EXTERIOR)

NOTES:

1. All dimensions are in millimetre unless otherwise mentioned.
2. Elastomer hardness 60 Ñ5 duro, Ash Content max. = 5%, Shear Modulus 0.9 N/mm ^{2}, Compression Set 35% max.
3. Provide two layer polythene sheet between the elastomeric bearing pad and the girder.
4. Top of bearing seat is to be adjusted according to the longitudinal slope of girder as as shown on the elevation drawing of bridge.



SECTION. C-C

NAME OF THE CLIENT :
GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH
LOCAL GOVERNMENT ENGINEERING DEPARTMENT

NAME OF THE PROJECT :
CONSULTANCY SERVICES FOR FEASIBILITY, DETAILED SURVEY AND DESIGN OF CHITTAGONG HILL TRACT CONNECTIVITY CONNECTING THEGAMUKH AND CHITTAGONG PORT.

NAME OF THE CONSULTANTS :
SAI Consulting Engineers Pvt. Ltd, India.
in association with
BETS Consulting Services Ltd, Bangladesh
Project office :
Tahmid Mahmood Palace
Flat # 9A, House # 77, Road # 4, Block-C,
Banani, Dhaka-1213, Bangladesh.

DRAWING TITLE :
DETAILS OF ELASTOMERIC NEOPRENE BEARING PAD ON ABUTMENT

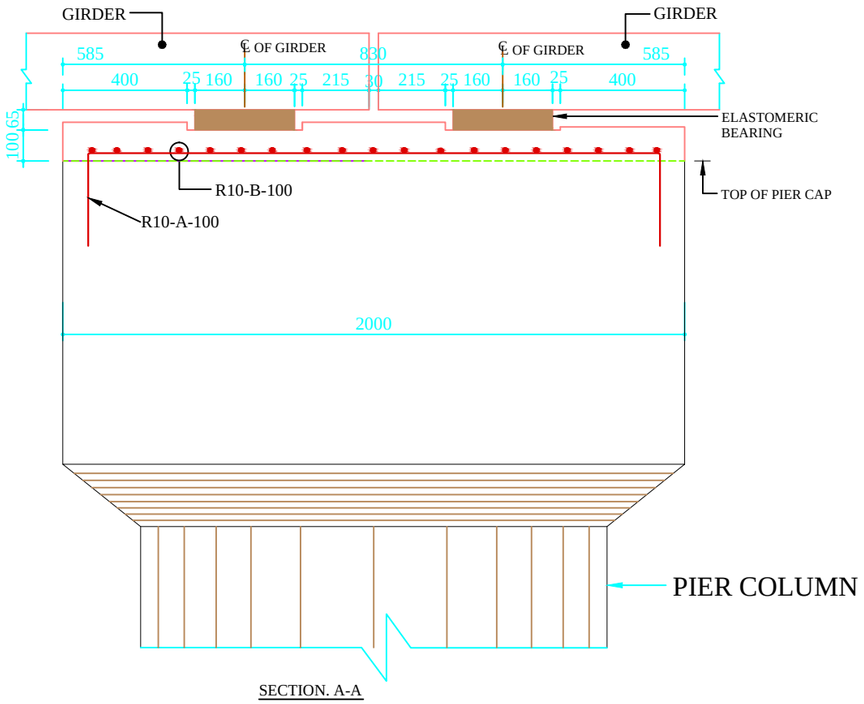
DRAWING NO : LGED/MISC./B. PAD-04

Scale :As shown

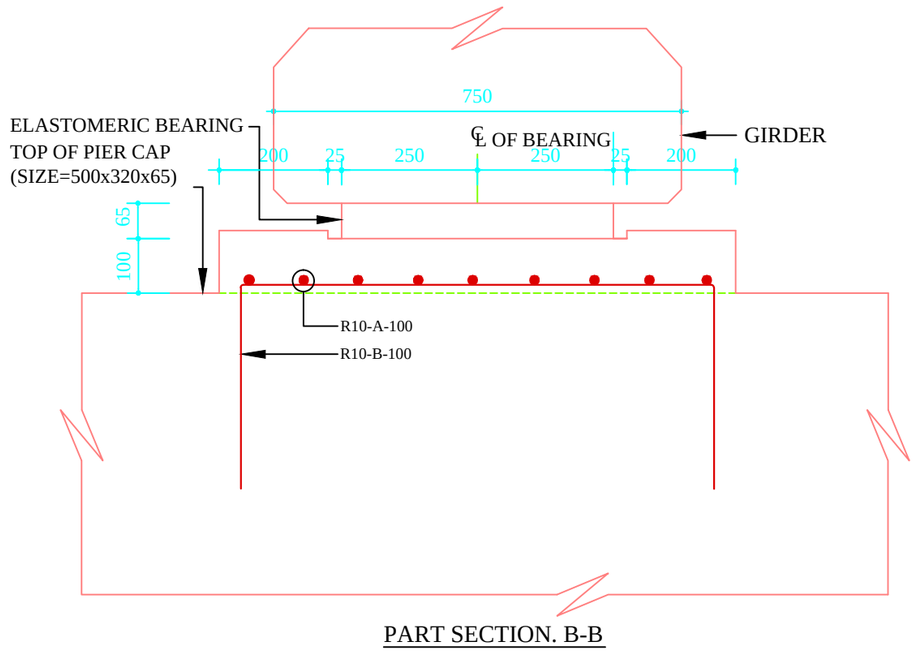
Date : 28-01-16

DESIGNED BY :	DRAWN BY :	CHECKED BY :	APPROVED BY :
MD. TAZUDDIN	MD. TAZUDDIN	AFM HAMIDUL HAQUE	DR. PRABHAT SHRIVASTAVA

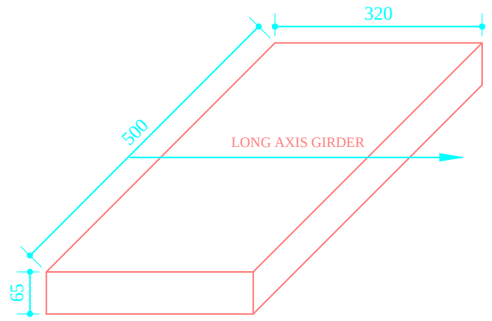
REV.	DESCRIPTION	DATE



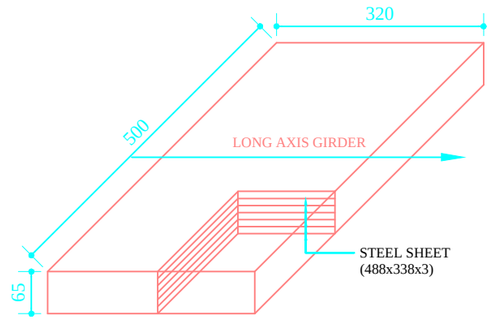
SECTION. A-A



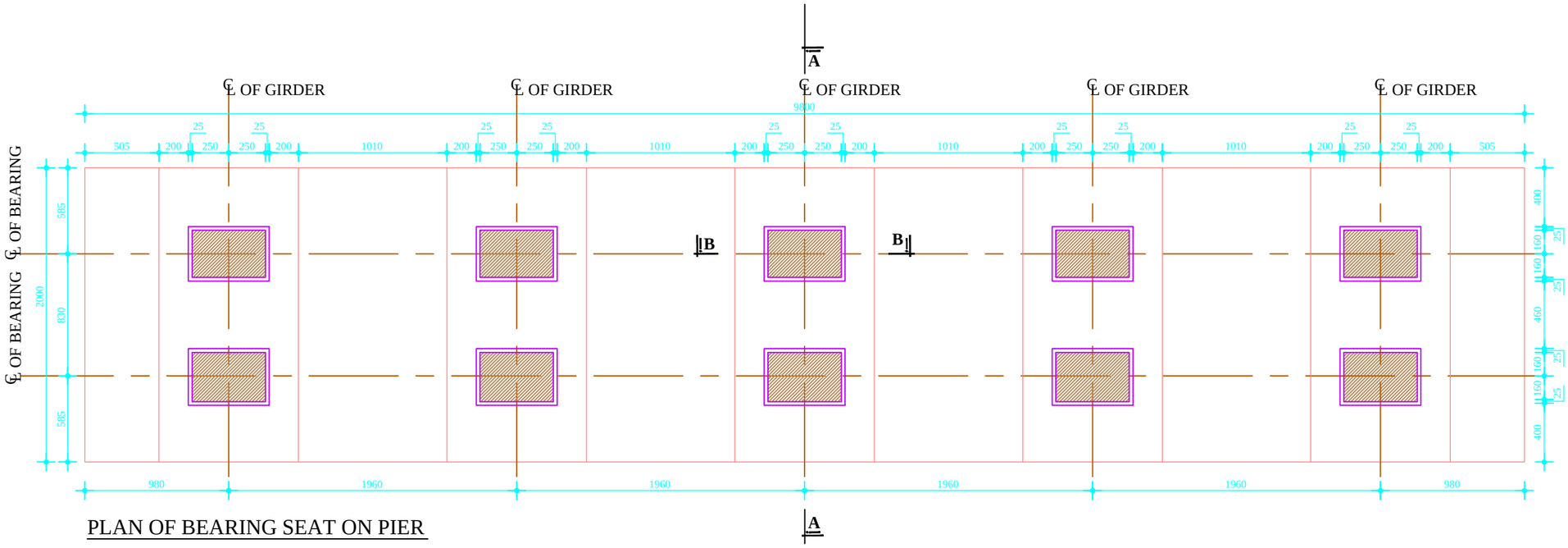
PART SECTION. B-B



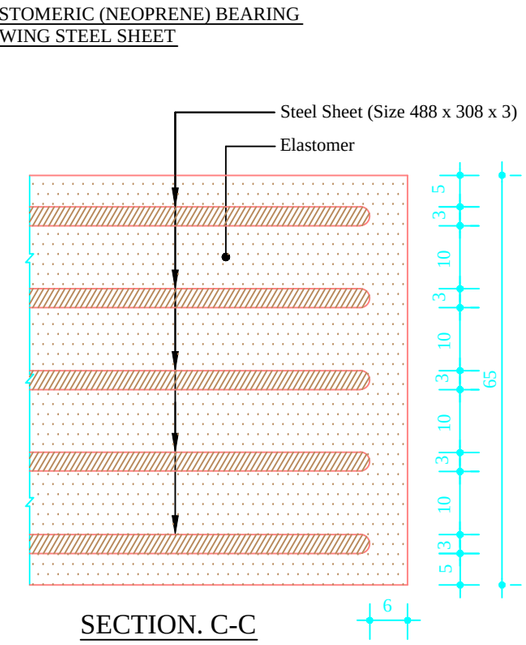
ELASTOMERIC BEARING
ISOMERIC VIEW



ELASTOMERIC (NEOPRENE) BEARING
SHOWING STEEL SHEET



PLAN OF BEARING SEAT ON PIER



SECTION. C-C

NOTES:

1. All dimensions are in millimetre unless otherwise mentioned.
2. Elastomer hardness 60 Ñ5 duro, Ash Content max. = 5%, Shear Modulus 0.9 N/mm ^{2}, Compression Set 35% max.
3. Provide two layer polythene sheet between the elastomeric bearing pad and the girder.
4. Top of bearing seat is to be adjusted according to the longitudinal slope of girder as shown on the elevation drawing of bridge.

NAME OF THE CLIENT :
GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH
LOCAL GOVERNMENT ENGINEERING DEPARTMENT

NAME OF THE PROJECT :
CONSULTANCY SERVICES FOR FEASIBILITY, DETAILED SURVEY AND DESIGN OF CHITTAGONG HILL TRACT CONNECTIVITY CONNECTING THEGAMUKH AND CHITTAGONG PORT.

NAME OF THE CONSULTANTS :
SAI Consulting Engineers Pvt. Ltd, India.
in association with
BETS Consulting Services Ltd, Bangladesh
Project office :
Tahmid Mahmood Palace
Flat # 9A, House # 77, Road # 4, Block-C,
Banani, Dhaka-1213, Bangladesh.

DRAWING TITLE :
DETAILS OF ELASTOMERIC NEOPRENE BEARING PAD ON PIER

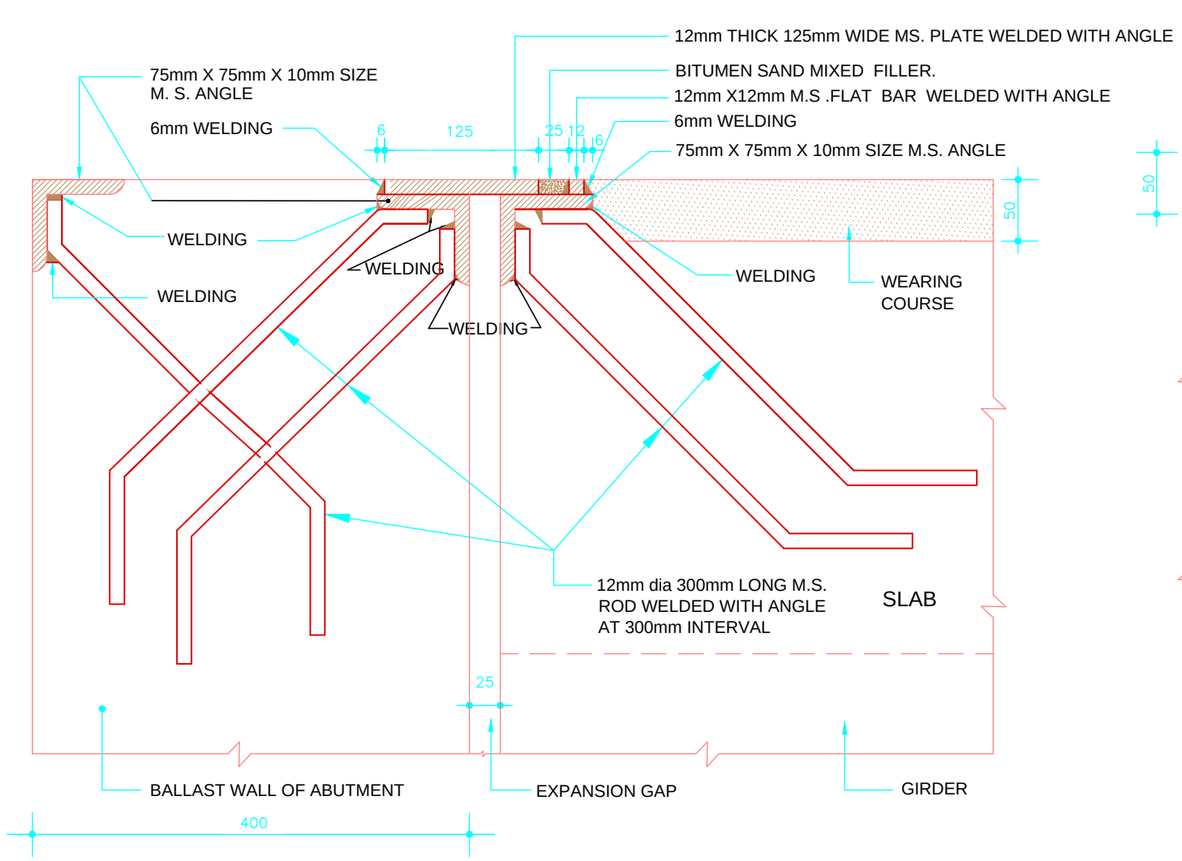
DRAWING NO : LGED/MISC./B. PAD-05

Scale :As shown

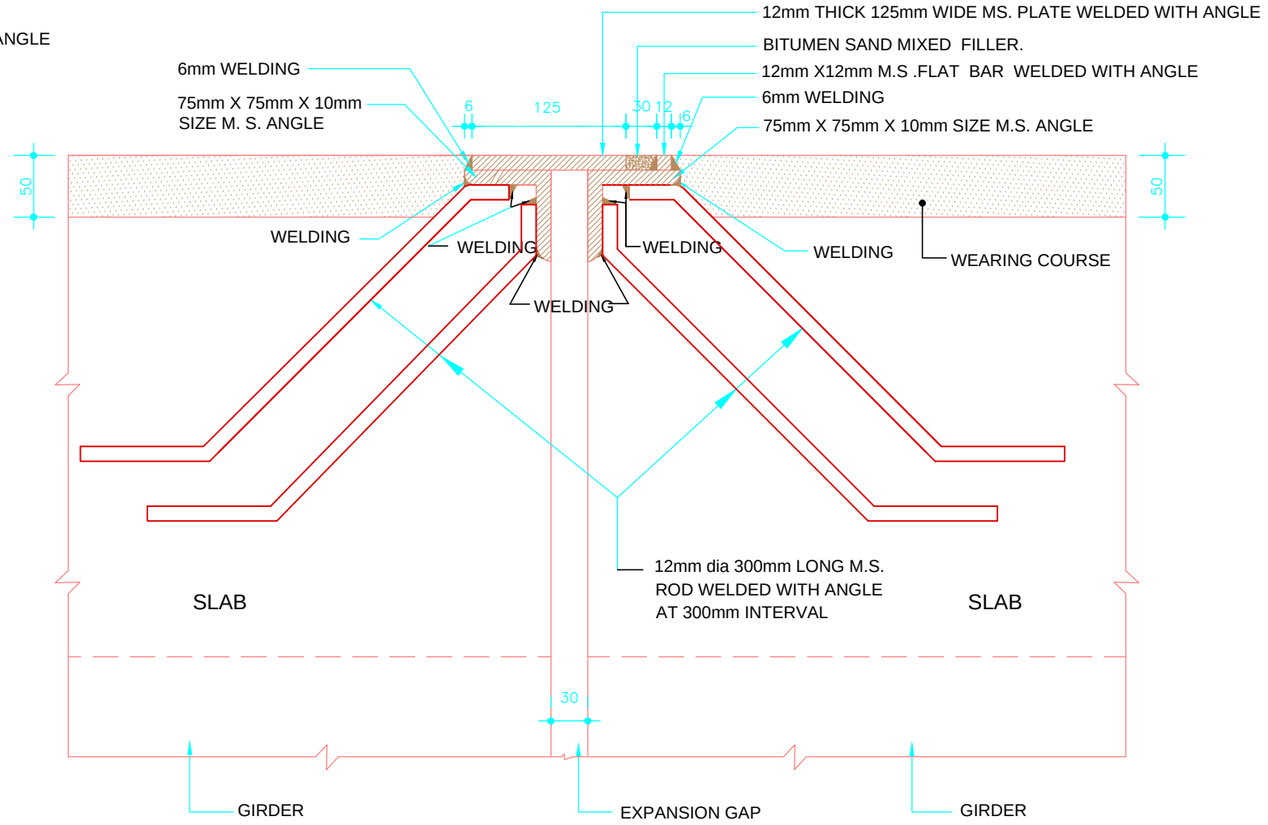
Date : 28-01-16

DESIGNED BY :	DRAWN BY :	CHECKED BY :	APPROVED BY :
MD. TAZUDDIN	MD. TAZUDDIN	AFM HAMIDUL HAQUE	DR. PRABHAT SHRIVASTAVA

REV.	DESCRIPTION	DATE



CROSS SECTION OF EXPANSION JOINT OVER ABUTMENT



CROSS SECTION OF EXPANSION JOINT OVER PIER

NAME OF THE CLIENT :
GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH
LOCAL GOVERNMENT ENGINEERING DEPARTMENT

NAME OF THE PROJECT :
CONSULTANCY SERVICES FOR FEASIBILITY, DETAILED SURVEY AND DESIGN OF CHITTAGONG HILL TRACT CONNECTIVITY CONNECTING THEGAMUKH AND CHITTAGONG PORT.

NAME OF THE CONSULTANTS :
SAI Consulting Engineers Pvt. Ltd, India.
in association with
BETS Consulting Services Ltd, Bangladesh
Project office :
Tahmid Mahmood Palace
Flat # 9A, House # 77, Road # 4, Block-C,
Banani, Dhaka-1213, Bangladesh.

DRAWING TITLE : DETAILS OF EXPANSION JOINT

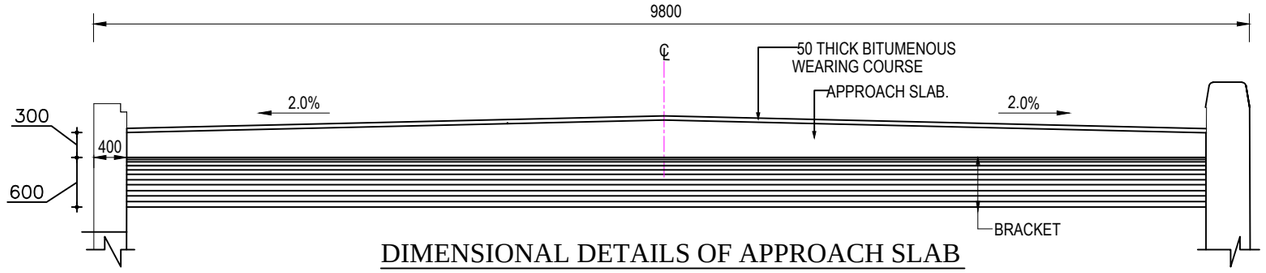
DRAWING NO : LGED/MISC./EXP.J-06

Scale :As shown

Date : 28-01-16

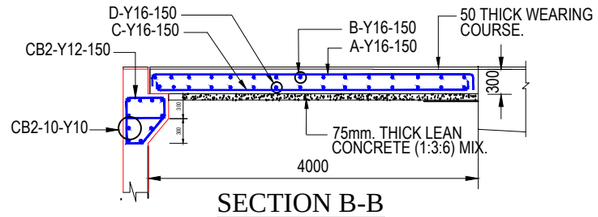
DESIGNED BY :	DRAWN BY :	CHECKED BY :	APPROVED BY :
MD. TAZUDDIN	MD. TAZUDDIN	AFM HAMIDUL HAQUE	DR. PRABHAT SHRIVASTAVA

REV.	DESCRIPTION	DATE



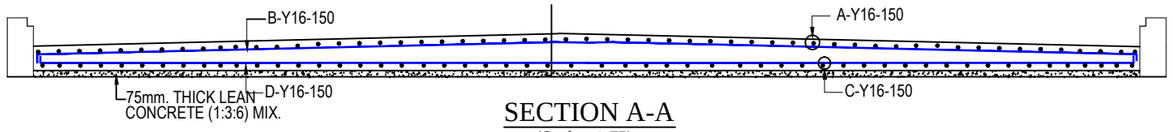
DIMENSIONAL DETAILS OF APPROACH SLAB

(Scale : 1:75)



SECTION B-B

(Scale : 1:75)

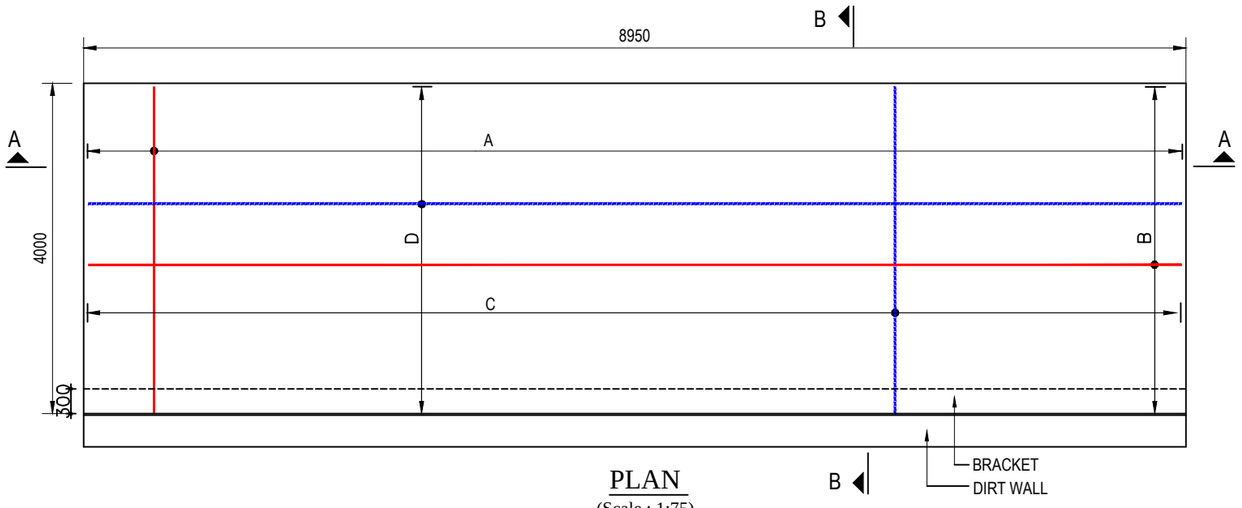


SECTION A-A

(Scale : 1:75)

BAR BENDING SCHEDULE OFAPPROACH SLAB (EACH)

TYPE OF BAR	SYM. OF MARK	DIA OF BAR	SHAPE CODE	SPACE OF BAR	BENDING DIMENSION (mm) a	b	c	d	LENGTH OF BAR	NO OF BAR	TOTAL LENGTH (m)	WT. OF STEEL (Kg)	SHAPE CODE	BAR SHAPE
GRADE-60 DEFORMED BAR	A	16	38	150	3900	75	75		4050	64	259.20	409.18	38	a b c
	B	16	99	150	9550	75	75		9700	27	261.90	413.28		
	C	16	38	150	3900	75	75		4050	64	259.20	409.18	38	a b c
	D	16	38	150	9550	75	75		9700	27	261.90	413.28		
										TOTAL =		1644.92		



PLAN

(Scale : 1:75)

INDICATES TOP REINF.

INDICATES BOTTOM REINF.

SYMB. OF BAR	SHAPE	SYMB. OF BAR	SHAPE
38	150 a 150	85	286, 172, 200
60	a, b	99	a, 150, 150
70	a, b, c, d		

NOTES :

1. ALL DIMENSIONS ARE IN mm UNLESS OTHERWISE SPECIFIED.
2. DIMENSIONS SHOWN IN THE BAR BENDING SCHEDULE SHALL BE VERIFIED AT SITE.
3. CONCRETE COVER FOR APPROACH SLAB & BRACKET = 50mm

NAME OF THE CLIENT :

GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH

LOCAL GOVERNMENT ENGINEERING DEPARTMENT

NAME OF THE PROJECT :

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NAME OF THE CONSULTANTS :

SAI Consulting Engineers Pvt. Ltd, India.

in association with

BETS Consulting Services Ltd, Bangladesh

Project office :

Tahmid Mahmood Palace
Flat # 9A, House # 77, Road # 4, Block-C,
Banani, Dhaka-1213, Bangladesh.

DRAWING TITLE :

DETAILS OF APPROACH SLAB

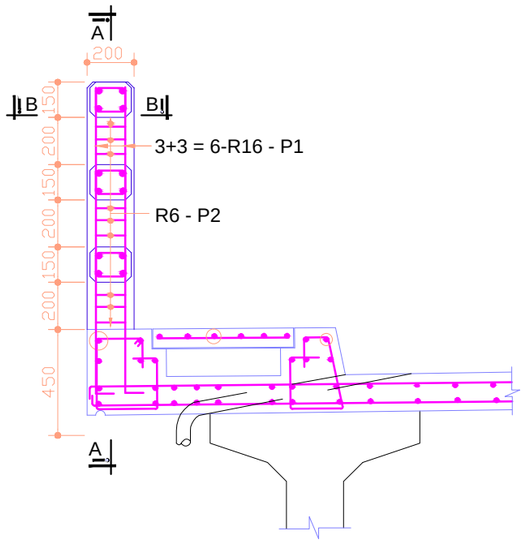
DRAWING NO : LGED/MISC./APPS-07

Scale :As shown

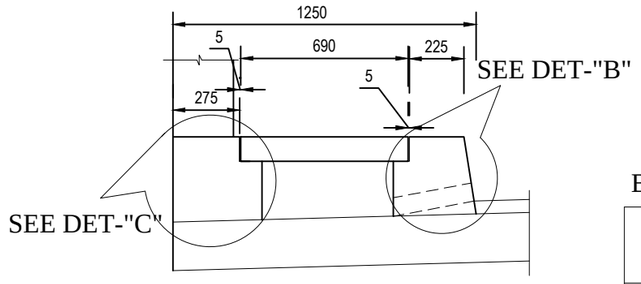
Date : 28-01-16

DESIGNED BY :	DRAWN BY :	CHECKED BY :	APPROVED BY :
MD. TAZUDDIN	MD. TAZUDDIN	AFM HAMIDUL HAQUE	DR. PRABHAT SHRIVASTAVA

REV.	DESCRIPTION	DATE



REINF. DETAILS OF RAILING



ELEVATION OF KERB

SCALE : 1 : 25

BAR BENDING SCHEDULE OF PRECAST SLAB (PER METER)

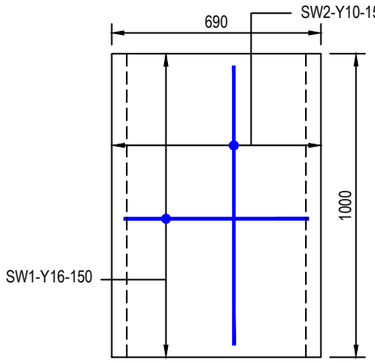
TYPE OF BAR	SYM. OF MARK	DIA OF BAR	SPACE OF BAR	BENDING DIMENSION (mm) a	b	c	d	e	LENGTH OF BAR	NO OF BAR	TOTAL LENGTH (m)	WT. OF STEEL (Kg)	SHAPE OF BAR
GRADE-60 DEFORMED BAR	SW1	16	150	640					640	7	4.48	7.07	640
	SW2	12	150	950					950	5	4.75	4.22	950
TOTAL WT. OF REBAR PER UNIT NO. =												11.29	

BAR SCHEDULE OF EDGE BEAM (PER METER)

BAR MARK	DIA OF BAR (mm)	SHAPE OF BARS	LENGTH OF EACH BAR (mm)	NO. OF BARS	TOTAL LENGTH OF BARS (m)	TOTAL WEIGHT (Kg)
EB1	12	1000	1000	5	5.0	4.45
EB2	10	200, 150, 150, 400, 250, 300	1450	7	10.15	6.29
TOTAL WT. OF REBAR PER METER =						10.74

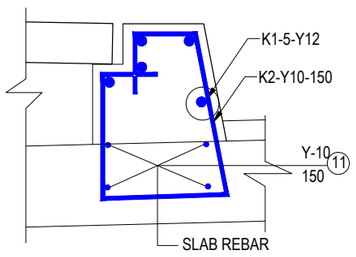
BAR SCHEDULE OF KERB (PER METER)

BAR MARK	DIA OF BAR (mm)	SHAPE OF BARS	LENGTH OF EACH BAR (mm)	NO. OF BARS	TOTAL LENGTH OF BARS (m)	TOTAL WEIGHT (Kg)
K1	12	1000	1000	5	5.0	4.45
K2	10	175, 125, 160, 260, 290	2245	7	15.71	9.74
TOTAL WT. OF REBAR PER METER =						14.19



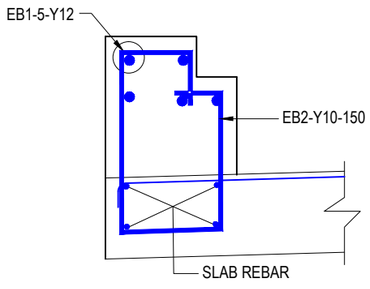
PLAN OF PRECAST SLAB

SCALE : 1 : 20



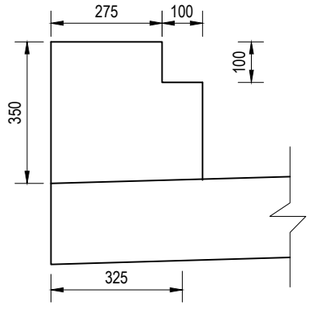
REINF. DETAILS (KERB)

SCALE : 1 : 15



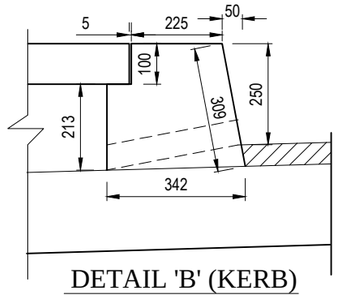
REINF. DETAILS (EDGE BEAM)

SCALE : 1 : 15



DETAIL 'C' (EDGE BEAM)

SCALE : 1 : 15



DETAIL 'B' (KERB)

SCALE : 1 : 15

NAME OF THE CLIENT :

GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH

LOCAL GOVERNMENT ENGINEERING DEPARTMENT

NAME OF THE PROJECT :

CONSULTANCY SERVICES FOR FEASIBILITY, DETAILED SURVEY AND DESIGN OF CHITTAGONG HILL TRACT CONNECTIVITY CONNECTING THEGAMUKH AND CHITTAGONG PORT.

NAME OF THE CONSULTANTS :

SAI Consulting Engineers Pvt. Ltd, India.

in association with

BETS Consulting Services Ltd, Bangladesh

Project office :

Tahmid Mahmood Palace
Flat # 9A, House # 77, Road # 4, Block-C,
Banani, Dhaka-1213, Bangladesh.

DRAWING TITLE :

DETAILS OF FOOTPATH, EDGE BEAM & KERB

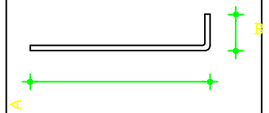
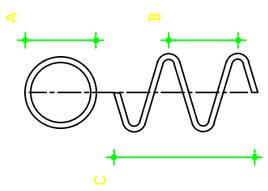
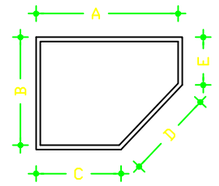
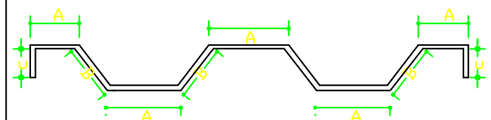
DRAWING NO : LGED/MISC./F.P-08

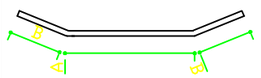
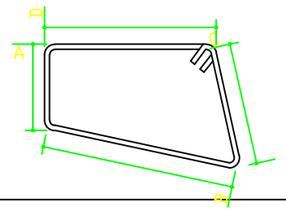
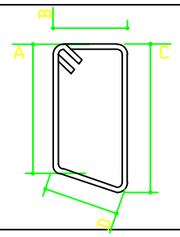
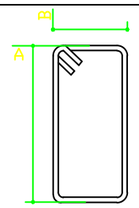
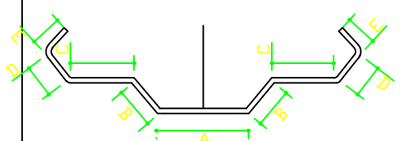
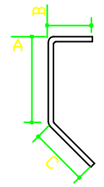
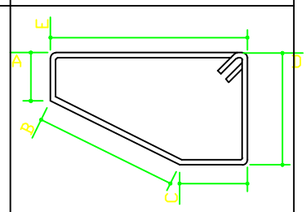
Scale :As shown

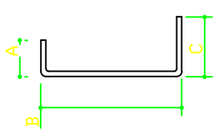
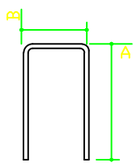
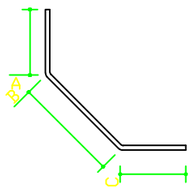
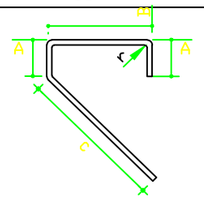
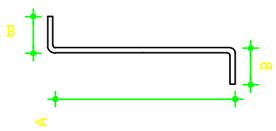
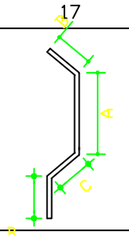
Date : 28-01-16

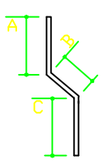
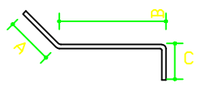
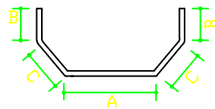
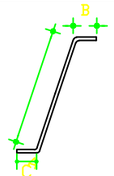
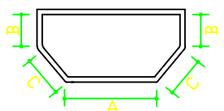
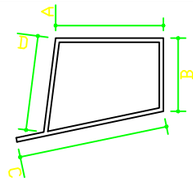
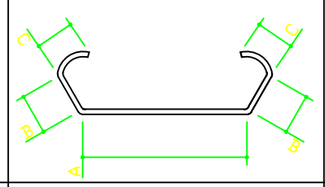
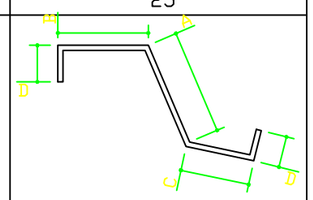
DESIGNED BY :	DRAWN BY :	CHECKED BY :	APPROVED BY :
MD. TAZUDDIN	MD. TAZUDDIN	AFM HAMIDUL HAQUE	DR. PRABHAT SHRIVASTAVA

REV.	DESCRIPTION	DATE

SHAPE CODE	01	02	03	99	100
SHAPE OF BAR					
CUT LENGTH	A	A+B-0.5r-d	$\frac{C}{B}\wedge$ (A-d)	A+B-0.5r-d	

SHAPE CODE	04	05	06	07	08	09	10
SHAPE OF BAR							
CUT LENGTH	A+2B	A+B+C+D+12d	A+B+C+D+12d	2(A+B)+12d	A+2(B+C+D+E)-6d	A+B+C-2d	A+B+C+D+E+12d

SHAPE CODE	11	12	13	14	15	16	17
SHAPE OF BAR							
CUT LENGTH	A+B+C-4d	2A+B-4d	A+B+C	A+2B-4d	2A+B+C-1.5r-3d	A+2B-4d	A+2B+C-4d

SHAPE CODE	18	19	20	21	22	23	24	25
SHAPE OF BAR								
CUT LENGTH	A+B+C	A+B+C-2d	A+2B+2C	A+B+C	2A+2B+3.14C+12D	A+B+C-4D	A+2(B+C)	A+B+C+2D

NAME OF THE CLIENT :

GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH

LOCAL GOVERNMENT ENGINEERING DEPARTMENT

NAME OF THE PROJECT :

CONSULTANCY SERVICES FOR FEASIBILITY, DETAILED SURVEY AND DESIGN OF CHITTAGONG HILL TRACT CONNECTIVITY CONNECTING THEGAMUKH AND CHITTAGONG PORT.

NAME OF THE CONSULTANTS :

SAI Consulting Engineers Pvt. Ltd, India.

in association with

BETS Consulting Services Ltd, Bangladesh

Project office :

Tahmid Mahmood Palace
Flat # 9A, House # 77, Road # 4, Block-C,
Banani, Dhaka-1213, Bangladesh.

DRAWING TITLE :

BAR SHAPE & CODE

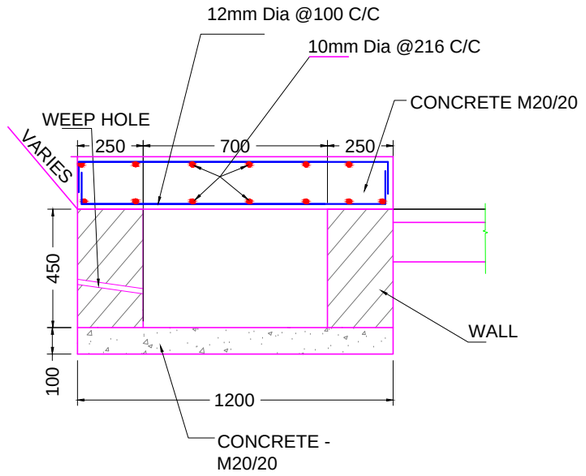
DRAWING NO : LGED/MISC/S.CD-09

Scale :As shown

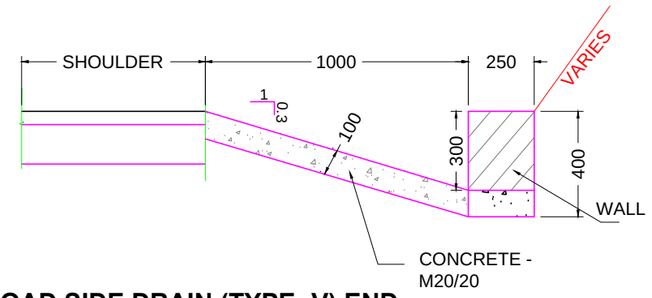
Date : 28-01-16

DESIGNED BY :	DRAWN BY :	CHECKED BY :	APPROVED BY :
MD. TAZUDDIN	MD. TAZUDDIN	AFM HAMIDUL HAQUE	DR. PRABHAT SHRIVASTAVA

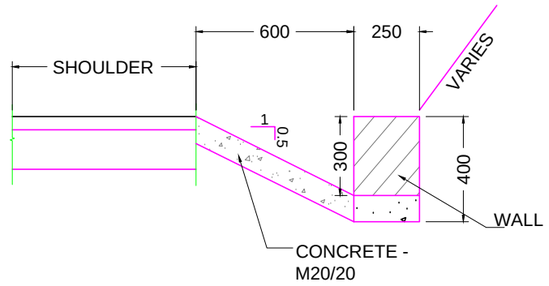
REV.	DESCRIPTION	DATE



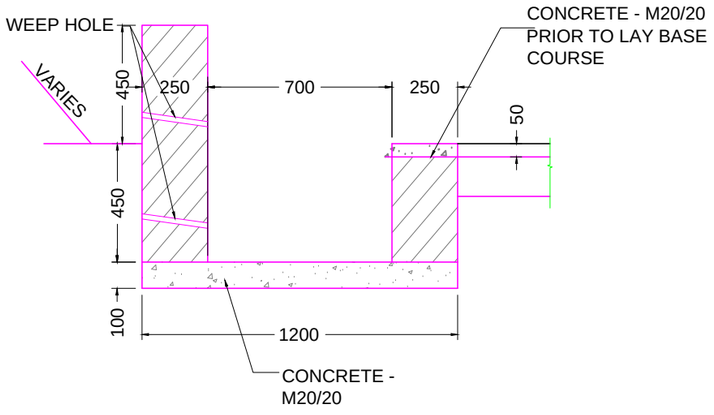
ROAD SIDE DRAIN (TYPE -U WITH SLAB)



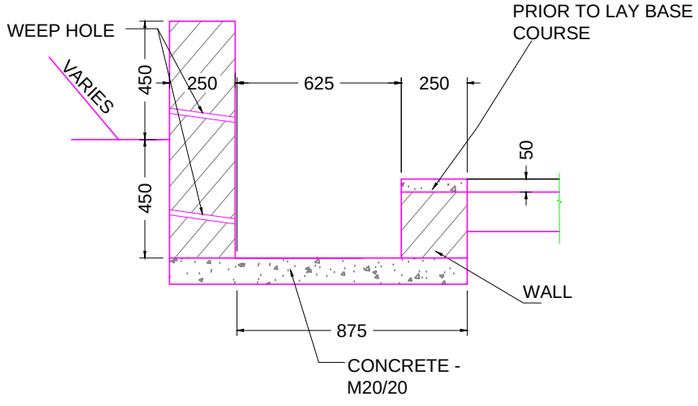
ROAD SIDE DRAIN (TYPE -V) END



ROAD SIDE DRAIN (TYPE -V) START



ROAD SIDE DRAIN (TYPE -U) END



ROAD SIDE DRAIN (TYPE -U) START

Note:
Height of drain wall may vary in case of deeper drain
to meet the requirement as per the site condition

NAME OF THE CLIENT :
GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH
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NAME OF THE PROJECT :
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in association with
BETS Consulting Services Ltd, Bangladesh
Tahmid Mahmood Palace Flat # 9A,
House # 77, Road # 4, Block-C, Banani,
Dhaka-1213, Bangladesh.

DRAWING TITLE :
STANDARD DRAWINGS OF
ROAD SIDE DRAINS

DRAWING NO: LGED/TYP/AP./SUR_DR-10

SCALE : AS Shown

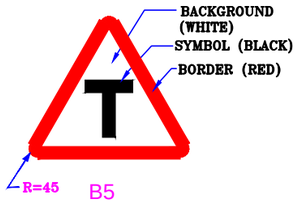
Date : 28-01-16

DESIGNED BY :	DRAWN BY :	CHECKED BY :	APPROVED BY :
MD. TAZUDDIN	Ashraful Islam Khan	AFM Hamidul Haque	DR. PRABHAT SHRIVASTAVA

REV.	DESCRIPTION	DATE

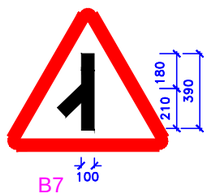
SIGN

WARNING



B5

'টি' সংযোগস্থল

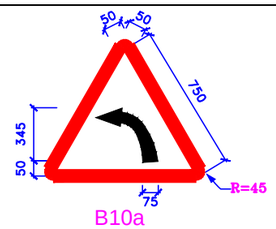


B7

বামে রাস্তা

B8

ডানে রাস্তা



B10a

বামে মোড়

B10b

ডানে মোড়

B12a

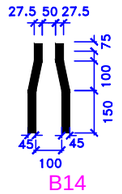
আকাঁবাঁকা রাস্তা ডানে

B12b

আকাঁবাঁকা রাস্তা বামে

B14

সামনে সরু রাস্তা



B14

DETAILS OF B14

B25

সামনে স্কুল

B23

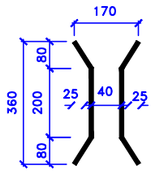
পথচারী পারাপার

B31

সামনে গতিরোধক

B35

সামনে সরু সেতু



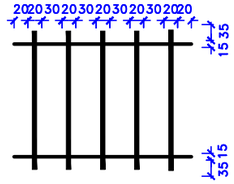
DETAILS OF B35

B44

অরক্ষিত রেলওয়ে ক্রসিং

B45

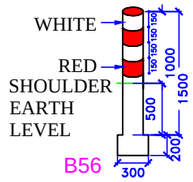
সামনে রেল ক্রসিং



DETAILS OF B45

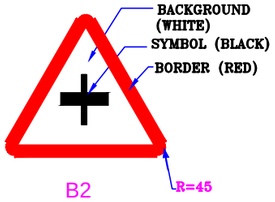
B47

এখানে রেল ক্রসিং



B56

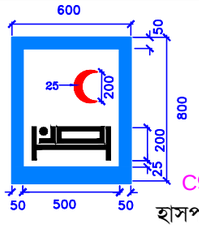
GUIDE POST



B2

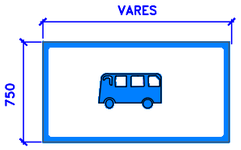
সম্মুখে প্রধান সড়ক

INFORMATION



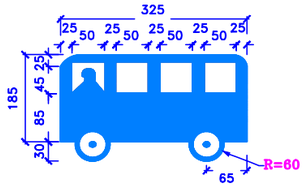
C9

হাসপাতাল

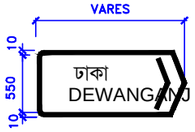


C21

বাস স্টান্ড



DETAILS OF C21

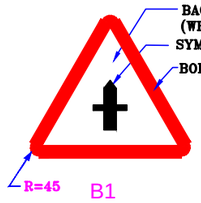


C34

DIRECTION SIGN

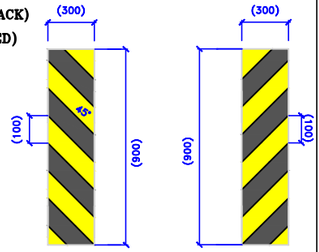
B13

আচমকা মোড়
(বিপরীত ক্ষেত্রে
পরিবর্তন প্রযোজ্য)



B1

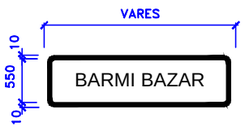
দুটি রাস্তার সংযোগস্থল



B49

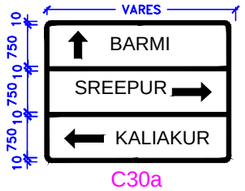
বিপদজ্জনক প্রতিরোধক
(এক পার্শ্বে)

DESTINATION



C25

PLACE IDENTIFICATION SIGN

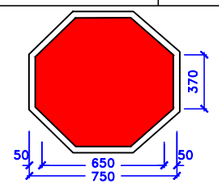


C30a

DESTINATION SIGN

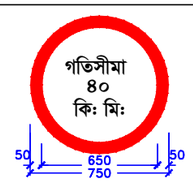
SIGN

REGULATORY



A1

থামুন



D12

গতিসীমা

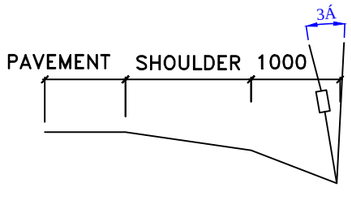
B38

সামনে কাজ চলিতেছে

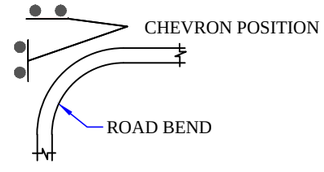
CHARACTERISTICS OF ROAD SIGN

SIGN	MARK	SHAPE	COLOUR		
			BORDER	BACKGROUND	SYMBOL
WARNING	WS	EQUILATERAL TRIANGLE WITH APEX POINTING UPWARDS	RED	WHITE	BLACK
REGULATORY	RS	GENERALLY CIRCULAR BUT IN CASE OF STOP SIGN OCTAGONAL	RED/ WHITE	WHITE/ RED	BLACK OR RED
INFORMATION	IS	RECTANGULAR WITH LONGER SIDE VERTICAL	WHITE/ BLUE	BLUE/WHITE	BLACK OR RED
DESTINATION	DS	RECTANGULAR WITH LONGER SIDE HORIZONTAL	BLACK	WHITE	BLACK

TYPE OF SIGN	LOCATION
B10a , B10b	75m BEFORE CURVE
B5, B7, B8	75m BEFORE JUNCTION
B23, B45	75m BEFORE CROSSING
A1, B13, B14, B25, B31, B44,B47, B56,	75m BEFORE LOCATION
C9, C21,C25,C30a, D9, D12,	75m BEFORE DIRECTION



PLAN ORIENTATION OF SIGN



POSITION OF B-13

NOTE:

1. LANGUAGE OF SIGN MAY BE MODIFIED AS PER DIRECTION OF THE ENGINEER
2. SAMPLES OF SIGNS HAVE BEEN SHOWN. ADDITIONAL SIGN MAY BE REQUIRED AS PER FIELD CONDITION
3. DIRECTION OF ARROWS SHOWN ON THE SIGNS ARE INDICATIVE ONLY
4. DIRECTION, DESTINATION AND PLACE IDENTIFICATION SIGNS SHALL BE FIXED ON TWO POSTS.
5. ALL PAINT SHOULD BE RETRO REFLECTING

NAME OF THE CLIENT :

GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH

LOCAL GOVERNMENT ENGINEERING DEPARTMENT

NAME OF THE PROJECT :

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NAME OF THE CONSULTANTS :

SAI Consulting Engineers Pvt. Ltd, India.

in association with

BETS Consulting Services Ltd, Bangladesh

Project office :

Tahmid Mahmood Palace
Flat # 9A, House # 77, Road # 4, Block-C,

DRAWING TITLE :

DRAWING OF TRAFFIC SIGNS

DRAWING NO : LGED/MISC/TS-11a

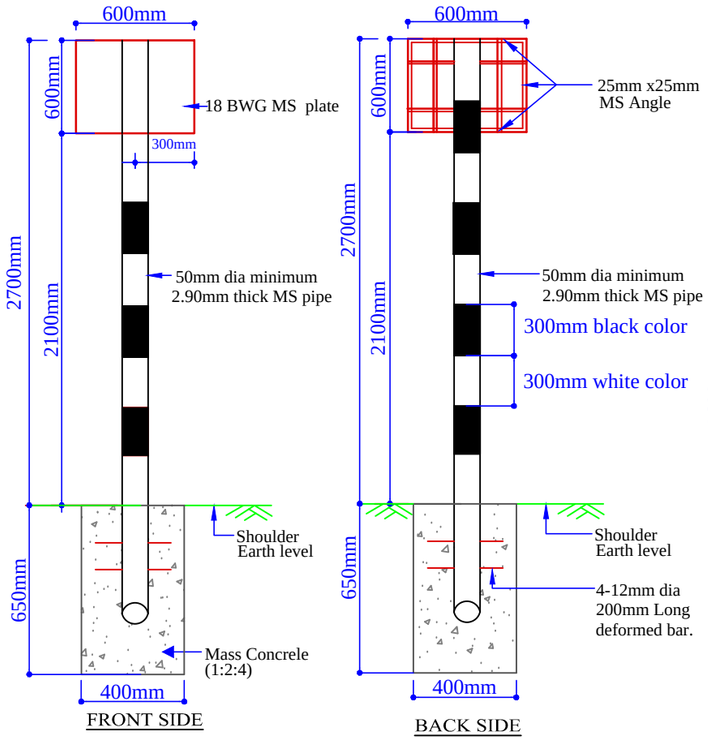
Scale :As shown

Date : 28-01-16

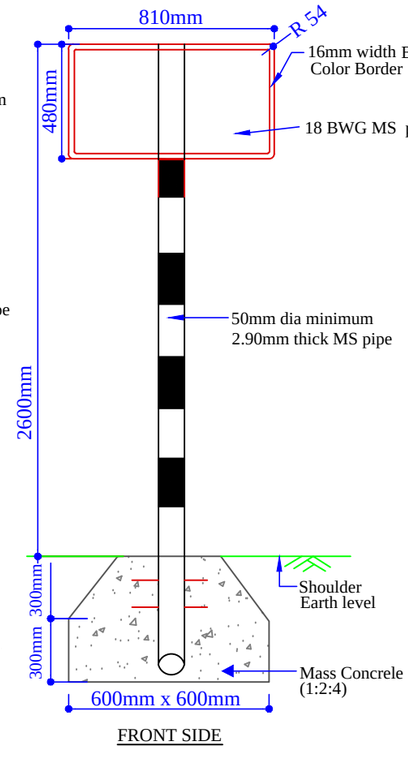
DESIGNED BY :	DRAWN BY :	CHECKED BY :	APPROVED BY :
MD. TAZUDDIN	MD.NOOR AMIN	AFM HAMIDUL HAQUE	DR. PRABHAT SHRIVASTAVA

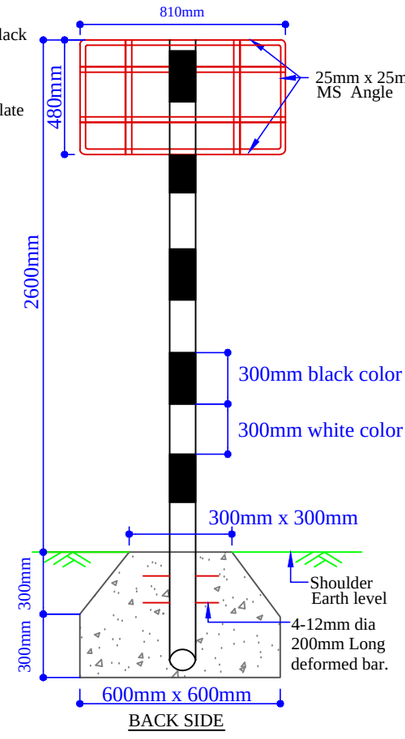
REV.	DESCRIPTION	DATE

(A) Information

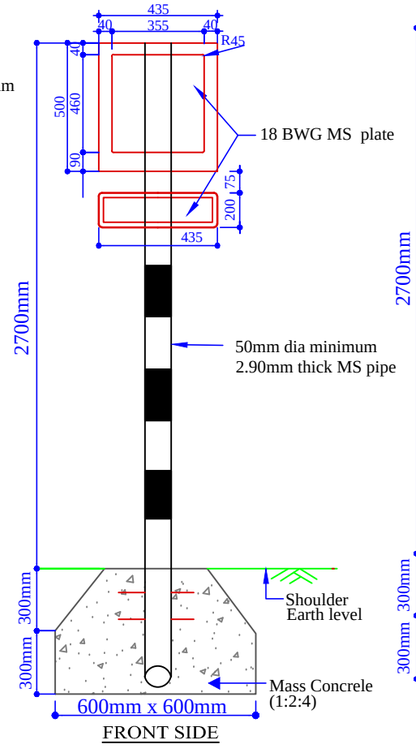


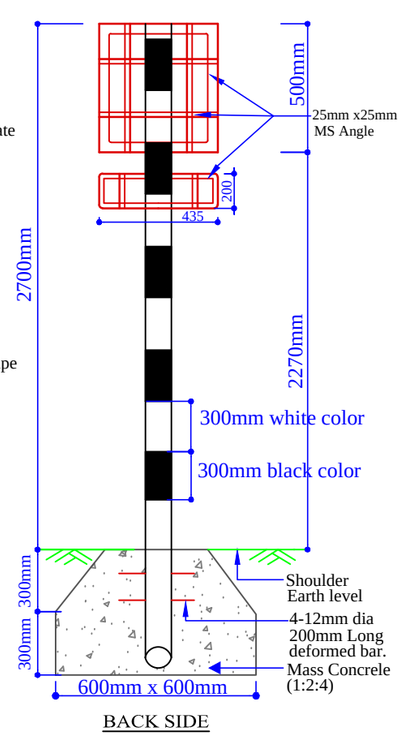
SECTION OF TRAFFIC SIGN (Information)





SECTION OF TRAFFIC SIGN (Information)





SECTION OF TRAFFIC SIGN (Information)

NOTE:

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4. DIRECTION, DESTINATION AND PLACE IDENTIFICATION SIGNS SHALL BE FIXED ON TWO POSTS.
5. ALL PAINT SHOULD BE RETRO REFLECTING

NAME OF THE CLIENT :

GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH

LOCAL GOVERNMENT ENGINEERING DEPARTMENT

NAME OF THE PROJECT :

CONSULTANCY SERVICES FOR FEASIBILITY, DETAILED SURVEY AND DESIGN OF CHITTAGONG HILL TRACT CONNECTIVITY CONNECTING THEGAMUKH AND CHITTAGONG PORT.

NAME OF THE CONSULTANTS :

SAI Consulting Engineers Pvt. Ltd, India.

in association with

BETS Consulting Services Ltd, Bangladesh

Project office :

Tahmid Mahmood Palace
Flat # 9A, House # 77, Road # 4, Block-C,

DRAWING TITLE :

DRAWING OF TRAFFIC SIGNS

DRAWING NO : LGED/MISC/TS-11b

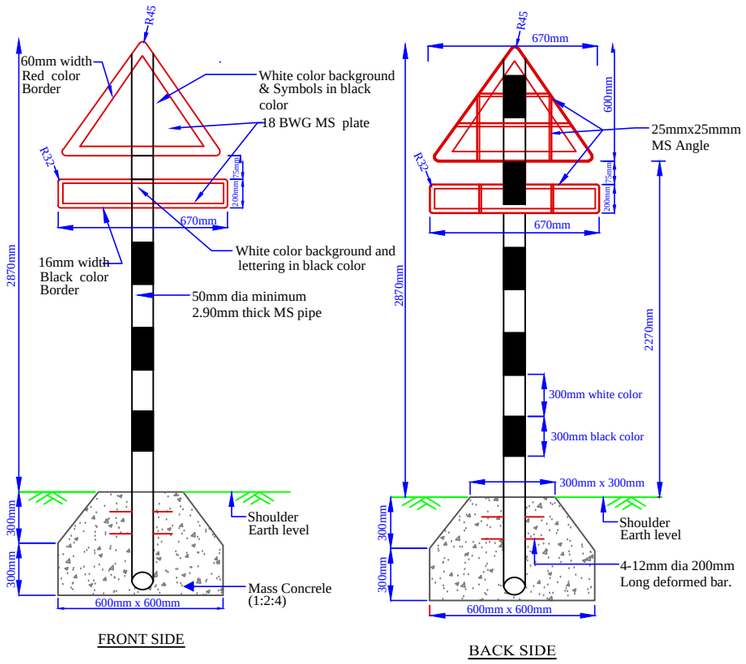
Scale :As shown

Date : 28-01-16

DESIGNED BY :	DRAWN BY :	CHECKED BY :	APPROVED BY :
MD. TAZUDDIN	MD.NOOR AMIN	AFM HAMIDUL HAQUE	DR. PRABHAT SHRIVASTAVA

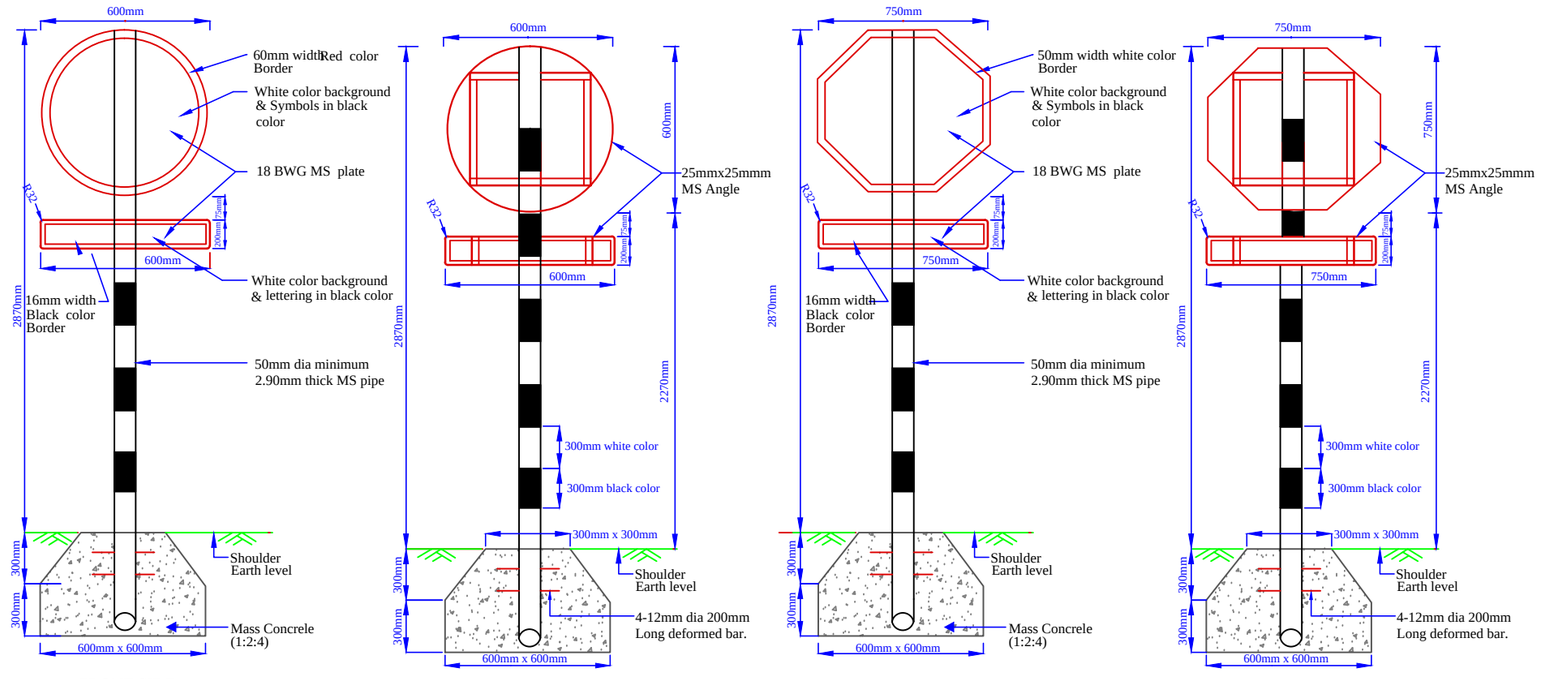
REV.	DESCRIPTION	DATE

(B) Warning



SECTION OF TRAFFIC SIGN (Warning)

(C) Regulatory



SECTION OF TRAFFIC SIGN (Regulatory)

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NOTE:

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Flat # 9A, House # 77, Road # 4, Block-C,

DRAWING TITLE :

DRAWING OF TRAFFIC SIGNS

DRAWING NO : LGED/MISC/TS-11c

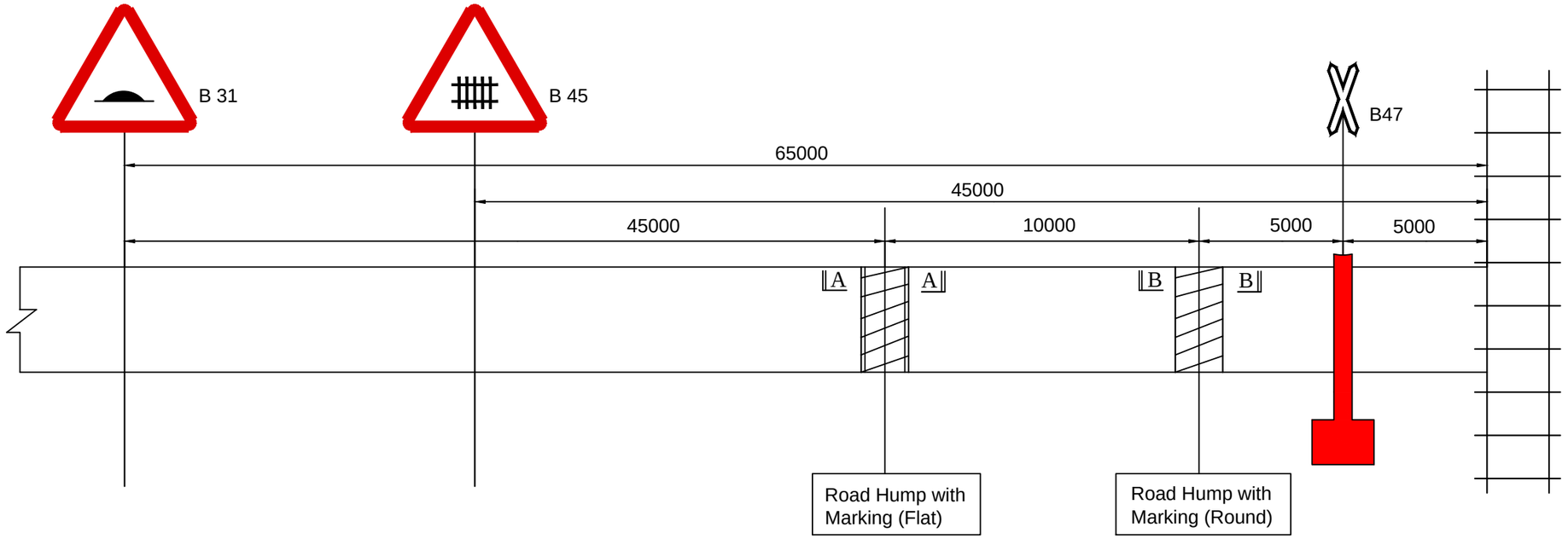
Scale :As shown

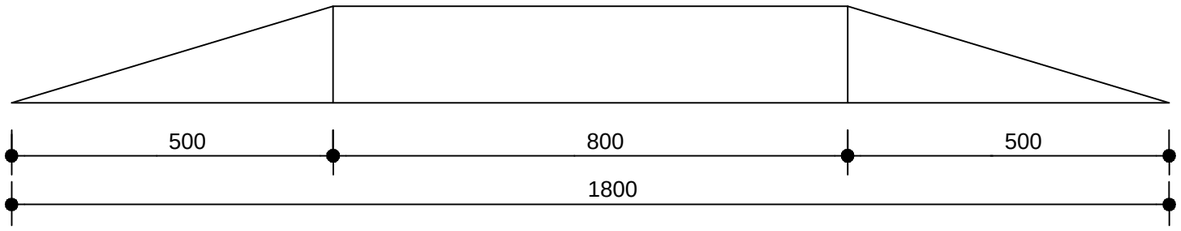
Date : 28-01-16

DESIGNED BY :	DRAWN BY :	CHECKED BY :	APPROVED BY :
MD. TAZUDDIN	MD.NOOR AMIN	AFM HAMIDUL HAQUE	DR. PRABHAT SHRIVASTAVA

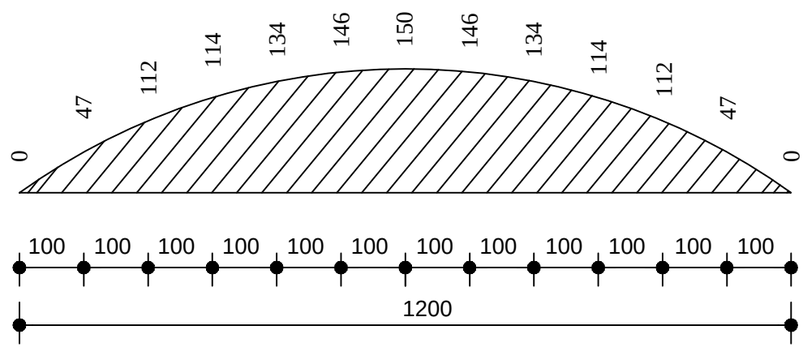
REV.	DESCRIPTION	DATE

TYPICAL LAYOUT PLAN SHOWING PHYSICAL SAFTY WORKS WITH BARRIER AT RAILWAY CROSSING





ROAD HUMP (Flat)
SECTION A-A



ROAD HUMP (Round)
SECTION B-B

NOTE:

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NAME OF THE CONSULTANTS :
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in association with
BETS Consulting Services Ltd, Bangladesh
Project office :
Tahmid Mahmood Palace
Flat # 9A, House # 77, Road # 4, Block-C,

DRAWING TITLE :
DRAWING OF TRAFFIC SIGNS

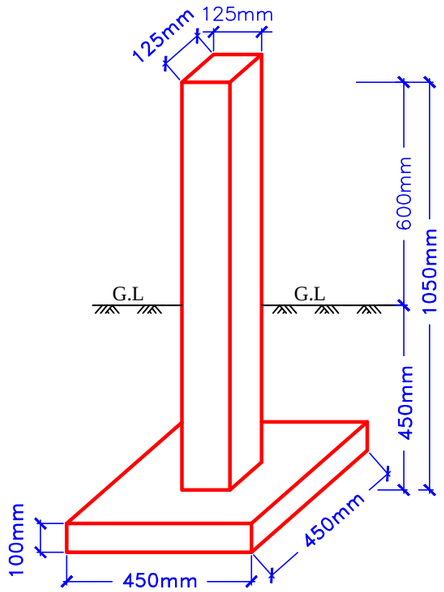
DRAWING NO : LGED/MISC/TS-11d

Scale :As shown

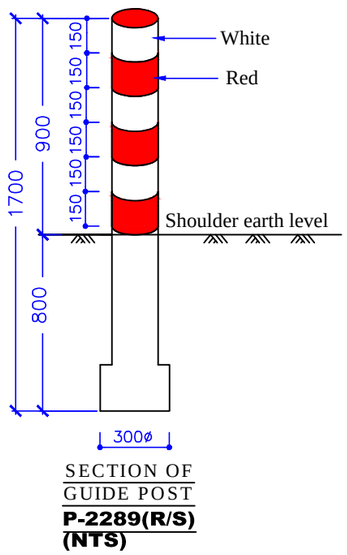
Date : 28-01-16

DESIGNED BY :	DRAWN BY :	CHECKED BY :	APPROVED BY :
MD. TAZUDDIN	MD.NOOR AMIN	AFM HAMIDUL HAQUE	DR. PRABHAT SHRIVASTAVA

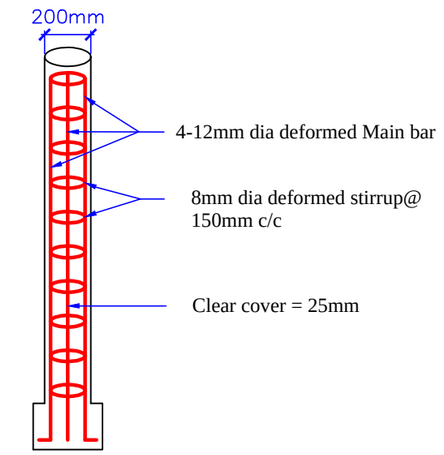
REV.	DESCRIPTION	DATE



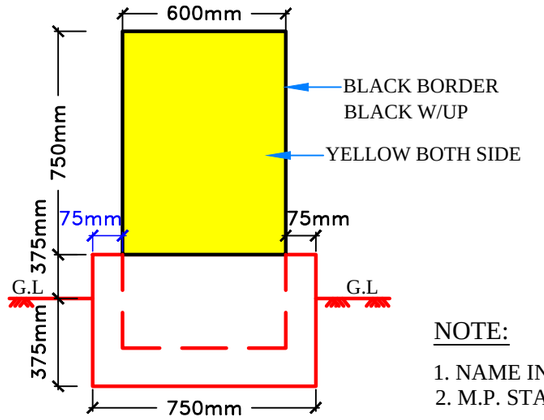
BOUNDARY PILLAR
(NTS)



SECTION OF GUIDE POST
P-2289(R/S)
(NTS)



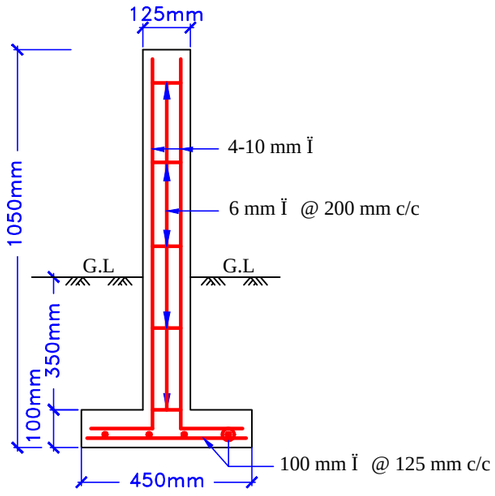
SECTION OF GUIDE POST **(NTS)**



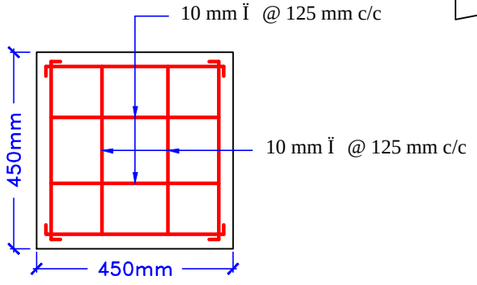
NOTE:

1. NAME IN BLACK COLOR
2. M.P. STAGGERED

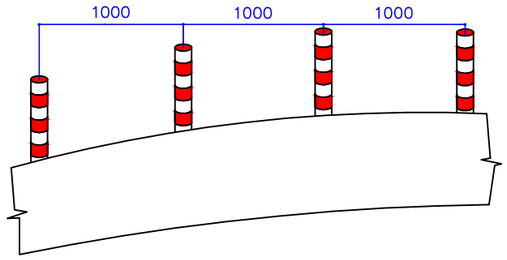
ELEVATION OF KILOMETER POST
(NTS)



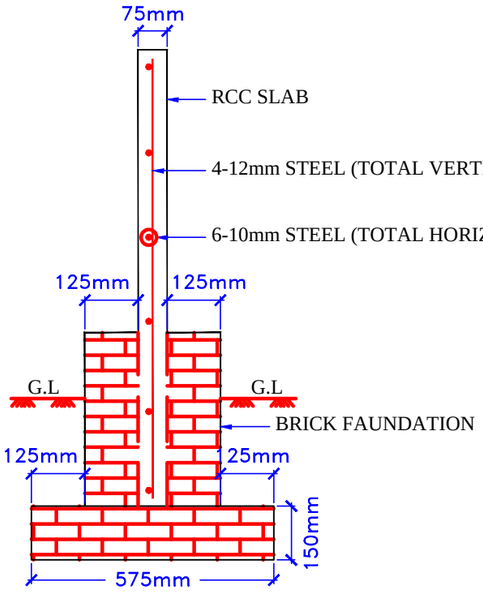
REINF. DETAIL OF BOUNDARY PILLAR
(NTS)



FOOTING OF BOUNDARY PILLAR
(NTS)



SECTION OF GUIDE POST
(NTS)



SECTIONAL ELEVATION OF KILOMETER POST
(NTS)

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LOCAL GOVERNMENT ENGINEERING DEPARTMENT

NAME OF THE PROJECT :
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NAME OF THE CONSULTANTS :
SAI Consulting Engineers Pvt. Ltd, India.
in association with
BETS Consulting Services Ltd, Bangladesh
Project office :
Tahmid Mahmood Palace
Flat # 9A, House # 77, Road # 4, Block-C,

DRAWING TITLE :
DRAWING OF Km. POST, BOUNDARY PILLAR,GUARD POST & TRAFFIC SIGNS

DRAWING NO : LGED/MISC/TS-11e

Scale :As shown

Date : 28-01-16

DESIGNED BY :	DRAWN BY :	CHECKED BY :	APPROVED BY :
MD. TAZUDDIN	MD.NOOR AMIN	AFM HAMIDUL HAQUE	DR. PRABHAT SHRIVASTAVA

REV.	DESCRIPTION	DATE

SAFETY AT ROADWORKS

A code of Practice for Signing at Road works

Principles

Everyone responsible for work on or near the road has a duty to try and prevent road accidents. All roadways, no matter how small, must be properly signed. This leaflet shows you what to do.

Good Signing **WARNS, INFORMS** and **DIRECTS.** It warns road users that there is a hazard ahead, so that they can be ready to take action. It informs them of what kind of thing to expect, so that they know what manoeuvre or action they will need to make. And it directs them how to pass through the hazard in a safe manner. Good signing also helps protect the road workers and keeps traffic delays to a minimum.

Plan ahead - It is our responsibility to sign your works safely, so think what signs and cones you will need before you leave the depot. This leaflet will help you decide what you need. Get Police advice in difficult or dangerous situations.

Be seen - All persons working on or near the road must wear brightly - colored clothing, preferably an orange or yellow waistcoat.

Face the traffic when setting out signs - Put the *Road Works Ahead* warming sign out first and then move towards the works site, and always try and face the traffic when you set out the signs and cones.

Check the signs carefully - Ask yourself this question: “Will someone coming along the road in either direction understand exactly what is happening and what is expected of them?” As the works proceed, alter the signing so that it is always consistent with the work that is going on.

Fix the signs properly - In most cases it will be best to fix the signs on upright poles set in heavy, concrete block bases. This will help prevent theft and stops the signs from being blown over or dislodged by moving traffic. If the works are to last more than a few weeks fix the sign poles into proper concrete foundations. Check the signs regularly to see if they are all still in place, and clean them if they get dirty.

Ensure the signs are visible at night - Make every effort to finish the work before dark, but, if this is not possible, use reflective signs and cones, and preferably supplement them with flashing lights.

Removing unnecessary signs - Never leave signs on the road once they are no longer needed. This annoys drivers and leads to distrust of road works signing.

Keep the site tidy - Take up as little road space as possible, and store construction materials and equipment off the road if you can. When you have finished make sure than the road surface has been properly reinstated and that there are no dangerous holes or trenches. Clean away any mud or gravel.

Always use the standard signs - do not design your own - Design details for each sign are given in Volume - 2 of the Traffic Signs Manual.

The Basic Signs You Will Need

The *Road Works Ahead* sign is the first sign to be seen by the driver, so place it well before the work site - about 45 metres in town and 90 metres on rural roads - but on a high speed National Highway it should be at least 150 metres away. Put the sign where it can be seen from a distance. For example, if the works are just after a bend in the road, put the sign before the bend. This sign has a black symbol on a white background, all within a red triangle.

The *Road Narrows Ahead* sign warns drivers which side of the road is obstructed. Place it midway between the Road Works Ahead sign and the works site. Make sure you use the appropriate sign on each approach to the obstruction. This sign has a black symbol on a white background, all within a red triangle.

Place *Keep Left* or, if appropriate Keep Right, signs at the beginning and end of the works - at the point where the works extend furthest into the road. This sign has a white arrow on a light blue background.

Place a line of *Traffic Cones* to guide pedestrian and vehicle traffic past the works. Leave some working space between the line of cones and the actual excavation or works area. Traffic cones should be red, and, if used at night, should preferably have white reflective sleeves. Where theft is likely to be a problem oil drums painted red and white may be used instead.

Where there is a lot of traffic or the works site is very long, you will need to control traffic manually using the *STOP / GO* boards. If the obstruction is less than 30 metres long and is on a straight section of road you will only need a single board operating at one end or in the middle. Do not use flags, as these can be confusing, and make sure that the boards are operated by a responsible adult. Provide training if necessary.

Sign plates should normally be 750mm in diameter (750mm high triangle). On low speed (40km/h or less) single carriageway roads 600mm high signs will normally be adequate.

Sign Layouts

Shown on the next page are sign layouts for two typical road works operations. For ease of illustration the advance signing is shown close to the works site, but in practice it would be much further away - see the advice given on this page.

NOTE:

1. LANGUAGE OF SIGN MAY BE MODIFIED AS PER DIRECTION OF THE ENGINEER
2. SAMPLES OF SIGNS HAVE BEEN SHOWN. ADDITIONAL SIGN MAY BE REQUIRED AS PER FIELD CONDITION
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5. ALL PAINT SHOULD BE RETRO REFLECTING

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LOCAL GOVERNMENT ENGINEERING DEPARTMENT

NAME OF THE PROJECT :
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NAME OF THE CONSULTANTS :
SAI Consulting Engineers Pvt. Ltd, India.
in association with
BETS Consulting Services Ltd, Bangladesh
Project office :
Tahmid Mahmood Palace
Flat # 9A, House # 77, Road # 4, Block-C,

DRAWING TITLE : DRAWING OF ROAD SAFETY

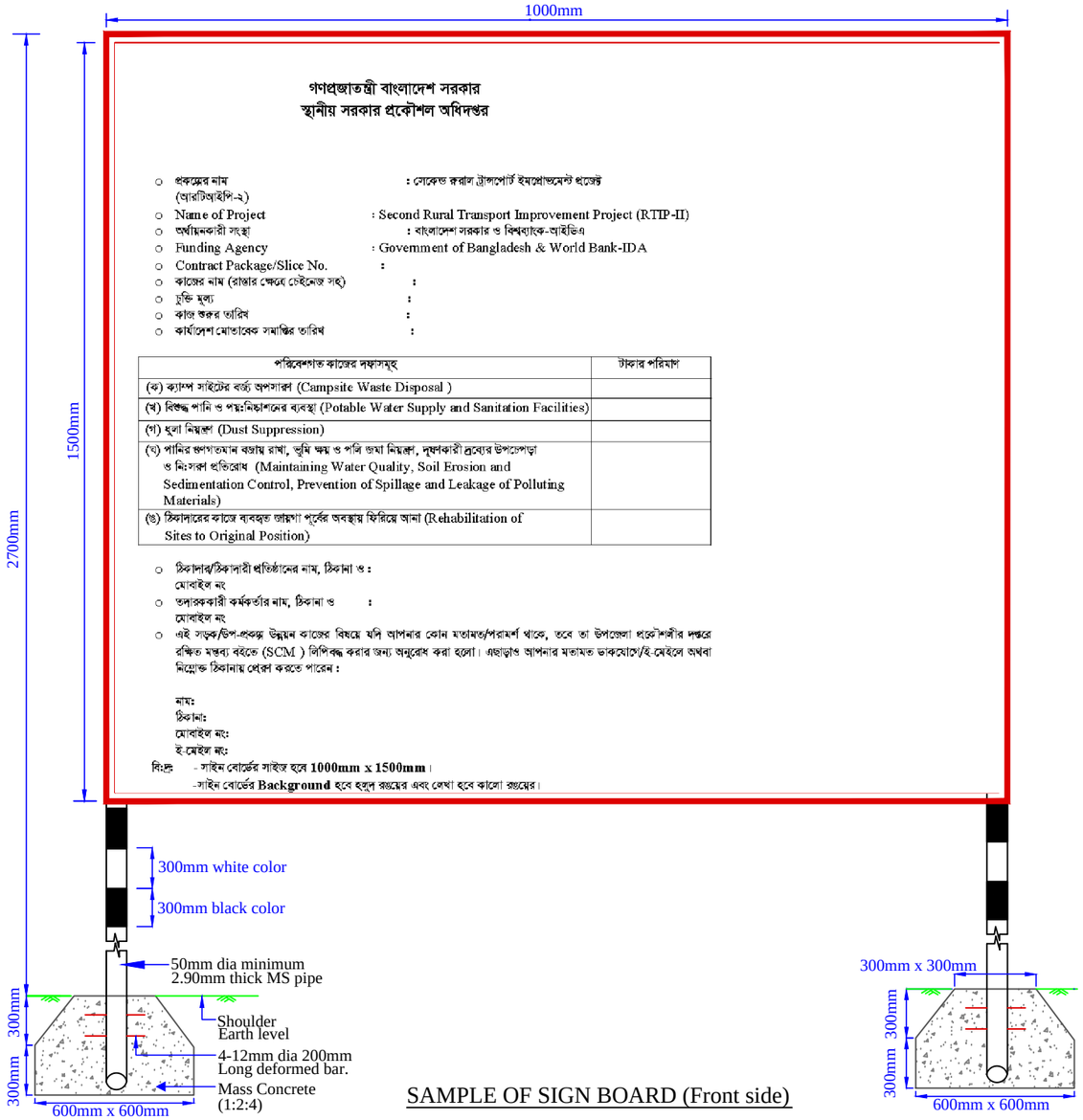
DRAWING NO : LGED/MISC/TS-11f

Scale :As shown

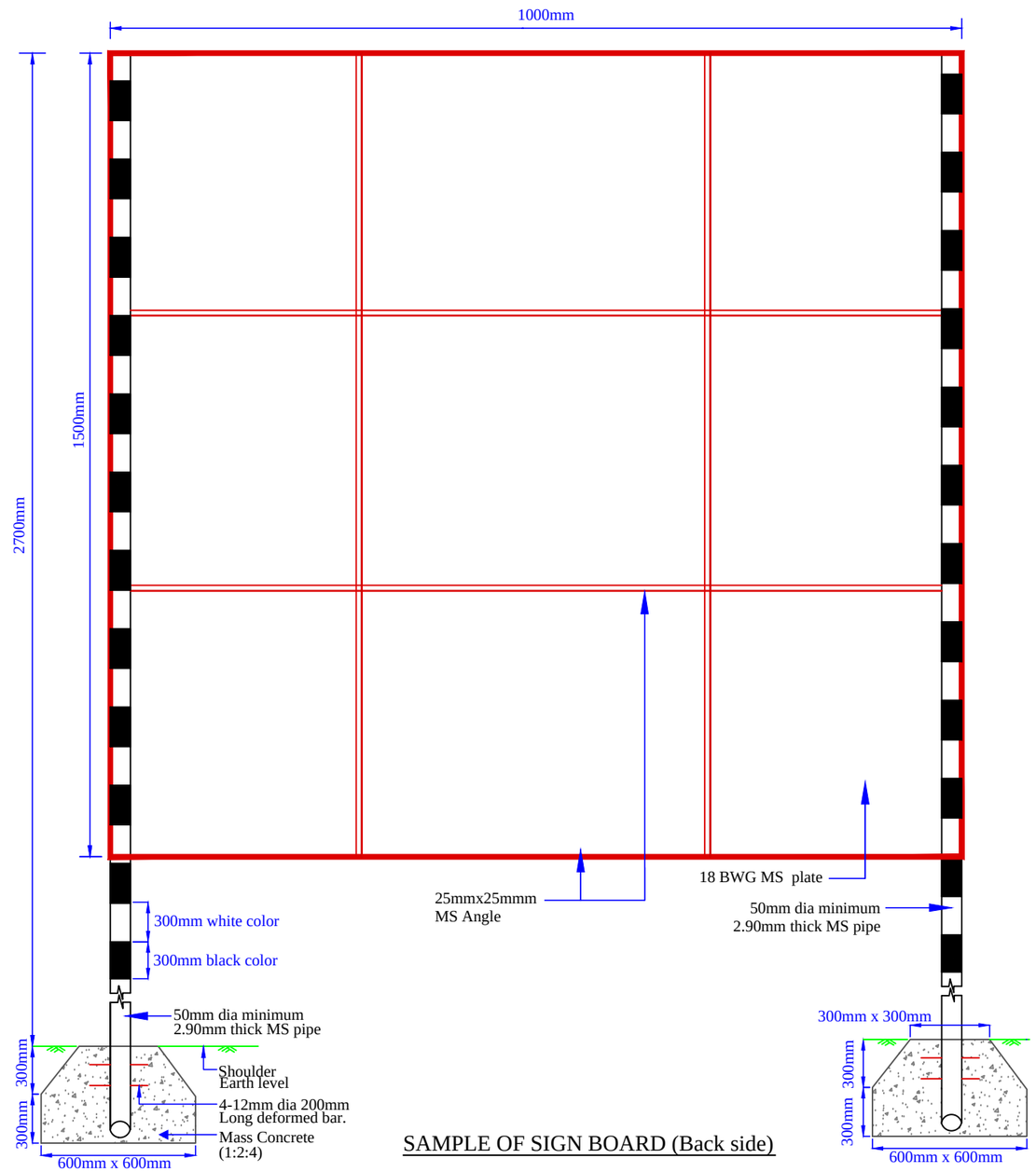
Date : 28-01-16

DESIGNED BY :	DRAWN BY :	CHECKED BY :	APPROVED BY :
MD. TAZUDDIN	MD.NOOR AMIN	AFM HAMIDUL HAQUE	DR. PRABHAT SHRIVASTAVA

REV.	DESCRIPTION	DATE



SAMPLE OF SIGN BOARD (Front side)



SAMPLE OF SIGN BOARD (Back side)

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in association with
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Project office :
Tahmid Mahmood Palace
Flat # 9A, House # 77, Road # 4, Block-C,

DRAWING TITLE :
DRAWING OF SIGN BOARD

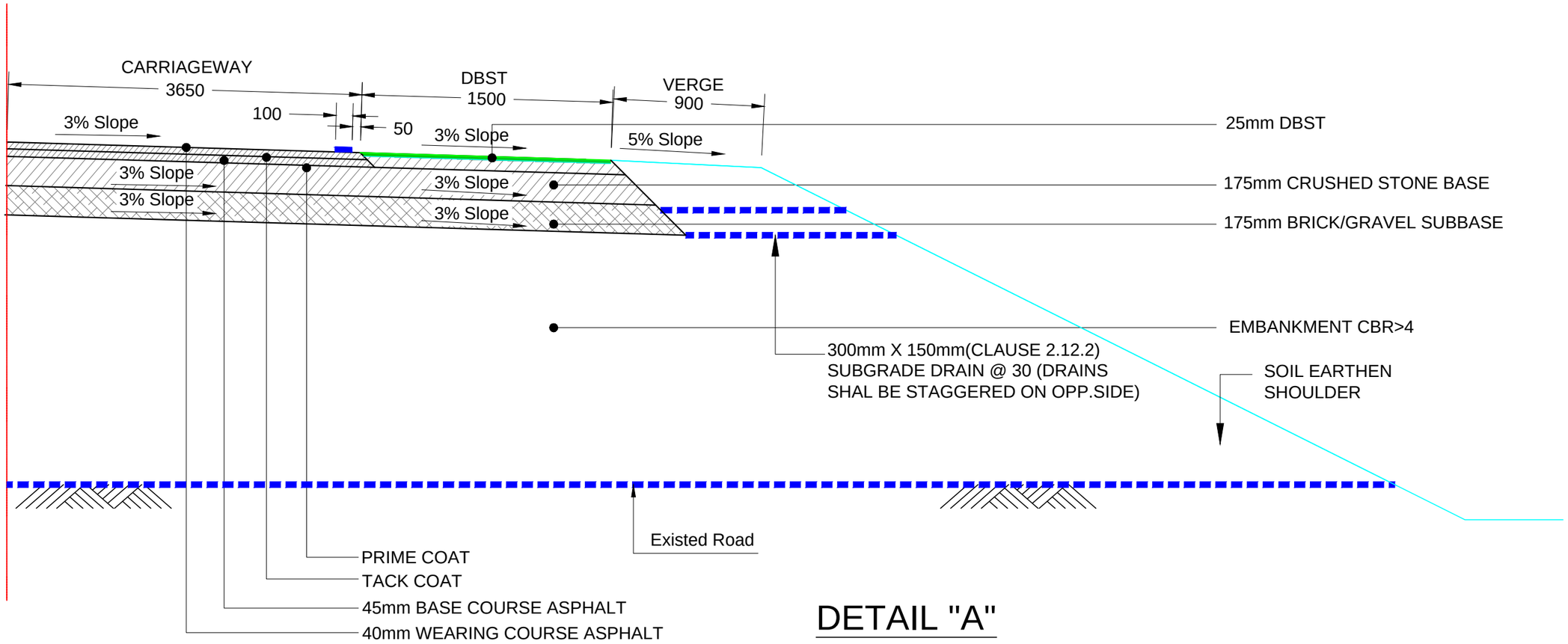
DRAWING NO : LGED/MISC/TS-11g

Scale :As shown

Date : 28-01-16

DESIGNED BY :	DRAWN BY :	CHECKED BY :	APPROVED BY :
MD. TAZUDDIN	MD.NOOR AMIN	AFM HAMIDUL HAQUE	DR. PRABHAT SHRIVASTAVA

REV.	DESCRIPTION	DATE



DETAIL "A"

NAME OF THE CLIENT :

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LOCAL GOVERNMENT ENGINEERING DEPARTMENT

NAME OF THE PROJECT :

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SAI Consulting Engineers Pvt. Ltd, India.

in association with

BETS Consulting Services Ltd, Bangladesh

Tahmid Mahmood Palace Flat # 9A,
House # 77, Road # 4, Block-C, Banani,
Dhaka-1213, Bangladesh.

DRAWING TITLE : **DETAIL "A"**

DRAWING NO: LGED/MISC/CR-12a

Scale :As shown

Date : 28-01-16

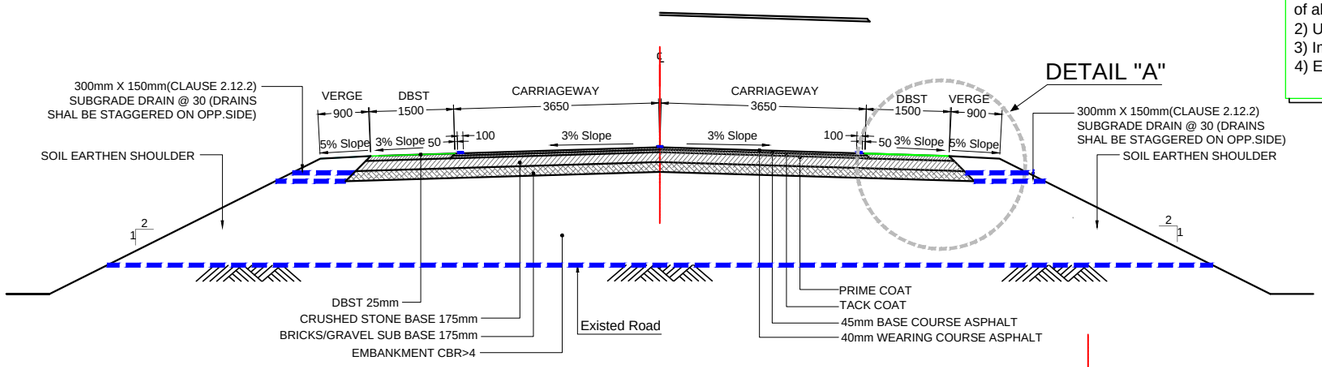
DESIGNED BY :	DRAWN BY :	CHECKED BY :	APPROVED BY :
Engr. Kamrul Hasan	Ashraful Islam Khan	AFM Hamidul Haque	DR. PRABHAT SHRIVASTAVA

REV.	DESCRIPTION	DATE

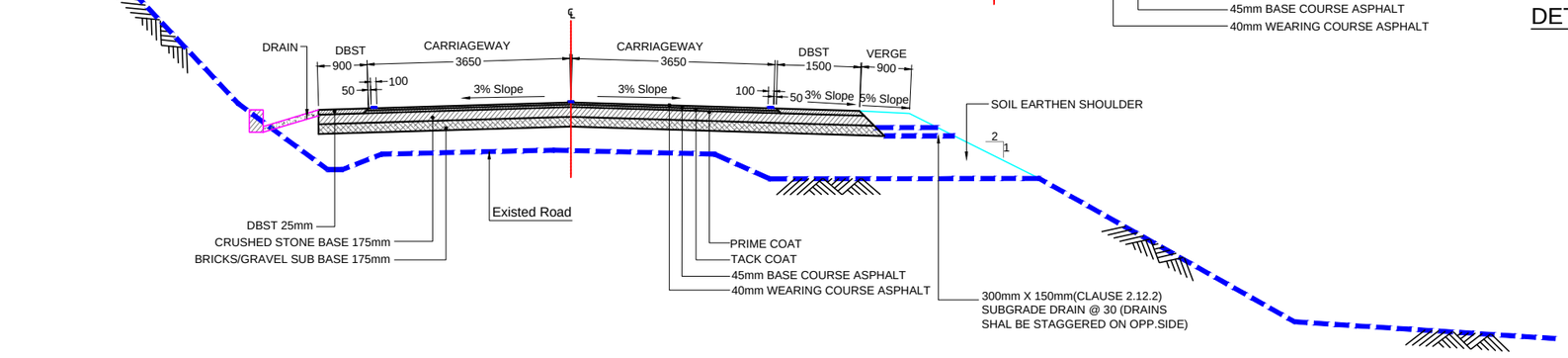
ALL DIMENSIONS ARE IN MILLIMETER UNLESS OTHERWISE SHOWN

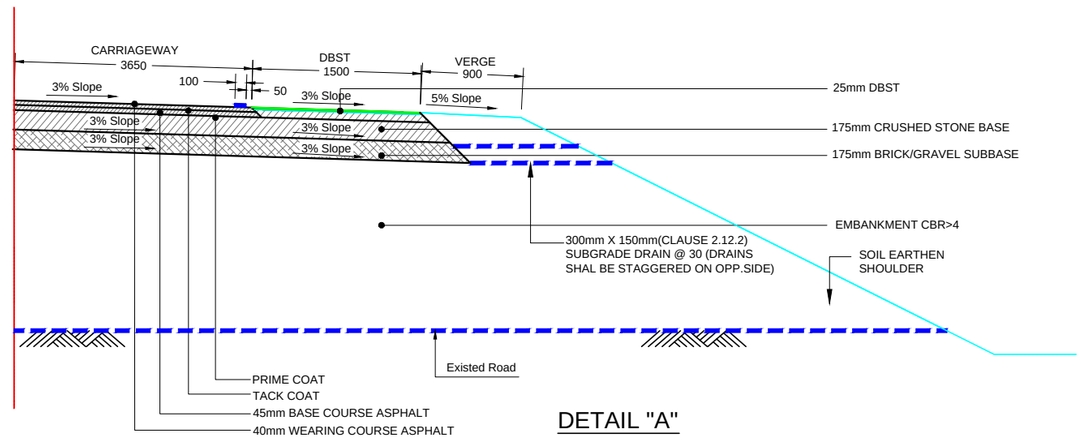
TYPICAL CROSS SECTION & DETAIL DRAWINGS (1)

CROSS SECTION OF ROAD OPEN AREA



CROSS SECTION ON EXISTING ROAD -ONE SIDE HILL & OTHER SIDE OPEN





DETAIL "A"

NOTE

1) Site clearance is defined as the clearing, grubbing, breaking out, removal, and disposal of all vegetation, underground obstructions, structures, and debris.
2) Unsuitable material shall not be acceptable for embankment construction.
3) Improve sub grade requires material of CBR superior to 10.
4) Embankment requires material of CBR superior to 4.

* Thicknes of Pavement will be decided after Design

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in association with
BETS Consulting Services Ltd, Bangladesh
Tahmid Mahmood Palace Flat # 9A,
House # 77, Road # 4, Block-C, Banani,
Dhaka-1213, Bangladesh.

DRAWING TITLE : **TYPICAL CROSS SECTION & DETAIL DRAWINGS OF ROAD**

DRAWING NO: LGED/MISC/CR-12b

Scale :As shown

Date : 28-01-16

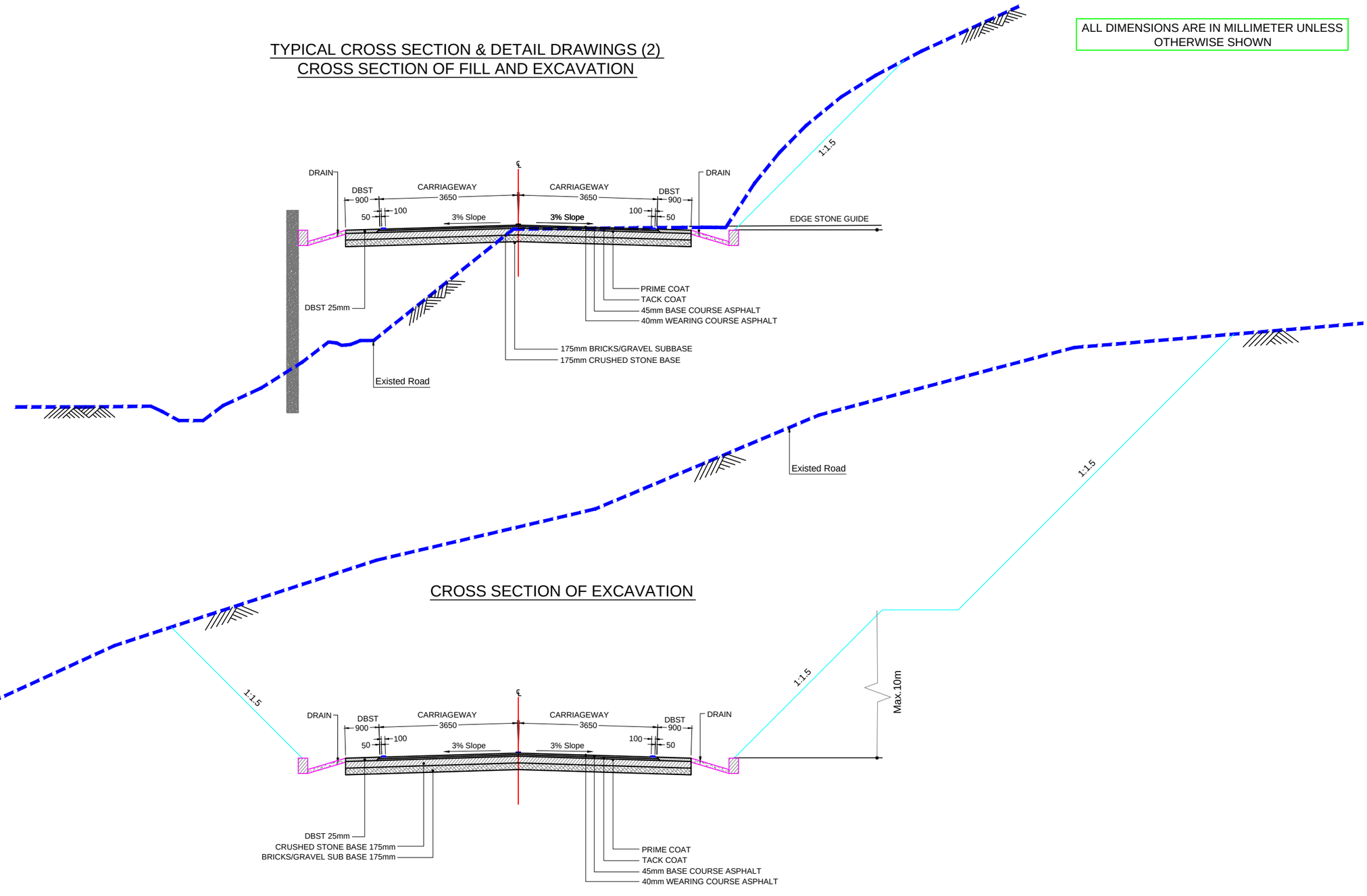
DESIGNED BY :	DRAWN BY :	CHECKED BY :	APPROVED BY :
Engr. Kamrul Hasan	Ashraful Islam Khan	AFM Hamidul Haque	DR. PRABHAT SHRIVASTAVA

REV.	DESCRIPTION	DATE

ALL DIMENSIONS ARE IN MILLIMETER UNLESS OTHERWISE SHOWN

TYPICAL CROSS SECTION & DETAIL DRAWINGS (2)

CROSS SECTION OF FILL AND EXCAVATION



CROSS SECTION OF EXCAVATION

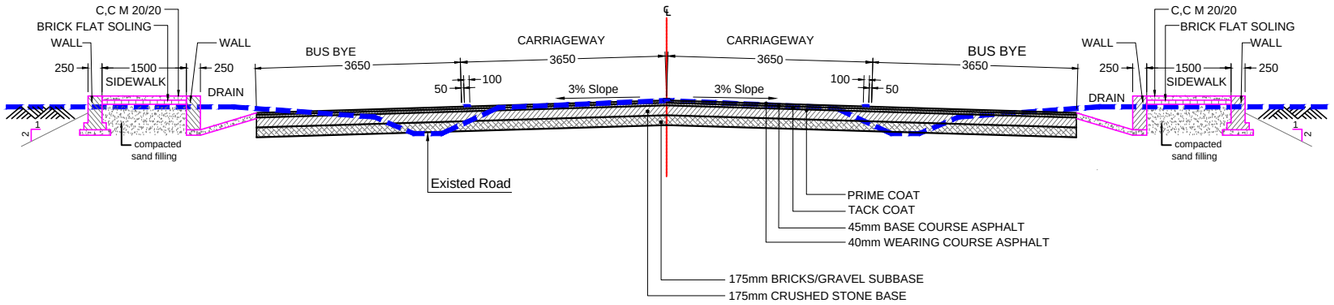
* Thicknes of Pavement will be decided after Design

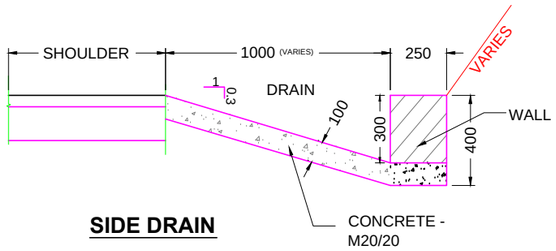
NAME OF THE CLIENT : GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH LOCAL GOVERNMENT ENGINEERING DEPARTMENT NAME OF THE PROJECT : CONSULTANCY SERVICES FOR FEASIBILITY, DETAILED SURVEY AND DESIGN OF CHITTAGONG HILL TRACT CONNECTIVITY CONNECTING THEGAMUKH AND CHITTAGONG PORT.	NAME OF THE CONSULTANTS : SAI Consulting Engineers Pvt. Ltd, India. in association with BETS Consulting Services Ltd, Bangladesh Tahmid Mahmood Palace Flat # 9A, House # 77, Road # 4, Block-C, Banani, Dhaka-1213, Bangladesh.	DRAWING TITLE : **TYPICAL CROSS SECTION & DETAIL DRAWINGS OF ROAD** DRAWING NO: LGED/MISC/CR-12c Scale :As shown Date : 28-01-16	DESIGNED BY : Engr. Kamrul Hasan	DRAWN BY : Ashraful Islam Khan	CHECKED BY : AFM Hamidul Haque	APPROVED BY : DR. PRABHAT SHRIVASTAVA

REV.	DESCRIPTION	DATE

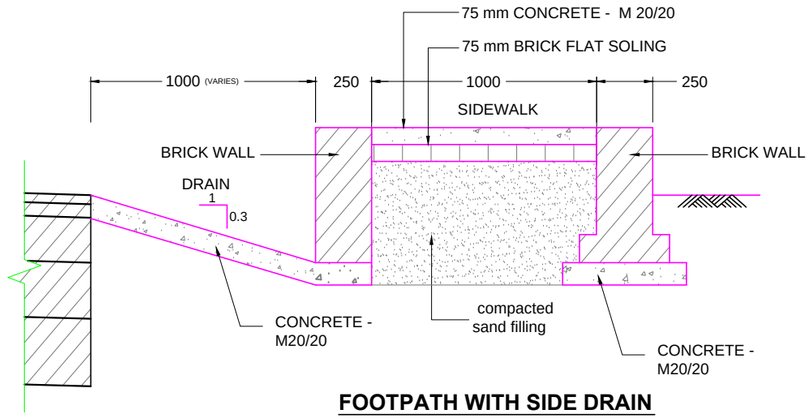
ALL DIMENSIONS ARE IN MILLIMETER UNLESS OTHERWISE SHOWN

TYPICAL CROSS SECTION & DETAIL DRAWINGS (3)





SIDE DRAIN



FOOTPATH WITH SIDE DRAIN

* Thicknes of Pavement will be decided after Design

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YPICAL CROSS SECTION OF ROADT

TITLE OF DRAWINGS

Sl. No.	Drawing Title	Sheet No.
A.	General Notes	
1	General Notes for RCC Girder Bridge	GEN. RC-01
2	General Notes for PSC Girder bridge	GEN. PC-02
B.	TYPICAL RCC GIRDER	
1	Details of 25.0m Long RCC Girder	LGED/D-25/RCG-01
2	Details of 22.0m Long RCC Girder	LGED/D-22/RCG-01
3	Details of 20.0m Long RCC Girder	LGED/D-20/RCG-01
4	Details of 18.0m Long RCC Girder	LGED/D-18/RCG-01
5	Details of 17.0m Long RCC Girder	LGED/D-17/RCG-01
6	Details of 15.0m Long RCC Girder	LGED/D-15/RCG-01
7	Details of 12.0m Long RCC Girder	LGED/D-12/RCG-01
8	Details of 10.0m Long RCC Girder	LGED/D-10/RCG-01
9	Details of 8.0m Long RCC Girder	LGED/D-8/RCG-01
C.	TYPICAL DECK SLAB FOR RCC GIRDER	
1	Details of Deck Slab (S-25)	LGED/DK-25/C-01
2	Reinf. Details of Deck Slab (S-25)	LGED/DK-25/RNF.-02
3	Details of Deck Slab (S-22)	LGED/DK-22/C-01
4	Reinf. Details of Deck Slab (S-22)	LGED/DK-22/RNF.-02
5	Details of Deck Slab (S-20)	LGED/DK-20/C-01
6	Reinf. Details of Deck Slab (S-20)	LGED/DK-20/RNF.-02
7	Details of Deck Slab (S-18)	LGED/DK-18/C-01
8	Reinf. Details of Deck Slab (S-18)	LGED/DK-18/RNF.-02
9	Details of Deck Slab (S-17)	LGED/DK-17/C-01
10	Reinf. Details of Deck Slab (S-17)	LGED/DK-17/RNF.-02
11	Details of Deck Slab (S-15)	LGED/DK-15/C-01
12	Reinf. Details of Deck Slab (S-15)	LGED/DK-15/RNF.-02
13	Details of Deck Slab (S-12)	LGED/DK-12/C-01
14	Reinf. Details of Deck Slab (S-12)	LGED/DK-12/RNF.-02
15	Details of Deck Slab (S-10)	LGED/DK-10/C-01
16	Reinf. Details of Deck Slab (S-10)	LGED/DK-10/RNF.-02
17	Details of Deck Slab (S-8)	LGED/DK-8/C-01
18	Reinf. Details of Deck Slab (S-8)	LGED/DK-8/RNF.-02
D.	TYPICAL PSC GIRDER	
1	26.0m Long PC Girder Concrete Outline Details	LGED/PCG-26/CON-01
2	26.0m Long PC Girder P-stressing Cable Details	LGED/PCG-26/CAB-02
3	26.0m Long PC Girder Non-Prestressing Reinf.	LGED/PCG-26/RNF.-03
4	End Block Details of 26.0m Long PC Girder	LGED/PCG-26/EBL-04
5	Typical Pre-Stressing Anchorage Details for 26.0m PC Girder	LGED/PCG-26/ANC-05
6	Reinf. Details of X-Girder for 26.0m PC Girder	LGED/PCG-26/XG-06
7	28.0m Long PC Girder Concrete Outline Details	LGED/PCG-28/CON-01
8	28.0m Long PC Girder P-stressing Cable Details	LGED/PCG-28/CAB-02
9	28.0m Long PC Girder Non-Prestressing Reinf.	LGED/PCG-28/RNF.-03
10	End Block Details of 28.0m Long PC Girder	LGED/PCG-28/EBL-04
11	Typical Pre-Stressing Anchorage Details for 28.0m PC Girder	LGED/PCG-28/ANC-05
12	Reinf. Details of X-Girder for 28.0m PC Girder	LGED/PCG-28/XG-06
13	30.0m Long PC Girder Concrete Outline Details	LGED/PCG-30/CON-01
14	30.0m Long PC Girder P-stressing Cable Details	LGED/PCG-30/CAB-02
15	30.0m Long PC Girder Non-Prestressing Reinf.	LGED/PCG-30/RNF.-03
16	End Block Details of 30.0m Long PC Girder	LGED/PCG-30/EBL-04
17	Typical Pre-Stressing Anchorage Details for 30.0m PC Girder	LGED/PCG-30/ANC-05
18	Reinf. Details of X-Girder for 30.0m PC Girder	LGED/PCG-30/XG-06
19	33.0m Long PC Girder Concrete Outline Details	LGED/PCG-33/CON-01
20	33.0m Long PC Girder P-stressing Cable Details	LGED/PCG-33/CAB-02
21	33.0m Long PC Girder Non-Prestressing Reinf.	LGED/PCG-33/RNF.-03
22	End Block Details of 33.0m Long PC Girder	LGED/PCG-33/EBL-04
23	Typical Pre-Stressing Anchorage Details for 33.0m PC Girder	LGED/PCG-33/ANC-05
24	Reinf. Details of X-Girder for 33.0m PC Girder	LGED/PCG-33/XG-06
25	35.0m Long PC Girder Concrete Outline Details	LGED/PCG-35/CON-01

TITLE OF DRAWINGS

Sl. No.	Drawing Title	Sheet No.
26	35.0m Long PC Girder P-stressing Cable Details	LGED/PCG-35/CAB-02
27	35.0m Long PC Girder Non-Prestressing Reinf.	LGED/PCG-35/RNF.-03
28	End Block Details of 35.0m Long PC Girder	LGED/PCG-35/EBL-04
29	Typical Pre-Stressing Anchorage Details for 35.0m PC Girder	LGED/PCG-35/ANC-05
30	Reinf. Details of X-Girder for 35.0m PC Girder	LGED/PCG-35/XG-06
31	38.0m Long PC Girder Concrete Outline Details	LGED/PCG-38/CON-01
32	38.0m Long PC Girder P-stressing Cable Details	LGED/PCG-38/CAB-02
33	38.0m Long PC Girder Non-Prestressing Reinf.	LGED/PCG-38/RNF.-03
34	End Block Details of 38.0m Long PC Girder	LGED/PCG-38/EBL-04
35	Typical Pre-Stressing Anchorage Details for 38.0m PC Girder	LGED/PCG-38/ANC-05
36	Reinf. Details of X-Girder for 38.0m PC Girder	LGED/PCG-38/XG-06
37	40.0m Long PC Girder Concrete Outline Details	LGED/PCG-40/CON-01
38	40.0m Long PC Girder P-stressing Cable Details	LGED/PCG-40/CAB-02
39	40.0m Long PC Girder Non-Prestressing Reinf.	LGED/PCG-40/RNF.-03
40	End Block Details of 40.0m Long PC Girder	LGED/PCG-40/EBL-04
41	Typical Pre-Stressing Anchorage Details for 40.0m PC Girder	LGED/PCG-40/ANC-05
42	Reinf. Details of X-Girder for 40.0m PC Girder	LGED/PCG-40/XG-06
E.	TYPICAL DECK SLAB FOR PC GIRDER	
1	Details of Deck Slab (S-26)	LGED/DK-26/C-01
2	Reinf. Details of Deck Slab (S-26)	LGED/DK-26/RNF.-02
3	Details of Deck Slab (S-28)	LGED/DK-28/C-01
4	Reinf. Details of Deck Slab (S-28)	LGED/DK-28/RNF.-02
5	Details of Deck Slab (S-30)	LGED/DK-30/C-01
6	Reinf. Details of Deck Slab (S-30)	LGED/DK-30/RNF.-02
7	Details of Deck Slab (S-33)	LGED/DK-33/C-01
8	Reinf. Details of Deck Slab (S-33)	LGED/DK-33/RNF.-02
9	Details of Deck Slab (S-35)	LGED/DK-35/C-01
10	Reinf. Details of Deck Slab (S-35)	LGED/DK-35/RNF.-02
11	Details of Deck Slab (S-38)	LGED/DK-35/C-01
12	Reinf. Details of Deck Slab (S-38)	LGED/DK-38/RNF.-02
13	Details of Deck Slab (S-40)	LGED/DK-40/C-01
14	Reinf. Details of Deck Slab (S-40)	LGED/DK-40/RNF.-02
F.	TYPICAL DRAWING OF PIER	
1	Details of Pier, Span (30.0m~40.0m), Typ-I	LGED/PR-I/C-01
2	Reinf. Details of Pier, Span (30.0m~40.0m), Typ-I	LGED/PR-I/RNF.-02
3	Details of Pier, Span (18.0m~28.0m), Typ-II	LGED/PR-II/C-01
4	Reinf. Details of Pier, Span (18.0m~28.0m), Typ-II	LGED/PR-II/RNF.-02
5	Details of Pier, Span (10.0m~16.0m), Typ-III	LGED/PR-III/C-01
6	Reinf. Details of Pier, Span (10.0m~16.0m), Typ-III	LGED/PR-III/RNF.-02
G.	TYPICAL DRAWING OF ABUTMENT	
1	Dimensional Details of Abutment (Height, H= 10.0m), Typ-I	LGED/AB-10 (I)/C-01
2	Reinf. Details of Abutment Pile cap (Height, H= 10.0m), Typ-I	LGED/AB-10 (I)/RNF.-02
3	Reinf. Details of Abut. & Ballast wall(Height, H= 10.0m), Typ-I	LGED/AB-10 (I)/RNF.-03
4	Details of Counterfort (Height, H= 10.0m), Typ-I	LGED/AB-10 (I)/COUNT.-04
5	Dimensional Details of Abutment (Height, H= 7.0m), Typ-II	LGED/AB-7 (II)/C-01
6	Reinf. Details of Abutment Pile cap (Height, H= 7.0m), Typ-II	LGED/AB-7 (II)/RNF.-02
7	Reinf. Details of Abut. & Ballast wall(Height, H= 7.0m), Typ-II	LGED/AB-7 (II)/RNF.-03
8	Details of Counterfort (Height, H= 7.0m), Typ-II	LGED/AB-7 (II)/COUNT.-04
9	Dimensional Details of Abutment (Height, H= 6.0m), Typ-III	LGED/AB-6 (III)/C-01
10	Reinf. Details of Abutment Pile cap (Height, H= 6.0m), Typ-III	LGED/AB-6 (III)/RNF.-02
11	Reinf. Details of Abut. & Ballast wall(Height, H= 6.0m), Typ-III	LGED/AB-6 (III)/RNF.-03
12	Sectional Reinf. Details of Abutment (HT., H= 6.0m), Typ-III	LGED/AB-6 (III)/RNF.-04
13	Dimensional Details of Abutment (Height, H= 5.0m), Typ-IV	LGED/AB-5 (IV)/C-01
14	Reinf. Details of Abutment Pile cap (Height, H= 5.0m), Typ-IV	LGED/AB-5 (IV)/RNF.-02
15	Reinf. Details of Abut. & Ballast wall(Height, H= 5.0m), Typ-IV	LGED/AB-5 (IV)/RNF.-03
16	Sectional Reinf. Details of Abutment (HT., H= 5.0m), Typ-IV	LGED/AB-5 (IV)/RNF.-04

TITLE OF DRAWINGS

Sl. No.	Drawing Title	Sheet No.
H.	TYPICAL DRAWING OF PIER PILE	
1	Details of Pier Pile (Typ-I) (Span : 33.0m to 40.0m)	LGED/PR/TYP-I/PL-01
2	Details of Pier Pile (Typ-II) (Span : 18.0m to 30.0m)	LGED/PR/TYP-II/PL-02
3	Details of Pier Pile (Typ-III) (Span : 8.0m to 17.0m)	LGED/PR/TYP-III/PL-03
I.	TYPICAL DRAWING OF ABUTMENT PILE	
1 (a)	Details of Abut. Pile (Typ-I) (Span : 35.0m to 40.0m/ ht = 10.0m)	LGED/AB/TYP-I/PL-01
1 (b)	Details of Abut. Pile (Typ-II) (Span : 33.0m to 35.0m/ ht = 8.0m)	LGED/AB/TYP-II/PL-02
2	Details of Abut. Pile (Typ-II) (Span : 18.0m to 30.0m/ ht = 6.0m)	LGED/AB/TYP-II/PL-02
3	Details of Abut. Pile (Typ-IV) (Span : 8.0m to 17.0m/ ht = 6.0m)	LGED/AB/TYP-III/PL-03
J.	TYPICAL DRAWING OF CULVERTS	
1	Details of RCC Box Culvert at Ch. 0+025 (1x4.0x3.0)	LGED/CUL-01/C-01
	Reinf. Details of RCC Box Culvert at Ch. 0+025 (1x4.0x3.0)	LGED/CUL-01/RNF.-02
2	Details of RCC Box Culvert at Ch. 18+533 (2x6.0x3.0)	LGED/CUL-02/C-01
	Reinf. Details of RCC Box Culvert at Ch. 18+533 (2x6.0x3.0)	LGED/CUL-02/RNF.-02
3	Details of RCC Box Culvert at Ch. 20+119 (2x5.0x5.0)	LGED/CUL-03/C-01
	Reinf. Details of RCC Box Culvert at Ch. 20+119 (2x5.0x5.0)	LGED/CUL-03/RNF.-02
4	Details of RCC Box Culvert at Ch. 20+175 (1x6.0x4.0)	LGED/CUL-04/C-01
	Reinf. Details of RCC Box Culvert at Ch. 20+175 (1x6.0x4.0)	LGED/CUL-04/RNF.-02
5	Details of RCC Box Culvert at Ch. 20+353 (1x6.0x4.5)	LGED/CUL-05/C-01
	Reinf. Details of RCC Box Culvert at Ch. 20+353 (1x6.0x4.5)	LGED/CUL-05/RNF.-02
6	Details of RCC Box Culvert at Ch. 22+079 (1x4.0x3.0)	LGED/CUL-06/C-01
	Reinf. Details of RCC Box Culvert at Ch. 22+079 (1x4.0x3.0)	LGED/CUL-06/RNF.-02
7	Details of RCC Box Culvert at Ch. 48+705 (1x6.0x5.0)	LGED/CUL-07/C-01
	Reinf. Details of RCC Box Culvert at Ch. 48+705 (1x6.0x5.0)	LGED/CUL-07/RNF.-02
8	Details of RCC Box Culvert at Ch. 57+321 (2x4.0x6.0)	LGED/CUL-08/C-01
	Reinf. Details of RCC Box Culvert at Ch. 57+321 (2x4.0x6.0)	LGED/CUL-08/RNF.-02

Sl. No.	Drawing Title	Sheet No.
9	Details of RCC Box Culvert at Ch. 59+560 (2x4.0x3.0)	LGED/CUL-09/C-01
	Reinf. Details of RCC Box Culvert at Ch. 59+560 (2x4.0x3.0)	LGED/CUL-09/RNF.-02
10	Details of RCC Box Culvert at Ch. 60+290 (2x3.5x4.0)	LGED/CUL-10/C-01
	Reinf. Details of RCC Box Culvert at Ch. 60+290 (2x3.5x4.0)	LGED/CUL-10/RNF.-02
11	Details of RCC Box Culvert at Ch. 61+373 (2x3.0x4.0)	LGED/CUL-11/C-01
	Reinf. Details of RCC Box Culvert at Ch. 61+373 (2x3.0x4.0)	LGED/CUL-11/RNF.-02
12	Details of RCC Box Culvert at Ch. 62+864 (2x4.5x3.0)	LGED/CUL-12/C-01
	Reinf. Details of RCC Box Culvert at Ch. 62+864 (2x4.5x3.0)	LGED/CUL-12/RNF.-02
13	Details of RCC Box Culvert at Ch. 64+042 (1x6.0x4.5)	LGED/CUL-13/C-01
	Reinf. Details of RCC Box Culvert at Ch. 64+042 (1x6.0x4.5)	LGED/CUL-13/RNF.-02
14	Details of RCC Box Culvert at Ch. 67+183 (2x4.5x4.0)	LGED/CUL-14/C-01
	Reinf. Details of RCC Box Culvert at Ch. 67+183 (2x4.5x4.0)	LGED/CUL-14/RNF.-02
15	Details of RCC Box Culvert at Ch. 73+730 (2x4.5x4.0)	LGED/CUL-15/C-01
	Reinf. Details of RCC Box Culvert at Ch. 73+730 (2x4.5x4.0)	LGED/CUL-15/RNF.-02
16	Details of RCC Box Culvert at Ch. 74+567 (2x3.5x3.0)	LGED/CUL-16/C-01
	Reinf. Details of RCC Box Culvert at Ch. 74+567 (2x3.5x3.0)	LGED/CUL-16/RNF.-02
17	Details of RCC Box Culvert at Ch. 75+615 (1x6.0x6.0)	LGED/CUL-17/C-01
	Reinf. Details of RCC Box Culvert at Ch. 75+615 (1x6.0x6.0)	LGED/CUL-17/RNF.-02
18	Details of RCC Box Culvert at Ch. 82+980 (2x4.0x5.0)	LGED/CUL-18/C-01
	Reinf. Details of RCC Box Culvert at Ch. 82+980 (2x4.0x5.0)	LGED/CUL-18/RNF.-02
19	Details of RCC Box Culvert at Ch. 85+638 (2x5.0x4.0)	LGED/CUL-19/C-01
	Reinf. Details of RCC Box Culvert at Ch. 85+638 (2x5.0x4.0)	LGED/CUL-19/RNF.-02
20	Details of RCC Box Culvert at Ch. 87+059 (2x4.0x3.0)	LGED/CUL-20/C-01
	Reinf. Details of RCC Box Culvert at Ch. 87+059 (2x4.0x3.0)	LGED/CUL-20/RNF.-02
21	Details of RCC Box Culvert at Ch. 100+306 (3x5.0x5.0)	LGED/CUL-21/C-01
	Reinf. Details of RCC Box Culvert at Ch. 100+306 (3x5.0x5.0)	LGED/CUL-21/RNF.-02

TITLE OF DRAWINGS

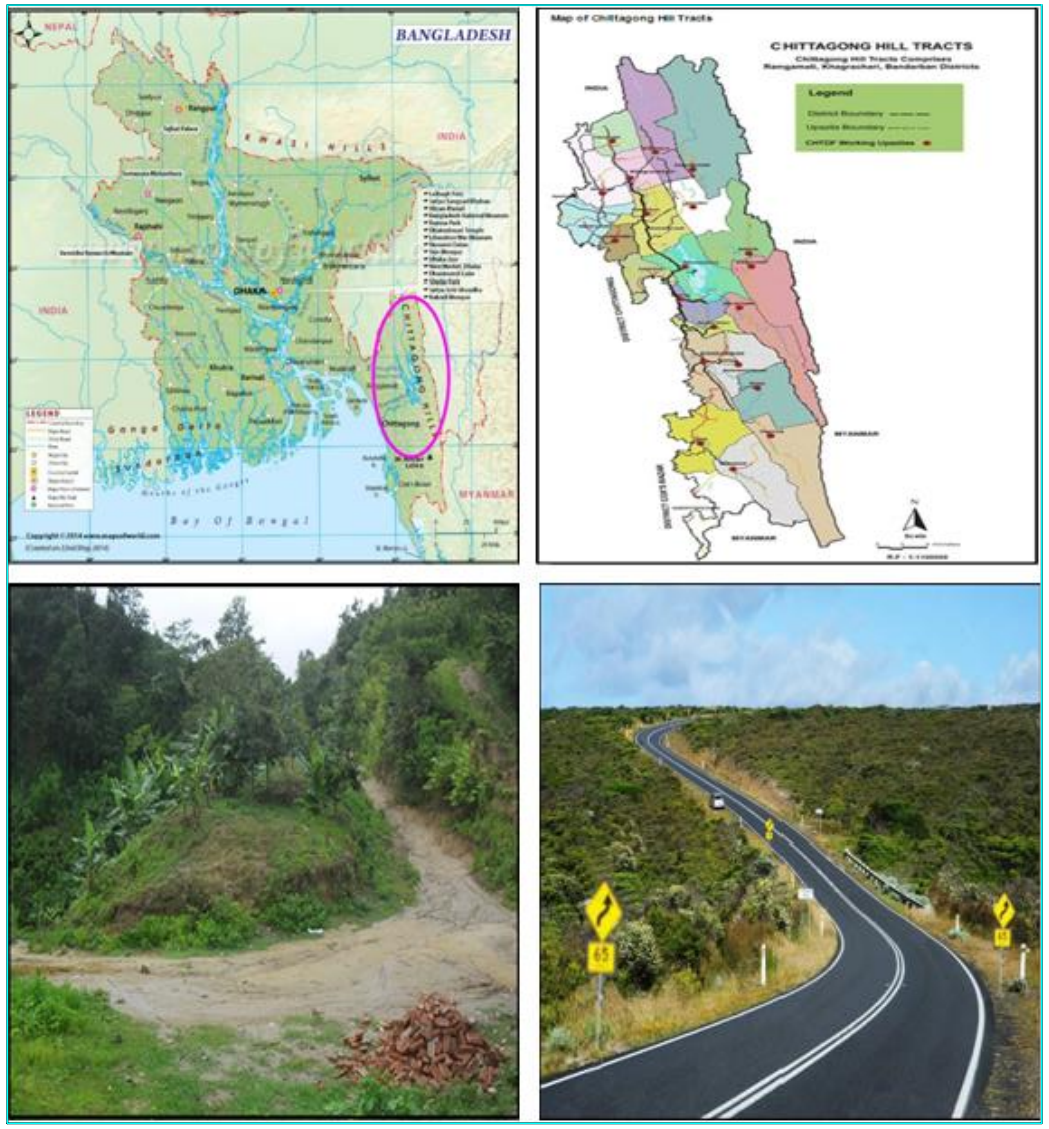
Sl. No.	Drawing Title	Sheet No.
K.	TYPICAL DRAWING OF RETAINING WALL	
1	Details of RCC Retaining Wall (H = 3.0m ~ 10.0m)	LGED/TYP-I/RW-01
L.	TYPICAL APPROACH ROAD SIDE DRAIN	
1	Approach Road Side Drain Details	LGED/AP./SUR_DR-01
M.	WATERWAY STRUCTURE DRAWINGS	
1	General Arrangement Plan Pontoon Main Deck Plan Elevation	01
2	General Arrangement Plan Pontoon Main Deck Plan Elevation	02
3	Long Section of MS Spud Section A-A	03
4	Layout Plan of Proposed R.C.C Jetty Sectional Elevation	04
5	Layout Plan of Proposed R.C.C Landing Station/Terminal Building	05
N.	MISC. DRAWING	
1	Reinf. Details of Railing on Abutment & Wing Wall	LGED/MISC./RL-01
2	Details of Guard Post	LGED/MISC./GP-02
3	Details of Slope Protection work	LGED/MISC./SLP-03
4	Details of Elastomeric Neoprene Bearing Pad on Abutment	LGED/MISC./B.PAD-04
5	Details of Elastomeric Neoprene Bearing Pad on Pier	LGED/MISC./B.PAD-05
6	Details of Expansion Joint	LGED/MISC./EXP.J-06
7	Details of Approach Slab	LGED/MISC./Apps-07
8	Details of Footpath, Edge Beam & Kerb	LGED/MISC./F.P.-08

Sl. No.	Drawing Title	Sheet No.
9	Bar Shape & Code	LGED/MISC./S.CD-09
10	ROAD SIDE DRAIN	LGED/TYP/AP./SUR_DR-10
11a	DRAWING OF TRAFFIC SIGNS	LGED/MISC/TS-11a
11b	DRAWING OF TRAFFIC SIGNS	LGED/MISC/TS-11b
11c	DRAWING OF TRAFFIC SIGNS	LGED/MISC/TS-11c
11d	DRAWING OF TRAFFIC SIGNS	LGED/MISC/TS-11d
11e	DRAWING OF Km. POST, BOUNDARY PILLAR,GUARD POST & TRAFFIC SIGNS	LGED/MISC/TS-11e
11f	DRAWING OF ROAD SAFETY	LGED/MISC/TS-11f
11g	DRAWING OF SIGN BOARD	LGED/MISC/TS-11g
12	TYPICAL CROSS SECTION OF ROAD	
12a	DETAIL "A"	LGED/MISC/CR-12a
12b	TYPICAL CROSS SECTION & DETAIL DRAWINGS OF ROAD	LGED/MISC/CR-12b
12c	TYPICAL CROSS SECTION & DETAIL DRAWINGS OF ROAD	LGED/MISC/CR-12c
12d	TYPICAL CROSS SECTION & DETAIL DRAWINGS OF ROAD	LGED/MISC/CR-12d

GOVERNMENT OF THE PEOPLE'S REPUBLIC OF BANGLADESH

Consultancy Services for Feasibility, Detailed Survey and Design of Chittagong Hill Tracts Connectivity Connecting Thegamukh and Chittagong Port; Bangladesh Trade and Transport Studies, RETF Project.

CONTRACT PACKAGE NO. MOS -S4



STRUCTURAL DRAWINGS OF ROAD AND MULTIMODAL ROUTE

FEASIBILITY REPORT (FINAL DRAWING) ,VOLUME- IIIA OF IV

JUNE, 2016

LOCAL GOVERNMENT ENGINEERING DEPARTMENT (LGED)

REPORT SUBMITTED BY : SAL SYSTRA GROUP | BETS

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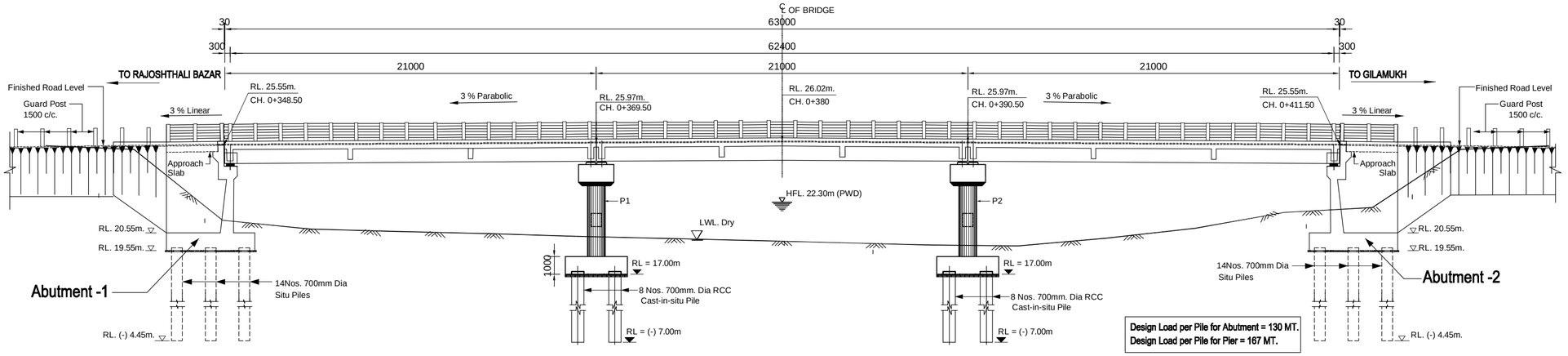


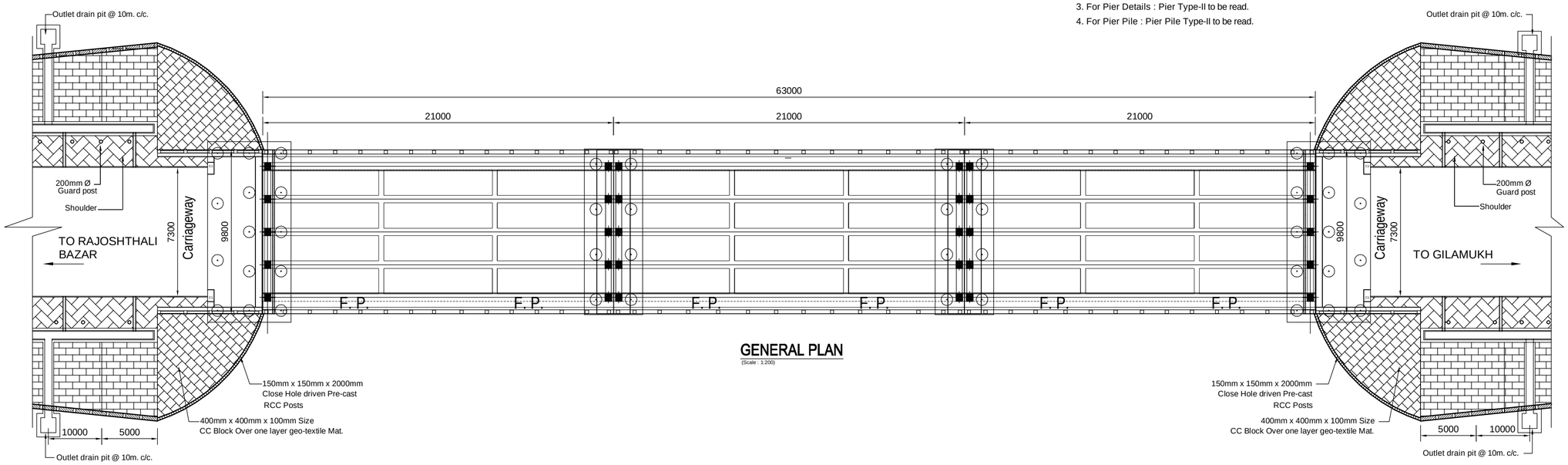
Existing Level (m)	23.60	23.00	21.45	21.65	20.35	19.67	19.01	18.87	18.75	18.60	18.69	19.94	20.46	20.98	21.78	22.43	23.54	
Distance (m)	(-) 10.00	(-) 5.00	0.00 (0+348.50)	5.00	10.00	15.00	20.00	25.00	30.00	35.00	40.00	45.00	50.00	55.00	60.00	60.00	65.00	

GENERAL ELEVATION

(Scale : 1:200)

REFF. DWG :

1. For Abutment Details : Abut. Type-III to be read.
2. For Abutment Pile : Abut. Pile Type-II to be read.
3. For Pier Details : Pier Type-II to be read.
4. For Pier Pile : Pier Pile Type-II to be read.

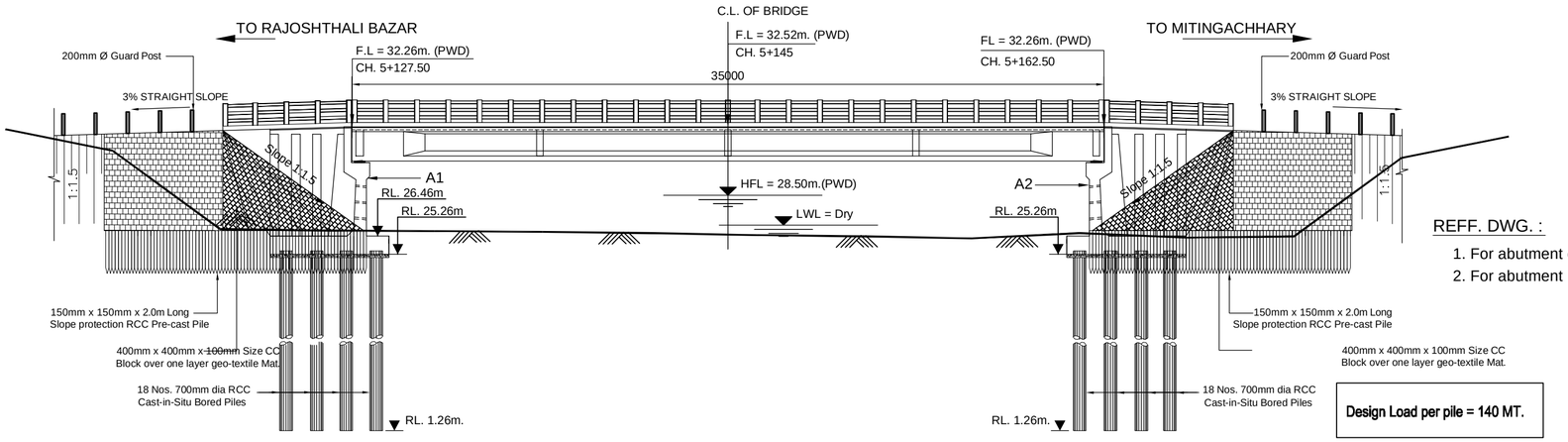


GENERAL PLAN

(Scale : 1:200)

NAME OF THE CLIENT : GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH **LOCAL GOVERNMENT ENGINEERING DEPARTMENT** NAME OF THE PROJECT : CONSULTANCY SERVICES FOR FEASIBILITY, DETAILED SURVEY AND DESIGN OF CHITTAGONG HILL TRACT CONNECTIVITY CONNECTING THEGAMUKH AND CHITTAGONG PORT.	NAME OF THE CONSULTANTS : **SAI Consulting Engineers Pvt. Ltd, India.** in association with **BETS Consulting Services Ltd, Bangladesh** Project office : Tahmid Mahmood Palace Flat # 9A, House # 77, Road # 4, Block-C,	DRAWING TITLE : PLAN & SECTIONAL ELEVATION OF 63.0m LONG RCC GIRDER BRIDGE AT CH. 0+378 (BR-01) DRAWING NO : LGED/RCG/PLE-01 Scale :As shown Date : 28-01-16	DESIGNED BY : MD. TAZUDDIN	DRAWN BY : MD. TAZUDDIN	CHECKED BY : AFM HAMIDUL HAQUE	APPROVED BY : DR. PRABHAT SHRIVASTAVA

REV.	DESCRIPTION	DATE

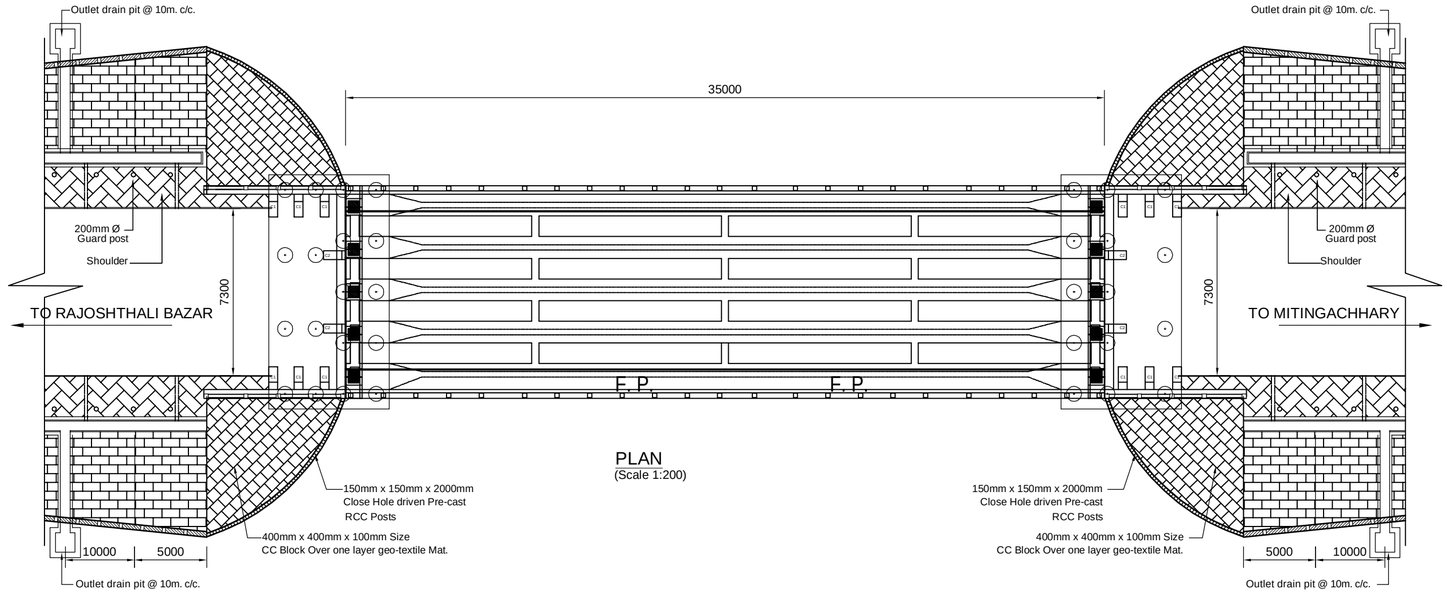


R.L. in m. (PWD)	33.00	32.00	28.36	28.29	28.26	28.23	28.17	28.08	28.02	27.93	28.17	27.96	28.02	31.67	32.70
Distance in m.	(-) 10.00	(-) 5.00	0.00	5.00	10.00 (5+127.50)	15.00	20.00	25.00	30.00	35.00	40.00	45.00	50.00	55.00	60.00

SECTIONAL ELEVATION
(Scale 1:200)

REFF. DWG. :

1. For abutment details : Abutment Type-II to be read.
2. For abutment pile : Abut. pile Type-I(b) to be read.



PLAN
(Scale 1:200)

NAME OF THE CLIENT :
GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH
LOCAL GOVERNMENT ENGINEERING DEPARTMENT

NAME OF THE PROJECT :
CONSULTANCY SERVICES FOR FEASIBILITY, DETAILED SURVEY AND DESIGN OF CHITTAGONG HILL TRACT CONNECTIVITY CONNECTING THEGAMUKH AND CHITTAGONG PORT.

NAME OF THE CONSULTANTS :
SAI Consulting Engineers Pvt. Ltd, India.
in association with
BETS Consulting Services Ltd, Bangladesh
Project office :
Tahmid Mahmood Palace
Flat # 9A, House # 77, Road # 4, Block-C,

DRAWING TITLE :
PLAN & SECTIONAL ELEV. OF 35.0m PSC GIRDER BRIDGE AT CH.4+932 OVER GHILAMUKH CHHARA KHAL (BR-02)

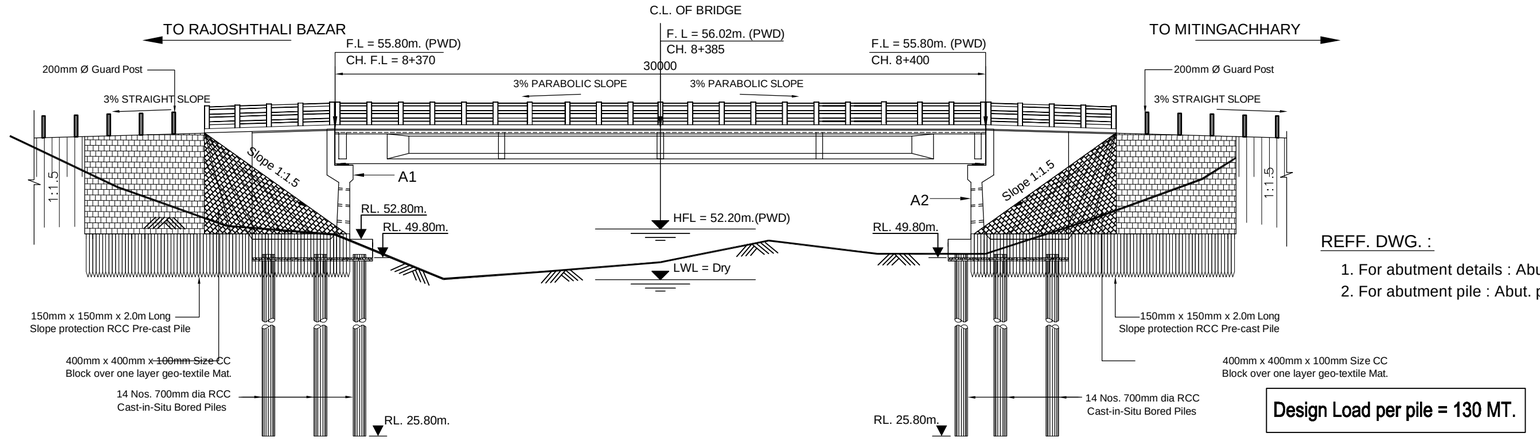
DRAWING NO : LGED/PCG/PLE-02

Scale :As shown

Date : 28-01-16

DESIGNED BY :	DRAWN BY :	CHECKED BY :	APPROVED BY :
MD. TAZUDDIN	MD. TAZUDDIN	AFM HAMIDUL HAQUE	DR. PRABHAT SHRIVASTAVA

REV.	DESCRIPTION	DATE



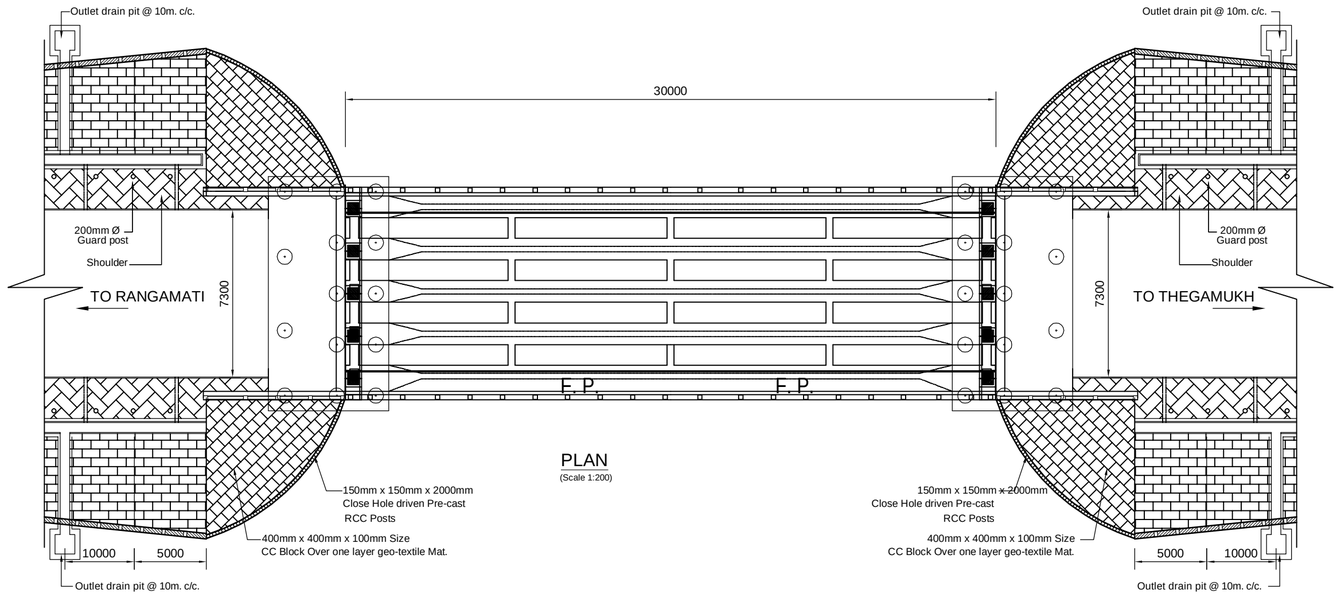
REFF. DWG. :

1. For abutment details : Abutment Type-III to be read.
2. For abutment pile : Abut. pile Type-II to be read.

Design Load per pile = 130 MT.

R.L. in m. (PWD)	57.65	55.27	53.50	53.10	51.05	51.42	51.82	52.82	52.21	52.21	53.83	55.66	58.83
Distance in m.	(-) 15.00	(-) 10.00	(-) 5.00	0.00	5.00	10.00	15.00	20.00	25.00	30.00	35.00	40.00	45.00

SECTIONAL ELEVATION
(Scale 1:200)



PLAN
(Scale 1:200)

NAME OF THE CLIENT :
GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH
LOCAL GOVERNMENT ENGINEERING DEPARTMENT

NAME OF THE PROJECT :
CONSULTANCY SERVICES FOR FEASIBILITY, DETAILED SURVEY AND DESIGN OF CHITTAGONG HILL TRACT CONNECTIVITY CONNECTING THEGAMUKH AND CHITTAGONG PORT.

NAME OF THE CONSULTANTS :
SAI Consulting Engineers Pvt. Ltd, India.
in association with
BETS Consulting Services Ltd, Bangladesh
Project office :
Tahmid Mahmood Palace
Flat # 9A, House # 77, Road # 4, Block-C,

DRAWING TITLE :
PLAN & SECTIONAL ELEV. OF 30.0m PSC GIRDER BRIDGE AT CH. 8+040 OVER NARAICORI CHHARA KHAL (BR-03)

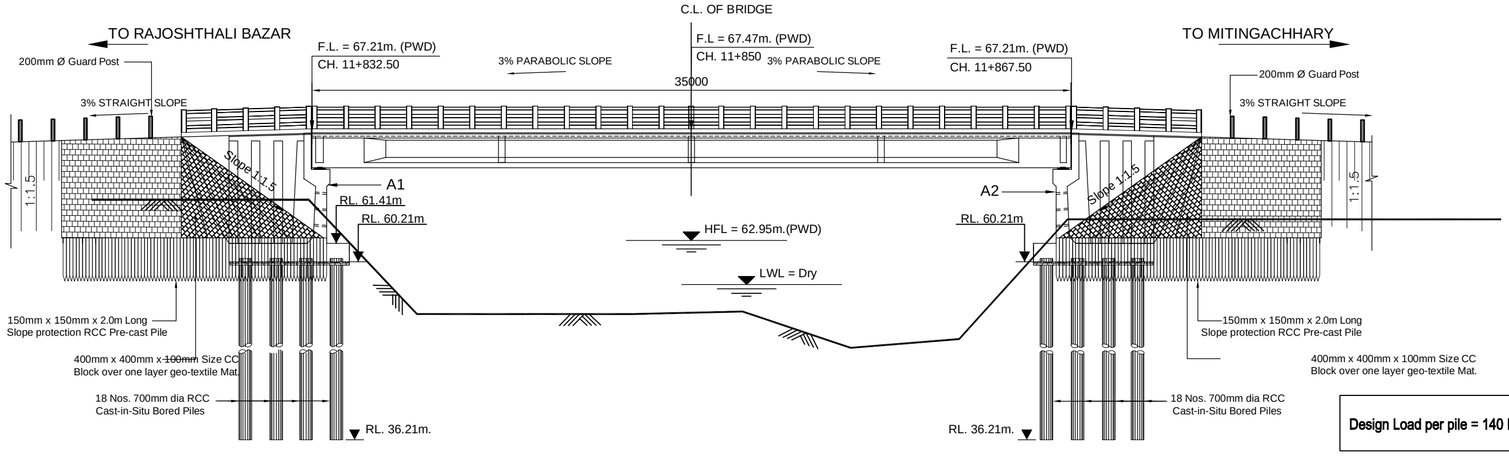
DRAWING NO : LGED/PCG/PLE-03

Scale :As shown

Date : 28-01-16

DESIGNED BY :	DRAWN BY :	CHECKED BY :	APPROVED BY :
MD. TAZUDDIN	MD. TAZUDDIN	AFM HAMIDUL HAQUE	DR. PRABHAT SHRIVASTAVA

REV.	DESCRIPTION	DATE

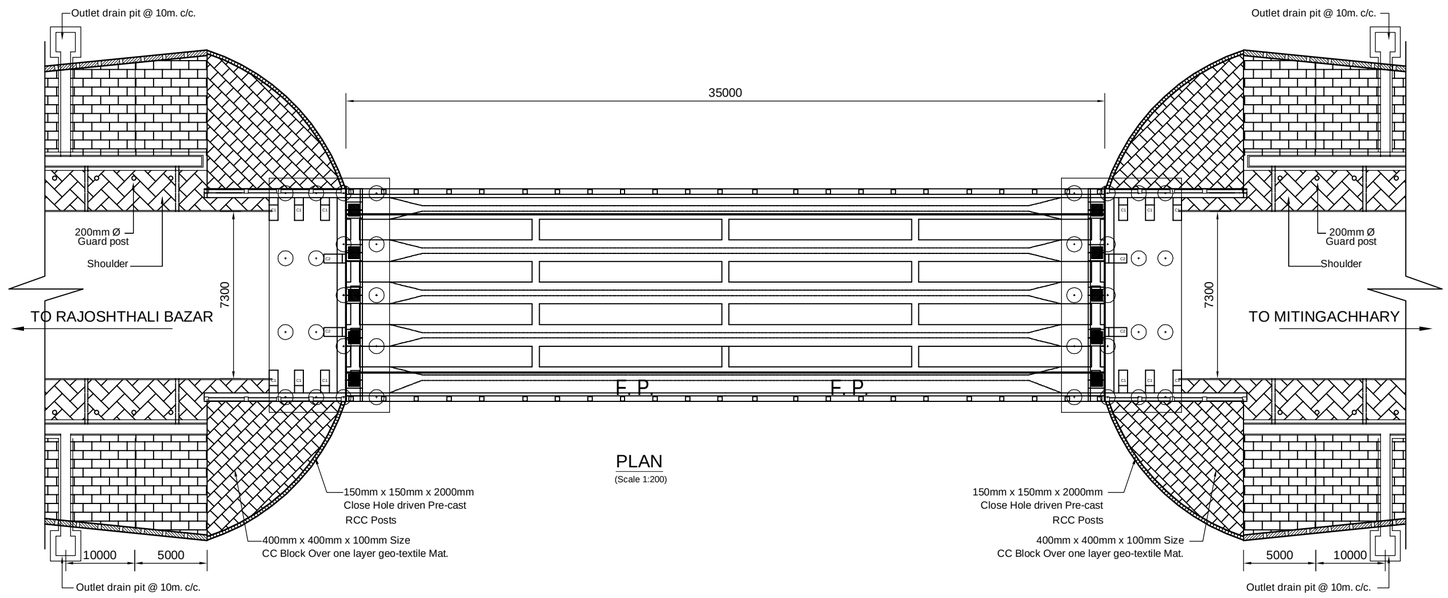


R.L. in m. (PWD)	64.83	64.83	64.83	59.56	59.56	59.56	59.68	58.00	60.13	63.93	63.93	63.93	63.93	63.93	63.93
Distance in m.	(-) 10.00	(-) 5.00	0.00 (11+832.50)	5.00	10.00	15.00	20.00	25.00	30.00	35.00	40.00	45.00	50.00	55.00	60.00

SECTIONAL ELEVATION
(Scale 1:200)

REFF. DWG. :

1. For abutment details : Abutment Type-II to be read.
2. For abutment pile : Abut. pile Type-I(b) to be read.



PLAN
(Scale 1:200)

NAME OF THE CLIENT :
GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH
LOCAL GOVERNMENT ENGINEERING DEPARTMENT

NAME OF THE PROJECT :
CONSULTANCY SERVICES FOR FEASIBILITY, DETAILED SURVEY AND DESIGN OF CHITTAGONG HILL TRACT CONNECTIVITY CONNECTING THEGAMUKH AND CHITTAGONG PORT.

NAME OF THE CONSULTANTS :
SAI Consulting Engineers Pvt. Ltd, India.
in association with
BETS Consulting Services Ltd, Bangladesh
Project office :
Tahmid Mahmood Palace
Flat # 9A, House # 77, Road # 4, Block-C,

DRAWING TITLE :
PLAN & SECTIONAL ELEV. OF 35.0m PSC GIRDER BRIDGE AT CH. 11+268 OVER MITINGACHHARA KHAL (BR-04)

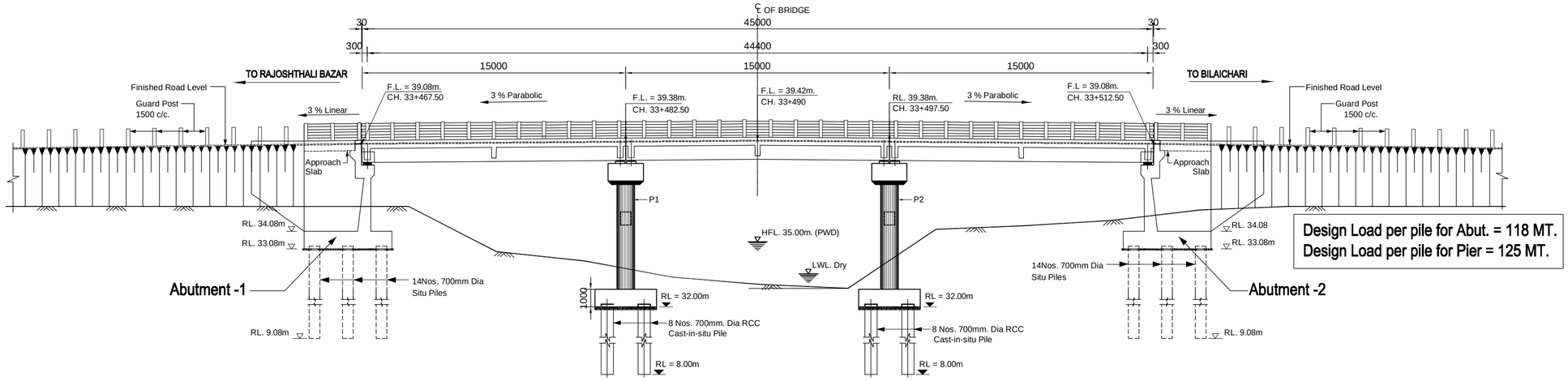
DRAWING NO : LGED/PCG/PLE-04

Scale :As shown

Date : 28-01-16

DESIGNED BY :	DRAWN BY :	CHECKED BY :	APPROVED BY :
MD. TAZUDDIN	MD. TAZUDDIN	AFM HAMIDUL HAQUE	DR. PRABHAT SHRIVASTAVA

REV.	DESCRIPTION	DATE



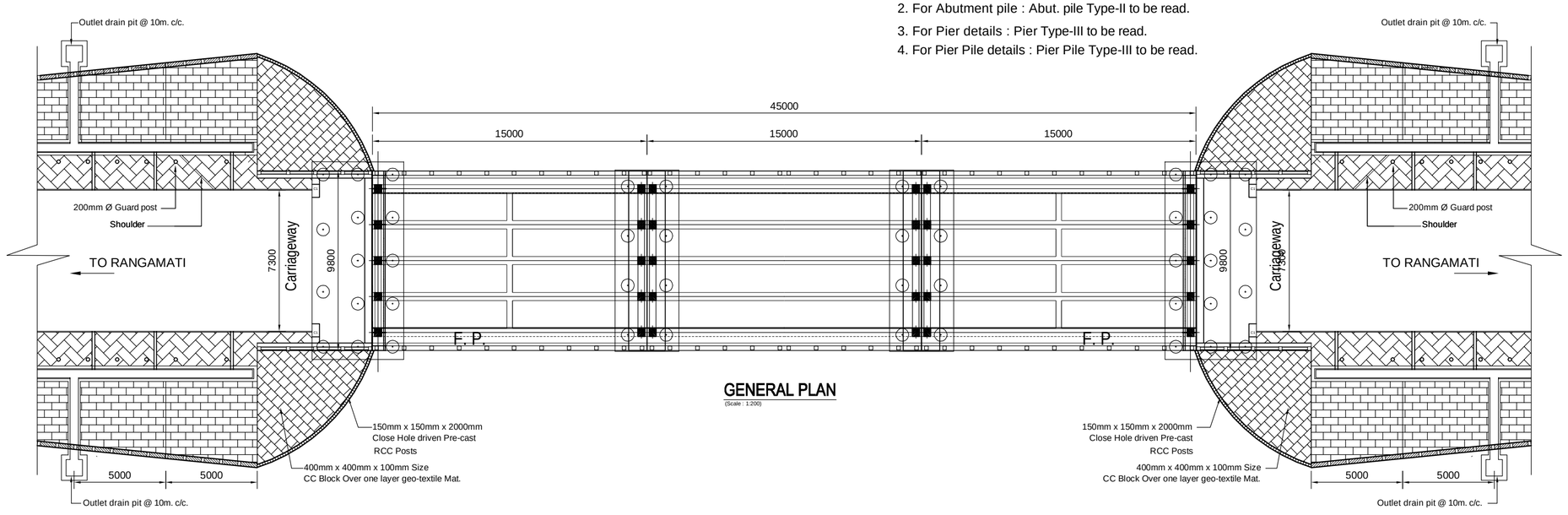
Existing Level in m.	37.00		37.00	34.42	33.90	33.23	32.56	32.34	35.70	35.90	36.20	36.80	37.00	37.00
Distance in m.	(-) 10.00	(-) 7.65 (33+467.50)	(-) 5.00	0.00	5.00	10.00	15.00	20.00	25.00	30.00	35.00	40.00	45.00	50.00

GENERAL ELEVATION

(Scale : 1:200)

REFF. DWG. :

1. For Abutment details : Abutment Type-III to be read.
2. For Abutment pile : Abut. pile Type-II to be read.
3. For Pier details : Pier Type-III to be read.
4. For Pier Pile details : Pier Pile Type-III to be read.



GENERAL PLAN

(Scale : 1:200)

NAME OF THE CLIENT :

GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH

LOCAL GOVERNMENT ENGINEERING DEPARTMENT

NAME OF THE PROJECT :

CONSULTANCY SERVICES FOR FEASIBILITY, DETAILED SURVEY AND DESIGN OF CHITTAGONG HILL TRACT CONNECTIVITY CONNECTING THEGAMUKH AND CHITTAGONG PORT.

NAME OF THE CONSULTANTS :

SAI Consulting Engineers Pvt. Ltd, India.

in association with

BETS Consulting Services Ltd, Bangladesh

Project office :

Tahmid Mahmood Palace
Flat # 9A, House # 77, Road # 4, Block-C,

DRAWING TITLE :

PLAN & SECTIONAL ELEV. OF 45.0m RCC GIRDER BRIDGE AT CH. 32+251 OVER ALIKHONG KHAL (BR-05)

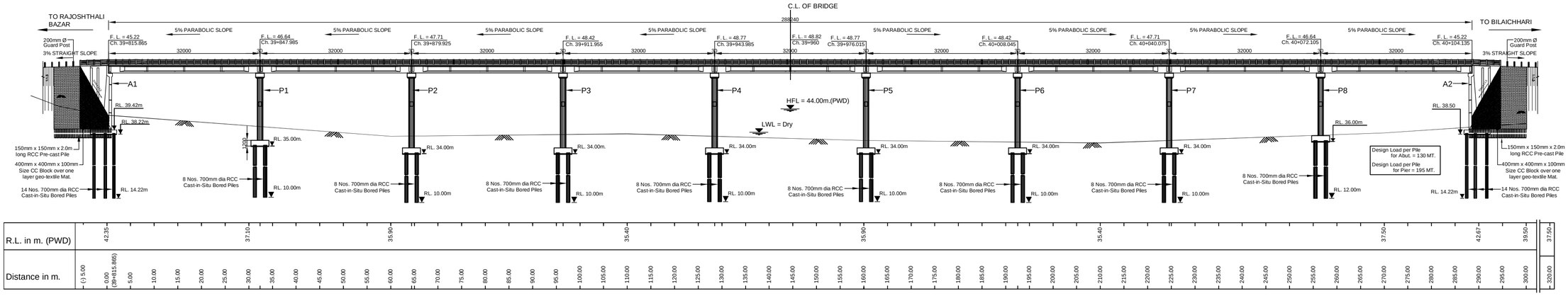
DRAWING NO : LGED/RCG/PLE-05

Scale :As shown

Date : 28-01-16

DESIGNED BY :	DRAWN BY :	CHECKED BY :	APPROVED BY :
MD. TAZUDDIN	MD. TAZUDDIN	AFM HAMIDUL HAQUE	DR. PRABHAT SHRIVASTAVA

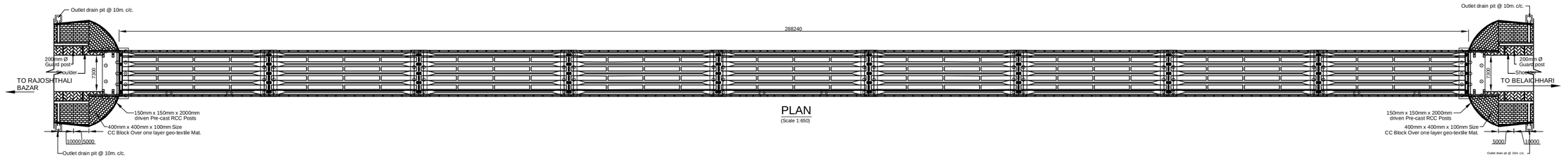
REV.	DESCRIPTION	DATE



SECTIONAL ELEVATION

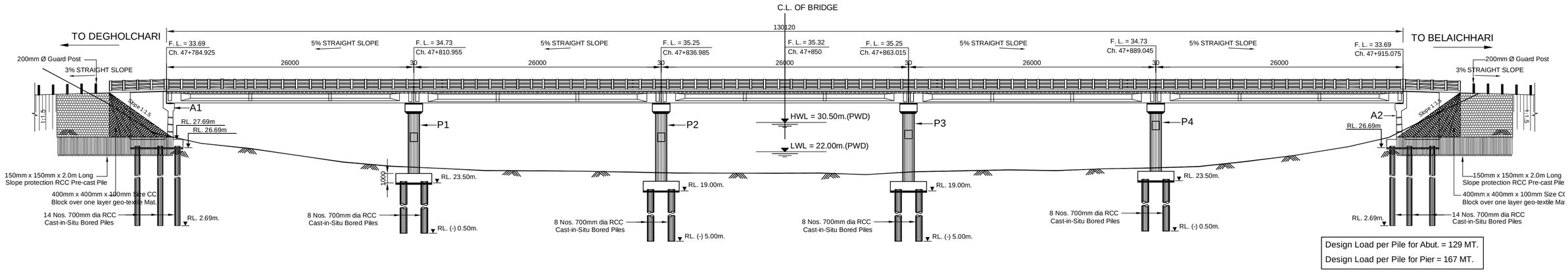
REFF. DWG :

1. For Abutment Details : Abut. Type-II to be read.
2. For Abutment Pile : Abut. Pile Type-II to be read.
3. For Pier Details : Pier Type-II to be read.
4. For Pier Pile : Pier Pile Type-II to be read.



PLAN
(Scale 1:650)

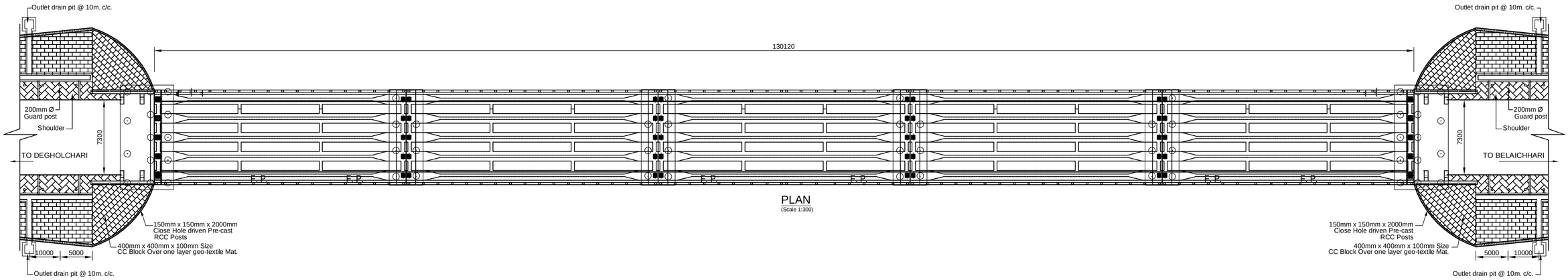
NAME OF THE CLIENT : GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH **LOCAL GOVERNMENT ENGINEERING DEPARTMENT** NAME OF THE PROJECT : CONSULTANCY SERVICES FOR FEASIBILITY, DETAILED SURVEY AND DESIGN OF CHITTAGONG HILL TRACT CONNECTIVITY CONNECTING THEGAMUKH AND CHITTAGONG PORT.	NAME OF THE CONSULTANTS : **SAI Consulting Engineers Pvt. Ltd, India.** in association with **BETS Consulting Services Ltd, Bangladesh** Project office : Tahmid Mahmood Palace Flat # 9A, House # 77, Road # 4, Block-C,	DRAWING TITLE : PLAN & SECTIONAL ELEVATION OF 288.24m LONG PSC GIRDER BRIDGE (DOWN BRIDGE) AT CH. 38+543 (BR-06) DRAWING NO : LGED/PCG/PLE-06 Scale :As shown Date : 28-01-16	DESIGNED BY : MD. TAZUDDIN	DRAWN BY : MD. TAZUDDIN	CHECKED BY : AFM HAMIDUL HAQUE	APPROVED BY : DR. PRABHAT SHRIVASTAVA	REV. / DESCRIPTION / DATE



R.L. in m. (PWD)	30.78	30.45	28.89	28.09	27.21	26.25	25.65	25.27	24.81	23.98	23.65	21.09	20.85	20.65	20.11	20.01	20.12	20.22	20.46	20.79	21.79	22.10	23.55	24.84	25.26	26.38	27.32	29.74	29.87	25.67	28.05	29.3
Distance in m.	(-) 15.00	(-) 10.00	(-) 5.00	(-) 3.50 (47+784.925)	0.00	5.00	10.00	15.00	20.00	25.00	30.00	35.00	40.00	45.00	50.00	55.00	60.00	65.00	70.00	75.00	80.00	80.00	85.00	90.00	95.00	100.00	105.00	110.00	115.00	120.00	125.00	130.00	135.00

SECTIONAL ELEVATION
(Scale 1:300)

Design Load per Pile for Abut. = 129 MT.
Design Load per Pile for Pier = 167 MT.



PLAN
(Scale 1:300)

REFF. DWG :

1. For Abutment Details : Abut. Type-III to be read.
2. For Abutment Pile : Abut. Pile Type-II to be read.
3. For Pier Details : Pier Type-II to be read.
4. For Pier Pile : Pier Pile Type-II to be read.

NAME OF THE CLIENT :
GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH
LOCAL GOVERNMENT ENGINEERING DEPARTMENT

NAME OF THE PROJECT :
CONSULTANCY SERVICES FOR FEASIBILITY, DETAILED SURVEY AND DESIGN OF CHITTAGONG HILL TRACT CONNECTIVITY CONNECTING THEGAMUKH AND CHITTAGONG PORT.

NAME OF THE CONSULTANTS :
SAI Consulting Engineers Pvt. Ltd, India.
in association with
BETS Consulting Services Ltd, Bangladesh
Project office :
Tahmid Mahmood Palace
Flat # 9A, House # 77, Road # 4, Block-C,

DRAWING TITLE :
PLAN & SECTIONAL ELEVATION OF 130.12m PSC GIRDER BRIDGE AT CH.45+862 OVER RAING KHONG RIVER(BR-07)

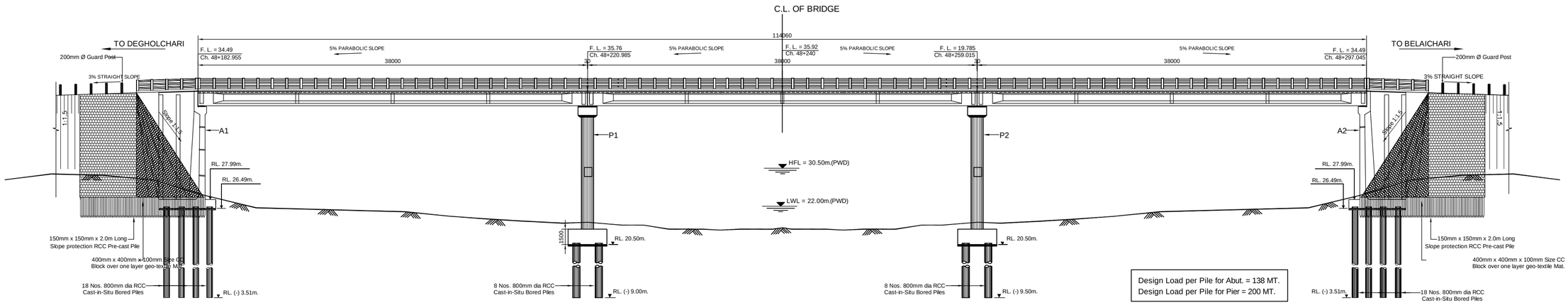
DRAWING NO : LGED/PCG/PLE-07

Scale :As shown

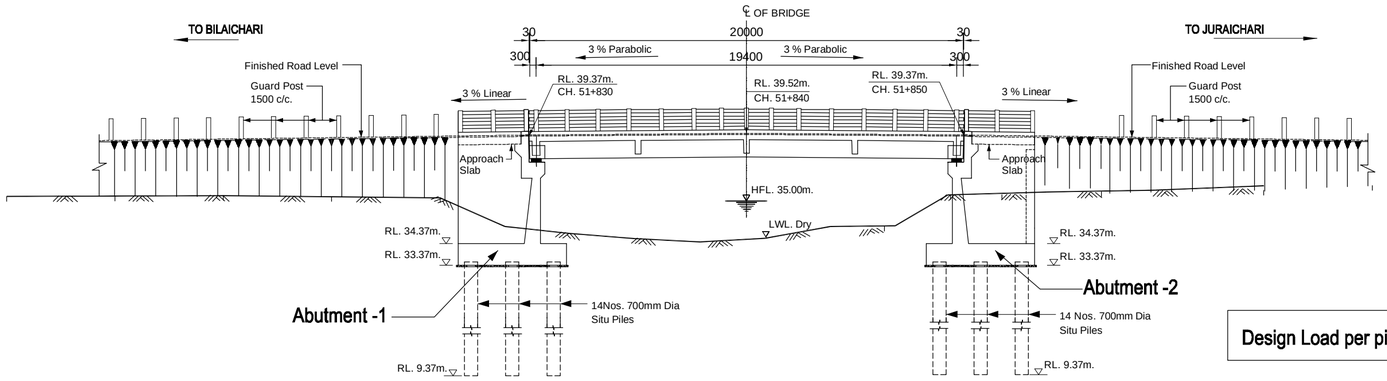
Date : 28-01-16

DESIGNED BY :	DRAWN BY :	CHECKED BY :	APPROVED BY :
MD. TAZUDDIN	MD. TAZUDDIN	AFM HAMIDUL HAQUE	DR. PRABHAT SHRIVASTAVA

REV.	DESCRIPTION	DATE


C.L. OF BRIDGE
114060
TO DEGHOLCHARI
TO BELAICHARI
F. L. = 34.49
Ch. 48+182.955
F. L. = 35.76
Ch. 48+220.985
F. L. = 35.92
Ch. 48+240
F. L. = 19.785
Ch. 48+259.015
F. L. = 34.49
Ch. 48+297.045
5% PARABOLIC SLOPE
38000
30
200mm Ø Guard Post
3% STRAIGHT SLOPE
1:1.5
Slope 1:1.5
A1
P1
P2
A2
RL. 27.99m.
RL. 26.49m.
HFL = 30.50m.(PWD)
LWL = 22.00m.(PWD)
1500
RL. 20.50m.
150mm x 150mm x 2.0m Long
Slope protection RCC Pre-cast Pile
400mm x 400mm x 100mm Size CC
Block over one layer geo-textile Mat.
18 Nos. 800mm dia RCC
Cast-in-Situ Bored Piles
RL. (-) 3.51m.
8 Nos. 800mm dia RCC
Cast-in-Situ Bored Piles
RL. (-) 9.00m.
RL. (-) 9.50m.
Design Load per Pile for Abut. = 138 MT.
Design Load per Pile for Pier = 200 MT.

| | | |



Existing Level (m)	36.15	36.23	35.15	34.71	33.13	33.28	34.34	36.11	37.01
Distance (m)	(-) 10.00	(-) 5.00	0.00 (51+830)	5.00	10.00	15.00	20.00	25.00	300.00

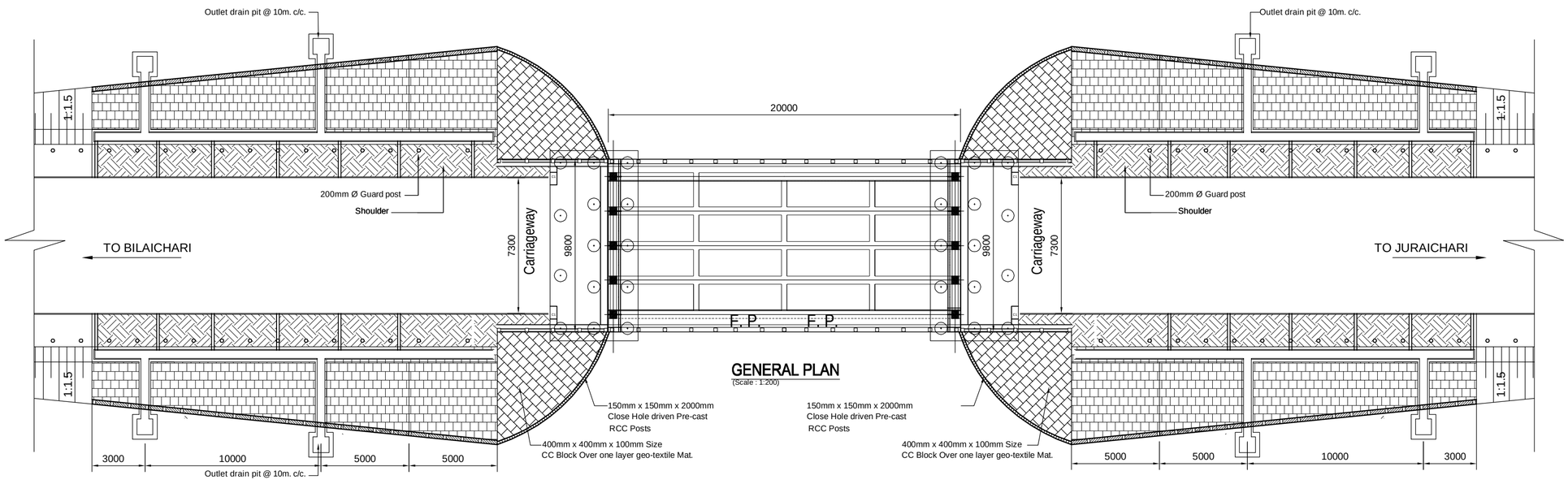
GENERAL ELEVATION

(Scale : 1:200)

Design Load per pile = 120 MT.

REFF. DWG. :

1. For abutment details : Abutment Type-III to be read.
2. For abutment pile : Abut. pile Type-II to be read.



GENERAL PLAN

(Scale : 1:200)

NAME OF THE CLIENT :

GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH

LOCAL GOVERNMENT ENGINEERING DEPARTMENT

NAME OF THE PROJECT :

CONSULTANCY SERVICES FOR FEASIBILITY, DETAILED SURVEY AND DESIGN OF CHITTAGONG HILL TRACT CONNECTIVITY CONNECTING THEGAMUKH AND CHITTAGONG PORT.

NAME OF THE CONSULTANTS :

SAI Consulting Engineers Pvt. Ltd, India.

in association with

BETS Consulting Services Ltd, Bangladesh

Project office :

Tahmid Mahmood Palace
Flat # 9A, House # 77, Road # 4, Block-C,

DRAWING TITLE :

PLAN & SECTIONAL ELEVATION OF 20.0m LONG RCC GIRDER BRIDGE AT CH. 49+645 (BR-09)

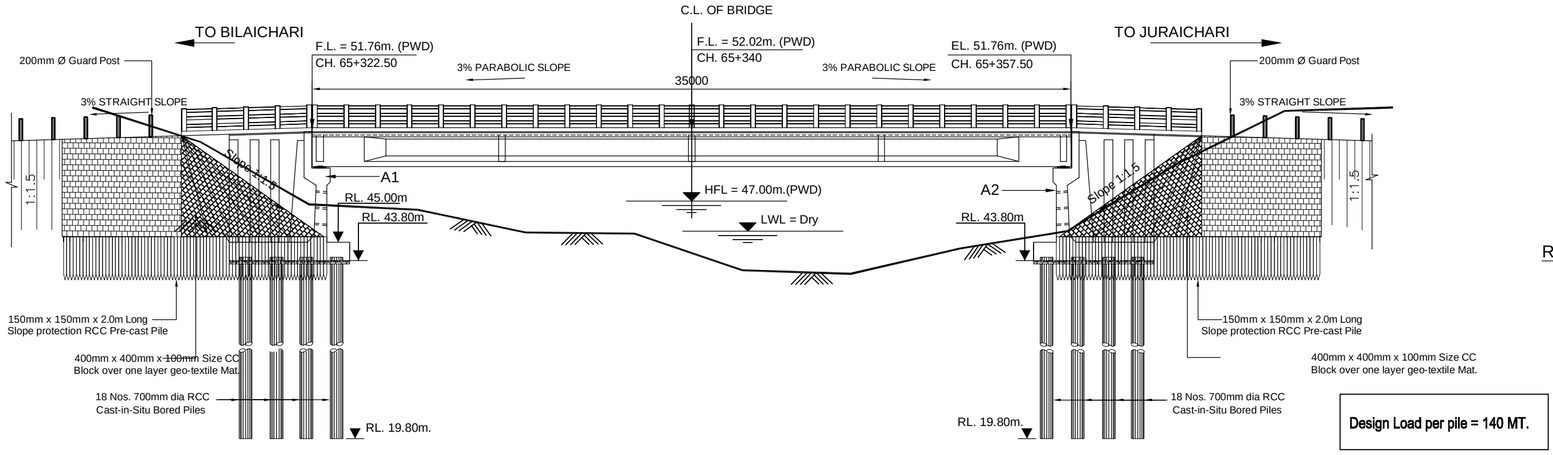
DRAWING NO : LGED/RCG/PLE-09

Scale :As shown

Date : 28-01-16

DESIGNED BY :	DRAWN BY :	CHECKED BY :	APPROVED BY :
MD. TAZUDDIN	MD. TAZUDDIN	AFM HAMIDUL HAQUE	DR. PRABHAT SHRIVASTAVA

REV.	DESCRIPTION	DATE



Design Load per pile = 140 MT.

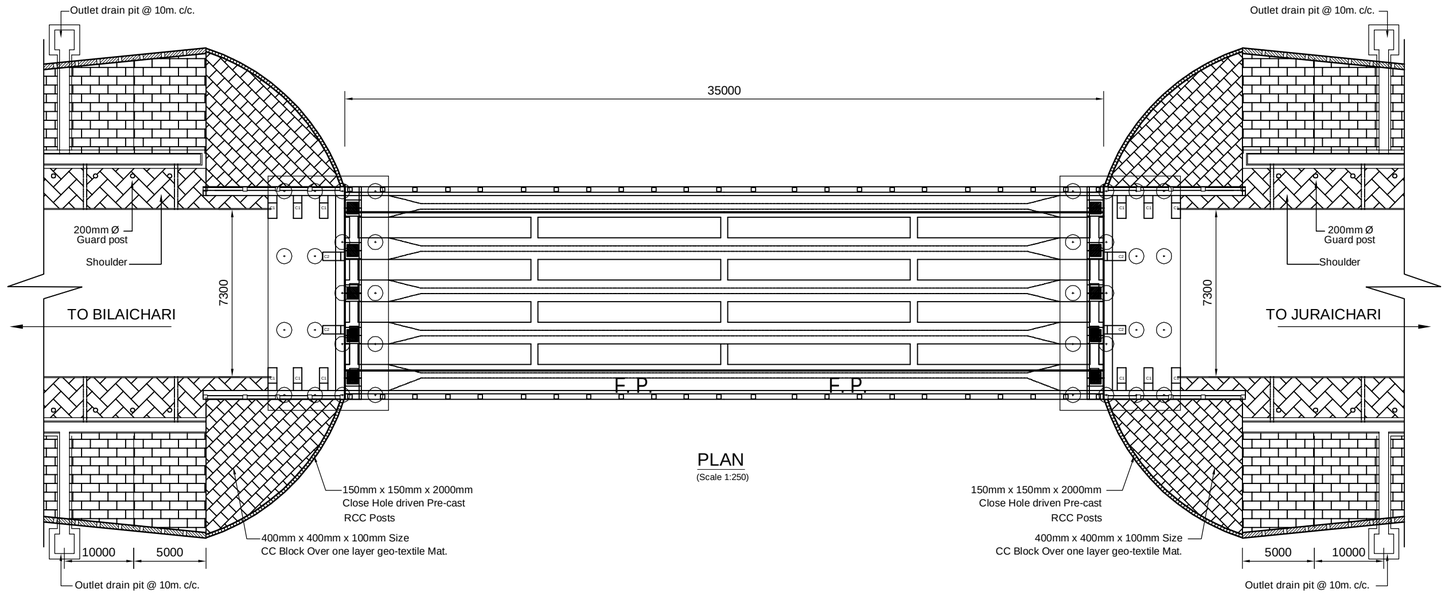
REFF. DWG. :

1. For abutment details : Abutment Type-II to be read.
2. For abutment pile : Abut. pile Type-I(b) to be read.

R.L. in m. (PWD)	51.32	49.73	46.85	46.61	45.56	45.51	43.81	43.65	44.81	45.62	48.71	51.162	51.32
Distance in m.	(-) 10.00	(-) 5.00	0.00 (65+322.50)	5.00	10.00	15.00	20.00	25.00	30.00	35.00	40.00	45.00	50.00

SECTIONAL ELEVATION

(Scale 1:250)

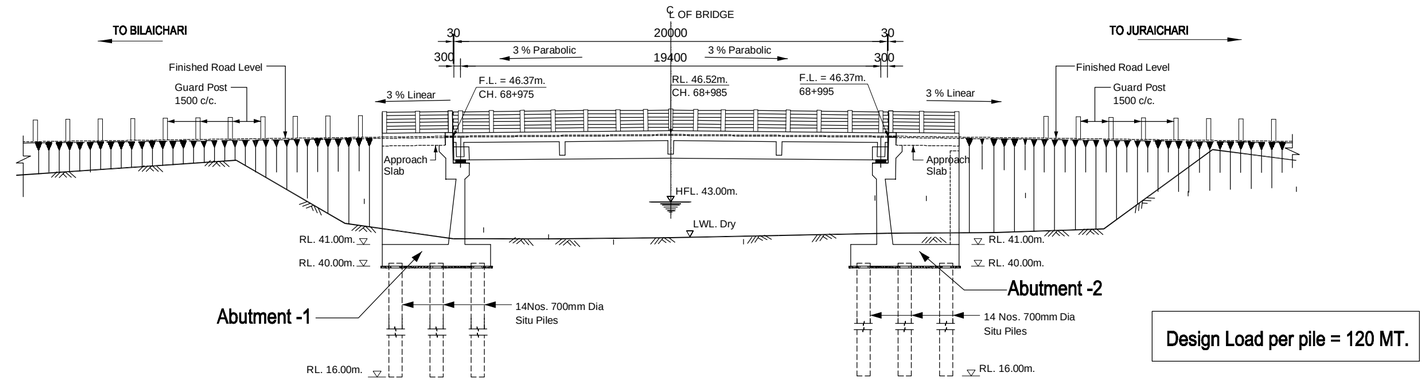


PLAN

(Scale 1:250)

NAME OF THE CLIENT : GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH **LOCAL GOVERNMENT ENGINEERING DEPARTMENT**	NAME OF THE CONSULTANTS : **SAI Consulting Engineers Pvt. Ltd, India.** in association with **BETS Consulting Services Ltd, Bangladesh** Project office : Tahmid Mahmood Palace Flat # 9A, House # 77, Road # 4, Block-C,	DRAWING TITLE : PLAN & SECTIONAL ELEV. OF 35.0m PSC GIRDER BRIDGE AT CH. 62+607 OVER MITINGACHHARA KHAL (BR-10)	DESIGNED BY : MD. TAZUDDIN	DRAWN BY : MD. TAZUDDIN
NAME OF THE PROJECT : CONSULTANCY SERVICES FOR FEASIBILITY, DETAILED SURVEY AND DESIGN OF CHITTAGONG HILL TRACT CONNECTIVITY CONNECTING THEGAMUKH AND CHITTAGONG PORT.		DRAWING NO : LGED/PCG/PLE-10 Scale :As shown Date : 28-01-16	CHECKED BY : AFM HAMIDUL HAQUE	APPROVED BY : DR. PRABHAT SHRIVASTAVA

REV.	DESCRIPTION	DATE



Existing Level in m.	45.21	42.31	41.59	41.59	41.65	41.75	41.84	41.89	42.05	45.70
Distance in m.	(-) 10.00	(-) 5.00	0.00 (68+975)	5.00	10.00	15.00	20.00	25.00	30.00	35.00

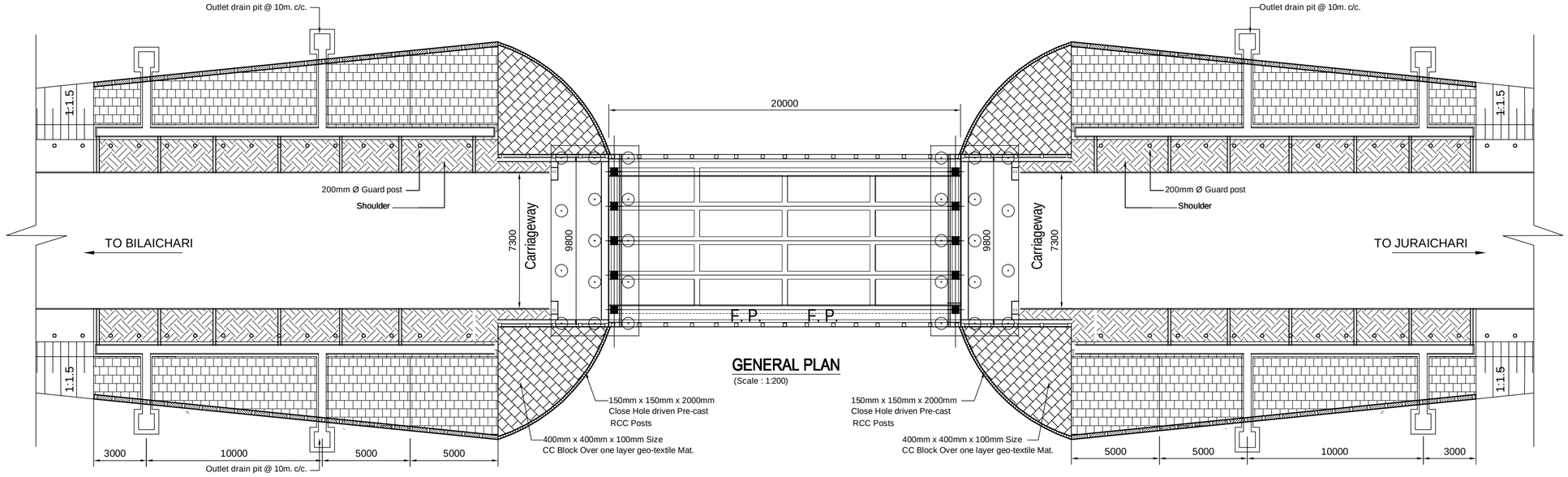
GENERAL ELEVATION

(Scale : 1:200)

Design Load per pile = 120 MT.

REFF. DWG. :

1. For abutment details : Abutment Type-III to be read.
2. For abutment pile : Abut. pile Type-II to be read.



GENERAL PLAN

(Scale : 1:200)

NAME OF THE CLIENT :

GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH

LOCAL GOVERNMENT ENGINEERING DEPARTMENT

NAME OF THE PROJECT :

CONSULTANCY SERVICES FOR FEASIBILITY, DETAILED SURVEY AND DESIGN OF CHITTAGONG HILL TRACT CONNECTIVITY CONNECTING THEGAMUKH AND CHITTAGONG PORT.

NAME OF THE CONSULTANTS :

SAI Consulting Engineers Pvt. Ltd, India.

in association with

BETS Consulting Services Ltd, Bangladesh

Project office :

Tahmid Mahmood Palace
Flat # 9A, House # 77, Road # 4, Block-C,

DRAWING TITLE :

PLAN & SECTIONAL ELEVATION OF 20.0m LONG RCC GIRDER BRIDGE AT CH. 66+047 (BR-11)

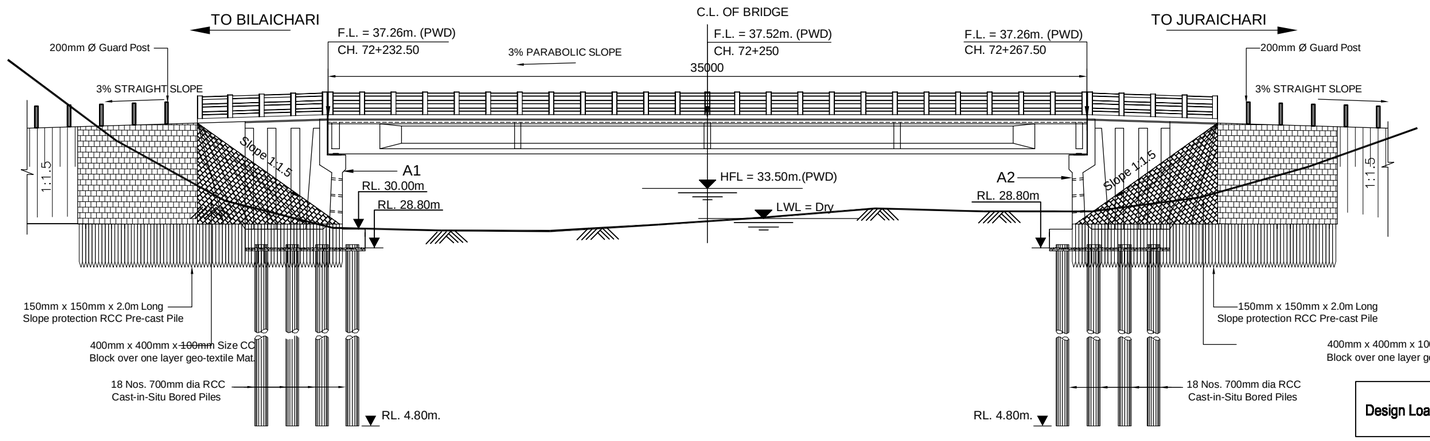
DRAWING NO : LGED/RCG/PLE-11

Scale :As shown

Date : 28-01-16

DESIGNED BY :	DRAWN BY :	CHECKED BY :	APPROVED BY :
MD. TAZUDDIN	MD. TAZUDDIN	AFM HAMIDUL HAQUE	DR. PRABHAT SHRIVASTAVA

REV.	DESCRIPTION	DATE



REFF. DWG. :

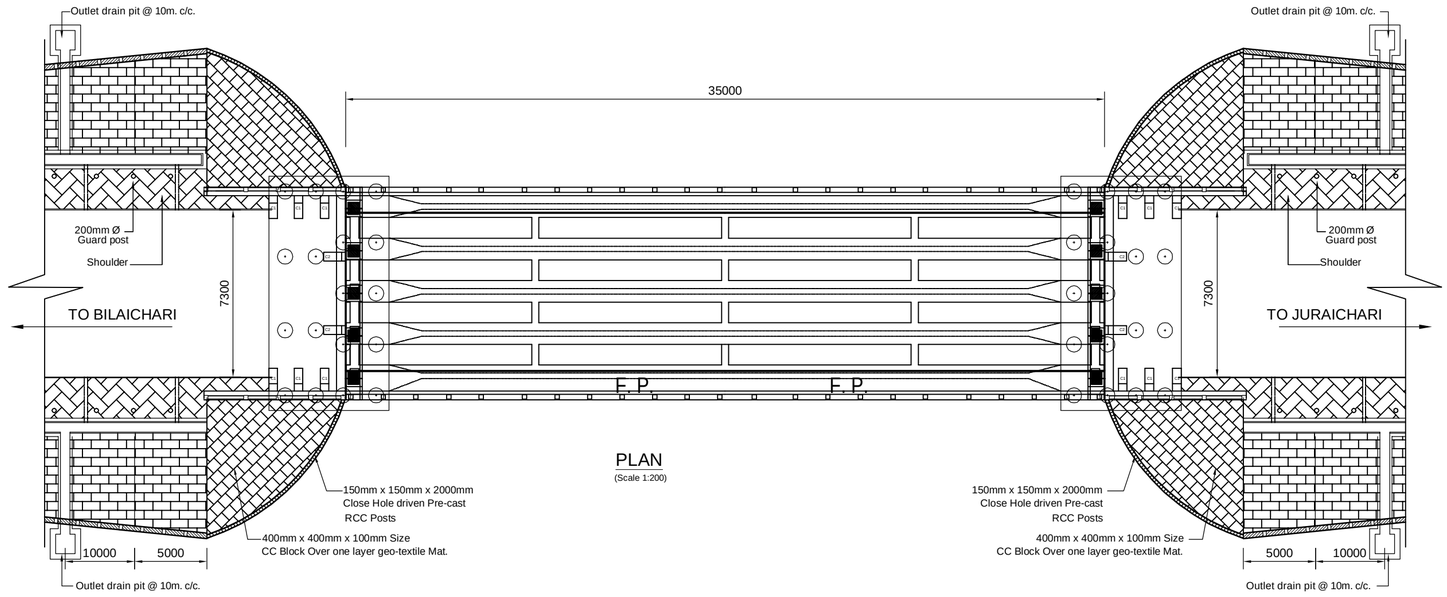
1. For abutment details : Abutment Type-II to be read.
2. For abutment pile : Abut. pile Type-I(b) to be read.

Design Load per pile = 140 MT.

R.L. in m. (PWD)	38.67	34.94	32.17	30.92	30.80	30.77	31.07	31.41	31.81	31.68	31.86	32.32	33.75	35.52
Distance in m.	(-) 15.00	(-) 10.00	(-) 5.00	0.00 (72+232.50)	5.00	10.00	15.00	20.00	25.00	30.00	35.00	40.00	45.00	50.00

SECTIONAL ELEVATION

(Scale 1:200)



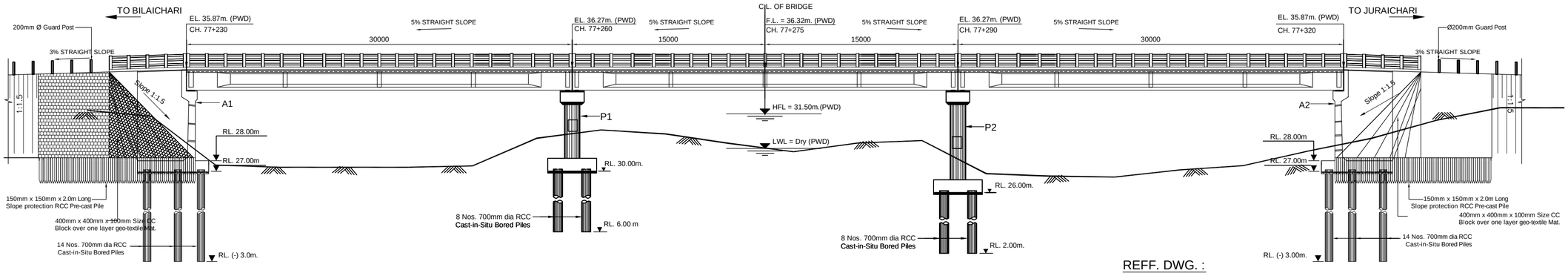
PLAN

(Scale 1:200)

NAME OF THE CLIENT : GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH **LOCAL GOVERNMENT ENGINEERING DEPARTMENT**	NAME OF THE CONSULTANTS : **SAI Consulting Engineers Pvt. Ltd, India.** in association with **BETS Consulting Services Ltd, Bangladesh** Project office : Tahmid Mahmood Palace Flat # 9A, House # 77, Road # 4, Block-C,	DRAWING TITLE : PLAN & SECTIONAL ELEVATION OF 35.0m PSC GIRDER BRIDGE AT CH. 69+197 (BR-12) DRAWING NO : LGED/PCG/PLE-12 Scale :As shown Date : 28-01-16	DESIGNED BY : MD. TAZUDDIN	DRAWN BY : MD. TAZUDDIN	CHECKED BY : AFM HAMIDUL HAQUE	APPROVED BY : DR. PRABHAT SHRIVASTAVA	REV.	DESCRIPTION	DATE

NAME OF THE PROJECT :

CONSULTANCY SERVICES FOR FEASIBILITY, DETAILED SURVEY AND DESIGN OF CHITTAGONG HILL TRACT CONNECTIVITY CONNECTING THEGAMUKH AND CHITTAGONG PORT.



REFF. DWG. :

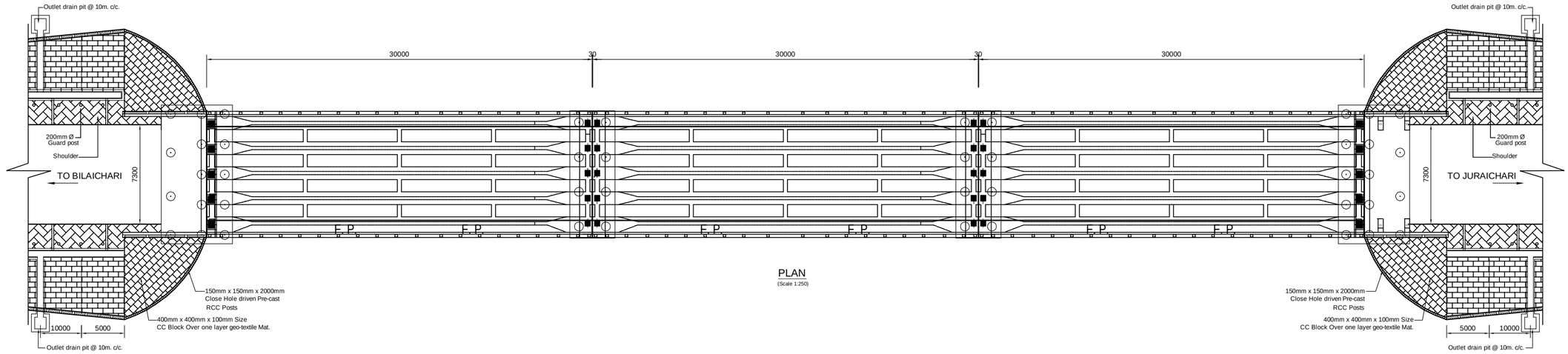
1. For abutment details : Abutment Type-III to be read.
2. For abutment pile : Abut. pile Type-II to be read.

Design Load per Abut. pile = 130 MT.
Design Load per Pier pile = 130 MT.

R.L. (PWD) (m)	32.32	31.85	28.06	27.90	27.90	27.90	28.01	30.15	31.53	31.05	29.75	29.10	29.78	29.97	27.40	27.21	27.13	27.69	28.02	29.15	30.15	31.53	32.52	32.52
Distance (m)	(-) 10.00	(-) 5.00	(-) 2.25 (77+230)	0.00	5.00	10.00	15.00	20.00	25.00	30.00	35.00	40.00	45.00	50.00	55.00	60.00	65.00	70.00	75.00	80.00	85.00	90.00	95.00	100.00	105.00

SECTIONAL ELEVATION

(Scale 1:250)



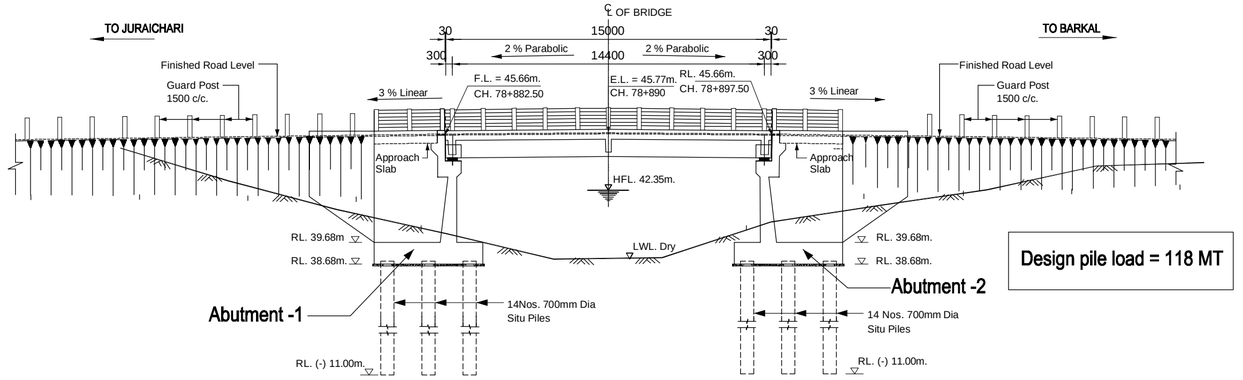
PLAN

(Scale 1:250)

NAME OF THE CLIENT : GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH **LOCAL GOVERNMENT ENGINEERING DEPARTMENT**	NAME OF THE CONSULTANTS : **SAI Consulting Engineers Pvt. Ltd, India.** in association with **BETS Consulting Services Ltd, Bangladesh** Project office : Tahmid Mahmood Palace Flat # 9A, House # 77, Road # 4, Block-C,	DRAWING TITLE : PLAN & SECTIONAL ELEVATION OF 90.0m LONG PSC GIRDER BRIDGE AT CH. 73+925
NAME OF THE PROJECT : CONSULTANCY SERVICES FOR FEASIBILITY, DETAILED SURVEY AND DESIGN OF CHITTAGONG HILL TRACT CONNECTIVITY CONNECTING THEGAMUKH AND CHITTAGONG PORT.		DRAWING NO : LGED/PCG/PLE-13 Scale :As shown Date : 28-01-16

DESIGNED BY :	DRAWN BY :	CHECKED BY :	APPROVED BY :
MD. TAZUDDIN	MD. TAZUDDIN	AFM HAMIDUL HAQUE	DR. PRABHAT SHRIVASTAVA

REV.	DESCRIPTION	DATE



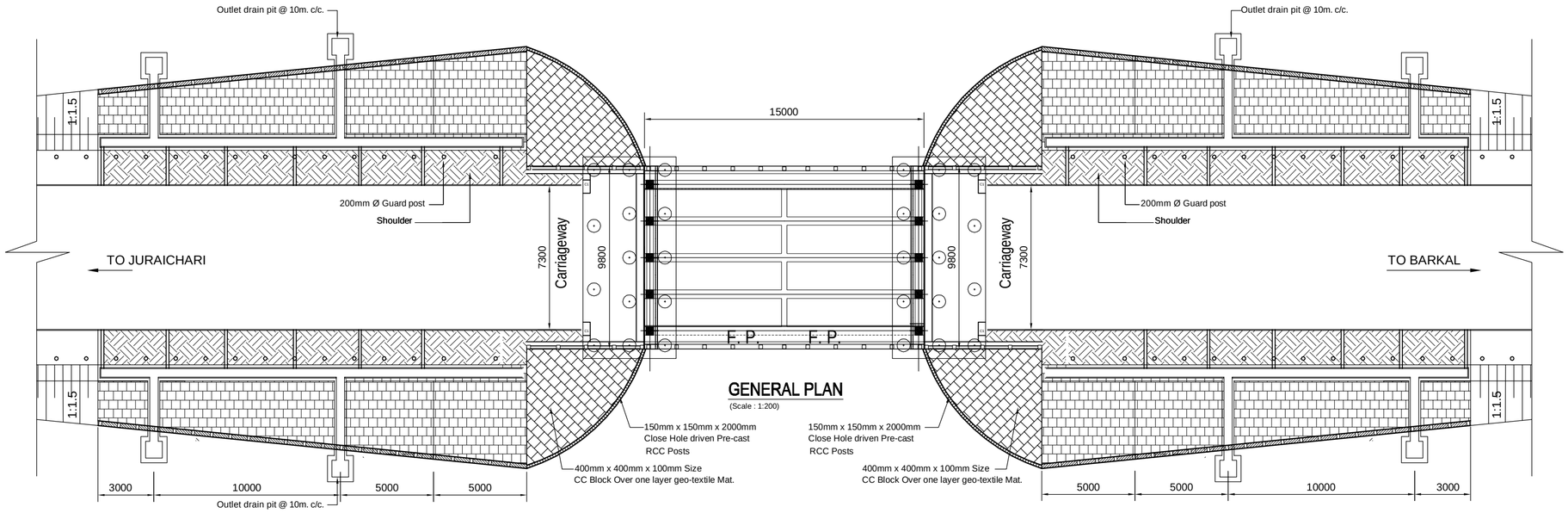
Existing Level in m.	43.62	42.10	40.78	39.68	38.50	38.57	40.21	40.97	41.70	42.79	42.95
Distance in m.	(-) 15.0	(-) 10.00	(-) 5.00	0.00 (78+882.5)	5.00	10.00	15.00	20.00	25.00	30.00	30.00

GENERAL ELEVATION

(Scale : 1:200)

REFF. DWG. :

1. For abutment details : Abutment Type-III to be read.
2. For abutment pile : Abut. pile Type-II to be read.



GENERAL PLAN

(Scale : 1:200)

NAME OF THE CLIENT :

GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH

LOCAL GOVERNMENT ENGINEERING DEPARTMENT

NAME OF THE PROJECT :

CONSULTANCY SERVICES FOR FEASIBILITY, DETAILED SURVEY AND DESIGN OF CHITTAGONG HILL TRACT CONNECTIVITY CONNECTING THEGAMUKH AND CHITTAGONG PORT.

NAME OF THE CONSULTANTS :

SAI Consulting Engineers Pvt. Ltd, India.

in association with

BETS Consulting Services Ltd, Bangladesh

Project office :

Tahmid Mahmood Palace
Flat # 9A, House # 77, Road # 4, Block-C,

DRAWING TITLE :

PLAN & SECTIONAL ELEVATION OF 15.0m LONG RCC GIRDER BRIDGE AT CH. 75+507

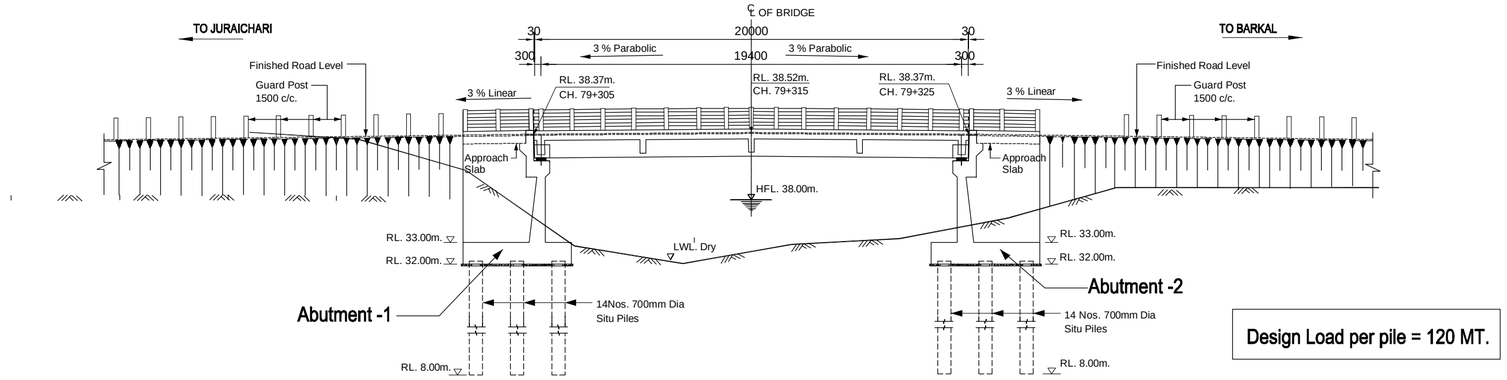
DRAWING NO : LGED/RCG/PLE-14

Scale :As shown

Date : 28-01-16

DESIGNED BY :	DRAWN BY :	CHECKED BY :	APPROVED BY :
MD. TAZUDDIN	MD. TAZUDDIN	AFM HAMIDUL HAQUE	DR. PRABHAT SHRIVASTAVA

REV.	DESCRIPTION	DATE



Design Load per pile = 120 MT.

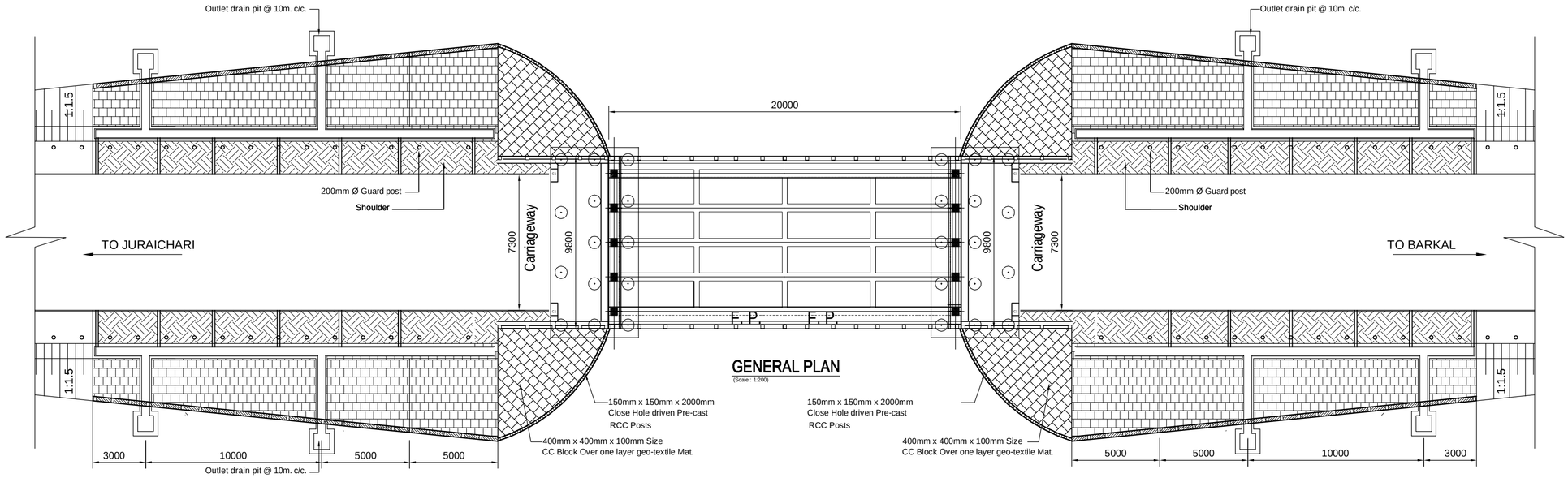
Existing Level in m.	39.02	38.71	37.26	33.78	32.96	33.32	34.12	35.07	36.47
Distance in m.	(-) 8.00	(-) 3.00	0.00	5.00	10.00	15.00	20.00	25.00	30.00

GENERAL ELEVATION

(Scale : 1:200)

REFF. DWG. :

1. For abutment details : Abutment Type-III to be read.
2. For abutment pile : Abut. pile Type-II to be read.



GENERAL PLAN

(Scale : 1:200)

NAME OF THE CLIENT :

GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH

LOCAL GOVERNMENT ENGINEERING DEPARTMENT

NAME OF THE PROJECT :

CONSULTANCY SERVICES FOR FEASIBILITY, DETAILED SURVEY AND DESIGN OF CHITTAGONG HILL TRACT CONNECTIVITY CONNECTING THEGAMUKH AND CHITTAGONG PORT.

NAME OF THE CONSULTANTS :

SAI Consulting Engineers Pvt. Ltd, India.

in association with

BETS Consulting Services Ltd, Bangladesh

Project office :

Tahmid Mahmood Palace
Flat # 9A, House # 77, Road # 4, Block-C,

DRAWING TITLE :

PLAN & SECTIONAL ELEVATION OF 20.0m LONG RCC GIRDER BRIDGE AT CH. 75+870 (BR-15)

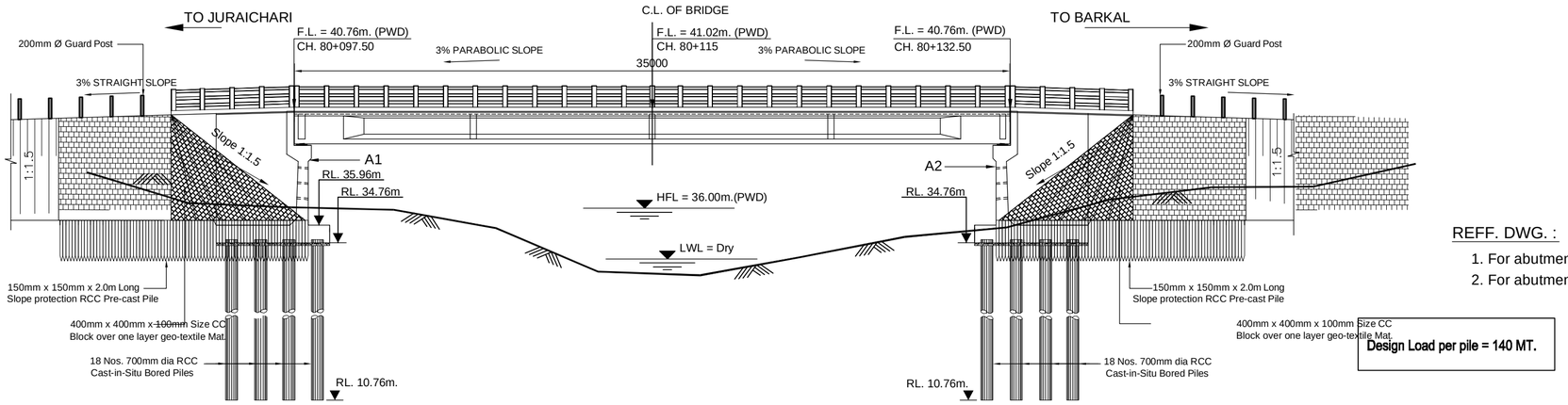
DRAWING NO : LGED/RCG/PLE-15

Scale :As shown

Date : 28-01-16

DESIGNED BY :	DRAWN BY :	CHECKED BY :	APPROVED BY :
MD. TAZUDDIN	MD. TAZUDDIN	AFM HAMIDUL HAQUE	DR. PRABHAT SHRIVASTAVA

REV.	DESCRIPTION	DATE



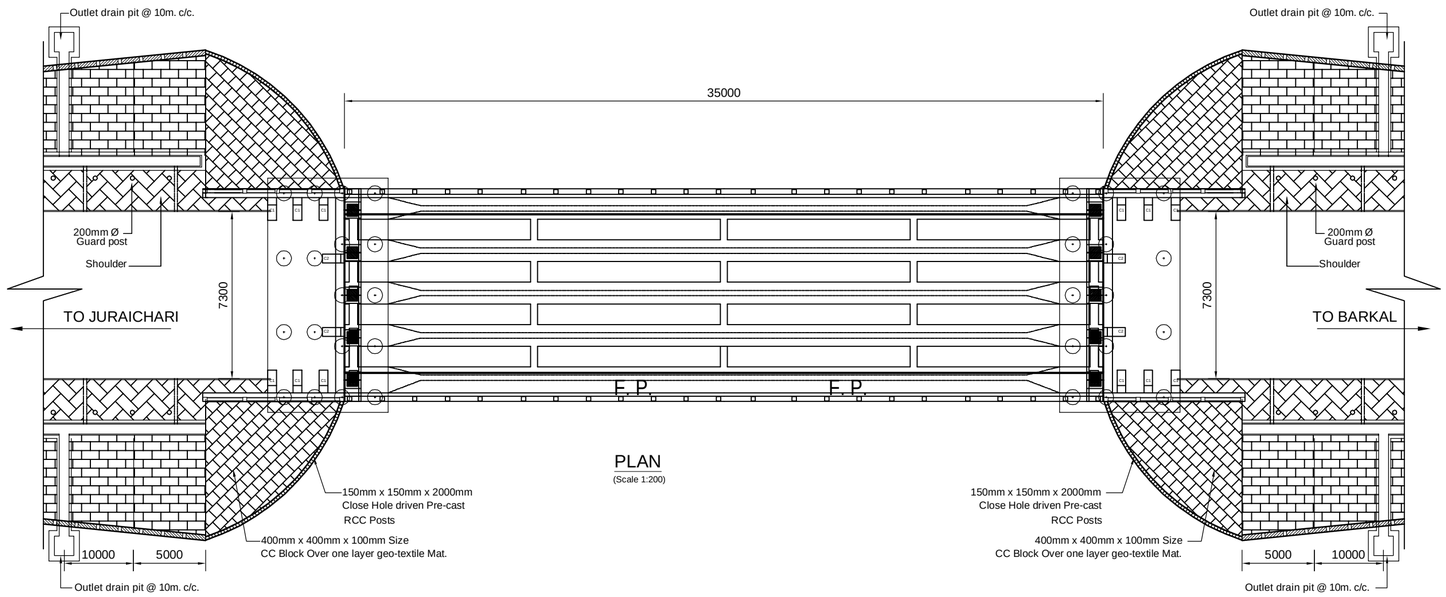
R.L. in m. (PWD)	38.70	37.20	36.99	36.68	35.98	33.85	33.67	34.58	35.55	36.01	37.37	37.98	38.01	39.13	43.93
Distance in m.	(-) 10.00	(-) 5.00	0.00	5.00	10.00	15.00	20.00	25.00	30.00	35.00	40.00	45.00	50.00	55.00	60.00

SECTIONAL ELEVATION
(Scale 1:200)

REFF. DWG. :

1. For abutment details : Abutment Type-II to be read.
2. For abutment pile : Abut. pile Type-I(b) to be read.

Design Load per pile = 140 MT.



PLAN
(Scale 1:200)

NAME OF THE CLIENT :
GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH
LOCAL GOVERNMENT ENGINEERING DEPARTMENT

NAME OF THE PROJECT :
CONSULTANCY SERVICES FOR FEASIBILITY, DETAILED SURVEY AND DESIGN OF CHITTAGONG HILL TRACT CONNECTIVITY CONNECTING THEGAMUKH AND CHITTAGONG PORT.

NAME OF THE CONSULTANTS :
SAI Consulting Engineers Pvt. Ltd, India.
in association with
BETS Consulting Services Ltd, Bangladesh
Project office :
Tahmid Mahmood Palace
Flat # 9A, House # 77, Road # 4, Block-C,

DRAWING TITLE :
PLAN & SECTIONAL ELEVATION OF 35.0m PSC GIRDER BRIDGE AT CH. 76+660 (BR-16)

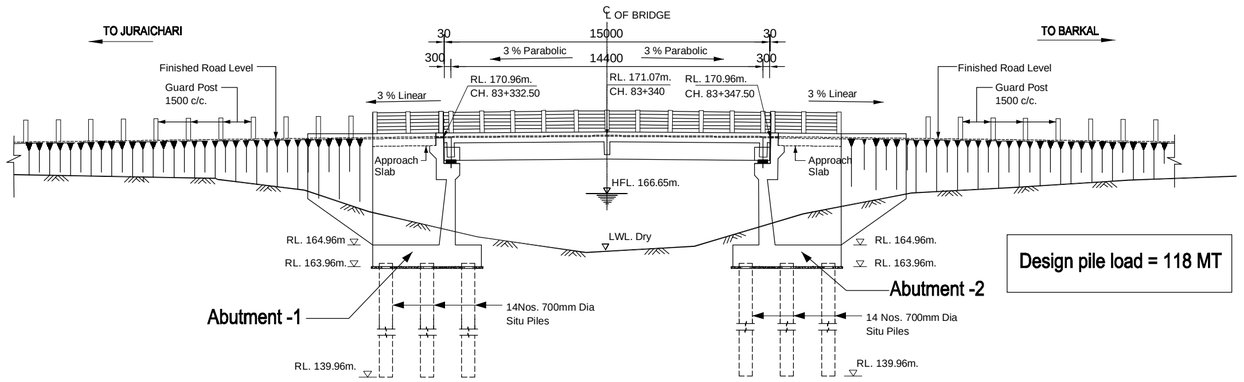
DRAWING NO : LGED/PCG/PLE-16

Scale :As shown

Date : 28-01-16

DESIGNED BY :	DRAWN BY :	CHECKED BY :	APPROVED BY :
MD. TAZUDDIN	MD. TAZUDDIN	AFM HAMIDUL HAQUE	DR. PRABHAT SHRIVASTAVA

REV.	DESCRIPTION	DATE



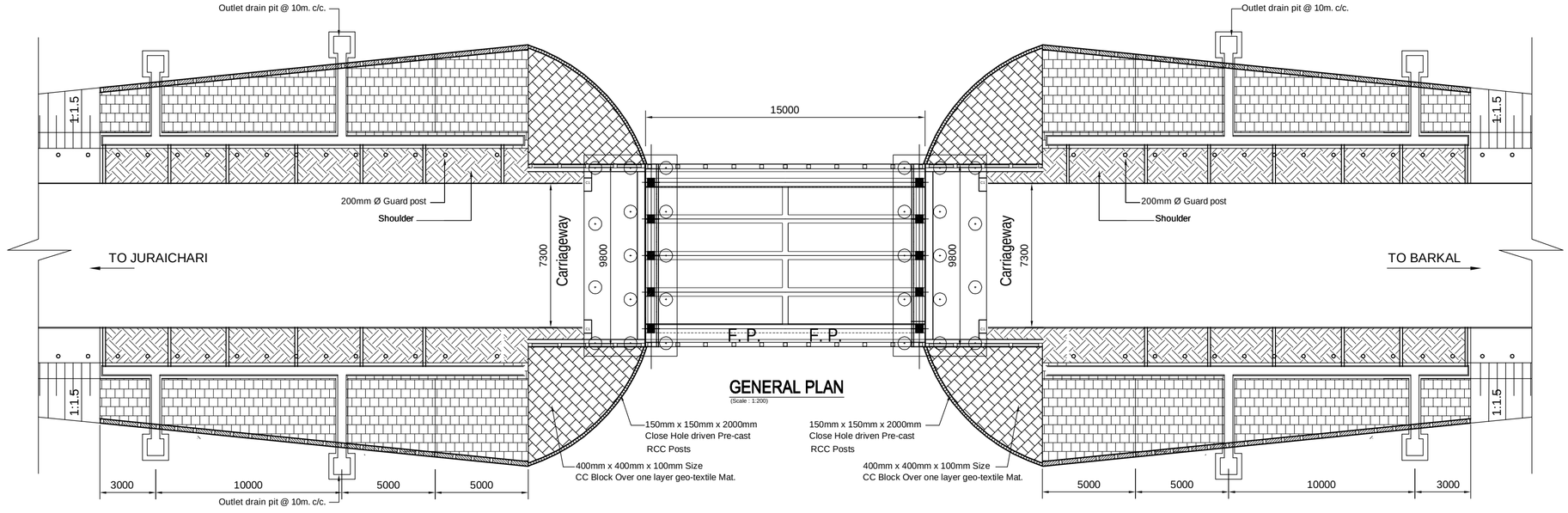
Existing Level in m.	167.46	167.35	166.86	165.86	164.70	163.98	164.27	165.76	166.73	167.00	167.32	167.51
Distance in m.	(-) 15.0	(-) 12.0	(-) 10.00	(-) 5.00	0.00	5.00	10.00	15.00	20.00	25.00	30.00	30.00

GENERAL ELEVATION

(Scale : 1:200)

REFF. DWG. :

1. For abutment details : Abutment Type-III to be read.
2. For abutment pile : Abut. pile Type-II to be read.



GENERAL PLAN

(Scale : 1:200)

NAME OF THE CLIENT :

GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH

LOCAL GOVERNMENT ENGINEERING DEPARTMENT

NAME OF THE PROJECT :

CONSULTANCY SERVICES FOR FEASIBILITY, DETAILED SURVEY AND DESIGN OF CHITTAGONG HILL TRACT CONNECTIVITY CONNECTING THEGAMUKH AND CHITTAGONG PORT.

NAME OF THE CONSULTANTS :

SAI Consulting Engineers Pvt. Ltd, India.

in association with

BETS Consulting Services Ltd, Bangladesh

Project office :

Tahmid Mahmood Palace
Flat # 9A, House # 77, Road # 4, Block-C,

DRAWING TITLE :

PLAN & SECTIONAL ELEVATION OF 15.0m LONG RCC GIRDER BRIDGE AT CH.79+700(BR-17)

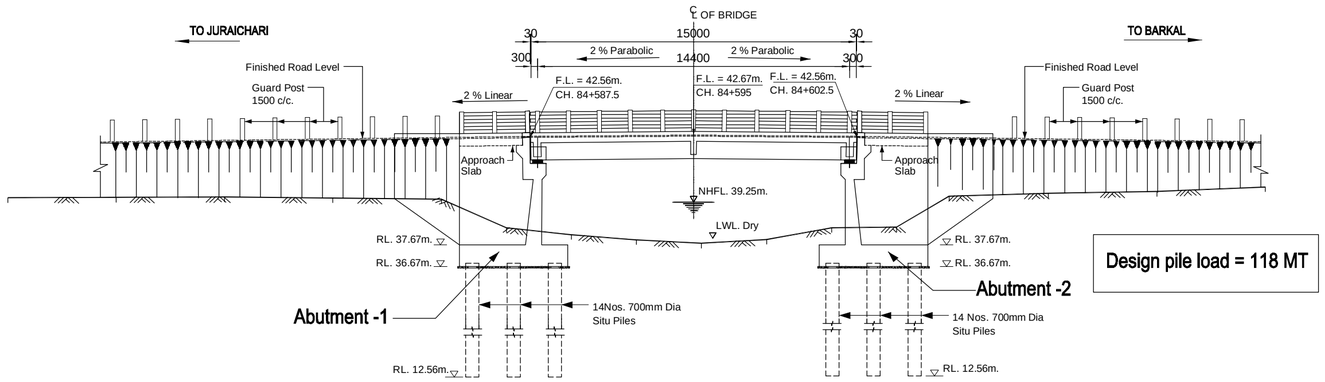
DRAWING NO : LGED/RCG/PLE-17

Scale :As shown

Date : 28-01-16

DESIGNED BY :	DRAWN BY :	CHECKED BY :	APPROVED BY :
MD. TAZUDDIN	MD. TAZUDDIN	AFM HAMIDUL HAQUE	DR. PRABHAT SHRIVASTAVA

REV.	DESCRIPTION	DATE



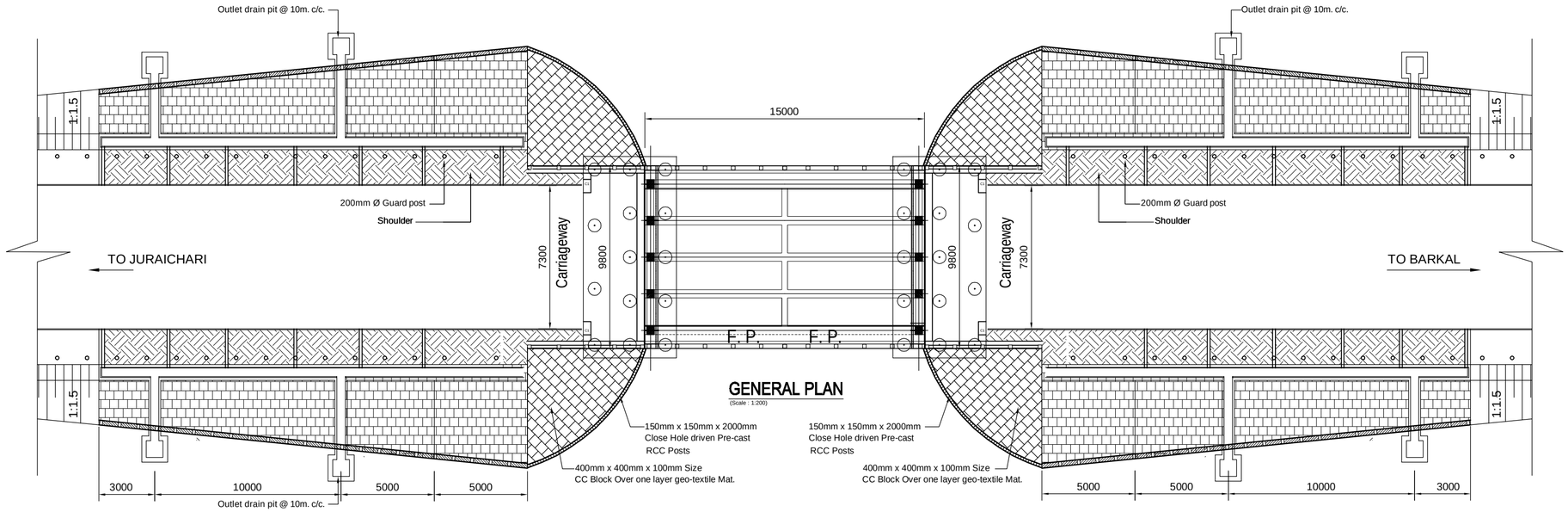
Existing Level in m.	40.64	38.05	37.75	37.93	36.05	38.20	40.92	5.23
Distance in m.	(-) 10.00	(-) 5.00	0.00	5.00	10.00	15.00	20.00	24.00

GENERAL ELEVATION

(Scale : 1:200)

REFF. DWG. :

1. For abutment details : Abutment Type-III to be read.
2. For abutment pile : Abut. pile Type-II to be read.



GENERAL PLAN

(Scale : 1:200)

NAME OF THE CLIENT :

GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH

LOCAL GOVERNMENT ENGINEERING DEPARTMENT

NAME OF THE PROJECT :

CONSULTANCY SERVICES FOR FEASIBILITY, DETAILED SURVEY AND DESIGN OF CHITTAGONG HILL TRACT CONNECTIVITY CONNECTING THEGAMUKH AND CHITTAGONG PORT.

NAME OF THE CONSULTANTS :

SAI Consulting Engineers Pvt. Ltd, India.

in association with

BETS Consulting Services Ltd, Bangladesh

Project office :

Tahmid Mahmood Palace
Flat # 9A, House # 77, Road # 4, Block-C,

DRAWING TITLE :

PLAN & SECTIONAL ELEVATION OF 15.0m LONG RCC GIRDER BRIDGE AT CH. 80+842 (BR-18)

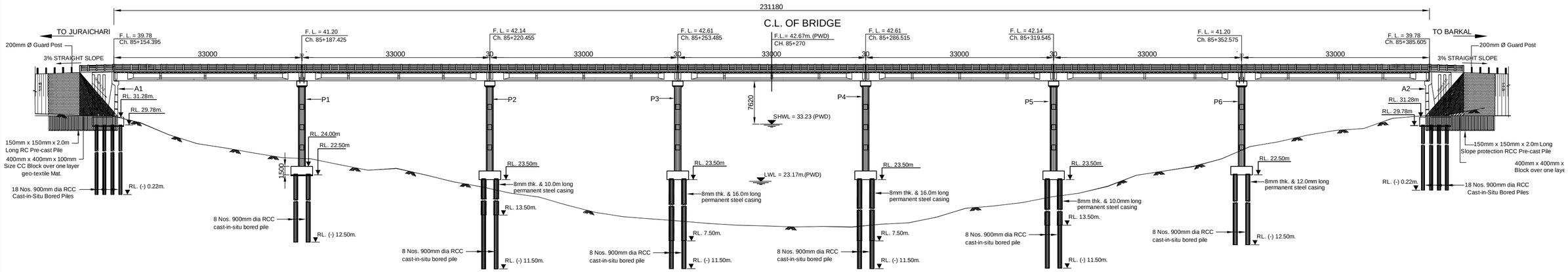
DRAWING NO : LGED/RCG/PLE-18

Scale :As shown

Date : 28-01-16

DESIGNED BY :	DRAWN BY :	CHECKED BY :	APPROVED BY :
MD. TAZUDDIN	MD. TAZUDDIN	AFM HAMIDUL HAQUE	DR. PRABHAT SHRIVASTAVA

REV.	DESCRIPTION	DATE

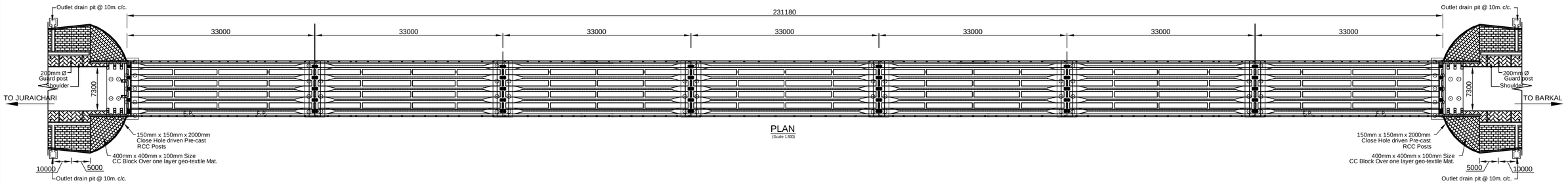


R.L. in m. (PWD)	32.12	31.98	30.78	28.67	27.12	26.36	25.45	24.67	24.45	23.45	22.45	22.78	21.67	20.45	19.55	18.45	17.78	16.32	15.065	14.31	13.93	13.53	13.13	12.83	12.67	12.52	12.62	12.50	12.98	13.25	14.25	15.78	16.21	16.78	17.78	18.45	19.65	21.56	22.34	23.12	24.45	26.61	27.45	28.61	29.45	29.78	31.58	31.98	32.22
Distance in m.	(-) 10.00	(-) 5.00 (85+154.395)	0.00	5.00	10.00	15.00	20.00	25.00	30.00	35.00	40.00	45.00	50.00	55.00	60.00	65.00	70.00	75.00	80.00	85.00	90.00	95.00	100.00	105.00	110.00	115.00	120.00	125.00	130.00	135.00	140.00	145.00	150.00	155.00	160.00	165.00	170.00	175.00	180.00	185.00	190.00	195.00	200.00	205.00	210.00	215.00	220.00	225.00	230.00

SECTIONAL ELEVATION
(Scale 1:500)

REFF. DWG. :

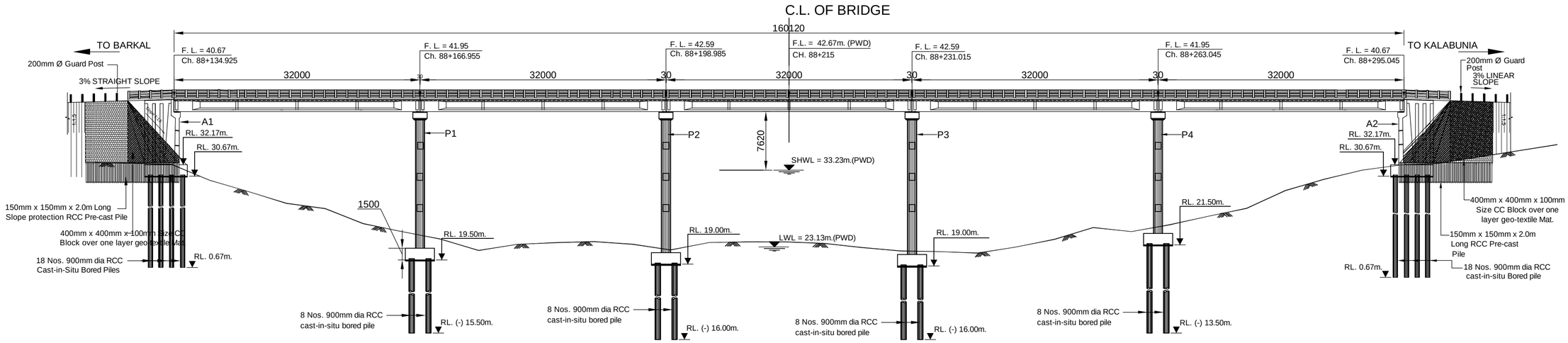
1. For abutment details : Abutment Type-I to be read.
2. For abutment pile : Abut. pile Type-I(a) to be read.
3. For pier details : Pier Type-I to be read.
4. For pier pile : Pier Pile Type-I to be read.



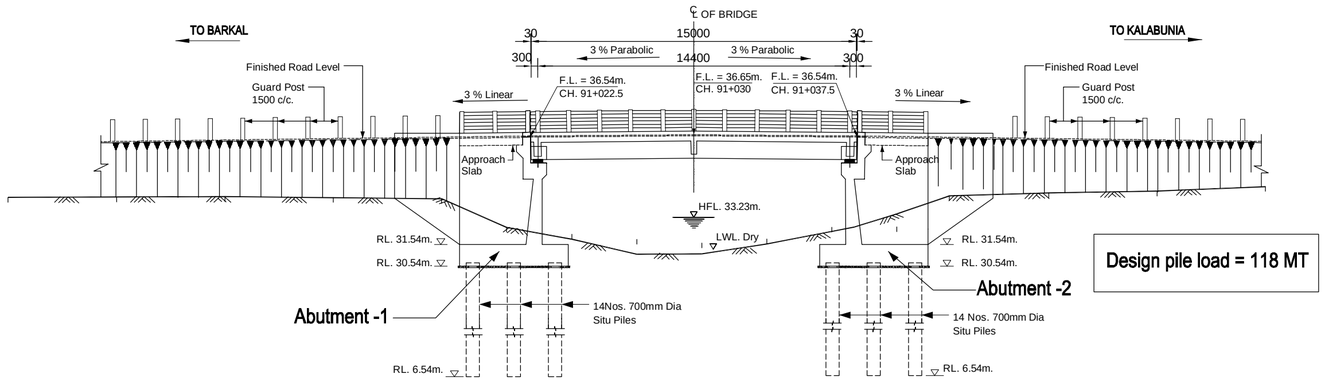
PLAN
(Scale 1:500)

NAME OF THE CLIENT : GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH **LOCAL GOVERNMENT ENGINEERING DEPARTMENT**	NAME OF THE CONSULTANTS : **SAI Consulting Engineers Pvt. Ltd, India.** in association with **BETS Consulting Services Ltd, Bangladesh** Project office : Tahmid Mahmood Palace Flat # 9A, House # 77, Road # 4, Block-C,	DRAWING TITLE : PLAN & SECTIONAL ELEVATION OF 231.18m LONG PSC GIRDER BRIDGE AT CH. 81+480 (BR-19)	DESIGNED BY : MD. TAZUDDIN
NAME OF THE PROJECT : CONSULTANCY SERVICES FOR FEASIBILITY, DETAILED SURVEY AND DESIGN OF CHITTAGONG HILL TRACT CONNECTIVITY CONNECTING THEGAMUKH AND CHITTAGONG PORT.		DRAWING NO : LGED/PCG/PLE-19 Scale :As shown Date : 28-01-16	DRAWN BY : MD. TAZUDDIN
			CHECKED BY : AFM HAMIDUL HAQUE
			APPROVED BY : DR. PRABHAT SHRIVASTAVA

REV.	DESCRIPTION	DATE


C.L. OF BRIDGE
160120
TO BARKAL
TO KALABUNIA
F. L. = 40.67
Ch. 88+134.925
F. L. = 41.95
Ch. 88+166.955
F. L. = 42.59
Ch. 88+198.985
F.L. = 42.67m. (PWD)
CH. 88+215
F. L. = 42.59
Ch. 88+231.015
F. L. = 41.95
Ch. 88+263.045
F. L. = 40.67
Ch. 88+295.045
32000
30
200mm Ø Guard Post
3% STRAIGHT SLOPE
200mm Ø Guard Post
3% LINEAR SLOPE
A1
A2
P1
P2
P3
P4
RL. 32.17m.
RL. 30.67m.
7620
SHWL = 33.23m.(PWD)
LWL = 23.13m.(PWD)
1500
RL. 19.50m.
RL. 19.00m.
RL. 21.50m.
RL. 0.67m.
150mm x 150mm x 2.0m Long Slope protection RCC Pre-cast Pile
400mm x 400mm x 100mm Size CC Block over one layer geo-textile Mat.
18 Nos. 900mm dia RCC Cast-in-Situ Bored Piles
8 Nos. 900mm dia RCC cast-in-situ bored pile
RL. (-) 15.50m.
RL. (-) 16.00m.
RL. (-) 13.50m.
150mm x 150mm x 2.0m Long RCC Pre-cast Pile
18 Nos. 900mm dia RCC cast-in-situ Bored pile

| | | |



Design pile load = 118 MT

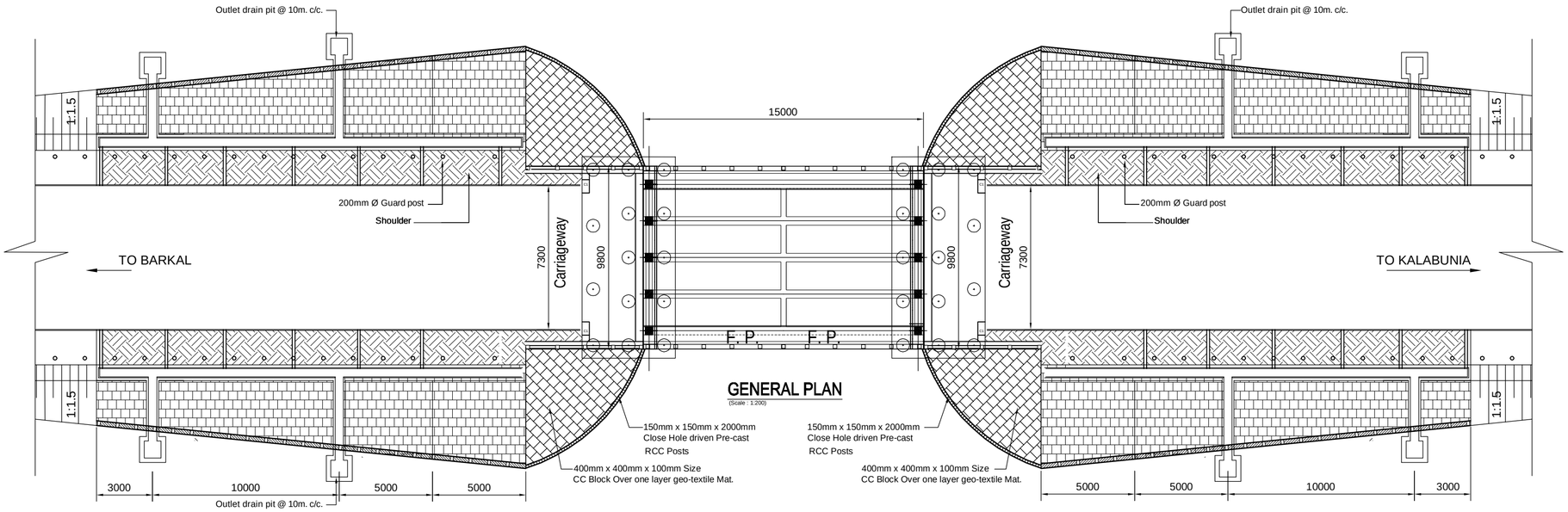
Existing Level in m.	33.65	33.12	32.50	31.51	30.78	31.49	31.74	32.81	32.98
Distance in m.	(-) 15.00	(-) 10.00	(-) 5.00	0.00	5.00	10.00	15.00	20.00	24.00

GENERAL ELEVATION

(Scale : 1:200)

REFF. DWG. :

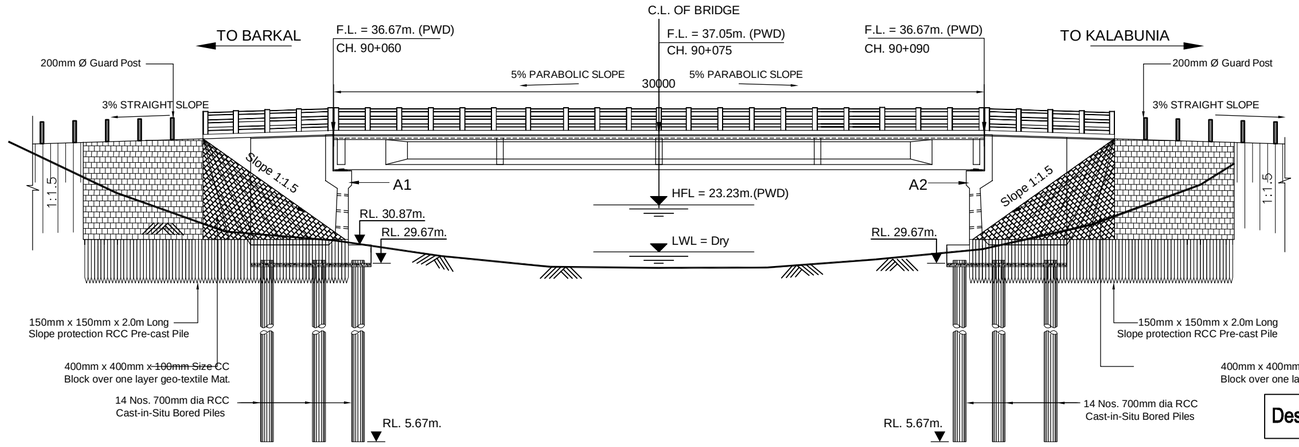
1. For abutment details : Abutment Type-III to be read.
2. For abutment pile : Abut. pile Type-II to be read.



GENERAL PLAN

(Scale : 1:200)

NAME OF THE CLIENT : GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH **LOCAL GOVERNMENT ENGINEERING DEPARTMENT** NAME OF THE PROJECT : CONSULTANCY SERVICES FOR FEASIBILITY, DETAILED SURVEY AND DESIGN OF CHITTAGONG HILL TRACT CONNECTIVITY CONNECTING THEGAMUKH AND CHITTAGONG PORT.	NAME OF THE CONSULTANTS : **SAI Consulting Engineers Pvt. Ltd, India.** in association with **BETS Consulting Services Ltd, Bangladesh** Project office : Tahmid Mahmood Palace Flat # 9A, House # 77, Road # 4, Block-C,	DRAWING TITLE : PLAN & SECTIONAL ELEVATION OF 15.0m LONG RCC GIRDER BRIDGE AT CH. 85+570 (BR-21) DRAWING NO : LGED/RCG/PLE-21 Scale :As shown Date : 28-01-16	DESIGNED BY : MD. TAZUDDIN	DRAWN BY : MD. TAZUDDIN	CHECKED BY : AFM HAMIDUL HAQUE	APPROVED BY : DR. PRABHAT SHRIVASTAVA	REV. / DESCRIPTION / DATE



REFF. DWG. :

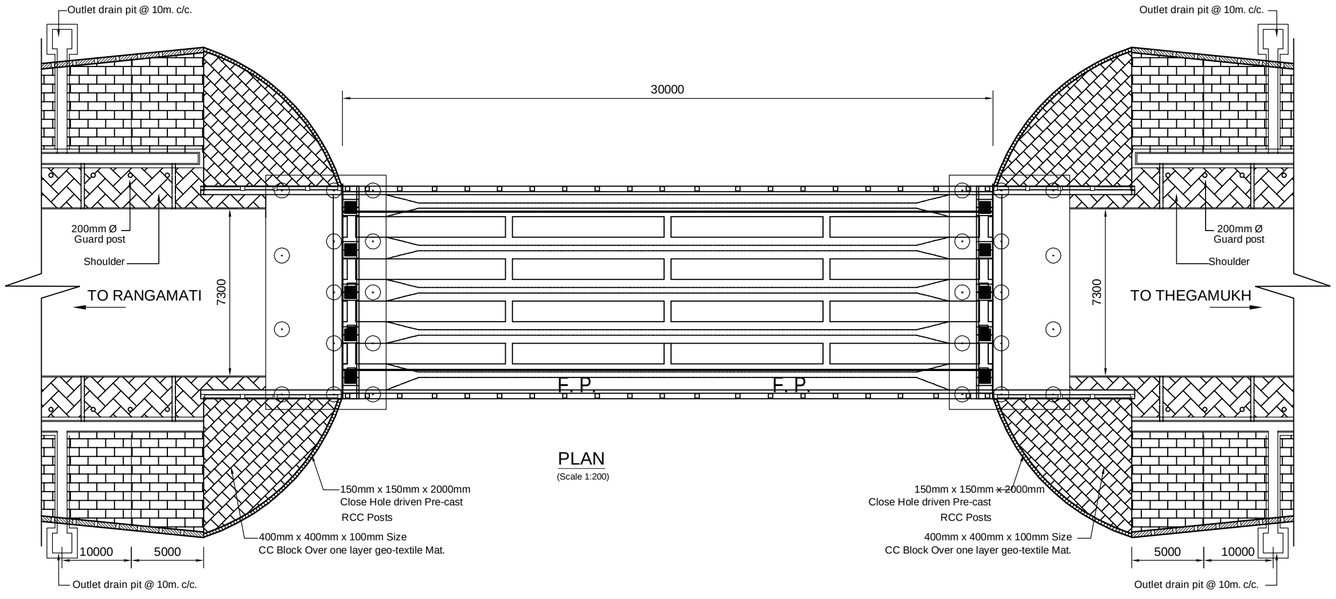
1. For abutment details : Abutment Type-III to be read.
2. For abutment pile : Abut. pile Type-II to be read.

Design Load per pile = 130 MT.

R.L. in m. (PWD)	33.45	32.50	31.67	31.37	30.96	30.86	30.67	30.89	30.89	31.05	31.86	32.89	33.98
Distance in m.	(-) 15.00	(-) 10.00	(-) 5.00	0.00	5.00	10.00	15.00	20.00	25.00	30.00	35.00	40.00	45.00

SECTIONAL ELEVATION

(Scale 1:250)



PLAN

(Scale 1:200)

NAME OF THE CLIENT :

GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH

LOCAL GOVERNMENT ENGINEERING DEPARTMENT

NAME OF THE PROJECT :

CONSULTANCY SERVICES FOR FEASIBILITY, DETAILED SURVEY AND DESIGN OF CHITTAGONG HILL TRACT CONNECTIVITY CONNECTING THEGAMUKH AND CHITTAGONG PORT.

NAME OF THE CONSULTANTS :

SAI Consulting Engineers Pvt. Ltd, India.

in association with

BETS Consulting Services Ltd, Bangladesh

Project office :

Tahmid Mahmood Palace
Flat # 9A, House # 77, Road # 4, Block-C,

DRAWING TITLE :

PLAN & SECTIONAL ELEVATION OF 30.0m PSC GIRDER BRIDGE AT CH. 86+104 (BR-22)

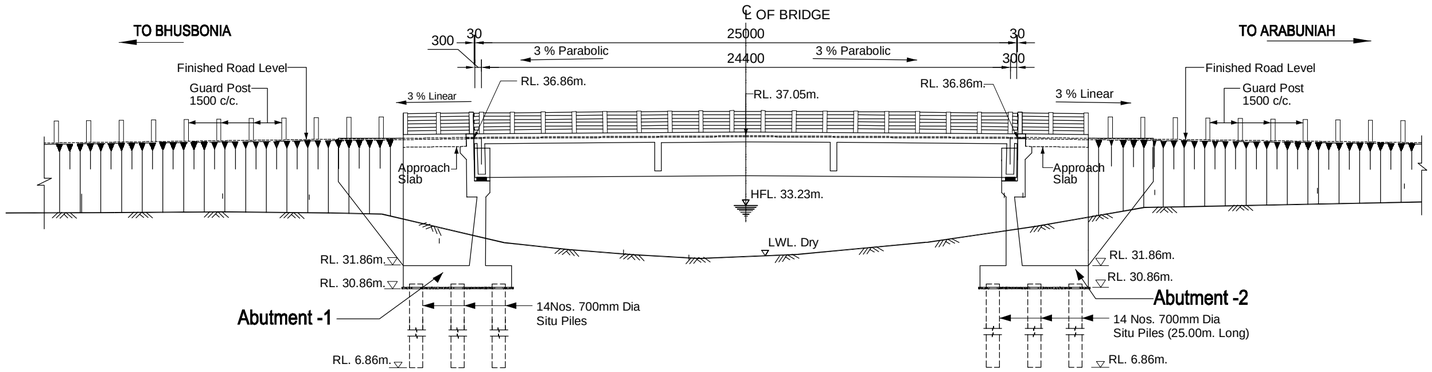
DRAWING NO : LGED/PCG/PLE-22

Scale :As shown

Date : 28-01-16

DESIGNED BY :	DRAWN BY :	CHECKED BY :	APPROVED BY :
MD. TAZUDDIN	MD. TAZUDDIN	AFM HAMIDUL HAQUE	DR. PRABHAT SHRIVASTAVA

REV.	DESCRIPTION	DATE



Existing Level in m.	30.45	30.35	29.65	29.45	29.31	29.36	29.61	29.74	30.25	30.89
Distance in m.	(-) 10.00	(-) 5.00	0.00	5.00	10.00	15.00	20.00	25.00	30.00	35.00

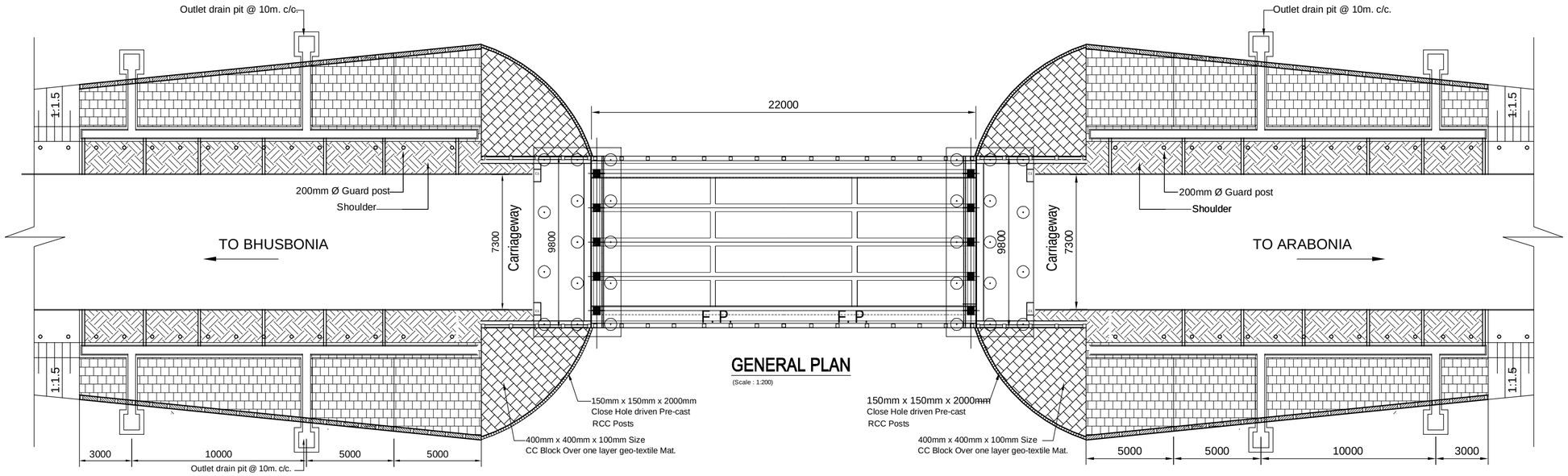
GENERAL ELEVATION

(Scale : 1:200)

Desugn Load per pile = 125 MT.

REFF. DWG. :

1. For abutment details : Abutment Type-III to be read.
2. For abutment pile : Abut. pile Type-II to be read.

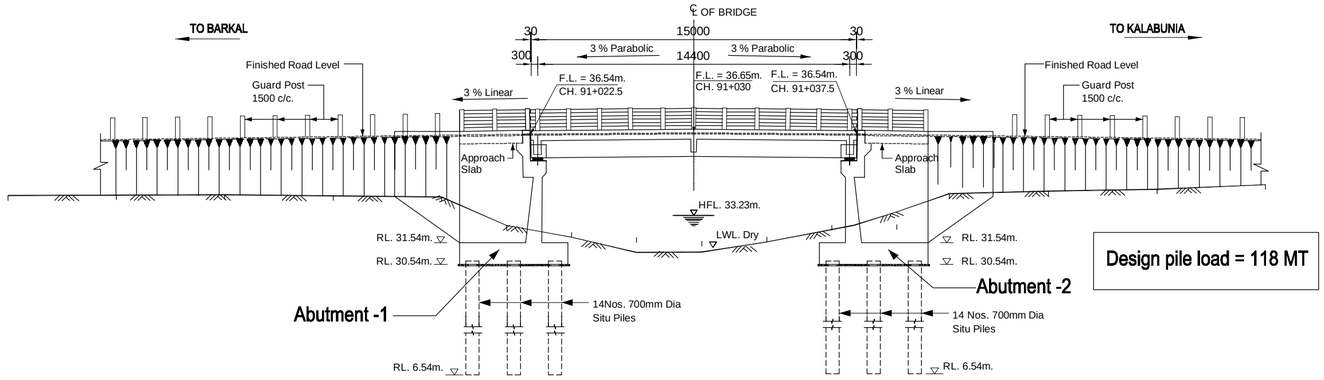


GENERAL PLAN

(Scale : 1:200)

NAME OF THE CLIENT : GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH **LOCAL GOVERNMENT ENGINEERING DEPARTMENT** NAME OF THE PROJECT : CONSULTANCY SERVICES FOR FEASIBILITY, DETAILED SURVEY AND DESIGN OF CHITTAGONG HILL TRACT CONNECTIVITY CONNECTING THEGAMUKH AND CHITTAGONG PORT.	NAME OF THE CONSULTANTS : **SAI Consulting Engineers Pvt. Ltd, India.** in association with **BETS Consulting Services Ltd, Bangladesh** Project office : Tahmid Mahmood Palace Flat # 9A, House # 77, Road # 4, Block-C,	DRAWING TITLE : PLAN & SECTIONAL ELEVATION OF 25.0m LONG RCC GIRDER BRIDGE AT CH. 86+685 (BR-23) DRAWING NO : LGED/RCG/PLE-23 Scale :As shown Date : 28-01-16	DESIGNED BY : MD. TAZUDDIN	DRAWN BY : MD. TAZUDDIN	CHECKED BY : AFM HAMIDUL HAQUE	APPROVED BY : DR. PRABHAT SHRIVASTAVA

REV.	DESCRIPTION	DATE



Design pile load = 118 MT

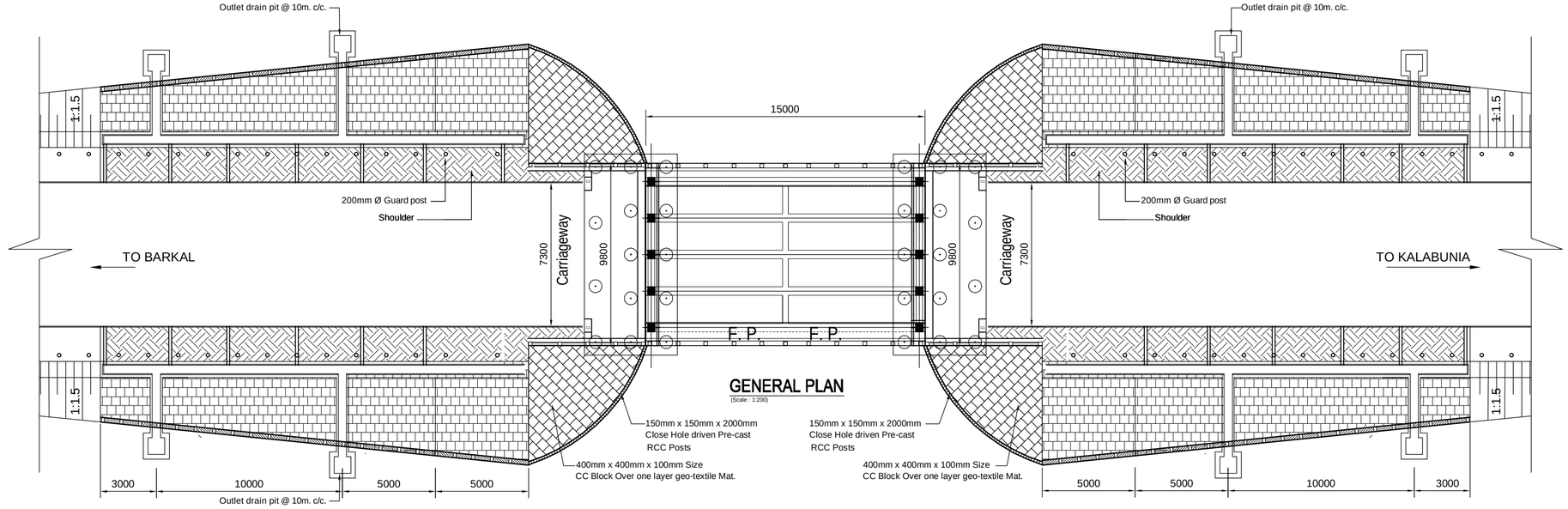
Existing Level in m.	33.45	32.78	32.50	31.74	30.96	31.05	31.86	32.61	32.82
Distance in m.	(-) 15.00	(-) 10.00	(-) 5.00	0.00	5.00	10.00	15.00	20.00	24.00

GENERAL ELEVATION

(Scale : 1:200)

REFF. DWG. :

1. For abutment details : Abutment Type-III to be read.
2. For abutment pile : Abut. pile Type-II to be read.



GENERAL PLAN

(Scale : 1:200)

NAME OF THE CLIENT :

GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH

LOCAL GOVERNMENT ENGINEERING DEPARTMENT

NAME OF THE PROJECT :

CONSULTANCY SERVICES FOR FEASIBILITY, DETAILED SURVEY AND DESIGN OF CHITTAGONG HILL TRACT CONNECTIVITY CONNECTING THEGAMUKH AND CHITTAGONG PORT.

NAME OF THE CONSULTANTS :

SAI Consulting Engineers Pvt. Ltd, India.

in association with

BETS Consulting Services Ltd, Bangladesh

Project office :

Tahmid Mahmood Palace
Flat # 9A, House # 77, Road # 4, Block-C,

DRAWING TITLE :

PLAN & SECTIONAL ELEVATION OF 15.0m LONG RCC GIRDER BRIDGE AT CH. 86+972 (BR-24)

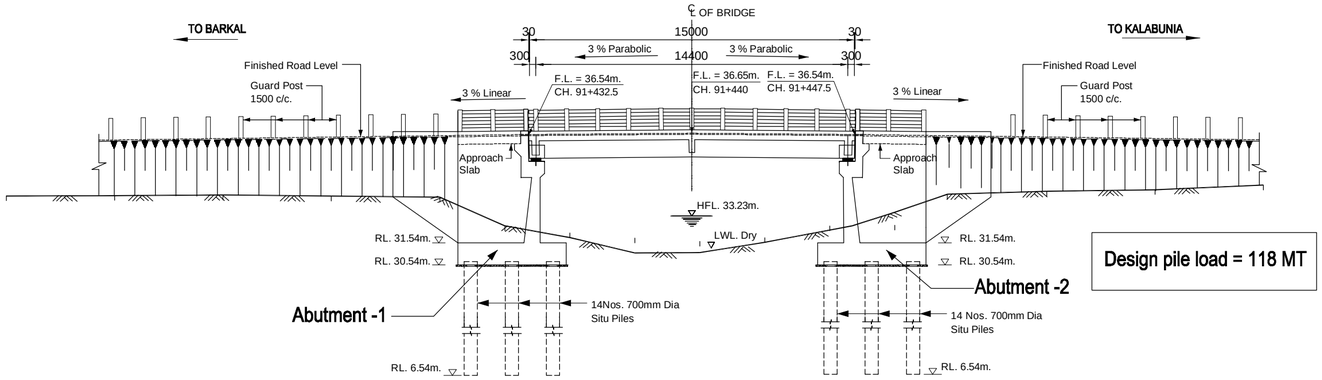
DRAWING NO : LGED/RCG/PLE-24

Scale :As shown

Date : 28-01-16

DESIGNED BY :	DRAWN BY :	CHECKED BY :	APPROVED BY :
MD. TAZUDDIN	MD. TAZUDDIN	AFM HAMIDUL HAQUE	DR. PRABHAT SHRIVASTAVA

REV.	DESCRIPTION	DATE



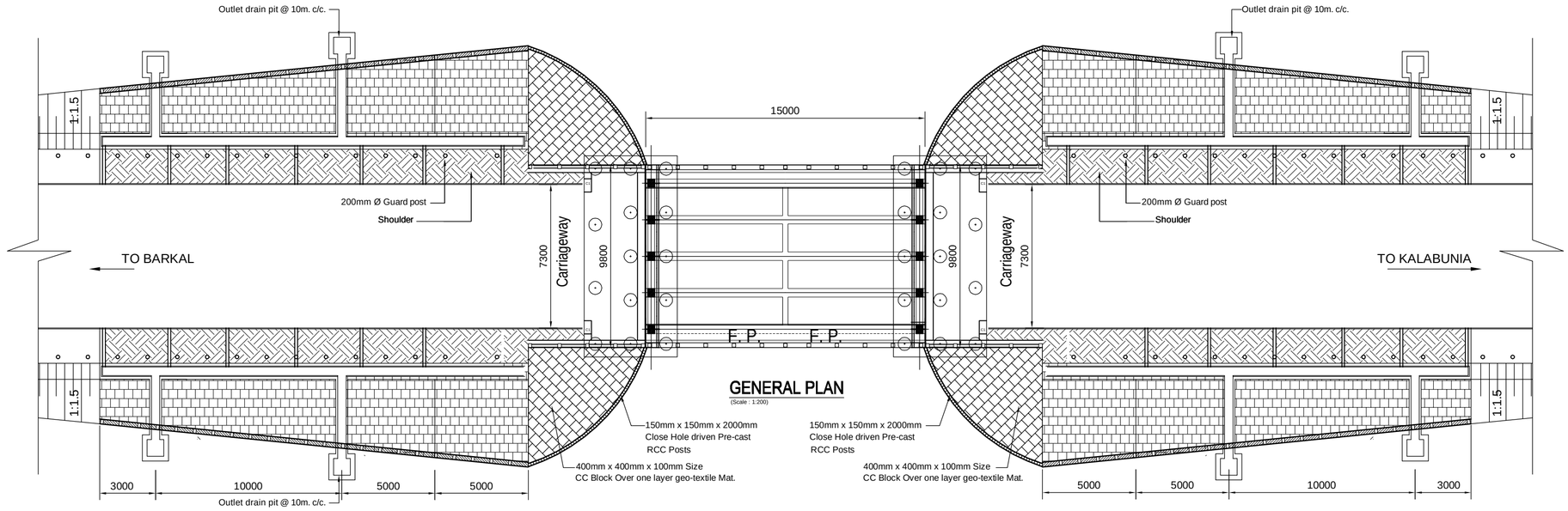
Existing Level in m.	32.14	32.01	31.73	31.68	30.96	31.01	31.86	32.64	33.12
Distance in m.	(-) 15.00	(-) 10.00	(-) 5.00	0.00	5.00	10.00	15.00	20.00	24.00

GENERAL ELEVATION

(Scale : 1:200)

REFF. DWG. :

1. For abutment details : Abutment Type-III to be read.
2. For abutment pile : Abut. pile Type-II to be read.



GENERAL PLAN

(Scale : 1:200)

NAME OF THE CLIENT :

GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH

LOCAL GOVERNMENT ENGINEERING DEPARTMENT

NAME OF THE PROJECT :

CONSULTANCY SERVICES FOR FEASIBILITY, DETAILED SURVEY AND DESIGN OF CHITTAGONG HILL TRACT CONNECTIVITY CONNECTING THEGAMUKH AND CHITTAGONG PORT.

NAME OF THE CONSULTANTS :

SAI Consulting Engineers Pvt. Ltd, India.

in association with

BETS Consulting Services Ltd, Bangladesh

Project office :

Tahmid Mahmood Palace
Flat # 9A, House # 77, Road # 4, Block-C,

DRAWING TITLE :

PLAN & SECTIONAL ELEVATION OF 15.0m LONG RCC GIRDER BRIDGE AT CH. 87+379 (BR-25)

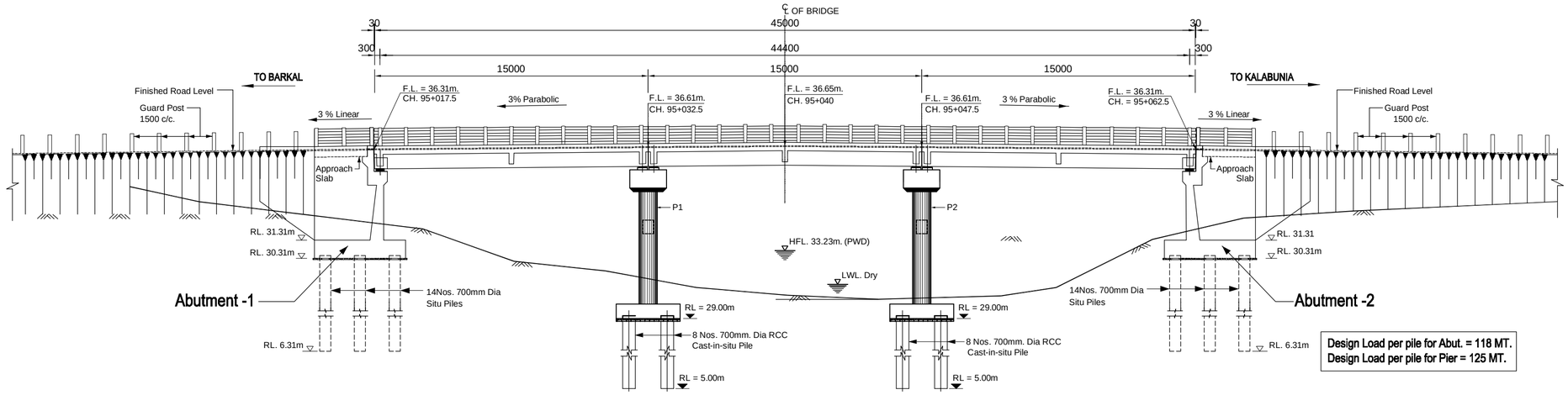
DRAWING NO : LGED/RCG/PLE-25

Scale :As shown

Date : 28-01-16

DESIGNED BY :	DRAWN BY :	CHECKED BY :	APPROVED BY :
MD. TAZUDDIN	MD. TAZUDDIN	AFM HAMIDUL HAQUE	DR. PRABHAT SHRIVASTAVA

REV.	DESCRIPTION	DATE



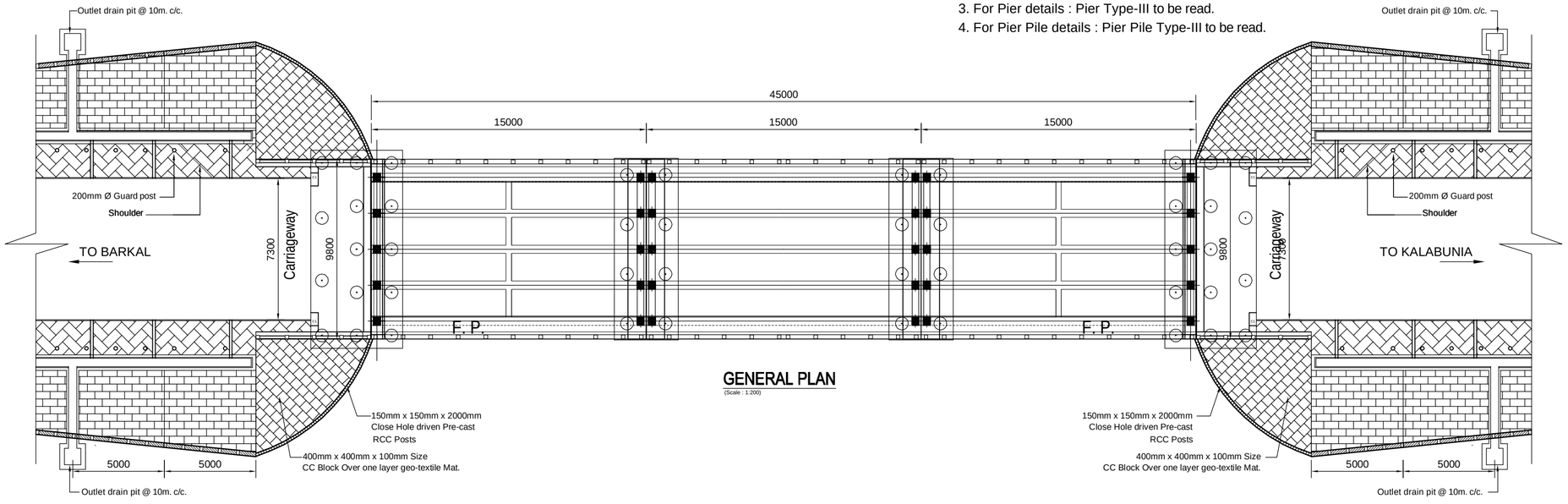
Existing Level in m.	34.45	33.15	32.56	32.11	31.06	30.92	30.80	30.65	30.77	30.71	30.84	31.85	32.89	32.93
Distance in m.	(-) 15.00	(-) 10.00	(-) 5.00	0.00	5.00	10.00	15.00	20.00	25.00	30.00	35.00	40.00	45.00	50.00

GENERAL ELEVATION

(Scale : 1:200)

REFF. DWG. :

1. For Abutment details : Abutment Type-III to be read.
2. For Abutment pile : Abut. pile Type-II to be read.
3. For Pier details : Pier Type-III to be read.
4. For Pier Pile details : Pier Pile Type-III to be read.



GENERAL PLAN

(Scale : 1:200)

NAME OF THE CLIENT :

GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH

LOCAL GOVERNMENT ENGINEERING DEPARTMENT

NAME OF THE PROJECT :

CONSULTANCY SERVICES FOR FEASIBILITY, DETAILED SURVEY AND DESIGN OF CHITTAGONG HILL TRACT CONNECTIVITY CONNECTING THEGAMUKH AND CHITTAGONG PORT.

NAME OF THE CONSULTANTS :

SAI Consulting Engineers Pvt. Ltd, India.

in association with

BETS Consulting Services Ltd, Bangladesh

Project office :

Tahmid Mahmood Palace
Flat # 9A, House # 77, Road # 4, Block-C,

DRAWING TITLE :

PLAN & SECTIONAL ELEVATION OF 45.0m RCC GIRDER BRIDGE AT CH. 90+825 OVER KALABUNIA KHAL

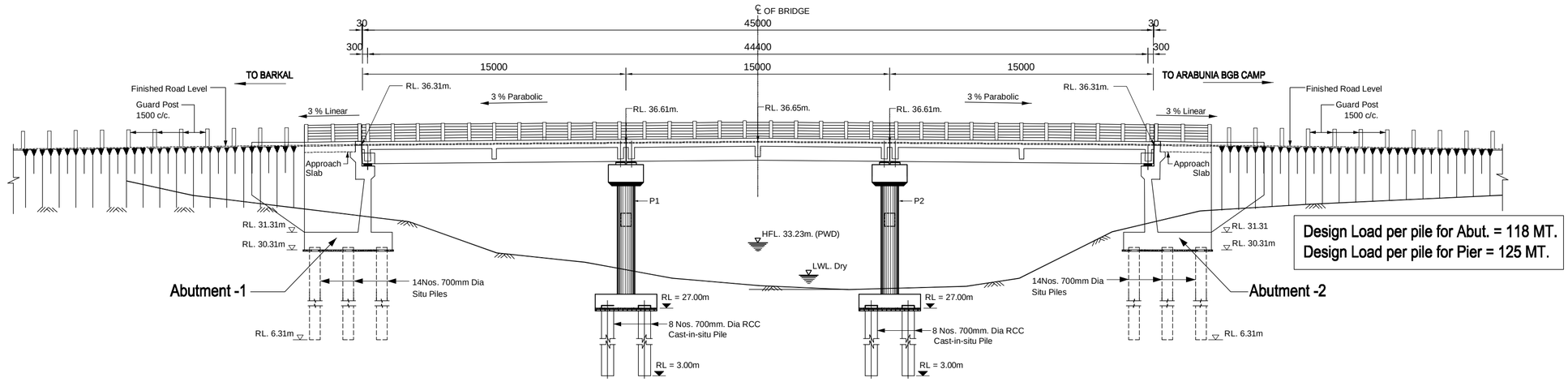
DRAWING NO : LGED/RCG/PLE-26

Scale :As shown

Date : 28-01-16

DESIGNED BY :	DRAWN BY :	CHECKED BY :	APPROVED BY :
MD. TAZUDDIN	MD. TAZUDDIN	AFM HAMIDUL HAQUE	DR. PRABHAT SHRIVASTAVA

REV.	DESCRIPTION	DATE



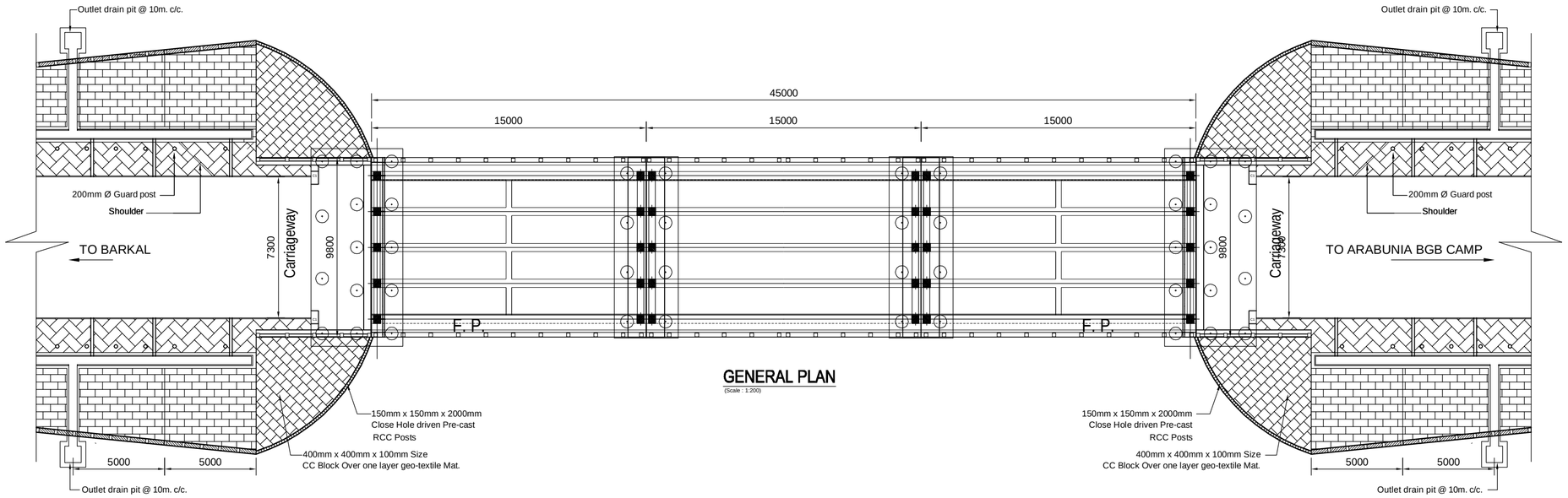
Existing Level in m.	31.97	31.86	31.64	31.64	30.78	30.12	28.97	28.71	28.76	28.11	28.68	31.74	31.84	31.96
Distance in m.	(-) 15.00	(-) 10.00	(-) 5.00	0.00	5.00	10.00	15.00	20.00	25.00	30.00	35.00	40.00	45.00	50.00

GENERAL ELEVATION

(Scale : 1:200)

REFF. DWG. :

1. For Abutment details : Abutment Type-III to be read.
2. For Abutment pile : Abut. pile Type-II to be read.
3. For Pier details : Pier Type-III to be read.
4. For Pier Pile details : Pier Pile Type-III to be read.

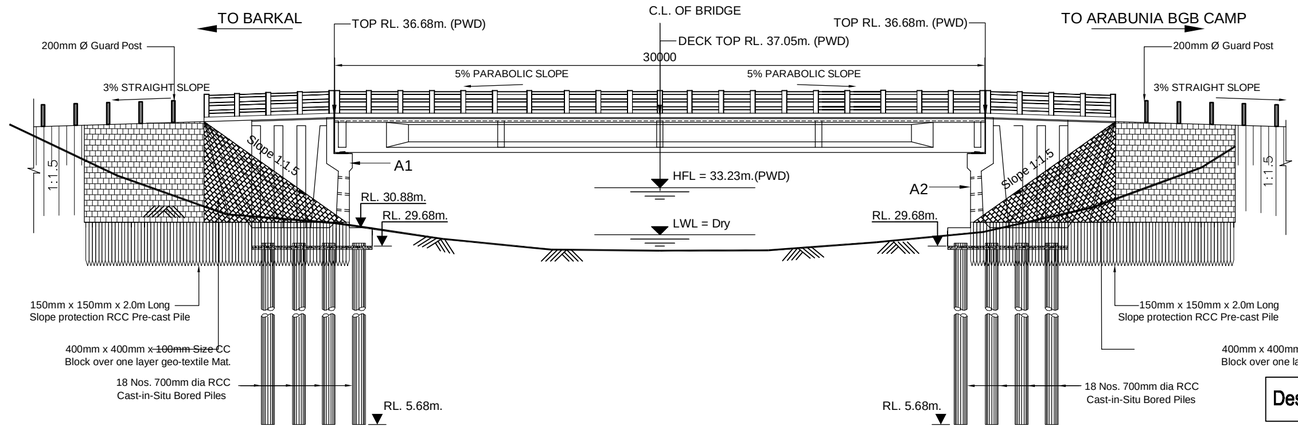


GENERAL PLAN

(Scale : 1:200)

NAME OF THE CLIENT : GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH **LOCAL GOVERNMENT ENGINEERING DEPARTMENT** NAME OF THE PROJECT : CONSULTANCY SERVICES FOR FEASIBILITY, DETAILED SURVEY AND DESIGN OF CHITTAGONG HILL TRACT CONNECTIVITY CONNECTING THEGAMUKH AND CHITTAGONG PORT.	NAME OF THE CONSULTANTS : **SAI Consulting Engineers Pvt. Ltd, India.** in association with **BETS Consulting Services Ltd, Bangladesh** Project office : Tahmid Mahmood Palace Flat # 9A, House # 77, Road # 4, Block-C,	DRAWING TITLE : PLAN & SECTIONAL ELEVATION OF 45.0m RCC GIRDER BRIDGE AT CH. 91+327 OVER KALABUNIA KHAL DRAWING NO : LGED/RCG/PLE-27 Scale :As shown Date : 28-01-16	DESIGNED BY : MD. TAZUDDIN	DRAWN BY : MD. TAZUDDIN	CHECKED BY : AFM HAMIDUL HAQUE	APPROVED BY : DR. PRABHAT SHRIVASTAVA

REV.	DESCRIPTION	DATE



REFF. DWG. :

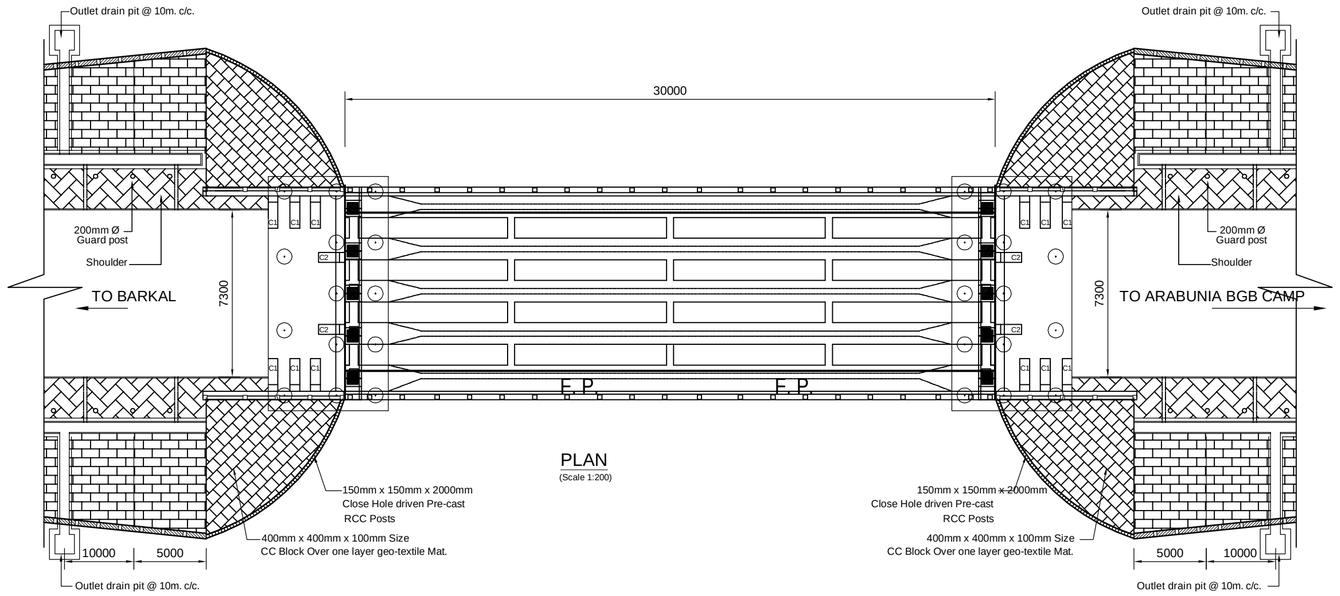
1. For Abutment details : Abutment Type-II to be read.
2. For Abutment Pile : Abut. Pile Type-II to be read.

Design Load per pile = 130 MT.

R.L. in m. (PWD)	31.89	30.31	30.28	30.12	29.87	29.50	29.30	29.48	29.87	30.18	30.56	31.68	31.98
Distance in m.	(-) 15.00	(-) 10.00	(-) 5.00	0.00	5.00	10.00	15.00	20.00	25.00	30.00	35.00	40.00	45.00

SECTIONAL ELEVATION

(Scale 1:200)



PLAN

(Scale 1:200)

NAME OF THE CLIENT :

GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH

LOCAL GOVERNMENT ENGINEERING DEPARTMENT

NAME OF THE PROJECT :

CONSULTANCY SERVICES FOR FEASIBILITY, DETAILED SURVEY AND DESIGN OF CHITTAGONG HILL TRACT CONNECTIVITY CONNECTING THEGAMUKH AND CHITTAGONG PORT.

NAME OF THE CONSULTANTS :

SAI Consulting Engineers Pvt. Ltd, India.

in association with

BETS Consulting Services Ltd, Bangladesh

Project office :

Tahmid Mahmood Palace
Flat # 9A, House # 77, Road # 4, Block-C,

DRAWING TITLE :

PLAN & SECTIONAL ELEVATION OF 30.0m PSC GIRDER BRIDGE AT CH. 91+770 (BR-28)

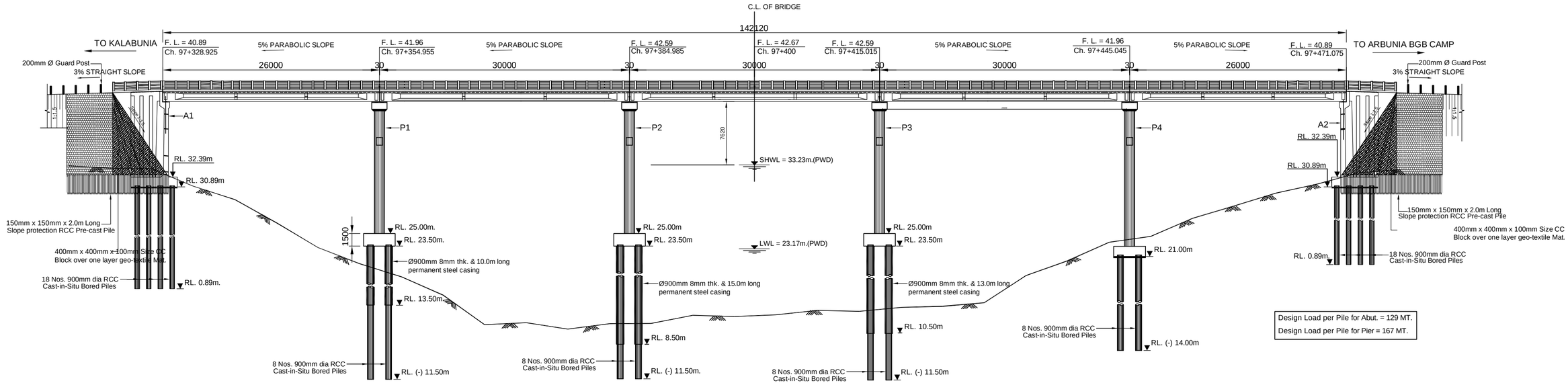
DRAWING NO : LGED/PCG/PLE-28

Scale :As shown

Date : 28-01-16

DESIGNED BY :	DRAWN BY :	CHECKED BY :	APPROVED BY :
MD. TAZUDDIN	MD. TAZUDDIN	AFM HAMIDUL HAQUE	DR. PRABHAT SHRIVASTAVA

REV.	DESCRIPTION	DATE

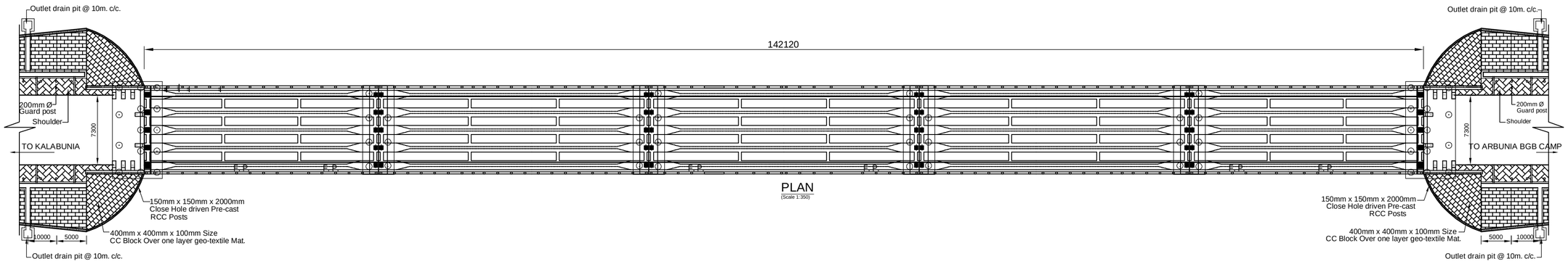


Exist. R.L. (m), PWD	33.25	32.98	32.61	29.51	27.89	25.12	22.15	20.21	18.65	16.45	14.5	13.12	12.35	13.40	13.04	14.01	13.87	14.08	14.60	14.50	14.98	15.10	15.54	18.78	20.57	22.78	23.51	25.65	27.15	28.69	29.78	32.32	32.68
Distance (m)	(-) 10.00	(-) 5.00	0.00	5.00	10.00	15.00	20.00	25.00	30.00	35.00	40.00	45.00	50.00	55.00	60.00	65.00	70.00	75.00	80.00	85.00	90.00	95.00	100.00	105.00	110.00	115.00	120.00	125.00	130.00	135.00	140.00	145.00	150.00

SECTIONAL ELEVATION
(Scale 1:350)

REFF. DWG. :

1. For abutment details : Abutment Type-I to be read.
2. For abutment pile : Abut. pile Type-I(a) to be read.
3. For pier details : Pier Type-I to be read.
4. For pier pile : Pier Pile Type-I to be read.

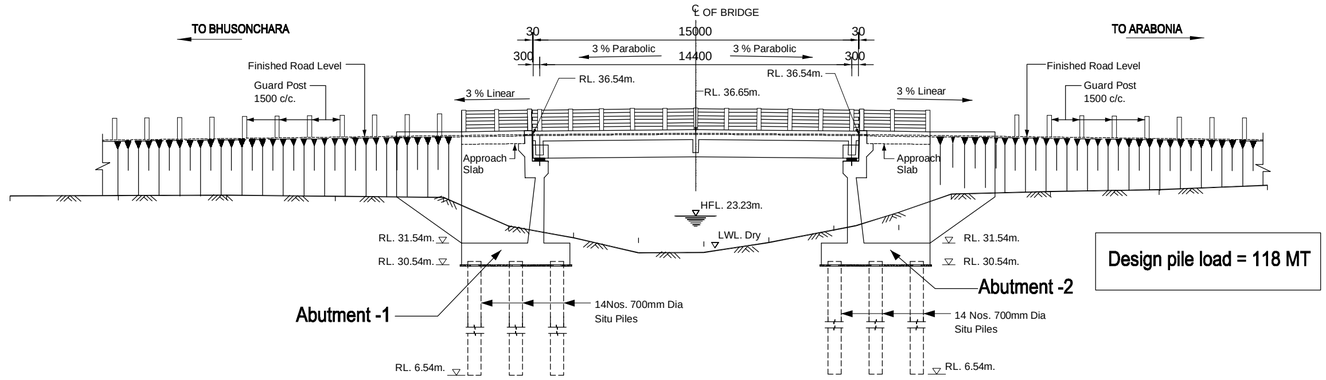


PLAN
(Scale 1:350)

NAME OF THE CLIENT : GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH **LOCAL GOVERNMENT ENGINEERING DEPARTMENT**	NAME OF THE CONSULTANTS : **SAI Consulting Engineers Pvt. Ltd, India.** in association with **BETS Consulting Services Ltd, Bangladesh** Project office : Tahmid Mahmood Palace Flat # 9A, House # 77, Road # 4, Block-C,	DRAWING TITLE : PLAN & SECTIONAL ELEVATION OF 142.12m LONG PSC GIRDER BRIDGE AT CH. 93+082 OVER KARNAFULI RIVER DRAWING NO : LGED/PCG/PLE-29 Scale :As shown Date : 28-01-16	DESIGNED BY : MD. TAZUDDIN	DRAWN BY : MD. TAZUDDIN	CHECKED BY : AFM HAMIDUL HAQUE	APPROVED BY : DR. PRABHAT SHRIVASTAVA

NAME OF THE PROJECT :
CONSULTANCY SERVICES FOR FEASIBILITY, DETAILED SURVEY AND DESIGN OF CHITTAGONG HILL TRACT CONNECTIVITY CONNECTING THEGAMUKH AND CHITTAGONG PORT.

REV.	DESCRIPTION	DATE



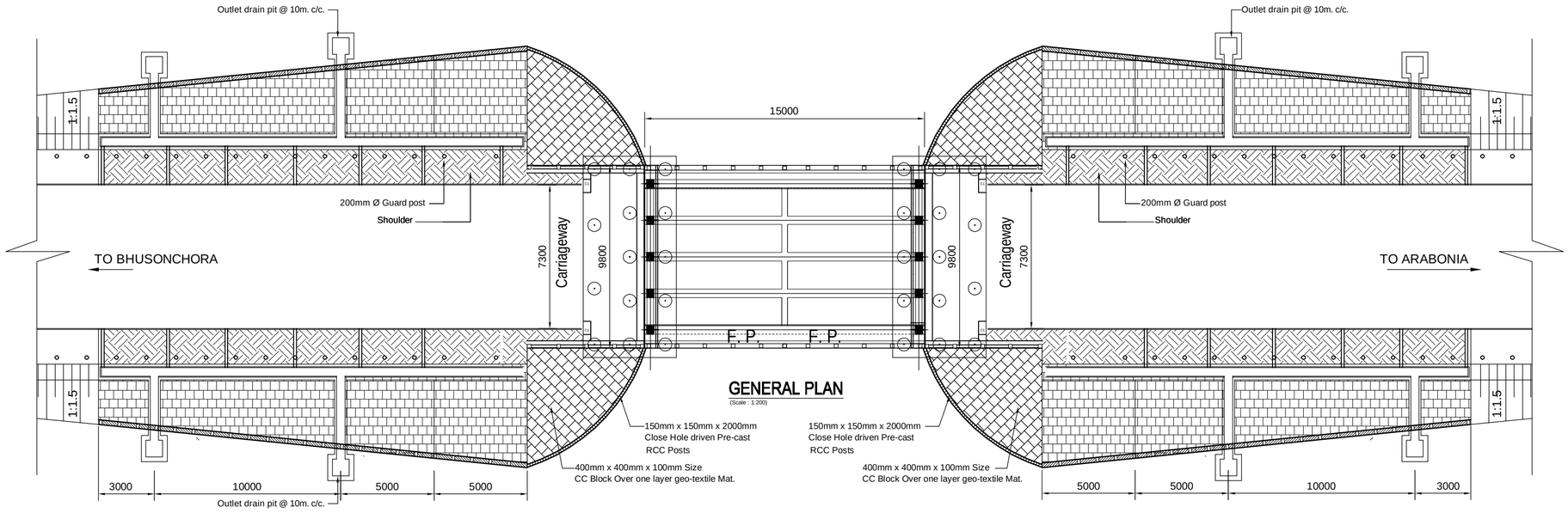
Existing Level in m.	34.19	34.26	34.12	33.42	33.30	33.39	34.21	34.27	34.15
Distance in m.	(-) 15.00	(-) 10.00	(-) 5.00	0.00	5.00	10.00	15.00	20.00	24.00

GENERAL ELEVATION

(Scale : 1:200)

REFF. DWG. :

1. For abutment details : Abutment Type-III to be read.
2. For abutment pile : Abut. pile Type-II to be read.



GENERAL PLAN

(Scale : 1:200)

NAME OF THE CLIENT :

GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH

LOCAL GOVERNMENT ENGINEERING DEPARTMENT

NAME OF THE PROJECT :

CONSULTANCY SERVICES FOR FEASIBILITY, DETAILED SURVEY AND DESIGN OF CHITTAGONG HILL TRACT CONNECTIVITY CONNECTING THEGAMUKH AND CHITTAGONG PORT.

NAME OF THE CONSULTANTS :

SAI Consulting Engineers Pvt. Ltd, India.

in association with

BETS Consulting Services Ltd, Bangladesh

Project office :

Tahmid Mahmood Palace
Flat # 9A, House # 77, Road # 4, Block-C,

DRAWING TITLE :

PLAN & SECTIONAL ELEVATION OF 15.0m LONG RCC GIRDER BRIDGE AT CH. 95+687 (BR-30)

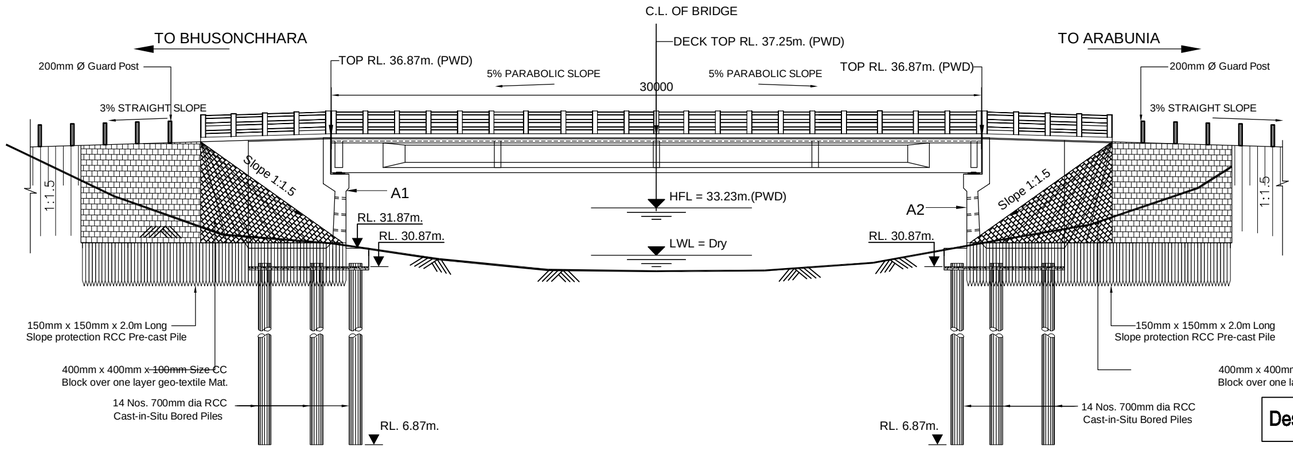
DRAWING NO : LGED/RCG/PLE-30

Scale :As shown

Date : 28-01-16

DESIGNED BY :	DRAWN BY :	CHECKED BY :	APPROVED BY :
MD. TAZUDDIN	MD. TAZUDDIN	AFM HAMIDUL HAQUE	DR. PRABHAT SHRIVASTAVA

REV.	DESCRIPTION	DATE



REFF. DWG. :

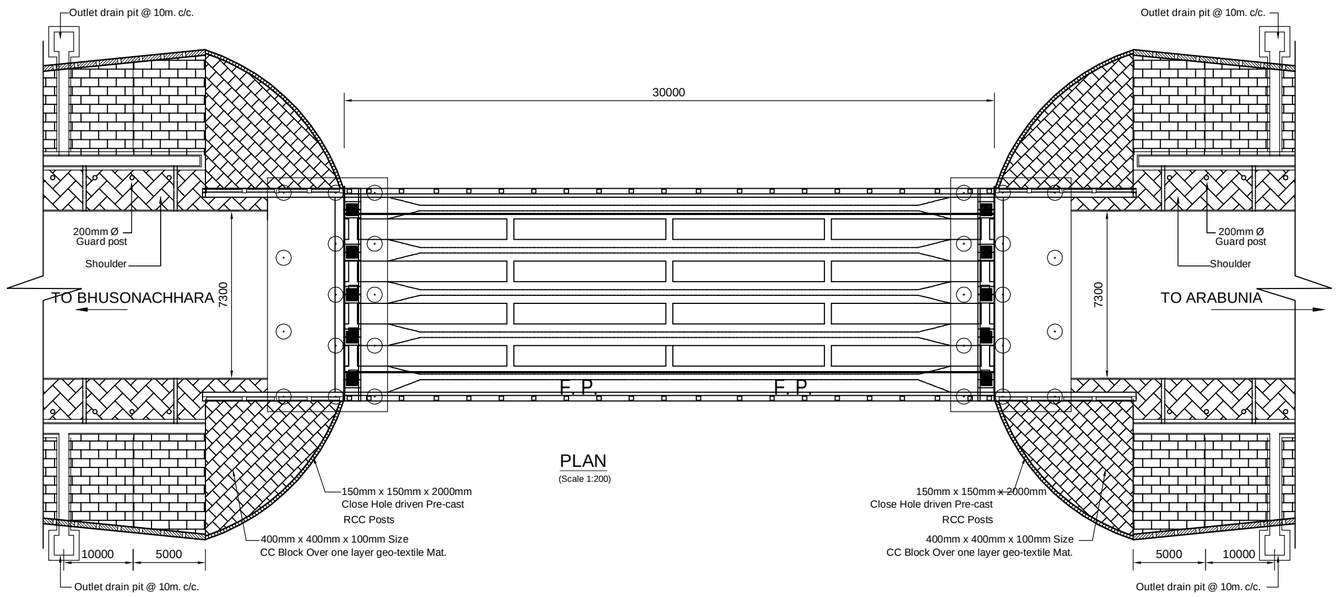
1. For Abutment details : Abutment Type-III to be read.
2. For Abutment Pile : Abut. Pile Type-II to be read.

Design Load per pile = 130 MT.

R.L. in m. (PWD)	32.61	32.45	32.02	31.91	31.82	31.62	31.64	31.71	31.87	31.98	32.05	33.15	32.57
Distance in m.	(-) 15.00	(-) 10.00	(-) 5.00	0.00	5.00	10.00	15.00	20.00	25.00	30.00	35.00	40.00	45.00

SECTIONAL ELEVATION

(Scale 1:200)



PLAN

(Scale 1:200)

NAME OF THE CLIENT :

GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH

LOCAL GOVERNMENT ENGINEERING DEPARTMENT

NAME OF THE PROJECT :

CONSULTANCY SERVICES FOR FEASIBILITY, DETAILED SURVEY AND DESIGN OF CHITTAGONG HILL TRACT CONNECTIVITY CONNECTING THEGAMUKH AND CHITTAGONG PORT.

NAME OF THE CONSULTANTS :

SAI Consulting Engineers Pvt. Ltd, India.

in association with

BETS Consulting Services Ltd, Bangladesh

Project office :

Tahmid Mahmood Palace
Flat # 9A, House # 77, Road # 4, Block-C,

DRAWING TITLE :

PLAN & SECTIONAL ELEVATION OF 30.0m PSC GIRDER BRIDGE AT CH. 97+200 (BR-31)

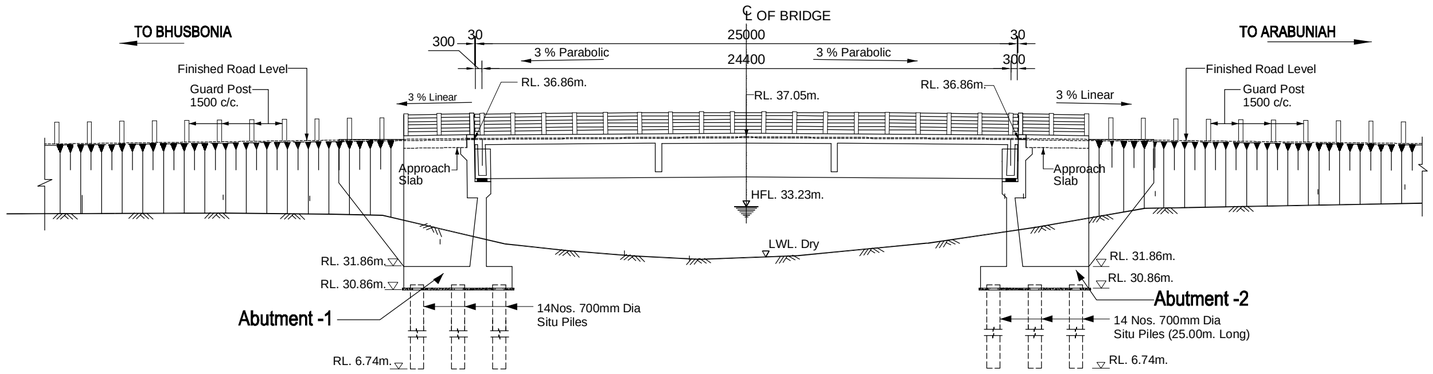
DRAWING NO : LGED/PCG/PLE-31

Scale :As shown

Date : 28-01-16

DESIGNED BY :	DRAWN BY :	CHECKED BY :	APPROVED BY :
MD. TAZUDDIN	MD. TAZUDDIN	AFM HAMIDUL HAQUE	DR. PRABHAT SHRIVASTAVA

REV.	DESCRIPTION	DATE



Existing Level in m.	35.21	35.01	34.94	34.73	34.65	34.75	34.84	34.89	35.01	31.64
Distance in m.	(-) 10.00	(-) 5.00	0.00	5.00	10.00	15.00	20.00	25.00	30.00	35.00

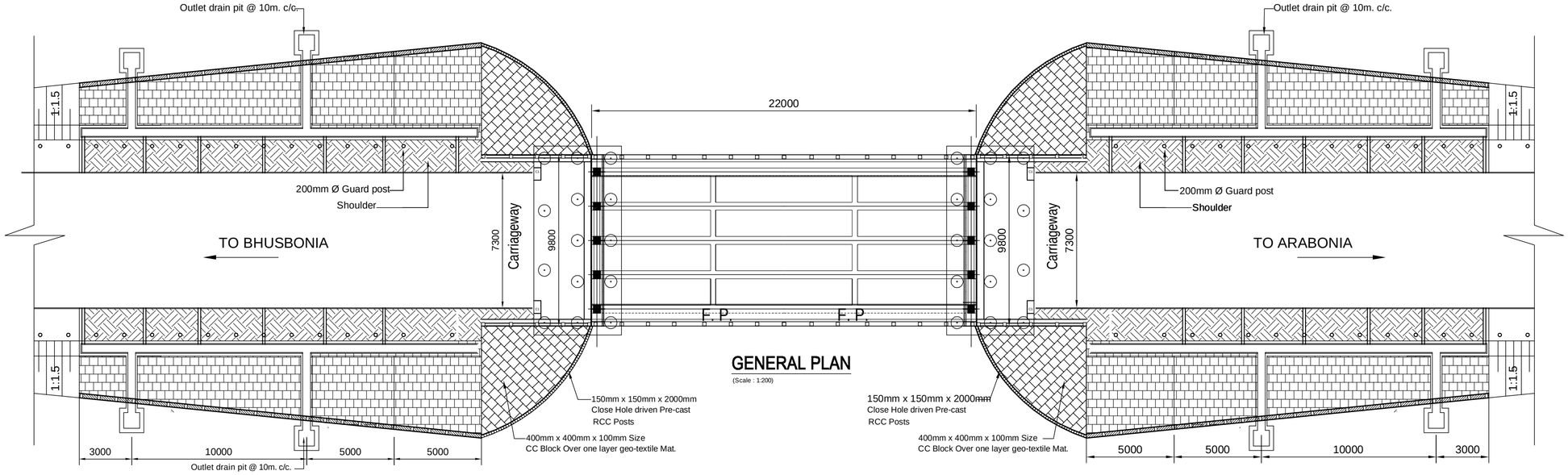
GENERAL ELEVATION

(Scale : 1:200)

Desugn Load per pile = 125 MT.

REFF. DWG. :

1. For abutment details : Abutment Type-III to be read.
2. For abutment pile : Abut. pile Type-II to be read.



GENERAL PLAN

(Scale : 1:200)

NAME OF THE CLIENT :
GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH
LOCAL GOVERNMENT ENGINEERING DEPARTMENT

NAME OF THE PROJECT :
CONSULTANCY SERVICES FOR FEASIBILITY, DETAILED SURVEY AND DESIGN OF CHITTAGONG HILL TRACT CONNECTIVITY CONNECTING THEGAMUKH AND CHITTAGONG PORT.

NAME OF THE CONSULTANTS :
SAI Consulting Engineers Pvt. Ltd, India.
in association with
BETS Consulting Services Ltd, Bangladesh
Project office :
Tahmid Mahmood Palace
Flat # 9A, House # 77, Road # 4, Block-C,

DRAWING TITLE :
PLAN & SECTIONAL ELEVATION OF 25.0m LONG RCC GIRDER BRIDGE AT CH. 98+802 (BR-32)

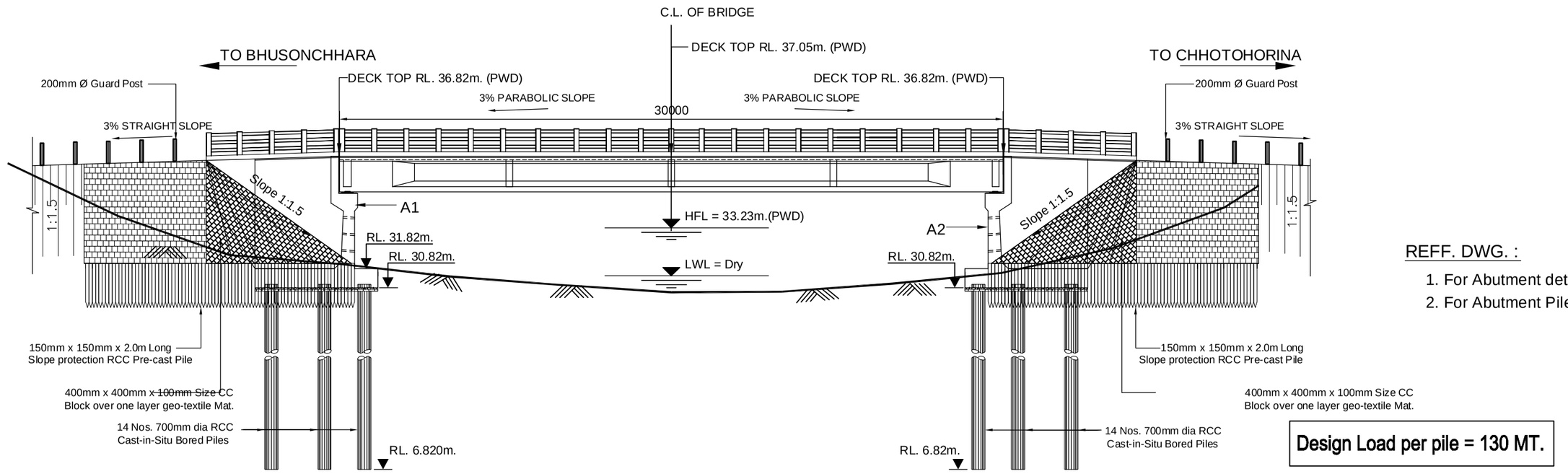
DRAWING NO : LGED/RCG/PLE-32

Scale :As shown

Date : 28-01-16

DESIGNED BY :	DRAWN BY :	CHECKED BY :	APPROVED BY :
MD. TAZUDDIN	MD. TAZUDDIN	AFM HAMIDUL HAQUE	DR. PRABHAT SHRIVASTAVA

REV.	DESCRIPTION	DATE



REFF. DWG. :

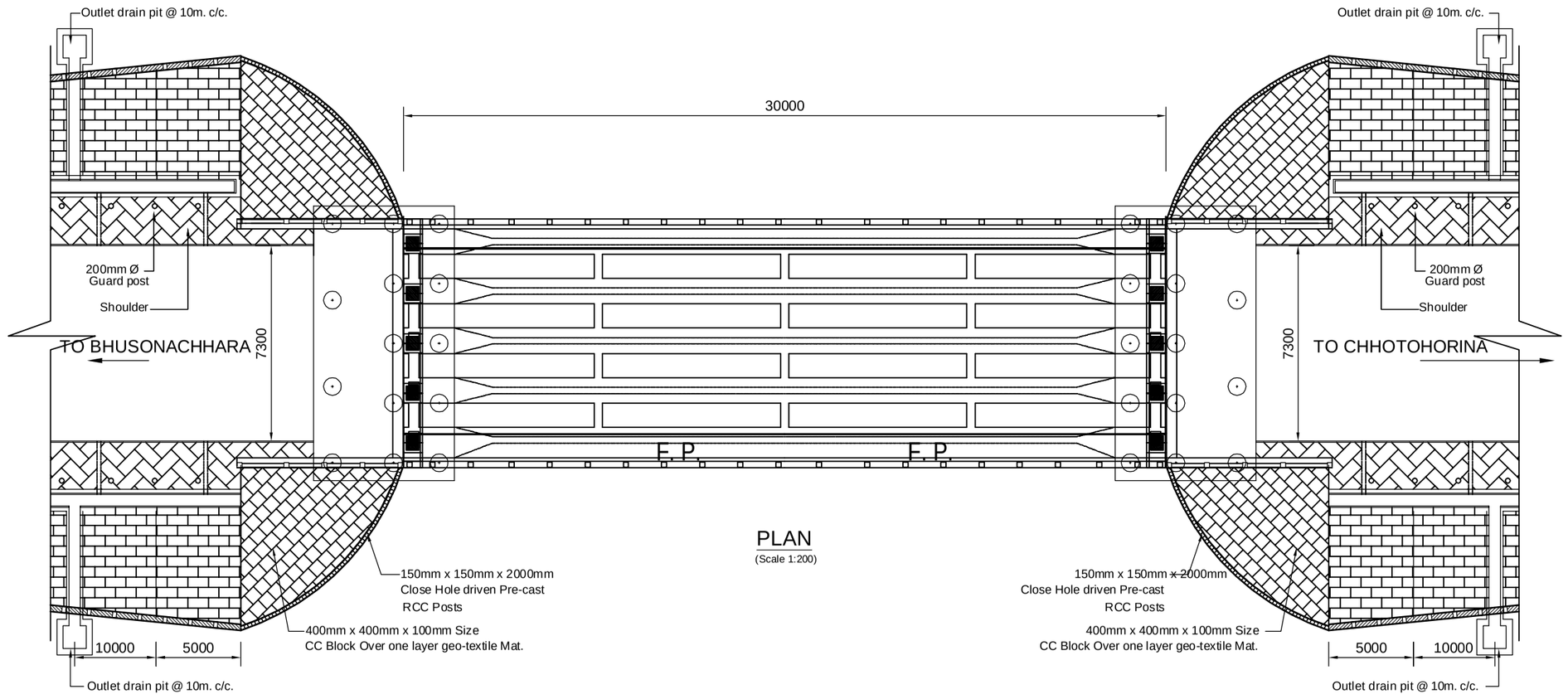
1. For Abutment details : Abutment Type-III to be read.
2. For Abutment Pile : Abut. Pile Type-II to be read.

Design Load per pile = 130 MT.

R.L. in m. (PWD)	34.87	34.59	32.65	32.15	31.95	31.86	31.74	31.75	31.85	31.93	33.45	35.61	36.12
Distance in m.	(-) 15.00	(-) 10.00	(-) 5.00	0.00	5.00	10.00	15.00	20.00	25.00	30.00	35.00	40.00	45.00

SECTIONAL ELEVATION

(Scale 1:200)



PLAN

(Scale 1:200)

NAME OF THE CLIENT :

GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH

LOCAL GOVERNMENT ENGINEERING DEPARTMENT

NAME OF THE PROJECT :

CONSULTANCY SERVICES FOR FEASIBILITY, DETAILED SURVEY AND DESIGN OF CHITTAGONG HILL TRACT CONNECTIVITY CONNECTING THEGAMUKH AND CHITTAGONG PORT.

NAME OF THE CONSULTANTS :

SAI Consulting Engineers Pvt. Ltd, India.

in association with

BETS Consulting Services Ltd, Bangladesh

Project office :

Tahmid Mahmood Palace
Flat # 9A, House # 77, Road # 4, Block-C,

DRAWING TITLE :

PLAN & SECTIONAL ELEVATION OF 30.0m PSC GIRDER BRIDGE AT CH. 99+175 (BR-33)

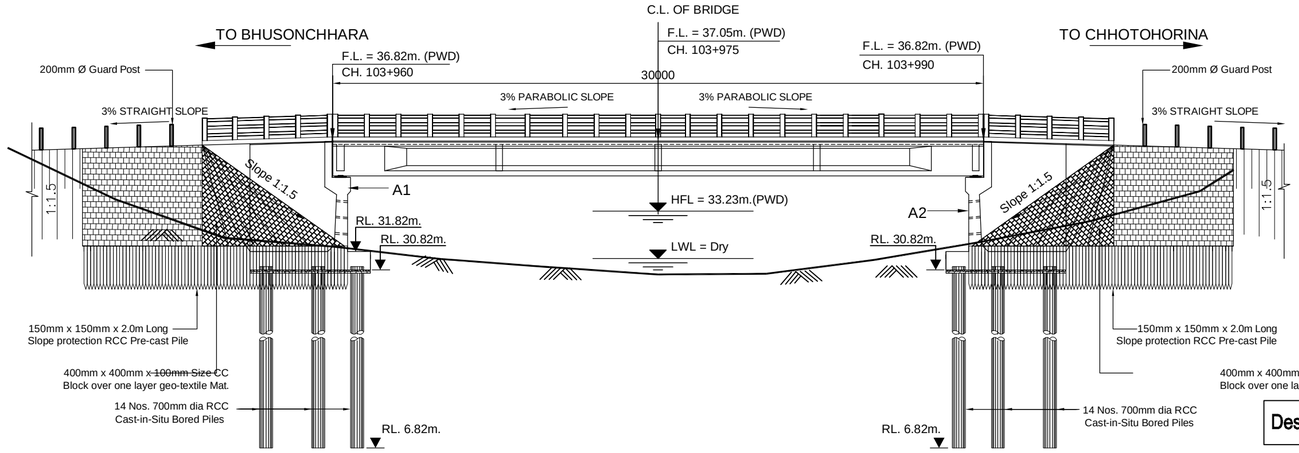
DRAWING NO : LGED/PCG/PLE-33

Scale :As shown

Date : 28-01-16

DESIGNED BY :	DRAWN BY :	CHECKED BY :	APPROVED BY :
MD. TAZUDDIN	MD. TAZUDDIN	AFM HAMIDUL HAQUE	DR. PRABHAT SHRIVASTAVA

REV.	DESCRIPTION	DATE



REFF. DWG. :

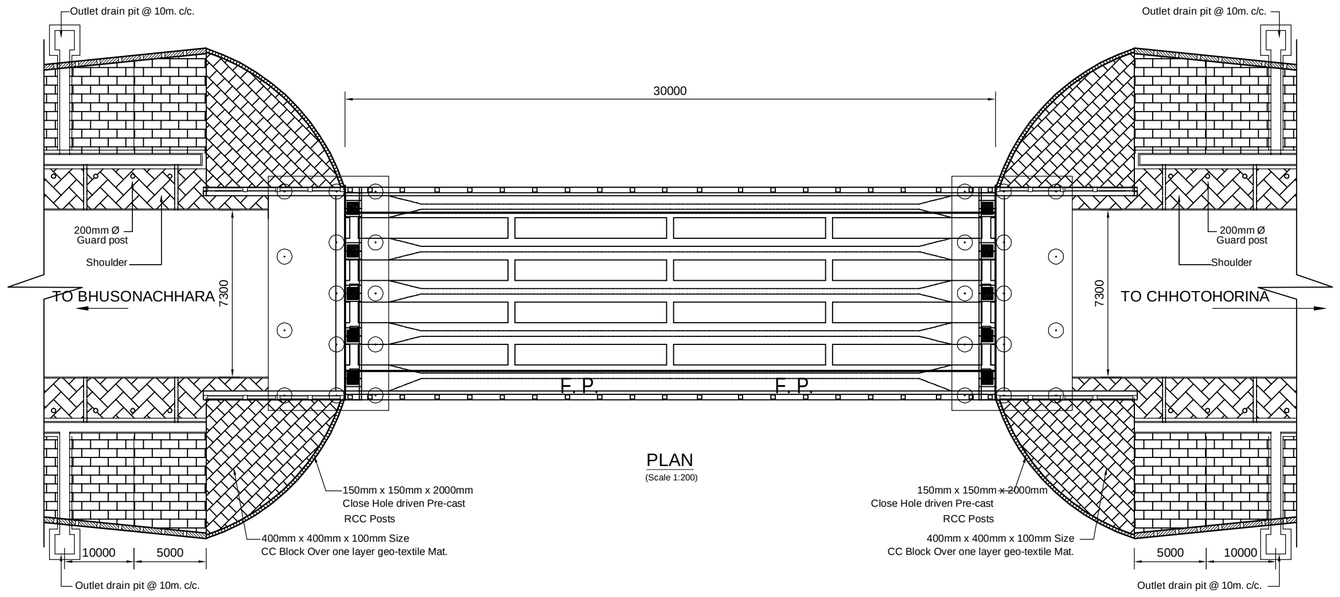
1. For Abutment details : Abutment Type-III to be read.
2. For Abutment Pile : Abut. Pile Type-II to be read.

Design Load per pile = 130 MT.

R.L. in m. (PWD)	33.86	33.47	33.31	33.27	32.98	32.78	32.34	32.37	32.69	33.37	3.53	34.61	35.98
Distance in m.	(-) 15.00	(-) 10.00	(-) 5.00	0.00	5.00	10.00	15.00	20.00	25.00	30.00	35.00	40.00	45.00

SECTIONAL ELEVATION

(Scale 1:200)



PLAN

(Scale 1:200)

NAME OF THE CLIENT :

GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH

LOCAL GOVERNMENT ENGINEERING DEPARTMENT

NAME OF THE PROJECT :

CONSULTANCY SERVICES FOR FEASIBILITY, DETAILED SURVEY AND DESIGN OF CHITTAGONG HILL TRACT CONNECTIVITY CONNECTING THEGAMUKH AND CHITTAGONG PORT.

NAME OF THE CONSULTANTS :

SAI Consulting Engineers Pvt. Ltd, India.

in association with

BETS Consulting Services Ltd, Bangladesh

Project office :

Tahmid Mahmood Palace
Flat # 9A, House # 77, Road # 4, Block-C,

DRAWING TITLE :

PLAN & SECTIONAL ELEVATION OF 30.0m PSC GIRDER BRIDGE AT CH. 99+425 (BR-34)

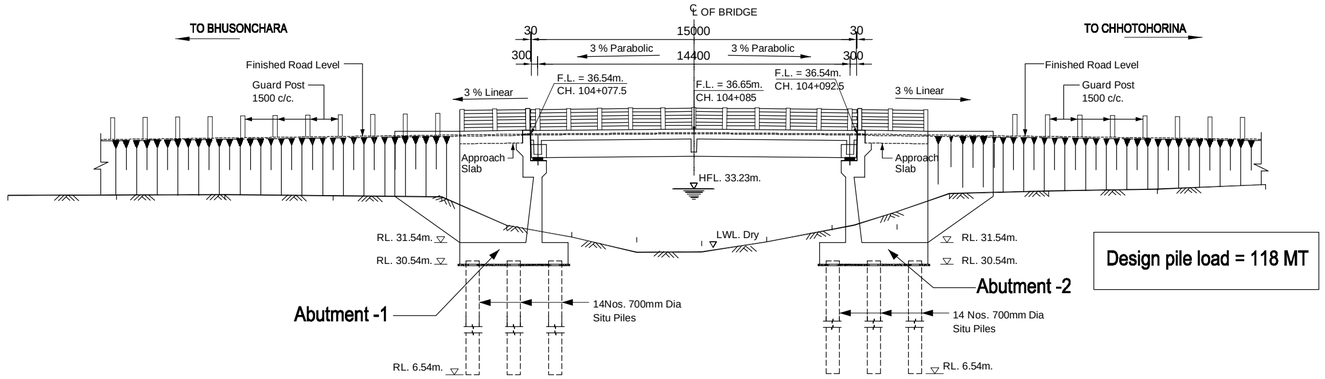
DRAWING NO : LGED/PCG/PLE-34

Scale :As shown

Date : 28-01-16

DESIGNED BY :	DRAWN BY :	CHECKED BY :	APPROVED BY :
MD. TAZUDDIN	MD. TAZUDDIN	AFM HAMIDUL HAQUE	DR. PRABHAT SHRIVASTAVA

REV.	DESCRIPTION	DATE



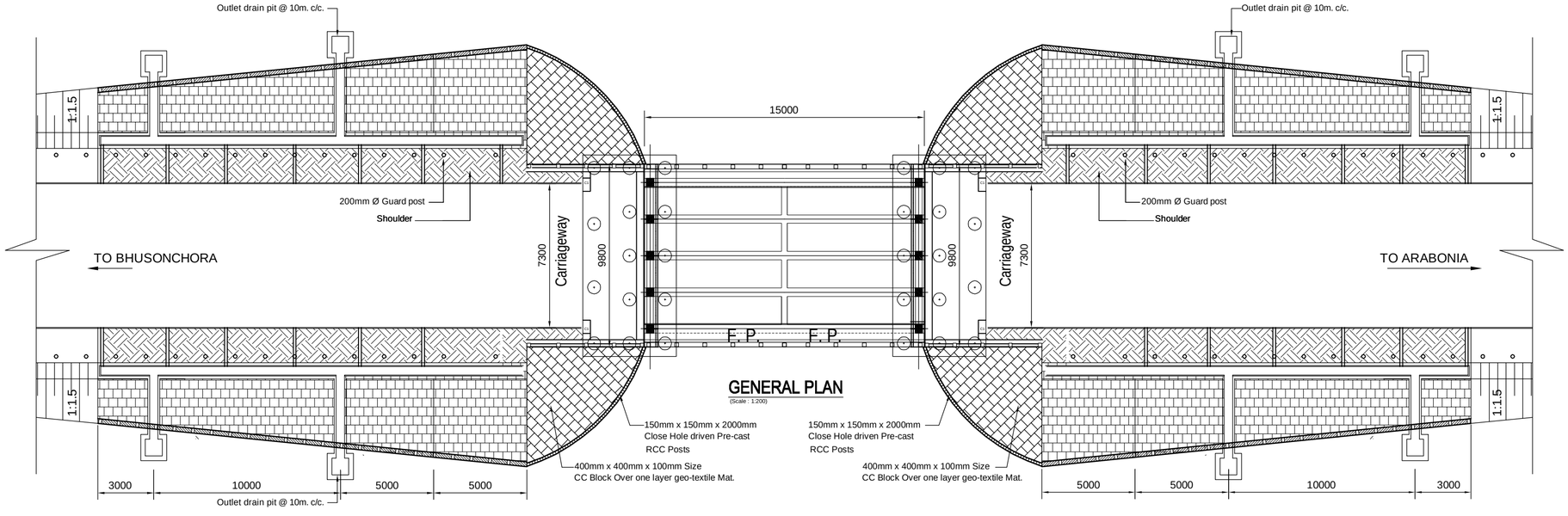
Existing Level in m.	32.81	32.79	32.59	31.65	30.45	30.65	31.78	32.84	32.94
Distance in m.	(-) 15.00	(-) 10.00	(-) 5.00	0.00	5.00	10.00	15.00	20.00	24.00

GENERAL ELEVATION

(Scale : 1:200)

REFF. DWG. :

1. For abutment details : Abutment Type-III to be read.
2. For abutment pile : Abut. pile Type-II to be read.



GENERAL PLAN

(Scale : 1:200)

NAME OF THE CLIENT :

GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH

LOCAL GOVERNMENT ENGINEERING DEPARTMENT

NAME OF THE PROJECT :

CONSULTANCY SERVICES FOR FEASIBILITY, DETAILED SURVEY AND DESIGN OF CHITTAGONG HILL TRACT CONNECTIVITY CONNECTING THEGAMUKH AND CHITTAGONG PORT.

NAME OF THE CONSULTANTS :

SAI Consulting Engineers Pvt. Ltd, India.

in association with

BETS Consulting Services Ltd, Bangladesh

Project office :

Tahmid Mahmood Palace
Flat # 9A, House # 77, Road # 4, Block-C,

DRAWING TITLE :

PLAN & SECTIONAL ELEVATION OF 15.0m LONG RCC GIRDER BRIDGE AT CH. 99+527 (BR-35)

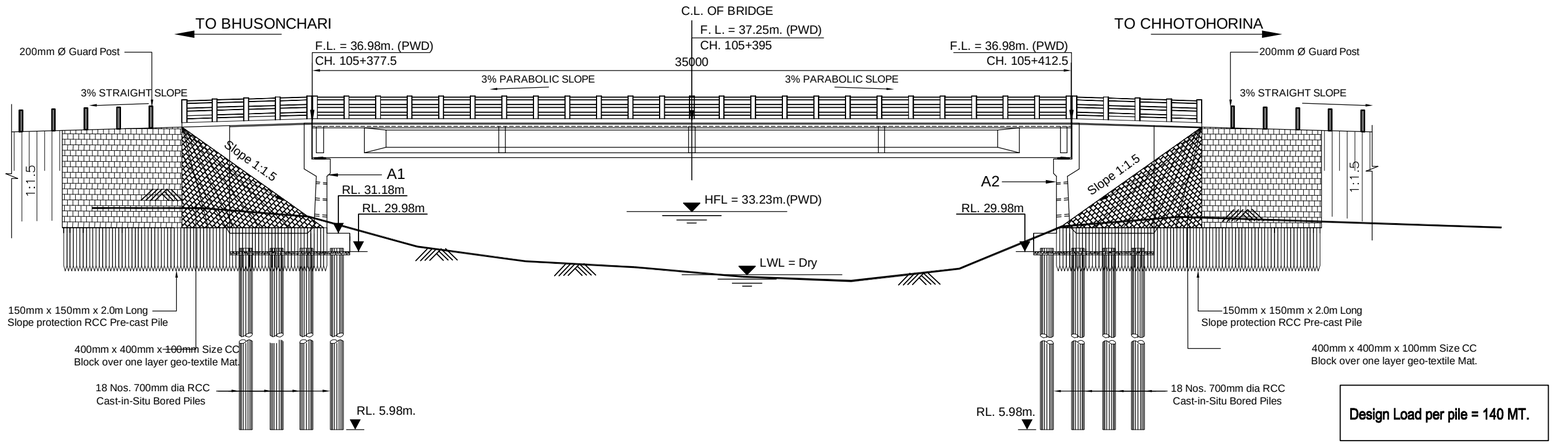
DRAWING NO : LGED/RCG/PLE-35

Scale :As shown

Date : 28-01-16

DESIGNED BY :	DRAWN BY :	CHECKED BY :	APPROVED BY :
MD. TAZUDDIN	MD. TAZUDDIN	AFM HAMIDUL HAQUE	DR. PRABHAT SHRIVASTAVA

REV.	DESCRIPTION	DATE

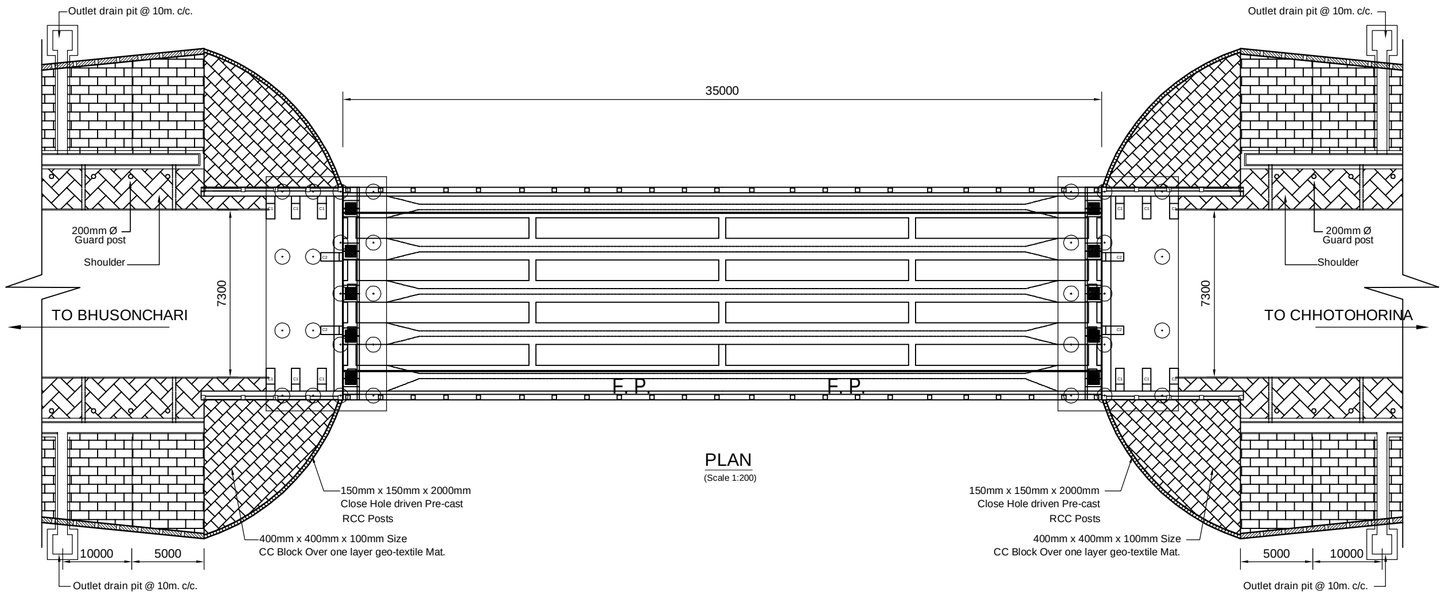


R.L. in m. (PWD)	31.59	31.38	31.25	31.12	29.89	29.73	29.53	29.43	30.34	31.20	31.35	31.44
Distance in m.	(-) 10.00	(-) 5.00	0.00	5.00	10.00	15.00	20.00	25.00	30.00	35.00	40.00	45.00

SECTIONAL ELEVATION
(Scale 1:200)

REFF. DWG. :

1. For abutment details : Abutment Type-II to be read.
2. For abutment pile : Abut. pile Type-I(b) to be read.



PLAN
(Scale 1:200)

NAME OF THE CLIENT :

GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH

LOCAL GOVERNMENT ENGINEERING DEPARTMENT

NAME OF THE PROJECT :

CONSULTANCY SERVICES FOR FEASIBILITY, DETAILED SURVEY AND DESIGN OF CHITTAGONG HILL TRACT CONNECTIVITY CONNECTING THEGAMUKH AND CHITTAGONG PORT.

NAME OF THE CONSULTANTS :

SAI Consulting Engineers Pvt. Ltd, India.

in association with

BETS Consulting Services Ltd, Bangladesh

Project office :

Tahmid Mahmood Palace
Flat # 9A, House # 77, Road # 4, Block-C,

DRAWING TITLE :

PLAN & SECTIONAL ELEVATION OF 35.0m PSC GIRDER BRIDGE AT CH. 100+837 (BR-36)

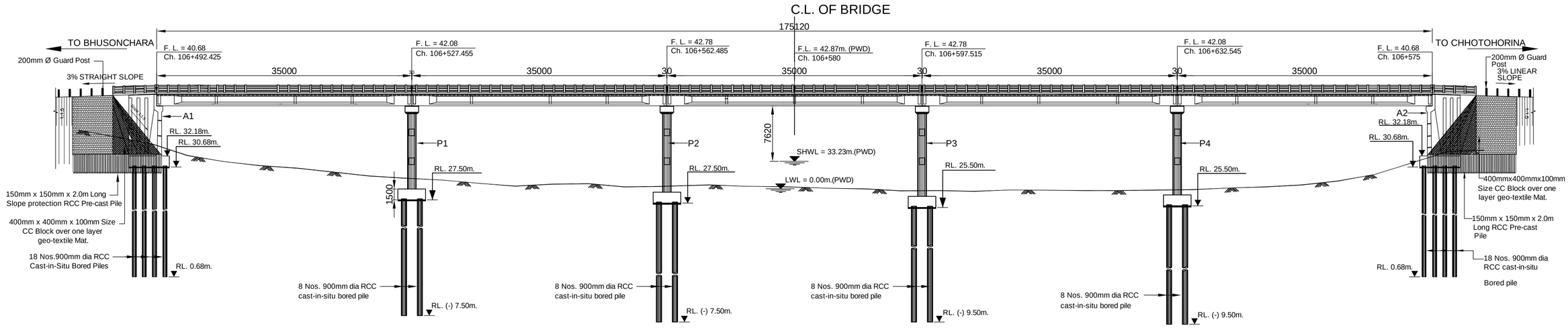
DRAWING NO : LGED/PCG/PLE-36

Scale :As shown

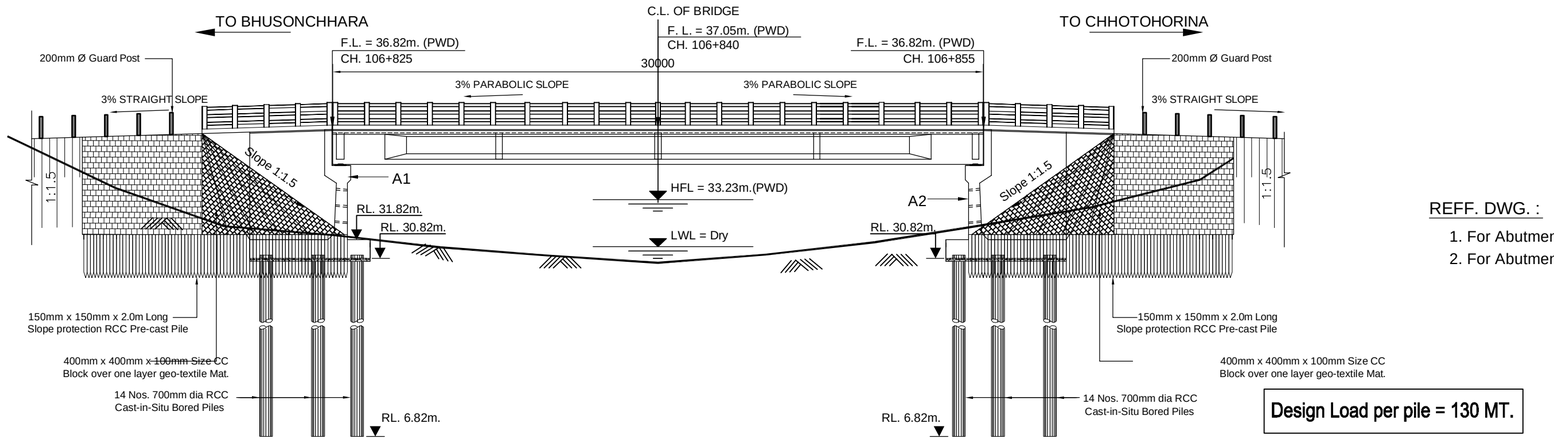
Date : 28-01-16

DESIGNED BY :	DRAWN BY :	CHECKED BY :	APPROVED BY :
MD. TAZUDDIN	MD. TAZUDDIN	AFM HAMIDUL HAQUE	DR. PRABHAT SHRIVASTAVA

REV.	DESCRIPTION	DATE


C.L. OF BRIDGE
175120
TO BHUSONCHARA
TO CHHOTOHORINA
F. L. = 40.68
Ch. 106+492.425
F. L. = 42.08
Ch. 106+527.455
F. L. = 42.78
Ch. 106+562.485
F.L. = 42.87m. (PWD)
Ch. 106+580
F. L. = 42.78
Ch. 106+597.515
F. L. = 42.08
Ch. 106+632.545
F. L. = 40.68
Ch. 106+575
35000
30
200mm Ø Guard Post
3% STRAIGHT SLOPE
3% LINEAR SLOPE
A1
A2
P1
P2
P3
P4
RL. 32.18m.
RL. 30.68m.
RL. 27.50m.
RL. 25.50m.
7620
SHWL = 33.23m.(PWD)
LWL = 0.00m.(PWD)
1500
150mm x 150mm x 2.0m Long Slope protection RCC Pre-cast Pile
400mm x 400mm x 100mm Size CC Block over one layer geo-textile Mat.
18 Nos.900mm dia RCC Cast-in-Situ Bored Piles
RL. 0.68m.
8 Nos. 900mm dia RCC cast-in-situ bored pile
RL. (-) 7.50m.
RL. (-) 9.50m.
400mmx400mmx100mm Size CC Block over one layer geo-textile Mat.
150mm x 150mm x 2.0m Long RCC Pre-cast Pile
18 Nos. 900mm dia RCC cast-in-situ Bored pile

| | | |



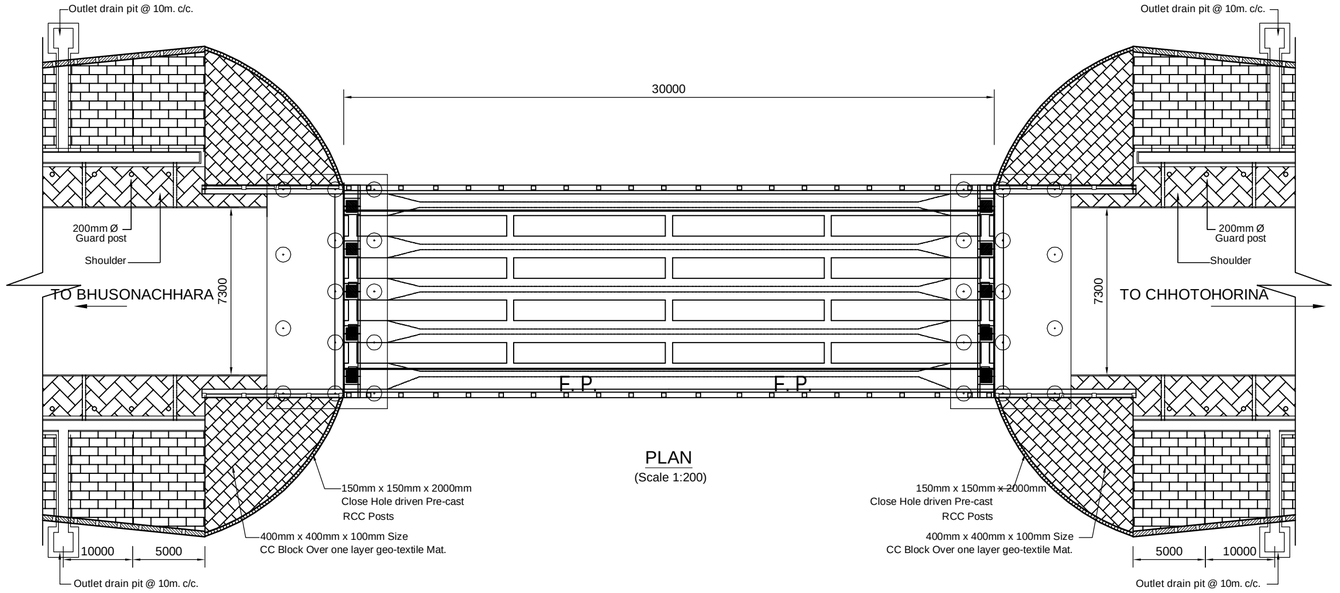
REFF. DWG. :

1. For Abutment details : Abutment Type-III to be read.
2. For Abutment Pile : Abut. Pile Type-II to be read.

Design Load per pile = 130 MT.

R.L. in m. (PWD)	34.17	33.98	32.73	32.52	32.34	32.17	31.78	32.63	32.79	32.87	32.94	33.10	33.31	33.81	34.81
Distance in m.	(-) 15.00	(-) 10.00	(-) 5.00	0.00	5.00	10.00	15.00	20.00	25.00	30.00	35.00	40.00	45.00	50.00	55.00

SECTIONAL ELEVATION
(Scale 1:200)



PLAN
(Scale 1:200)

NAME OF THE CLIENT :
GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH
LOCAL GOVERNMENT ENGINEERING DEPARTMENT

NAME OF THE PROJECT :
CONSULTANCY SERVICES FOR FEASIBILITY, DETAILED SURVEY AND DESIGN OF CHITTAGONG HILL TRACT CONNECTIVITY CONNECTING THEGAMUKH AND CHITTAGONG PORT.

NAME OF THE CONSULTANTS :
SAI Consulting Engineers Pvt. Ltd, India.
in association with
BETS Consulting Services Ltd, Bangladesh
Project office :
Tahmid Mahmood Palace
Flat # 9A, House # 77, Road # 4, Block-C,

DRAWING TITLE :
PLAN & SECTIONAL ELEVATION OF 30.0m PSC GIRDER BRIDGE AT CH. 102+265 (BR-38)

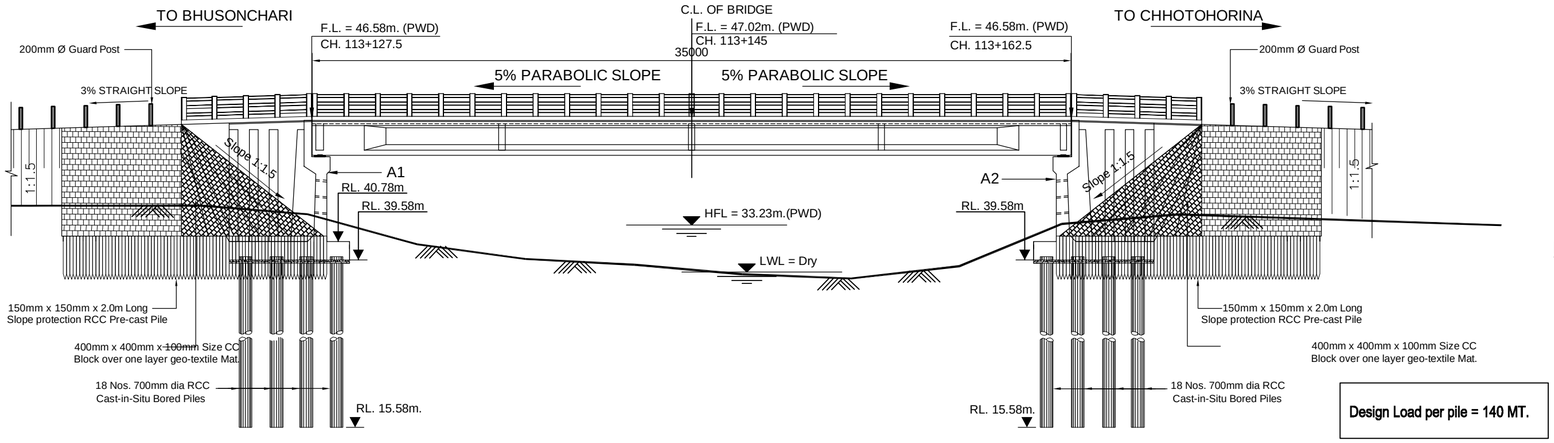
DRAWING NO : LGED/PCG/PLE-38

Scale :As shown

Date : 28-01-16

DESIGNED BY :	DRAWN BY :	CHECKED BY :	APPROVED BY :
MD. TAZUDDIN	MD. TAZUDDIN	AFM HAMIDUL HAQUE	DR. PRABHAT SHRIVASTAVA

REV.	DESCRIPTION	DATE

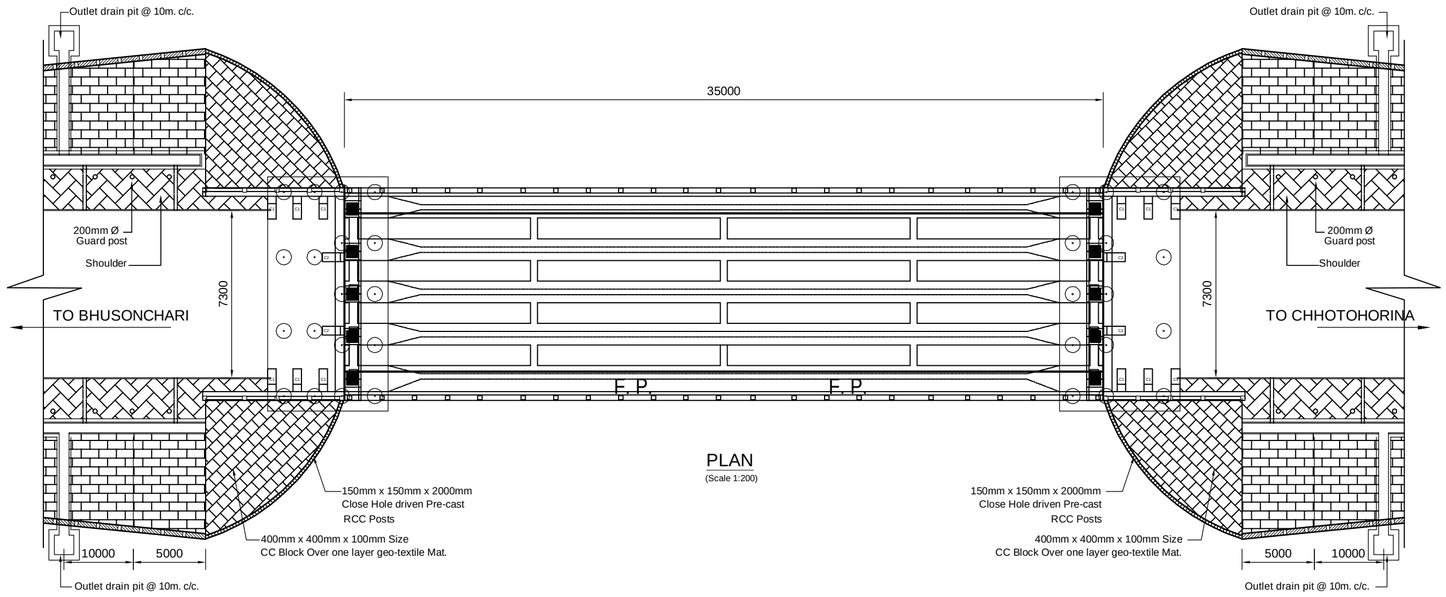


REFF. DWG. :

1. For abutment details : Abutment Type-II to be read.
2. For abutment pile : Abut. pile Type-II to be read.

R.L. in m. (PWD)	44.98	44.85	44.73	43.65	42.72	42.35	42.25	41.30	42.65	44.87	45.21	45.13	44.89	43.89	43.55
Distance in m.	(-) 10.00	(-) 5.00	0.00	5.00	10.00	15.00	20.00	25.00	30.00	35.00	40.00	45.00	50.00	55.00	60.00

SECTIONAL ELEVATION
(Scale 1:200)



PLAN
(Scale 1:200)

NAME OF THE CLIENT :
GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH
LOCAL GOVERNMENT ENGINEERING DEPARTMENT

NAME OF THE PROJECT :
CONSULTANCY SERVICES FOR FEASIBILITY, DETAILED SURVEY AND DESIGN OF CHITTAGONG HILL TRACT CONNECTIVITY CONNECTING THEGAMUKH AND CHITTAGONG PORT.

NAME OF THE CONSULTANTS :
SAI Consulting Engineers Pvt. Ltd, India.
in association with
BETS Consulting Services Ltd, Bangladesh
Project office :
Tahmid Mahmood Palace
Flat # 9A, House # 77, Road # 4, Block-C,

DRAWING TITLE :
PLAN & SECTIONAL ELEVATION OF 35.0m PSC GIRDER BRIDGE AT CH. 108+152 (Road Route), CH. 5+855 (Road Portion of Multimodal Route)

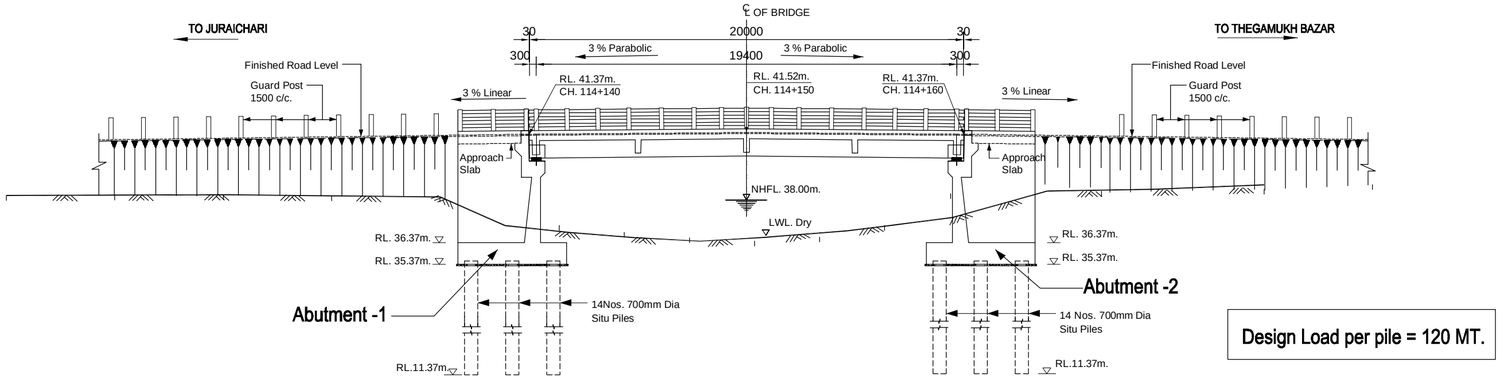
DRAWING NO : LGED/PCG/PLE-39

Scale :As shown

Date : 28-01-16

DESIGNED BY :	DRAWN BY :	CHECKED BY :	APPROVED BY :
MD. TAZUDDIN	MD. TAZUDDIN	AFM HAMIDUL HAQUE	DR. PRABHAT SHRIVASTAVA

REV.	DESCRIPTION	DATE



Existing Level in m.	39.02	38.71	37.26	33.78	32.96	34.92	35.12	35.48	36.47
Distance in m.	(-) 8.00	(-) 3.00	0.00	5.00	10.00	15.00	20.00	25.00	30.00

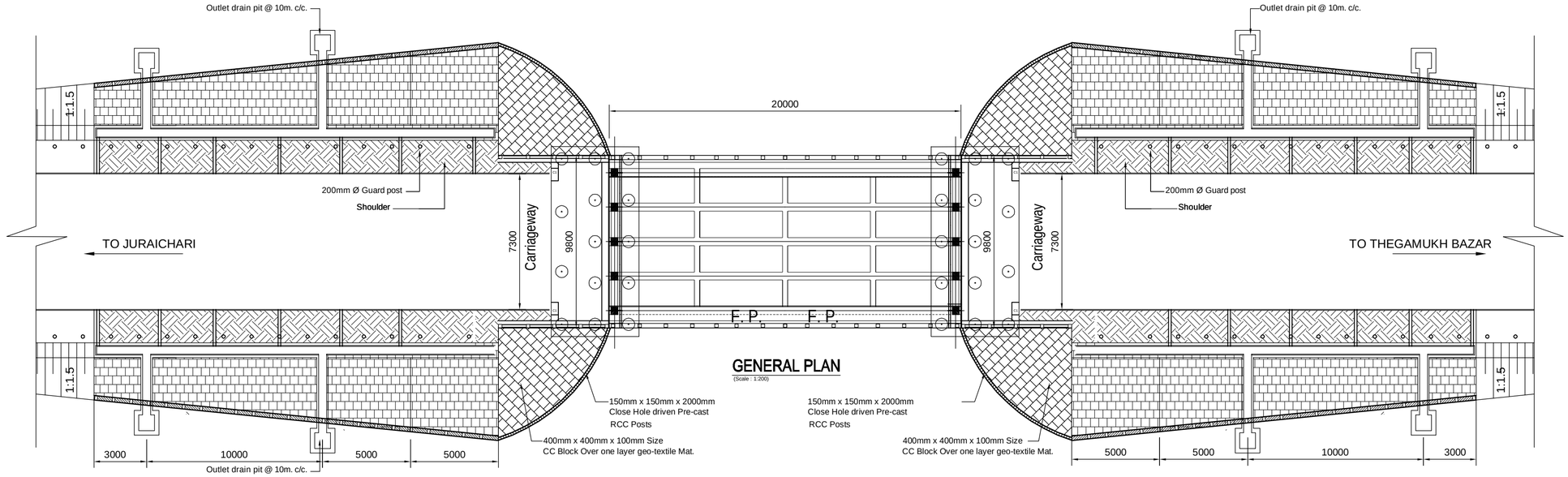
GENERAL ELEVATION

(Scale : 1:200)

Design Load per pile = 120 MT.

REFF. DWG. :

1. For abutment details : Abutment Type-III to be read.
2. For abutment pile : Abut. pile Type-II to be read.



GENERAL PLAN

(Scale : 1:200)

NAME OF THE CLIENT :

GOVERNMENT OF THE PEOPLES REPUBLIC OF BANGLADESH

LOCAL GOVERNMENT ENGINEERING DEPARTMENT

NAME OF THE PROJECT :

CONSULTANCY SERVICES FOR FEASIBILITY, DETAILED SURVEY AND DESIGN OF CHITTAGONG HILL TRACT CONNECTIVITY CONNECTING THEGAMUKH AND CHITTAGONG PORT.

NAME OF THE CONSULTANTS :

SAI Consulting Engineers Pvt. Ltd, India.

in association with

BETS Consulting Services Ltd, Bangladesh

Project office :

Tahmid Mahmood Palace
Flat # 9A, House # 77, Road # 4, Block-C,

DRAWING TITLE :

PLAN & SECTIONAL ELEVATION OF 20.0m LONG RCC GIRDER BRIDGE AT CH. 109+105(Road Route), CH. 6+805 (Road Portion of Multimodal Route)

DRAWING NO : LGED/RCG/PLE-40

Scale :As shown

Date : 28-01-16

DESIGNED BY :	DRAWN BY :	CHECKED BY :	APPROVED BY :
MD. TAZUDDIN	MD. TAZUDDIN	AFM HAMIDUL HAQUE	DR. PRABHAT SHRIVASTAVA

REV.	DESCRIPTION	DATE

TITLE OF DRAWINGS

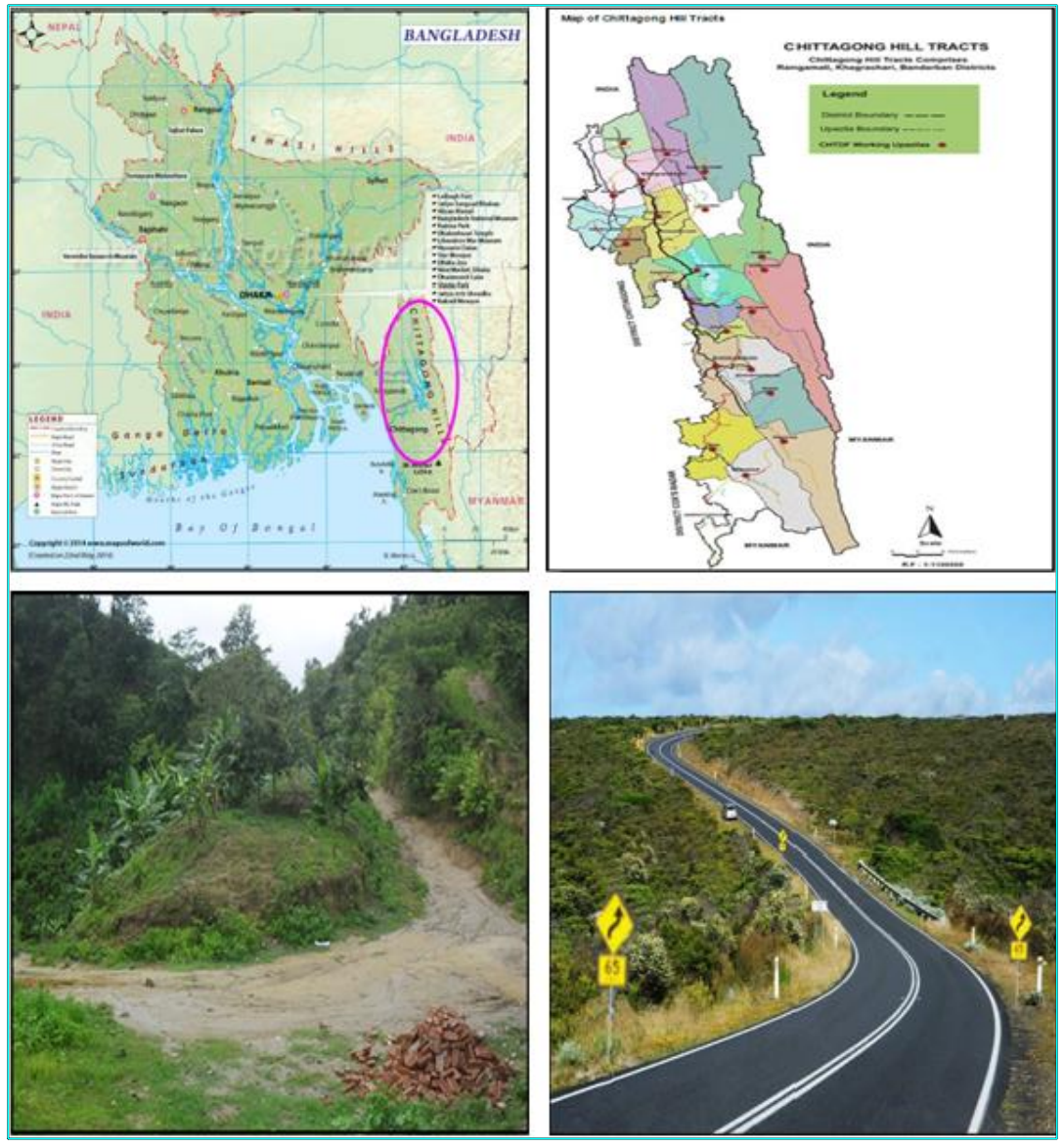
Sl. No.	Drawing Title	Sheet No.
A	Plan & Sectional Elevation (Bridge)	
1	General Elevation & Plan of 63.0m RCC Bridge at Ch. 0+378	LGED/RCG/PLE-01
2	General Elevation & Plan of 35.0m PCC Bridge at Ch. 4+932	LGED/PCG/PLE-02
3	General Elevation & Plan of 30.0m PCC Bridge at Ch. 8+040	LGED/PCG/PLE-03
4	General Elevation & Plan of 35.0m PCC Bridge at Ch. 11+268	LGED/PCG/PLE-04
5	General Elevation & Plan of 45.0m RCC Bridge at Ch. 32+251	LGED/RCG/PLE-05
6	General Elevation & Plan of 288.0m PCC Bridge at Ch. 38+543	LGED/PCG/PLE-06
7	General Elevation & Plan of 130.0m PCC Bridge at Ch. 45+862	LGED/PCG/PLE-07
8	General Elevation & Plan of 114.0m RCC Bridge at Ch.46+262	LGED/RCG/PLE-08
9	General Elevation & Plan of 20.0m RCC Bridge at Ch. 49+645	LGED/RCG/PLE-09
10	General Elevation & Plan of 35.0m PCC Bridge at Ch. 62+607	LGED/PCG/PLE-10
11	General Elevation & Plan of 20.0m RCC Bridge at Ch. 66+047	LGED/RCG/PLE-11
12	General Elevation & Plan of 35.0m PCC Bridge at Ch. 69+197	LGED/PCG/PLE-12
13	General Elevation & Plan of 90.0m PCC Bridge at Ch. 73+925	LGED/PCG/PLE-13
14	General Elevation & Plan of 15.0m RCC Bridge at Ch. 75+507	LGED/RCG/PLE-14
15	General Elevation & Plan of 20.0m PCC Bridge at Ch. 75+870	LGED/PCG/PLE-15
16	General Elevation & Plan of 35.0m PCC Bridge at Ch. 76+660	LGED/PCG/PLE-16
17	General Elevation & Plan of 15.0m RCC Bridge at Ch. 79+700	LGED/RCG/PLE-17
18	General Elevation & Plan of 15.0m RCC Bridge at Ch. 80+842	LGED/RCG/PLE-18
19	General Elevation & Plan of 231.18m PCC Bridge at Ch. 81+480	LGED/PCG/PLE-19
20	General Elevation & Plan of 160.12m PCC Bridge at Ch. 84+250	LGED/PCG/PLE-20
21	General Elevation & Plan of 15.0m RCC Bridge at Ch.85+570	LGED/RCG/PLE-21
22	General Elevation & Plan of 30.0m PCC Bridge at Ch. 86+104	LGED/PCG/PLE-22
23	General Elevation & Plan of 25.0m RCC Bridge at Ch. 86+685	LGED/RCG/PLE-23
24	General Elevation & Plan of 15.0m RCC Bridge at Ch. 86+972	LGED/RCG/PLE-24

Sl. No.	Drawing Title	Sheet No.
25	General Elevation & Plan of 15.0m RCC Bridge at Ch. 87+379	LGED/RCG/PLE-25
26	General Elevation & Plan of 45.0m RCC Bridge at Ch. 90+825	LGED/RCG/PLE-26
27	General Elevation & Plan of 45.0m RCC Bridge at Ch. 91+327	LGED/RCG/PLE-27
28	General Elevation & Plan of 30.0m PCC Bridge at Ch. 91+770	LGED/PCG/PLE-28
29	General Elevation & Plan of 142.12m PCC Bridge at Ch. 93+082	LGED/PCG/PLE-29
30	General Elevation & Plan of 15.0m RCC Bridge at Ch. 95+687	LGED/RCG/PLE-30
31	General Elevation & Plan of 30m PCC Bridge at Ch. 97+200	LGED/PCG/PLE-31
32	General Elevation & Plan of 25.0m RCC Bridge at Ch. 98+802	LGED/RCG/PLE-32
33	General Elevation & Plan of 30.0m PCC Bridge at Ch. 99+175	LGED/PCG/PLE-33
34	General Elevation & Plan of 30.0m PCC Bridge at Ch. 99+425	LGED/PCG/PLE-34
35	General Elevation & Plan of 15.0m RCC Bridge at Ch. 99+527	LGED/RCG/PLE-35
36	General Elevation & Plan of 35.0m PCC Bridge at Ch. 100+837	LGED/PCG/PLE-36
37	General Elevation & Plan of 175.12m PCC Bridge at Ch.101+997	LGED/PCG/PLE-37
38	General Elevation & Plan of 30.0m PCC Bridge at Ch.102+265	LGED/PCG/PLE-38
39	General Elevation & Plan of 35.0m PCC Bridge at Ch.108+152 (Road Route), CH. 5+855 (Road Portion of Multimodal Route)	LGED/PCG/PLE-39
40	General Elevation & Plan of 20.0m RCC Bridge at Ch. 109+105 (Road Route), CH. 6+805 (Road Portion of Multimodal Route)	LGED/RCG/PLE-40

GOVERNMENT OF THE PEOPLE'S REPUBLIC OF BANGLADESH

Consultancy Services for Feasibility, Detailed Survey and Design of Chittagong Hill Tracts Connectivity Connecting Thegamukh and Chittagong Port; Bangladesh Trade and Transport Studies, RETF Project.

CONTRACT PACKAGE NO. MOS -S4



DRAWINGS OF PLAN & SECTIONAL ELEVATION OF BRIDGE IN 1:200 SCALE

FEASIBILITY REPORT (FINAL DRAWING) ,VOLUME- IIIB OF IV

JUNE, 2016

LOCAL GOVERNMENT ENGINEERING DEPARTMENT (LGED)

REPORT SUBMITTED BY : SAL SYSTRA GROUP | BETS

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PLAN & SECTIONAL ELEVATION (BRIDGE)

Volume III A

1. **General Alignment Plan (1:25000 Scale)**
2. **Plan with GPS Coordinates (1:5000 vertical & 1:50000 horizontal Scale)**
3. **Drawings of Structures (Bridges, Culverts, Retaining Wall and other structures for Road way, Structures for Water way)**

1. General Alignment Plan (1:25000 Scale)

i) Road Route (Rajosthali to Thegamukh)
ii) Waterway (Rangamati to Chotoharina)
iii) Section of waterway
iv) Longitudinal Profile of waterway
v) Road Part of Multimodal route (Chottoharina to Thegamukh)

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3. Drawings of Structures

(Bridges, Culverts, Retaining Wall and other structures for Road way, Structures for Water way)

Volume III B

Drawings of Plan & Sectional Elevation of Bridge in 1:200 Scale