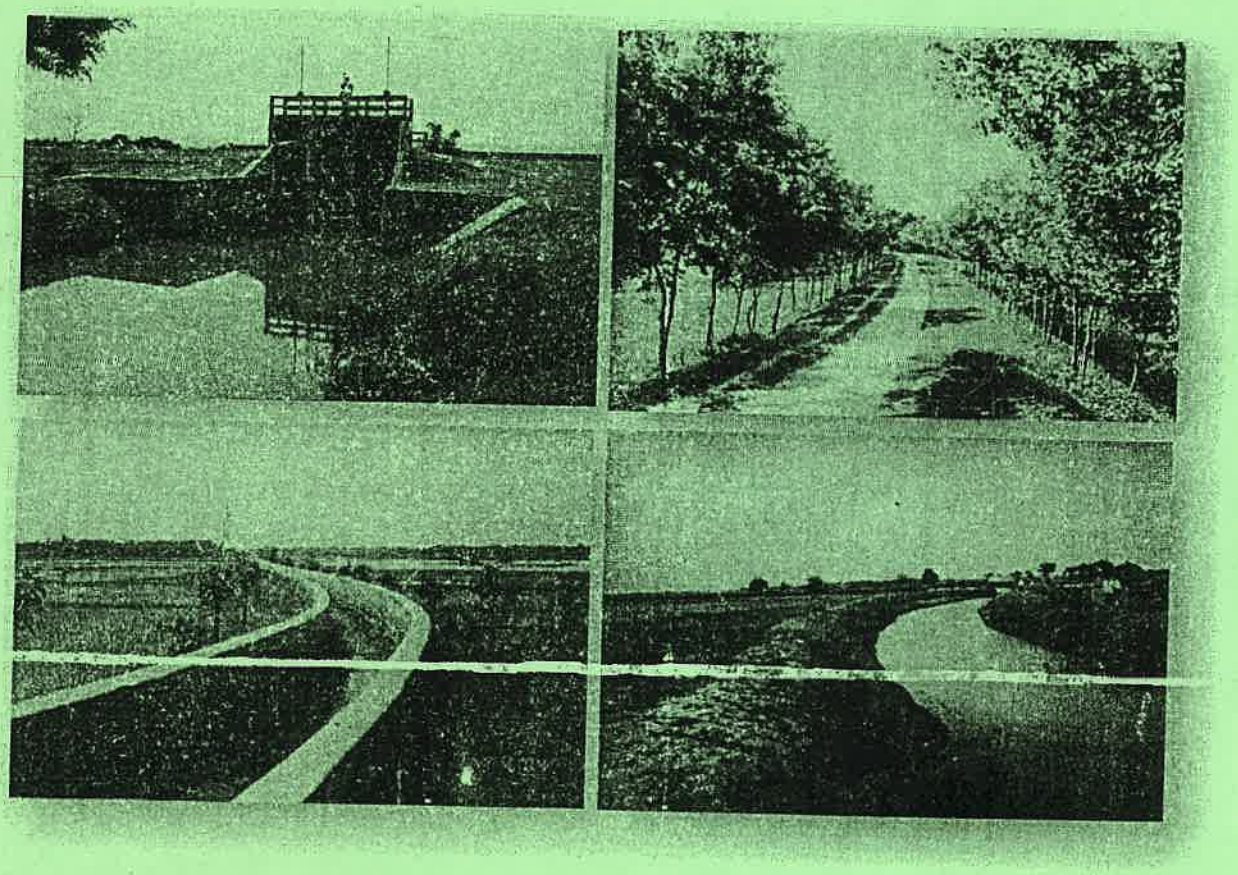
স্থানীয় সরকার প্রকৌশল অধিদপ্তর
ক্ষুদ্রাকার পানি সম্পদ উন্নয়ন প্রকল্প (২য় পর্যায়)

হাইড্রলিক অবকাঠামোর ডিজাইন ও ড্রইং বিষয়ক প্রশিক্ষণ



ডিসেম্বর ২০১৯

সমন্বিত পানি সম্পদ ব্যবস্থাপনা ইউনিট

সহযোগিতায়-এসএসডব্লিউআরডিপি-২ (জাইকা)

স্থানীয় সরকার প্রকৌশল অধিদপ্তর
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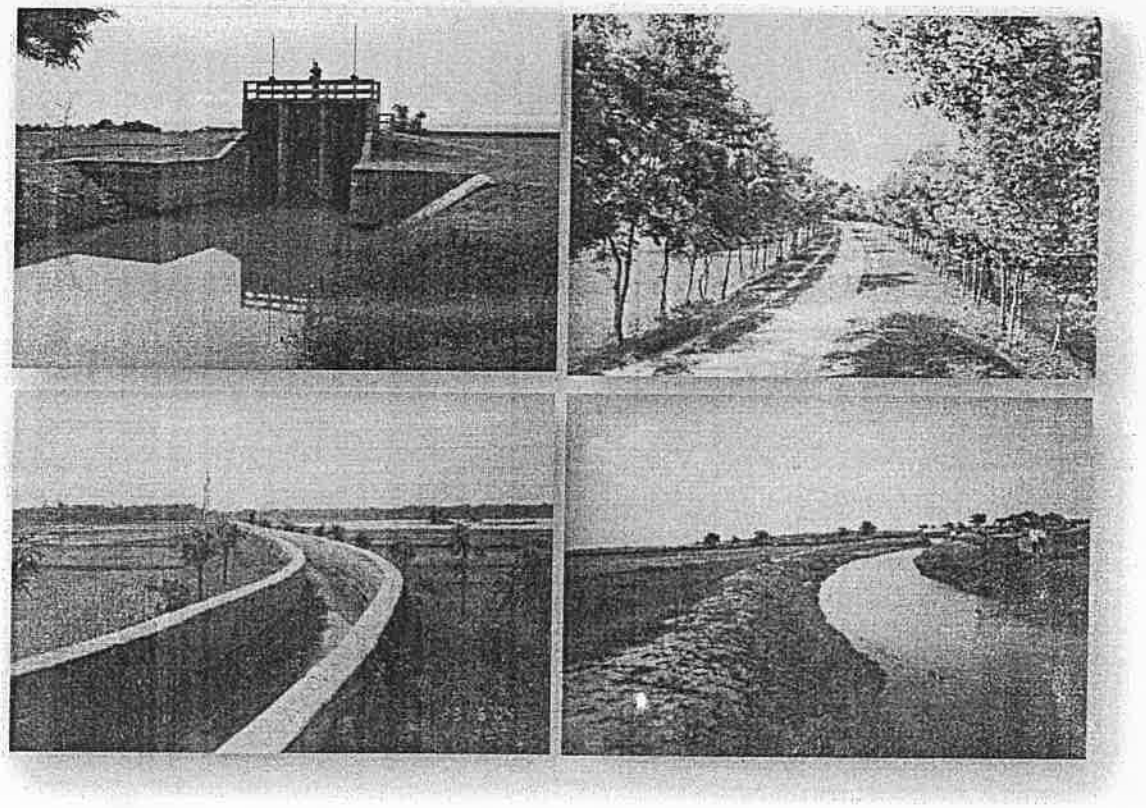

ডিসেম্বর ২০১৯

সমন্বিত পানি সম্পদ ব্যবস্থাপনা ইউনিট

সহযোগিতায়-এসএসডব্লিউআরডিপি-২ (জাইকা)

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১.১ পটভূমিঃ

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অধ্যায়-২

উপ-প্রকল্প সংক্ষেপ

২.১ উপ-প্রকল্পের সংক্ষিপ্ত বর্ণনা

এই প্রকল্পের মূল লক্ষ্য হচ্ছে পল্লী এলাকার দরিদ্র জনগোষ্ঠি সহ জনগণের সক্রিয় অংশগ্রহণ নিশ্চিত করে টেকসই ক্ষুদ্রাকার পানি সম্পদ ব্যবস্থা পদ্ধতির উন্নয়নের মাধ্যমে প্রাকৃতিক সম্পদের যথোপযুক্ত ব্যবহার এবং কৃষি ও মৎস্য উৎপাদন বৃদ্ধি করে সরকারের দারিদ্র বিমোচন কার্যক্রমকে সহায়তা প্রদান। বিশেষ করে স্থানীয় জনগণের দারিদ্র বিমোচনে প্রান্তিক ও ক্ষুদ্র কৃষক ও মহিলাদের আয় বৃদ্ধিতে সহযোগিতা দান। এই লক্ষ্য অর্জনে বিগত ১৯৯৫-৯৬ অর্থ বছরে এশীয় উন্নয়ন ব্যাংক, ইফাদ, নেদারল্যান্ড সরকার ও বাংলাদেশ সরকারের আর্থিক সহায়তায় "থানা ও ইউনিয়ন পর্যায়ে ক্ষুদ্রাকার পানি সম্পদ উন্নয়ন সেক্টর প্রকল্প" ১ম পর্যায় দেশের উত্তর, দক্ষিণ ও পশ্চিম অংশের ৩৭ জেলায় বাস্তবায়ন শুরু হয়। এই প্রকল্পের অধীনে ১৯৯৬-২০০২ ইং সাল পর্যন্ত ২৮০টি উপ-প্রকল্প বাস্তবায়িত হয়েছে। এর ফলে ১,৬৫,০০০০ হেক্টর আবাদী জমি উপকৃত হয়েছে এবং কৃষি উৎপাদন বৃদ্ধি পেয়েছে। এই কার্যাদী আশাব্যঞ্জক হওয়ায় এর অভিজ্ঞতার আলোকে দ্বিতীয় ক্ষুদ্রাকার পানি সম্পদ উন্নয়ন সেক্টর প্রকল্পটি পার্বত্য এলাকার ৩টি জেলা (বান্দরবন, খাগড়াছড়ি ও রাঙ্গামাটি) ব্যতিত সারাদেশব্যাপি অর্থাৎ ৬১টি জেলায় এই প্রকল্পের অধীনে ২০০২ সালে শুরু হয়ে ৩০০টি উপ-প্রকল্প বাস্তবায়নের শেষ পর্যায়ে আছে। প্রতিটি উপ-প্রকল্পে উপকৃত এলাকা অবশ্যই ১০০০ হেক্টর বা এর নীচে হতে হবে। এই ৩০০টি উপ-প্রকল্প বাস্তবায়িত হলে প্রায় ১,৯৬,০০০ হেক্টর আবাদি জমিতে টেকসই পানি ব্যবস্থাপনা নিশ্চিত হবে এবং ১,৫০,০০০টি কৃষি পরিবারকে উপকৃত ও দারিদ্র্য বিমোচনে সহায়ক ভূমিকা রাখবে।

উপরোক্ত দুইটি প্রকল্পের অভিজ্ঞতা থেকে লক্ষ্য করা যায় যে, স্থানীয় জনগণের অংশগ্রহণে ক্ষুদ্রাকার পানি সম্পদ প্রকল্প কৃষি উৎপাদন বৃদ্ধিতে সহায়তা ও দারিদ্র্য বিমোচনে অগ্রণী ভূমিকা পালন করছে। এই ধারাবাহিকতায় পরবর্তীতে জাপান সরকারের সহায়তায় ২০০৫-২০০৬ ইং অর্থ বছরে বৃহত্তর ময়মনসিংহ জেলার পানি সম্পদ উন্নয়ন মাষ্টার প্ল্যান করা হয়। মাষ্টার প্ল্যানের আওতায় পানি সম্পদ নিরূপণ সমীক্ষায় দেখা যায় যে বন্যা ব্যবস্থাপনা, জলাবদ্ধতা দূরীকরণ, পানি সংরক্ষণ ও সেচ এলাকা উন্নয়নের আরও সুযোগ রয়েছে। এর ফলশ্রুতিতে বৃহত্তর ময়মনসিংহ, সিলেট ও ফরিদপুর জেলার অন্তর্গত ১৫টি জেলায় ক্ষুদ্র পানি সম্পদ প্রকল্প বাস্তবায়নের জন্য হাতে নেওয়া হয়েছে। এই প্রকল্পে ২০০৯-২০১৩ সালের মধ্যে ২১৫টি উপ-প্রকল্প বাস্তবায়নের মাধ্যমে প্রায় ১১০,০০০ হেক্টর কৃষি জমি উন্নত পানি ব্যবস্থাপনার আওতায় আসবে এবং আনুমানিক ২,৮৫,০০০ টন অতিরিক্ত ফসল উৎপাদন হবে। এর মাধ্যমে আনুমানিক ১,৫০,০০০টি কৃষি পরিবার উপকৃত হবে। এ সমস্ত উপ-প্রকল্পের উদ্দেশ্যে হলো:

- পানি ব্যবস্থাপনা অবকাঠামো সার্বিকভাবে নির্মাণ ও তার দীর্ঘস্থায়ী ব্যবহার
- উপ-প্রকল্প সুফলভোগীদের শক্তিশালী সংগঠনের মাধ্যমে অবকাঠামো পরিচালনা ও রক্ষণাবেক্ষণ করা ও টেকসই পানি ব্যবস্থাপনা প্রবর্তন।
- পরিচালনা ও রক্ষণাবেক্ষণে সরকারী প্রতিষ্ঠান সমূহ থেকে প্রয়োজনীয় সহায়তা প্রাপ্তির ব্যবস্থা
- উপ-প্রকল্প এলাকার ভূমিহীন দরিদ্র জনগোষ্ঠির কর্মসংস্থানের সুযোগ বৃদ্ধি
- উপ-প্রকল্প এলাকাধীন প্রাকৃতিক সম্পদের যথোপযোগী ও পরিবেশ অনুকূল ব্যবহার।

২.২ সামাজিক ও প্রাতিষ্ঠানিক পদ্ধতি (Social and Institutional Process)

উপ-প্রকল্প অনুমোদনের পর সংশি-ষ্ট এলাকার অভ্যন্তরে বসবাসকারী প্রতিটি পরিবার থেকে প্রাপ্ত বয়স্ক পুরুষ ও মহিলা নিয়ে একটি সমবায় সমিতি গঠনের প্রক্রিয়া শুরু হয়। এর নাম দেয়া হয় পানি ব্যবস্থাপনা সমবায় সমিতি (WMCA) বা পাবসস। সমবায় আইন মোতাবেক সম্পূর্ণ গণতান্ত্রিক পদ্ধতিতে পাবসস গঠিত ও পরিচালিত হয়। এই সমিতি সমবায়ের নিয়মানুসারে এক দিকে সঞ্চয় ও শেয়ার কার্যক্রমের মাধ্যমে নিজস্ব পুঁজি সৃষ্টি করে এবং অপর দিকে উপ-প্রকল্পের বাস্তবায়ন প্রক্রিয়াজাত, পরিচালনা ও রক্ষণাবেক্ষণ কর্মকান্ডে উপকারভোগীদের প্রতিনিধিত্ব করে থাকে। প্রকল্প অনুমোদন লাভ করার পর পাবসস প্রকল্পের সাথে সরাসরি যুক্ত হয় এবং এলজিইডি, কৃষি সম্প্রসারণ, মৎস্য, পশুসম্পদ, সমবায় অধিদপ্তর এর সংশি-ষ্ট কর্মকর্তাদের সাথে ঘনিষ্ট যোগাযোগ রক্ষা করে থাকে। ইউনিয়ন পরিষদ এক্ষেত্রে সহায়ক ভূমিকা পালন করে।

২.৩ স্থানীয় উপকারভোগী জনগণের অংশগ্রহণ (Local Beneficiaries Participation)

উপ-প্রকল্প চিহ্নিতকরণ, সম্ভাব্যতা যাচাই, ডিজাইন, অবকাঠামোর প্রয়োজনীয়তা ও ধরণ নিরূপণ এবং নির্মাণ কাজ স্থানীয় জনগণের সাথে পরামর্শক্রমে এবং তাদের অনুমোদন নিয়ে কাজ করা হয়। নিজ এলাকায় পানি সম্পদ উন্নয়ন সম্পর্কে জনগণের মনোভাব, বিদ্যমান সমস্যা ও সমাধানের উপায়, এ ব্যাপারে তাদের চাহিদা কি তা সঠিক ভাবে জানার লক্ষ্যে অংশগ্রহণমূলক জরিপ (পিআরএ) পদ্ধতি গ্রহণ করা হয়েছে।

এ উদ্দেশ্যে প্রকৌশলী, সমাজতত্ত্ববিদ, কৃষিবিদ এবং মৎস্য ও পরিবেশ বিশেষজ্ঞের সমন্বয়ে পিআরআরএ দল গঠন করা হয়েছে। এই দল সম্ভাব্য এলাকায় গিয়ে জনগণের নিকট নীচে উলে-খিত বিষয়ের উপর মতামত সংগ্রহ করে চুড়ান্ত প্রতিবেদন তৈরী করে।

- উপ-প্রকল্পের পক্ষে স্থানীয় জনগণের সামগ্রিক সমর্থন আছে কি না
- বিপক্ষে মতামত আছে কিনা এবং থাকলে কেন
- উপ-প্রকল্প বাস্তবায়িত হলে পরিবেশগত কোন বিরূপ প্রভাব পড়বে কিনা, পড়লে প্রতিকারের জন্য কি কি ব্যবস্থা নেয়া যেতে পারে।
- সুফলভোগীরা প্রকল্পের নিয়ামানুযায়ী উপ-প্রকল্প নির্মাণ শেষে নিয়মিত পরিচালনা ও রক্ষণাবেক্ষণে দায়িত্ব নিতে রাজী কি না।

২.৪ নির্মাণ কাজে WMCA এর সম্পৃক্ততা (WMCA Involvement in Construction)

উপ-প্রকল্প এলাকার উপকারভোগীগণ উপ-প্রকল্প বাস্তবায়নে মূখ্য অংশগ্রহণকারীর ভূমিকা পালন করবে। পানি ব্যবস্থাপনা সমবায় সমিতি (পাবসস) কে উপ-প্রকল্পের সকল স্তরে বিশেষ করে উপ-প্রকল্প বাস্তবায়নে সম্পৃক্ত করা হবে। এ কারণে উপ-প্রকল্পে পানি ব্যবস্থাপনা সমবায় সমিতি (পাবসস)-এর কি দায়িত্ব ও কর্তব্য রয়েছে সে সম্পর্কে বিশদভাবে জ্ঞাত হওয়া প্রকল্প সংশি-ষ্ট প্রত্যেক ব্যক্তির জন্য একান্ত প্রয়োজন।

উপ-প্রকল্পের অধীনে পাবসস এর দায়িত্ব:

প্রতিটি পাবসস তার সমবায় আইনগত দায়িত্বসমূহ ছাড়াও প্রকল্পাধীনে কতিপয় দায়িত্ব পালন করবে, যেমন-

১। উপ-প্রকল্পের নির্মাণ কাজে পর্যবেক্ষক এর ভূমিকা পালন

২। উপ-প্রকল্প সমাপ্তির পর উহার দায়িত্ব গ্রহণ

৩। উপ-প্রকল্প পরিচালনা ও রক্ষণাবেক্ষণে অংশগ্রহণ

৪। উপ-প্রকল্প পরিচালনা ও রক্ষণাবেক্ষণে নিয়মিত তহবিল সংগ্রহকরণ

৫। বিবিধ

পরিকল্পনা, নক্সা প্রণয়ন, নির্মাণ কাজে পাবসস-এর ভূমিকা:

- পাবসস প্রকল্পের প্রতিটি পর্যায়ে যেমন পরিকল্পনা, নক্সা প্রণয়ন, নির্মাণ কাজ ও কারিগরী ব্যাপারে ভূমিকা রাখবে;
- পাবসস, এলজিইডি এবং এলসিএস এর মধ্যে সম্পাদিত চুক্তি মোতাবেক উপ-প্রকল্পের যাবতীয় কাজের বাস্তবায়ন পর্যবেক্ষণ করবে;
- নির্মিত অবকাঠামোর পরিচালনা ও রক্ষণাবেক্ষণের দায়িত্ব পালন করবে।

২.৫ প্রকল্প পরিচালনা ও রক্ষণাবেক্ষণে WMCA এর ভূমিকা

নির্মাণ সমাপ্তির পরবর্তী এক বছর উপ-প্রকল্পের পরিচালনা ও রক্ষণাবেক্ষণের যাবতীয় দায়িত্ব যৌথভাবে এলজিইডি ও পাবসস-এর উপর ন্যস্ত থাকে। এক বছর পুর্তির পর অবকাঠামো যৌথ পরিদর্শন শেষে উপ-প্রকল্প পাবসস এর নিকট হস্তান্তর করা হয়। হস্তান্তরিত হওয়ার পর উপ-প্রকল্পের পরিচালনা ও রক্ষণাবেক্ষণের দায়িত্ব পাবসস গ্রহণ করে থাকে এবং এ বাবদ প্রয়োজনীয় খরচ উপকারভোগীদের নিকট থেকে সংগ্রহ করা হয়।

অধ্যায়-৩

হাইড্রলিক অবকাঠামোর ডিজাইন ও ড্রইং অধ্যয়ন

৩.১ পানি সম্পদ উপ-প্রকল্পের অবকাঠামোর কাজ সমূহ:

এলজিইডি কর্তৃক বাস্তবায়নকৃত উপ-প্রকল্পের আওতায় মূলত: দুই ধরণের কাজ থাকে। যেমন:

ক) পাকা কাঠামো

খ) মাটির কাজ

৩.২ বিভিন্ন ধরনের পানি নিয়ন্ত্রণ কাঠামো:

পানি সম্পদ উন্নয়ন প্রকল্পের অধীনে বিভিন্ন উদ্দেশ্যে নিম্নলিখিত কাঠামোগুলো ব্যবহৃত হয়।

- রেগুলেটর (Regulator)
- স্লুইস (Sluice)
- পানি সংরক্ষণ কাঠামো (Water Retention Structures)
- ফ্লাসিং স্লুইস (Flushing Sluice/ইনলেট কাঠামো (Inlet structure)
- পাকা সেচ খাল (Lined Irrigation Canal)
- একুইডাক্ট (Aqueduct)
- সাইফোন (Syphon)

৩.২.১ রেগুলেটর (Regulator)

- বন্যা নিয়ন্ত্রণ, পানি নিষ্কাশন, পানি Intake এবং পানি ধারণ করার কাজে রেগুলেটর ব্যবহার করা হয়।
- রেগুলেটর Tidal এবং Non-Tidal এলাকায় Construction করা হয়ে থাকে।
- Vertical gate, Flap gate থাকে।
- রেগুলেটরের উভয় পাশে Stilling Basin থাকে।
- রেগুলেটরের Standard Opening (প্রস্থ×উচ্চতা) নিম্নরূপ হয়ে থাকেঃ

  ১.৫০ মি. (প্রস্থ)×১.৮০মি. (উচ্চতা), ১.৫০ মি. (প্রস্থ)×১.৫০মি. (উচ্চতা)

  ১.২০ মি. (প্রস্থ)×১.৫০মি. (উচ্চতা), ১.২০ মি. (প্রস্থ)×১.২০মি. (উচ্চতা)

  Pipe Regulator: ০.৯০ মি. (ব্যাস) ও ০.৬০মি. (ব্যাস)
- রেগুলেটরের Standard Opening এর উপরে Head Wall / Breast Wall থাকে।
- রেগুলেটরের ভেন্ট সংখ্যা Basin area, বৃষ্টিপাতের পরিমান এবং নদীর পানির লেভেল-এর উপাত্ত বিশে-ষণ করে নির্ধারণ করা হয়।

৩.২.২ স্লুইস (Sluice)

- বন্যা নিয়ন্ত্রণ ও পানি নিস্কাশন কাজে স্লুইস ব্যবহার করা হয়।
- স্লুইস শুধুমাত্র জোয়ার-ভাটা অঞ্চলে তৈরী করা হয়ে থাকে।
- স্লুইসে শুধু Flap gate থাকে।
- স্লুইসে শুধু River side এ stilling basin থাকে।
- স্লুইসের Standard opening (প্রস্থ×উচ্চতা) রেগুলেটরের Standard opening (প্রস্থ×উচ্চতা) এর মত হয়ে থাকে।
- স্লুইসের ভেন্ট সংখ্যা Basin area, বৃষ্টিপাতের পরিমান এবং নদীর পানির লেভেল-এর উপাত্ত বিশে-ষণ করে নির্ধারণ করা হয়।

৩.২১.৩ পানি সংরক্ষণ কাঠামো Water Retention Structure (WRS)।

- পানি ধারণ ও নিস্কাশন করার জন্য WRS ব্যবহার করা হয়।
- WRS সাধারণত: Non-tidal Zone এ কনষ্ট্রাকশন হয়ে থাকে।
- Vertical gate অথবা fixed weir দ্বারা পানি ধারন করা হয়।
- WRS এ শুধুমাত্র Down stream এ stilling basin থাকে।
- WRS Standard opening (প্রস্থ×উচ্চতা):

Gate type: রেগুলেটরের মত opening (প্রস্থ×উচ্চতা) হয়ে থাকে কিন্তু Head wall/Breast wall থাকে না।

Weir type: Fixed weir type wall দ্বারা পানি ধারণ করা হয় বিধায় কোন Standard vent size নাই।

৩.২.৪ ফ্লাসিং স্লুইস (Flushing Sluice)/ইনলেট কাঠামো (Inlet structure)

- উপ-প্রকল্পের বাহিরের নদীর পানি উপ-প্রকল্প এলাকায় প্রবেশ করানোর কাজে ব্যবহার করা হয়।
- সাধারণত: Tidal zone এ construction হয়ে থাকে।
- যেখানে বন্যার সম্ভাবনা নেই সেখানে শুধুমাত্র Vertical gate দেওয়া হয়।
- সে ক্ষেত্রে ফ্লাসিং স্লুইসের Country side এ Stilling Basin হয়ে থাকে।
- ফ্লাসিং স্লুইসের Standard Opening size/Vent size রেগুলেটর মত হয়ে থাকে।
- ফ্লাসিং স্লুইসের ভেন্ট সংখ্যা উপ-প্রকল্পের পানির চাহিদার উপর নির্ভর করে।

৩.২.৫ পাকা সেচ খাল (Lined Irrigation Canal)

- কমান্ড এরিয়া ডেভেলপমেন্ট (CAD) নামে উপ-প্রকল্পে পাকা সেচ খাল করা হয়।
- নদী থেকে পাম্পের সাহায্যে পানি উত্তোলন করে পানি সরবারাহ করার জন্য পাকা খাল করা হয়।
- এই পাকা সেচ খাল দিয়ে Gravity Flow-তে পানি সরবরাহ করা হয়ে থাকে।
- পাকা সেচ খালের Design Cross-section উপ-প্রকল্পের কমান্ড এরিয়া এর উপর নির্ভর করে।

৩.২.৬ একুইডাক্ট (Aqueduct):

- সেচ খাল পানি নিষ্কাশন খালকে অতিক্রম করিয়া উপ-প্রকল্পে পানি সরবরাহ করার জন্য একুইডাক্ট নির্মাণ করা হয়। এই একুইডাক্টকে পানি চলাচলের জন্য Bridgeও বলা হয়ে থাকে।

৩.২.৭ সাইফোন (Syphon)

সেচ খালের পানি সরবরাহের প্রতিবন্ধক নিষ্কাশন খাল, রাস্তা ও বেড়ী বাঁধ অতিক্রম করার জন্য প্রতিবন্ধক কাঠামোর নীচ দিয়ে সাইফোন নির্মাণ করা হয়।

- সাইফোন সাধারণতঃ Pipe বা Box Culvert Type হয়ে থাকে।

৩.৩ বিভিন্ন ধরনের মাটির কাজ

- বন্যা নিয়ন্ত্রণ বাঁধ (Flood Control Embankment)
- পানি নিষ্কাশণ (Drainage)/ধারণ (Conservation) খাল।

৩.৩.১ বন্যা নিয়ন্ত্রণ বাঁধ (Flood Control Embankment)

- উপ-প্রকল্প এলাকা বন্যামুক্ত রাখার জন্য প্রয়োজনীয় উচ্চতা, Top width & side slope বজায় রেখে বন্যা নিয়ন্ত্রণ বাঁধ নির্মাণ করা হয়।

৩.৩.২ পানি নিষ্কাশণ (Drainage)/ ধারণ(Conservation) খাল

- উপ-প্রকল্প এলাকায় পানি নিষ্কাশন ব্যবস্থার উন্নয়ন, পানি প্রবেশ এবং পানি সংরক্ষণ করার জন্য খাল পুন:খনন করা হয়।

৩.৪ Site Layout Plan:

- Structure এর Centre point Outfall khal থেকে কমপক্ষে ৬০ মি. দূরে হবে। তবে নদীতে ভাঙ্গন থাকেল অন্ততঃ ১০ বছরের ভাঙ্গনের হারের সমান দূরে থাকবে। কাঠামোর Longitudinal Centre line নিষ্কাশন খালের Centre line বরাবর ও Flow বরাবর হতে হবে।
- খাল বেশ গভীর হলে কাঠামো খালে নির্মাণ না করে খালের পাড়ের জমিতে নির্মাণ করে Diversion খালের মাধ্যমে সংযোগ করতে হবে। প্রয়োজনে Land Acquisitionও করা যেতে পারে। সুতরাং খালের উভয় পাড়ের জায়গা ভালভাবে পর্যবেক্ষণ করে কাঠামো এমন জায়গায় সেট করতে হবে যেন খালের প্রবাহ সোজাসুজি থাকে।
- Typical Site Layout Plan Reference হিসাবে দেয়া হ'ল (অতিরিক্ত ড্রইং সেট)।

৩.৫ কাঠামো ভিত্তির জন্য সাব-সয়েল পরীক্ষা করা

- কাঠামোর Location ঠিক হলে সাব-সয়েল এর অবস্থা জানার জন্য ৩টি Bore hole প্রদর্শিত Sketch অনুসারে তদারক করতে হবে।
- প্রতিটি Bore hole point এর Top Reduced level (RL) PWD Datum অনুসারে Survey করে Bore log sheet-এ দেখাতে হবে।

৩.৬ কাঠামোর ভিত্তি (Foundation of Structure)

৩.৬.১ Sub-soil এর প্রতিবেদন অনুসারে কাঠামোর Foundation Treatment নিম্নলিখিত উপায়ে করা হয়ে থাকে।

ক) Sand filling (Soil replacement)
খ) Pre-cast pile
গ) Cast-in-situ pile

ঘ) Sand piling

৩.৬.২ Sand filling (soil replacement)

কাঠামোর Working Drawing অনুসারে বিদ্যমান ground level থেকে Sand filling এর প্রদর্শিত RL পর্যন্ত মাটি কাটতে হবে। মাঝারী মোটা বালু (FM≥0.8) ১৫০ মি.মি. স্তরে স্তরে পানি ছিটিয়ে Compaction করে Base slab এর সি.সি এর Bottom level পর্যন্ত দিতে হবে। Compaction করার জন্য Concrete hammer (Durmus) ব্যবহার করা যেতে পারে এবং Compaction Maximum dry density এর ৯০% হতে হবে।

৩.৬.৩ Pre-cast RCC Pile

Working Drawing এ প্রদর্শিত Pre-cast RCC Pile এর জন্য নিম্নলিখিত Point গুলি বিবেচনা করতে হবে।

- Pre-cast RCC Pile এর আকার সাধারণতঃ ৩০০মি.মি.x৩০০মি.মি. এবং সর্বাধিক ১২মি. দৈর্ঘ্য হয়।
- Structure এর Centre থেকে Pile Driving শুরু করে বাইরের দিকে অগ্রসর হতে হবে।
- Pile Driving এর সময় প্রতি ৩০০ মি.মি. পর পর Pile Driving blows number রেকর্ড করতে হইবে। Blows Number যদি প্রতি ৩০০ মি.মি. Driving-এ ৭০ এর অতিরিক্ত হয় তাহলে Pile Driving বন্ধ করে সাথে সাথে সদর দপ্তরে জানাতে হবে।
- Pre-Cast RCC Pile এর উপরিভাগের ১০০ মি.মি. Base slab এর Concrete এর ভিতরে অবশ্যই প্রবেশ করাতে হবে এবং পাইল এর উপরিভাগ থেকে ৭৫ মি.মি. Clear cover রেখে Base slab এর Reinforcement বসাতে হবে। এর ফলে pipe ব্যবহার করলে thickness বেশী হয়।

৩.৬.৪ Cast-in-Situ RCC Pile

Working Drawing এ প্রদর্শিত cast-in-situ RCC pile এর জন্য নিম্নলিখিত Point গুলি বিবেচনা করতে হবে।

- Cast-in-situ RCC pile এর size সাধারণতঃ ৪০০ মি.মি. ব্যাসের এবং ১২মি. অধিক দৈর্ঘ্যের হয়ে থাকে।
- RCC pile এর উপরিভাগের Main Reinforcement গুলি Base slab-এ প্রবেশ করিয়ে একসঙ্গে ঢালাই করতে হবে।
- Pile এর clear cover maintain করার জন্য Spacer bar অথবা RCC block বিভিন্ন Location এ main Reinforcement এর নীচে দিতে হবে।
- Pile এর Typical Drawing দেওয়া হ'ল (অতিরিক্ত ড্রইং সেট)।

৩.৭ Fish Screen

- উপ-প্রকল্প এলাকায় মৎস্য প্রজাতি সংরক্ষণার্থে হাইড্রলিক অবকাঠামোর সাথে Fish Screen ব্যবহার করা হয়ে থাকে।
- Fish Screen এর Typical Drawing দেওয়া হ'ল (অতিরিক্ত ড্রইং সেট)।

অধ্যায়-৪

হাইড্রলিক অবকাঠামোর ডিজাইন ড্রইং অধ্যয়ন (অংশ-২)

৪.১ হাইড্রলিক কাঠামো (Hydraulic Structure)

হাইড্রলিক কাঠামোর নকশা প্রণয়নের সময় নিম্নলিখিত ৪ (চার) টি বিষয়ের উপর বিশেষভাবে গুরুত্ব দেওয়া হয়ে থাকে।

- Hydrology
- Hydraulic
- Structure
- Foundation

৪.২ হাইড্রলিক কাঠামোর প্রধান উপাদান সমূহ (Main Components of Hydraulic Structure)

হাইড্রলিক কাঠামোকে প্রধানত: তিন ভাগে ভাগ করা যেতে পারে।

- Barrel part অথবা Box Part
- Country side Stilling Basin part
- River side Stilling Basin part

৪.২.১ Barrel part or Box part

এই অংশটি হাইড্রলিক কাঠামোর মাঝের অংশ। নিম্নলিখিত উপাদানসমূহ এই অংশে অবস্থিত।

- Sill level/invert level
- Deck slab level/road level
- Operation Deck level
- Breast wall / Head Wall
- Gate (Vertical & Flap)
- Gate Groove Channel & angle
- Base Plate & Hoist System
- Curb/wheel guard
- Railing & railing post

৪.২.১.১ Sill level/Invert level

Barrel part-এ base slab এর সর্বাধিক উপরিভাগের লেভেল বা Base slab এর যে লেভেল এ Vertical gate নামানো অবস্থায় বসে সেই level-কে Sill level বলা হয়ে থাকে। Sill level নির্ধারণ করার জন্য নিম্নলিখিত বিষয় সমুহ বিশেষভাবে গুরুত্ব দিতে হবে।

- কোন লেভেল পর্যন্ত পানি নিস্কাশন প্রয়োজন?
- খালের Existing/design bed level কত?

- নদীর গড় Low Water level কত?
- Tidal নদীর ক্ষেত্রে Monsoon Low Water Level.

৪.২.১.২ Deck slab level/Road level

- Structure এর উপরিভাগে যে অংশ Roadway হিসাবে ব্যবহৃত হয় তাকে Deck slab level/Road level বলা হয়।
- Roadway পাকা বা মাটির হতে পারে এবং Roadway এর প্রস্থ ৩.৬৬ মি. (১২ ফুট) হয়ে থাকে।

৪.২.১.৩ Operation Deck Level (Vertical gate Operation)

- যে slab level এ দাড়িয়ে operator vertical lift gate উঠানো ও নামানো করে থাকে ঐ লেভেলকে Operation Deck Level বলা হয়। Deck level-এ Gate Hoisting System এর Base Plate, Nut ও Bolt দিয়ে Operating Platform এর সাথে সংযোজন করা হয়।

৪.২.১.৪ Breast Wall / Head Wall

- ডিজাইন Vent size ঠিক রাখার জন্য এবং Flap gate বসানোর জন্য যে Vertical wall টি Operation Deck Slab হতে নীচের দিকে নামিয়ে নির্মাণ করা হয়ে থাকে। তাকে Breast Wall / Head Wall বলা হয়।

৪.২.১.৫ Gate (Vertical & Flap)

- এলজিইডি কাঠামোতে সচরাচর দুই ধরনের Gate ব্যবহৃত হয়ে থাকে। যথা: Vertical Lift Gate, Flap gate। Vertical gate হ্যান্ডেলের সাহায্যে উঠানো নামানো হয় এবং Flap Gate স্বয়ংক্রিয় ভাবে খোলা বন্ধ হয়। তবে উপ-প্রকল্পে পানি প্রবেশের জন্য ফ্ল্যাপ গেট Chain-Pully এর সাহায্যে ম্যানুয়ালী উঠাতে হয়।
- Regulator/Sluice এর Gate কাঠামোর একটি অতি গুরুত্বপূর্ণ অংশ এবং প্রকল্প পরিচালনায় বিরাট ভূমিকা রাখে। Gate ঠিকমত পরিচালনা না করা গেলে প্রকল্প থেকে পরিকল্পনা মোতাবেক উপকার পাওয়া যায় না।

৪.২.১.৬ Vertical Gate:

- এই Gate পরিচালনার জন্য অপারেটর প্রয়োজন হয়।
- এই Gate দিয়ে বন্যা নিয়ন্ত্রণ ও বিভিন্ন সময় যথা প্রাক বর্ষা, বর্ষা এবং বর্ষা শেষে পানি সংরক্ষণ করা যায় এবং প্রয়োজনে অতিরিক্ত পানি নিষ্কাশন করা যায়।
- পানি সংরক্ষণের জন্য রেগুলেটরের ক্ষেত্রে নদীর দিকে (R/S) রাবার সীল লাগানো হয়ে থাকে। তবে পানি সংরক্ষণ কাঠামোর গেটের ক্ষেত্রে ভাটিতে রাবার সীল লাগাতে হবে অর্থাৎ যেদিক থেকে পানির চাপ আসছে তার বিপরীত দিকে।
- Regulator এ বন্যা নিয়ন্ত্রণের জন্য Vertical গেট Breast wall এর সাথে নদীর দিকে থাকে।

৪.২.১.৭ Flap Gate:

- Gate দিয়ে স্বয়ংক্রিয়ভাবে বন্যা নিয়ন্ত্রণ ও পানি নিষ্কাশন হয়ে থাকে।

- Flap gate নদীর দিকে Barrel এর শেষ প্রান্তে Breast wall থেকে hinge plate ও gate link এর মাধ্যমে ঝুলানো থাকে।
- Rubber Seal Flap Gate এর ভিতরের দিকে অর্থাৎ উপ-প্রকল্পের দিকে লাগানো হয়।

৪.২.১.৮ Gate Groove Channel এবং Base Plate

- Vertical gate নির্বিঘ্নে উঠানামা করার জন্য Abutment ও Pier এ Gate Groove রাখা হয় যার সাইজ ১৩০ মি.মি.x১০০মি.মি. clear হয়ে থাকে।
- Base slab এর Top level এ Vertical Gate বসার জন্য Base Slab এর সাথে Monolithic করে Base Plate (M.S) বসানো হয়ে থাকে।
- Vertical এবং Horizontal Alignment সঠিক রাখতে Groove এ M.S Channel এবং M.S Angle ব্যবহৃত হয়ে থাকে।

৪.২.১.৯ Curb/Wheel Guard

- Deck slab এর উভয়পার্শ্বে রাস্তা বরাবর ২০০ মি.মি. উচ্চতা বিশিষ্ট Curb/wheel guard নির্মাণ করা হয়।

৪.২.১.১০ Railing & Railing Post

- Curb/Wheel Guard এর উপর Road বরাবর Railing & Railing post (৮০০ মি.মি. উচ্চতা) নির্মাণ করা হয়।

৪.২.২ Country side Stilling Basin part

- Glacis এর Toe থেকে End sill পর্যন্ত অংশটাকে Stilling Basin বলা হয়ে থাকে।
- এই Basin এ Hydraulic jump হয় যার ফলে Energy dissipate হয়ে থাকে।
- Jump এর কারণে High velocity water flow, low velocity তে পরিবর্তিত হয়।
- Regulator এ পানি প্রবেশ করানোর ব্যবস্থা থাকলে Country side এবং River side উভয়দিকে Stilling Basin দেওয়া হয়।

Stilling Basin এ Energy Dissipator হিসাবে ব্যবহৃত ব-কগুলি হ'ল।

- Chute Block
- Baffle Block
- End Sill

৪.২.৩ River Side Stilling Basin part

- Chute Block
- Baffle Block
- End Sill

৪.৩ হাইড্রলিক অবকাঠামোর অন্যান্য অংশসমূহ (Others Component of Hydraulic Structure)

- Cut-off wall (RCC/Steel sheet pile)

- Abutment
- Pier
- Wing wall
- Return Wall
- Water level gauge
- Ladder
- Protective works (Brick Blocks/CC Blocks, inverted filter & Toe wall)
- Launching Apron (Brick Blocks/ CC Blocks)
- Guide wall

৪.৩.১ Cut-off wall (RCC/Steel Sheet Pile)

- Scour depth এবং seepage line নির্দ্ধারণ করে Base slab এর উভয়দিকের শেষ প্রান্তে Cut-off wall দেওয়া হয়ে থাকে।
- Cut-off wall দুই ধরণের হয়ে থাকে যথা RCC Cut-off wall এবং Steel Sheet Pile.
- ২.০০মি. থেকে ৩.০০ মি. পর্যন্ত উচ্চতা বিশিষ্ট ২৫০ মি.মি. Thickness এর RCC Cut-off wall দেয়া হয়।
- ৩.০০ মি. বা ততোধিক উচ্চতা বিশিষ্ট Specified thickness এবং আকার অনুযায়ী Steel sheet pile, cut-off-wall হিসাবে ব্যবহৃত হয়ে থাকে।

৪.৩.২ Abutment wall

Barrel portion এর বাইরের দিকের যে দুইটি Wall দ্বারা মাটি Retain করা হয় তাকে Abutment wall বলা হয়। Abutment wall সাধারণতঃ Top ২৫০ মি.মি. Thickness এবং bottom এ design অনুযায়ী Thickness দেয়া হয়।

৪.৩.৩ Pier

দুই Abutment wall এর মাঝামাঝি একাধিক ভেন্ট সংখ্যা রাখার জন্য প্রদত্ত Vertical wall গুলিকে Pier বলা হয়ে থাকে। Pier এর Thickness ৪০০ মি.মি. থেকে ৪৫০ মি.মি. হয়ে থাকে।

৪.৩.৪ Wing wall

দুইদিকের Abutment থেকে Country side ও River side এর দিকে যে wall গুলি প্রসারিত হয়ে Stilling basin এর উভয় পার্শ্বে মাটিকে Retain করে থাকে তাকে Wing wall বলা যেতে পারে।

৪.৩.৫ Return wall

Wing wall এর শেষপ্রান্ত থেকে Protective works পর্যন্ত খাড়া RCC Wall যার দ্বারা মাটি Retain করা হয় তাকে Return wall বলা হয়।

৪.৩.৬ Water Level Gauge

- River side এবং Country side এর উভয় পার্শ্বের Wing wall এ পানি সমতল (Water level) মাপার জন্য Water level gauge বানানো হয় যা invert level এর reference RL থেকে মার্কিং করা হয়ে থাকে।

৪.৩.৭ Ladder (মই)

- River side এবং Country side এর উভয় পার্শ্বের Hand hold bar সহ ৩০০ মি.মি. পর পর Ladder বসানো হয়ে থাকে।
- River side এবং Country side এর Ground level থেকে Basin এ উঠানামা করার কাজে Ladder ব্যবহার হয়ে থাকে।
- নদীর দিকের মই (Ladder) এমনভাবে বসাতে হবে যেন Flap gate উঠার সময় বাধাপ্রাপ্ত না হয়।

৪.৩.৮ Protective Works (Brick Blocks/ CC Block, Inverted filter & Toe Wall)

- River side এবং Country side এ RCC Floor এর পরেই ডিজাইন অনুসারে Protective works দেওয়া হয়ে থাকে।
- ১৫০ মি.মি. মোটা বালু (F.M≥1.5) এর উপর ১৫০ মি.মি. Khoa এবং ৩৮০x৩৮০x৩০০ মি.মি. Brick Block / ৪০০x৪০০x৩০০ মি.মি. CC Block (Single Layer) Bed & Slope এ বসিয়ে Protective Works নির্মাণ করা হয়ে থাকে।
- Protective works কে ধরে রাখার জন্য ২৫০ মি.মি. Brick wall দিয়ে Toe wall নির্মাণ করা হয়।

৪.৩.৯ Launching Apron

- Protective works এর পরেই ৩৮০x৩৮০x৩০০ মি.মি. Brick Block/ ৪০০x৪০০x৩০০ মি.মি. CC Block Bed এ Double layer এবং Slope এ Single layer দিয়ে Launching Apron নির্মাণ করা হয়।
- Launching Apron এ প্রয়োজন না থাকায় Inverted Filter দেয়া হয় না।

৪.৩.১০ RCC Guide Wall

Return wall পরেই Slope portion এর Brick Block/CC Block ধরে রাখার জন্য উভয় পার্শ্বে Return wall এর শুরু থেকে ২৫০ মি. প্রস্থ ও ৬০০ মি.মি. উচ্চতা বিশিষ্ট RCC Guide wall দেওয়া হয়ে থাকে।

অধ্যায়-৫

বন্যা নিয়ন্ত্রণ বাঁধ এবং পানি নিষ্কাশন খালের ডিজাইন ও ড্রইং অধ্যয়ণ

৫. **বিভিন্ন ধরণের মাটির কাজ**

ক) বন্যা নিয়ন্ত্রণ বাঁধ (Flood Control Embankment)

খ) পানি নিষ্কাশন (Drainage)/ধারণ (Conservation) খাল।

৫.১ বন্যা নিয়ন্ত্রণ বাঁধ (Flood Control Embankment)

উপ-প্রকল্প এলাকা বন্যা মুক্ত রাখার জন্য প্রয়োজনীয় উচ্চতা ও Slope বজায় রেখে যে বাঁধ নির্মাণ করা হয় তা বন্যা নিয়ন্ত্রণ বাঁধ বা বেড়ী বাঁধ নামে পরিচিত। উক্ত বন্যা নিয়ন্ত্রণ বাঁধে বন্যা নিয়ন্ত্রণ ও পানি নিষ্কাশনের জন্য রেগুলেটর/স্লুইস নির্মাণ করা হয়ে থাকে। বন্যা নিয়ন্ত্রণ বাঁধ নির্মাণ করতে নিম্নলিখিত উপাত্ত প্রয়োজন।

- Engineering Survey
- Design Highest Flood Level (1:20 Yr. Return Period)

৫.১.১ Engineering Survey:

- অবকাঠামো নির্মাণে Survey works একটি অতীব গুরুত্বপূর্ণ অংশ।
- PWD/SOB এর Permanent Bench Mark (BM) কে ডাটা ধরে প্রস্তাবিত বেড়ী বাঁধ/খালের Alignment level Survey করা হয়ে থাকে।
- PWD এর Survey datum SOB এর Survey datum থেকে ০.৪৬ মি. বেশী।
- Datum এর Reference এ Survey করে প্রতিটি Point এ যে লেভেল পাওয়া যায় তাকে RL (Reduced Level/EL (Elevation) বলা হয়ে থাকে।
- RL/EL value গুলি Bangladesh Water Development Board (BWDB) এর Water Level Gauge Station এর Reference এ m(PWD) তে প্রকাশ করা হয়ে থাকে।
- উপ-প্রকল্প এলাকায় সার্ভে করার সুবিধার্থে Permanent BM (PWD/SOB) থেকে fly leveling করে সুবিধামত বিভিন্ন জায়গাতে Reference RL রাখা হয় যাহা Temporary Bench Mark (TBM) নামে পরিচিত।
- Arbitrary BM value in metre, SSWRDP-তে প্রযোজ্য নয় কারণ উক্ত RL BWDB's Water level gauge station এর সাথে সামঞ্জস্য পূর্ণ নয় বলে Design কাজে ব্যবহার করা যায় না।

৫.১.২ Design Highest Flood Water Level (1:20 year return period):

- উপ-প্রকল্প এলাকার কাছাকাছি BWDB's Water Level gauge station এর কমপক্ষে ১০ বছর থেকে ২০ বছরের Highest water level data নিয়ে Frequency analysis করে 1 in 20 year return period এর জন্য water level নির্ধারণ করা হয়।

- উপ-প্রকল্প এলাকাটি যদি ২টি BWDB's water level gauge station-এর মাঝামাঝিতে কোন একটি জায়গায় অবস্থান করে তাহলে ২টি gauge station এর calculated HFLকে Interpolation করে উপ-প্রকল্প এলাকার HFL (1:20 Yr. Return Period) নির্ধারণ করে বন্যা নিয়ন্ত্রণ বাঁধ ডিজাইন করা হয়।

৫.১.৩ Long section - X-section (Embankment/Drainage Channel):

- প্রস্তাবিত বন্যা নিয়ন্ত্রণ বাঁধের Alignment বরাবর ১০০মি./১৫০মি. পরপর Existing Road/Channel bed এর Centre এ একটা লেভেল এবং উভয় পার্শ্বের Toe side/Bank side-এ দুইটি লেভেল নিয়ে long section অঙ্কন করা হয়ে থাকে।
- যেখানে long section নেওয়া হয় সেখানে সাধারণতঃ প্রতি ১.৫মি. Interval-এ আঁড়াআড়ি ভাবে বিদ্যমান (existing) x-section অঙ্কন করা হয়ে থাকে। Abnormal case এ ১.৫মি. এর পরিবর্তে অনেক সময় ঘন ঘন/দূরে দূরে Interval I Spot level নেয়া হয়ে থাকে।
- বাঁধের প্রি-ওয়াক সার্ভে প্রস্তাবিত Alignment এর যে কোন Point থেকে আরম্ভ হতে পারে যার চেইনেজ হবে Ch. 0+000 km.
- খালের প্রি-ওয়ার্ক সার্ভে প্রস্তাবিত Alignment-এ outfall river/khal থেকে আরম্ভ হবে যার চেইনেজ হবে Ch. 0+000km.

৫.১.৪ Pre-work & Post work survey:

- বাঁধ নির্মাণ/খাল খনন কাজ আরম্ভ হওয়ার আগে সার্ভে করে যে Spot level নেয়া হয় তা Pre-work নামে পরিচিত অপরপক্ষে নির্মাণ/খনন কাজ শেষ হওয়ার পর যে Spot level নেয়া হয় তা Post work নামে পরিচিত।

৫.১.৫ Side Slope of Embankment and Drainage Channel:

- সাধারণতঃ বাঁধ-এর side slope উভয় পার্শ্বে (R/S & C/S) ১:১.৫ হয়ে থাকে। তবে বাঁধের উচ্চতা এবং বাঁধের মাটির বৈশিষ্টের উপর এই Slope কম বেশী হতে পারে।
- Drainage Channel এর উভয় পার্শ্বে Side slope সাধারণতঃ ১:১.৫ হিসাবে ডিজাইন করা হয়।

5.2 Design of Rubber Dams

Advantages and Considerations: Rubber Dams, usually built in small to medium rivers and large khals to retain water in the channel of the khals/rivers for use in irrigation in the dry season. Rubber Dams are up to about 30% cheaper than gated regulator structures in channels having widths 30 m or more. For channels smaller than 30m, Rubber Dam is not a recommended option on economic ground.

Rubber Dams require much less effort and cost for operation and maintenance compared to gated structures of comparable sizes. Rubber Bags are observed to have 20-yr life period under average care-taking conditions.

The principal consideration in designing Rubber Dams is that the structure may not constrict the existing waterway of the channel at the site and cause raised flood level in the upstream. In practice, a maximum of 10% reduction of waterway area is usually allowed. As the damming rubber bag between abutments are deflated to pass monsoon flow of the river/khal, waterway area at the structure calculates to length of Rubber Dam between abutments (L_{dam}) multiplied by the depth of water over the sill of the concrete floor on the river bed (D_w) i.e. $A_{structure} = L_{dam} \times D_w$.

A Plane Table survey of the site of the Rubber Dam covering at least 100m distances in the upstream and downstream from the structure location including both banks of the river/khal is obtained and alignments of the mean bank lines over the surveyed 200 m reach on both banks are established by visual inspection of the PT survey map and considering a smooth flow of the river between the bank lines over the surveyed reach. The distance between these two mean bank lines at the proposed centre line of the Rubber Dam is taken as **Length of Rubber Dam (L_{dam})**.

Considering longitudinal profile of lowest bed level the river/khal over a reach of about a kilometre, the mean bed profile of the river/khal is established and the mean bed level at the proposed centreline of the Rubber Dam is determined. Usually, **sill of the concrete structure** at the bed of the river/khal is set 300-500 mm above this mean bed level of the river/khal and the rubber bag is fixed on this part of the concrete floor at the river bed. Depth of water for waterway calculation at the Rubber Dam location shall be measured from the 1:20-yr flood flow water level to this sill level and denoted as D_w.

Existing waterway at the Rubber Dam location ($A_{existing}$) shall be computed from the surveyed cross-section of the river at the location corresponding to the 1:20-yr flood level. It is to be checked that $\mathbf{A_{structure} > 0.90xA_{existing}}$.

Afflux at Flood Flow: Hydraulically, the Rubber Dam structure with the dam bag fully deflated acts as a single vent hydraulic structure in discharging flood flow. The 1:20-yr flood flow (Q_{20}) of the river/khal at the location is estimated from the surveyed cross section of the river/khal using the computed / estimated 1:20-yr HFL and the surveyed mean channel bed slope by Manning's equation considering roughness co-efficient (n) value to be 0.035. The Speadsheet Design Program ***SizeCal*** will be used to calculate afflux (h) at the structure to pass Q_{20}. It is recommended that the afflux may not be more than 500mm. It is expected that with this size of the Rubber Dam structure, afflux at ordinary to low order floods will be insignificant.

Design of Downstream Stilling Basin and Cut-off Walls: The distance between abutments being quite large (more than 30m) and there being no piers and consequently no possibilities of flow obstruction between the abutments, it is not expected that flow at the structure will ever occur with a significant difference in water level between upstream and downstream, say more than 500-600 mm, in non-tidal rivers/khals. In floods, flows at the structures will, accordingly, be subcritical. Energy dissipation issue will come at falling floods at smaller depths of water in the river. It is recommended to use Design Program ***EnergyStill*** to generate a set of flow situation (forms hydraulic jump or not, length of jump, scour depth, etc) with different upstream WLs and flow heads of 400mm, 600mm and 800mm with a downstream floor depressed by, say, 1.00m. From the scenario of assumed flow condition and required stilling basins as given by the above calculations, a design stilling basin and cut-off wall depths will be judged out.

In tidal rivers/khals, the downstream water level in the river lowers faster under the tidal effect and the differential head between upstream and downstream water levels may be higher depending on the tidal range at the site. That is, the set of calculations using ***EnergyStill*** may be done with a set of a little higher flow heads – say 600 to 1000 mm. The other aspects of the analysis in designing will be similar to the non-tidal Rubber Dams.

Design of Upstream Floor/Apron: In Rubber Dam structures, upstream floor is not required to be designed for any hydraulic flow considerations. However, water retention head in Rubber Dams are quite big – usually 3 to 5 meters. Such big retention heads require quite long impervious floors, much longer than what are needed at the downstream floor for energy dissipation. Usually, most of this additional length requirement is provided at the upstream floor for reasons of economy as the floor thickness at upstream is only nominal.

Design for Floor Thickness and Exit Gradient: Rubber Dams retain significant depths (3-5 meters) of water in the upstream and usually this retained pressure head governs requirement of impervious floor length. Thus, additionally safe lengths of downstream stilling basin can be provided. The design program ***ExitG-Uplift*** will be used to design the floor lengths in respect of exit gradient and uplift.

Example *run-output* of *DesignPro-8* ***ExitG-Uplift*** is given in ***Table G6-III.1: List of Spreadsheet Design Programs*** of this Document for reference. Detailed design of the Rubber Dam structure planned will be done using design program ***ExitG-Uplift*** and print out of *run-outputs* will be submitted in the Detailed Design and Drawing Folder of the subproject for review by the PMO-Project Consultants.

5.3 CAD Subprojects: Design of Irrigation Canals

Alignment: Irrigation canals should be aligned meticulously for economy and efficiency of the system. The selected alignment should provide:

- Minimum disruption of existing drainage pattern - lines of high grounds to be followed.
- Minimum requirement for cross drainage structures like aqueducts, siphons, culverts.
- Minimum interference with existing roads, navigation and property lines. The alignment may be shifted to boundary line to avoid fragmentation of land properties into cut-off un-accessible small plots
- Maximum command area per unit length of canal to minimize land requirement, construction and maintenance cost.

Design of Canal Section: General criteria and methods for design of canals (khals) and embankments are applicable in designing cross-section of irrigation canals. Hydraulic design of canals will be done using Manning's equation with roughness factor selected appropriately (n=0.035 for earthen and n= 0.03 for concrete sections). Seepage gradient (minimum 6H:1V) through canal embankments should be checked with FSL in the canal and GL at low points along the outside toe of the canal. To reduce land requirement and increase section efficiency, the inside side slopes may be constructed 1:1 and strengthened with concrete, brick lining, etc. if considered appropriate and cost effective.

To prevent sediment deposition, minimum flow velocity should be not less than 0.5 m/s, while the maximum velocity should be selected as non-erodible velocity for earthen canals usually not more than 1.0 m/s.

Canals with trapezoidal section (earthen section with lined bed and internal slopes) should be provided with 0.3 m freeboard above full supply level (FSL). Square/rectangular section canals made of concrete or brick walls should be provided with 0.15 m freeboard above FSL.

To facilitate inspection and communication/transportation, crest width of irrigation canal bank in fill should be provided as per local requirement but not less than the recommended minimum crest width of 0.6 m.

Compaction of fill: The irrigation canal earthen section can be (i) in excavation (ii) in fill, and (iii) partly in excavation and partly in fill. Ideally, earthen canal on fill should be avoided. However, if unavoidable, much care is to be taken for compaction of the fill soil properly and a suitable lining on canal bed and side slopes is to be provided to avoid severe seepage and section failure as water flow starts.

Construction of raised canals with square/rectangular section of RCC, concrete or brick constructed over earth-filled embankment should be scheduled for 2 years. Earthen portion of the canal should be completed in the first year of construction (with section increased for settlement and erosion) and allowed to settle during monsoon season, and the concrete section constructed in the second construction year, in dry season.

CAD Subprojects (Buried Pipes): Design for Pipe Diameter and Pressure Head

Review of System Layout and Design Parameters: Layout of pipeline system with irrigation area delineation and design parameters like crop water and irrigation water requirements, irrigation Duty, etc and preliminary design of discharge, pipe diameter will be obtained from Feasibility Report – given in maps, tables and charts in various Appendices in the Engineering Annex. These will be reviewed for revisions, adjustments, if required.

Design of Pipelines: Deign pressure head at each outlet is taken as 0.50 m above the highest irrigated land level in the command area of the outlet i.e the irrigator unit. That means, each outlet will have a minimum pressure head it requires to supply irrigation water throughout the entire irrigator unit.

Head loss in flowing pipes due to friction can be calculated by two formulas: Darcy-Wiesbach formula and Colebrook White Formula as shown below. Either one can be used in design of the pipe system of CAD subprojects. In design of LGED's buried pipe irrigation subprojects, the Darcy-Wiesbach formula has been used.

Darcy-Wiesbach Formula: HL = f (L/D)(v2/2g)

Where

L=pipe length of reach between nodes (m)

D=internal diameter of pipe (m)

V=pipe flow velocity (m/s), for PVC pipes max=1.5m/s, min=0.30m/s, mod=0.80m/s

g= acceleration due to gravity (9.81 m/s2)

f= Moody friction factor; for PVC pipes 0.0168, for Conc pipes 0.02.

HL= head loss in pipe reach (m)

The above formula is written using pipe diameter D. The formula can also be written using hydraulic depth of full flowing pipe which is D/4. In that case, Moody friction factor f in this formula is changed to 4f' where value of f' is taken as one-fourth of what is to be taken for f.

Colebrook White Formula: V= (-)2(2gDS)0.5 log [(ks/3.7D) + (2.51v/D(2gDS)0.5]

Where

V= pipe flow velocity (m/s), for PVC pipes max=1.5m/s, min=0.30m/s, mod=0.80m/s

D= internal diameter of pipe (m)

S= hydraulic gradient

ks=effective roughness (m); PVC pipes: spigot-socket=0.06mm, chem. cemented=0.03mm.

g= acceleration due to gravity (9.81 m/s2)

v= kinematic viscosity of water (0.00111 at 15oC)

Buried pipe system includes bends, fittings like tees, valves and entry and exit conditions. This cause loss of head to different extents. These losses are expressed in fractions of the velocity head at the place as hl = C V2/2g, where C is the coefficient defining the fraction and V2/2g is the velocity head. The coefficient C varies from 0.05 to 1.2 depending on fittings and on smooth or rough conditions faced by flowing water. In practice, a very accurate calculation of head loss for fittings is not necessary. A conservative approach in estimating these head losses is to count all types of fittings and bends together in the reach and use an average value of C as 0.75 to calculate the total head loss of the reach.

MS Excel Spreadsheet Design Program BuriedPipeDesign has been developed and used to facilitate design and choice of pipe diameters, head losses, hydraulic pressure head in each reach of the pipeline. The design is carried out working from the tail towards upstream up to the header tank. All the pipe lines will be designed this way and it is to be checked that the pressure head at the header tank has been the minimum to meet the requirement of all the branch and sub-branch pipelines.

Example run-output of DesignPro-9 BuriedPipeDesign is given in Table G6-III.1: List of Spreadsheet Design Programs of this Document for reference. Detailed design of all the buried pipelines planned in the subproject will be done using design program BuriedPipeDesign and print out of run-outputs will be submitted in the Detailed Design and Drawing Folder of the subproject for review by the PMO-Project Consultants.

Height of Header Tank

Design of pipe system described above is to be done twice - first with pipe discharges calculated using the usual (three-month) duty of irrigation and second using the peak (one-month) duty of irrigation. The first one will give design diameter of pipes and the second one will give the design height of the header tank. Maximum pressure head and height of header tank should be limited to 3-5 meters for usual duty condition and 5-8 meters for the peak duty condition.

Surges and Water Hammer

Surge: Any transient pressure fluctuation in an open pipe line system is termed as surge. Surge is caused when air enters into and gets trapped in water in the pipe line and suddenly finds way to exit say through air-vents. Surges particularly occur when pumping re-starts after a closure when air in the pipelines gets trapped easily. If a large volume of air is suddenly released, a shock wave will be developed.

Water Hammer: When kinetic energy of flowing water is transformed into pressure energy, say by sudden closing of valves, sudden release of large volume of air and sudden stoppage of pumps, a pressure wave is generated that oscillates back and forth in the pipeline. This is called water hammer. When the pressure wave finds a open water surface as in a air-vent stand pipe, the wave reflects back on itself resulting a dampening effect and eventually the water hammer dies out. If a free surface of water is not met, the oscillation will continue undampened.

The uPVC pipes used in LGED's CAD subprojects are of 3.25 bar (32 m) rated pressure. For such low pressure pipes, standard specification requires that surge/ water hammer pressure may not exceed 30% of rated pressure (10 m) of the pipes. If the maximum operating pressure in the pipe system and the surge pressure exceeds rated pressure of the pipe, the pipe wall or joints may blow up.

Providing air valves at the air-vent pipes which prevent sudden air release prevents surge pressures. However, in the flat terrain of Bangladesh, protection against surge and water hammer is provided by the followings:

- Using steel pipe between pumps and the header tank,
- Providing open standpipes upstream of every outlet (these release air and dampen water hammer),
- Using standpipe diameter equal to or not less than 70% of the diameter of the pipeline at the place.

Buried Pipe Irrigation Structures

Type of structures and their typical numbers that are usually required in a typical buried irrigation (uPVC) pipe distribution system are described below in Table G6-II.1 below along with summary of their functions. The number of structures shown is typical and will be determined by design of individual subprojects. Some structure, particularly pump house, flow control structure, standpipe outlets, may not be necessary in some subprojects. Outline drawings of the structures are given in Exhibit G6-L: Criteria and Design of Command Area Development Subprojects for reference. Detailed design and construction drawings of the structures will be prepared and provided in Detailed Design and Drawing Folder of the subproject for review by the PMO-Project Consultants.

Descriptions and Functions of Buried Pipe Irrigation System Structures

Nr	Structures	Typical Nr Required	Description	Function
	Pump House	0-1		

Masonry walls and concrete floor, may be depressed, to house required number of motors and pumps. Steel shutter windows and doors, and corrugated iron sheet or concrete slab roofing. Protection and security of pumping equipment.

Header Tank 1 Rectangular reinforced concrete structure with 3 main separate compartments, and with (steel) ladder and operating platforms to provide access to gates / shutters and flow measurement V-notches. Also hand railing and washouts

(A cheaper alternative would be a circular reinforced concrete tank with electronic flow monitoring devices to outlet pipes). To receive discharge from pumps and allow settlement of sediment to removed by flushing / manually. Also to enable flow control and flow measurement to offtaking pipelines. Height to be sufficient to drive design flow through conveyance pipelines.

Flow Control Structures 0-3

Reinforced concrete structures with gates / shutters / valves and V-notch weirs located at head of rotation units. To provide flow control and flow measurement facilities at head of rotation units.

Outlets for irrigation

(risers) 30 (typ.) Lateral uPVC pipe offtake from pipeline leading to (concrete/PVC) riser pipe capped with an alfalfa valve. Masonry outlet box to be located over riser pipe. The outlet box supplies water to field channels with pucca-nuccas built into the walls of the outlet box controlling flows to the field channels.

If lay flat hose connections are proposed then the walls of the outlet box are about 1.2 m high and steel pipes are set into the walls of the outlet box to which hoses may be attached. To release irrigation flows from pipeline to typically 5-15 ha irrigator units, usually every 200-500 m along pipeline.

Standpipe Outlets 0-10 Lateral uPVC pipe offtake with control valve and RC access box leading to steel pipe riser to which 1-2 lay flat hoses may be attached. To release smaller flows for hose conveyance to irrigate small areas of higher land, ponds, homestead gardens, etc

Standpipes (air vents) 30 (typ.) Vertical uPVC pipe leading off from top of uPVC pipeline at high points and usually just upstream of outlets (risers). Standpipes to comprise uPVC pipe placed within concrete pipes for support / protection. To ensure pressures within pipeline remains within design limits and to allow air to vent. Top of standpipes to be 0.6 (typ) m above design HGL

Escapes (standpipe overflows) 3 Vertical uPVC pipe leading off from top of PVC pipeline at key locations and where escape flow can discharge safely through surface ditches. Small clear piezometric tube to be fitted to allow monitoring of water level (pressure).

To allow monitoring of pressures in pipeline, feed back to pump operator to increase / decrease pumping flows, and for excess flow to discharge safely into drainage ditch. Top of standpipes to be 0.3 (typ) m above design HGL.

Washouts 3 uPVC pipe offtake with control valve and RC access box located at low point(s) in pipelines. To allow periodic flushing and emptying of pipeline for repairs and removal of sediment.

Pump House

The pump house will typically have brick masonry walls and a concrete floor that may be depressed below ground level so that the suction head for the pumps does not exceed a practical limit of 5-6 m. It should be sufficiently large to house the required number of motors and pumps. Steel suction and delivery pipe work should be arranged to facilitate access to the pumps for operation/ maintenance. For ventilation steel shutter windows and doors are required. The roof may be corrugated-iron sheets or a concrete slab. The pump house provides protection and security for pumping equipment. A typical arrangement of pumps in

a pump house is shown in Exhibit G6-L: Criteria and Design of Command Area Development Subprojects. However, arrangements at different sites will be different.

For subprojects drawing water from larger rivers, it may not be practical to locate pumps inside the pump house, even with a depressed floor, as the pumping suction head could be too high (more than about 4-6 m) in the lean season. In this case, usual practice is either to provide a concrete platform on the river bank slope where the pumps may be placed in the lean season and removed during the monsoon, or to provide a floating platform anchored to the river bank. Unless the river bank is stable any pumping platform should comprise a reinforced concrete slab supported on top of precast concrete / steel sheet piles. Access steps to the platform would facilitate placement/ removal of pumps.

Header Tank

Height of header tank is determined by pipeline design considering peak demand flow based on 1-month irrigation duty to provide necessary head to supply irrigation water to all the outlet risers. A freeboard of 0.2 m may be provided. As pressure head requirement for usual flows is much lower, to avoid pumping excessive heights that incur unnecessary pumping cost, the discharge pipes from the pump house enter the tank in the bottom half of the tank.

There would be three main compartments in the Header Tank. The first receives water from the delivery pipes and facilitate settlement of any coarse sediment. Flows into the second compartment are controlled by (200mm or 250mm) alfalfa valves operated from an operating platform on top of the tank. From the second compartment, if flow measurement is not necessary, flows may be through orifices (can be closed by valves operated from the platform) into the third compartment. If flow measurement is required, the orifices will be closed and flow will be passed over 900 V-notch weirs and measurements are recorded.

The second and third compartments are divided into sub-compartments according to the number of off-taking pipelines. The number and diameter of alfalfa valves is determined from the design flows, adopting a head loss of 100 mm for each valve.

Only one V-notch weir will be provided to measure the flows to each off-taking pipeline and their crest levels vary according to the design discharges – the higher the discharge the lower is the crest. Sufficient head loss (likely to be 150 mm) should be allowed so that flow over the notch remains free i.e unaffected by downstream water level

Flow Control/Measurement Structures

190. For many subprojects flow control/measurement for rotation units would be at the header tank when each rotation unit will be supplied by a separate pipeline from the header tank. However, for the larger subprojects, a pipeline offtaking from the header tank may supply water to two or more rotation units, in which case an additional flow control / measurement structure will be needed at junction of the pipelines from those rotation units.

A typical secondary flow control/measurement structure will comprise several compartments. The inlet pipe would discharge into the first compartment, from which flows into second compartment would be controlled by alfalfa valves operated from the top of the tank. Flow measurement to each pipeline would be by a 900 V-notch weir set into the partition wall between adjacent compartments.

The secondary flow control/measurement structure would incorporate the following features: (i) trash racks to prevent trash entering the off-taking pipelines; (ii) an operating platform to access the valve operating handles and V-notch weirs; (iii) access ladders; (iv) small pipe drains set at the floor of the structure to allow cleaning of each compartment; and (v) pipe overflows set at design water level.

Height of the structure is given by the pressure head obtained from pipeline design, specifically the hydraulic pressure head in the off-taking pipelines plus head losses at the structure itself.

If flow measurement is not needed then a simple and much less expensive alternative would be to provide a gate / sluice valve located within a valve chamber/box at the head of each off-taking pipeline. To protect against surge pressures and allow exit / entry of air a standpipe should be located just upstream of the valve.

Riser Outlets

In uPVC pipe line system, outlets typically comprise a laterally off-taking uPVC pipe leading to a riser pipe capped with an alfalfa valve set at an offset position from the main pipe line. The offsetting is to avoid damage to the main pipeline due to construction of heavy masonry works on it and also to allow access to the pipeline in events of repairs being required. For main pipeline with concrete pipes, the riser pipe can offtake directly from top of the main line and the distribution box built there. A masonry distribution box is located over the riser pipe. To prevent tampering of alfalfa valve, a lockable cover may be provided on top the outlet box.

Depending on area of the irrigator unit, the offtaking pipe diameter should vary from 160-225 mm, and the alfalfa valve be either 150mm or 200mm in diameter. The distribution box supplies water to field channel, and the pucca-nucca built into the walls of the outlet box control flow to the field channel.

For outlets supplying water for lay-flat hose conveyance to farmers' fields an alternative design of the distribution box will be with high walls - assuming water is to be conveyed less than 100-150 m then, a 1.2 m high walls are likely to required. In the walls, outlet pipes are fixed to which farmers are to connect their irrigation hoses.

Standpipe outlets

For smaller areas, less than about 10 ha, or to provide water to fish ponds, standpipe outlets are suggested. These structures comprise a uPVC pipe lateral offtake, with control valve housed in a small masonry chamber, leading to a steel pipe riser to which arrangements for connecting 1-2 lay flat hoses may be made.

Air Vent Standpipes

Air-vent standpipes comprise vertical (uPVC / concrete) standpipes leading from the top of the main pipeline. Air-vents are located at high points along the pipeline and just upstream of every outlet. They allow entrapped air from the pipeline to vent and ensure that surge/ water hammer pressures in the pipeline remain within limits. Top of air-vent standpipes is usually 0.6 m above the design hydraulic grade line (pressure head) at the standpipe point.

The air-vent standpipes may comprise just concrete pipes placed one above the other from small base concrete on top of a short uPVC riser pipe. If this simple design is adopted then the concrete joints must be sealed carefully and may require periodic re-sealing. Alternatively, the uPVC riser pipe may be taken to the required height, in which case a concrete pipe surround will be used in the lower part of the PVC pipe for protection.

Diameter of the standpipes should not be less than about 70% of the parent buried pipe diameter while their heights will depend on the design pressure in the pipeline. For an upstream control system, as in ours, the pressure in the pipeline declines from the header tank to the tail. For most subprojects, heights of standpipes will probably vary from about 6.0 m at the head to a minimum of 1.6 m at the tail end.

Escape Standpipes

Escape standpipes also, like air-vent standpipes, comprise vertical uPVC / concrete pipes leading from the top of the parent pipeline. Escape standpipes are located at a few key locations and allow excess flow to discharge safely into a drainage ditch. The top of escape standpipes is usually set just 0.3 m above the design hydraulic grade line at the position. Escapes always are provided with a small clear piezometric tube fixed to the standpipe to

allow monitoring of pressures in the pipeline and "feed back" to the pump operator to increase supply if pressure is low, and to decrease supply if pressure is too high.

Construction of escape standpipe will be like the alternative construction of air-vent standpipe explained above – continuing the uPVC riser pipe up to the full height and using a protective concrete pipe surround in the lower part. The piezometer pipe will be fixed above the concrete pipe surround. The escape pipes will be provided with a bend pipe at the top so that excess water falls a distance away from the standpipe, where the ditch starts.

Washouts

Washouts comprise a side pipe off-take from the parent pipeline fitted with a control (gate) valve and leading to a concrete / masonry protective box. Washouts should be located at particularly low points along the pipelines, usually one for each line, to allow periodic flushing of sediments from inside the pipelines and emptying for repairs, when needed.

Pumps and Power Requirements

A pump set comprises the followings and is about 1-2 percent of the subproject cost:

- Pump - cast iron centrifugal pumps up to 8 inch (200mm) size manufactured locally.
- Power unit – either an electric motor or a diesel engine
- Steel base frame- on which the motor and pump are fixed – usually skid type
- Main switch and starter – for electric motors only
- Electric connection to mains – for electric motors only
- Battery and starter – for diesel engines only (manufactured locally)
- Other associated items - steel pipes (suction and delivery), pipe bends, gate valves, foot-valve (to prevent back flow) and screen, etc.

Electric motors (average power efficiency 75%) are much more efficient than diesel engines (average fuel efficiency 25%). Also electric power attracts a significant subsidy in Bangladesh. For these reasons adoption of electric motors will reduce operation costs. However, complete reliance on electric motors makes farmers vulnerable to load shedding, frequent in Bangladesh, and crop losses.

Roto-dynamic pumps fall into the following categories: (i) axial flow pumps – low head and high discharge; (ii) centrifugal pumps – high head and low discharge; and (ii) mixed flow pumps. They are all designed to run at constant speed and their performance is dependent on pumping head and discharge, power requirement, efficiency of operation.

Axial flow pumps, very popular in China, Thailand, Vietnam but not much in use in South Asian countries including Bangladseh, are 10-50% energy saving for static lifts of 1-2 m but not energy saving for heads 3m and above. Axial flow pumps are therefore not suitable for CAD subprojects that usually involve pumping heads of 5-6 meters.

Centrifugal pumps covering wide range of discharges and heads are manufactured in Bangladesh by Milners Pumps Ltd. Most of the CAD subprojects under SSWR development have used these local pumps. Information of the pumps on model and sizes, operating range of heads and discharges are given in Table G6-II.2 below. For subprojects with pumping heads ranging between 6-13 m, Pump Type C is likely to be most suitable, while for higher heads, 11-20 m, Pump Type F is suitable. The Yanshan pump is suitable where even larger heads, from 12-29 m, and higher discharges are required.

Particulars of Centrifugal Pumps for Use in CAD Subprojects

(Pumps A to F are from Milners and Yanshan is from China)

Significant friction loss occurs at the pump set and accessories which should be considered with due care. For a reasonable typical pumping installation comprising 4 bends / fittings and

40 m of pipe, the total friction head loss would be about 3-4 m for peak flows which may drop to about half this for usual flows.

Observations indicate that amount spent on energy in a single year is more than the cost of the pump sets. Thus, taking care to select pumps that will be operating efficiently will reduce irrigation cost significantly.

To allow for varying irrigation demand, at least three pump sets are recommended for CAD subprojects, and in general 3-6 pumps will be provided depending on scheme size, location and crops grown.

For a given discharge and head the energy required is given by:

Energy (kWh) = 9.81 Q H T

(e1 e2)

where:

Q is the pumped discharge (m3/s)

H is the average pumping head (m)

e1 the pump efficiency (in the order 0.7–0.85)

e2 the motor driving efficiency (0.7–0.9 for electric motors and 0.1–0.35 for diesel engines).

Using the above formula and considering pump efficiency 75% and electric motor efficiency 75%, a spreadsheet calculation of power requirement for a scheme of net irrigation area of 313 ha, a gross water requirements of 826 mm and an average pumping head of about 9 m, gives energy requirement using electricity as 360 kWh/ha which with a rate of BDT 4.50 per kWh costs BDT 1620 per ha per season.

অধ্যায়-৬ SPECIFICATION

SPECIFICATION & NOTES :			
1. R.C.C WORKS :	All R.C.C WORKS	R.C.C PILES	LEAN CONCRETE
A. Concrete . i)Strength:	28- days standard cylinder crushing strength shall be 17 N/ mm²	28- days standard cylinder crushing strength shall be 20.7 N/ mm²	--
ii)Proportion by volume	1:2:4	1:1:5:3	1:3:6
iii)Cement	Portland Type -1		
iv) Coarse aggregate	20mm down graded crushed stone chips (Well graded between 20mm & 8mm size.) (LAA value not more than 40)		20mm down graded brick chips (Well graded between 20mm & 8mm size.) (LAA value not more than 40)
v) Sand	FM 1.80	FM 1.80	FM 1.00
vi)Slump : (at work)	60-75 mm	60-75 mm (Precast) 100- 125 mm (cast – in situ)	60 -75 mm
B. Reinforcement	40 grade deformed M.S. bar Minimum yield strength 275 N/ mm²		--
2. Clear concrete cover	Earth faces = 75 mm. Water faces = 50 mm All other faces = 25mm. R.C.C Piles = 40 mm		--
3. C.C blocks	C.C blocks with cement, sand (FM> 1.50) and shingles (40 mm down graded) with mix proportion 1 : 3 : 6		
4. Back filling	Back filling outside abutments, wing walls and return walls up to FGL shall be done simultaneously on both sides with local sandy soil and should be free from vegetable roots and other organic materials, as soon as wall lifts are constructed.		
5. Foundation Treatment	Sand filling below the foundation shall be completed in 150 mm layers in optimum moist condition as per sub –soil investigation report.		
6. Strength	During pouring samples shall be collected by the contractor in presence of Engineer – in- charge in standard cylinder, one for each wing wall, abutment, return wall, top slab, apron and barrel foundation for testing 7 day strengths for quality control.		
7. Protective work	Earthfill in side slopes shall be compacted in horizontal layers to satisfaction of the Engineer in charge before placing filter material and block.		
8. Filter Materials	i) Brick Chips : 20mm to 40mm Size (LAA Value < 40) ii) Sand : Coarse Sand (FM= 1.5)		
9. Embeded Parts of gates :	M.S embeded parts such as angles, channels for vertical gates and fram & wall brackets for flap gates welded to anchor bars shall be installed in proper alignment before casting of concrete as shown in working drawing.		
10. Formwork	Formwork for Concrete for making fully leak proof shall be faced with plain 28/26 gauge steel fitted over 38 mm thick wooden plank panels suitably braced or steel framing faced with minimum 12/ 14 BWG mild steel sheet. Formwork for C.C blocks shall be fabricated from m.s steel of sufficient thickness to prevent any distortion.		

DRAWINGS & FIGURES

Sample Drawings of a CAD Subproject

SP 33097 Mongalpur

Appendix E1: Index Map, Schematic Layout and Layout Drawing
Appendix E2: Pump House
Appendix E3: Header Tank
Appendix E4: Flow Control Tank
Appendix E5: Long Profile for Main Pipelines
Appendix E6: Standard Drawings

Government of the People's Republic of Bangladesh
Local Government Engineering Department

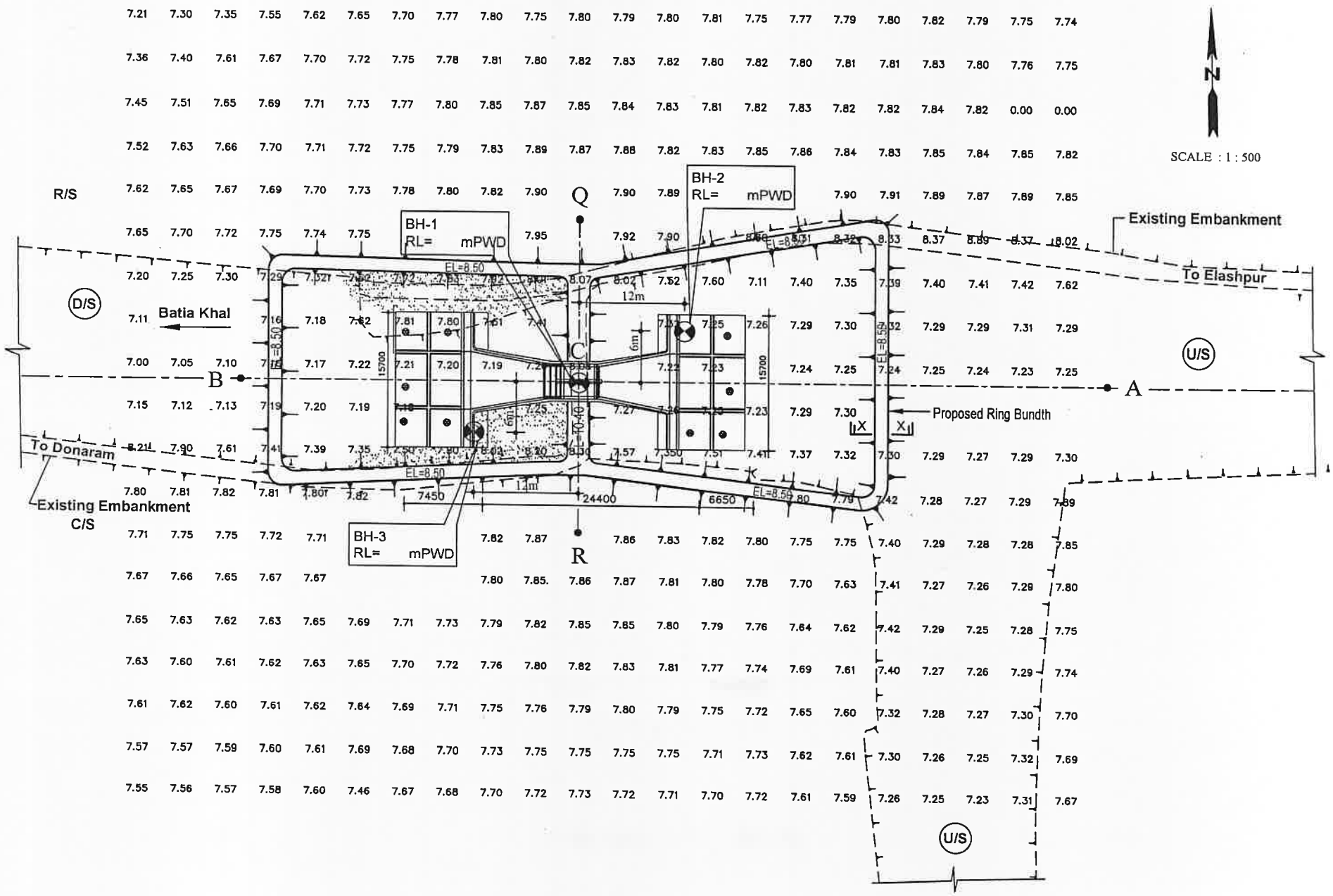
Small Scale Water Resources Development Project (Jica-2)

RDEC Bhaban (Level-6), Agargaon, Shere-Bangla Nagar
Dhaka-1207

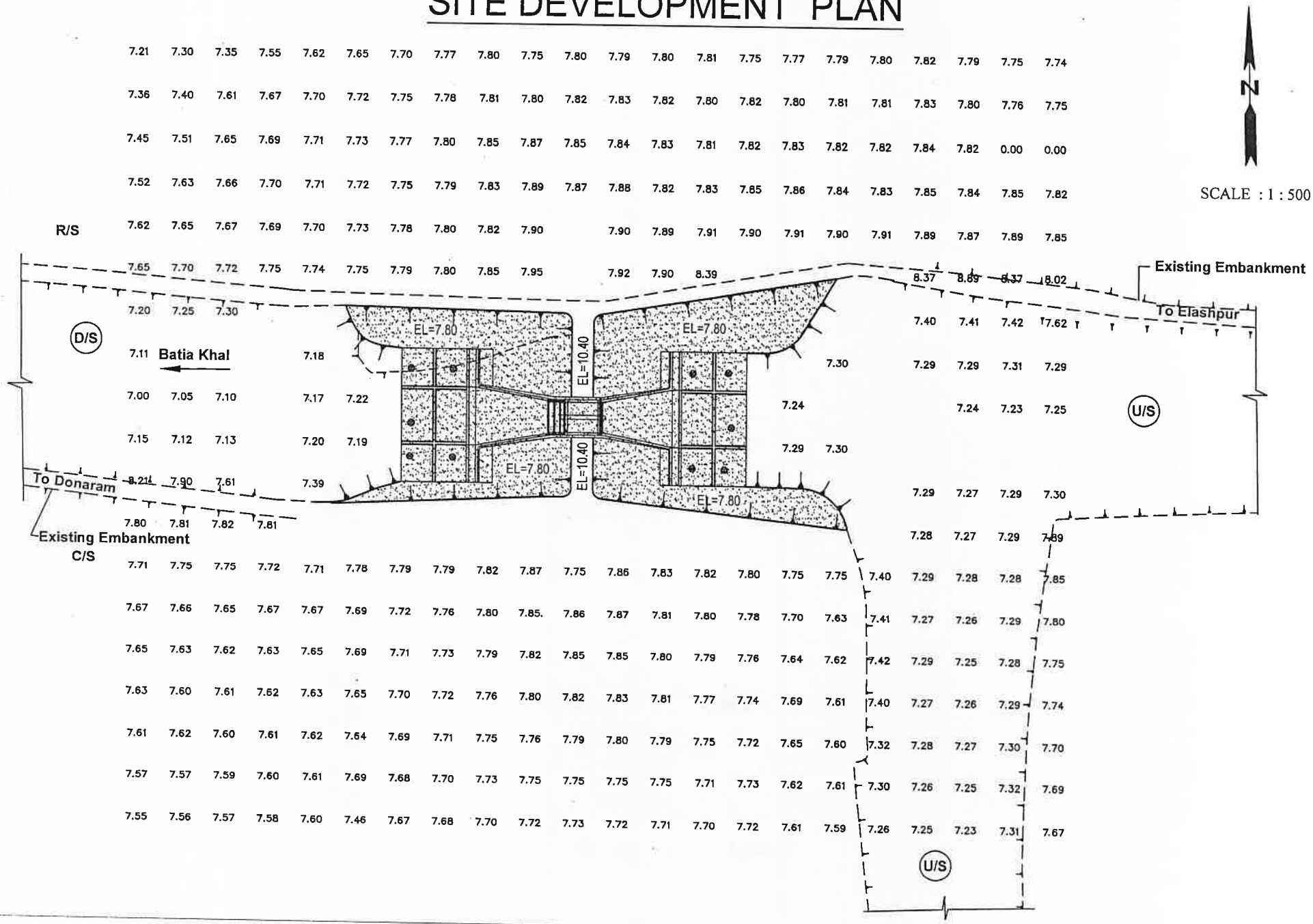
DETAIL DRAWINGS OF

REGULATOR (size : 4v-1.50mx1.80m)

LAYOUT PLAN


N
SCALE : 1 : 500
R/S
D/S
U/S
U/S
Batia Khal
To Donaram
Existing Embankment
C/S
Existing Embankment
To Elashpur
Proposed Ring Bundth
BH-1
RL= mPWD
BH-2
RL= mPWD
BH-3
RL= mPWD
A
B
C
Q
R
X
X
EL=8.50
12m
6m
15700
7450
24400
6650

SITE DEVELOPMENT PLAN



SUB-SOIL BORE LOGS

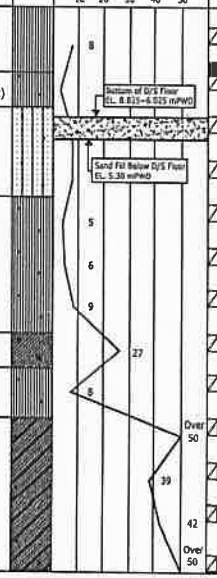
THE NATIONAL SOIL ENGINEERS
DHAKA

BORE LOG
CILIENT : LOCALI GOVERNMENT ENGINEERING DEPARTMENT
LOCATION : JAG CHHRA, UPAZILA : SRIMANGAL,
DIST : MOULVIBAZAR

BORE HOLE NO.01 (D/S) RL 9.70m DEPTH : 20.00m DIA : 100m DATE : 06-01-12

RL IN METER	THICK-NESS	CLASSIFICATION OF SOIL RL 9.70m	REMARKS ON SAMPLES	DEPTH IN METER
RL 7.50m	2.20m	Yellowish brown & grey high plastic CLAY. (stiff)	D-1=11.66m to 11.20m	
6.20m	1.30m	Yellowish brown & grey medium plastic CLAY, some fine sand.(soft)	U-1=10.66m to 10.16m D-2=10.16m to 9.70m	
3.20m	3.00m	Yellowish brown fine SAND, little CLAY. (Loose)	D-3=8.66m to 8.20m	
(-) 1.50m	4.70m	Yellowish brown & grey medium plastic CLAY, little fine sand. (Medium stiff to stiff)	D-4=7.16m to 6.70m D-5=5.66m to 5.20m D-6=4.16m to 3.70m D-7=2.66m to 2.20m	
(-) 2.80m	1.30m	Yellowish brown fine SAND, some silt, trace mica. (Medium dense)	D-8=-1.16m to -0.70m	
(-) 4.50m	1.70m	Light yellowish brown & grey medium plastic CLAY, little fine sand. (Stiff)	D-9=-0.34m to -0.80m	
RL -10.30m	5.80m	Light brown fine SAND & SILT (dense to very dense)	D-10=-1.84m to -2.30m D-11=-3.34m to -3.80m D-12=-4.84m to -5.30m D-13=-6.84m to -7.30m	

LOG — STANDARD PENETRATION TEST/FEET (10 20 30 40 50)



G. W. T. 2.40m

DISTURBE D SAMPLE ☐ UNDISTURBE D SAMPLE ■

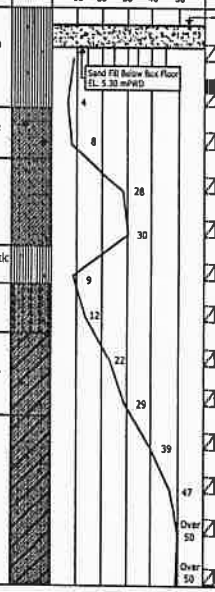
THE NATIONAL SOIL ENGINEERS
DHAKA

BORE LOG
CILIENT : LOCALI GOVERNMENT ENGINEERING DEPARTMENT
LOCATION : JAG CHHRA, UPAZILA : SRIMANGAL,
DIST : MOULVIBAZAR

BORE HOLE NO.02 (Centre) RL 7.00m DEPTH : 20.00m DIA : 100m DATE : 06-01-12

RL IN METER	THICK-NESS	CLASSIFICATION OF SOIL RL 7.00m	REMARKS ON SAMPLES	DEPTH IN METER
RL 3.50m	3.50m	Yellowish brown & grey medium plastic CLAY, trace fine sand. (Medium stiff to soft)	D-1=8.96m to 8.50m	
1.80m	1.70m	Yellowish brown fine SAND some silt, trace mica. (Loose)	U-1=7.96m to 7.46m D-2=7.46m to 7.00m D-3=5.96m to 5.50m	
(-)1.20m	3.00m	Yellowish brown fine SAND & SILT. (Medium dense)	D-4=4.96m to 4.00m	
(-)2.50m	1.30m	Yellowish brown & grey high plastic CLAY, trace fine sand (Stiff)	D-5=2.96m to 2.50m D-6=1.46m to 1.00m	
(-)4.50m	1.70m	Yellowish brown fine SAND, some CLAY. (Medium dense)	D-7=-0.04m to -0.50m	
(-)7.20m	3.00m	Light yellowish brown SILT, some fine sand. (Medium dense)	D-8=-1.54m to -2.00m D-9=-3.04m to -3.50m	
RL -13.00m	5.80m	Light brown fine SAND & SILT (dense to very dense)	D-10=-4.54m to -5.00m D-11=-6.04m to -6.50m D-12=-7.54m to -8.00m D-13=-9.54m to -10.0m	

LOG — STANDARD PENETRATION TEST/FEET (10 20 30 40 50)



G. W. T. 0.45m Above

DISTURBE D SAMPLE ☐ UNDISTURBE D SAMPLE ■

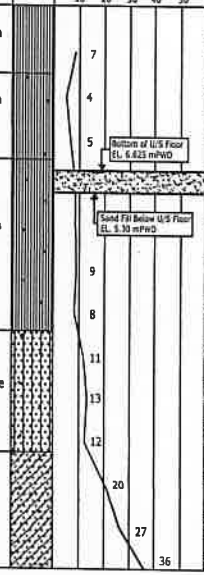
THE NATIONAL SOIL ENGINEERS
DHAKA

BORE LOG
CILIENT : LOCALI GOVERNMENT ENGINEERING DEPARTMENT
LOCATION : JAG CHHRA, UPAZILA : SRIMANGAL,
DIST : MOULVIBAZAR

BORE HOLE NO.03 U/S RL 9.40m DEPTH : 20.00m DIA : 100m DATE : 07-01-12

RL IN METER	THICK-NESS	CLASSIFICATION OF SOIL RL 9.40m	REMARKS ON SAMPLES	DEPTH IN METER
RL 4.20m	2.20m	Yellowish brown & grey medium plastic CLAY.(Medium stiff)	D-1=11.38m to 10.90m	
7.20m	3.00m	Yellowish brown & grey medium plastic CLAY, trace fine sand. (Soft to medium stiff)	U-1=10.36m to 9.86m D-2=9.86m to 9.40m U-2=8.82m to 8.36m D-3=8.36m to 7.90m	
(-)1.80m	6.00m	Yellowish brown & grey medium plastic CLAY, little fine sand. (Stiff)	D-4=6.86m to 6.40m D-5=5.36m to 4.90m D-6=3.86m to 3.40m D-7=2.36m to 1.90m	
(-) 6.10m	4.30m	Yellowish brown fine SAND, some silt, trace clay.(Medium dense)	D-8=0.86m to 0.40m D-9=-0.64m to -1.10m D-10=-2.14m to -2.60m	
RL (-)10.60m	4.50m	Light brown SILT & fine SAND (Medium dense to dense)	D-11=-3.64m to -4.10m D-12=-5.14m to -5.60m D-13=-7.14m to -7.60m	

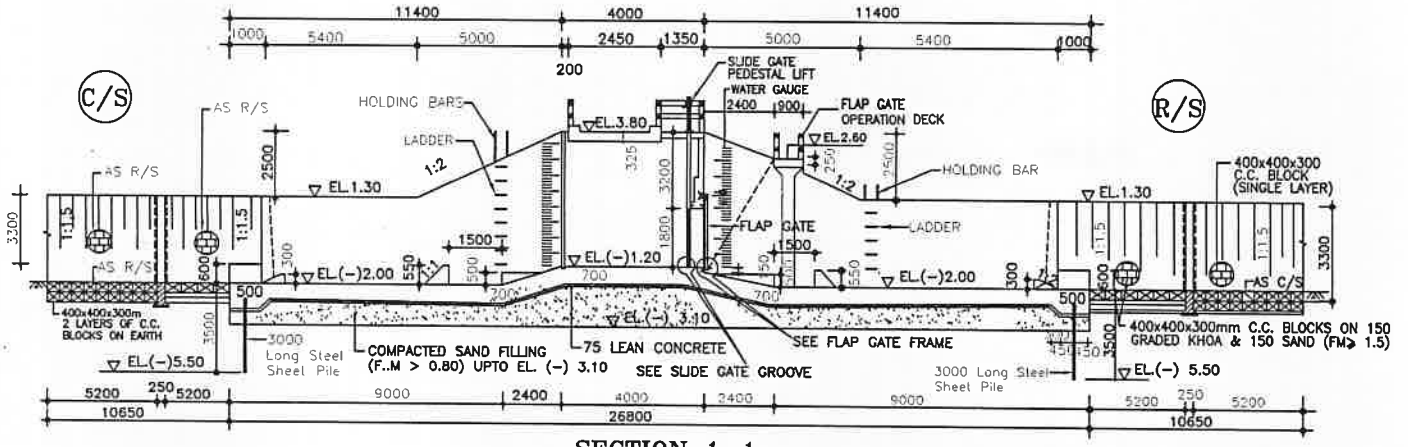
LOG — STANDARD PENETRATION TEST/FEET (10 20 30 40 50)



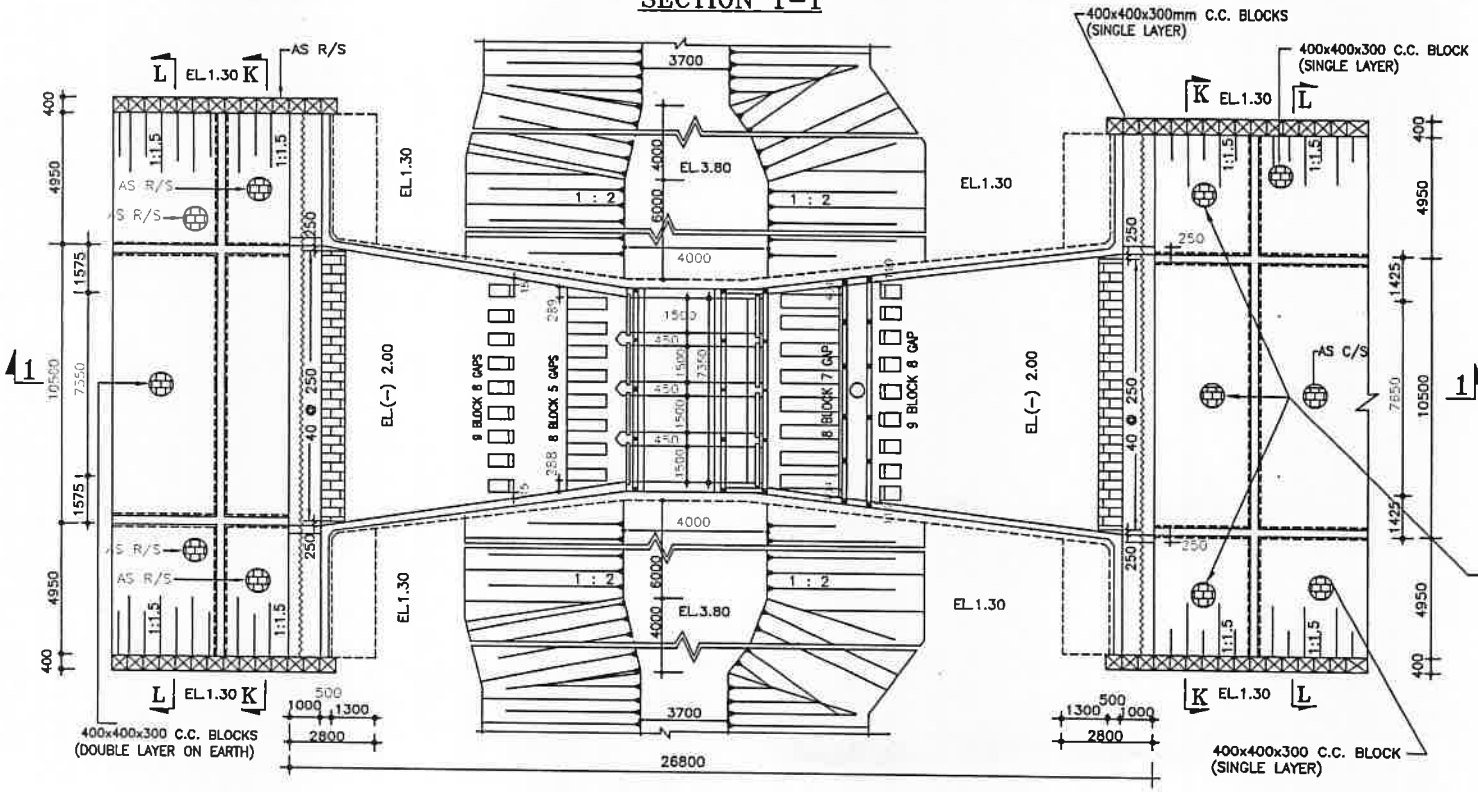
G. W. T. 2.10m

DISTURBE D SAMPLE ☐ UNDISTURBE D SAMPLE ■

GENERAL PLAN & LONG SECTION



SECTION 1-1



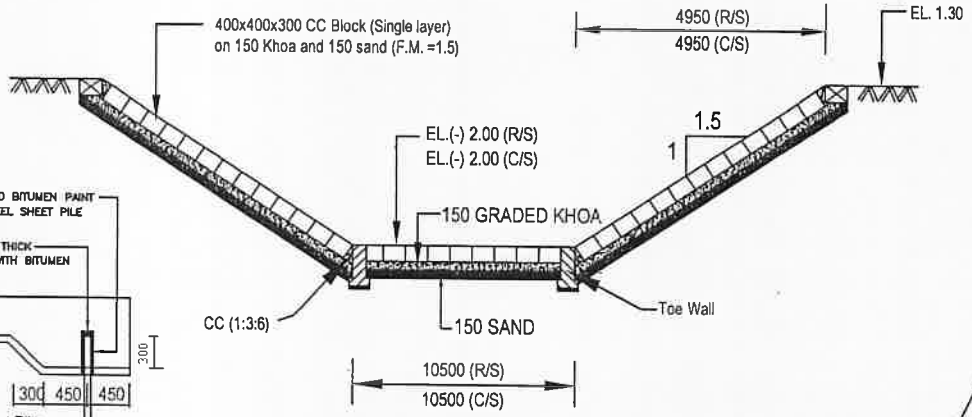
GENERAL PLAN

SPECIFICATION & NOTES ON MATERIAL & WORK

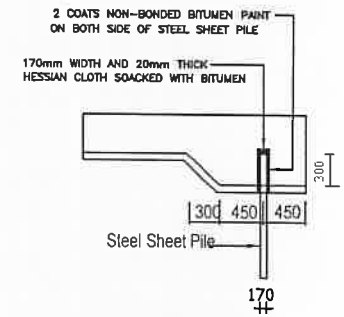
1. R.C.C WORKS:	All R.C.C WORKS	R.C.C PILES	LEAN CONCRETE
A. Concrete : I) Strength:	28-days standard cylinder crushing strength shall be 17 N/mm²	28-days standard cylinder crushing strength shall be 20.7 N/mm²	--
II) Proportion by volume	1:2:4	1:1.5:3	1:3:6
III) Cement	Portland Type-1	Portland Type-1	Portland Type-1
iv) Coarse aggregate	20mm down graded crushed stone chips (Well graded between 20mm & 8mm size.) (LAA value not more than 30)	20mm down graded crushed stone chips (Well graded between 20mm & 8mm size.)	20mm down graded brick chips (well graded between 20mm & 8mm size.)
v) Sand	FM >1.80	FM >1.80	FM> 1.00
vi) Slump: (at work)	60-75 mm	60-75 mm (Precast) 100-125mm (cast-in situ)	60-75 mm
B. Reinforcement	40 grade deformed M.S. bar	40 grade deformed M.S. bar	
	Minimum yield strength 275 N/mm		
	No hook should be used for M.S deformed bars.		

2. Clear concrete cover over reinforcement bars shall be :
   - Earth faces = 75mm
   - Water faces = 50mm
   - All other faces = 25mm
   - R.C.C Piles = 40mm
3. C.C. Bolcks : C.C blocks with cement sand (FM>1.5) and singles (40 mm down graded) with proportion 1:3:6
4. Back filling : Back filling outside abutments, wing walls and return walls up to FGL shall be done simultaneously on both sides with local sandy soil and should be free from vegetable roots and other organic materials, as soon as wall lifts are constructed.
5. Foundation Treatment : Foundation treatment to be done as per design drawing
6. Strength : During pouring samples shall be collected by the contractor in presence of Engineer-in-charge in standard cylinder, one for each wing wall, abutment, return wall, top slab, apron and barrel foundation for testing 7day strengths for quality control.
7. Protective work : Earthfill in side slopes shall be compacted in horizontal layers to the satisfaction of the Engineer-in-charge before placing filter material and blocks.
8. Filter Materials : i) Brick Chips : 20mm to 40mm Size (LAA Value <40) ii) Sand : Coarse Sand (FM = 1.50)
9. Elevations : All elevations are in meter (PWD).
10. Dimensions : All dimensions are in millimeters.
11. Embedded : M.S. embedded parts such as angles, channels for gates welded to anchor bars shall be installed in proper alignment during casting of concrete as shown in working drawings.
12. Formwork : Formwork of Concrete for making shuttering fully leak proof, shall be faced with plain 28/28 gauge steel sheet fitted over 38 mm. thick wooden plank, panels suitably braced or steel framing faced with minimum 12/14 BWDG mild steel sheet. Formwork for C.C blocks shall be fabricated from m.s. steel of sufficient thickness to prevent any distortion.

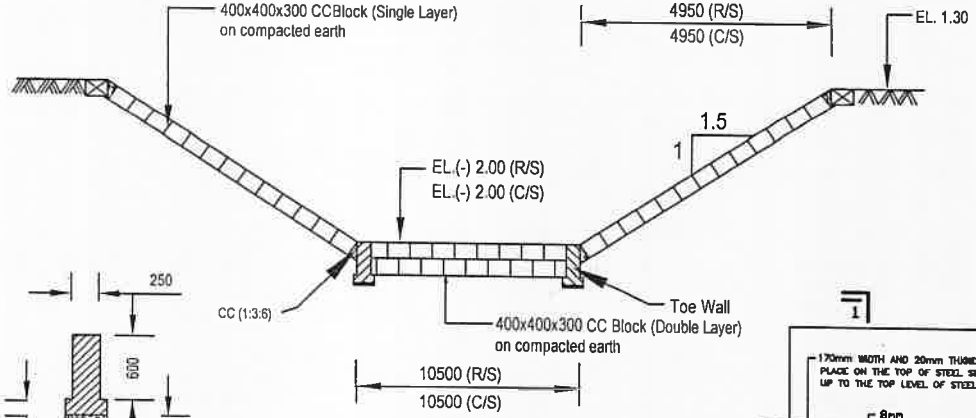
PROTECTIVE WORK DETAILS



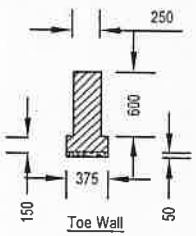
SECTION K-K

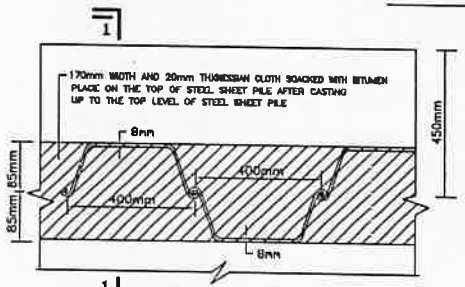


SECTION 1–1
(TYPICAL)

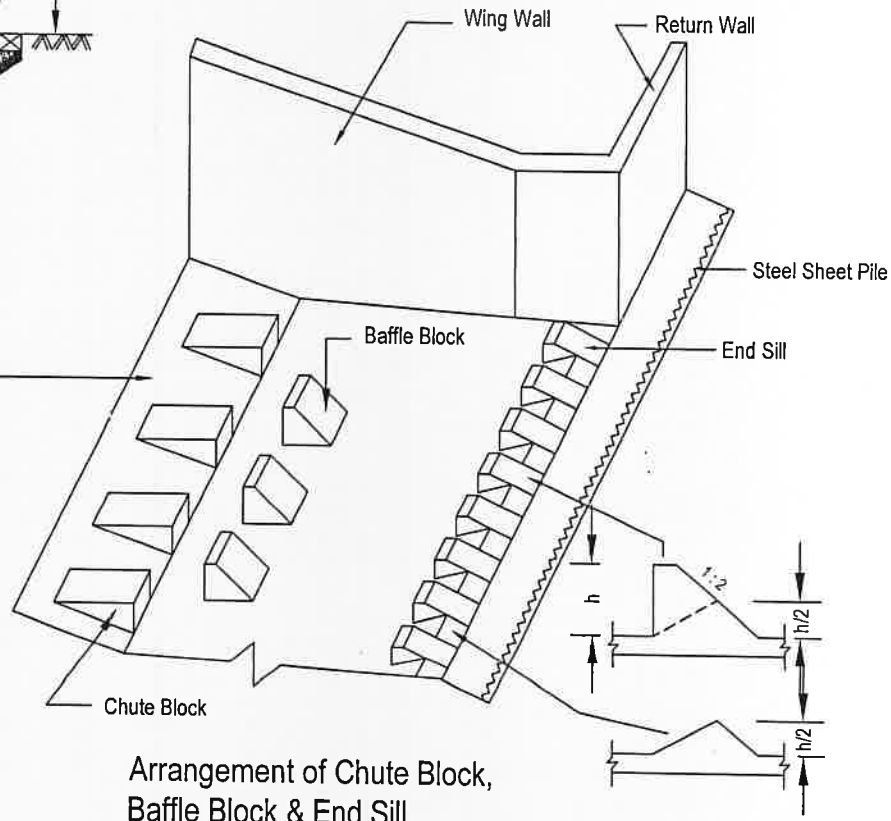


SECTION L- L



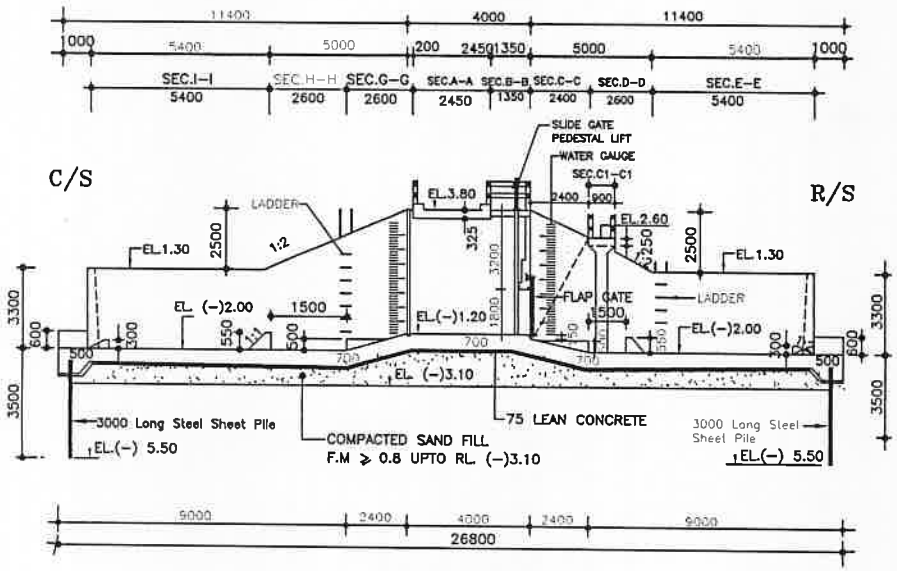


STEEL SHEET PILE

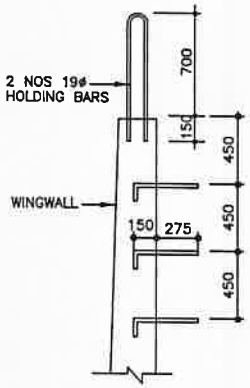


Arrangement of Chute Block,
Baffle Block & End Sill

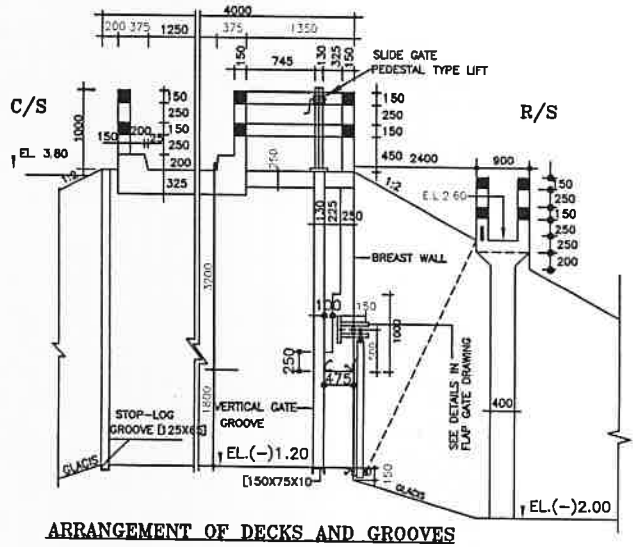
SECTION LIMIT DETAILS



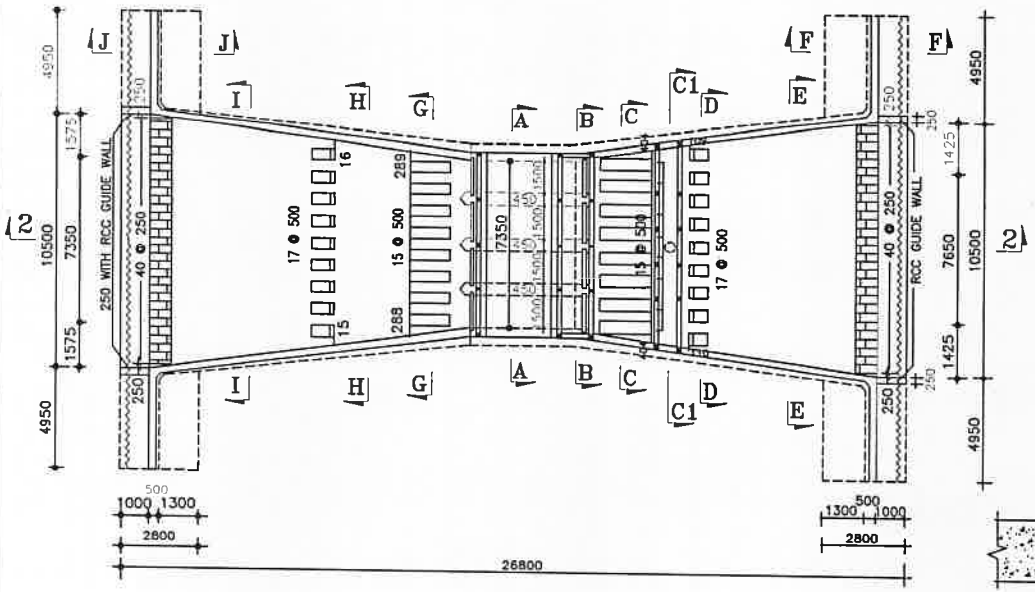
SECTION 2-2



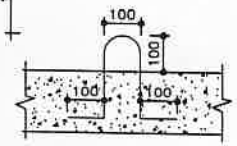
DETAIL OF LADDER



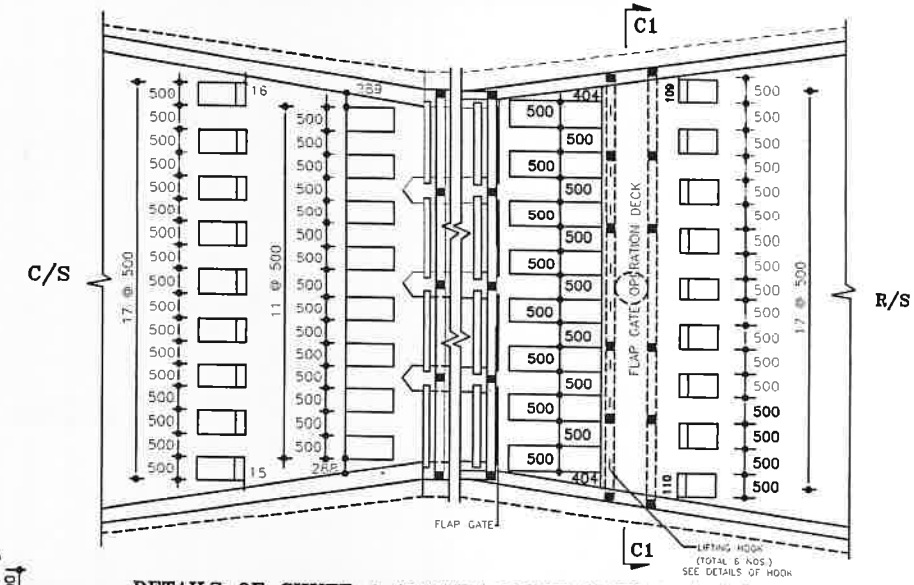
ARRANGEMENT OF DECKS AND GROOVES



PLAN

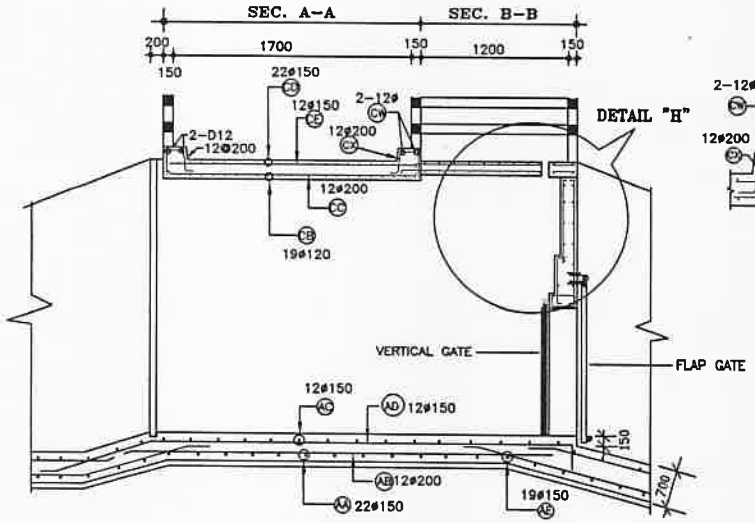


DETAILS OF HOOK

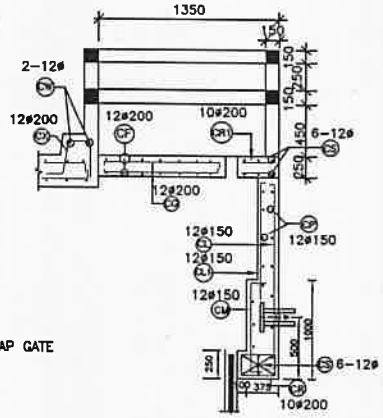


DETAILS OF CHUTE & BUFFLE BLOCK (C/S) & (R/S)

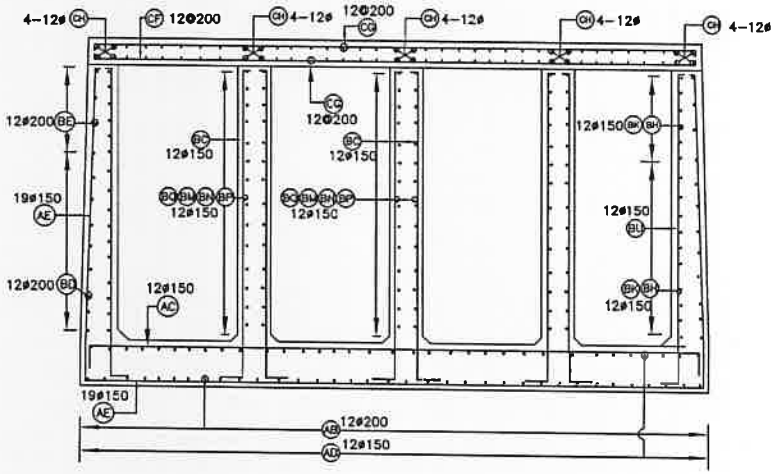
REINF. DETAILS (BOX-PART)



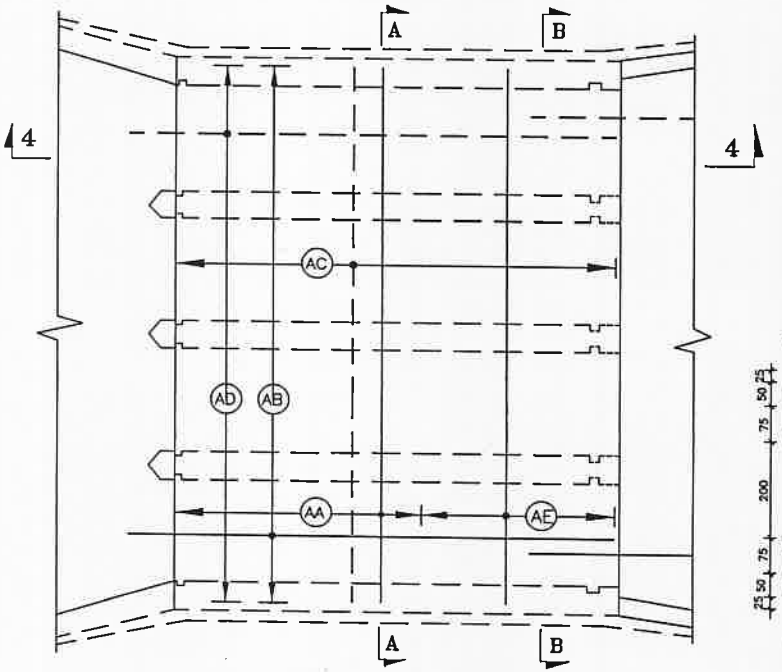
SECTION 4-4



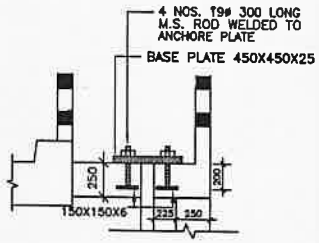
DETAILS "H"
OPERATION DECK SLAB
REINF. DETAILS



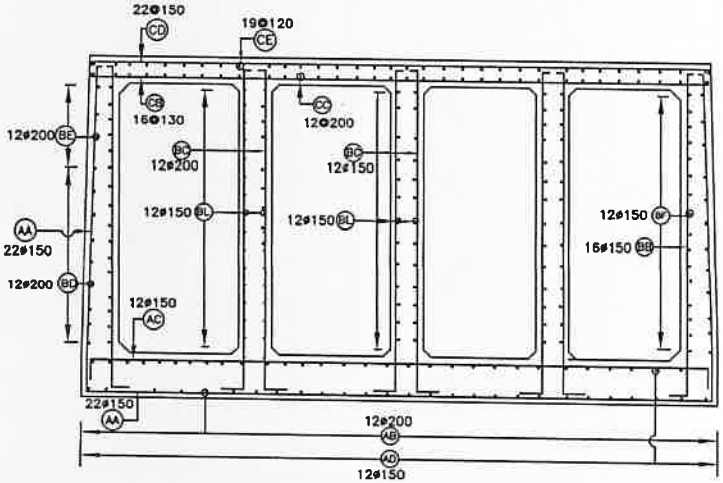
SECTION. B-B



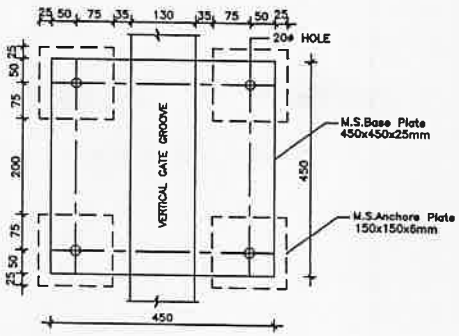
BASE SLAB
(BOX PART)



SECTION OF BASE PLATE
AND ANCHORE PLATE OF
OPERATING DECK

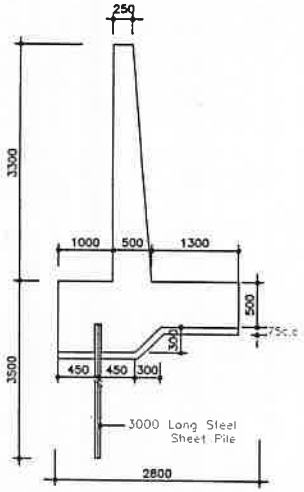


SECTION. A-A

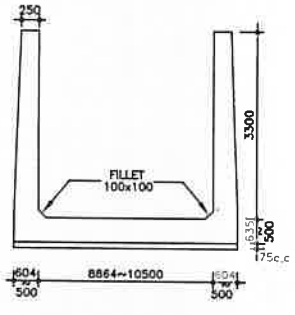


DETAILS OF A

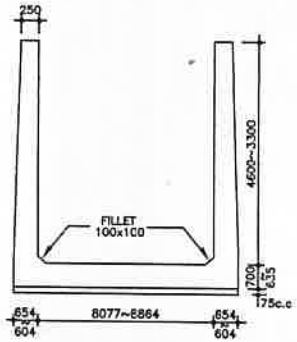
CONCRETE SECTION DETAILS



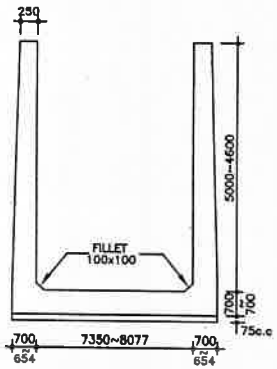
SECTION J-J (C/S)



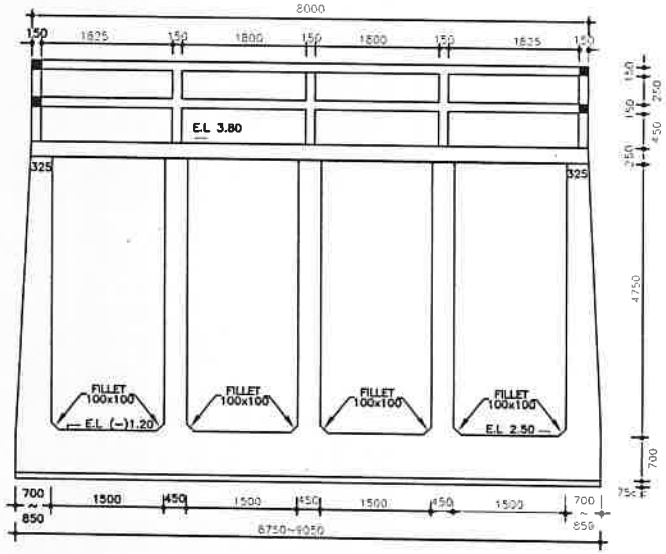
SECTION I-I(C/S)



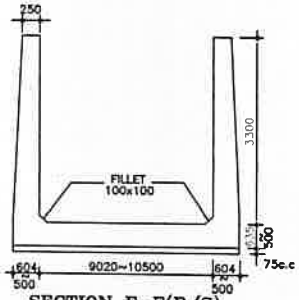
SECTION H-H(C/S)



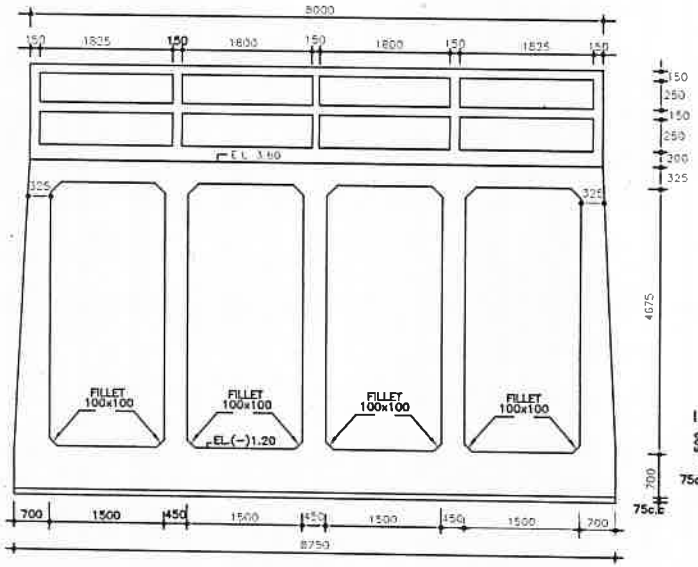
SECTION G-G (C/S)



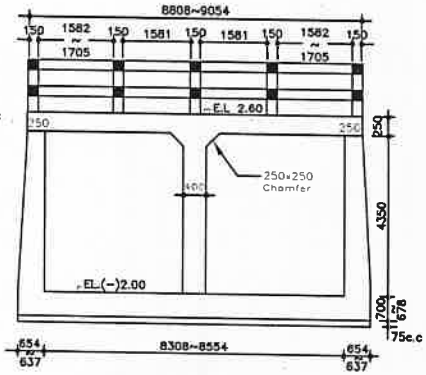
SECTION B-B



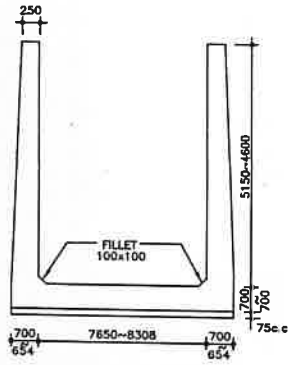
SECTION E-E(R/S)



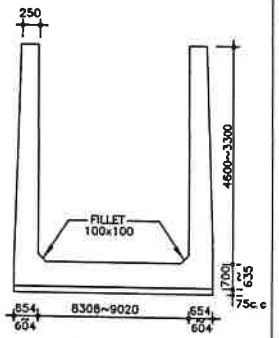
SECTION A-A



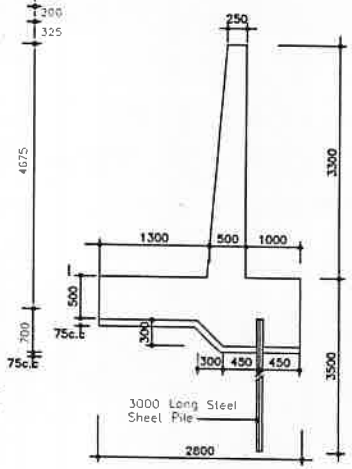
SECTION C1-C1(R/S)



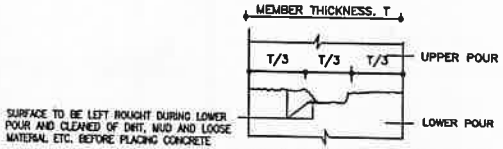
SECTION C-C (R/S)



SECTION D-D(R/S)

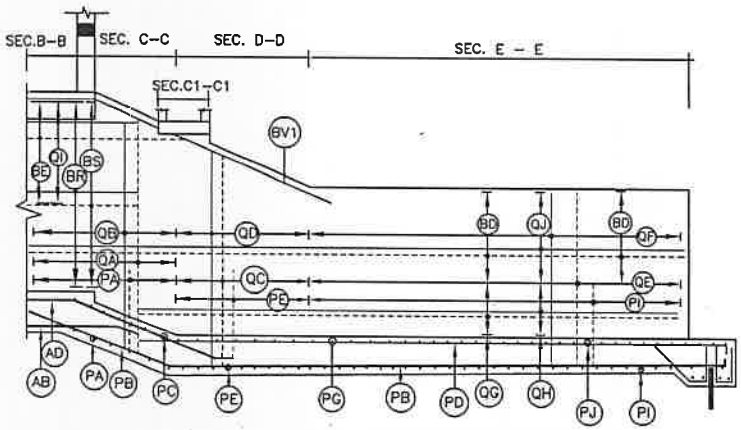


SECTION F-F (R/S)

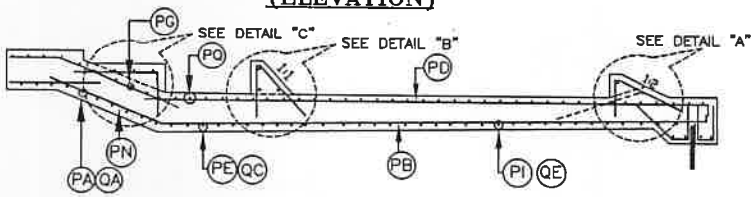


DETAILS OF CONSTRUCTION JOINTS (TYPICAL)

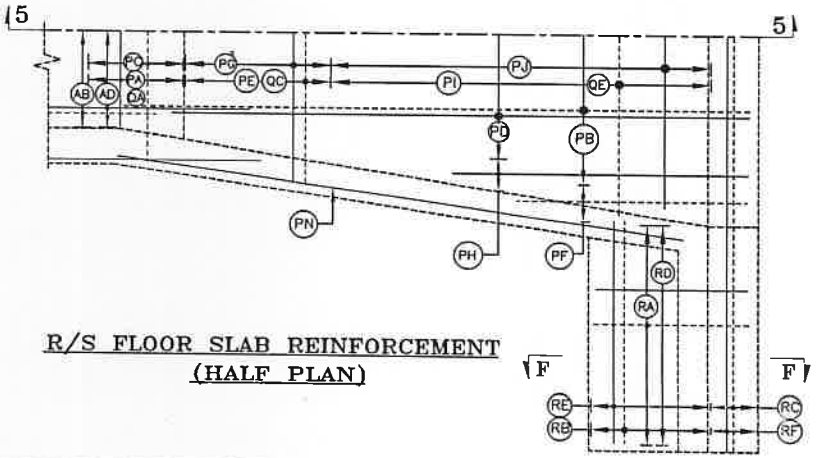
REINF. DETAILS (R/S FLOOR & WING WALL)



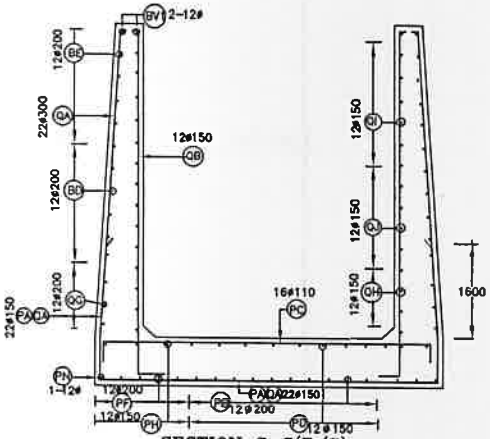
R/S WINGWALL REINFORCEMENT
(ELEVATION)



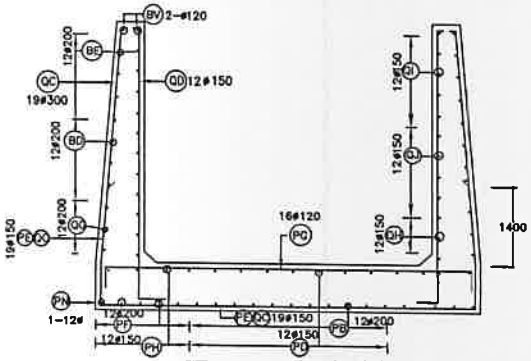
SEC. 5-5



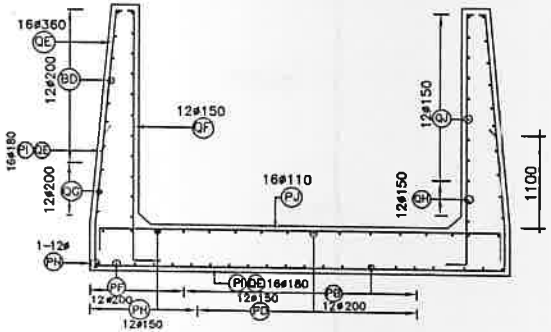
R/S FLOOR SLAB REINFORCEMENT
(HALF PLAN)



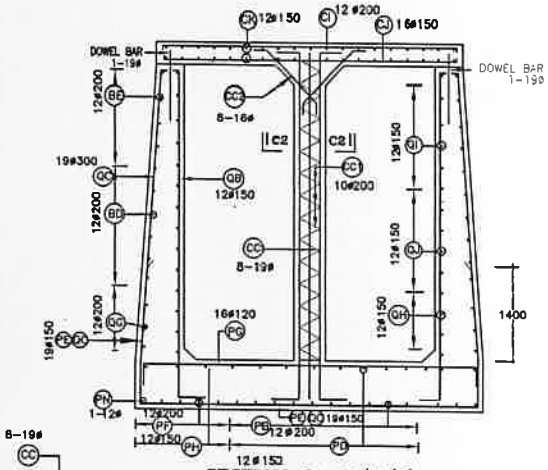
SECTION C-C(R/S)



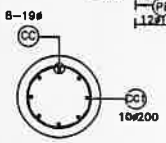
SECTION D-D(R/S)



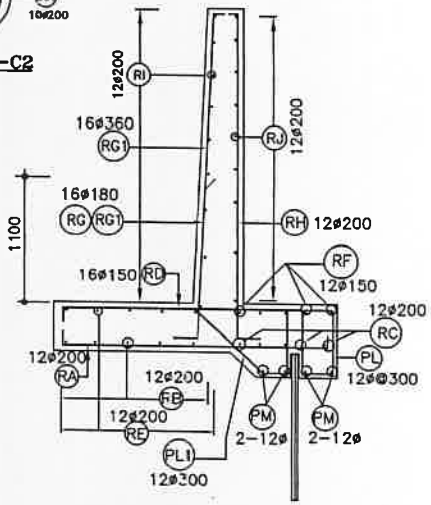
SECTION E-E(R/S)



SECTION C1-C1(R/S)

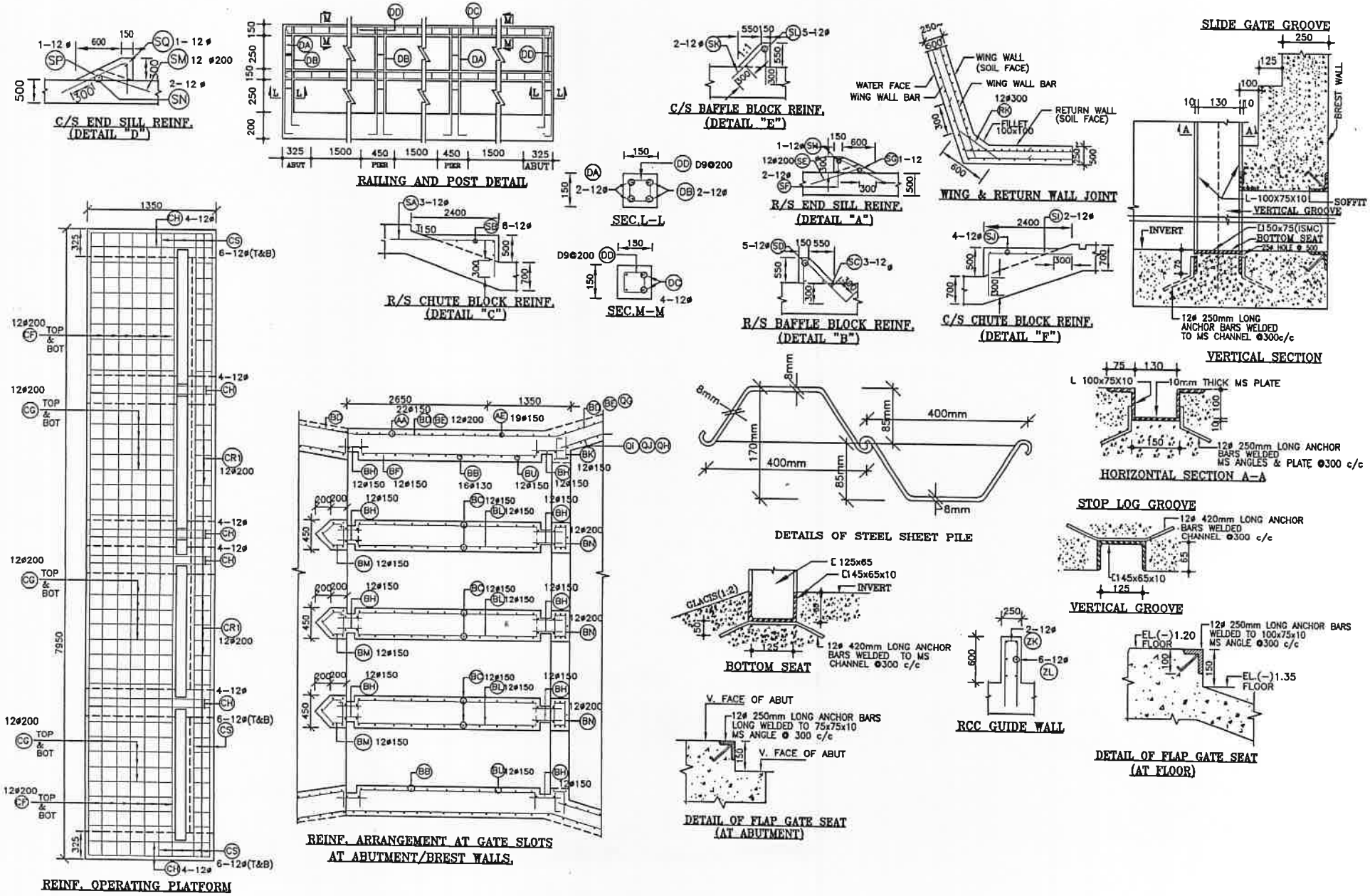


SEC.C2-C2

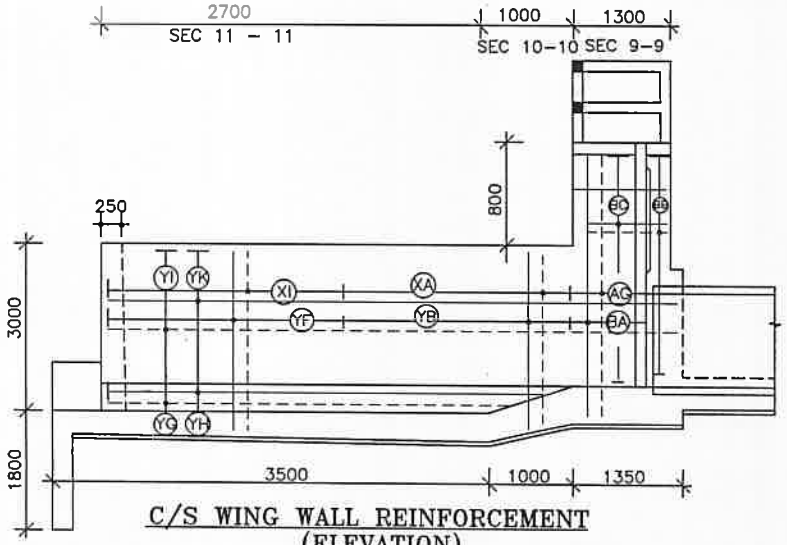


SECTION F-F(R/S)

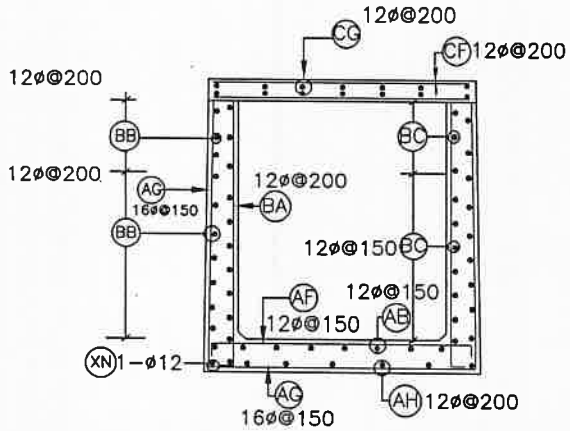
MISCELLANEOUS DETAIL



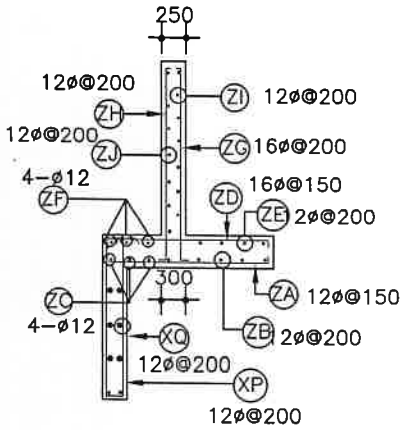
C/S WING WALL & FLOOR



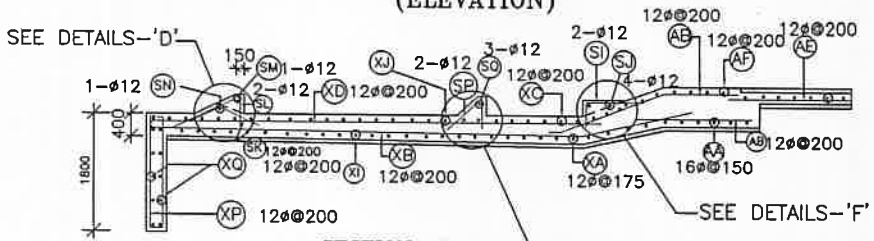
C/S WING WALL REINFORCEMENT
(ELEVATION)



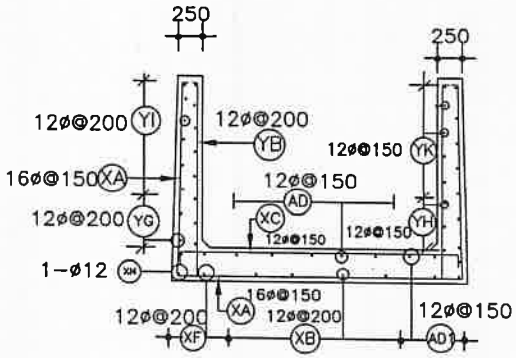
SECTION 9–9 (C/S)



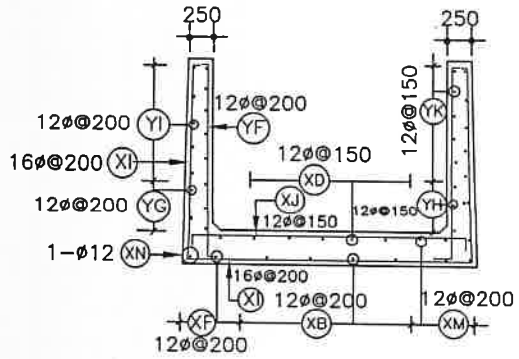
SECTION 12–12



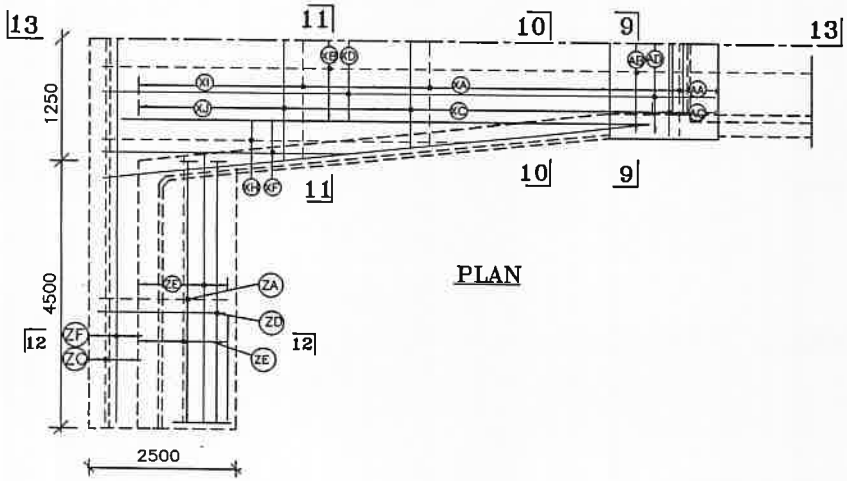
SECTION 13–13



SECTION 10–10 (C/S)

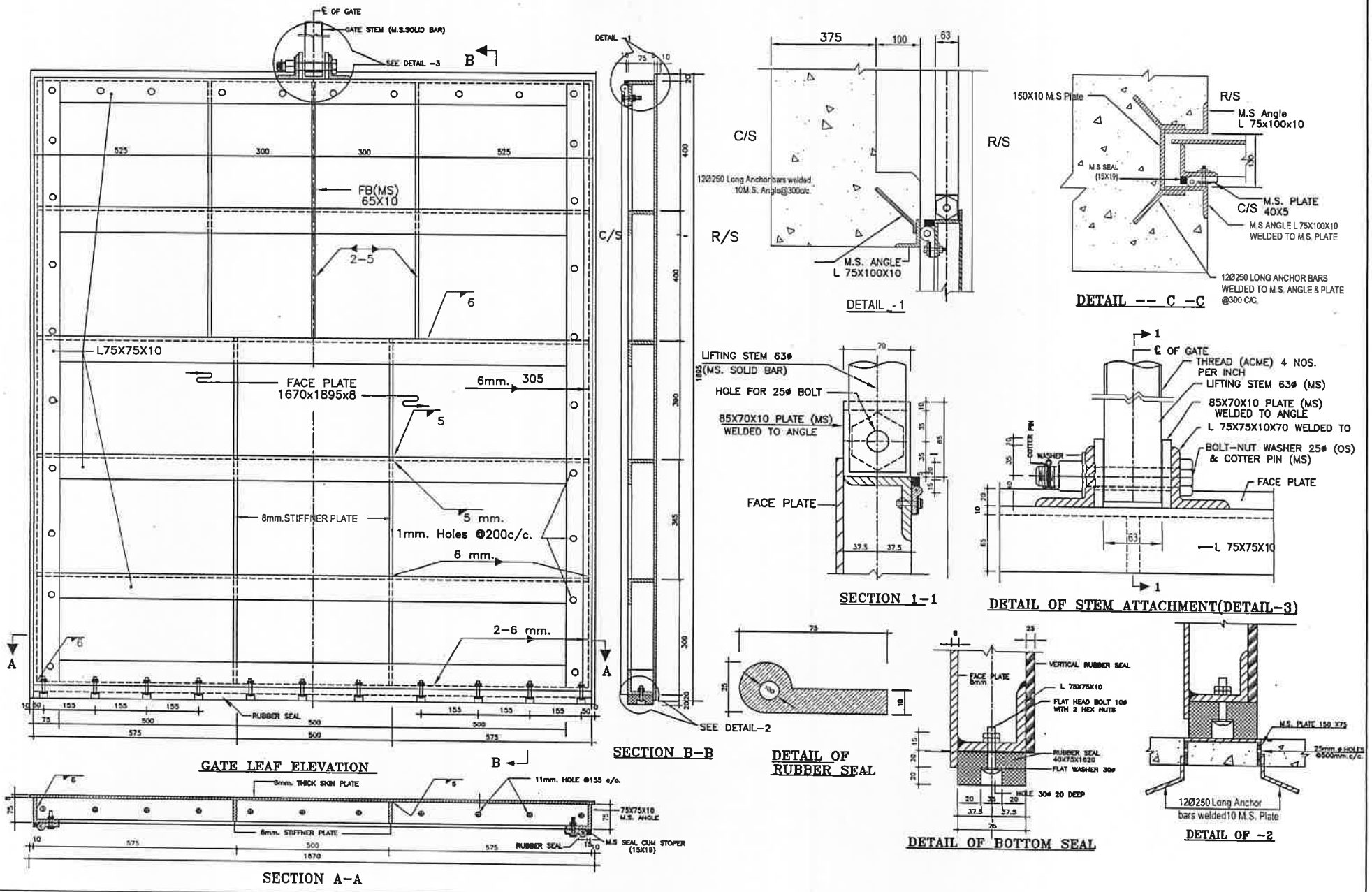


SECTION 11–11 (C/S)

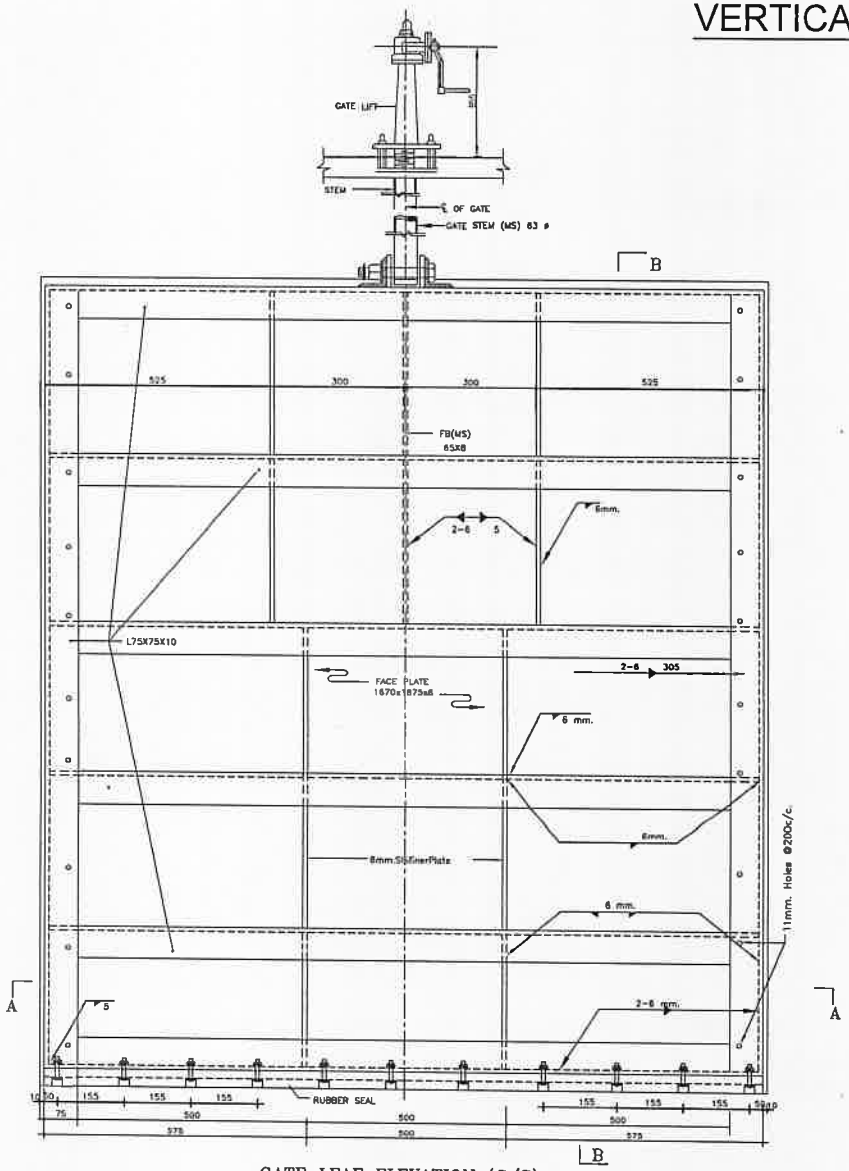


PLAN

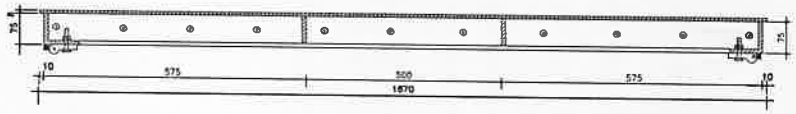
VERTICAL LIFT GATE – 1



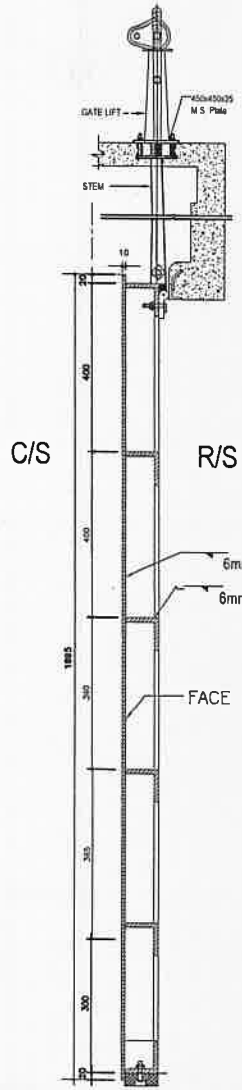
VERTICAL GATE-2



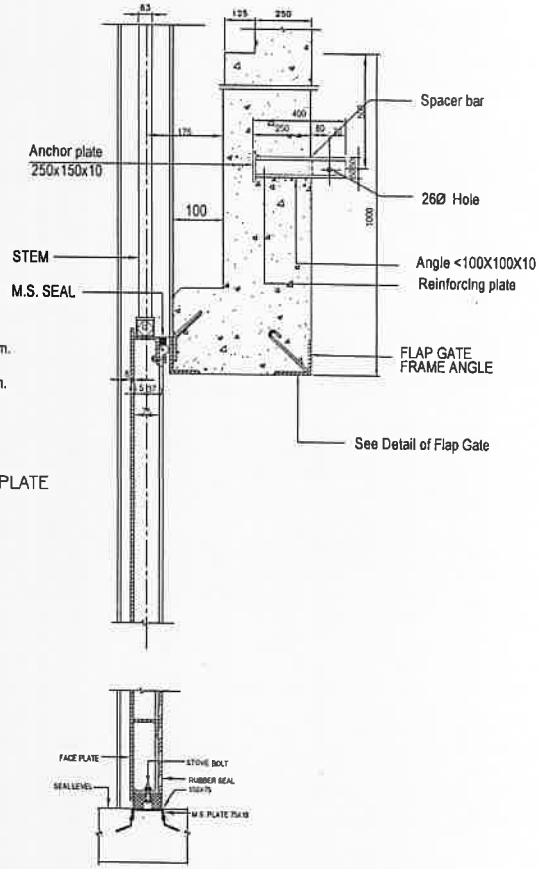
GATE LEAF ELEVATION (C/S)



SECTION A-A

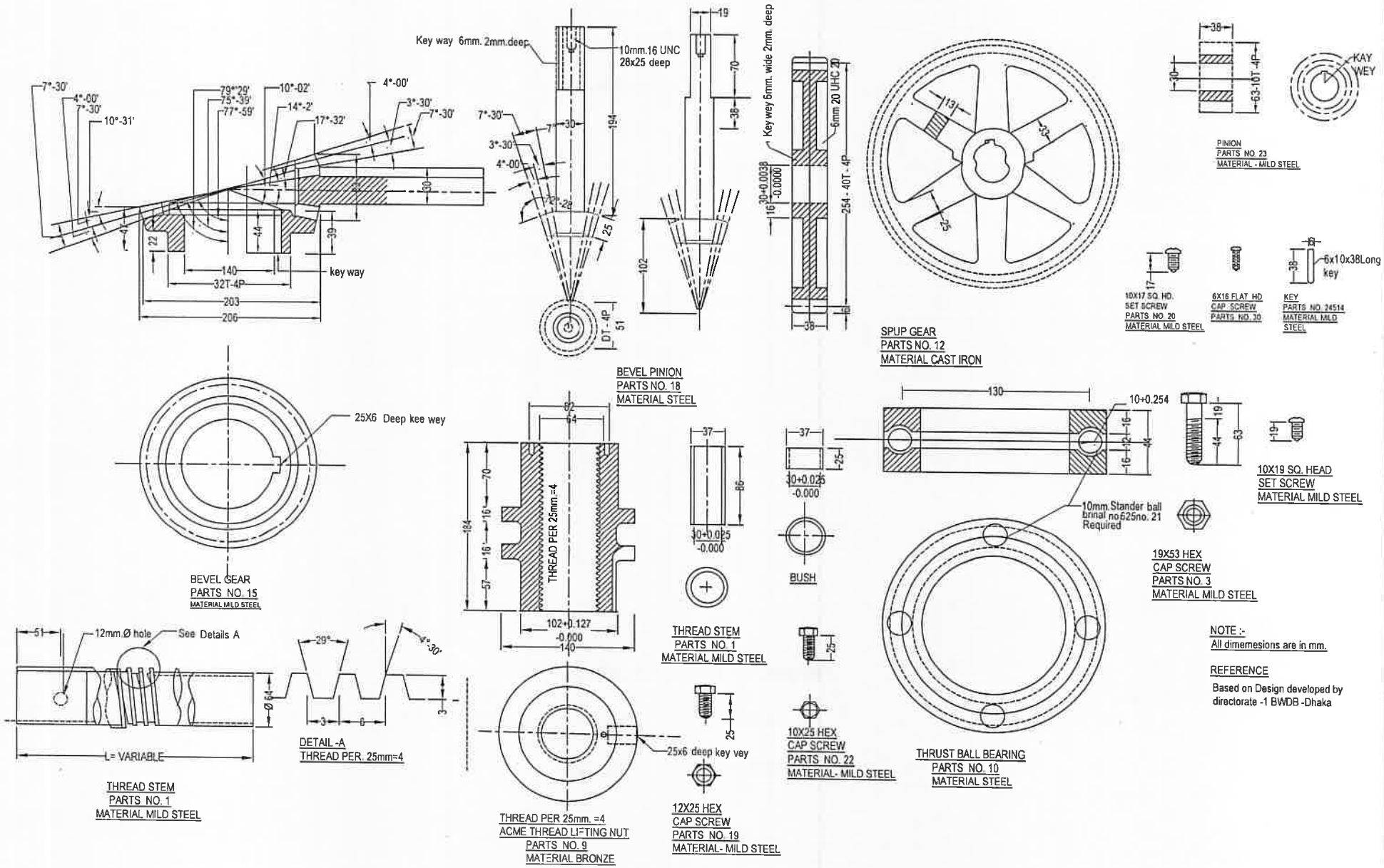


SECTION B-B



DETAILS OF BOTTOM SEAL ,SIDE RUBBER SEAL ,
M.S. SEAL FLAP GATE ANCHOR & BREAST WALL

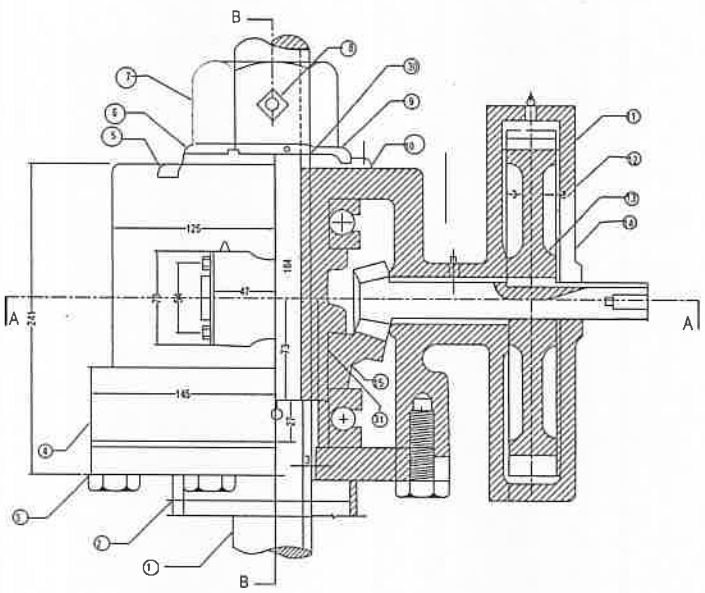
VERTICAL LIFT GATE-3



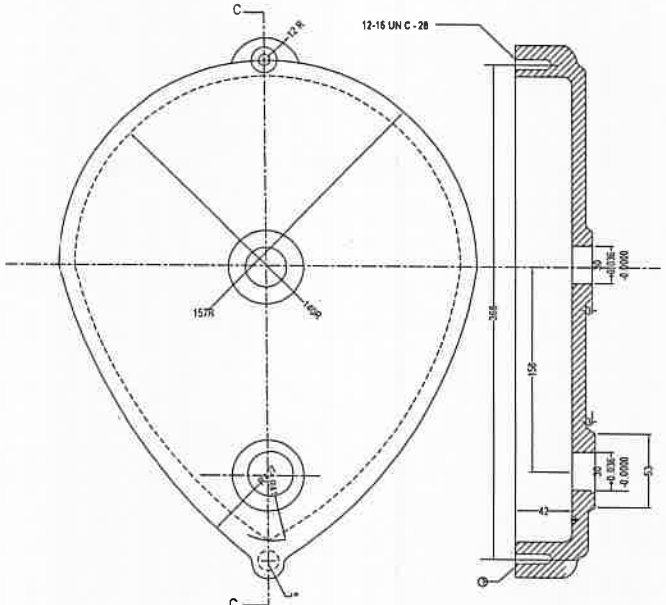
NOTE :-
All dimemesions are in mm.

REFERENCE
Based on Design developed by directorate -1 BWDB -Dhaka

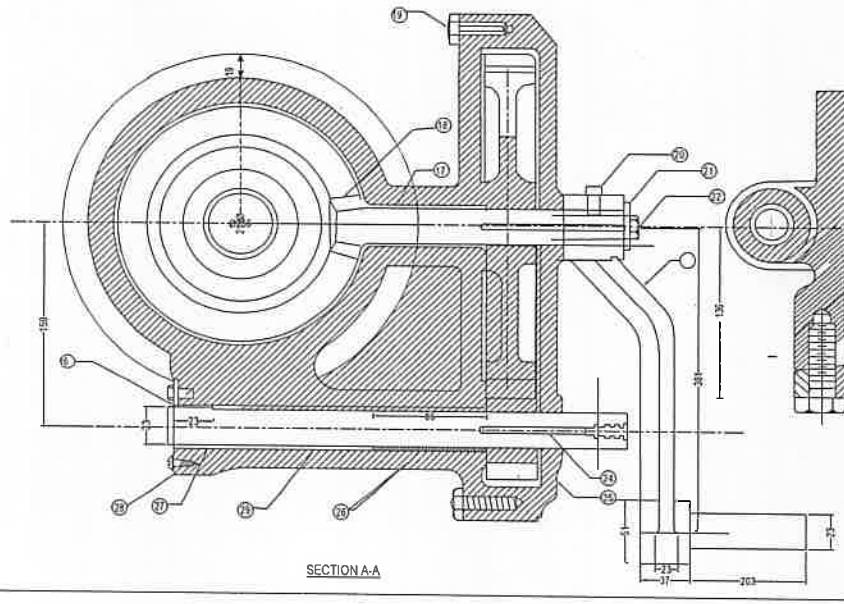
VERTICAL LIFT GATE-4



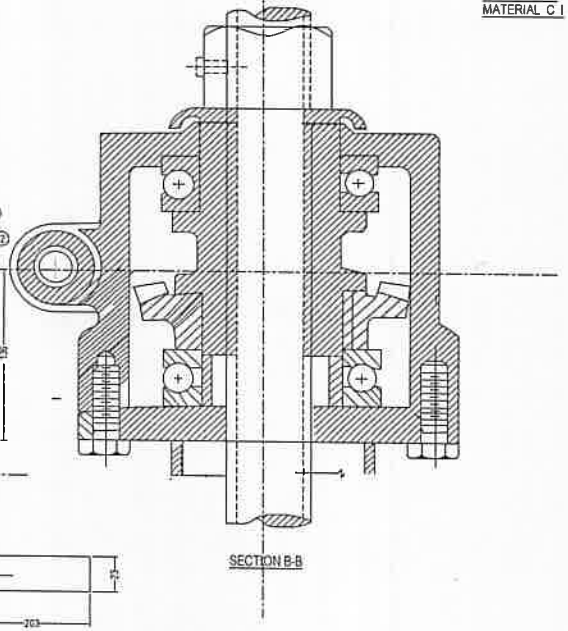
HALF ELEVATION



SECTION C - C
GEAR COVER
PARTS NO.11
MATERIAL C I



SECTION A-A



SECTION B-B

PARTS LIST					
P.C.NO	N A M E	QTY	MAT.	P/M	REMARKS
1	THREADED STEM	1	MS	M	ASI 1020
2	PEDESTAL	1	MS	M	STRUCTURAL
3	HEX HD CAP SCROW	10	MS	P	STRUCTURAL
4	BOWL	1	C.I	M	ASTM 30
5	GREASE FITTING	9	—	P	ASTM 30
6	RAIN SHIELD	1	C.I	M	ASTM 30
7	64mm. HEX STOP UNIT	1	MS	M	STRUCTURAL
8	10mm SQUARE HEAD SET SCREW	1	MS	M	STRUCTURAL
9	LIFT NUT	1	BRONZ	M	ASTM 30
10	THAUST BALL BEARING	2	—	M	—
11	GEAR COVER	1	C.I	M	ASTM 30
12	SPUR GEAR	1	C.I	M	ASTM 30
13	6mm. ALLEN HEAD SET SCREW	1	MS	M	STRUCTURAL
14	KEY	1	MS	M	STRUCTURAL
15	DEYEL GEAR	1	MS	P	AISI 2317
16	6mm. HEX HD. CAP SCREW	4	MS	M	STRUCTURAL
17	BRONZE DRUSHINGS	1	BRONZ	M	SAE 64
18	PINION AND SHAFT	1	MS	M	STRUCTURAL
19	12mm. HEX HD. CAP SCREW	2	MS	P	STRUCTURAL
20	10mm SQ. HD SET SCREW	1	MS	M	STRUCTURAL
21	LOCK WASHER	1	MS	M	STRUCTURAL
22	10mm. CAP SCREW	1	MS	P	—
23	CRANK	1	MS	M	STRUCTURAL
24	KEY	1	MS	M	STRUCTURAL
25	PINION	1	MS	M	STRUCTURAL
26	BRONZE BRUSHINGS	1	BRONZ		SAE 64
27	BRONZE BRUSHINGS	1	BRONZ	M	SAE 64
28	LOCK WASHER	1	BRONZ	M	SAE 64
29	PINION	1	MS	M	AISI 1020
30	6mm FLAT HEAD CAP SCREW	2	MS	M	STRUCTURAL
31	KEY	1	MS	M	STRUCTURAL

* Std , thrust bearings of nearest dimension may be used necessary alteration of other members for this shall have to be approved before manufacture.

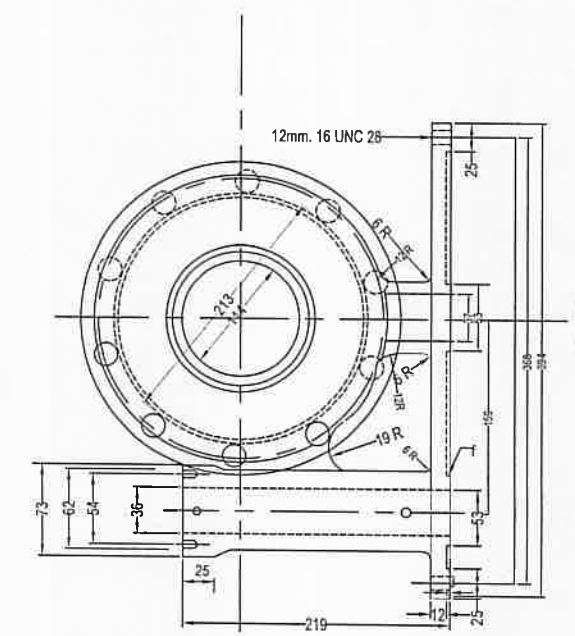
NOTE :

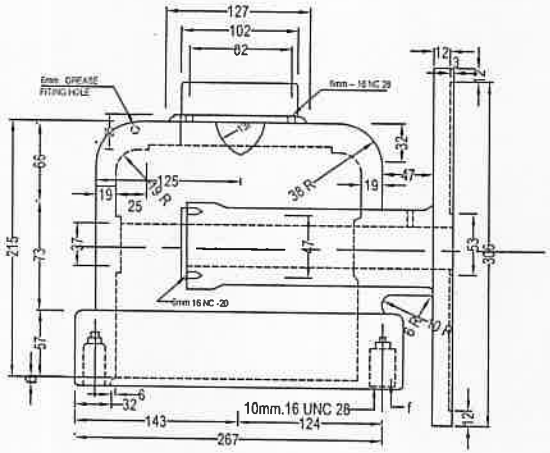
1. For other notes see drg. no
2. All dimension s are in mm.

REFERENCE :-

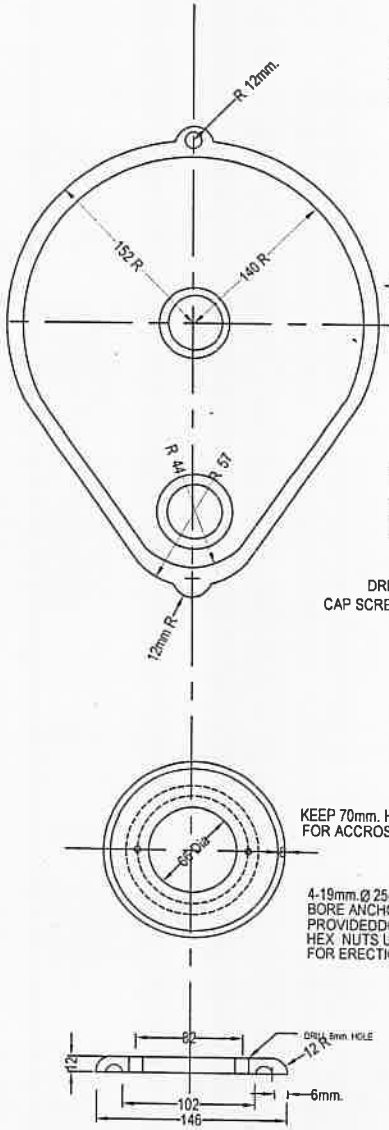
Based on Design developed by Design Directorate -1 , BWDB, Dhaka.

VERTICAL LIFT GATE-5

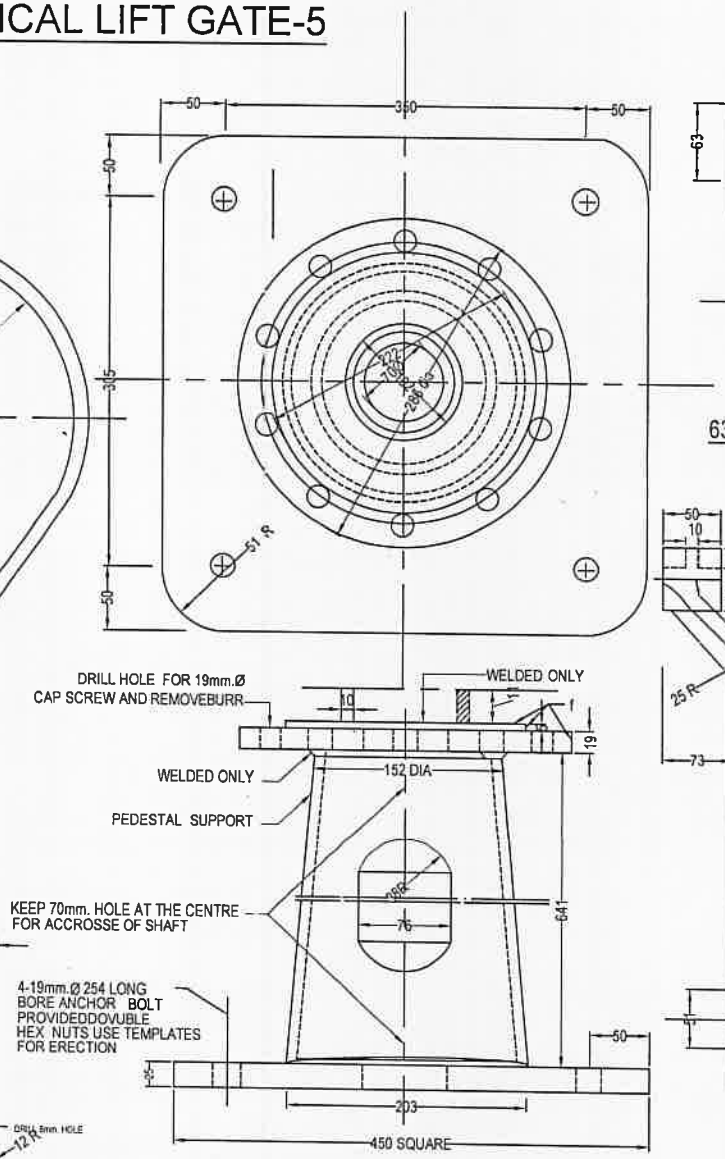


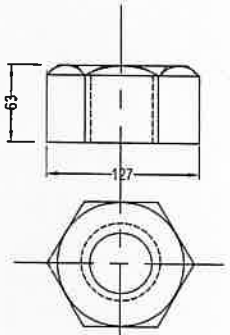


BOWL
PARTS NO. 4
MAT C. I.

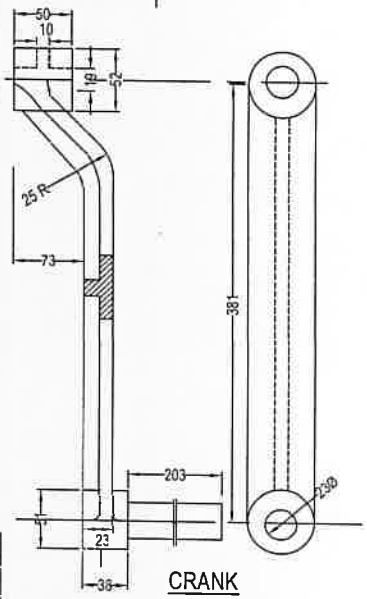


RAIN SHIELD
PARTS NO. 6
MAT C. I.



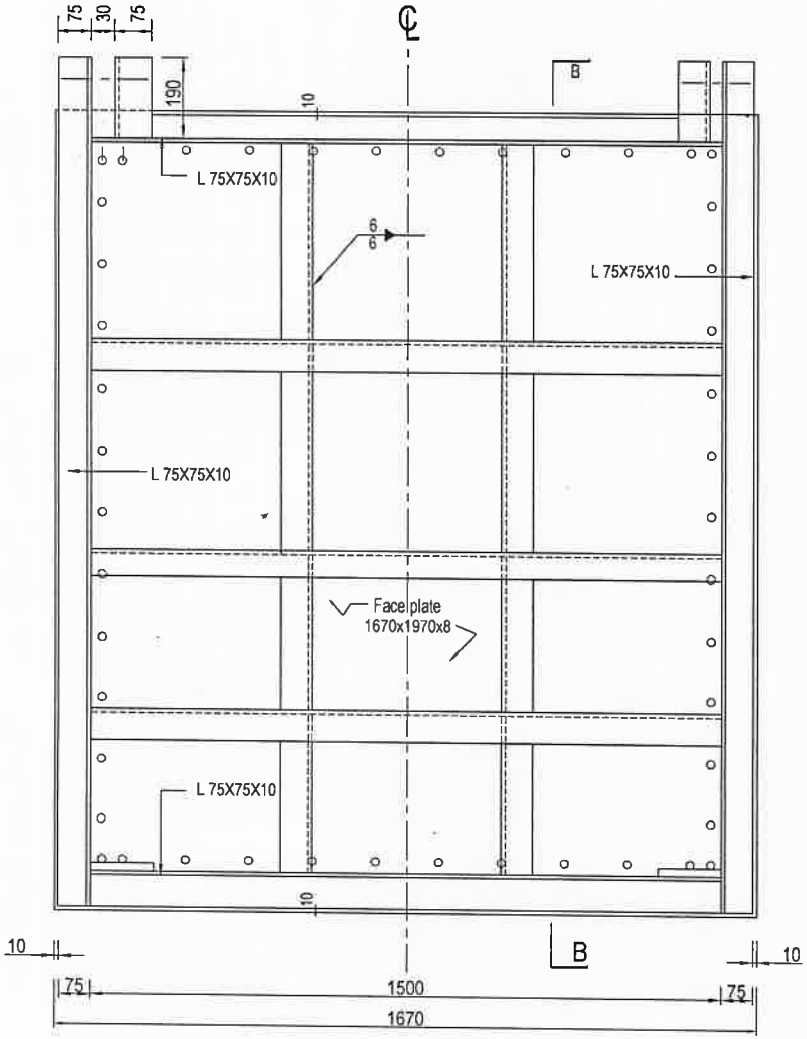


63 mm.HEX STOP NUT
PARTS NO. 7
MAT M. S.

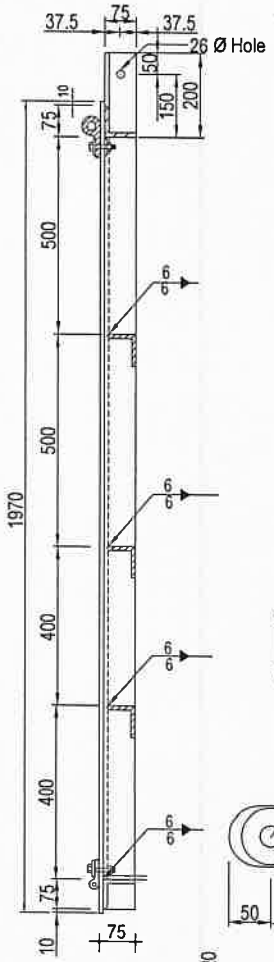


CRANK
PARTS NO. 23
HAT.M.S.

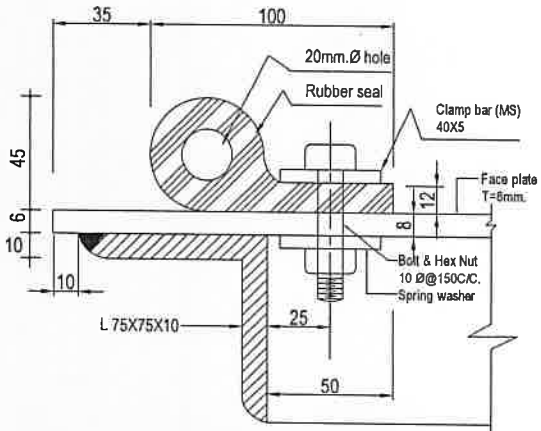
FLAP GATE



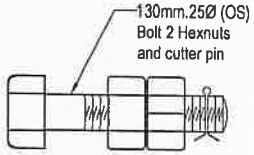
ELEVATION (R/S.)



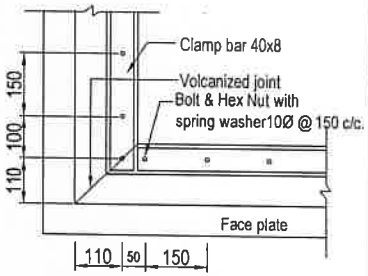
SECTION B-B



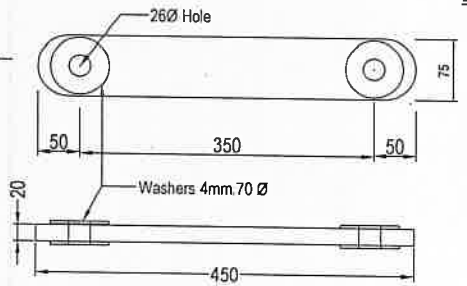
DETAIL OF RUBBER SEAL ATTAHMENT
(SECTION)



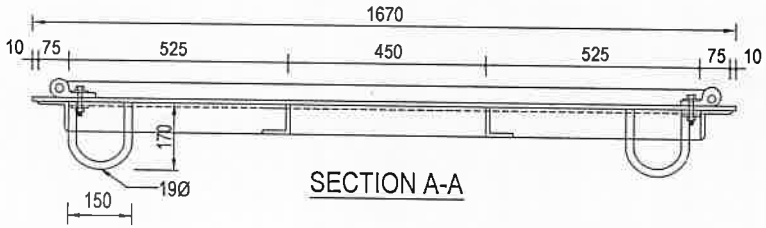
LNK BOLT (4NOS)



DETAIL OF RUBBER SEAL ATTAHMENT
(FACE PLATE ELEVATION)

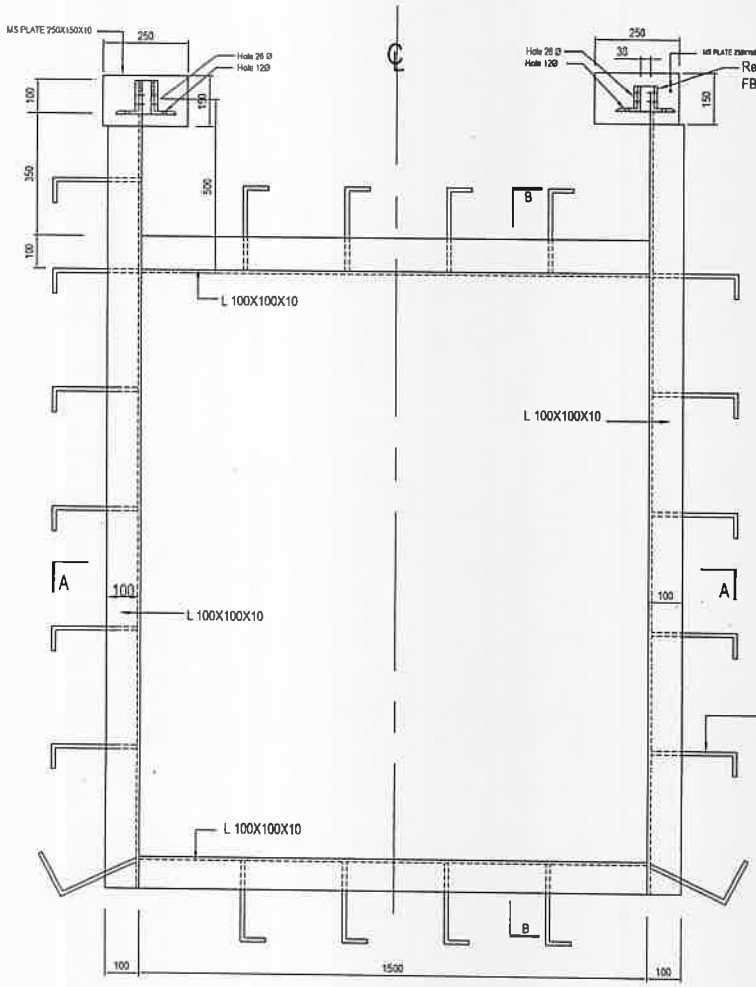


GATE LINK (2 NOS.)

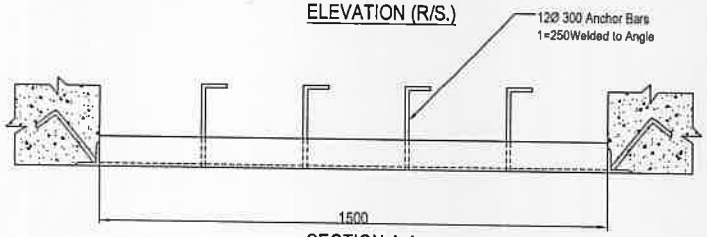


SECTION A-A

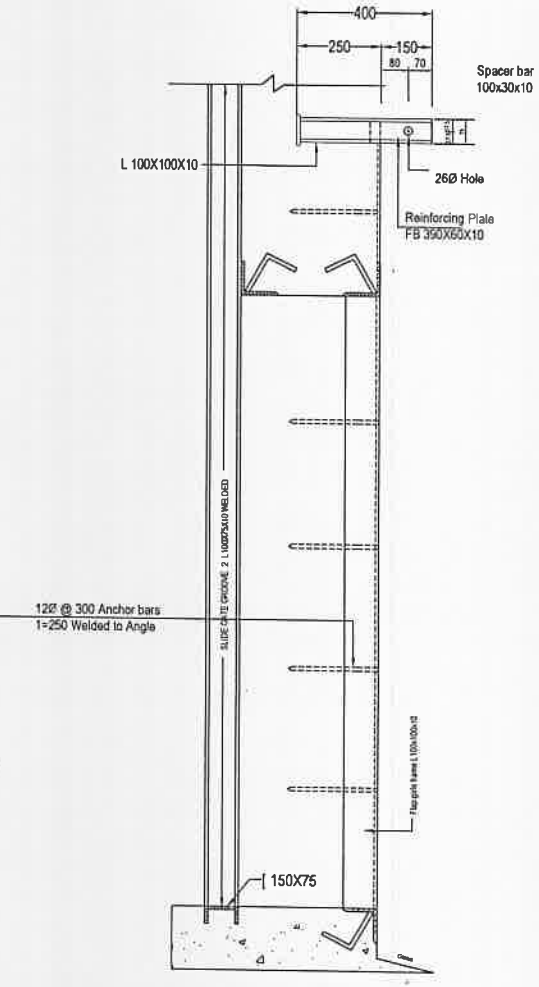
FLAP GATE FRAME



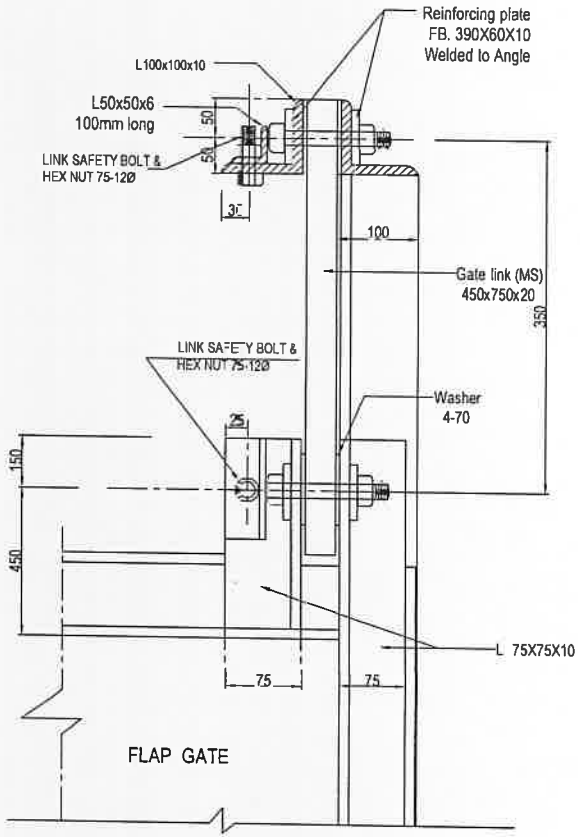
ELEVATION (R/S.)



SECTION A-A



SECTION B-B



DETAIL OF GATE ATTACHMENT

Government of the People's Republic of Bangladesh
Local Government Engineering Department

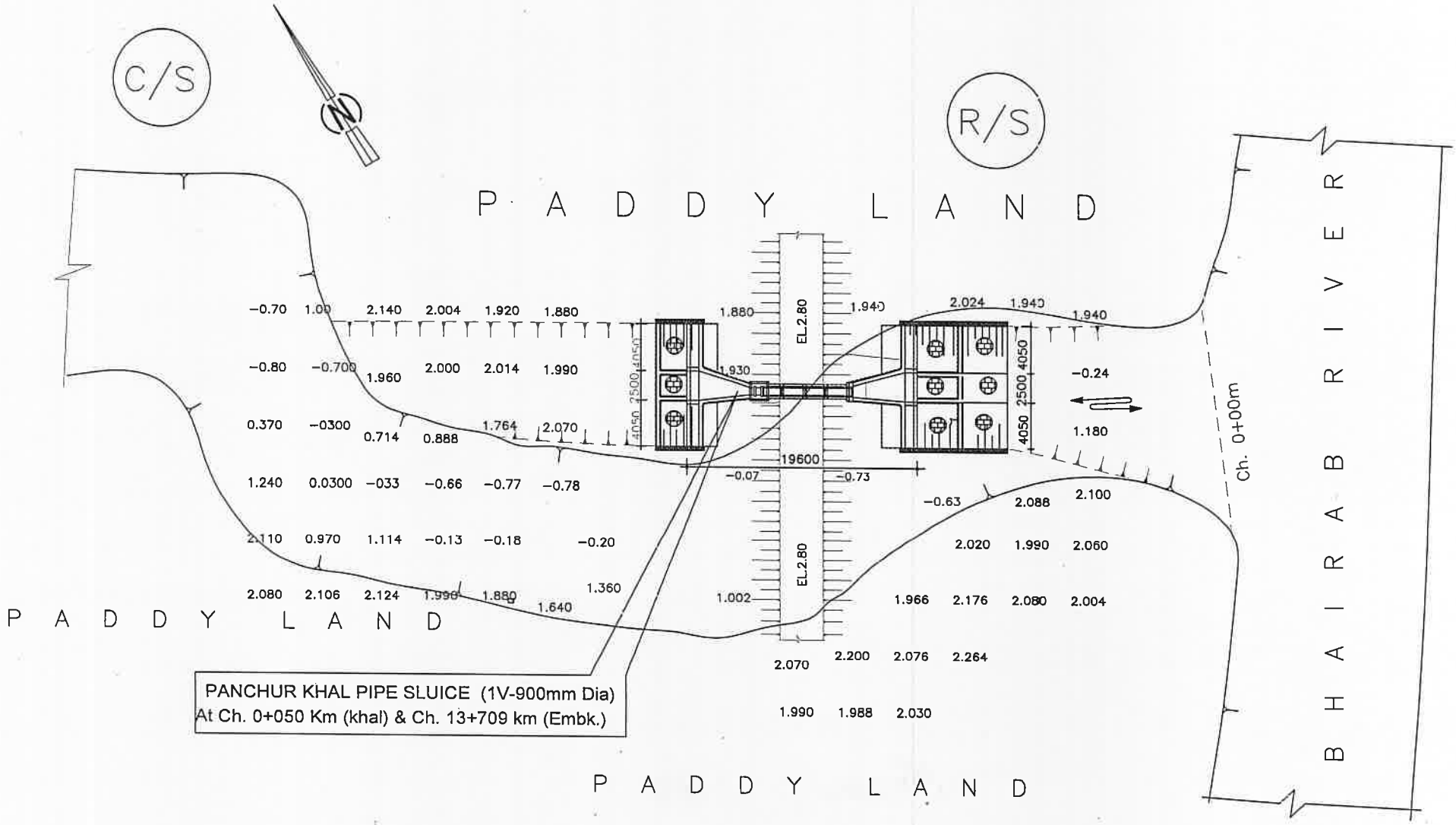
Small Scale Water Resources Development Project (Jica-2)

RDEC Bhaban (Level-6), Agargaon, Shere-Bangla Nagar
Dhaka-1207

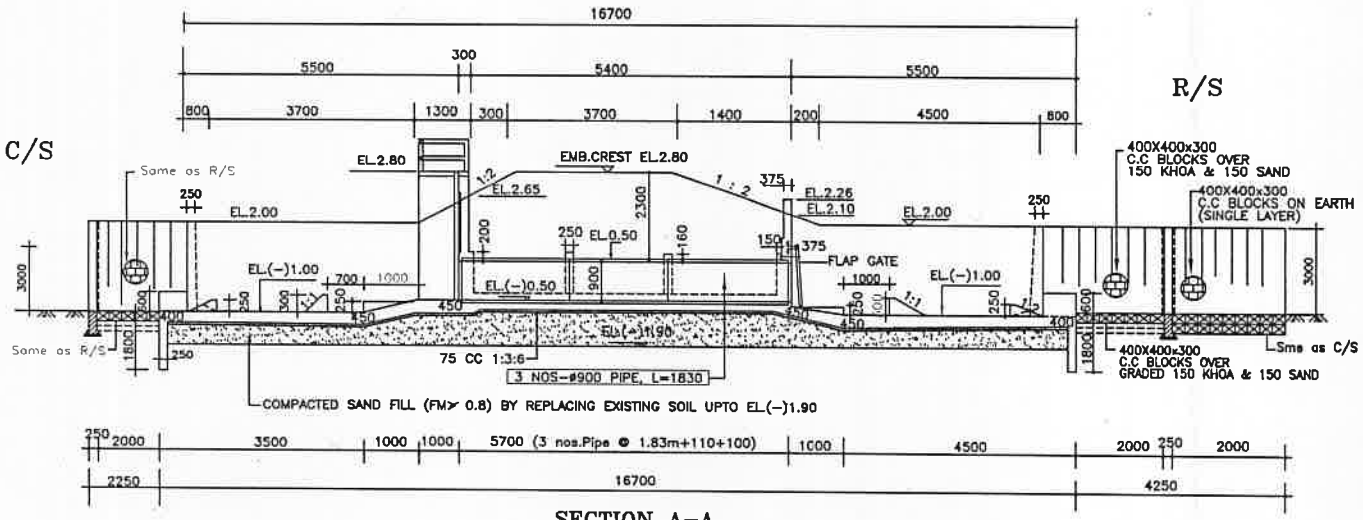
DETAIL DRAWINGS OF

PIPE SLUICE (size : 1v-900mm dia)

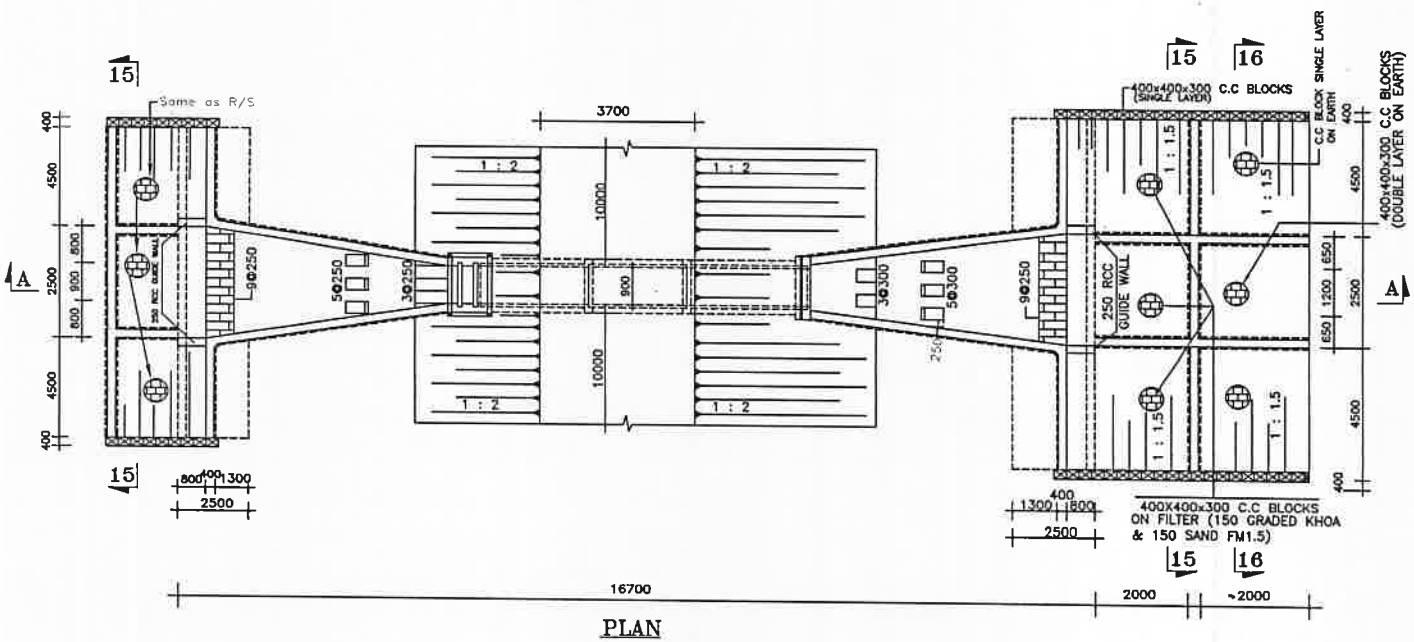
LAYOUT PLAN


C/S
R/S
N
P A D D Y L A N D
P A D D Y L A N D
P A D D Y L A N D
B H A I R A B R I V E R
Ch. 0+00m
EL.2.80
EL.2.80
19600
4050
2500
4050
PANCHUR KHAL PIPE SLUICE (1V-900mm Dia)
At Ch. 0+050 Km (khal) & Ch. 13+709 km (Embk.)

GENERAL PLAN AND LONG SECTION



SECTION A-A



PLAN

SPECIFICATION & NOTES ON MATERIAL & WORK

1. R.C.C WORKS: A. Concrete : I) Strength:	All R.C.C WORKS 28-days standard cylinder crushing strength shall be 17 N/mm²	R.C.C PILES 28-days standard cylinder crushing strength shall be 20.7 N/mm²	LEAN CONCRETE --
II) Proportion by volume	1:2:4	1:1.5:3	1:3:6
III) Cement	Portland Type-1	Portland Type-1	Portland Type-1
iv) Coarse aggregate	20mm down graded crushed stone chips (Well graded between 20mm & 8mm size.) (LAA value not more than 30)	20mm down graded crushed stone chips (Well graded between 20mm & 8mm size.)	20mm down graded brick chips (Well graded between 20mm & 8mm size.) (LAA value not more than 40)
v) Sand	FM >1.80	FM >1.80	FM> 1.00
vi) Slump: (at work)	60-75 mm	60-75 mm (Precast) 100-125mm (cast-in situ)	60-75 mm
B. Reinforcement	40 grade deformed M.S. bar	40 grade deformed M.S. bar	
	Minimum yield strength 275 N/mm2	Same as in all RCC works	
	No hook should be used for M.S deformed bars.		

2. Clear concrete cover over reinforcement bars shall be :
   Earth faces = 75mm
   Water faces = 50mm
   All other faces = 25mm
   R.C.C Piles = 40mm

3. C.C. Bolcks : C.C blocks with cement sand (FM>1.5) and singles (40 mm down graded) with proportion 1:3:6

4. Back filling : Back filling outside abutments, wing walls and return walls up to FGL shall be done simultaneously on both sides with local sandy soil and should be free from vegetable roots and other organic materials, as soon as wall lifts are constructed.

5. Foundation Treatment : Sand filling below the foundation slab shall be compacted in 150 mm layers in moist condition as per schedule.

6. Strength : During pouring samples shall be collected by the contractor in presence of Engineer-in-charge in standard cylinder, one for each wing wall, abutment, return wall, top slab, apron and barrel foundation for testing 7day strengths for quality control.

7. Protective work : Earthfill in side slopes shall be compacted in horizontal layers to the satisfaction of the Engineer-in-charge before placing filter material and blocks.

8. Filter Materials : I) Brick Chips : 20mm to 40mm Size (LAA Value <40)
   II) Sand : Coarse Sand (FM=1.50)

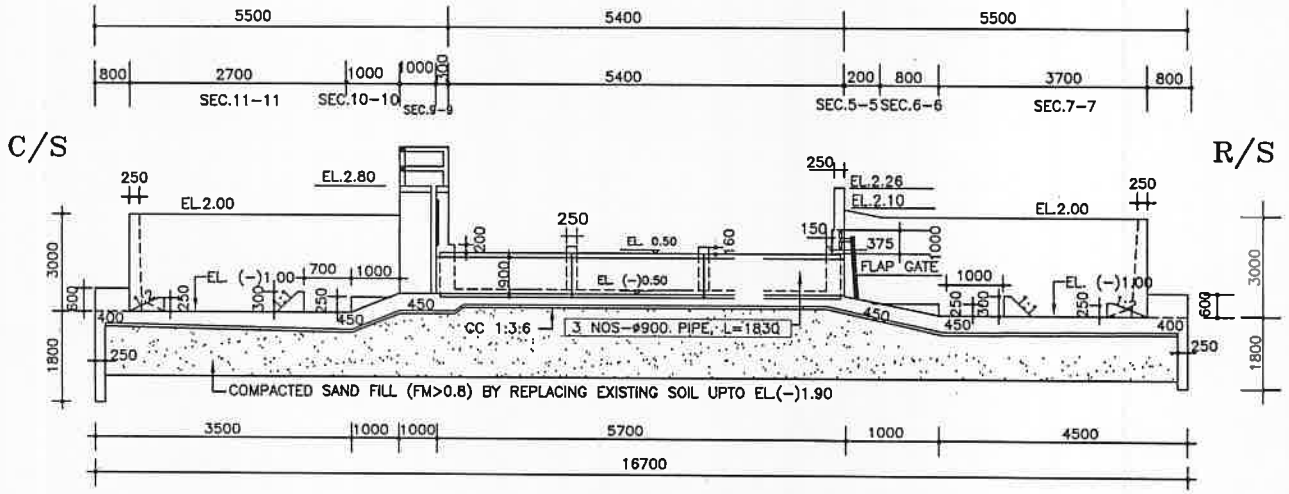
9. Elevations : All elevations are in meter (PWD).

10. Dimensions : All dimensions are in millimeters.

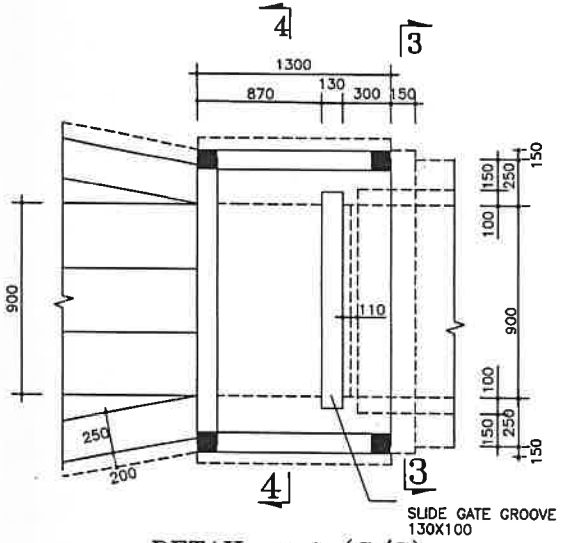
11. Embedded Parts of gates : M.S. embedded parts such as angles, channels for gates welded to anchor bars shall be installed in proper alignment during casting of concrete as shown in working drawings.

12. Formwork : Formwork of Concrete for making fully leak proof, shall be faced with plain 28/26 gauge steel sheet fitted over 38 mm thick wooden plank, panels suitably braced or steel framing faced with minimum 12/14 BWG mild steel sheet.
   Formwork for C.C blocks shall be fabricated from m.s. steel of sufficient thickness to prevent any distortion.

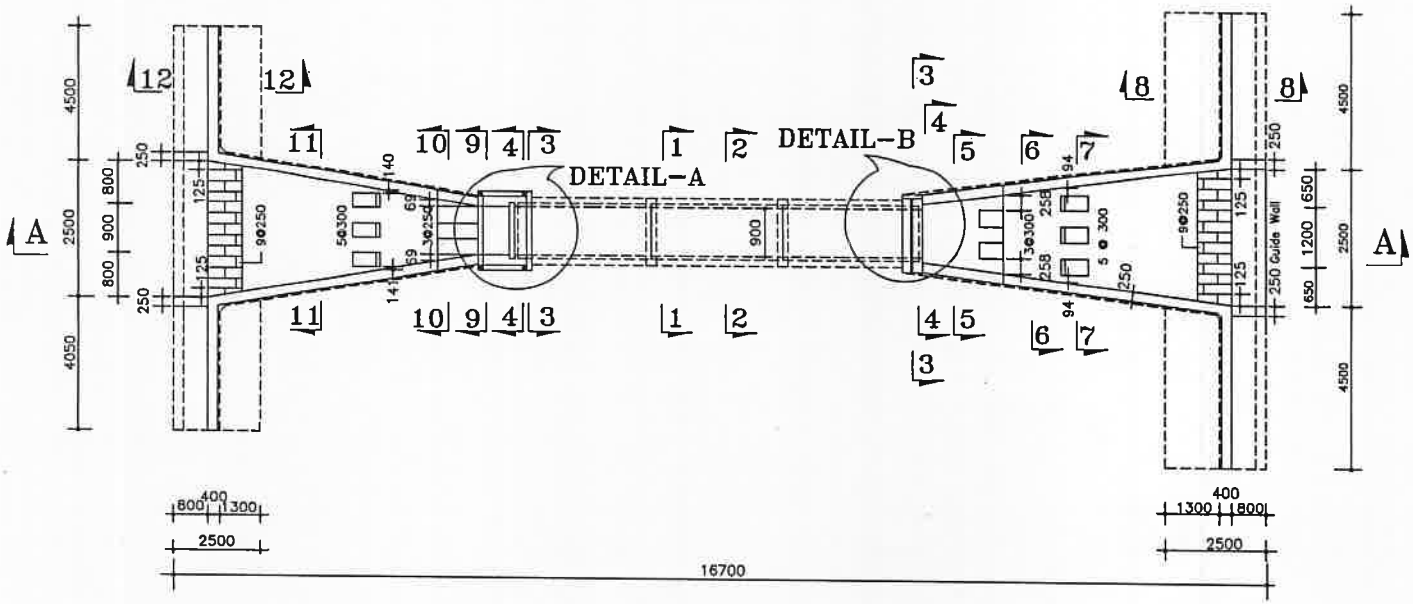
SECTION LIMIT DETAILS



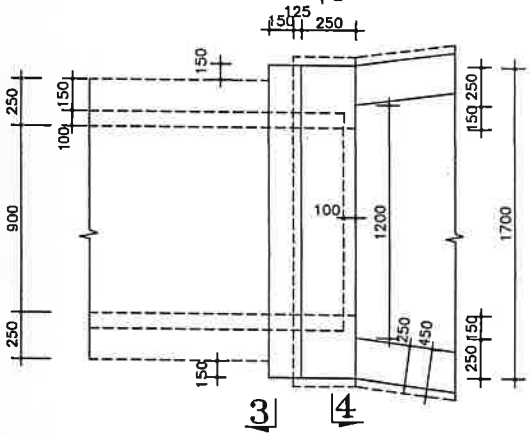
SECTION B-B



DETAIL - A (C/S)

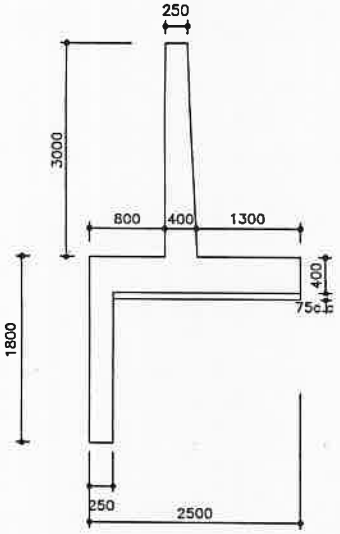


PLAN

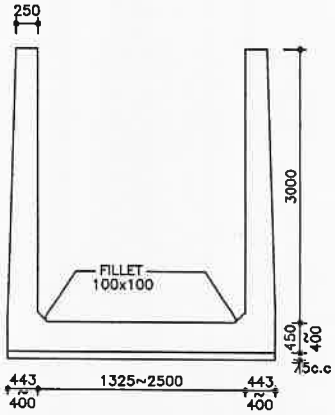


DETAIL - B (R/S)

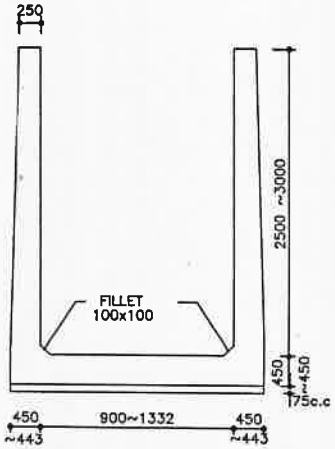
CONCRETE OUTLINE : SECTIONS



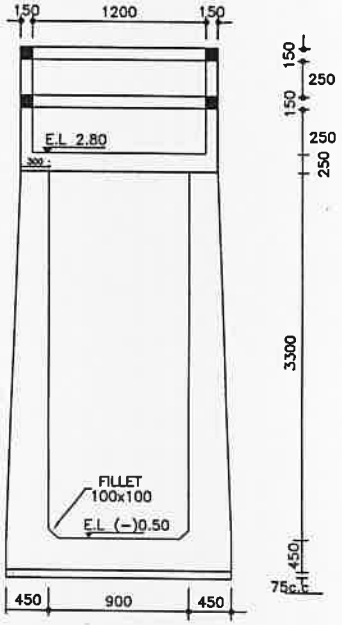
SECTION 12-12 (C/S)



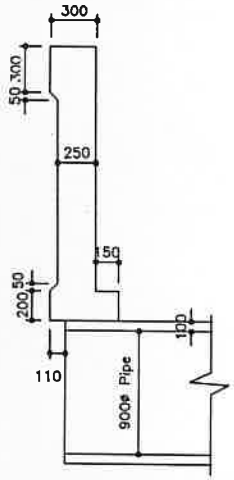
SECTION 11-11(C/S)



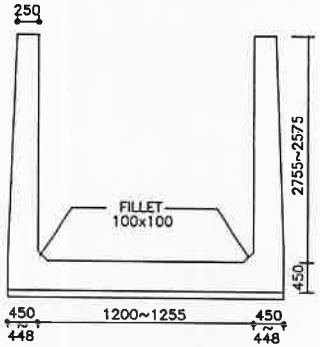
SECTION 10-10(C/S)



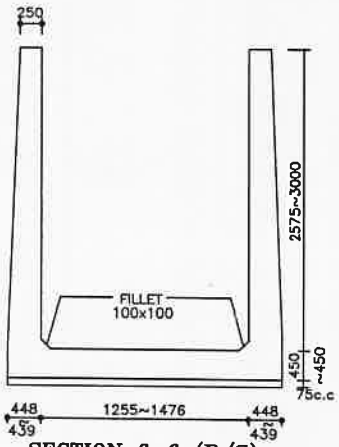
SECTION 9-9 (C/S)



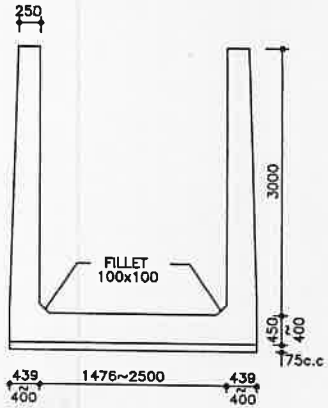
HEADWALL DETAILS (C/S)



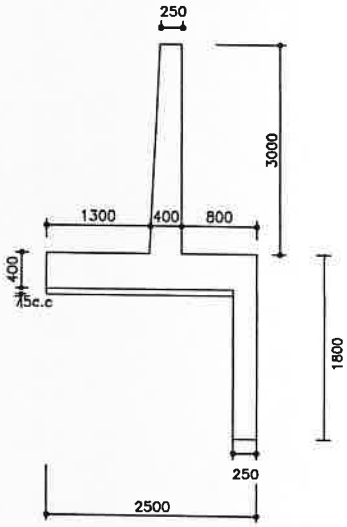
SECTION 5-5(R/S)



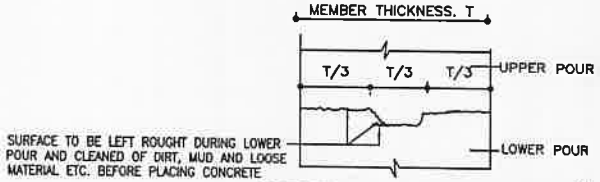
SECTION 6-6 (R/S)



SECTION 7-7(R/S)



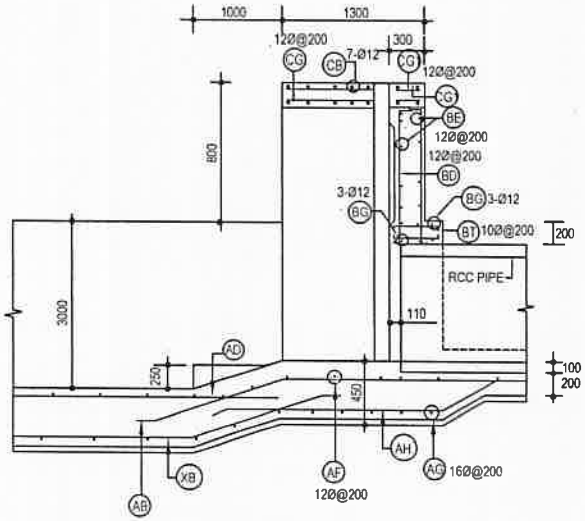
SECTION 8-8 (R/S)



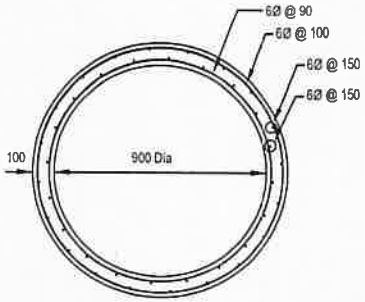
DETAILS OF CONSTRUCTION JOINTS (TYPICAL)

OF UPPER POUR.

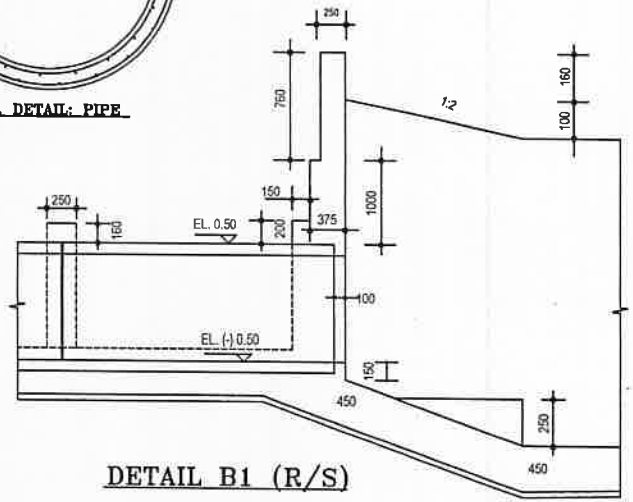
PIPE FLOOR & HEAD WALL



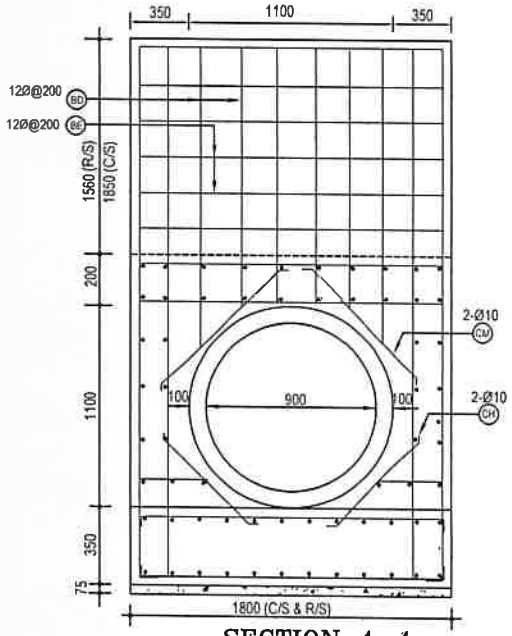
DETAIL A1 (C/S)



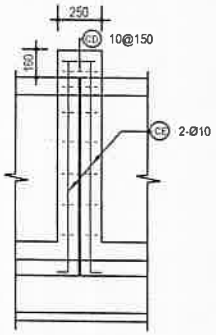
REINF. DETAIL: PIPE



DETAIL B1 (R/S)

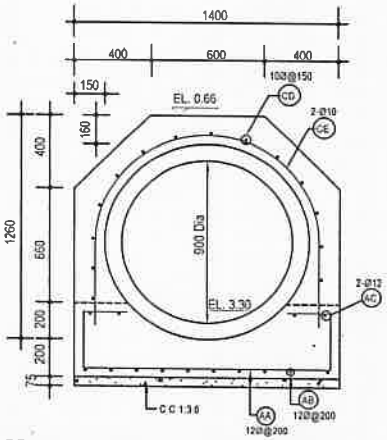


SECTION 4-4

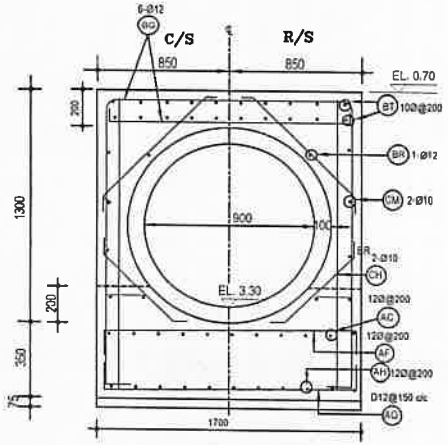


(ELEVATION)

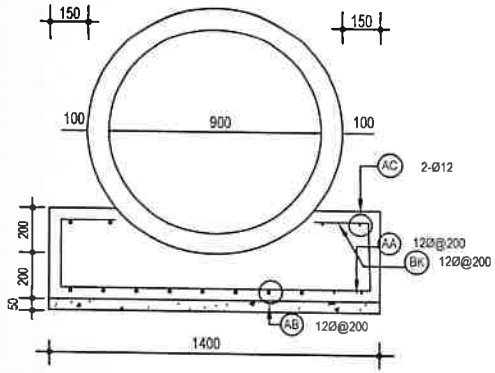
REINF. DETAIL : PIPE COLLAR



SECTION 1-1(TROUGH COLLAR)

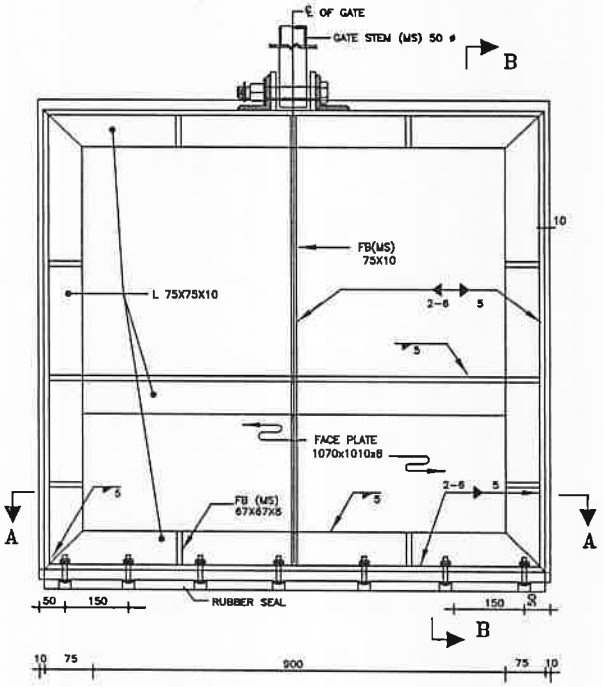


SECTION 3-3
(THROUGH PIPE TO HEADWALL JOINT)

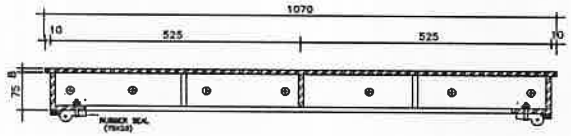


SECTION 2-2(THROGH PIPE)

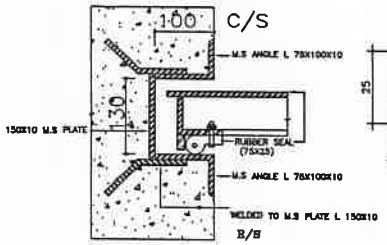
VERTICAL LIFT GATE



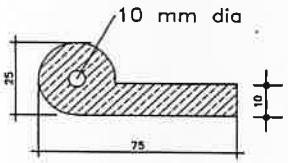
GATE LEAF ELEVATION (C/S)



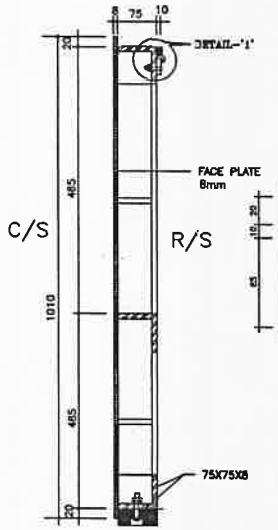
SECTION A–A



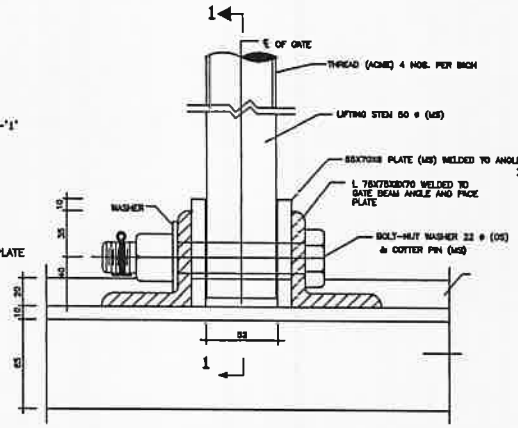
DETAIL–C–C



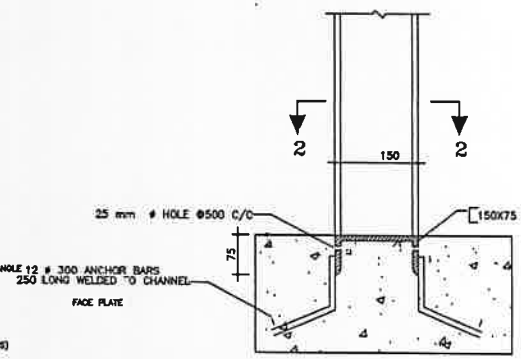
RUBBER SEAL



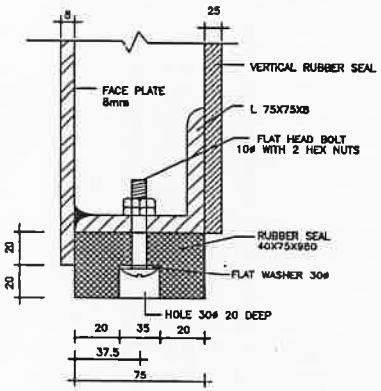
SECTION B–B



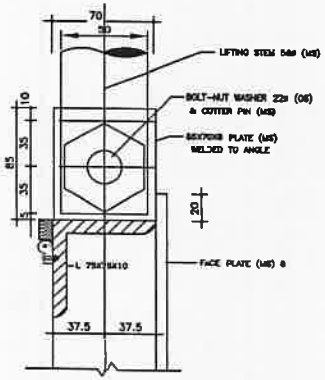
DETAIL OF STEM ATTACHMENT



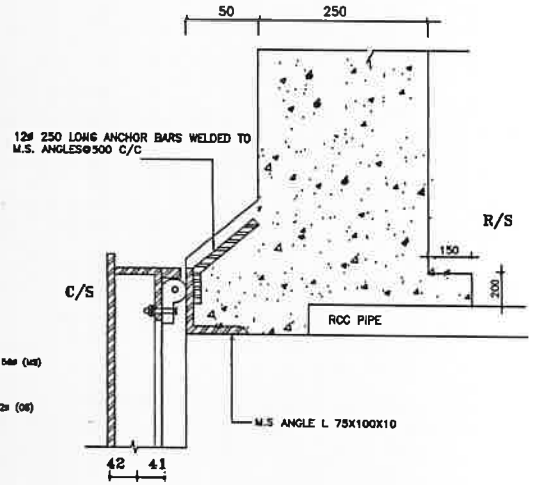
DETAIL OF GATE GROOVE



DETAIL OF BOTTOM SEAL

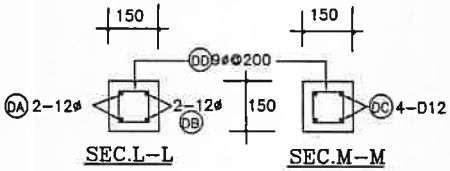


SECTION 1–1

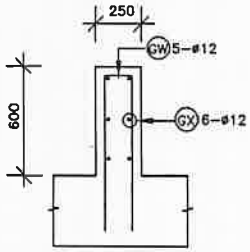


DETAIL–1

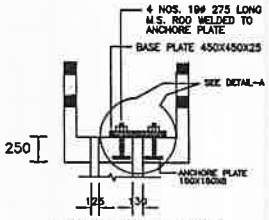
MISCELLANEOUS DETAILS



SEC.L-L SEC.M-M

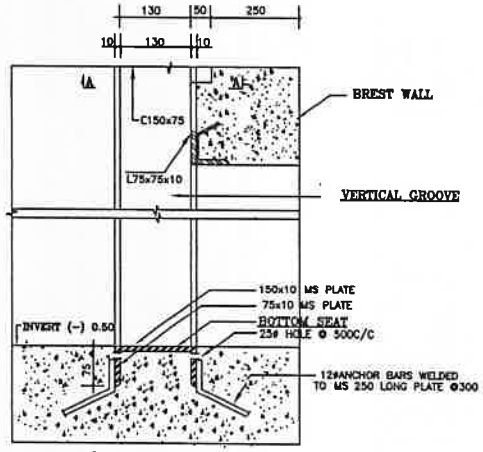


RCC GUIDE WALL

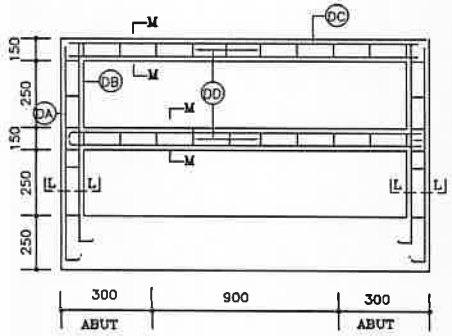


SECTION OF BASE PLATE AND ANCHORE PLATE OF OPERATING DECK

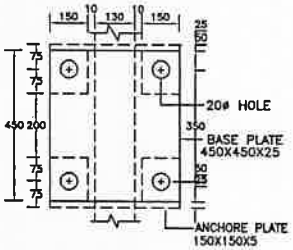
SLIDE GATE GROOVE



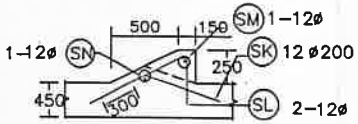
VERTICAL SECTION



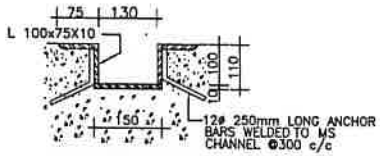
RAILING AND POST DETAIL



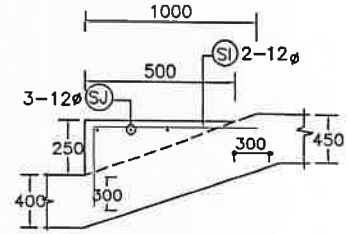
DETAILS OF A



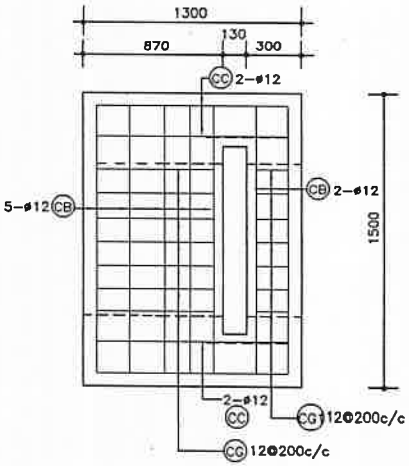
C/S END SILL REINF. (DETAIL "D")



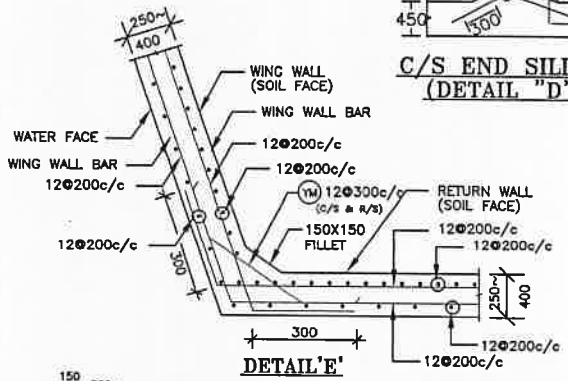
HORIZONTAL SECTION A-A



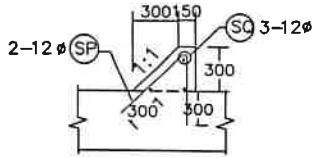
C/S CHUTE BLOCK REINF. (DETAIL "F")



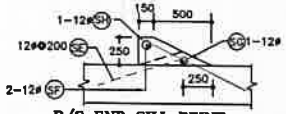
REINF. OPERATING PLATFORM



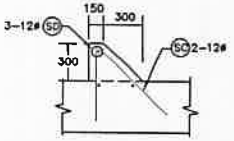
DETAIL'E'



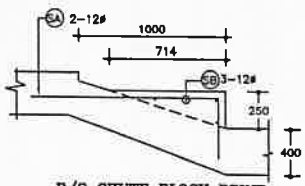
C/S BAFFLE BLOCK REINF. (DETAIL "E")



R/S END SILL REINF. (DETAIL "A")

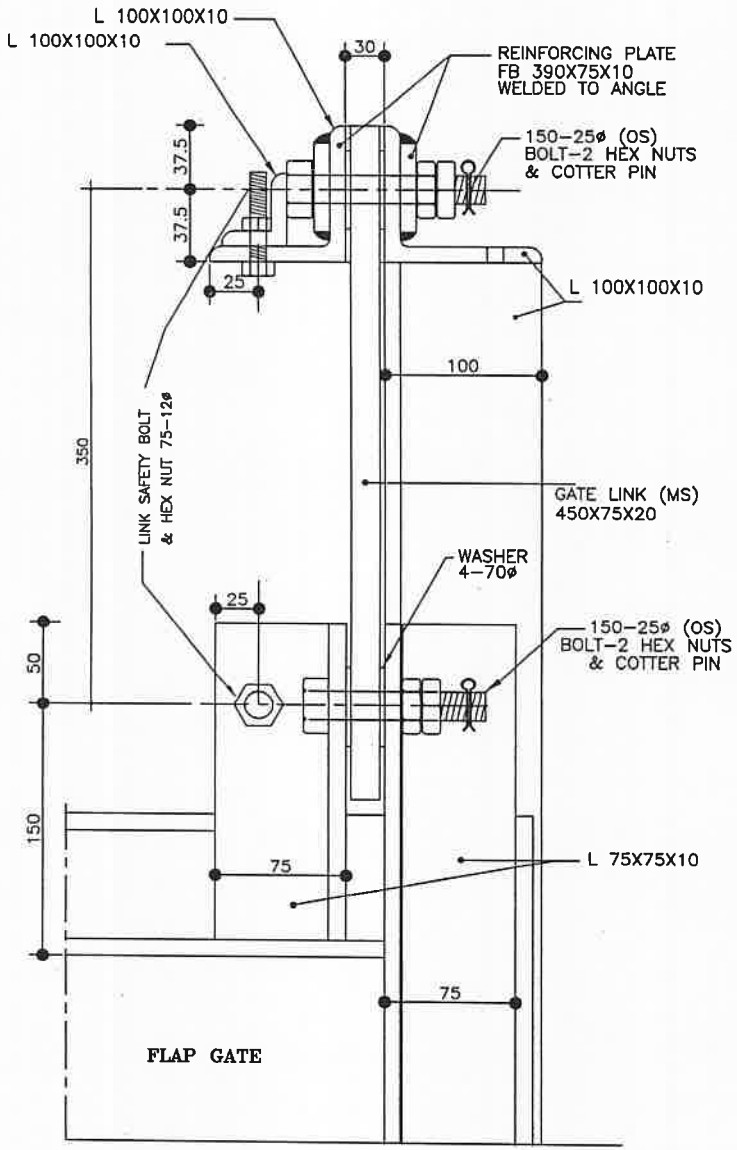


R/S BAFFLE BLOCK REINF. (DETAIL "B")

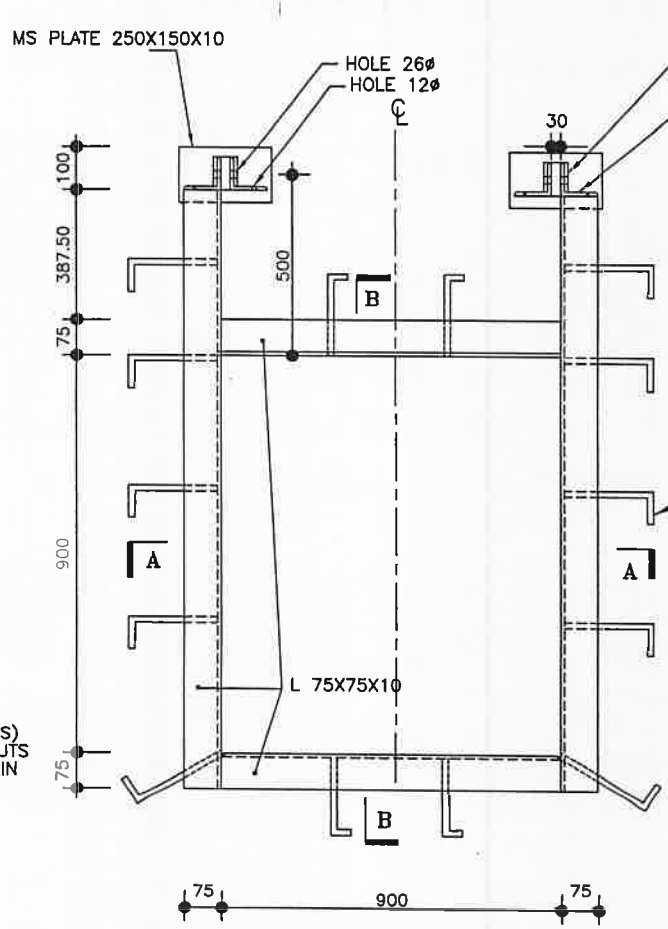


R/S CHUTE BLOCK REINF. (DETAIL "C")

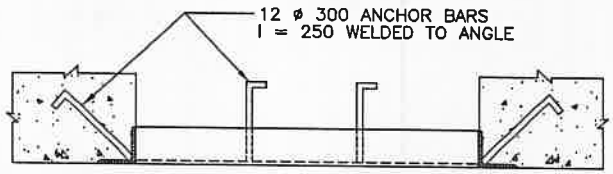
FLAP GATE



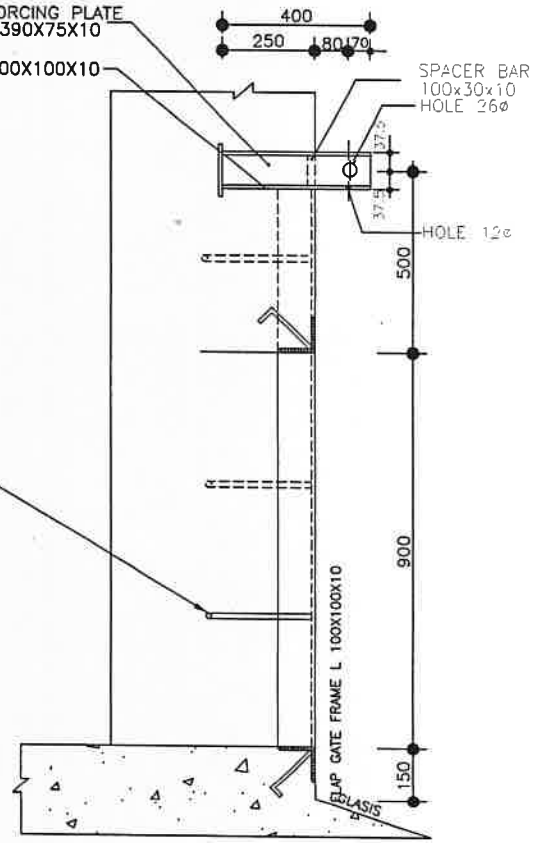
DETAIL OF GATE ATTACHMENT



ELEVATION (R/S)



SECTION A-A



SECTION B-B

Government of the People's Republic of Bangladesh
Local Government Engineering Department

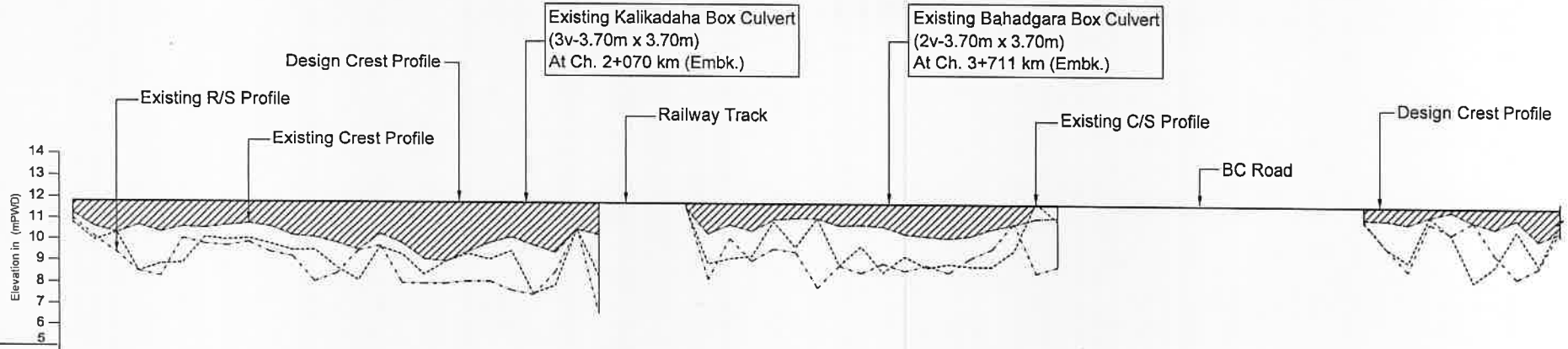
Small Scale Water Resources Development Project (Jica-2)

RDEC Bhaban (Level-6), Agargaon, Shere-Bangla Nagar
Dhaka-1207

DETAIL DRAWINGS OF

LONG & CROSS SECTION OF EMBANKMENT

LONG SECTION OF EMBANKMENT



Chainage (km)	Exist. GL. C/S (m PWD)	Crest Level (m PWD)	Exist. GL. R/S (m PWD)
0+000	10.79	11.25	10.61
0+100	9.95	10.60	9.72
0+200	10.30	10.30	8.98
0+300	8.51	10.68	8.13
0+400	8.85	10.35	7.91
0+500	8.90	10.60	9.67
0+600	10.10	10.55	9.42
0+700	9.99	10.68	9.33
0+800	10.06	10.79	9.51
0+900	9.81	10.63	9.03
1+000	9.51	10.21	8.83
1+100	9.53	10.13	7.70
1+200	8.73	9.88	8.05
1+300	8.14	9.54	8.11
1+400	8.68	10.29	9.36
1+500	9.32	9.87	7.44
1+600	8.41	9.11	7.63
1+700	9.01	9.01	7.63
1+800	9.36	9.46	7.73
1+900	9.11	9.91	7.73
2+000	8.51	10.16	7.33
2+100	7.58	9.80	7.15
2+200	7.95	9.45	8.17
2+300	10.56	10.54	10.18
2+400	8.36	10.29	6.28
2+500	11.58	11.58	11.19
2+600	8.95	10.36	7.88
2+700	9.20	10.60	9.77
2+800	9.31	10.49	8.71
2+900	10.66	11.06	9.28
3+000	9.74	11.12	9.14
3+100	11.12	11.12	7.52
3+200	8.91	10.79	8.52
3+300	9.80	10.82	8.19
3+400	8.60	10.74	8.42
3+500	9.33	10.38	8.30
3+600	8.63	10.28	8.55
3+700	9.00	10.20	8.22
3+800	8.90	10.31	8.88
3+900	8.90	10.64	8.33
4+000	9.63	10.87	10.55
4+100	11.90	11.15	8.22
4+200	11.03	11.20	8.52
4+300			
4+400			
4+500			
4+600			
4+700			
4+800			
4+900	11.17	11.23	10.71
5+000	9.80	11.20	9.52
5+100	8.83	11.03	8.85
5+200	11.09	11.39	11.01
5+300	10.51	11.61	10.18
5+400	8.35	11.16	10.78
5+500	9.10	10.85	9.22
5+600	10.74	11.28	8.16
5+700	9.13	10.29	8.65
5+800	11.09	10.69	10.41

PRE-WORK

DESIGN

Crest Level (m PWD): 11.80

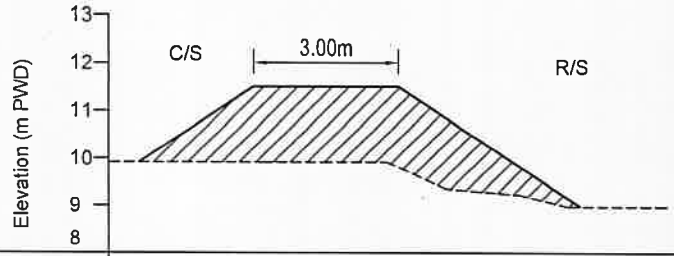
Chainage (km): 0+000 to 5+800

Cross-Section No.: 1 to 53

Sectional Parameter:
- Ch. 0+000 km to 2+400 km, Crest Width=3.70m, Side Slope : 1 : 1.5, (C/S & R/S)
- Ch. 2+400 to 2+800 Railway Track
- Ch. 2+800 km to 4+500 km, Crest Width=3.70m, Side Slope : 1 : 1.5, (C/S & R/S)
- Ch. 4+500 km to 5+900 km BC Road
- Ch. 5+900 km to 13+500 km Crest Width=3.70m,

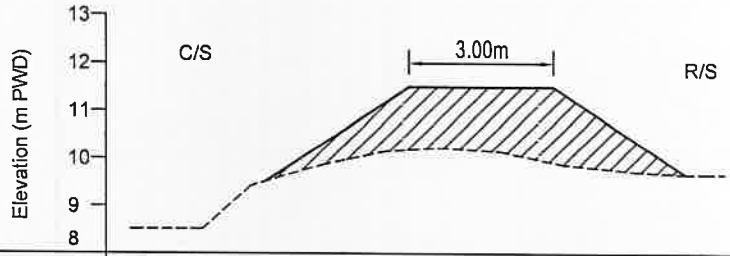
LONG SECTION OF EMBANKMENT

CROSS SECTION OF EMBANKMENT



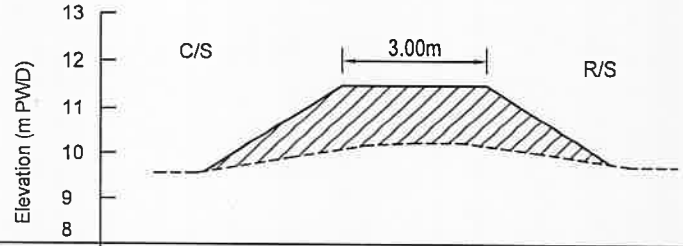
RL (m PWD)	9.920	9.920	9.920	9.920	9.350	9.230	8.980
Distance (m)	-2.50	-1.25	**0.00**	1.25	2.50	4.00	5.00
Design Section Parameters	Top E.L.= 11.50 m, Fill Area= 10.20 sqm, [Turfing= 8.59 m] Side Slope : C/S= 1 : 1.5, R/S= 1 : 1.5						

CROSS SECTION NO. 3 : CH. 0+200 Km



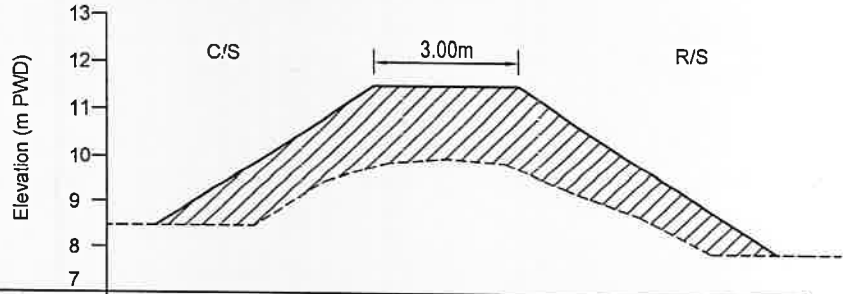
RL (m PWD)	8.520	9.420	9.870	10.150	10.220	10.140	9.870	9.720	9.670
Distance (m)	-5.00	-4.00	-2.50	-1.20	**0.00**	1.20	2.50	4.00	5.00
Design Section Parameters	Top E.L.= 11.50 m, Fill Area= 8.14 sqm, [Turfing=8.08 m] Side Slope : C/S= 1 : 1.5, R/S= 1 : 1.5								

CROSS SECTION NO. 6 : CH. 0+500 Km



RL (m PWD)	9.570	9.920	10.170	10.220	10.220	10.020	9.720
Distance (m)	-4.50	-2.50	-1.00	**0.00**	1.00	2.50	4.50
Design Section Parameters	Top E.L.= 11.50 m, Fill Area= 7.65 sqm, [Turfing= 7.72 m] Side Slope : C/S= 1 : 1.5, R/S= 1 : 1.5						

CROSS SECTION NO. 2 : CH. 0+100 Km



RL (m PWD)	8.470	9.470	9.870	9.970	9.870	9.270	8.720	7.910
Distance (m)	-4.00	-2.50	-1.20	**0.00**	1.20	2.50	4.00	5.50
Design Section Parameters	Top E.L.= 11.50 m, Fill Area= 15.62 sqm, [Turfing= 13.15 m] Side Slope : C/S= 1 : 1.5, R/S= 1 : 1.5							

CROSS SECTION NO. 5 : CH. 0+400 Km

Government of the People's Republic of Bangladesh
Local Government Engineering Department

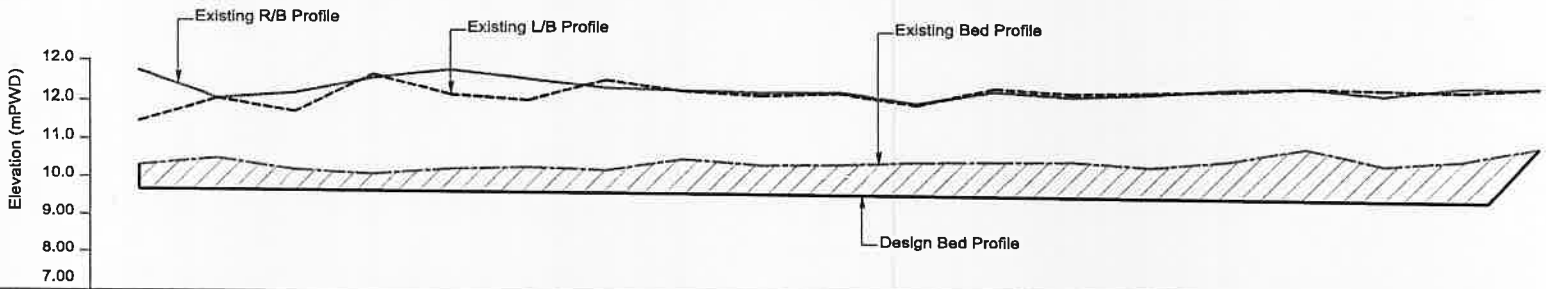
Small Scale Water Resources Development Project (Jica-2)

RDEC Bhaban (Level-6), Agargaon, Shere-Bangla Nagar
Dhaka-1207

DETAIL DRAWINGS OF

LONG & CROSS SECTION OF KHAL

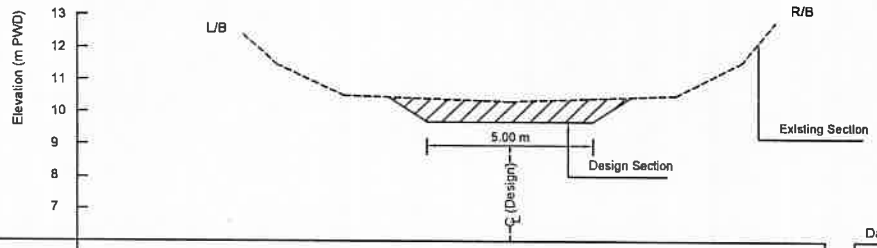
LONG SECTION OF KHAL



PRE-WORK																			
Exist. Left Bank (m PWD)	11.46	12.06	11.73	12.66	12.16	12.03	12.54	12.26	12.16	12.22	11.95	12.36	12.24	12.28	12.32	12.41	12.38	12.34	12.45
Existing Bed Level (m PWD)	10.31	10.49	10.19	10.08	10.23	10.28	10.21	10.51	10.36	10.38	10.45	10.47	10.49	10.36	10.53	10.88	10.44	10.58	10.95
Exist. Right Bank (m PWD)	12.75	12.06	12.18	12.57	12.78	12.56	12.34	12.28	12.24	12.25	11.99	12.28	12.16	12.23	12.37	12.41	12.24	12.45	12.44
Chainage (km)	5+200	5+300	5+400	5+500	5+600	5+700	5+800	5+900	6+000	6+100	6+200	6+300	6+400	6+500	6+600	6+700	6+800	6+900	7+000
DESIGN																			
Design bed Level (m PWD)	9.67	9.66	9.65	9.64	9.63	9.62	9.61	9.60	9.59	9.58	9.57	9.56	9.55	9.54	9.53	9.52	9.51	9.50	9.49
Chainage (km)	5+200	5+300	5+400	5+500	5+600	5+700	5+800	5+900	6+000	6+100	6+200	6+300	6+400	6+500	6+600	6+700	6+800	6+900	7+000
Cross Section No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Sectional Parameter	Reach-1 (Ch.5+200 km to 6+500 km), Design Bed Width = 5.00m PWD, Side Slope : 1 : 1.5 (L/S & R/S), Longitudinal Slope : 0.0001													Reach-2 (Ch.6+500 km to 7+000 km), DBW = 3.00m PWD, SS : 1 : 1.5 (L/S & R/S), LS : 0.0001					

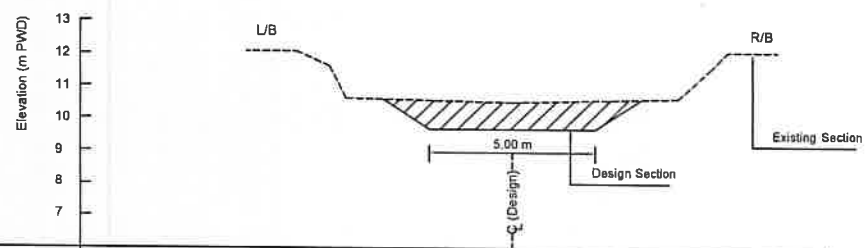
LONG SECTION OF FORKANALA KHAL

CROSS SECTION OF kHAL



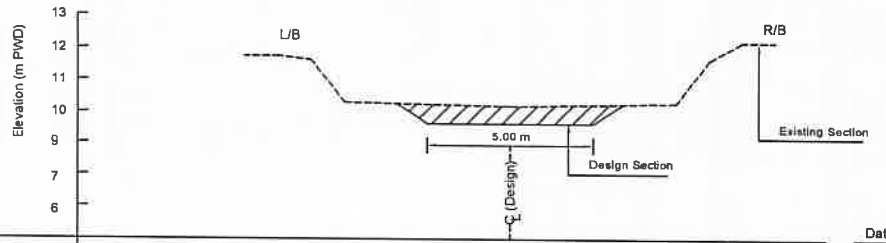
Datum								
RL (m PWD)	12.370	11.460	10.490	10.310	10.490	11.530	12.750	
Distance (m)	-8.00	-7.00	-5.00	0.00	5.00	7.00	8.00	
Design Section Parameters	Design Bed Level RL= 9.67 m, Cutting Area = 4.270 sqm Side Slope : R/S= 1 : 1.5, C/S= 1 : 1.5							

CROSS SECTION NO. 1 : CH. 5+200 km



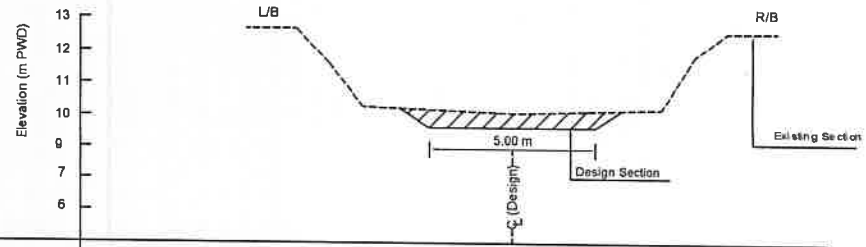
Datum								
RL (m PWD)	12.060	12.060	11.610	10.610	10.490	10.620	11.550	12.060	12.060
Distance (m)	-8.00	-6.50	-5.50	-5.00	0.00	5.00	6.00	6.50	8.00
Design Section Parameters	Design Bed Level RL= 9.66 m, Cutting Area = 5.548 sqm Side Slope : R/S= 1 : 1.5, C/S= 1 : 1.5								

CROSS SECTION NO. 2 : CH. 5+300 km



Datum									
RL (m PWD)	11.730	11.730	11.610	10.310	10.190	10.290	11.610	12.180	12.180
Distance (m)	-8.00	-7.00	-6.00	-5.00	0.00	5.00	6.00	7.00	8.00
Design Section Parameters	Design Bed Level RL= 9.65 m, Cutting Area = 3.387 sqm Side Slope : R/S= 1 : 1.5, C/S= 1 : 1.5								

CROSS SECTION NO. 3 : CH. 5+400 km



Datum									
RL (m PWD)	12.660	12.660	11.600	10.280	10.080	10.210	11.840	12.570	12.570
Distance (m)	-8.00	-6.50	-5.50	-4.50	0.00	4.50	5.50	6.50	8.00
Design Section Parameters	Design Bed Level RL= 9.64 m, Cutting Area = 2.879 sqm Side Slope : R/S= 1 : 1.5, C/S= 1 : 1.5								

CROSS SECTION NO. 4 : CH. 5+500 km

LOCAL GOVERNMENT ENGINEERING DEPARTMENT

PARTICIPATORY SMALL SCALE WATER RESOURCES SECTOR PROJECT

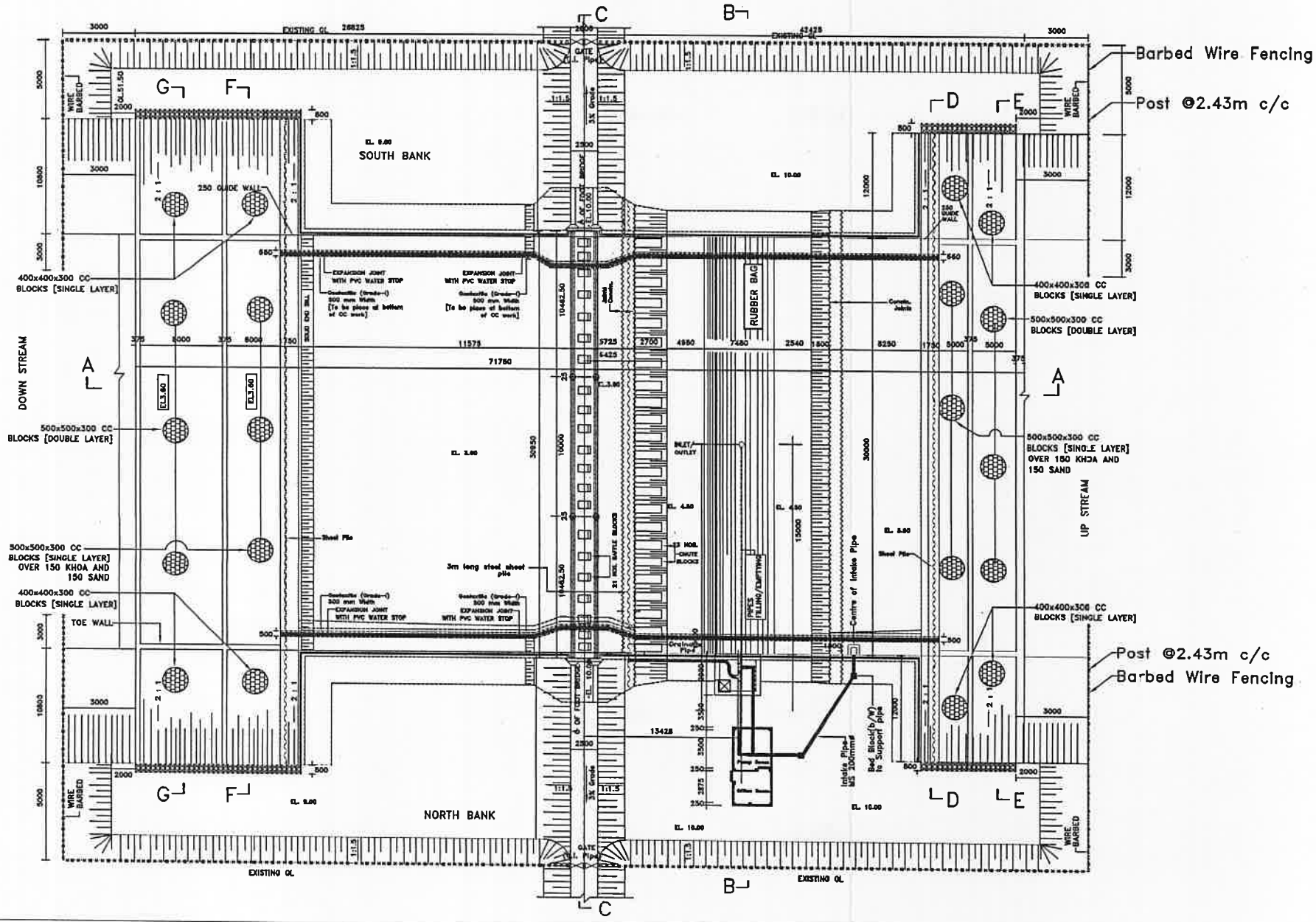
STRUCTURAL DRAWINGS

OF

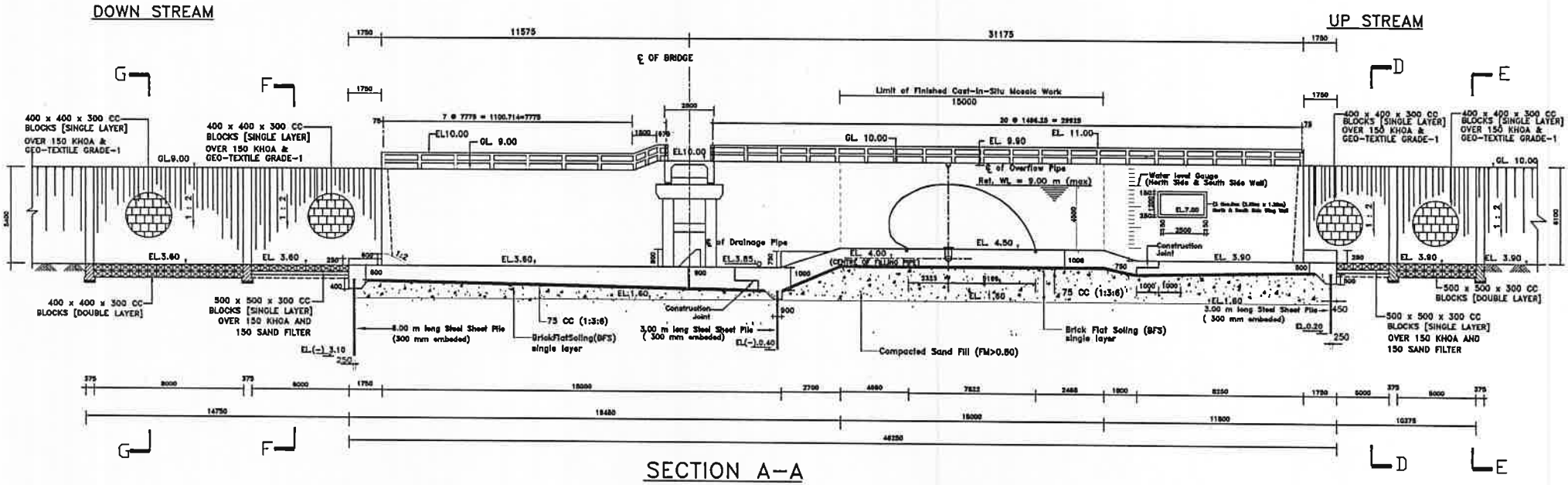
RUBBER DAM

(SIZE 30.00m x 4.50m)

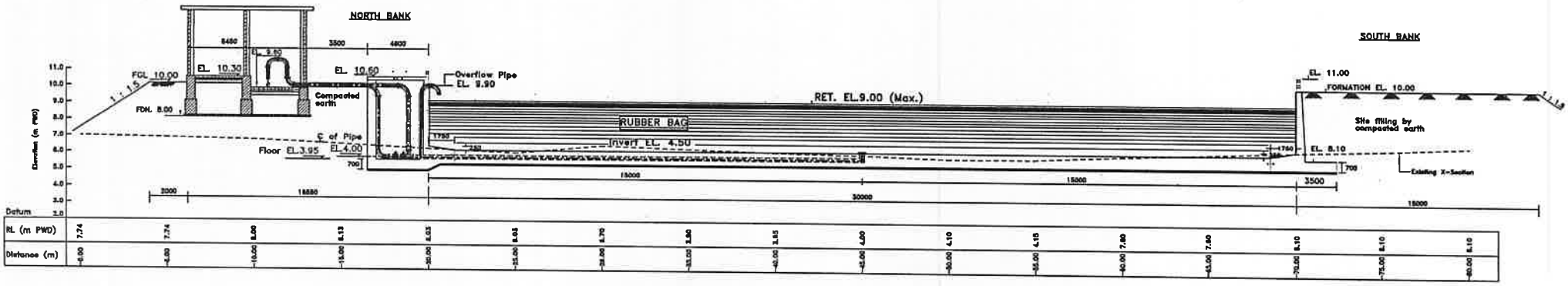
GENERAL PLAN



LONGITUDINAL SECTIONS A-A & B-B

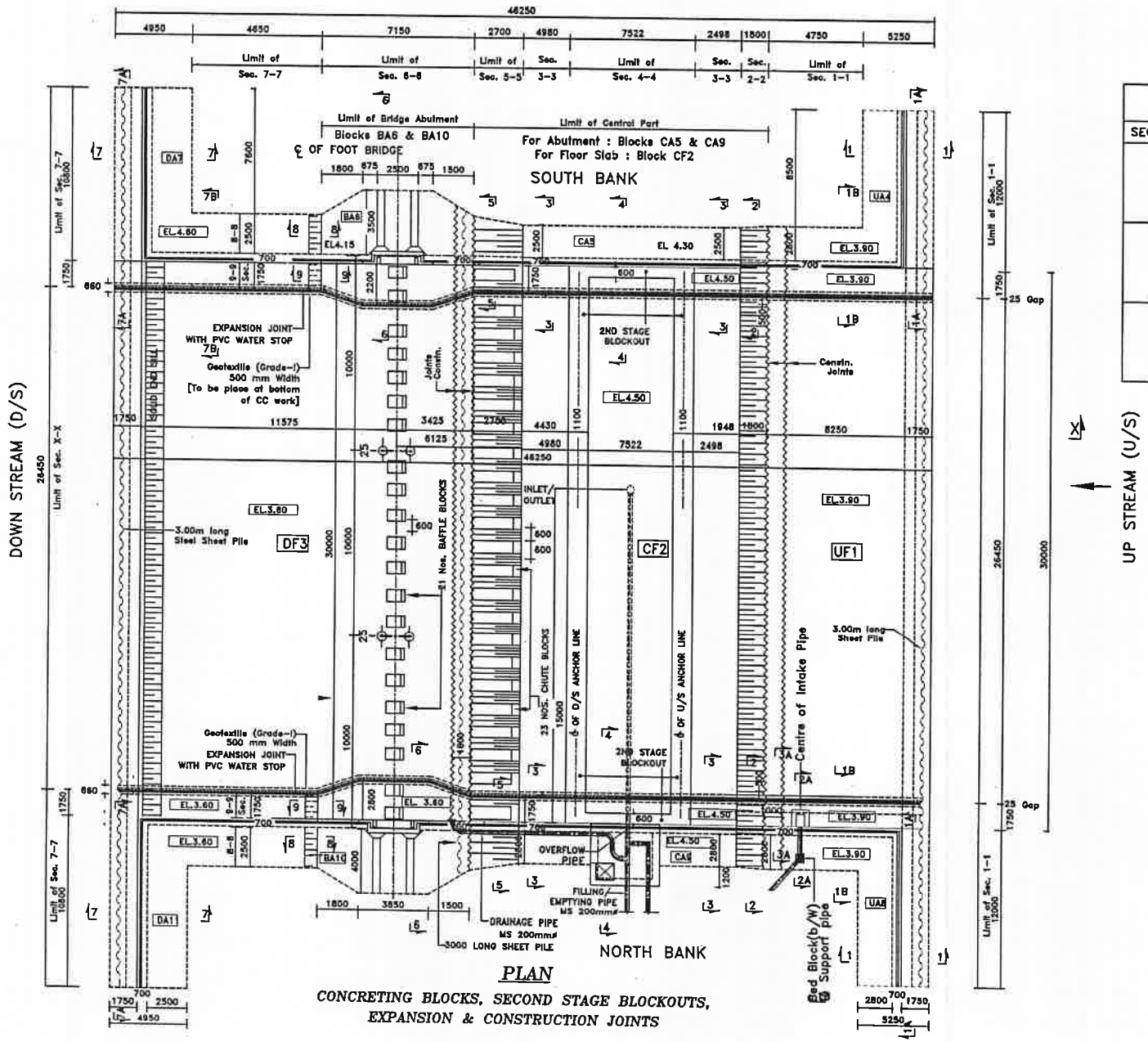


SECTION A–A



SECTION B–B

CONCRETE OUTLINE : SECTIONS

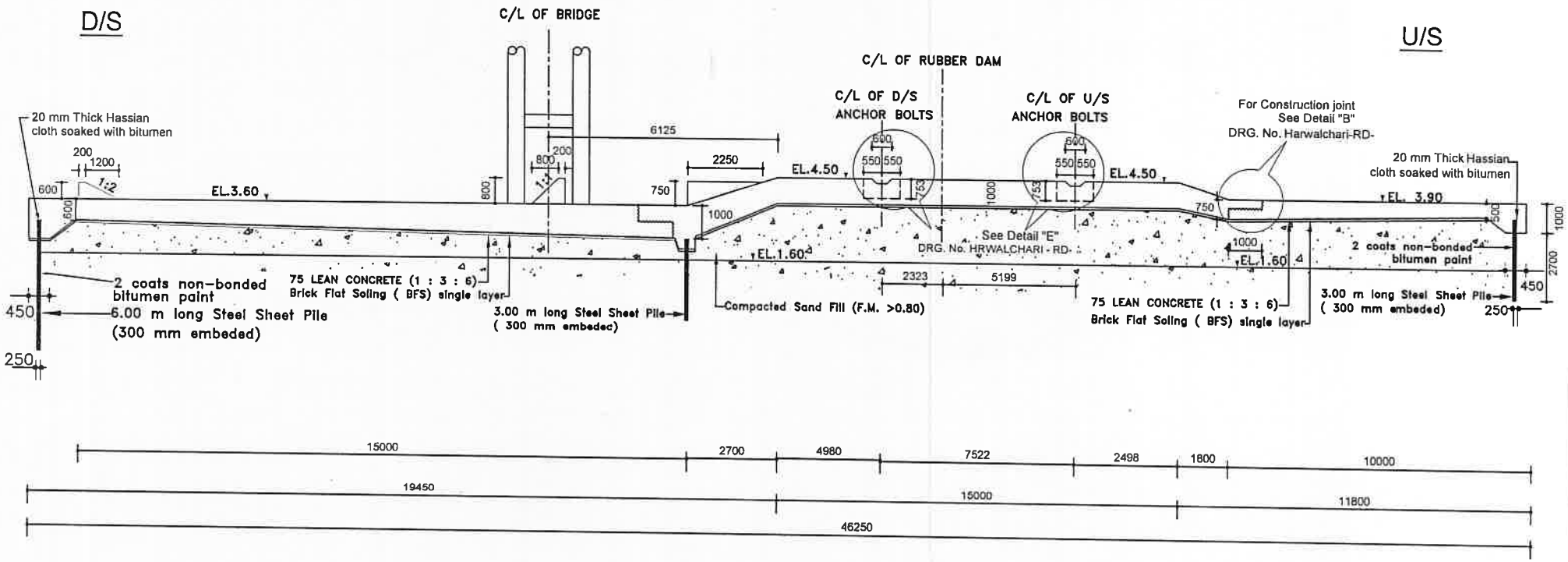


PLAN

CONCRETING BLOCKS, SECOND STAGE BLOCKOUTS, EXPANSION & CONSTRUCTION JOINTS

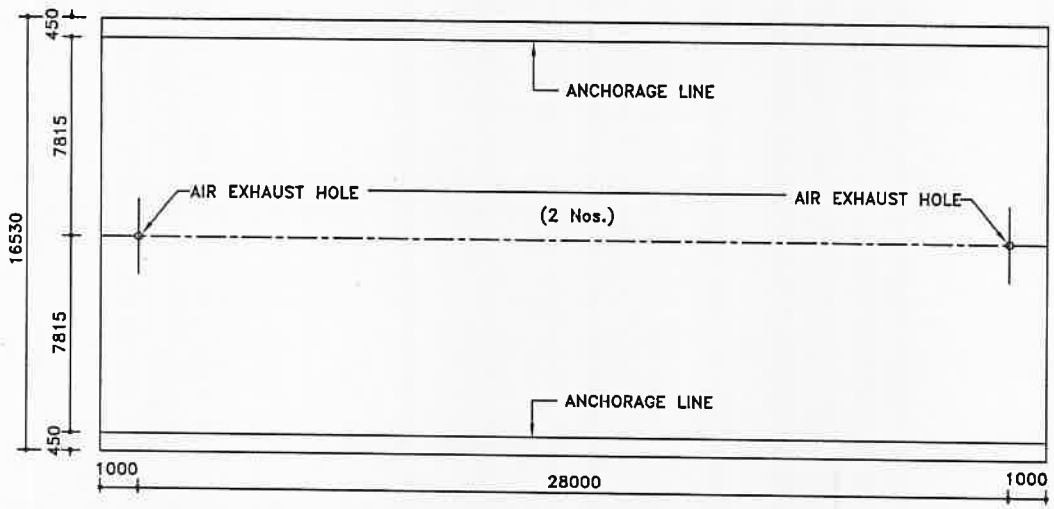
SEQUENCE OF FLOOR CASTING OF THE MAIN STRUCTURE		
SEQUENCE	SUB-SEQUENCE	BLOCKS
I	IA	UF1
	IB	UA4
	IC	UA8
II	IIA	CF2
	IIB	CA5
	IIC	CA9
III	IIIA	DF3
	IIIB	DA7 & DA11
	IIIC	DA6 & DA10

CONCRETE OUTLINE : FLOOR SECTION

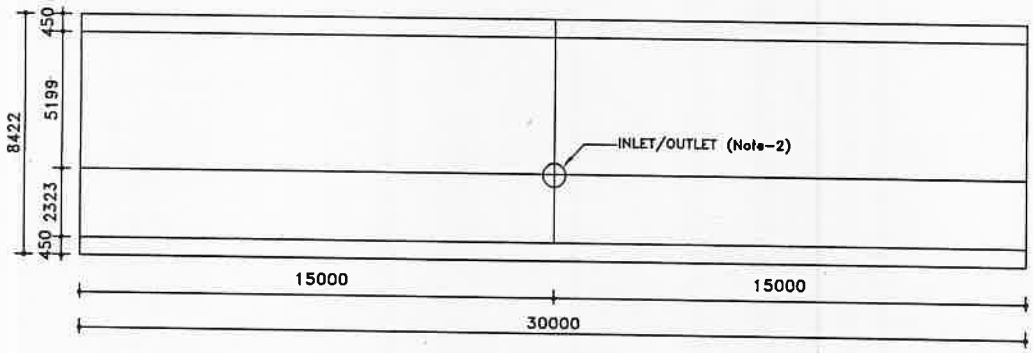


SECTION X–X

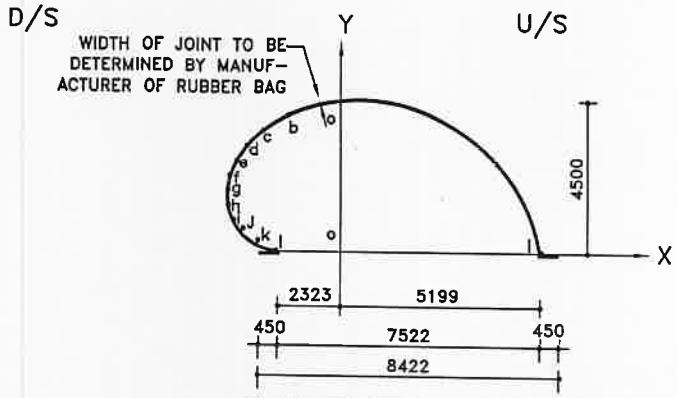
DETAILS OF RUBBER BAG



PLAN OF UNFOLD RUBBER BAG



PLAN OF BASE COVER SHEET



PLAN OF UNFOLD LATERAL CLOSER OF RUBBER BAG

CO-ORDINATE OF D/S PORTION OF RUBBER DAM

POINT	a	b	c	d	e	f	g	h	I	J	k	l
Y (m)	4.50	4.10	3.70	3.30	2.90	2.50	2.10	1.70	1.30	0.90	0.30	0
X (mm)	0.00	?	?	?	?	?	?	?	?	?	?	2060

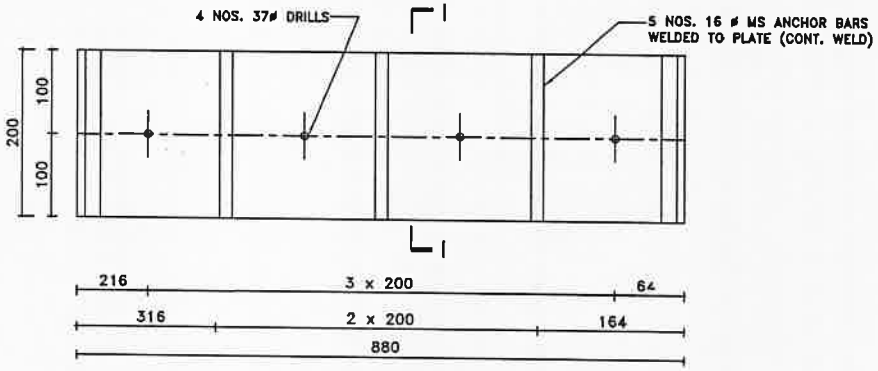
SPECIAL NOTES FOR ANCHORING SYSTEM

1. Anchor Bolt shall be fixed during 2nd stage casting of concrete.
2. Dowel bars shall be provided during 1st stage casting.
3. Level of the embedded Lower anchoring plate should be carefully maintained by adding horizontal dowel bar by means of welding.
4. Anchoring system should be finalized during 2nd stage casting of concrete. Proper vibration and rich concrete (1:1.5:3) shall be used during casting to attain the minimum 28 days cylinder strength of 28 N/sqmm
5. Test Results must conform to the specifications mentioned in this drawing. All the tests must be accomplished in presence of the Engineer in charge.

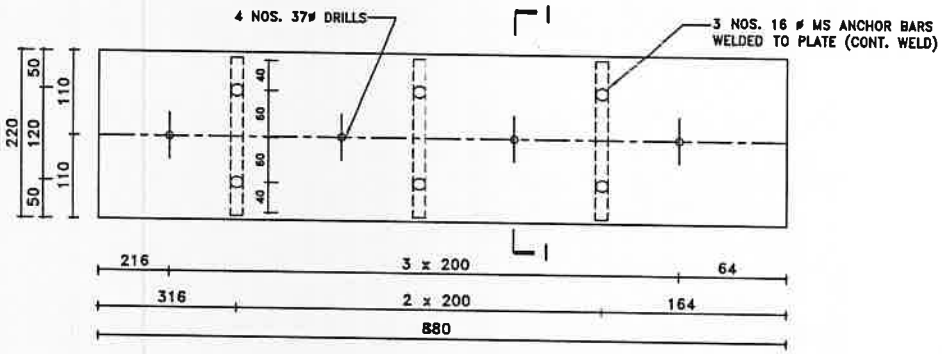
Note :

1. Holes on both bag & coversheet should be stretched locally by pasting on extra layer of rubber sheet which is three times as holes in dia.
2. Opening on cover sheet shall be made at site according to location of inlet/outlet on Base floor.
3. Dimensions of A & B is to be provided by BIC, China, so it will be supplied before construction.

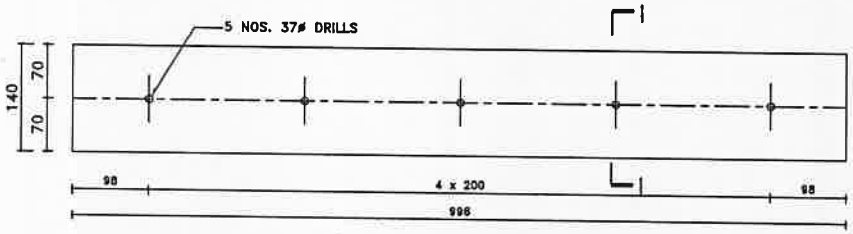
ANCHORAGE PLATES-2



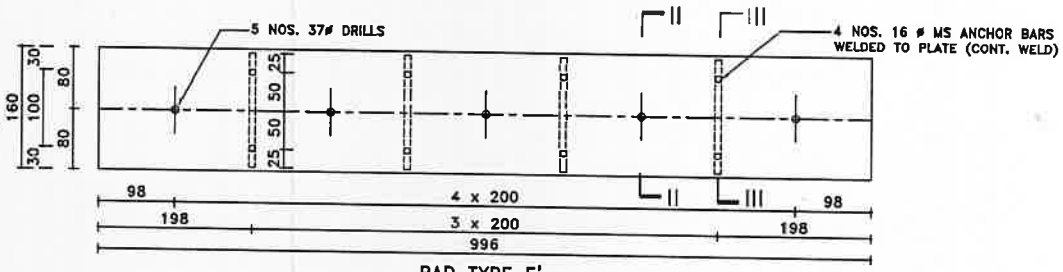
PLATEN TYPE D



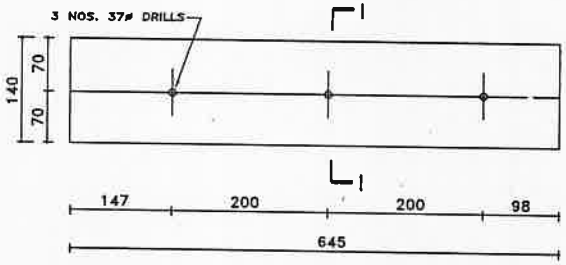
PLATEN TYPE D'



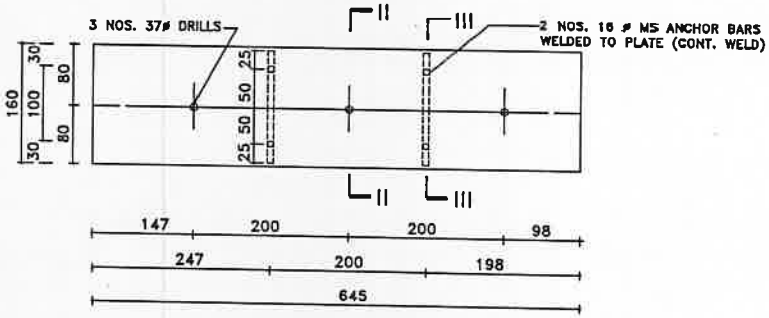
PLATEN TYPE E (WITHOUT STIFFNER)



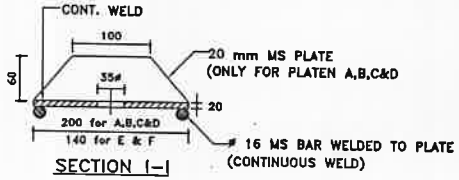
PAD TYPE E'



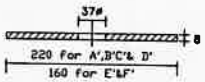
PLATEN TYPE F (WITHOUT STIFFNER)



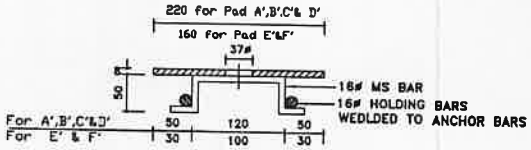
PAD TYPE F'



SECTION I-I

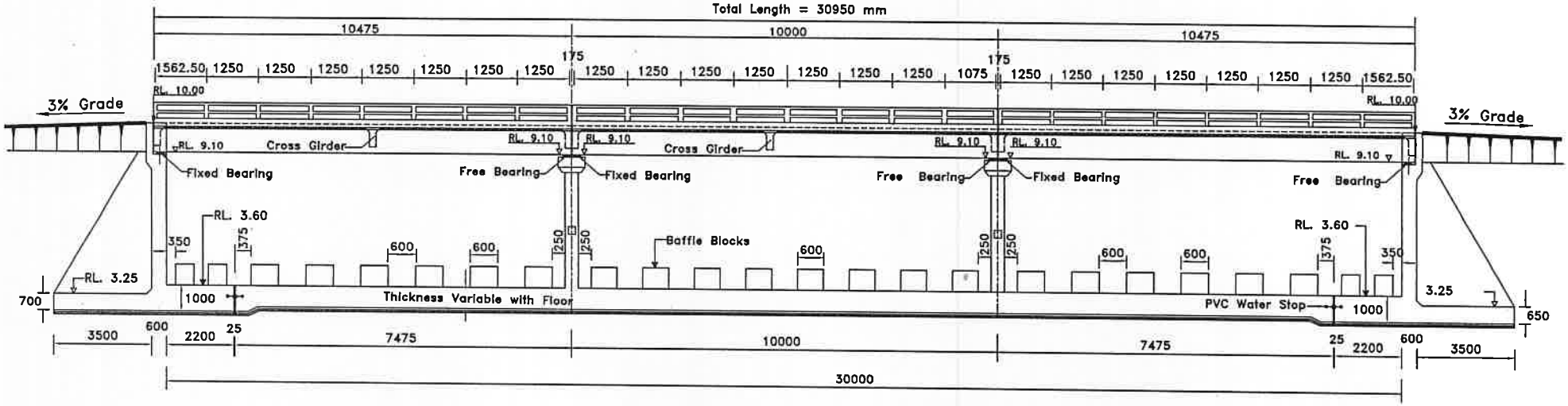


SECTION II-II

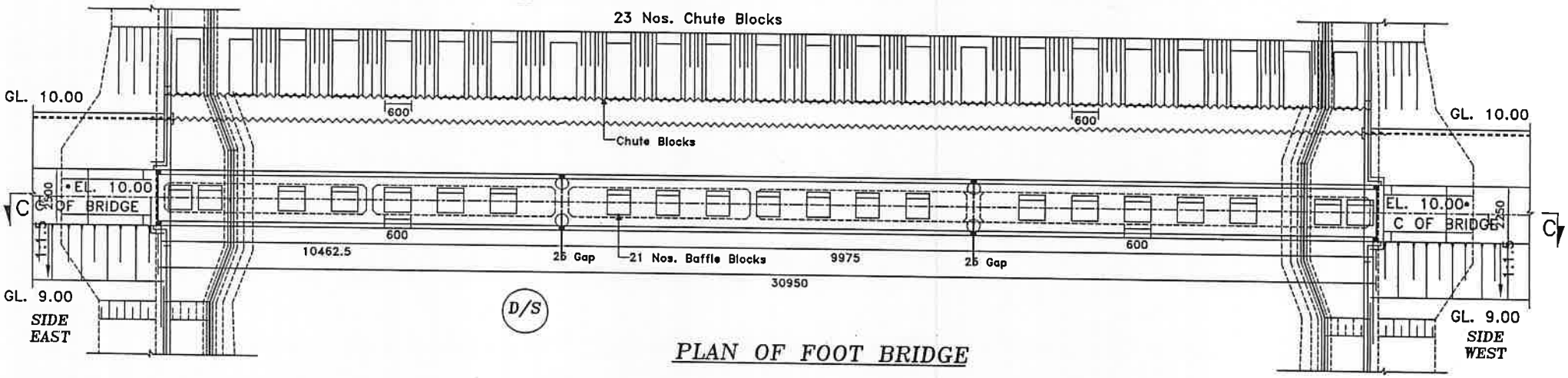


SECTION III-III

PLAN & ELEVATION OF BRIDGE



ELEVATION
SECTION C–C



PLAN OF FOOT BRIDGE

Government of the People's Republic of Bangladesh
Local Government Engineering Department

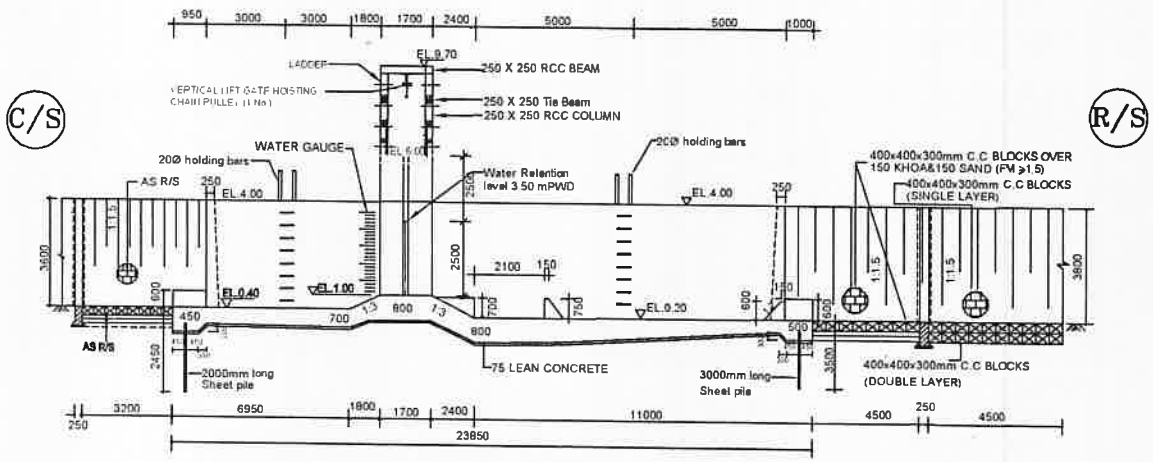
Small Scale Water Resources Development Project (Jica-2)

RDEC Bhaban (Level-6), Agargaon, Shere-Bangla Nagar
Dhaka-1207

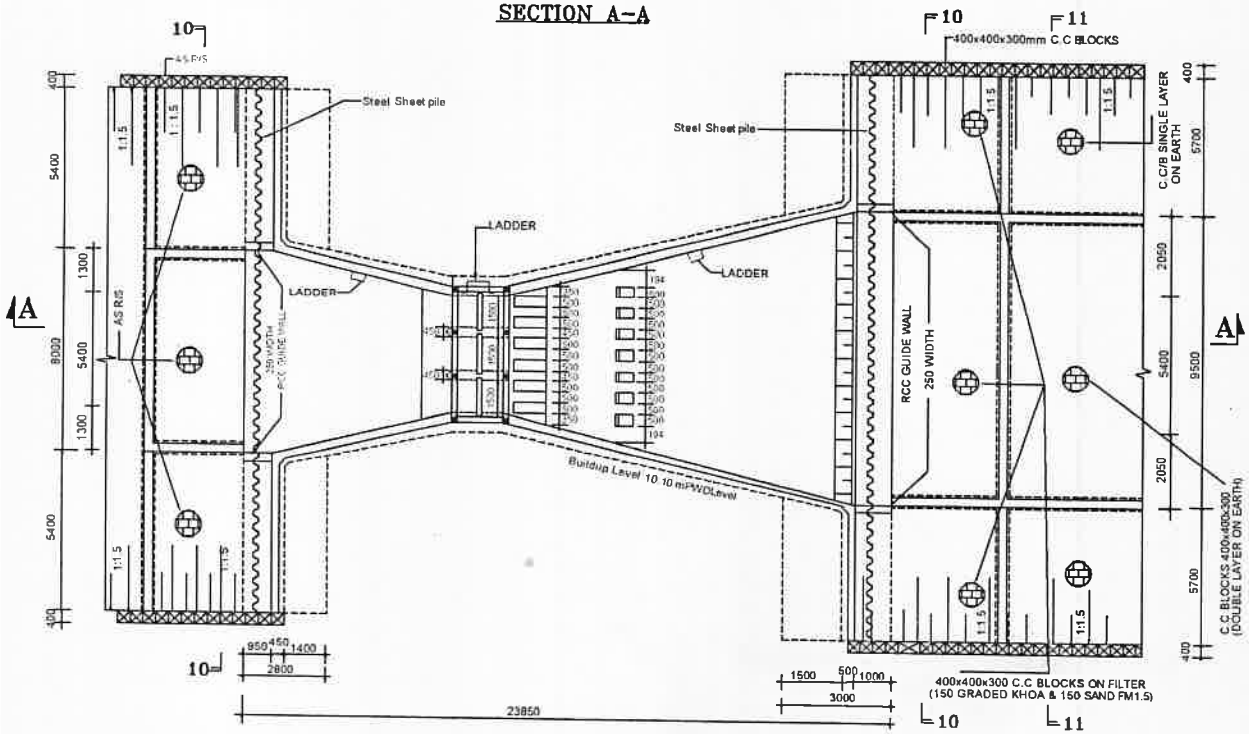
DETAIL DRAWINGS OF

WRS (size : 3v-1.50mx2.50m)

GENERAL PLAN AND LONG SECTION



SECTION A-A



GENERAL PLAN

SPECIFICATION & NOTES ON MATERIAL & WORK

1. R.C.C WORKS: A. Concrete : i) Strength:	All R.C.C WORKS 28-days standard cylinder crushing strength shall be 17 N/mm²	R.C.C PILES 28-days standard cylinder crushing strength shall be 20.7 N/mm²	LEAN CONCRETE --
ii) Proportion by volume	1:2:4	1:1.5:3	1:3:6
iii) Cement	Portland Type-1	Portland Type-1	Portland Type-1
iv) Coarse aggregate	20mm down graded crushed stone chips (Well graded between 20mm & 8mm size.) (LAA value not more than 40)	20mm down graded crushed stone chips (Well graded between 20mm & 8mm size.)	20mm down graded brick chips (Well graded between 20mm & 8mm size.) (LAA value not more than 40)
v) Sand	FM 1.80	FM 1.80	FM 1.00
vi) Slump: (at work)	60-75 mm	60-75 mm (Precast) 100-125mm (cast-in situ)	60-75 mm
B. Reinforcement	60 grade deformed M.S. bar	60 grade deformed M.S. bar	--
	Minimum yield strength 414 N/mm²	Same as in all R.C.C Works	--
	No hook should be used for M.S deformed bars.		

2. Clear concrete cover over reinforcement bars shall be :
   Earth faces = 75mm
   Water faces = 50mm
   All other faces = 25mm
   R.C.C Piles = 40mm

3. C.C blocks : C.C blocks with cement, sand (FM> 1.50) and shingles (40 mm down graded) with mix proportion 1 : 3 : 6

4. Back filling : Back filling outside abutments, wing walls and return walls up to FGL shall be done simultaneously on both sides with local sandy soil and should be free from vegetable roots and other organic materials, as soon as wall lifts are constructed.

5. Foundation Treatment : Sand filling below the foundation shall be compacted in 150 mm layers in optimum moisture content as per Schedule.

6. Strength : During pouring samples shall be collected by the contractor in presence of Engineer-in-charge in standard cylinder, one for each wing wall, abutment, return wall, top slab, apron and barrel foundation for testing 7day strengths for quality control.

7. Protective work : Earthfill in side slopes shall be compacted in horizontal layers to satisfaction of the Engineer in charge before placing filter material and block.

8. Filter Materials : i) Brick Chips : 20mm to 40mm Size (LAA Value < 40)
   ii) Sand : Coarse Sand (FM=1.5)

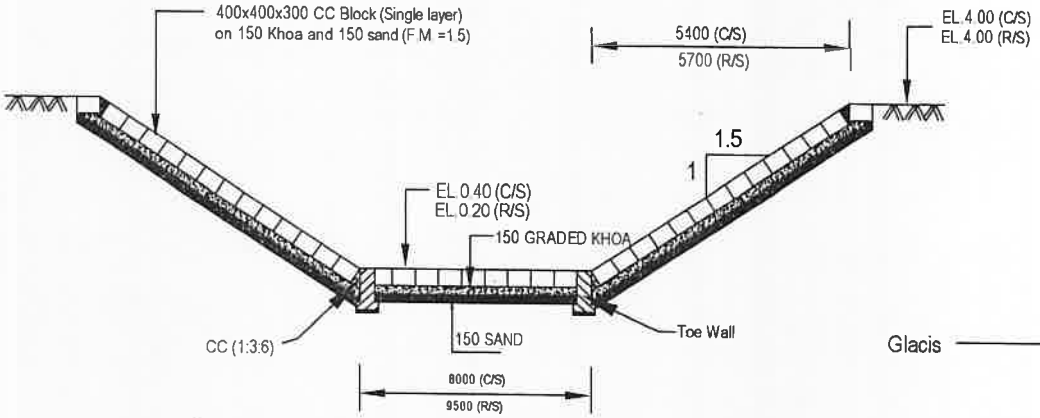
9. Elevations : All elevations are in meter (PWD).

10. Dimensions : All dimensions are in millimeters.

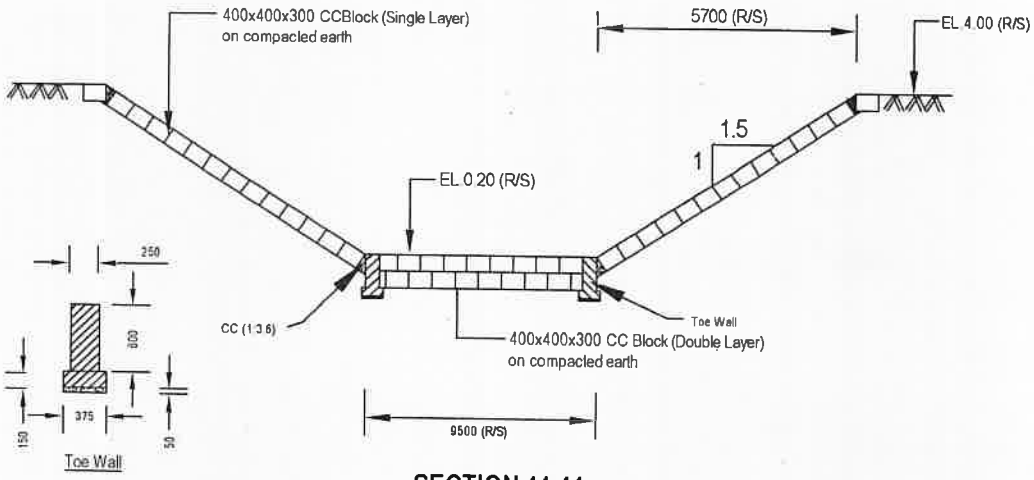
11. Embeded Parts of gates : M.S embedded parts such as angles, channels for vertical gates and fram & wall brakets for flap gates welded to anchor bars shall be installed in proper alignment during casting of concrete as shown in working drawing.

12. Formwork : Formwork for Concrete for making fully leak proof shall be faced with plain 28/26 gauge steel sheet fitted over 38mm thick wooden plank panels suitably braced or steel framing faced with minimum 12/14 BWG mild steel sheet
Formwork for C.C blocks shall be fabricated from m.s steel of sufficient thickness to prevent any distortion

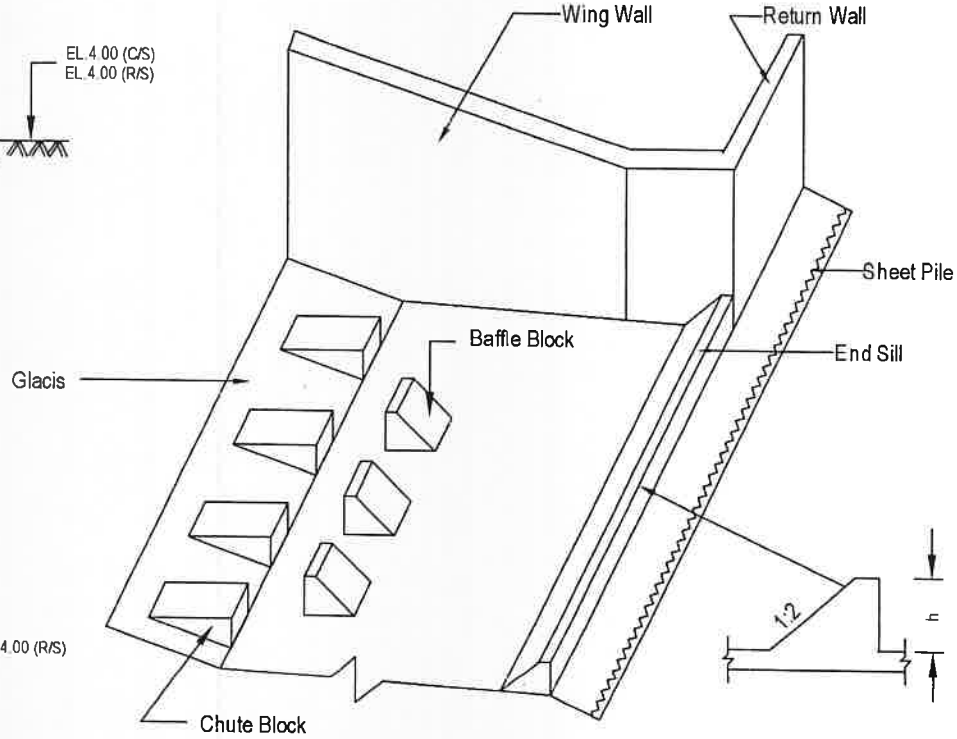
SECTIONS & DETAILS OF PROTECTIVE WORKS



SECTION 10-10

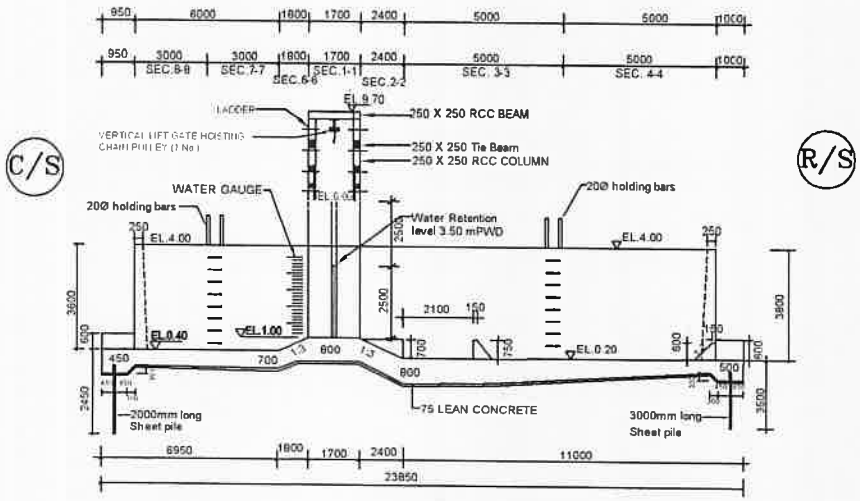


SECTION 11-11

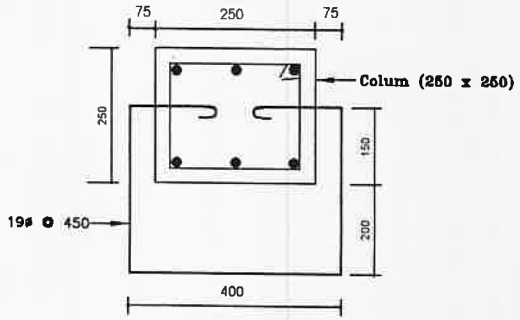


Arrangement of Chute Block,
Baffle Block & End Sill

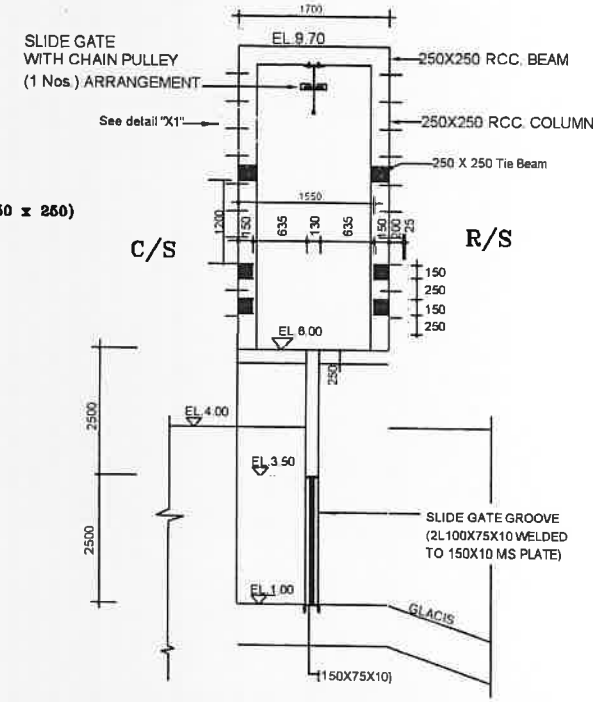
SECTION LIMIT DETAILS



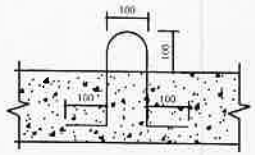
SECTION B–B



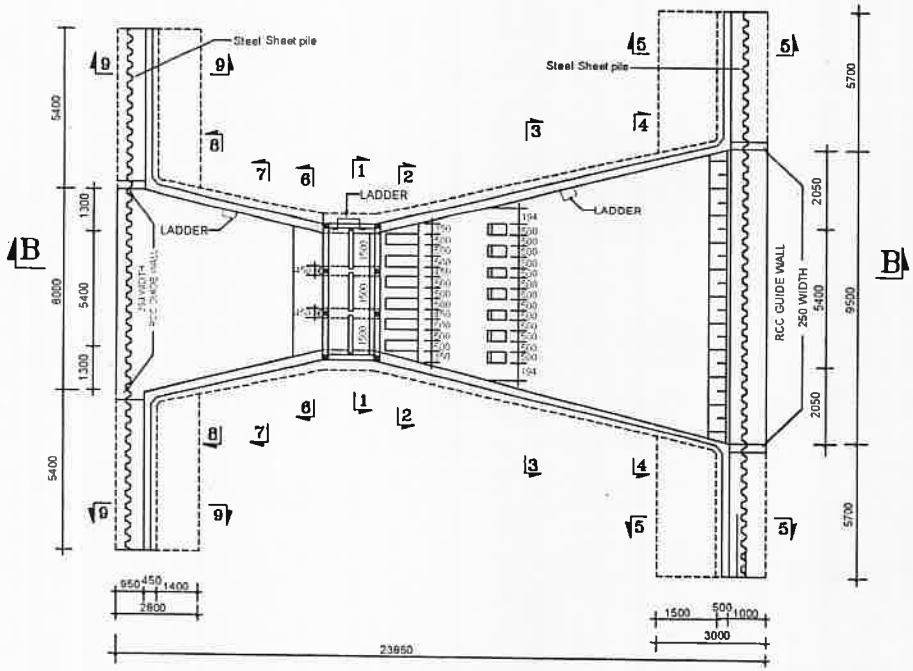
DETAIL "X1"



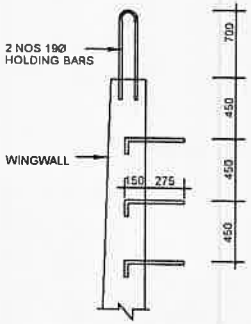
ARRANGEMENT OF DECKS AND GROOVES



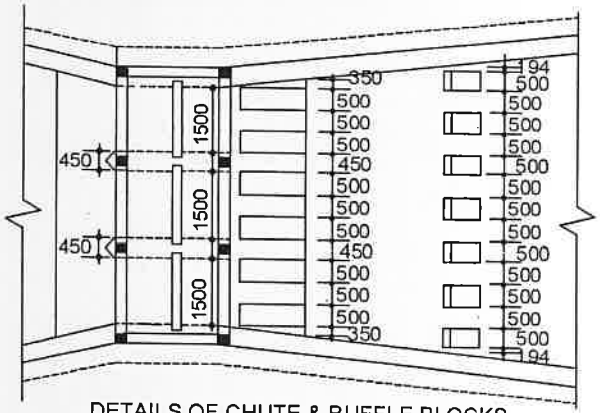
DETAILS OF HOOK



PLAN

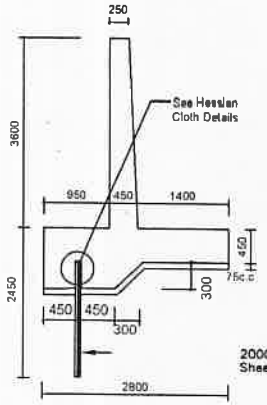


DETAIL OF LADDER

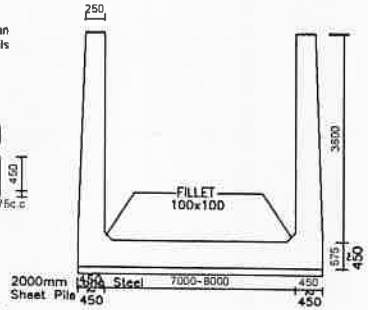


DETAILS OF CHUTE & BUFFLE BLOCKS

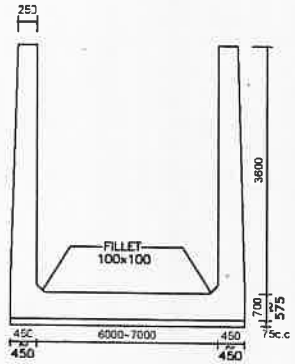
CONCRETE OUTLINE DETAILS



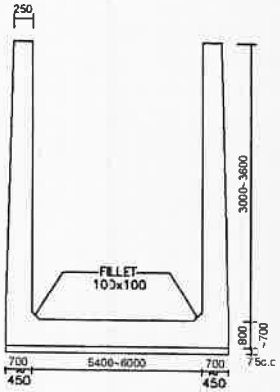
SECTION 9-9 (C/S)



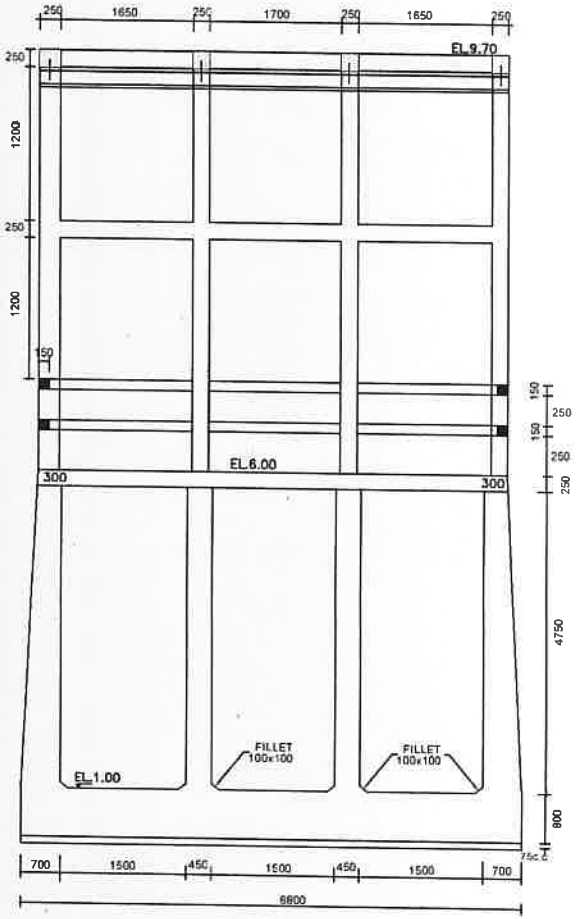
SECTION 8-8(C/S)



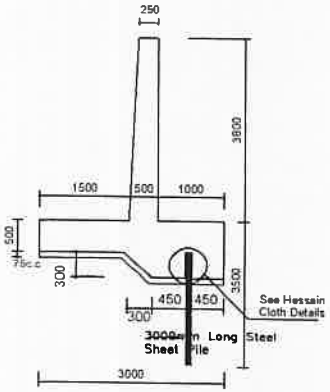
SECTION 7-7(C/S)



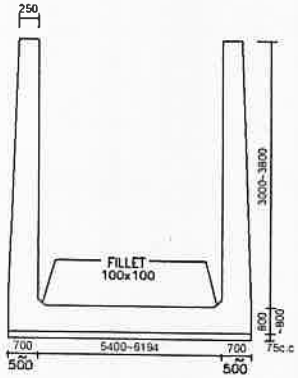
SECTION 6-6(C/S)



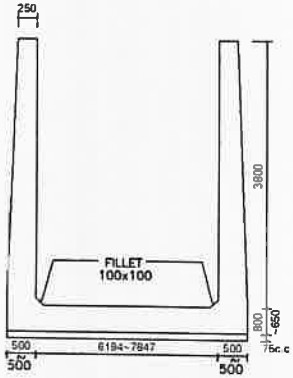
SECTION 1-1



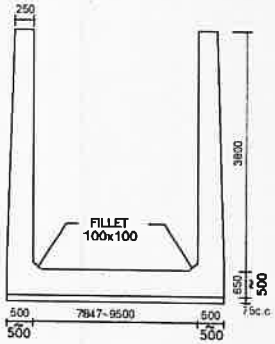
SECTION 5-5(R/S)



SECTION 2-2 (R/S)



SECTION 3-3 (R/S)



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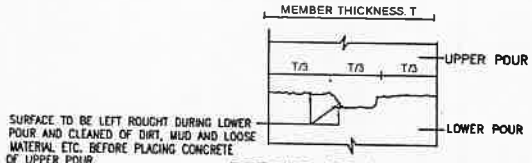
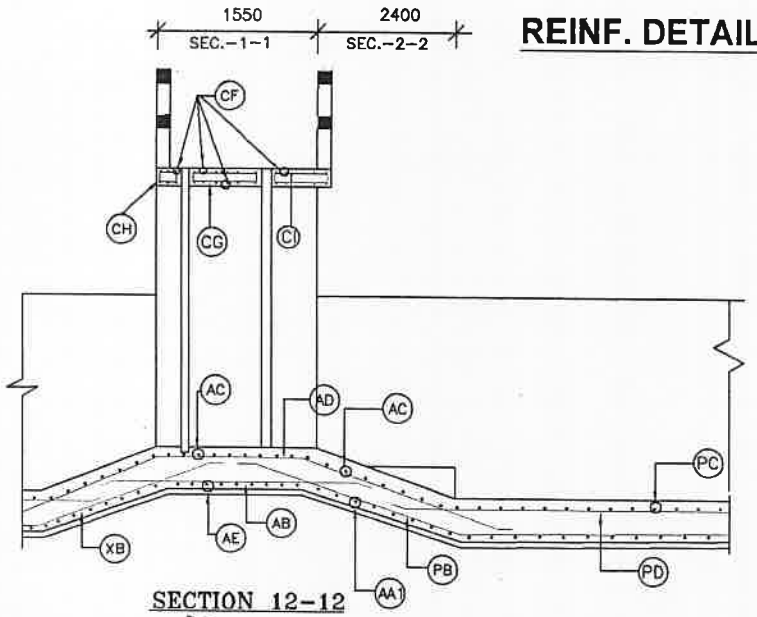
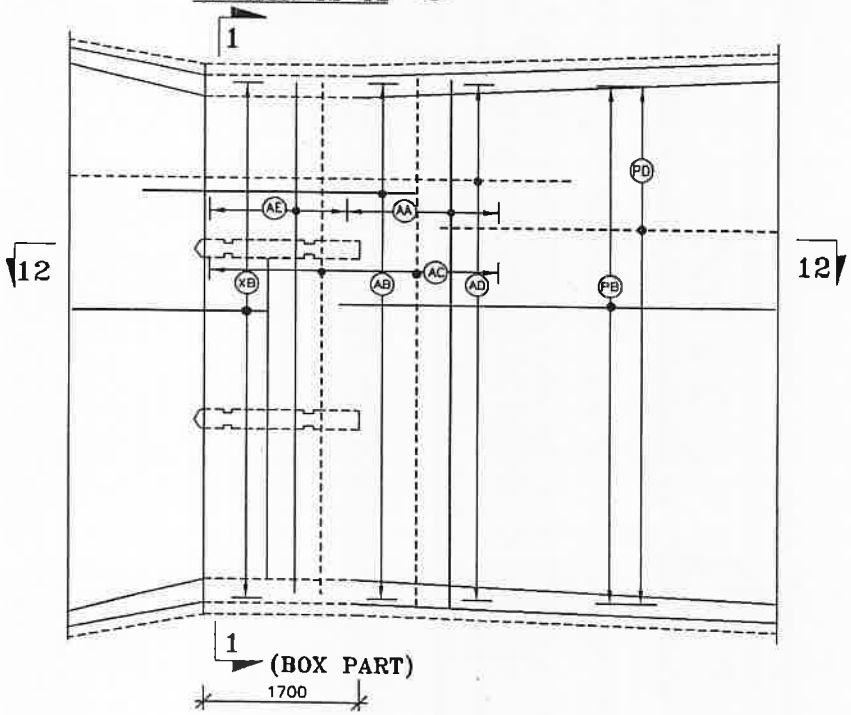


DETAILS OF CONSTRUCTION JOINTS (TYPICAL)

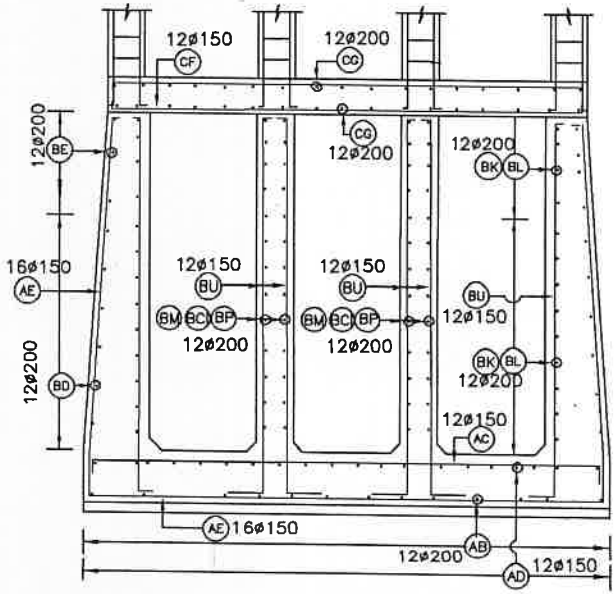
REINF. DETAILS: ABUTMENTS, TOP SLAB, FLOOR



SECTION 12-12

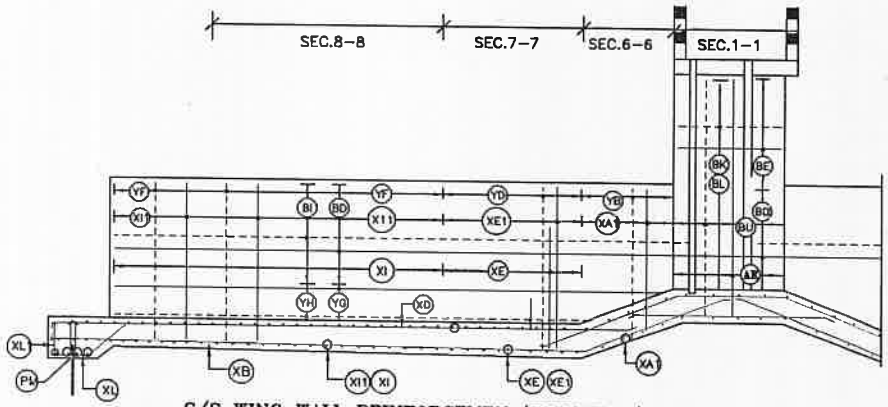


BASE SLAB REINFORCEMENT

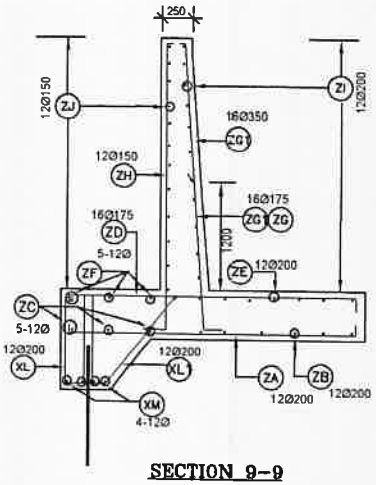


SECTION.1-1

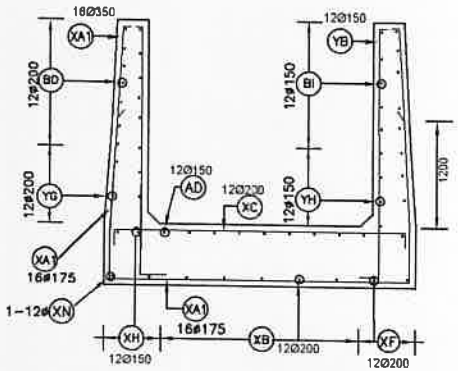
REINF. DETAILS OF C/S FLOOR, WING & RETURN WALL



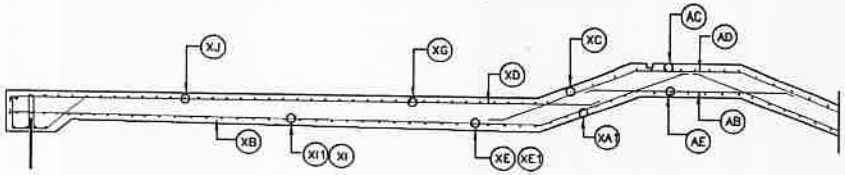
C/S WING WALL REINFORCEMEN (ELEVATION)



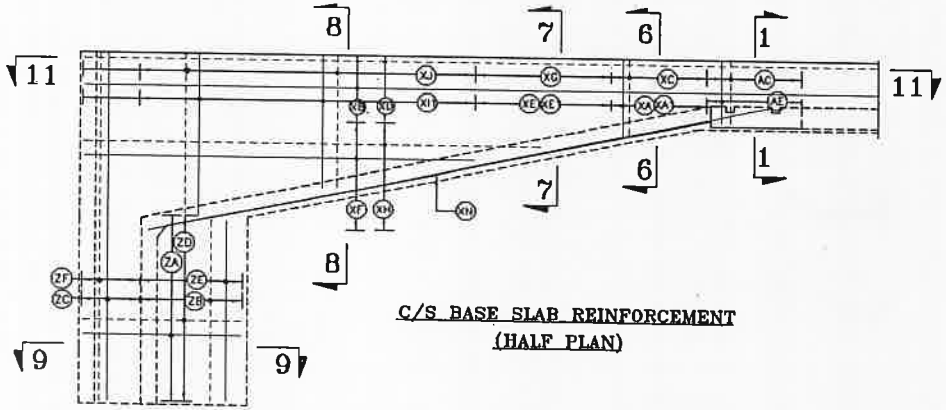
SECTION 9-9



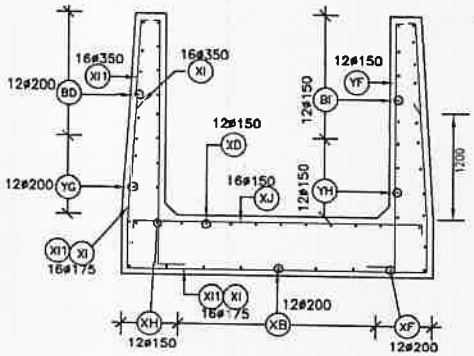
SECTION 6-6



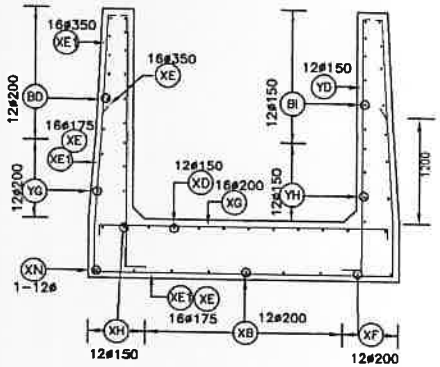
SEC.11-11



C/S BASE SLAB REINFORCEMENT
(HALF PLAN)

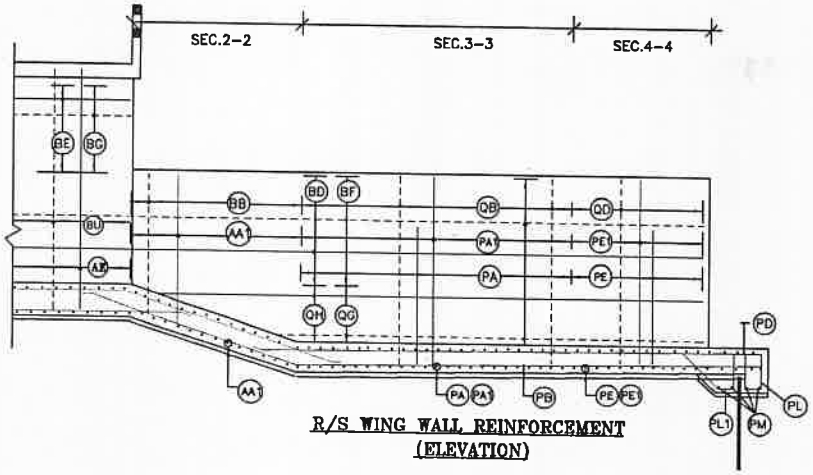


SECTION 8-8

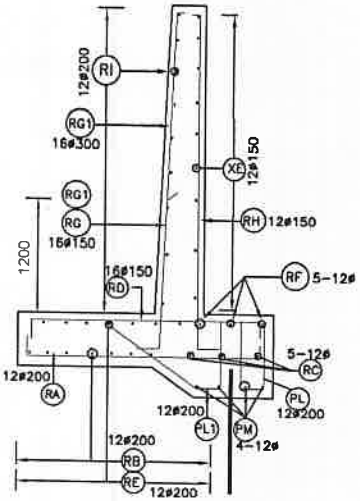


SECTION 7-7

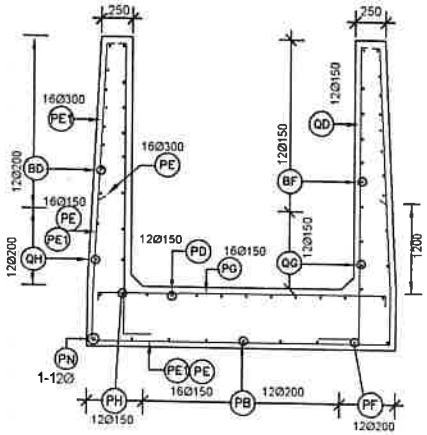
REINF. DETAILS OF R/S FLOOR, WINGS & RETURN WALL



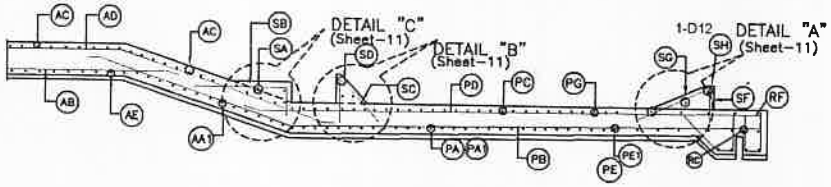
R/S WING WALL REINFORCEMENT
(ELEVATION)



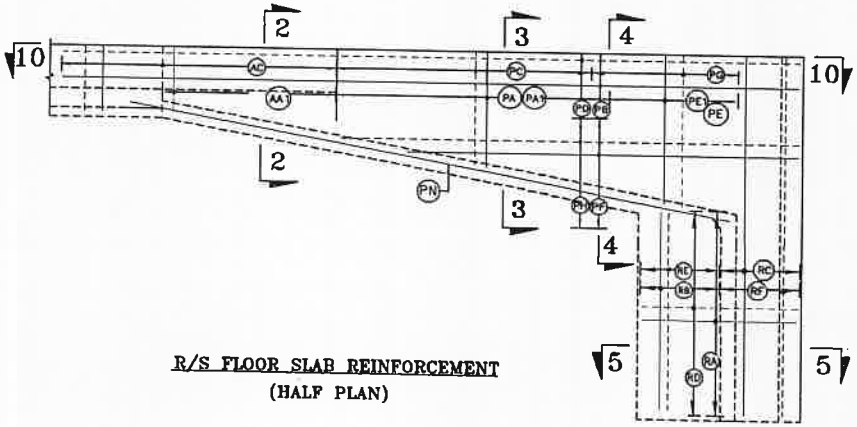
SECTION 5-5



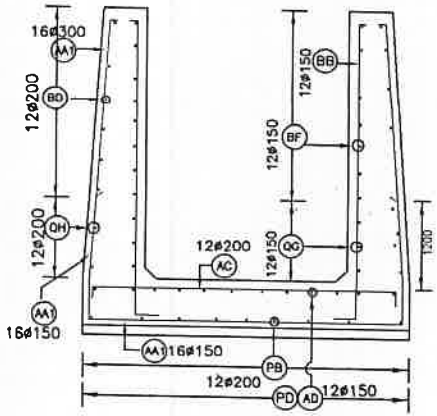
SECTION4-4



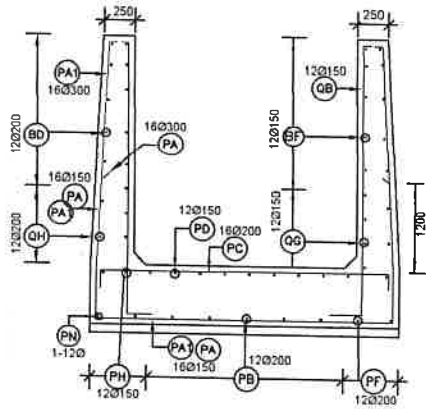
SECTION 10-10



R/S FLOOR SLAB REINFORCEMENT
(HALF PLAN)

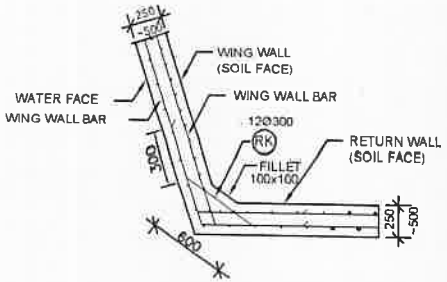


SECTION 2-2

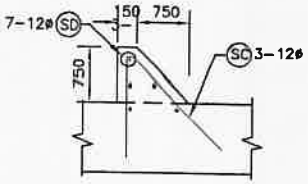


SECTION 3-3

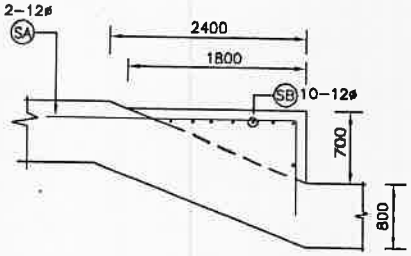
MISCELLANEOUS DETAILS



WING & RETURN WALL JOINT

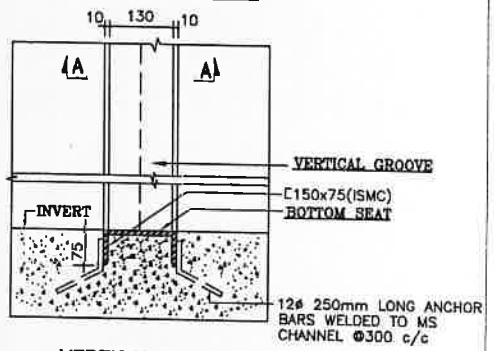


R/S BAFFLE BLOCK REINF. (DETAIL "B")

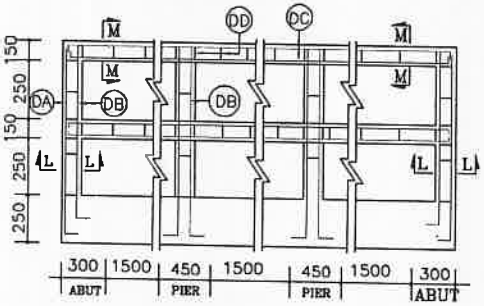


R/S CHUTE BLOCK REINF. (DETAIL "C")

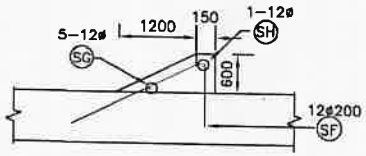
SLIDE GATE GROOVE



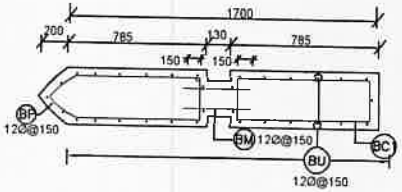
VERTICAL SECTION



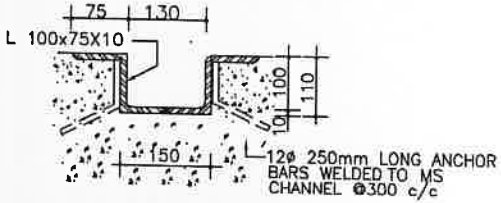
RAILING AND POST DETAIL



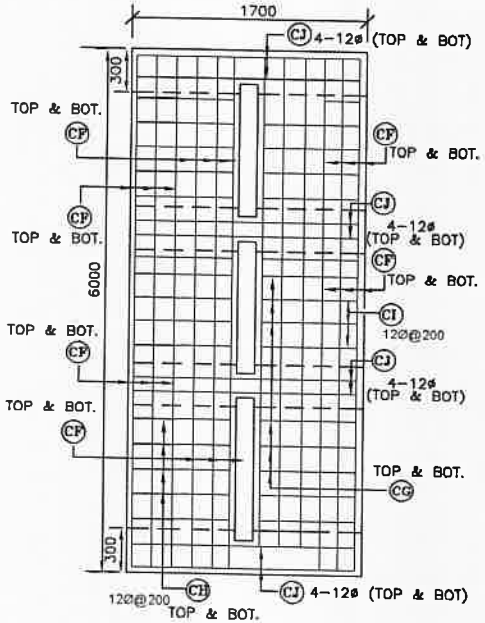
R/S END SILL REINF. (DETAIL "A")



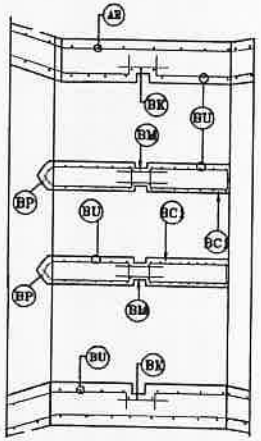
REINFORCEMENT DETAILS OF SHORT PIER



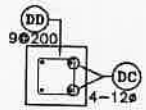
HORIZONTAL SECTION A-A



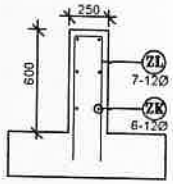
REINF. OPERATING PLATFORM



REINF. ARRANGEMENT AT GATE SLOTS AT ABUTMENT & PIER



SECTION M-M



RCC GUIDE WALL

Government of the People's Republic of Bangladesh
Local Government Engineering Department

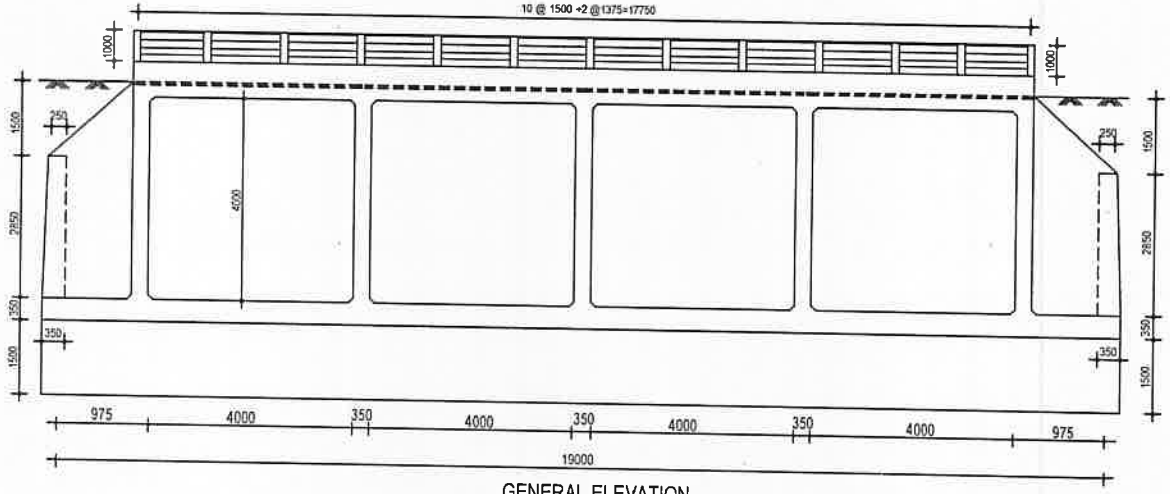
Small Scale Water Resources Development Project (Jica-2)

RDEC Bhaban (Level-6), Agargaon, Shere-Bangla Nagar
Dhaka-1207

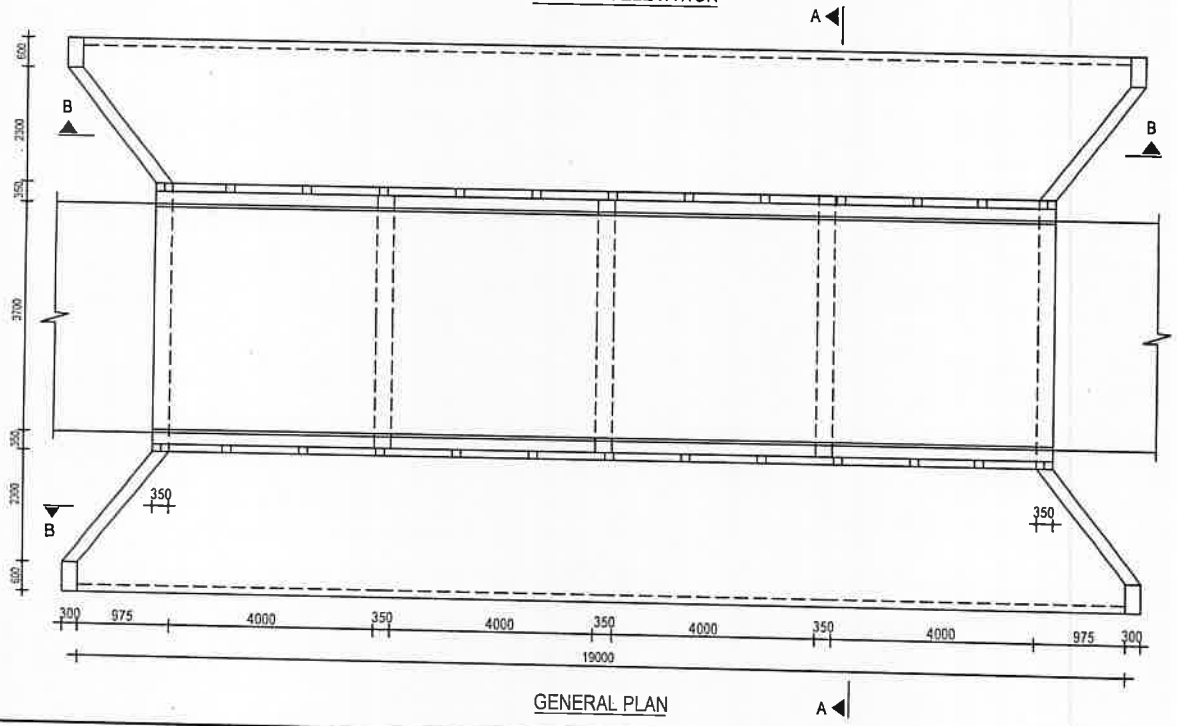
DETAIL DRAWINGS OF

BOX-CULVERT (Size : 4v-4.00mx4.00m)

GENERAL PLAN & LONG SECTION



GENERAL ELEVATION



GENERAL PLAN

SPECIFICATION & NOTES ON MATERIAL & WORK

1. R.C.C WORKS	All R.C.C WORKS	R.C.C PILES	LEAN CONCRETE
A. Concrete : i) Strength; 25 N/mm²	28-days standard cylinder crushing strength shall be	28-days standard cylinder crushing strength shall be 25 N/mm²	–
ii) Proportion by volume	1:1.5:3	1:1.5:3	1:3:6
iii) Cement	Portland Type-1	Portland Type-1	Portland Type-1
iv) Coarse aggregate (LAA value not more than 40)	20mm down graded crushed stone chips (Well graded between 20mm & 6mm size.)	20mm down graded crushed stone chips (Well graded between 20mm & 6mm size.)	20mm down graded brick chips (Well graded between 20mm & 6mm size.) (LAA value not more than 40)
v) Sand	FM 1.80	FM 1.80	FM 1.00
vi) Slump (at work)	60-75 mm	60-75 mm (Precast) 100-125mm (cast-in situ)	60-75 mm
B. Reinforcement	60 grade deformed M.S. bar	60 grade deformed M.S. bar	–
	Minimum yield strength 415 N/mm²	Same as in all R.C.C Works	–
	No hook should be used for M.S deformed bars		

2. Clear concrete cover over reinforcement bars shall be :
Earth faces = 75mm
Water faces = 50mm
All other faces = 25mm
R.C.C Piles = 40mm

3. C.C bolcks : C.C blocks with cement, sand (FM> 1.50) and shingles (40 mm down graded) with mix proportion 1 : 3 : 6

4. Back filing : Back filling outside abutments, wing walls and return walls up to FGL shall be done simultaneously on both sides with local sandy soil and should be free from vegetable roots and other organic materials, as soon as wall lifts are constructed.

5. Foundation Treatment : Sand filing below the foundation shall be compacted in 150 mm layers in optimum moisture content as per Schedule.

6. Strength : During pouring samples shall be collected by the contractor in presence of Engineer-in-charge in standard cylinder, one for each wing wall, abutment, return wall, top slab, apron and barrel foundation for testing 7day strengths for quality control

7. Protective work : Earthfill in side slopes shall be compacted in horizontal layers to satisfaction of the Engineer in charge before placing filter material and block.

8. Filter Materials : i) Brick Chips : 20mm to 40mm Size (LAA Value < 40)
ii) Sand : Coarse Sand (FM>1.5)

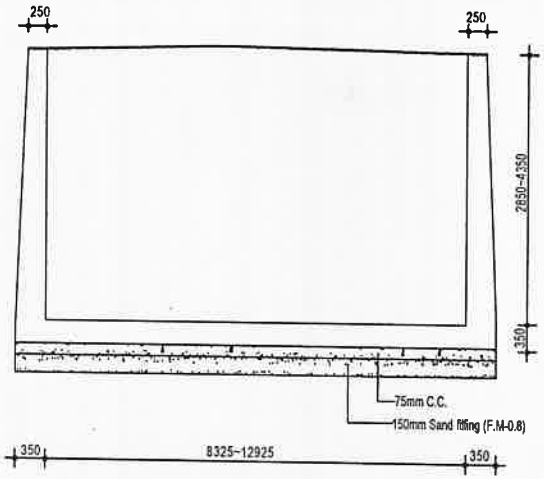
9. Elevations : All elevations are in meter (PWD).

10. Dimensions : All dimensions are in millimeters.

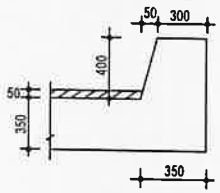
11. Embeded Parts of gates : M.S embedded parts such as angles, channels for vertical gates and thim & wall brakets for flap gates welded to anchor bars shall be installed in proper alignment during casting of concrete as shown in working drawing

12. Formwork : Formwork for Concrete for making fully leak proof shall be faced with plain 28/26 gauge steel sheet fitted over 38mm thick wooden plank panels suitably braced or steel framing faced with minimum 12/14 BWG mild steel sheet
Formwork for C.C blocks shall be fabricated from m s steel of sufficient thickness to prevent any distortion

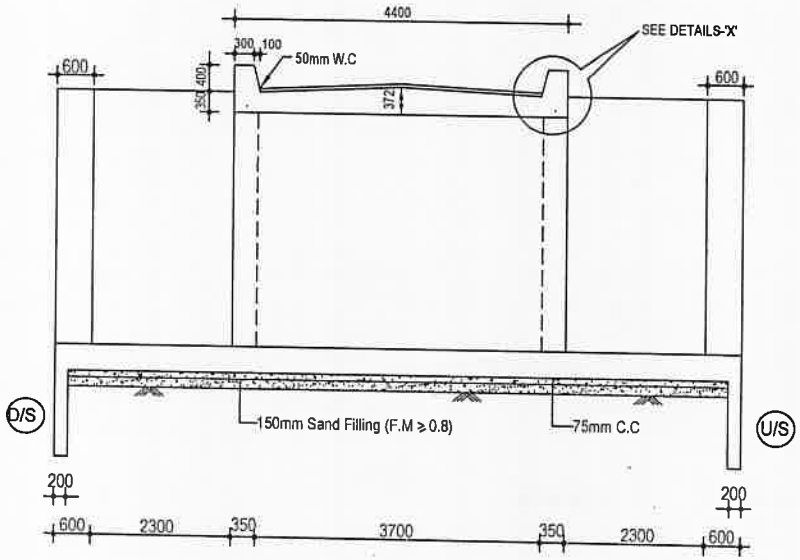
SECTIONS DETAILS



SECTION B-B

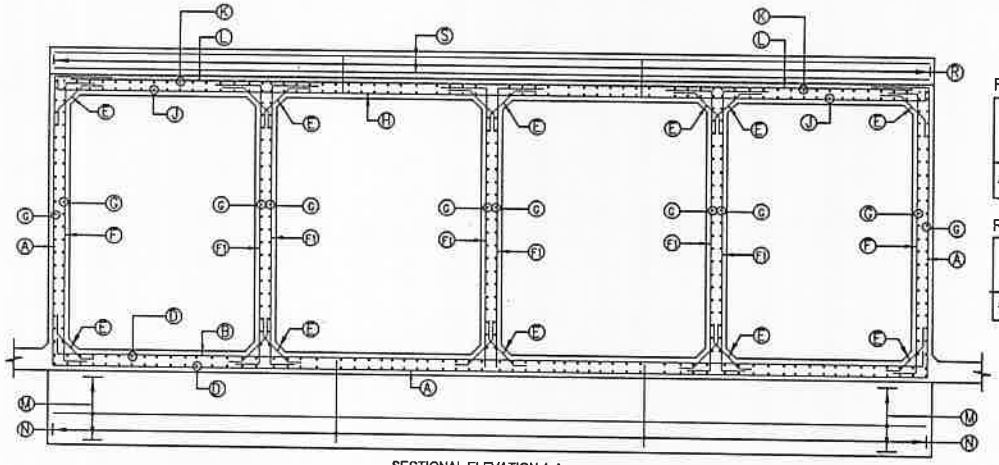


DETAIL-X



SECTION A-A

REINF. DETAILS OF BASE SLAB & SECTIONS



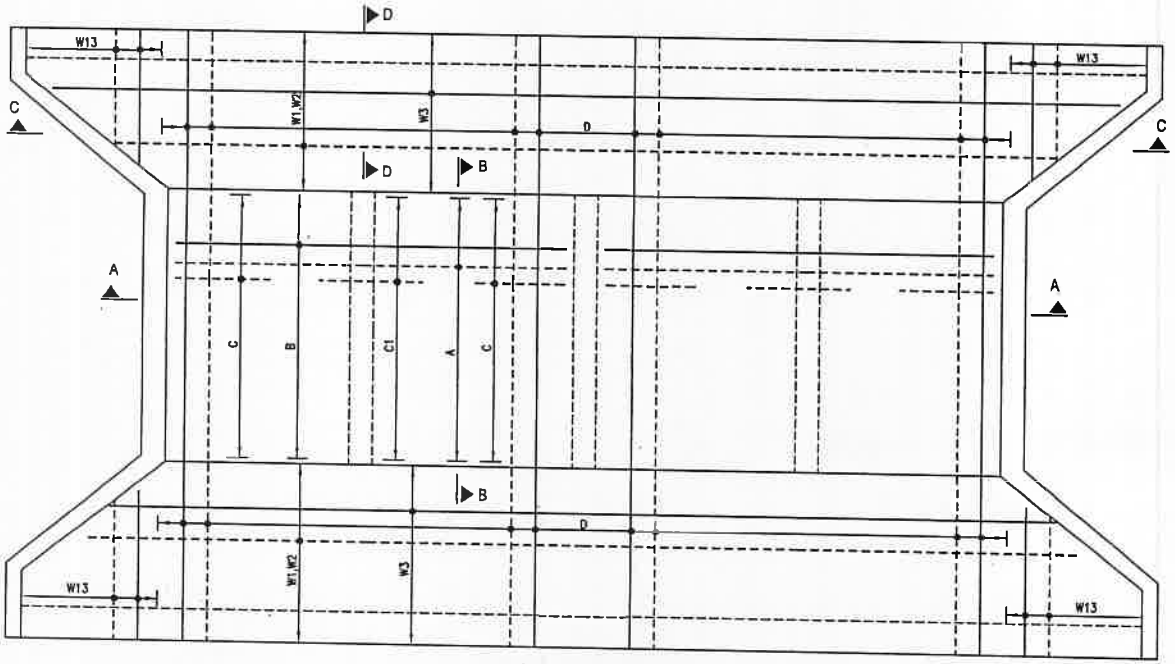
SECTIONAL ELEVATION A-A

REINFORCEMENT DATA FOR BOX

BOX SIZE	BAR MARK, SIZE & SPACING (mm)											
	A	B	D	F	F1	H	J	K	L	M	N	S
4.0mx4.0m	Y16-140	Y16-140	Y12-150	Y12-150	Y12-150	Y16-150	Y12-100	Y12-150	Y16-140	Y12-150	Y12-150	8-10 Ø

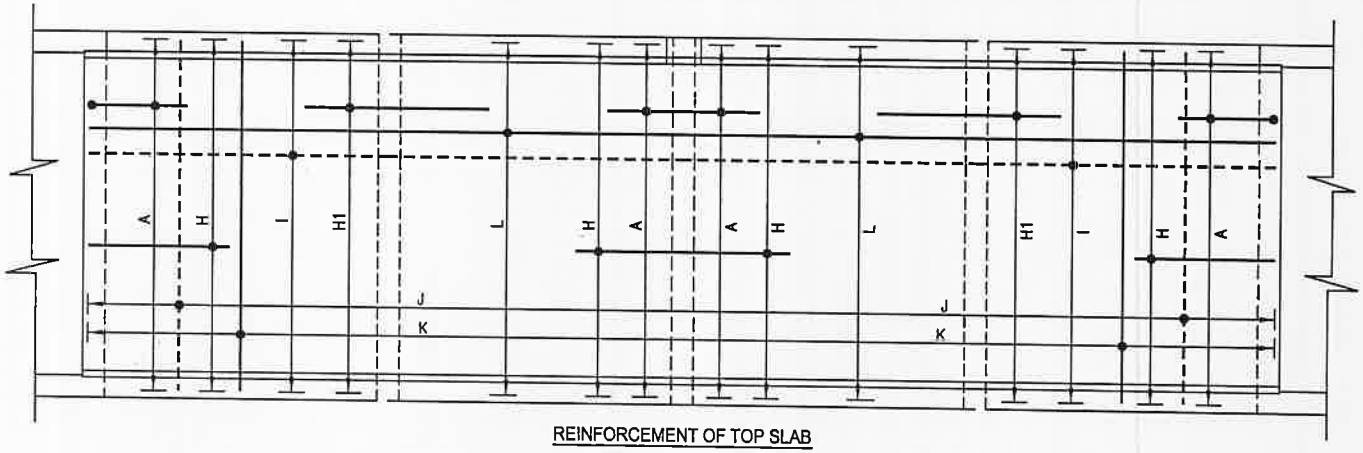
REINFORCEMENT DATA FOR WING WALL

BOX SIZE	BAR MARK, SIZE & SPACING (mm)															
	W1	W2	W3	W4	W5	W6	W7	W8	W9	W10	W11	W12	W13	W14	W15	W16
4.0mx4.0m	Y20-350	Y20-350	Y20-150	Y12-150	Y12-200	Y12-200	Y12-150	Y12-150	Y12-150	2-Y12 Ø	2-Y12 Ø	Y12-200	2-Y12 Ø	Y12-150	Y12-150	Y12-200

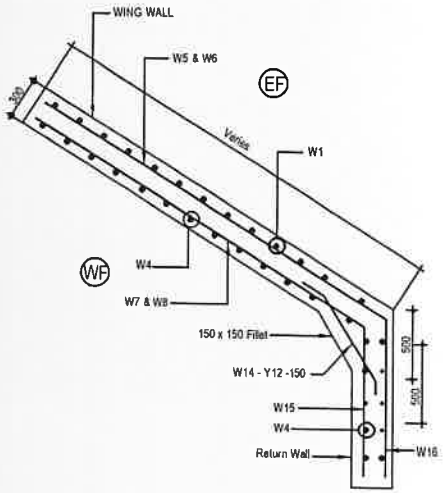


REINFORCEMENT OF BASE SLAB

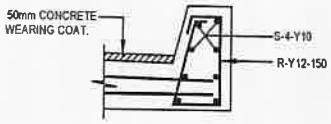
REINF. DETAILS OF SECTIONS



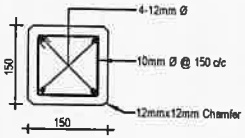
REINFORCEMENT OF TOP SLAB



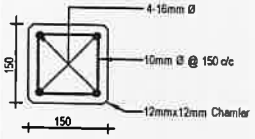
REINF. DETAILS OF WING WALL



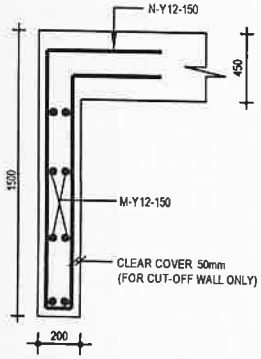
DETAIL-Y



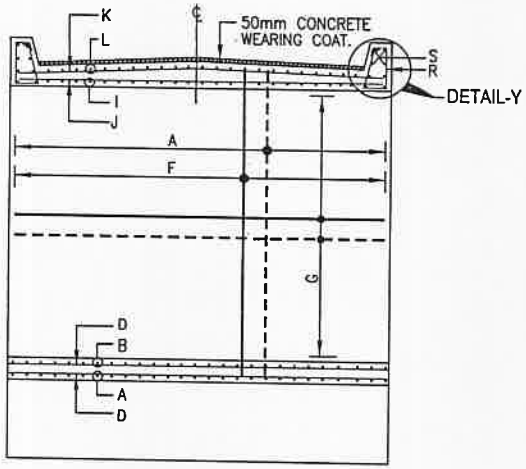
HAND RAIL



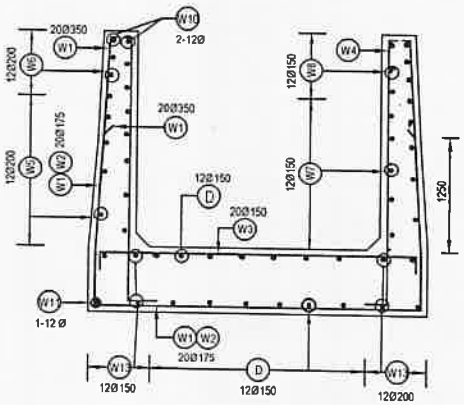
RAIL POST



SECTION D-D



SECTIONAL ELEVATION B-B



SECTION C-C

Government of the People's Republic of Bangladesh
Local Government Engineering Department

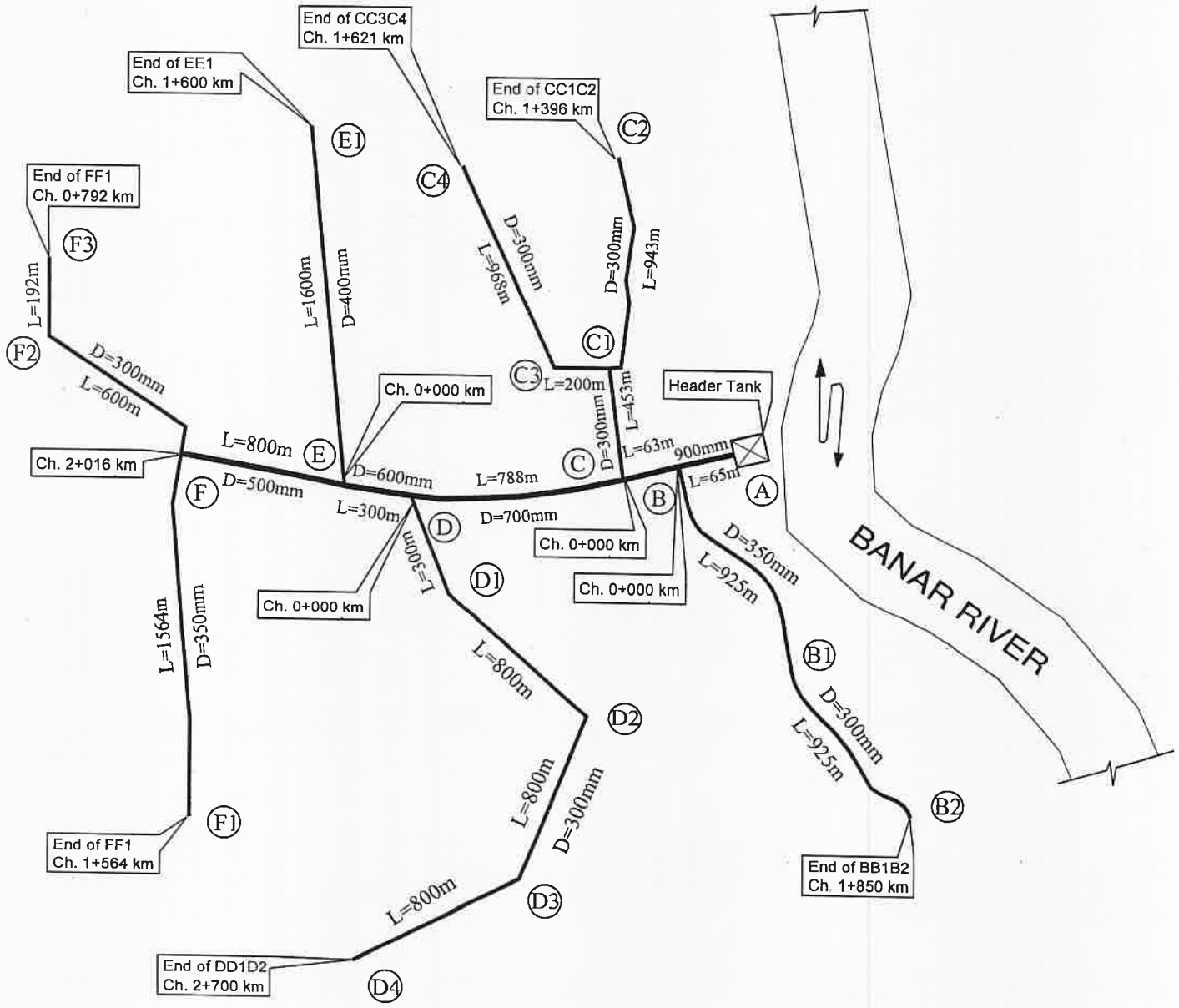
Small Scale Water Resources Development Project (Jica-2)

RDEC Bhaban (Level-6), Agargaon, Shere-Bangla Nagar
Dhaka-1207

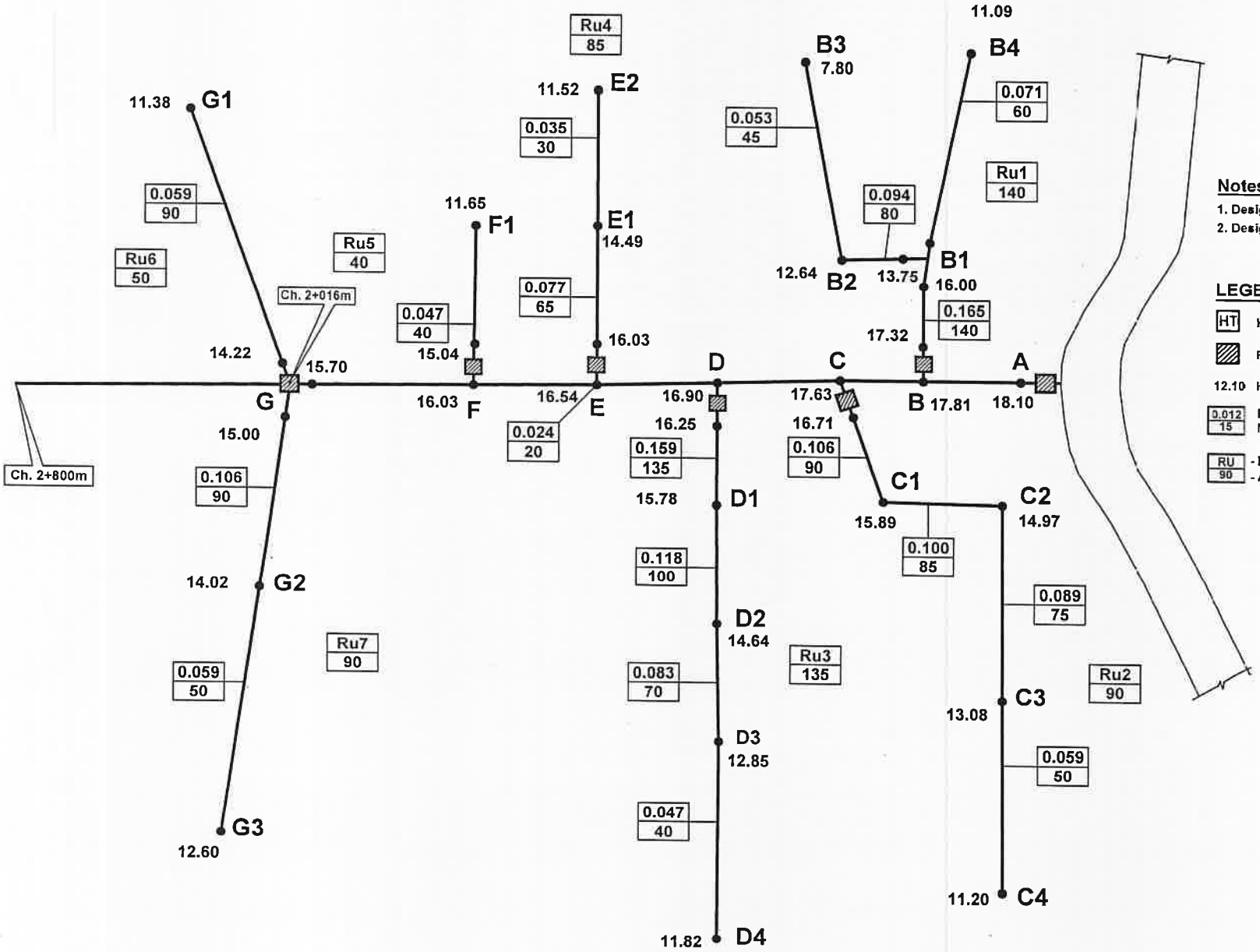
DETAIL DRAWINGS OF

HEADER, LINED & BURRIED PIPE

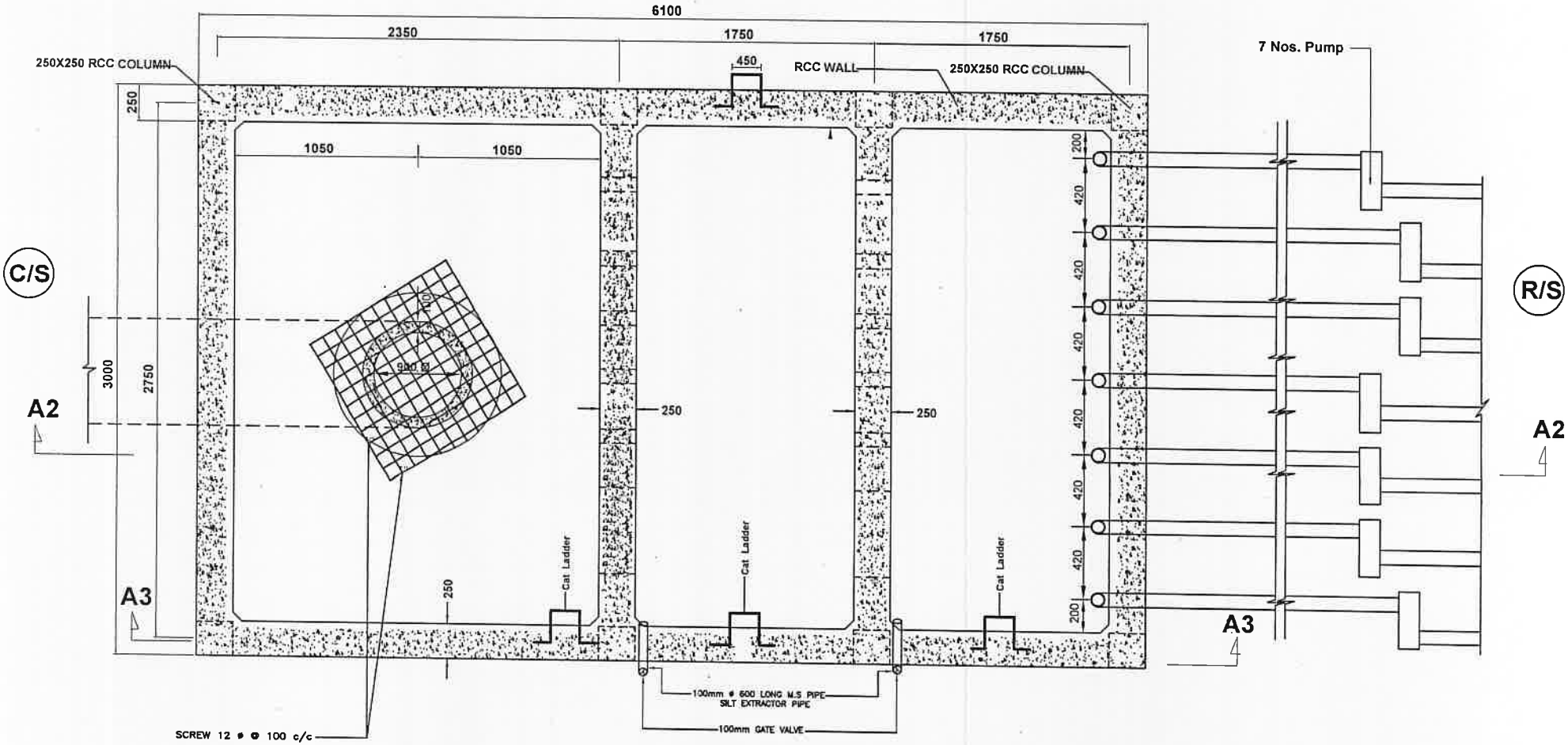
LAYOUT PLAN OF BURIED PIPE NETWORK



SCHEMATIC LAYOUT AND HYDRAULIC DATA

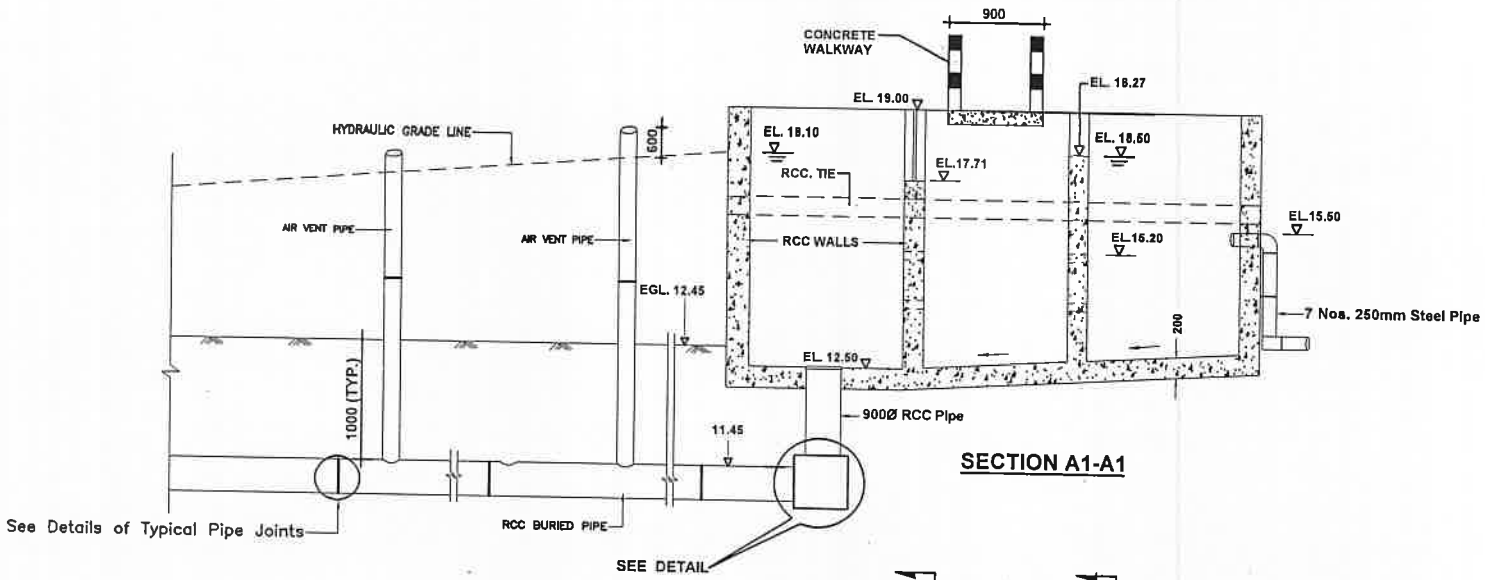


HEADER TANK PLAN

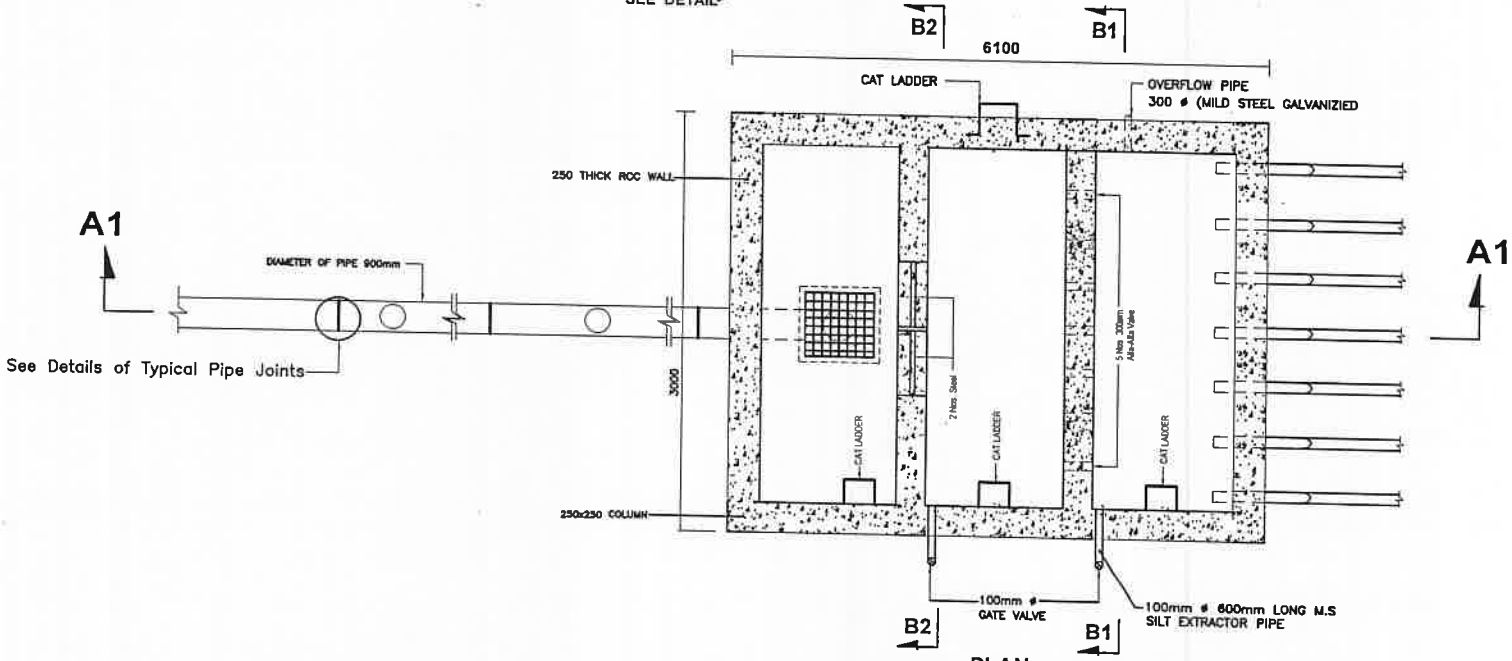


PLAN

HEADER TANK GENERAL ARRANGEMENT-1



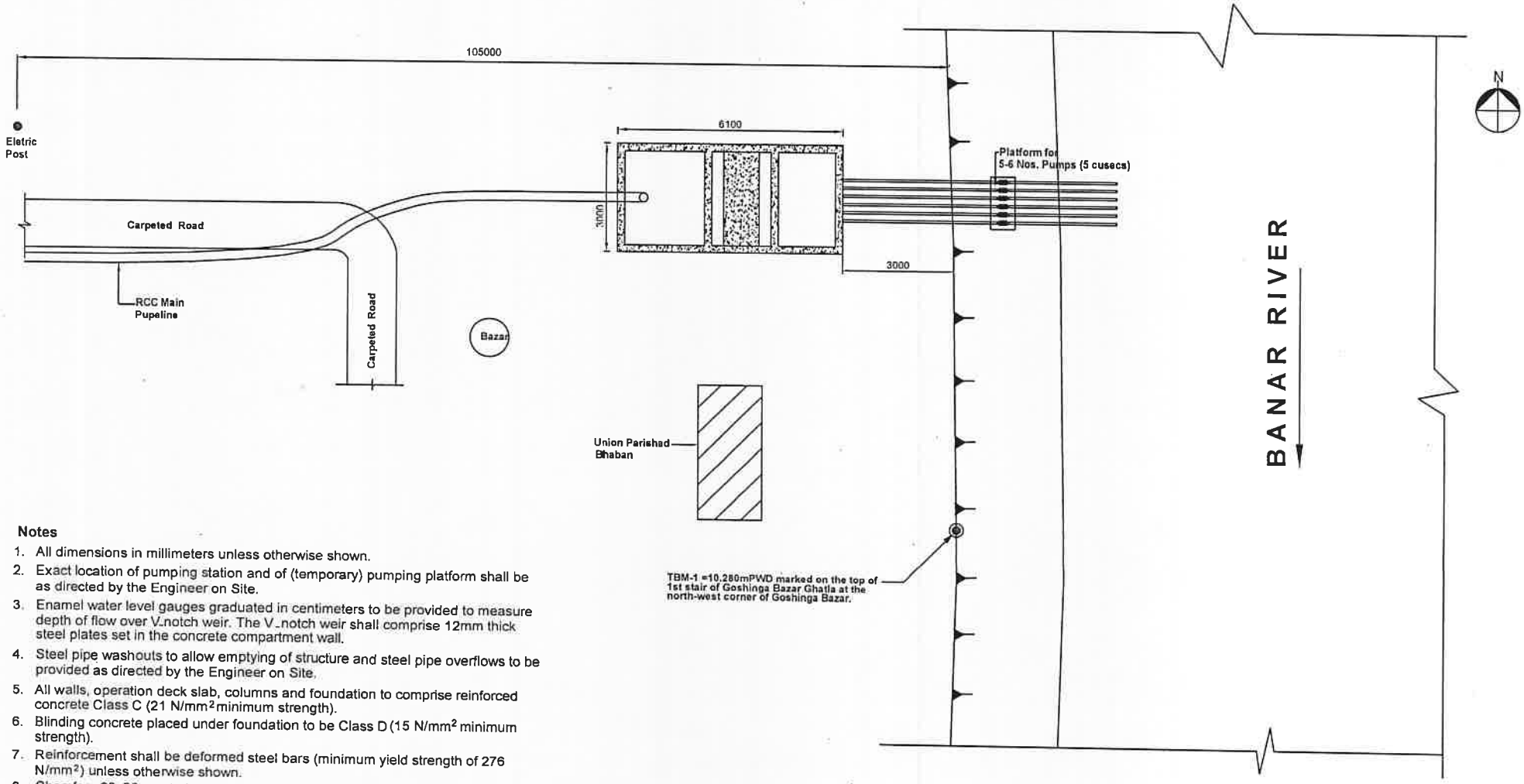
SECTION A1-A1



PLAN

FOUNDATION AND WALKWAY NOT SHOWN

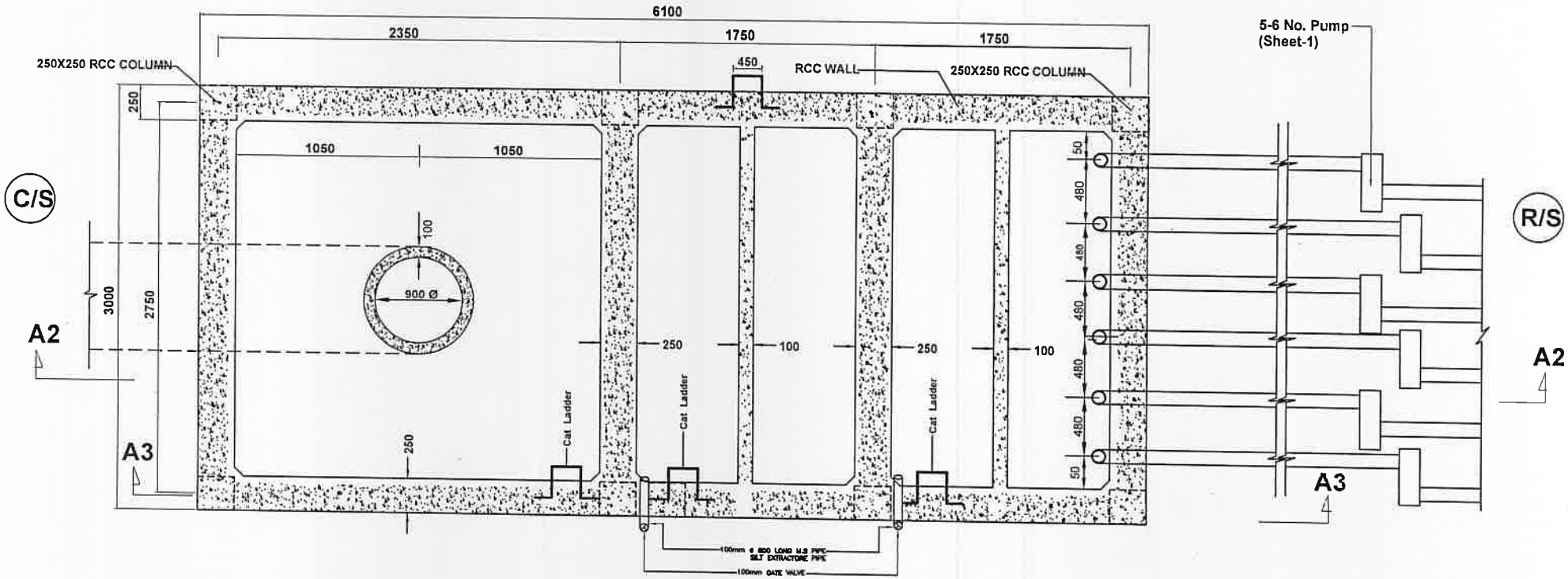
SITE PLAN



Notes

1. All dimensions in millimeters unless otherwise shown.
2. Exact location of pumping station and of (temporary) pumping platform shall be as directed by the Engineer on Site.
3. Enamel water level gauges graduated in centimeters to be provided to measure depth of flow over V-notch weir. The V-notch weir shall comprise 12mm thick steel plates set in the concrete compartment wall.
4. Steel pipe washouts to allow emptying of structure and steel pipe overflows to be provided as directed by the Engineer on Site.
5. All walls, operation deck slab, columns and foundation to comprise reinforced concrete Class C (21 N/mm^2 minimum strength).
6. Blinding concrete placed under foundation to be Class D (15 N/mm^2 minimum strength).
7. Reinforcement shall be deformed steel bars (minimum yield strength of 276 N/mm^2) unless otherwise shown.
8. Chamfers 20x20 mm to be provided to all exposed concrete edges.
9. 1 No outer access rung ladders and 3 No inner ladders to be provided (1 to each compartment).
10. Foundation fill material shall comprise suitably graded and compacted sand, gravel or stone or blinding concrete as directed by the Engineer.
11. Invert level of MS Overflow Pipe set at DWL + 200 mm.

HEADER TANK PLAN

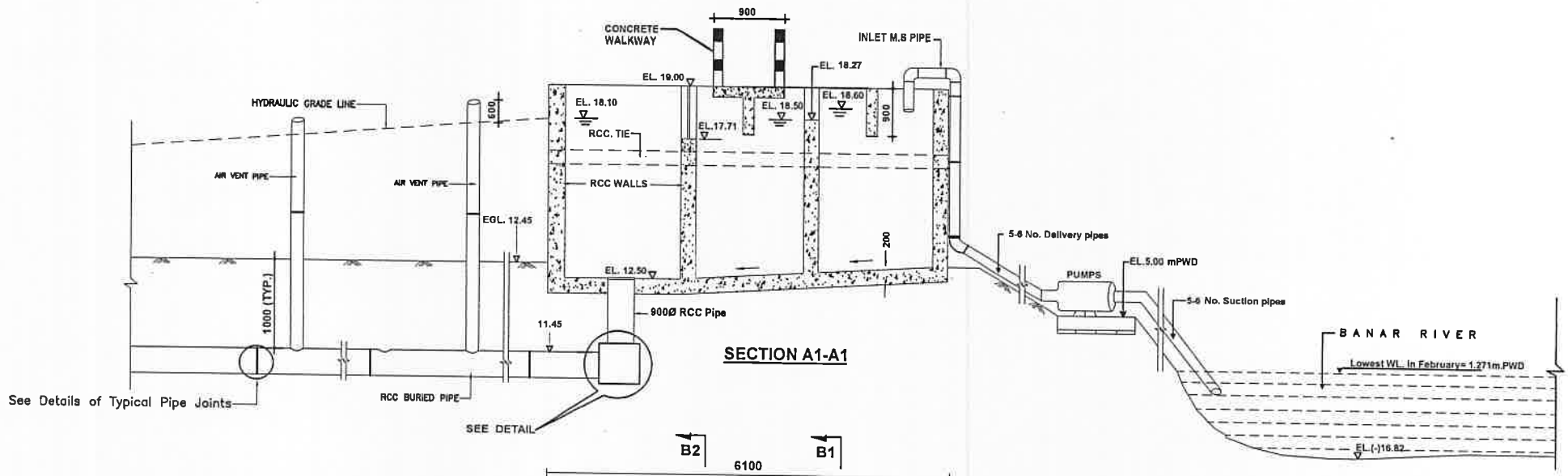


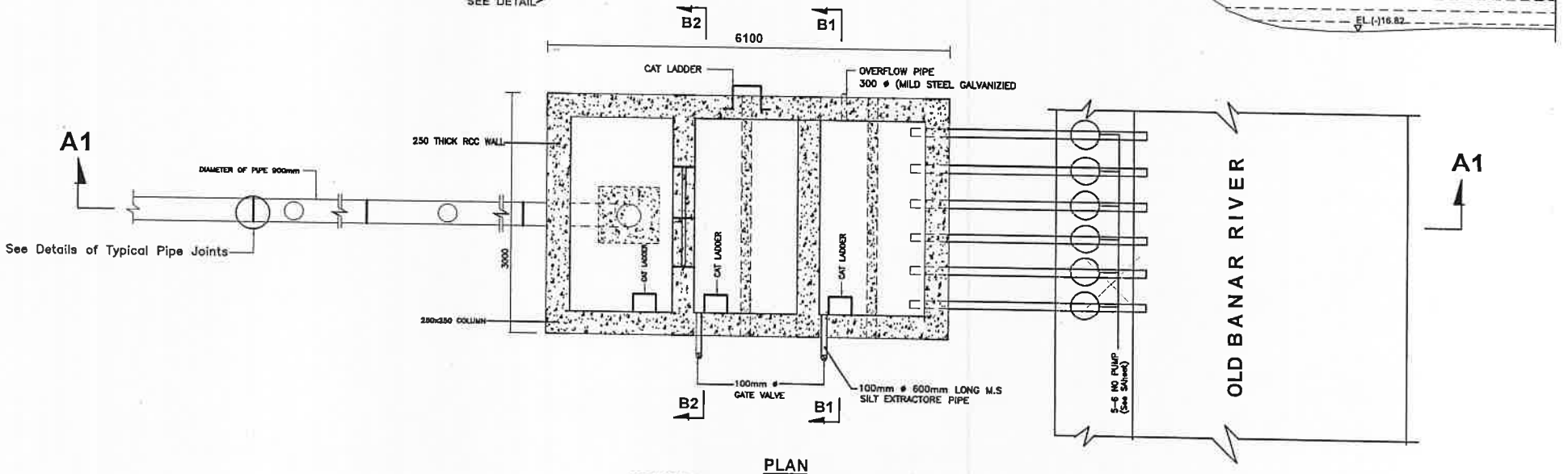
PLAN

NOTES:

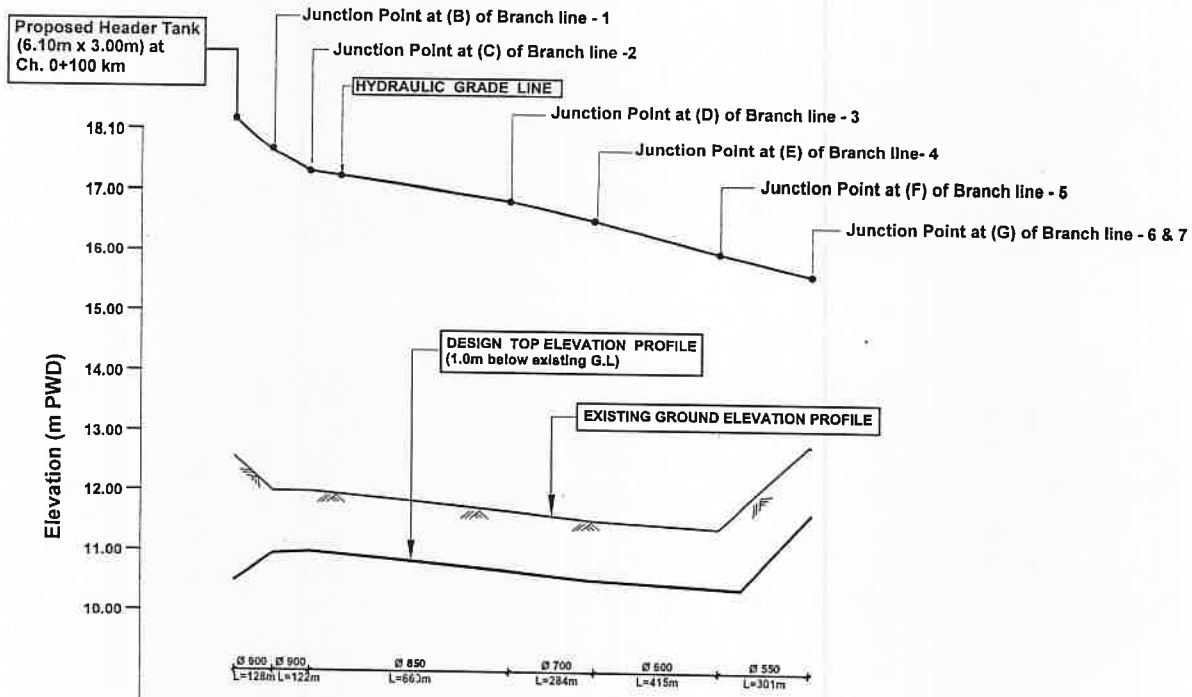
1. For notes see Sheet-1

HEADER TANK GENERAL ARRANGEMENT-1



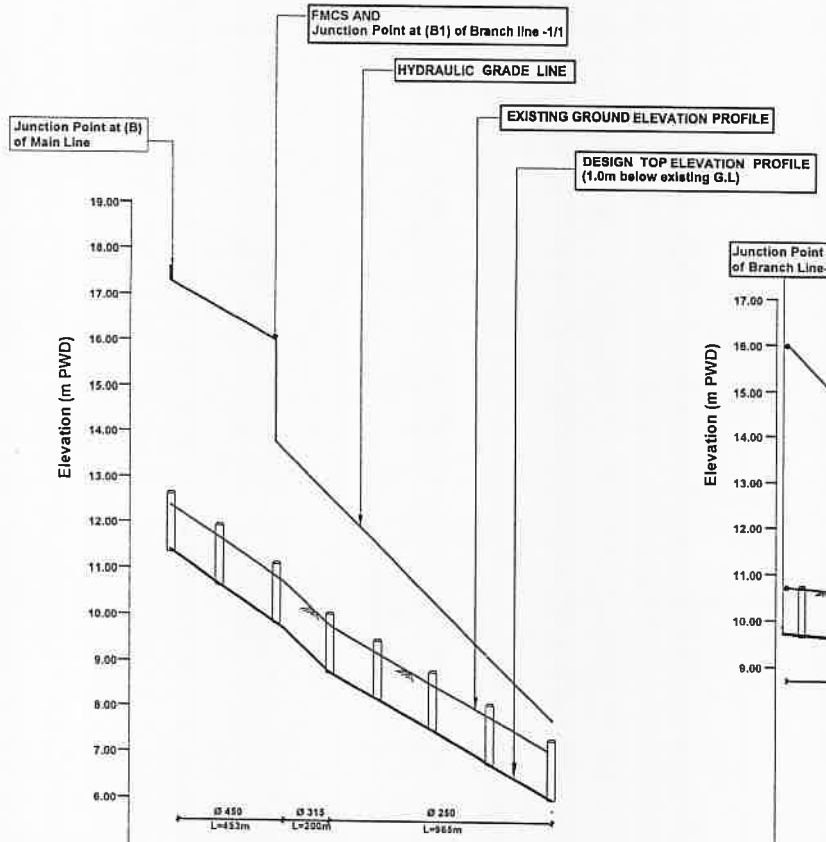


PLAN
FOUNDATION AND WALKWAY NOT SHOWN



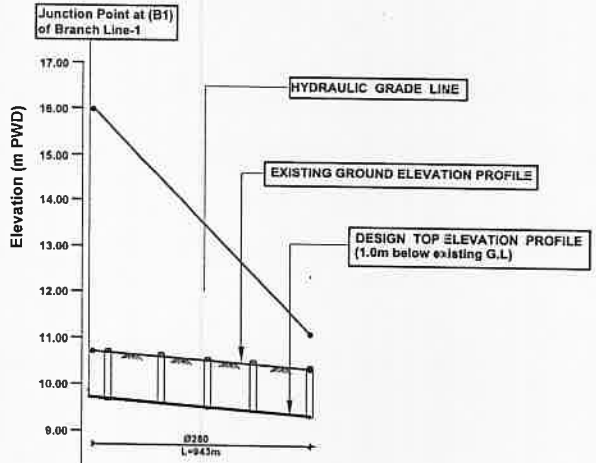
Chainage (Km) of Airvent pipe		0+100	0+220	0+340	1+000	1+290	1+710	2+000
Chainage (Km) of Riser(Alfa-Alfa Valve)								
Ground Level at Centre Line of of RCC pipe, m(PWD)		12.45	12.00	12.00	11.80	11.70	11.50	12.72
Chainage (Km) of Location Point of Branch line / Bend	0+000	0+100	0+228	0+350	1+016	1+300	1+715	2+016
Location Point of Branch line / Bend Points	O	A	B	C	D	E	F	G
Top level of RCC Pipe after Laying m (PWD)		10.55	11.00	11.00	10.80	10.70	10.50	11.72
Hydraulic Grade Line level m (PWD)		18.10	17.81	17.63	16.90	16.54	16.03	15.70

LONG PROFILE OF RCC BURIED PIPE SYSTEM OF MAIN LINE (LENGTH=2.016 km)
AND HYDRAULIC GRADE LINE (A-B-C-D-E-F-G)



Chainage (Km) of Airvent pipe						0+863		1+350		
Chainage (Km) of Riser(Alfa-Alfa Valve)	0+000	0+100	0+300	0+453	0+653	0+863	1+100	1+350	1+618	
Ground Level at Centre Line of of RCC pipe, m(PWD)	12.18			10.73	9.88				7.00	
Chainage (Km) of Location Point of Branch line / Bend	0+000			0+453	0+653				1+618	
Location Point of Branch line / Bend Points	B			B1	B2				B3	
Top level of uPVC Pipe after Laying m (PWD)	11.18			9.73	8.88				6.00	
Hydraulic Grade Line level m (PWD)	17.81 / 17.32			16.00 / 13.76	12.64				7.80	

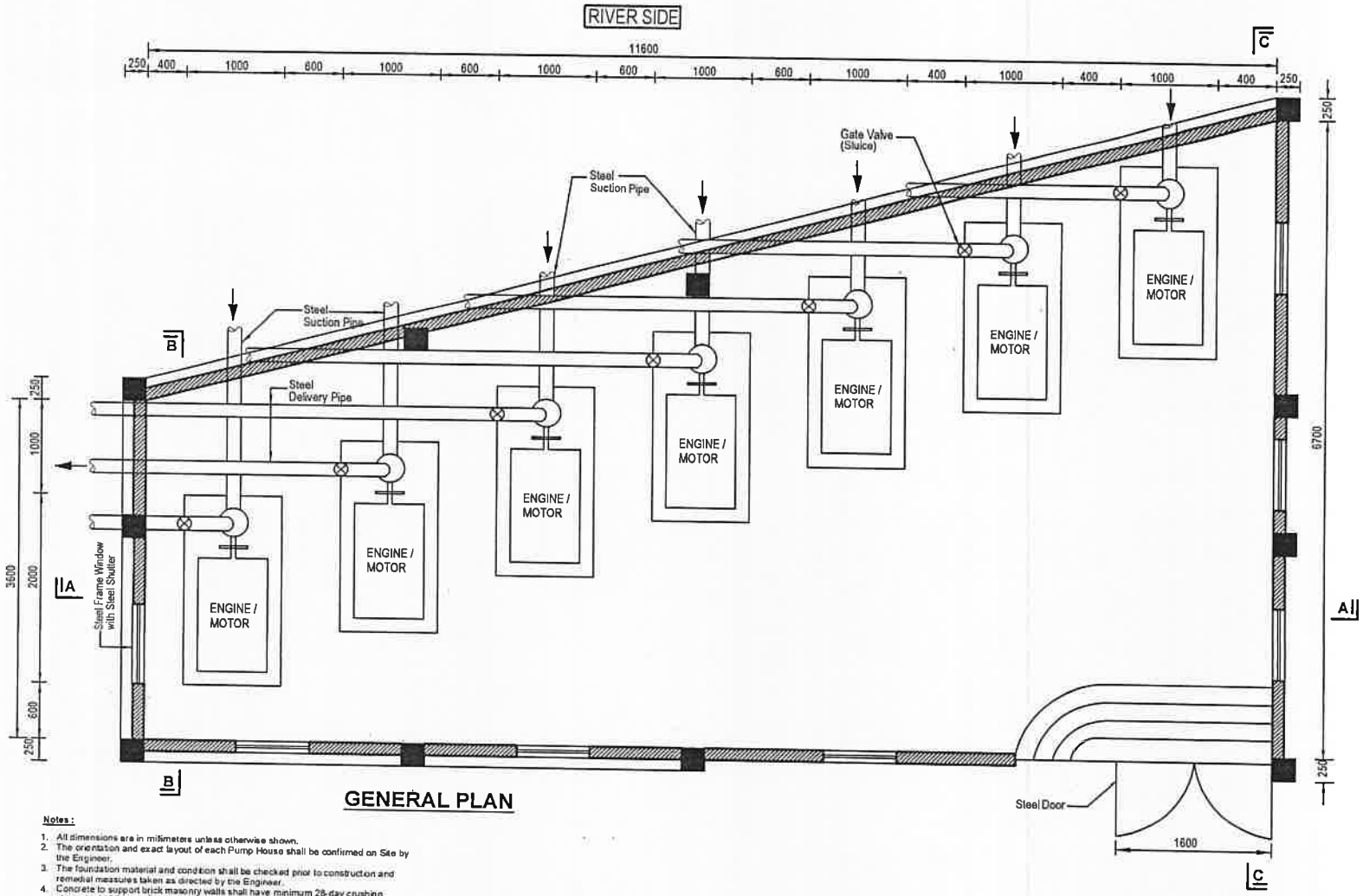
LONG PROFILE OF RCC BURIED PIPE SYSTEM OF BR. PIPE LINE-1
(LENGTH=1.618 Km) AND HYDRAULIC GRADE LINE (B-B1-B2-B3)



			0+500			
	0+100	0+300	0+500	0+700	0+930	
	10.73				10.25	
	0+000				0+643	
	B1				B4	
	9.53				9.25	
	16.00				11.09	

LONG PROFILE OF RCC BURIED PIPE SYSTEM OF BR. PIPE LINE-1/1
(LENGTH=943 Km) AND HYDRAULIC GRADE LINE

PLAN OF PUMP HOUSE

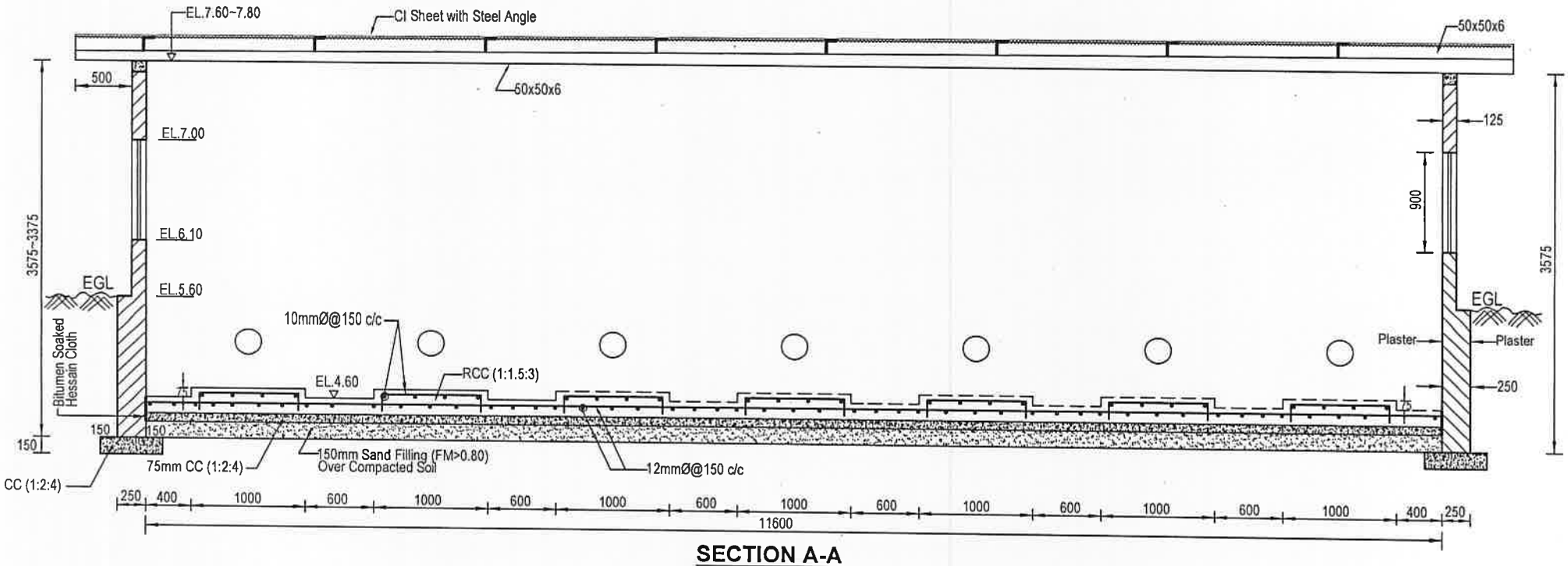


GENERAL PLAN

Notes :

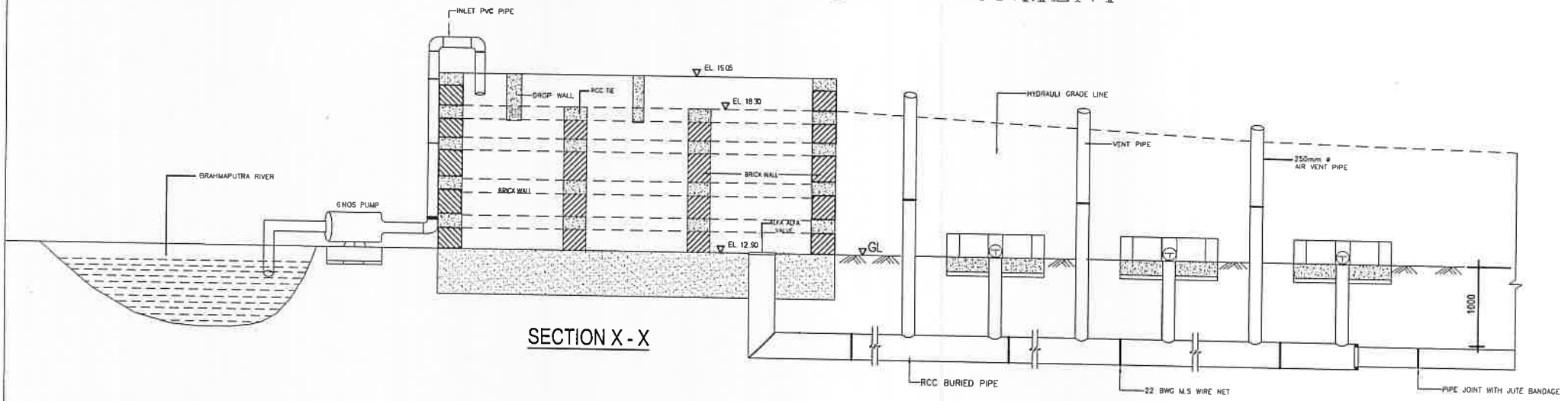
1. All dimensions are in millimeters unless otherwise shown.
2. The orientation and exact layout of each Pump House shall be confirmed on Site by the Engineer.
3. The foundation material and condition shall be checked prior to construction and remedial measures taken as directed by the Engineer.
4. Concrete to support brick masonry walls shall have minimum 28-day crushing strength of 150 kg/cm^2 (15 N/mm^2); suggested mix proportions 1:2:4
5. Reinforced concrete for floor and pump plinths shall have minimum 28-day crushing strength of 210 kg/cm^2 (21 N/mm^2); suggested mix proportions 1:1.5:3.
6. Floor plinth dimensions shall be confirmed before casting.
7. Reinforcement shall be high strength deformed steel bars minimum yield strength of 415 N/mm^2 (Grade 60) unless otherwise shown.
8. All steelwork shall be fabricated and painted or galvanized as shown / directed by the Engineer in accordance with the Specification.
9. All brickwork shall be pointed / plastered and painted as directed by the Engineer in accordance with the Specification.

SECTIONS OF PUMP HOUSE

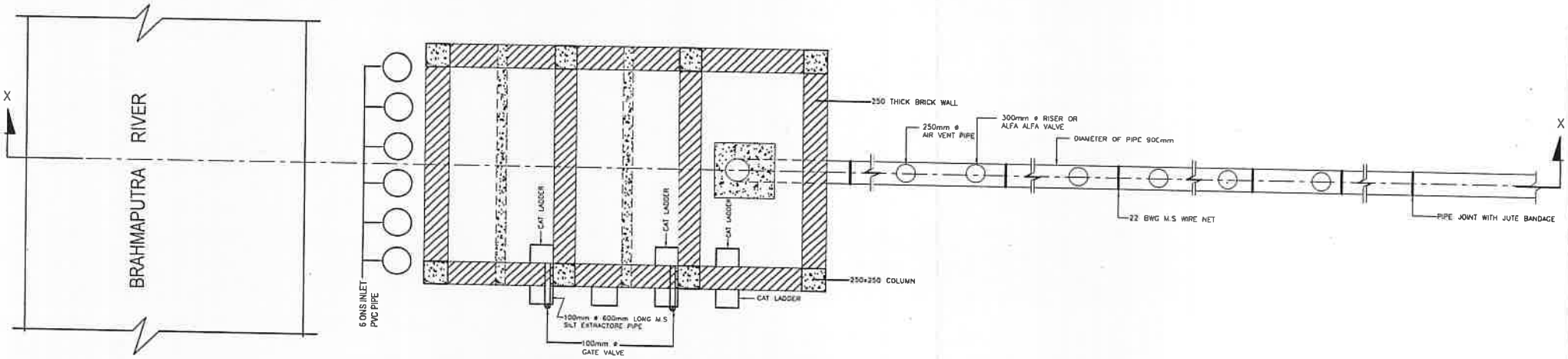


SECTION A-A

PLAN & SECTION OF HEADER TANK WITH BURIED PIPE ALIGNMENT

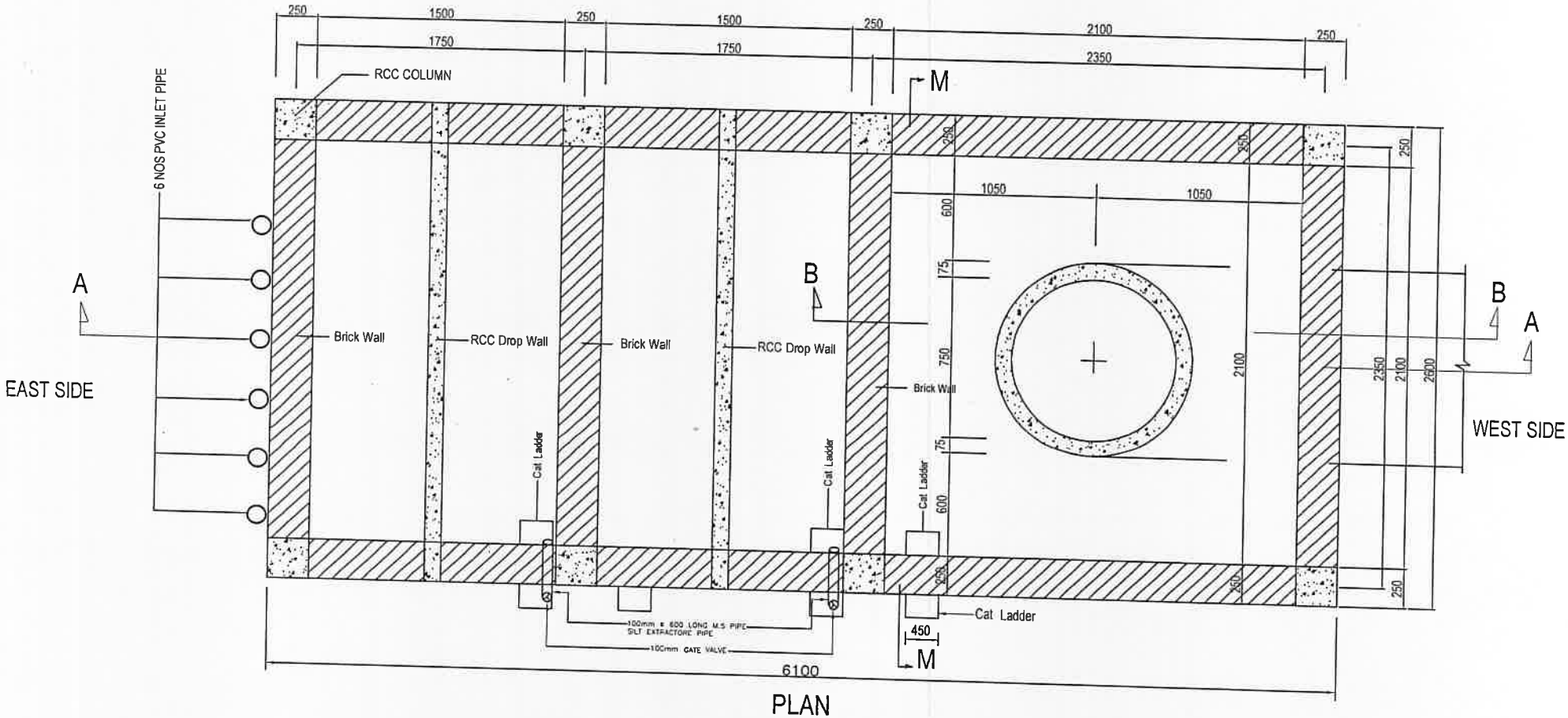


SECTION X - X



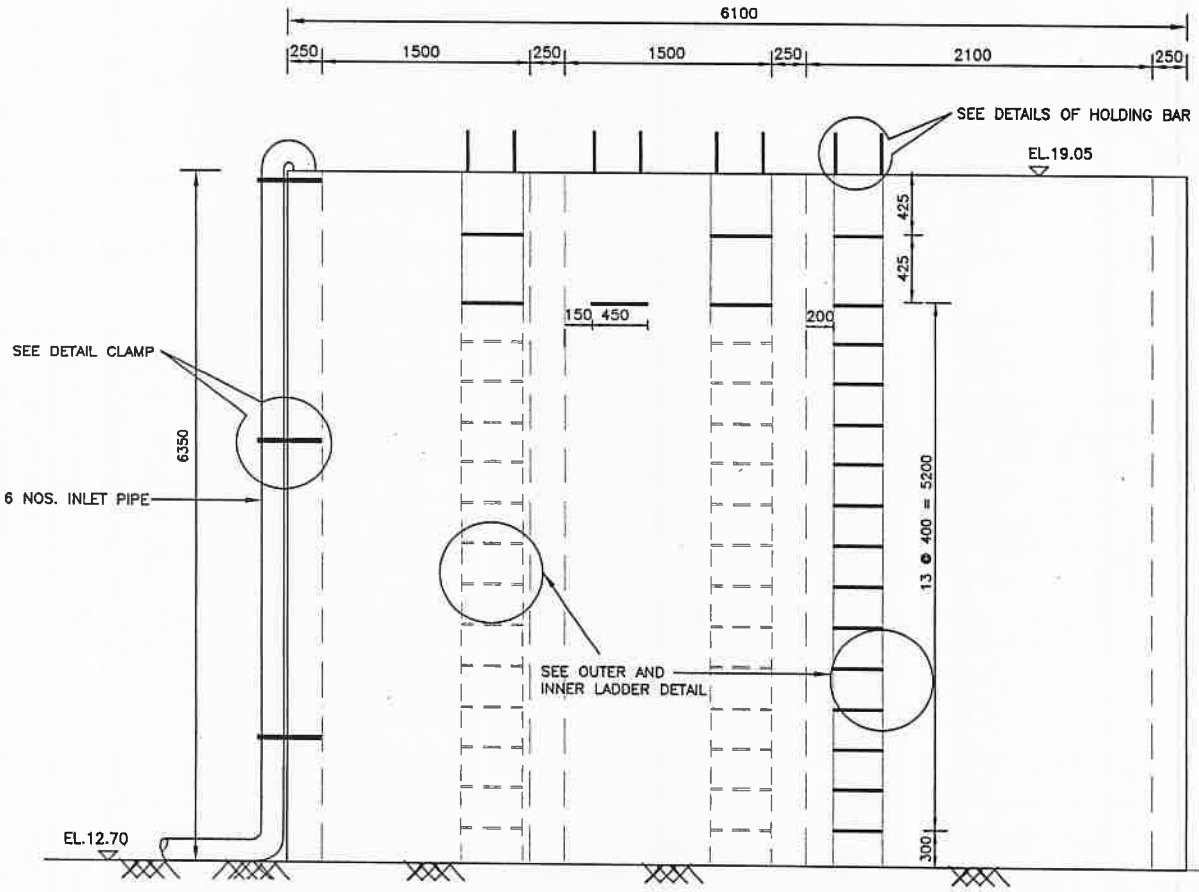
PLAN

PLAN OF HEADER TANK

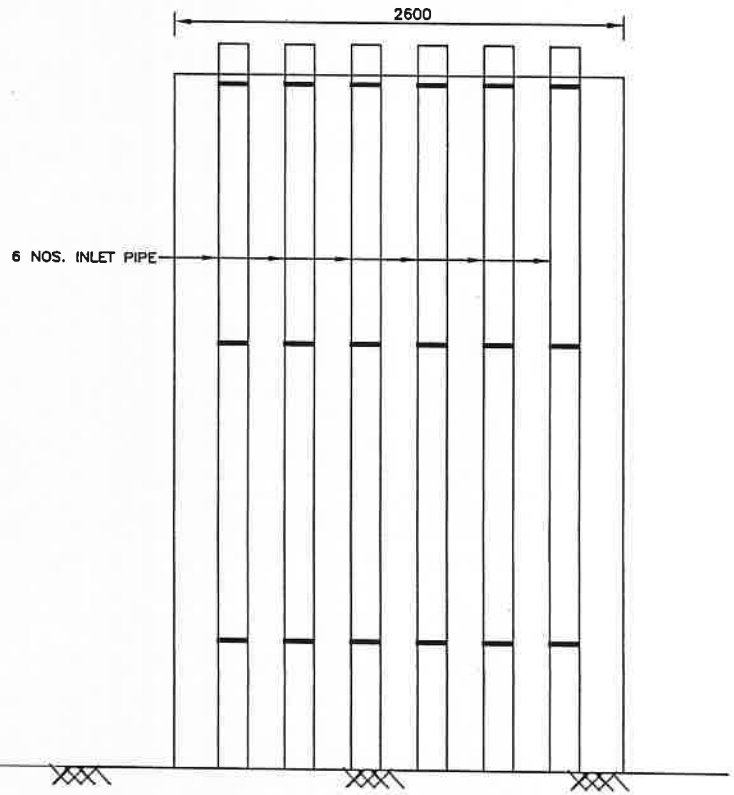


PLAN

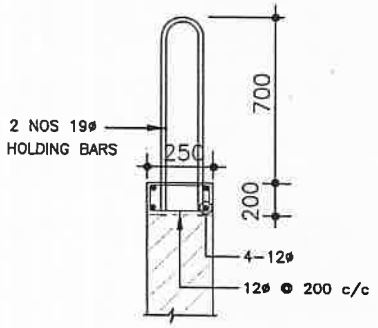
ELEVATION OF HEADER TANK



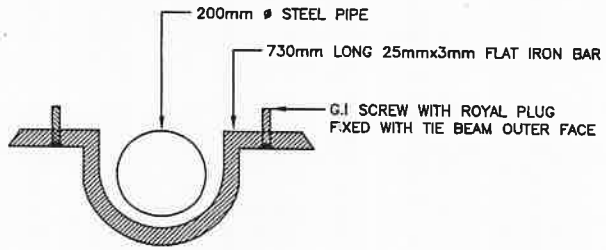
NORTH ELEVATION



EAST ELEVATION

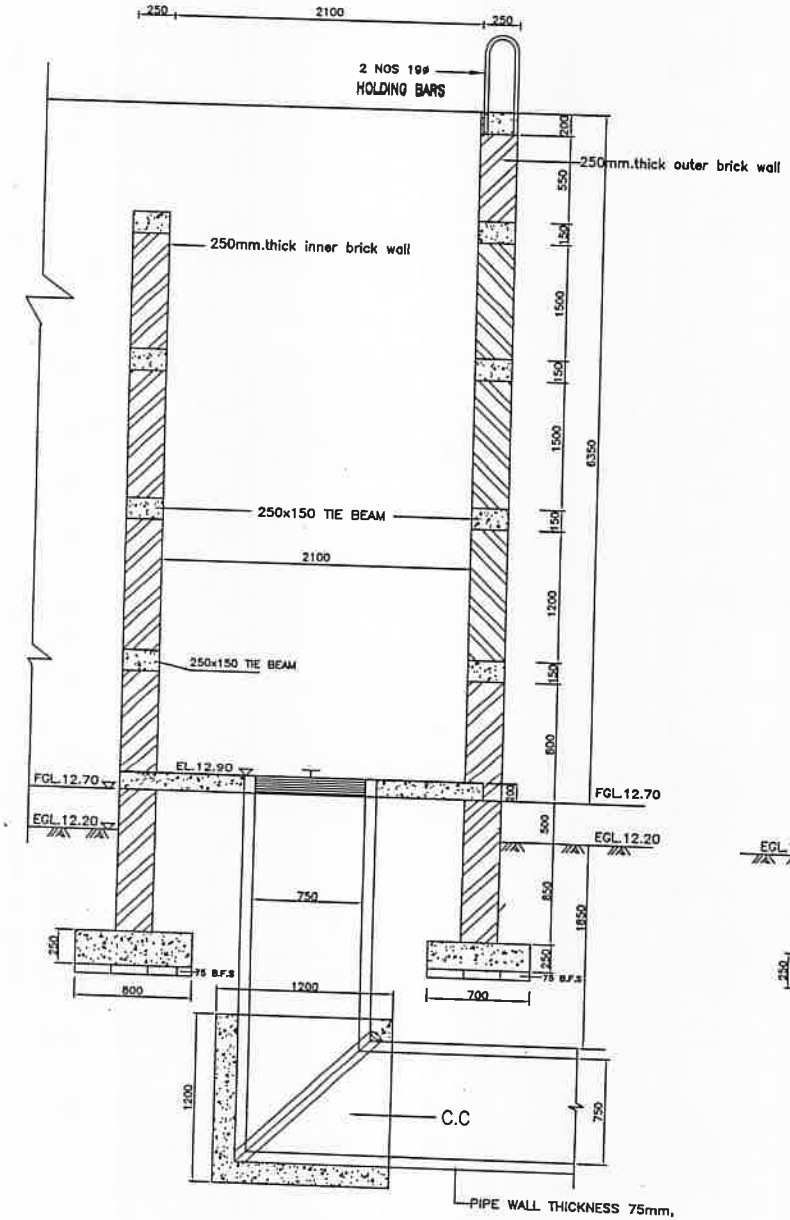


DETAILS OF LADDER HOLDING BAR

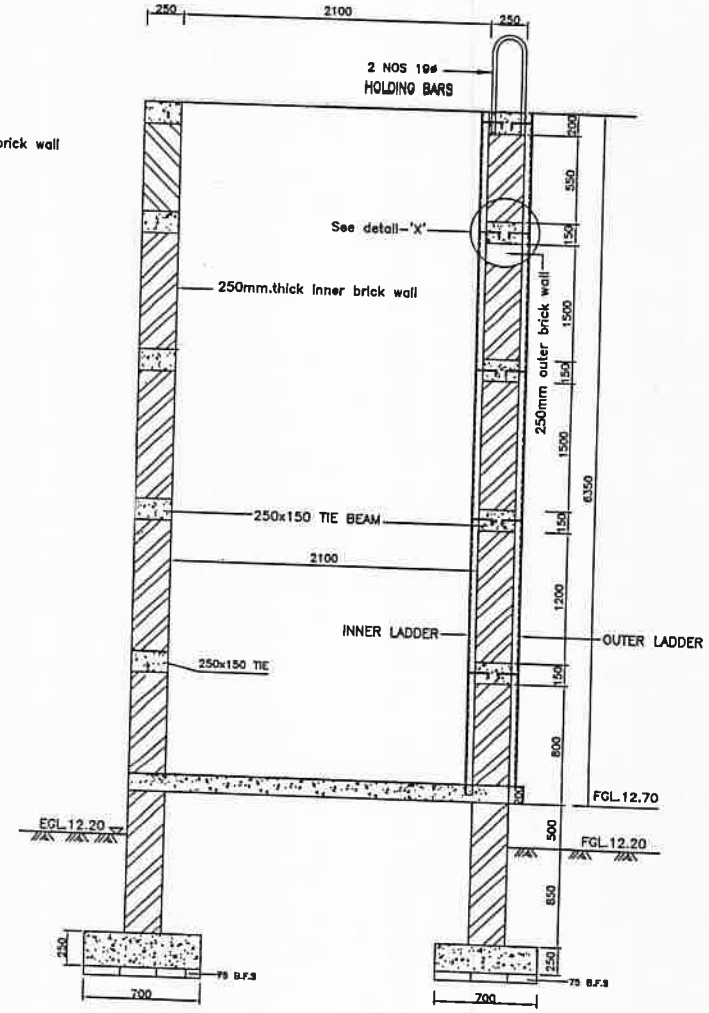


DETAIL OF CLAMP

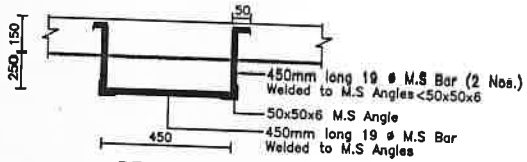
PIPE INSTALLATION FROM OUTLET CHAMBER



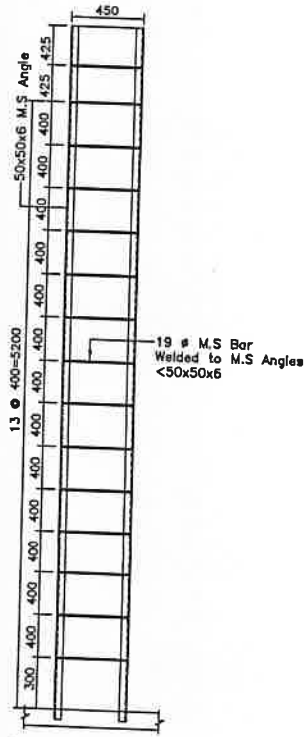
SECTION ON B–B



SECTION ON M–M

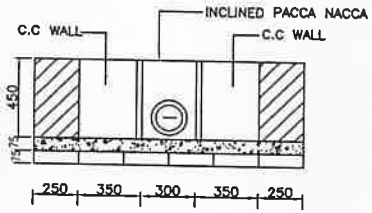


DETAIL–'X'

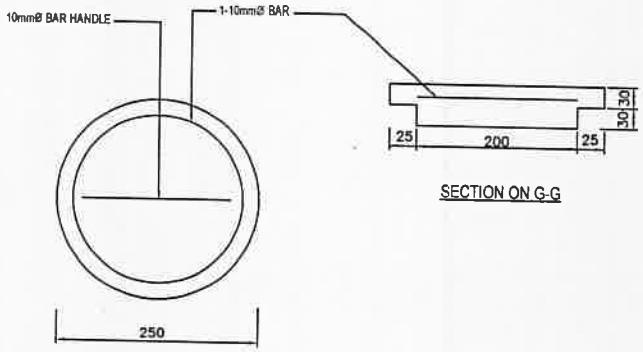


INNER & OUTER LADDER
FRONT VIEW

DETAILS OF WATER CONTROL STRUCTURE

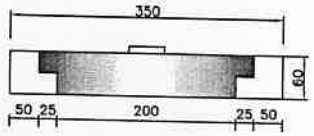


SECTION B-B

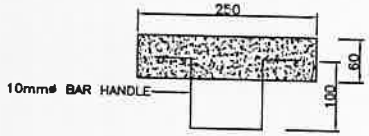


DETALED MS ROD OF PACCA NACCA LID

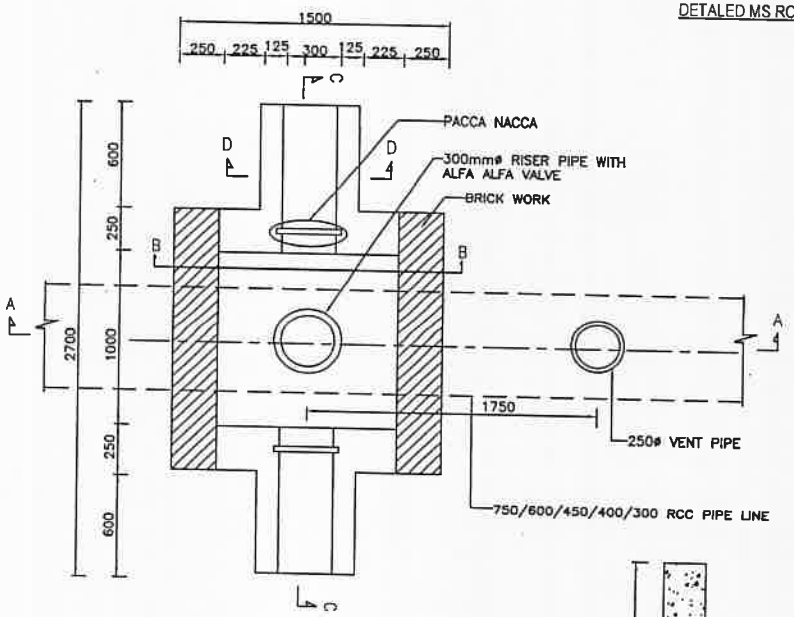
SECTION ON G-G



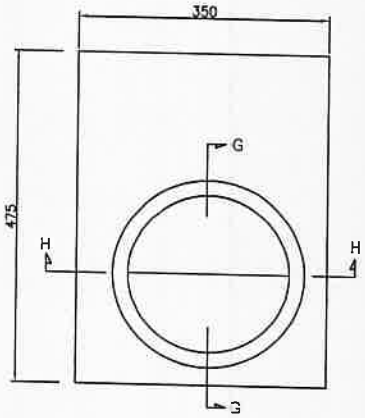
SECTION ON H-H



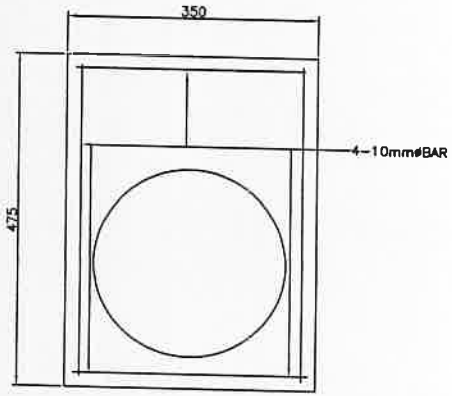
SECTION OF HANDLE



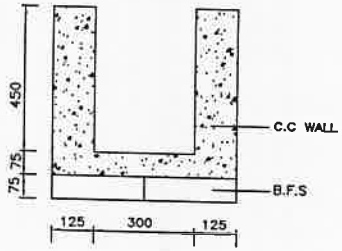
PLAN OF WATER CONTROL STRUCTURE



PLAN OF PACCA NACCA

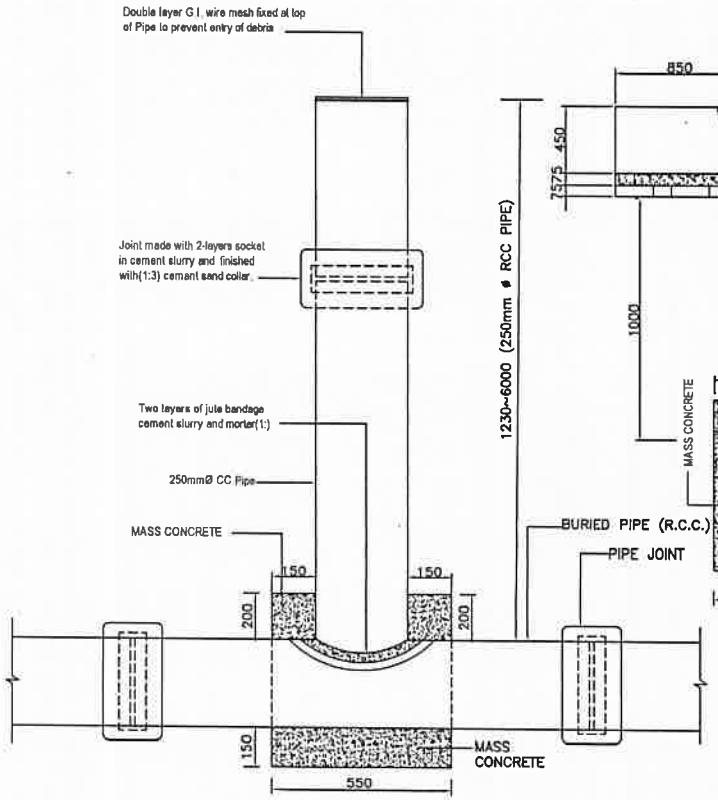


MS ROD OF PACCA NACCA

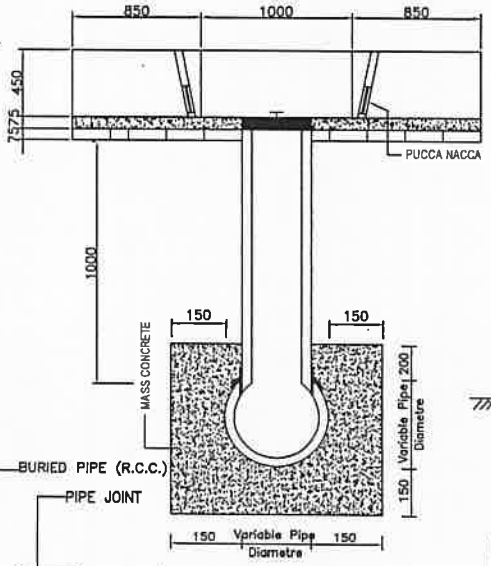


SECTION D-D

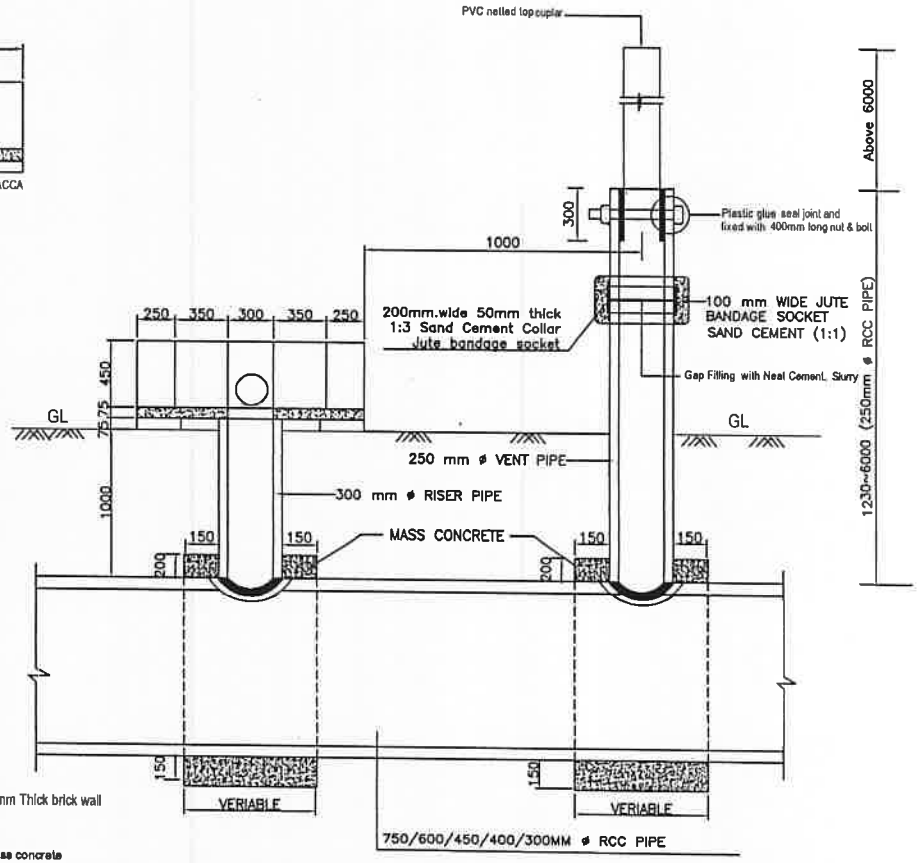
DETAILS X– SECTION OF PIPE JOINT, AIR VENT & WATER CONTROL STRUCTURE



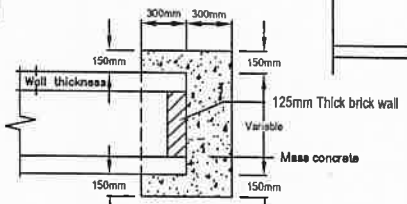
AIR VENT (CC) STRUCTURE
(DETAILS OF AIR VENT PIPE)



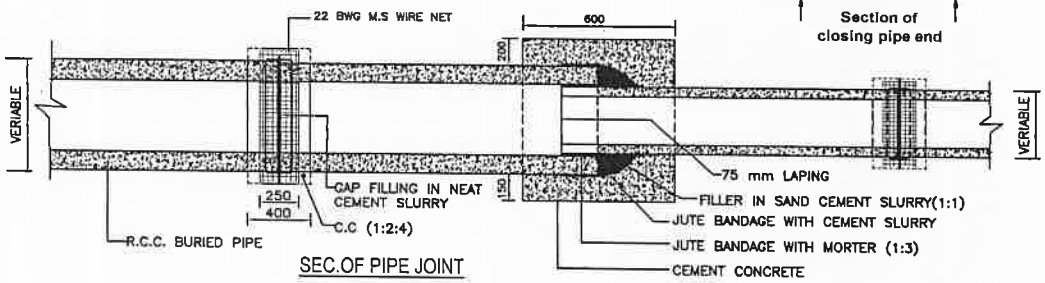
DETAILS OF
ALFA-ALFA VALVE



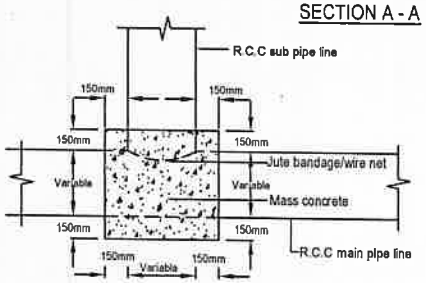
SECTION A - A



Section of
closing pipe end

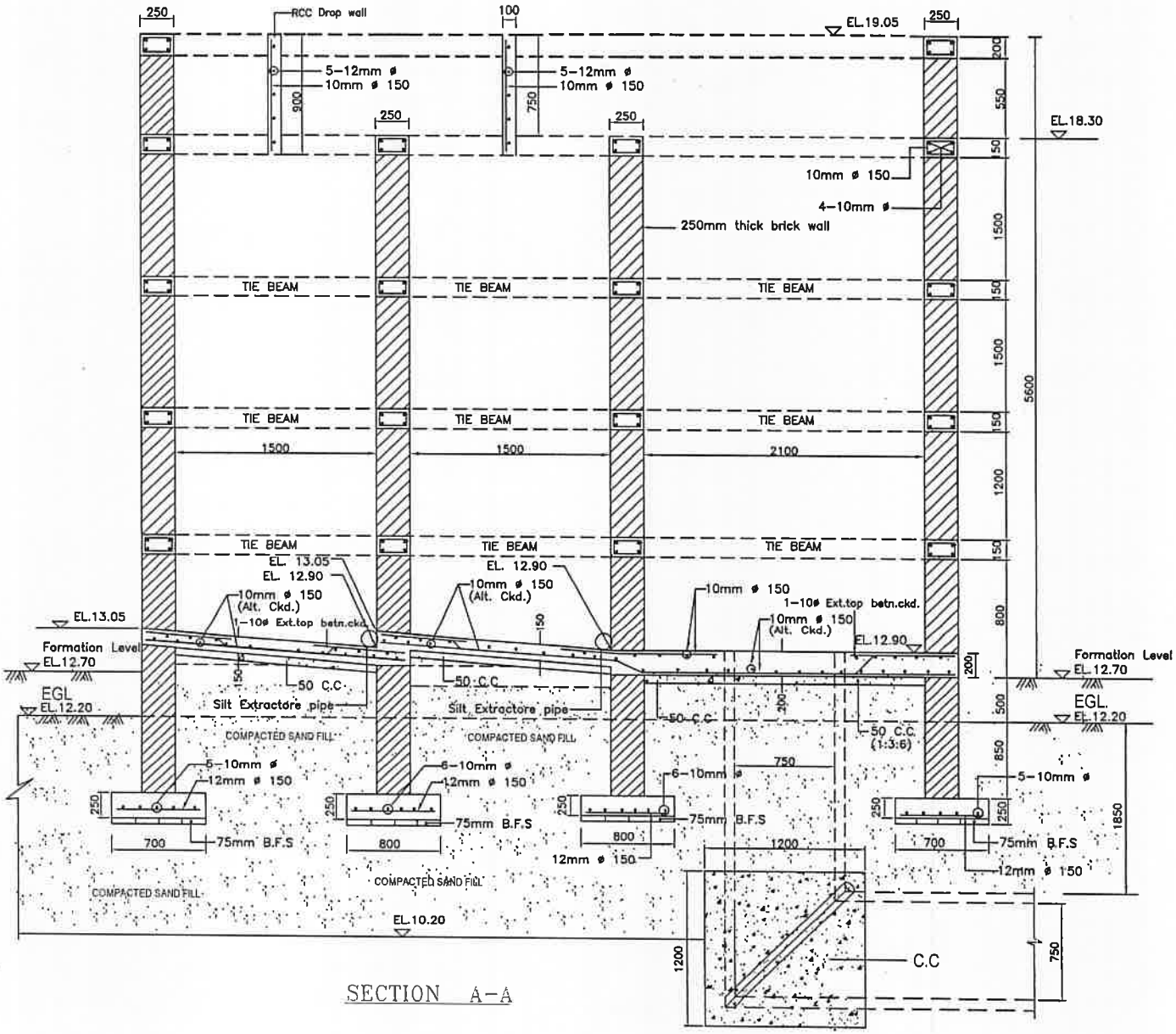


SEC.OF PIPE JOINT



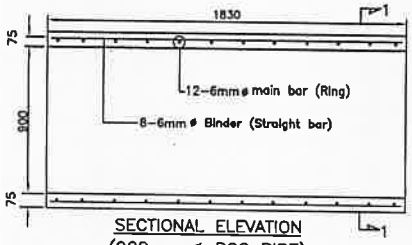
Joint (T) for
main line to sub line

HEADER TANK

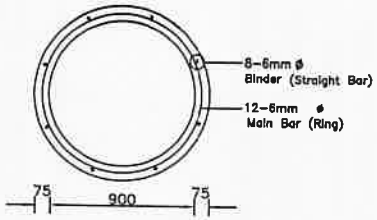


SECTION A-A

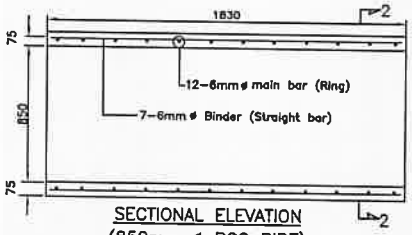
REINF. DETAILS OF R.C.C BURIED PIPE



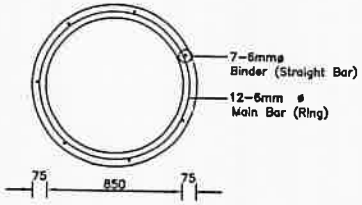
SECTIONAL ELEVATION
(900mm ø RCC PIPE)



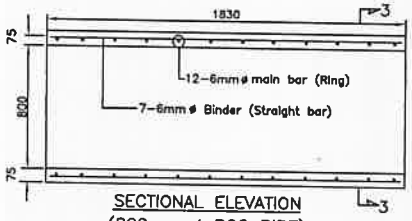
SECTION 1-1



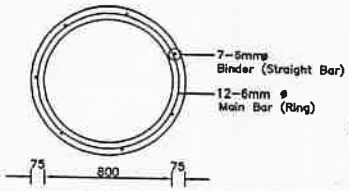
SECTIONAL ELEVATION
(850mm ø RCC PIPE)



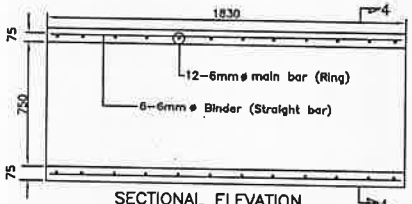
SECTION 2-2



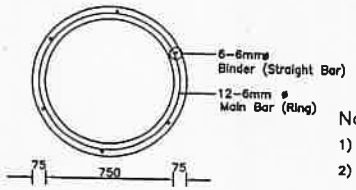
SECTIONAL ELEVATION
(800mm ø RCC PIPE)



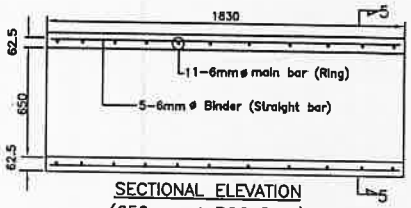
SECTION 3-3



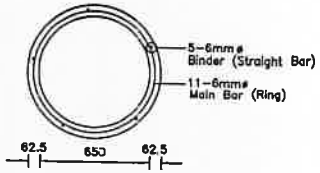
SECTIONAL ELEVATION
(750mm ø RCC PIPE)



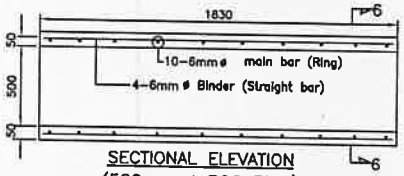
SECTION 4-4



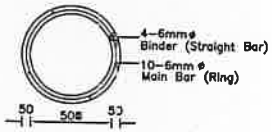
SECTIONAL ELEVATION
(650mm ø RCC PIPE)



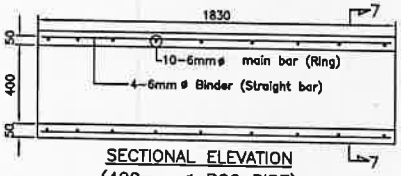
SECTION 5-5



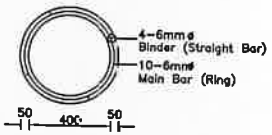
SECTIONAL ELEVATION
(500mm ø RCC PIPE)



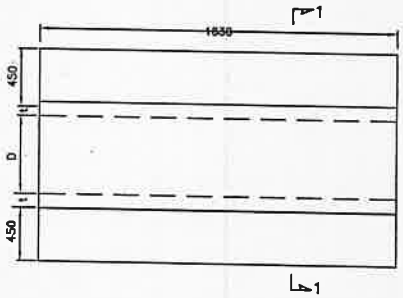
SECTION 6-6



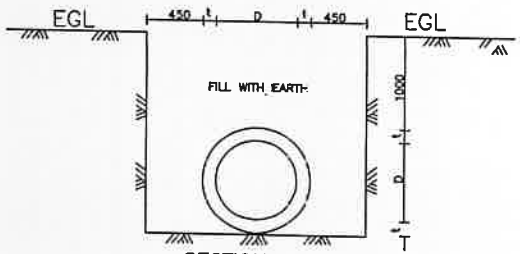
SECTIONAL ELEVATION
(400mm ø RCC PIPE)



SECTION 7-7



PLAN OF FOUNDATION TRENCH OF RCC BURIED PIPE



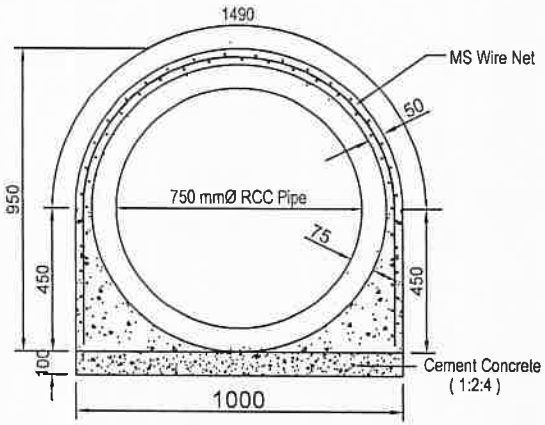
SECTION 1-1

Note:

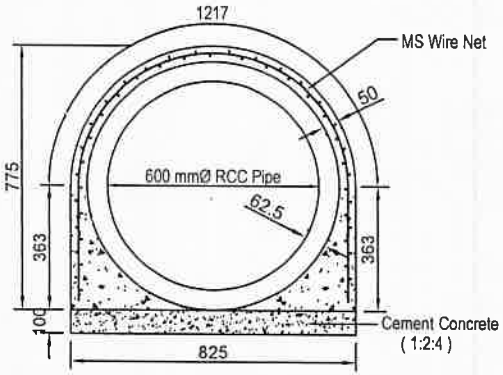
1) All dimensions are in millimeter

2) D & t are Diameter & Thickness in mm of Pipe respectively

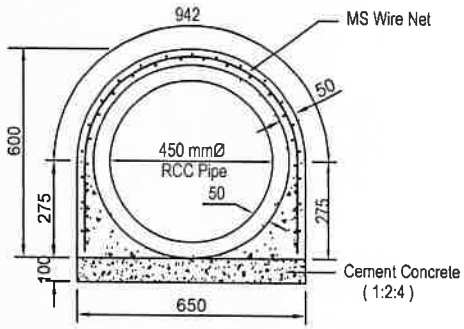
DETAILS OF PIPE JOINT



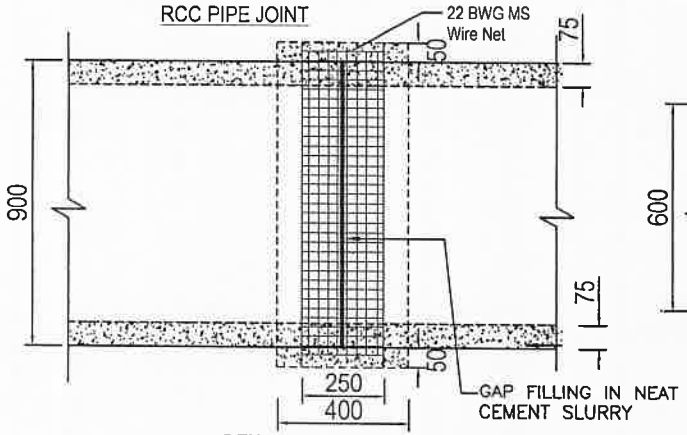
SECTION THROUGH 750mm Ø
RCC PIPE JOINT



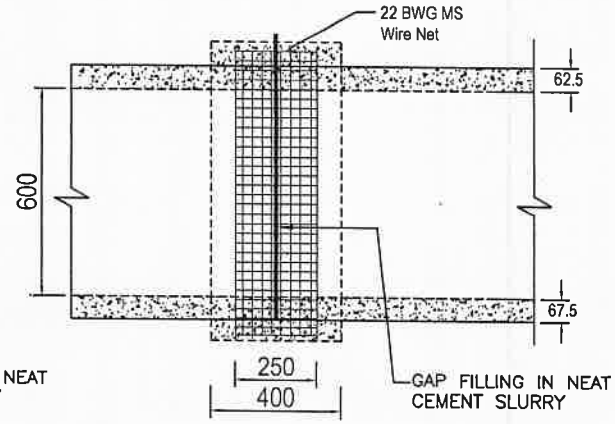
SECTION THROUGH 600mm Ø
RCC PIPE JOINT



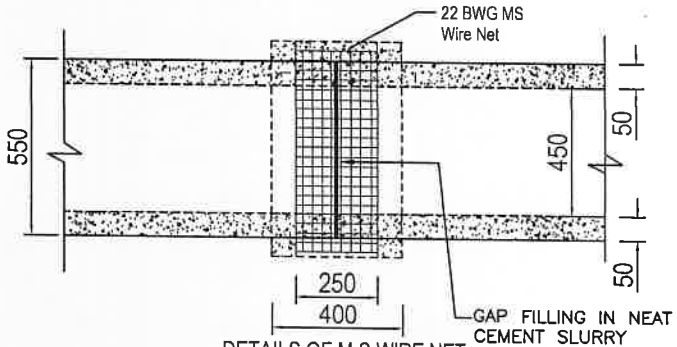
SECTION THROUGH 450mm Ø
RCC PIPE JOINT



DETAILS OF M.S WIRE NET
PIPE JOINT(PLAN)

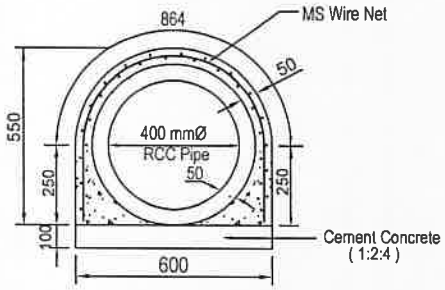


DETAILS OF M.S WIRE NET
PIPE JOINT(PLAN)

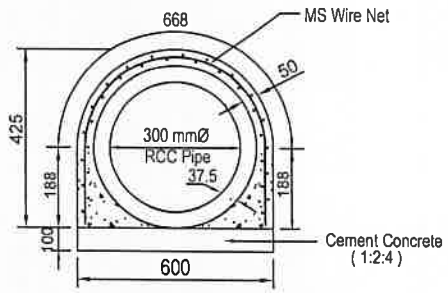


DETAILS OF M.S WIRE NET
PIPE JOINT(PLAN)

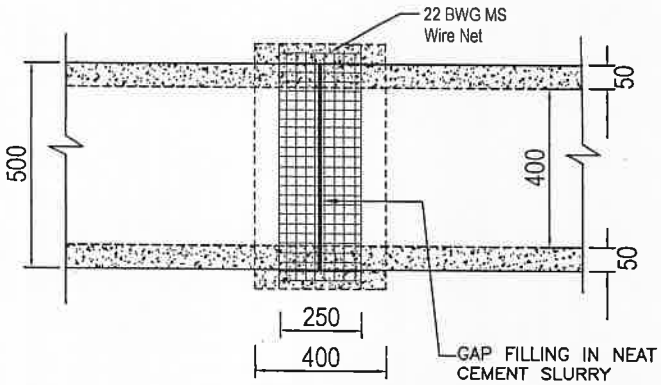
DETAILS OF PIPE JOINT



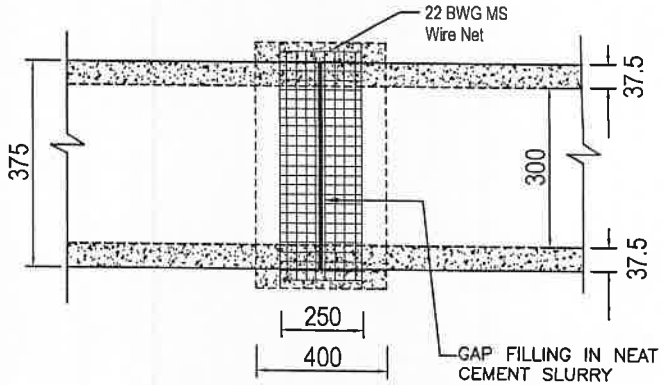
SECTION THROUGH 400mm Ø
RCC PIPE JOINT



SECTION THROUGH 300mm Ø
RCC PIPE JOINT

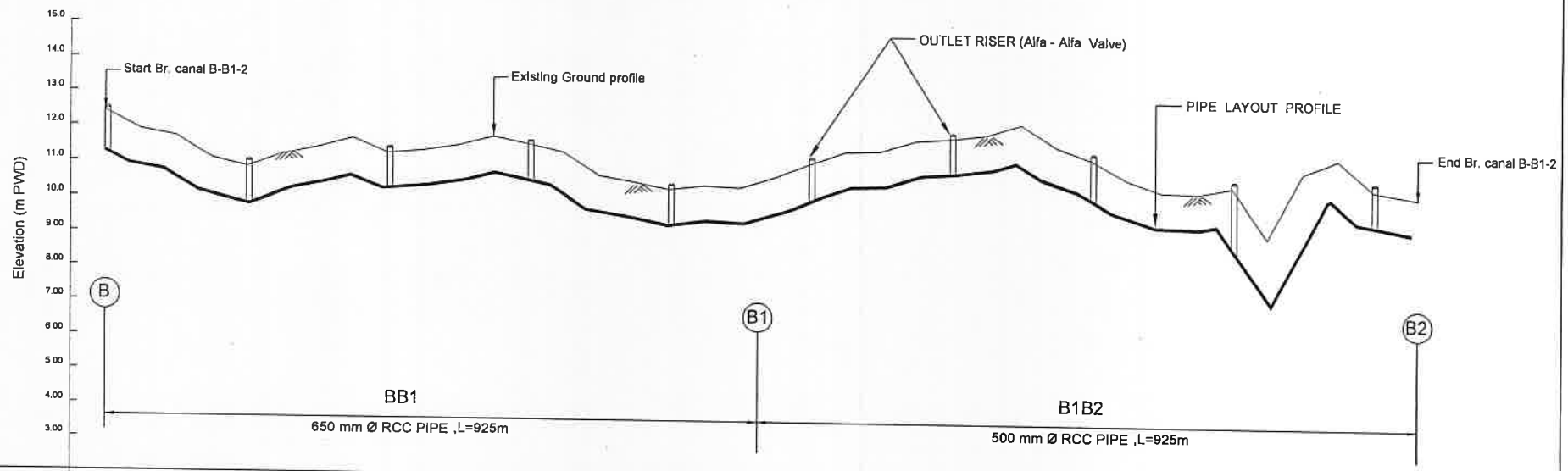


DETAILS OF M.S WIRE NET
PIPE JOINT(PLAN)



DETAILS OF M.S WIRE NET
PIPE JOINT(PLAN)

LONG PROFILE OF RCC BURIED PIPE SYSTEM
And HYDRAULIC GRADE LINE

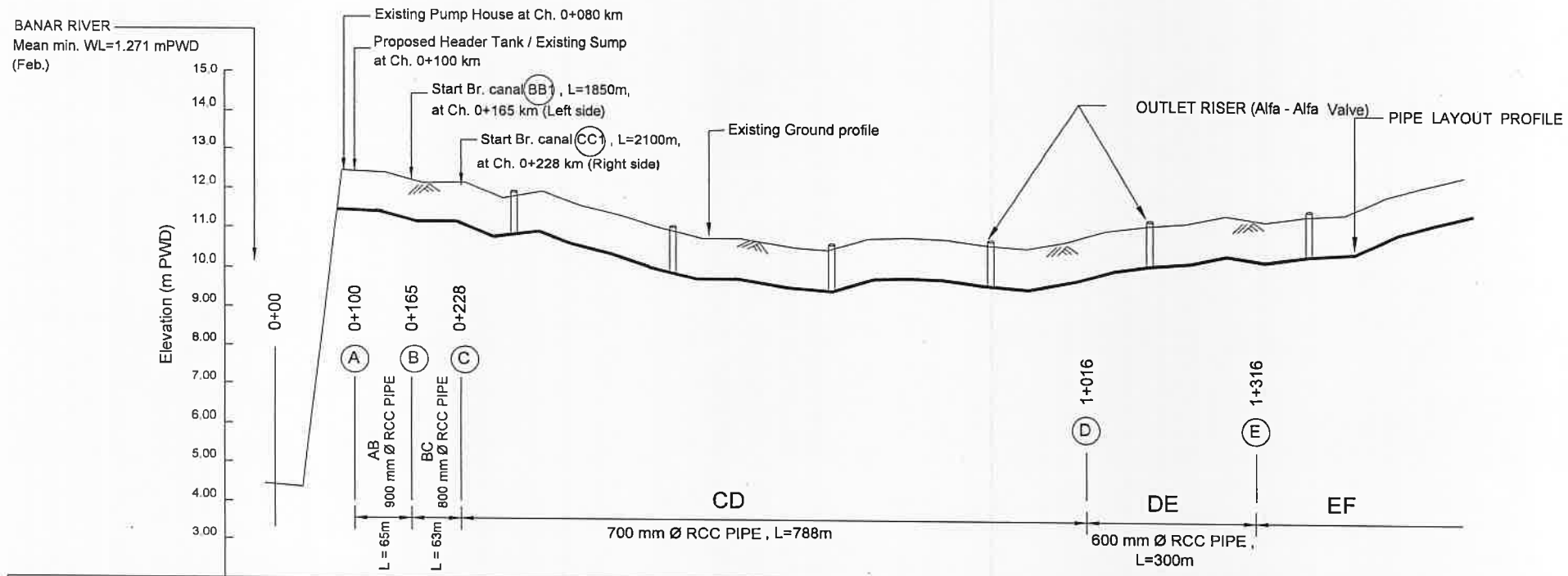


PRE-WORK																																								
Ground Level at Centre Line of of RCC pipe, m(PWD)	12.43	11.91	11.73	11.13	10.88	11.25	11.45	11.71	11.31	11.39	11.54	11.79	11.59	11.37	10.71	10.54	10.34	10.46	10.41	10.71	11.11	11.46	11.49	11.79	11.86	11.98	12.29	11.66	11.32	10.75	10.42	10.39	10.58	9.14	11.01	11.40	10.54	10.36
Chainage (Km)	0+00	0+50	0+100	0+150	0+200	0+250	0+300	0+350	0+400	0+450	0+500	0+550	0+600	0+650	0+700	0+750	0+800	0+850	0+900 0+925	0+950	1+000	1+050	1+100	1+150	1+200	1+250	1+300	1+350	1+400	1+450	1+500	1+550	1+600	1+650	1+700	1+750	1+800	1+850
Cross Section No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38
DESIGN																																								
Pipe Laying level m (PWD)	11.43	10.91	11.73	10.13	9.88	10.25	10.45	10.71	10.31	10.39	10.54	10.79	10.59	10.37	9.71	9.54	9.34	9.46	9.41	9.71	10.11	10.46	10.49	10.79	10.86	10.98	11.29	10.66	9.32	9.75	9.42	9.39	9.58	8.14	10.01	9.40	9.54	9.36
Hydraulic Grade Line level m (PWD)																																								

LONG PROFILE OF RCC BURIED PIPE SYSTEM
AND HYDRAULIC GRADE LINE

LONG PROFILE OF RCC BURIED PIPE SYSTEM (3.00 Km) And HYDRAULIC GRADE LINE MAIN CANAL : A-B-C-D-E-F

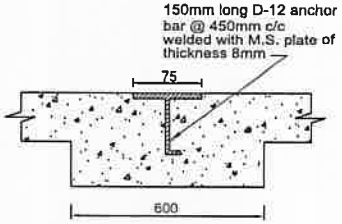
FIGURE-2



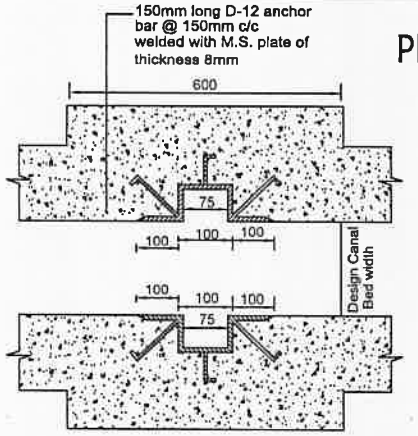
PRE-WORK																															
Ground Level at Centre Line of of RCC pipe, m(PWD)				12.45	12.40	12.14	12.16	11.76	11.93	11.56	11.31	11.01	10.74	10.74	10.52	10.45	10.74	10.77	10.73	10.59	10.51	10.69	10.97	11.10	11.17	11.37	11.22	11.35	11.41	11.86	12.14	12.38
Chainage (Km)	(-)0+020	0+00	0+50	0+100	0+150 0+165	0+200	0+228 0+250	0+300	0+350	0+400	0+450	0+500	0+550	0+600	0+650	0+700	0+750	0+800	0+850	0+900	0+950	1+000	1+050	1+100	1+150	1+200	1+250	1+300	1+350	1+400	1+450	1+500
Cross Section No.		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
DESIGN																															
Pipe Laying level m (PWD)				11.45	11.40	11.14	11.16	10.76	11.93	10.56	9.31	10.01	9.74	9.74	9.52	9.45	9.74	9.77	9.73	9.59	9.51	9.69	9.97	10.10	10.37	10.37	10.22	10.35	10.41	10.86	11.14	11.38
Hydraulic Grade Line level m (PWD)																															

LONG PROFILE OF RCC BURIED PIPE SYSTEM
AND HYDRAULIC GRADE LINE (A-B-C-D-E-F)

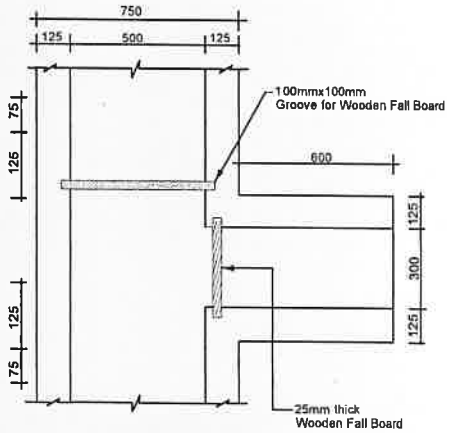
PLAN AND SECTION OF RCC CANAL



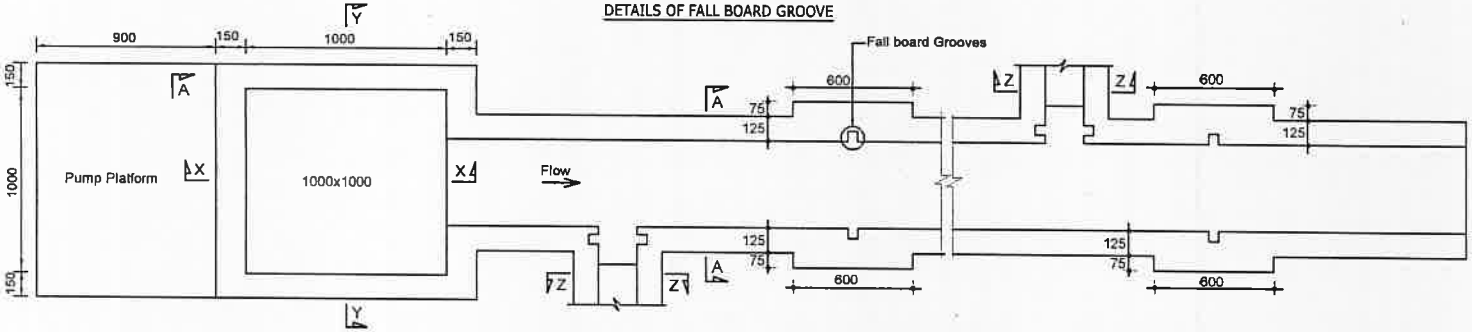
DETAILS OF BOTTOM SEAL



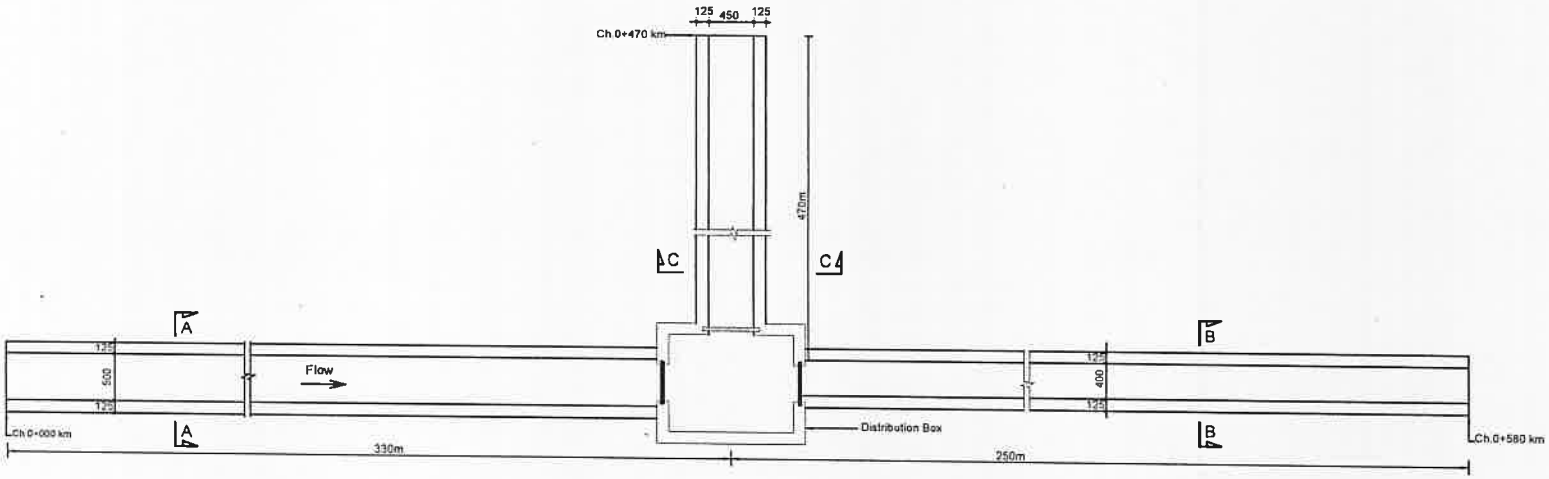
DETAILS OF FALL BOARD GROOVE



DETAILS CF OUTLET

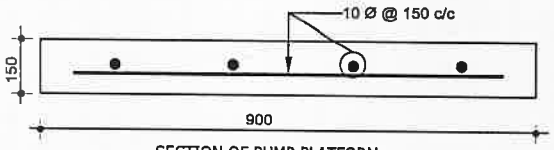


PLAN OF RCC CANAL

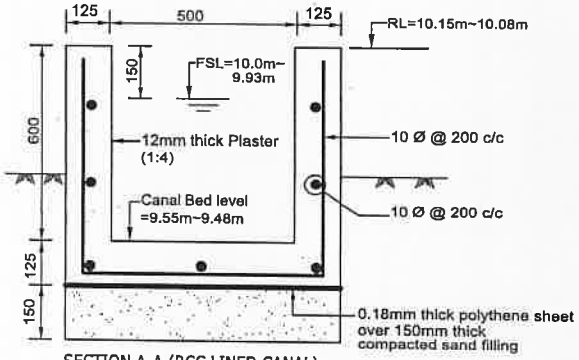


LAYOUT PLAN

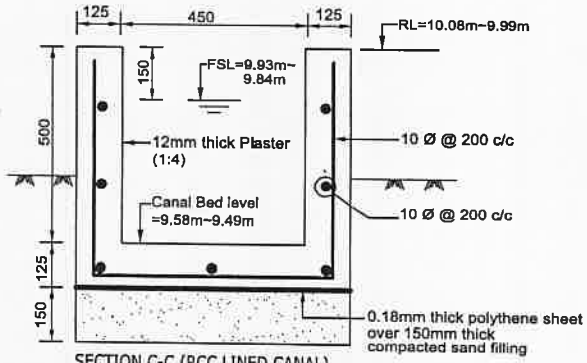
PLAN AND SECTION OF RCC CANAL



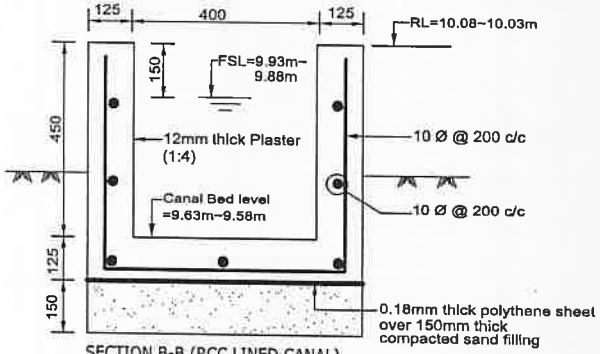
SECTION OF PUMP PLATFORM



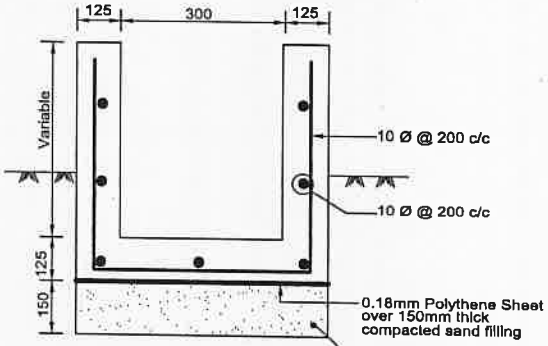
SECTION A-A (RCC LINED CANAL)
CH. 0+000 km to 0+330 km



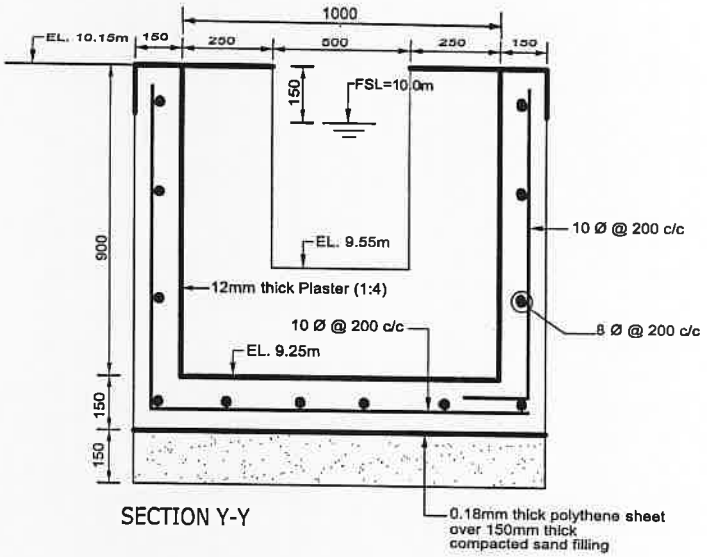
SECTION C-C (RCC LINED CANAL)
CH. 0+000 km to 0+470 km



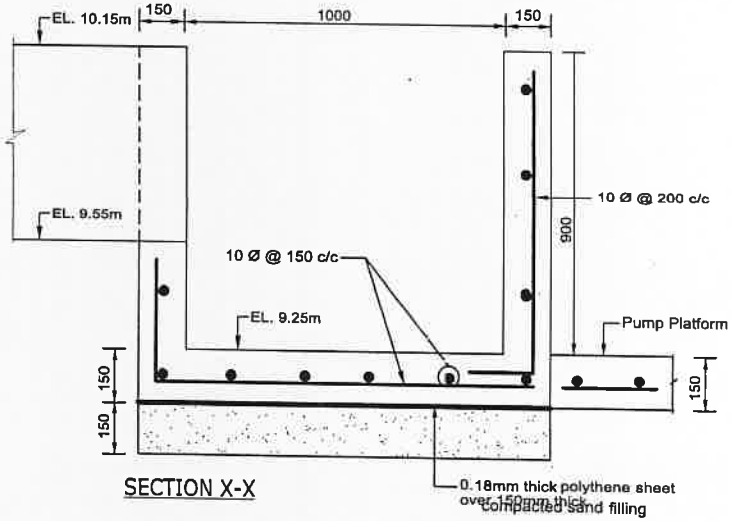
SECTION B-B (RCC LINED CANAL)
CH. 0+330 km to 0+580 km



DETAILS OF RCC OUTLET DRAIN
SECTION Z-Z



SECTION Y-Y

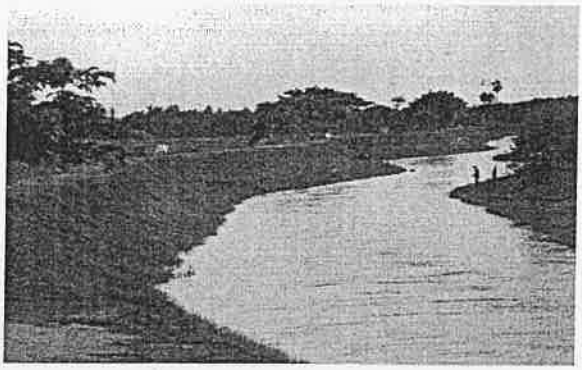


SECTION X-X

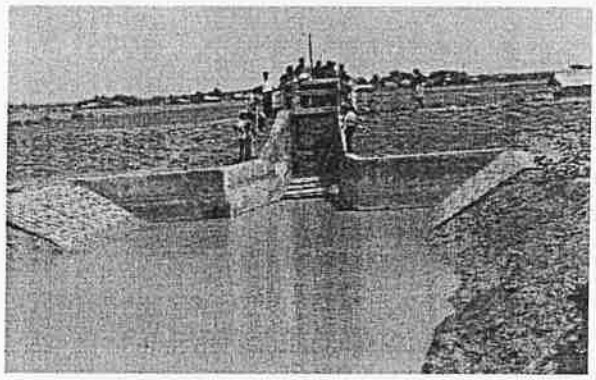
বিভিন্ন পানি সম্পদ অবকাঠামোর চিত্র

বিভিন্ন পানি সম্পদ অবকাঠামোর চিত্র

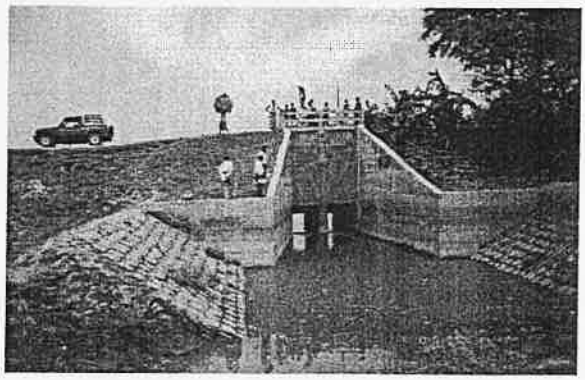
বন্যা নিয়ন্ত্রণ বাঁধ



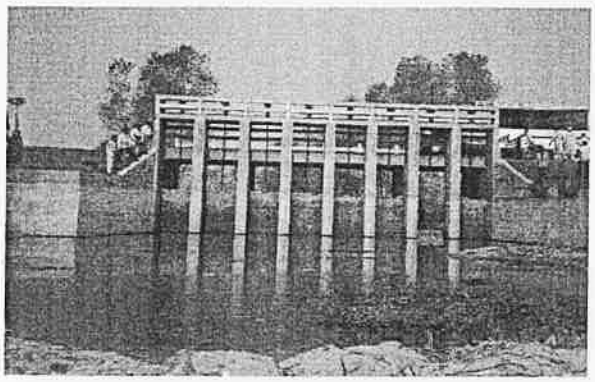
পানি নিষ্কাশন/ধারণ খাল



স্লুইস

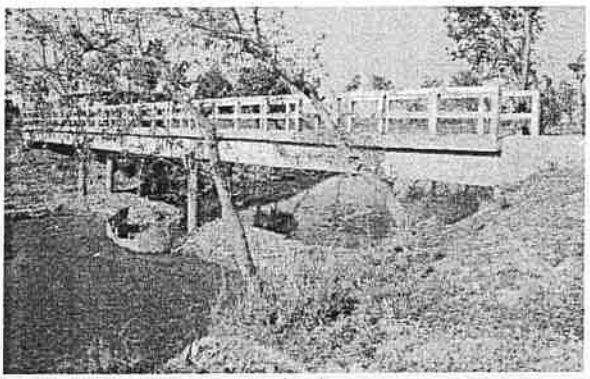


রেগুলেটর

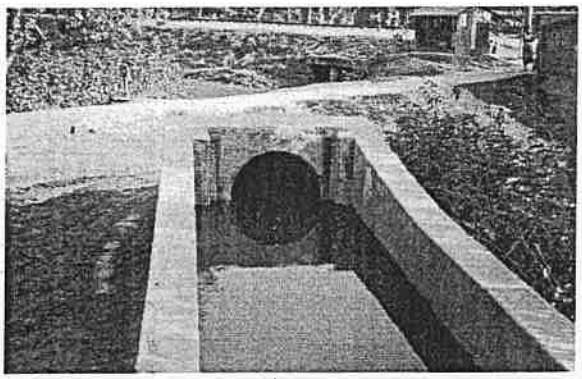


পানি সংরক্ষণ কাঠামো

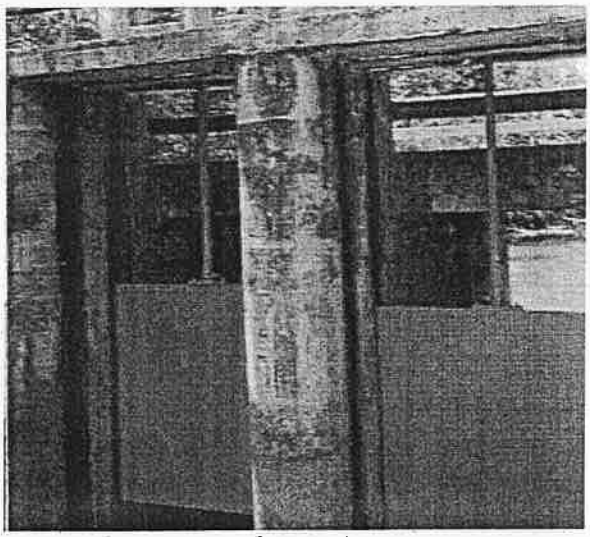
সেচ খাল



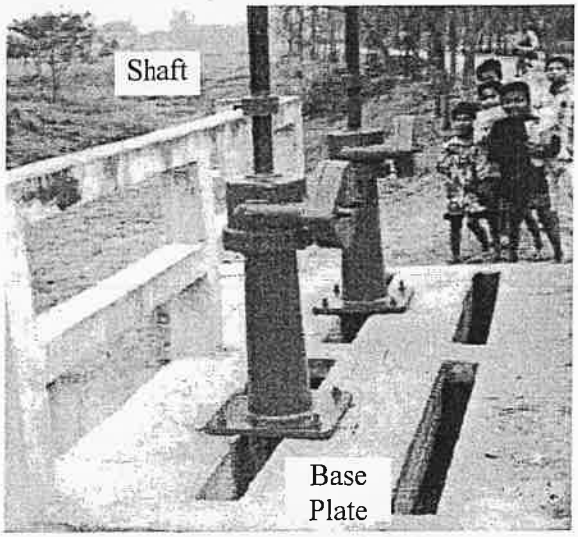
একুইডাক্ট



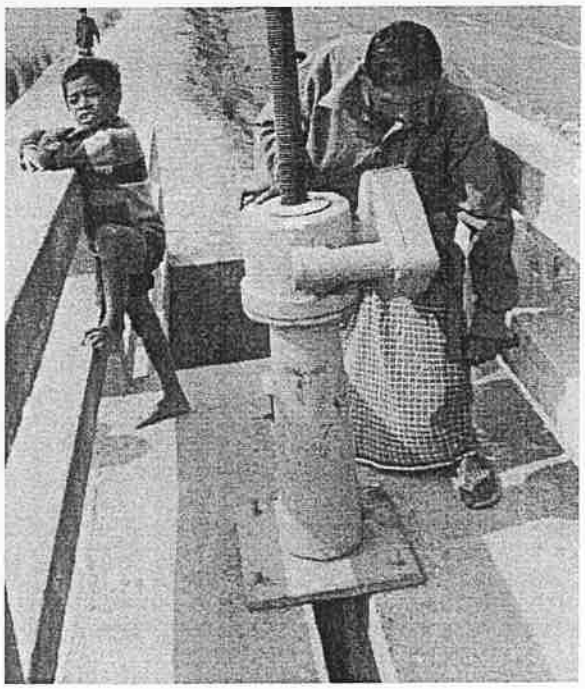
সাইফুন



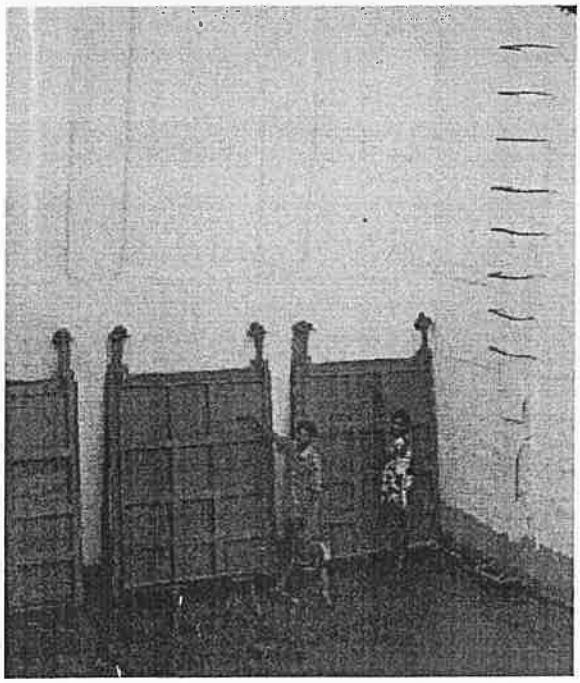
ভাটিক্যাল গেট



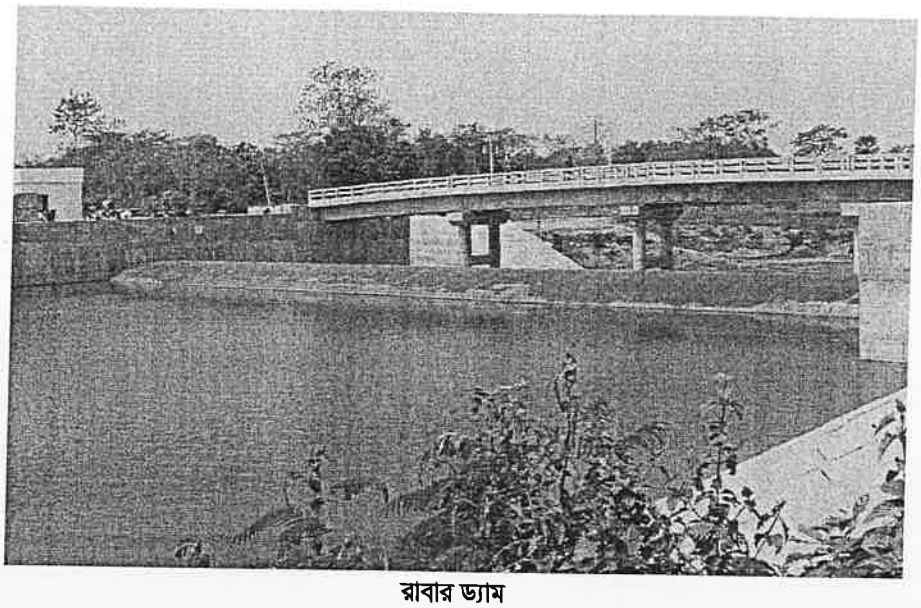
ভাটিক্যাল গেটের হয়েস্ট সিস্টেম



ভাটিক্যাল গেট তোলা হচ্ছে

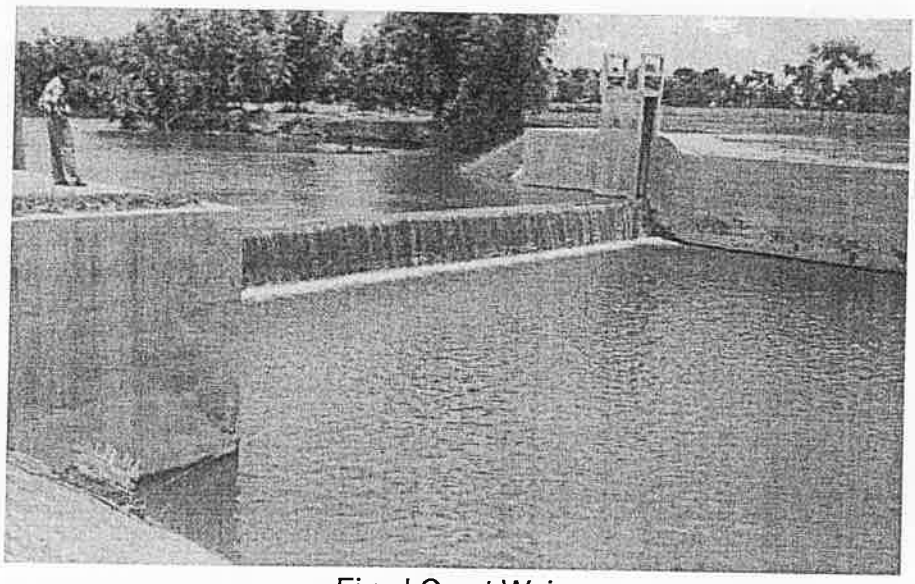


ফ্ল্যাপ গেট

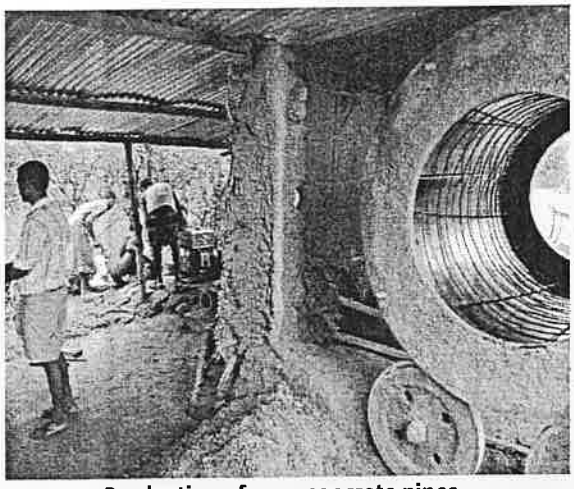


রাবার ড্যাম

ফ্ল্যাপ গেট তোলা হচ্ছে

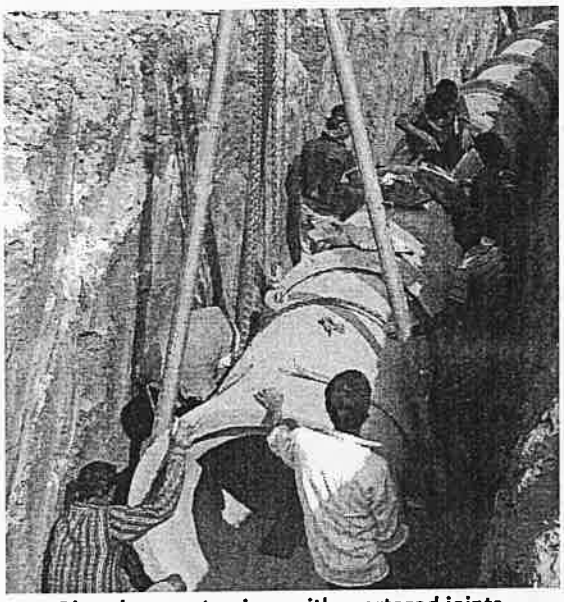


Fixed Crest Weir

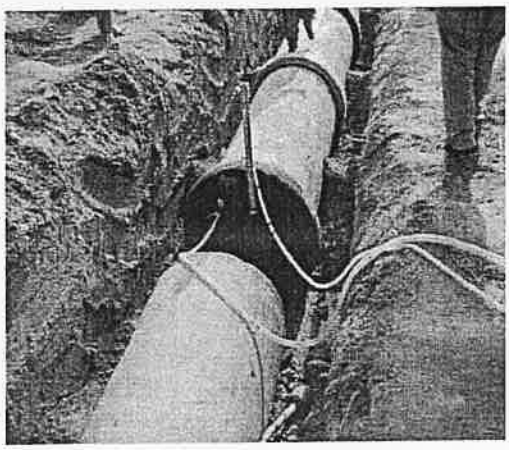


Production of spun concrete pipes
(SP 31001, Rouha, Mymensingh)

Spun concrete pipes – curing
SP 31001 Rouha, Mymensingh



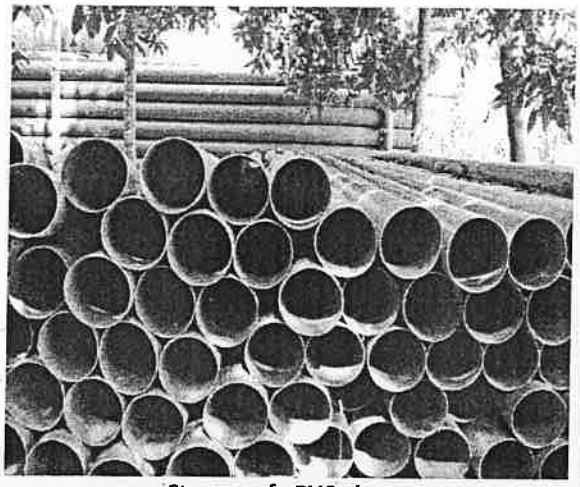
Placed concrete pipes with mortared joints
SP 31001 Rouha, Mymensingh



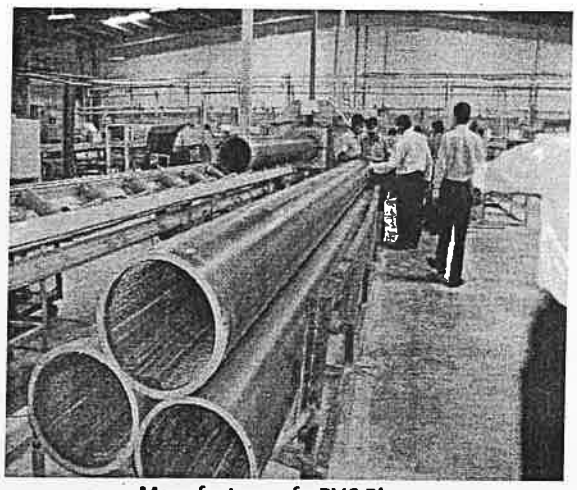
Pressure Testing of concrete pipes
(in SSWRD this is not carried out)

Elevated concrete pipe aqueduct
(Orissa, India)

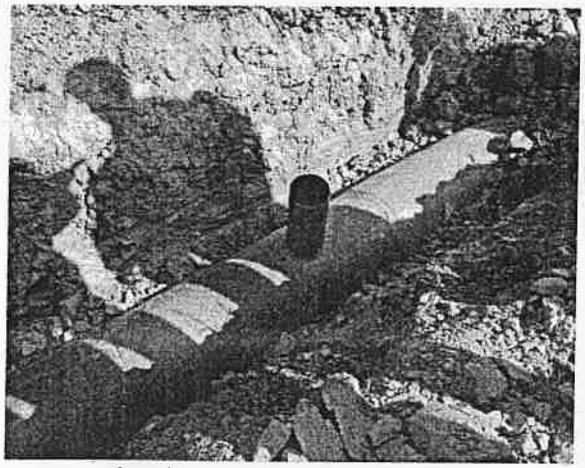
Leakage from joints of buried concrete pipeline



Storage of uPVC pipes
SP 35161 Noyemullah Khal, Habiganj

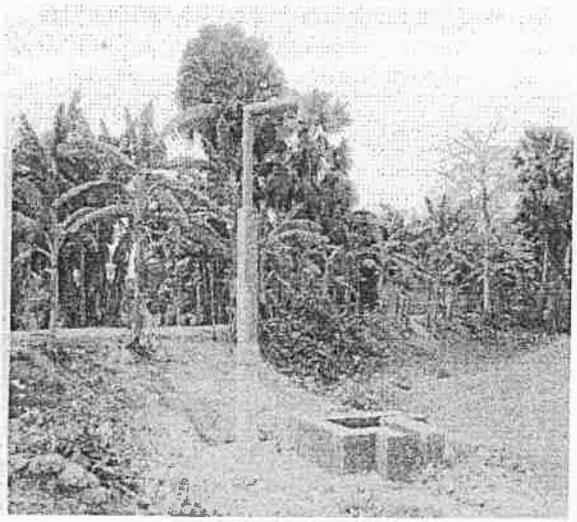


Manufacture of uPVC Pipes
RFL Factory, Bangladesh

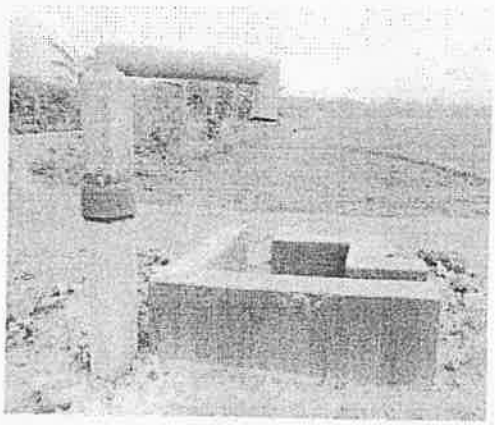


T-placed on pipe for airvent standpipe
SP33059 Baneswardi, Farldpur

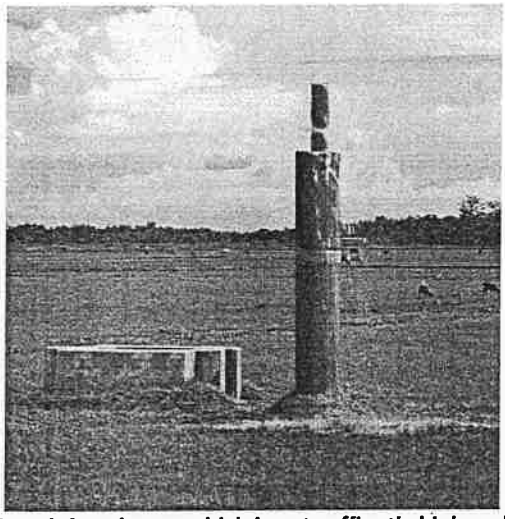
Backfill to uPVC Pipe
SP 33097 Mongalpur, Sunamganj



Airvent standpipe about 5 m high
(near to head of system)
SP 33044 Bajra Panai, Faridpur



Airvent standpipe about 1.4 m high
(at tail of system)
SP 33044 Bajra Panai, Faridpur



Standpipe airvent which is not suffiently high and venting water
SP 33096 Saherber Gaon, Sunamganj

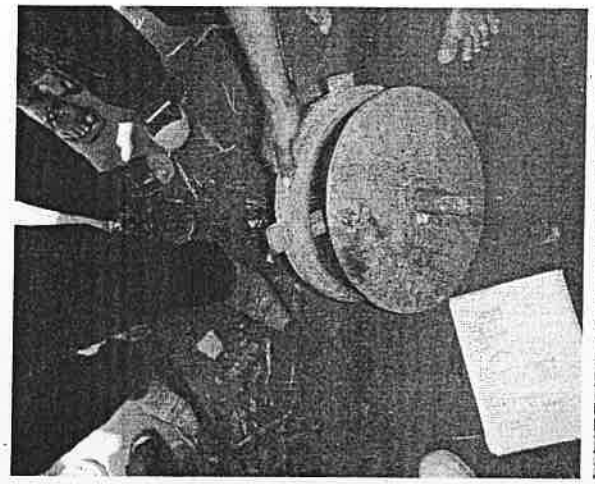
Piezomentric tube not yet fixed to airvent standpipe
SP 33096 Saherber Gaon, Sunamganj

Outlet riser box with alfalfa valve for flow control
SP 25288 Dariapur, Chapai Nawabganj

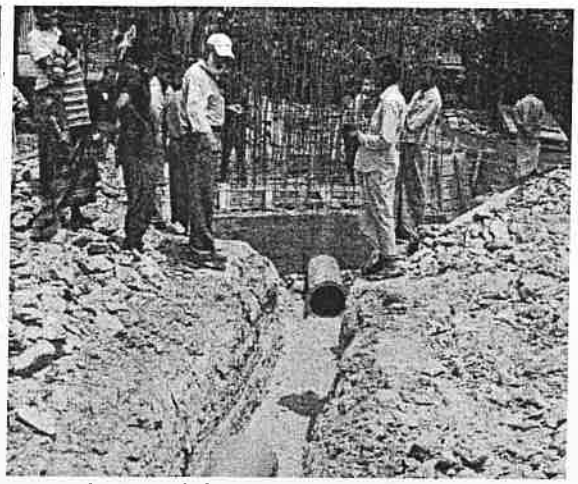
Flow from pucca-nucca / outlet riser box during system testing
SP 33096 Saherber Gaon, Sunamganj

Outlet box arrangement with pucca-nucca to control flow to field channels
SP 25240 Chara Para, Unmesh, Mymensingh

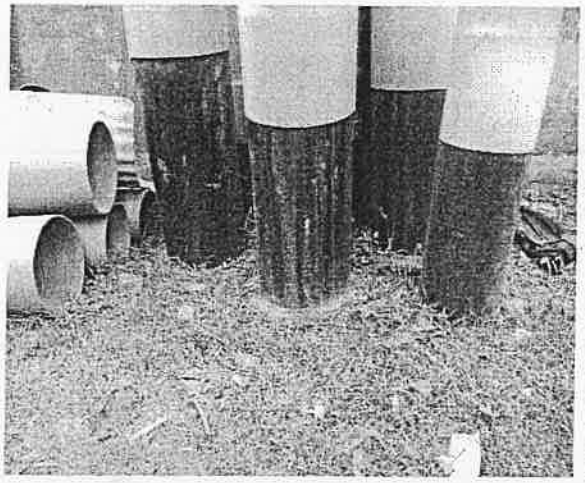
Locked cover to prevent tampering with alfalfa valve
SP 25240 Chara Para, Unmesh, Mymensingh



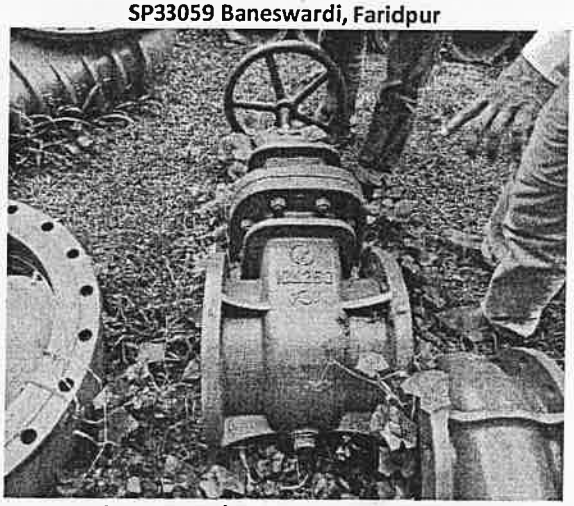
Cast Iron Alfalfa Valve



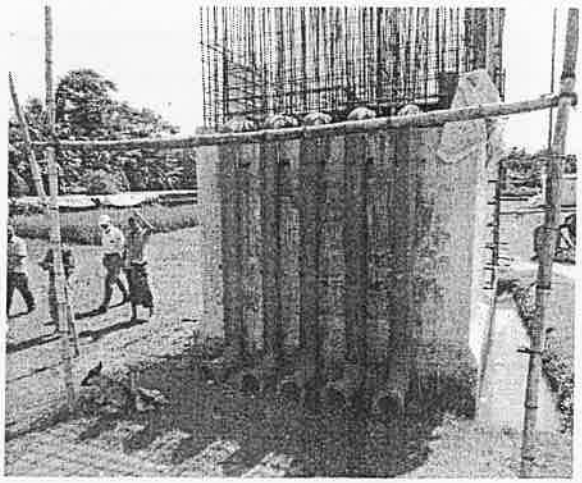
Steel pipe with flange to connect to uPVC pipe
SP33059 Baneswardi, Faridpur



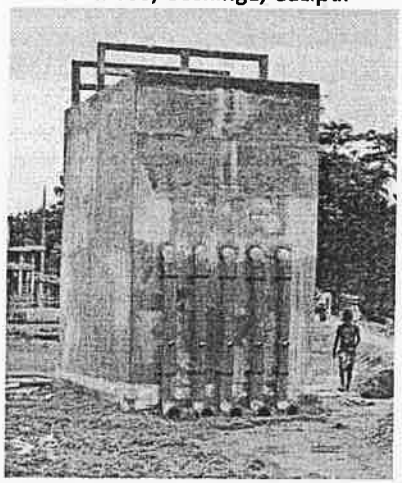
Factory mande connection between flanged steel and uPVC pipes
SP 41008 Goshinga, Gazipur



Gate valves for on / off flow control may be used instead of alfalfa valves built into flow control structures
SP 41008, Goshinga, Gazipur

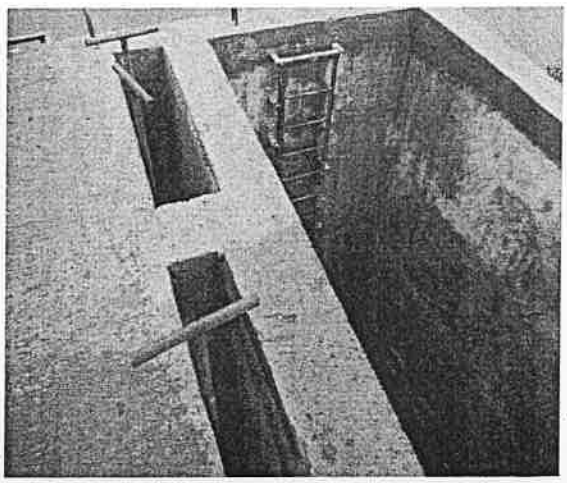


Header Tank under construction
SP 33096 Saherber Gaon, Sunamganj

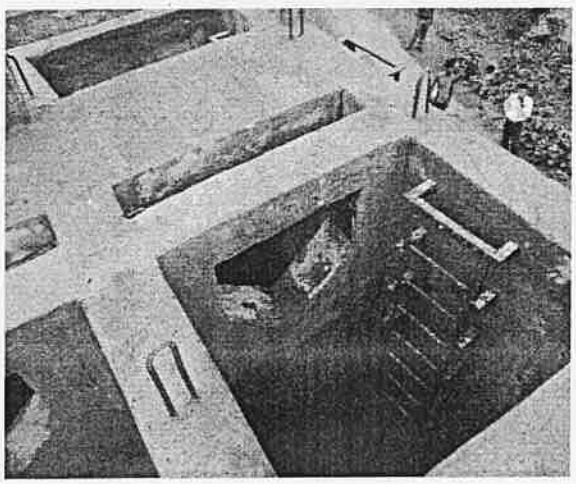


Completed Header Tank
SP 33096 Saherber Gaon, Sunamganj

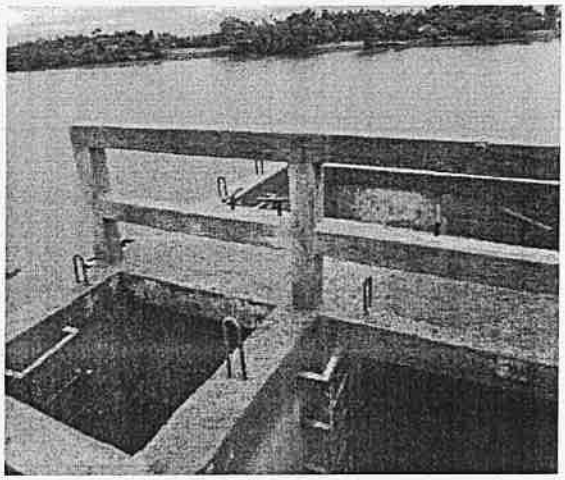
Access ladder arrangement to top of Header Tank, SP 25288 Dariapur, Chapai Nawabganj



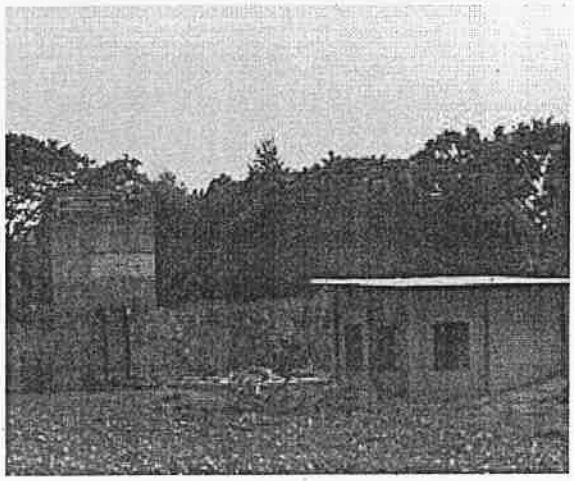
Handles to open / close valves from top of tank, SP 33096 Saherber Gaon, Sunamganj



Flow measurement V-notch weir between compartments 2 & 3, SP 33096 Saherber Gaon, Sunamganj

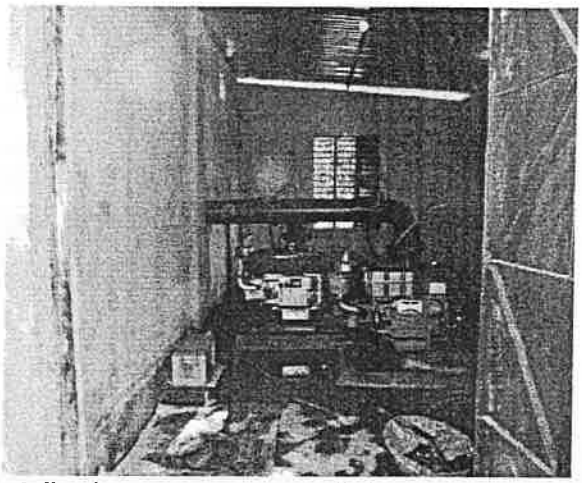


Operating Platform on top of Header Tank, SP 33096 Saherber Gaon, Sunamganj

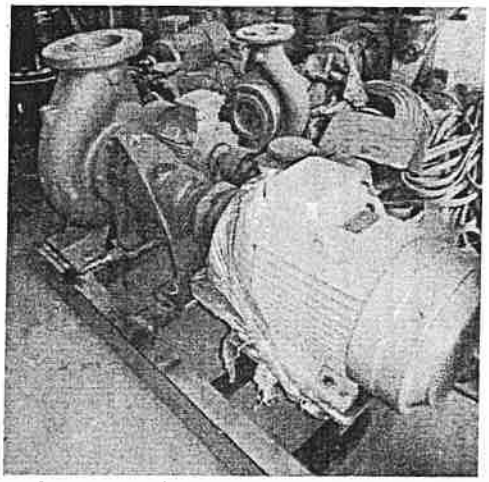


Pump house and header tank
SP 33044 Bajra Panail, Faridpur

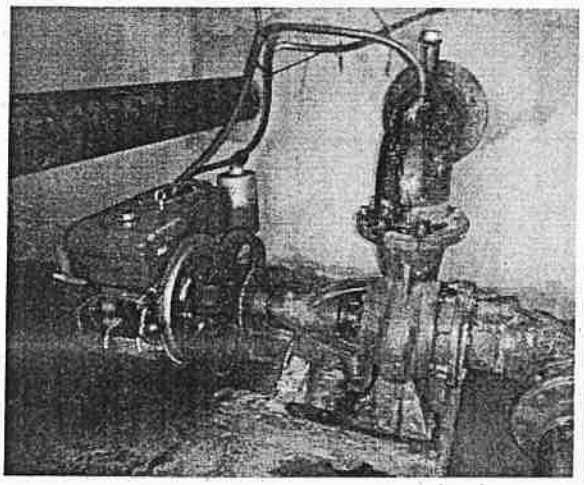
Operating Platform
SP33059 Baneswardi, Faridpur

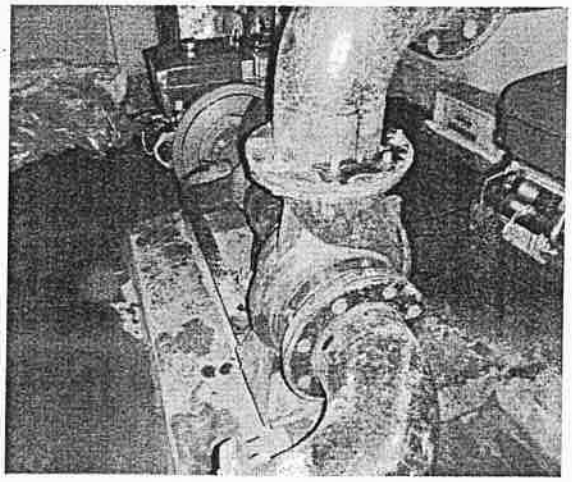


2 diesel motors & pumps installed in pump house, SP33059 Baneswardi, Faridpur

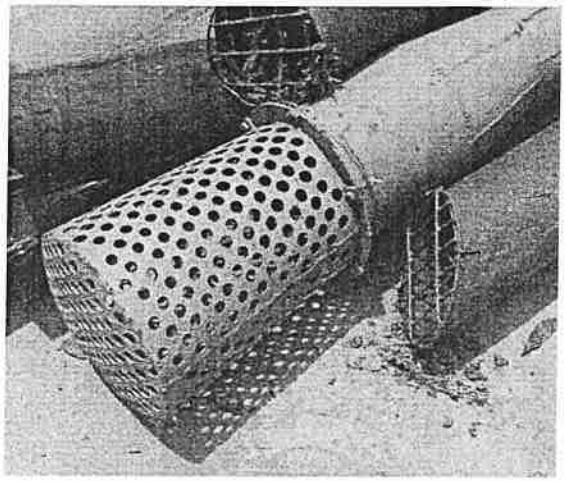


Electric motor and pump mounted on steel frame / skid, Milner Pump Foundry, Tongi, Dhaka

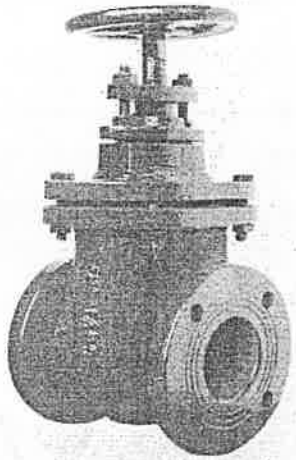




Diesel Pump set arrangement
Baneswardi Pump House



Screen (& Foot valve) at end of Suction Pipe



Gate (Sluice) Valve