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Welcome

Presented by:
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MSc in Geotechnical Engineering

- Financed by:

"***LGED's Human Resources Development and Capacity Building Project***"

- Course duration: 10.01.2021 – 10.01.2022

Course overview:

- The ground is the greatest area of technical risk in construction — therefore the demand for qualified specialists in geotechnical engineering is ever-growing among all over the world.
- To reduce construction risk and optimize the design of geotechnical structures to ensure that they are safe, sustainable and resilient.
- Understanding the real-world geotechnical problems in industry, including shallow and deep foundations, soil-structure interaction, ground as a source of energy, environmental geotechnics, and slope and ground stabilization.

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Course structure:

This is a full-time MSc programme over one year (3 semesters) and comprised of modules totalling 180 credits.

It is divided into two parts:

- **Part one:** a teaching programme over two semesters.

  - Three Modules (45 credits) in 1st semester

  - Four Modules (75 credits) in 2nd semester

- **Part two:** Dissertation (60 credits).

Taught Programme details:

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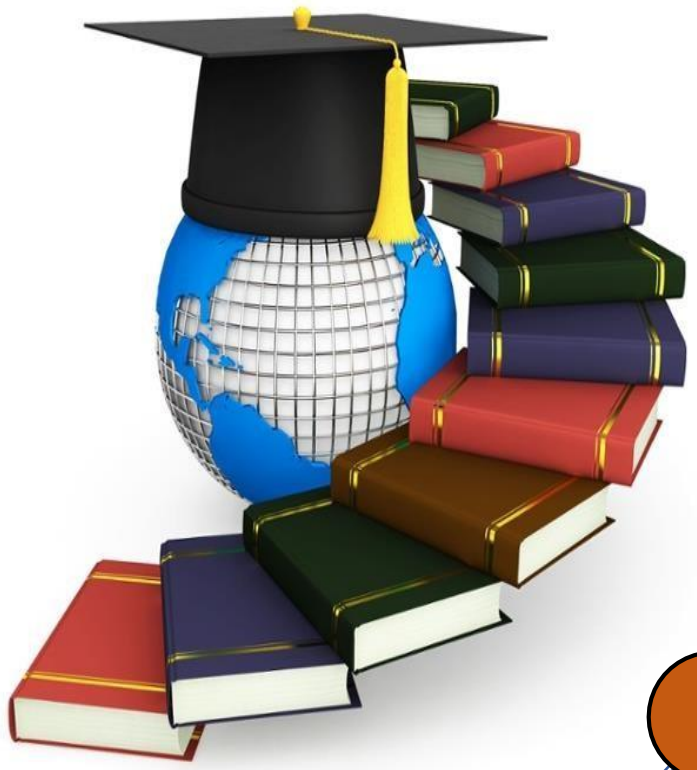

- Geotechnical Engineering
- Foundation Engineering
- Constitutive model & Numerical Analysis
- Geotechnical Investigation and Characterisation
- Energy Geotechnics
- Transport Infrastructure strategy
- Ground Water Pollution and Contaminated land

Dr. Mark Thomas

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CIVE 5160 Geotechnical Investigation and Characterisation

Module outlines:

- Identifying most of the risk in geotechnical design according to topographical, hydrogeological, geological, historical and geotechnical characteristics of a site.
- Creating a ground model with the help of desk studies and available data.
- Data collection from the site, analyze the data and validate with the desk studies. Then provide the data to the design team.
- Introduction of some destructive and nondestructive soil test and their implementation.
- Geophysical studies

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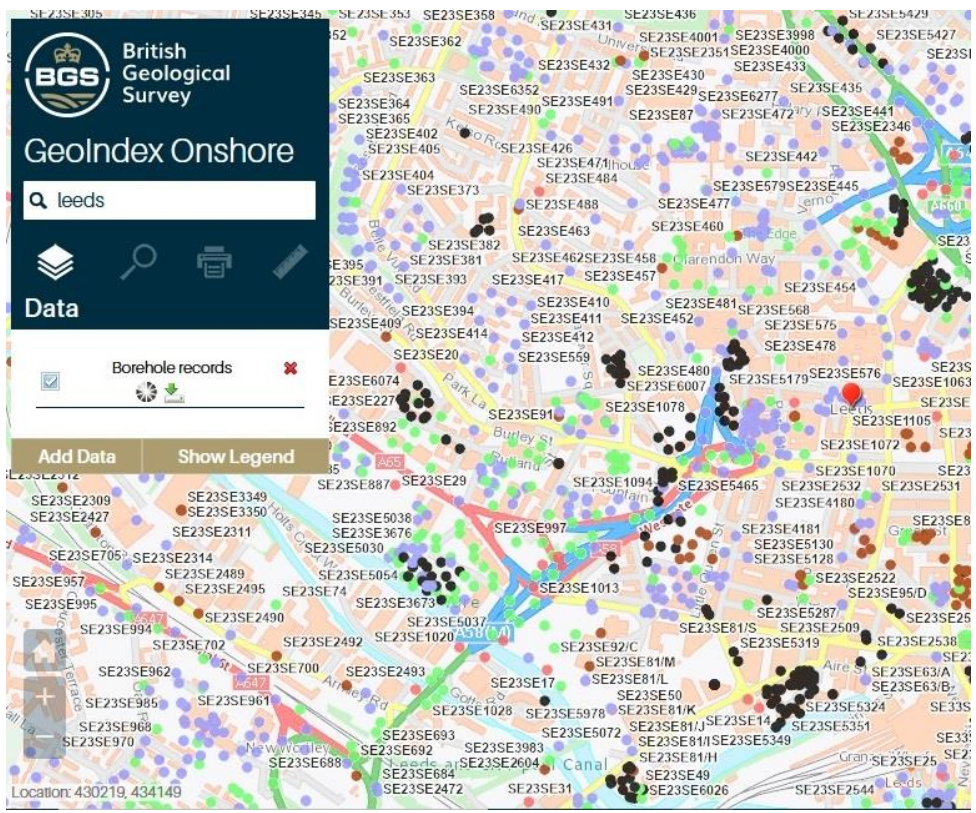
CIVE 5160 Geotechnical Investigation and Characterisation



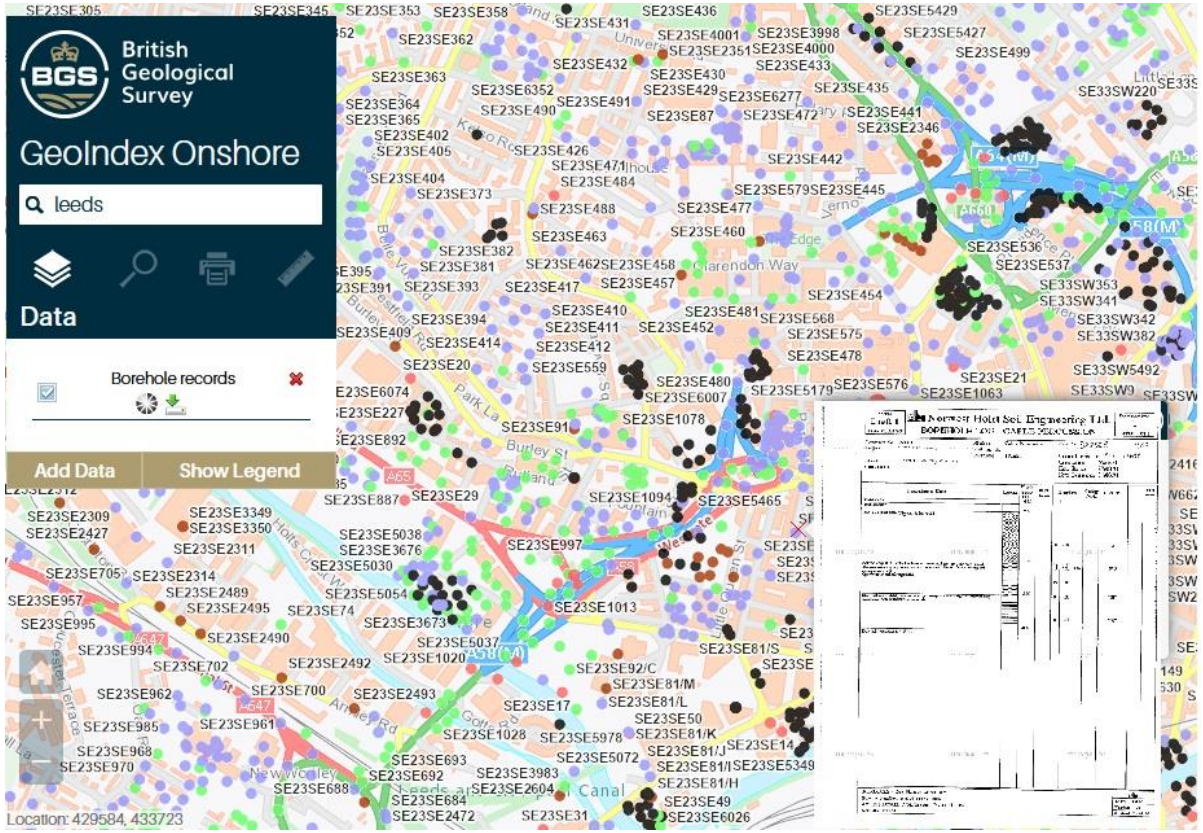


Figure 1 (a), (b) BGS borehole data

CIVE 5160 Geotechnical Investigation and Characterisation

Figure 2 (a), (b) Modern and Historical Data from Digimap

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Dr. Barry Clarke

CIVE 5670 Geotechnical Engineering

Module outlines:

- This course is about ground processes and geotechnical structures including tunnels, pipes, retaining walls, embankments and roads.
- It covers design and construction using case studies to highlight the issues of dealing with uncertainty.

Figure 3 Retaining Structure Soil Nail

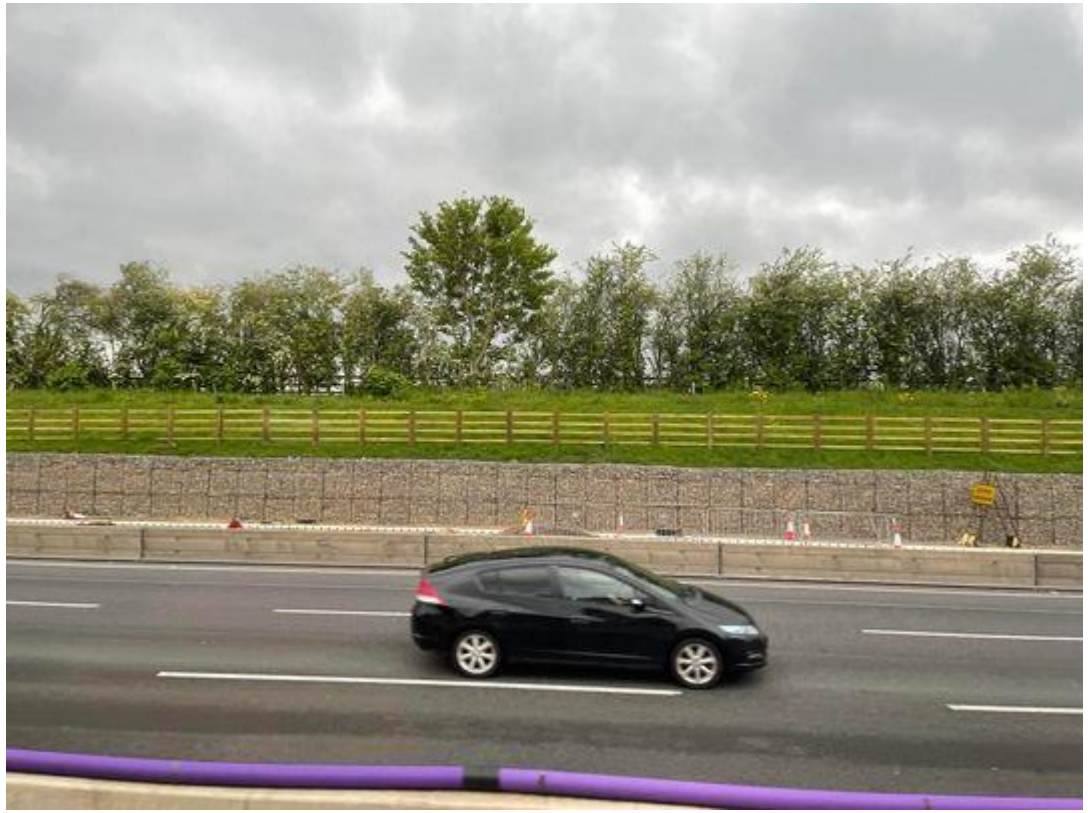

Figure 4 Retaining Structure Gabion Wall

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Dr. Barry Clarke

CIVE 5975 Foundation Engineering

Module outlines:

- All structure are built on, in or with ground. Geotechnical engineering focuses on structures that are built with the ground or support the ground. Foundation engineering, a core subject for all civil engineering, deals with foundations of structures.
- This course also focuses on the design and construction of several deep and shallow foundation.
- This module also introduce some ground improvement techniques.

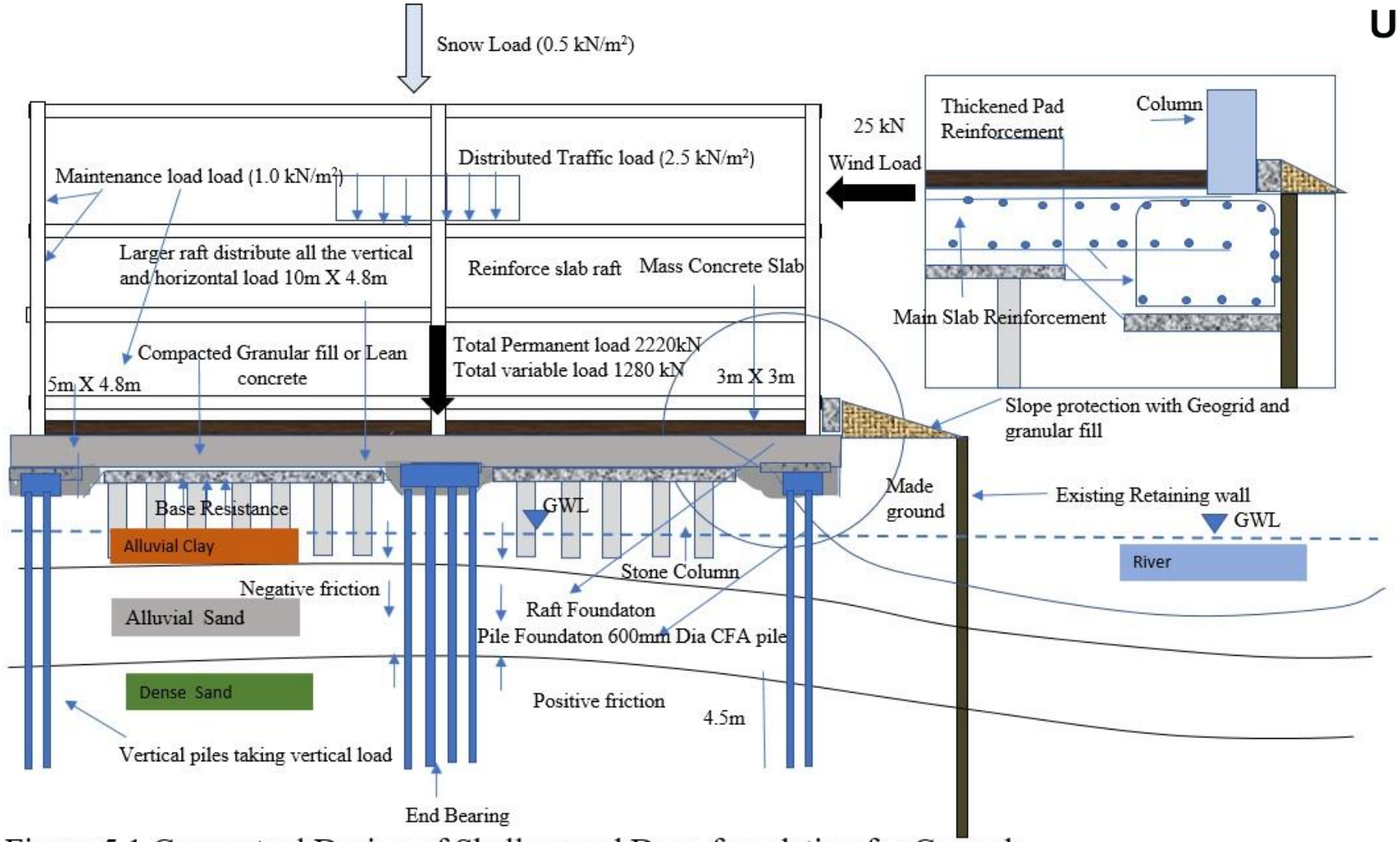

Figure 5.1 Conceptual Design of Shallow and Deep foundation for Carpark

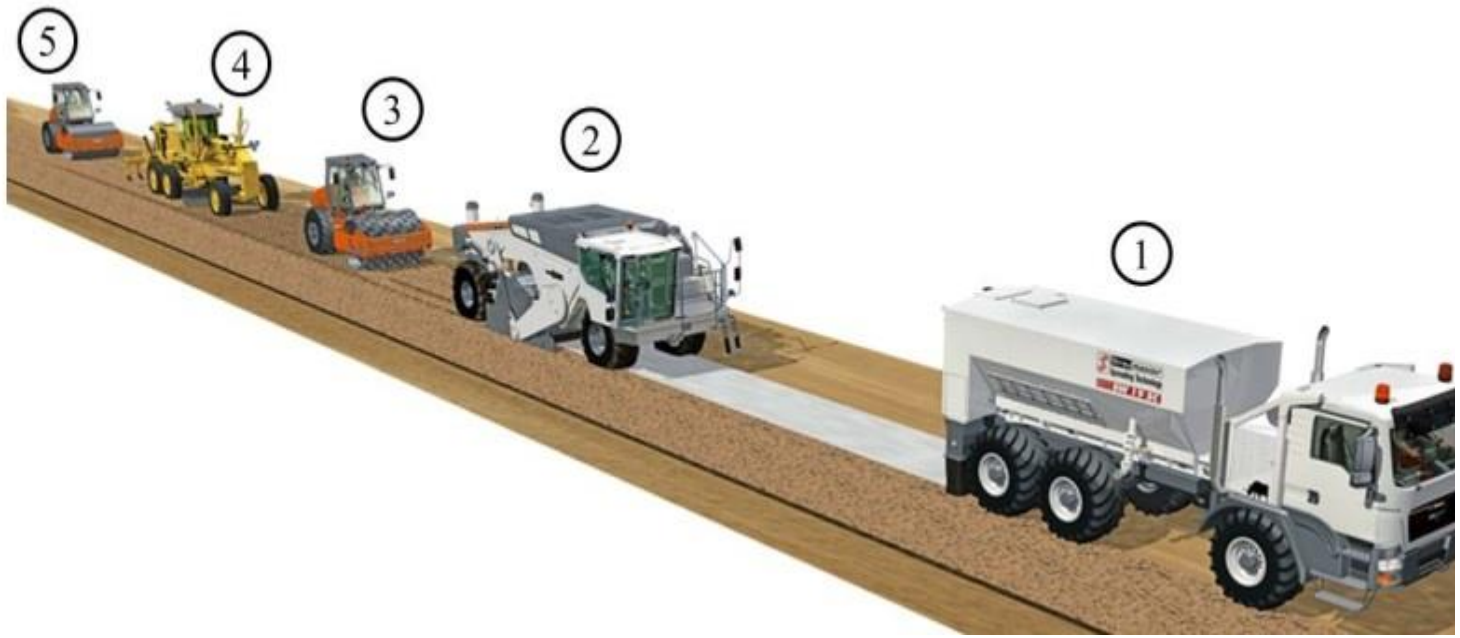

Figure 5.2 Shallow stabilization to form road base

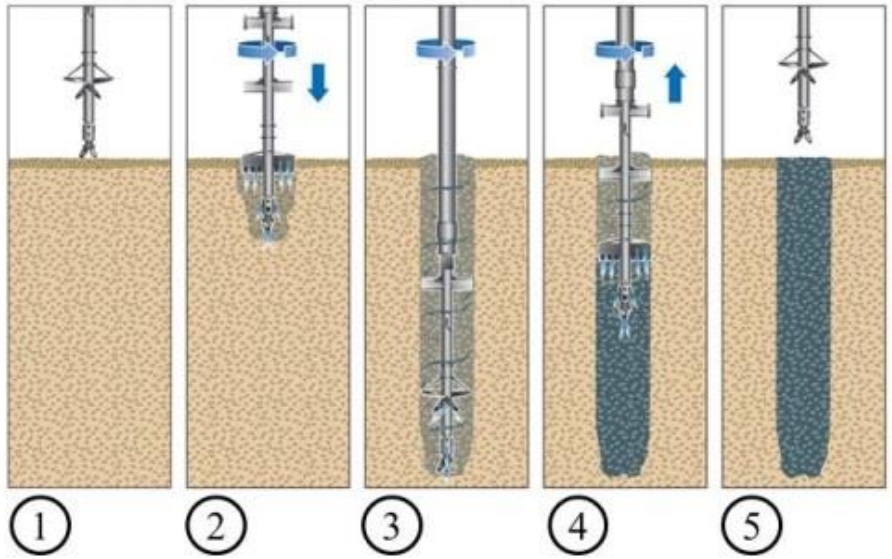

Figure 5.2 Deep stabilization to form road base

Dr. Fleur Loveridge

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CIVE5161M Energy Geotechnics

Module outlines:

- The ground is probably the greatest source of energy that is readily accessible. This can take the form of high grade energy such as geothermal energy or low grade energy created by solar energy in the upper layers. Innovative techniques to extract and store heat are covered.
- Introduction of ground source heat pump. Design, construction and application of several types ground source heat pump.
- Discussed about energy piles.

CIVE5161M Energy Geotechnics

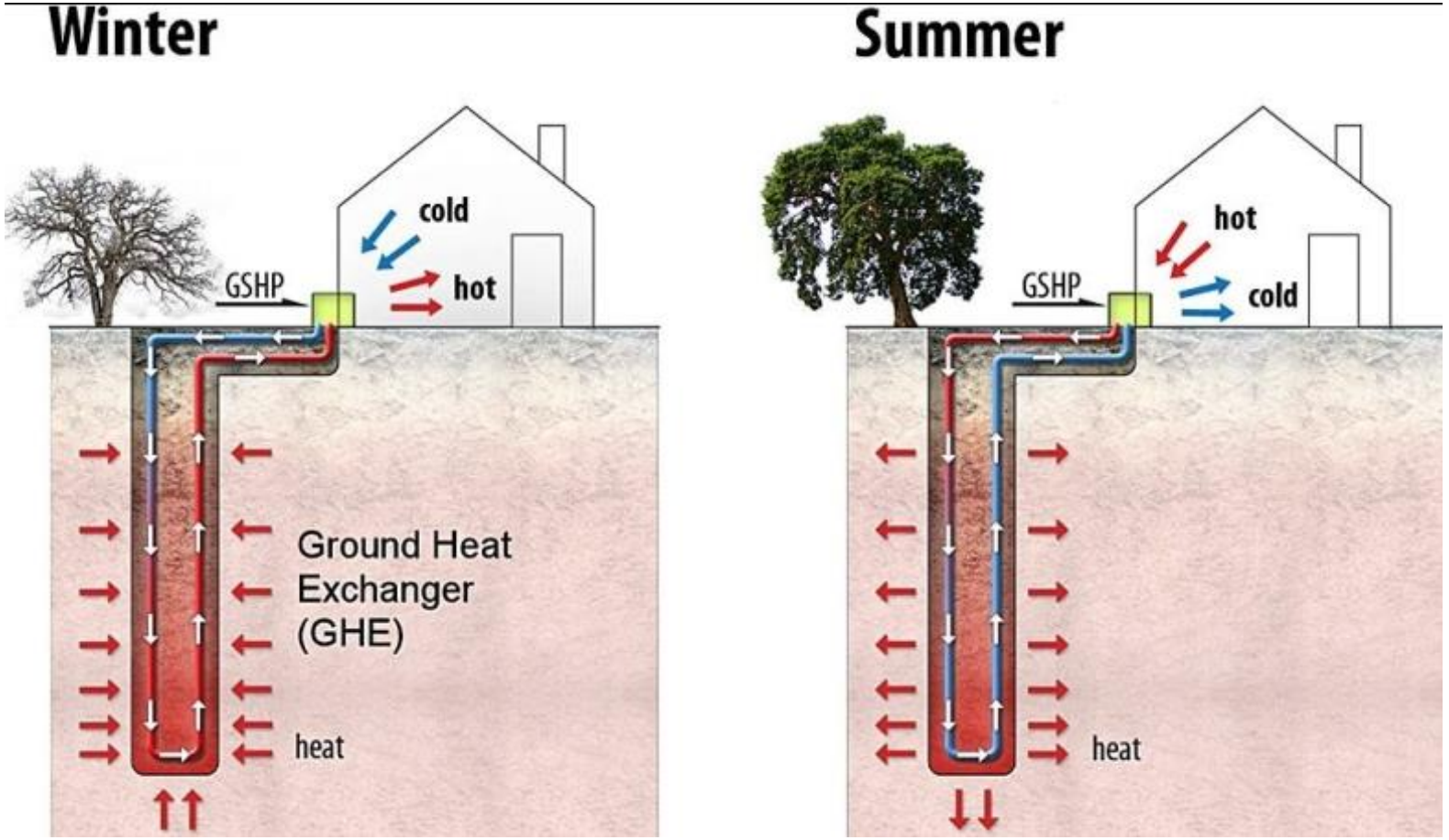

Figure 6.1 Common Ground heat Exchanger

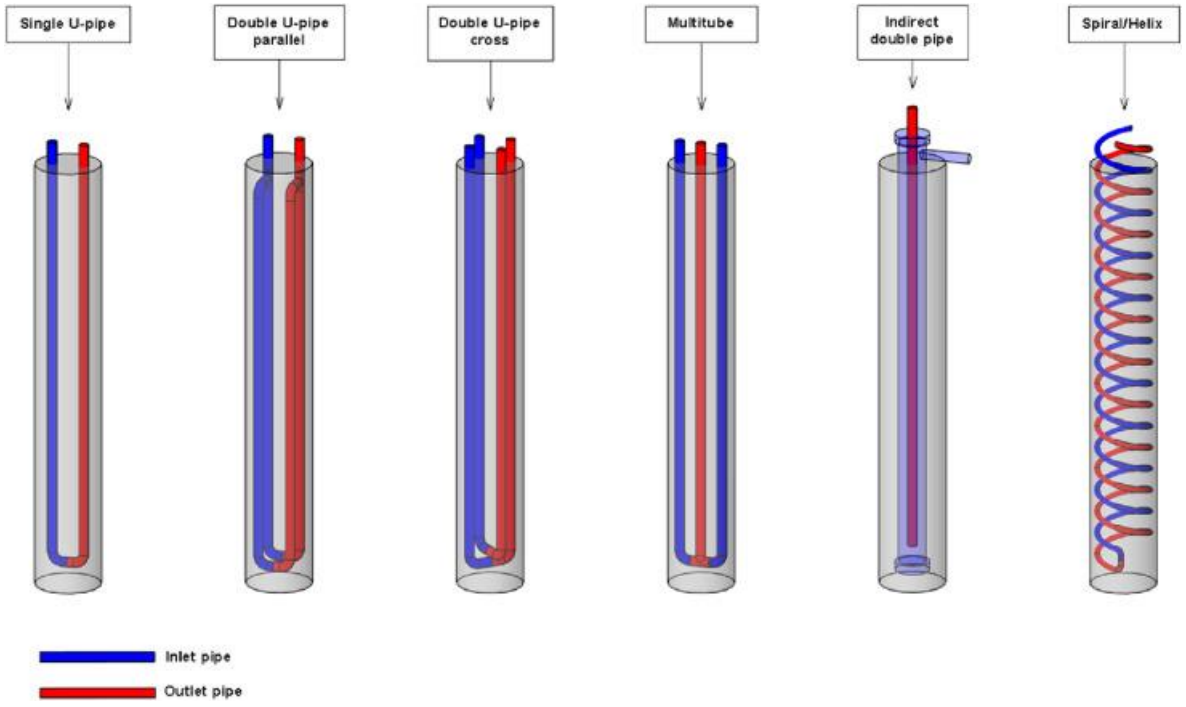

Figure 6.2 Energy pile

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Dr. Ana Heitor

CIVE5162M Constitutive model and numerical analysis

Module outlines:

- The spatial variation of soils and the uncertainty of dealing with these complex materials means that, increasingly, numerical methods are used to undertake sensitivity studies.
- Predicting ground behavior using numerical methods requires an understanding of the constitutive models and the limitations of the methods of analysis; the basis of the module.
- COMSOL, PLAXIS 2D and 3D are used as the numerical analysis software.

CIVE5162M Constitutive model and numerical analysis

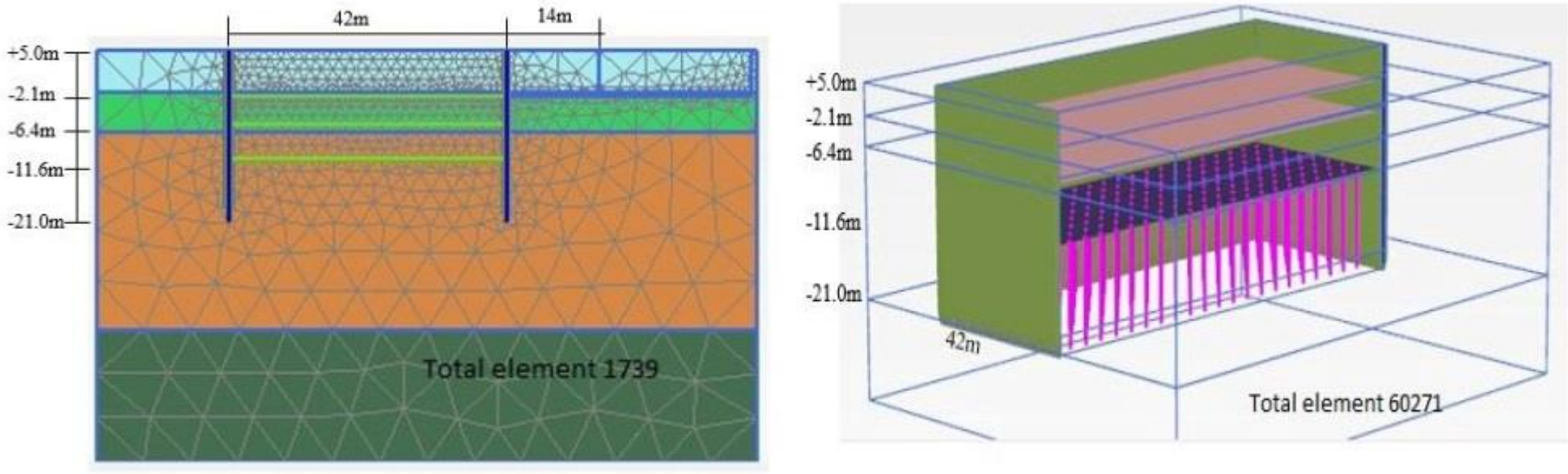

Figure 7 2D and 3D Model of a warehouse building

Dr. David Connolly

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CIVE5164M Transport Infrastructure Strategy

Module outlines:

- This module provides a holistic and systematic approach to the design of transport infrastructure focusing on the alignment and resulting geotechnical structures.
- It is assessed as an integrated project using team work to produce a viable, sustainable and resilient solution. Team consists of two geotechnical engineers, two transportation engineers and one railway engineer.
- Final project submission was judged by the British Rail

CIVE5164M Transport Infrastructure Strategy

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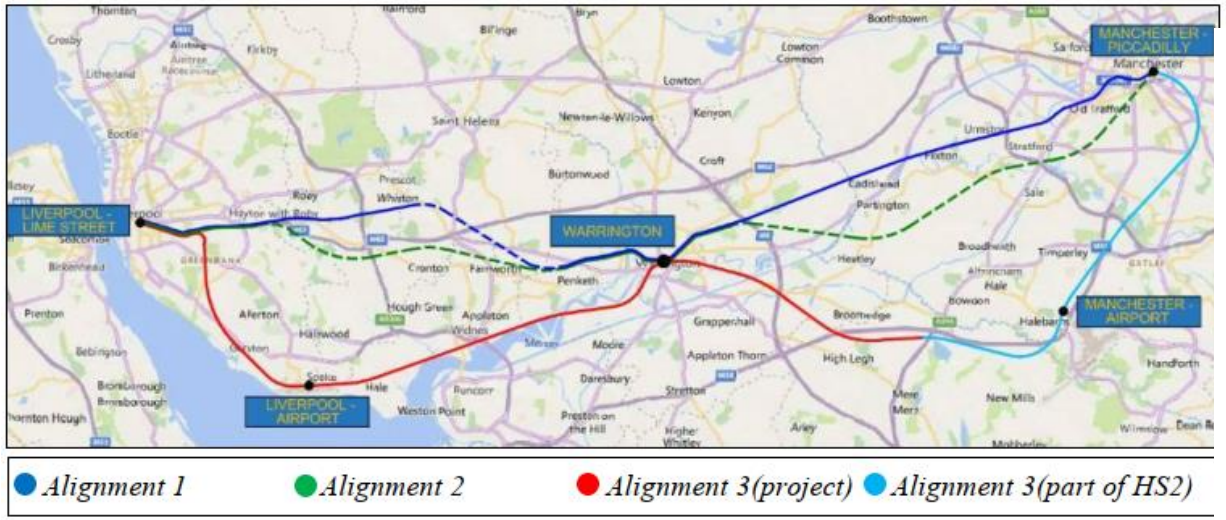
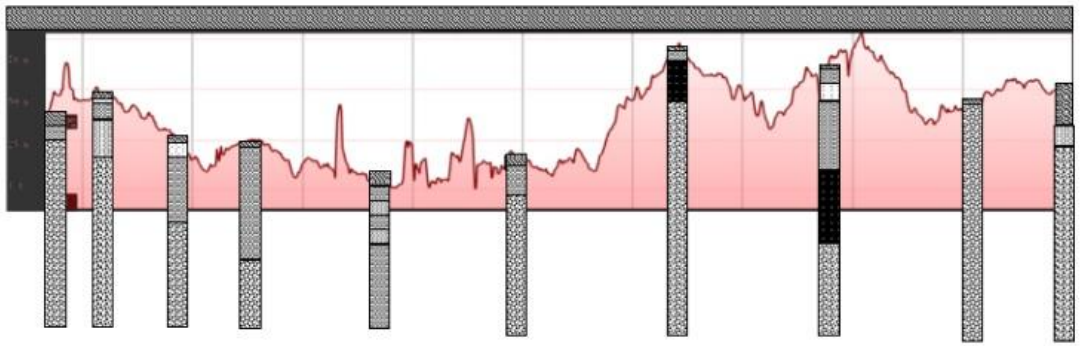
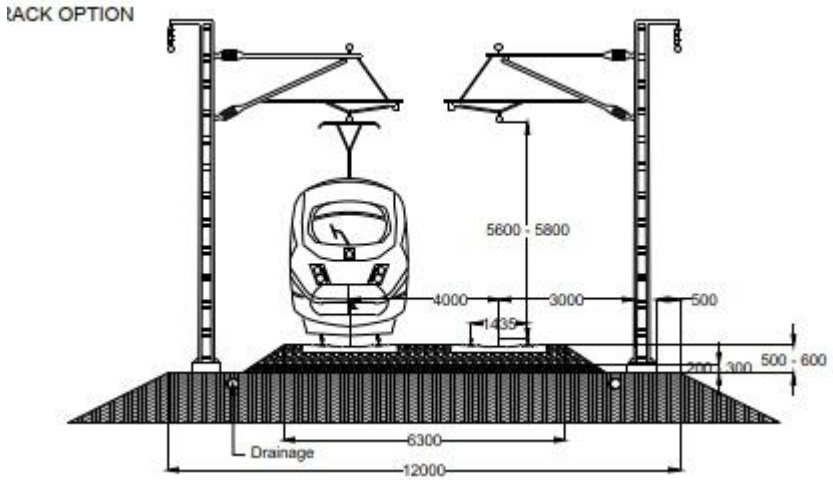
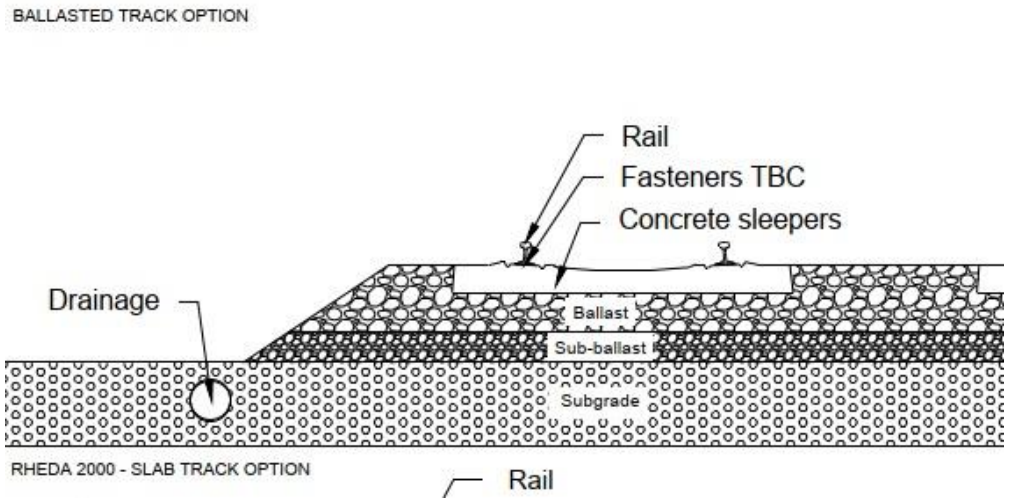




Legend:

- Made Ground
- Medium stiff to stiff Clay
- Sandstone
- Mudstone
- Coarse Sand
- Dense Sand
- Stony Clay





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Dr. Xiaohui Chen

CIVE5575M Ground Water pollution and contaminated land

Module outlines:

- Any geotechnical engineering project has the ability to contaminate the ground; urban geotechnical projects will have to deal with contaminated ground. Understanding ground contamination, how it can affect the soil behaviour and how it can be dealt with are a core component of any geotechnical design in urban areas.
- PHREEQC and COMSOL were used as the numerical analysis software.

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CIVE5575M Ground Water pollution and contaminated land

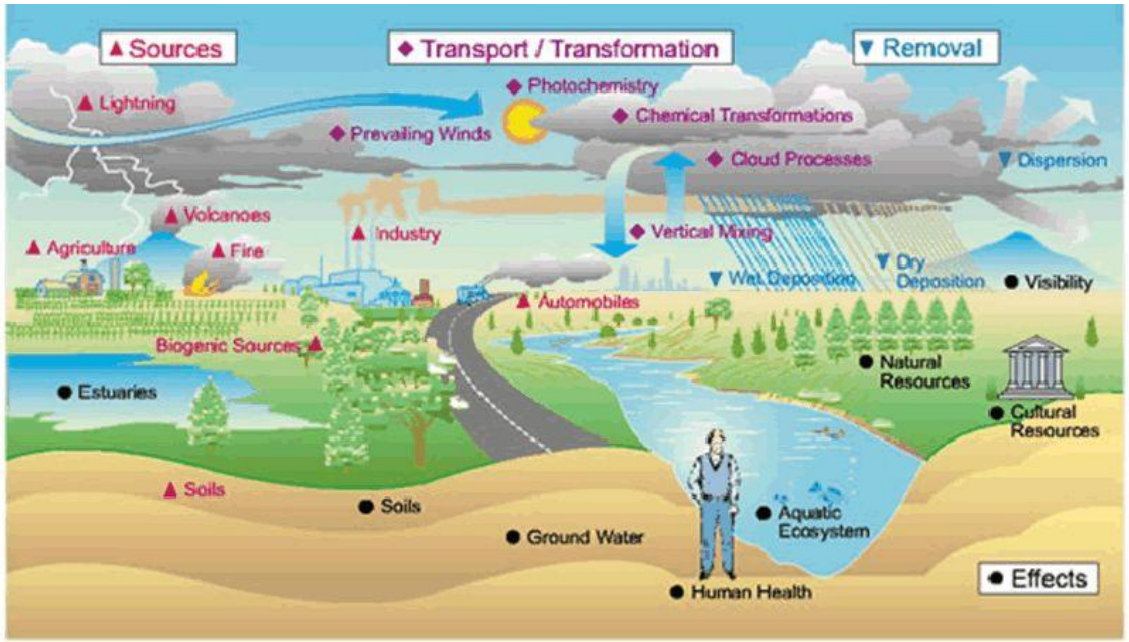

Figure 8 Different Types sources and contaminants for Soil Contamination

Ex-situ(contaminat removal from the site)	In-situ (Contaminated treated in the site)
☐ Source removal	☐ Monitored natural attenuation
☐ Free LNAPL/DNAPL removal	☐ Bioventing / Biosparging
☐ Soil washing	☐ Bioaugmentation
☐ Soil Flushing	☐ Phytoremediation
☐ Pump and treat groundwate	☐ Permeable reactive barriers
☐ Soil Stabilization/ Solidification	
☐ Air Sparging	
☐ Soil Vapour extraction	

CIVE 5000 M.Sc. Dissertation

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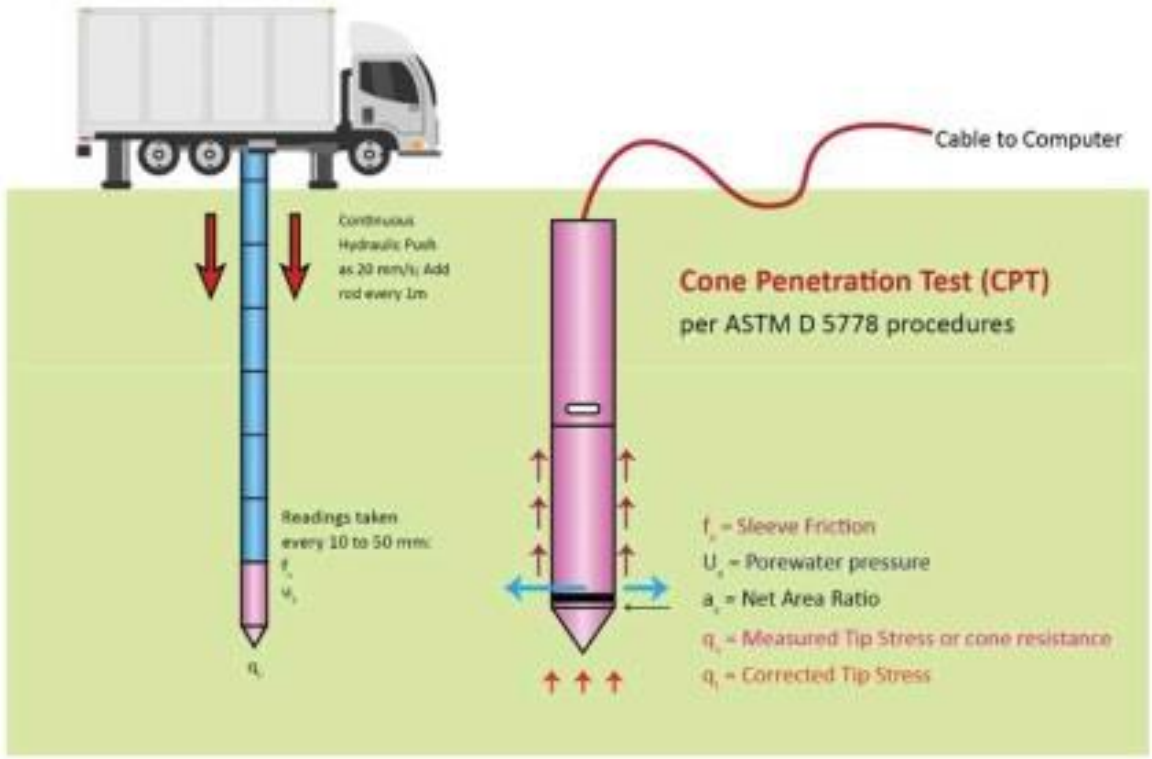
Dr. Maryam Asachi

Numerical modelling using Discrete Element method (DEM) for soil penetration problem



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Research question:

"How DEM simulation can be applied for large deformation CPT studies cost effectively, and what are the main mechanisms related to the impact of different input variables on the cone resistance".

Research objectives:

- Providing a brief review of the studies which have implemented DEM to simulate large deformation CPT and tabulating the main objectives and findings for these studies.
- A library of input parameters for simulating CPT based on DEM will be provided for different particle types (e.g. glass bead, different sand types such as silica sand, etc)
- The main variables impacting the cone resistance in dry sands will be reviewed. The main mechanisms related to the impact of these variables on the trajectory of particles and cone resistance will be discussed based on DEM findings.
- In case of the software availability, a simple 3D DEM model will be carried out using LS-DYNA software to analyze its computational time. The computational time of CPT into different particle conditions will be compared.

Research plan:

A systematic review structure will be prepared to report the results as follow:

- Two tables will be provided to summarize the main findings of the research separately for 2D and 3D CPT analysis. Another table will be provided to discuss the pros and cons of different techniques used to reduce the computational time of CPT using DEM.
- A simple model is created with the help of LS-DYNA software to statistically compare the efficiency of several approaches to reduce the computational time of a simple CPT. The latter depends on the software license availability and computer's capacity for running DEM analysis.

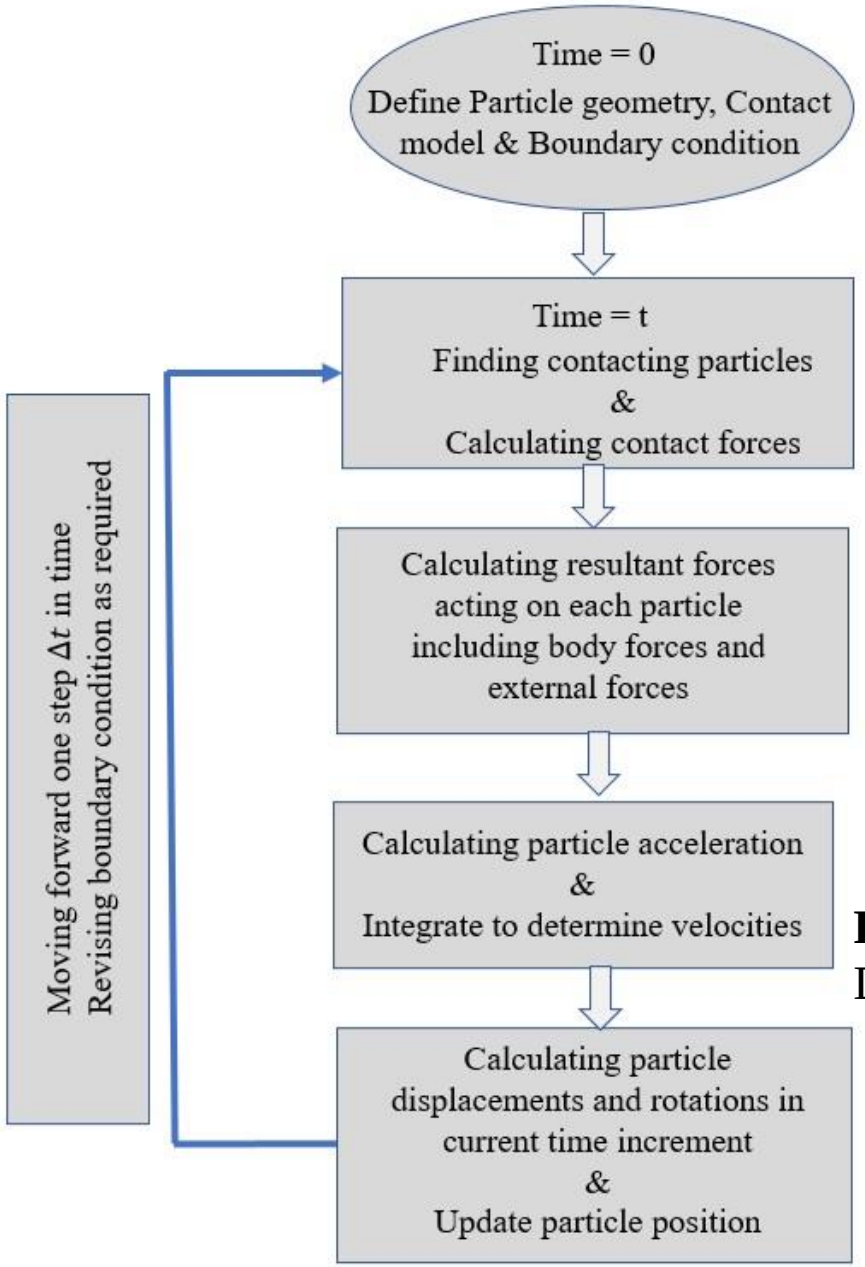


Figure 9 Overall calculation procedure of DEM analysis

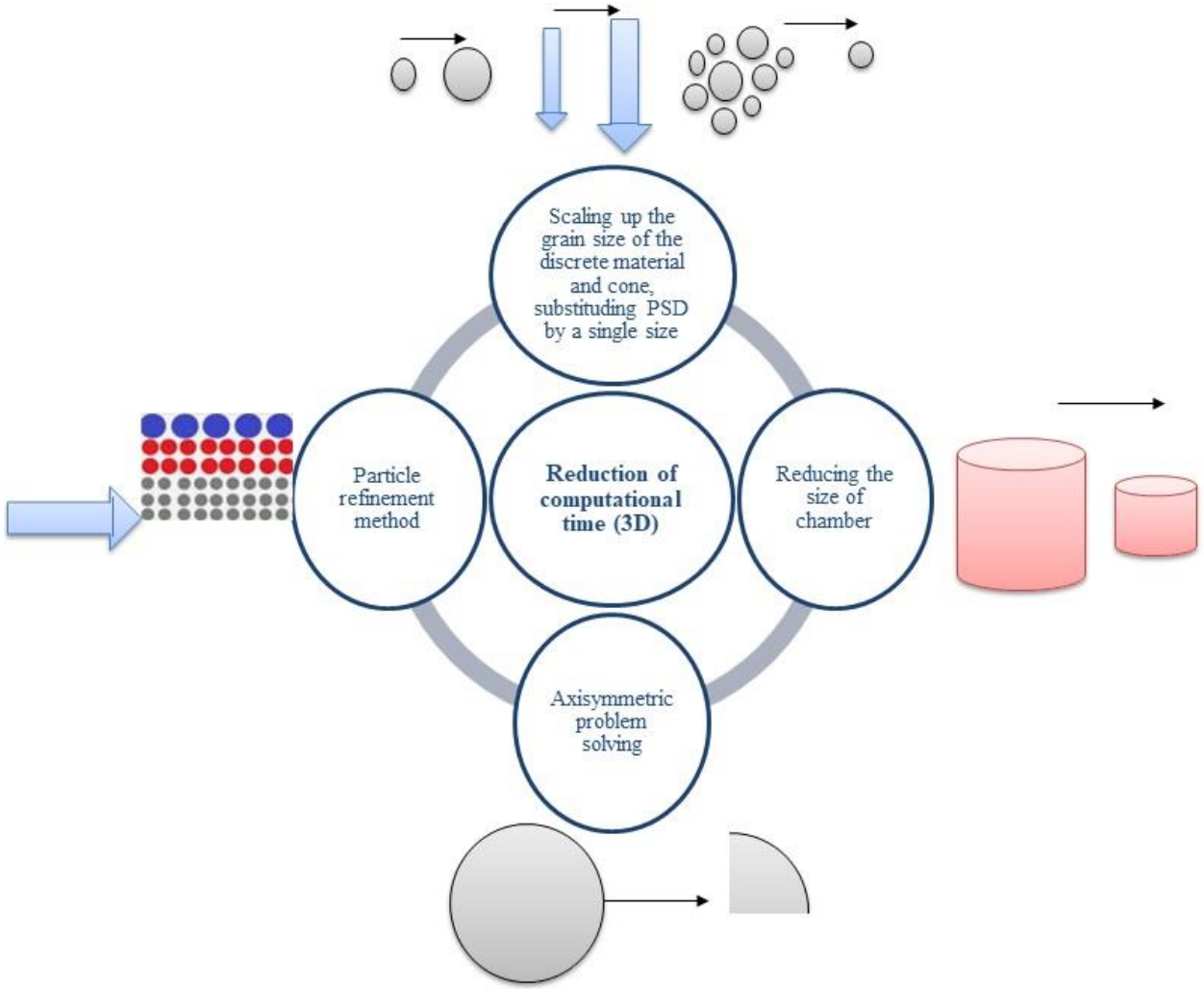
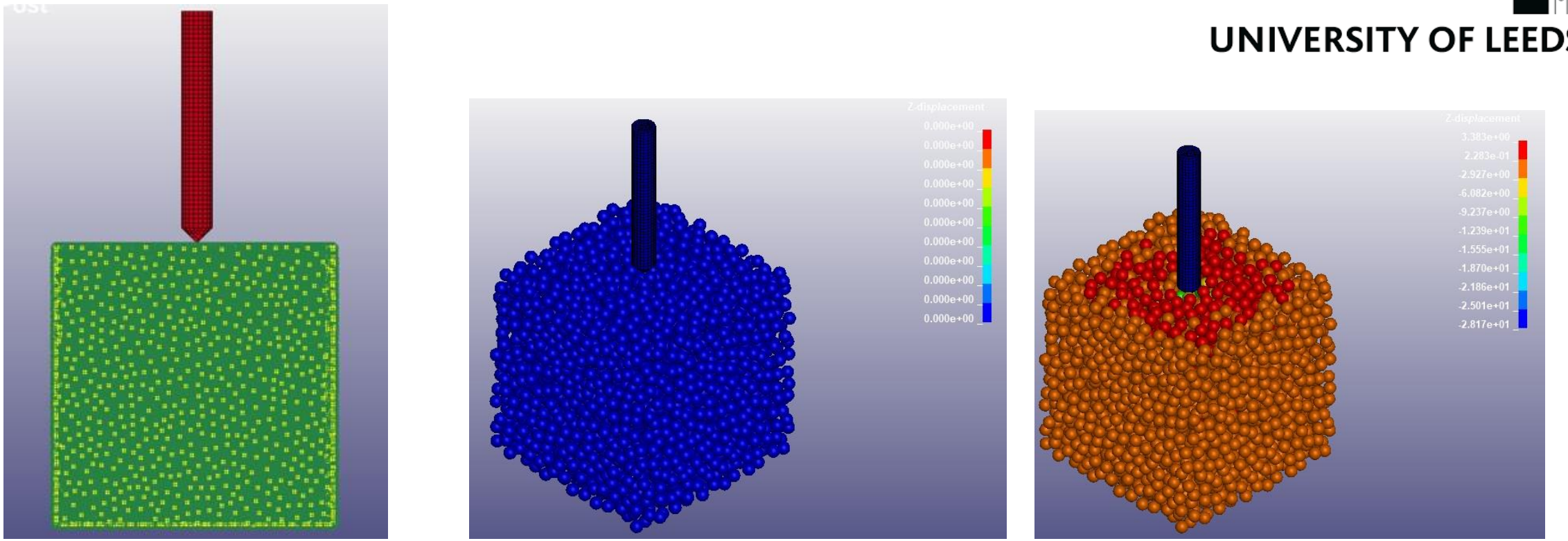


Figure 10 Different techniques to reduce the 3D DEM computational time



(a) (b) (c)

Figure 11 (a) DEM model with Boundary condition, (b) Deformation before penetration, (c) Deformation after penetration.

Scope of using this knowledge in the LGED

- LGED performs a lot of soil test including SPT test, those soil test can be included in the GIS map like British Geological Society data.
- Soil nail, Gabion wall can be introduced as retaining structure where the slope condition is very critical.
- Now a days LGED builds lot of high storied buildings where energy pile might be an option for green building.
- Shallow and deep stabilization of soil can also increase the capacity of soil. which can be used in road where underneath soil is softy.
- To determine the soil capacity, CPT test can be used as this test is rapid, effective and reliable.
- The whole course is fully aligned with the SDG goals.
- The experimental findings can be useful in providing some innovative solutions to solve some engineering problems

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Thank you