First year of Geomatics Department
Engineering Geology 2018
Lecture 1

Principles of Engineering Geology

Dr. Eng. Hassan Mohamed

About this course

For students undertaking this course, the aims are to:

1-Have knowledge on the principles of Geology, Plate tectonics, Minerals, Igneous rocks, Sedimentary rocks and Metamorphic rocks, Earthquakes, Structural Geology, underground water, materials for construction.

2-Understand a geological map.

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Course Syllabus 2018

1. Week 1 Principles of Engineering Geology
2. Week 2 Plates and Global tectonics
3. Week 3 Minerals 1
4. Week 4 Minerals 2
5. Week 5 Igneous rocks and volcanoes
6. Week 6 Igneous rocks and weathering
7. Week 7 Sedimentary rocks
8. Week 8 Sedimentary rocks and metamorphic rocks
9. Week 9 Earthquakes
10. Week 10 Structural Geology
11. Week 11 Underground water and surface dams
12. Week 12 Materials for constructions

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Weighting of Assessments

Assessment	Weight
Mid-term Examination	20 %
Final Examination	70 %
Oral Examination	0 %
Practical Examination	0 %
Semester work	10 %
Total	100 %

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What Is Engineering Geology?

- Engineering geology is the application of geological data, techniques and principles to the study of rock and soil surficial materials, and ground water.
- Is the application of geology in design, construction and performance of civil engineering works.
- This is essential for the proper location, planning, design, construction, operation and maintenance of engineering structures. Engineering geology complements environmental geology, or hydrogeology.

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What does Engineering Geology study?

- Rocks, soil, water, the interaction among these three constituents, as well as with engineering materials and structures.

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Why Engineering Geology matter?

- **Serve civil engineering to provide information in 3 most important areas:**
  - **–Resources for construction;**
    - **Aggregates, fills and borrows.**
  - **–Finding stable foundations;**
    - **Present is the key to the past –geology**
    - **Past is the key to the future -engineering**
  - **–Mitigation of geological hazards**
    - **Identify problems, evaluate the costs, provide information to solve the problems**

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GEOTECHNICAL AND STRUCTURAL ENGINEERING GONE WRONG

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GEOTECHNICAL AND STRUCTURAL ENGINEERING GONE WRONG

Interstate 35W bridge collapse in Minneapolis, Minnesota
August 1st, 2007

Areas Covered by Engineering Geology

1. Geological Hazard
2. Geotechnical
3. Material Properties
4. Landslide & Slope stability
5. Erosion
6. Flooding
7. Dewatering
8. Seismic Studies Etc.
9. Most important roles of the engineering geologist is the interpretation of landforms and earth processes to identify potential geologic and related man-made hazards that may impact civil structures and human development.

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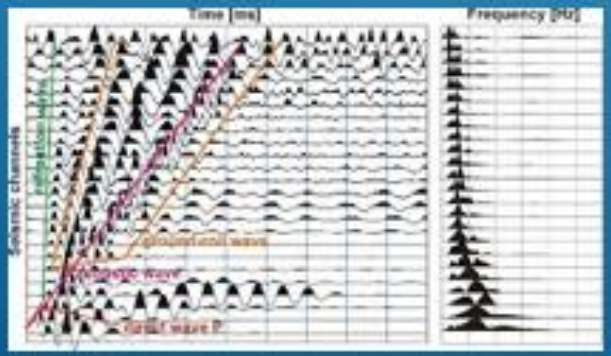
Areas Covered by Engineering Geology



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IMPORTANCE OF ENGINEERING GEOLOGY IN DEVELOPMENT

- To recognize potential difficult ground conditions prior to detailed design and construction
- It helps to identify areas susceptible to failure due to geological hazards
- To establish design specifications
- To have best selection of site for engineering purposes
- To have best selection of engineering materials for construction

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Who is a Geological Engineer ?

Honors Degree + 4 years experience.

Types:

1. Civil Engineer with geotechnical option (P.Eng.)
2. Geological Engineer with geotechnical option

(P.Eng., P.Geo.)

3. Geologist with extra courses and experience

(Engineering Geologist, P.Geo)

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Division of tasks:

Civil Engineer

-designs structure

Geotechnical/Geological, Geo-environmental Engineer

- carries out site investigation
- evaluates soil/rock properties
- carries out analysis
- provides geotechnical/geo-environmental design recommendations

Engineering Geologist

- carries out site investigation and evaluates geological factors
- provides geological input for analysis
- assesses hazards and impact of geological processes
- prospects for materials

Application of Geology in Civil Engineering

(a)Planning
(i) Topographic maps
(ii)Hydrological maps
(iii)Geological maps

b) Design

c) Construction

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➢PLANNING

I. **Topographic maps**

- A maps which gives the details of different features & are essential to understand merits & demerits of all different possible site of making structure.
- Also include valleys **(a long depression in the surface of the land that usually contains a river)** & gorge **(gori) (a narrow pass (especially one between mountains))** can be easily computed from maps.

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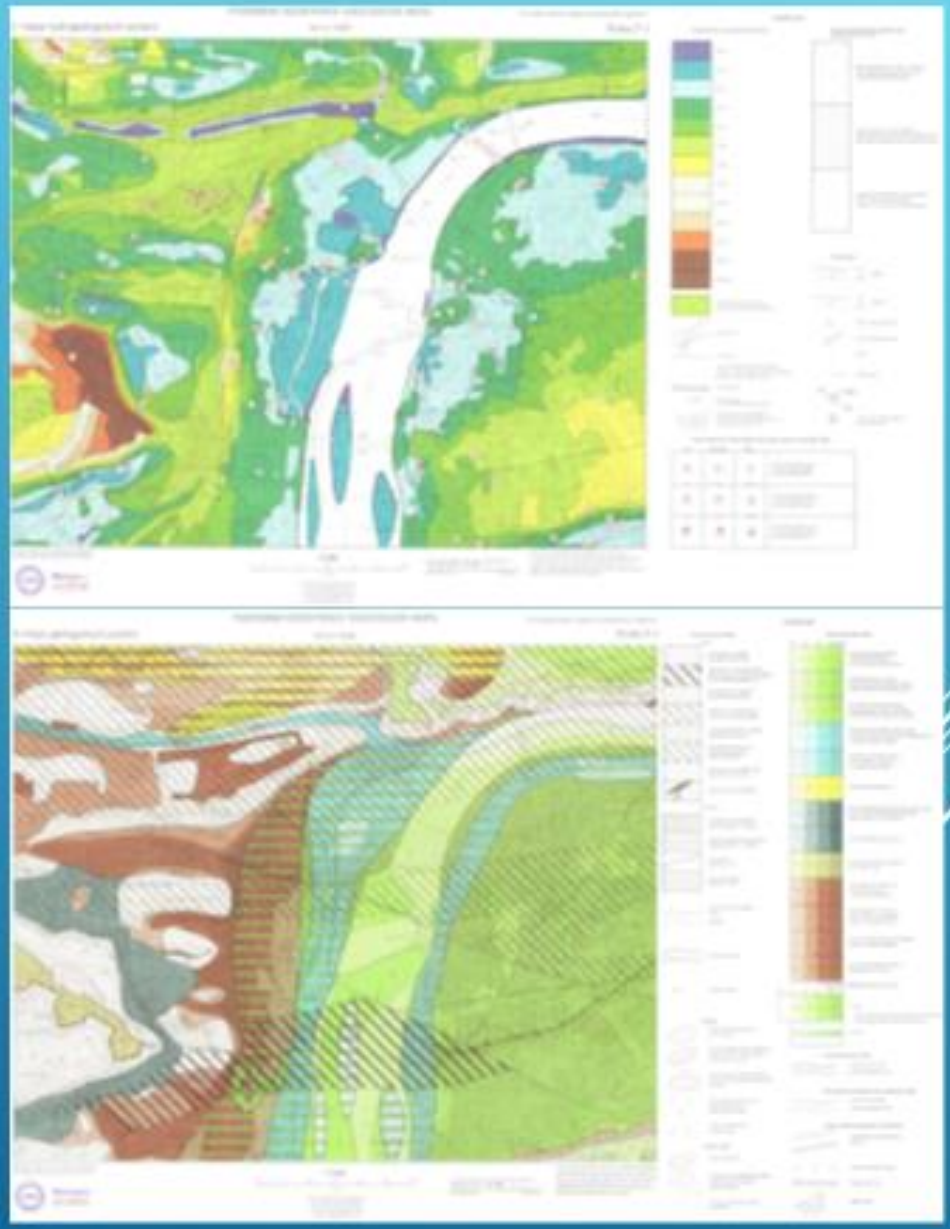
II. **Hydrological maps**

- Gives surface water & ground water & also with occurrence & depth of contours of water catchment area.

III. **Geological maps**

- Rock types.
- Fracturing & displacement of rocks.
- Availability of construction materials.



➢DESIGN

- Matter of designing an engineering project, the role of geological information is very important.

i) Existence of hard bed rocks & their depth from & inclination with the surface

ii) Mechanical properties along & across of site

- Compressive strength
- Shear strength
- Porosity & permeability
- Modulus of elasticity

iii. On earth surface plane of weakness

iv. Zone of weak material

v. Ground water table

vi. Seismic zone (earthquake zone)

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➢CONSTRUCTION

- Selection of right type of material, which should be nearer to construction site of rock bed.
- Knowledge of quality control of material comes from the knowing basic properties of materials.
- In seismic region structure should light weight, for that light weight material used.
- Large structure like dam, bridge, tunnel – must have knowledge geology.

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What does a geological engineer do?

1. Determines distribution of geological materials, structures and groundwater (X - ray picture)
2. Estimates or measures properties of materials
3. Provides a quantitative or qualitative assessment of geological processes
4. Uses all the above information to give advice regarding planning, design of projects and environmental management

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Basic Methods used by Engineering Geologist

1. Geological field mapping of geological structures, formations, soil units and hazards.
2. Review of Geological literatures, maps, Geotechnical reports, engineering plans, environmental reports, Arial photographic studies, remote sensing data, topographical map etc.
3. The surface and subsurface investigations as the excavation, sampling and logging of earth/rock materials in drilled borings, backhoe test pits and trenches, fault trenching, and bulldozer pits, Geomechanical test, hydrological tests etc.
4. Geophysical survey.
5. Deformation monitoring of soil (Plate load Test), Rock on surface & subsurface.
6. Recommendation for safety measures.

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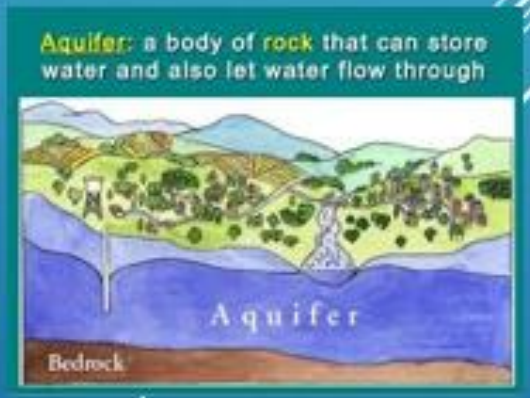
Geological Engineering: Other tasks:

1. Environmental studies
2. Groundwater exploration and development
3. Aquifer protection
4. Environmental cleanup
5. Exploration and evaluation of mineral resources
6. Mining production
7. Geophysical exploration



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Career in Engineering Geology

1. Infrastructure Projects as Hydro Power Plant,
2. Tunnels for railway/transport, Canal, Dam, reservoir, highways, bridges, buildings, water treatment plant, land use, environmental studies etc.
3. For Mine and Quarry excavations, mine reclamation.
4. For coastal engineering, sand replenishment, sea cliff stability, water front development.
5. For offshore drilling platform, sub sea pipeline and cables etc.

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GEOTECHNICAL ENGINEER

- Prepares and inspects projects involving drilling and exploration.
- Responsible for geological mapping, report writing, site characterization, numerical modeling and analysis of excavations/supports.

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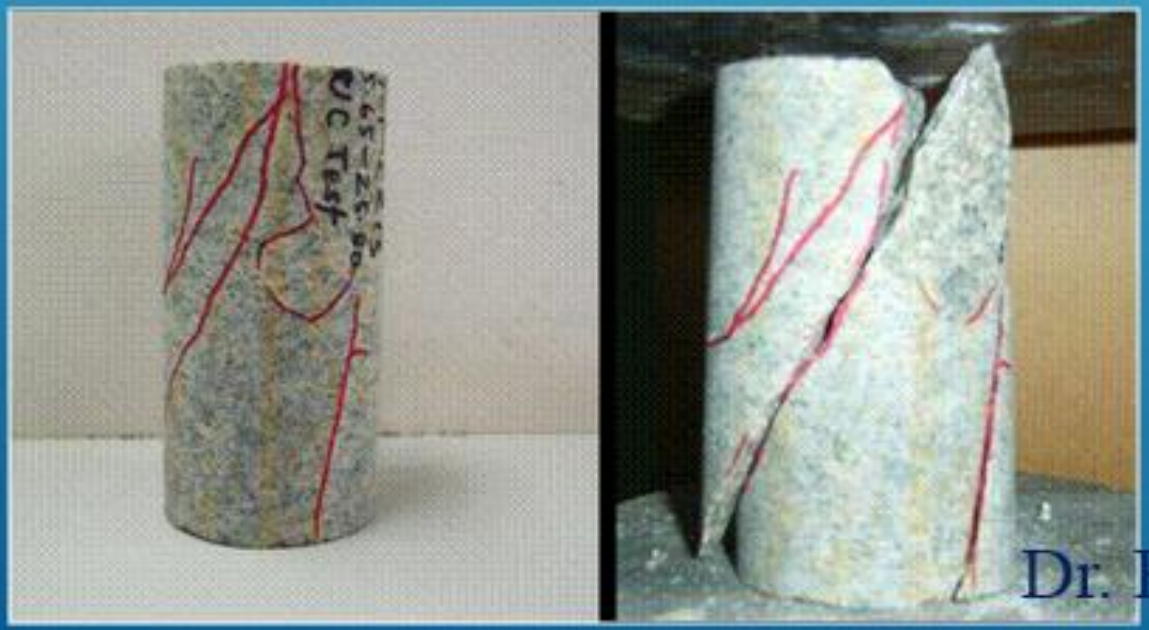

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WHAT IS GEOTECHNICAL ENGINEERING?

- Geo = earth
- Technical = having special knowledge
- What do Geotechnical Engineers do?
  - Evaluate soil properties to fully understand the below surface conditions of an area.
  - Design the foundations that structures will be built on.

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WHY DO WE NEED GEOTECHNICAL ENGINEERS?

- Questions Geotechnical Engineers answer:
  - How tall can we make a building on this ground?
  - What kind of foundation will be able to support this structure?
  - Can we build a road, bridge or dam here?
  - If we cut through this mountain, will the slopes collapse down onto the road?

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WHEN DO WE NEED GEOTECHNICAL ENGINEERS?

- In order to have a successful structure, you have to have a successful foundation.
- If the foundation fails then the structure will fail.
- Need to protect against differential settlement, rock slides (slope stability), flooding and many other types of failures.
- So to answer the question…Geotechnical Engineers are needed whenever there is construction!

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THANKS

1. Please visit the link
   https://www.youtube.com/watch?v=xLdTTv6TLq0
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   https://www.youtube.com/watch?v=aTVDiRtRook&list=PLDF5162B475DD915F

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