CE3121
SOIL MECHANICS

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Course content:

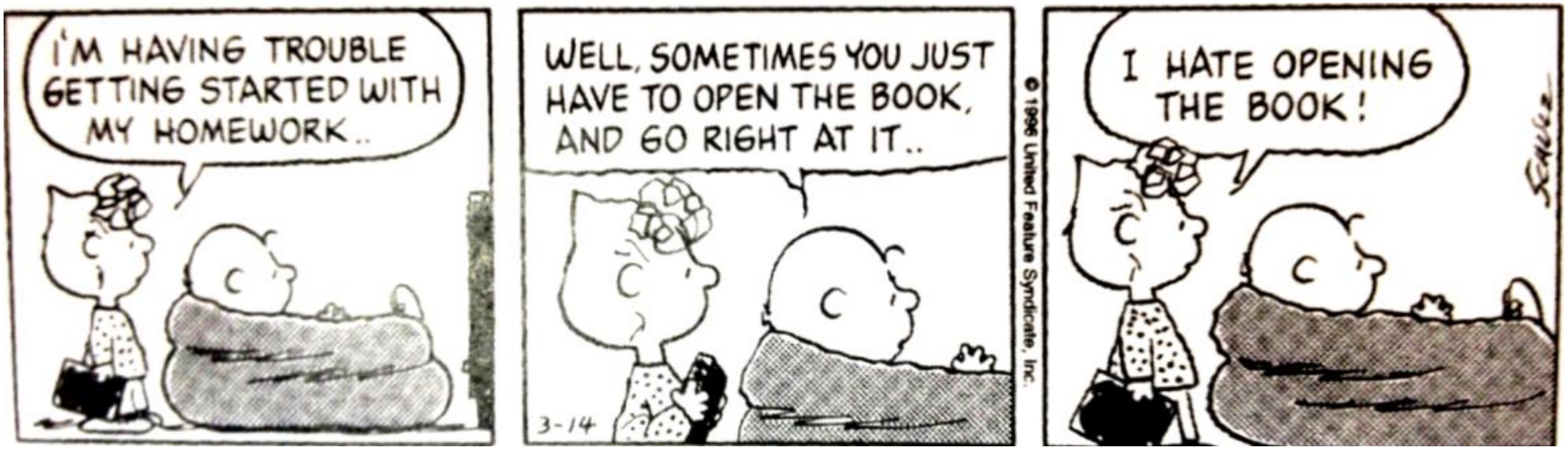
- Introduction to Soil Mechanics
- Index properties of Soils
- Classification of Soils
- Water flow in Soils
- Soil Stresses
- Compressibility of Soils
- Shear strengh of Soils
- Soil improvement- soil compaction

Course Materials:

- Class Notes (Take your own class notes)
- Principles of Geotechnical Engineering, Braja M. DAS

How to Be Sucessful In This Class

- Attend classes regularly (Tuesdays: 14.00-17.00 and Thursdays: 15.00-17.00)
- Take your own notes during the class (copy center notes are not recommended)
- Study and take a look at the course book (Reference book (Braja Das's book)
- Ask questions
- Attend the laboratory classes
- Do the homework assignments



- Homework Assignments :5

Midterm Exam: 1 (At the end of semester)

Make-up Exam: 1 (At the end of semester)

Final Exam: 1

Final Grade= %60 Midterm Exam+ %40 Final Exam

%80 Homerwork Grades+%20 Midterm Exam

Outcomes of the Soil Mechanics Class

- When you complete this class, you should be able to
- 1. Determine and evaluate the problems caused by soils (settlement computation, safety against boiling in excavations,
- 2. Evaluate and interpret the results of laboratory tests to obtain the soil proporties needed for geotechnical applications

Week 1: Introduction to Soil Mechanics

- Soil is defined as the uncemented aggregate of mineral grains and decayed organic matter (solid particles) with liquid and gas in the empty spaces between the solid particles.
- Soil is used as a construction material in various civil engineering projects, and it supports structural foundations.

What is soil mechanics?

- Soil mechanics is the branch of science that deals with the study of the physical properties of soil and the behavior of soil masses subjected to various types of forces.
- Civil engineers must study the properties of soil, such as its origin, grain-size distribution, ability to drain water, compressibility, shear strength, and load-bearing capacity.

Introduction to Soil Mechanics

- Soil mechanics that can be considered as the branch of Civil Engineering that deals with soil, rock and underground water and their relationships each other.
- This scope is also called Soils Engineering or Geotechnical Engineering.
- All civil engineering projects must be supported by the ground. Therefore, every project needs Geotechnical Engineering knowledge.

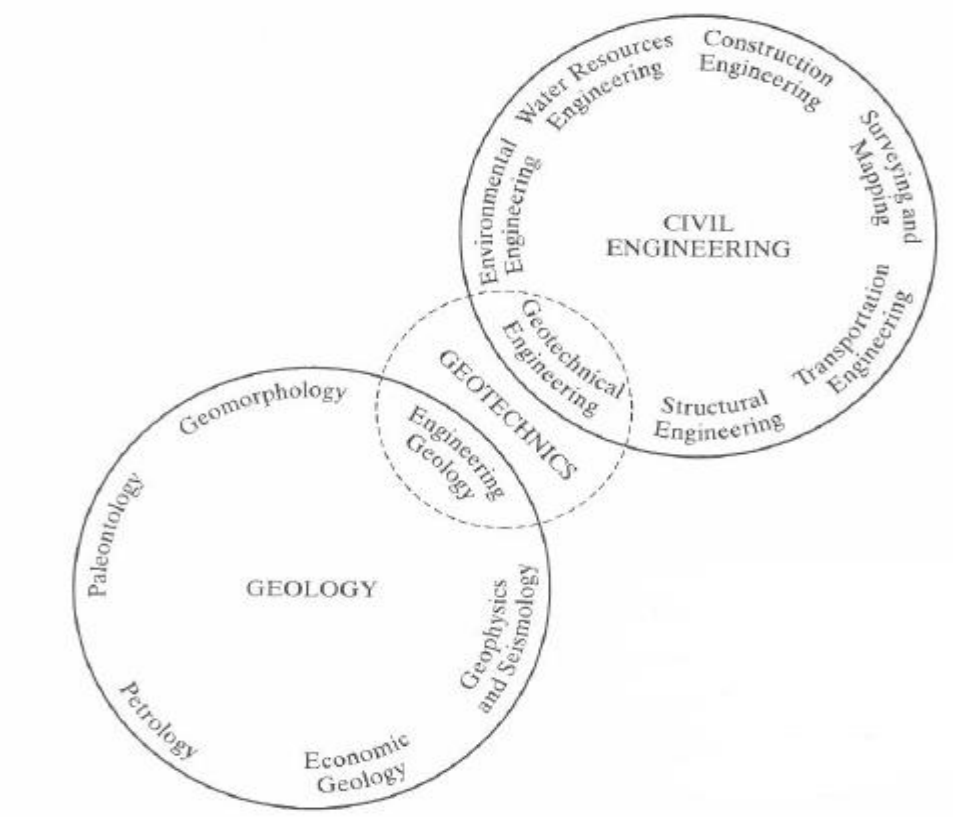
Important questions which need to be answered by Geotechnical Engineers

- Can soils and rocks under the construction site safely support the current project ?
- What are the ground water conditions, How may they change in future, How do they effect the project?
- What will be the impact of any planned excavation or filling for adjacent structures?
- Are the natural or proposed earth slopes stable? If not, what must we do to stabilize them?

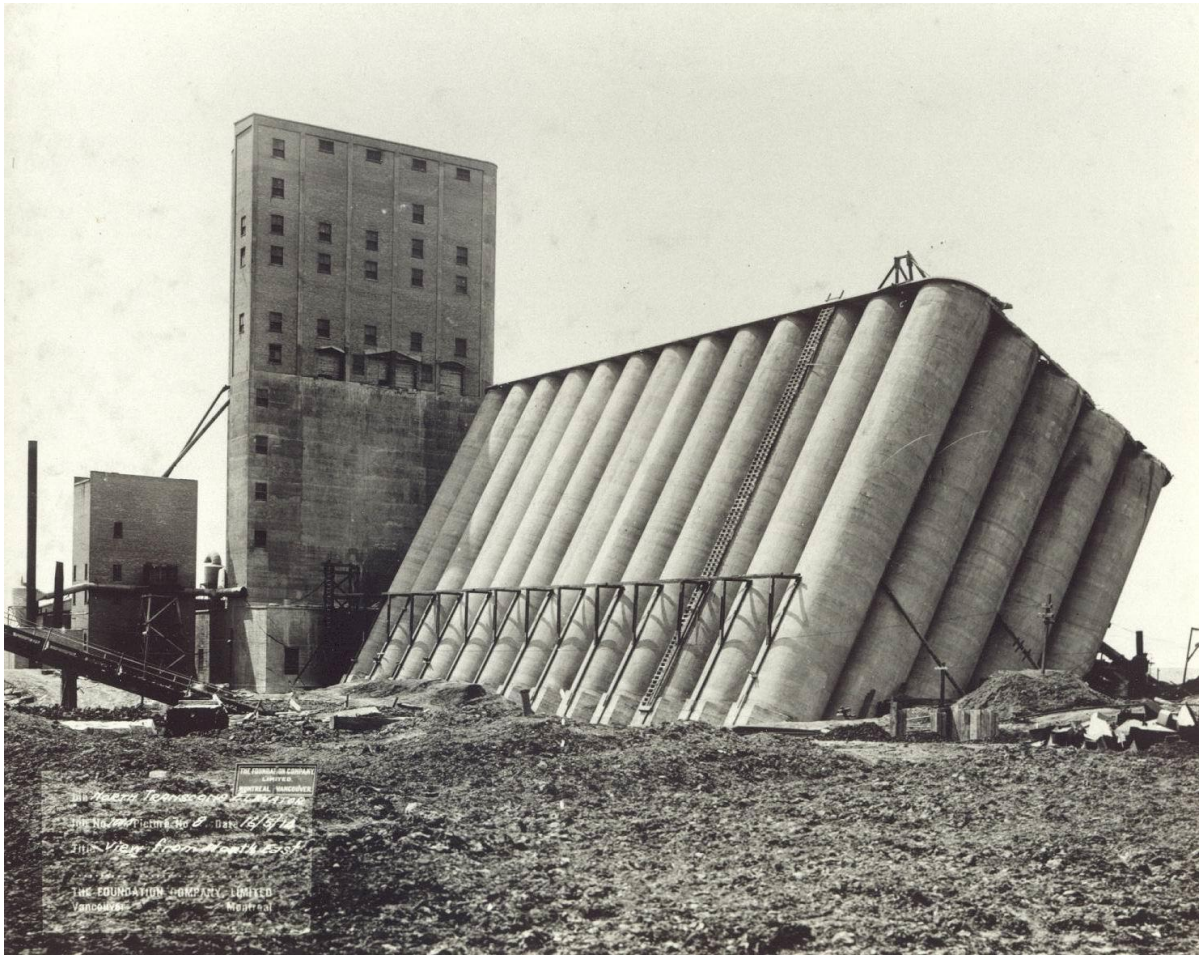
Important questions which need to be answered by Geotechnical Engineers

- What kind of foundations are necessary to suppot planned structures, how should we design them?
- If the project requires retaining walls, what kind would be best and how should we design them?
- How will the site respond to potential earthquakes?

- Geotechnical engineering is closely related to Engineering Geology, which is a branch of Geology.
- Generally, engineers from both area should work together. This combined effort is called «Geotechnics»



Transcosna Grain Elevator, Canada Oct. 18, 1913



73cm settlements took place underneath the West side foundation.

Transcosna Grain Elevator

One of the earliest failures that was investigated and contributed to our knowledge of soil behavior is the failure of the Transcona Grain Elevator in 1913.

Within 24 hours after loading the grain elevator at a rate of about 1 m of grain height per day, the bin house began to tilt and settle.

Fortunately, the structural damage was minimal and the bin house was later restored.

No borings were done to identify the soils and to obtain information on their strength. Rather, an open pit about 4 m deep was made for the foundations and a plate was loaded to determine the bearing strength of the soil.

The Transcona Grain Elevator was designed at a time when soil mechanics was not yet born.

One eyewitness (White, 1953) wrote:

"Soil Mechanics as a special science had hardly begun at that time. If as much had been known then as is now about the shear strength and behavior of soils, adequate borings would have been taken and tests made and these troubles would have been avoided. We owe more to the development of this science than is generally recognized."

Settlements& Tilting

Leaning Tower of Pisa, Italy

LandSlides-Slope Stability Problem

The building suffered a liquefaction-induced bearing capacity failure during the Izmit Earthquake in Turkey on August 17, 1999. (*Photograph from the Izmit Collection, EERC, University of California, Berkeley.*)

The building suffered a liquefaction-induced punching shear failure during the Izmit earthquake in Turkey on August 17, 1999. (*Photograph from the Izmit Collection, EERC, University of California, Berkeley.*)

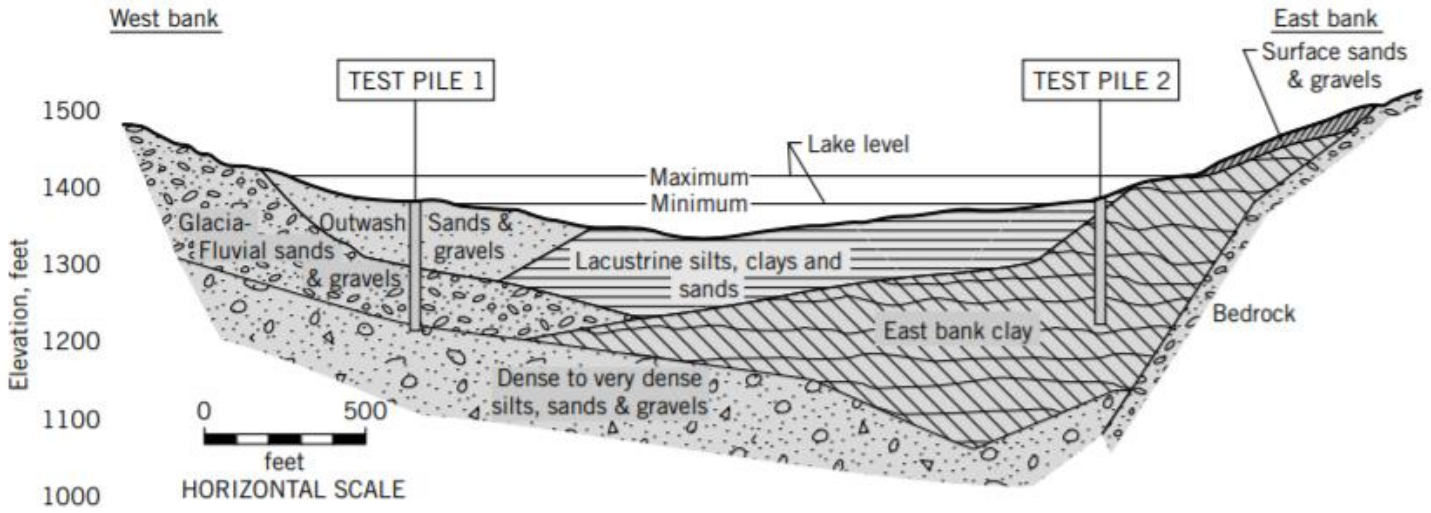
Failure Examples

General Shear Failure
Çinicioğlu, İMO Seminar 2005

GEOTECHNICAL ENGINEERING SOLUTIONS

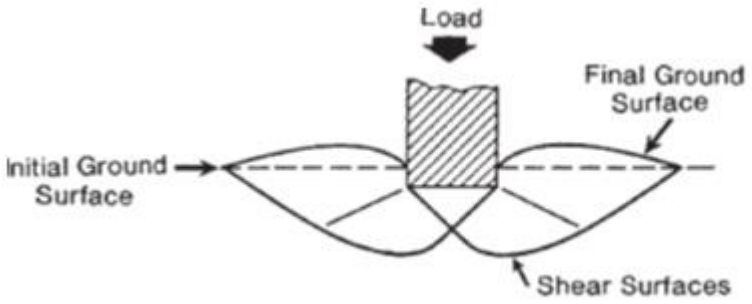
GEOLOGY, SITE EXPLORATION, ECONOMY, SAFETY	**ENGINEERING JUDGEMENT**

→ **GEOTECHNICAL SOLUTION**



Problems Encountered In Geotechnical Engineering /Soil Mechanics

- Bearing Capacity Problems(Foundations, footings)



- Slope Stability Problems(Man made slopes, Earth Dams, Landslides, Earth Fills, Excavation slopes)

Problems Encountered In Geotechnical Engineering /Soil Mechanics

- Groundwater Flow Problems
- Underground Structures (Tunnels, Metro subways, Underground storage tanks)

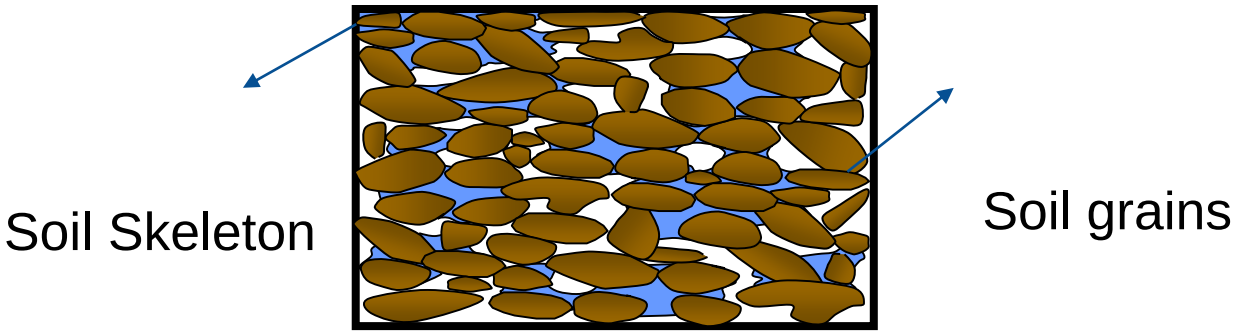
- The design of foundations of structures such as buildings, bridges, and dams generally requires a knowledge of such factors as
- (a) The load that will be transmitted by the superstructure to the foundation system
- (b) The requirements of the local building code
- (c) The behavior and stress-related deformability of soils that will support the foundation system
- (d) the geological conditions of the soil under consideration.
- To a Geotechnical Engineer, the last two factors are extremely important because they concern Soil Mechanics.

- The geotechnical properties of a soil such as its grain-size distribution, plasticity, compressibility, and shear strength—can be assessed by proper laboratory testing and in-situ field testing.

What is Soil?

Soils are formed from the physical and chemical weathering of rocks.

Common descriptive terms such as **gravels, sands, silts, and clays** are used to identify specifi c textures in soils



SAND

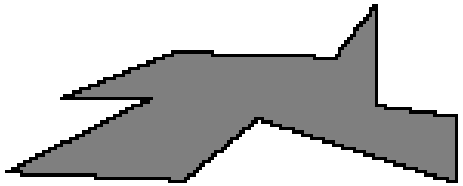
CLAY

SILT

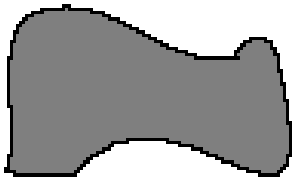
GRAVEL

GRAIN SHAPE

Coarse Grained Soils

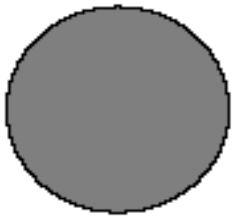


Angular



Semi-Angular

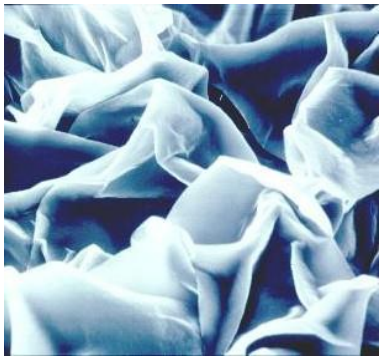
Semi
Spherical

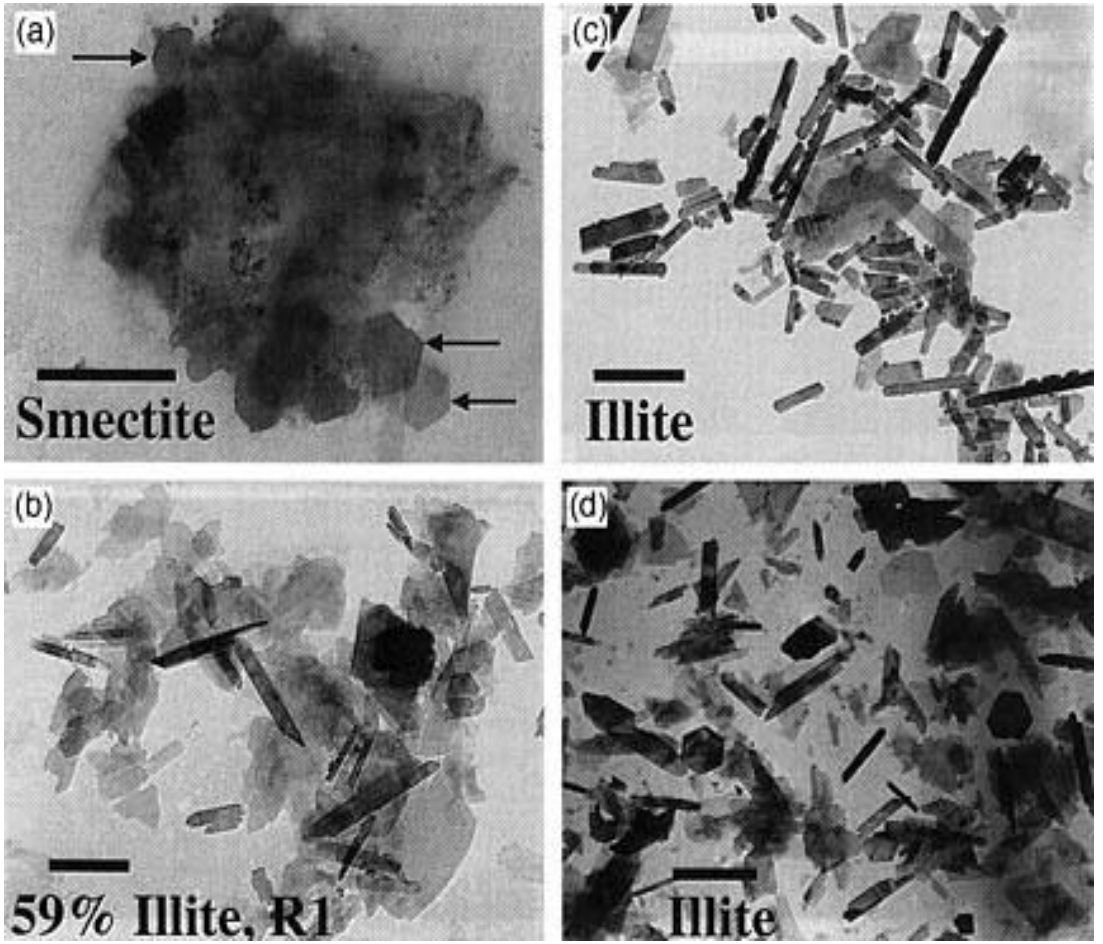


Spherical

Grain Shape

- Fine Grained Soils
  - Clays
    - Flakey Like





QUESTIONS TO GUIDE FOR THE NEXT CLASS

1. Why is geology important in geotechnical engineering?
2. What is engineering soil?
3. What is the composition of soils?
4. What are the main minerals in soils?
5. How is soil described?
6. What are the differences between coarse-grained and fine-grained soils?
7. What is a grading curve?
8. How do you determine the particle size distribution in soils?
9. How do you interpret a grading curve?