Department of Civil Engineering

College of Engineering

University of Salahaddin-Erbil

Subject: Soil Mechanics

Course Book – Spring Semester – Bologna System

Lecturer's Name: Dr. Ahmed Mohammed Hasan

(PhD in Soil Mechanics and Geotechnical Engineering)

Academic Year: 2022/2023

Course Book - Spring Semester

1. Course name	**Soil Mechanics**
2. Lecturer in charge	**Dr. Ahmed Mohammed Hasan**
3. Department/ College	**Civil / Engineering**
4. Contact	**e-mail: ahmed.hasan@su.edu.krd** **Tel: 07504630741**
5. Time (in hours) per week	**Theory: 4** **Practical: 1**
6. Office hours	**4 hour per week**
7. Course code	**CE303**
8. Teacher's academic profile	Dr. Ahmed M. Hasan is a lecturer in Civil Engineering Department - College of Engineering - Salahaddin University. Dr. Hasan received his Ph.D in Geotechnical Engineering from University of Glasgow, UK in 2016. He has published a number of papers. He was an Editor for a year in the Civil Engineering Department (2009-2010). Dr.Hasan is interested in researching on different topics such as expansive soils, small and large strain behaviour of saturated and unsaturated soils and soil anisotropy. He is a member of Kurdistan Engineer Union from 1997 and Institution of Civil Engineers ICE, UK from 2014. He has been a lecturer in different courses such as Foundation Engineering, Soil Mechanics, Computer programming and numerical methods C++, Civil drawing. In addition, He supervised several Engineering projects for undergraduate students.
9. Keywords	Soil classification, Soil compaction, Effective stress, cohesion, consolidation, shear strength

10. Course overview:

Soil mechanics is a branch of Engineering Mechanics that describes the behavior of soils. In soil mechanics, the various properties of the soils are studied. These properties will be used for various engineering construction works. There are various reasons (listed below) that as a civil Engineer one must study this rather new branch of the Engineering science.

Foundations:

All Civil Engineering structures ultimately rest on soils. They transfer their whole load to the soils; therefore properties of the soils have to be determined accordingly.

Earth Dams:

There are so many earth dams constructed to retain water. Soils to be used for construction of these earth dams must be suitable enough to be used in terms of various properties such as permeability, strength and density.

Retaining and under ground structures:

Retaining structures such as retaining walls, are constructed to retain lateral pressures from soils, water, surcharge etc…

It is important for Civil Engineers to have very good knowledge in terms of Soil Mechanics and Geotechnical Engineering, in order to have opportunity to get good jobs with local/international companies.

11. Course objective:

General Objectives are:

1. To learn students what are principles of soil Mechanics (Weathering, clay minerals, stress within soils, etc…) and how to find them.
2. How to apply these principles in the real life (Civil Engineering projects).

Some specific objectives are:

1. Teaching students how to classify soils according to popular standard systems such as Unified soil classification system.
2. Teaching students how to determine amount of rate of flow through and underneath earth structures (such as earth dam) and pore water pressure at any point of them.
3. Explaining the nature of soil problems faces Geotechnical and Civil Engineers.

12. Student's obligation

1. Attendance of students is required. Absence not exceed 10% throughout an academic year.
2. A group of student (3 students) has to prepare presentation slides on a specific top on the Soil Mechanics
3. Every two weeks, the knowledge of the students is tested by doing short quizzes.
4. Students solve problems linked to the theoretical part of this course.
5. Experimental tests on soils will be performed by students in the soil laboratory that are directly related to the theoretical part of the course. They are responsible to plot data, and deduce material properties from the plotted data.

13. Forms of teaching

In order to elegantly and actively transmit the knowledge to the students, various teaching ways and tools are applied including data show, power point slides, white board, touch screen laptop (to explain things on the slides efficiently), discussions, hand-outs, solving problems by student (tutorial) and lastly preparing and presenting related slides in classes.

14. Assessment scheme

The assessment will be on various different works and activities including class room activities, quizzes, homework, Mid-term exam and first semester final exam. The grading of theoretical part and practical part will be as below:

Theoretical Part	
- Mid-term exam	20 %
- Activities	12 %
- Assignment	8%
- Final exam	40%
Practical Part	
- Reports	7%
- Mid-term exam	3%
- final exam	10 %
- **Total Grade**	**100%**

15. Student learning outcome:

In this course students learn about the core concepts mentioned in item 11 above. They will be capable of recognizing types of soils and how these soils will be used in different kind of engineering projects such as highway, embankments and retaining walls.

16. Course Reading List and References:

- Key references:
  1. Craig s Soil Mechanics, 2014. R.F. Craig, 8 Edition
  2. Core Principles of Soil Mechanics, ICE textbooks, 2014. Sanjay K. Shukla.
  3. Soil Mechanics: Concepts and Applications, 2014. William Powrie, 3rd edition.
  4. Principals of Geotechnical Engineering, 2002. Braja M. Das, 5th edition.
- Useful references:
  1. Soil Mechanics, 1995. G. E. Barens.
  2. Soil Mechanics, 1979. T. W. Lambe and Robert V. Whitman.
  3. Soil Mechanics and Foundation Engineering, 2002. DR. K. R. Arora

4. Physical and Geotechnical Properties of Soils, 1984. Joseph E. Bowles.
5. An Introduction of Geotechnical Engineering, 1982. R. D. Holtz and W. D. Kovacs.
6. Problem Solving in Soil Mechanics, 2003. A. Aysen.
7. Solving problems in Soil Mechanics, 1986. B. H. C. Sutton.

17. The Topics:
Theoretical part

Lecturer's name

Soil Mechanics

Lecturer's name: Dr.Ahmed M. Hasan

Month	Week No.	Description
February	Week 1	Chapter 1: Basic characteristics of soils
	Week 2	Chapter 2: Soil description and classification
	Week 3	Chapter 2: Soil description and classification
	Week 4	Chapter 3: Soil phase relationships
March	Week 5	Chapter 4: Compaction of soils
	Week 6	Chapter 5: Permeability and seepage
	Week 7	Holiday
	Week 8	Chapter 6: Stress within a soil mass
April	Week 9	Mid-term exam
	Week 10	Chapter 7: Shear strength of soil
	Week 11	Chapter 8: Compressibility and consolidation of soil
	Week 12	Chapter 9: Slope stability
June	Week 13	Chapter 10: Lateral earth pressure
	Week 14	Chapter 11: Soil Investigations
	Week 15	
	Week 16	Final exam

Lecturer's name: Hawkar Hashim
ex: (1 hrs)

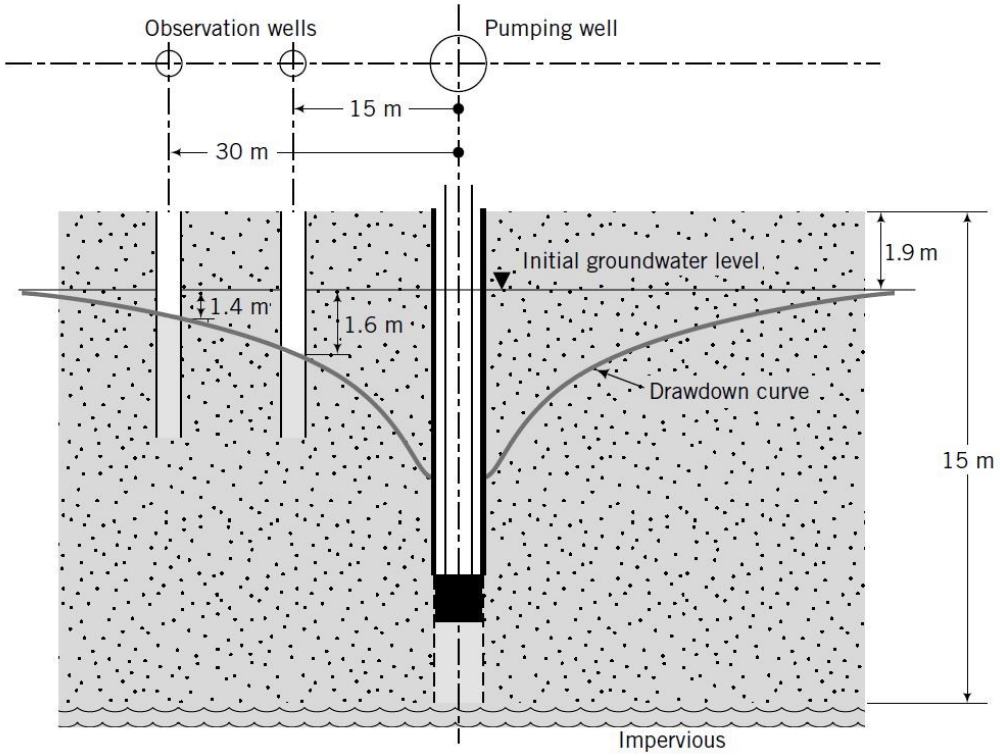
19. Examinations:

Problem 1:

A pumping test was carried out in a soil bed of thickness 15m and the following measurements were recorded. Rate of pumping was $10.6 \times 10^{-3} m^3/s$; drawdowns in observation wells located at 15m and 30m from the center of the pumping well were 1.6m and 1.4m, respectively, from the initial groundwater level. The initial groundwater level was located at 1.9m below ground level. Determine k.

Solution:

Step 1: Draw a sketch of the pump test with the appropriate dimensions (see Figure below).



Step 2: Substitute given values in Equation (3.13) to find k.

$$r_2 = 30 \text{ m}, \quad r_1 = 15 \text{ m}, \quad h_2 = 15 - (1.9 + 1.4) = 11.7 \text{ m}$$

$$h_1 = 15 - (1.9 + 1.6) = 11.5 \text{ m}$$

$$k = \frac{q_z \ln (r_2/r_1)}{\pi(h_2^2 - h_1^2)} = \frac{10.6 \times 10^{-3} \ln (30/15)}{\pi(11.7^2 - 11.5^2)10^4} = 5.0 \times 10^{-2} \text{ cm/s}$$

Problem 2:

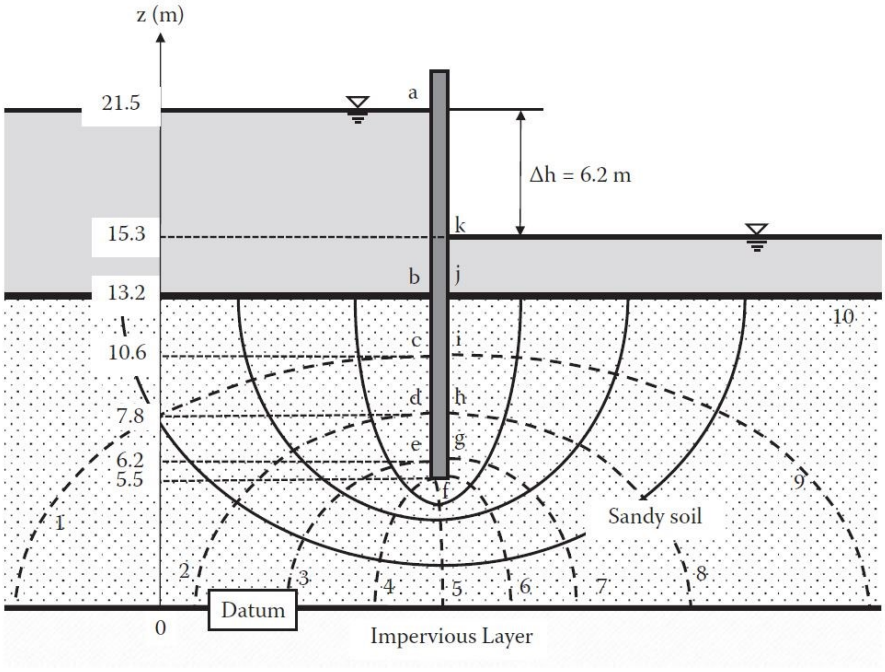
The figure below shows a completed flow net around a sheet pile. Points a, b, c, d, e, f, g, h, i, j and k are labelled along the sheet pile. Determination of water pressures at those points is required.

SOLUTION:

STEP 1: Calculate heads and water Pressure for the all points in Figure above.

Total head loss Δh = 6.2 m.

N_d = 10, so that head loss for one equipotential line drop $\Delta h_i = h/N_d = 6.2/10 = 0.62$ m.



Point	No. on Equipotential Line (i)	h_z (m)	h_t (m)	h_p (m)	u (kN/m²)
a		21.5	21.5	0	0
b	0	13.2	21.5	8.3	81.4
c	1	10.6	21.5 – 1 × 0.62 = 20.88	10.28	100.8
d	2	7.8	21.5 – 2 × 0.62 = 20.26	12.46	122.2
e	3	6.2	21.5 – 3 × 0.62 = 19.64	13.44	131.8
f	5	5.5	21.5 – 5 × 0.62 = 18.4	12.9	126.5
g	7	6.2	21.5 – 7 × 0.62 = 17.16	10.96	107.5
h	8	7.8	21.5 – 8 × 0.62 = 16.54	8.74	85.7
i	9	10.6	21.5 – 9 × 0.62 = 15.92	5.32	52.2
j	10	13.2	21.5 – 10 × 0.62 = 15.3	2.1	20.6
k		15.3	15.3	0	0
