Addis Ababa University
Addis Ababa Institute of Technology
School of Civil and Environmental Engineering

Fundamentals of Geotechnical Engineering III (CEng3143)
Fx-Examination Question Paper Set

Full Name			
ID No.		**Section**	
Signature		**Exam Date:**	**26.02.2020**

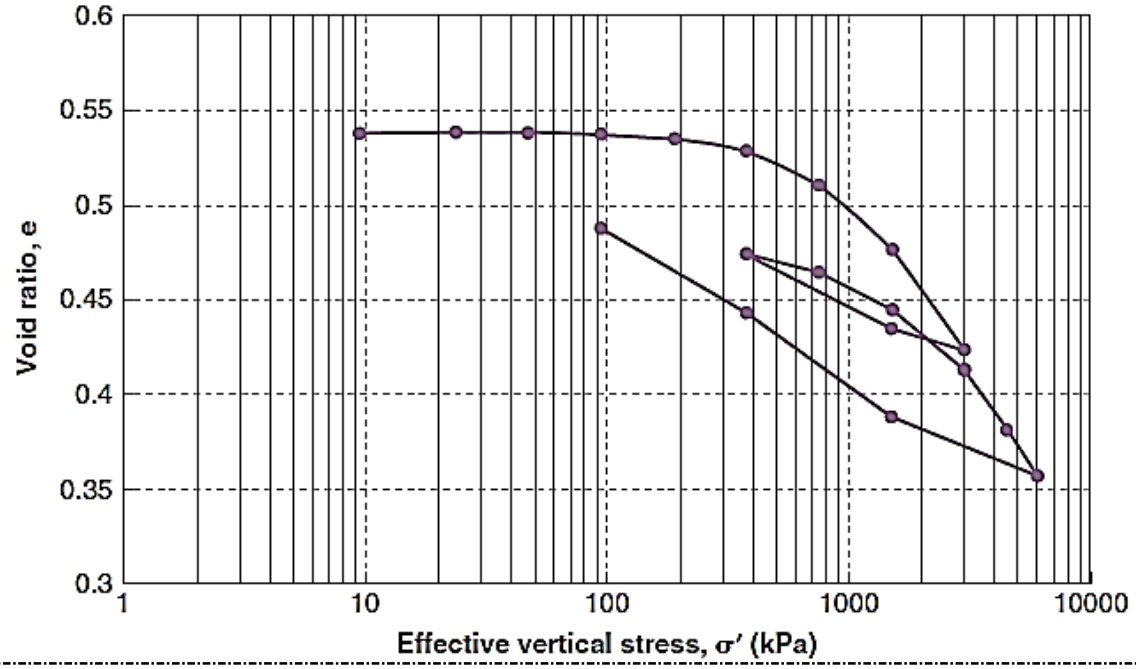
Instruction:

1) This examination is closed book and constitutes 100% of your final grade.
2) The time allowed for this exam is 2.5 hour.
3) Please read the questions carefully and make sure you understand the facts before you begin answering. Write as legibly and concisely as possible.
4) Use the provided space properly to present you answer in a neat manner.

Question #	**Weight** [marks]	**Score** [marks]
1	20	
2	20	
3	20	
4	20	
5	20	

QUESTION 1: Soil Compressibility & Settlement Analysis

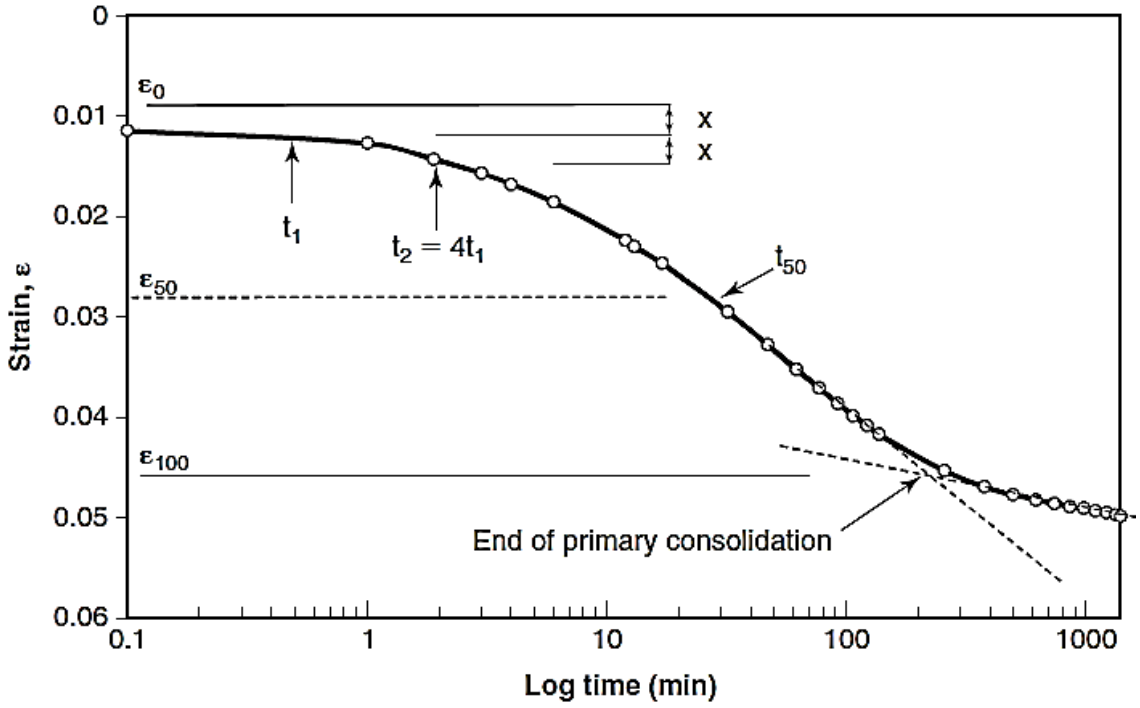
1.1 Given the log of vertical effective stress vs. vertical strain curve, find the pre-consolidation pressure σ_p and calculate the compression index *Cc*.



Pre-consolidation pressure

Compression Index

1.4 Given the strain versus time curve of Figure 14.6s, and knowing that the initial void ratio *eo* is 0.7, calculate the secondary compression index $C\alpha$.



QUESTION 2: Shear Strength of Soils

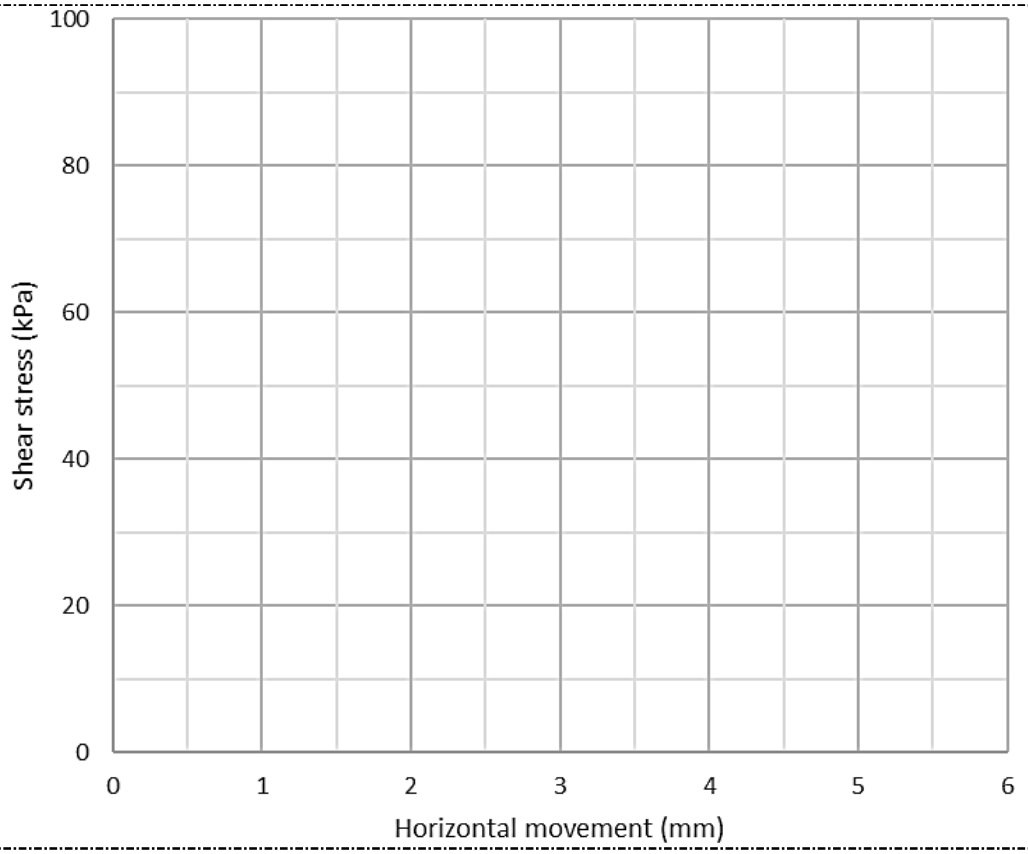
2.1 The result of the shear box test on clayey and is tabulated below.
Proving ring constant: $n = 0.0102$ kN/div
Area of sample: $A = 3600$ mm^2 $= 3.6 \times 20^{-3}$ m^2

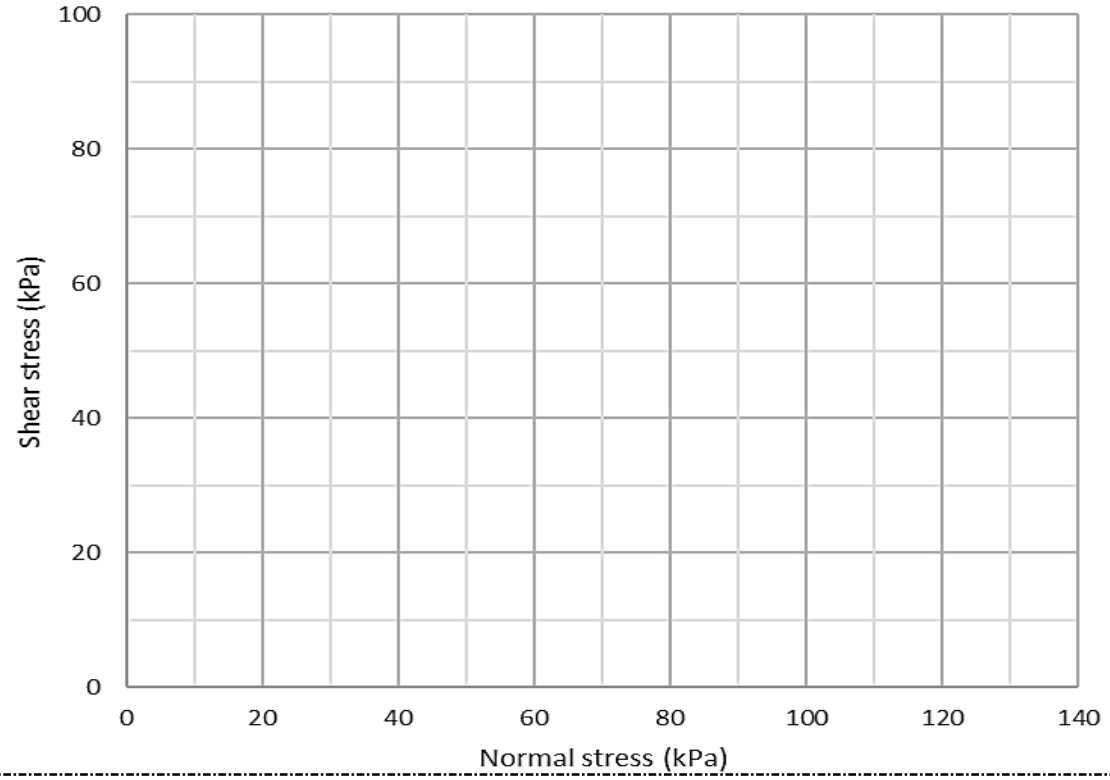
$$S = nD_1 \text{ and } \tau = \frac{S}{A}$$

		Sample A			Sample B			Sample C		
		$\sigma_n = 42$ kN/m²			$\sigma_n = 78$ kN/m²			$\sigma_n = 130$ kN/m²		
Time (Sec)	Dial (D_2) read-ings (mm)	Dial (D_1) (div)	Shear force S (kN)	Shear stress τ (kN/m²)	D_1 (div)	S (kN)	τ (kN/m²)	D_1 (div)	S (kN)	τ (kN/m²)
0	0	0	0	0	0	0	0	0	0	0
15	0.3	31.8	0.02	9	63.5	0.065	18.0	91.8	0.094	26.0
30	0.6	54.7	0.056	15.5	102.4	0.104	29.0	141.2	0.144	40.0
45	0.9	74.1	0.076	21.0	129.9	0.132	36.8	183.5	0.187	52.0
60	1.2	90.0	0.092	25.5	148.2	0.151	42.0	215.3	0.220	61.0
75	1.5	104.0	0.106	29.5	170.8	0.174	48.4	240.0	0.245	68.0
90	1.8	114.7	0.117	32.5	186.4	0.19	52.8	259.0	0.264	73.5
105	2.1	123.5	0.126	35.0	198.7	0.203	56.3	277.4	0.283	78.6
120	2.4	130.4	0.133	37.0	209.6	0.214	59.4	292.2	0.298	82.8
135	2.7	137.6	0.140	39.0	217.4	0.222	61.6	302.4	0.308	85.7
150	3.0	139.4	0.142	39.5	218.8	0.223	62.0	315.9	0.322	89.5
165	3.3	135.9	0.139	38.5	217.0	0.221	61.5	324.7	0.331	92.0
180	3.6	123.5	0.126	35.0	197.6	0.202	56.0	332.4	0.339	94.2
195	3.9							338.8	0.346	96.0
210	4.2							343.8	0.351	97.4
225	4.5							348.0	0.355	98.6
240	4.8							351.0	0.358	99.4
255	5.1							347.0	0.354	98.3
270	5.4							338.8	0.346	96.0

2.1 Plot horizontal movement against shear stress on the graph provided below and determine maximum shear stresses of the sample.

2.2 By plotting maximum shear stresses determined in 2.1 against their respective normal stress on graph provided below. Draw the failure envelope and determine the shear strength parameters.





Shear strength parameters:

c=

φ=

QUESTION 3: Lateral Earth Pressure

3.1 Show the pressure diagram, calculate the resultant push, and give its location for a 10m high wall due to:

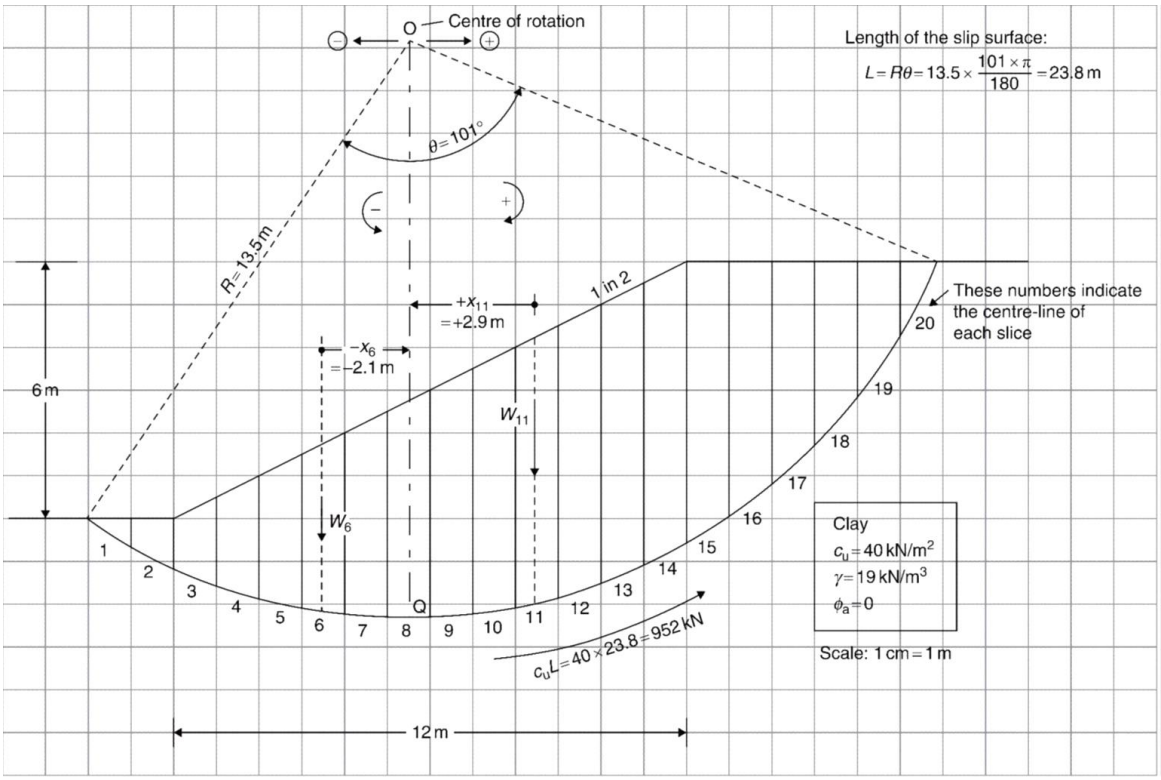
a. water only

b. dry soil with unit weight of 20 kN/m3 and friction angle of 30° (active and passive)

c. the same soil but with water at the top of the wall (active and passive)

QUESTION 4: Slope Stability

4.1 Calculate the factor of safety for soil slope shown and sliced as below.



QUESTION 5: Bearing Capacity

5.1 A 1.5 m wide strip footing is placed at a depth of 1.2 m, in uniform clay. The soil characteristics are: c= 50kN/m^2 ; φ=15° ; γ=17.7kN/m; γ_{sat}=19.8kN/m

Calculate the safe bearing capacity, when the water level is at:

i. 10 m below the foundation level

ii. 0.9 m below the foundation level

iii. 0.5 m below the ground level

iv. 0.8 m above the ground level due to flooding

PS. For φ=15°: Nc= 13, Nq= 4.5, N_γ= 2.1