MACHAKOS UNIVERSITY

University Examinations for 2021/2022 Academic Year

SCHOOL OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF BUILDING AND CIVIL ENGINEERING

FOURTH YEAR FIRST SEMESTER EXAMINATION FOR

BACHELOR OF SCIENCE (CIVIL ENGINEERING)

ECV 403: FOUNDATION ENGINEERING I

DATE: 22/8/2022 **TIME: 11.00-1.00 PM**

INSTRUCTIONS:

- *This paper comprises of four questions. Answer **two** questions*
- *Question one is **compulsory** and carry 30 marks*
- *Answer any other **one** questions*

Necessary tables and charts are provided in the appendix at the end of the questions

QUESTION ONE (COMPULSORY) (30 MARKS)

a) With aid of well labelled sketches differentiate between:

i. Active lateral earth pressure and passive lateral earth pressure (4 marks)

ii. Deep foundation and shallow foundation (4 marks)

b) With aid of appropriate sketches and the Mohr circle, derive an expression of the lateral active earth pressure acting on a smooth vertical wall and as a function of the internal angle of friction of the soil and the vertical stress. Assume that the soil is homogeneous and semi-infinite, the soil is dry and cohesionless, the ground surface is horizontal, and the soil is in a state of plastic equilibrium (that is, at the verge of failure) (6 marks)

c) From first principles, derive Terzaghi's theory of consolidation. (8 marks)

d) Explain five conditions where use of pile foundations is necessary. (5 marks)

e) State the limitations of the plate load test (3 marks)

SECTION B: Answer ANY TWO questions (*40 Marks*)

QUESTION TWO (20 MARKS)

A vertical wall was erected to retain soil as shown in Figure Q1.

a) Calculate and plot the pressure diagrams on both sides of the wall (16 marks)

b) Calculate the total active and passive thrusts on the wall and their points of action (4 marks)

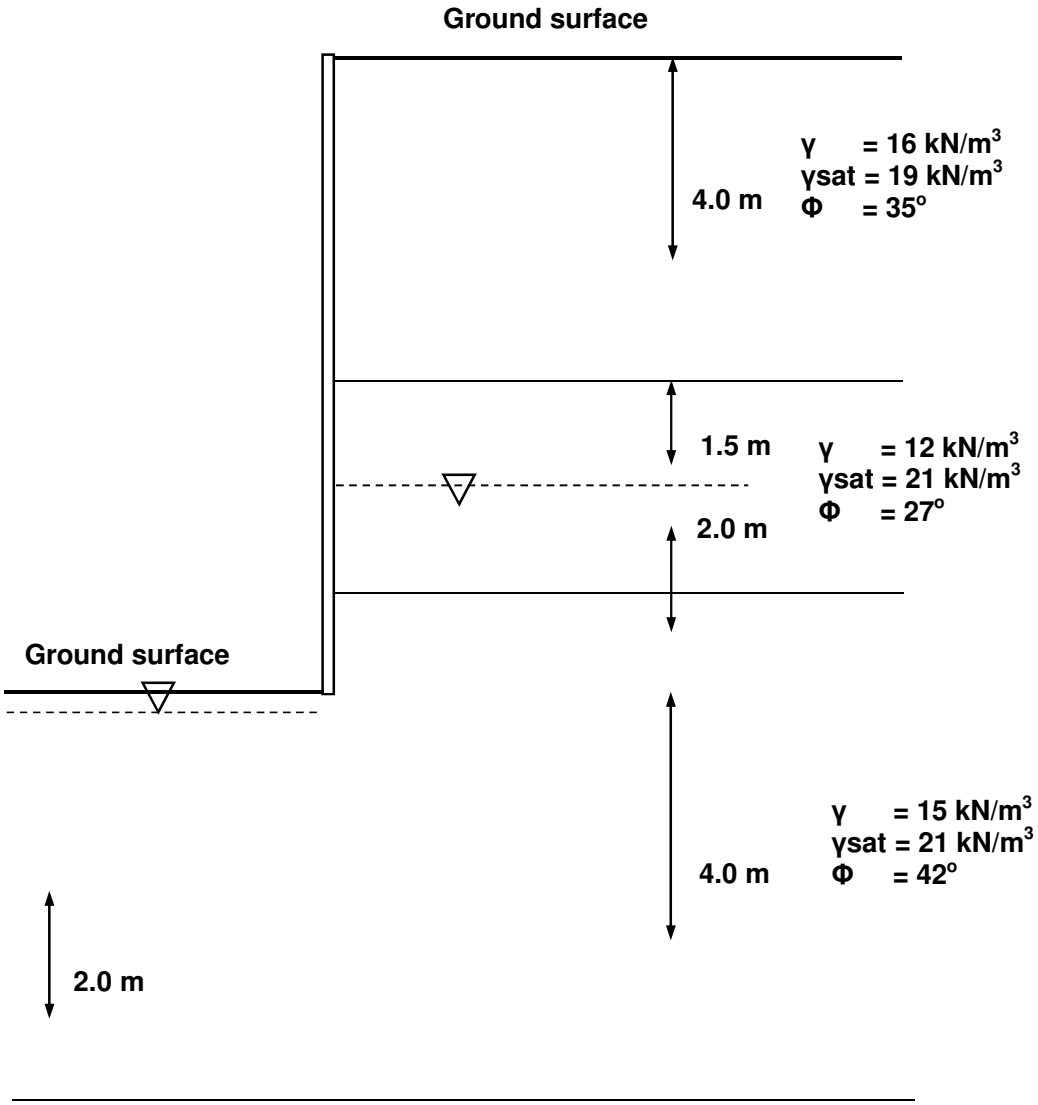

Figure Q2

QUESTION THREE (20 MARKS)

Consider a square footing foundation of 2m x 2m plan at depth of 2m in a sand deposit, as shown in the Figure Q3 below.

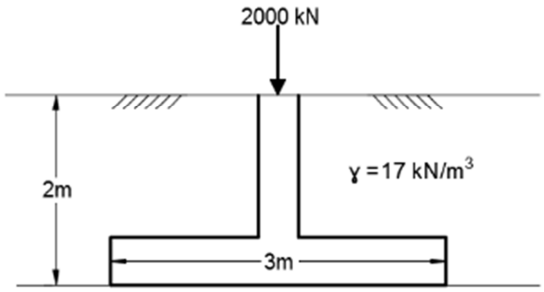

Figure Q3

Calculate the elastic settlement of the footing after 6 years of construction using strain influence factor method given the cone penetration test values in the table Q3. (10 marks)

Table Q3

Depth below ground surface (m)	0 – 2	2 – 4	4 -6	6 – 8
q_c (kN/m^2)	8000	10000	9000	8500

Calculate the net allowable bearing capacity, If the corrected standard penetration number = 10 and the allowable settlement is 25.4mm. (10 marks)

QUESTION FOUR (20 MARKS)

The following results were recorded during an oedometer test when applied stress was increased from 100 kPa to 200 kPa.

Elapsed time (min)	0	0.04	0.25	0.5	1.0	2.25	4.0	6.25
Thickness of specimen (mm)	18.98	18.91	18.81	18.75	18.67	18.52	18.40	18.27

Elapsed time (min)	9.0	12.25	16.0	25.0	36.0	64.0	100.0
Thickness of specimen (mm)	18.14	18.05	17.98	17.90	17.85	17.79	17.76

After 24 hours the thickness was 17.58 mm. Using the root-time method, determine

i. The coefficient of consolidation, and (16 marks)

ii. The initial and primary compression ratios, for the stress stage. (4 marks)

QUESTION FIVE (20 MARKS)

A 30 cm diameter pile of length 12 m was subjected to a pile load test and the following results were obtained. Determine the allowable load, if allowable settlement is 10% pile diameter.

Load (kN)	0	500	1000	1500	2000	2500
Settlement (mm)	0	0.5	1.1	1.9	3.2	7.1