MACHAKOS UNIVERSITY

University Examinations for 2022/2023

SCHOOL OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF BUILDING AND CIVIL ENGINEERING

FOURTH YEAR FIRST SEMESTER EXAMINATION

BACHELOR OF SCIENCE (CIVIL ENGINEERING)

ECV 411 FOUNDATION ENGINEERING II

DATE: **TIME:**

INSTRUCTIONS

Answer Question One and Any Other Two Questions

QUESTION ONE (COMPULSORY) (30 MARKS)

a) Discuss any three soil factors that should be considered in then design of a retaining wall (6 marks)

b) Discuss any three factors that should be considered when determining the depth of footings. (6 marks)

c) With aid of well labelled sketches, describe the following types of shallow foundations:
   i) Cantilever footing (3 marks)
   ii) Raft foundation (3 marks)

d) With aid of sketches, describe the following types of coffer dams:
   i) Earth (2 marks)
   ii) Braced (2 marks)

e) Describe any four categories of piles based on their use (8 marks)

SECTION B (ATTEMPT ANY TWO QUESTIONS)

QUESTION TWO (20 MARKS)

Details of a reinforced concrete cantilever retaining wall are as shown in Figure Q2. The back of the wall is vertical and its face is inclined. Due to inadequate drainage the water table has risen to the level indicated. Above the water table the unit weight of the retained soil is 18 kN/m^3, and below the water table the saturated unit weight is 20 kN/m^3. Characteristic values of the shear strength parameters of the retained soil are: cohesion is 0 and internal angle of friction is 34^o. The angle of friction between the base of the wall and the foundation soil is 25^o. The unit weight of concrete is 24 kN/m^3.

(i) Check the stability of the wall against sliding, overturning and bearing capacity failure (15 marks)

(ii) Discuss any two ways of improving the stability of the wall? (5 marks)

Notes: (1) Use Rankine's theory

(2) Minimum factor of safety against sliding is 1.5

(3) Minimum factor of safety against overturning is 2.0

(4) Minimum factor of safety against bearing capacity failure is 3.0

(5) All dimensions are in metres

(6) Bearing capacity of the soil is 500 kN/m^2

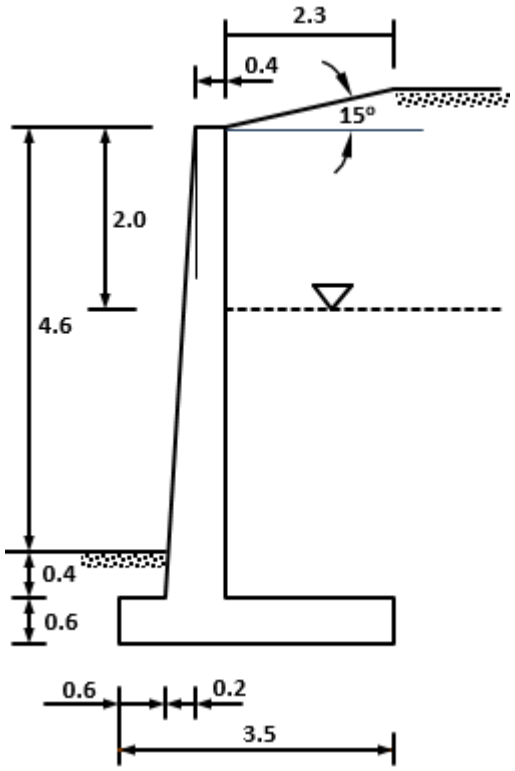

Figure Q1

QUESTION THREE (20 MARKS)

a) For the anchored sheet pile shown in Figure Q3(a), assume fixed end conditions and determine: -

i) the embedment depth d (7 marks)

ii) the force in the anchor per metre run (3 marks)

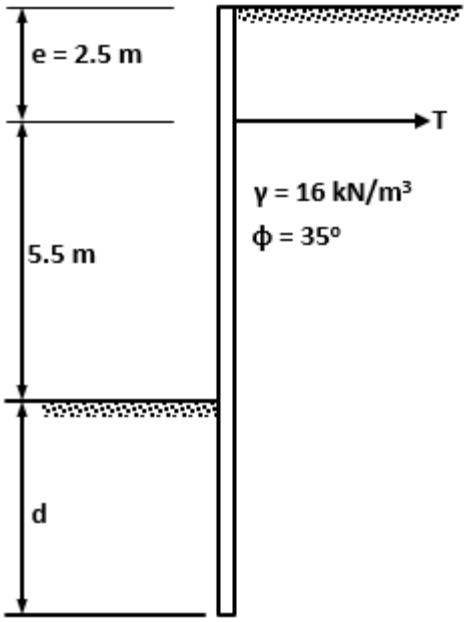

Figure Q3(a)

b) Design a circular cellular coffer dam of total height 15 m resting on rock as shown in Figure Q3(b). Take allowable interlock tension of 1500 kN/m, $\varphi = 30^o$, $\delta = 25^o$, K = 0.6, f = 0.30, $\gamma_w = 10$ kN/m^3, $\gamma = 19$ kN/m^3, saturated unit weight of soil is 29 kN/m^3.

(10 marks)

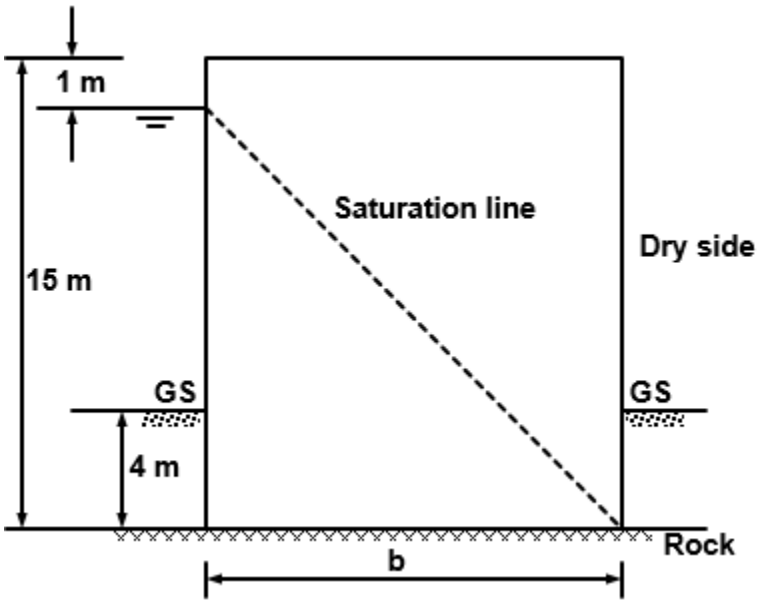

Figure Q3(b)

QUESTION FOUR (20 MARKS)

a) Design a combined footing for the two columns shown in Figure Q4. Take allowable soil pressure as 150 kN/m^2. Columns are of square cross-section of 0.5 m by 0.5 m. Sketch the pressure distribution underneath the foundation and the shear force and bending moment diagrams along the centre-line.

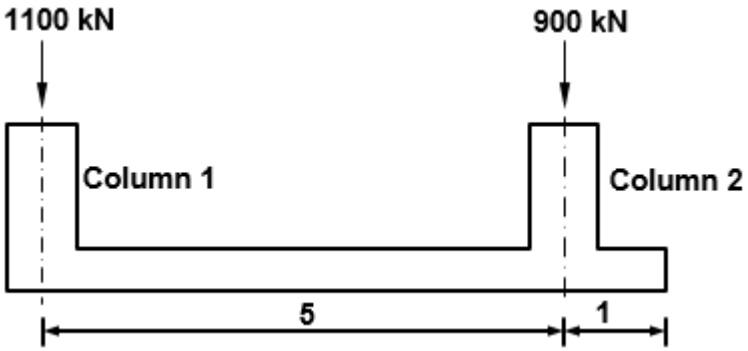

Figure Q4A

QUESTION FIVE (20 MARKS)

A 30 cm diameter pile of length 12 m was subjected to a pile load test and the results obtained are as shown in Table Q5

Table Q5

Load (kN)	0	500	1000	1500	2000	2500
Settlement during loading (cm)	0	0.85	1.65	2.55	3.8	6.0
Settlement during unloading (cm)	4.0	4.6	5.2	5.5	5.8	6.0

Determine the allowable load