MACHAKOS UNIVERSITY

University Examinations for 2019/2020Academic Year

SCHOOL OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF BUILDING AND CIVIL ENGINEERING

FOURTH YEAR SECOND SEMESTER EXAMINATION FOR

BACHELOR OF SCIENCE IN CIVIL ENGINEERING

ECV 411: FOUNDATION ENGINEERING II

DATE: 9/11/2020 **TIME: 8.30-10.30 AM**

INSTRUCTIONS

a) This question paper has **FOUR** questions

b) Answer question **ONE** and any other **TWO** questions

c) Show all your workings clearly on answer booklet

d) State any assumptions used

QUESTION ONE (30 MARKS) - COMPULSORY

a) Define cofferdam and state **THREE** design considerations. (4 marks)

b) The end column along a property line is connected to an interior column by a trapezoidal footing. The following data are given: Column Loads: *Q1* = 2016 kN, *Q2* = 1560 kN. Size of columns: 0.46 x 0.46 m. Columns are 5.48m apart c/c and $q_{all\ net}$ = 190 kPa. Design a suitable size of the footing so that it does not extend beyond the face of the columns. (5 marks)

c) A group of 12 piles with 4 piles in a row was driven into a soft clay extending from ground level to a depth of 12 meters and the piles were placed 120 cm center to center. Find the allowable bearing capacity of a single pile in the group of piles given: (Diameter=0.4m, Cu=50kPa, γ=18kN/m^3, adhesion factor = 0.6 and Nc = 9 and use F.S. =2.5). (7 marks)

d) Check the stability of a cantilever retaining wall of smooth vertical back of 6 m height and 0.2 m thick at the top and 0.3 m at the bottom of the stem. Foundation base of retaining wall of depth 0.6 m projected on the left side as 0.5 m and 2 m on right side. It supports sandy backfill with unit weight of 18 kN/m^3 levelled to the top of the wall. The angle of internal

friction of soil is 34^0 while the friction angle between the material of the base of the wall and the soil is 24.23^0. (9 marks)

e) Using a well labelled sketch, state the different components of pneumatic caisson and explain what a caisson disease is? (5 marks)

QUESTION TWO (20 MARKS)

a) Determine the outside dimensions, internal dimensions and thickness of wall of a cylindrical open caisson to be sunk through 35 m of sand and water to bed rock if the allowable bearing pressure is 2000 N/m^2. The caisson has to support a load of 60 MN from the superstructure. Assuming that the external diameter is two and half times the internal diameter, test the feasibility of sinking if the skin friction is 40 kN/m^2. Also calculate the necessary thickness of the seal and check for perimeter shear. Assume γ_c = 24 kN/m^3, γ_w = 9.81 kN/m^3, σ_c = 3000 kN/m^2 and allowable perimeter shear stress = 650 kN/m^2. (12 marks)

b) Define depth of footing and explain the factors that must be taken into consideration when determining/fixing the depth of footing. (4 marks)

c) Write whether the following statements are T**rue or False**: (4 marks)

i. The drilled piers can be of diameter less than 0.5 m.

ii. A pneumatic caisson is open at the top.

iii. The value of N_q for drilled piers is generally smaller than that for piles.

iv. The angle that the inclined walls of the belled pier make with the horizontal is usually 45^0

v. The construction of drilled piers generally requires lighter equipment than that for pile driving.

vi. The angle of the cutting edge of the caisson with the vertical should not be greater than 35^0

vii. The air pressure in the air lock of a pneumatic caisson is usually limited to 600 kN/m^2.

viii. For a floating caisson the metacentric height must be positive.

QUESTION THREE (20 MARKS)

a) Define group efficiency of pile giving the relevant equations and explain how the selection of pile is carried out? (4 marks)

b) State four factors considered in selection of type of cofferdams. (2 marks)

c) A mat foundation is to be designed by the conventional method for the loadings shown below. All columns are 0.5x0.5m and ultimate soil bearing pressure, q_{ult} = 100kPa. Check the soil pressures in the four corners of the raft. Also calculate the depth of embedment of the fully compensated foundation if the unit weight of soil is 15kN/m^2. (14 marks)

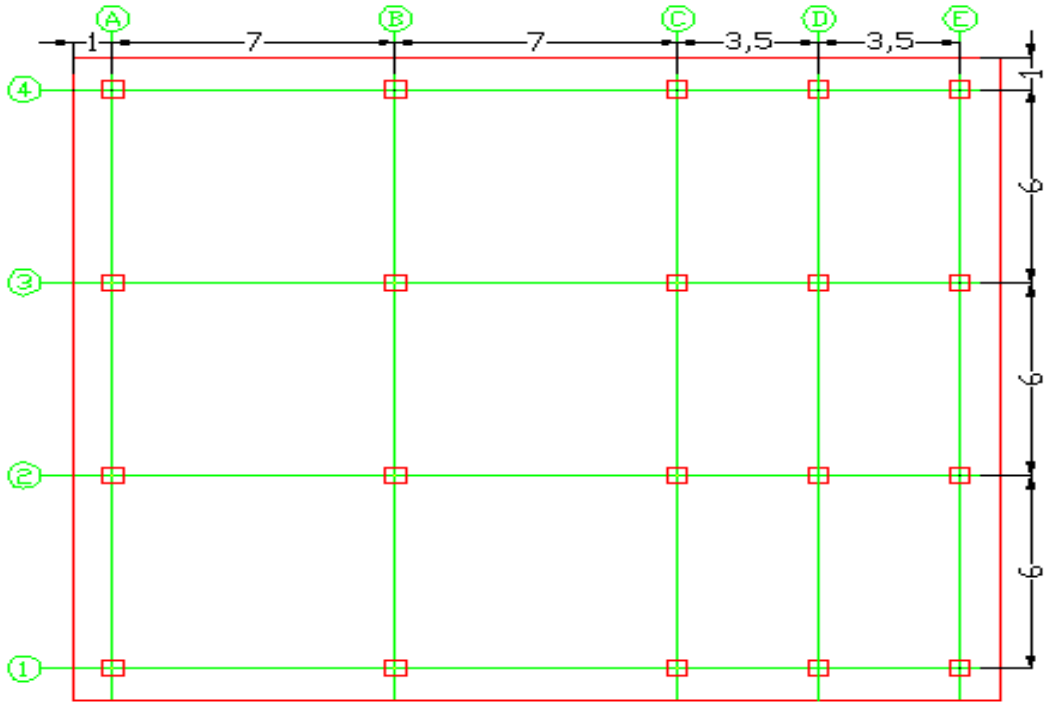

Figure Q 3(c)

Column no.	Columns Location (Grids intersection)	DL (kN)	LL (kN)	Total service load (kN)	Total factored load (kN)
C1	A-4, A-1, E-4, E-1	765	630	1395	1926
C2	B-4, B-1, C-4, C-1	1190	980	2170	2996
C3	A-3, A-2, E-3, E-2	1148	945	2093	2889
C4	B-3, B-2, C-3, C-2	1785	1470	3255	4494
C5	D-4	500	300	800	1080
C6	D-3	450	250	700	940
C7	D-2	400	200	600	800
C8	D-1	350	150	500	660

Table Q3(c)

QUESTION FOUR (20 MARKS)

a) Determine the group efficiency of a pile group in square form consists of 16 piles of each 20 m long, its diameter and c/c spacing in both directions being 1.0 m which are embedded on a clay deposit having cohesive strength of 35 kN/m^2. Take adhesion factor as 0.6 and Nc = 9. (11 marks)

b) A footing was designed based on ultimate bearing capacity arrived for the condition of water table at the ground surface. If there is a chance for raise in water level much above the ground level do you expect any change in the bearing capacity, why? (2 marks)

c) State the circumstances under which it is advantageous to adopt caisson/well foundation than to provide piled foundation. (2 marks)

d) Design a strap footing to support two columns, spaced 8.0m c/c. Exterior column is 80cm x 80cm carrying 1500 KN and interior column is 80cm x 80cm carrying 2500KN. Assume L1 = 2m and the $q_{all\ net}$ = 200 KN/m^2. (5 marks)

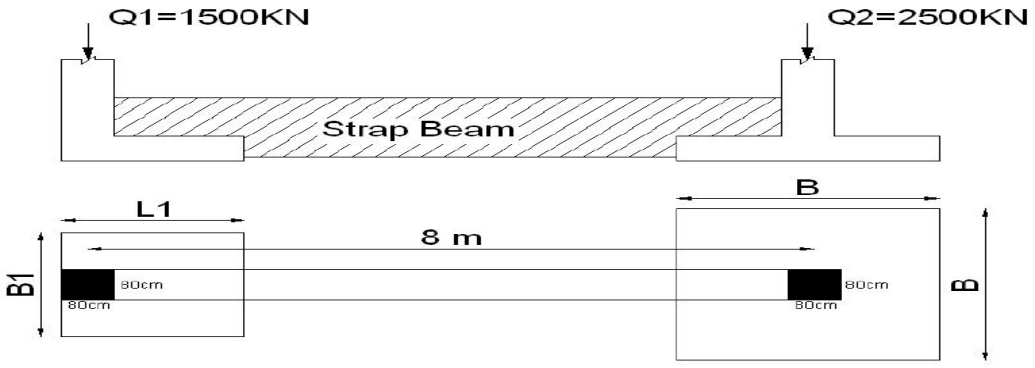

Figure Q 4(d)