Ref. No. : Ex/CE/PC/B/T/412/2024(S)

B.E. CIVIL ENGINEERING FOURTH YEAR FIRST SEMESTER SUPPLE EXAM – 2024

SUBJECT: GEOTECHNICAL ENGINEERING III

Time: 3 HOURS Full Marks : 100

(50 Marks for each Part)

Use separate answer script for each Part

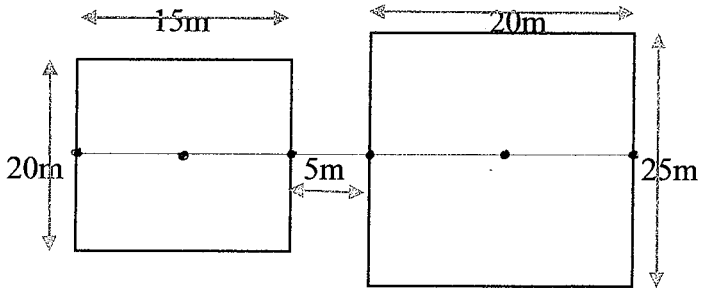
PART I (50 MARKS)

Assume reasonable values of data not supplied

1. CO1

Draw a Newmark's chart used for determining vertical stresses below a loaded area. Show all relevant calculations

Using this Newmark's chart determine the vertical stresses at a depth of 7.5m and 17.5m below the centre and both the edges (inner and outer)-as mkd., of two closely spaced raft foundation of sizes 15m x 20m and 20m x 25m resting 2m below existing ground level. Clear spacing between the inner edges of the rafts is 5m. Take average foundation pressure for both the raft = 8 t/m^2. 8+12=20



2. CO3

Using the above stresses determine the consolidation settlement below the centre and both the edges of the rafts for the subsoil data given below. Take ground water table 2m below ground surface. 10

Stratum I: Soft / firm brownish grey silty clay / clayey silt of thickness 2.0m with undrained cohesion Cu = 35kPa, γ_{sat}=18.5kN/m^3, Cc'/1+e0 = 0.04, p_c= 70 kN/m^2, Cc/1+e0 = 0.14.

Stratum II: Soft dark grey / grey silty clay / clayey silt with decomposed wood of thickness 15.0m with undrained cohesion Cu = 25kPa, γ_{sat}=17kN/m^3, Cc/1+e0 = 0.14.

Stratum III: Stiff bluish grey / mottled brown silty clay / clayey silt with undrained cohesion Cu = 75kPa, γ_{sat}=19kN/m^3, Cc/1+e0=0.07 down to 22.0m below ground level.

Stratum IV: A deep deposit of sand (below 22.0m) of angle of shearing resistance 34^0 and bulk density 19.5kN/m^3.

GWT is at the ground level.

3. CO 5

A pile group is to be constructed to support a design column load (vertical) of 3500kN. Subsoil at the site consists of top soft clay of thickness 15m (undrained cohesion Cu = 25kPa, α=1.0, γ_{sat}=17.5kN/m^3, Cc/1+e_0 = 0.14) followed by a layer of medium / stiff clay (undrained cohesion Cu = 75kPa, α=0.64, γ_{sat}=19.5kN/m^3, Cc/1+e_0=0.08) down to 22.0m below ground level. This is underlain by a deep deposit of hard clay with undrained cohesion 120kPa (α=0.42), bulk density 20.0kN/m^3 and Cc/1+e_0=0.07. GWT is at the ground level.

Take length of pile = 25m, diameter = 500mm and cut-off level at 2.0m below existing ground level.

Determine the safe vertical capacity of single pile for a factor of safety of 2.5. Design the pile group and also determine the settlement of the pile group under superimposed vertical load. Show all relevant calculations in detail. 10+4+6=20

[Turn over

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GEOTECHNICAL ENGINEERING III
PART-II

[Answer All the Questions] **Total = 100**

This Part = 50

[Use code: IS: 6403, IS: 2131, IS: 1904, IS: 8009 (Part-I) & IS1893(Part-I)-2016]

[Assume any data reasonably if not provided]

1. (a) Write down the assumptions associated with Terzaghi's bearing capacity theory.

(b) In Terzaghi's bearing capacity theory, briefly discuss on different failure zones below foundation with neat a sketch. [5+7]

[CO2]

2. (a) Discuss on the choices of different foundations in brief.

(b) An isolated column in a building frame carries a superimposed load of 460kN. The subsoil condition is shown in the figure (Fig. 1) below. Design a suitable isolated footing for the column. [*Assume water table at 1m below ground surface*] [5+18]

[CO4]

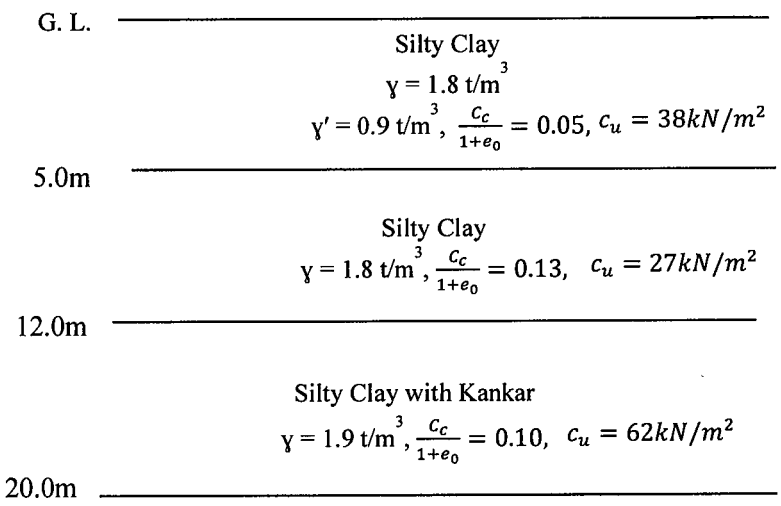

Fig. 1

3. At a project site SPT tests have been carried out at every 0.75m depth. The measured penetration resistance with depth is given in the table (Table 1) below and the soil profile obtained from the bore-log data is also shown in figure (Fig. 2) below. The region is expected to experience an earthquake of magnitude 6.2. The project site is estimated to experience a_{max} of '0.20g' ground shaking under the expected earthquake. Estimate the liquefaction potential of the site at every 0.75m depth interval and also prepare a plot of depth vs CSR/ CRR showing the liquefied zone. [15]

[CO6]

Table 1

Depth (m)	0.75	1.5	2.25	3.0	3.75	4.5
N-value	6	4	6	8	15	12

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ɜwer All the Questions] **Total = 100**

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[*Assume any data reasonably if not provided*]

Given:

[SPT conducted following IS standard

Use unit weight of water, $\gamma_w = 10$ kN/m^3 in the calculations]

Assume Water Table at ground surface]

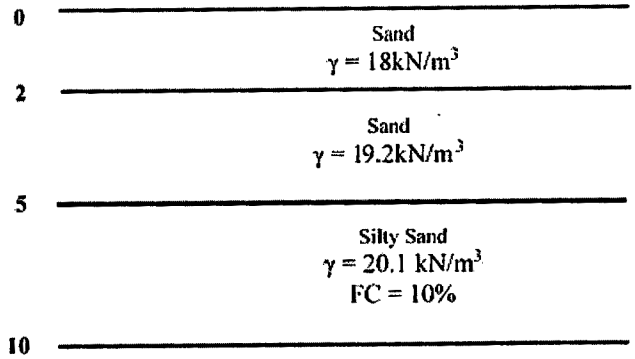

Fig. 2