Total No. of printed pages = 3

CE 1818 PE 41

17/6/23

Roll No. of candidate

2023

B.Tech. 8th Semester End-Term Examination

Civil Engineering

DESIGN OF SUBSTRUCTURE

New Regulation (w.e.f. 2017-2018) & New syllabus (w.e.f. 2018-2019)

Full Marks – 70

Time – Three hours

The figures in the margin indicate full marks for the questions.

Answer question No. 1 and any *four* from the rest.

1. Answer the following: (10 × 1 = 10)

(i) Discuss how the foundations are classified into shallow, intermediate and deep type.

(ii) Write briefly about a combined footing.

(iii) Define Allowable Bearing Pressure.

(iv) Define "Depth of fixity" for piles.

(v) Draw a rough sketch of the e vs. p graph showing all the components of settlement.

(vi) Underline the causes behind opting for raft foundation below a proposed structure.

(vii) What is a "Floating foundation"?

(viii) Mention the relevant I.S. codes applicable to driven piles and bored piles of uniform c/s.

(ix) Briefly define "Tilt and Shift" that may occur during well sinking operation.

(x) Define anchored and cantilevered sheet piles.

[Turn over

2. Calculate the allowable load on an isolated footing of size 2.0 m × 2.5m to be laid at a depth of 2.0 m below EGL for the sub-soil profile as produced below. Consider the parsed W.T. to lie at the EGL during monsoon. (15)

Dept (m) Below EGL	1	2	3	4	5	6	7	8	9	10	11-20
Soil type	ML	SM	SM	SM	CL	CL	CL	SC	SC	SP	SW
C in t/m²	3.4	2.1	2.2	2.0	3.8	3.6	3.9	2.5	2.4	1.5	1.0
Φ In degrees	5	8	14	16	4	5	5	11	12	25	30
γ in t/m³	2.07	1.94	2.03	2.05	2.15	2.12	2.14	1.99	1.96	2.0	2.2
Observed N value	3	8	10	15	6	5	7	13	17	22	28 (AV.)
Consolidat ion test result	N/A				$C_c = 0.4$ $e_0 = 0.3$			N/A			

3. Design an isolated footing for a column 500 mm × 500 mm, reinforced with 6-25 mm bars with Fe415 steel and M25 concrete subjected to a factored axial load of 1200 kN and a factored uniaxial moment (M_{ux}) 120 kNm (with respect to the major axis) at the column base. Assume that the moment is reversible. The safe bearing capacity may be taken as 200 kN/sqm at a depth of 1.25 m. Assume M20 concrete and Fe 415 steel for footing. (15)

4. Design a combined footing for two columns each having size 400 mm × 400 mm and are 1.2 m apart. The column the right is subjected to an axial load of 900 kN and the column to the left is subjected to an axial load of 800 kN. Design the combined footing. Assume M25 grade concrete and Fe415 grade steel. The Bearing capacity of soil is 150 kN/sqm. (15)

5. Check whether a partially compensated basement may be selected as the sub-structure for a proposed G + 6 storied RCC commercial building, with the ground floor being the basement; on a plot of land comprising of soft clay having an allowable bearing pressure of 5 t/m². The built-up area of the building is proposed to be 81 sq.m. The plan area of the plot is 60m × 30m (L × B). Consider the ramp to the basement to have a vertical angle of 20° and the rise to the first floor to be 1.3 m from the FGL. Also suggest alternative foundation option in case such a foundation turns out to be not practically sufficient to bear the proposed load. (15)

6. (a) Calculate the safe load against compression for a single under-reamed pile of stem diameter 0.3 m and bulb diameter 0.6 m, bored into a stiff clay sub-soil of av. N value 11 up to a termination depth of 10 m below EGL. The parsed water table comes up to the ground surface during monsoon and the bore holes are expected to be filled up with mud water during concreting. (4)

(b) Derive the expression for the optimal spacing (s) of piles corresponding to 100% efficiency for a group of piles with diameter "d" with "m" no.s of columns, "n" no.s of rows. (4)

(c) Calculate the safe load on a bored and cast-in-situ concrete pile of diameter 0.5m, length 10.0Cm with cut-off depth of 1.0m below EGL for a site which is likely to get inundated during monsoon. The sub-soil consists of the following layers: (7)

Depth below EGL	Soil Type	C (t/m²)	φ (Degree)	γ (t/m²)
0.0 m to 5.0 mm	CL	3.5	5	2.0
6.0 m to 8.0 m	SC	2.0	20	1.8
9.0 m to 10.0 m	SP	1.5	25	1.9

7. Write short notes on Well Curb, Cutting Edge and Bottom Plug. Also derive the expression for staining thickness of a circular well of diameter D. (4 + 4 + 4 + 3)