

Total No. of printed pages = 6

CE1318E031

Roll No. of candidate

--	--	--	--	--	--	--	--	--	--

2020

B.Tech 8th Semester End-Term Examination

DESIGN OF SUB-STRUCTURES

Full Marks – 50

Time – Two hours

(Use of design aid to IS: 456-1978, IS: 456-2000 is allowed)

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

Answer Question No. 1 and any *Three* from the rest.

1. Answer any *five* of the following questions :

(5 × 1 = 5)

- (i) How many types of foundations are there based on depth criteria?
- (a) 2 (b) 3
(c) 4 (d) 5
- (ii) What type of footing is used in load bearing masonry construction?
- (a) Isolated footing
(b) Strap footing
(c) Strip footing
(d) Pile foundation

[Turn over

- (iii) As per IS: 1904- 1986 the minimum factor of safety for stability of structure against sliding and overturning is
- (a) 1.0 (b) 1.5
(c) 2.0 (d) 2.5
- (iv) When the soil is having poor safe bearing capacity and building loads are heavy, the footing type used is _____
- (a) Isolated footing
(b) Combined footing
(c) Raft foundation
(d) Well foundation
- (v) The design of rectangular combined footing consist in determining the _____
- (a) Pressure distribution
(b) Location of centre of gravity
(c) Shear force
(d) Safe bearing pressure
- (vi) A circular pile is designed as a long column if the ratio of effective length to diameter is greater than
- (a) 10 (b) 12
(c) 15 (d) 25

- (vii) The critical section for checking of punching shear for a shallow footing having effective depth "d" is at a distance....from the face of the column.
- (a) $d/2$ (b) d
(c) $2.d$ (d) None of the above
- (viii) In the design of a raft foundation the main beams connecting the columns are called as _____ beams.
- (a) Primary beams
(b) Secondary beams
(c) Simply supported beams
(d) None of the above
- (ix) Grade of cement concrete used in bottom support of isolated footing is
- (a) 1:2:4 (b) 1:3:6
(c) 1:4:8 (d) Both (b) and (c)
- (x) Minimum depth of foundation required can be estimated using _____
- (a) Terzaghi's theory
(b) Mayerhoff's theory
(c) Rankine's theory
(d) None of the above

2. An isolated footing for a column 500 mm x 500 mm in size, is carrying an axial load of 600 kN and a uniaxial moment of 50 kNm. The Allowable bearing pressure of subsoil is 140 kN/m². Using M20 grade of concrete and Fe415 HYSD bars,
- (a) Proportionate the footing and determine the reinforcement to be provided. (10)
 - (b) Check for I-way shear and punching shear. (5)
3. A combined footing for two columns 400 mm x 400 mm in section each carrying 750 kN and 500 kN respectively spaced at 4.0 m centre to centre. The allowable bearing pressure for subsoil is 130 kN/m². The projection of the footing beyond the heavier column face is to be restricted at 150 mm. Using M20 grade of concrete and Fe415 HYSD bars,
- (a) Proportionate the footing. (7)
 - (b) Design the footing slab and check for shear. (8)
4. Two columns having cross section of 250 mm x 250 mm and 300 mm x 300 mm are loaded with 300 kN and 500 kN respectively. The centre to centre distance between the columns is 4 m and bearing capacity of soil is 100 kN/m². Using M20 grade of concrete and Fe415 HYSD bars, design a rectangular combined footing. (15)

5. A structure consists of 12 columns of 400mm X 400mm size arranged in three rows of four each. The distance between columns is 5.0 m each. The load carried by corner and exterior columns is 500 kN each and that carried by interior columns is 800 kN each. The SBC of soil is 50 kN/m².

(a) Proportionate a raft foundation and design the raft slab.

(b) Design one of the secondary beams. (9+6)

6. Design a pile group consisting of RCC piles for a column of size 650 mm x 650 mm carrying load of 5000 kN. Consider 600 mm diameter piles with overall length of 18 m.

Assume, bearing capacity factor (N_c) = 9

Unconfined compressive strength = 40 kN/m²

Factor of safety = 2.5

Adhesion factor (α) = 0.45 (15)

7. A RCC column of size 300 mm x 450 mm (b x d) is supported on two 400mm diameter piles. The centre to centre spacing of the piles is 800 mm. With the following given data, design a suitable pile cap.

Factored load on the column = 1072.8 kN

Factored moment (~about x axis) = 51.29 kN.m

Safe load on single pile = 500 kN

Use M20 grade of concrete and Fe415 grade steel.

(15)

8. (a) Based on method of achieving stability, what are the different types of retaining walls? (3)
- (b) A cantilever retaining wall is used to retain earth embankment 4.5 m above ground level. The bulk unit weight of soil is 19kN/m^3 and angle of repose is 30° . The backfill is horizontal on top. The coefficient of friction between soil and concrete is 0.5. Proportionate the retaining wall and check its stability against sliding and overturning. (12)
9. (a) What are the forces to be considered for design of a well foundation? (5)
- (b) What precautions are necessary during sinking of a well foundation? (5)
- (c) Briefly explain how finite difference technique is used for analyse of footings. (5)
-