

Bihar Engineering University, Patna
End Semester Examination - 2022

Course: B.Tech.
Code: 101501

Semester: V
Subject: Analysis and Design of Concrete Structure

Time: 03 Hours
Full Marks: 70

Instructions:-

- (i) The marks are indicated in the right-hand margin.
- (ii) There are NINE questions in this paper.
- (iii) Attempt FIVE questions in all.
- (iv) Question No. 1 is compulsory.
- (v) IS 456:2000 is allowed.

Q.1 Choose the correct answer of the following (Any seven question only): [2 x 7 = 14]

- (a) The characteristic strength of concrete is defined as that compressive strength below which not more than
(i) 10% of result fail (ii) 20% of result fail
~~(iii) 5% of result fail~~ (iv) None of the above
- (b) By controlling the span to depth ratio of beam, which of the following can be controlled
(i) shear stress in beam (ii) flexural stress in beam
(iii) deflection of beam ~~(iv) all of the above.~~
- (c) The minimum area of tension steel for Fe415 in the slab as per IS 456:2000 is
(i) 0.10% of gross area (ii) 0.12% of gross area
(iii) 0.15% of gross area ~~(iv) 0.20% of gross area~~
- (d) As per IS456:2000, the ultimate compressive strain in concrete in bending is assumed as
(i) 0.002 ~~(ii) 0.0035~~ (iii) 0.003 (iv) 0.004
- (e) The material factor of safety for concrete and steel in the limit state method of design are respectively:
(i) 1.0 and 1.5 ~~(ii) 1.5 and 1.5~~ ~~(iii) 1.5 and 1.15~~ (iv) 1.15 and 1.15
- (f) A reinforced concrete structure has to be constructed along a seacoast. The minimum grade of concrete to be used as per IS 456:2000 is
(i) M-15 ~~(ii) M-20~~ (iii) M-25 ~~(iv) M-30~~
- (g) In a singly reinforced beam the tensile steel reaches its maximum allowable stress earlier than concrete. Such section is known as
~~(i) Under Reinforced section~~ (ii) Over Reinforced section
(iii) Balanced section (iv) Economic section
- (h) The lateral ties in a reinforced concrete rectangular column under axial compression are used to
(i) avoid the buckling of longitudinal steel under compression
~~(ii) provide adequate shear capacity~~
~~(iii) provide adequate confinement to concrete~~
(iv) Reduce the axial deformation of column
- (i) To minimize the effect of differential settlement, the area of a footing should be designed for
(i) dead load only (ii) dead load + live load
~~(iii) dead load + fraction of live load~~ (iv) fraction of dead load + live load
- (j) The modulus of rupture of concrete in terms of its characteristic cube compressive strength f_{ck} (in MPa) according to IS 456:2000 is
(i) $7000 \sqrt{f_{ck}}$ ~~(ii) $0.7 \sqrt{f_{ck}}$~~ (iii) $0.07 \sqrt{f_{ck}}$ (iv) $7 \sqrt{f_{ck}}$

Q.2

- (a) What do you mean by principle of stability? [2]
- (b) Distinguish between under reinforced and over reinforced beams. [3]

- (c) Enlist and explain various design philosophies for the design of reinforced concrete structure. [9]
- Q.3** (a) Design an isolated footing for a square column, 400 mm x 500 mm, reinforced with 8-20 ϕ bars and carrying a service load of 2000 kN. Assume soil with a safe bearing capacity of 300 kN/m at a depth of 1.5 m below ground. Assume M25 grade concrete and Fe415 grade steel for the footing. [14]
- Q.4** A doubly reinforced concrete beam is 400 mm wide and 600 mm deep to the centre of tensile reinforcement. The compression reinforcement consists of 4 bars of 16 mm diameter, and is placed with its centre at a depth of 40 mm from the top. The tensile reinforcement consists of 4 bars of 20 mm diameter. The section is subjected to a bending moment of 100 kN-m. Determine the stresses in concrete and steel. Take $m = 16$. [14]
- Q.5** (a) Explain different types of loads and their combination for the design of reinforced concrete structure. [6]
- (b) Discuss the role of engineer, architects, user and builder in building planning design and construction. [8]
- Q.6** (a) Design a circular column with helical reinforcement subjected to a working load of 1500 kN. Diameter of the column is 450 mm. The column has unsupported length of 3.5 m and is effectively held in position at both ends but not restrained against rotation. Use limit state design method. Use M25 concrete and HYSD Fe415 steel. [14]
- Q.7** (a) If maximum strain at a highly compressed zone is considered as 0.0025 then the depth of neutral axis for the balanced section will be? [7]
 Use following data:
 Width of beam = 250 mm
 Overall depth of beam = 400 mm
 Effective cover = 50 mm
 Area of steel in tension = 500 mm²
 Grade of concrete and steel are M20 and Fe250 respectively.
- (b) A reinforced concrete beam of rectangular cross section of breadth 230 mm and effective depth of 400 mm is subjected to a factored shear force of 120 kN. The grade of concrete, main steel and stirrup steel are M20, Fe415 and Fe250 respectively. [7]
 Area of main steel provided gives, design shear strength of concrete (τ_c) as 0.48 N/mm². For a limited state of collapse in shear, design shear reinforcement.
- Q.8** A hall has clear dimension 3 m x 9 m, with wall thickness 230 mm. The live load on the slab is 3 KN/m² and finishing load of 1 KN/m² may be assumed. Use M20 concrete and Fe415 grade steel. Design the slab. [14]
- Q.9** Determine the moment of resistance a T-section having the following properties: Flange width = 2000 mm, Flange depth = 100 mm, Web width = 250 mm, Effective depth = 750 mm, Area of steel = 8 bars of 20 mm diameter, material used = M25 grade of concrete and Fe415 HYSD bars. [14]