Code : 011617

B.Tech. 6th Semester Exam., 2016

DESIGN OF CONCRETE STRUCTURE—I

Time : 3 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.*

1. Choose the correct answer (any *seven*) : 2×7=14

(a) The total compressive force at the time of failure of a concrete beam section of width b without considering the partial safety factor of the material is

(i) $0 \cdot 36 f_{ck} b X_u$

(ii) $0 \cdot 54 f_{ck} b X_u$

(iii) $0 \cdot 66 f_{ck} b X_u$

(iv) $0 \cdot 8 f_{ck} b X_u$

(b) The characteristic strength of concrete is defined as that compressive strength below which not more than

(i) 10% of result fail

(ii) 5% of result fail

(iii) 2% of result fail

(iv) None of the above

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(c) The effective width of a reinforced concrete T-beam flange under compression, according to IS 456:1978, given l_0 is the distance between the adjacent zero moment points, b is the breadth of the rib and D is the thickness of the flange, is

(i) $l_0 / 6 + b + 6D$

(ii) $l_0 + 6D$

(iii) $l_0 / 6 + 6D$

(iv) $l_0 / 6 + b$

(d) The span to depth ratio limit is specified in IS 456:1978 for the reinforced concrete beams, in order to ensure that the

(i) tensile crack width is below a limit

(ii) shear failure is avoided

(iii) stress in the tension reinforcement is less than the allowable value

(iv) deflection of the beam is below a limiting value

(e) The partial factor of safety for concrete as per IS 456:2000 is

(i) 1·50

(ii) 1·15

(iii) 0·87

(iv) 0·446

(Continued)

(f) As per the provisions of IS 456:2000, the modulus of elasticity of M-25 grade concrete (in N / mm^2) can be assumed to be

(i) 25000

(ii) 28500

(iii) 30000

(iv) 36000

(g) 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

(h) 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) $5000 f_{ck}$

(ii) $0 \cdot 7 f_{ck}$

(iii) $5000 \text{sqrt}(f_{ck})$

(iv) $0 \cdot 7 \text{sqrt}(f_{ck})$

(Turn Over)

(i) The maximum possible value of compaction factor for fresh (green) concrete is

(i) 0·5

(ii) 1·0

(iii) 1·5

(iv) 2·0

(j) The first moment of area about the axis of bending for a beam cross-section is

(i) moment of inertia

(ii) shape factor

(iii) section modulus

(iv) polar moment of inertia

2. Determine the moment of resistance of a single-reinforced beam 160 mm wide and 300 mm deep to the centre of reinforcement, if the stresses in steel and concrete are not to exceed $140\ N/mm^2$ and $5\ N/mm^2$ respectively. The reinforcement consists of 4 bars of 16 mm diameter. Take $m = 18$.

If the above beam is used over an effective span of 5 m, find the maximum load the beam can carry, inclusive of its own weight. 14

(Continued)

3. A simply supported beam, 300 mm wide and 500 mm effective depth, carries a uniformly distributed load of 50 kN/m including its own weight, over an effective span of 4 meters. Design the shear stirrups in the form of vertical stirrups. Use M-15 concrete. Take $\sigma_{st} = \sigma_{sv} = 140 N/mm^2$ and $f_y = 250\ N/mm^2$. Assume that the beam contains 0·75% reinforcement throughout the length. For $100 A_s / bd = 0 \cdot 75\%$, permissible shear stress = $0 \cdot 34\ N/mm^2$. 14

4. Design the reinforcement for a reinforced concrete beam 300 mm wide and 400 mm deep of grade M-20, to resist an ultimate moment of 150 kN-m, using mild steel bars of grade Fe-250. 14

5. An isolated T-beam carries a uniformly distributed load of 40 kN/m run, inclusive of its own weight, over an effective span of 6 m. The beam has the following dimension : Width of flange=800 mm, thickness of flange=100 mm, effective depth of the beam=480 mm and width of rib = 300. Determine the necessary areas of tensile and compressive reinforcement. Take $\sigma_{st} = 140 N/mm^2$ and $\sigma_{cbc} = 5 N/mm^2$ and $m = 18$. 14

(Turn Over)

6. Design an RC slab, only for section and main reinforcement, for a room having inside dimensions 3 m × 6 m. The thickness of the supporting wall is 300 mm. The slab carries 100 mm thickness lime concrete at its top, the unit weight of which may be taken as $19000\,N/m^3$. The live load on the slab may be taken as $2500\,N/m^3$. Assume the slab to the simply supported at the ends. Use M-20 concrete and Fe-415 steel. Constants are : For M-20, $c = \sigma_{cbc} = 7\,N/mm^2$, $\sigma = \sigma_{st}\,230\,N/mm^2$, $m = 13{\cdot}33.$, $k_c = 0{\cdot}289$, $j_c = 0{\cdot}904$, and $R_c = 0{\cdot}914$. 14

7. Design a short square column to carry an axial load of 1200 kN. Use M-25 concrete mix, and Fe-415 steel. 14

8. A brick wall, 300 mm thick, carries a load of 180 kN/m length. Design an RCC footing, if the safe bearing capacity of soil is $120\,kN/m^2$. Use M-20 concrete and Fe-415 steel. Constants are : For M-20, $c = \sigma_{cbc} = 7\,N/mm^2$, $\sigma = \sigma_{st}\,230\,N/mm^2$, $m = 13{\cdot}33.$, $k_c = 0{\cdot}289$, $j_c = 0{\cdot}904$, and $R_c = 0{\cdot}914$. Use $\tau_c = 0{\cdot}28\,N/mm^2$ and $k = 1{\cdot}1$. 14

9. 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

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