RCC Structures

DESIGN CONCEPTS

Q.1. Most popular method of design of R.C.C. structures is
(a) working stress method
(b) ultimate load method
(c) limit state method*
(d) none of these

Q.2. Code IS: 456-2000 is meant for
(a) prestressed concrete
(b) r.c.c. structures (limit state design method)*
(c) r.c.c. structures (working stress method)
(d) all of these

Q.3. The state which corresponds to maximum load carrying capacity, is called
(a) limit state of serviceability
(b) limit state of collapse*
(c) both (a) and (b)
(d) none of these

Q.4. The state which corresponds to development of excessive deformation, is called
(a) limit state of serviceability*
(b) limit state of collapse
(c) both (a) and (b)
(d) none of these

Q.5. Limit state concept of design of reinforced concrete structures takes into account the probabilistical and structural variation in the
(a) material properties
(b) loads
(c) safety factors
(d) all of the above*

Q.6. In the limit state of concrete structures the strain distribution is assumed to be
(a) linear*
(b) non linear
(c) parabolic
(d) parabolic and rectangular

Q.7. For limit state design method, partial safety factor for concrete is
(a) 1
(b) 1.2
(c) 1.5*
(d) 1.15

Q.8. In above question, partial safety factor for steel is
(a) 1
(b) 1.2
(c) 1.5
(d) 1.15*

Q.9. The partial safety factors for concrete and steel are 1.5 and 1.15 respectively, because
(a) concrete is heterogeneous while steel is homogeneous
(b) the control of quality of concrete is not as good as that of steel*
(c) concrete is weak in tension
(d) voids in concrete are 0.5% while those in steel are 0.15%

Q.10. When a structure is designed for wind or earthquake, the permissible stresses in concrete and steel may be increased by
(a) 10%
(b) 25%
(c) 33.33%*
(d) 66.67%

Q.11. According to IS: 456, modulus of elasticity of concrete is
(a) 24 kN/mm^2
(b) 22.4 kN/mm^2*
(c) 20 kN/mm^2
(d) none of these

Q.12. As per the provisions of IS 456:2000, the short term modulus of elasticity of M25 grade concrete(in N/mm^2) can be assumed to be
(a) 25000*
(b) 28500
(c) 30000
(d) 36000

Hint: $E_c = 5000\sqrt{\sigma_{ck}}$

Q.13. The ratio of direct tensile strength to compressive strength of concrete is taken as
(a) 0.05
(b) 0.15*
(c) 0.25
(d) 0.35

Q.14. Creep reduces modulus of elasticity by a factor of
(a) 2 to 3*
(b) 3 to 4
(c) 4 to 5
(d) none of these

Q.15. If f_{cu} and f_y are cube compressive strength of concrete and yield stress of steel respectively and E_s is the modulus of elasticity of steel for all grades of concrete, the ultimate flexural strain in concrete can be taken as
(a) 0.002
(b) $f_{cu}/1000$
(c) 0.0035*
(d) $\frac{f_y}{1.15E_s} + 0.002$

Q.16. High strength deformed bars are available in grades
(a) Fe 415
(b) Fe 500
(c) TMT
(d) all of the above*

Q.17. Young modulus of steel is
(a) 150 kN/mm^2
(b) 175 kN/mm^2
(c) 200 kN/mm^2*
(d) 415 kN/mm^2

Q.18. TOR bar is
(a) high strength cold worked deformed ribbed bar*
(b) corrosion resistant bar
(c) mild steel bar
(d) both (a) and (b)

Q.19. TMT steel
(a) is thermally and mechanically treated
(b) has a definite yield point
(c) both (a) and (b) *
(d) none of these

Q.20. In a limit state method of design, the failure criterion for reinforced concrete beams and columns is
(a) maximum principal stress theory
(b) maximum principal strain theory*
(c) maximum shear stress theory
(d) maximum strain energy theory

Q.21. The probability of failure implied in limit state design is of the order of
(a) 10^{-2}
(b) 10^{-3}*
(c) 10^{-4}
(d) 10^{-5}

Q.22. As compared to working stress method of design, limit state method takes concrete to
(a) a higher stress level*
(b) a lower stress level
(c) same stress level
(d) sometimes higher but generally lower stress level

Q.23. In limit state design of reinforced concrete, deflection is computed by using
(a) initial tangent modulus
(b) secant modulus
(c) tangent modulus
(d) short and long term values of Young's modulus*

BEAMS

Q.24. The maximum strain in concrete at the outermost compression fibre is assumed as
(a) 0.10% in bending
(b) 0.15% in bending
(c) 0.25% in bending
(d) 0.35% in bending*

Q.25. The maximum strain in concrete at the outermost compression fiber in the limit state design of flexural member is (as per IS code)
(a) 0.0020
(b) 0.0035*
(c) 0.0065
(d) 0.0050

Q.26. Read the following two statements
I. Maximum strain in concrete at outermost compression

fibre is taken to be 0.0035 in bending

II. The maximum compressive strain in concrete in axial compression is taken as 0.002.

Keeping the provisions of IS 456-2000 on limit state design in mind, which of the following is true

(a) statement I is true but II is false*
(b) statement I is false but II is true
(c) both statements are true
(d) both statements I and II are false

Q.27. The relationship between stress-strain distribution is assumed to be
(a) linear
(b) logarithmic
(c) parabolic*
(d) none of these

Q.28. The maximum stress is equal to
(a) $0.2\sigma_{ck}$
(b) $0.246\sigma_{ck}$
(c) $0.446\sigma_{ck}$*
(d) $0.87\sigma_{ck}$

Q.29. As per IS 456-1978 (Now IS 456-2000), the ratio of stress in concrete to its characteristic strength at collapse in flexure for design purposes is taken as
(a) 0.67*
(b) 0.576
(c) 0.447
(d) 0.138

Q.30. The maximum strain (ε_s) in tension reinforcement in the section at failure should be

(a) equal to $\frac{\sigma_y}{1.15E_s} + 0.002$

(b) $< \frac{\sigma_y}{1.15E_s} + 0.002$

(c) $\leq \frac{\sigma_y}{1.15E_s} + 0.002$

(d) $\geq \frac{\sigma_y}{1.15E_s} + 0.002$ *

where σ_y is characteristic strength of steel and E_s is modulus of elasticity of steel.

Q.31. A reinforced concrete beam is designed for the limit state of collapse in flexure and shear. Which of the following limit states of serviceability have to be checked?
1. deflection
2. cracking
3. durability

(a) 1 only
(b) 1 and 2*
(c) 2 and 3
(d) 1, 2 and 3

Q.32. The depth from the extreme compression fibre to the centroid of tensile forces is called
(a) depth of neutral axis (x)
(b) overall depth
(c) lever arm (z)
(d) effective depth (d) *

Q.33. In a singly reinforced beam, force of compression will be
(a) $0.446\sigma_{ck}bx$
(b) $0.87\sigma_{ck}bx$
(c) $0.36\sigma_{ck}bx$*
(d) none of these

where b is beam width and x is depth of neutral axis from extreme compression fibre.

Q.34. In a singly reinforced beam, force of tension will be
(a) $0.36\sigma_yA_t$
(b) 0.446_yA_t
(c) σ_yA_t
(d) $0.87\sigma_yA_t$*

Q.35. For calculating depth of neutral axis, force of compression should be
(a) equal to force of tension*
(b) equal or less than force of tension
(c) more than force of tension
(d) none of these

Q.36. The distance between compressive force and tensile force is called
(a) depth of neutral axis
(b) effective depth
(c) overall depth
(d) lever arm*

Q.37. For a singly reinforced beam, lever arm (z) will be
(a) d - 0.42x
(b) $d - 0.42\left(\frac{0.87\sigma_y A_t}{0.36\sigma_{ck} b}\right)$
(c) $d - \frac{\sigma_y A_t}{\sigma_{ck} b}$
(d) all the above*

Q.38. Moment of resistance with respect to concrete is
(a) $0.36\sigma_{ck}bz$*
(b) $0.446\sigma_{ck}bz$
(c) $0.87\sigma_{ck}bz$
(d) none of these

Q.39. Moment of resistance with respect to steel is
(a) $0.87\sigma_y A_t z$*
(b) $\sigma_y A_t z$
(c) $0.36\sigma_y A_t z$
(d) none of these

Q.40. When maximum strain in steel and concrete reach simultaneously, the section is called
(a) over reinforced
(b) under reinforced
(c) balanced*
(d) rectangular

Q.41. When in a beam steel is kept less than that in balanced section then
(a) neutral axis moves upwards
(b) maximum strain in concrete remains less than 0.35%
(c) steel is strained beyond yield point
(d) all the above*

Q.42. In above question, the beam is called
(a) balanced
(b) over reinforced
(c) under reinforced*
(d) none of these

Q.43. In above problem
(a) beam is failed due to tension failure
(b) yield of steel is responsible for failure
(c) continued higher strains in concrete due to steel yield*
(d) all the above

Q.44. In a beam when amount of steel is kept more than that in balanced section, the beam is called
(a) balanced beam
(b) under reinforced beam
(c) over reinforced beam*
(d) none of these

Q.45. In above question, failure is
(a) tension failure
(b) compression failure*
(c) both (a) and (b)
(d) none of these

Q.46. In a singly reinforced beam, if the stress in concrete reaches its allowable limit later than the steel reaches its permissible value, the beam section is said to be
(a) under-reinforced*
(b) balanced
(c) over-reinforced
(d) critically balanced

Q.47. Which of the following statements about the percentage of tensile steel required produce a balanced reinforced concrete section is correct?
(a) reduces as the yield strength of steel increases*
(b) remains unchanged irrespective of the yield strength of steel
(c) is the same for a given quality of steel irrespective of whether working stress method is followed or ultimate load method is used
(d) only a function of modulus of elasticity of steel

Q.48. Maximum depth of neutral axis (x_m) for Fe415 grade steel is
(a) 0.46d
(b) 0.48d*
(c) 0.53d
(d) 0.67d

Q.49. Maximum depth of neutral axis (x_m) for Fe 500 steel is
(a) 0.46d*
(b) 0.48d
(c) 0.53d
(d) 0.67d

Q.50. According to Whitney's theory, the maximum depth of concrete stress block in a balanced RCC beam section of depth "d" is
(a) 0.3d
(b) 0.43d
(c) 0.5d
(d) 0.53d*

Q.51. As per IS: 456-1978 (now IS: 456-2000), for a singly reinforced rectangular section
(a) $\frac{x_{u,max}}{d}$ for Fe 415 steel is 0.48*
(b) depth of centroid of compression is $0.43x_{u,max}$
(c) depth of rectangular position of the stress block is $0.38x_{u,max}$
(d) maximum value of lever arm is $d - x_{u,max}$

Q.52. limiting value of moment of resistance with respect to concrete will be (for Fe 250 steel)
(a) $0.148\sigma_{ck}bd^2$*
(b) $0.138\sigma_{ck}bd^2$
(c) $0.133\sigma_{ck}bd^2$
(d) none of these

Q.53. In above question, value of limiting moment of resistance for Fe 415 steel will be
(a) $0.148\sigma_{ck}bd^2$
(b) $0.138\sigma_{ck}bd^2$*
(c) $0.133\sigma_{ck}bd^2$
(d) none of these

Q.54. Percentage of tensile reinforcement corresponding to limiting moment of resistance will be
(a) $\frac{\sigma_{ck}}{\sigma_y}\left(\frac{x_m}{d}\right)100$
(b) $\frac{0.36\sigma_{ck}}{0.87\sigma_y}\left(\frac{x_m}{d}\right)100$*
(c) $\frac{0.87\sigma_{ck}}{0.36\sigma_y}\left(\frac{x_m}{d}\right)100$
(d) none of these

Q.55. Limiting tensile reinforcement in rectangular beam of concrete M20 and steel Fe415 will be
(a) 1.76
(b) 0.96*
(c) 0.76
(d) 2.20

Q.56. In above question, limiting tensile reinforcement for M20 concrete and Fe 250 steel will be
(a) 1.76*
(b) 0.96
(c) 0.76
(d) 2.20

Q.57. According to clause 26.5.1.1 of code IS 456: 2000, condition for minimum tension reinforcement (A_0) is
(a) $\frac{A_0}{bd} = \frac{0.35}{\sigma_y}$
(b) $\frac{A_0}{bd} = \frac{0.87}{\sigma_y}$
(c) $\frac{A_0}{bd} = \frac{0.446}{\sigma_y}$
(d) $\frac{A_0}{bd} = \frac{0.85}{\sigma_y}$ *

Q.58. Maximum tension reinforcement should not exceed ___ % of the gross cross-sectional area.
(a) 0.4
(b) 4*
(c) 8
(d) 10

Q.59. The effective span of a beam or slab is
(a) $L_c + d$
(b) l
(c) greater of (a) and (b)
(d) lesser of (a) and (b) *
where L_c is clear span, d is effective depth and l is c/c distance between supports.

Q.60. The effective span of a continuous beam or slab is (if width of support ≤ $L_c/12$)
(a) $L_c + d$
(b) l
(c) greater of (a) and (b)
(d) lesser of (a) and (b) *

Q.61. In above question if width of support is greater than $L_c/12$ or 600

mm, whichever is less, then effective span will be L_c for
(a) end span with one end fixed and other continuous
(b) for intermediate span
(c) either (a) or (b) *
(d) end span with one end free and other continuous

Q.62. In above question, effective span for end span with one end free and other continuous, will be
(a) $L_c + 0.5d$
(b) $L_c + 0.5t_s$
(c) greater of (a) and (b)
(d) lesser of (a) and (b) *
where t_s is width of discontinuous support.

Q.63. The design thickness of concrete cover to all steel reinforcements is called
(a) effective cover
(b) nominal cover*
(c) clear cover
(d) all the above

Q.64. The actual cover at site should not be less than
(a) nominal cover
(b) clear cover
(c) nominal cover + 10 mm*
(d) clear cover + 10 mm

Q.65. A reinforcement is exposed to mild conditions, then nominal cover should be
(a) 20 mm
(b) 25 mm*
(c) 30 mm
(d) 35 mm

Q.66. A reinforcement is exposed to moderate conditions, then nominal cover should be
(a) 25 mm
(b) 30 mm*
(c) 45 mm
(d) 50 mm

Q.67. A reinforcement is exposed to severe conditions, then nominal cover should be
(a) 25 mm
(b) 30 mm
(c) 45 mm*
(d) 75 mm

Q.68. The vertical distance between two parallel main bars should not be less than
(a) 15 mm
(b) diameter of larger bar
(c) 2/3 of nominal maximum size of coarse aggregate
(d) greatest of above*

Q.69. A rectangular beam having width 200 mm and effective depth 400 mm is reinforced with 3 - 20ϕ bars. Given $\sigma_{ck} = 20$ N/mm^2 and $\sigma_y = 415$ N/mm^2. Force of tension will be
(a) 300 kN
(b) 340.1 kN*
(c) 441 kN
(d) none of these

Q.70. In above question, depth of neutral axis will be
(a) 236 mm
(b) 192 mm*
(c) 190 mm
(d) 212 mm

Q.71. In above question, the beam is
(a) balanced
(b) under reinforced
(c) over reinforced*
(d) can not say

Q.72. In above question if $\sigma_{ck} = 15$ N/mm^2 and $\sigma_y = 250$ N/mm^2 then depth of neutral axis will be
(a) 236 mm
(b) 192 mm
(c) 190 mm*
(d) 212 mm

Q.73. A rectangular beam is 250 mm wide and has an effective depth equal to 360 mm. $\sigma_{ck} = 20$ N/mm^2, $\sigma_y = 250$ N/mm^2. The beam is reinforced with 3 - 16ϕ bars at bottom. The lever arm will be
(a) 275.30 mm
(b) 290.40 mm
(c) 329.40 mm*
(d) none of these

Q.74. A rectangular beam is 20 cm wide and 40 cm deep upto the centre of reinforcement. The beam has to resist a moment of 40 kNm. Concrete mix is M20 and steel is Fe

415 grade. The area of reinforcement should be
(a) 273 mm^2
(b) 373 mm^2
(c) 473 mm^2*
(d) 515 mm^2

Q.75. A doubly reinforced beam is provided with steel bars in/at
(a) compression region
(b) tension region
(c) both (a) and (b) *
(d) neutral axis

Q.76. In a doubly reinforced beam, strain in compression region (ε_{sc}) will be
(a) $\left(1-\frac{d'}{x_m}\right)$
(b) $\left(1-\frac{x_m}{d'}\right)$
(c) $0.0035\left(1-\frac{d'}{x_m}\right)$ *
(d) $0.0035\left(1-\frac{x_m}{d'}\right)$
where d' is effective cover to compression reinforcement.

Q.77. In doubly reinforced rectangular beam, the allowable stress in compression steel is
(a) equal to the permissible stress in tension in steel
(b) more than the permissible stress in tension in steel
(c) less than the permissible stress in tension in steel*
(d) not related to the permissible concrete compression stress

Q.78. Match List I and List II and select the correct answer using the codes given below the list:
List I
a. doubly reinforced beam
b. limit state design
c. minimum cover
d. span depth ratio
List II
1. serviceability
2. durability
3. reduction in sectional depth
4. ultimate moment capacity
(a) A2, B1, C3, D4
(b) A4, B3, C2, D1
(c) A1, B2, C3, D4
(d) A3, B4, C2, D1*

Q.79. A doubly reinforced beam is considered less economical than a singly reinforced beam because
(a) tensile steel required is more than for a balanced section
(b) shear reinforcement is more
(c) concrete is not stressed to its full value
(d) compressive steel is under stressed*

Q.80. Unequal top and bottom reinforcement in an RC section leads to
(a) creep deflection
(b) shrinkage deflection*
(c) long term deflection
(d) large deflection

Q.81. If d is effective depth, b is width and D is overall depth then maximum area of compression reinforcement in a beam is
(a) 0.04bd
(b) 0.04bD*
(c) 0.12bd
(d) 0.12bD

Q.82. In an RCC beam of breadth b and overall depth D exceeding 750 mm, side face reinforcement required and the allowable area of maximum tension reinforcement shall be respectively
(a) 0.2% and 0.02bD
(b) 0.3% and 0.03bD
(c) 0.1% and 0.04bD*
(d) 0.4% and 0.01bD

Q.83. When concrete slabs and beams are cast monolithic then we get
(a) T beam
(b) L beam
(c) any of (a) and (b) *
(d) none of these

Q.84. In flanged beams at continuous supports
(a) slab is in tension and part of beam is in compression*

(b) slab is in compression and part of beam is in tension
(c) both slab and beam will be in tension
(d) both slab and beam will be in compression

Q.85. In a floor system consisting of several beams cast monolithically with the slab
(a) intermediate beam will act as T beam
(b) end beam will acts as L beam
(c) beam round the staircase will act as L beam
(d) all the above*

Q.86. The web width of T beam is b_w. The effective depth of the T beam is d and depth of flange (or slab) is D_f. Effective width of flange will be lesser of
(a) $\frac{l_0}{6} + b_w + 6D_f$ or $x_1 + x_2 + b_w$ *
(b) $\frac{l_0}{(l_0/b)+4} + b_w$ or b
(c) $\frac{l_0}{12} + b_w + 3D_f$ or $x_1 + b_w$
(d) $\frac{0.5l_0}{(l_0/b)+4} + b_w$ or b
where b is actual width of flange, l_0 is distance between points of zero moment in beam and x_1, x_2 are half the clear distance between two adjacent beams.

Q.87. In above question, for an isolated T beam, effective width of flange will be
(a) $\frac{l_0}{6} + b_w + 6D_f$ or $x_1 + x_2 + b_w$
(b) $\frac{l_0}{(l_0/b)+4} + b_w$ or b*
(c) $\frac{l_0}{12} + b_w + 3D_f$ or $x_1 + b_w$
(d) $\frac{0.5l_0}{(l_0/b)+4} + b_w$ or b

Q.88. The effective width of a reinforced concrete T beam flange under compression, according to IS 456 code, given I_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
(a) $\frac{l_0}{6} + B + 6D$ *
(b) $l_0 + 6D$
(c) $\frac{l_0}{6} + 6D$
(d) $\frac{l_0}{6} + b$

Q.89. A T-beam roof consists of 100 mm thick reinforced concrete slab cast monolithic with 300 mm wide beams spaced 4 m centre to centre, the effective span of the beam being 5 m. The effective width of the flange, as per code, will be
(a) 1500 mm
(b) 1637 mm
(c) 1733 mm*
(d) 2050 mm

Q.90. A T-beam roof section has the following particulars:
Thickness of slab = 100 mm
Width of rib = 300 mm
Depth of beam = 500 mm
C/C distance of beams = 3 m
Effective span of beams = 6 m
Distance between points of contraflexure is = 3.6 m
The effective width of flange of the beam is
(a) 3000 mm
(b) 1900 mm
(c) 1600 mm
(d) 1500 mm*

Q.91. The minimum tension reinforcement in a T beam is given by
(a) $A_0/b_wd = 0.85/\sigma_y$*
(b) $A_0/b_fd = 0.85/\sigma_y$
(c) $A_0/D_fd = 0.85/\sigma_y$
(d) lesser of the (a) and (b)

Q.92. In a T beam, maximum area of tension or compression steel will be
(a) $0.04b_wD$*

(b) $0.04b_fD$
(c) $0.08b_wD$
(d) $0.08b_fD$

Q.93. A T beam is singly reinforced, balanced/ or over reinforced and its neutral axis lies in the web. Also $D_f/d \le 0.20$. Force of compression will be
(a) $0.36\sigma_{ck}b_wx_m$
(b) $0.446\sigma_{ck}(b_f - b_w)D_f$
(c) sum of (a) and (b) *
(d) difference of (a) and (b)

Q.94. In above question tension force will be
(a) σ_yA_t
(b) $0.36\sigma_yA_t$
(c) $0.87\sigma_yA_t$*
(d) none of these

Q.95. In above question, moment of resistance will be
(a) $0.36\sigma_{ck}b_wx_m(d - 0.42x_m)$
(b) $0.446\sigma_{ck}(b_f - b_w)D_f(d - 0.5D_f)$
(c) sum of (a) and (b) *
(d) difference of (a) and (b)

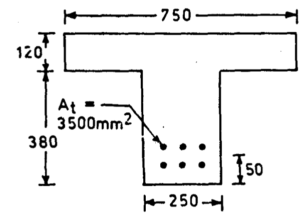
Q.96. A T beam is singly reinforced, balanced/ or over reinforced and its neutral axis lies in the web. Also $D_f/d > 0.20$. Moment of resistance will be
(a) $0.36\sigma_{ck}b_wx_m(d - 0.42x_m)$
(b) $0.446\sigma_{ck}(b_f - b_w)y_f(d - 0.5y_f)$
(c) sum of (a) and (b) *
(d) difference of (a) and (b)
where $y_f = (0.15x_m + 0.65D_f)$

Q.97. A T beam is singly reinforced, under reinforced and its neutral axis lies in the web. Also $D_f/x \le 0.43$. Moment of resistance will be
(a) $0.36\sigma_{ck}b_wx(d - 0.42x)$
(b) $0.446\sigma_{ck}(b_f - b_w)D_f(d - 0.5D_f)$
(c) sum of (a) and (b) *
(d) difference of (a) and (b)

Q.98. A T beam is singly reinforced, under reinforced and its neutral axis lies in the web. Also $D_f/x > 0.43$. Moment of resistance will be
(a) $0.36\sigma_{ck}b_wx(d - 0.42x)$
(b) $0.446\sigma_{ck}(b_f - b_w)y_f(d - 0.5y_f)$
(c) sum of (a) and (b) *
(d) difference of (a) and (b)
where $y_f = 0.15x + 0.65D_f$

Q.99. If in a T beam, neutral axis lies in flange then
(a) concrete below N.A. is assumed to have cracked
(b) beam is treated as rectangular beam having width b_f and depth d
(c) expressions for singly/doubly reinforced beam will be valid for this beam too
(d) all of the above*

Q.100. Consider following figure.



The neutral axis lies in
(a) flange
(b) web*
(c) mid way of web
(d) mid way of flange

Q.101. In a reinforced concrete T-beam (in which the flange is in compression). The position of neutral axis will
(a) be within the flange
(b) be within the web
(c) depend on the thickness of flange in relation to total depth and percentage of reinforcement*
(d) at the junction of flange and web

Q.102. Side face reinforcement, if required, in a T-beam will be
(a) 0.1% of the web area*
(b) 0.15% of the web area
(c) 0.2% to 0.3% of the web area
(d) half the longitudinal reinforcement

Q.103. Side face reinforcement is provided in a beam when the depth of web exceeds
(a) 300 mm

(b) 450 mm
(c) 500 mm
(d) 750 mm*

Q.104. Deep beams are designed for
(a) shear force only
(b) bending moment only*
(c) both shear force and bending moment
(d) bearing

Q.105. From limiting deflection point of view, use of high strength steel in RC beam results in
(a) reduction in depth
(b) no change in depth
(c) increase in depth*
(d) increase in width

Q.106. Beams sections of reinforced concrete designed in accordance with ultimate strength or limit state design approach, as compared to sections designed by working stress method for the same conditions of load and span and the same width, usually have
(a) a larger depth and smaller amount of reinforcement
(b) same depth and same reinforcement
(c) smaller depth and more reinforcement*
(d) same depth as that of a deep beam

SHEAR AND DEVELOPMENT LENGTH

Q.107. Shear force is present in the beam where there is
(a) change in force along the span
(b) change in shear force along the span
(c) change in bending moment*
(d) none of these

Q.108. According to Code, nominal shear stress τ_v is obtained as
(a) V_u/bd^2
(b) $V_u/\sqrt{bd}$
(c) V_u/bd*
(d) $0.4V_u/bd$
where V_u is factored shear stress.

Q.109. In above question if the beam is of varying section then nominal shear stress is given by
(a) $\dfrac{V_u + (M_u/d)\tan\beta}{bd}$
(b) $\dfrac{V_u - (M_u/d)\tan\beta}{bd}$
(c) $\dfrac{V_u \pm (M_u/d)\tan\beta}{bd}$*
(d) none of these
where M_u is factored bending moment at the section and β is angle between top and bottom edges of the beam.

Q.110. When shear reinforcement is necessary, the shear strength of the beam is sum of shear resistance of
(a) effective concrete area as a function of longitudinal main steel bars
(b) vertical shear stirrups
(c) inclined shear stirrups
(d) all the above*

Q.111. The chances of diagonal tension cracks in R.C.C. member reduce when
(a) axial compression and shear force act simultaneously
(b) axial tension and shear force act simultaneously*
(c) only shear force act
(d) flexural and shear force act simultaneously

Q.112. The maximum permissible shear stress $\tau_{c,\ max}$ given in IS code 456:2000 is based on
(a) diagonal tension failure*
(b) diagonal compression failure
(c) flexural tension failure
(d) flexural compression failure

Q.113. For inclined stirrups, most effective angle is
(a) 30^0
(b) 45^0*
(c) 60^0
(d) none of these

Q.114. If shear force V_u is less than 0.5 times of shear capacity then

(a) shear reinforcement must be provided
(b) minimum shear reinforcement should be provided
(c) maximum shear reinforcement should be provided
(d) no shear reinforcement is needed*

Q.115. If nominal shear stress is less than or equal to shear strength of the concrete then
(a) maximum shear reinforcement is provided
(b) minimum shear reinforcement is provided*
(c) no shear reinforcement is required
(d) either (b) or (c)

Q.116. In case of minimum shear reinforcement, spacing x of stirrups is given by
(a) $0.87\sigma_y A_0/b$
(b) $0.67\sigma_y A_0/0.4b$
(c) $0.87\sigma_y A_0/0.4b$*
(d) none of these
where A_0 is total cross sectional area of stirrup legs effective in shear.

Q.117. If nominal shear stress τ_v exceeds the shear strength of concrete, shear reinforcement must be provided. In this case spacing of vertical stirrups (x) will be obtained by equation
(a) $V_{us} = 0.87\sigma_y A_{sv}(d/x)$ *
(b) $V_{us} = \sigma_y A_{sv}(d/x)$
(c) $V_{us} = 0.87\sigma_y A_{sv}(x/d)$
(d) none of these
where V_{us} is net design shear.

Q.118. In above question, if instead of vertical stirrups we take inclined bars then spacing (x) will be obtained by
(a) $V_{us} = 0.87\sigma_y A_{sv}\frac{d}{x}(\cos\alpha)$
(b) $V_{us} = 0.87\sigma_y A_{sv}\frac{d}{x}(\sin\alpha)$
(c) $V_{us} = 0.87\sigma_y A_{sv}\frac{d}{x}(\sin\alpha + \cos\alpha)$ *
(d) $V_{us} = 0.87\sigma_y A_{sv}\frac{d}{x}(\tan\alpha)$

Q.119. Bond stress is defined as the shear force per unit of nominal surface area of
(a) beam section (vertical)
(b) beam section (horizontal)
(c) reinforcing bar*
(d) both (a) and (b)

Q.120. Bond stress acts
(a) perpendicular to bar
(b) 45^0 to the bar
(c) parallel to bar*
(d) on concrete

Q.121. If the bond stress developed in reinforced concrete beam is more than permissible value it can be brought down by increasing
1. depth of beam
2. diameter of bars
(a) 1 and 2 only
(b) 2 and 3 only
(c) 1 and 3 only*
(d) 1,2 and 3

Q.122. With respect to bond stress, critical sections may occur at
(a) face of support
(b) section of maximum stress
(c) point of contraflexure and points where bars may be curtailed theoretically
(d) all the above*

Q.123. Development length (L_d) is given by the formula
(a) $0.87\sigma_y\phi/\tau_{bd}$
(b) $0.87\sigma_y\phi/2\tau_{bd}$
(c) $0.87\sigma_y\phi/3\tau_{bd}$
(d) $0.87\sigma_y\phi/4\tau_{bd}$*
where ϕ is bar diameter and τ_{bd} is design bond stress for steel bar.

Q.124. Design bond stress for mild steel bar in tension for M20 grade concrete is (in N/mm^2)
(a) 1
(b) 1.2*
(c) 1.4
(d) 1.5

Q.125. Design bond stress for mild steel in tension for M25 grade concrete is (in N/mm^2)
(a) 1
(b) 1.2

(c) 1.4*
(d) 1.5

Q.126. For deformed bars in tension, the design bond stress is
(a) 25% more than that for mild steel bars
(b) 50% more than that for mild steel bars
(c) 60% more than that for mild steel bars*
(d) 1.9 N/mm^2

Q.127. In the above question if the bars are in compression then design bond stress will further be increased by
(a) 10%
(b) 20%
(c) 25%*
(d) 50%

Q.128. For an Fe250 grade steel bar in tension and M20 grade concrete, the development length will be
(a) 31ϕ
(b) 37ϕ
(c) 39ϕ
(d) 46ϕ*

Q.129. In above question if the bar is in compression then development length will be
(a) 31ϕ
(b) 37ϕ*
(c) 39ϕ
(d) 46ϕ

Q.130. For an Fe415 grade steel bar in tension and M20 grade concrete, the development length will be
(a) 32ϕ
(b) 38ϕ
(c) 40ϕ
(d) 47ϕ*

Q.131. At certain locations in a beam high bond stress may arise due to large variation of bending moment over a short distance. This bond stress is called
(a) shear stress
(b) critical shear stress
(c) flexural bond stress*
(d) critical bond stress

Q.132. If the design bond stress τ_{bd} is not to be exceeded, development length (L_d) should be less than or equal to
(a) $\frac{M_1}{V} + 2L_0$
(b) $\frac{M_1}{V}$
(c) $\frac{M_1}{V} + 4L_0$
(d) $\frac{M_1}{V} + L_0$ *
where L_0 is sum of anchorage beyond the centre of support and equivalent anchorage value of any hook.

Q.133. The anchorage value of a 45^0 bend is
(a) ϕ
(b) 2ϕ
(c) 4ϕ*
(d) 6ϕ

Q.134. The anchorage value of a standard U-type hook is equal to
(a) 4ϕ
(b) 8ϕ
(c) 12ϕ
(d) 16ϕ*

Q.135. For a simply supported beam, 50% bars are curtailed at a distance __ form face of support.
(a) 0.05 l
(b) 0.08 l*
(c) 0.10 l
(d) 0.20 l
where l is span.

Q.136. In cantilever beam, 50% bars are curtailed at __ from face of support.
(a) 0.5 l
(b) L_d
(c) greater of (a) and (b) *
(d) lesser of (a) and (b)

SLABS

Q.137. Which of the following statements is wrong?
(a) slabs are designed as having a unit width
(b) compression reinforcement must be provided in slabs*

(c) shear reinforcement is not provided in slabs instead depth is increased
(d) check for deflection is very important consideration in slab design

Q.138. Which of the following statements is true with regard to slab design?
(a) temperature reinforcement is provided at right angles to the main reinforcement*
(b) slabs are thicker than beams
(c) slab is designed by yield line theory only
(d) all the above

Q.139. In one way slabs
(a) L > B
(b) L > 2B*
(c) $L \geq 2B$
(d) none of these

Q.140. In design of slab, steel for negative moments is provided at
(a) 0.1 l
(b) L_d
(c) greater of (a) and (b) *
(d) lesser of (a) and (b)
where l is c/c distance between supports.

Q.141. If a solid slab is having a thickness less than or equal to 150 mm then its shear strength τ_c is increased by a factor k equal to
(a) 1.00
(b) 1.10
(c) 1.20
(d) 1.30*

Q.142. In above question if slab is thicker than 300 mm or more, then factor k is
(a) 1.00*
(b) 1.10
(c) 1.30
(d) 1.50

Q.143. In solid slabs, the nominal shear stress τ_v should be
(a) equal to $k\tau_c$
(b) $< k\tau_c$*
(c) $> k\tau_c$
(d) $\geq k\tau_c$

Q.144. A slab is having size 8 m x 3.5 m. It is
(a) one way slab*
(b) two way slab
(c) three way slab
(d) four way slab

Q.145. For the purpose of design as per IS 456, deflection of RC slab or beam is limited to
(a) 0.2% of span
(b) 0.25% of span
(c) 0.4% of span*
(d) 0.45% of span

Q.146. For checking deflection in a slab, the condition which must be fulfilled is
(a) $\frac{L}{d} \leq 180$
(b) $\frac{L}{d} \leq \alpha\beta\gamma\delta\lambda$ *
(c) $\frac{L}{d} \geq \alpha\beta\gamma\delta\lambda$
(d) none of these
where α is basic values of span to depth ratios for spans upto 10 m, β is a factor which accounts for correction in the value of α for spans greater than 10 m, γ is a factor which depends on the stress at service and amount of steel for tension reinforcement, δ is a factor which depends on the area of compression reinforcement and γ is the factor for flanged beams.

Q.147. In above question, value of α for cantilever is
(a) 5
(b) 7*
(c) 20
(d) 26

Q.148. In above question value of α for a simply supported beam is
(a) 5
(b) 9
(c) 20*
(d) 26

Q.149. In above question, value of α for continuous beam is
(a) 7

(b) 20
(c) 26*
(d) 35

Q.150. Value of β is (if the span is more than 10 m)
(a) 9
(b) 10/span*
(c) span/10
(d) greater of (a) and (b)

Q.151. Size of the room is 8m x 3.5 m. Given α = 20, β = 1, γ = 1, δ = 1 and γ = 1. The effective depth of slab from deflection criterion will be
(a) 400 mm
(b) 175 mm*
(c) 100 mm
(d) none of these

Q.152. Deflection can be controlled by using the appropriate
(a) aspect ratio
(b) modular ratio
(c) span/depth ratio*
(d) water/cement ratio

Q.153. Limit state of serviceability for deflection in including the effects due to creep, shrinkage and temperature occurring after erection of partitions and application of finishes as applicable to floors and roofs is restricted to
(a) span/150
(b) span/200
(c) span/250
(d) span/350*

Q.154. In case of 2-way slab, the limiting deflection of the slab is
(a) primarily a function of the long span
(b) primarily a function of the short span*
(c) independent of long or short spans
(d) dependent on both long and short spans

Q.155. Select the wrong statement
(a) when slabs are supported on four sides, two way spanning action occurs
(b) deflection is a two way slab is much less as compared to one way slab
(c) bending moment is two way slab is much less as compared to one way slab
(d) two way slab is thicker than one way slab for same load*

Q.156. For a two way slab
(a) $M_x = \alpha_x w l_x^2; M_y = \alpha_y w l_y^2$
(b) $M_x = \alpha_y w l_x^2; M_y = \alpha_x w l_y^2$
(c) $M_x = \alpha_x w l_y^2; M_y = \alpha_y w l_y^2$
(d) $M_x = \alpha_x w l_x^2; M_y = \alpha_y w l_x^2$ *

where l_x is length of shorter span and l_y is length of longer span. α_x and α_y are moment coefficients.

Q.157. In above question if $l_y/l_x = 1$ the values of α_x and α_y are respectively
(a) 0.124, 0.124
(b) 0.118, 0.118
(c) 0.074, 0.074
(d) 0.062, 0.062*

Q.158. The code requires that at least 50% of the tension reinforcement provided at midspan should extend to within ____ of the support (as appropriate).
(a) 0.1 l_x or 0.1 l_y*
(b) 0.2 l_x or 0.2 l_y
(c) 0.15 l_x or 0.15 l_y
(d) none of these

Q.159. The nature of bending moment developing on top face (on the supported sides) of a restrained slab is
(a) negative*
(b) positive
(c) zero
(d) either (a) or (b)

Q.160. For a two way restrained slab
(a) $M_x = \beta_x w l_x^2; M_y = \beta_y w l_y^2$
(b) $M_x = \beta_y w l_x^2; M_y = \beta_x w l_y^2$
(c) $M_x = \beta_x w l_y^2; M_y = \beta_y w l_y^2$
(d) $M_x = \beta_x w l_x^2; M_y = \beta_y w l_x^2$ *

where l_x is length of shorter span and l_y is length of longer span. β_x and β_y are moment coefficients.

Q.161. In above question if $l_y/l_x = 1$ and we are designing interior panel then β_x for negative moment at continuous edge will be
(a) 0.032*
(b) 0.037
(c) 0.047
(d) 0.051

Q.162. In above question for the same interior panel value of β_x for a positive moment at mid span will be
(a) 0.032
(b) 0.024*
(c) 0.037
(d) 0.041

Q.163. For a restrained slab if l_y/l_x = any value and we are designing interior panel then β_y for negative moment at continuous edge will be
(a) 0.032*
(b) 0.037
(c) 0.041
(d) 0.051

Q.164. In above question for the same interior panel value of β_y for a positive moment at mid span will be
(a) 0.032
(b) 0.024*
(c) 0.012
(d) 0.05

Q.165. For the purpose of designing restrained slab, the slab is divided into
(a) middle strip
(b) edge strips
(c) both (a) and (b) *
(d) neither (a) nor (b)

Q.166. The bending moments, calculated from coefficients β_x and β_y are assumed to act in
(a) edge strips
(b) middle strip*
(c) both (a) and (b)
(d) neither (a) nor (b)

Q.167. In above question, minimum reinforcement is provided in
(a) edge strips*
(b) middle strips
(c) neither (a) nor (b)
(d) both (a) and (b)

Q.168. In limit state approach, spacing of main reinforcement controls primarily
(a) collapse
(b) cracking*
(c) deflection
(d) durability

Q.169. Select false statement with regard to restrained slab design
(a) In two way restrained slab, negative moments arise at discontinuous edges
(b) At discontinuous edge, tension reinforcement equal to 50% of that at mid span is provided
(c) torsion reinforcement must be provided along shorter span*
(d) slab thickness must be sufficient for resisting shear

Q.170. If a two way simply supported slab has both spans less than 3.5 metre and the maximum live load is 3000 N/m^2, then according to Code, short span to overall depth ratio for Fe 415 grade steel will be
(a) 35
(b) 28*
(c) 40
(d) 32

Q.171. If a two way continuous slab has both spans less than 3.5 metre and the maximum live load is 3000 N/m^2, then according to Code, short span to overall depth ratio for Fe 415 grade steel will be
(a) 35
(b) 28
(c) 40
(d) 32*

Q.172. A reinforced concrete slab is 75 mm thick. The maximum size of reinforcement bar that can be used is
(a) 12 mm diameter
(b) 10 mm diameter
(c) 8 mm diameter*
(d) 6 mm diameter
Hint: max dia = 75/8 = 9.375 mm hence use 8 mm dia bars.

Q.173. Marcus correction is introduced as simple correction to
(a) reactions at support of a continuous slab obtained by Westergaard method to allow for corner restraint of slab
(b) sagging moments of a slab continuous over supports to allow for assistance given by torsion
(c) moments obtained by Rankine Grashof method to allow for corner restraint at corners and for resistance given by torsion*
(d) be applied to the steel area of counteract the negative bending moment at support to take care of stress concentration

Q.174. The bending moment coefficients for continuous RC slabs in IS 456-1978 code is based on
(a) Piegeaud method
(b) Marcus's method
(c) Yield line theory
(d) Westergaard's analysis*

Q.175. In the circular slab, tensile stresses develop on
(a) convex surface*
(b) concave surface
(c) both (a) and (b)
(d) neither (a) nor (b)

Q.176. In the above question, compressive stresses develop on
(a) convex surface
(b) concave surface*
(c) both (a) and (b)
(d) nowhere

Q.177. In the circular slab, reinforcement is provided near the
(a) convex surface*
(b) concave surface
(c) both (a) and (b)
(d) nowhere

Q.178. In above question, reinforcement is provided in
(a) radial direction
(b) circumferential direction
(c) both (a) and (b) *
(d) none of these

Q.179. A simply supported circular slab of radius "a" is simply supported and subject to a uniformly distributed load (w) them radial moment (M_r) at a section at distance "r" from the origin will be
(a) $\frac{w}{16}[(3+\mu)(a^2-r^2)]$ *
(b) $\frac{w}{24}[(3+\mu)(a^2-r^2)]$
(c) $\frac{w}{32}[(3+\mu)(a^2-r^2)]$
(d) none of these
where μ is Poisson's ratio.

Q.180. In the above question, circumferential moment (M_θ) will be
(a) $\frac{w}{16}[a^2(3+\mu)-r^2(1+3\mu)]$ *
(b) $\frac{w}{24}[a^2(3+\mu)-r^2(1+3\mu)]$
(c) $\frac{w}{32}[a^2(3+\mu)-r^2(1+3\mu)]$
(d) none of these

Q.181. In above question, radial shear force (V) will be
(a) wr*
(b) 0.33wr
(c) 0.67wr
(d) 0.5wr

Q.182. A fully restraint circular slab of radius "a" is simply supported and subject to a uniformly distributed load (w) them radial moment (M_r) at a section at distance "r" from the origin will be
(a) $\frac{w}{16}[a^2(1+\mu)+r^2(3+\mu)]$
(b) $\frac{w}{16}[a^2(3+\mu)-r^2(1+3\mu)]$
(c) $\frac{w}{16}[(3+\mu)(a^2-r^2)]$
(d) $\frac{w}{16}[a^2(1+\mu)-r^2(3+\mu)]$ *

Q.183. In above question, circumferential moment, M_θ, will be

(a) $\frac{w}{16}[a^2(1+\mu)+r^2(3+\mu)]$
(b) $\frac{w}{16}[a^2(3+\mu)-r^2(1+3\mu)]$
(c) $\frac{w}{16}[(3+\mu)(a^2-r^2)]$
(d) $\frac{w}{16}[a^2(1+\mu)-r^2(1+3\mu)]$*

Q.184. A slab which is supported on column without beams is called
(a) restrained slab
(b) simply supported slab
(c) flat slab*
(d) none of these

Q.185. Minimum thickness of flat slab should be
(a) 100 mm
(b) 125 mm*
(c) 150 mm
(d) 175 mm

Q.186. A flat slabs acts as a
(a) one way slab
(b) two way slab*
(c) either (a) or (b), depending upon length to breadth ratio
(d) circular slab

Q.187. Drops are provided in flat slabs to resist
(a) bending moment
(b) thrust
(c) shear*
(d) torsion

COLUMNS

Q.188. A short column has a maximum slenderness ratio of
(a) 10
(b) 12*
(c) 14
(d) 16

Q.189. Slenderness ratio of a long column should be in between
(a) 12 and 30
(b) 12 and 45
(c) 12 and 60*
(d) 12 and 180

Q.190. If a column is effectively held in position and restrained against rotation at both ends then effective height of column will be
(a) L
(b) 0.80 L
(c) 0.65 L *
(d) 1.2 L

Q.191. In the above question if the column is restrained at one end then effective height of column will be
(a) L
(b) 0.80 L*
(c) 1.2 L
(d) 2.0 L

Q.192. If a column is effectively held in position at both ends, but not against rotation then effective height of column will be
(a) L*
(b) 0.80 L
(c) 1.20 L
(d) 1.50 L

Q.193. In the design of column, tensile strength of concrete is
(a) taken
(b) reduced by 50%
(c) reduced by 25%
(d) ignored*

Q.194. In the design of column, maximum compressive strain in concrete in axial compression is taken as
(a) 0.001
(b) 0.002*
(c) 0.003
(d) 0.004

Q.195. According to Code, minimum eccentricity should be
(a) $e_{min} < \frac{l}{500}+\frac{D}{30} > 20$ mm
(b) $e_{min} > \frac{l}{500}+\frac{D}{30} > 20$ mm
(c) $e_{min} \geq \frac{l}{500}+\frac{D}{30} > 20$ mm*
(d) there is no minimum eccentricity in axially loaded column

where l is unsupported length of column in mm and D is lateral dimension (under consideration) of column in mm.

Q.196. For a short column under axial compression, factored axial load (P_u) is given by

(a) $0.4\sigma_{ck}\left(A_g - \frac{pA_g}{100}\right) + 0.67\sigma_y \frac{pA_g}{100}$

(b) $0.4\sigma_{ck}A_c + 0.67\sigma_y A_{sc}$

(c) both (a) and (b) *

(d) none of these

where A_c is area of concrete, and A_{sc} is total area of steel, A_g is gross area of cross section = bD, p is percentage of reinforcement.

Q.197. In above question, the expression of P_u should be based on stresses in concrete and steel corresponding to a maximum strain of

(a) 0.001
(b) 0.002*
(c) 0.003
(d) any strain

Q.198. Maximum stress in concrete at strain of 0.002 will be

(a) $0.33\sigma_{ck}$
(b) $0.4\sigma_{ck}$
(c) $0.446\sigma_{ck}$*
(d) none of these

Q.199. Maximum stress in mild steel for a strain of 0.002 will be

(a) σ_y
(b) $0.67\sigma_y$
(c) $0.87\sigma_y$*
(d) $0.79\sigma_y$

Q.200. Maximum stress in Fe 415 steel for a strain of 0.002 will be

(a) σ_y
(b) $0.67\sigma_y$
(c) $0.87\sigma_y$
(d) $0.79\sigma_y$*

Q.201. In the expression of P_u, maximum values of stresses in concrete and steel are reduced by

(a) 5%
(b) 10%*
(c) 15%
(d) 20%

Q.202. The minimum area of cross section of longitudinal bars must be at least __ % of the gross sectional area of column.

(a) 0.5
(b) 0.8*
(c) 0.10
(d) 0.12

Q.203. The maximum area of cross-section of longitudinal bars must not exceed __ % of the gross sectional area of concrete.

(a) 4
(b) 6*
(c) 8
(d) 12

Q.204. The limits of percentage p of the longitudinal reinforcement in a column is

(a) 0.15% to 2%
(b) 0.8 to 4%
(c) 0.8 to 6%*
(d) 0.8 to 8%

Q.205. The longitudinal bar should not be less than

(a) 8 mm in diameter
(b) 10 mm in diameter
(c) 12 mm in diameter*
(d) 22 mm in diameter

Q.206. The minimum number of longitudinal bars in rectangular column should be

(a) 2
(b) 4*
(c) 6
(d) 8

Q.207. The minimum number of longitudinal bars in circular column should be

(a) 2
(b) 4
(c) 6*
(d) 8

Q.208. Spacing of longitudinal bars measured along the periphery of a column should not exceed

(a) 100 mm
(b) 200 mm
(c) 300 mm*
(d) 400 mm

Q.209. Transverse reinforcement is provided in the form of

(a) lateral ties
(b) spiral
(c) either (a) or (b) *

(d) none of these

Q.210. Lateral ties in RC columns are provided to resist
(a) bending moment
(b) shear
(c) buckling of longitudinal steel bars*
(d) both bending moment and shear

Q.211. The diameter of lateral ties/helical reinforcement should not be less than
(a) one fourth of diameter of largest longitudinal bar
(b) 6 mm
(c) both (a) and (b) *
(d) none of these

Q.212. The pitch of lateral ties should not exceed
(a) least lateral dimension of column
(b) 16 x smallest dia. of longitudinal reinforcement
(c) 300 mm
(d) all the above*

Q.213. If an increased load on the column on the strength of the helical reinforcement is allowed for, its pitch should not exceed
(a) 75 mm
(b) 1/6 of core diameter of column
(c) both (a) and (b) *
(d) neither (a) nor (b)

Q.214. If an increased load on the column on the strength of helical reinforcement is not allowed for, its pitch should not exceed
(a) least lateral dimension of column
(b) 16 x smallest dia. of longitudinal bar
(c) 300 mm
(d) all the above*

Q.215. Which of the following statements is correct?
(a) maximum longitudinal reinforcement in an axially loaded short column is 6% of gross sectional area*
(b) columns with circular section are provided with transverse reinforcement of helical type only
(c) spacing of lateral ties cannot be more than 16 times the diameter of tie bar
(d) longitudinal reinforcement bar need not be in contact with lateral ties

Q.216. Torsion resisting capacity of a given RC section
(a) decreases with decrease in stirrup spacing
(b) decreases with increase in longitudinal bars
(c) does not depend upon stirrup and longitudinal steels
(d) increases with the increase in stirrup and longitudinal steels*

Q.217. The collapse load (P) for an axially loaded spirally reinforced column without any partial safety factor is
(a) $0.67\sigma_{ck}A_c + \sigma_y A_{sc} + k_s\sigma_{sp}A_{sp}$ *
(b) $0.67\sigma_{ck}A_c + \sigma_y A_{sc} + 2k_s\sigma_{sp}A_{sp}$
(c) $0.67\sigma_{ck}A_c + \sigma_y A_{sc} + 3k_s\sigma_{sp}A_{sp}$
(d) none of these

where k_s is a constant, σ_{sp} is characteristic strength of helical reinforcement, A_c is area of core and A_{sp} is volume of spiral steel per unit length of column.

Q.218. In above question, value of k_s is
(a) 1.5 to 2.5*
(b) 2.5 to 4.0
(c) 4.0 to 6.0
(d) none of these

Q.219. In a helically reinforced column, characteristic strength of helical reinforcement (σ_{sp}) should not exceed
(a) 250 N/mm^2
(b) 415 N/mm^2*
(c) 500 N/mm^2
(d) none of these

Q.220. Size of a column is 60 cm x 60 cm. Longitudinal bars provided are of 20 mm diameter. The diameter of lateral ties will be
(a) 6 mm*
(b) 5 mm
(c) 8 mm

(d) 12 mm

Q.221. In above question, pitch of the lateral ties should be
(a) 600 mm
(b) 320 mm
(c) 300 mm*
(d) 200 mm

Q.222. In an axially loaded spirally reinforced short column, the concrete inside the core is subjected to
(a) bending and compression
(b) biaxial compression
(c) triaxial compression
(d) uniaxial compression*

WORKING STRESS METHOD

Q.223. Consider the following statements regarding the working stress design of under reinforced RC section:
1. The neutral axis depth will be greater than that of a balanced section
2. The stress in steel in tension will reach its maximum permissible value
3. The moment of resistance will be less than that of the balanced section
4. The concrete on the tension side is also to be considered for calculating the moment of resistance of the section.

Of these statements
(a) 1, 2 are correct
(b) 1, 4 are correct
(c) 3, 4 are correct
(d) 2, 3 are correct*

Q.224. Which of the following sections of equal cross-sectional area can resist the torsional moment of an RCC beam section more efficiently when the working stress design is being adopted?
(a) an unsymmetrical I-section
(b) a box section
(c) a solid rectangular section*
(d) a symmetrical I-section

Q.225. For a singly reinforced beam
(a) $N_b d = \dfrac{d}{1 + \dfrac{\sigma_{st}'}{m\sigma_{cb}'}}$
(b) $b\dfrac{x^2}{2} - mA_t(d - x) = 0$
(c) $C = bNd\dfrac{\sigma_{cb}'}{2}$ and $T = A_t\sigma_{st}'$
(d) all the above*

where N_b is coeff. of balanced depth, d is effective depth of the section, σ_{st}' is computed tensile stress in tension steel, σ_{cb}' is computed compressive stress in the extreme fibre, m is modular ratio, b is breadth of section, x is Nd i.e. depth of neutral axis, N is coeff. of depth of neutral axis and A_t is total area of steel in tension. C is force of compression and T is force of tension.

Q.226. For a singly reinforced beam, lever arm is
(a) d - Nd/2
(b) d - Nd/3*
(c) d - Nd/4
(d) none of these

Q.227. For a singly reinforced beam, moment of resistance with respect to compression is
(a) $bNd\sigma_{cb}'(d - Nd/3)$
(b) $0.33bNd\sigma_{cb}'(d - Nd/3)$
(c) $0.5bNd\sigma_{cb}'(d - Nd/3)$ *
(d) none of these

Q.228. In above question moment of resistance with respect to steel is
(a) $A_t\sigma_{st}'(d - Nd/3)$*
(b) $0.5A_t\sigma_{st}'(d - Nd/3)$
(c) $0.33A_t\sigma_{st}'(d - Nd/3)$
(d) none of these

Q.229. Permissible stress in bending σ_{cb} for M15 concrete in compression is
(a) 2 N/mm^2
(b) 5 N/mm^2*
(c) 7 N/mm^2
(d) 10 N/mm^2

Q.230. Average bond stress for plain bars in tension τ_{bd} in N/mm^2, for M15 concrete is
(a) 1.2
(b) 1.0
(c) 0.9
(d) 0.6*

Q.231. The effective depth of a singly reinforced beam is 30 cm. the section is over reinforced and the neutral axis is 12 cm below the top. If the maximum stress attained by concrete is 50 kg/cm^2 and the modular ratio is 18, then stress developed in steel would be
(a) 1800 kg/cm^2
(b) 1600 kg/cm^2
(c) 1350 kg/cm^2*
(d) 1300 kg/cm^2

Q.232. For a doubly reinforced beam, depth of neutral axis (x) is obtained from equation
(a) $(bx^2/2)+(1.5m-1)A_{sc}(x-d')-mA_t(d-x)=0$ *
(b) $(bx^2/2)+(1.5m-1)A_{sc}(x-d')-A_t(d-x)=0$
(c) $(bx^2/2)+(m-1)A_{sc}(x-d')-mA_t(d-x)=0$
(d) none of these
where A_{sc} is area of compression steel and d' is centre of gravity of compression steel from extreme fibre in compression.

Q.233. Force of compression in concrete (C_1) in doubly reinforced beam is
(a) $Nd(\sigma_{cb}'/2)$
(b) $(1.5m-1)A_{sc}\sigma_{cb}''$
(c) $bNd(\sigma_{cb}'/3)$
(d) $bNd(\sigma_{cb}'/2)$ *
where σ_{cb}'' is compression stress in concrete at the level of compression steel.

Q.234. Force of compression in steel (C_2) is
(a) $Nd(\sigma_{cb}'/2)$
(b) $(1.5m-1)A_{sc}\sigma_{cb}''$ *
(c) $bNd(\sigma_{cb}'/3)$
(d) $bNd(\sigma_{cb}'/2)$

Q.235. In above two questions, value of σ_{cb}'' is given by equation
(a) $\left(\frac{Nd-d'}{Nd+d'}\right)\sigma_{cb}'$
(b) $\left(\frac{Nd-d'}{Nd}\right)\sigma_{cb}'$ *
(c) $\left(\frac{Nd+d'}{Nd}\right)\sigma_{cb}'$
(d) none of these

Q.236. In doubly reinforced beam, force of tension in bottom steel T is
(a) $0.5A_t\sigma_{st}'$
(b) $1.5mA_t\sigma_{st}'$
(c) $A_t\sigma_{st}'$ *
(d) none of these

Q.237. In doubly reinforced beam, combined line of action of forces due to C_1 and C_2 acts at a distance "a" from top fibre. this distance "a" is given by formula
(a) $\frac{C_1Nd/3-C_2d'}{C_1+C_2}$
(b) $\frac{C_1d'+C_2Nd/3}{C_1+C_2}$
(c) $\frac{C_1Nd/3+C_2d'}{C_1+C_2}$ *
(d) Nd/3

Q.238. In doubly reinforced beam, moment of resistance with respect to compression is
(a) $C_1(d-Nd/3)-C_2(d-d')$
(b) $C_2(d-Nd/3)-C_1(d-d')$
(c) $C_1(d-Nd/3)+C_2(d-d')$ *
(d) $A_t\sigma_{st}'(d-a)$

Q.239. In above question, moment of resistance with respect to steel is
(a) $C_1(d-Nd/3)-C_2(d-d')$
(b) $C_1(d-Nd/3)+C_2(d-d')$
(c) $A_t\sigma_{st}'(Nd-a)$ *
(d) $A_t\sigma_{st}'(d-a)$

Q.240. For a singly reinforced T beam, depth of neutral axis is computed from equation

(a) $b_f D_f (x - 0.5D_f) + b_w (x - D_f)^2 - mA_t (d - x) = 0$
(b) $b_f D_f (x - 0.5D_f) + (b_w / 3)(x - D_f)^2 - mA_t (d - x) = 0$
(c) $b_f D_f (x - 0.5D_f) + (b_w / 2)(x - D_f)^2 - mA_t (d - x) = 0$ *
(d) none of these

where b_f is effective width of flange, D_f is depth of flange, b_w is breadth of web and x is Nd = depth of neutral axis which is assumed to lie in web.

Q.241. In above question
(a) $C_1 = b_f D_f [(\sigma_{cb}' + \sigma_{cb}'')/2]$
(b) $C_2 = b_w (Nd - D_f)\sigma_{cb}''/2$
(c) $T = A_t \sigma_{st}'$
(d) all the above*

where C_1 is force of compression in flange, C_2 is force of compression in web and T is force of tension in steel. Also σ_{cb}" is compressive stress at depth D_f from top fibre.

Q.242. In above question, force C_1 acts at a distance a_1 from top which is given by
(a) $D_f + \left(\frac{Nd - D_f}{3}\right)$
(b) $\left(\frac{\sigma_{cb}' + 2\sigma_{cb}''}{\sigma_{cb}' + \sigma_{cb}''}\right)\left(\frac{D_f}{3}\right)$ *
(c) $(D_f + Nd)/3$
(d) none of these

Q.243. In above question, force C_2 acts at a_2 from top fibre, which is given by
(a) $D_f + \left(\frac{Nd - D_f}{3}\right)$ *
(b) $\left(\frac{\sigma_{cb}' + 2\sigma_{cb}''}{\sigma_{cb}' + \sigma_{cb}''}\right)\left(\frac{D_f}{3}\right)$
(c) $(D_f + Nd)/3$
(d) none of these

Q.244. In above questions, resultant line of forces C_1 and C_2 lies at a distance "a" from top fibre. "a" is
(a) $d - a$
(b) $(D_f + Nd)/3$
(c) $\frac{C_1 a_1 + C_2 a_2}{C_1 + C_2}$ *
(d) $\frac{C_1 a_1 - C_2 a_2}{C_1 - C_2}$

Q.245. In T beam, moment of resistance with respect to compression is
(a) $T(d - a)$
(b) $C_1(d - a_1) - C_2(d - a_2)$
(c) $C_1(d - a_1) + C_2(d - a_2)$ *
(d) none of these

Q.246. In above question, moment of resistance with respect to tension is
(a) $T(d - a)$ *
(b) $C_1(d - a_1) - C_2(d - a_2)$
(c) $C_1(d - a_1) + C_2(d - a_2)$
(d) none of these

Q.247. Permissible axial load (P) on a *short* column is
(a) $\sigma_c A_c + \sigma_{sc} A_{sc}$ *
(b) $\sigma_c A_c + 1.5\sigma_{sc} A_{sc}$
(c) $1.5\sigma_c A_c + \sigma_{sc} A_{sc}$
(d) none of these

where A_c is net area of concrete, σ_c is permissible stress in concrete in direct compression, σ_{sc} is permissible stress in steel in direct compression and A_{sc} is area of longitudinal steel.

Q.248. Strength of a slender column is equal to strength of a short column multiplied by a reduction factor which is given as C_r, which is
(a) $1.25 - \frac{1}{48b}$
(b) $1.25 - \frac{1}{160r}$
(c) any of (a) and (b) *
(d) neither (a) nor (b)

Q.249. The load carrying capacity of a column designed by working stress method is 500 kN. The collapse load of the column is
(a) 500 kN

(b) 662.5 kN
(c) 750 kN*
(d) 1100 kN

QUESTIONS FROM VARIOUS EXAMS (LIMIT STATE/WORKING STRESS)

Q.250. In design of R.C.C. structures, the tensile strength of concrete is taken as:
(a) 5 N/mm^2
(b) 2 N/mm^2
(c) 0.3 N/mm^2
(d) None of these* (SSC 2018)

Q.251. In which beam tension capacity of steel is greater than combined compression capacity of steel and concrete?
(a) Over-reinforced
(b) Under-reinforced*
(c) Singly reinforced
(d) Doubly reinforced (SSC 2018)

Q.252. If permissible compressive stress in concrete is 15 kg/cm^2, tensile stress in steel is 1400 kg/cm^2 and modular ratio is 18, the depth of the beam is
(a) $d = \sqrt{\frac{0.11765xBM}{breadth}}$ *
(b) $d = \sqrt{\frac{0.22765xBM}{breadth}}$
(c) $d = \sqrt{\frac{0.33765xBM}{breadth}}$
(d) $d = \sqrt{\frac{0.44765xBM}{breadth}}$
(SSC 2018)

Q.253. The breadth of a ribbed slab containing two bars must be between
(a) 6 cm to 7.5 cm
(b) 8 cm to 10 cm
(c) 10 cm to 12 cm*
(d) None of these (SSC 2018)

Q.254. When not specified, the volume of steel in R.C.C. work is taken as:-
(a) 1% to 1.6% of R.C.C. volume
(b) 2% to 4% of R.C.C. volume
(c) 4% to 6% of R.C.C. volume
(d) 0.6% to 1% of R.C.C. volume*
(SSC 2018)

Q.255. Lateral ties in RCC columns are provided to resist
(a) Bending moment
(b) Shear
(c) Buckling of longitudinal steel base*
(d) Both bending moment and Shear
(RRB 2014)

Q.256. In a Cantilever beam carrying gravity load, main reinforcement to resist Bending moment is provided
(a) above the Neutral Axis *
(b) as vertical stirrups
(c) as a helical reinforcement
(d) below the Neutral Axis
(RRB 2014)

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