ACE Engineering Academy

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ESE- 2020 (Prelims) - Offline Test Series **Test- 13**

CIVIL ENGINEERING

SUBJECT: SOLID MECHANICS, CONSTRUCTION PLANNING & MANAGEMNET AND REINFORCED CEMENT CONCRETE

SOLUTIONS

01. Ans: (c)

Sol: Poisson's ratio (μ) = $\dfrac{-\text{lateral strain}}{\text{longitudinal strain}}$

Since 'μ' is –ve, lateral strain and longitudinal strain are of same sign. i.e., under compression, cross-section area decreases.

$\therefore$ True stress (σ_a) = $\dfrac{P}{(A-\Delta A)}$

Engineering stress (σ_o) = $\dfrac{P}{A}$

$\therefore$ $\sigma_a > \sigma_o$ for a particular strain.

Hence option 'c' is correct.

02. Ans: (b)

Sol: Strain matrix = $\begin{bmatrix} \varepsilon_{xx} & \dfrac{\phi_{xy}}{2} & \dfrac{\phi_{xz}}{2} \\ \dfrac{\phi_{xy}}{2} & \varepsilon_{yy} & \dfrac{\phi_{yz}}{2} \\ \dfrac{\phi_{xz}}{2} & \dfrac{\phi_{yz}}{2} & \varepsilon_{zz} \end{bmatrix}$

$\therefore$ shear strain in x. y plane = ϕ_{xy}

$$\therefore \frac{\phi_{xy}}{2} = 0.006$$

$$\therefore \phi_{xy} = 0.012$$

Shear modulus $G = \dfrac{\tau}{\phi_{xy}}$

$$= \frac{100\times10^6}{0.012}$$

$= 8333.33 \times 10^6$ MPa

$= 8.33$ GPa

03. Ans: (b)

Sol:

Working stress

$$= \frac{P}{A} = \frac{110\times10^3}{\frac{22}{7}\times\frac{50\times50}{4}} = 56 \text{ MPa}$$

Factor of safety $= \dfrac{\text{ultimate stress}}{\text{working stress}}$

$$= \frac{252}{56} = 4.5$$

Margin of safety = FOS – 1 = 4.5 – 1 = 3.5

04. Ans: (b)

Sol: Deflection due to self weight = (δ_{BC} due to self weight of BC) + (δ_{AB} due to self weight of AB) + (δ_{AB} due to self weight of BC)

$$= \frac{W_2L_2}{2A_2E_2} + \frac{W_1L_1}{2A_1E_1} + \frac{W_2L_1}{A_1E_1}$$

$$= \frac{40\times10^3\times(2000)}{2\times400\times100\times10^3} + \frac{60\times10^3\times2000}{2\times600\times200\times10^3} + \frac{40\times10^3\times2000}{600\times200\times10^3}$$

= 1 + 0.5 + 0.67

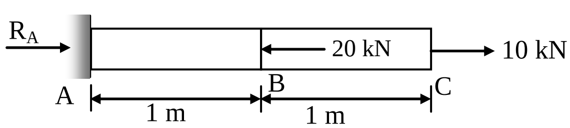
= 2.167 mm

05. Ans: (a)

Sol: Stem of counterfort is designed as a continuous slab supported on counterforts,

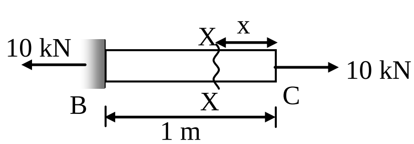
06. Ans: (b)

Sol:

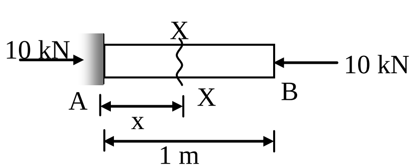


$\Sigma F_x = 0 \qquad R_A - 20 + 10 = 0$

$\therefore \qquad R_A = 10$ kN



FBD:



In AB: at section 'x' from A

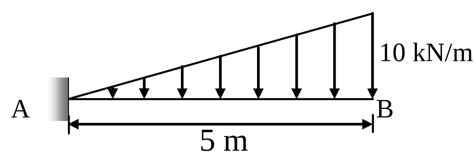
$$\delta_x = \frac{Px}{AE} = \frac{-10\times10^3\times x}{(10\times10)(100\times10^3)} = \frac{-x}{1000}$$

$\therefore$ at A : $\qquad x = 0 \therefore \delta_A = 0$

at B : $\qquad x = 1$ m $\therefore \delta_B = -1$mm

07. Ans: (d)

Sol: The loading is linearly varying as shown



At B: loading = 2× 5 = 10 kN/m

$$\therefore \text{ Max BM at A} = \left(\frac{1}{2}\times10\times5\right)\times\frac{2}{3}\times5$$

= 83.33 kN-m

08. Ans: (b)

Sol: Shear flow is variation of shear per unit length $= \dfrac{VA\bar{y}}{I_{xx}}$

09. Ans: (c)

Sol: Shear stress $= \dfrac{T}{Z} = \dfrac{PR}{\left(\dfrac{\pi d^3}{16}\right)}$

$$= \frac{16\times100\times\left(\frac{100}{2}\right)}{\pi\times10^3}\text{ MPa}$$

$$= \frac{80}{\pi}\text{ MPa}$$

10. Ans: (d)

Sol: Euler's buckling load = $\dfrac{\pi^2 EI}{\ell_{eff}^2}$

For circular column, $I = \dfrac{\pi D^4}{64}$

$\therefore$ $P \propto D^4$ for constant E, l

$\therefore$ $P = kD^4$

$\therefore$ $\log P = \log k + 4 \log D$

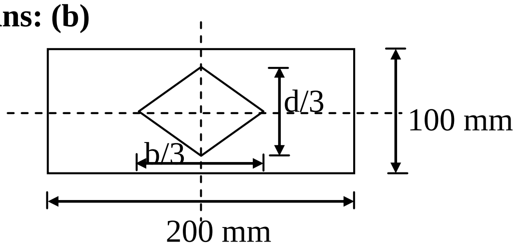
$\therefore$ $\dfrac{\Delta P}{P} = 0 + 4\dfrac{\Delta D}{D}$

$= 4 \times 10$

$= 40\%$

11. Ans: (b)

Sol:



The core (or) kern of a rectangular c/s is rhombus

Equation in first quadrant is

$$\frac{x}{\left(\frac{b}{6}\right)} + \frac{y}{\left(\frac{d}{6}\right)} = 1$$

$$\Rightarrow \frac{x}{\left(\frac{200}{6}\right)} + \frac{y}{\left(\frac{100}{6}\right)} = 1$$

$\Rightarrow$ $3x + 6y = 100$

12. Ans: (d)

Sol: Shear strain = $\phi = \dfrac{\partial u}{\partial y} + \dfrac{\partial v}{\partial x}$

$$= \left[\frac{\partial}{\partial y}(2x+3y) + \frac{\partial}{\partial x}(3x+2y)\right] \times 10^{-3}$$

$= (3 + 3) \times 10^{-3}$

$= 6 \times 10^{-3}$

$\therefore$ shear stress $= G \times \phi$

$= 100 \times 10^3 \times 6 \times 10^{-3}$

$= 600$ MPa

13. Ans: (c)

Sol: $\sigma = \left(\dfrac{\sigma_x + \sigma_y}{2}\right) + \left(\dfrac{\sigma_x - \sigma_y}{2}\right)\cos 2\theta$

$\tau = \left(\dfrac{\sigma_x - \sigma_y}{2}\right)\sin 2\theta$

At 30^o $\tau = 0$ $\therefore$ $\sigma_x = \sigma_y$

$$\sigma = \left(\frac{\sigma_x + \sigma_y}{2}\right)$$

$$\Rightarrow 100 = \frac{\sigma_x + \sigma_y}{2}$$

$\sigma_x = \sigma_y = 100$ MPa.

14. Ans: (c)

Sol: All the failure theories gives nearly same result for uniaxial tension test.

15. Ans: (a)

Sol: Critical stress under biaxial moments

$$= \frac{P}{A} - \frac{M_x}{Z} - \frac{M_y}{Z} \geq 0$$

$$\Rightarrow \frac{120 \times 10^3}{100 \times 100} - \frac{M}{100 \times \frac{100^2}{6}} - \frac{M}{100 \times \frac{100^2}{6}} \geq 0$$

$$\Rightarrow 12-\frac{12}{10^6}M\geq 0$$

$$\Rightarrow \quad M\leq 10^6 \text{ Nmm}$$

$$M\leq 1 \text{ kN-m}$$

$\therefore$ If M > 1 kN-m, tension develops

16. Ans: (c)

Sol: Toughness is the ability to store large strain energy before fracture and is area under stress strain curve upto fracture

Since ductile materials have large area, upto fracture, they are tough.

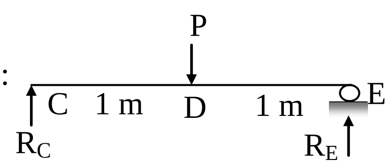
17. Ans: (c)

Sol:

- Since the bar is subjected to temperature rise, it tries to expand, As the ends are fixed, the expansion is prevented by inducing compressive stress.
- Stress induced in the longitudinal direction = EαT (Compressive)
- Since the bar is free in lateral direction, it expands and lateral stress is zero
-

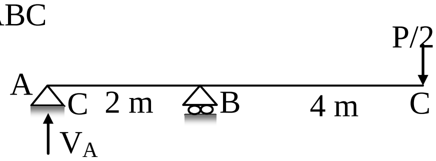
18. Ans: (b)

Sol: In CDE:



$$\therefore R_C=R_E=\frac{P}{2}$$

In ABC



Taking moments about 'B'

$$V_A(2)+\left(\frac{P}{2}\right)(4)=0$$

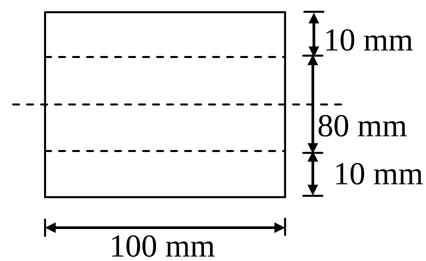
$$V_A=-P$$

i.e., $\quad V_A = P\ (\downarrow)$

19. Ans: (a)

Sol: Modular ratio $=\dfrac{2\times10^5}{2\times10^4}=10$

Equivalent wooden sections

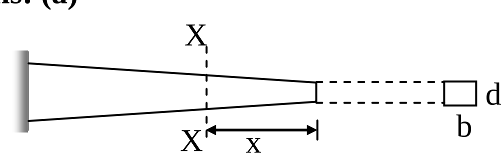


$\therefore$ Maximum stress

$$=\frac{M}{Z}=\frac{100\times10^6}{\frac{100\times100^2}{6}}=600\text{ MPa}$$

20. Ans: (a)

Sol:



For a cantilever subjected to UDL, a distance 'x' from free end

$$BM=\frac{wx^2}{2}$$

For beam of uniform strength, stress at extreme fiber is constant

$$\frac{M}{Z} = \text{constant}$$

$$\Rightarrow \frac{wx^2}{\frac{b_x d_x^2}{6}} = \text{constant}$$

$$\Rightarrow x^2 = (\text{constant}) \frac{b_x d_x^2}{6}$$

$\therefore$ For constant width, $d \propto x$.

i.e., depth should vary linearly

21. Ans: (c)

Sol: $$\varepsilon_h = \frac{\text{Change in diameter}}{\text{original diameter}} = \frac{1}{E}(\sigma_h - \mu\sigma_\ell)$$

$$\Rightarrow \frac{\Delta D}{D} = \frac{1}{E}\left(\frac{PD}{2t} - \frac{\mu PD}{4t}\right)$$

$$\Rightarrow \Delta D = \frac{PD^2}{4tE}(2-\mu)$$

22. Ans: (c)

Sol: Torsional flexibility = $\frac{L}{GI_p}$

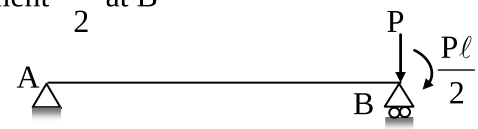
$$\text{Ratio} = \left(\frac{L_s}{L_h}\right) \times \left(\frac{I_{p,\text{hallow}}}{I_{p,\text{solid}}}\right)$$

$$= \frac{L_s}{L_h}\left(\frac{\frac{\pi}{32}(D^4 - d^4)}{\frac{\pi}{32}D^4}\right)$$

$$= \left[1 - \left(\frac{d}{D}\right)^4\right]\frac{L_s}{L_h}$$

23. Ans: (d)

Sol: Load at 'c' can be replaced by load 'P' and moment $\frac{P\ell}{2}$ at B



$\therefore$ Slope at A = slope due to moment

$$= \frac{M\ell}{6EI}$$

$$= \left(\frac{P\ell}{2}\right)\frac{\ell}{6EI}$$

$$= \frac{P\ell^2}{12EI}$$

24. Ans: (c)

Sol: Deflection at c = $\Delta_B + (\theta_B)$ (BC)

$$= \frac{ML^2}{2EI} + \frac{ML}{EI} \times L$$

$$= \frac{3}{2}\frac{ML^2}{EI}$$

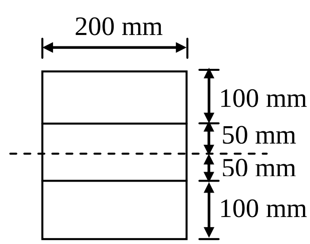
25. Ans: (a)

Sol: Shear stress = $\frac{VA\bar{y}}{Ib}$

$$I = 200 \times \frac{(300)^3}{12}$$

$$A\bar{y} = (200 \times 100)\left(50 + \frac{100}{2}\right)$$

$$= 200 \times 100 \times 100$$



$$\therefore\ \tau = \frac{200\times10^{3}\times200\times100\times100}{200\times\frac{(300)^{3}}{12}\times200}$$

$= 4.44$ MPa

26. Ans: (b)

Sol: Slope at 'c' due to 'P'

$$= \frac{P\ell^{2}}{2EI}(\text{anti clock wise})$$

Slope at 'c' due to W

$$= \frac{W(2\ell)^{2}}{2EI}(\text{clockwise})$$

$$\text{Net slope at c} = \frac{P\ell^{2}}{2EI} - \frac{4W\ell^{2}}{2EI} = 0\,c$$

$$\Rightarrow \frac{W}{P} = \frac{1}{4}$$

27. Ans: (c)

Sol: Maximum shear force

$$= P = \frac{W}{2} = \frac{10}{2} = 5\text{ kN}$$

Maximum shear stress for circular c/s $= \frac{4}{3}\tau_{avg}$

$$\Rightarrow 2 = \frac{4}{3}\times\frac{P}{\frac{\pi}{4}d^{2}}$$

$$\Rightarrow 2 = \frac{4}{3}\times\frac{5\times10^{3}}{\frac{\pi}{4}\times d^{2}}$$

$$\Rightarrow d = 65.14\text{ mm}$$

28. Ans: (a)

Sol: strain energy $= \frac{1}{2E}\left[\sigma_1^2+\sigma_2^2-2\mu\sigma_1\sigma_2\right]$

For pure shear = $\sigma_x = 0$, $\sigma_y = 0$, $\tau_{xy} = 300$ MPa

$\therefore \sigma_1 = 300$ MPa

$\sigma_2 = -300$ MPa

$\therefore$ Strain energy

$$= \frac{1}{2\times2\times10^{5}}\left[300^{2}+(-300)^{2}-2(0.2)(300)(-300)\right]$$

$= 0.54$ MPa

29. Ans: (c)

Sol: Lawyers are part of the project. They are responsible for verifying contracts, providing legal advice to owner, arbitration etc.

30. Ans: (d)

31. Ans: (a)

Sol: The preliminary estimate of irrigation canal is based on length involved.

32. Ans: (c) **33. Ans: (a)**

34. Ans: (d) **35. Ans: (a)**

36. Ans: (d)

Sol: $\sigma = \sqrt{16} = 4$

For 95% probability, $Z \simeq 1.65$

$$Z = \frac{T_S - T_E}{\sigma},$$

$T_S = \sigma\times Z + T_E$

$T_S = 4\times1.65 + 50 \simeq 57$

37. Ans: (c)

Sol: $t_E = \dfrac{t_o + 4t_L + t_p}{6}$

$$t_E = \frac{15 + 4\times 20 + 31}{6} = 21$$

$$\sigma = \frac{t_p - t_o}{6} = \frac{31-15}{6} = 2.67$$

38. Ans: (b)

39. Ans: (d)

40. Ans: (a)

41. Ans: (b)

42. Ans: (a)

Sol: Cycle time = Hauling time + Return time + time lost in gear shift

$$= \frac{0.9\text{km}}{1.8\frac{\text{km}}{\text{hr}}} + \frac{0.9\text{ km}}{18\text{ km/hr}} + (3/60)\text{ hr}$$

= 0.6 hr

Number of trips in a shift of 6 hours

$$= \frac{6\text{hr}}{0.6\text{hr}} = 10 \text{ trips}$$

43. Ans: (b)

Sol:

Smoothing attempts to minimize gap between max & min loads.

Levelling attempts to minimize delay.

LOB helps in project contains blocks of repetitive work activities.

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44. Ans: (d)

Sol: Risk analysis and evaluation process includes data collection, modeling of uncertainty and evaluation of potential impact of risk.

45. Ans: (c)

46. Ans: (b)

47. Ans: (a)

Sol: For a cantilever, the distance from the free end to edge of support should not exceed 25b or $100b^2/d$ whichever is less to be safe against lateral stability

$= \min(25 \times 300, 100 \times 300^2/500) = 7.5\text{m}$

48. Ans: (c)

Sol: Minimum reinforcement required in any face when mild steel bars are used is 0.64% as per cl.8.1 of IS3370-2009 part 2.

$= 0.0064 \times 200 \times 1000/\text{m}$

$= 1280\text{mm}^2$ per metre

49. Ans: (b)

Sol: In post tensioning when the tendons are tensioned simultaneously loss due to elastic shortening is zero in all the tendons.

If the tendons are tensioned sequentially, say tendon II is tensioned after tendon I, then loss due to elastic shortening occurs in tendon I due to tendon II.

Loss due to elastic shortening in tendon I occurs due to tensioning of tendons II,III,IV.

Loss due to elastic shortening in tendon II occurs due to tensioning of tendons III,IV.

Loss due to elastic shortening in tendon III occurs due to tensioning of tendon IV.

Hence loss due to elastic shortening in I>II>III>IV.

50. Ans: (a)

- Providing shear walls ending at first storey i.e. discontinuous shear walls results in discontinuity in load path and stress concentration.
- Providing Discontinuous columns also results in discontinuity in load path.
- Ensuring sufficient space between adjacent buildings reduces the possibility of pounding. Hence adequate has to be maintained.

51. Ans: (c)

Sol: For composite beams (like RCC slab over precast girder) to act as single unit, provision has to made to transfer the shear from one material to another to avoid the relative slip between them. This is done by providing shear connectors.

52. Ans: (b)

Sol: Moment coefficients as per IS 456 are based on inelastic analysis and depends on ratio of long span to short span and the end conditions of the panel.

The assumptions made in the inelastic analysis are

- Bottom steel is uniformly distributed in the middle strip (over 75% of span) in both the directions.
- Edge strip lies on either side of middle strip and has a width of $l_x/8$ or $l_y/8$
- Corner reinforcement provided is sufficient to prevent the formation of "corner lever" (lifting off the corner element).

Top steel is provided in the edge strip adjoining a continuous edge such that corresponding ultimate negative moment capacity is 4/3 times corresponding ultimate positive moment capacity due to the bottom steel provided in the direction under consideration.

53. Ans: (b)

Sol: In type 1 beam, tensile stresses are not permitted.

During service condition, the critical case is the tensile stress at the bottom of the beam.

$$= \left(\frac{P}{A}\right) + \left(\frac{Pe}{Z}\right) - \left(\frac{M}{Z}\right) = 0$$

Prestressing force P = 2000 kN

Area of concrete section = 300 × 600

$= 18 \times 10^4\ mm^2$

Section modulus $Z = \frac{bd^2}{6} = \frac{300 \times 600^2}{6}$

$= 18\times 10^6\ mm^2$

Eccenticity e = (600/2)-100 = 200mm

$$\left(\frac{2000 \times 10^2}{18 \times 10^4}\right) + \left(\frac{2000 \times 10^3 \times 200}{18 \times 10^6}\right) - \left(\frac{M}{18 \times 10^6}\right) = 0$$

M = 600 × 10^6 Nmm = 600kNm

54. Ans: (c)

Sol: For staircases supported at each end by landings (which span transversely) parallel to the risers, effective span = going +x+y

x = min(1m, half width of landing)

= min(1, 1.8/2) = 0.9m

y = min(1m, half width of landing)

= min(1, 2.2/2) = 1.0m

Effective span = 2.5 + 0.9 + 1 = 4.4m

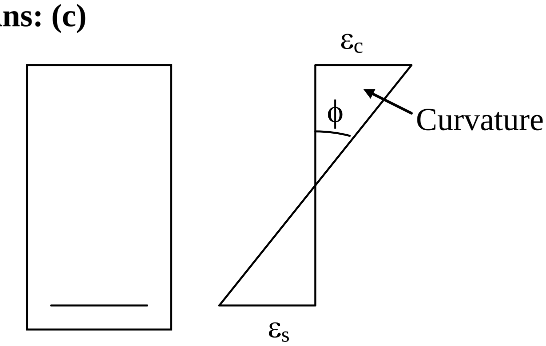
55. Ans: (c)

Sol: Pedestals are used to reduce the development length requirements of the column and also result in reduced slenderness ratio of the column. Pedestals can be used under structural steel columns. The load transfer between and column and pedestal is achieved by gusseted steel base plates with holding down bolts.

56. Ans: (c)

57. Ans: (c)

Sol:



Curvature = $\frac{\epsilon_c + \epsilon_s}{d}$

Under failure

Strain in concrete = 0.0035

Strain in steel = 0.002+ $0.87f_y/E_s$

= 0.002 + (0.87×500/2×10^5) = 0.004175

Curvature = (0.0035+0.004175)/500

= 1.535 × 10^{-5}

58. Ans: (a)

Sol: Nominal bond strength = P/(πφL) = 65 x 1000/(3.14 x 16x800) = 1.61MPa

59. Ans : (b)

Sol: Effective depth is the distance between extreme compressive fibre and centroid of tension reinforcement

Distance of centroid of tension reinforcement from the bottom of the beam

$$= \frac{4A\left(30+8+\frac{16}{2}\right)+2A\left(30+8+16+20+\frac{16}{2}\right)}{6A}$$

$= 58$ mm

Effective depth = 400-58 = 342mm

60. Ans: (d)

Sol: Failure of plain concrete member is caused by torsional cracking due to diagonal tensile stresses. Hence, ideal way of reinforcing is by providing steel in the form of spirals.

61. Ans: (a)

Sol: Transmission length depends on

- Size and type of tendon
- Surface conditions of tendon
- Tendon stress
- Method of transfer
- Concrete strength
- Concrete compaction
- Concrete confinement level (by stirrups or hoops etc)
- State of strain in transfer region

62. Ans: (c)

Sol: Let area of cross section = A

Area of concrete = 0.00A

Area of steel = 0.01A

Load resisted by concrete $P_c = 0.4f_{ck}A_c$

= 0.4 x 25 x 0.99A

Load resisted by steel $P_s = 0.67f_yA_{sc}$

= 0.67 x 500 x 0.01A

$$\frac{P_s}{P_c} = \frac{0.67\times500\times0.01A}{0.4\times25\times0.99A} = 0.33$$

63. Ans: (a)

Sol: Explanation: In ultimate limit state method, non linear stress strain curves are used and stress condition at the state impending failure (ie ultimate strength) is analysed. This method results in slender sections

In limit state method generally Load factors are greater than 1. However, dead load factor is taken as 0.8 or 0.9 for stability (overturning or sliding) analysis as this results in more safety.

64. Ans: (a)

Sol: Cracking moment = $f_{cr}Z$

$F_{cr} = 0.7\sqrt{f_{ck}} = 3.5$MPa

$Z = bD^2/6 = 300 \times 600^2/6 = 18 \times 10^6$

Cracking moment = $3.5 \times 18 \times 10^6$

= 63kNm

65. Ans: (c)

Sol: As pe cl 23.2 of IS 456-2000, the maximum deflection (including long term effects like creep and shrinkage) that occur after the construction of partitions and finishes is span/350 or 20mm whichever is less

= min(8000/350,20)

= min(22.85,20)

= 20mm

66. Ans:(b)

Sol: Minimum longitudinal reinforcement required as per IS 13920: 2016 is

$$= 0.24\frac{\sqrt{f_{ck}}}{f_y} = 0.24\times\frac{\sqrt{25}}{415} = 0.289\%$$

= 0.289/100 × 250×550

= 397.375 mm^2

67. Ans: (d)

Sol: Compressive force in concrete with FOS as 1.5 = $0.36f_{ck}bx_u$

With FOS as 1.7, compressive force in concrete = $0.36f_{ck}bx_u\times\frac{1.7}{1.5}$

C = T

$$0.36f_{ck}bx_u \times\frac{1.7}{1.5} = 0.87f_yA_{st}$$

$$0.36\times 25\times 300\times x\times\frac{1.7}{1.5} = 0.87\times 500\times 350$$

x = 49.75mm

68. Ans: (d)

Sol: Principle of superposition is valid only for if

(i) Structure is made of linearly elastic material

(ii) Deformations are small such that they are negligible and equilibrium equations are based on underformed geometry of structure.

However under the action of more than one load

$$\text{strain energy} = \int_0^L \frac{\left(\sum P\right)^2 dx}{2AE}$$

For 2 loads, P_1 , P_2

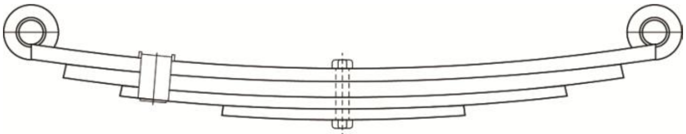
$$U = \int_0^L \frac{(P_1 + P_2)^2}{2AE}dx$$

$$= \frac{P_1^2L}{2AE} + \frac{P_2^2L}{2AE} + \frac{2P_1P_2L}{2AE}$$

i.e., total strain energy is not obtained by simply adding strain energy due to individual loads i.e., principle of superposition is not applicable.

69. Ans: (a)

Sol:



Leaf Spring

Leaf spring (or) laminated spring are made by overlapping plates without any bond between them, the plates are initially bent to same radius. Since there is no bond, the plates are free to slide over each other.

When the spring is loaded, each plate will bend about its own axis, i.e, each plate is subjected to both tension and compression.

70. Ans: (b)

Sol: Buckling stress $(\sigma) = \dfrac{\pi^2 EI}{\ell^2 \times A}$

$\therefore \sigma \propto I$ for constant E, l, A

For square cross-sections: $I_s = \dfrac{a^4}{12}$

For circular cross-sections: $I_c = \dfrac{\pi d^4}{64}$

Since area is same

$$a^2 = \frac{\pi d^2}{4}$$

$$\frac{\text{Buckling stress of square column}}{\text{Buckling stress of circular column}} = \frac{I_s}{I_c}$$

$$= \frac{\dfrac{\left(\dfrac{\pi d^2}{4}\right)^2}{12}}{\left[\dfrac{\pi d^4}{64}\right]}$$

$$\frac{\sigma_s}{\sigma_c} = \frac{I_s}{I_c} = \frac{\pi^2 d^4 \times 64}{16 \times 12 \times \pi d^4}$$

$$\frac{\sigma_s}{\sigma_c} = \frac{I_s}{I_c} = \frac{\pi}{3} > 1$$

$\therefore \sigma_s > \sigma_c$

Also, for same geometry length and end conditions,

Buckling load $\propto \dfrac{1}{\ell^2}$

i.e., with increase in length, buckling load decreases.

71. Ans: (d)

72. Ans: (c)

73. Ans: (d)

Sol: When the applied moment is less than cracking moment, the section remains uncracked and the second moment of area corresponds to gross transformed section

When the applied moment exceeds cracking moment, the section gets cracked and concrete in the tension zone is neglected theoretically . Hence second moment of area corresponds to cracked transformed section .

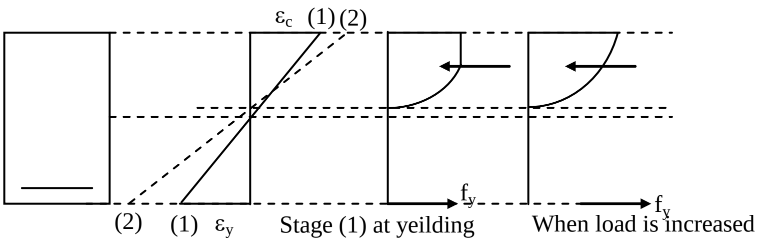
As the second moment of area (I) of gross transformed section is more than cracked transformed section , flexural rigidity (EI) for uncracked section is more than cracked section

Flexural rigidity is the slope of moment (M) –curvature(1/R) relation

74. Ans: (b)

Sol: In under reinforced concrete beam at ultimate limit state, the yield strain is reached in steel and strain concrete is less than ultimate strain.

With increase in load, steel continues to yield i.e elongates without any increase in stress. Hence the neutral axis shifts upwards i.e depth of neutral axis decreases.



75. Ans: (b)

Sol: Shrinkage occurs in concrete due to loss of moisture by evaporation. Due to alternate wet and dry conditions shrinkage is reversible. It does not depend on the stress conditions.