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ESE- 2019 (Prelims) - Offline Test Series Test- 19

CIVIL ENGINEERING

SUBJECT: BUILDING MATERIALS, STRUCURAL ANALYSIS, DESIGN OF STEEL STRUCTURES

SOLUTIONS

01. Ans: (c)

Sol: In case of welded gusset base, welds are provided to connect gusset plate & base plate gusset angle are used only for riveted /bolted base.

02. Ans: (c)

Sol: The central rise 'δ' is $= \frac{\ell^2 + 4y_c^2}{4y_c} \times \propto t$

$$= \frac{20^2 + 4 \times 4^2}{4 \times 4} \times 12 \times 10^{-6} \times 20$$

$$= \frac{464}{4 \times 4} \times 12 \times 10^{-6} \times 20$$

$$= 116 \times 20 \times 10^{-6} \times 3 = 6.96 \text{ mm}$$

03. Ans: (b)

Sol: Total shear force acting on beam (V_u)

$$= 60 \times \frac{6}{2} = 180 \text{ kN}$$

Design shear capacity of beam (V_d)

$= 250$ kN

$V_u > 0.6\ V_d$, hence beam is under high shear as per IS 800 – 2007

04. Ans: (c)

Sol:

- Alumina in brick helps in moulding the brick in an easy manner (A-2)
- Silica keeps the shape of brick at high temperature and also reduces shrinkage (B-4)

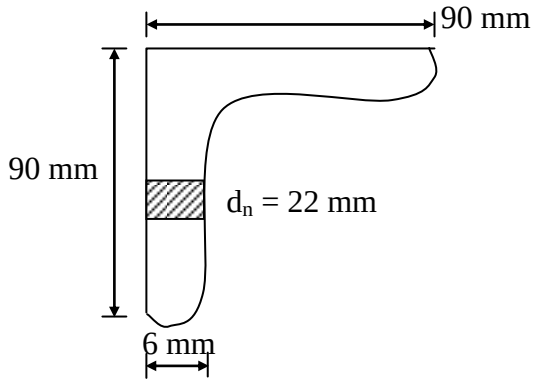
05. Ans: (c)

Sol: Maximum pitch for staggered riveting subjected to compressive load = (18t of 300 mm) whichever is less

06. Ans: (b)

Sol: For ISA 90 × 90 × 6 connected by M20 bolt

$= 330\ mm^2$



$A_{nc} = (90 - 22 - 6/2) \times 6 = 330\ mm^2$

$A_{go} = \left(90 - \frac{6}{2}\right) \times 6 = 522\ mm^2$

Where $A_{nc} \rightarrow$ Net area of connected leg

$A_{go} \rightarrow$ Gross area of outstanding leg

Design tensile capacity due to rupture

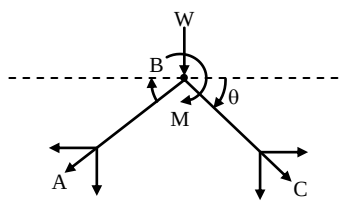
$$(T_{dn}) = \frac{0.9 f_u}{\gamma_{m1}} \times A_{nc} + \beta \frac{f_y}{\gamma_{mo}} A_{go}$$

$$= 0.9 \times \frac{410}{1.25} \times 330 + 0.9 \times \frac{250}{1.1} \times 522$$

$= 204.18\ kN \simeq 205\ kN$

07. Ans: (d)

Sol:



$\Sigma x = 0$

$F_{AB} = F_{BC}$ _____ (1)

$\Sigma y = 0$

$- w - F_{AB} \sin\theta - F_{BC} \sin\theta = 0$

$- w - 2F_{AB} \sin\theta = 0$

$$F_{AB} \sin\theta = \frac{-w}{2}$$

$$F_{AB} = \frac{-w}{2\sin\theta} = \frac{-w}{2 \times \frac{3}{5}} = \frac{-5}{6} w$$

$$F_{AB} = \frac{5w}{6} \text{ (compression)}$$

08. Ans: (d)

Sol: Eccentric reaction of one structural member is normal to the plane of bolt group. Hence eccentric load is simplified in to one direct concentric load (P) and bending moment (M=P×e). Direct concentric load is causing equal shear force and bearing force in each bolt and bending moment is causing maximum tensile force in extreme critical bolt. Hence critical bolt in a bolt group should be designed for combined shear force, bearing force and tensile force.

09. Ans: (a)

Sol: **Dry rot:** fungal effect (A-1)

Wet rot: Chemical decomposition of wood (C-2)

White rot: White layer on the surface due to Fungus (D-4)

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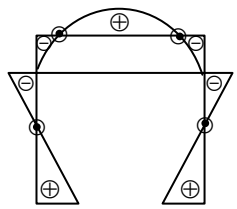
10. Ans: (d)

Sol:



B.M.D

⊙ Shows point of contra flexure

∴ No. of contra flexure points = 4

11. Ans: (a)

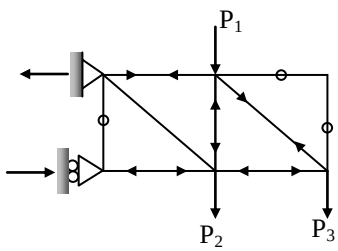
Sol: Web crippling occurs if web is thin & load is heavy & concentrated. It may be eliminated if web is thicker or by providing bearing stiffness.

12. Ans: (b)

Sol: Soundness of cement is determined by Le-Chatelier or auto clave test not by rebound hammer test. Rebound hammer test is used to determine in-situ strength of concrete (one of the NDT methods)

13. Ans: (b)

Sol:

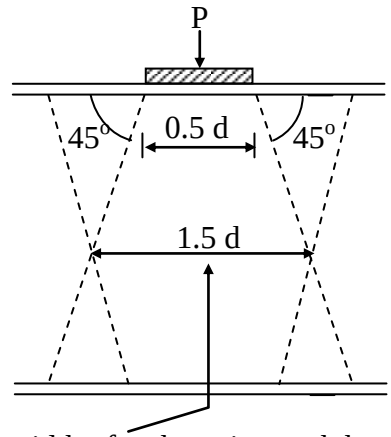


14. Ans: (c)

Sol: In gauged mortar lime + cement + sand are used.

15. Ans: (c)

Sol:



Critical width of web against web buckling

Width of load (b) = 0.5 d

Critical section of web resisting web buckling = b + d = 1.5 d

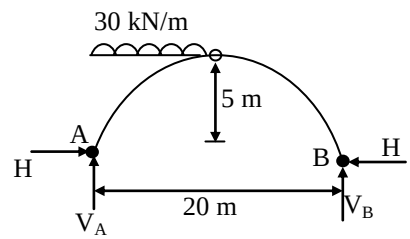
Hence maximum load that may be applied

$= (1.5\ d) \times (t) \times f$

$= 1.5\ dtf$

16. Ans: (c)

Sol:



$\sum M_B = 0$

$\Rightarrow V_A \times 20 = 30 \times 10 \times 15$

$V_A = 225$ kN

$\Rightarrow V_B = 30 \times 10 - 225 = 75$ kN

Taking moments about central hinge from right side

$H \times 5 = V_B \times 10$

$\Rightarrow H = 75 \times \frac{10}{5}$

$H = 150$ kN

17. Ans: (b)

18. Ans: (b)

Sol: Rich mortar mixes (richer than 1:3) are not responsible for gain in strength of masonry.

- At the same time they possess high shrinkage.

19. Ans: (d)

Sol: For a column whose one end is hinged and other end is roller support has $l_{eff} = 2.0\, l_o$

Where l_o = Unsupported length of column

20. Ans: (c)

21. Ans : (d)

Sol: When roof slope > 10°

Live load = [750–20 (θ–10)]

$\not< 400$ N/m^2

θ =33°

Live load = 750–20 (33–10)

= 290 N/m^2

$\not< 400$ N/m^2

22. Ans: (b)

Sol: Split tensile strength of concrete is 15 to 20% of cube compressive strength.

23. Ans: (a)

Sol: A member normally acting as a tie in a roof truss or a bracing system, when is subjected to possible reversal of stresses resulting from the action of wind or earth quake forces, the maximum slenderness ratio is 350

$$r_{min} = \sqrt{\frac{I_{min}}{A}} = \sqrt{\frac{\frac{\pi}{64}d^4}{\frac{\pi}{4}d^2}} = \frac{d}{4}$$

$$= \frac{18}{4} = 4.5\text{mm}$$

$$\lambda = \frac{L}{r_{min}}$$

$L = 350 \times 4.5$

$L = 1575$ mm

24. Ans: (d)

Sol:

(i) MDM is approximate method

(ii) This method is applicable for beams with variable cross section if we can derive equivalent stiffness of the beam.

25. Ans: (a) **26. Ans : (c)**

27. Ans: (a)

Sol: Distribution factor for BA

$$= \frac{\frac{3}{4}\left(\frac{I}{L}\right)}{\frac{3I}{4L}+\frac{I}{L}} = \frac{\frac{3}{4}}{\frac{3}{4}+1} = \frac{3}{7}$$

$\therefore$ Distribution factor for B= $1-\frac{3}{7}=\frac{4}{7}$

$$\therefore \frac{\delta_{BA}}{\delta_{BC}} = \frac{\frac{3}{7}}{\frac{4}{7}} = 3:4$$

28. Ans: (d)

29. Ans: (b)

30. Ans: (a)

Sol: English bond is the strongest bond, because of brick arrangement in masonry

31. Ans: (a)

Sol: Throat of fillet, t = 0.70 × size = 0.7 × 10 = 7 mm

Approximate Torque capacity,

$$T = \pi \, d. \, t. \, \tau_{vf} \, . \, \frac{d}{2}$$

$$= \pi \, 120 \times 7 \times 110 \times \frac{120}{2}$$

$$= 17.4 \times 10^6 \text{ N-mm}$$

$$= 17.4 \text{ kNm}$$

32. Ans: (b)

33. Ans : (c)

Sol: Strength of the weld, $P = l \, . \, t. \, \tau_{vf}$

$l = 2 \times 200 + 150 = 550$ mm

$t = 0.7 \times \text{size} = 0.7 \times 6 = 4.2$ mm

$\tau_{vf} = 110 \text{ N / mm}^2$

$P = 550 \times 4.2 \times 110$

$= 254100 \text{ N} = 254 \text{ kN}$

34. Ans: (a)

Sol: The workability of cement concrete can be improved by the cement content and water with proper water cement ratio.

35. Ans: (b)

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36. Ans: (d)

Sol: $w = \sqrt{\frac{k}{m}}$

k = stiffness in N/m

m = mass of body in kg

w = 11.5 kN = 1150 kg

$k = 1050 \times 10^3$ N/m

$\therefore \quad w = \sqrt{\frac{1050 \times 10^3}{1150}} = 30.22$

37. Ans: (a)

38. Ans: (b)

Sol: Ordinary Sawing: Parallel cuts made throughout the length of the log.

39. Ans: (d) **40. Ans: (c)**

41. Ans: (c) **42. Ans: (d)**

43. Ans: (b)

Sol: Veneers are manufactured scientifically in a factors is termed as the industrial timber.

44. Ans: (c)

Sol: Tricalcium silicate - C_3S - Alite

Dicalcium silicate - C_2S - Belite

Tricalcium aluminate - C_3A - Celit

Tetra calcium aluminate - C_4AF - Felite

45. Ans: (d) **46. Ans: (d)**

47. Ans: (c)

Sol: Modified equation for simply supported end

$$M_{BC} = \overline{M}_{BC} - \frac{\overline{M}_{CB}}{2} + \frac{3EI}{L}\left(\theta_B - \frac{\delta}{\ell}\right)$$

$$\overline{M}_{BC} = \frac{-W\ell^2}{12} = \frac{-12 \times 4^2}{12} = -16$$

$$\overline{M}_{CB} = \frac{W\ell^2}{12} = \frac{12 \times 4^2}{12} = 16$$

$$M_{BC} = -16 - \frac{16}{2} + \frac{3EI}{4}(\theta_B - 0)$$

$$M_{BC} = -24 + \frac{3}{4}EI\theta_B$$

48. Ans: (b)

Sol: Spinning is one of the recent methods of compaction of concrete. The plastic concrete when spun at a very high speed, gets well compacted by spinning process.

49. Ans: (b)

Sol: Kinematic indeterminacy

$D_k = 1+1+3+3+3$

= 11 (considering axial deformations)

$D_k = 11 - 4$

(Neglecting axial deformation)

= 7

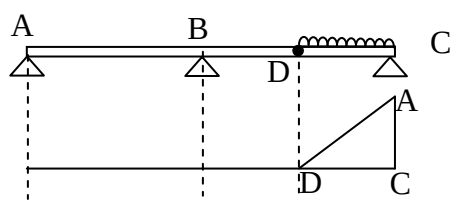
$\therefore$ The order of stiffness matrix is 7×7

50. Ans: (a)

Sol: Mulberry is used for baskets and sports goods like hockey sticks, tennis rackets and cricket bats.

51. Ans: (a)

Sol:



Above figure shows the ILD for V_c

Hence for V_c to be maximum the live load should atleast cover the length DC

Max reaction at C = $60 \times \frac{3}{2} \times 1$

= 90 kN

52. Ans: (b)

Sol: Sap wood is present in between the heart wood and cambium layer

53. Ans: (a)

Sol: $\overline{M}_{bc} = \frac{-w\ell^2}{12} - \frac{6EI_{bc}\delta}{\ell^2}$

$= \frac{-12 \times 4^2}{12} - \frac{6 \times 200 \times 4 \times 10^7 (7-2)}{4^2 \times 10^9}$

$= -16 - 15$

$= -31$ kN-m

54. Ans: (b)

55. Ans: (d)

Sol: Increase in dip = $dh = \frac{3}{16}\alpha t \frac{\ell^2}{h}$

$= \frac{3}{16} \times 12 \times 10^{-6} \times 20 \times \frac{100^2}{5} = 0.09$ m

56. Ans: (a)

Sol: It imparts plasticity to the earth so that it can be moulded.

57. Ans: (b)

Sol:

- A two hinged stiffening girder is statically indeterminate.
- Bending moment at any section

$BM_{section} = BM_{beam} - Hy$

58. Ans: (c)

59. Ans: (d)

Sol:

Apply strain energy,

$U = \frac{1}{2} \times w \times \Delta$

Rewrite the equation

$\Delta = \frac{2U}{w}$

60. Ans: (b)

Sol:

1. Alumina imparts plasticity to clay so that it can be moulded.
2. Alkalines causes efflorescence i.e. white powder on the bricks and makes the clay unsuitable.

61. Ans: (c) **62. Ans: (c)**

63. Ans: (b)

Sol: Slightly less than normal consistency (0.85 p) is maintained for setting times. (IS:4031-part:5)

- Low heat cement should have lesser C_3A.
- Early strength cement contains higher value of C_3S and lesser C_2S.

64. Ans: (c)

65. Ans: (c)

Sol:

- Water reducing admixtures are calcium lignosulphates (A-3)
- Calcium chloride is accelerator (D-2)

66. Ans: (d)

Sol: Kani's method is Displacement method.

67. Ans: (c)

Sol: In Pin jointed plane frame $D_k > D_s$; so force methods are used to analyse.

68. Ans: (d)

Sol: In Dynamic loading Both magnitude of loading and natural frequency will be varied along with time.

69. Ans: (c)

Sol: Only in the moment Distribution method, the slope deflection equations are solved without writing them explicitly.

70. Ans: (b) **71. Ans: (c)**

72. Ans: (b) **73. Ans: (d)**

74. Ans: (a)

75. Ans: (d)

Sol: Workability of a fresh concrete decreases with time due to loss of water by evaporation, absorption and by chemical reactions

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