ACE Engineering Academy

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ESE- 2020 (Prelims) - Offline Test Series Test- 15

CIVIL ENGINEERING

SUBJECT: BUILDING MATERIALS, STRUCTURE ANALYSIS & DESIGN OF STEEL STRUCTURES

SOLUTIONS

01. Ans: (d)

Sol: Glass is also an amorphous material. All ceramic materials are brittle materials. They undergo failure without appreciable material yielding. Hence, they lack toughness.

02. Ans: (d)

Sol: All the three statements are correct.

03. Ans: (d)

Sol: Natural or Air seasoning is a very slow process. It takes around 4 to 6 months. Its very cost effective and at the same time produces best quality timber.

04. Ans: (a)

Sol: Epoxy is a thermosetting plastic while all PVCs come under thermoplastics.

05. Ans: (b)

Sol: Oleic acid or stearic acid forms a thin protective film on the cement particles. This protective film does not allow atmospheric moisture to react with the cement particles, hence this cement can be stored for long durations and even in humid locations. Once water is added to this cement in the preparation of concrete, the protective film collapses and thus the engineering properties of this cement are similar to OPC.

06. Ans: (c)

Sol: Magnetic property of steel decreases with increase in the proportion of impurities. Stainless steel has around 0.2% carbon, 8% nickle and 18% chromium. Thus, because of the high presence of impurities stainless steel has very poor magnetic property.

07. Ans: (a)

Sol: AIV is used to assess the toughness and AAV is used to assess the hardness of coarse aggregate.

08. Ans: (b)

Sol: Grade is defined only for OPC. There is not concept of grade for other cements. Setting times of OPC and Rapid Hardening cement are the same.

09. Ans: (c)

10. Ans: (d)

Sol: Like all plasticizers, air-entraining agents increase the setting times.

11. Ans: (c)

Sol: The water content in the cement for Le Chatelier's test is 0.78P%.

12. Ans: (a)

Sol: Blaine's air permeability test is used to determine the fineness of cement by determining the specific surface area. In sieve analysis, 90-micron sieve is used and fineness is asses based on percentage residue on this sieve.

13. Ans: (b)

Sol: Generally, Glass Fiber Reinforced Plastics are made of thermosetting plastics reinforced with glass fibers.

14. Ans: (a)

Sol: Mild Steel cannot be produces directly from the ores. First, pig iron is produces using the ores of iron in a blast furnace. This pig iron is further processed to produces different kinds of steel and iron, including mild steel

15. Ans: (c)

Sol: Volcanic pumice has voids inside which makes it very light in weight. Hence, this aggregates from this rock are used in the preparation of light weight concrete.

16. Ans: (b)

Sol: Teak wood and sal wood are non-resinous in nature, hence they are refractory timber.

17. Ans: (a)

Sol: In general, thermosetting plastics are cheaper than thermoplastics.

18. Ans: (c)

Sol: $$1.54 = \frac{\text{Sum of volumes of dry weights of ingredients}}{\text{Volume of concrete}}$$

$$1.54 = \frac{X+3X+6X}{1}$$

Volume of fine aggregate = 3X = 0.46 m^3.

19. Ans: (b)

Sol: If organic matter is present in the brick earth, it gets burnt in the burning stage and makes the brick porous.

20. Ans: (d)

Sol: Excess alkalis in brick earth leads to efflorescence, porous brick, etc., but does not affect the crushing strength of the brick.

21. Ans: (c)

Sol: Fire clay has very high proportion of Silica and Alumina compared to ordinary clay.

22. Ans: (b)

Sol: $$1.54 = \frac{\text{Sum of volumes of dry weights of ingredients}}{\text{Volume of concrete}}$$

$$1.54 = \frac{X+3X+6X}{1}$$

Volume of Cement = X = 0.154 m^3.

Weight of Cement = 1440 x 0.154 kg

= 221.76 kg.

Quantity of concrete which can be prepared from one bag of cement = 50 / 221.76 cum.

= 0.225 cum.

23. Ans: (a)

Sol: Plywood is prepared by bonding odd number of veneers. Hence, 10- plywood is non-existent. Generally, batten-boards and lamin-boards are used in the preparation of flush door shutters.

24. Ans: (c)

Sol: Star shakes are observed when the tree experiences too hot or too cold weather conditions.

25. Ans: (a)

Sol: Sulphate resistant cement has very low proportion of C_3A and high proportion of C_4AF. The heat of hydration of this cement and OPC are almost the same.

26. Ans: (a) **27. Ans: (b)**

28. Ans: (d) **29. Ans: (c)**

30. Ans: (d) **31. Ans: (c)**

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

34. Ans: (d)

35. Ans: (c)

Sol: Strength of solid plate per pitch length

$= p.t.\sigma_{at}$

$= 60 \times 14 \times 0.6 \times f_y$

$= 126$ kN

$$\eta = \frac{\text{strength of joint per pitch length}}{\text{strength of solid plate per pitch length}} \times 100$$

Strength of joint per pitch length is lesser of 88 kN, 98 kN, 78 kN

$$\therefore\ \eta = \frac{78}{126} \times 100 = 61.9\% \simeq 62\%$$

36. Ans (b) **37. Ans: (b)**

38. Ans: (b)

39. Ans: (d)

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 forces, the maximum slenderness ratio is 350.

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

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

$$\lambda = \frac{L_{max}}{r_{min}}$$

$L_{max} = 4.5 \times 350 = 1575$ mm

40. Ans: (a)

Sol: Minimum depth $= \dfrac{L}{45} = \dfrac{3500}{45}$

$= 77.78$ mm

Minimum width $= \dfrac{L}{60} = \dfrac{3500}{60}$

$= 58.3$ mm

41. Ans: (a)

Sol: Self weight of truss $= \left(\dfrac{\text{span}}{3}+5\right)\times 10$

$= \left(\dfrac{16}{3}+5\right)\times 10 = 103.33\ \text{N/m}^2$

$\simeq 104\ \text{N/m}^2$

42. Ans: (d)

Sol: As per IS : 800:1984

Ultimate load capacity $(P_u)_{tension}$

$= 0.85 \times A \times f_y = 0.85 \times 1020 \times 250$

$= 216.75$ kN $\simeq 217.75$ Kn

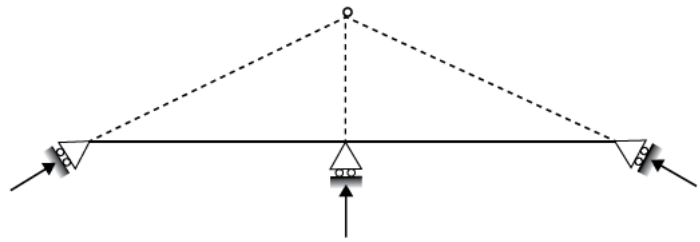
43. Ans: (c) **44. Ans: (d)**

45. Ans: (c)

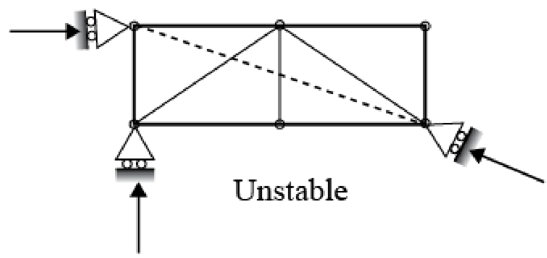
46. Ans: (b)

Sol:

Unstable
All the support reactions are parallel



Unstable
All the support reactions are concurrent

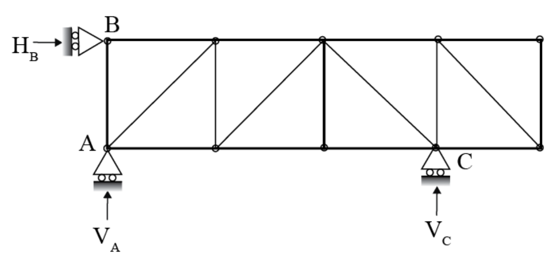


Unstable

47. Ans: (d)

48. Ans: (b)

Sol:



$\Sigma H = 0$ $\Sigma V = 0$

$H_B = 0$ $V_A + V_C = 30$

$\Sigma M_E = 0$ –ve +ve

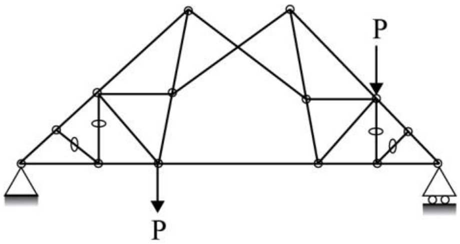
$-V_C \times 9 + 30 \times 12 = 0$

$V_C = 40$ kN (↑)

$V_A = -10$ kN (↓)

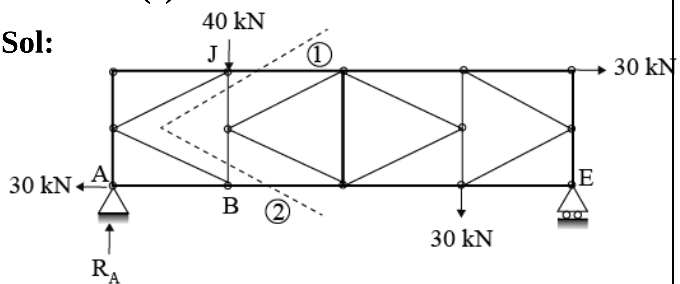
49. Ans: (c)

Sol:



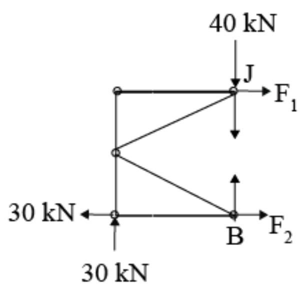
50. Ans: (c)

Sol:



$+R_A \times 12 - 40 \times 9 - 30 \times 3 + 30 \times 3 = 0$

$R_A = 30$ kN (↑)



$\Sigma M_B = 0$ –ve +ve

$+F_1 \times 3 + 30 \times 3 = 0$

$F_1 = -30$ kN

$F_1 = 30$ kN (Compression)

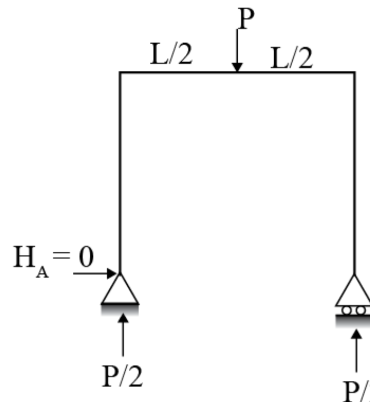
$\Sigma M_J = 0$ –ve +ve

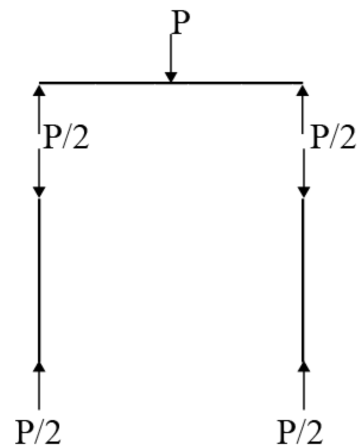
$-F_2 \times 3 + 30 \times 3 + 30 \times 3 = 0$

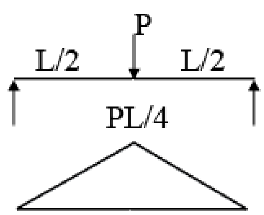
$F_2 = 60$ kN (Tension)

51. Ans: (b)

Sol:

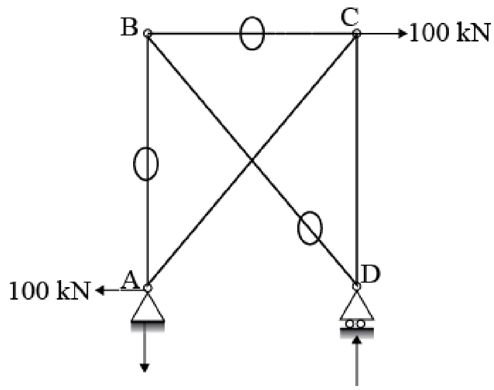






52. Ans: (a)

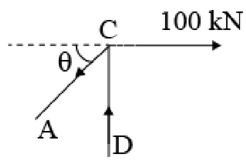
Sol: Horizontal displacement of the roller support $\delta_{HD} = \Sigma \dfrac{PKL}{AE}$



$$\cos\theta = \frac{3}{5}$$

$$\sin\theta = \frac{4}{5}$$

At joint 'C':



$\Sigma H = 0$

$F_{CA}\cos\theta = 100$

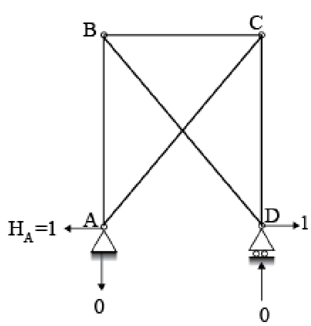
$$F_{CA} = 100 \times \frac{5}{3} = \frac{500}{3} \text{ (Tension)}$$

$\Sigma V = 0$

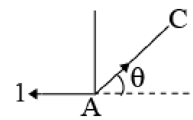
$$F_{CD} = F_{CA}\sin\theta = \frac{500}{3} \times \frac{4}{5}$$

$$= \frac{400}{3} \text{ (Compression)}$$

K-Values: Apply unit load at 'D' in horizontal direction



At joint 'A':

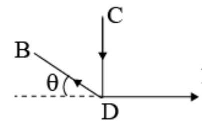


$\Sigma H = 0$

$F_{AC}\cos\theta = 1$

$$F_{AC} = \frac{5}{3} \text{ (Tension)}$$

At joint 'D':



$\Sigma H = 0$

$F_{DB}\cos\theta = 1$

$$F_{DB} = \frac{5}{3} \text{ (Tension)}$$

$\Sigma V = 0$

$F_{DC} = F_{DB}\sin\theta$

$$= \frac{5}{3} \times \frac{4}{5} = \frac{4}{3} \text{ (Compression)}$$

Tension +ve, Compression –ve

Member	P	K	L (m)	A	$\frac{PKL}{AE}$
AC	$\frac{500}{3}$	5/3	5	2×10^{-3}	3.47×10^{-3}
CD	$-\frac{400}{3}$	–4/3	4	2.5×10^{-3}	1.42×10^{-3}
				Σ	4.89×10^{-3}

$\delta_{HD} = 4.89 \times 10^{-3}$ m $= 4.89$ mm $(\rightarrow)$

53. Ans: (c)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AIR 3 ABHISHEK ANAND EE
AIR 3 ROHIT KUMAR E&T
AIR 3 KUMAR CHANDAN ME
AIR 3 AMARJEET CE
AIR 4 ANKIT TAYAL EE
AIR 4 AMIR KHAN E&T
AIR 4 SAURAV ME
AIR 4 AMAN GULIA CE
AIR 5 KUMAR MAYANK EE
AIR 5 AYUSH CHANDRA CE
AIR 6 RITESH LALWANI EE
AIR 6 PUSHPAK ME
AIR 6 KABIL BHARGABAVA CE
AIR 7 KARTIKEY SINGH EE
AIR 7 RAHUL JAIN E&T
AIR 7 MANISH RAJPUT ME
AIR 8 KULDEEP KUMAR E&T
AIR 8 HEMANT KUMAR ME
AIR 8 YOGESH KUMAR CE
AIR 9 DEEPITA ROY EE
AIR 9 SHUBHAM KARNANI E&T
AIR 9 D SABAPARA ME
AIR 9 ANKIT KUMAR CE
AIR 10 ANKITA SHARMA EE
AIR 10 GAURAV SRIVASTAVA E&T
AIR 10 SUMIT BHAMBOO ME
and many more...
TOTAL SELECTIONS in Top 10: 33
(EE: 9, E&T: 8, ME: 9, CE: 7) and many more...


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54. Ans: (d)

Sol: Fixed End Moments:

$$M_{FAB} = \frac{4EI\theta_A}{L} = 160 \text{ kN-m}$$

$$M_{FBA} = \frac{2EI\theta_A}{L} = 80 \text{ kN-m}$$

$$M_{FBC} = M_{FCB} = 0$$

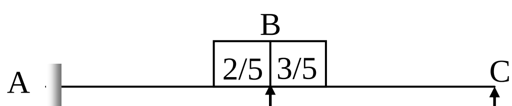
Distribution Factors (DF):

$$K_{BA} = \frac{4EI}{4} = EI \quad K_{BC} = \frac{3EI}{2}$$

$$\Sigma K_B = EI + \frac{3EI}{2} = \frac{5EI}{2}$$

$$D_{FBA} = \frac{2}{5}, \qquad D_{FBC} = \frac{3}{5}$$

Moment Distribution:



	A	B (BA)	B (BC)	C
FEM	+160	+80	0	0
Balance		–32	– 48	
Carryover	–16			0
Final moment	144	48	– 48	0

M_{AB} = + 144 kN-m

55. Ans: (d)

56. Ans: (b)

Sol: Elongation of each rod will be same

$$\frac{P_1 L}{AE} = \frac{P_2(2L)}{AE} = \frac{P_3 L}{AE}$$

$P_1 = P_3 = 2P_2$

Stress in central rod will be half the stress in the outer rods. As 'P' is increased the stress in outer bars will reach 'σ_y' the yield stress but the central bar will have stress of $\frac{\sigma_y}{2}$.

Therefore, the load at this point will be

$$P_y = 2\sigma_y A + \frac{1}{2}\sigma_y A = 2.5\sigma_y A$$

57. Ans: (d)

Sol: $\Sigma M_C = 0$ –ve +ve

$-R_D \times 5 + 10 \times 5 \times 5/2 = 0$

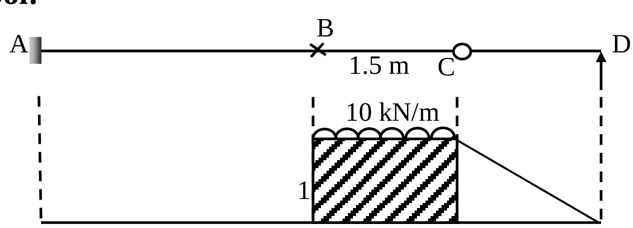
$R_D = 25$ kN

$\Sigma M_A = 0$ –ve +ve

$$-25 \times 20 + 10 \times 20 \times \frac{20}{2} - R_B \times 10 = 0$$

58. Ans: (c)

Sol:



ILD for SF_B

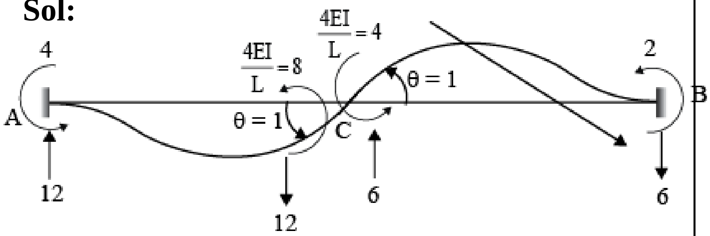
Maximum shear force at B = Intensity of udl × Area of shaded ILD

= 10 [1.5 × 1]

= 15 kN

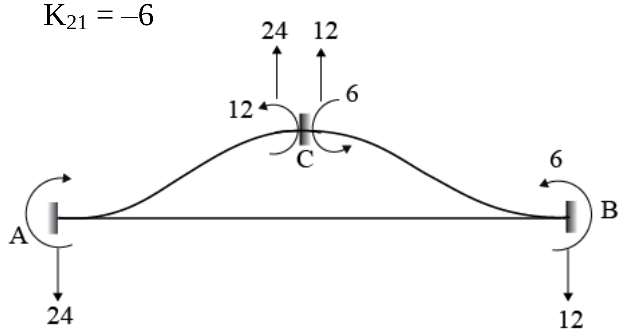
59. Ans: (b)

Sol:



$K_{11} = 12$

$K_{21} = -6$



$K_{12} = -6$

$K_{22} = 36$

$$K = \begin{bmatrix} 12 & -6 \\ -6 & 36 \end{bmatrix}$$

60. Ans: (c)

Sol: Joint Equilibrium equation at 'B'

$M_{BA} + M_{BC} = 0$ …………….(1)

$$M_{BA} = \cancelto{0}{M_{FBA}} + \frac{2EI}{L}\left[2\theta_B + \cancelto{0}{\theta_A} - \cancelto{0}{\frac{3\delta}{L}}\right]$$

$$= \frac{EI\theta_B}{2} \text{ …………….(2)}$$

$$M_{BC} = \cancelto{0}{M_{FBC}} + \frac{2EI}{L}\left[2\theta_B + \cancelto{0}{\theta_C} - \cancelto{0}{\frac{3\delta}{L}}\right]$$

$$= \frac{-wL^2}{30} + \frac{2EI\theta_B}{3}$$

$$= -7.2 + \frac{2EI\theta_B}{3} \text{ ………..(3)}$$

$M_{BA} + M_{BC} = 0$

$$\frac{EI\theta_B}{6} - 7.2 + \frac{2EI\theta_B}{3} = 0$$

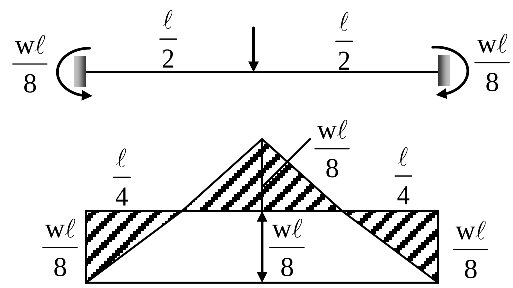
$$\frac{7EI\theta_B}{6} = 7.2$$

$$\theta_B = \frac{6.17}{EI} \text{ radians}$$

61. Ans: (b)

62. Ans: (a)

Sol:



From similar triangles the points of contraflexure will occur at distance $\frac{\ell}{4}$ from supports.

63. Ans: (b) **64. Ans: (c)**

65. Ans: (b) **66. Ans: (a)**

67. Ans: (b) **68. Ans: (b)**

69. Ans: (d) **70. Ans: (a)**

71. Ans: (b)

Sol: Both the statements are correct. But Statement (II) is not the correct explanation for statement (I). Hence, option (b) is the Ans.

72. Ans: (a)

Sol: Due to the shrinkage of concrete during the hydration of cement, micro cracks are formed throughout the concrete volume which makes the concrete weak in tension.

73. Ans: (d)

Sol: Statement (I) is incorrect as Autoclave test is used to determine the soundness of cement due to the presence of free lime and magnesia. Hence, option (d) is the Ans.

74. Ans: (c)

Sol: Aluminium is a very reactive metal. When it comes into the contact with air an Aluminium oxide layer is formed on the surface. This layer does not allow further oxidation. Thus, Aluminium is highly non-corrosive.

75. Ans: (d)

Sol: Presence of reinforcement affects the test results. Hence, the test results have to corrected for steel present in the path of the ultra-sonic pulse.