TEST ID: 402

ACE Engineering Academy

Head Office : Sree Sindhi Guru Sangat Sabha Association, # 4-1-1236/1/A, King Koti, Abids, Hyderabad - 500001.

Ph: 040-23234418, 040-2324419, 040-2324420, 040-24750437

Hyderabad | Kukatpally | Kothapet | Delhi | Bhopal | Patna | Pune | Bhubaneswar | Lucknow | Bengaluru | Chennai | Vijayawada | Vizag | Tirupati | Kolkata | Ahmedabad

ESE- 2020 (Prelims) - Offline Test Series Test- 3

CIVIL ENGINEERING

SUBJECT: STRUCTURAL ANALYSIS & DESIGN OF STEEL STRUCTURES SOLUTIONS

01. Ans: (c)

Sol: Minimum thickness of web plate, when web plate is directly exposed to weather and accessible for cleaning and painting t_w is 6 mm.

Plate girder with vertical stiffener, first and second horizontal stiffener are required as per IS800:1984 when the depth to thickness ratio of web is in between 250 to 400

$$250 < \frac{d_2}{t_w} \le 400 \qquad (t_w = 6\text{ mm})$$

$$\frac{d_2}{t_w} \le 400$$

$$d_2 \le 400 \times t_w$$

$$\le 400 \times 6$$

$$\le 2400\text{mm}$$

Maximum depth of web plate d_2= d=2400 mm

02. Ans: (d)

Sol: Stress due to concentric load P is

$$f_a = \frac{P}{A} = \frac{P}{L \times B}$$

Bending stress due to bending moment M is

$$f_b = \pm\frac{M}{I} \times y = \pm\frac{P \times e}{\frac{B \times L^3}{12}} \times \frac{L}{2}$$

$$= \pm\frac{6 \times P \times e}{B \times L^2}$$

Combined stress due to P and M is

$$f_a \pm f_b = \frac{P}{L \times B} \pm \frac{6 \times P \times e}{B \times L^2} = \frac{P}{L \times B}\left(1 \pm \frac{6 \times e}{L}\right)$$

Tensile stress below the base plate to be developed substantial, when e > L/3

03. Ans: (d)

Sol: When slope of roof $\theta > 10^0$

The minimum live load on roof truss as per IS875

For roofs sloping > 10°

(i) For roof membrane, sheets or purlins: 750 N/m^2 less 20 N/m^2 for every degree increase in slope over 10^o subjected to a minimum of 400 N/m^2.

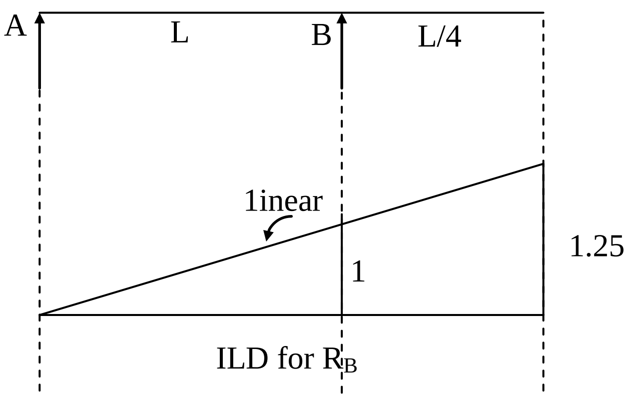
Note: The live load shall not be taken less than 400 N/m^2.

Live load per square meter area

$= 750 - 20\times(\theta\text{-}10^0)$ not less than 400 N/m^2

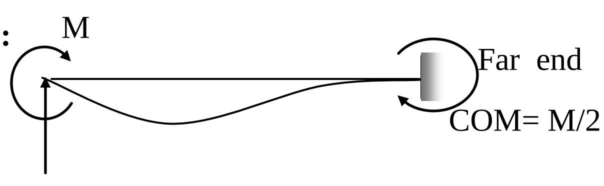
04. Ans: (a)

Sol:



05. Ans: (d)

Sol:

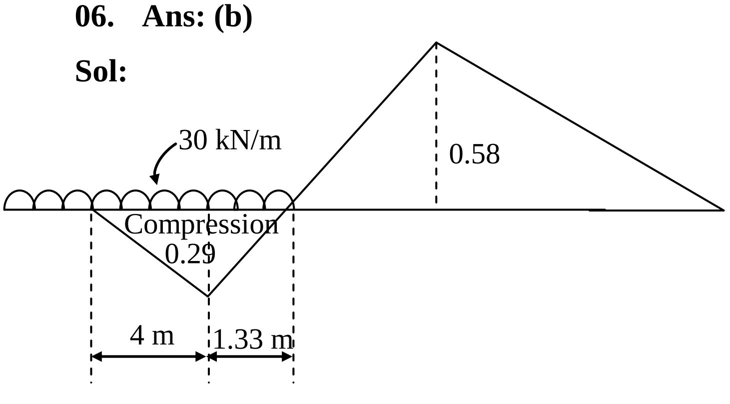


$$\text{Carry over factor} = \frac{\text{Carry over moment}}{\text{Applied moment}}$$

$$= \frac{M/2}{M} = \frac{1}{2}$$

06. Ans: (b)

Sol:



Maximum compressible force

$$= 30\left[\frac{1}{2}\times 5.33\times 0.29\right] = 23.186 \text{ kN}$$

07. Ans: (a)

Sol:

- Equilibrium of structure is considered in method of section.
- For pin-jointed plane frame, number of equilibrium equations are 3 i.e $\Sigma H = 0$, $\Sigma V = 0$ & $\Sigma M = 0$
- Using these three equilibrium equations, we can find three unknowns at a time.

08. Ans: (a)

Sol: An increase in load 'w' will not increase the moment at the fixed end but will increase the moment in the beam as in a simply supported beam.

09. Ans: (d)

Sol: Span of pulin l (*i. e* spacing of truss) = 4.5 m

= 4500 mm

Minimum leg with of angle purlin parallel to the slope of roof not less than $l/60$

= 4500/60 = 75mm

Minimum leg with of angle purlin normal to the slope of roof not less than $l/45$

= 4500/45= 100

10. Ans: (b)

Sol: Shear stress in weld due to concentric load $q_1 = 50$ MPa

Shear stress in weld due to due to in plane moment $q_2 = 120$ MPa

Fillet welded connection is designed for maximum resultant shear stress between q_1 and q_2 is q_{Rmax} is maximum at top right corner of fillet weld group and $\theta = 45^0$

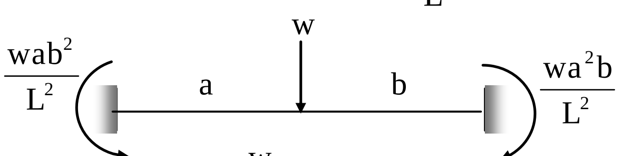
$$q_{R\max} = \sqrt{q_1^2 + q_1^2 + 2\times q_1 \times q_2 \cos\theta}$$

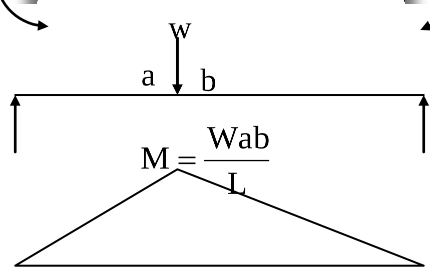
$$q_{R\max} = \sqrt{50^2 + 120^2 + 2\times 50\times 120\times \cos 45^0}$$

$$= 159.32 MPa \approx 160 \text{ MPa}$$

11. Ans: (a)

Sol: Maximum free BM, $M = \dfrac{Wab}{L}$





SSBMD

Sum of fixed end moments

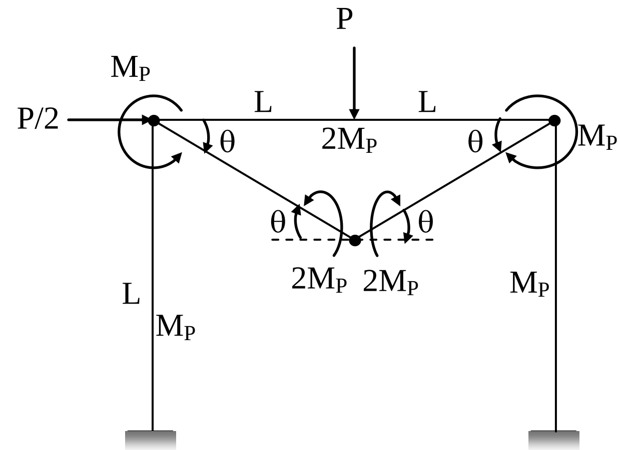
$$= \frac{Wab^2}{L^2} + \frac{Wa^2b}{L^2}$$

$$= \frac{Wab}{L^2}[b + a] \qquad [L = a + b]$$

$$= \frac{Wab}{L} = M$$

12. Ans: (b)

Sol: Beam mechanism

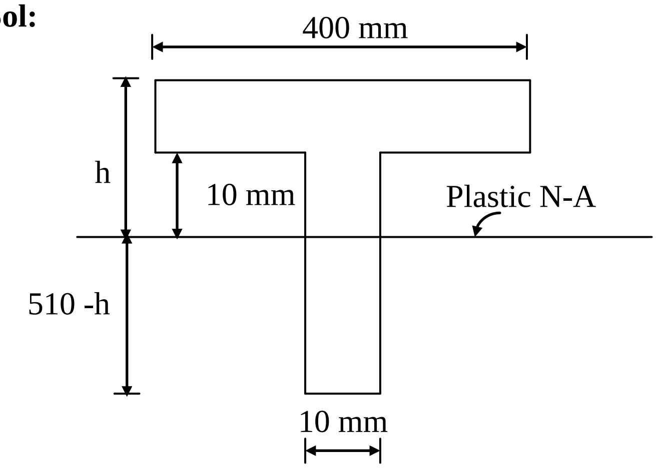


$$P_u \times L\theta = 6\,M_P\,\theta$$

$$P_u = \frac{6M_P}{L}$$

13. Ans: (c)

Sol:



Area under compression = Area under tension

$4000 + 10(h – 10) = 10(510 – h)$

$h = 60$ mm from top

$510 – 60 = 450$ mm from bottom

14. Ans: (c)

Sol: Design strength of bolt V_{db} = 60 kN

Critical bolt is one is farthest from C.G of bolt group and close to the applied load line, hence bolt 2 is critical.

Vertical shear force in each bolt due to P is

$F_a = \frac{P}{n} = \frac{P}{4} = 0.25P$

Shear force in critical bolt due to twisting moment is $F_{m,2} = \frac{Mr_2}{\sum r^2}$

$r_1 = r_2 = r_3 = r_4 = 120/2 = 60$ mm

$$F_{m,2} = \frac{P \times 180 \times 60}{4 \times 60^2} = 0.75P$$

The maximum resultant shear force in bolt 2 is $F_{Rmax} = F_{R2} = F_a + F_{m2}$

= 0.25P+0.75P = P

For safety of critical bolt, the design criteria as per IS800, $F_{rmax} \le V_{db}$

Equating $F_{rmax} = V_{db}$ = 60 kN

15. Ans: (c)

Sol: As per IS 875 Part 3 Wind Loads

V_z= Design wind velocity in m/sec at a height z

$V_z = k_1 . k_2 . k_3 . V_b$

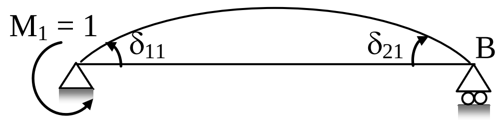
k_1 = probability or risk factor

k_2 = terrain, height and structure size factor.

K_3 = topography factor.

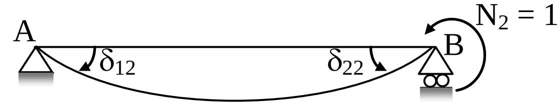
16. Ans: (a)

Sol: Apply unit moment at 'A'



$$\delta_{11} = \frac{L}{3EI}$$

$$\delta_{21} = \frac{-L}{6EI}$$



$$\delta_{21} = -\frac{L}{6EI}$$

$$\delta_{22} = \frac{L}{3EI}$$

$$\delta = \begin{bmatrix} \frac{L}{3EI} & -\frac{L}{6EI} \\ \frac{-L}{6EI} & \frac{L}{3EI} \end{bmatrix}$$

17. Ans: (b)

Sol: Joint equilibrium equation at 'B'

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

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

$$= \frac{WL}{8} + \frac{4EI\theta_B}{L}$$

$$= \frac{10 \times 4}{8} + EI\theta_B$$

$M_{BA} = 5 + EI\theta_B$

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

$= EI\theta_B$

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

$5 + EI\theta_B + EI\theta_B = 0$

$\theta_B = \frac{-2.5}{EI}$

18. Ans: (c)

Sol: Effective length about major axis

$KL_{zz} = 1.0 \times L$

Effective length about minor axis

$KL_{yy} = 0.5 \times L$

Radius of gyration about minor axis

$r_{zz} = 60$ mm

Radius of gyration about major axis

$r_{yy} = 15$ mm

Limiting slenderness ratio of column (KL/r) = 180

Effective slenderness ratio about minor axis (0.5L/15) =180

L = 5400mm = 5.4m

19. Ans: (d)

Sol: Non dimensional effective slenderness ratio of steel column $\lambda = \sqrt{\frac{f_y \times \left(\frac{KL}{r}\right)^2}{\pi^2 E}}$

λ depends on material (f_y, E),

radius of gyration (cross sectional property)

$r_{min} = \sqrt{\frac{I_{min}}{A}}$

Effective length of column (end conditions) and unsupported length of column depends on lateral bracing)

20. Ans: (d)

Sol: Battens are used in built up column to join two column components together, so that the joined column components with battens behaves as a single steel component to shear the applied compressive load uniformly on components.

21. Ans: (b)

Sol: $\frac{C}{r_{min}} \ngtr 0.7\frac{kL}{r}$ of built up column

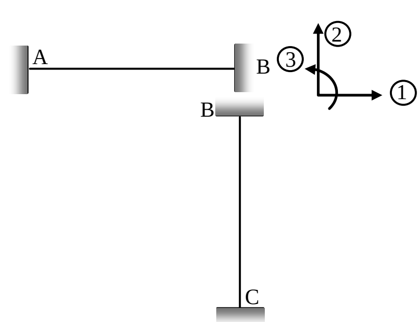
Where C = maximum spacing of batten of built up column

$C \ngtr 0.7 \times 25 \times 50$

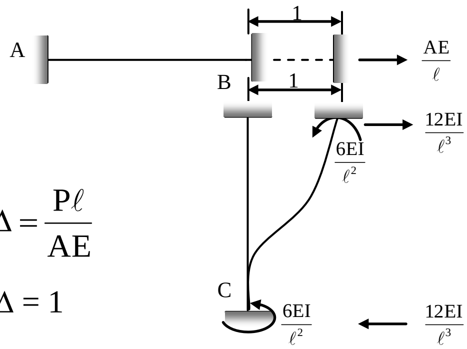
$C \ngtr 875$ mm

22. Ans: (b)

Sol: Restrain the structure initially in the given coordinate directions (1,2,3)



Given unit displacement in the direction of (1)



$$\Delta = \frac{P\ell}{AE}$$

$\Rightarrow \Delta = 1$

$$\Rightarrow P = \frac{AE}{\ell}$$

$$K_{11} = \frac{AE}{\ell} + \frac{12EI}{\ell^3}$$

23. Ans: (d)

Sol: Effective length of fillet weld L_w = 200mm

$L_{w1} + L_{w2} = L_w$ = 200mm --- (1)

To have moment free welded connection, the C.G of weld group and C.G of load line must be on same line

Consider moment of weld section about C.G of weld group

$$\left(\frac{P_1}{P_2}\right) = \left(\frac{L_{w1}}{L_{w2}}\right) = \left(\frac{25}{100-25}\right) = \frac{1}{3}$$

$L_{w1} = 0.5\ L_{w2}$ --- (2)

From Equation (1) and Equation (2)

L_{w1} = 50mm

L_{w2} = 150mm

L_{w1}/L_{w2} = 0.33

24. Ans: (d)

Sol: Maximum tensile load (P) = Safe tensile strength of main tie P_t

$P_t = A_{net} \times \sigma_{at} = A_g \times \sigma_{at}$

Permissible axial tensile stress

$\sigma_{at} = 1.33 \times 0.6\ f_y$

$= 1.33 \times 0.6 \times 250 = 200$ Mpa

$P_t = 2 \times 1150 \times 200 = 460000$ N = 460 kN

25. Ans: (a)

Sol: The tensile load carrying capacity of lug angle (P_l)

P_l = 1.2 × tensile strength of outstanding leg of an angle tie =1.2 × P_o

$P_o = A_o \times \sigma_{at}$

$= (100-10/2) \times 10 \times 150 = 142.5 \times 10$N

= 142.5 kN

$P_l = 1.2 \times P_o = 1.2 \times 142.5 = 171$ kN

26. Ans: (d)

Sol: $U = \int_0^{\ell} \frac{M^2 dx}{2EI}$

$U = U_{AB} + U_{BC}$

$$U = \int_0^{\ell} \frac{\left(\frac{P\ell}{2}\right)^2 dx}{2EI} + \int_0^{\ell/2} \frac{(Px)^2 dx}{2EI}$$

$$U = \frac{7}{48}\frac{P^2\ell^3}{EI}$$

27. Ans: (c)

28. Ans: (d)

Sol: For two hinged semicircular arch carrying a concentrated load W at crown, the horizontal thrust, $H = \frac{W}{\pi}$

H is independent of radius

Thus, the ratio is 1:1:1

29. Ans: (b)

30. Ans: (d)

Sol: In bracket type connection, due to out plane beam reaction produces bending moment and concentric load on bolt group.

Concentric load causes shear force in bolt and bending moment is produces tensile force in bolt, hence bolt in a bolt group should be designed for shear force and tensile force.

31. Ans: (d)

Sol: Ratio of flexural strength of semi compact section to flexural strength of plastic section of steel beam in case of laterally restrained beam

$$\left(\frac{M_{d,s}}{M_{d,s}}\right) = \left(\frac{Z_e \times f_y/\gamma_{m0}}{1.2 \times Z_e \times f_y/\gamma_{m0}}\right) = \left(\frac{1}{1.20}\right)$$

$$= 0.83$$

32. Ans: (b)

Sol: Strength of rivets per pitch (P_r) = n × Rivet Value = 2 × 45 = 90 kN = 90×10^3 N

Nominal diameter of rivet ϕ = 20 mm

Gross diameter of rivet d = 20+1.5

= 21.5mm

Tensile strength of plate per pitch

$P_t = A_{net}\times \sigma_{at} = (p-n\times d)\times t \times \sigma_{at}$

$= (p-1\times21.5)\times10\times150$

To have maximum efficiency of riveted connection by equating $P_r = P_t$

$90\times10^3 = (p-1 \times 21.5)\times10\times150$

Pitch (p) = 81.5mm ≈ 80mm

33. Ans: (c)

Sol: $$DF_{BA} = \frac{\frac{4}{12}}{\frac{4}{12}+\frac{4}{12}} = 0.5 = DF_{BC}$$

$$DF_{CB} = \frac{\frac{4}{12}}{\frac{4}{12}+\frac{4}{8}} = 0.4,\ DF_{CD} = 0.6$$

$$FEM_{BC} = -\frac{10\times12^2}{12} = -120\ \text{kNm}$$

$$FEM_{CD} = \frac{-125\times8}{8} = -125\ \text{kNm} = -FEM_{DC}$$

34. Ans: (b)

Sol: Displacement methods

(i) Slope deflection method

(ii) Stiffness method

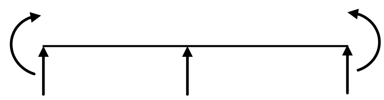
Force methods

(i) Method of consistent deformation

(ii) Flexibility method

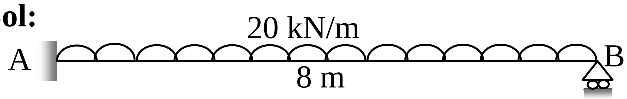
35. Ans: (d)

Sol: $D_s = r - 2 = 5 - 2 = 3$



36. Ans: (a)

Sol:



$$MF_{AB} = -MF_{BA} = -\frac{w\ell^2}{12} = -20 \times \frac{8^2}{12}$$

$$= -106.67 \text{ kNm}$$

$$M_{AB} = MF_{AB} + \frac{4EI}{L}\theta_A + \frac{2EI}{L}\theta_B - \frac{6EI}{L^2}\Delta$$

$$= -106.67 + \frac{EI}{4}\theta_B \quad \text{(as } \theta_A = 0, \Delta = 0\_$$

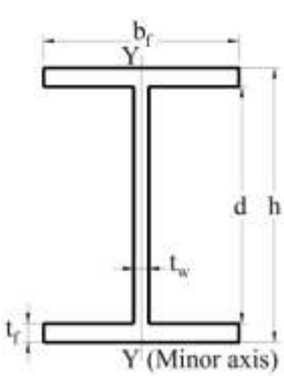
$$M_{BA} = MF_{BA} + \frac{2EI}{L}\theta_A + \frac{4EI}{L}\theta_B - \frac{6EI}{L^2}\Delta$$

$$= 106.67 + \frac{EI}{2}\theta_B \quad (\text{as } \theta_A = 0, \Delta = 0)$$

37. Ans: (b)

38. Ans: (b)

Sol:



Plastic section modulus of I section girder about minor axis (Z_{py})

$$Z_{py} = b_f \times t_f \times \frac{b_f}{2} \times 2 + \frac{t_w}{2(h - 2 \times t_f)} \times \frac{t_w}{4} \times 2$$

$$Z_{py} = b_f \times t_f \times b_f + t_w \times d \times \frac{t_w}{4}$$

$$Z_{py} = A_f \times b_f + \frac{A_w}{4} \times t_w$$

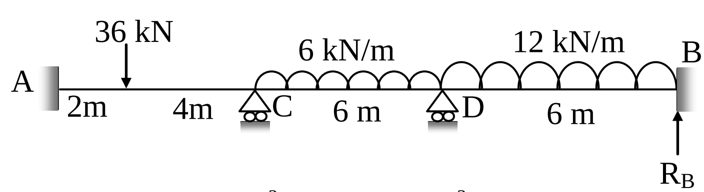
[Area of flange (A_f) = $b_f \times t_f$ & Area of web (A_w) = $d \times t_w$]

39. Ans: (d)

Sol: The shear force is maximum near support, due to heavy support reaction, the web of plate girder is behaves as thin column and Due to maximum compressive stress at centre of web plate under heavy support reaction, the web plate of plate girder buckle vertically, such buckling is called bearing or vertical buckling of web plate

40. Ans: (d)

Sol:



$$MF_{AC} = -\frac{Pab^2}{\ell^2} = -\frac{36 \times 2 \times 4^2}{6^2} = -32 \text{ kNm}$$

$$MF_{CA} = +\frac{Pa^2b}{\ell^2} = \frac{36 \times 2^2 \times 4}{6^2} = 16 \text{ kNm}$$

$$MF_{CD} = -MF_{DC} = -\frac{w\ell^2}{12} = -\frac{6 \times 6^2}{12} = -18 \text{ kNm}$$

$$MF_{DB} = -MF_{BD} = -\frac{12\times 6^2}{12} = -36\ \text{kNm}$$

$$M_{AC} = M_{FAC} + \frac{2EI}{L}(\overset{0}{\cancel{2\theta_A}} + \theta_C)$$

$$= -32 + \frac{2EI}{6}\theta_C$$

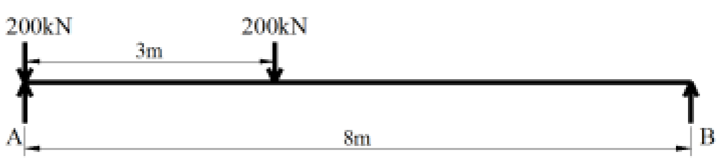
$$= -32 + \frac{EI}{3}\theta_C$$

$$M_{DB} = -36 + \frac{2EI}{6}(2\theta_D)$$

$$= -36 + \frac{2EI\theta_D}{3}$$

41. Ans: (c)

Sol: The condition for maximum shear force due to wheel loads shall be place as shown in figure (i.e one of the wheel load on should be placed at support)



Taking moment about support B

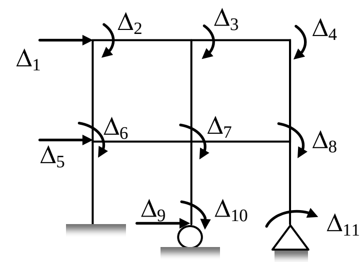
$R_A \times 8 = 200 \times 8 + 200 \times (8 - 3)$

$$R_A = \frac{[200\times 8 + 200\times(8-3)]}{8}$$

= 325 kN

42. Ans: (c)

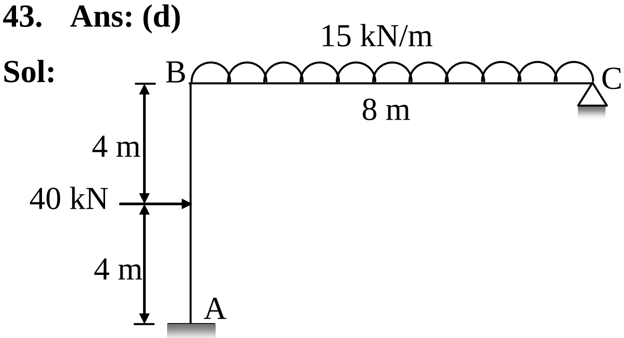
Sol:



Hence the kinematic indeterminacy = 11

43. Ans: (d)

Sol:



$$MF_{AB} = -MF_{BA} = -\frac{P\ell}{8} = -40\times\frac{8}{8} = -40\ \text{kNm}$$

$$MF_{BC} = -MF_{CB} = -\frac{w\ell^2}{12} = -\frac{15\times 8^2}{12} = -80\ \text{kNm}$$

$$M_{AB} = MF_{AB} + \frac{4EI}{\ell}\theta_A + \frac{2EI}{\ell}\theta_B - \frac{6EI}{\ell^2}\Delta$$

$= -40 + 0.25\ EI\ \theta_B \quad (\theta_A = 0, \Delta = 0)$

$$M_{BA} = 40 + \frac{4EI}{\ell}\theta_B + \frac{2EI}{\ell}\theta_A - \frac{6EI}{\ell^2}\Delta = 40 + 0.5EI\theta_B$$

$$M_{BC} = MF_{BC} + \frac{4EI}{\ell}\theta_B + \frac{2EI}{\ell}\theta_C - \frac{6EI}{\ell^2}\Delta$$

$$= -80 + 0.5EI\theta_B + 0.25\theta_C$$

$$M_{CB} = MF_{CB} + \frac{4EI}{\ell}\theta_C + \frac{2EI}{\ell}\theta_B - \frac{6EI}{\ell^2}\Delta$$

$$= 80 + 0.25EI\theta_B + 0.5EI\theta_C$$

44. Ans: (c)

Sol: The slenderness of a tension member to be limited as per IS800, to take care stress reversals, to control the self weight of deflections and to prevent lateral vibrations

45. Ans: (b)

Sol: Limiting slenderness ratio of compression flange $\left(\frac{KL}{r_{min}}\right) = 250$

Effective length of rigidly supported beam KL= 0.65L = L

Minimum radius of gyration r_{min} = r_{yy} =10.4mm

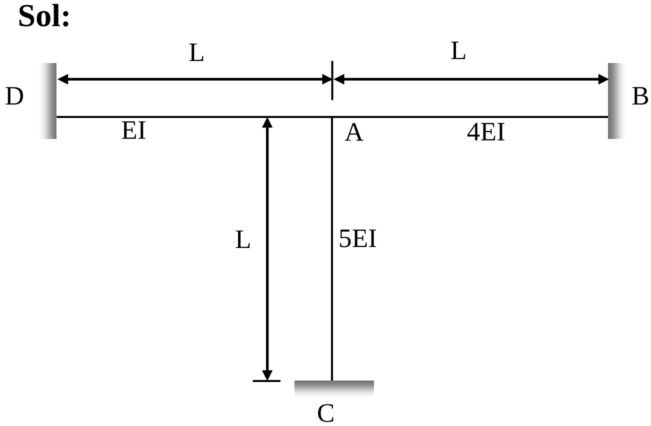
$$\frac{KL}{r_{min}} = \frac{KL}{r_{yy}} = 250$$

$$\frac{0.65L}{r_{yy}} = 250$$

$$L = \frac{250 \times 10.4}{0.65} = 4000 \text{ mm}$$

46. Ans: (b)

Sol:



$$K_{AD} = \frac{4(EI)}{L}, \quad K_{AB} = \frac{4(4EI)}{L}, \quad K_{AC} = \frac{4(5EI)}{L}$$

$$\therefore K = K_{AD} + K_{AB} + K_{AC} = \frac{40EI}{L}$$

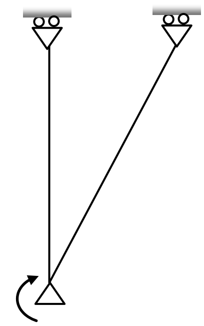
$$\therefore DF_{AB} = \frac{K_{AB}}{K} = 0.4$$

47. Ans: (b)

Sol: $K_{OA} = \frac{4EI}{L} \rightarrow$ Far End fixed

$K_{OB} = \frac{3EI}{L} \rightarrow$ Far End pinned

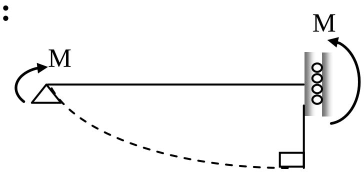
For OD:



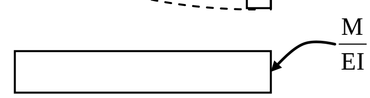
No moment can be resisted by OD as can be seen

$\therefore$ $K_{OD} = 0$

For OC:



$\frac{M}{EI}$ diagram



Applying 1st moment + Area theorem

$\theta_C - \theta_O = \frac{ML}{EI}$, but $\theta_C = 0$

$\therefore |\theta_O| = \frac{ML}{EI} \quad \Rightarrow M = \frac{EI}{L}|\theta_O|$

$\therefore K_{OC} = \frac{EI}{L}$

Hence $DF_{OA} = \frac{4}{4+3+1+0} = 0.5$

48. Ans: (d)

Sol: $DF_{BA} = \frac{\frac{3(2)}{6}}{\frac{3(2)}{6}+\frac{3}{4}} = \frac{4}{7}$

$DF_{BC} = \frac{3}{7}$

$FEM_{AB} = -FEM_{BA} = -60$

$FEM_{BC} = -33.75$

$FEM_{CB} = 11$

	AB	BA	BC	CB
DF		4/7	3/7	
FFM	–60	60	–33.75	11.25
Dist	60	–15	–11.25	–11.25
C.O		30	–5.625	
Dist		–13.93	–10.45	
	0	61.1	–61.1	0

Balance at exterior hinge support

49. Ans: (c)

Sol: There are number of advantages of bolted joints over riveted joints. The noise nuisance, the preheating of rivets, the labour cost, replacement of faulty rivet and for same strength lesser number of bolts, minimum erection time and overall cost of bolted joint is minimum.

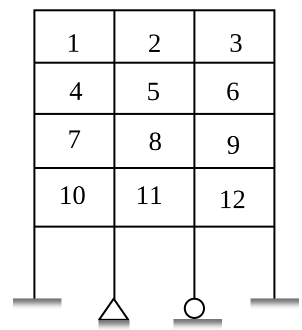
50. Ans: (d)

Sol: Under axial loads fillet welds, slot and plug weld are generally designed for shear stresses only and but welds are designed for axial stresses.

51. Ans: (d) **52. Ans: (c)**

53. Ans: (a)

Sol:



Total number of support reactions

= 3 + 2 + 1 + 3 = 9

∴ Degree of external indeterminacy

= 9 – 3 = 6

Number of closed loops in the structure = 12

∴ Degree of internal indeterminacy

= 3C[C = no of closed loops]

= 3 × 12 = 36

Hence degree of static indeterminacy

= 6 + 36 = 42

54. Ans: (c)

Sol: Effective length of fillet weld

$L_w = 2 \times 100 + 75 = 275$ mm

Effective throat thickness

$t_t = K \times S = 0.7 \times 6 = 4.2$ mm

Design force P = Design Shear strength of fillet weld (P_{dw})

$$P = P_{dw} = \frac{L_w \times t_t \times f_u}{\sqrt{3} \times \gamma_{mw}}$$

$$= \frac{275 \times 4.2 \times 410}{\sqrt{3} \times 1.25} = 218.72 \times 10^3 \text{ N}$$

$$= 218.72 \text{ kN}$$

55. Ans: (c)

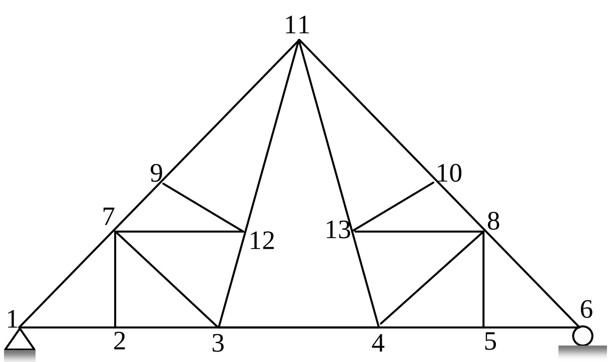
Sol: number of nodes = 13

degrees of freedom per node = 2

no. of restraints = 3

K.1 = 13 × 2 – 3

= 26 – 3 = 23



56. Ans: (a)

Sol: The Williot – Mohr diagram is a graphical method to obtain an approximate value for displacement of a structure which submitted to certain load.

57. Ans: (a)

Sol: m = 5, r = 4, j = 4

$D_{si} = m - 2j + 3 = 0$

$D_{se} = r - 3 = 1$

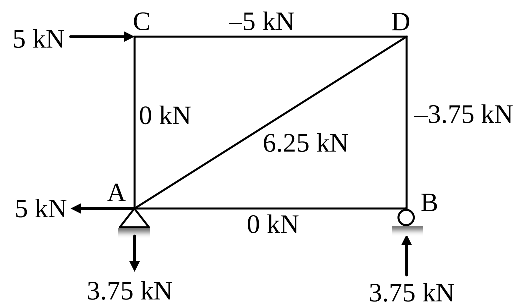
$D_s = 0$

Horizontal reactions (H_B) at B will be taken as redundant

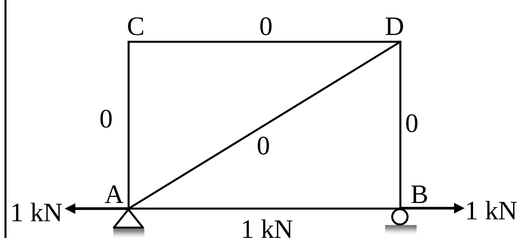
+ → Tensile

– → Compressive

Due to External Load:



Due to Unit Load:



$$H_B = -\frac{\Sigma N_n L}{\Sigma n^2 L} = -\frac{0}{0} = 0 \text{ kN}$$

58. Ans: (b)

Sol: When low percentage of carbon added to iron with other elements the yield stress of steel, ultimate tensile stress of steel and hardness of steel is lesser and ductility of steel & toughness of steel is increased. Hence option (b) is correct.

59. Ans: (d)

Sol: Permissible tensile stress of steel as per IS800:1984 $\sigma_{at} = 0.6\ f_y$

Permissible average stress of steel as per IS800:1984 $\tau_{vf} = 0.4\ f_y$

The ratio of permissible axial tensile stress to average shear stress = $\dfrac{0.6f_y}{0.4f_y} = 1.5$

60. Ans: (b)

Sol: m = 6, r 3, j = 4

$D_{si} = m - 2j + 3 = 6 - 8 + 3 = 1$

$D_{se} = r - 3 = 3 - 3 = 0$

$D_s = 1$

61. Ans: (c)

Sol: Here, m = 11, r = 3, j = 6

$D_{si} = m - 2j + 3 = 11 - 12 + 3 = 2$

$D_{se} = r - 3 = 3 - 3 = 0$

$D_s = 2 + 0 = 2$

Hence, statically indeterminate to degree 2.

62. Ans: (a)

63. Ans: (d)

Sol: $V_A + V_B = 100$ t

For right part 'BC'

$V_B \times 10 = 50 \times 5 + H \times 5$ ....(1)

For part 'AC'

$V_A \times 10 = 5 \times 10 \times 5 + H \times 5$ ....(2)

From equation (1) + (2)

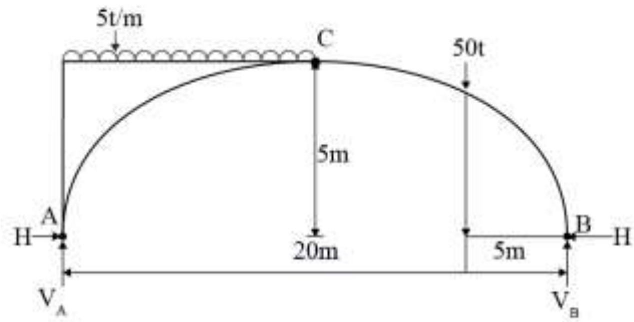
$V_B \times 10 = 250 + H \times 5$

$V_A \times 10 = 250 + H \times 5$

$(V_A + V_B) \times 10 = 500 + H \times 10$

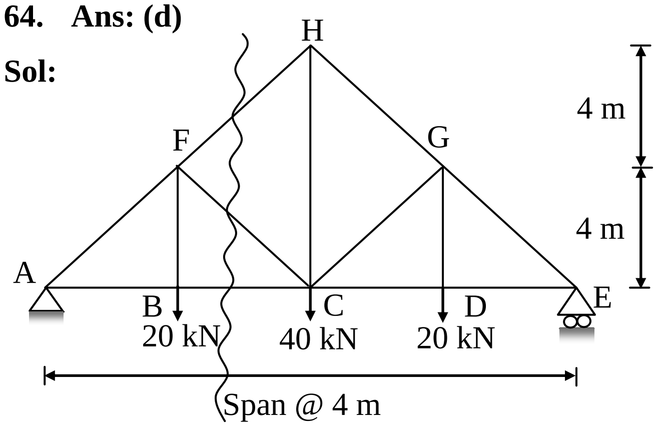
$100 \times 10 = 500 + H \times 10$

H = 50 t



64. Ans: (d)

Sol:

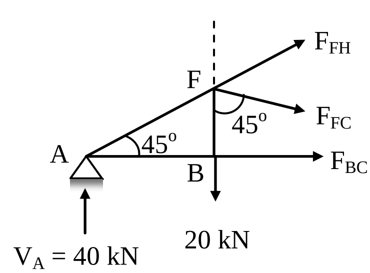


+n $\Sigma M_{Z|_E} = 0$

$V_A \times 16 = 20 \times 12 + 40 \times 8 + 20 \times 4$

$V_A = 40$ kN

Taking section as per figure



$+\curvearrowleft \Sigma M_A = 0$

$(F_{FC} \cos 45^o) \times 4 + (F_{FC} \sin 45^o) \times 4 + 20 \times 4 = 0$

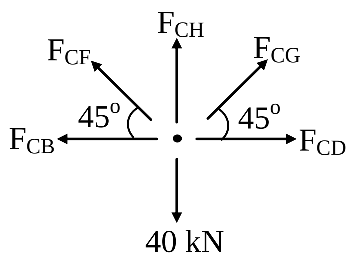
or, $F_{FC} = -14.14$ kN

As the truss is symmetric one,

Then, $F_{CG} = F_{CF}$

$= -14.14$ kN (compressive)

Joint C:

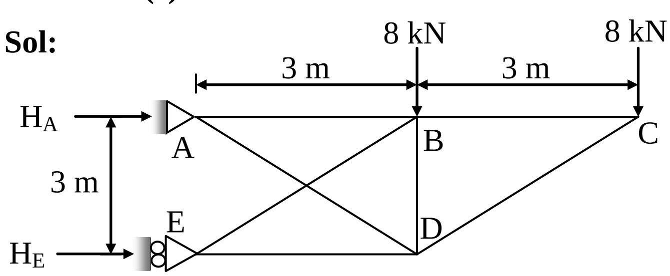


$F_{CH} + F_{CG} \sin 45 + F_{CF} \sin 45 = 40$

$F_{CH} = 60$ kN (Tensile)

65. Ans: (c)

Sol:



Here, m = 7, r = 3, j = 5

$D_{si} = m - 2j + 3 = 7 - 10 + 3 = 0$

$D_{se} = r - 3 = 3 - 3 = 0$

$D_s = 0$ statically determinate

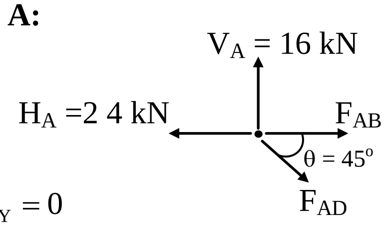
$\overset{+}{\uparrow} \Sigma F_Y = 0$ $V_A = 8 + 8 = 16$ kN

$+\curvearrowleft \Sigma M_{Z|_A} = 0$

$H_E \times 3 - 8 \times 3 - 8 \times 6 = 0$ or, $H_E = 24$ kN

$H_A = -24$ kN

Joint A:



$\overset{+}{\uparrow} \Sigma F_Y = 0$

$F_{AD} \sin \theta = 16$

$$F_{AD} = \frac{16}{\sin 45} = 22.627 \text{ kN (Tensile)}$$

66. Ans: (a)

Sol: For short joint lengths force in bolt in the bolted joint will be redistributed due to plastic action and the bolt will share the load equally. However in long joint, the shear distribution is non uniform, bolt at ends of the joint are forced more under tension, it may lead to failure of joint called unbuttoning.

67. Ans: (a)

Sol: It is assumed that the strength of longitudinal fillet welds and transverse fillet weld is same. Actually the strength of the transverse fillet weld is more than the longitudinal fillet weld, because a transverse fillet weld is stresses more uniformly for full length.


ACE
Engineering Academy
HEARTY CONGRATULATIONS
TO OUR ESE - 2019 TOP RANKERS
AIR 1 KARTIKEYA SINGH EE
AIR 1 RAJAT SONI E&T
AIR 1 HARSHAL BHOSALE ME
AIR 1 ABUZAR GAFFARI CE
AIR 2 SHAMBHAVI EE
AIR 2 SAHIL GOYAL ME
AIR 3 ROHIT KUMAR E&T
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 6 PUSHPAK ME
AIR 9 ANKIT KUMAR CE
TOTAL SELECTIONS in Top 10: 33
(EE: 9, E&T: 8, ME: 9, CE: 7) and many more...


Since 1995
ACE
DIGITAL CLASSES
for
ESE 2020/2021
General Studies &
Engineering Aptitude
GATE 2020/2021
Computer Science &
Information Technology
Access the Course at
www.deep-learn.in

68. Ans: (c)

Sol: Generally gantry girder are designed as laterally unsupported beam unless the compression flange beam is laterally supported by either by catwalk or additional member (such girder is laterally supported gantry girder). Such arrangement increases the cost of girder and not provided to be economical.

69. Ans: (c)

Sol: Block shear failure of tension member at end of connection along path involving tension on one plane and shear on the perpendicular plane due to smaller length of connection for use of higher grade bolts.

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

72. Ans: (a)

Sol: Excessive deformation may create problems for roof drainage and they may cause twisting and distortion of connection and connected members and lead to high secondary stresses

73. Ans: (a)

74. Ans: (a)

Sol: Fillet weld closure to the minimum size of the weld are economical for the same strength. It is because the volume of material required for large size weld for the same strength will be several times of that required for smaller size

75. Ans: (c)

Sol: Statement I is true but statement II false.