

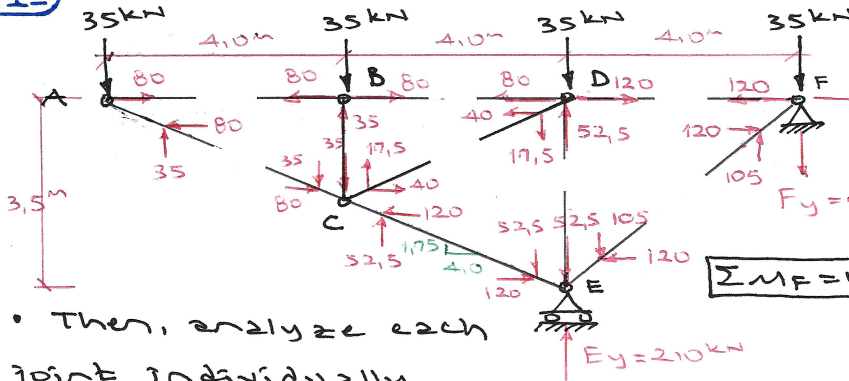


DATE 13-Oct-2012	1 P56-Solution	PAGE 1 of 3
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		2 Stud. no ###

Problem set 6 (P56)

Solution

1-



• First, find the support reactions using the whole truss.

$$\sum M_F = 0 \Rightarrow 35 \cdot 12.0 + 35 \cdot 8.0 + 35 \cdot 4.0 - E_y \cdot 4.0 = 0$$

$$\Rightarrow E_y = 210 \text{ kN}$$

$$\sum F_y = 0 \Rightarrow F_y = 210 - 35 \cdot 4 = 70 \text{ kN}$$

$$\sum F_x = 0 \Rightarrow F_x = 0$$

• Then, analyze each joint individually.

Follow the order of joint A, B, F, D, E and check the equilibrium at C before completing the solution.

• Note: Joint C includes two inclined members. Analyzing it will require solving simultaneous equations. Therefore, I left it out and solved all other joints.

$$\text{at C: } \sum F_x = 80 + 40 - 120 = 0 \quad \text{OK} \checkmark$$

$$\sum F_y = 52.5 + 17.5 - 35 - 35 = 0 \quad \text{OK} \checkmark$$

• Member Forces
(9 members in total)

ANSWERS

$$F_{AB} = +80 \text{ kN (T)} ; F_{BC} = -35 \text{ kN (C)}$$

$$F_{AC} = -\sqrt{80^2 + 35^2} = -87.3 \text{ kN (C)}$$

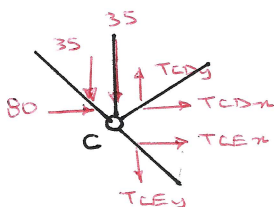
$$F_{CE} = -\sqrt{120^2 + 52.5^2} = -131.0 \text{ kN (C)}$$

$$F_{CD} = +\sqrt{40^2 + 17.5^2} = +43.7 \text{ kN (T)}$$

$$F_{BD} = +80 \text{ kN (T)} ; F_{DF} = +120 \text{ kN (T)}$$

$$F_{EF} = -\sqrt{105^2 + 120^2} = -159.5 \text{ kN (C)} ; F_{DE} = -52.5 \text{ kN (C)}$$

• If one attempts to solve the truss with the order of: A, B, C, D, F, E (without skipping C), more work will be involved as follows:



$$\sum F_x = 0 \Rightarrow 80 + T_{CDx} + T_{CEx} = 0$$

$$\sum F_y = 0 \Rightarrow T_{CDy} - T_{CEy} - 70 = 0$$

$$T_{CDy} = \frac{1.75}{4.0} T_{CDx} \Rightarrow T_{CDy} = 0.4375 T_{CDx}$$

$$T_{CEy} = \frac{1.75}{4.0} T_{CEx} \Rightarrow T_{CEy} = 0.4375 T_{CEx}$$

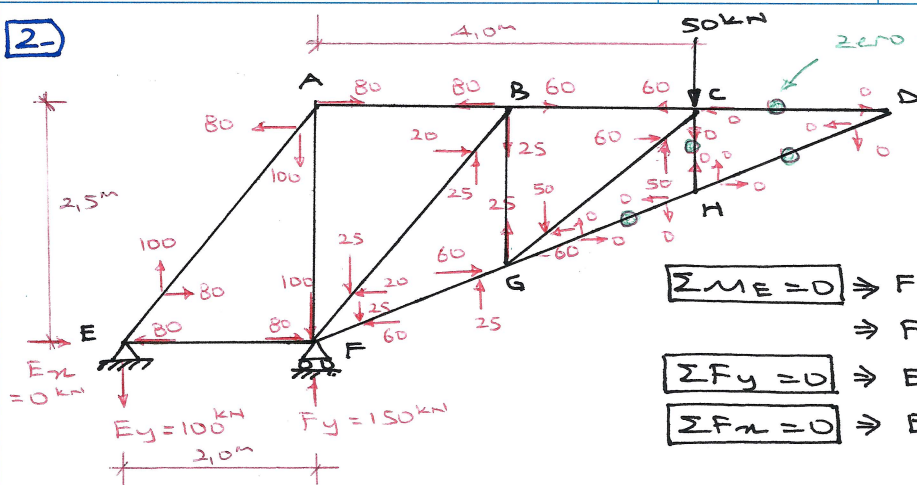
4 eq's and 4 unknowns. Solving:

$$T_{CDx} = 40 \text{ kN} ; T_{CDy} = 17.5 \text{ kN} ; T_{CEx} = -120 \text{ kN}$$

$T_{CEy} = -52.5 \text{ kN}$ (-ve sign indicates assumed direction is wrong. Fix the direction of the FBD above.)



2-



zero force members

• First, find the support reactions using the whole system.

$$\sum M_E = 0 \Rightarrow F_y \cdot 2,0\text{m} - 50\text{kN} \cdot 6,0\text{m} = 0$$

$$\Rightarrow F_y = 150\text{ kN}$$

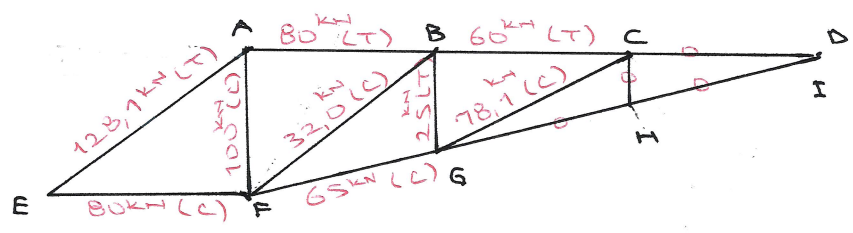
$$\sum F_y = 0 \Rightarrow E_y = 150 - 50 = 100\text{ kN}$$

$$\sum F_x = 0 \Rightarrow E_x = 0$$

• Then analyze each joint individually on a FBD. My order is D, H, C, G, B, A, E

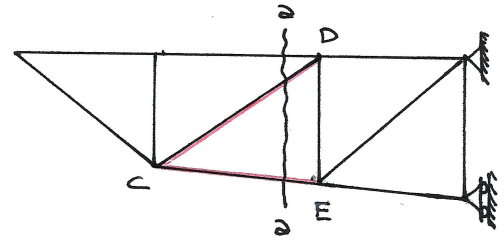
• check if $\sum F_x = 0$ and $\sum F_y = 0$

• Answer:

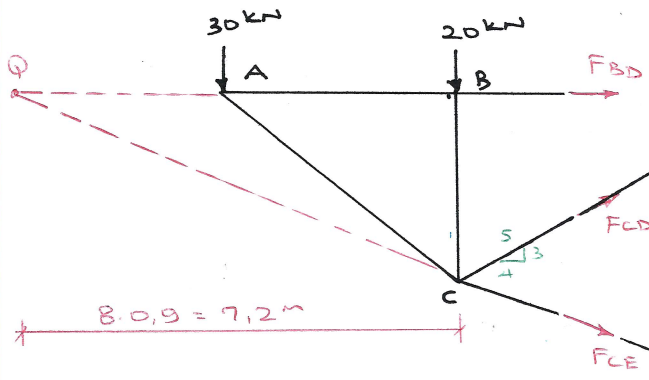


T: tension
C: compression

3-



• Members CD and CE are of interest. Get a section cut involving those members. (Section a-a) Analyze the left hand side to avoid having to calculate the support reactions.



• Intersect FBD and FCE at Q. Move FCD to point D.

$$\sum M_Q = 0 \Rightarrow F_{CDx} \cdot 8,4\text{m} - 30 \cdot 6,0\text{m} - 20 \cdot 7,2\text{m} = 0$$

$$\Rightarrow F_{CDx} = 38,6\text{ kN}$$

$$F_{CDy} = \frac{4}{3} \cdot 38,6 = 51,5\text{ kN}$$

$$\Rightarrow F_{CD} = 64,3\text{ kN (T)}$$

• Move FCE to point E.

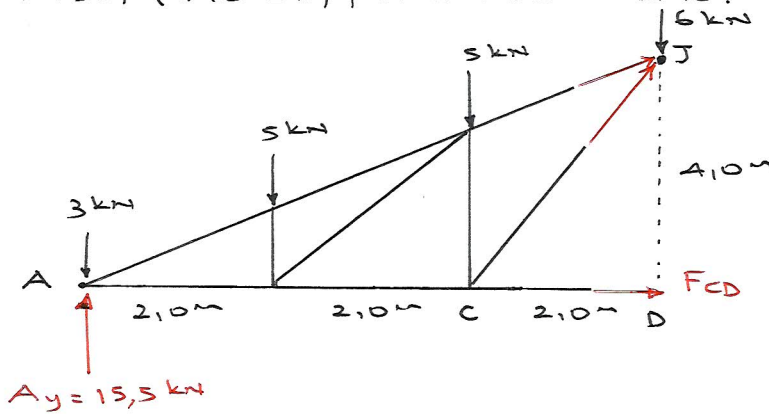
$$\sum M_D = 0 \Rightarrow F_{CEx} \cdot 1,05 + 30 \cdot 2,4\text{m} + 20 \cdot 1,2\text{m} = 0 \Rightarrow F_{CEx} = -91,4\text{ kN}$$

$$F_{CEy} = -11,4\text{ kN}$$

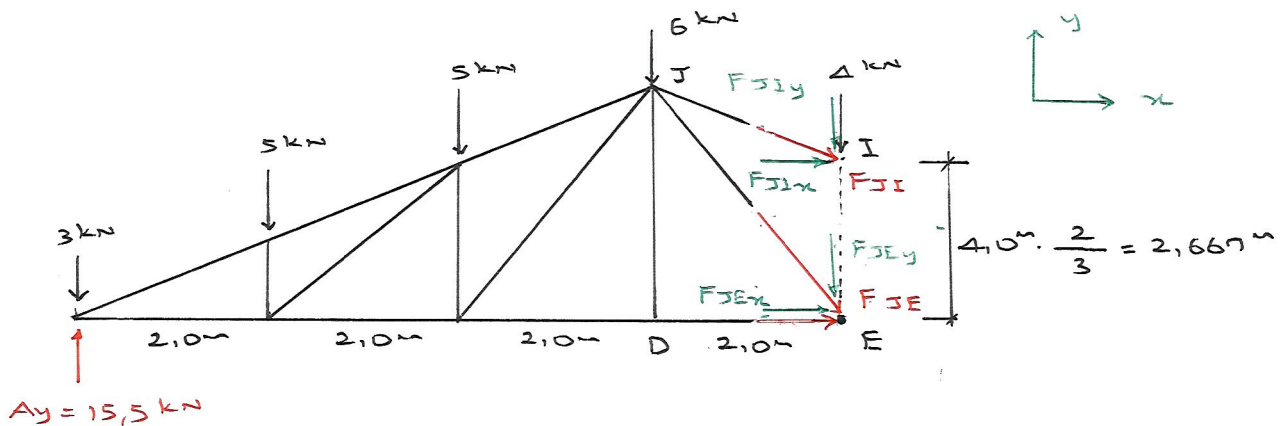
$$F_{CE} = -92,1\text{ kN (C)}$$



4. First, find support reactions. $\sum M_G = 0 \Rightarrow A_y = 15,5 \text{ kN}$



$$\begin{aligned} \bullet \quad \boxed{\sum M_J = 0} &\Rightarrow F_{CD} \cdot 4,0\text{m} + 3\text{kN} \cdot 6,0\text{m} + 5\text{kN} \cdot 4,0\text{m} + 5\text{kN} \cdot 2,0\text{m} \\ &\quad - 15,5\text{kN} \cdot 6,0\text{m} = 0 \\ &\Rightarrow \underline{F_{CD} = +11,25 \text{ kN (T)}} \end{aligned}$$



$$\begin{aligned} \bullet \quad \boxed{\sum M_E = 0} &\Rightarrow 3,0\text{kN} \cdot 8,0\text{m} + 5\text{kN} \cdot 6,0\text{m} + 5\text{kN} \cdot 4,0\text{m} + 6\text{kN} \cdot 2,0\text{m} \\ &\quad - 15,5\text{kN} \cdot 8,0\text{m} - F_{JIx} \cdot 2,667\text{m} = 0 \end{aligned}$$

$$\Rightarrow F_{JIx} = -14,25 \text{ kN}$$

$$F_{JIy} = -14,25 \text{ kN} \cdot \frac{4,0\text{m}}{6,0\text{m}} = -9,50 \text{ kN}$$

$$F_{JI} = \sqrt{F_{JIx}^2 + F_{JIy}^2} \Rightarrow \underline{F_{JI} = -17,13 \text{ kN (C)}}$$

$$\bullet \quad \boxed{\sum F_y = 0} \Rightarrow 15,5 + 9,50 - 3 - 5 - 5 - 6 - F_{JEy} = 0$$

$$\Rightarrow F_{JEy} = 6,0 \text{ kN}$$

$$F_{JEx} = 6,0 \cdot \frac{2,0\text{m}}{4,0\text{m}} = 3,0 \text{ kN}$$

$$F_{JE} = \sqrt{F_{JEx}^2 + F_{JEy}^2} \Rightarrow \underline{F_{JE} = +6,71 \text{ kN (T)}}$$