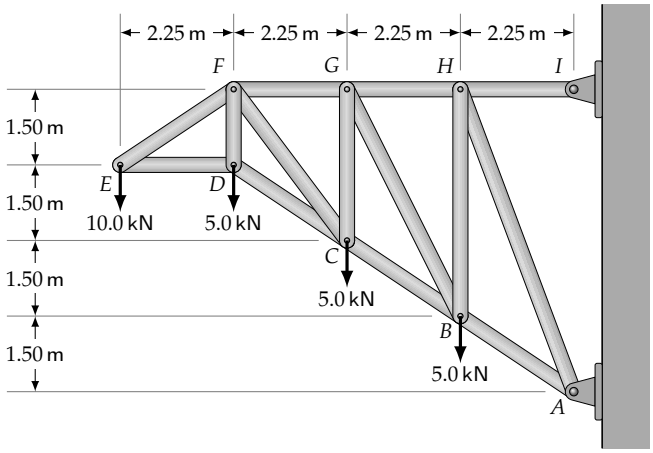
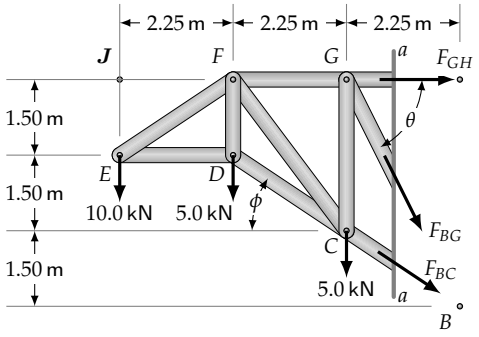
Engineering Statics - 08 Method of Sections - Instructor Copy

Exercise 1: Determine the force in truss members BC, BG and GH.



Draw Section $a-a$ and analyze the left portion of the truss.



$$\theta = \tan^{-1}\left[\frac{4.5}{2.25}\right] = 63.435^\circ$$

$$\phi = \tan^{-1}\left[\frac{1.5}{2.25}\right] = 33.690^\circ$$

Take moments about G to find F_{BC}:

$$\Sigma M_G = (F_{BC}\cdot\cos\phi)\cdot(3.00\,\text{m}) + (5.00\,\text{kN})\cdot(2.25\,\text{m}) + (10.00\,\text{kN})\cdot(4.50\,\text{m})$$

$$= F_{BC}\cdot(2.4962\,\text{m}) + 56.250\,\text{kN}\cdot\text{m} = 0$$

$$\Rightarrow F_{BC} = -22.534\,\text{kN}$$

Take moments about B to find F_{GH}:

$$\Sigma M_B = -(F_{GH})\cdot(4.50\,\text{m}) + (5.00\,\text{kN})\cdot(2.25\,\text{m}) + (5.00\,\text{kN})\cdot(4.50\,\text{m}) + (10.00\,\text{kN})\cdot(6.75\,\text{m}) = 0$$

$$\Rightarrow F_{GH} = 22.500\,\text{kN}$$

Multiple options: sum x-components, sum y-components or take moments around point J to find F_{BG}. (Taking moments here.)

$$\Sigma M_J = -(F_{BG}\cdot\sin\theta)\cdot(4.50\,\text{m}) - (5.00\,\text{kN})\cdot(4.50\,\text{m}) - (5.00\,\text{kN})\cdot(2.25\,\text{m})$$

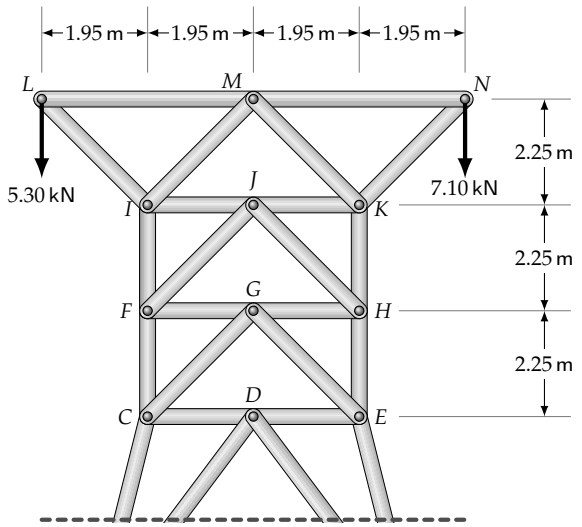
$$\Sigma M_J = -F_{BG}\cdot(4.0249\,\text{m}) - (33.750\,\text{kN}\cdot\text{m}) = 0$$

$$\Rightarrow F_{BG} = -8.3853\,\text{kN}$$

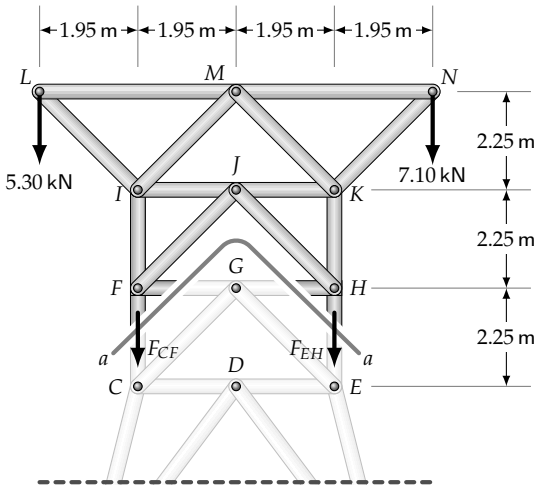
Answers:

$F_{BC} = 22.5\,\text{kN}$ (Compression)
$F_{BG} = 8.39\,\text{kN}$ (Compression)
$F_{GH} = 22.0\,\text{kN}$ (Tension)

Exercise 2: Determine the force in truss members CF, CG, EG and EH.



First Section: Draw $a-a$ and, using the upper portion of the truss, determine F_{CF} and F_{EH}.



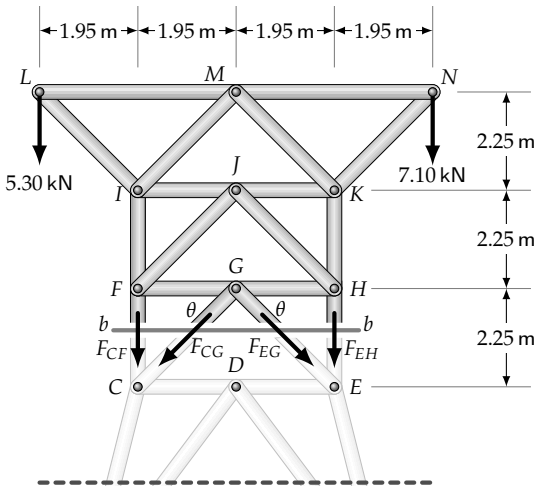
$$\Sigma M_F = 5.30\,\text{kN}\cdot(1.95\,\text{m}) - F_{EH}\cdot(3.90\,\text{m}) - 7.10\,\text{kN}\cdot(5.85\,\text{m}) = 0$$

$$\Rightarrow F_{EH} = -8.0000\,\text{kN} \qquad \underline{\textbf{Ans. } \boldsymbol{F_{EH} = 8.00\,\text{kN}}\ \textbf{(Compression)}}$$

$$\Sigma M_H = 5.30\,\text{kN}\cdot(5.85\,\text{m}) + F_{CF}\cdot(3.90\,\text{m}) - 7.10\,\text{kN}\cdot(1.95\,\text{m}) = 0$$

$$\Rightarrow F_{CF} = -4.4000\,\text{kN} \qquad \underline{\textbf{Ans. } \boldsymbol{F_{CF} = 4.40\,\text{kN}}\ \textbf{(Compression)}}$$

Second Section: Draw $b-b$ and, using the upper portion of the truss, determine F_{CG} and F_{EG}.



$$\theta = \tan^{-1}\left[\frac{2.25\,\text{m}}{1.95\,\text{m}}\right] = 49.086^\circ$$

$$\Sigma F_x = F_{EG}\cdot\cancel{\cos 49.086^\circ} - F_{CG}\cdot\cancel{\cos 49.086^\circ} = 0$$

$$\Rightarrow F_{CG} = F_{EG}$$

$$\begin{aligned}\Sigma F_y &= -5.30\,\text{kN} - 7.10\,\text{kN} - F_{CF} - F_{EH} \\ &\quad - 2F_{CG}\cdot\sin 49.086^\circ \\ &= -12.400\,\text{kN} - (-4.4000\,\text{kN}) - (-8.0000\,\text{kN}) \\ &\quad - 2F_{CG}\cdot\sin 49.086^\circ \\ &= -2F_{CG}\cdot\sin 49.086^\circ = 0\end{aligned}$$

$$\Rightarrow F_{CG} = 0 \qquad \underline{\textbf{Ans. } \boldsymbol{F_{CF} = 0}}$$

$$\Rightarrow F_{EG} = 0 \qquad \underline{\textbf{Ans. } \boldsymbol{F_{EG} = 0}}$$