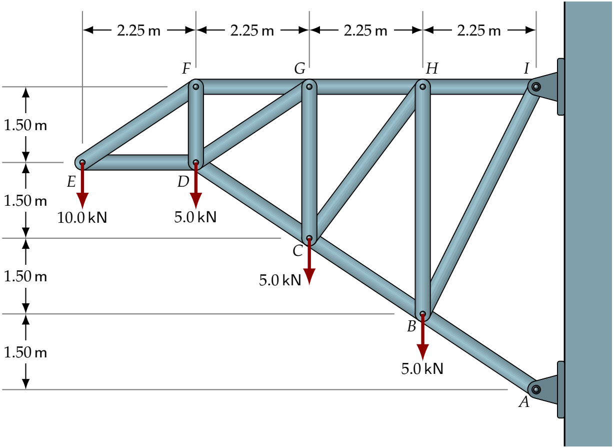
Method of Sections — Step by Step Examples

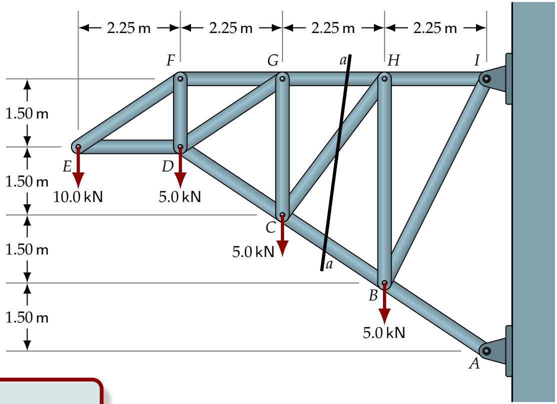
Engineering Statics

Last revision on October 20, 2025

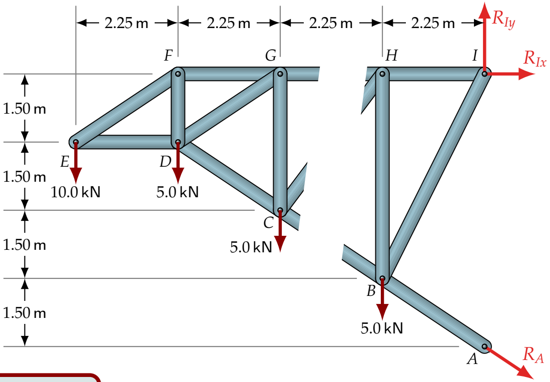


Method of Sections: Example 3

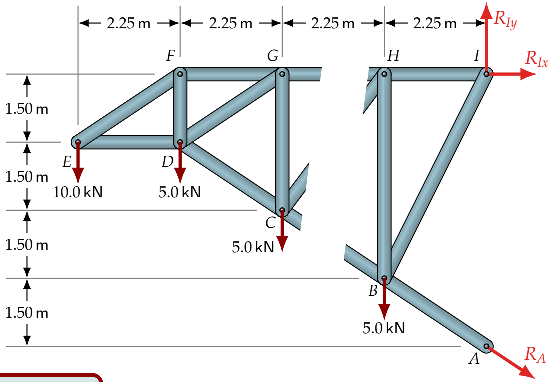
Use the method of sections to determine the forces in members BC, CH and GH.



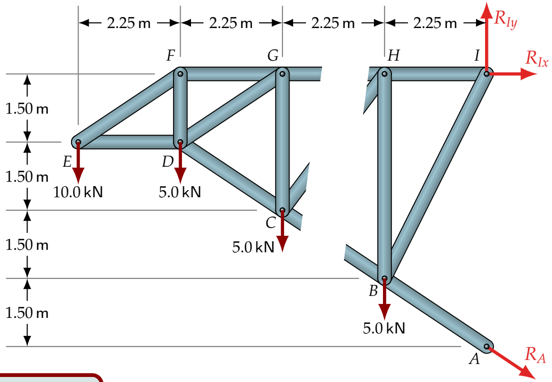
- Draw section $a-a$ to expose the forces in members BC, CH and GH.



- Draw section $a-a$ to expose the forces in members BC, CH and GH.
- Analyze the frame segment to the left of section $a-a$. There are more external loads to consider but we don't need to calculate, and later include, the reactions at A and I.



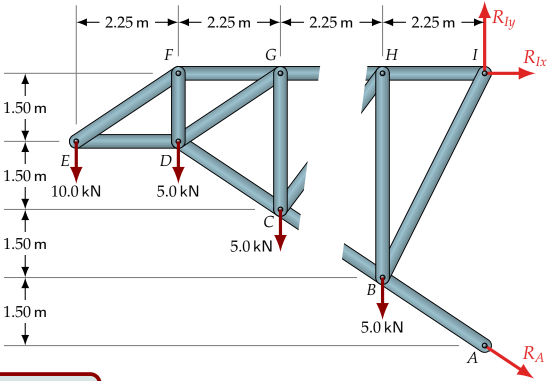
- Draw section $a-a$ to expose the forces in members BC, CH and GH.
- Analyze the frame segment to the left of section $a-a$. There are more external loads to consider but we don't need to calculate, and later include, the reactions at A and I.
- Find the reaction at E.



- Draw section a–a to expose the forces in members BC, CH and GH.
- Analyze the frame segment to the left of section a–a. There are more external loads to consider but we don't need to calculate, and later include, the reactions at A and I.
- Find the reaction at E.

$$\Sigma M_A = R_E \cdot (11.60\,\text{m}) - (4.00\,\text{kN}) \cdot (2.90\,\text{m}) - (5.50\,\text{kN}) \cdot (5.80\,\text{m}) = 0$$

$$\Rightarrow R_E = 3.75\,\text{kN}$$



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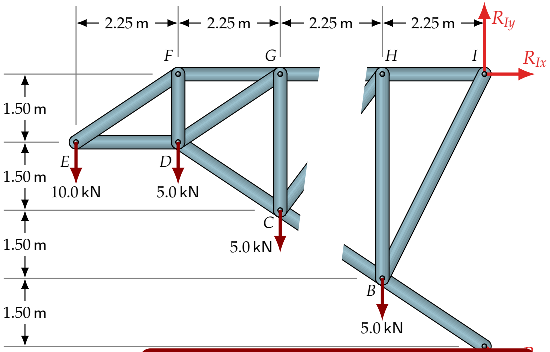
- Now for some angles...



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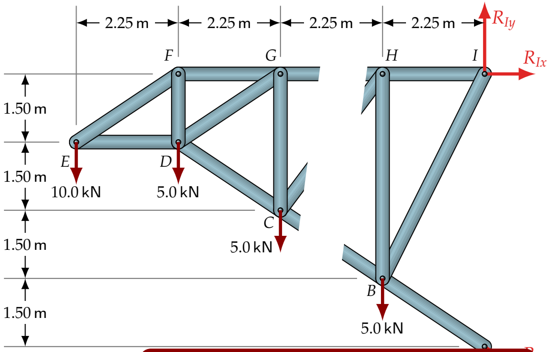
$$\angle BCH = \tan^{-1}\left[\frac{2.50\text{ m}}{2.90\text{ m}}\right]$$

$$= 40.764^\circ$$



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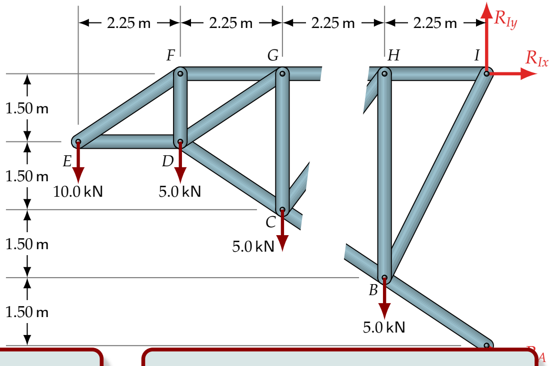
- Find the reaction at E.
- Now for some angles...

$$\angle BCH = \tan^{-1}\left[\frac{2.50\text{ m}}{2.90\text{ m}}\right]$$

$$= 40.764^\circ$$

$$\angle CGH = \tan^{-1}\left[\frac{2.90\text{ m}}{1.25\text{ m}}\right]$$

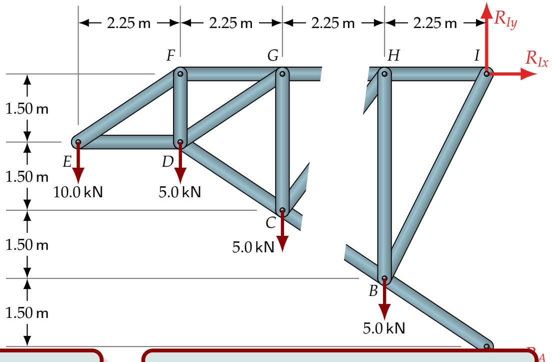
$$= 66.682^\circ$$



- Taking moments about the intersection of the lines of action of two of the required forces allows us to solve for the third unknown without resorting to solving simultaneous equations. Thus, taking moments about C will give direct access to F_{GH}.

$$\Sigma M_C = (3.75\,\text{kN})\cdot(5.80\,\text{m}) - F_{GH}\cdot\sin 66.682^\circ\cdot(3.75\,\text{m}) = 0$$

$$\Rightarrow F_{GH} = 6.3159\,\text{kN}$$



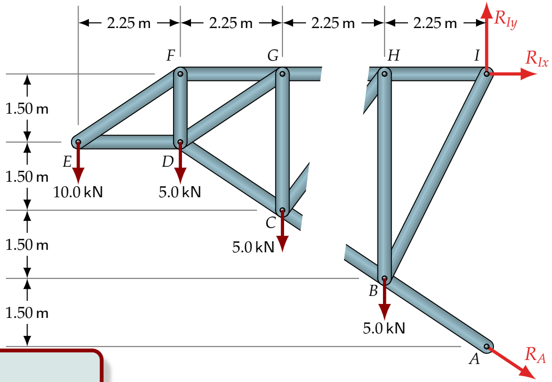
- Taking moments about the intersection of the lines of action of two of the required forces allows us to solve for the third unknown without resorting to solving simultaneous equations. Thus, taking moments about C will give direct access to F_{GH}.
- Similarly, moments about H yield F_{BC}.

$$\Sigma M_C = (3.75\,\text{kN})\cdot(5.80\,\text{m}) - F_{GH}\cdot\sin 66.682^\circ\cdot(3.75\,\text{m}) = 0$$

$$\Rightarrow F_{GH} = 6.3159\,\text{kN}$$

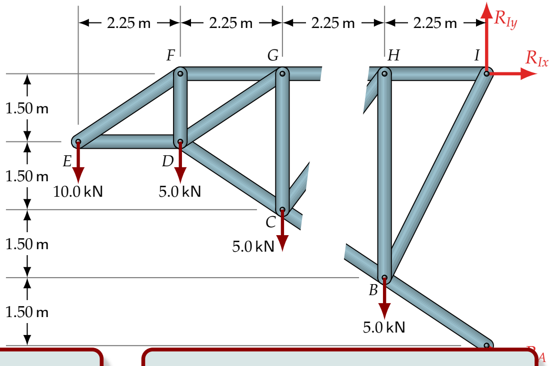
$$\Sigma M_H = (3.75\,\text{kN})\cdot(8.70\,\text{m}) + F_{BC}\cdot(2.50\,\text{m}) - (5.50\,\text{kN})\cdot(2.90\,\text{m}) = 0$$

$$\Rightarrow F_{BC} = -6.6700\,\text{kM}$$



- There are a number of options now:
  $\Sigma F_y = 0$ involves 5 terms;
  $\Sigma F_x = 0$ involves 3 terms;
  $\Sigma M_G = 0$ involves 3 terms.
  We could even recognize that the lines of action of F_{BC} and of F_{GH} intersect at a point 2.90 m to the left of A – moments about this point would involve 3 terms.

  Taking moments about G is a good option.



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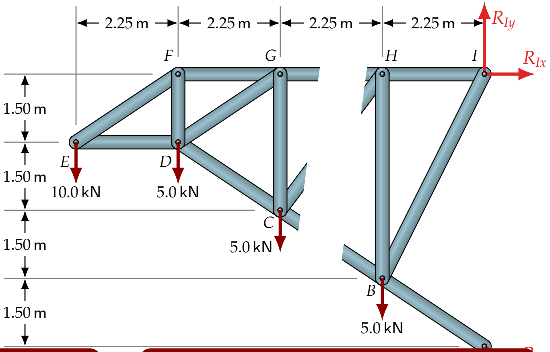
$$
\begin{aligned}
\Sigma M_G &= (3.75\,\text{kN})\cdot(5.80\,\text{m}) \\
&\quad + F_{CH}\cdot\cos 40.764^\circ\,(3.75\,\text{m}) \\
&\quad + F_{BC}\cdot(3.75\,\text{m}) \\
&= 21.75\cdot\text{kN}\cdot\text{m} + F_{CH}(2.8403\,\text{m}) \\
&\quad + (-6.6700\,\text{kN})\cdot(3.75\,\text{m}) = 0
\end{aligned}
$$

$$\Rightarrow F_{CH} = 1.1486\,\text{kN}$$



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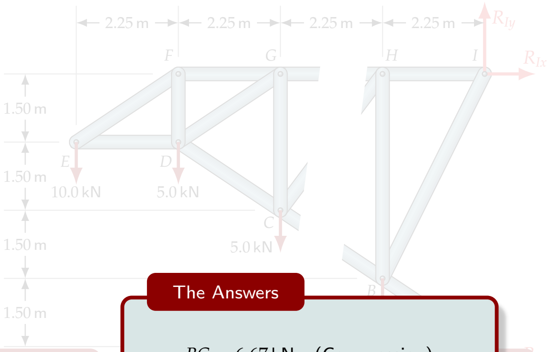

The Answers

$BC = 6.67\,\text{kN}$ (Compression)

$BE = 1.15\,\text{kN}$ (Tension)

$EF = 6.32\,\text{kN}$ (Tension)

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  Taking moments about G is a good option.

$$= 21.75\cdot\text{kN}\cdot\text{m} + F_{CH}(2.8403\,\text{m}) + (-6.6700\,\text{kN})\cdot(3.75\,\text{m}) = 0$$

$$\Rightarrow F_{CH} = 1.1486\,\text{kN}$$