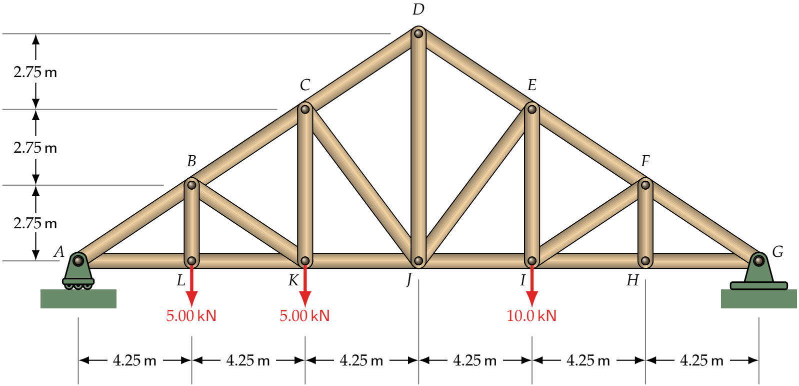
Method of Sections — Step by Step Examples

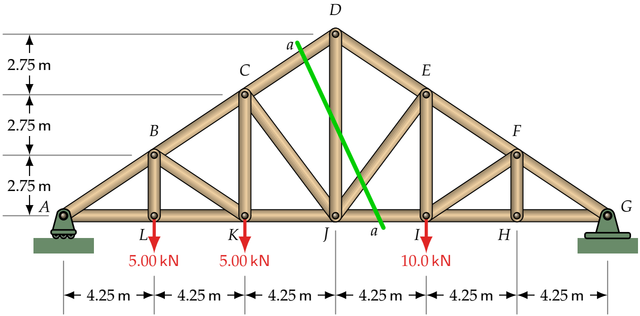
Engineering Statics

Last revision on October 22, 2025

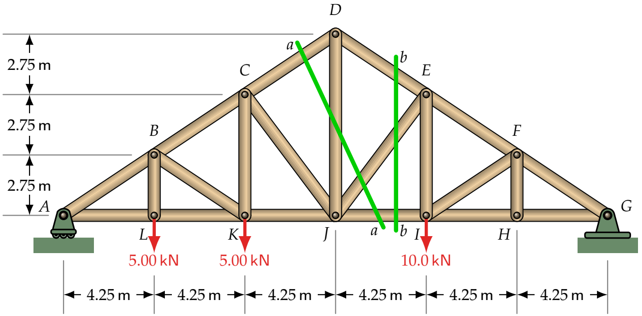


Method of Sections: Example 4

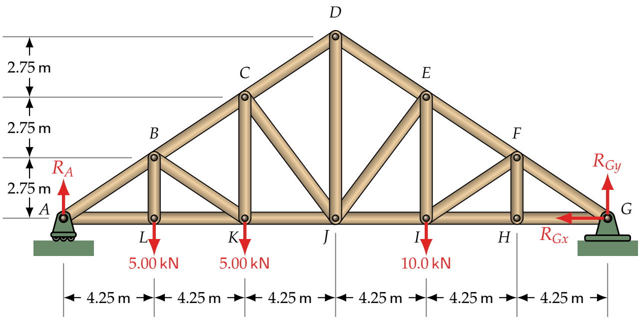
Use the method of sections to determine the force in DJ.



- Each section that cuts through DJ, such as $a-a$, also cuts through at least three other members. But we cannot solve for four unknowns with the three equilibrium equations.



- Each section that cuts through DJ, such as $a{-}a$, also cuts through at least three other members. But we cannot solve for four unknowns with the three equilibrium equations.
- A vertical section $b{-}b$ will enable us to solve for the force in IJ, after which we can solve for what we need using $a{-}a$.



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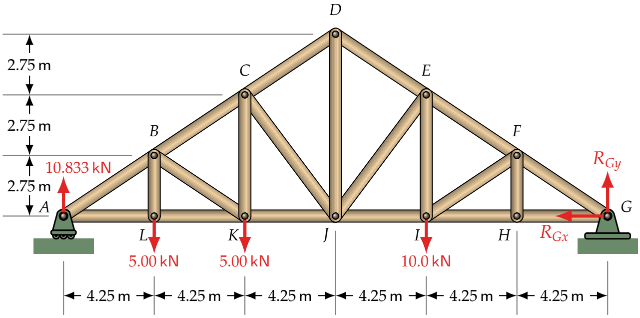
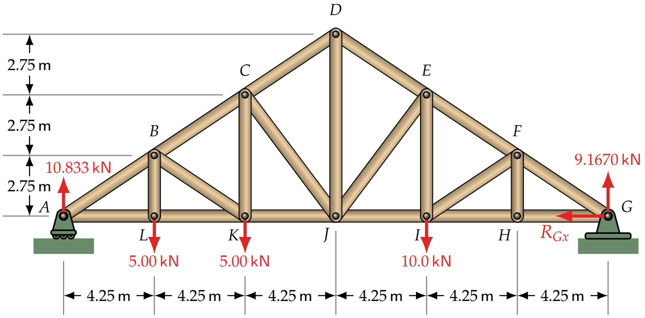
- First, find the reactions.



- Each section that cuts through DJ, such as $a\!-\!a$, also cuts through at least three other members. But we cannot solve for four unknowns with the three equilibrium equations.
- A vertical section $b\!-\!b$ will enable us to solve for the force in IJ, after which we can solve for what we need using $a\!-\!a$.
- First, find the reactions.

$$
\begin{aligned}
\Sigma M_G = {} & (10.0\,\mathrm{kN})\cdot(8.5\,\mathrm{m}) \\
& + (5.00\,\mathrm{kN})\cdot(17.0\,\mathrm{m}) \\
& + (5.00\,\mathrm{kN})\cdot(21.25\,\mathrm{m}) \\
& - R_A\cdot(25.50\,\mathrm{m}) = 0
\end{aligned}
$$

$$\Rightarrow R_A = 10.833\,\mathrm{kN}$$



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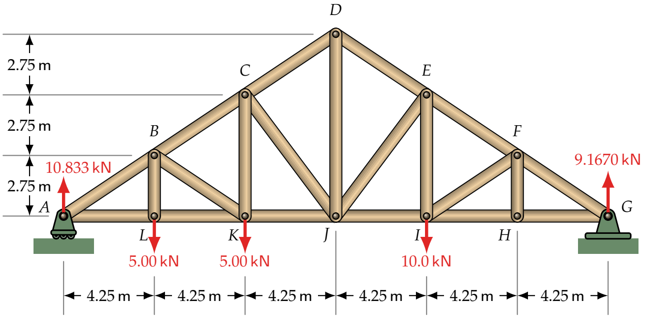
&\quad + (5.00\,\text{kN})\cdot(21.25\,\text{m}) \\
&\quad - R_A\cdot(25.50\,\text{m}) = 0 \\
\Rightarrow R_A &= 10.833\,\text{kN}
\end{aligned}$$

$$\begin{aligned}
\Sigma F_y &= R_{Gy} + 10.833\,\text{kN} - 20.0\,\text{kN} = 0 \\
\Rightarrow R_{Gy} &= 9.1670\,\text{kN}
\end{aligned}$$



- Each section that cuts through DJ, such as $a\!-\!a$, also cuts through at least three other members. But we cannot solve for four unknowns with the three equilibrium equations.
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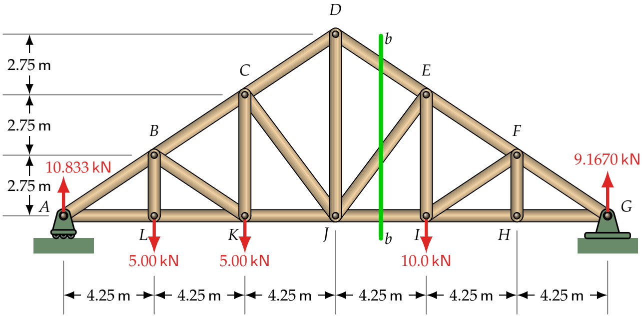
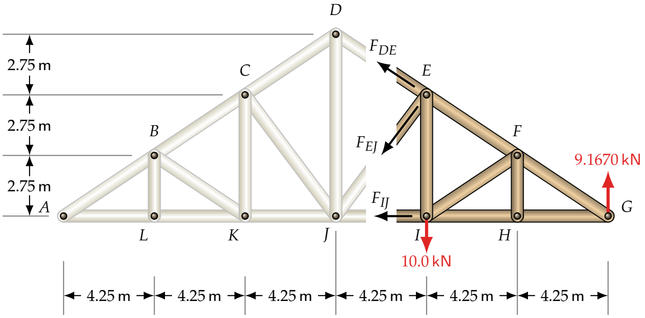
\Rightarrow R_A &= 10.833\,\text{kN} \\
\Sigma F_y &= R_{Gy} + 10.833\,\text{kN} - 20.0\,\text{kN} = 0 \\
\Rightarrow R_{Gy} &= 9.1670\,\text{kN} \\
R_{Gx} &= 0
\end{aligned}
$$



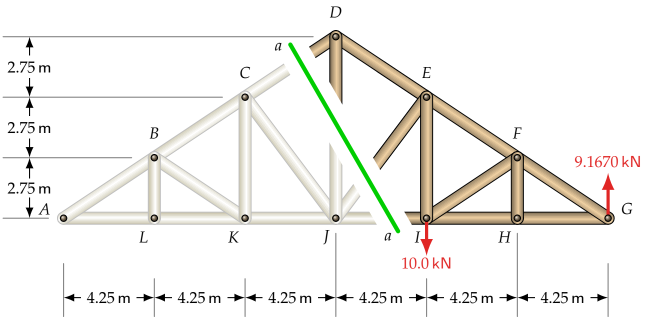
- Each section that cuts through DJ, such as $a-a$, also cuts through at least three other members. But we cannot solve for four unknowns with the three equilibrium equations.
- A vertical section $b-b$ will enable us to solve for the force in IJ, after which we can solve for what we need using $a-a$.
- First, find the reactions.
- Now, find the force in IJ using section $b-b$.



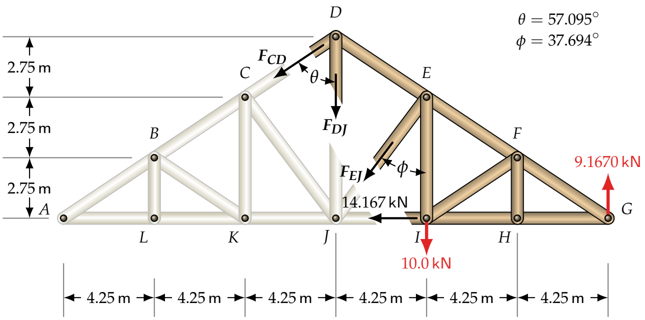
- Each section that cuts through DJ, such as $a\text{—}a$, also cuts through at least three other members. But we cannot solve for four unknowns with the three equilibrium equations.
- A vertical section $b\text{—}b$ will enable us to solve for the force in IJ, after which we can solve for what we need using $a\text{—}a$.
- First, find the reactions.
- Now, find the force in IJ using section $b\text{—}b$.
- Using the right portion of the truss...

$$\Sigma M_E = (9.1670\,\text{kN})\cdot(8.5\,\text{m}) - T_{IJ}\cdot(5.50\,\text{m}) = 0$$

$$\Rightarrow F_{IJ} = 14.167\,\text{kN}$$



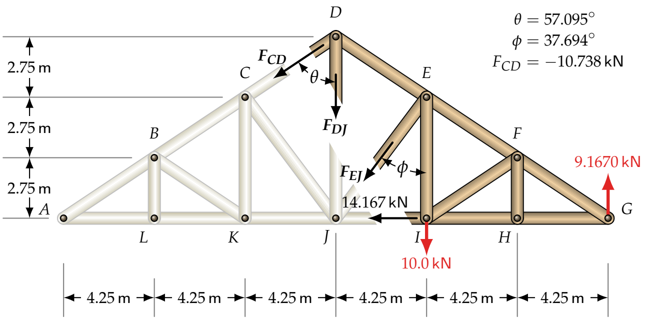
- Now we'll use section a–a...



- Now we'll use section a—a...
- Some angles that we'll need...

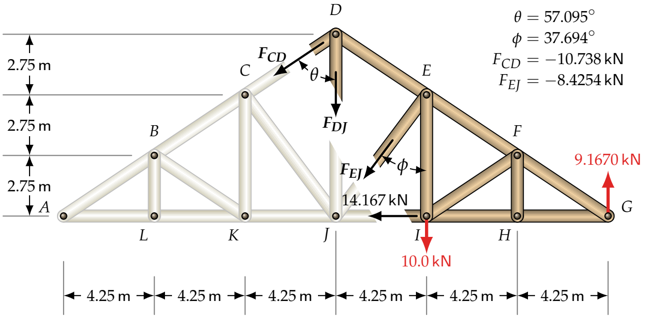
$$\theta = \tan^{-1}\left[\frac{4.25}{2.75}\right] = 57.095°$$

$$\phi = \tan^{-1}\left[\frac{4.25}{5.50}\right] = 37.694°$$



- Now we'll use section $a{-}a$...
- Some angles that we'll need...
- Take moments about J to find F_{CD}

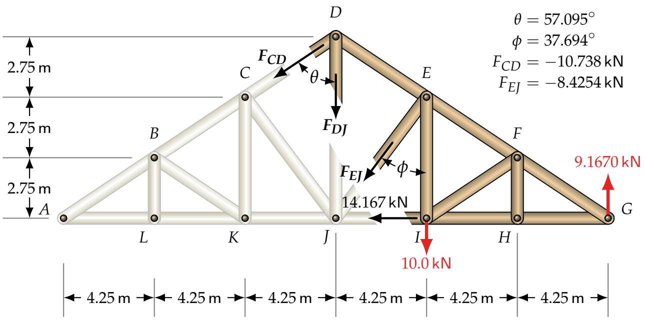
$$\begin{aligned}\Sigma M_J &= F_{CD} \cdot \sin 57.095° \cdot (8.25\,\text{m}) \\ &\quad + (9.1670\,\text{kN}) \cdot (12.75\,\text{m}) \\ &\quad - (10.0\,\text{kN}) \cdot (4.25\,\text{m}) \\ &= 0 \\ \Rightarrow F_{CD} &= -10.738\,\text{kN}\end{aligned}$$



- Now we'll use section $a-a$...
- Some angles that we'll need...
- Take moments about J to find F_{CD}
- Sum the x-components to find F_{EJ}

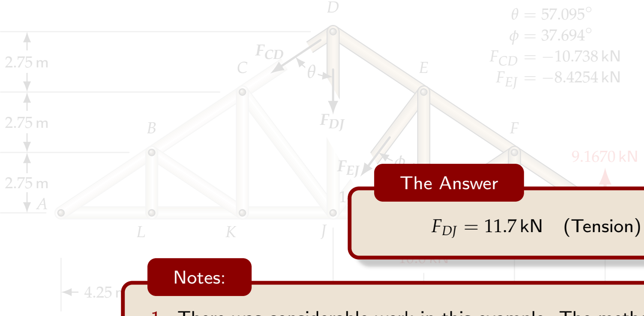
$$\begin{aligned}
\Sigma F_x &= -F_{CD} \cdot \sin\theta \\
&\quad - (14.167\,\text{kN}) \\
&\quad - F_{EJ} \cdot \sin\phi \\
&= -(-10.738\,\text{kN}) \cdot \sin 57.095° \\
&\quad - (14.167\,\text{kN}) \\
&\quad - F_{EJ} \cdot \sin 37.694° \\
&= 0
\end{aligned}$$

$$\Rightarrow F_{EJ} = -8.4254\,\text{kN}$$



- Now we'll use section a–a...
- Some angles that we'll need...
- Take moments about J to find F_{CD}
- Sum the x-components to find F_{EJ}
- Sum the y-components to find F_{DJ}

$$\begin{aligned}
\Sigma F_y &= -F_{CD}\cdot\cos\theta - F_{DJ} \\
&\qquad - F_{EJ}\cdot\cos\phi \\
&\qquad\quad - 10.0\,\text{kN} + 9.1760\,\text{kN} \\
&= 10.738\,\text{kN}\cdot\cos 57.095^\circ - F_{DJ} \\
&\qquad + 8.4254\,\text{kN}\cdot\cos 37.694^\circ \\
&\qquad\quad - 0.82400\,\text{kN} \\
&= 0 \\
\Rightarrow F_{DJ} &= 11.676\,\text{kN}
\end{aligned}$$



The Answer

$$F_{DJ} = 11.7\,\text{kN} \quad \text{(Tension)}$$

Notes:

1. There was considerable work in this example. The method of sections was required by the example statement but it might not be the simplest procedure for this truss.
2. Given that this is a relatively 'narrow' truss, the method of joints would only have required analysis of three joints: G, F and D since FH and IF are zero-force members.
3. The most straightforward – and – quickest approach, if free to choose, is to use either of sections $a-a$ or $b-b$ to take moments about J and find F_{CD} or F_{DE}. Then a single method of joints analysis, of joint D, gives F_{DJ}.
4. A combination of the method of sections and the method of joints is worth considering.