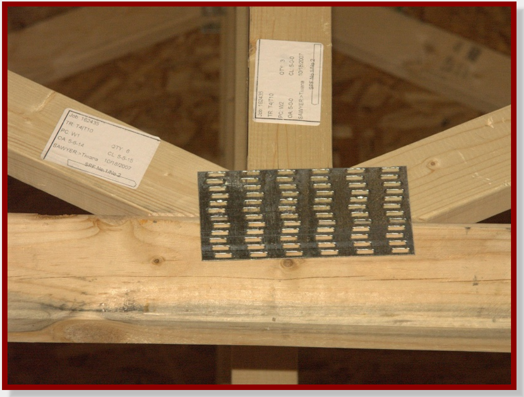
07 Method of Joints

Engineering Statics

Updated on: October 9, 2025

Trusses are the most common method to support residential roof systems

- Truss members are cut to length and laid out on a flat surface.
- Truss connectors are pressed in at the joints of the truss members.



- The truss connectors must be applied under proper pressure provided by a roller press in a factory.
- Damaged connectors **must not** be reinstalled with a hammer!

Trusses

- Trusses are delivered to site, often banded together.

- Careful storage is required before installation.

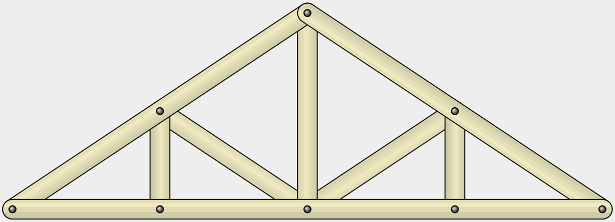
Trusses

- These trusses are built from heavy timbers and will be left exposed as an architectural feature.
- These may be fitted on site or manufactured off-site using computer numerically controlled (CNC) machinery

Trusses

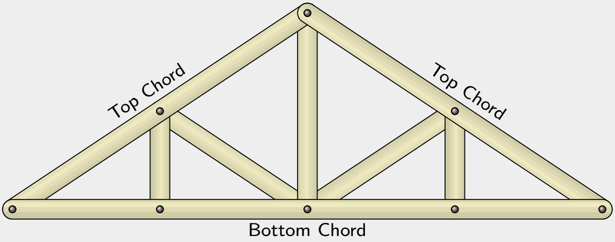
- This beautiful truss holds up the roof of an octagonal tower in an old church in the small village of Stoney Middleton, Derbyshire, England.

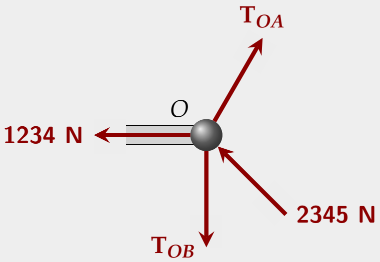
- A truss is a structure of slender two-force members with pinned connections at their end points.



Trusses

- A truss is a structure of slender two-force members with pinned connections at their end points.
- Although the top and bottom chords may be continuous in roof trusses, they are not designed to support heavy transverse loads so for our analysis we consider the top and bottom **chords** to be be comprised of separate two-force members connected at each joint.





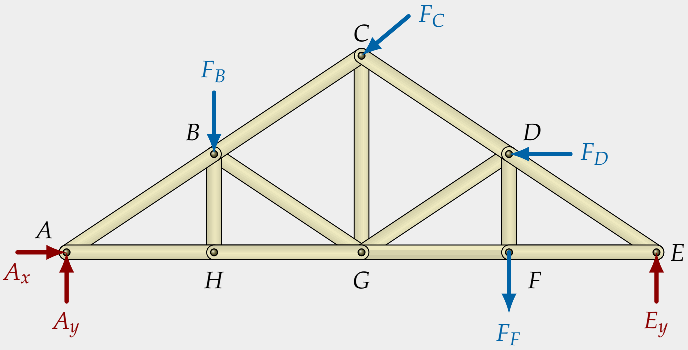
These are internal forces, exposed by ‘cutting’ the members to analyze the forces at a joint.

Arrowhead towards the joint indicates compression of 2345N

Arrowhead away from the joint indicates tension (1234N, $\mathbf{T}_{OA}$ and $\mathbf{T}_{OB}$).

If tension or compression is unknown, assume the member is in tension. Then, if the result is negative, the assumption of tension was incorrect and the member is actually in compression.

Trusses



- Forces are applied only at member end connections, so the members are **two-force members**
- The forces in two-force members are directed along a line from where the forces are applied. In this case, since the members are straight, the forces (tension or compression) are directed along the truss member itself.
- Trusses are often used to support roofs and bridges

Truss Bridges

Truss Bridges

A Camelback Pratt Truss bridge design, Montana, U.S.

Subway Bridge, Chicago, Illinois

Pinned Connections

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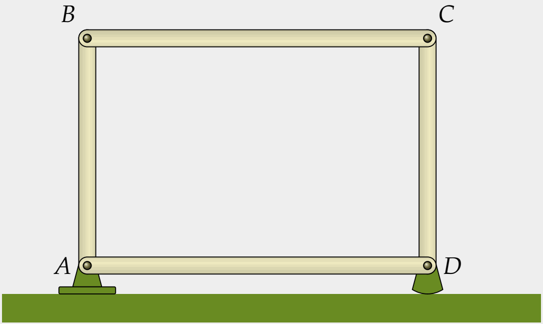

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Pinned Connections

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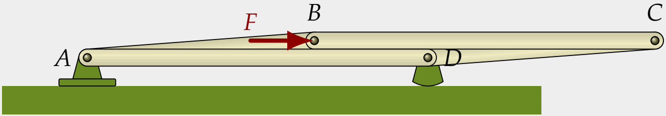
Pinned Connections



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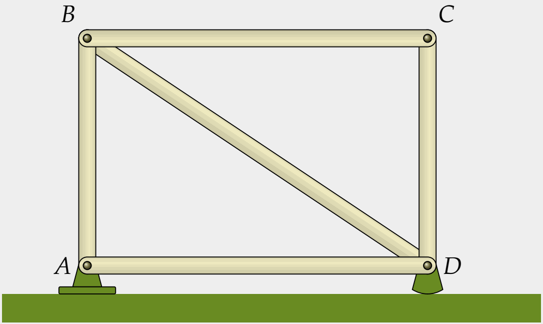
- A force applied at B...meets no resistance.

Pinned Connections



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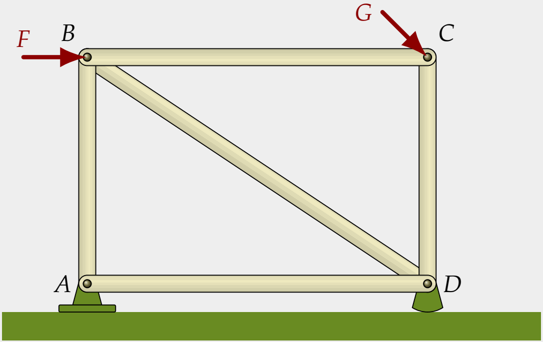
Pinned Connections



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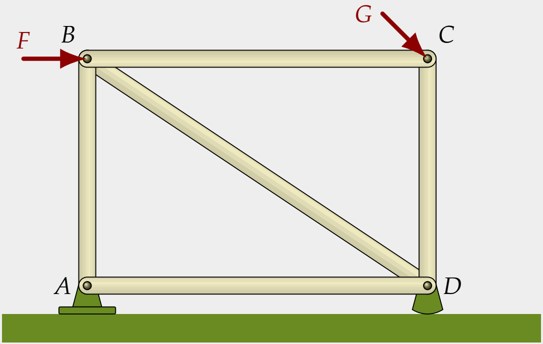
Pinned Connections



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- The addition of a diagonal member will create two triangles which are stable shapes; now the frame can support horizontal and vertical loads.
- Trusses are made up of (strong) triangles.

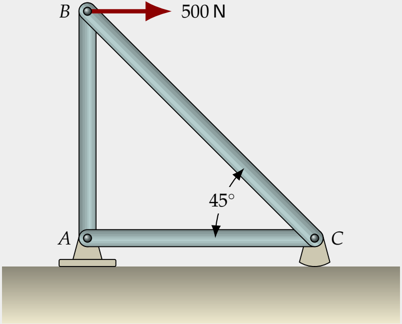
Pinned Connections

Diagonal bracing could have prevented this.

Truss and Bridge Supports - Pinned Connection

Truss and Bridge Supports - Rollers

- To analyze or design a truss, we need to determine the force in each truss member.



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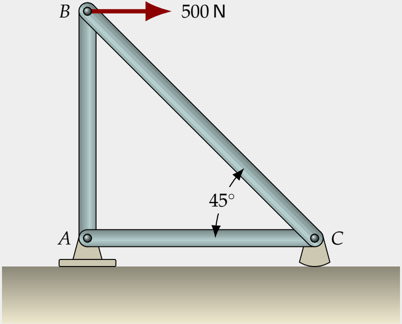
- The method we shall use here is the **Method of Joints**.



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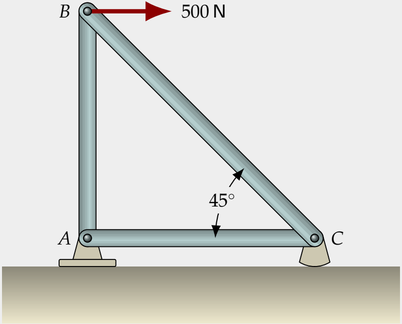
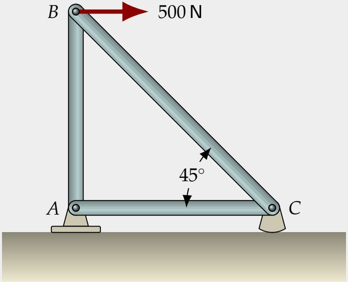
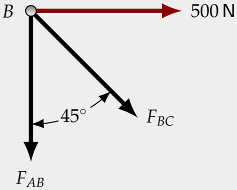
- If the entire truss is in equilibrium, then each of its joints is also in equilibrium (otherwise the joint would be in motion and the truss could not be in equilibrium).

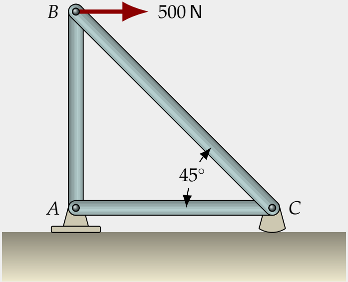


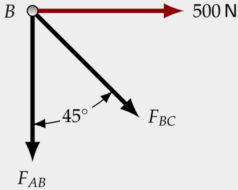




- A free-body diagram of each joint is drawn. Unknown forces are generally drawn in tension (i.e., with the arrowhead away from the joint); a negative result (from solving the system) then indicates compression.

The Method of Joints





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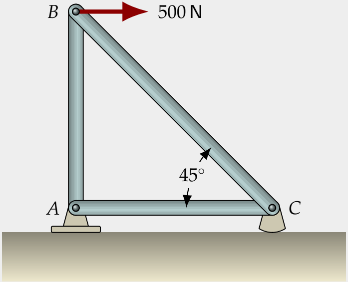

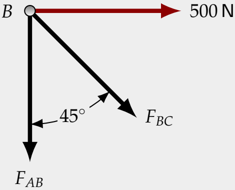

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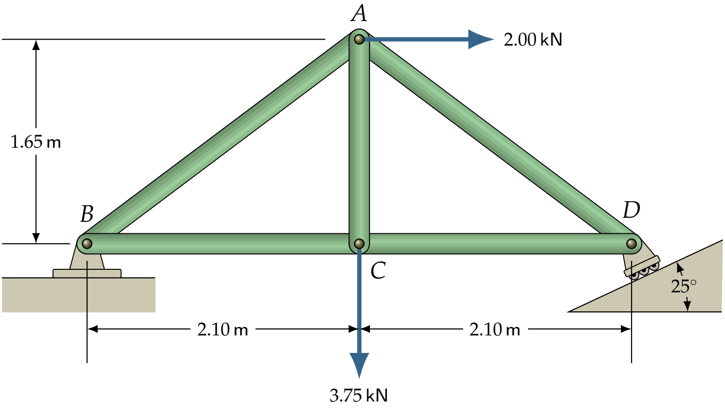
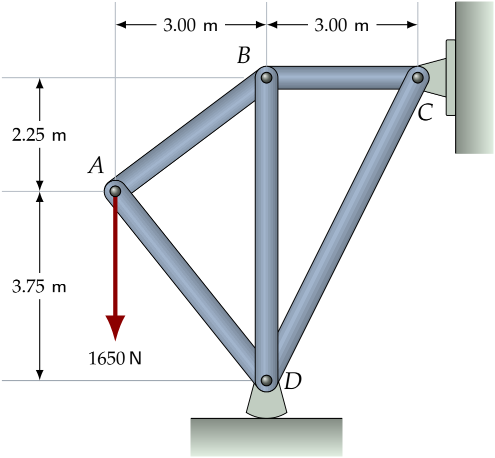
- Use $\Sigma F_x = 0$ and $\Sigma F_y = 0$ to analyze a joint with at most two unknowns.
- At least one force must be known at a joint to determine unknown forces.

Example 1



Determine the force in each truss member.

Example 2



Determine the force in each truss member.

(A full solution to this example can be downloaded from here. Refer to Example 2.)