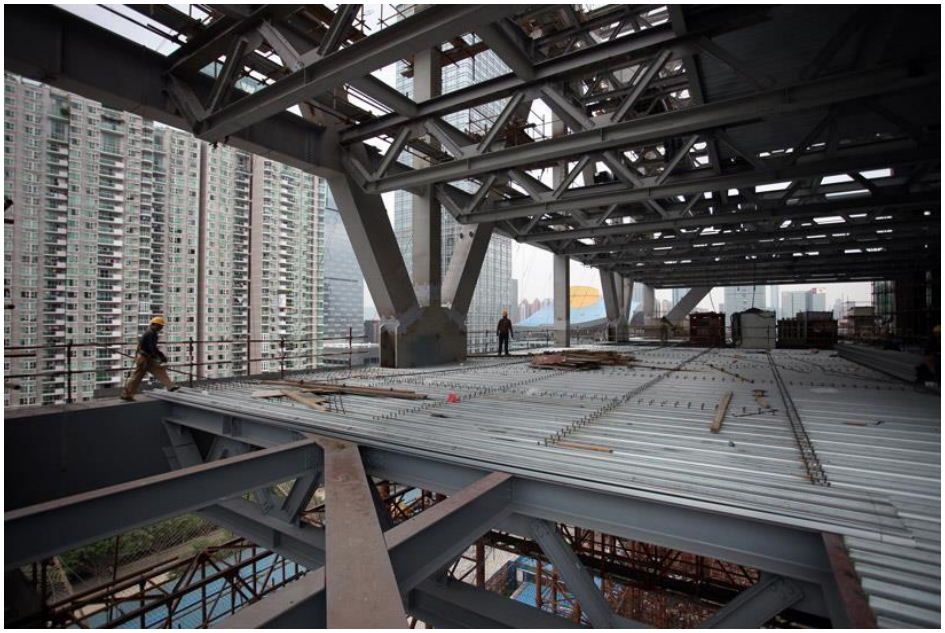
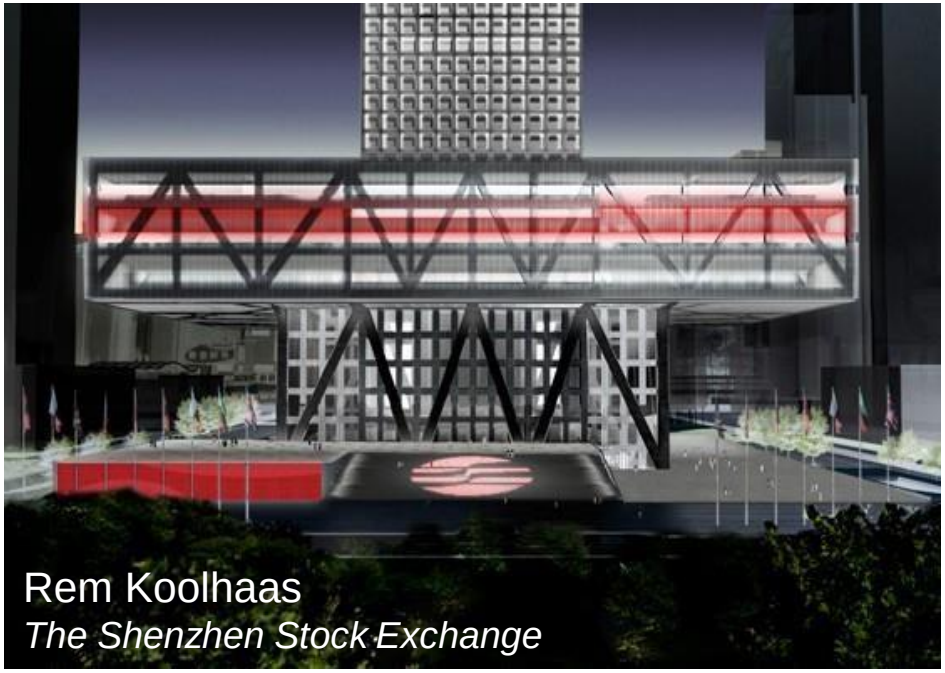
Unit IV Analysis of structures

…these are cool trusses

KMR



… be inspired!



Rem Koolhaas
The Shenzhen Stock Exchange

Renzo Piano
Kansai International Airport

KMR

So what are trusses?

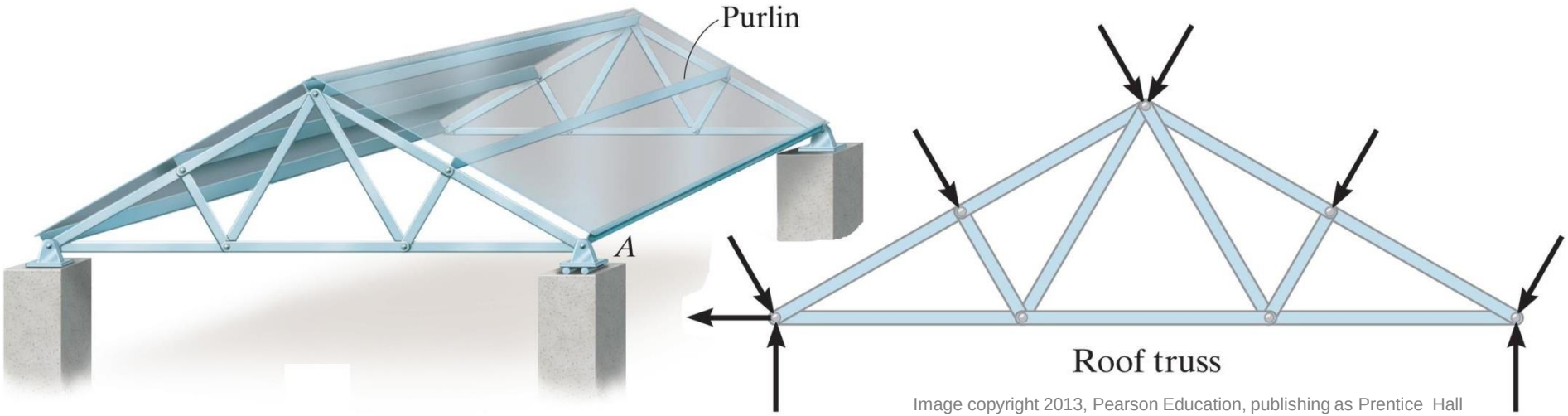
http://bridgehunter.com/story/1109/

ber-trusses-park-BIG.jpg

http://www.hndszj.com/eng/uploads/201008101822313.jpg

Trusses are …

- **Structures designed to support loads:**
  - Will transmit loads through the joints of the structure
  - Will ultimately transmit loads to the foundation
- **Cost effective in design because:**
  - Weight is minimized *(weight of members is typically light compared to loads carried, so it is often neglected)*
  - Strength to weight ratio is maximized



Truss/ Frame

Plane frame/ Truss: A frame in which all members lie in a single plane is called plane frame. They are designed to resist the forces acting in the plane of frame. Roof trusses and bridge trusses are the example of plane frames.

Space frame/ Truss: **If all the members of frame do not lie in a single plane, they are called** as space frame. Tripod, transmission towers are the examples of space frames.

Difference between truss and frame?

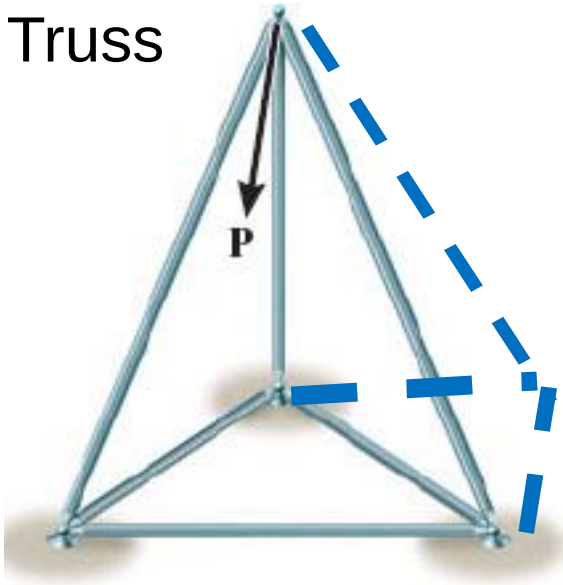
Structural Analysis: Space Truss

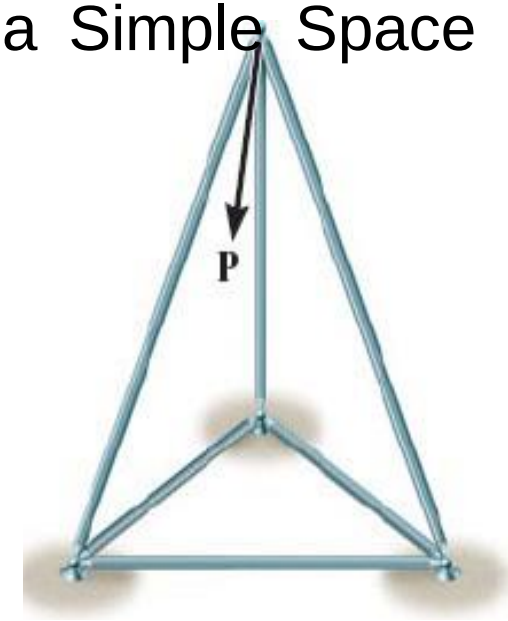
Space Truss

➢6 bars joined at their ends to form the edges of a tetrahedron as the basic non-collapsible unit.

➢3 additional concurrent bars whose ends are attached to three joints on the existing structure are required to add a new rigid unit to extend the structure.

A space truss formed in this way is called a Simple Space Truss

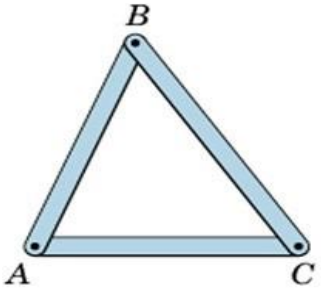




Structural Analysis: Plane Truss

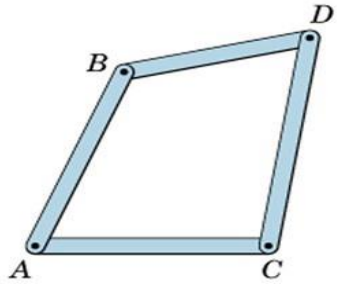
Simple Trusses

Basic Element of a Plane Truss is the Triangle



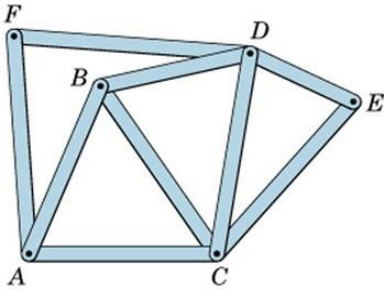
•Three bars joined by pins at their ends € Rigid Frame

– Non-collapsible and deformation of members due to induced internal strains is negligible

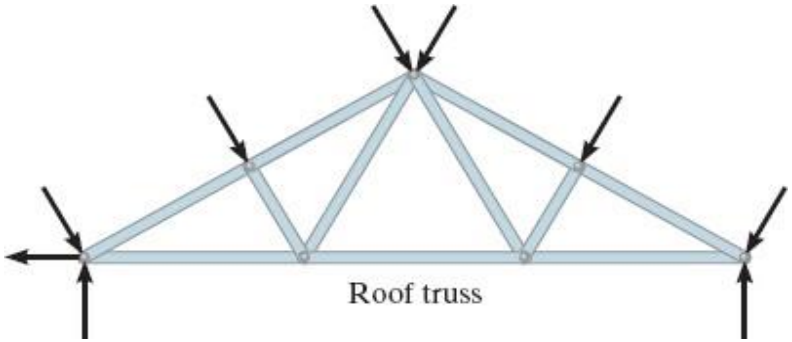


•Four or more bars polygon € Non-Rigid Frame
How to make it rigid or stable?

by forming more triangles!



Structures built from basic triangles e.g Simple Trusses



Perfect frame/ truss: A pin jointed frame which has got just sufficient number of members to resist the loads without undergoing appreciable deformation in shape is called a perfect frame. Triangular frame is the simplest perfect frame and it has 03 joints and 03 members.

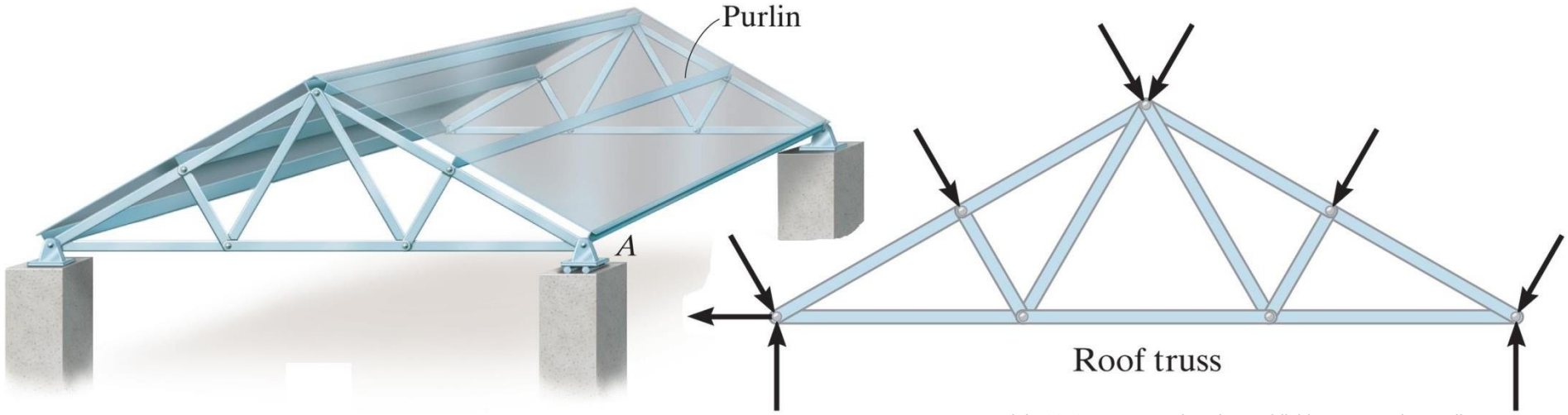
Number of joint j, and the number of members m in a perfect frame.

$m = 2j - 3$

(a) When LHS = RHS, Perfect frame.
(b) When LHS<RHS, Deficient frame.
(c) When LHS>RHS, Redundant frame.

Working with Trusses:
Assumptions

- All loads are applied / transmitted at joints
- All members are joined by pin connections
- **Consist entirely of two-force members**
- **Can contain zero-force members**



Zero-force Members

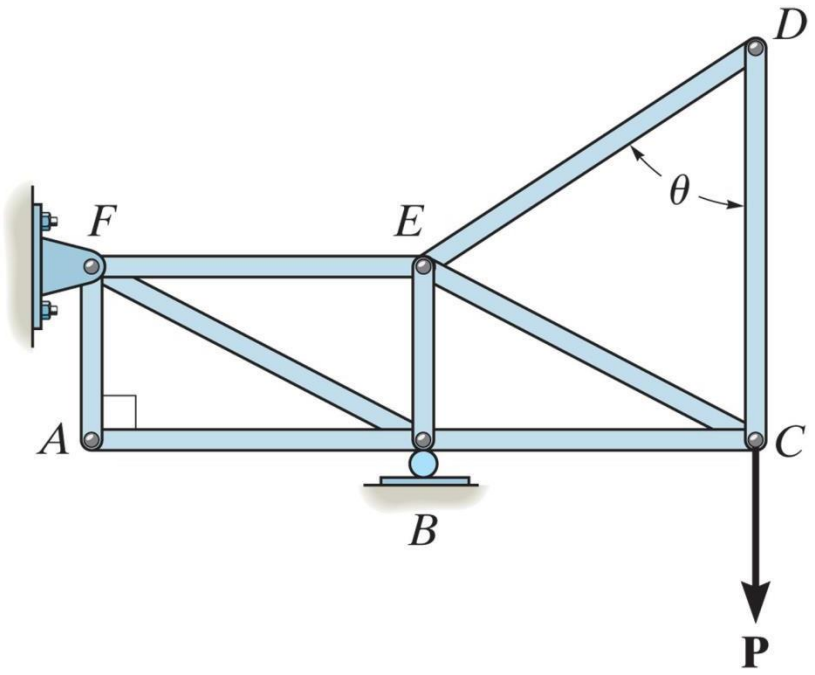
What are zero-force members?

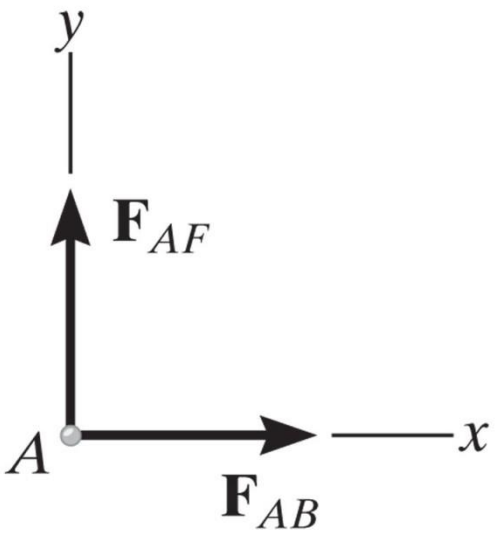
- Structural members that carry no force

Why do we use them?

- Used to provide stability
  - During construction
  - If (intermittent) loading of the truss changes
- Shortens chord length and increases buckling capacity of compression members

Zero-force Members: Case 1

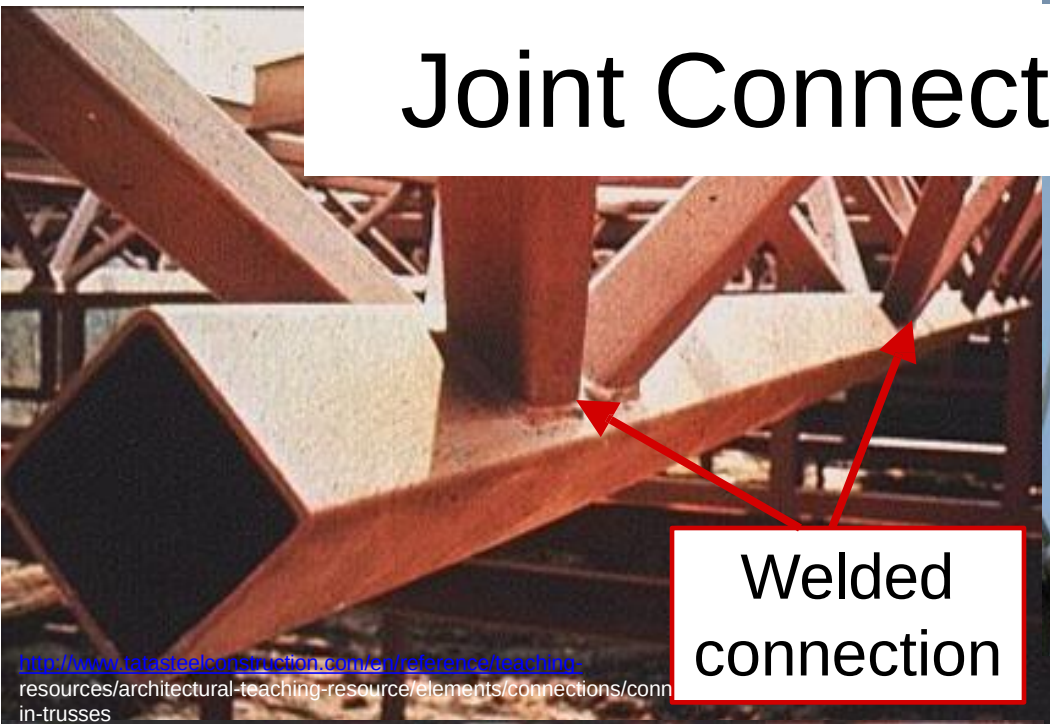




$$\overset{+}{\rightarrow} \Sigma F_x = 0;\ F_{AB} = 0$$

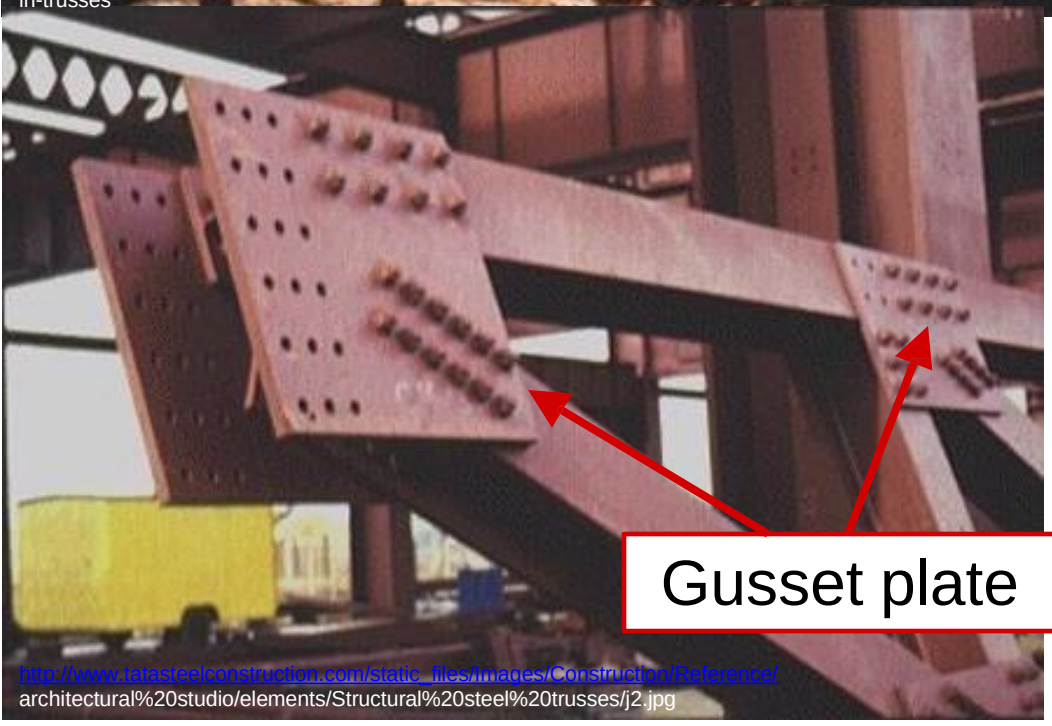
$$+\uparrow \Sigma F_y = 0;\ F_{AF} = 0$$

Joint Connections



http://www.tatasteelconstruction.com/en/reference/teaching-resources/architectural-teaching-resource/elements/connections/conn in-trusses

http://www.tboake.com/SSEF1/rose2.shtml



http://www.tatasteelconstruction.com/static_files/Images/Construction/Reference/architectural%20studio/elements/Structural%20steel%20trusses/j2.jpg

http://sluggyjunx.com/rr/georgetown_branch/gallery/04_16_03_gb_canal_bridges/04_16_03-gb_canal_br-34.jpg

Truss Supports

Rocker support

Roller supports

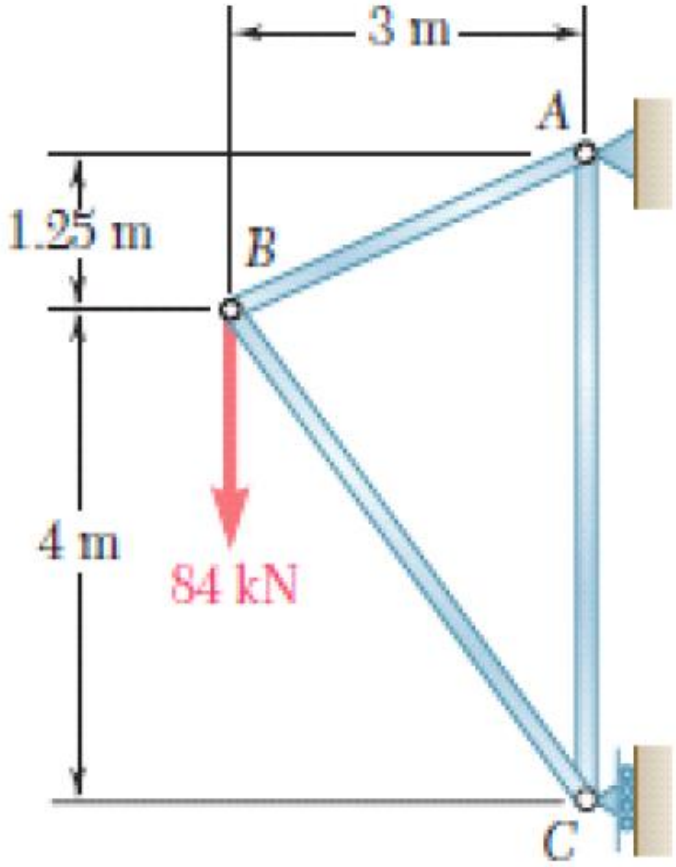
http://www.dot.state.mn.us/historicbridges/bridge_pictures.html

Working with Trusses:

Analyzing Structural Forces in Truss Members

- Truss **members will carry** either
  - axial **tension (T)** forces or
  - axial **compression (C)** forces
- There are **two methods** of evaluating trusses.
  - Method of Joints (static equilibrium of a point)
  - Method of Sections (static equilibrium of a rigid body)

Determine the force in each member of the truss shown. State whether each member is in tension or compression



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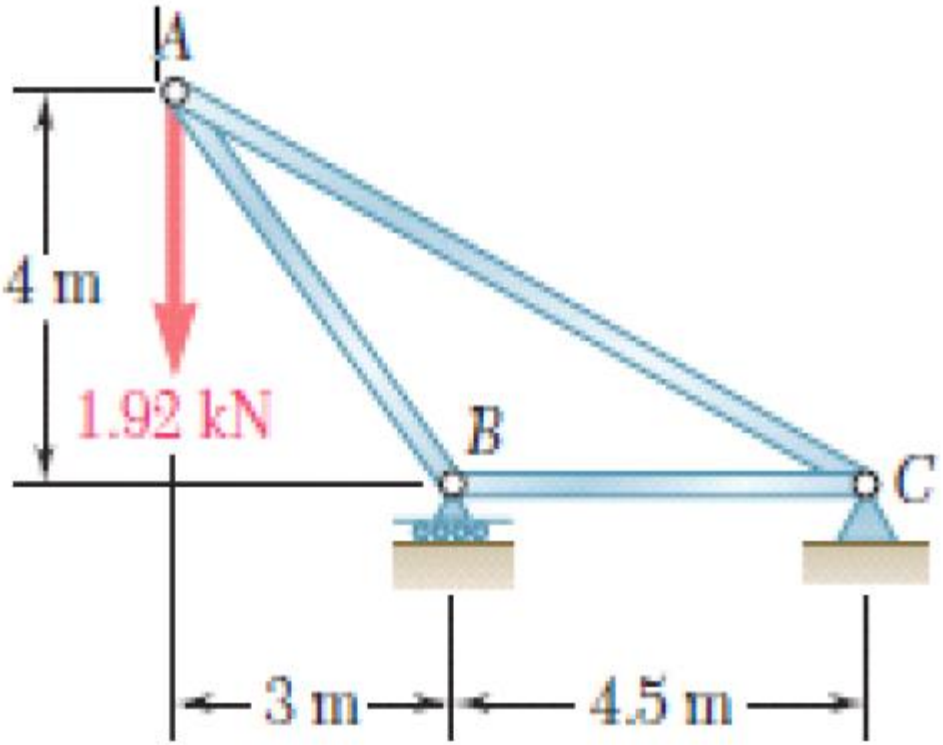

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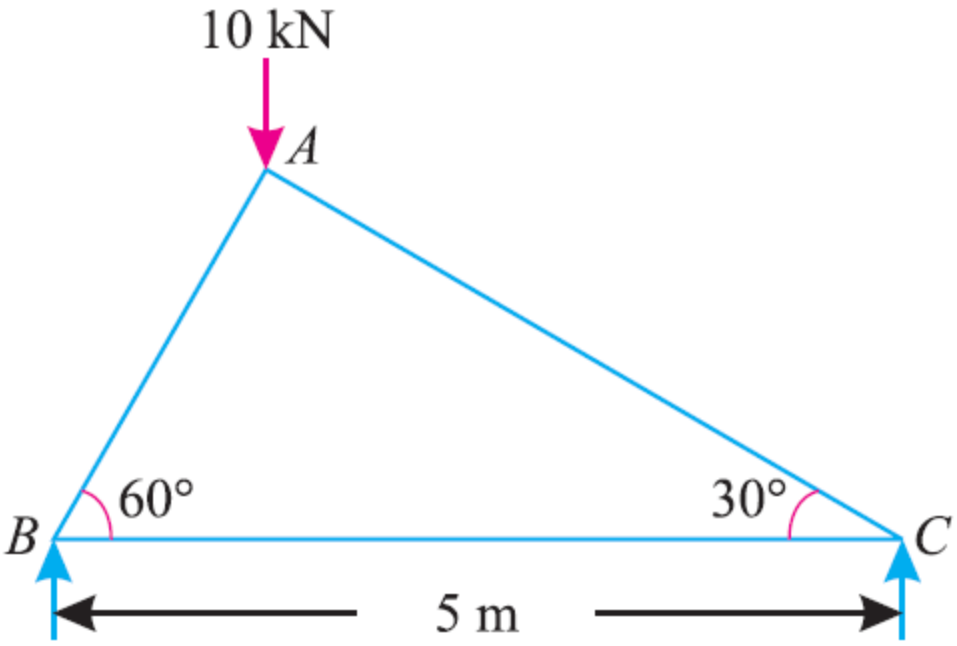

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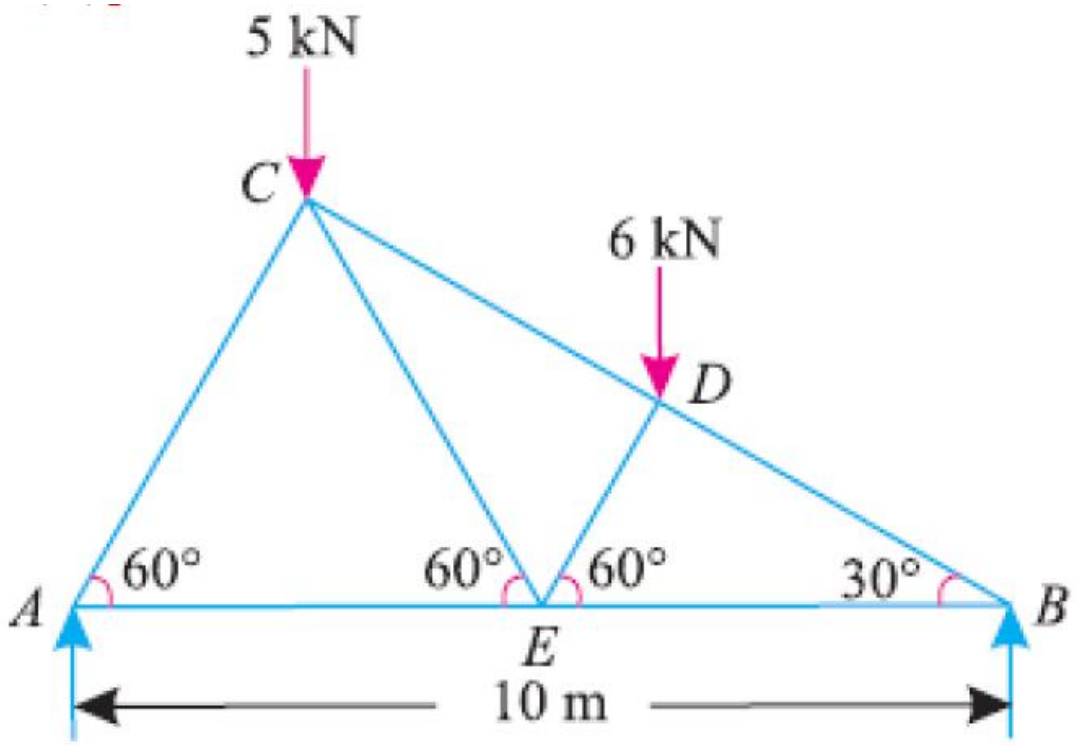

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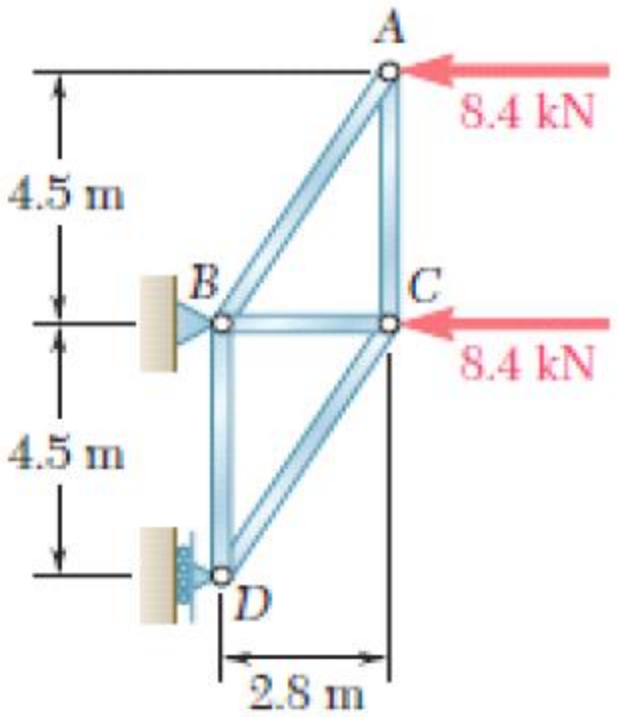

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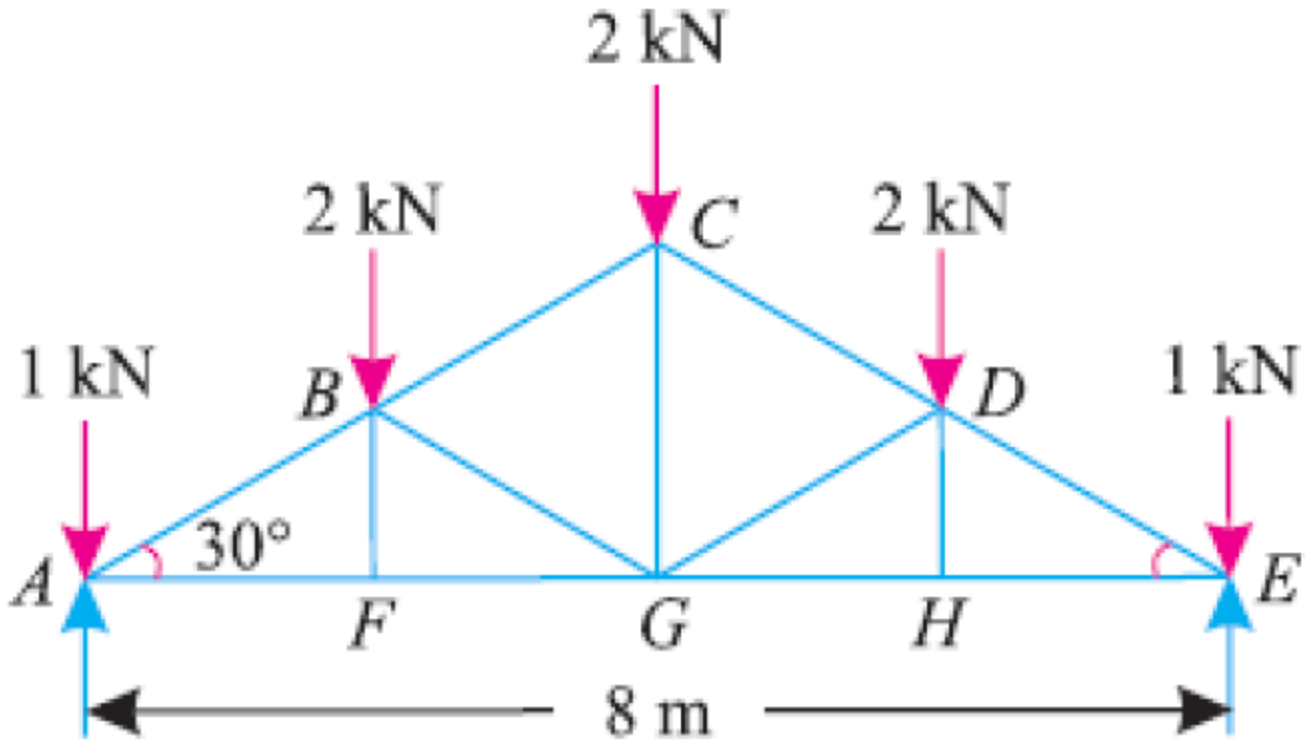

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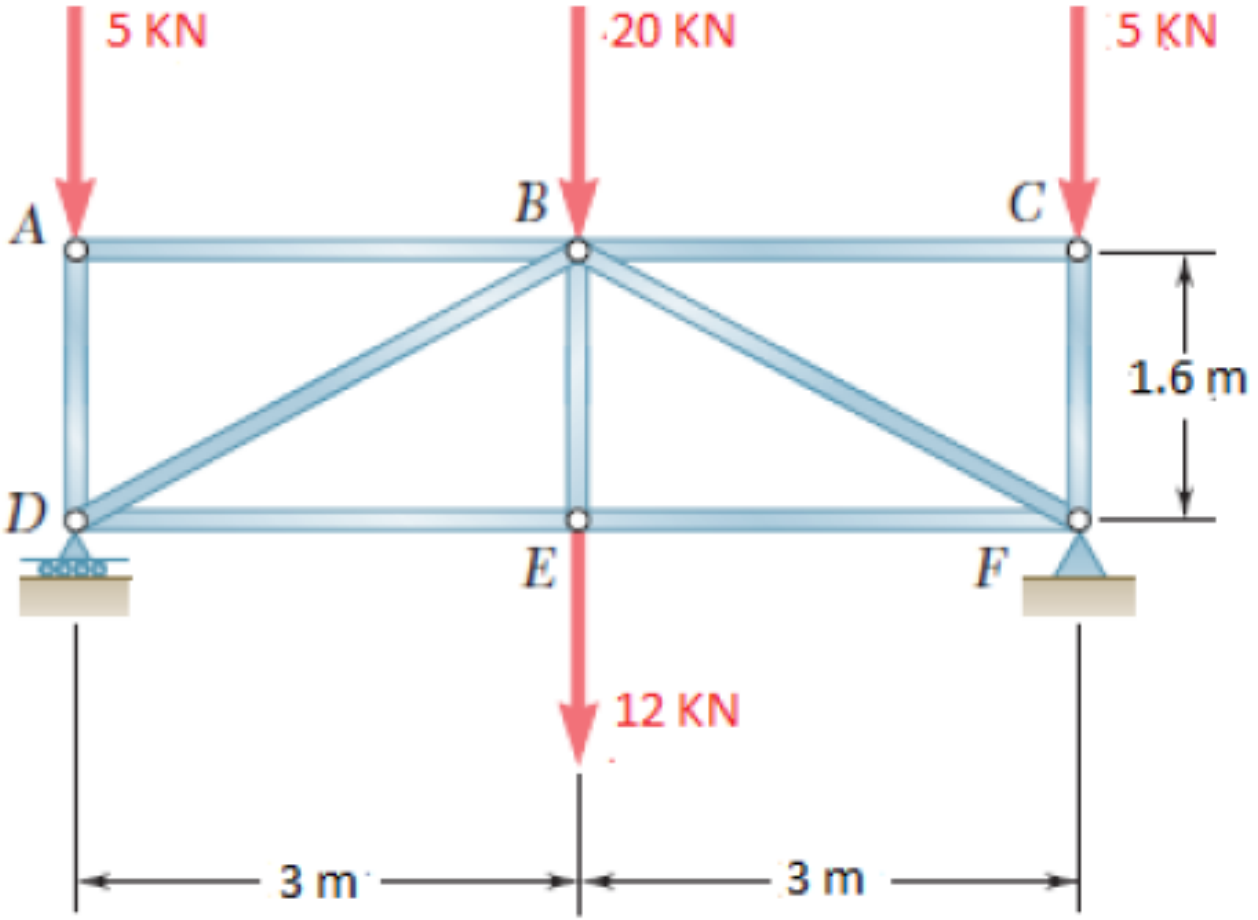

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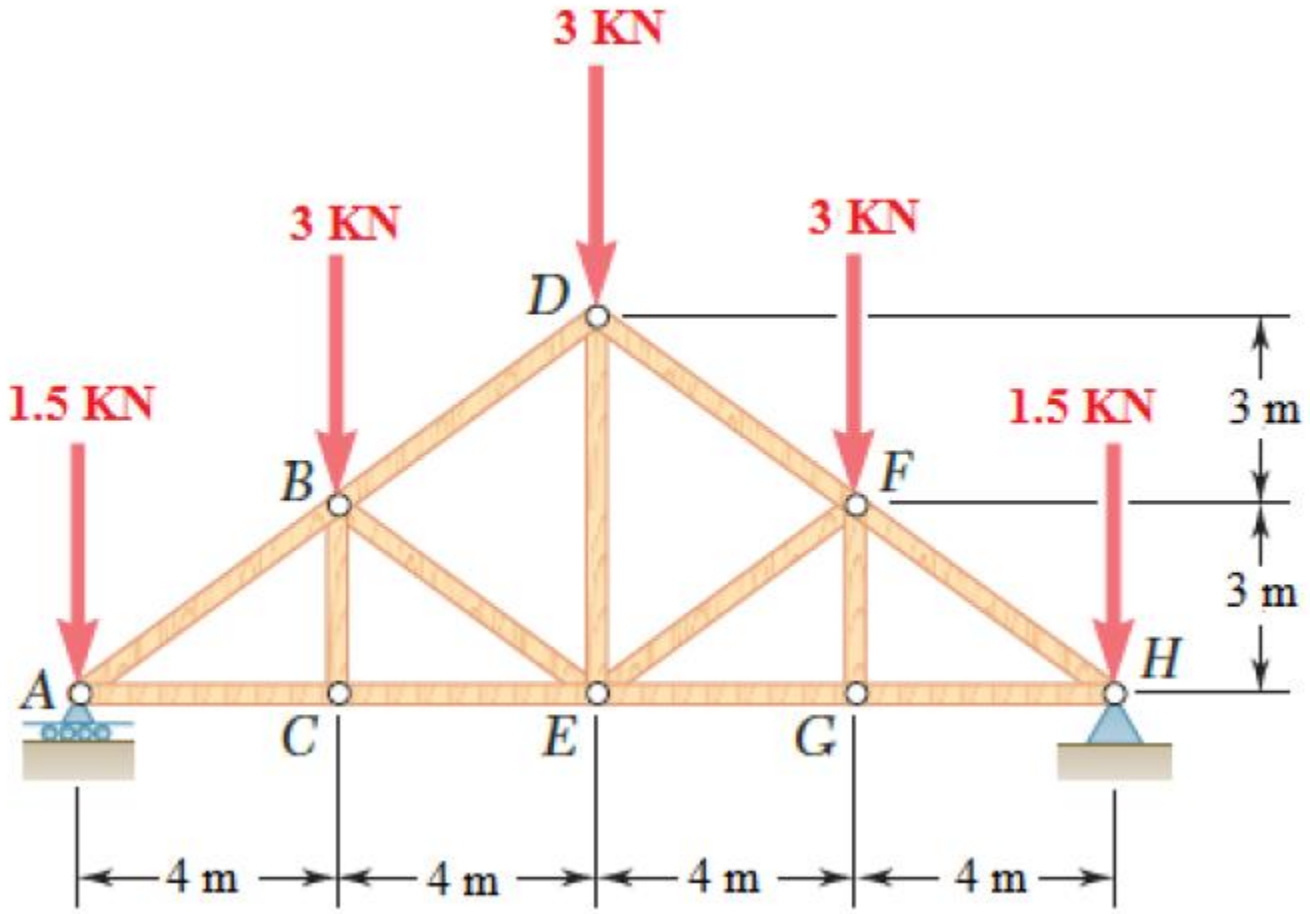

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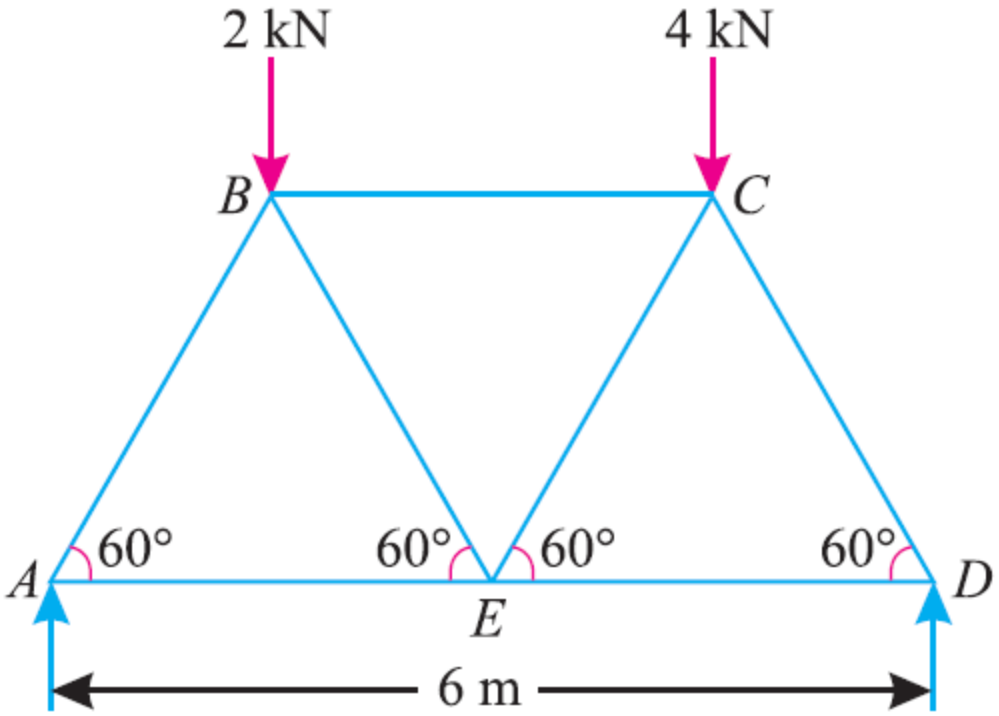

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