CE30 – Discussion 5

Analysis of Truss Structures

Textbook: 6.1 – 6.2

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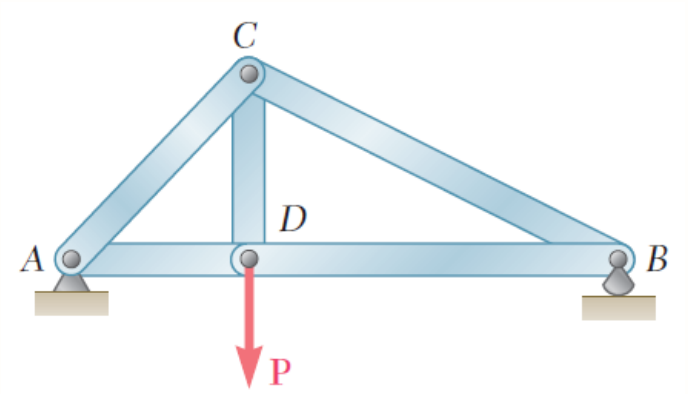
Announcements

- HW5 Problems from the textbook:
  6.14, 6.18, 6.41, 6.44, 6.48, 6.99, and 6.100

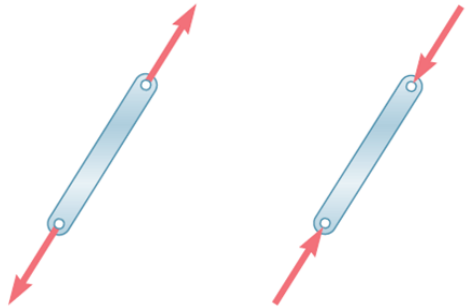
Truss Structures

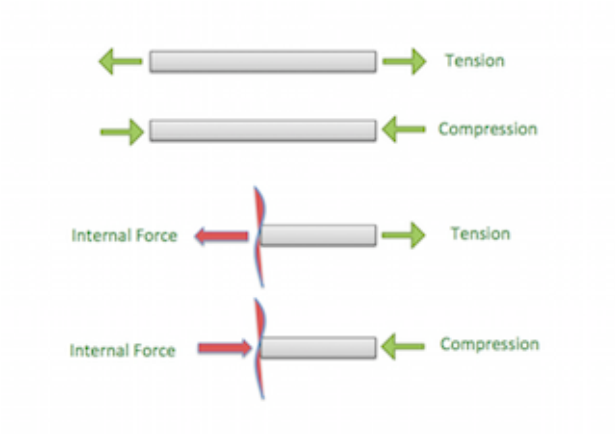
- Straight members, pinned together at joints
  - Each member is a ***two-force member***
  - No member is continuous through a joint
- Can be treated as 2D
- Loads are applied to the joints



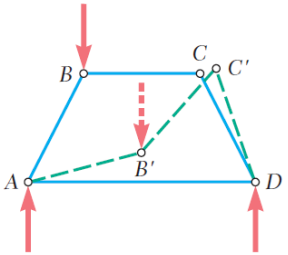
Truss Structures

- Single forces at each member, no couple (moment)
- Each member will be in either *tension* or *compression*
- Connections are assumed to be pins
- Internal forces:

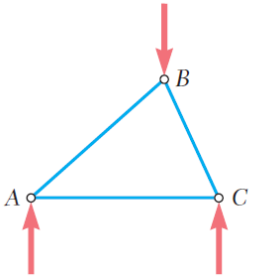




Simple Trusses

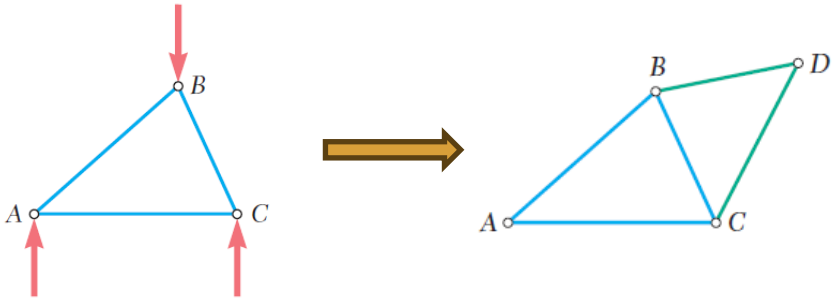


Unstable Truss



Rigid Truss

- Obtain simple trusses from rigid trusses:
  - Add two new members to existing joints
  - Connect them at a new joint



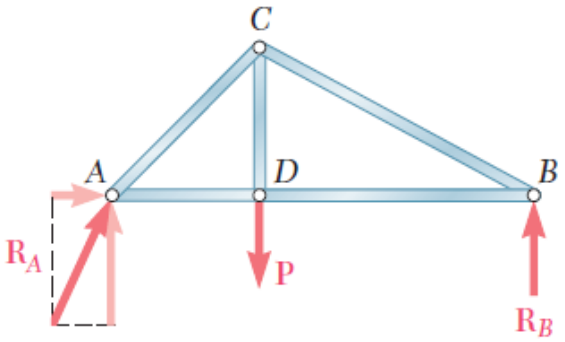
- Total number of members (m) in a simple truss:

$$m = 2n - 3$$

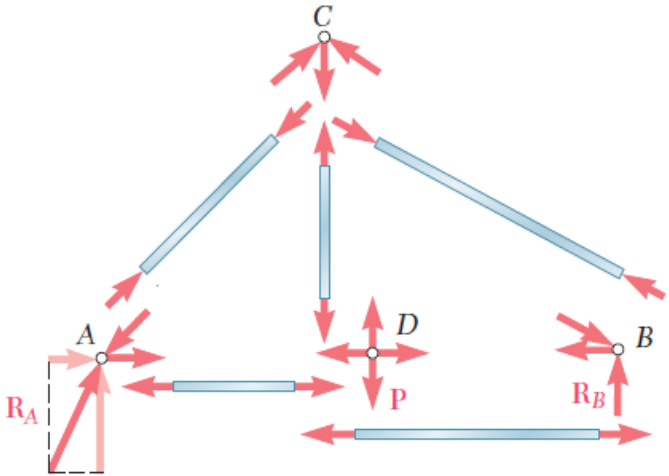
n = Number of joints

Analysis of Trusses: ***Method of Joints***

1. Find the support reactions by considering the entire truss FBD
2. Dismember the truss into pins and members
   - Draw the FBD of each pin; force exerted by a member to the pin is directed along that member
3. Use the force equilibrium at each pin to solve for member forces
   - **Choose the pins with 2 unknowns!**



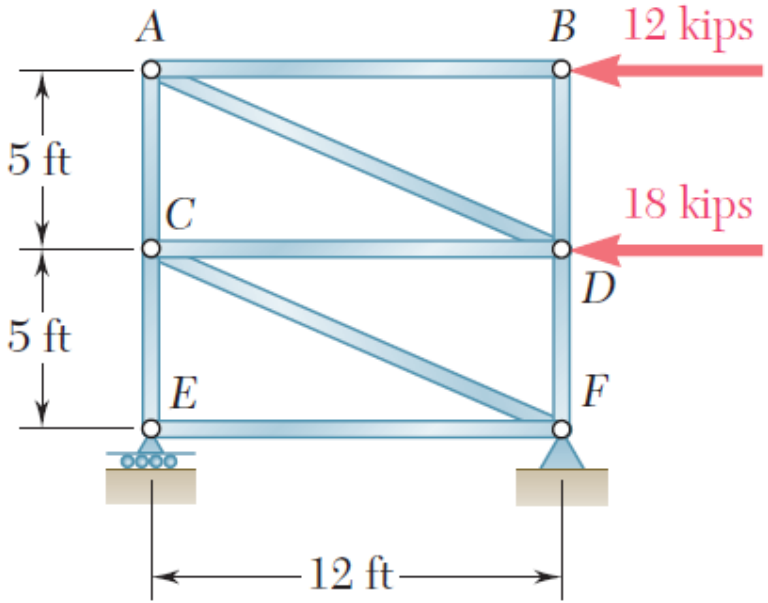
Entire FBD



FBD of pins/members

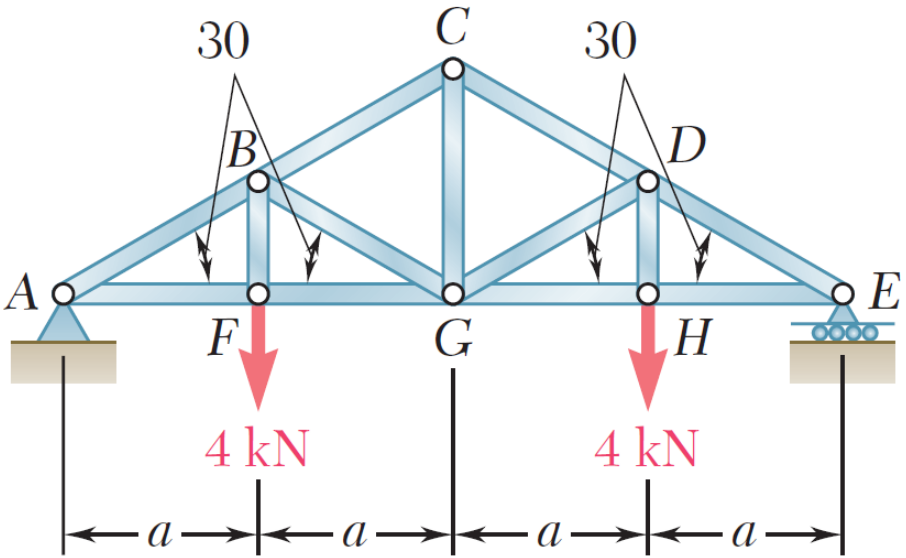
Practice

Determine the force in each member, using the method of joints



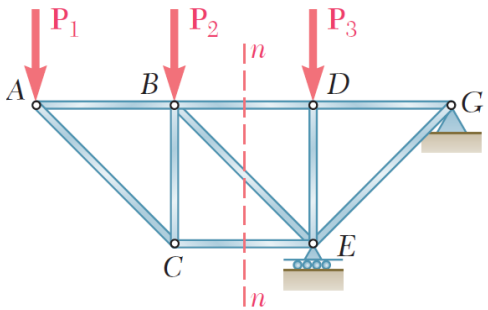
Practice – Similar to HW P6.18

Determine the force in each member, using the method of joints

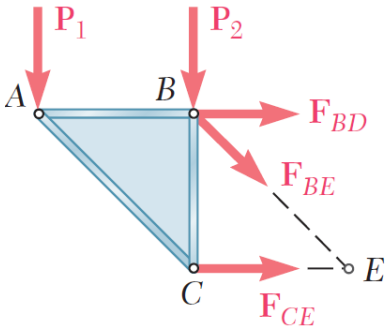


Analysis of Trusses: ***Method of Sections***

- Method of Joints solves for all the member forces, not very efficient!
- **Method of Sections** is usually preferred
  1. Pass a section through the member you want to solve
  2. Draw the FBD for the portion of the truss
  3. Use 3 equilibrium equations (2 force + 1 moment) to solve for member forces



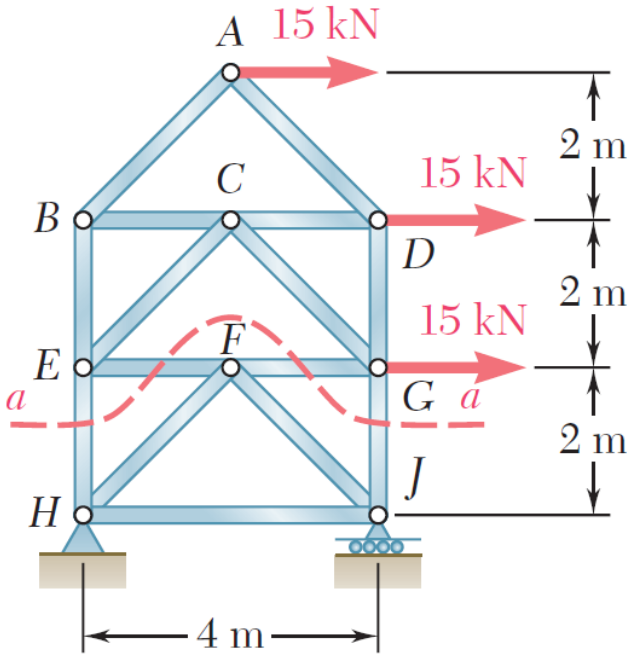
Section *n*, cutting through the interested members



Treat the portion of the truss as a free body

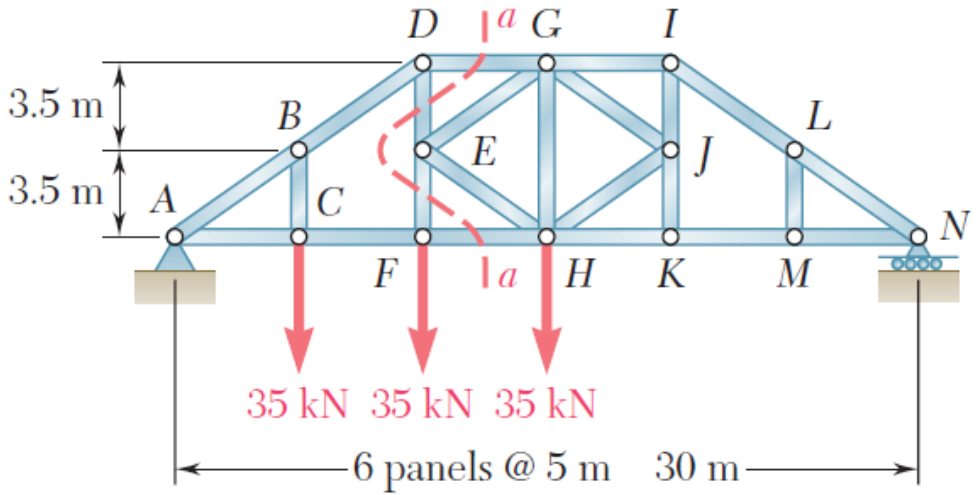
Practice – Similar to HW P6.41

Determine the force in member GJ of the truss shown. (*Hint:* Use section a-a.)



Practice – Similar to HW P6.100

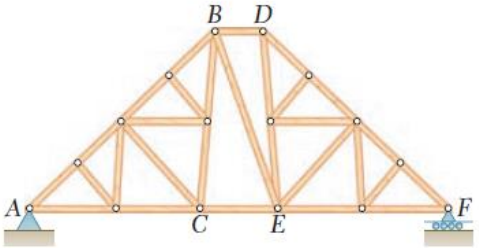
Determine the force in members *DG* and *FH* of the truss shown. (*Hint:* Use section *a-a*.)



Compound Trusses

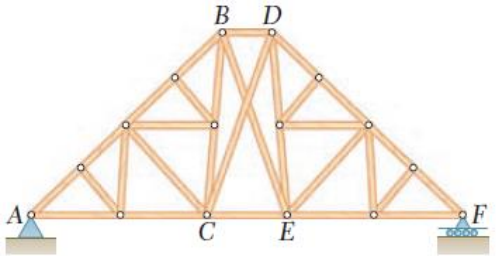
Simple truss: $m = 2n - 3$

- Made up combining simple trusses
- At each pin we have 2 equilibrium equations, total (2n) equations available
- Total number of unknowns = m + r (member forces + reactions)



Completely constrained, statically determinate, rigid

$$m + r = 2n$$



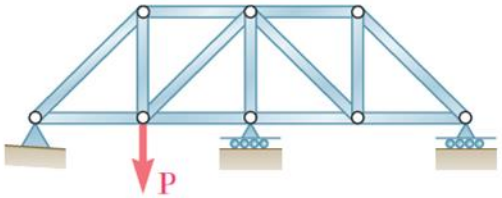
Statically indeterminate

$$m + r > 2n$$

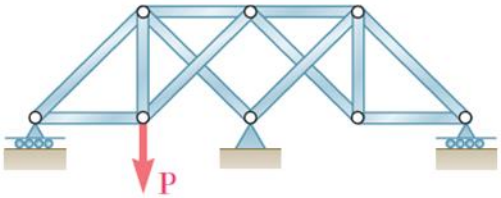
- Partially constrained: $m + r < 2n$

Practice – Similar to HW P6.48

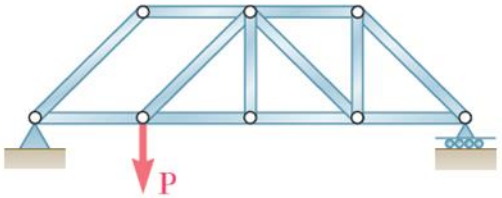
Classify each of the given structures as completely, partially, or improperly constrained; if completely constrained, further classify as determinate or indeterminate. All members can act both in tension and in compression.



(*a*)



(*b*)



(*c*)