Lec15

Monday, October 26, 2020 7:51 AM

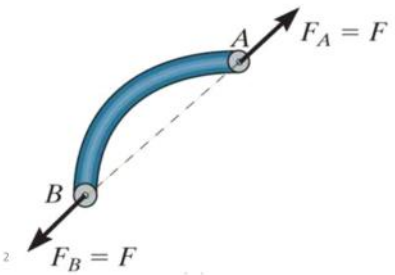
Lecture Objectives

- Reduction of distributed loading
- Equilibrium for a system of particles

1

Two-force members

In the cases above, members AB can be considered as two-force members, provided that their weight is neglected.



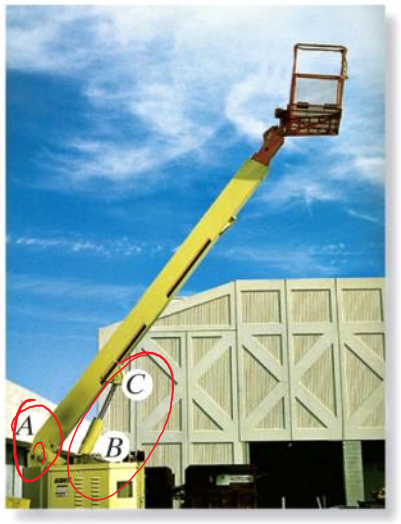
① two forces have the same magnitude

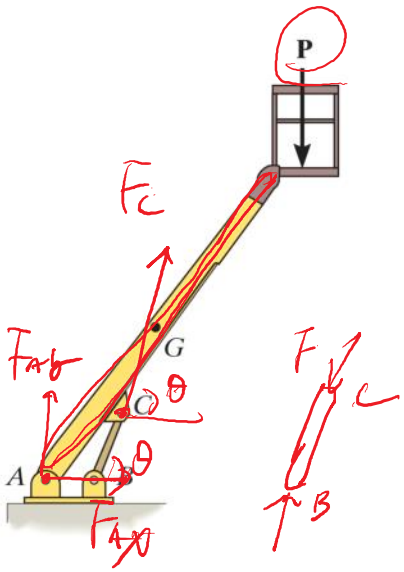
② opposite

③ Colinear

2

Find the maximum weight that can be support by cage if the maximum loads that can be applied on arm A and hydraulic BC are given.



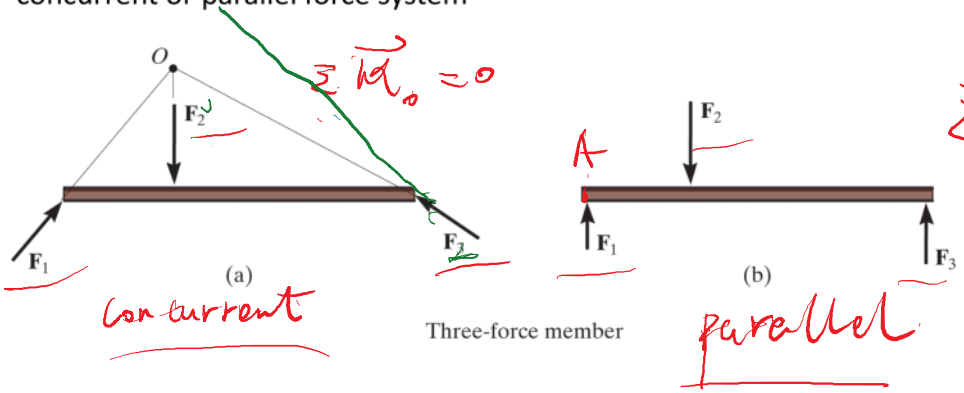


3

Three-force members

As the name implies, three-force members have forces applied at only three points.

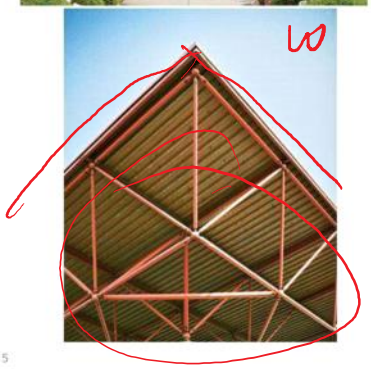
Moment equilibrium can be satisfied only if the three forces are concurrent or parallel force system



Three-force member

Simple trusses

Trusses are commonly used to support roofs.



A more challenging question is, that for a given load, how can we design the trusses' geometry to minimize cost?

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Simple trusses

Truss:

- Structure composed of slender members joined together at end points
- Transmit loads to supports

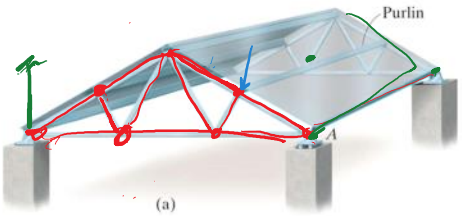
Assumption of trusses

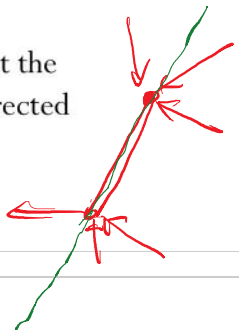
- Loading applied at joints, with negligible weight. Members joined by smooth pins

Result: all truss members are

two-force members

and therefore the force acting at the end of each member will be directed along the axis of the member





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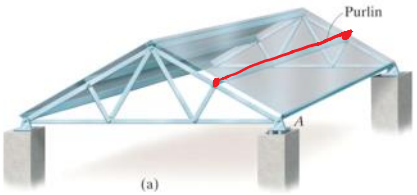
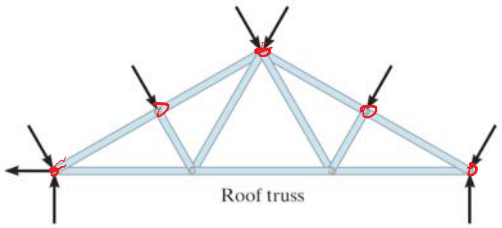
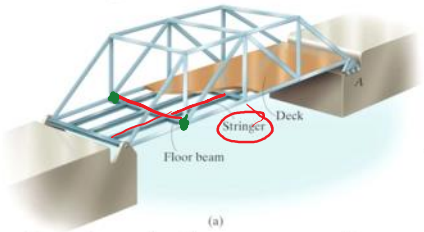
Roof trusses

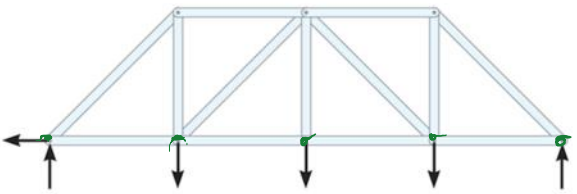




Load on roof transmitted to purlins, and from purlins to roof trusses at joints.

Bridge trusses





Load on deck transmitted to stringers, and from stringers to floor beams, and from floor beams to bridge trusses at joints.

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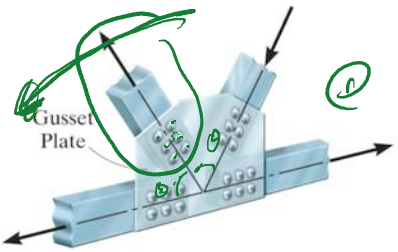
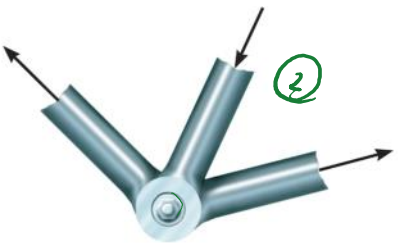
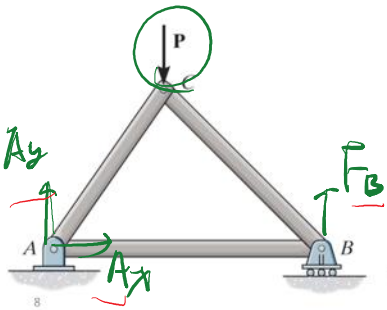
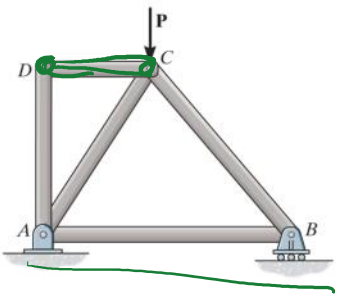
Truss joints

- Bolting or welding of the ends of the members to a gusset plates or passing a large bolt through each of the members
- Properly aligned gusset plates equivalent to pins (i.e., no moments) from coplanar, concurrent forces
- Simple trusses built from triangular members









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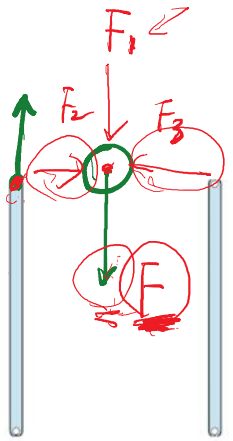
Method of joints

- Truss is in equilibrium ONLY if ALL individual pieces are in equilibrium
- Truss members are two-force members: equilibrium satisfied by equal, opposite, collinear forces



$\Sigma F_x = 0$

$\Sigma F_y = 0$

Procedure for analysis:

1. Draw a FBD of the whole truss and find the external reactions at the supports.
2. Draw a FBD of a joint with at least one known force and at most two unknown forces.
3. Use equations of equilibrium for the joint to solve for the unknown forces.
4. Repeat the process for finding forces in truss members of interest.

Remember, members in *compression* "pushes" back on the pin joints, and members in *tension* "pulls" back on the pin joints.

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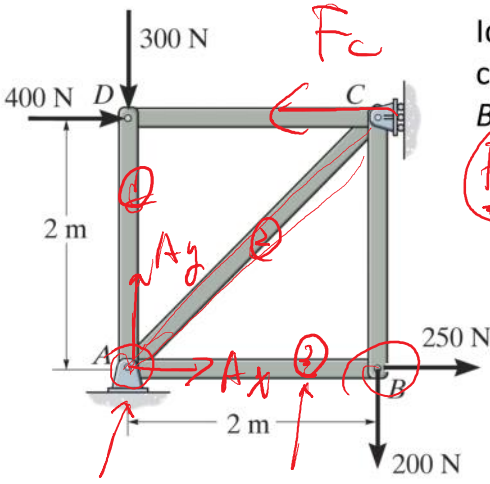
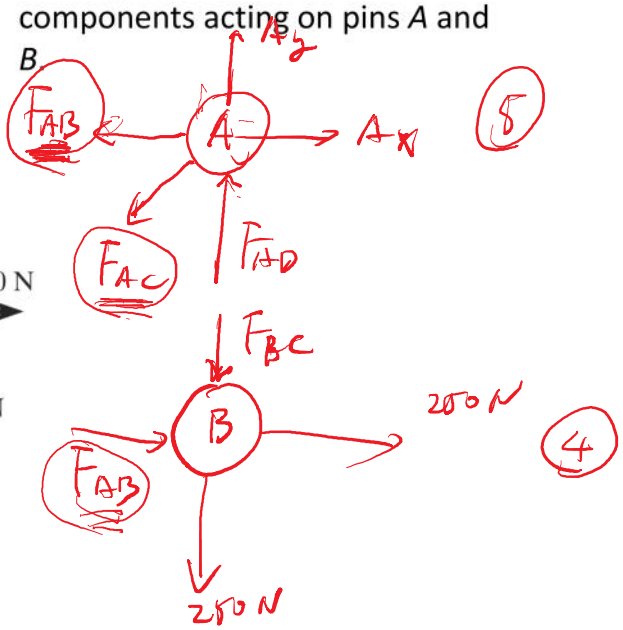


Identify the number of force components acting on pins *A* and *B*.



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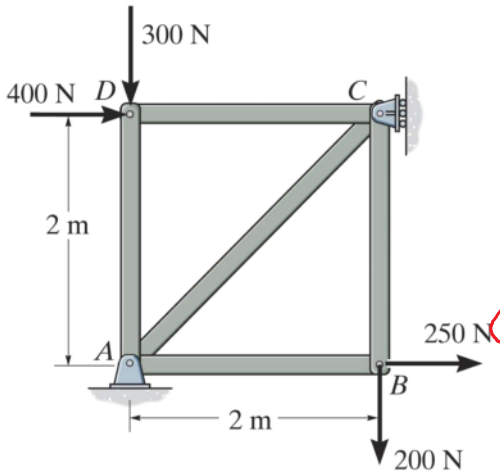

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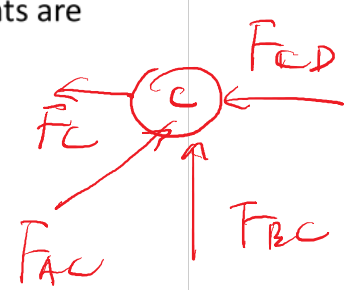
How many force components are acting on pin C?

A) 1
B) 2
C) 3
D) 4
E) I'm a big fat phony



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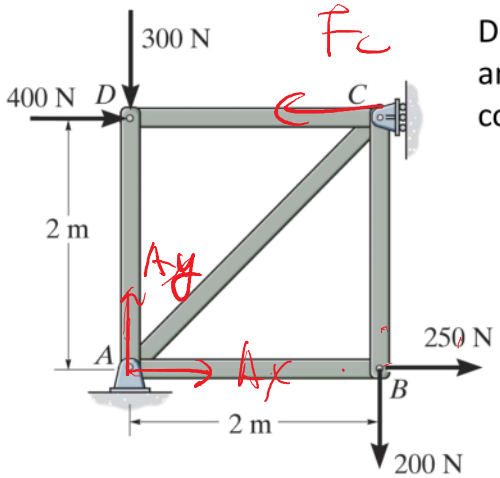
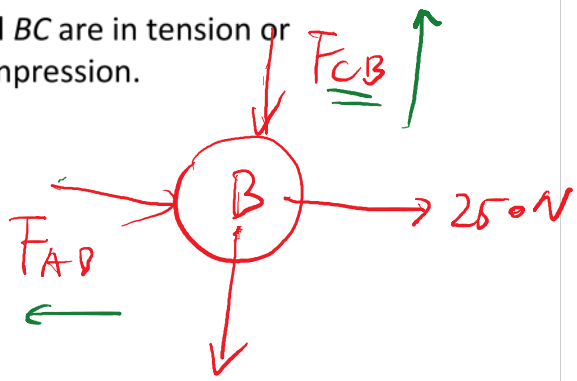
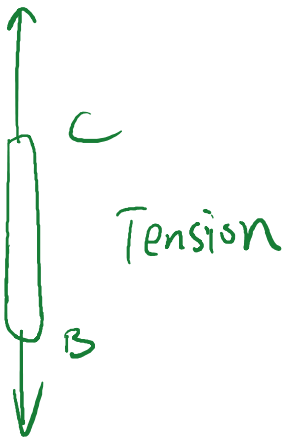


Determine whether members *AB* and *BC* are in tension or compression.



$F_{AB} = -250\ N$

$F_{CB} = -200\ N$



tension

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