

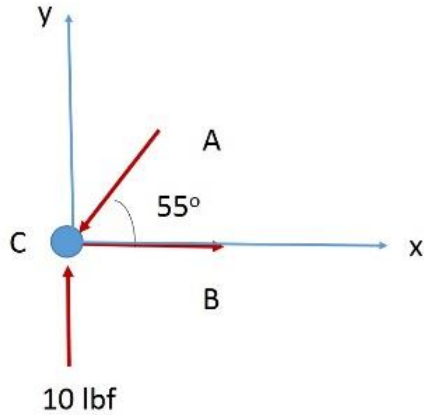
ENGR19000

Elementary Engineering Design

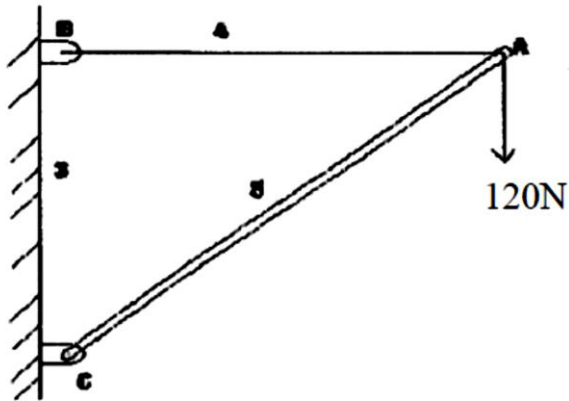
Mechanical and Civil Engineering (MCE)

Kimia Mortezaei
Department of Mechanical and Civil Engineering
Purdue University Northwest

Lecture 2

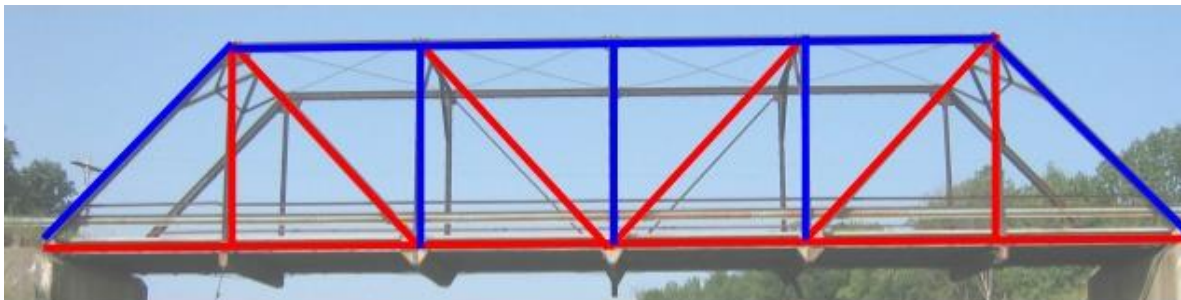


✓ HW1: vector and statics

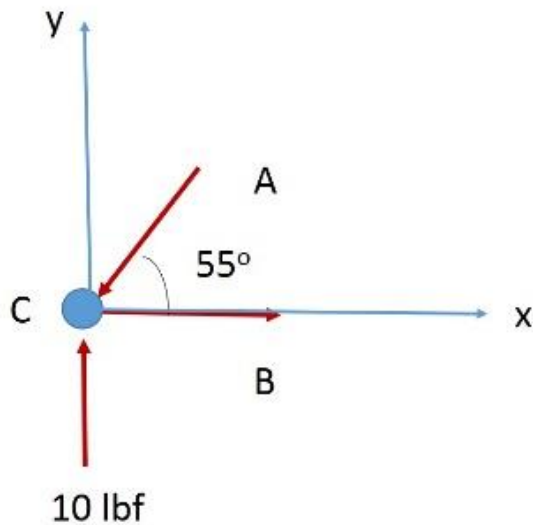


→ HW2: simple truss problem

→ HW3: bridge truss problem



Forces have been listed in HW 1



In realistic problems \rightarrow Forces are not listed

- E.g. If a system is in static equilibrium, find the force in each member F_{AB} , F_{BC} , F_{BD}

Steps:

1. Isolate one joint: B

2. Draw Free Body Diagram (FBD) of joint B

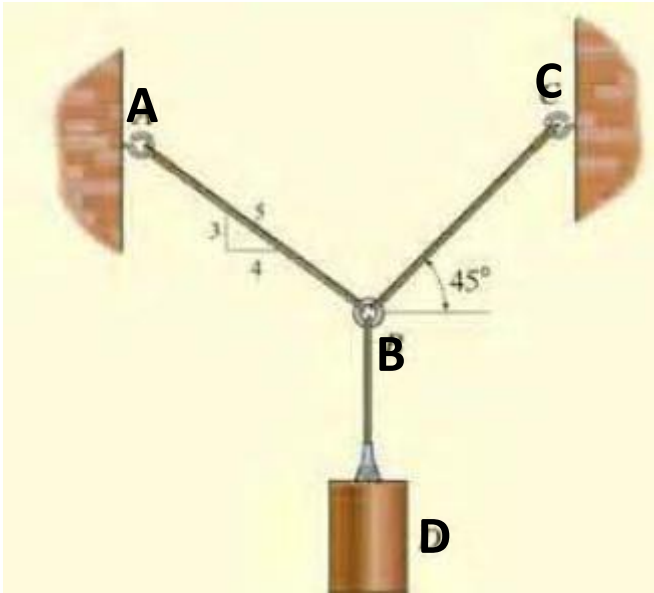
FBD: A sketch used to show and analyze *all the forces* acting upon a joint.

- Label all the known and unknown forces.
- The direction of a unknown force can be assumed.

3. Decompose forces into x and y component

4. Apply the equations of equilibrium $\sum F_x = 0$, $\sum F_y = 0$

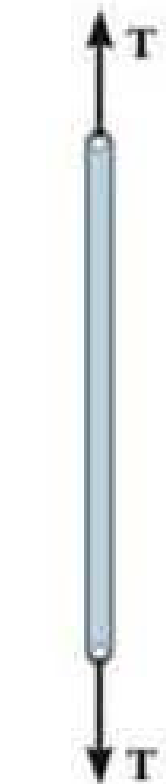
(5. If the system has more than one joint, repeat step 1-4 for other joints until all the forces have been found.)



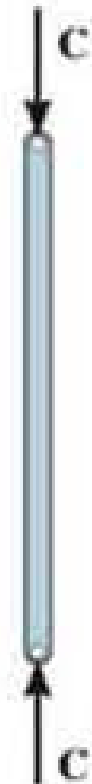
Forces: Tension (T) vs. Compression (C)

Two basic types of forces

- If the force tends to elongate the member, it is a tension (T).
- If it tends to shorten the member, it is a compression (C).



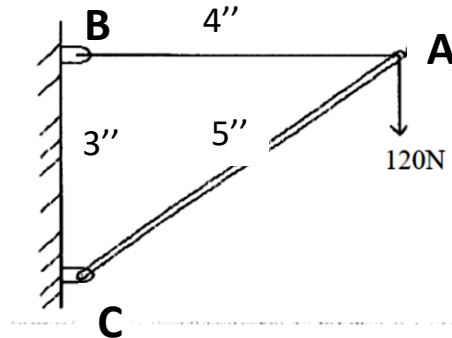
Tension
(a)



Compression
(b)

e.g. Determine the force magnitude in each member (AB, AC).
Indicate whether members are in tension (T) or Compression (C).

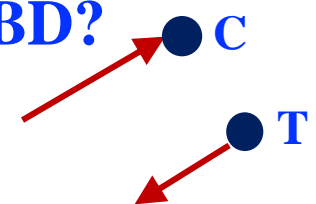
Simple truss



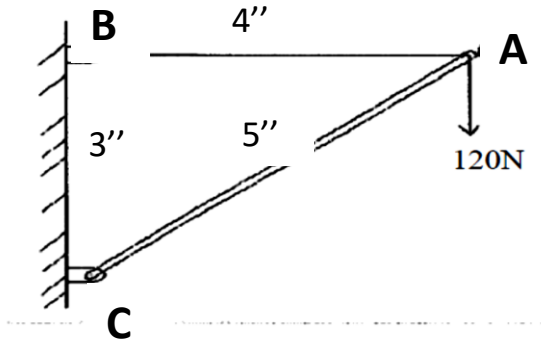
Note: All the problems in Pro_set_2 and Pro_set_3, are assumed to be static equilibrium.

Tips

- **Start from the joint with at least one known force and maximum of two unknown forces** → draw FBD of this joint A
- **In FBD, assume unknown forces as tension**, after calculation
 - if the answer of assumed force is '+', the force is tension.
 - If the answer of assumed force is '-', the force is compression.
- **How to describe tension T or compression C in FBD?**
 - Compression force points into the joint
 - Tension force points away from the joint



e.g. Determine the force magnitude in each member (AB, AC).
Indicate whether members are in tension (T) or Compression (C).



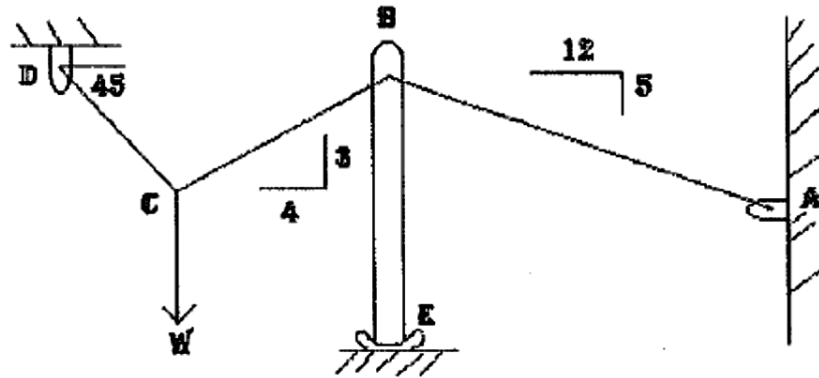
Steps:

- 1. Isolate one joint: A**
- 2. Draw Free Body Diagram (FBD) of joint A**
- 3. Decompose forces into x and y component**
- 4. Apply the equations of equilibrium $\sum F_x = 0$, $\sum F_y = 0$**

(5. If the system has more than one joint, repeat step 1-4 for other joints until all the forces have been found.)

If a system has many joints, which joint do we start from?

2. If force in AB is 1560 lb T, find W. Also forces in BC, BE, and CD. Note whether tension or compression.



- **Tips:**

- Start from the joint with at least one known force and maximum of two unknown forces
- Then move to the next joint with at least one known force and maximum of two unknown forces

Assignment of Week 2

1. HW#2
2. Lab 2 HW#2 Q&A