Lecture 16

Friday, October 6, 2017   12:01

To do ...

- CATME mid-course survey due **Fri**

- HW 11 ME due **Sat**

- Sign up for Quiz #4 (CBTF)
- HW 12 PL due **Tues**
- HW 13 ME due **Thurs**
- WA #2 due **Fri**

Recap

Joints

F_5 F_6

F_4

Member

F_1

F_7

F_2

F_8

F_3

Roof truss

T_9

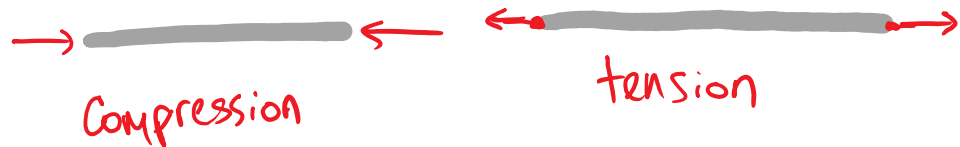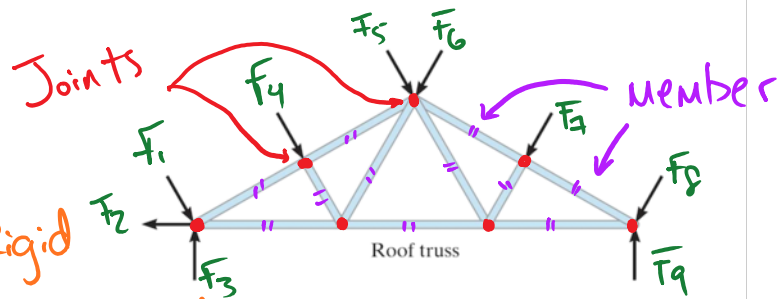- Truss Analysis

※ TRUSS is A Rigid Structure composed of two force Members

* External forces Act At joints (on pins only!!)
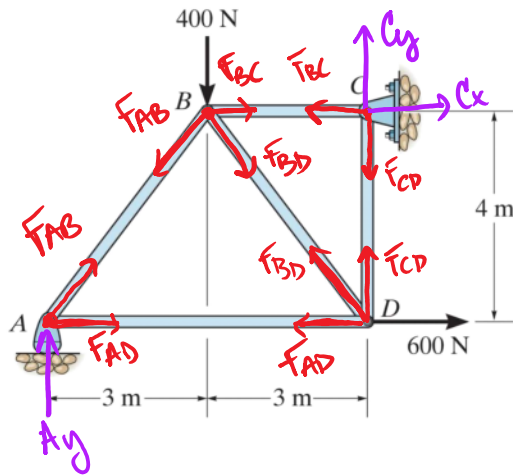
- Joint/pin method

- Zero force member

※ Since these Are two force Members, They Are in tension or Compression

Compression

tension

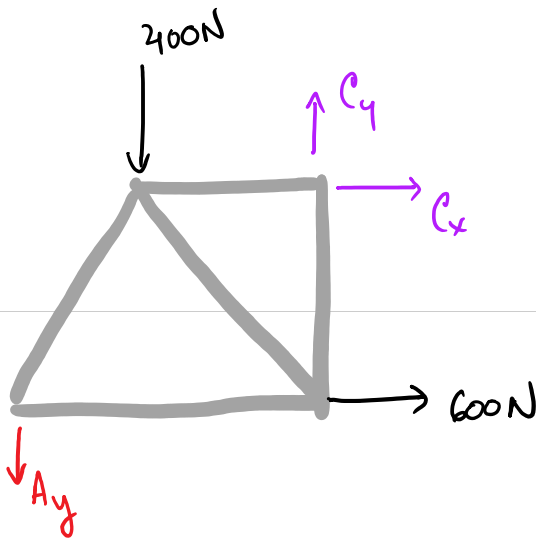# Tension vs. Compression

Rigid bodies respond differently to tension versus compression.

400 N

Find the forces in each member of the truss. Determine if members are in tension or compression.

4 m

600 N

—3 m— —3 m—

1. Draw FBD of truss

2. label external and reaction forces

3. DRAW FBD of joints

4. use EoE

Q: How many members/joints?

if J=4 the M= 2(4)−3 = 5

* ΣM of truss and support Rxns first!

$\Sigma F_x: \ 600 + C_x = 0$ $\underline{C_x = -600 \ N}$

$\Sigma F_y: \ C_y - A_y - 400 = 0$

$\Sigma M_C: \ (3)(400) + 4(600) + A_y \, 6 = 0$

$A_y = \dfrac{-3600}{6} = \underline{-600 \ N}$

$C_y = 400 + A_y = \underline{-200 \ N}$

now Analyze each joint!   (b/c truss is in ΣM!)
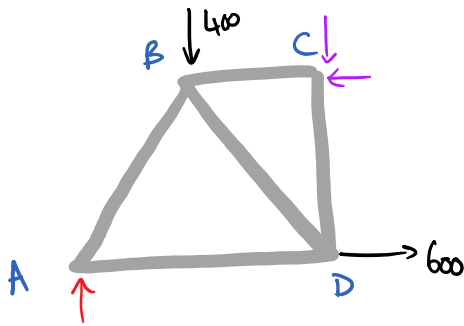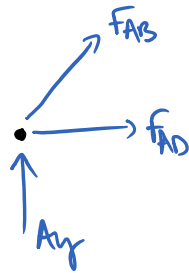
FBD of joint A

$$\Sigma F_x: \quad F_{AD} + \frac{3}{5} F_{AB} = 0$$

$$\Sigma F_y: \quad \frac{4}{5} F_{AB} + A_y = 0$$

$$F_A \quad - \frac{5}{4} A_y = -750 N \ (C)$$

$$F_{AD} = -\frac{3}{5} F_{AB} = 450 N \ (T)$$

FBD of joint D
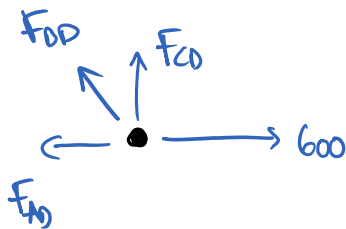
$$\Sigma F_x: \quad 600 - F_{AD} - \frac{3}{5} F_{BD} = 0$$

$$\Sigma F_y: \quad F_{CD} + \frac{4}{5} F_{BD} = 0$$

$$F_{BD} = \frac{5}{3}(600 - 450) = 250 N \ (T)$$

$$F_{CD} = \frac{-4}{5} F_{BD} = -200 N \ (C)$$

FBD of joint C

FBD of joint C
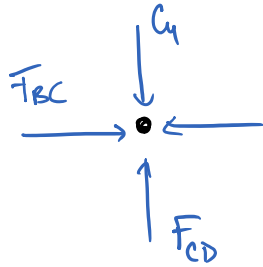
$$\Sigma F_x: \quad F_{BC} - C_x = 0$$

$$\Sigma F_y: \quad F_{CD} - C_y = 0$$

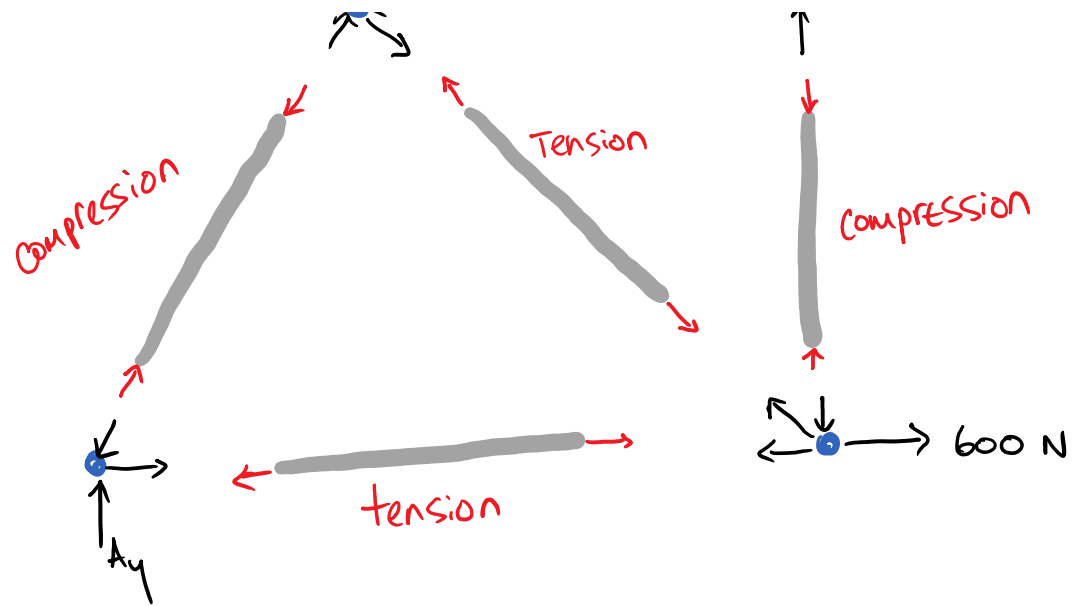$$F_{BC} = C_x = \underline{600 \text{ N}} \quad (T)$$

$$F_{CD} = C_y = \underline{200 \text{ N}} \quad (\text{check})$$

So what does this mean...
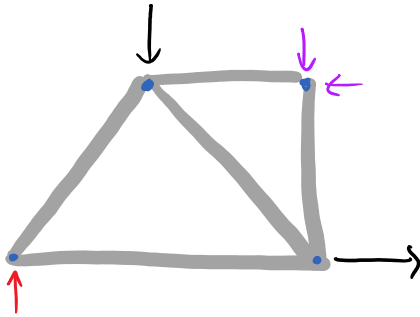
In $\equiv M$, the truss is a rigid structure, composed of rigid members, connected by smooth pins. For a given configuration and external loading, members experience tension or compression.

400 N   Compression C_y C_x

Compression

Tension

Compression

tension

Ay

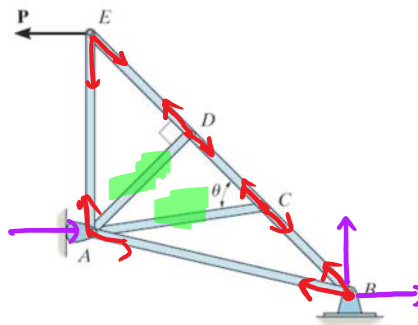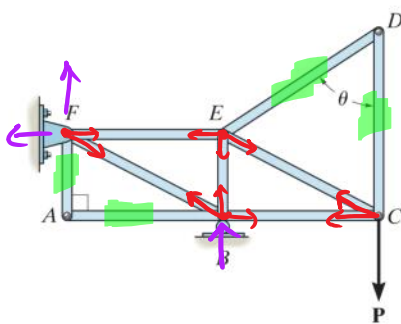600 N
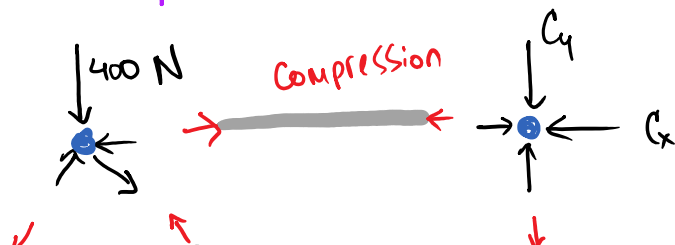
Zero-force members

→ support no load

- Particular members in a structure may experience no force for certain loads.
- Zero-force members are used to increase stability
- Identifying members with zero-force can expedite analysis.

2 members
- non collinear
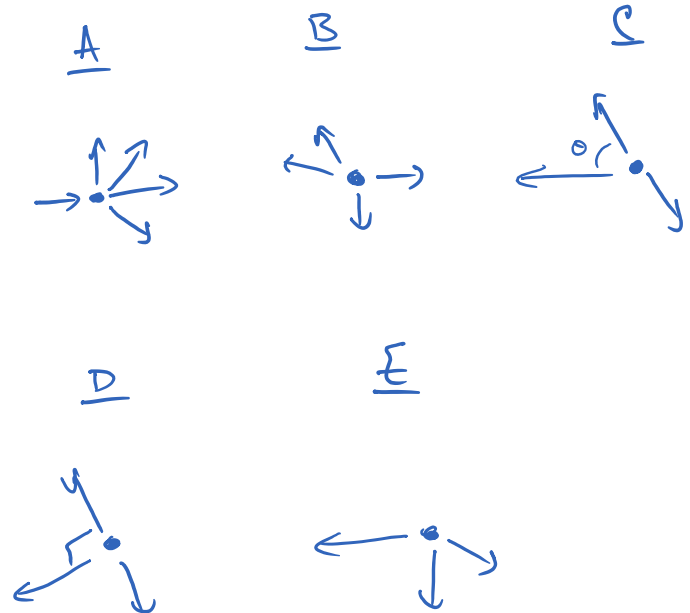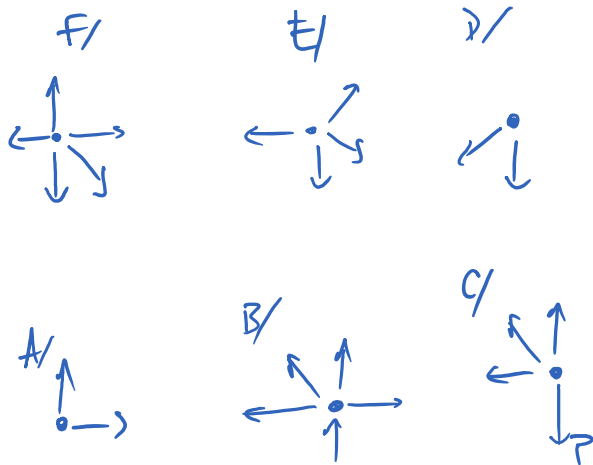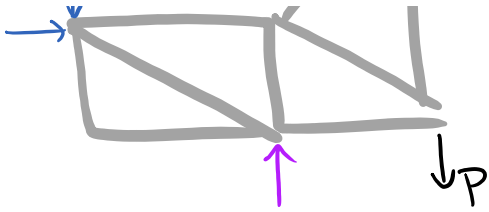- no external force, support
- both ZERO
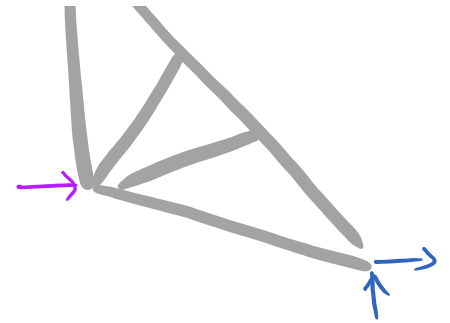
3 members
- 2 collinear, then 3rd member is ZERO
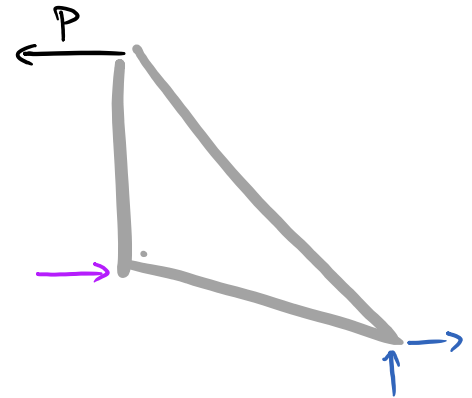
this truss has 6 joints

this truss has 5 joints

F/

E/
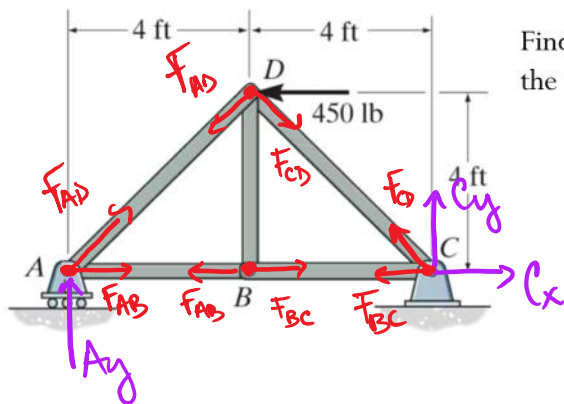
D/

A

B

C

A/

B/

C/

D

E

could be...

could be ...

P

4 ft   4 ft

F_{AD} D

450 lb

4 ft

F_{AD} F_{CD} F_D C_y

C

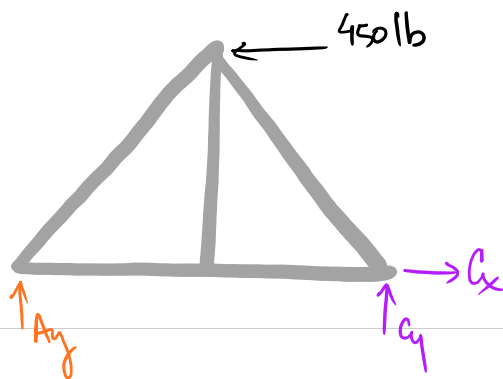A C_x
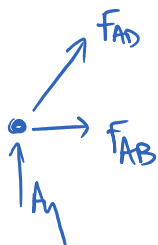
F_{AB} F_{AB} B F_{BC} F_{BC}

A_y
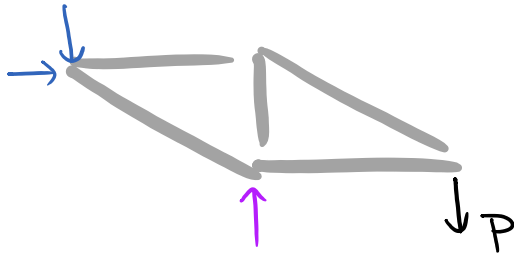
Find the forces in each member of the truss.

1. DRAW FBD of truss

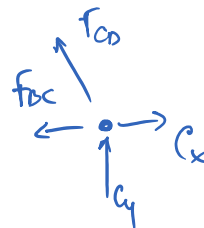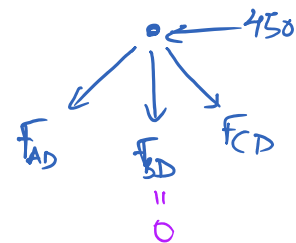2. locate zero force members

3. Apply Equations of Equilibrium

450 lb

C_x

A_y C_y

Joint A

F_{AD}

F_{AB}

A_y

Joint B

F_{BD}
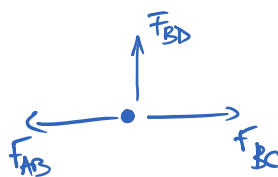
F_{AB} F_{BC}

* two collinear members, third member

$\underline{F_{BD} = 0}$

$\overline{F_{AB} = F_{BC}}$

Joint C

F_{CD}

F_{BC} C_x

C_y

Joint D

450

F_{AD} F_{BD} F_{CD}

$=$
0

$\Sigma F_x: \quad -450 - F_{AD} \cos 45 + F_{CD} \cos 45 = 0$
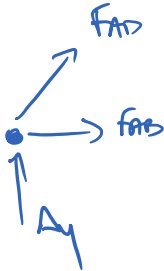
$\Sigma F_y: \quad -F_{AD} \sin 45 - F_{CD} \sin 45 = 0$

$F_{AD} = -F_{CD} =$

$$F_{CD} = \frac{450}{2\cos 45} = 318 \text{ lb } (\text{T})$$

$$F_{AD} = -318 \text{ lb } (\text{C})$$

Joint A

$$\Sigma F_x: \quad F_{AB} + F_{AD}\cos 45 = 0$$

$$\Sigma F_y: \quad A_y + F_{AD}\sin 45 = 0$$

$$F_{AB} = -F_{AD}\cos 45 = -(-318)\cos 45 = 225 \text{ lb } (\text{T})$$

$$F_{BC} = F_{AB} = 225 \text{ lb } (\text{T})$$

compression   zero force   tension

tension   tension