To do ...

- WA6 due Sunday March 6th

- Quiz 3 (Tues March 1 – Sat March 5)

- Thank you for your feedback!
Rapid Refresh ...

- i
- <3
- c
- l
- i
- c
- k
- e
- r
1. Frames and machines are different as compared to trusses since they have __________.
   A) Only two-force members  B) Only multforce members
   C) At least one multforce member  D) At least one two-force member

   + TRUSSES — (2 force members only)

   Frames and                              1. Connected in multiple ways
   Machines:                                2. Loads other than at joints
                                           3. See above

   Frames: fixed and support loads
   Machines: designed to move and transfer alter/transfer forces.
2. Imagine that you have drawn a FBD of member BC. What will be the easiest way to write an equation involving unknowns at B?

A) $\sum M_C = 0$  
B) $\sum M_B = 0$  
C) $\sum M_A = 0$  
D) $\sum F_Y = 0$

**Q:** How many 2-force members? - Member AB

**Q:** Global unknowns? - 3 unknowns, $C_x, C_y, F_A$

**Q:** Can solve whole? - Sum moments about C to solve for $F_A$ directly.
**Given:** The wall crane supports an external load of 700 lb.

**Find:** The force in the cable at winch motor W and the horizontal and vertical components of pin reactions at A, B, C, and D.

Q: any 2 force member?  
- Yes!  
- MEMBER BD  
- CABLE? Yes

\[ \Sigma F_y = T + T - W = 2T - W = 0 \]
\[ T = \frac{W}{2} = 350 \text{ lb} \]

\[ \Sigma F_x: C_x - T = 0 \Rightarrow C_x = T = 350 \text{ lb} \]

\[ \Sigma F_y: C_y - T = 0 \Rightarrow C_y = T = 350 \text{ lb} \]

\[ \Sigma F_x: T - B_x - T \sin(30) = 0 \]
\[ B_x = T(1 - \sin(30)) = 175 \text{ lb} \]

\[ \Sigma F_y: B_y - T \cos(30) = 0 \]
\[ B_y = 303.1 \text{ lb} \]
**FBD of the beam**

\[ A_x \quad \rightarrow \quad F_{BD} \quad \theta \]

\[ \begin{align*} 
A_x & \quad \downarrow \quad B_x \quad \downarrow \\
A_y & \quad \downarrow \quad B_y \\
C_x & \quad \uparrow \quad C_y \\
T & \quad \uparrow
\end{align*} \]

3 unknowns!

\[ A_x, A_y, F_{BD} \]

**Sum moments about A**

\[ \sum M_A = (4L)(F_{BD} \sin(45)) - 4B_y - 8C_y - 8T = 0 \]

\[ F_{BD} = \frac{4B_y + 8C_y - 8T}{4 \sin(45)} = 2409 \text{ lb} \quad \text{(magnitude)} \]

**Sum forces in x**

\[ \sum F_x: \quad A_x + B_x - C_x - F_{BD} \cos 45 = 0 \]

\[ A_x = C_x + F_{BD} \cos(45) - B_x = 1880 \text{ lb} \]

**Sum forces in y**

\[ \sum F_y: \quad A_y + F_{BD} \sin(45) - B_y - C_y - T = 0 \]

\[ A_y = B_y + C_y + T - F_{BD} \sin(45) = -700 \text{ lb} \]

**FBD of two force member**

\[ D_x = -2409 \cos(45) = -1700 \text{ lb} \]

\[ D_y = 2409 \sin(45) = 1700 \text{ lb} \]
Determine the horizontal and vertical components of force at pins A and D.

Q: How does the radius affect the results?

**FBD of pulley at E**

\[ T = \frac{F}{2} = 6 \text{kN} \]

Solve the moment about A.

\[ \sum M_A = d_1 F_y - J d_1 T + rT - (2d_1 - r)T = 0 \]

\[ \sum M_A = d_1 F_y + T \left( r - 2d_1 - r - 2d_1 \right) = 0 \]

\[ \sum M_A = d_1 F_y + 2 \left( 2d_1 T \right) = 0 \]

- Radius cancels out!
- Pulley is massless/frictionless.
If a 100 N force is applied to the handles of the pliers, determine the clamping force exerted on the smooth pipe $B$ and the magnitude of the resultant force that one of the members exerts on pin $A$.

Q: How many two force members? - Yes!

a) 0  

b) 1  

c) 2  

d) 3

Pipe is a two force member!

Sum the moment about $A$.

$$\sum M_A = -d_1F_1 + d_2F_B = 0$$

$$\Rightarrow F_B = \frac{d_1F_1}{d_2} = \frac{5d_2F_1}{d_2} = 5F_1$$

$$F_B = 500 \text{ N}$$
A 500 kg elevator car is being hoisted by a motor using a pulley system. If the car travels at a constant speed, determine the force developed in the cables. Neglect the cable and pulley masses.

We’ll label the tension in the rightmost cable $T_1$, and tension in the leftmost cable $T_2$. Which is an equation for equilibrium of pulley C?

A. $T_1 + 2T_2 = 0$
B. $2T_1 + T_2 = 0$
C. $T_1 - T_2 = 0$
D. $2T_1 - T_2 = 0$
E. $T_1 - 2T_2 = 0$

Q: How many two force members?