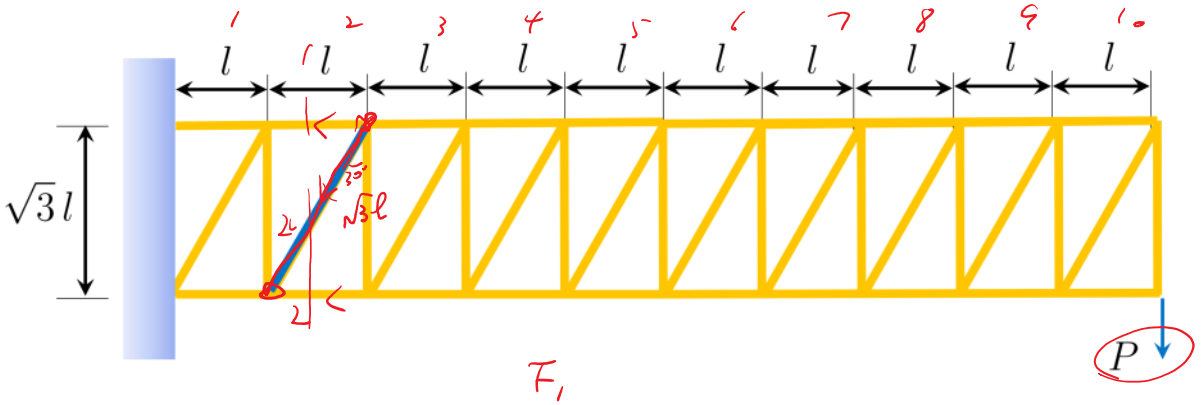
Lec18

Monday, November 2, 2020 7:35 AM

Lecture Objectives

Frames and Machines

1



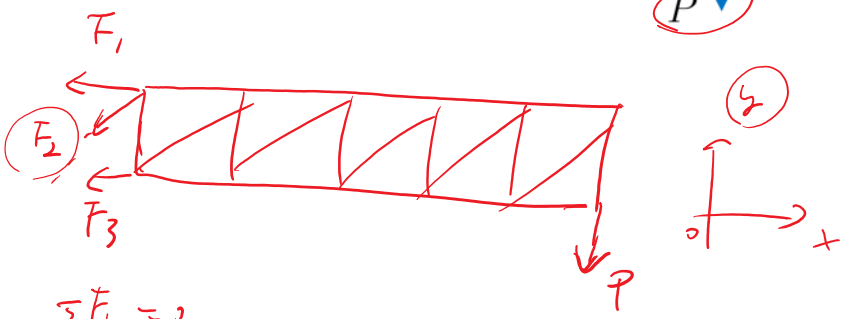
A) $F = P$

B) $F = -P$

C) $F = \frac{2}{\sqrt{3}}P$

D) $F = -\frac{2}{\sqrt{3}}P$

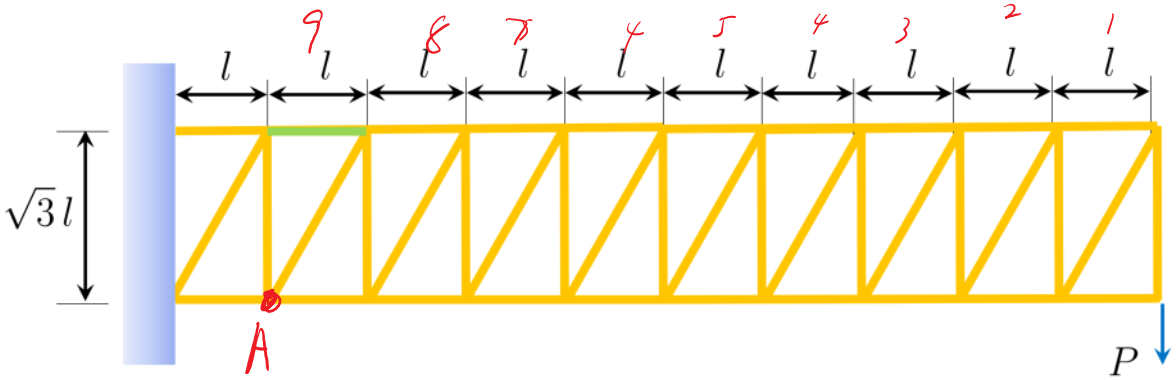
E) $F = 0$



$\sum F_y = 0$

$-F_2 \cdot \cos 30^\circ - P = 0$

$F_2 = -\frac{2}{\sqrt{3}}P$

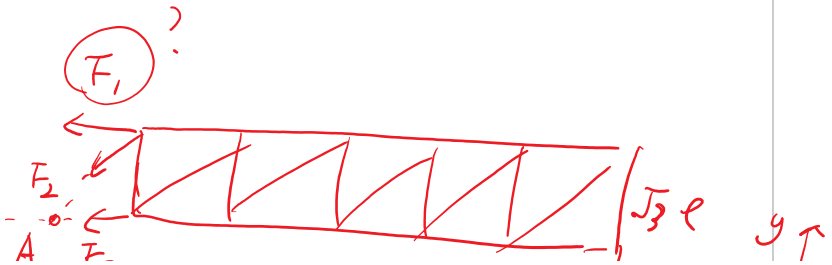


A) $F = 9P$

B) $F = -9P$

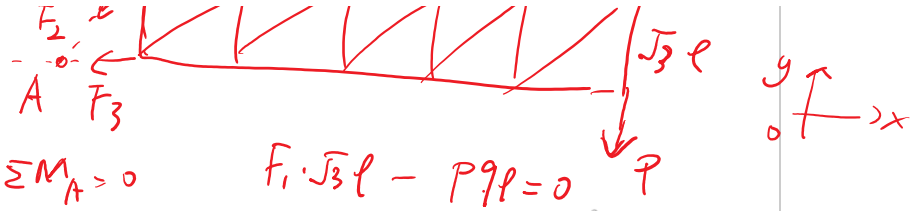
C) $F = +\frac{9}{\sqrt{3}}P$

D) $F = -\frac{9}{\sqrt{3}}P$



D) $F = -\frac{9}{\sqrt{3}}P$

E) $F = 0$



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Frames and machines

Frames and machines are two common types of structures that have at least one multi-force member (Recall that trusses have nothing but two-force members).

Frames are generally **stationary** and used to support various external loads.

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Frames and machines

Frames and machines are two common types of structures that have at least **one multi-force member** (Recall that trusses have nothing but two-force members).

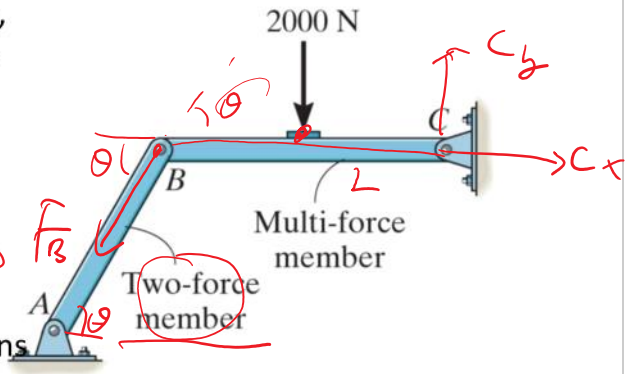
Machines contain moving parts and are designed to alter the effect of forces.

$\Sigma F_x = 0$
$\Sigma F_y = 0$
$\Sigma M_o = 0$

Frames and machines

The members can be truss elements, beams, pulleys, cables, and other components. The general solution method is similar to rigid body at equilibrium analysis:

1. Identify the structure member with force/moment of interest loading on it.
2. Perform equilibrium analysis on the whole structure to find support reactions if necessary.
3. Perform equilibrium analysis on identified member of the structure.



$\Sigma M_C = 0$
$\Rightarrow F_B = ?$

Example:

Find the force acting at *B* on member *BC*.

Find the force acting at *B* on member *BC*.

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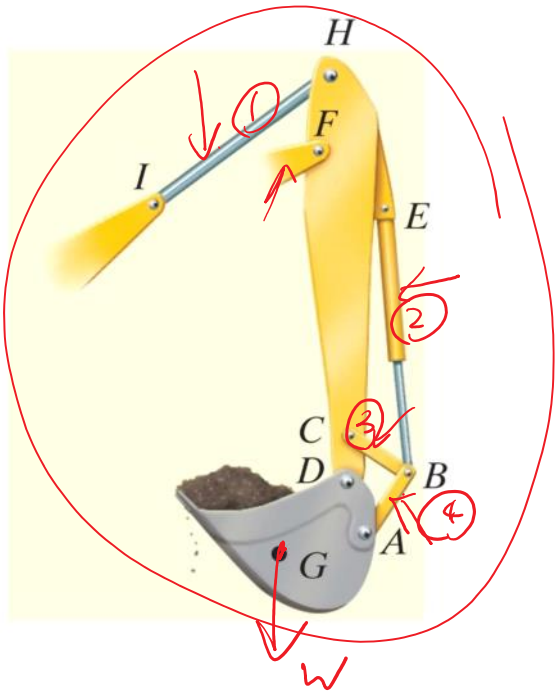
Draw the FBD of the members of the backhoe. The bucket and its contents have a weight *W*.



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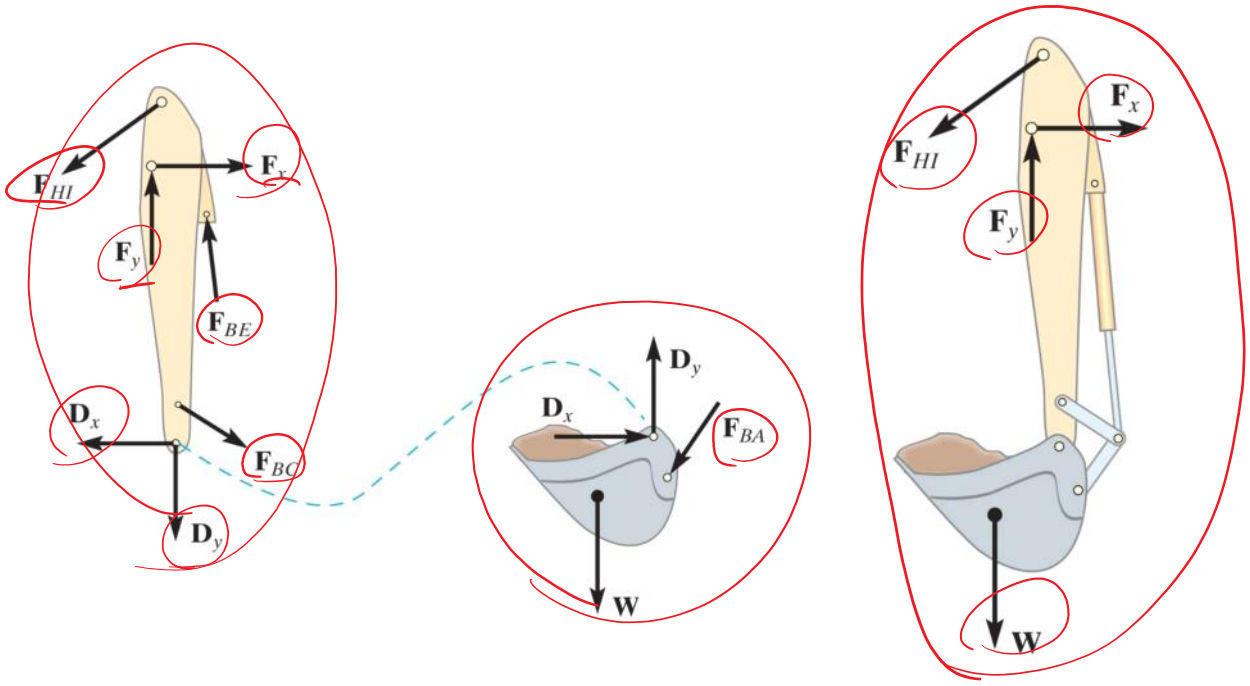

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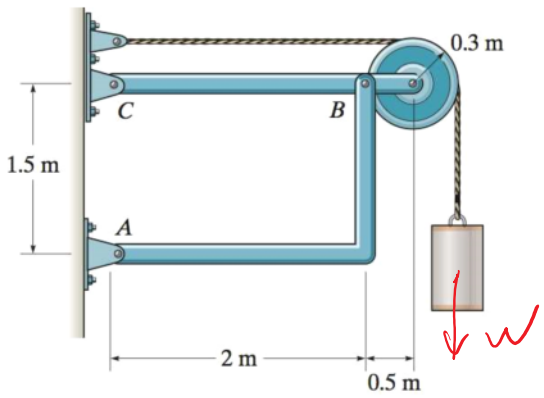
Example

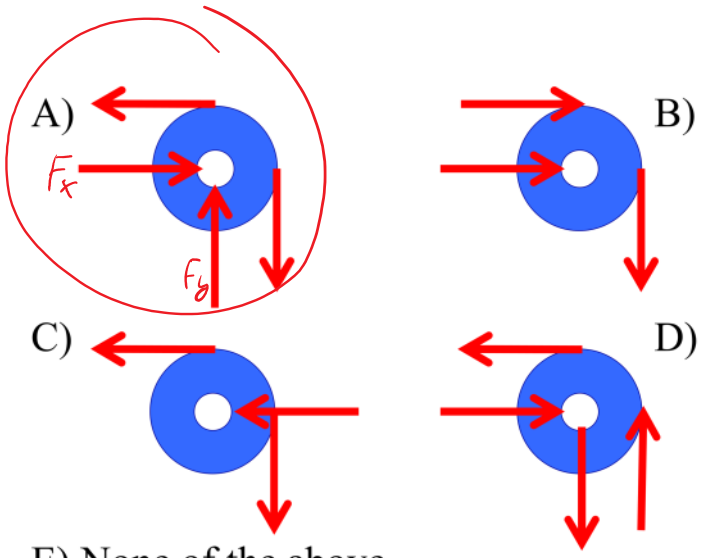
Given the weight of the cylinder is W, what is the loading on member BC by the pulley?

Strategy: Do analysis on the pulley to relate the tension in the rope (since it will be the same as W) to the forces from member BC.

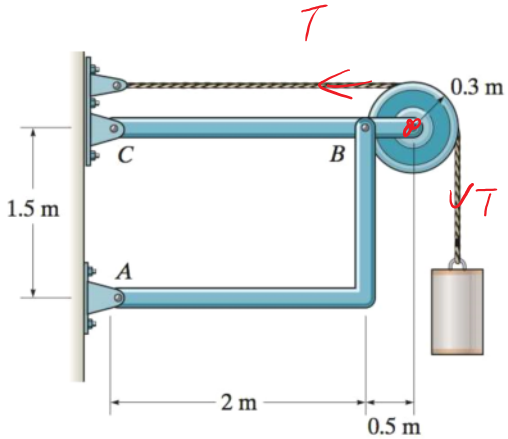


i-Clicker Time

What is the proper FBD for the pulley?



E) None of the above

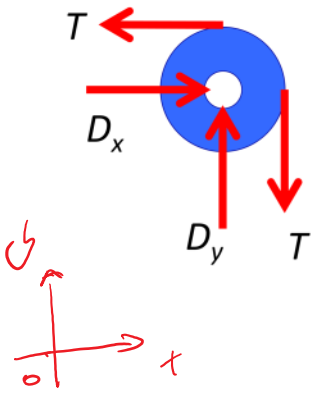


Example

Given the weight of the cylinder is W, what is the loading on member BC by the pulley?

Strategy: Do analysis on the pulley to relate the tension in the rope (since it will be the same as W) to the forces from member BC.

FBD (A)



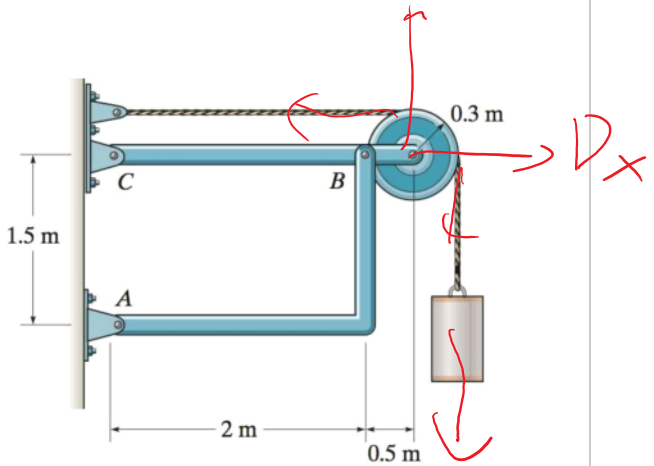
EoE

$$\sum F_x = D_x - T = 0$$

$$\sum F_y = D_y - T = 0$$

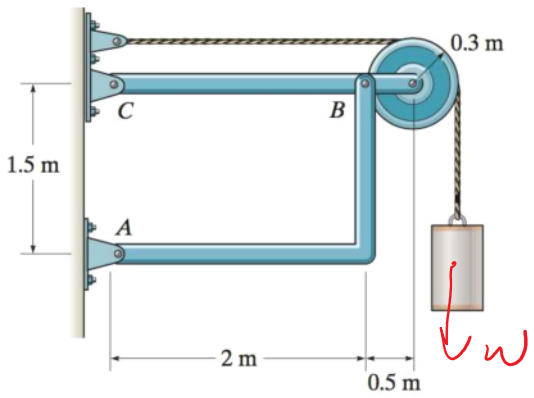
$$D_x = T = W$$

$$D_y = T = W$$



Example

Given the weight of the cylinder is W, what is the loading on member BC at B?



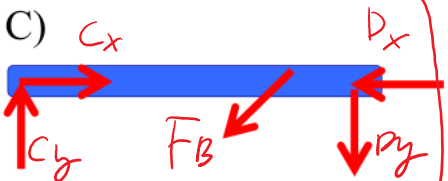
i-Clicker Time

Given FBD for the pulley, what is the proper FBD for beam *CB*?

A)

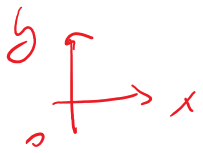
B)

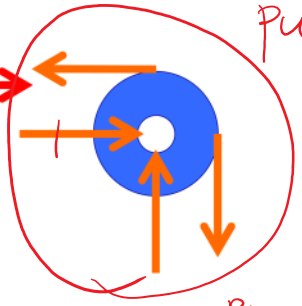
C)



D)

E) None of the above



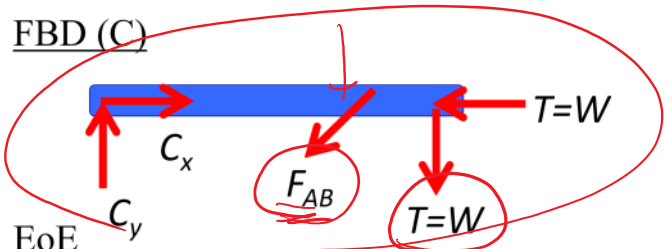


Example

Given the weight of the cylinder is W, what is the loading on member BC at B?

Strategy: Recognize member AB is a two-force member.

FBD (C)



EoE

$$\sum M_C = -F_{AB}\left(\frac{1.5}{2.5}\right)(2\text{ m}) - T(2.5\text{ m}) = 0$$

$$F_{AB} \approx -2.08T \approx -2.08W$$