MODULE 0: PREREQUISITE REVIEW

Samantha Ramirez, MSE

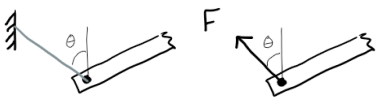
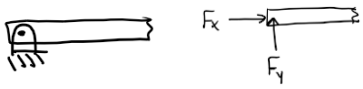
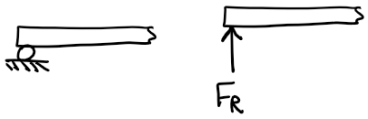
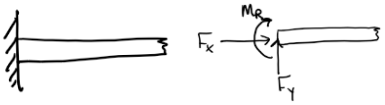
OBJECTIVE

- Review concepts from Statics and Engineering Materials in preparation for a pre-test.

FORCES & MOMENTS

- A **FORCE** is the action of one body on another.
- Forces always exist in equal magnitude, opposite direction pairs.
- A **MOMENT** is generated when a force does not have an equal and opposite force applied in its line of action.
- Moments are a measure of a force's tendency to cause a body to rotate about a specific point or axis.

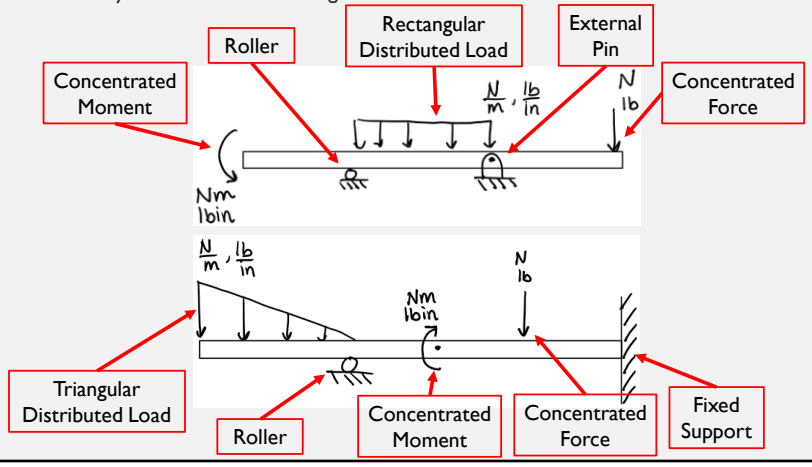
CONNECTIONS & REACTIONS

Connection	Reaction	Connection	Reaction
Wire/Cable	 1 Reaction	External/Internal Pin	 2 Reactions
Roller	 1 Reaction	Fixed Support	 3 Reactions

- If the support prevents translation in a given direction, then a force must be developed on the member in that direction.
- Likewise, if rotation is prevented, a couple moment must be exerted on the member.

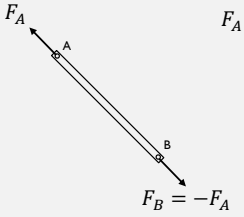
EXTERNAL LOADS

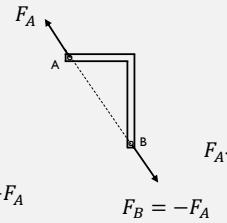
- Can be applied to a body as distributed or concentrated surface loadings or as body forces which act throughout the volume.

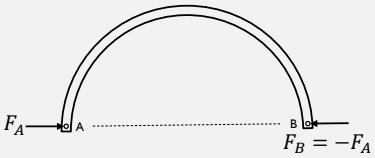


TWO-FORCE MEMBERS

- Two-force member
  - A member that has pin supports at both ends and is subjected to no load in between is called a two-force member.
- Two-force principal
  - If only two forces act on a body that is in equilibrium, these two forces must be equal in magnitude and opposite in sense.
- Line of Action
  - The reaction forces of a two-force member are directed along the line of action between the two pinned ends.

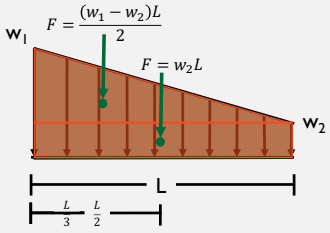


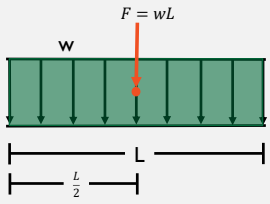




REDUCING DISTRIBUTED LOADS

- Linear distributed loadings produce a resultant force having a magnitude equal to the area under the load diagram, and having a location that passes through the centroid of this area.



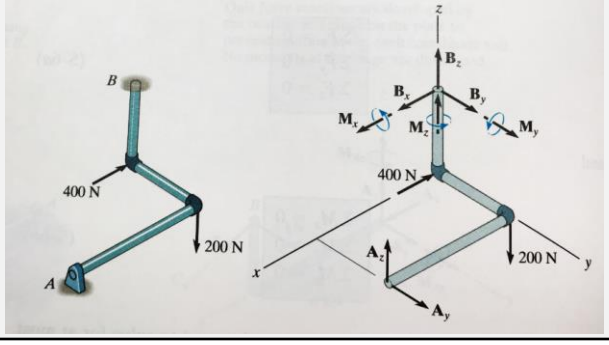


STATIC EQUILIBRIUM EQUATIONS

$$+ \swarrow \sum F_x = 0 \qquad + \sum M_x = 0$$

$$+ \searrow \sum F_y = 0 \qquad + \sum M_y = 0$$

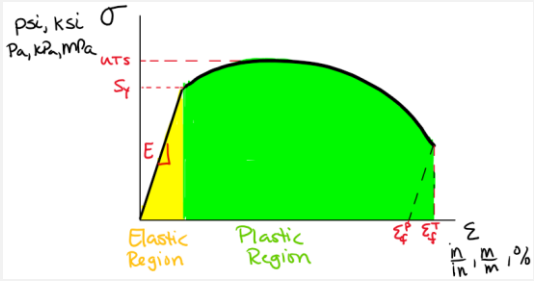
$$+ \uparrow \sum F_z = 0 \qquad + \sum M_z = 0$$



STRESS-STRAIN DIAGRAM

- The most important result from the tension test is the stress-strain diagram (σ-ε diagram).
- Nominal or engineering stress and strain are used to create a σ-ε diagram.

- E: Young's Modulus
- S_Y: Yield Strength
- UTS: Ultimate Tensile Strength
- ε_f^T: Total Strain at Failure
- ε_f^P: Plastic Strain at Failure



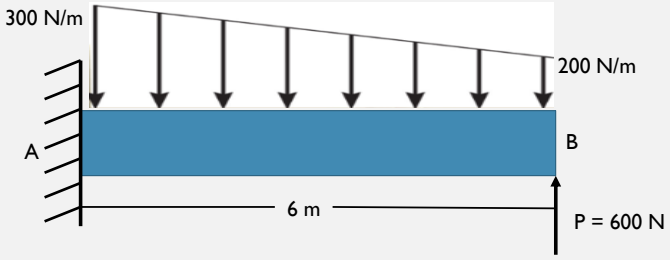
SOLVING FOR CHANGES IN DIMENSIONS

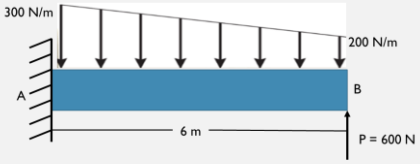
- $\sigma = \frac{F}{A}$
- $\varepsilon_{Long} = \frac{\Delta L}{L_o}$
- $E = \frac{\sigma}{\varepsilon_{Long}}$ (Only used if $\sigma < S_y$)
- $\upsilon = -\frac{\varepsilon_{Lat}}{\varepsilon_{Long}}$
- $\varepsilon_{Lat} = \frac{\Delta d}{d_o}$
- $G = \frac{E}{2(1+\upsilon)}$ (Only if material type and alloy is unknown)

- Knowns:
  - Original length, L_o
  - Original diameter, d_o
  - Material type and alloy
    - E & v
  - External force , F

EXAMPLE 1

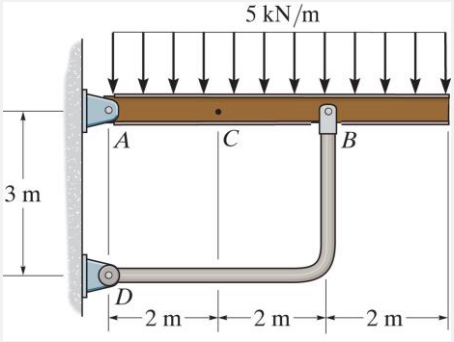
- Determine the reaction at point A.

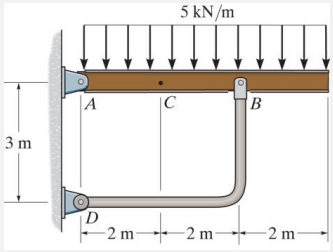



300 N/m
200 N/m
A
B
6 m
P = 600 N

EXAMPLE 2

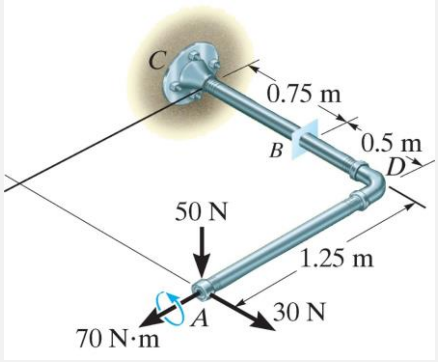
- Determine the reaction at point A.

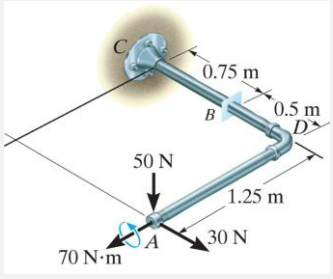



5 kN/m
A
C
B
3 m
D
2 m
2 m
2 m

EXAMPLE 3

- Determine the reactions at point C.




C
0.75 m
B
0.5 m
D
50 N
1.25 m
A
30 N
70 N·m

EXAMPLE 4

- The aluminum rod is 3 ft long and has a diameter of 0.15 in. If an axial load of 3.25 kip is applied to it, determine the change in its length and the change in its diameter. Note: $E_{AL}=10\times10^3$ ksi