Announcements

- CBTF Quiz 4 starts tomorrow (10/17-20)
  - Do HW14 on Prairie Learn to prepare
- Frame tutorial by Professor Kersh on Course Schedule

❑ Upcoming deadlines:

- Wednesday (10/18)
  - PL HW14
- Thursday (10/19)
  - ME HW15

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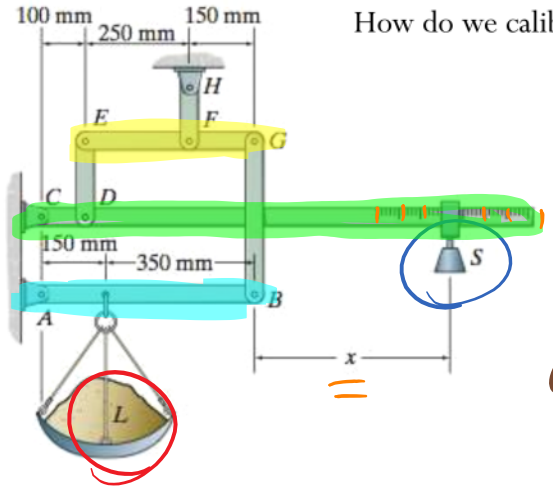
Recap: Frames and machines

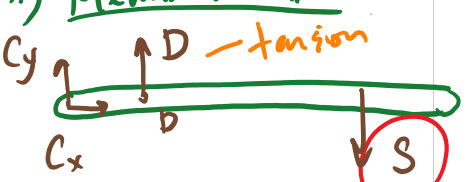
How do we calibrate a platform scale?



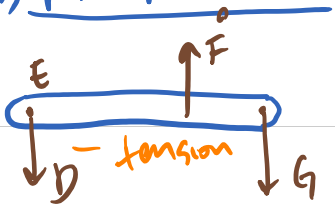
Given: S, L

Find: α

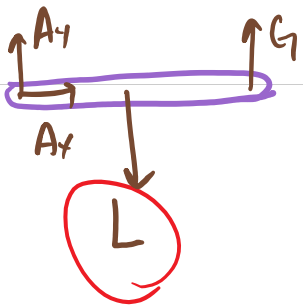
1.) Member CD



2.) Member EG



3.) Member AB



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Steps to take:

1.) CD: $\sum M_C = D(100mm) - S(500mm + x) = 0$

$\Rightarrow D = f(S) = \frac{(500+x)}{100} S$

2.) EG: $\sum M_F = D(250mm) - G(150mm) = 0$

$\Rightarrow G = g(D) = g(f(S)) = \left(\frac{250}{150}\right)\left(\frac{500+x}{100}\right) S$

3.) AB: $\sum M_A = -L(150mm) + G(500mm) = 0$

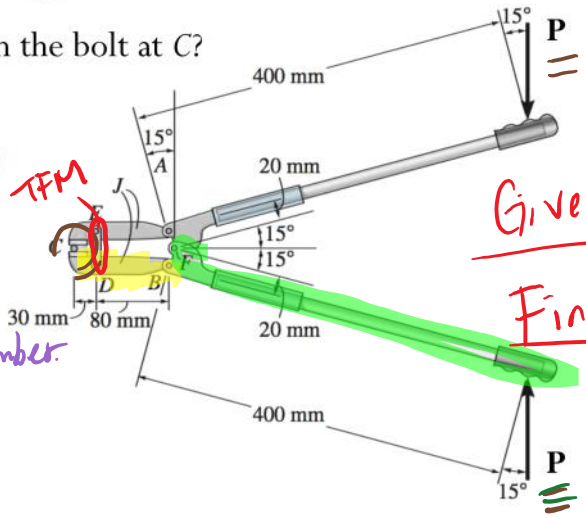
$\Rightarrow L = h(G) = h(g(f(S))) = \left(\frac{500}{150}\right)\left(\frac{250}{150}\right)\left(\frac{500+x}{100}\right) S$

relationship between input & output

$\Rightarrow \boxed{x = \left[\frac{L}{S}(18) - 500\right] mm}$

Machine/Tool Design

What is the force exerted on the bolt at *C*?

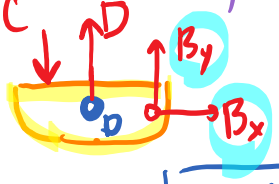


Given: P

Find: C

1.) Start w/ "given" or "find" member.

FBD

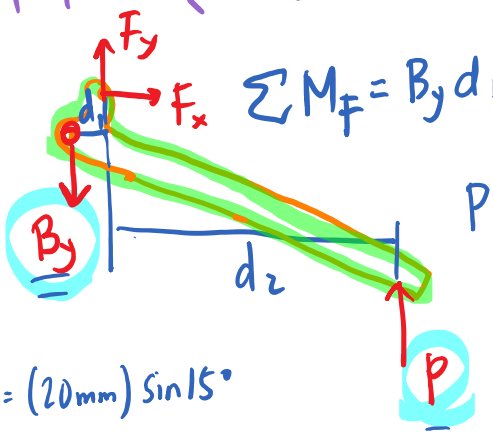


EoE $\Sigma F_x = B_x = 0$

3 $\Sigma M_D = C(30\text{mm}) + B_y(80\text{mm}) = 0$

$B_y = -\frac{3}{8}C$

2.) Next piece (BF)



$\Sigma M_F = B_y d_1 + P(d_2) = 0$

$P = -B_y\left(\frac{d_1}{d_2}\right) = -\left(\frac{-3}{8}C\right)\left(\frac{d_1}{d_2}\right)$

$d_1 = (20\text{mm})\sin 15°$

$d_2 = (400\text{mm})\cos 15° - (20\text{mm})\sin 15°$

$P = \frac{C}{196.4} \Rightarrow \frac{C}{P} = 196.4$

output / input

Mechanical Advantage

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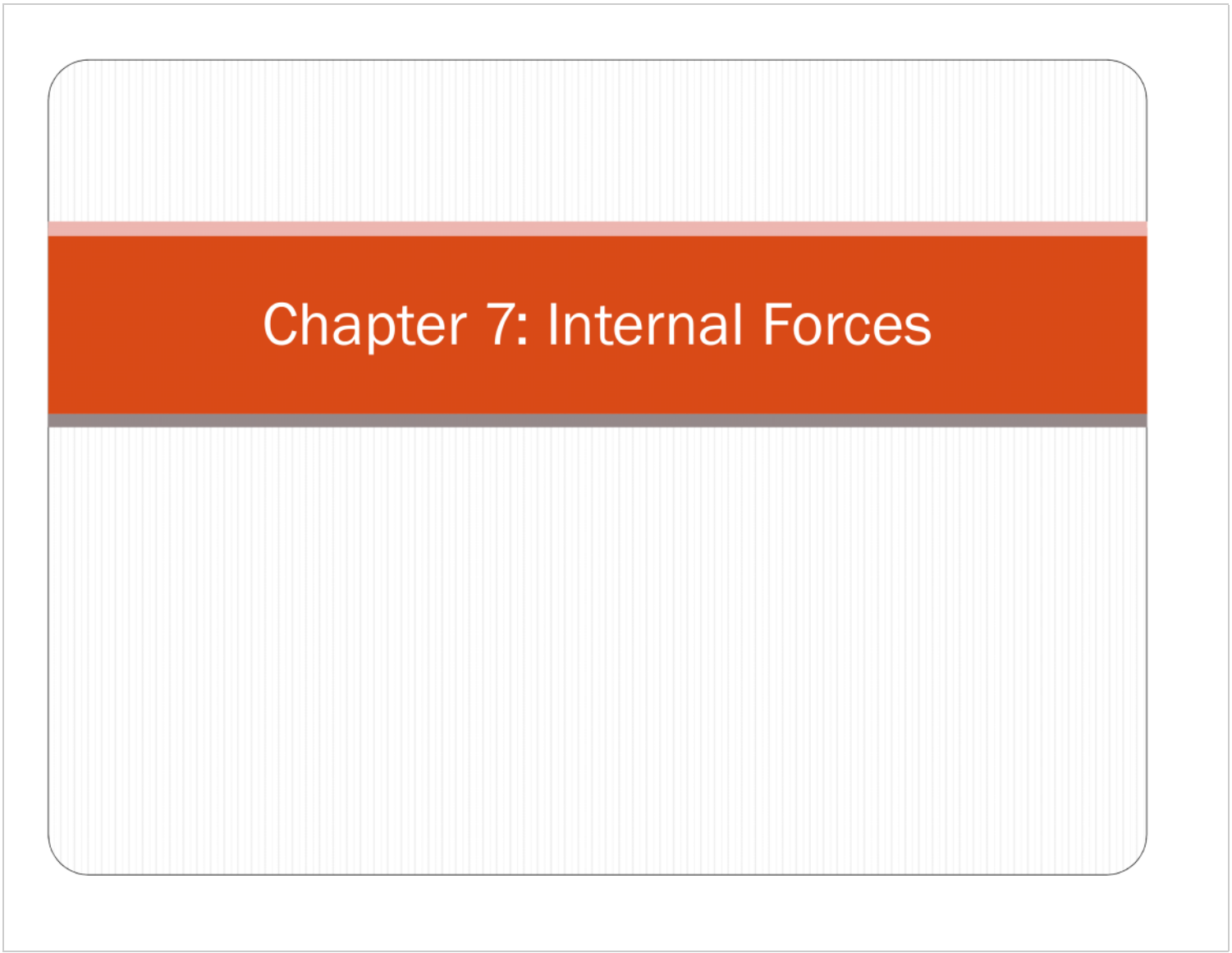

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Goals and Objectives

- Determine the internal loadings in members using the method of sections
- Generalize this procedure and formulate equations that describe the internal shear and moment throughout a member

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Internal loadings developed in structural members

Beams are structural members designed to support loads applied perpendicularly to their axes.

Beams can be used to support the span of bridges. They are often thicker at the supports than at the center of the span.

Why are the beams tapered? Internal forces are important in making such a design decision.

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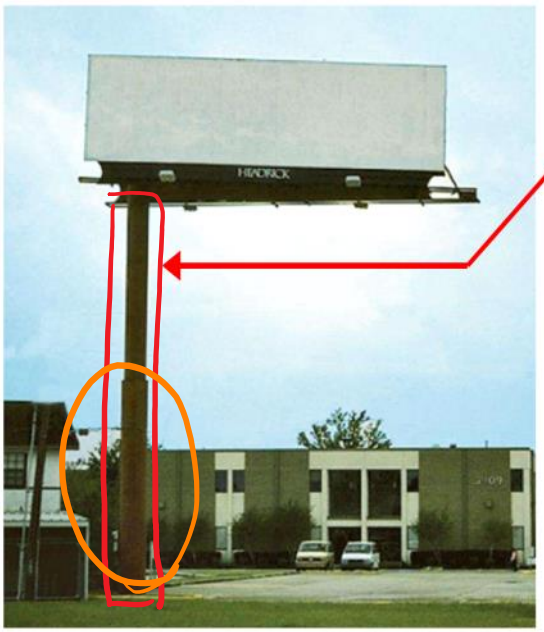
Internal loadings developed in structural members



A fixed column supports these rectangular billboards.

Usually such columns are wider/thicker at the bottom than at the top. Why?

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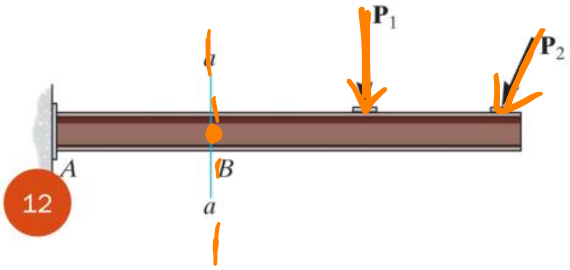
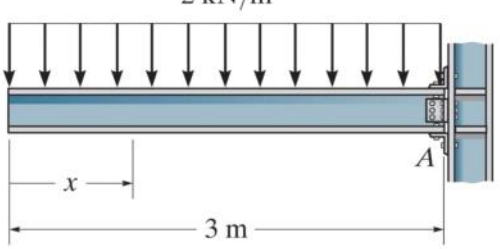
Internal loadings developed in structural members





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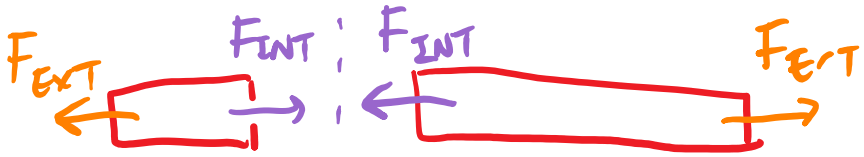
Internal loadings developed in structural members

Structural Design: need to know the loading acting within the member in order to be sure the material can resist this loading

Cutting members at internal points reveal **internal forces and moments.**

For two-force members (truss)



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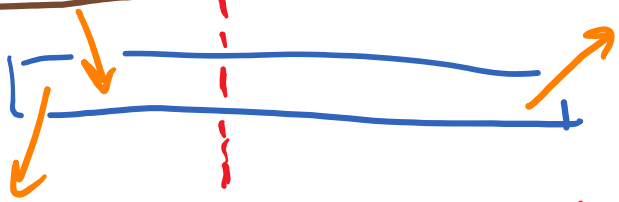
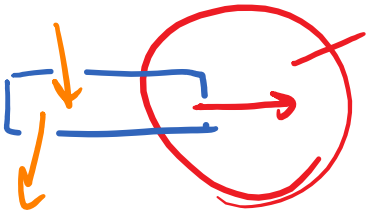
$\Sigma F_x = 0 \Rightarrow F_1 = F_x.$

What about non-two force members?





is one force adequate for achieving equilibrium for the section?