Announcements

- Quiz 3 next week – have you done your PL HW?
- Compass: additional examples > Lecture Slides.

❑ Upcoming deadlines:

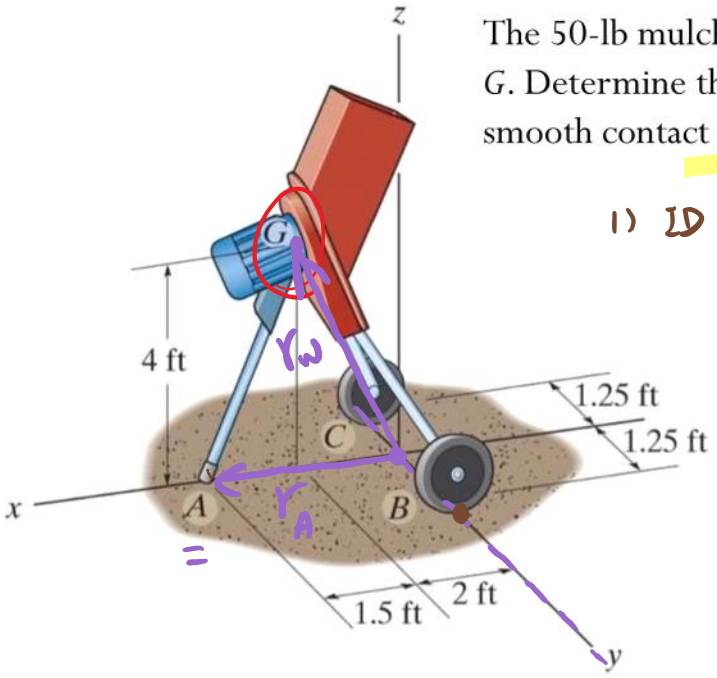
- Friday (10/5) – Today!
  - Written Assignment
- Tuesday (10/9)
  - PL HW
- Friday (10/12)
  - Written Assignment

1

Objectives

- 3D rigid body equilibrium example
- Structural analysis – Truss
  - Truss members in tension and compression
  - Method of joints

2

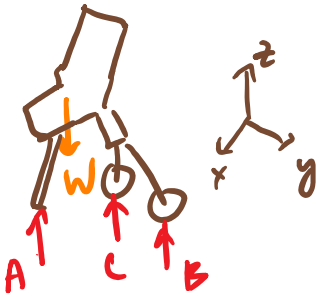


The 50-lb mulching has a center of gravity at G. Determine the vertical reactions at the smooth contact point A.

1) ID support types

A: ↑A B: ↑B C: ↑C

2.) FBD



3) EoE

$$\Sigma M_{y\text{-axis}} = (\vec{r}_A \times \vec{A})\cdot\hat{j} + (\vec{r}_W \times \vec{W})\cdot\hat{j}$$

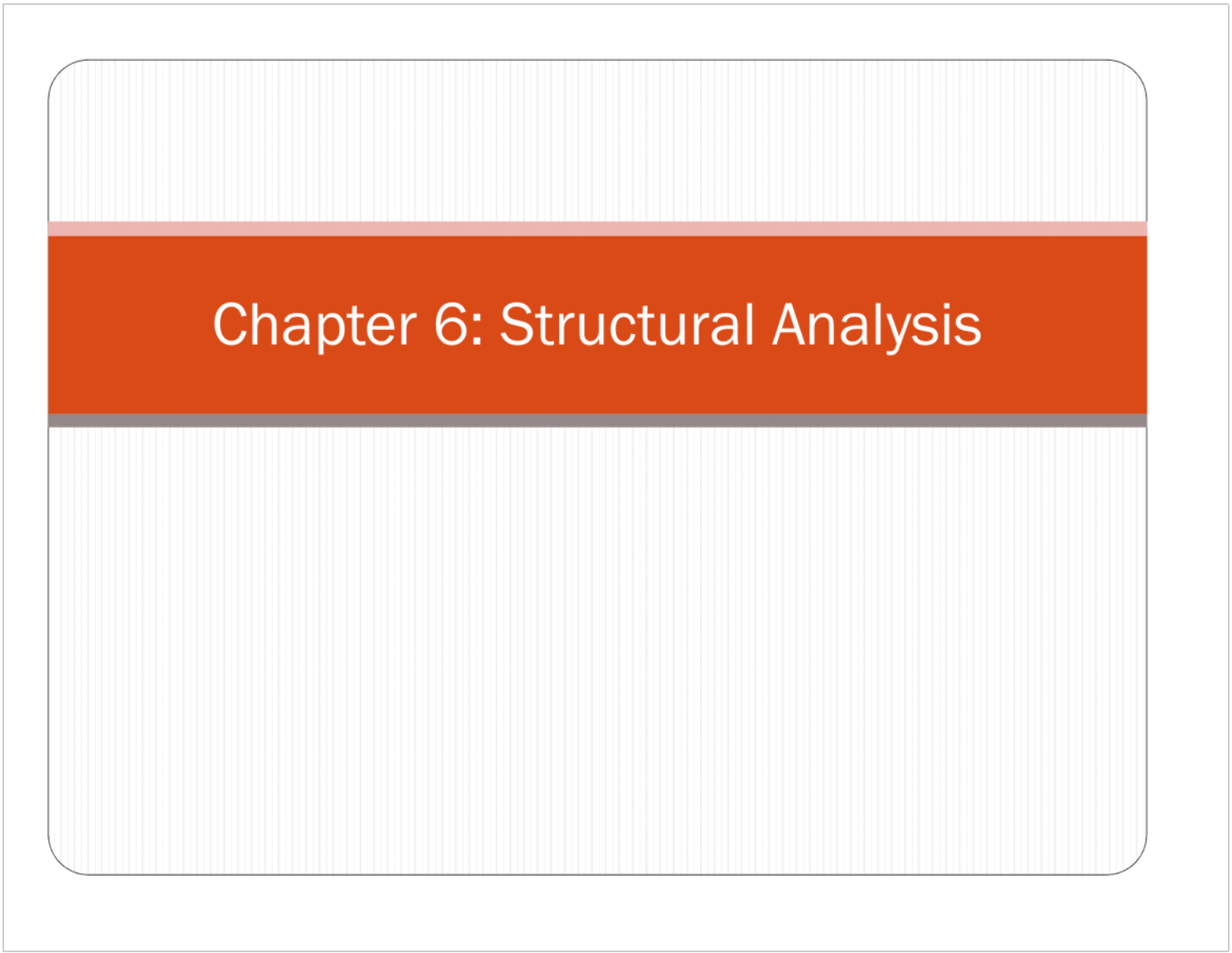
① ②

~ moment about an axis: $\hat{u}_a \cdot (\vec{r}\times\vec{F}) = M_a$

① $\begin{vmatrix} 0 & 1 & 0 \\ 3.5 & 0 & 0 \\ 0 & 0 & A \end{vmatrix} = -3.5A$

② $\begin{vmatrix} 0 & 1 & 0 \\ 2 & 0 & 4 \\ 0 & 0 & -W \end{vmatrix} = 2W$

$\Rightarrow \Sigma M_{y\text{-axis}} = -3.5A + 2W = 0 \rightarrow \boxed{A = \frac{2}{3.5}W}$


Chapter 6: Structural Analysis

Friday, October 5, 2018 11:57 AM

Goals and Objectives

- Determine the forces in members of a truss using the method of joints
- Determine zero-force members
- Determine the forces in members of a truss using the method of sections

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Simple trusses

Trusses are commonly used to support roofs.

A more challenging question is, that for a given load, how can we design the trusses' geometry to minimize cost?

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Scaffolding

An understanding of statics is critical for predicting and analyzing possible modes of failure.

Buckling of slender members in compression is always a consideration in structural analysis.

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Simple trusses

Truss:

- Structure composed of slender members joined together at end points
- Transmit loads to supports

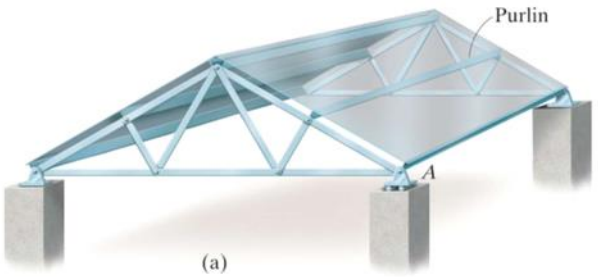
Assumption of trusses

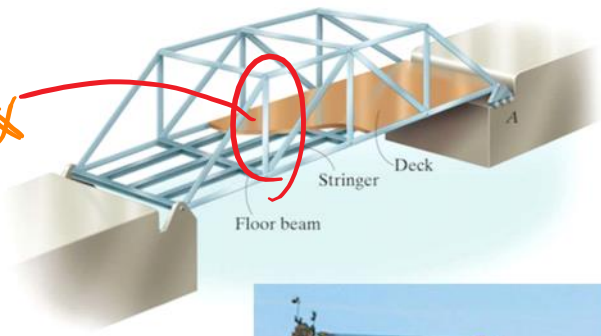
- Loading applied at joints, with negligible weight. Members joined by smooth pins

Result: all truss members are

2 Force Members

and therefore the force acting at the end of each member will be directed along the axis of the member





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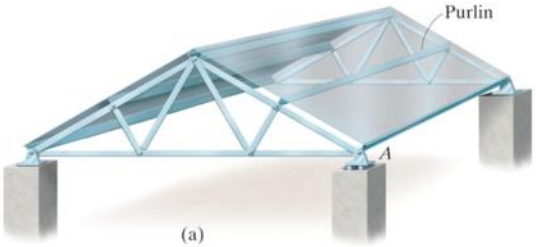
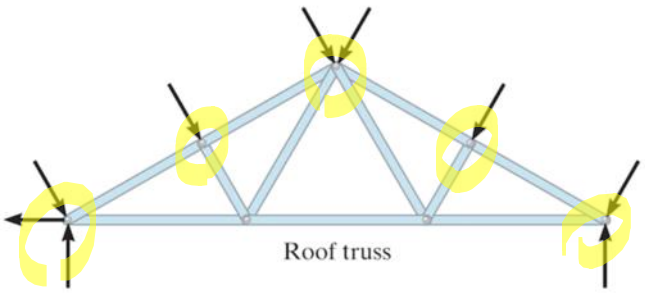
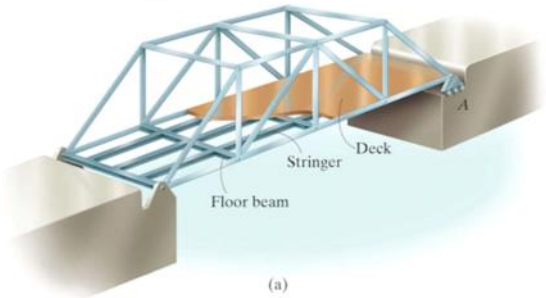
Roof trusses

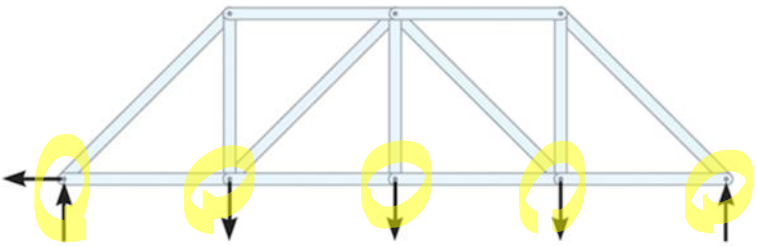




Load on roof transmitted to purlins, and from purlins to roof trusses at joints.

Bridge trusses





Load on deck transmitted to stringers, and from stringers to floor beams, and from floor beams to bridge trusses at joints.

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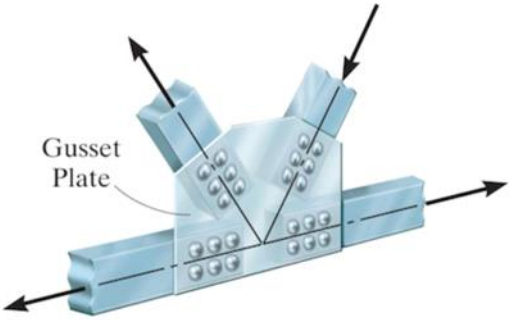
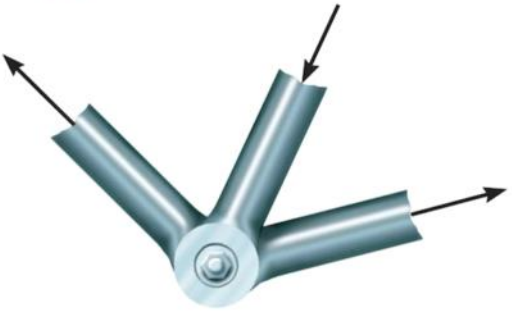
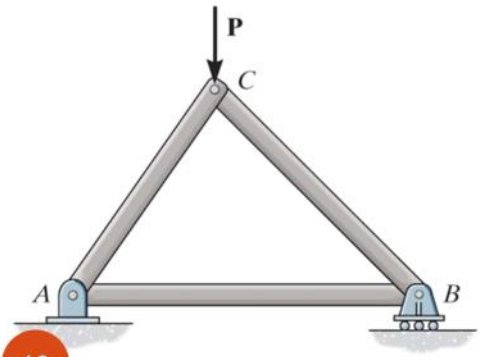
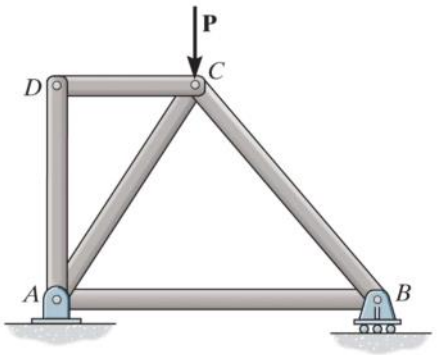
Truss joints

- Bolting or welding of the ends of the members to a gusset plates or passing a large bolt through each of the members
- Properly aligned gusset plates equivalent to pins (i.e., no moments) from coplanar, concurrent forces
- Simple trusses built from triangular members









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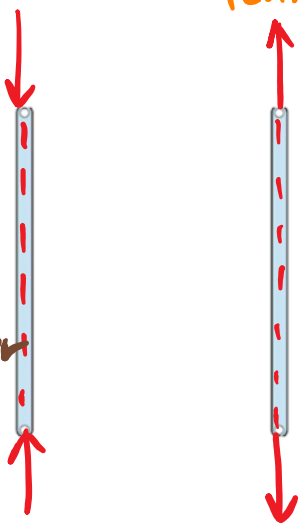
Method of joints (pins)

- Truss is in equilibrium ONLY if ALL individual pieces are in equilibrium
- Truss members are two-force members: equilibrium satisfied by equal, opposite, collinear forces

Compression (C)

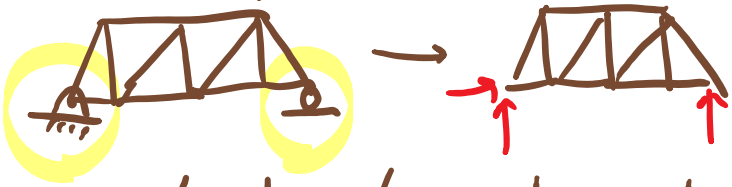
Tension (T)



- Can only be in T or C
- Use pins to determine whether a member is in T or C.

Procedure for analysis:

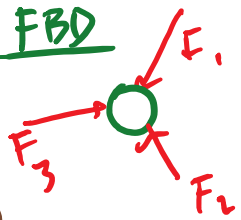
1) ID truss support.



2.) ID pins/joints w/ 2 or less unknowns.

3.) Draw FBD for the pin/joint from (2)

FBD



4.) Write EoE for the pin to find forces on members.

$\Sigma F_x = 0$ $\Sigma F_y = 0$ only.

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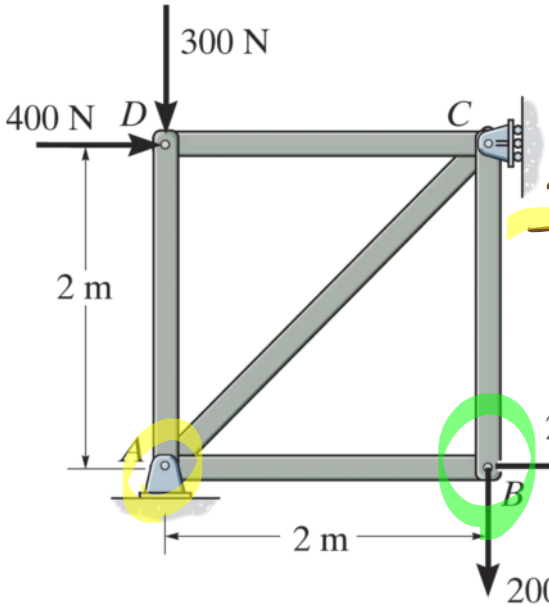

Identify the number of force components acting on pins A and B.

Pin A

F_{AD}

assume tension, until proven otherwise by EoE

F_{AC}

A_x

A

F_{AB} (Tension)

A B

A_y

equal & opposite.

Pin B

assume T

F_{BC} =

F_{BA} =

B

250 N

200 N

Good point to start (only 2 unknowns)

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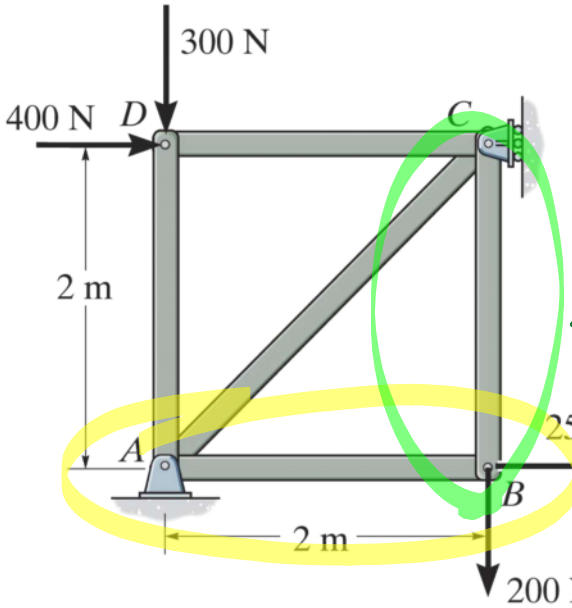
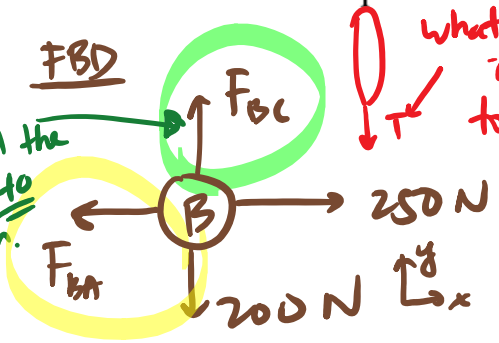


Determine whether members *AB* and *BC* are in tension or compression.

FBD

force FROM the truss to pin.



what the pin is doing to the truss member.

EoE

$\Sigma F_y = F_{BC} - 200N = 0$

$F_{BC} = 200\,N\ (T)$

$\Sigma F_x = 250N - F_{BA} = 0$

$\rightarrow F_{BA} = +250\,N\ (T)$

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