Class Today

• Print notes and examples
• 2D Rigid Body Equilibrium
  – Working with 2D rigid bodies
  – Summing forces and moments
  – Two & three force members
• Example Problems
• Group Work Time
A preliminary review: working with forces and moments

- **Forces** cause potential translation.
- **Moments** cause potential rotation.
- We can **sum multiple forces** and obtain a **single resultant force**.
- We can **sum multiple couple moments** and obtain a **resultant moment**.
- We have evaluated **equilibrium at a point**. ($\Sigma F = 0$)
Working with Static Equilibrium

RIGID BODY: tendency for **translation** and **rotation**.

POINT: tendency for **translation** only.
Equilibrium Considerations

- The sum of all external forces acting on the system is equal to ZERO.

- The sum of moments created by forces and couples on the system is equal to ZERO.

- Consider ACTIVE forces and moments.

- Consider REACTIVE forces and moments.
Working with 2D Rigid Bodies

• Instead of *point* in space, evaluate an *object* for static equilibrium.

• 2D evaluation uses *scalar analysis*.

• Object must have *supports* on which to rest. These will *product force / moment reactions* on the object. (pg. 202-203)

• **ALWAYS DRAW** Free Body Diagrams!
Equilibrium Equations

\[ \Sigma F_x = 0 \]
\[ \Sigma F_y = 0 \]
\[ \Sigma M_{\text{point}} = 0 \]

How many unknowns can there be in a solvable system of equations?
Free Body Diagrams

analyze as pin support
Free Body Diagrams

analyze as fixed support
Two-force Members

• Force is applied at only TWO points. (thus, the weight of the member is neglected)

• **Forces realized at the ends are:**
  – equal in magnitude & opposite in direction
  – colinear (directed along the line connecting the two end points)
Two-force Members

• Identifying these greatly simplifies problem solving because …
  ✓ Direction of resultant is known
  ✓ Only need to solve for the magnitude of the resultant

• Examples of two-force members:
Three-force Members

• Member is subjected to **NO more than three forces**.
• To establish equilibrium, the **forces applied must be:**
  – parallel or
  – concurrent (directed toward a single point)
Summary of Two Dimensional Equilibrium

- $\Sigma F = 0 ; \Sigma M_{\text{point}} = 0$

- When evaluating:
  - Consider **ACTIVE** forces and moments acting externally on the body.
  - Consider **REACTIVE** forces and moments from external supports.

- Use scalar analysis

- When applying equations of equilibrium, you can sum moments about more than one point.

- Drawing free-body diagrams
  - Establish coordinate system
  - Sketch the body or section being evaluated
  - Show all active / reactive forces, moments acting on the body
  - Label forces, moments
  - Sketch dimensions on free-body diagram