Pinned Frames and Arches

- A FRAME is made up of members where at least one member has more than 3 forces on it
  - Usually stationary and fully constrained

- A PINNED FRAME has member connected by pins
  - Considered non-rigid if it would collapse when the supports are removed
  - Considered rigid if it retains its original shape when the supports are removed

- A RIGID FRAME is all one member with no internal pins
  - Typically statically indeterminate
  - Portal frames look like door frames
  - Gable frames have a peak.

- INTERNAL PIN CONNECTIONS:
  - Pin connection forces are equal and opposite between the bodies they connect.
  - There are 2 unknown forces at a pin, but if we know a body is a two-force body, the direction of the resultant force is known.
- AN ARCH is a structural shape that can span large distances and sees compression along its slope. It may have no hinges (or pins), two hinges at the supports, or two hinges at the supports with a hinge at the apex. The three-hinged arch types are statically determinate with 2 bodies and 6 unknown forces.

Solution Procedure

1. Solve for the support forces on the entire frame (FBD) if possible.
2. Draw a FBD of each member:
   - Consider all two-force bodies first.
   - Pins are integral with members
   - Pins with applied forces should belong to members with greater than two forces
     [Same if pins connect 3 or more members]
   - Draw forces on either side of a pin equal and opposite with arbitrary direction chosen for the first side
   - Consider all multi-force bodies
   - Represent connection forces not known by x & y components
   - There are still three equilibrium equations available, but the moment equations may be more helpful when the number of unknowns is greater than two.
Example 1 (pg 114)
Example Problem 4.12

A pinned frame with a fixed base at A supports a load at the overhang equal to 500 pounds, as shown in Figure 4.68. Draw the body diagrams and solve for the support reactions and the reactions at B, C, and E.
Example 2 (pg 115)
Example 4.13 (Three-Hinged Arch)

An industrial building is framed using tapered steel sections (haunches) and connected with three hinges (Figure 4.70). Assuming that the loads shown are from gravity loads and wind, determine the support reactions at A and D and the pin reactions at B.