In this class, trusses are assumed to be an assemblage of axial-force members. This is true only if:

1) the member ends are pinned, i.e. no bending moments are transmitted from one member to another at any of the joints, and
2) loads are applied only at the joints.

Structures that do not meet the above two conditions must be analyzed using other procedures.

Each bar force calculation depends on earlier calculations of reactions and of other bar forces. An error made early in the calculations can affect many or all of the subsequent calculations. The following “extra” steps are recommended:

• Perform a preliminary analysis of the truss to identify zero-force members, members in tension or compression, and relative magnitudes of similar members
• Quickly check each calculated result for reasonableness.
• Perform a final check
  o On the reactions using an equilibrium equation not used previously, and
  o On the bar forces by using a joint not used previously

1. **Determine if truss is stable and determinate**  Structures can generally be classified as one of the following:
   a) Unstable,
   b) Stable and determinate, or
   c) (stable and) indeterminate

We will only calculate “by hand” the bar forces of trusses that are stable and determinate for this course.

2. **Perform a preliminary analysis.**

2.1 **Identify zero-force members.** The easiest check to perform is to identify zero-force members, so do this first. Some members of a truss may have no force *for a particular loading*. For example, Member 4 in the loaded truss in Figure 1a has “zero” force. Summing vertical forces for the free-body diagram of Joint 2 (see Figure 1b) will show that $f_4 = 0$. 
### Procedure for Calculating Truss Bar Forces

#### 2.2. Identify chords in tension and chords in compression

A truss loaded transversely to its long axis (see Figure 2 for examples) can be visualized as a beam. The deflected shape of the analogous beam is sketched. Outer “fibers” that are lengthened are identified as in tension (+ve for this class), and outer fibers that are shortened are identified as in compression (-ve for this class). The outer members of the truss perpendicular to the load are called “chords”. Chords in compression correspond to beam outer fibers in compression, and chords in tension correspond to beam outer fibers in tension.

#### 2.3. Estimate location of max chord forces, and location of max diagonal forces

Also, long slender trusses such as parallel-chord trusses behave similar to beams and we can apply our knowledge of bending moment distributions (typically resisted by the chords of a truss) and shear force distributions (typically resisted by the diagonals of a truss) to determine the relative bar-force magnitudes of these types of members (see Figure 3).
Figure 2. Identifying truss chords in compression/tension by thinking of truss as a beam.
3. **Calculate the reactions** at each support using equilibrium equations. Check the reactions using an equilibrium equation not used to calculate the reactions.

4. **Calculate the bar forces** using either the Method of Joints or the Method of Sections. Generally, Method of Joints for a joint with only one unknown bar force component in either the X or the Y direction involves the simplest calculations. Joints with two unknown components can be analyzed, but this involves solving two simultaneous equations. The key to calculating a bar force using the Method of Sections is selecting a sub-assemblage of the truss for which summation of moments about a point yields an equation with only one unknown bar force.

5. **Check your calculations** by summing forces at a joint not used in previous calculations. (This is similar to checking if a land survey “closes”.)