Objectives
- Give a feeling for some of the basic concepts of trusses
- Provide some practice in analysis of a simple truss

Summary: We’re now going to apply the concepts of equilibrium to some very basic structural systems. We will begin by looking at trusses, where it is assumed that all members are joined by pins and the weights of the members are negligible compared to the loads (forces) applied at the pins. Since we assume “smooth pins,” the joints transmit only forces and no moments. The first technique usually introduced in analyzing trusses is called the method of joints, which utilizes a separate FBD for each pin and noting that the sum of forces from the truss members acting on the pin must be zero. We also may use the method of sections where a section of the truss is analyzed.

Procedure

**Task 1.**

a) Put together 3 equal-length members to form a triangle using the bolts and nuts to form pin joints. On the top pin joint apply a force straight downward, off to each side (in the plane of the triangle), and straight up. Have a team member hold the triangle in place and tell you what forces he/she feels for each situation. Does this simple truss change shape or size?

b) Put together 4 equal-length members to make a square. Apply a force to one of the pins in the top corners, run the same tests, and again have your partner tell you what he/she feels. Note how the length of the diagonal changes for various orientations of the force.

c) Add a 5th longer member (diagonally) to the square, and run the tests again, again noting the forces to hold the truss in place.

d) Remove the diagonal 5th member to get back to the square, and add one piece of string diagonally across the square. Notice how this changes its response from part (c).

e) Add a second piece of string across the other diagonal, and record how the truss responds.

f) If time permits, make a truss using 5 equal-length members (i.e., a pentagon), and see how it responds to the applied forces. Then make the pentagon stable by using string and/or wood members.

**Analysis**

a) Why is the square with the solid diagonal member stable in all directions while the square with the single diagonal string is not?

b) Why is the square with the two diagonal strings stable?

**Task 2.** We have built a truss, with 3 of its members (AB, BD, and CD) able to register both tension
and compression forces (see figure on the next page). Note by clamping AD to a “fixed” support, we have in effect prevented the pins at A and D from moving in any direction.

a) Examine the spring scales used to measure tension and compression, and figure out how they work.

b) Record preliminary (at rest) readings from each of the scales before you load the truss.

c) Apply a vertical load of approximately 4 N to the pin at B, first downward and then upward, and record the readings on the spring scales. Before you do either, go through and try to figure out which of the members you think will be in tension, which will be in compression, and which will encounter no loads at all (zero force members).

d) Repeat step (c), but this time apply the 4 N force at pin C, first downward and then upward.

e) Compare your measured results to those you obtain by performing calculations using the method of joints and/or using the method of sections.

Analysis

a) In step (c), how would your results change if members BC and CD were removed, effectively creating a triangular truss ABD?

b) When the load is applied to joint C (step d), member BC simply acts to transmit the force to the pin at joint B. Thus, could member AB be omitted for step (d)? Could member CD be omitted?