1 - Materials & Suppliers

Robots, of course, are made of a collection of parts, each connected to the rest in a specific way in order to perform a function. Generally speaking, these parts can be divided into ones which we purchase from suppliers and ones which we make ourselves. But, those ones that we make in-house must be made out of some raw material, so ultimately everything comes from a supplier. This section covers the several suppliers which we typically use and the parts and materials which are available from them.

1.1 – Stock Materials

By far, the most common material in FRC robots is aluminum. It has a good strength-to-weight ratio, is easy to machine, and is available in a multitude of stock sizes and shapes. Plastic, in all its various types, is also very common and is perhaps the most flexible material in terms of possible applications. Finally, steel is also used occasionally, but it is often too heavy to be useful.

Materials come in the form of stock, the large, simple pieces from which robot parts are made. For both plastic and aluminum, stock is usually in the shape of a long tube, rod, or bar, or a flat sheet.

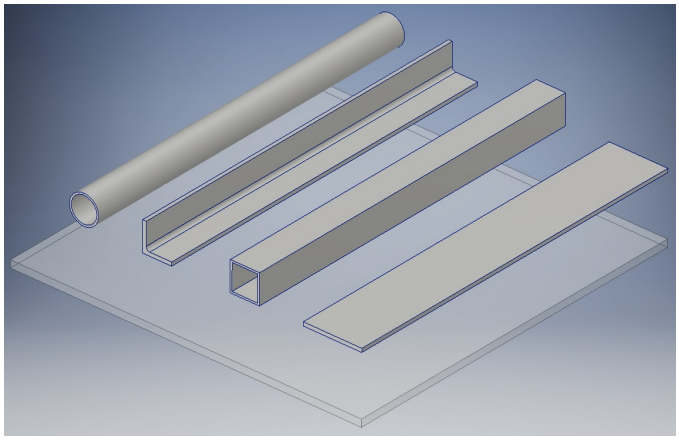
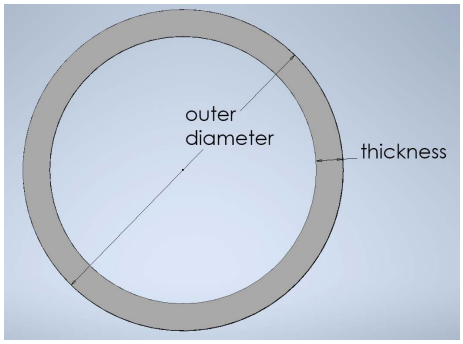
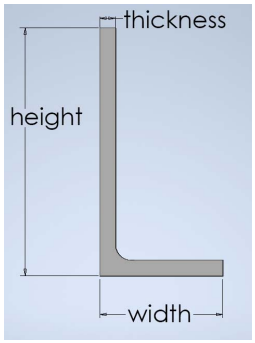
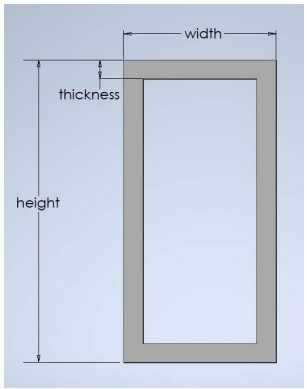
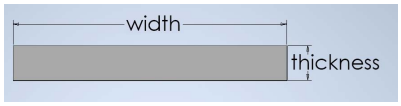


Figure 1: CAD models of several stock shapes: aluminum round tube, angle, square tube, and flat bar; and polycarbonate sheet

The type of stock is specified by the shape, a few critical dimensions, and the material. For example, you might hear someone talk about "one by two aluminum tube with an eight-inch wall" to describe aluminum rectangular tube stock with a width of 1", a height of 2", and a wall thickness of 0.125". These dimensions, furthermore, are available in standard sizes, often increments of sixteenths of an inch for thicknesses and

halves of an inch for heights and widths. Table 1 lists the descriptions and a few standard sizes for the most common stock options.

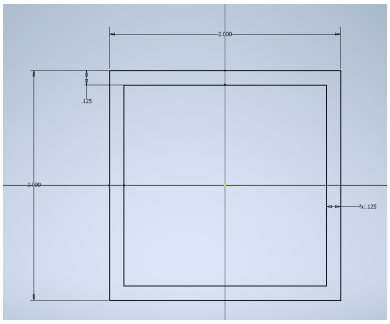
Table 1: Common stock types and sizes

Stock Type	Image	Naming Convention	Common Sizes
Round Tube		[outer diameter] x [thickness]	0.375" x 0.035" 0.5" x 0.049" 1" x 0.063" 1.5" x 0.125"
Angle		[height] x [width] x [thickness]	0.75" x 0.75" x 0.063" 1" x 1" x 0.063" 1.5" x 1.5" x 0.125" 2" x 1" x 0.125"
Rectangular Tube		[height] x [width] x [thickness]	1" x 1" x 0.063" 1" x 1" x 0.125" 2" x 1" x 0.063" 2" x 1" x 0.125" 2" x 2" x 0.125
Flat Bar		[width] x [thickness]	1" x 0.063" 1.5" x 0.125" 2" x 0.125" 3" x 0.125"

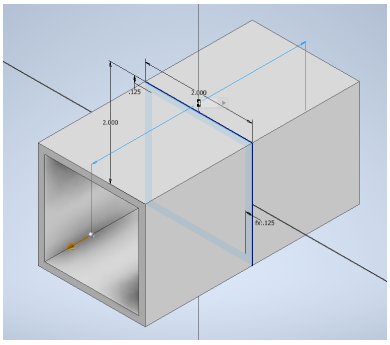
1.2 - Modelling Parts from Stock in Inventor

The fact that all parts start as stock material makes it rather easy to have a consistent starting point for all parts. The best way to model parts is the way that best matches their actual features. So, if a part is made from angle stock, you should start your CAD model as an extrusion of an L-shaped sketch. As you will learn soon, this roughly mirrors the actual manufacturing process of these parts as well. Additionally, using consistent modelling techniques makes it easier for you and your teammates to collaborate by editing each other's designs.

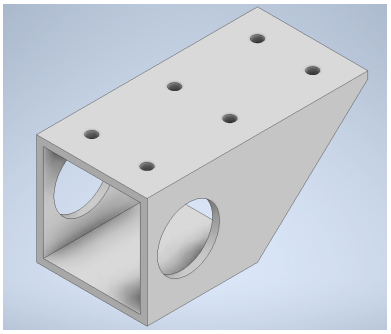
For parts made from extruded tubes and angles, begin with a sketch on the front (XY) plane that matches the profile of the extrusion, using the dimensions shown in Table 1. Many of these profiles are already available as templates in Common Parts. Then, extrude the sketch to the desired length, and finally add any other features, such as holes or cutouts.



Step 1: Sketch the profile of the stock on the XY plane.



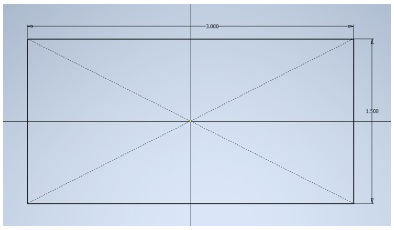
Step 2: Extrude the sketch to the desired length.



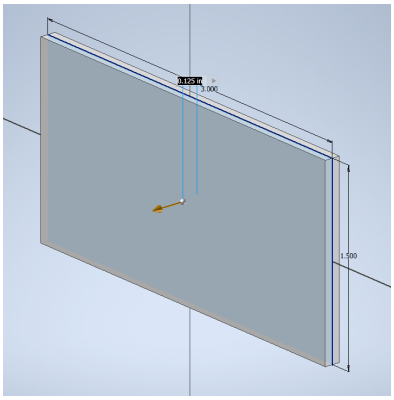
Step 3: Add any other necessary features.

Figure 2: Steps to model a part made from rectangular tube stock

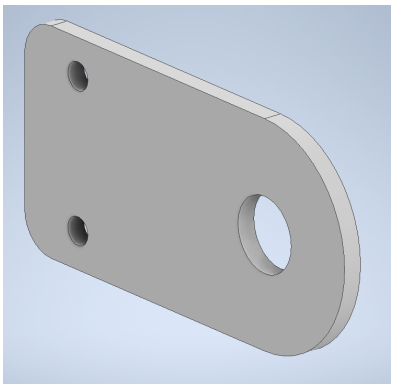
For parts made from flat bar or sheet stock, it is typically better to create a sketch showing the profile of the part itself, not the stock, on the front plane. Then, extrude that sketch to the thickness of the bar or sheet stock, and add any other features last.



Step 1: Sketch the profile of the part on the XY plane.



Step 2: Extrude the sketch to the thickness of the stock.



Step 3: Add any other necessary features.

Figure 3: Steps to model a part made from flat bar stock

Design Challenge 1: Stock Materials

Based on the following descriptions of simple parts, model the parts in Inventor using the methods described in Section 1.2. In addition, remember to set the appropriate material. These descriptions are similar to how you will likely hear teammates describe parts.

1. A 24"-long 1" by 2" aluminum tube with 1/16" wall
2. A 4"-long piece of 1.5" round aluminum tube with 1/8" thickness
3. A 12" by 10.25" piece of 0.05"-thick polycarbonate
4. An 8"-long 3/4" by 1/16" angle beam