

## 06: Working with Assemblies

### Assemblies

Fusion 360 supports several ways of designing assemblies. This module takes a look at a few common workflows.

### Joints

Joints control the position and motion between components. Joints are similar to assembly constraints in traditional parametric modelers in that they both are used to control the position of components in an assembly. Joints are different because they indicate the allowable motion between components. Assembly constraints remove degrees of freedom instead of allowing motion.

Fusion 360 has two types of joint commands. Use the As-built Joint command when components are already in position and you need to join them. As-built Joint is often used with top-down design. Use the Joint command when components are out of position. Joint is typically used with distributed designs.

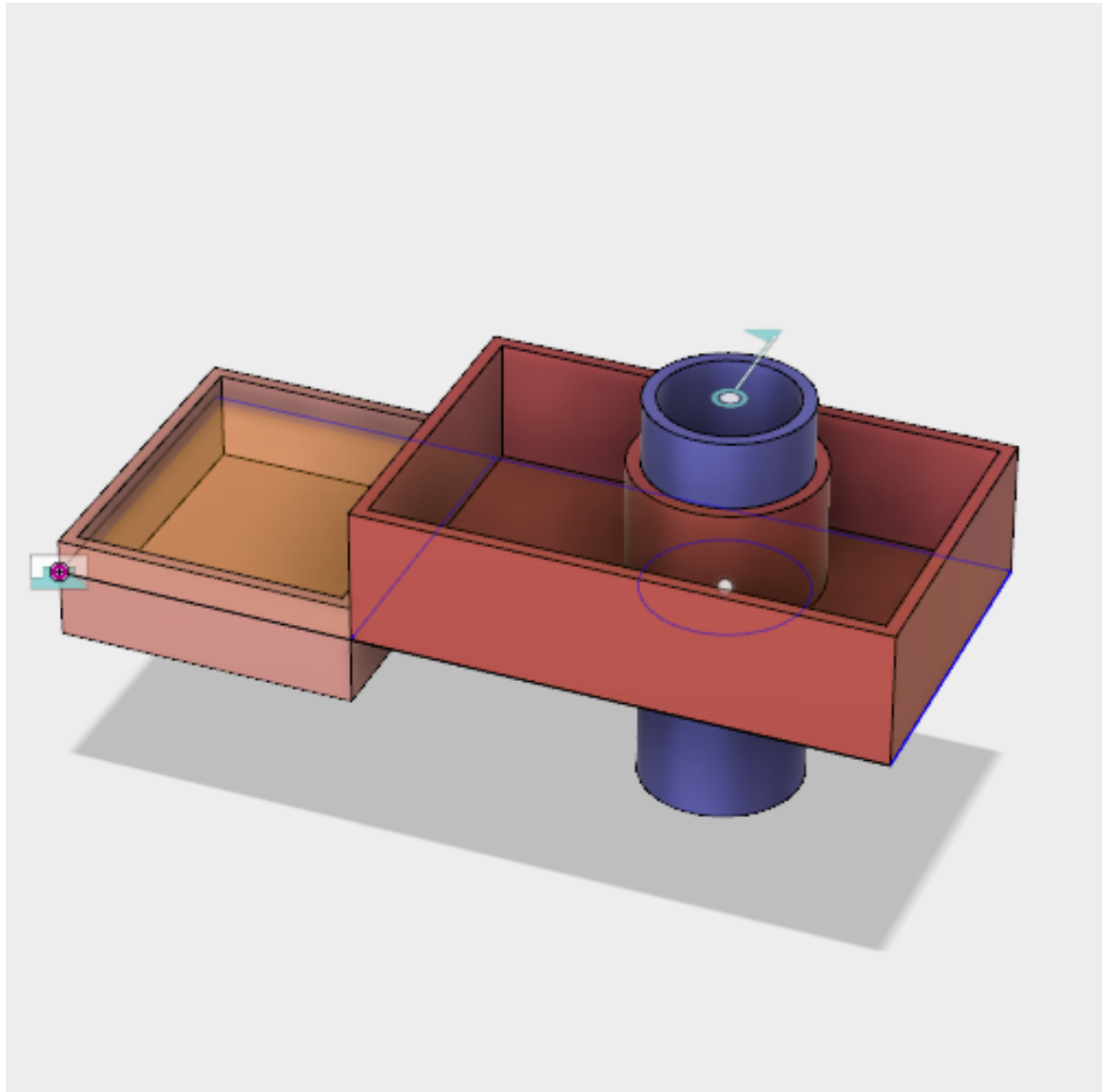
### Top-down design

Top-down design is a design method where you create your components in the same assembly design. Top-down design makes it easy to create and manage relationships between parts.

### Distributed design

Distributed design or bottom-up modeling is a design method where components are created individually then added to an assembly. Using distributed design allows you to reuse components and maintain the relationship back to the original component. Use distributed design when you use the same part in multiple assembly designs.

## Lesson 1: Top-down Design



### Learning Objectives

1. Create components in an assembly.
2. Modify components using the driving sketch.
3. Use as-built joints to position the components.

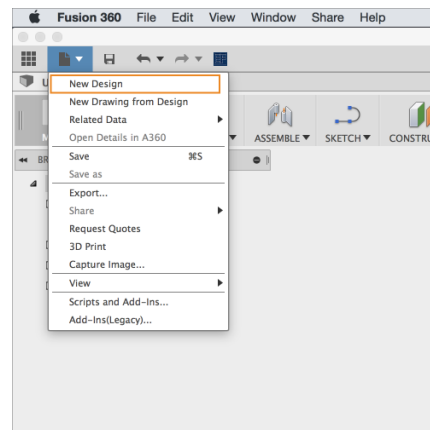
### Datasets

This lesson uses a new design for the exercise.

## Step-by-step Guides

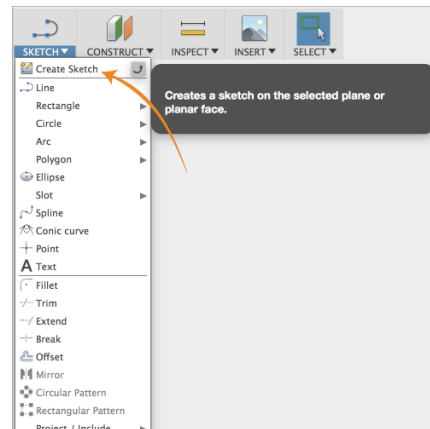
**Step 1:** Let's start with creating a new design. We are going to create an assembly in this design.

1. Launch Fusion 360.
2. Click **File > New Design** to start a new design.



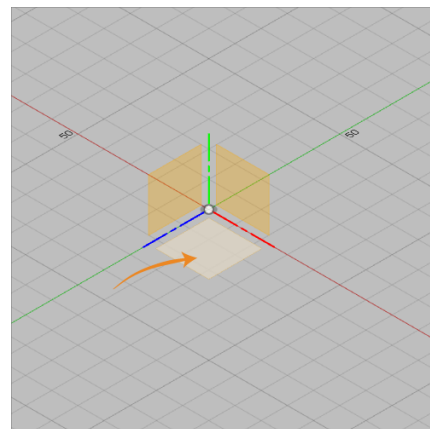
**Step 2:** Start the Create Sketch command.

1. Select **Model > Sketch > Create Sketch**.



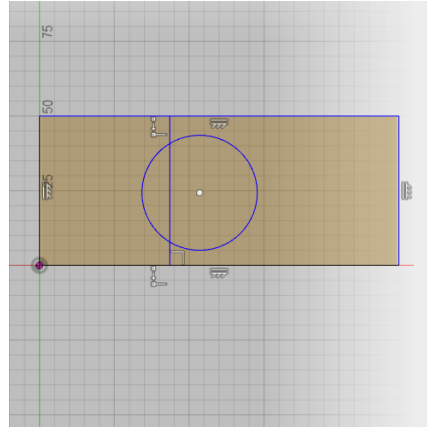
**Step 3:** Select the sketch plane.

1. You are prompted to select the plane you want to sketch on.
2. Select the bottom plane (XZ) plane.



**Step 4:** Create sketch curves.

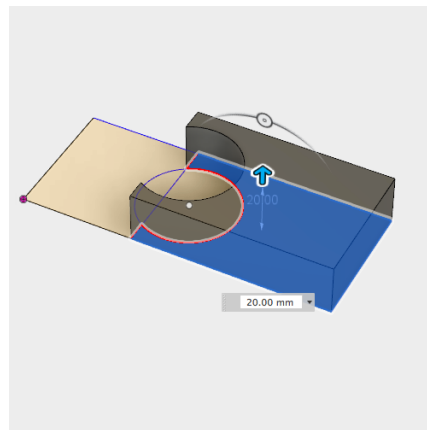
1. Draw a rectangle that starts at the origin and is **50 mm x 120 mm**.
2. Draw a vertical line that is approximately **50 mm** from the left edge of the rectangle.
3. Draw a circle with a center point near the vertical line and a diameter approximately **40 mm**.
4. Click **Stop Sketch**.



**Step 5:** Create the first component.

1. Click **Modify > Press Pull**.
2. Select the sketch profile on the right.
3. Enter **20 mm** for the Distance.
4. Select **New Component** for the Operation.

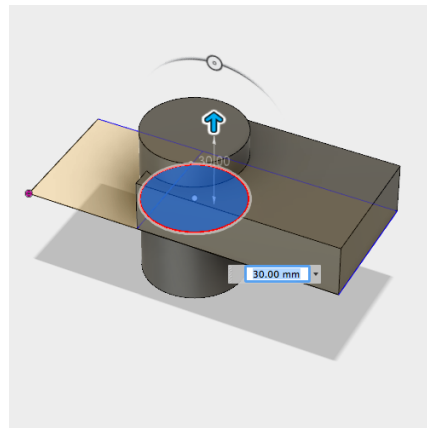
NOTE: Notice that a new component is added to the browser.



**Step 6:** Create a cylinder component.

1. Expand the Sketches node in the browser then click the light bulb next to Sketch1 to turn on the visibility.
2. Click **Modify > Press Pull**.
3. Select the two sketch profiles that make a circle.
4. Set the Direction to **Symmetric**.
5. Enter **30 mm** for the Distance.
6. Select **New Component** for the Operation.
7. Click **OK**.
8. Click **Inspect > Component Color Cycling Toggle**.

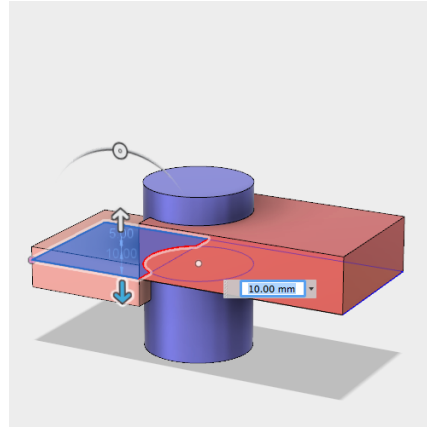
Note: Another component is added to the browser and you should see the two components displayed as different colors.



**Step 7:** Create the last component.

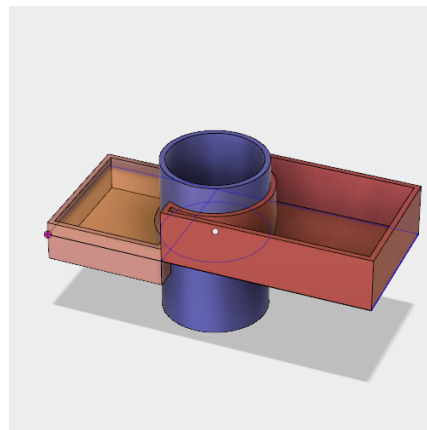
1. Click **Modify > Press Pull**.
2. Select the sketch profile on the left.
3. Set the Direction to **Two Side**.
4. Enter **5 mm** for the first Distance.
5. Enter **10 mm** for the second Distance.
6. Select **New Component** for the Operation.

Note: You now have three components in the browser.



**Step 8:** Shell the components.

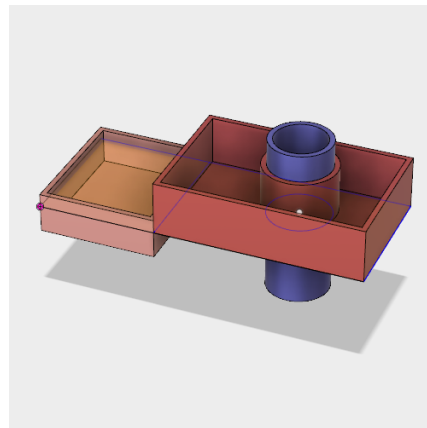
1. Click **Modify > Shell**.
2. Select the top face of the component on the left.
3. Hold ctrl (Windows) or command (Mac) then select the top faces of the other two components.
4. Enter **2 mm** for the Thickness.



**Step 9:** Modify the sketch to update the components.

1. Drag the edge of the sketch circle to change the diameter. Once you release the mouse button the components adjust to the change.
2. Drag the center point of the circle. Once you release the mouse button the components update again.

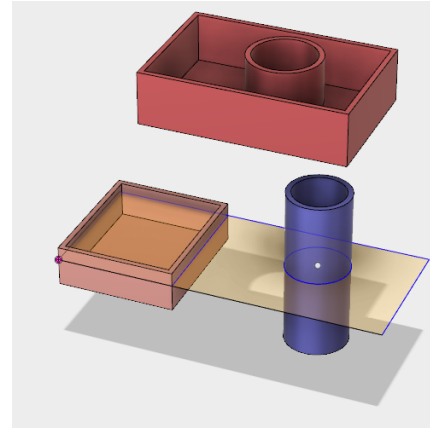
Note: The components update with sketch changes because all three components were created from the same sketch. This is top-down design.



**Step 10:** Move components.

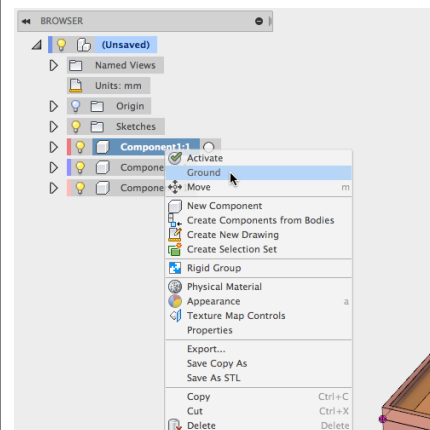
1. Drag the box on the right to move it. Notice a Position panel is displayed at the end of the toolbar.
2. Click **Position > Revert** to move the box back.

Note: All three objects are free to move because they are individual components.



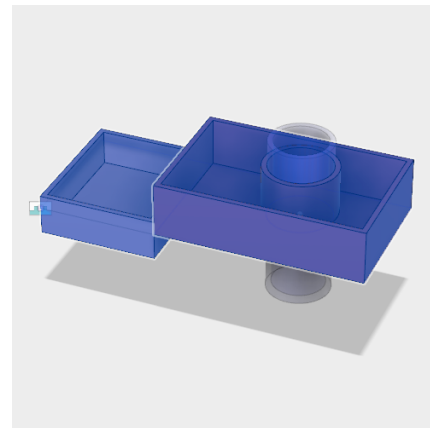
**Step 11:** Fix the first component in space.

1. In the Browser, right-click on Component1 then click **Ground**.
2. In the canvas, click and drag the box on the right (Component1). Now it cannot move because it is grounded.



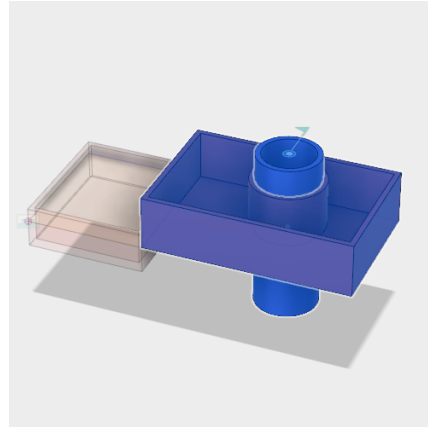
**Step 12:** Use joints to control the position the other box.

1. Click **Assemble > As-built Joint**.
2. Set the Type to **Rigid**.
3. Select the two boxes.
4. Click **OK**.
5. Click and drag the box on the left. It cannot move because it is rigidly joined to the other box.



**Step 13:** Use joints to control the position of the cylinder.

1. Click **Assemble > As-build Joint**.
2. Set the type to **Revolute**.
3. Select the cylinder and the box on the right.
4. Select the top edge of the cylinder for the Position.
5. Click **OK**.
6. Click and drag the cylinder. Notice the symbol rotates indicating that the cylinder can move.



## Lesson 2: Create Joints



### Learning Objectives

1. Create basic animations
2. Introduction to the animation timeline

### Datasets

In the Samples section of your Data Panel, browse to:

Basic Training > 06 - Assemblies > **06\_tripod**

Open the design and follow the step-by-step guide below to get started with the lesson.



## Step-by-step Guides

**Step 1:** Move components to test degrees of freedom.

1. Drag some of the components to see that they are free to move. A Position panel is displayed in the in toolbar after you drag components. You can use **Snapshot** to keep the position or **Revert** to put the components back.
2. Click **Position > Revert** to return the components to their original position.

**Note:** This design was created in another CAD system and uploaded to Fusion. All the geometry is imported in position but there are no joints to keep them in position.



**Step 2:** Move components to see components behind them.

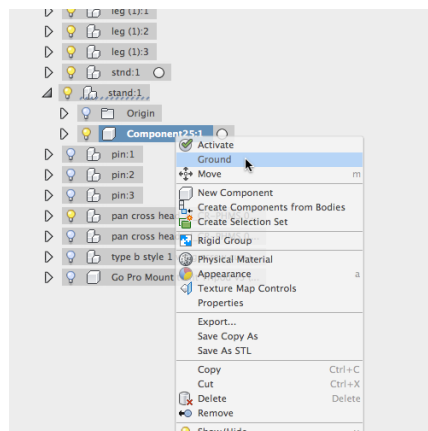
1. Drag the red stand and grey camera mount to the side.
2. Click **Position > Snapshot** to maintain this position.



**Step 3:** Lock the stand bracket in position.

1. In the Browser, expand **stand**.
2. Right-click on **Component25** then select **Ground**.

**Note:** Grounding a component locks it in the current position. Typically you will ground at least one component in an assembly.



**Step 4:** Add a joint to the cylindrical legs.

1. Click **Assemble > As-built Joint**. Make sure it is the “As-built Joint” command and not the “Joint” command.
2. Change the Type to **Slider**.
3. Select the two cylinders that make up one of the legs.
4. For the Position, select the lower circular edge of the white cylinder. You will see a preview of the motion set up by the joint.

**Note:** The legs are three instances of the same subassembly. Applying a joint to one instance adds that joint to all three instances.



**Step 5:** Add a joint to the bottom end cap.

1. Click **Assemble > As-built Joint**.
2. Change the Type to **Rigid**.
3. Select one of the bottom end caps and the grey leg attached to it.

**Note:** The end cap is also part of the leg subassembly so applying a joint to one end cap adds the same rigid joint to all three end caps.



**Step 6:** Add a joint to the top end cap.

1. Click **Assemble > As-built Joint**.
2. Select one of the top end caps and the white cylinder attached to it.



**Step 7:** Add a joint to the leg connector.

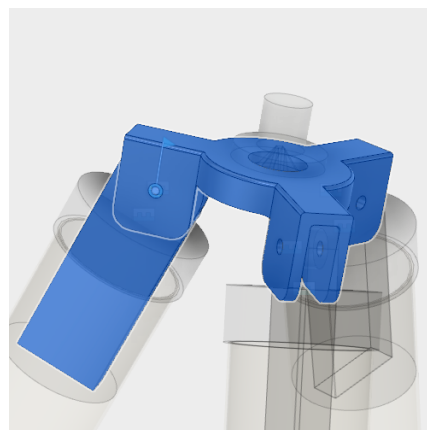
1. Click **Assemble > As-built Joint**.
2. Select one of the top end caps and the connector attached to it. The connector is the tombstone shaped component that connects the legs to the stand bracket.



**Step 8:** Add joints to connect the legs to the bracket.

1. Click **Assemble > As-built Joint**.
2. Change the Type to **Revolute**.
3. Select the connector you used in the previous joint and the bracket attached to it.
4. For the Position, select the edge of the hole in the bracket.

**Note:** This is a joint between one of the leg subassemblies and a component in the main assembly so it is only applied to the selected subassembly. Next we'll repeat this process to join the other two legs.



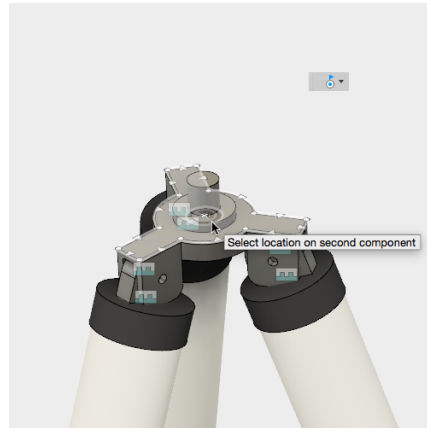
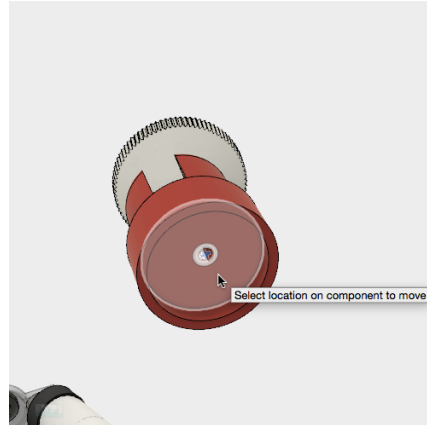
**Step 9:** Join the other two legs.

1. Use the **As-built Joint** command to join the other two legs to the bracket.
2. Drag the legs to see how the cylinders can move inside each other and how the legs rotate around the bracket.
3. Click **Position > Revert** to return the legs to their original position.



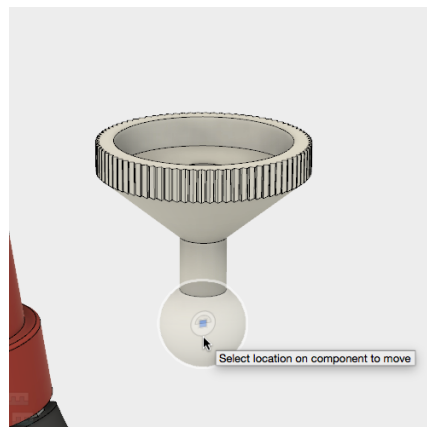
**Step 10:** Use the Joint command to join the red stand to the bracket.

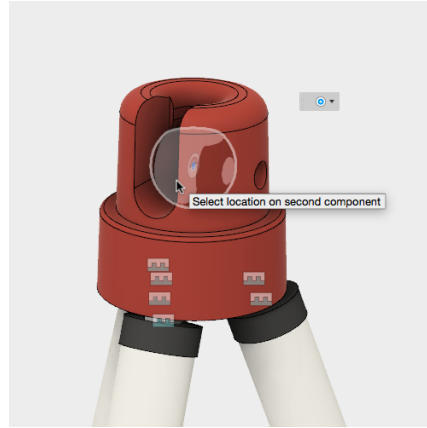
1. Click **Assemble > Joint**. Make sure you use the Joint command and not the As-built Joint we have been using.
2. Change the Type to **Rigid**.
3. Move the cursor over the bottom face of the red stand. Click when the joint glyph is displayed in the center of the hole in the stand.
4. Move the cursor over the top face of the bracket. Hold command (Mac) or ctrl (Windows) to lock on that face then click on the hole in the center.



**Step 11:** Use the Joint command to join the stand and the camera mount.

1. Click **Assemble > Joint**.
2. Change the Type to **Ball**.
3. Select the ball on the bottom of the camera mount.
4. Select the ball cavity on the inside of the red stand.





**Step 12:** Test the motion of the camera mount.

1. Drag the mount to see the available motion.
2. Click Position > Revert to return the mount to the original position.

Note: Fusion does not detect material interference unless you are set up contact sets.

