2. Geometry Modelling and CAD tools

Axis and Grid settings

In the COMSOL Multiphysics user interface you can set limits for the model axes and adjust the grid lines. To change these settings, use the Axes/Grid Settings dialog box that you open from the Options menu.

In 2D, the Axis equal option triggers tick mark increments on the *x*- and *y*-axes that are equal in size. Selecting the Auto check box makes COMSOL Multiphysics scale the *z*-axis limits automatically. Even though your model geometry does not include the third space dimension, the scale of the *z*-axis can figure into creating height plots, for example, in post processing.

In 3D, when the Auto check box is selected, the axes automatically adjust to enclose the entire geometry. By clearing this check box, you can manually set the axis limits. The Axis equal check box, selected by default, scales the data equally. If this feature is turned off, COMSOL Multiphysics scales the data units in a stretch-to-fill fashion. Select the Box check box to enclose the axis in a box.

1-D modelling

To create a 1D geometry model, use the following steps:

1. In the Model Navigator, click the New tab and then select 1D from the Space Dimension list. Click OK.
2. In Draw mode, open the Line dialog box from the Specify Objects submenu in the Draw menu.
3. Enter the coordinates in the x field (for ex. 0 0.2) and the name for the object in the Name field.
4. In the Style list you specify the style of the generated solid object. Select Polyline to generate a solid object with vertices in the specified coordinates. If you select Segments, the specified coordinates must have the structure start1 end1 start2 end2 and so on. This generates a solid object with segments according to the specified start and end coordinate values.

2-D modelling

The default 2D Draw mode provides an additional toolbar for creating and editing geometry objects. The Draw toolbar contains tools for creating 2D solid geometric primitives, lines, curves, and points:

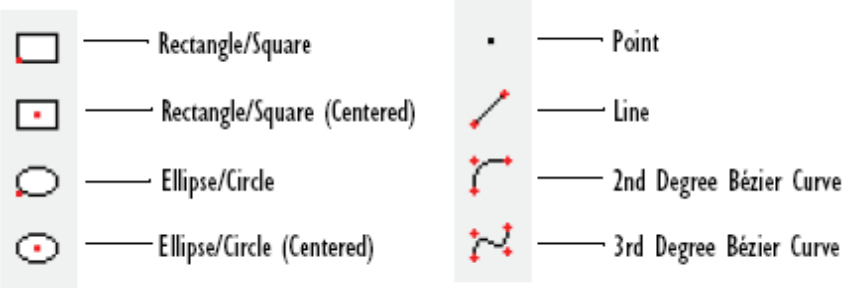
Rectangle/Square: Use the left mouse button to create a rectangle; use the right mouse button to create a square, with a reference point at the perimeter.

Rectangle/Square (Centred): Use the left mouse button to create a rectangle; use the right mouse button to create a square, with a reference point at the centre.

Ellipse/Circle: Use the left mouse button to create an ellipse; use the right mouse button to create a circle, with a reference point at the perimeter.

Ellipse/Circle (Centred): Use the left mouse button to create an ellipse; use the right mouse button to create a circle, with a reference point at the centre.

Point: Click in the drawing to add a point.



For all the above buttons, Shift-clicking the toolbar button opens a dialog box where you can specify the geometry object instead of creating it using the mouse. To make the dialog box appear directly (without Shift-clicking), double-click to select DIALOG in the status bar.

Line: Click at the start and end points or drag to create a line
2nd Degree Bézier Curve: Click at the start, mid, and end points.
3rd Degree Bézier Curve: Click at the start, mid, and end points.

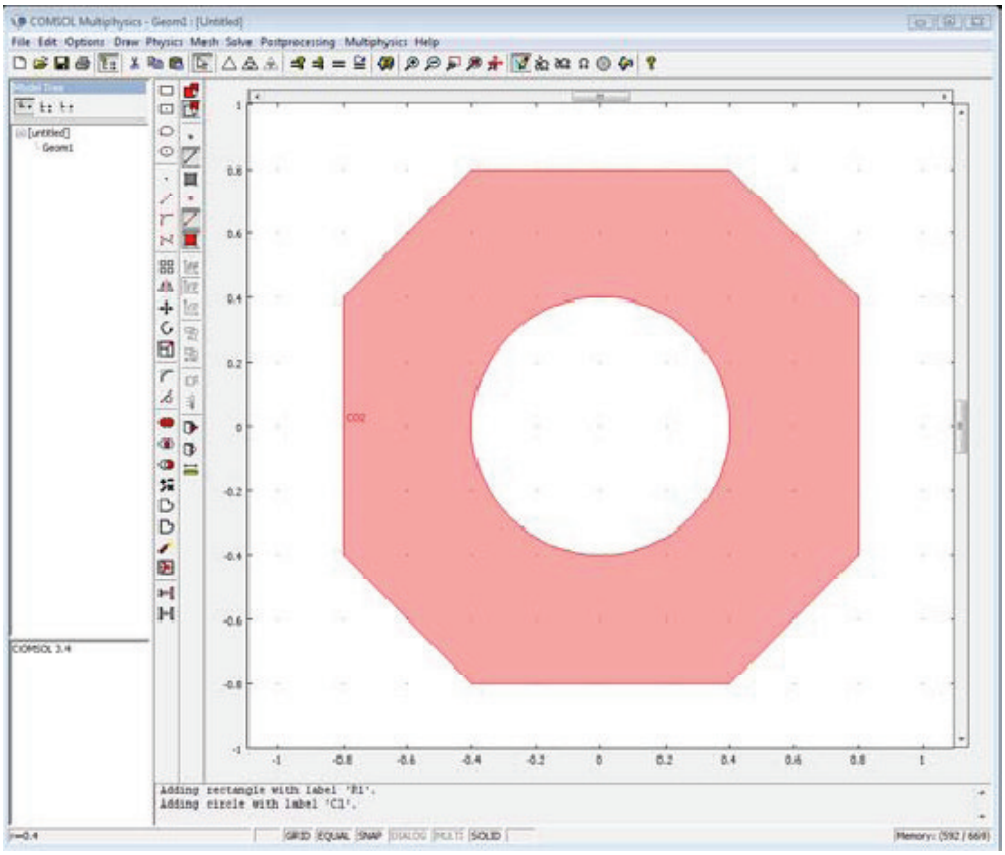
2-D Model (Example)

Start a new 2D model by going to the Model Navigator and selecting 2D in the Space dimension list on the New tab. Click OK.

1. First create a rectangle:
   The corner-aligned rectangle button at the top of the Draw toolbar; alternately, go to the Draw menu, point to Draw Objects, and then click Rectangle/Square.
   To describe the rectangle's corners, click the left mouse button and drag the cursor from (–0.8, –0.8) to (0.8, 0.8).
2. Create a circular hole:
   Click the centred ellipse button on the Draw toolbar.
   Click the right mouse button and drag the cursor from (0, 0).
   Release the mouse button when the solid circle has a radius of 0.4.
3. To drill a hole, create a composite solid object:
   Press Ctrl+A to select both objects.
   Click the Difference button on the Draw toolbar to create a hole.
4. COMSOL Multiphysics offers an alternative approach to drilling a hole:
   Go to the Draw menu and choose Create Composite Object.
   Click the Select All button.
   Edit the Set formula by changing the + sign to a – sign so that the set formula becomes R1-C1, subtracting the solid circle from the solid rectangle.

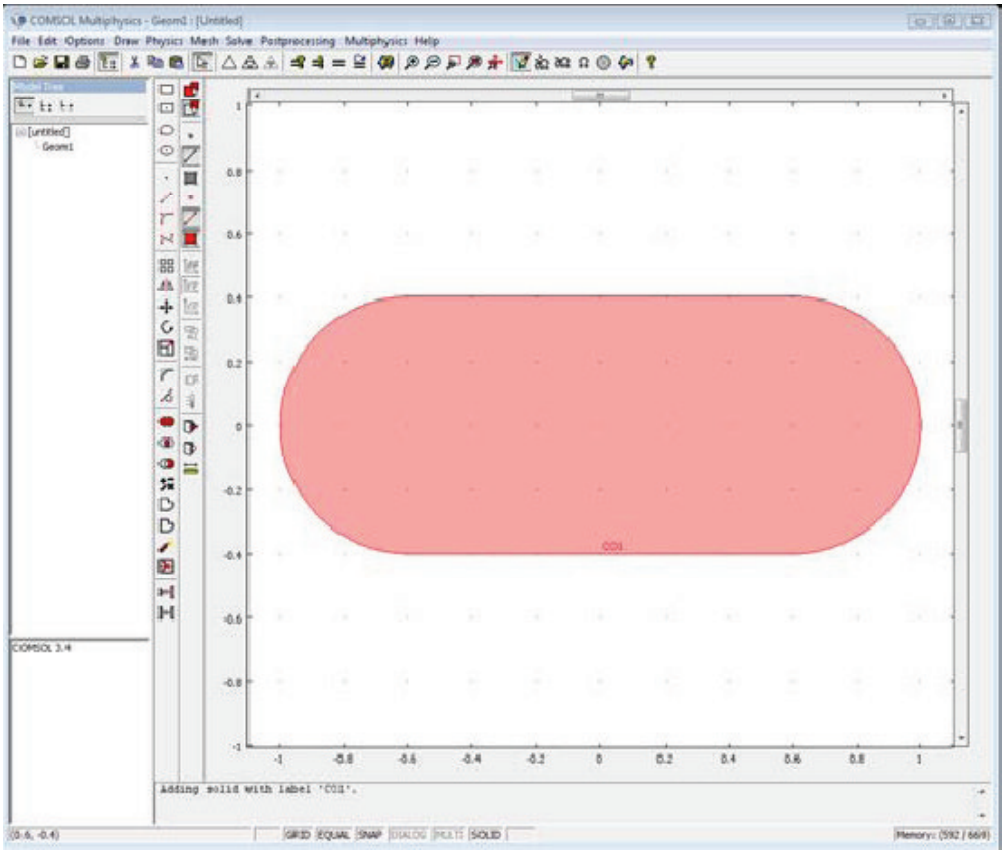
Trimming Solids
To flatten the corners on this and other objects, you can use chamfers. To do so, follow these steps:

1. Click the Fillet/Chamfer button on the Draw toolbar to open the Fillet/Chamfer dialog box.
2. Open the CO1 folder and select the vertices 1, 2, 7, and 8.
3. Click the Chamfer button, and then type 0.4 in the Distance edit field.
4. Click OK to chamfer the selected corners.



Another Example:

1. Start a new 2D model.
2. Click the 2nd Degree Bézier Curve button on the Draw toolbar.
3. Create the boundary by clicking at (−0.6, −0.4), (−1, −0.4), (−1, 0), (−1, 0.4) and (−0.6, 0.4) with the left mouse button.
4. Click the Line button on the Draw toolbar.
5. Click at (0.6, 0.4) to create a horizontal line segment.
6. Once again click the 2nd Degree Bézier Curve button on the Draw toolbar and then click at (1, 0.4), (1, 0), (1, −0.4) and (0.6, −0.4).
7. Click the right mouse button to create a solid object.



*Also try this model with Fillet command

3-D Modelling

The first step in creating a 3D geometry model is to create a COMSOL Multiphysics model with that space dimension:

1. In the Model Navigator, click the New tab and then select 3D from the Space Dimension list. Click OK.
2. Use the tools in the Draw toolbar and the Draw menu to create the 3D geometry.

Creating and Using 2D Work Planes

A work plane is a 2D plane positioned in 3D space. Three points and a normal direction define a work plane. You can specify a work plane's orientation in several ways by:
•Specifying properties explicitly
•Specifying its coordinates
•Using existing 3D geometry objects as reference points
To create a work plane, open the Work-Plane Settings dialog box from the Draw menu. There are five way to define a work plane, corresponding to each of the tabbed pages: Quick, Face Parallel, Edge Angle, Vertices, and Advanced:

1. Quick Positioning
   Click the Quick tab to create work planes that are parallel to the *xy*-, *yz*-, and *zx*-planes, with an optional offset in the *z*, *x*, and *y* direction, respectively

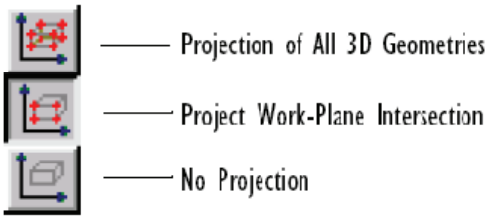
2. Face Parallel Positioning
   Click the Face Parallel tab to create a work plane that is parallel to an existing face. Select a face directly from the drawing area or in the Face selection list. You can also specify the *z*-axis direction for the work plane and an offset from the face.

3. Edge Angle Positioning
   Click the Edge Angle tab to create a work plane with a specified angle to a selected face. First select an edge to rotate, then select an adjacent face and specify an angle between the work plane and the face.

4. Vertices Positioning
   Click the Vertices tab to specify a work plane parallel to another plane specified by three vertices. Select the vertices in the Vertex selection list and move them to the Selected vertices list by clicking the >> button. You can also specify an offset from the plane. The order of the vertices determines the orientation of the work plane.

5. Advance Positioning
   Click the Advanced page to define a work plane using three points in the 3D space. Type the coordinates for the three points in the edit fields in the Points in plane area.

Geometry Projection in Work Planes
When you enter a work plane, a 2D Draw toolbar replaces the 3D Draw toolbar. Three buttons in the Visualization/Selection toolbar determine which portion of the 3D geometry that the software projects onto the plane.

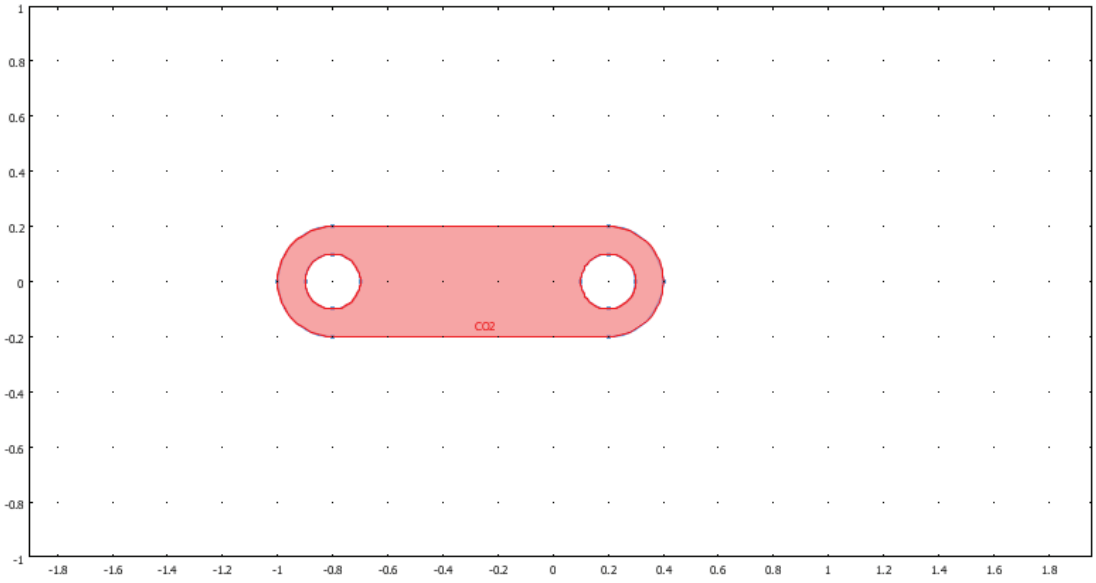


•Click the Projection of All 3D Geometries button to draw the projection of all 3D geometry edges
•Click the Project Work-Plane Intersection button to display only the edges that lie in the same plane as the work plane
•Click the No Projection button to display nothing of the 3D geometry.

COMSOL Multiphysics provides three ways of extending your 2D work plane geometries into 3D space:

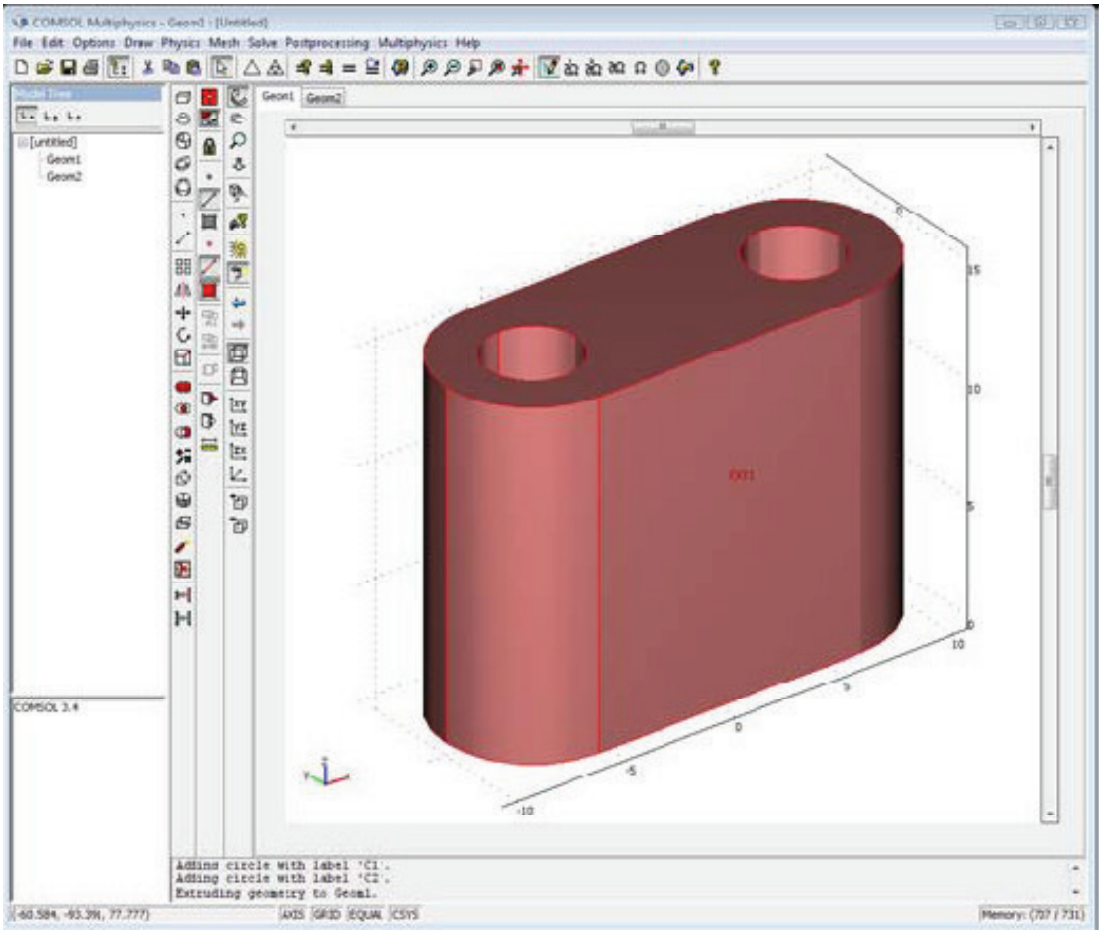
1. Extruding
2. Revolving
3. Embedding

Extruding a 2D Geometry
Draw the 2D figure shown in figure below



Choosing Extrude from the Draw menu opens the Extrude dialog box.
To extrude 2D geometry objects into 3D:

1. Select the objects to extrude in the Objects to extrude list.
2. Specify the length of the extrusion in the Distance edit field. To create an extruded geometry with several extrusion sections, type several space-separated values.
3. Specify the scale factors in the *x* and *y* directions in the Scale x and Scale y edit fields. These scale factors determines the difference in size between the end and start of the extrusion. For a straight extrusion, set them to 1.
4. Specify the displacements in the *x* and *y* direction at the end of the extrusion in the Displacement x and Displacement y edit fields. For a straight extrusion, set them to 0.
5. Specify the rotation (in degrees) of the top with respect to the bottom of the extruded object in the Twist (degrees) edit field.
6. Specify if faces should be kept between extrusion sections by selecting the Keep cross-sectional boundaries check box. If you clear this check box, the extruded geometry consists of the same number of subdomains as the original 2D geometry.
7. Select the 3D geometry to which the resulting 3D geometry object is added in the Extrude to geometry list.
8. If desired, enter a different name for the extruded object in the Extruded object name edit field.
9. Click OK.


File Edit Options Draw Physics Mesh Solve Postprocessing Multiphysics Help
[untitled]
Geom1
Geom2
COMSOL 3.4
Adding circle with label 'C1'.
Adding circle with label 'C2'.
Extruding geometry to Geom1.