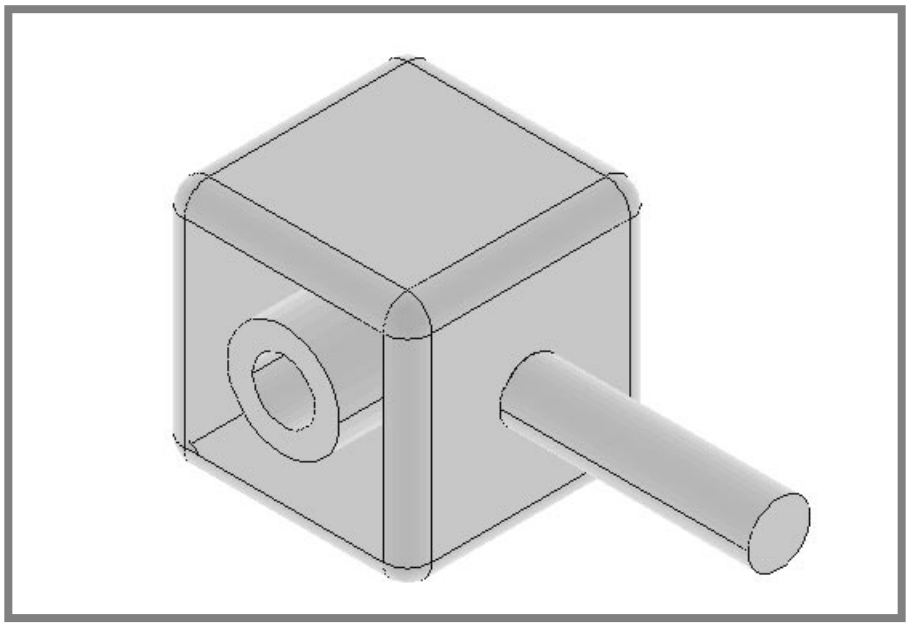
WORKSHOP 3

Modeling a Part



Objectives

- Use the solid modeling feature of MSC/N4W to create three dimensional geometry.
- Apply the loads and boundary constraints.
- Mesh the created structure.
- Submit the file for analysis in MSC/NASTRAN.
- Compute nodal displacements for desired time domain.

Model Description:

Consider an aluminum block fixed on a rigid rod with a cylindrical protrusion on the sides. The material properties of the block are shown in Table 3.1 below. A picture of the block with basic dimensions is supplied below in Figure 3.1.

Figure 3.1 - Dimensions

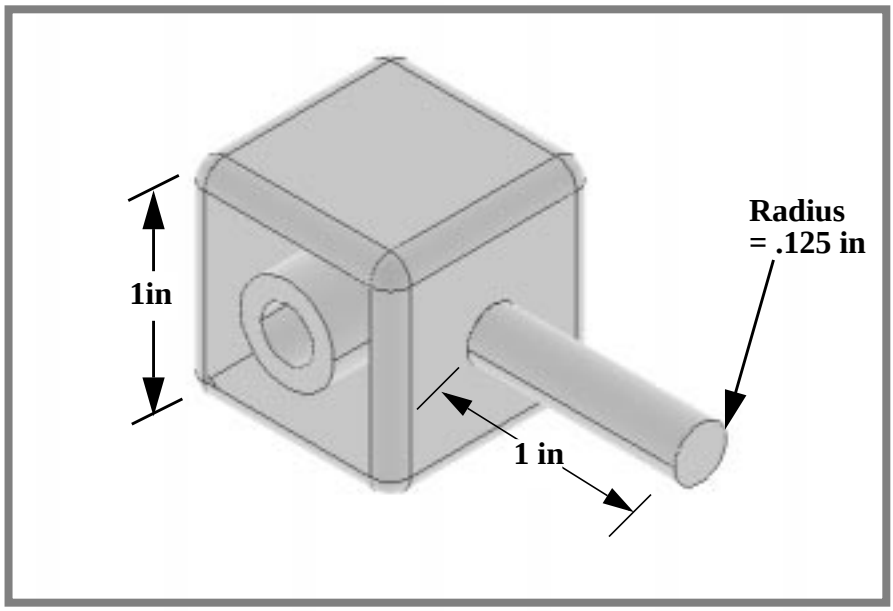


Table 3.1 - Material Properties

Elastic Modulus:	**30E6 psi**
Poisson's Ratio:	**0.3**
Density:	**0.282 lb/in^3**

Suggested Exercise Steps:

- Define a material, aluminum, from the material library.
- Define a solid property using the newly defined material.
- Create a 1 in cube using the primitive solid form with 1 in edge length.
- Create a cylinder inside the block using the new solid feature in the primitive solids form.
- Use the boolean operation to subtract the cylinder from the cube.
- Rotate the workplane onto a face of the cube to create the protrusion.
- Using the solid primitives form, create the protrusion as a new solid.
- Fillet the edges of the cube with 1 in radius fillets.
- Shell the cube. It is important to pick the correct surface to remove. Not excluding a face will create a hollow box. The wall thickness is 0.1 in.
- Apply restraints on the hole in the cube.
- Apply the 50 lbf load on the cylinder as a pressure load on the free end of the protrusion.
- To properly mesh the solids, use the project curve to surface feature to “interrupt” intersecting surfaces on the cube.
- Place 24 elements along the intersecting curve on the block and the joined end of the protrusion.
- Mesh the solid with a 0.1 default element size.
- The model is now ready for analysis.

Exercise Procedure:

1. Start up MSC/NASTRAN for Windows V3.0 and begin to create a new model.

Double click on the icon labeled **MSC/NASTRAN for Windows V3.0**.

On the *Open Model File* form, select **New Model.**

Open Model File:	**New Model**

2. Create a material called **mat_1**.

From the pulldown menu, select **Model/Material.**

Model/Material...

Title:	**mat_1**
Youngs Modulus:	**30e6**
Poisson's Ratio:	**0.3**
Mass Density:	**0.282**

OK

Cancel

3. Create a property called **solid** to apply to the members of the model.

From the pulldown menu, select **Model/Property**.

Model/Property...

Title:	**solid**

Elem/Property Type...

Volume Elements: ● **Solid**

OK

To select the material, click on the **List** icon next to the databox and select **mat_1**.

Material:	**1..mat_1**

OK

Cancel

4. Create the tube and make it easier to identify later, using the **block-corner** option, and name the solid **block**.

Geometry/Solid/Primitives...

Title: **block**

Material: ● **New Solid**

Direction: ● **Positive**

Under *Origin* input the following:

X: **0.0**

Y: **0.0**

Primitive: ● **Block-Corner**

X: **1.**

Y: **1.**

Z: **1.**

OK

5. To better view the solid, fit the view in the window.

View/Autoscale

6. To give perspective on the geometry, switch to a solid-shading mode.

Click on the **View Style** icon on the toolbar.

From the Pop-up menu: ☒ **Solid**

7. Rotate to an isometric view.

View/Rotate...

Isometric

OK

8. The next step is to create the hole. This is done by creating a cylinder through the solid and subtracting it from the block. Although MSC/N4W3.0 lets you create the hole directly using the subtract command, this method reinforces the boolean geometry capabilities of MSC/N4W3.0.

Geometry/Solid/Primitives...

Material: ● **New Solid**

Title: **hole**

Under *Origin* input the following:

X: **0.5**

Y: **0.5**

Primitive: ● **Cylinder**

Radius: **0.125**

Height: **1.**

OK

Now subtract the hole.

Geometry/Solid/Remove...

Select the base solid.

Entity ID: **1..block**

OK

Select the solid to remove.

Entity ID: **2..hole**

OK

9. In order to create the protrusion on the face using the **primitives** form, it will be necessary to rotate the workplane onto a face of the cube.

Tools/Workplane...

Under *Move Plane* select **Rotate**.

Rotate...

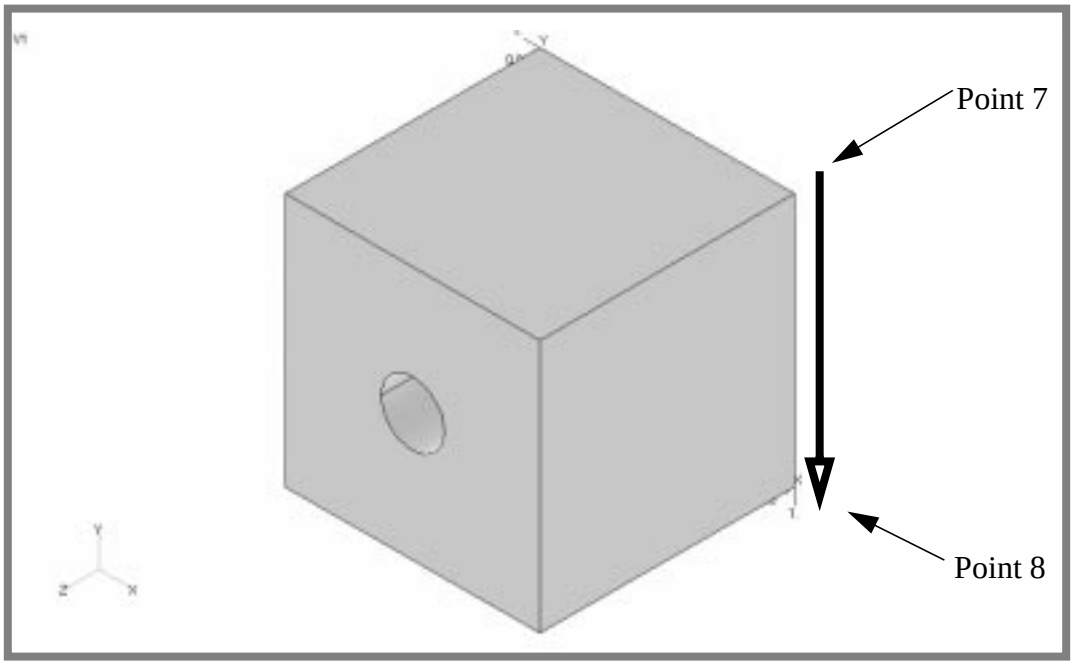
Now select the axis of rotation.

Methods^

☒ **Points**

Select the points as shown in Figure 3.2.

Figure 3.2 - Moving the workplane



Base Point ID: **7**

Tip Point ID: **8**

OK

Rotate the workplane. The direction of the rotation is found using the right hand rule. Point your right thumb along your axis of rotation and the direction your fingers curl is the positive rotation.

Rotation Angle: **90**

OK

10. Regenerate the display.

View/Regenerate

11. Create the protrusion.

Geometry/Solid/Primitives...

Material: ● **New Solid**

Title: **protrusion**

Direction: ● **Negative**

Under *Origin* input the following:

X: **1.5**

Y: **0.5**

Primitive: ● **Cylinder**

Radius: **0.125**

Height: **1.**

OK

12. Since we are no longer creating geometry, turn off the workplane.

View/Options...

Under *Category* select the following:

● **Tools and View Style**

Highlight **Workplane and Rulers.**

Workplane and Rulers

Uncheck the **Draw Entity** box.

☐ **Draw Entity**

OK

13. In real life, parts generally do not have sharp corners. To model this, fillet the edges.

Geometry/Solid/Fillet...

Select the curves to fillet.

ID: **1** *to:* **12** *by:* **1**

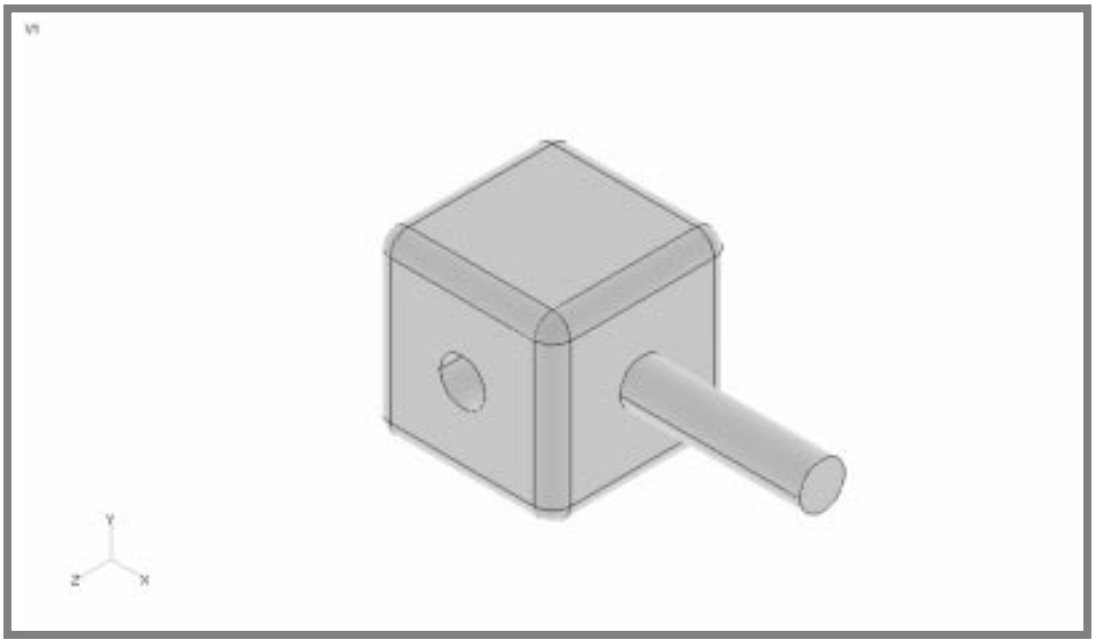
OK

Radius: **0.1**

OK

Your model should look like Figure 3.3.

Figure 3.3 - Moving the workplane



14. Hollow out one face of the cube using the shelling feature.

Geometry/Solid/Shell...

Select the base solid.

Entity ID: **1..block**

OK

Select surfaces to pierce.

ID: **1** *to:* **1** *by:* **1**

OK

Thickness: **0.1**

OK

Your completed model should look like Figure 3.1.

15. To create the mesh, place mesh seeds on the surface of the block and the connected face of the protrusion.

Geometry/Curve - From Surface/Update Surfaces

Geometry/Curve - From Surface/Project...

Select surface to project onto.

ID: **1**

OK

Select the two curves that makes the interface between the block and the protrusion with your mouse, or input the following.

ID: **23** **More**

ID: **24** **More**

OK

Cancel

16. Place the mesh seeds.

Mesh/Mesh Control/Size Along Curve...

Select the projected curves on the same interface between the block and the protrusion with your mouse or input the following.

ID: **23** **More**

ID: **87** **More**

ID: **24** **More**

ID: **88** **More**

● **Number of Elements** **24**

OK

Cancel

17. Mesh the solid with a 0.1 default element size.

Mesh/Mesh Control/Default Size...

Size: **0.1**

Min Elem: **1.**

OK

18. Mesh the solids individually.

First mesh the block.

Mesh/Geometry/Solids...

Select Solid to Mesh: **1..block**

OK

OK

Property: **1..solid**

OK

Place mesh seeds on the curves on the free end of the protrusion.

Mesh/Mesh Control/Size Along Curve...

Use your mouse to pick the curves or input the following:

ID: **21** **More**

ID: **22** **More**

OK

● **Number of Elements** **24**

OK

Cancel

Mesh the protrusion.

Mesh/Geometry/Solids...

Select Solid to Mesh: **1..protrusion**

OK

OK

Property: **1..solid**

OK

19. Finally, check coincident nodes.

Tools/Check/Coincident Nodes...

Select All

OK

When asked “OK to Specify Additional Range of Nodes to Merge?”, answer **No**.

No

☒ **Merge Coincident Entities**

OK

This model is now ready for analysis.

This concludes the exercise.