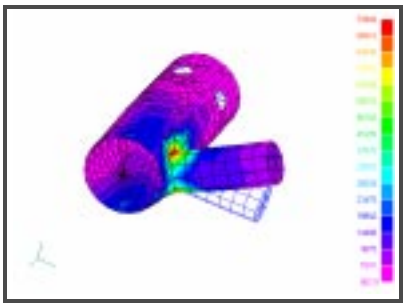
WORKSHOP 8

Mid-Plane Surface Extraction



Objectives:

- Create solid geometry adding features and shelling.
- Extract midplane surfaces.
- Mesh midplane surfaces.
- Create RBE2 elements at the ends of its cylinder and its protrusion.
- Apply a torque and boundary conditions.
- Run Analysis and post process results.

Model Description:

In this workshop, you will create a solid cylinder with a certain thickness. After obtaining the solid geometry, you can either solid mesh with 3D solid elements or extract midplane surfaces and mesh with 2D planar elements.

Figure 8.1

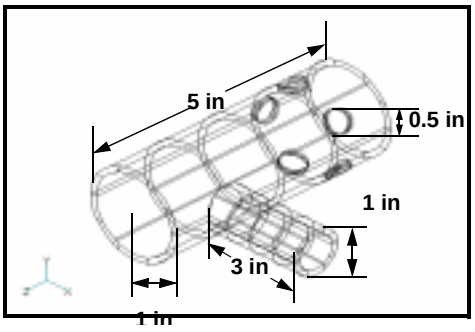


Table 8.1- Model Properties

Youngs Modulus:	**10E+06 lbs/in^2**
Poisson's Ratio:	**0.3**

Suggested Exercise Steps:

- Create a material, **mat_1**.
- Create a property called **plate**.
- Create a cylinder called **cylinder1** with a height of 5 and a radius of 1.
- Add a cylinder protrusion with a height of 3 and radius of 0.5 to **cylinder1**.
- Shell the geometry.
- Create 5 holes of radii 0.25 on the main cylinder.
- Extract midplane surfaces from the solid.
- Specify a mesh size on the surfaces by accepting the default element size.
- Mesh the midplane surfaces.

Exercise Procedure:

1. Start up MSC.Nastran for Windows V4.0 and begin to create a new model.

   Double click on the icon labeled **MSC.Nastran for Windows V4.0**.

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

Open Model File:	**New Model**

2. This exercise should be performed with the **Advanced Geometry-Parasolid Engine** turned on.

   Tools/Advanced Geometry...

   ● **Advanced Geometry-Parasolid**

   OK

3. Create a material called **mat_1**.

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

   Model/Material...

ID:	**1**
Title:	**mat_1**
Youngs Modulus:	**10E6**
Poisson's Ratio:	**0.3**

   OK

   Cancel

4. Create a new property called **plate**.

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

   Model/Property...

ID:	**1**
Title:	**prop_1**

Elem/Property Type...

Plane Elements:	● **Plate**

OK

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

Material:	**1..mat_1**
Thicknesses, Tavg or T1:	**0.125**

OK

Cancel

5. Create a cylinder named cylinder1 with a height of 5 and a radius of 1.

   Geometry/Solid/Primitives...

Title:	**cylinder1**
Direction:	● **Positive**
Primitive:	● **Cylinder**
Radius:	**1**
Height:	**5**

   OK

6. Rotate to an isometric view by selecting **View/Rotate**.

   View/Rotate... <F8>

   Isometric

   OK

7. Add a cylinder protrusion to the newly created cylinder.

   First, rotate the Workplane so that it is lying parallel to the length of the cylinder.

   Tools/Workplane... <F2>

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

Rotate...

Now, input the proper values for the Base and Tip.

	X:	*Y:*	*Z:*
Base:	**0**	**0**	**0**
Tip:	**0**	**1**	**0**

OK

Rotation Angle:	**90**

OK

To make the geometry fit within the window, select **View/Autoscale** or **Ctrl-A**. Now move the origin of the workplane.

Tools/Workplane... <F2>

Under *Origin and Axes* select **Move Origin**.

Move Origin

Methods^

Center

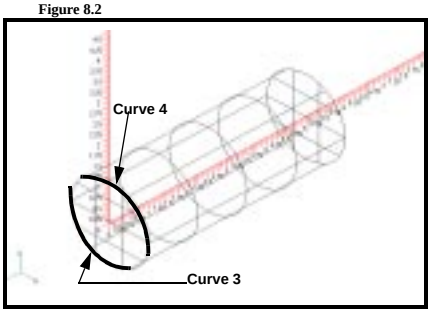
Pick either of the curves at the left end of the model. This will move the workplane origin to the center of the curve selected.

Curve ID:	**3 (or 4)**

OK

Use **CTRL+G** to regenerate the model.

Figure 8.2



Create a protrusion from **cylinder1**.

Geometry/Solid/Primitives...

Material: ● **Add**

Direction: ● **Positive**

Under *Origin* input the following:

X: **1.25**

Y: **0**

Primitive: ● **Cylinder**

Radius: **0.5**

Height: **3**

OK

8. Hollow out the solid by shelling it.

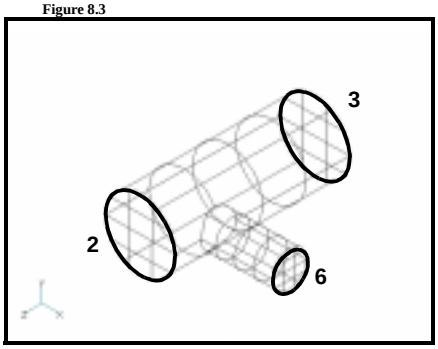
Geometry/Solid/Shell...

Entity ID: **1..cylinder1**

OK

Select surfaces to be pierced (**Surfaces 2, 3, & 6**) as shown below.

Figure 8.3



OK

Thickness: **0.125**

OK

Turn off the workplane.

Tools/Workplane... <F2>

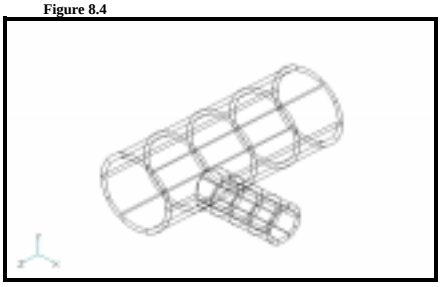
☐ **Draw Workplane**

Done

View/Regenerate... <Ctrl+G>

The resulting geometry should look like the figure below.

Figure 8.4



9. Create 5 holes on the cylinder by removing the material.

Geometry/Solid/Primitives...

Title: **subtract**

Material: ● **New Solid**

Direction: ● **Negative**

Under *Origin*, input the following:

X: **4**

Y: **0**

Primitive: ● **Cylinder**

Radius: **0.25**

Height: **3**

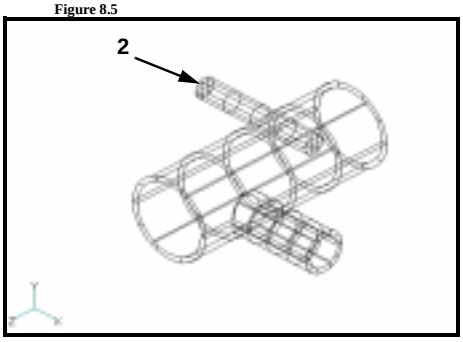
OK

Rotate the newly created solid to copy 4 more cylinders around the z-axis.

Geometry/Rotate/Solid...

< Select **solid 2**> as shown in Figure 8.5.

Figure 8.5



OK

Repititions: **4**

OK

Methods^

Locate

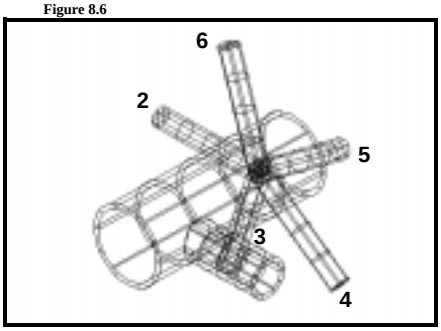
	X:	*Y:*	*Z:*
Base:	**0**	**0**	**0**
Tip:	**0**	**0**	**1**

OK

Rotation Angle: **72**

OK

Figure 8.6



Now, remove the solids to create the holes.

Geometry/Solid/Remove...

Entity ID: **1..cylinder1**

OK

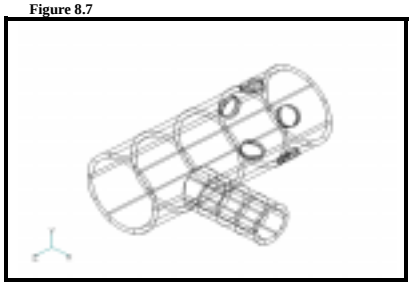
Select solids from screen <**solids 2, 3, 4, 5, & 6**>.

OK

Refit the geometry

View/Autoscale ... **<Ctrl+A>**

Figure 8.7



10. At this point, you can mesh the solid geometry with tetrahedral solid elements. However, to save time and disk space this model can be better idealized by a 2D mesh. To do this, extract midplane surfaces from the solid.

    First, create a group to put the new midsurface into.

    Group/Set...

    Title: **midsurface**

    OK

    Now, set the **Automatic Add** to the **Active** group to automatically add all entities created from this point on to the active group (midsurface).

    Group/Operations/Automatic Add...

    ● **Active**

    OK

    Extract the midsurface from the solid.

    Geometry/Midsurface/Automatic...

Select All

OK

Enter Target Thickness: **0.125**

OK

View the extracted midplane surfaces now in the "midsurface" group.

View/Select... <F5>

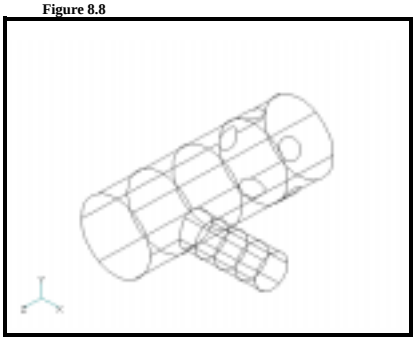
Model Data...

Group: ● **Active**

OK

OK

Figure 8.8



11. Specify a mesh size on the surfaces.

    Mesh/Mesh Control/Size on Surface...

Use *box select* (**SHIFT** and drag the left mouse button) to select **surfaces 32-35**.
NOTE: Do not use "Select All" for this surface selection. Using "Select All" will select these surfaces as well as all of the surfaces that represent the faces of the cylindrical solids.

OK

Accept the default element size.

OK

Cancel

12. Mesh the midplane surfaces.

    Mesh/Geometry/Surface...

    Use **SHIFT** and left mouse button to box select **surfaces 32-35** on the screen.

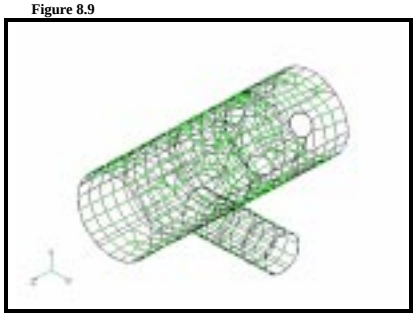
    OK

    Property: **1..plate**

    Element Shape: ● **Quads**

    OK

Figure 8.9



This concludes the exercise.

File/Save

File/Exit