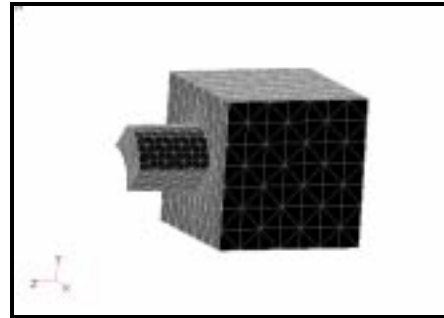


Solid Meshing Techniques



Objectives

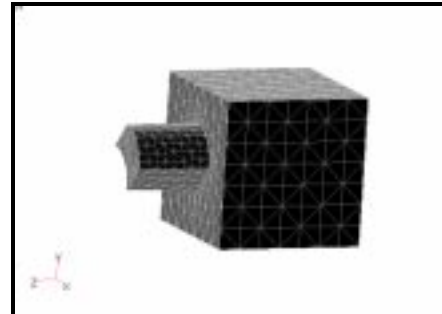
- Create solid geometry.
- Create surface meshes.
- Create solid mesh with Automesher.

WORKSHOP 9 *Solid Meshing Techniques*

Model Description:

The purpose of this exercise is to create two solid geometries (an assembly) and obtain a unified mesh of both parts.

Figure 9.1



Suggested Exercise Steps:

- Define materials.
- Define planar and solid properties.
- Create a solid box.
- Create a surface for extrusion.
- Extrude the surface to create a solid extrusion.
- Intersect the two solids to obtain a common interface.
- Apply mesh controls to interface surfaces.
- Mesh surfaces.
- Create curves and project onto the solid box.
- Extrude planar elements to get solid mesh.

Exercise Procedure:

1. Start up MSC.Nastran for Windows V4.0 and create a new model.
Double click on the icon labeled **MSC.Nastran for Windows V4.0**.

Open Model File:

2. Create two materials.

Model/Material...

Title:

Youngs Modulus:

Poisson's Ratio:

Title:

Youngs Modulus:

Poisson's Ratio:

3. Create three properties. The "Plot" type elements will only be used to generate a dummy surface mesh. This dummy surface mesh will be used to generate solid, tetrahedral elements and to extrude into penta elements.

Model/Property...

Elem/Property Type...

Plane Elements: Plot Only

Title:

When asked OK to Create?

Elem/Property Type...

Volume Elements: Solid

Title:

Material: (pulldown)

Title:

Material: (pulldown)

4. Create a 1 x 1 x 1 box.

Geometry/Solid/Primitives...

Title:

Material: New Solid

5. Get an isometric view of the box.

Click the **Dynamic Rotate** toolbar button.



Rotate the view with the **Left Mouse Button** to get an isometric view.
When done:

View/Autoscale <Ctrl+A>

View/Select... <F5>

Render

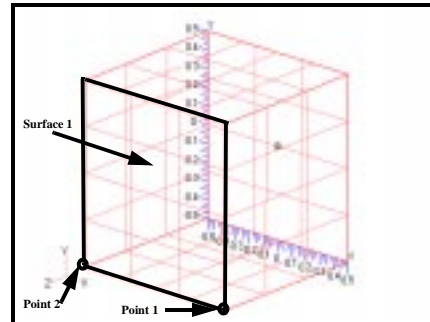
6. Create an extruded solid on Surface 1 of the original box.

Shift the workplane to **Surface 1**:

Right Click on screen.

Refer to the following figure for location surface and points of the cube.

Figure 9.2



Define Plane:

On Surface:

At Point:

Axis Point:

First Quadrant

OK

View/Autoscale <Ctrl+A>

Geometry/Curve - Arc/Angle-Center-Start...

Methods^

Locate in Workplane

Center of Arc

X: 0.5 Y: 0.5 OK

Start of Arc

X: 0.75 Y: 0.5 OK

Angle: 90

OK

Cancel

Geometry/Copy/Curve...

Select the previously created curve

ID: 13

OK

OK

Right Click on screen.

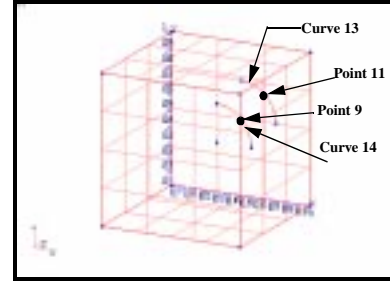
Snap to Point

In the *Vector Locate* form, **screen-select** the following points.

Base: Point 11 (midpoint of arc)

Tip: Point 9 (center point of arc)

Figure 9.3



OK

Geometry/Surface/Ruled...

From Curve: 14 (newest curve)

To Curve: 13 (first curve)

OK

Cancel

Geometry/Solid/Extrude...

Material: New Solid

Direction: Negative

To Depth: 0.5

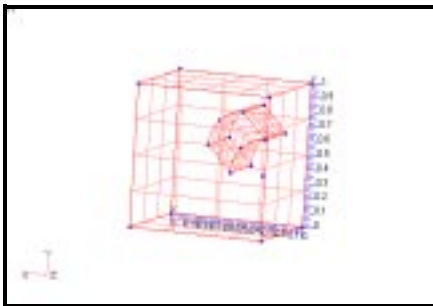
Surface...

ID: 7 (newly created surface)

OK

OK

Figure 9.4



- Break the surface of the box at the interface with the extruded solid. This step is necessary to ensure congruent mesh between the two solids.

Geometry/Curve - From Surface/Update Surfaces

Geometry/Curve - From Surface/Intersect...

Select First Surface for Intersection (actually the solid)

ID: 1 (the box) OK

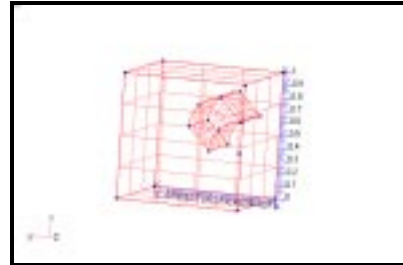
Select Second Surface for Intersection (actually the solid)

ID: 3 (the extruded solid) OK

Cancel

View/Autoscale <Ctrl+A>

Figure 9.5



- Specify mesh seeding on the interface.

Mesh/Mesh Control/Size on Surface...

(Select the two surfaces at the interface.)

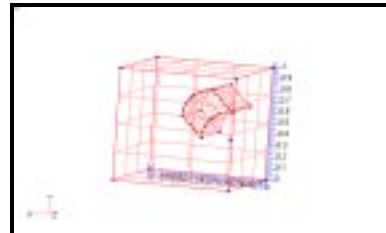
Entity Selection: +14, +13

OK

OK (use default element size)

Cancel

Figure 9.6



9. Mesh the interface making sure their meshes coincide.

Mesh/Geometry/Surface...

(Select the two surfaces at the interface.)

Entity Selection:

Property: (pulldown)

Element Shape: All Triangles

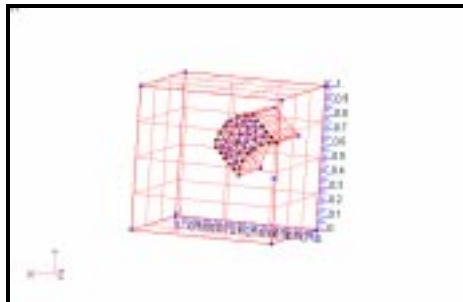
Zoom in on the mesh to take a closer look. Click the **Zoom** toolbar button and drag a box:



The meshes should coincide. When done:

View/Autoscale <Ctrl+A>

Figure 9.7



10. Create mesh controls for the solids.

Mesh/Mesh Control/Size on Solid...

(Select the first extruded solid.)

Entity Selection:

Tet Meshing

(use default element size)

Mesh/Mesh Control/Size on Solid...

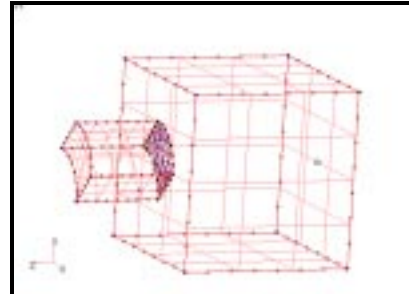
(Select the 1 x 1 x 1 box.)

Entity Selection:

Tet Meshing

(use default element size)

Figure 9.8



11. Mesh the solids.

Mesh/Geometry/Solids...

(Select the 1 x 1 x 1 box.)

Entity ID:

OK to Update Mesh Sizes?

Property: (pulldown)

Uncheck **Midside Nodes**.

Midside Nodes

Mesh/Geometry/Solids...

(Select the first extruded solid.)

Entity Selection:

OK to Update Mesh Sizes?

Property: (pulldown)

Uncheck **Midside Nodes**.

Midside Nodes

NOTE: When meshing solids with plate elements on the faces, the solid mesher will automatically match tet-elements to the triangular face elements.

12. Check for coincident nodes and merge them.

Tools/Check/Coincident Nodes...

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

Merge Coincident Entities

13. Get a better view of the model.

Right Click on screen.

Uncheck **Draw Workplane**.

Draw Workplane

View/Autoscale <Ctrl+A>

Click the **View Style** toolbar button.



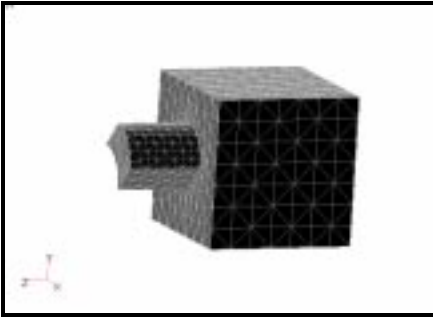
Click the **Quick Options** toolbar button or **<Ctrl+Q>**.



Turn off **Node**.

Node

Figure 9.9



14. Save your model.

File/Save As...

Filename:

This concludes the exercise.

File/Save

File/Exit