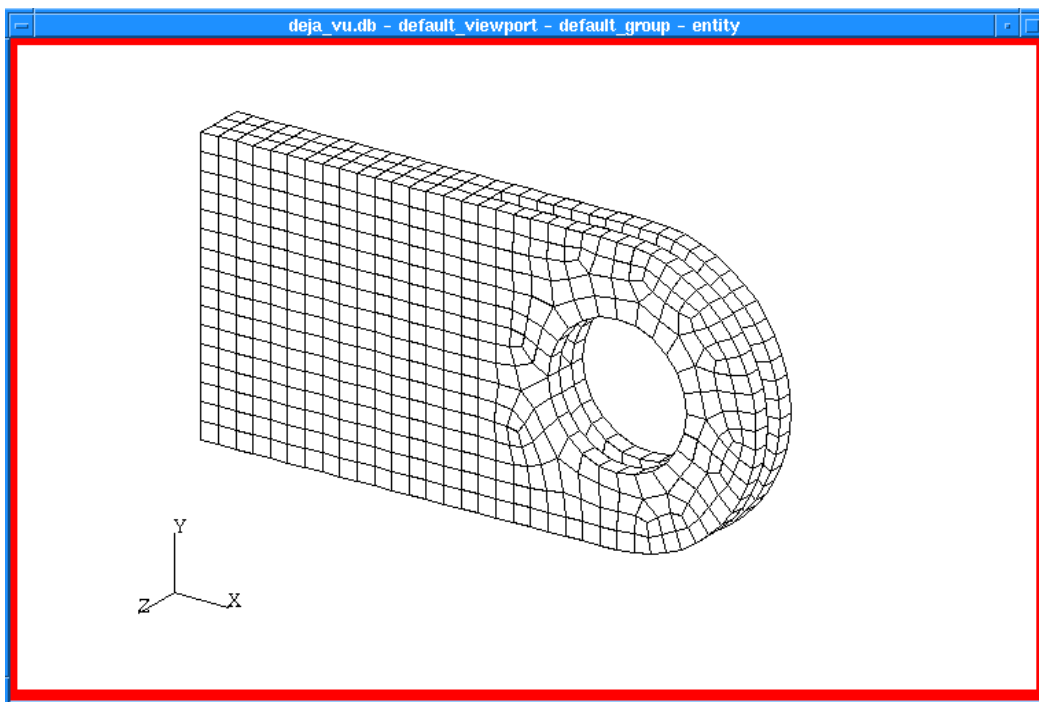

LESSON 8

(Another) Finite Element Model of a 3-D Clevis



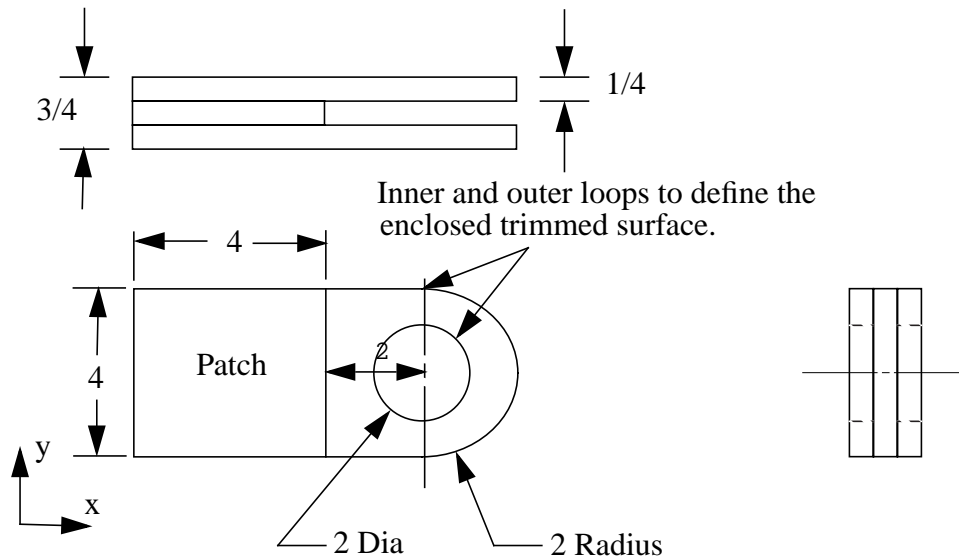
Objectives:

- Use Chaining to create a Curve.
- Create a Trimmed Surface.
- Sweep a Surface Mesh to create Solid elements.
- Use the Finite Elements Transform option.



Model Description:

In this exercise you will create a geometry model of one face of the now famous clevis. It will consist of a simple surface and a planar trimmed surface. You will create a quad mesh on these surfaces, then extrude that mesh to create solid elements. Finally you will translate elements to complete the model.

**Suggested Exercise Steps:**

- Create a new database and name it `deja_vu.db`. The approximate maximum model dimension is 8 units. Use MSC/NASTRAN for the Analysis Code.
- Create a surface to define the body of the clevis and lines to define the outer and inner bounds of the surface with a hole.
- Chain together the outer curves to create one continuous loop, and the curves defining the hole to create a second, continuous loop.
- Create a trimmed surface using the outer loop and the circular "hole".
- Mesh the 'simple surface' using isomesh, and the trimmed surface using paver. Then extrude the meshes to define the thicknesses of their respective portions of the clevis.
- Transform the mesh in the region defining the hole to complete the clevis finite element model.

Exercise Procedure:

1. Create a new database and name it `deja_vu.db`. The approximate maximum model dimension is 8 units. Use MSC/NASTRAN for the Analysis Code.

File/New Database...

New Database Name

deja_vu

OK

New Model Preference

Tolerance

Based on Model

Approximate Maximum Model Dimension

8

Analysis Code

MSC/NASTRAN

OK

2. Construct a surface to define the body of the clevis and curves to define the outer and inner bounds of the surface with a hole.

Create the first surface that will form the body of the clevis.

◆ Geometry

Action:

Create

Object:

Surface

Method:

XYZ

Vector Coordinate List

<4, 4, 0>

Apply

This will create a 4x4 square plane surface at the global origin.

Now you will define the remaining boundaries of the clevis; first, the hole.

Action:

Create

Object:

Curve

Method:

Revolve

The center of the hole is at $x = 6$ and $y = 2$. This will be the base of your rotation vector. To rotate about the positive z-axis, the tip of your rotation vector should define a point in that direction.

Click in the *Axis* data box and update its contents to **{[6 2 0] [6 2 1]}**. The 2 sets of brackets define an axis to the MSC/PATRAN list processor.

Axis

Total Angle

You can define any point on the circle as the point to sweep. For example click in the *Point List* data box and type **[5 2 0]**.

Point List

Now you will define the outer boundaries.

Total Angle

Point List

Create the final two curves to close the outer boundary.

Action:

Object:

Method:

Turn on curve label by selecting the **Label Control** icon from the toolbar.



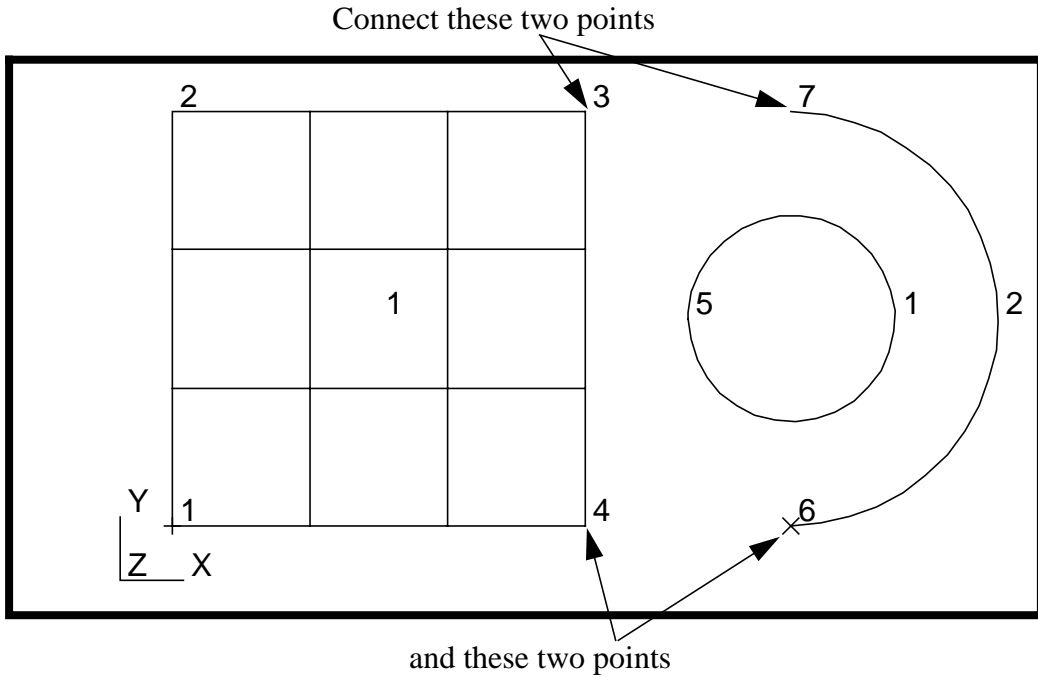
The *Label Control Panel* will appear and you will select the **Curve** icon.



Also, turn on *display lines* by selecting this icon from the toolbar.



Make straight curves between the point locations shown in the figure below.



3. Chain together the outer curves to create one continuous loop, and the curves defining the hole to create a second, continuous loop.

The outer boundary of the clevis model will be defined as a single curve by chaining the different segments of the outer boundary.

Chaining to Create Curves

Action:

Create

Object:

Curve

Method:

Chain

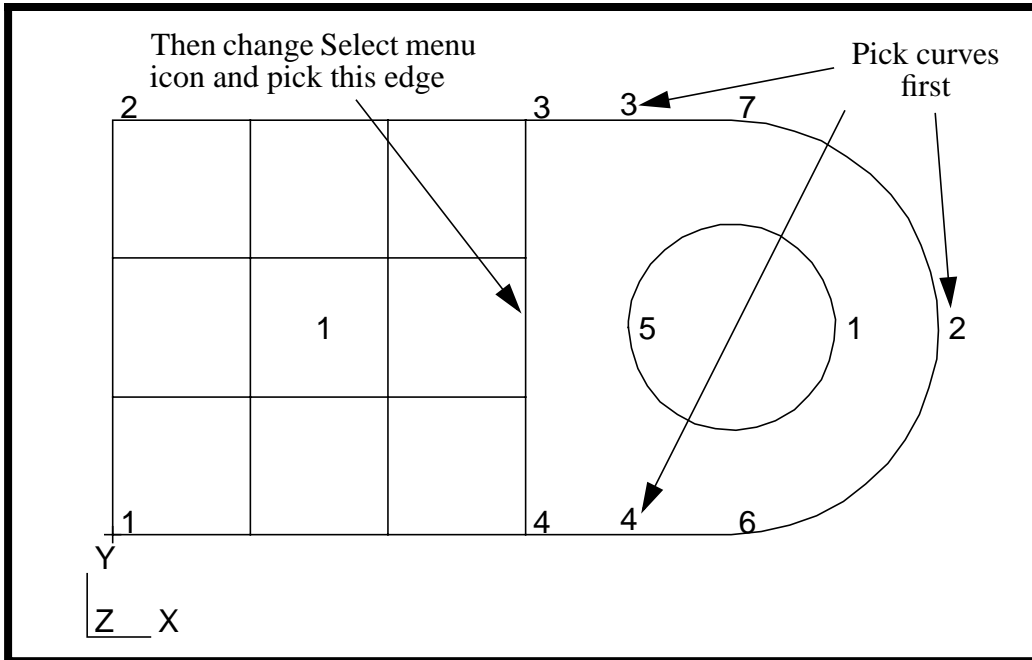
Curve List

Curve 4, 3, 2 Surface 1.3

Apply

See figure on next page for curve locations.

Select **Yes** when prompted for deletion of the original curves.



- Now, create the planar trim surface, using the outer and inner loops.

Action:

Create

Object:

Surface

Method:

Trimmed

Option

Planar

Outer Loop List

Select the curve you just created

Inner Loop List

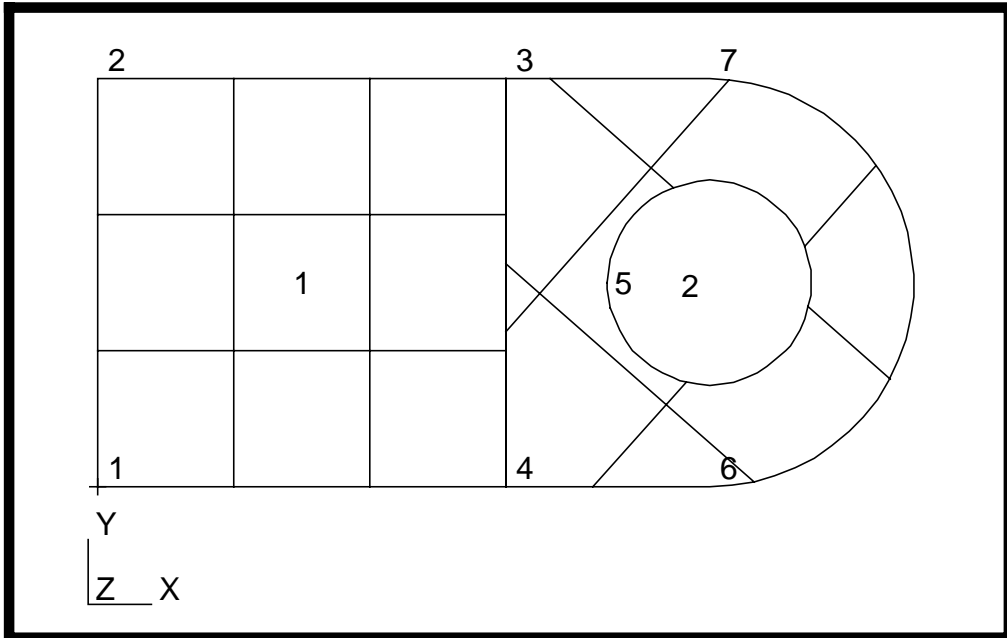
Select the inner circle

Apply

Select **Yes** when asked if you want to delete the original curves.

Create a Trimmed Surface

Your model will appear as shown below.



- Mesh the simple surface (green) using the isomesher, and the trimmed surface (magenta) using the paver. Then extrude the mesh through the thickness as is appropriate.

Click on the **Finite Elements** radio button in the *Main Form*.

◆ Finite Elements

Action:

Create

Object:

Mesh

Method:

Surface

Global Edge Length

0.25

Use **Isomesh** for Surface 1.

Use **Paver** for Surface 2.

Apply

Now you will sweep the surface elements to create solid elements.

Action:

Sweep

Object:

Element

Method:

Normal

Sweeping Finite Elements

In the **Mesh Control** form change...

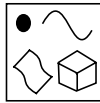
Number

Normal Length

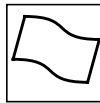
Delete Original Elements

Base Entity List

On the Select Menu, pick the **Meshed Entity** icon, then...



pick the **Meshed Surface** icon.



Then select **Surface 1**.

On the *Finite Elements* form select **Mesh Control...**,

Number

Normal Length

Delete Original Elements

Base Entity List

6. Transform the mesh in the region defining the hole to complete the clevis finite element model.

Now to create the other side of the clevis.

Action:

Object:

Element

Method:

Translate

Translation Vector

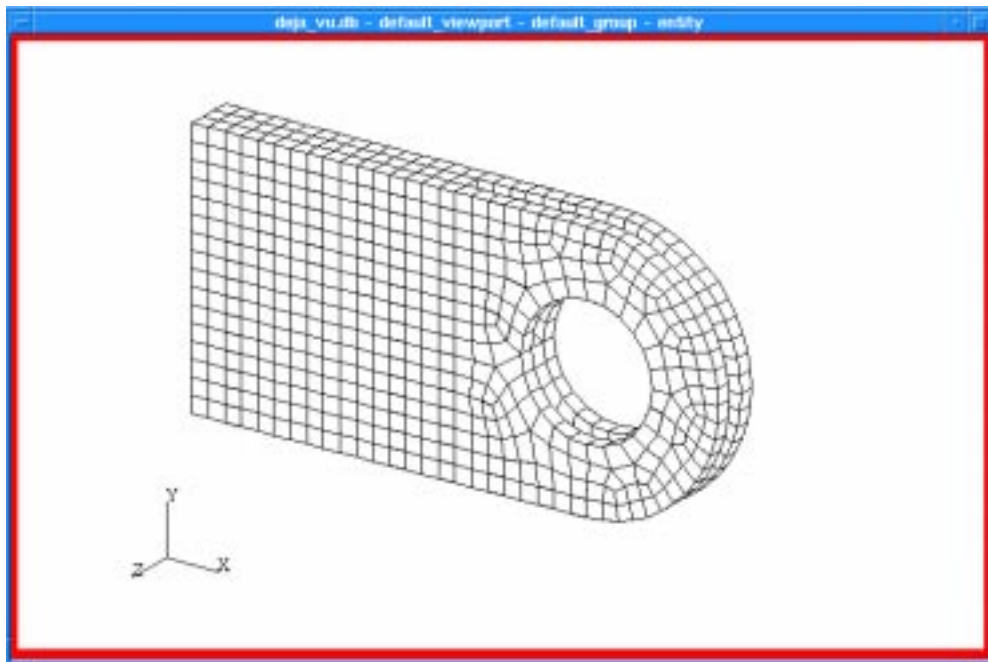
<0, 0, 0.5>

Element List

Click in the *Element List* databox and select all the hex elements extruded from the mesh on Surface 2.

Apply

Change the view to **Isometric**, and the *Render Style* to **Hidden Line**.



You may have pieces that appear to be missing in the **Hidden Line** *Render Style*. What is happening here is the FEM and the Geometry both exist in the same exact space. MSC/PATRAN does not know which one should be displayed over the other, hence the error of missing pieces in your viewport. To correct this erase all Geometry.

Display/Plot/Erase...

Erase All Geometry

OK

Quit Patran to complete this exercise.

File/Quit