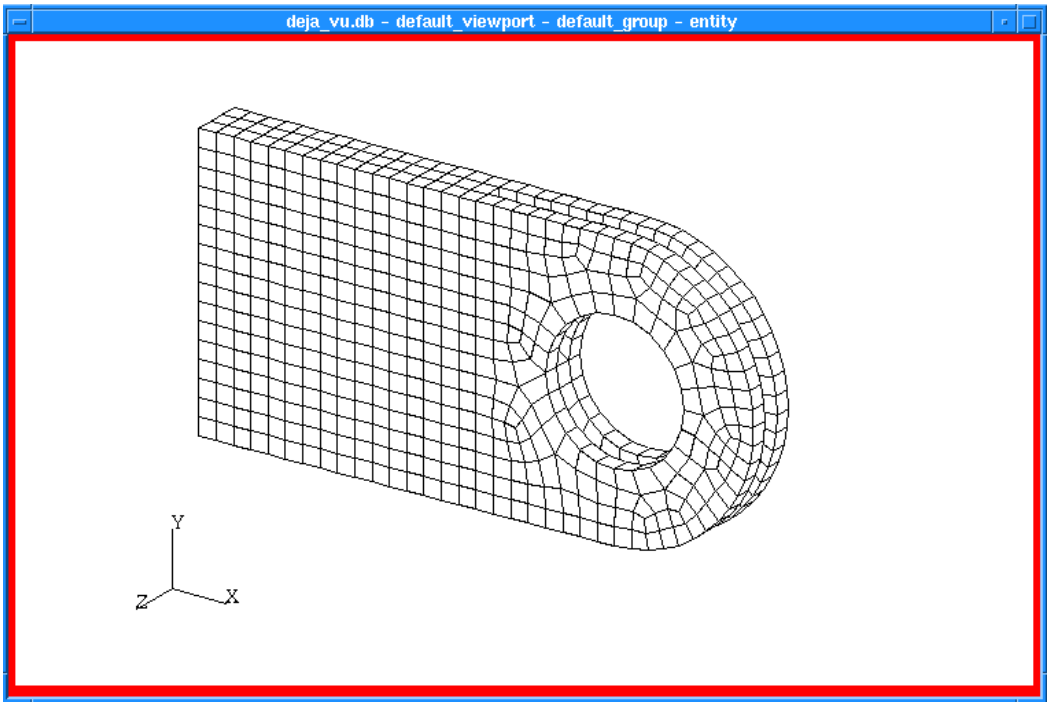
LESSON 5

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



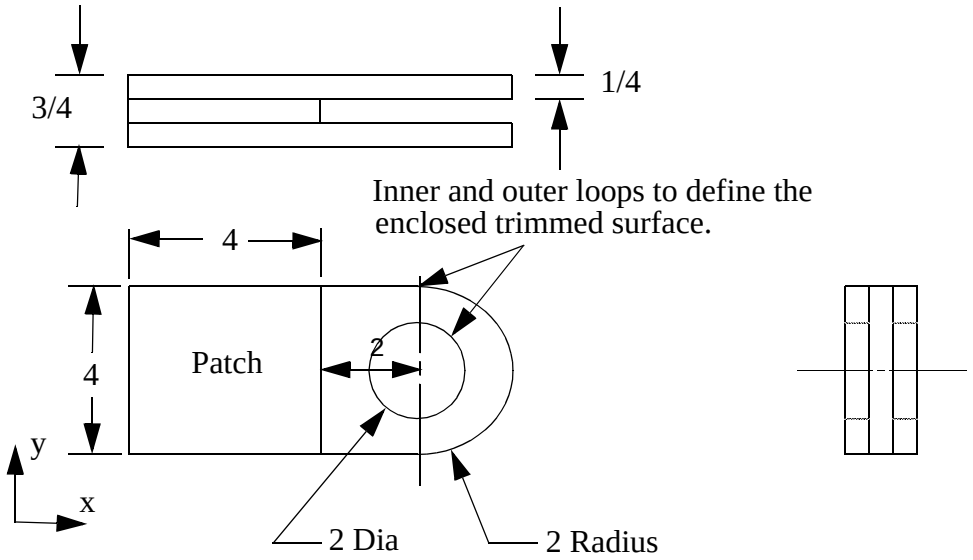
Objectives:

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

Another F. E. Model of a 3-D Clevis

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	**{[6, 2, 0] [6, 2, 1]}**
Total Angle	**360**

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	**[5, 2, 0]**

Apply

Now you will define the outer boundaries.

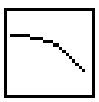
Total Angle	**180**
Point List	**[6, 0, 0]**

Create the final two curves to close the outer boundary.

Action:	**Create**
Object:	**Curve**
Method:	**Point**

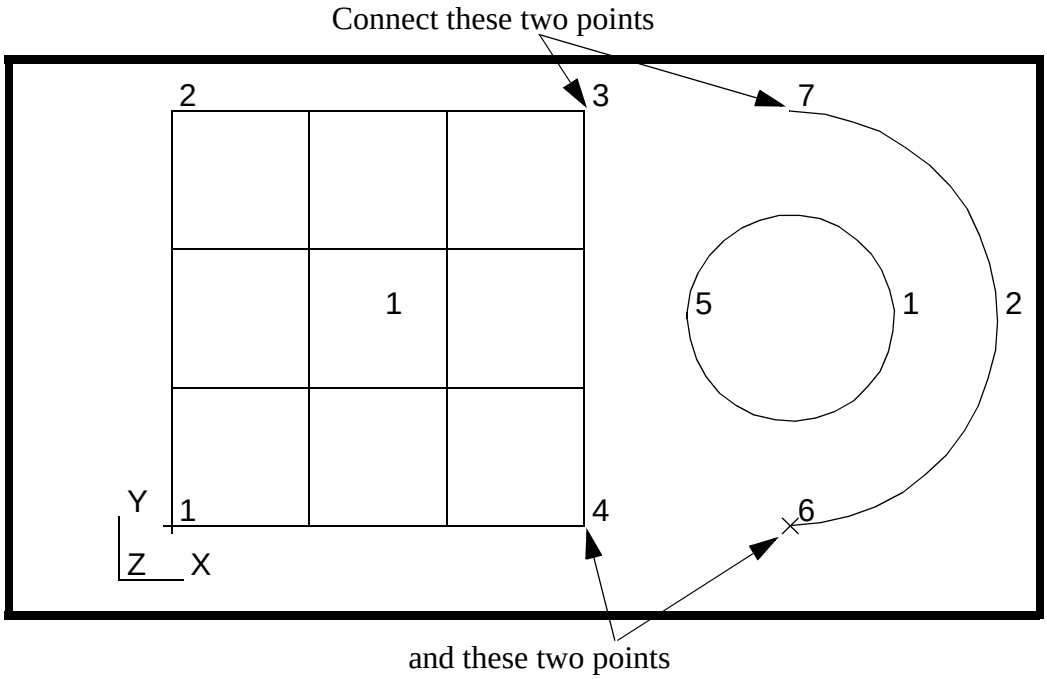
Turn on curve label by selecting the **Label Control** icon from the toolbar.

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.

Chaining to Create Curves

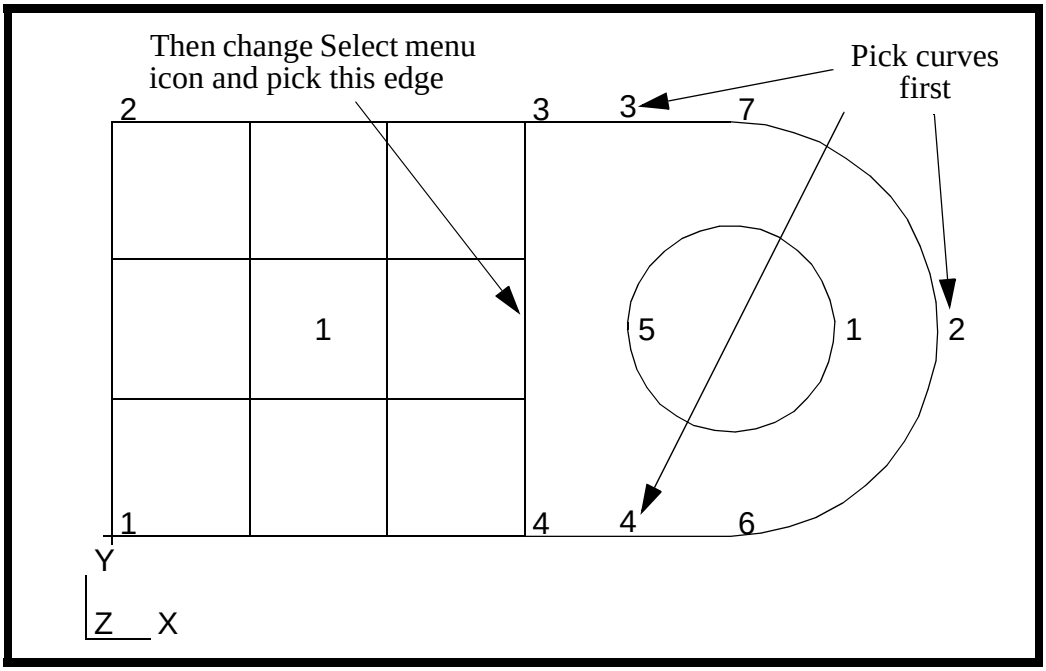
The outer boundary of the clevis model will be defined as a single curve by chaining the different segments of the outer boundary.

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.



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

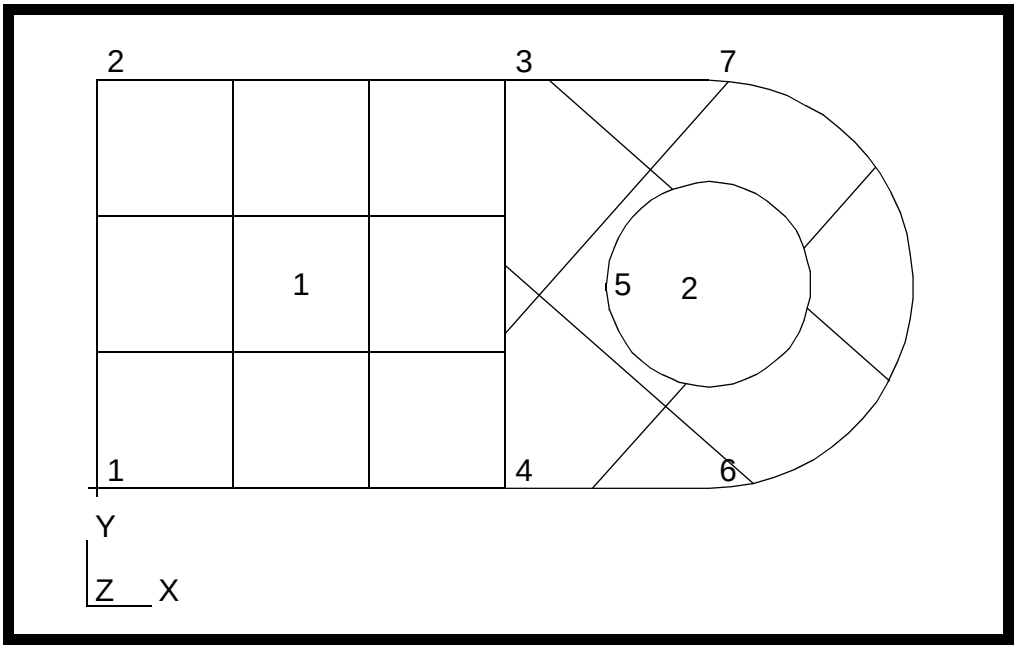
Create a Trimmed Surface

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.

Your model will appear as shown below.



5. 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

Sweeping Finite Elements

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

Action:	**Sweep**
Object:	**Element**
Method:	**Normal**

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

Number **3**

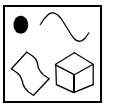
OK

Normal Length **0.75**

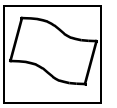
Delete Original Elements

Base Entity List **Surface 1**

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



pick the **Meshed Surface** icon.



Then select **Surface 1**.

Apply

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

Mesh Control...

Number **1**

OK

Normal Length **0.25**

Delete Original Elements

Base Entity List **Surface 2**

Apply

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.

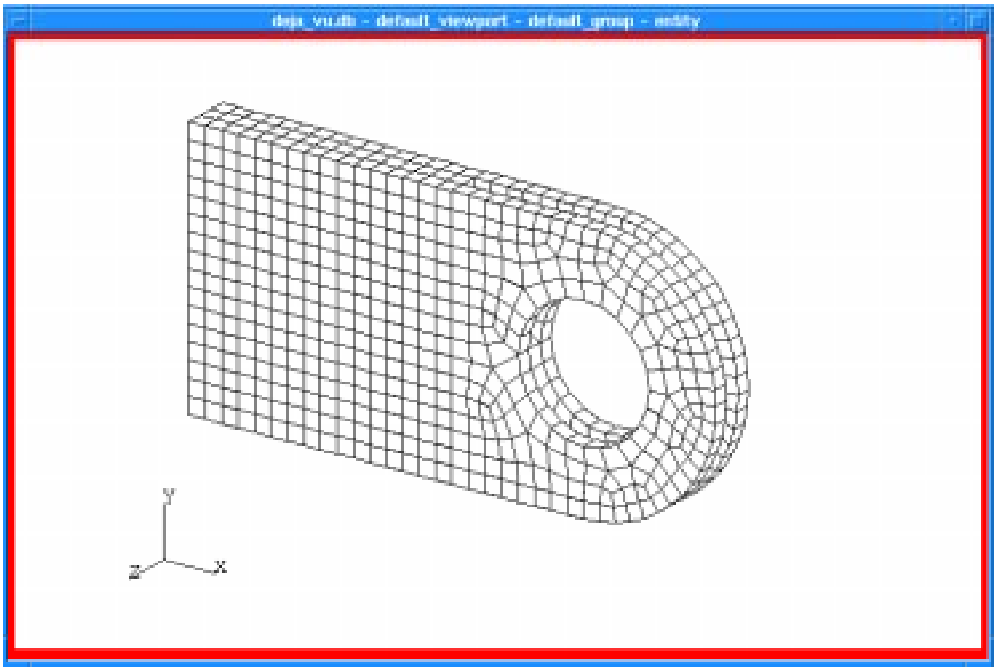
Action: **Transform**

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