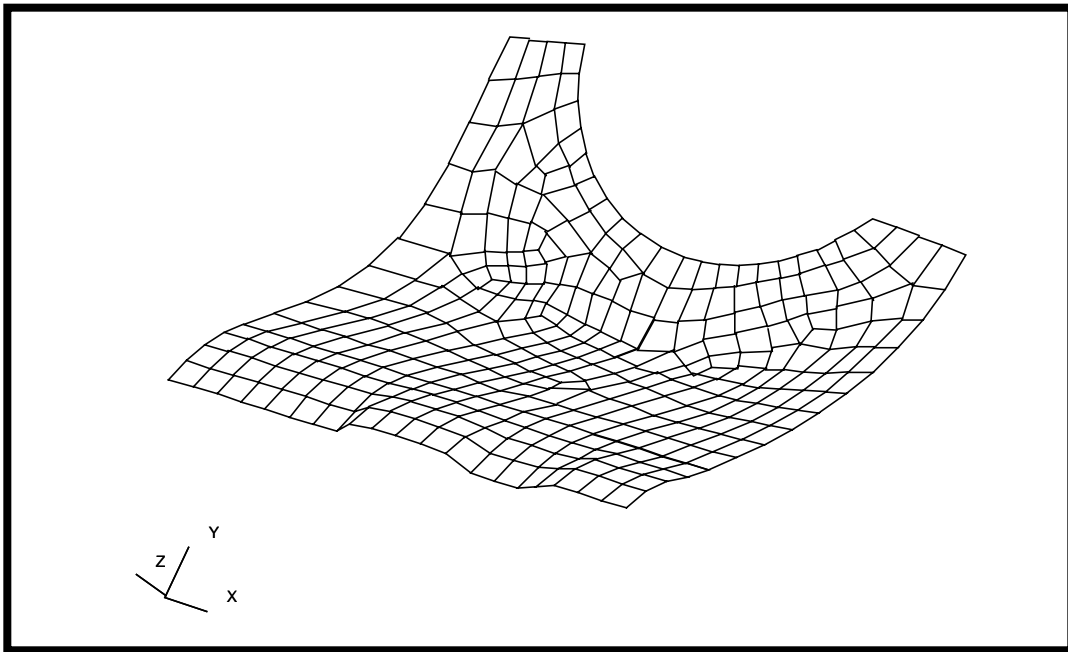

LESSON 4

Composite Trimmed Surfaces



Objectives:

- Import a CAD model into a database.
- Repair disjointed surfaces by creating composite surfaces.
- Mesh the newly created composite surfaces

Model Description:

In this exercise, a CAD file for an oilpan is imported into a database. However, the translation leads to certain gaps and discontinuities in the geometric model. In order to create a suitable mesh for analysis, the geometry needs to be “cleaned up”. This is where the concept of composite surfaces arises.

You will be taking many disjointed surfaces which represent the surface of the oilpan and combining them in a series of what are known as a composite surfaces. These newly created composite surfaces will then be meshed.

Exercise Procedure:

1. Open a new database. Name it **oilpan**.

Type **p3** in your xterm. The *Main Window* and *Command Window* will appear.

File/New ...

New Database Name

oilpan

OK

The viewport (PATRAN’s graphics window) will appear along with a *New Model Preference* form. The *New Model Preference* sets all the code specific forms and options inside MSC/PATRAN.

In the *New Model Preference* form set the *Tolerance* to **Default**.

Tolerance:

◆ **Default**

Analysis Code:

MSC/NASTRAN

Analysis Type:

Structural

OK

2. Import the oilpan geometry.

File/Import ...

Object:

Model

Source:

Neutral

Neutral Files:

oilpan_prt.out.1

Apply

You will get a summary of where the file comes from. When asked if you wish to continue, respond with **Yes**.

Yes

Using the following toolbar icons, change the display and view to get a better representation of the model you have just imported.



Iso2 View



Smooth Shaded

3. Check the model for geometric incongruities.

First, change the render style using the following toolbar icon:



Wireframe

◆ Geometry

Action:

Verify

Object:

Surface

Method:

Boundary

Surface List:

select all surfaces on screen

Apply

A warning message will appear, stating that “Free Edges and/or Non-manifold Edges exist.” Clear this warning.

OK

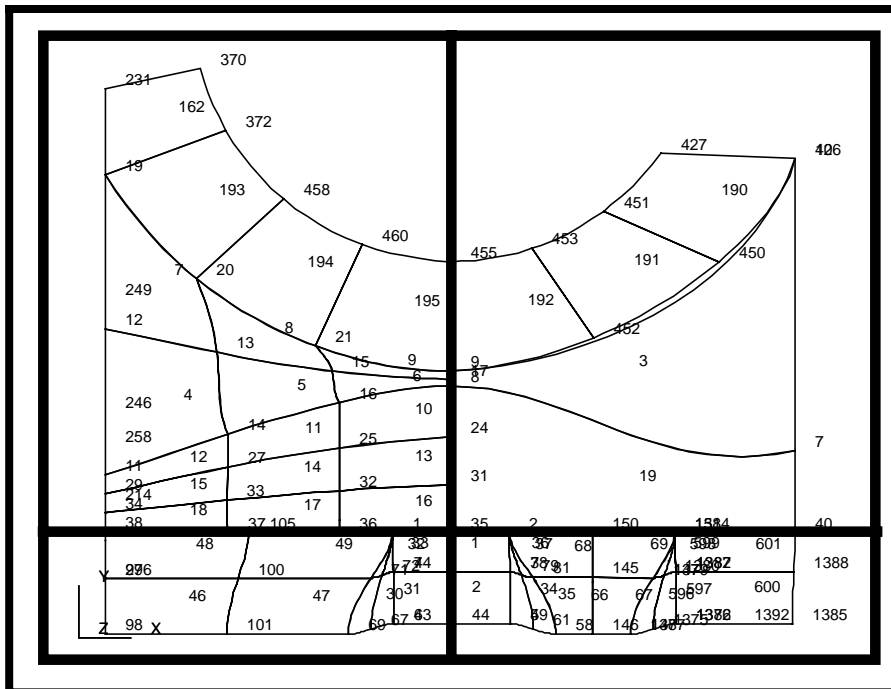
From the markers displayed on the interior of the model, you can see that there is a non-congruity problem which will affect the meshing process. That is, the mesh will not be compatible at the common boundary of non-congruent surfaces.

Composite Trimmed Surfaces

This problem can be fixed with the **Composite Trimmed Surface** tool in the *Geometry* form.

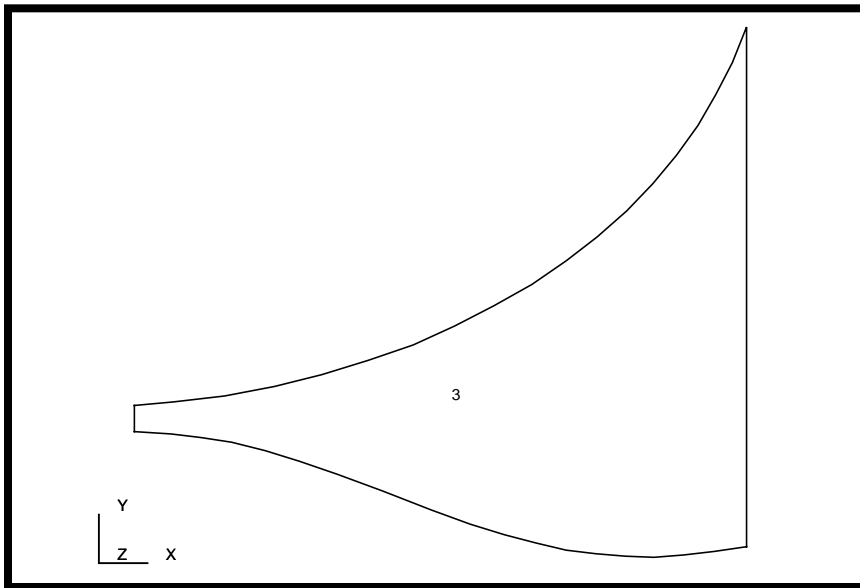
Several surfaces can be combined into a new simple or trimmed surface that will match adjacent surface boundaries.

A plan has to be developed for this issue. The following procedure will outline this plan:



The model will be divided into four quarters. The surfaces in each of the quarters will be used to construct a single, composite surface for that quarter of the model. The four newly created composite surfaces will then be meshed and equivalenced, creating a single, fluid, consistent mesh which can be used for purposes of analysis.

Also, shapes can be improved to eliminate distortion in the mesh, such as the following surface:



Change the display to a view which will make editing the model much easier.



Front View

Clear the *Update Graphics* form.

OK

4. Create the first (of four) composite surfaces.

◆ **Geometry**

Action:

Create

Object:

Surface

Method:

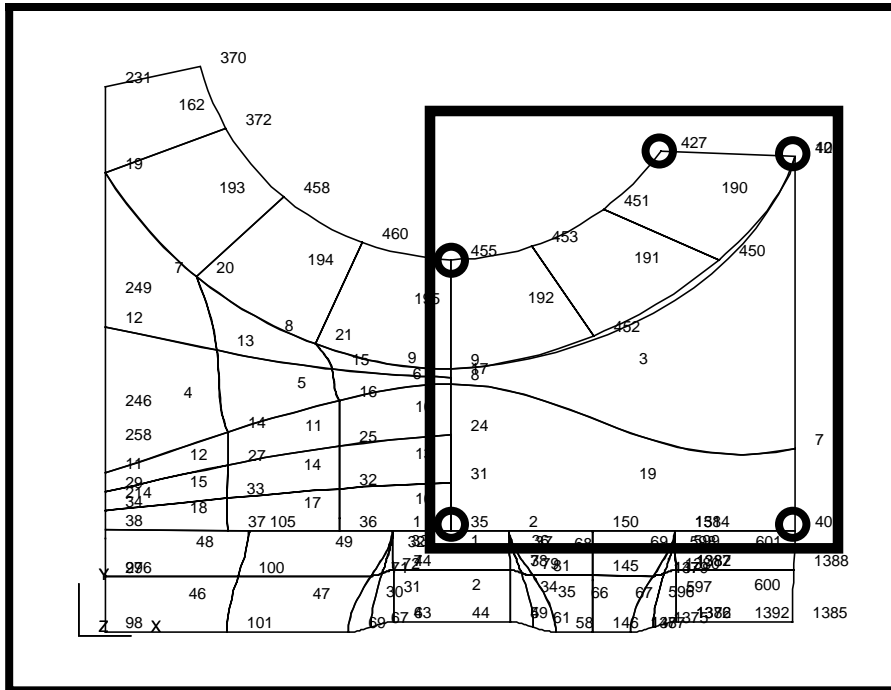
Composite

Surface List:

select surfaces in the upper right quarter of the model

Vertex List:

select the 5 points which form the outside corners of the selected surfaces



Preview Boundary

PATRAN now displays a message stating that the tolerance you presently have set (the Default of .005) is too strict for the model, and suggests a new tolerance to use. Clear the tolerance question message, accepting the new suggested tolerance:

Yes

A warning message will appear, explaining what the different colors represent in the preview. A summary of this message is as follows:

- White - free edges within the current selection
- Dark Blue - edges shared by two surfaces
- Light Blue - edges shared by more than two surfaces
- Red - edges that are not part of the boundary

If you need to know what the colors represent again, consult the above information. For now, clear the warning message:

OK

Modify Boundary:

◆ **Remove**

Edge List:

190.3 191.3 192.3 3.2 (the white surfaces that form an internal gap)

Apply

The reason you are removing the above edges is simple: PATRAN finds that these internal edges form a gap that exceeds the new tolerance while constructing the composite surface. These gaps must be reconciled so that the outer loop of the created composite surface is closed

A message will appear, stating that PATRAN believes it has found a better view to edit the model from. Ignore this suggestion.

No

An error message appears, stating that the gap is too big and that a new tolerance is needed. Clear this message and adjust the tolerance.

OK

Options ...

Cleanup Tolerance:

0.3

Gap Distance:

0.3

OK

Apply

A message will appear, stating that PATRAN believes it has found a better view to edit the model from. Ignore this suggestion.

No

Another message will appear, asking if you wish to delete the original surfaces. Respond **Yes**.

Yes

Clean up the display with the following toolbar icon



Refresh Graphics

Composite Trimmed Surfaces

You now have one of the four composite surfaces constructed. The procedure for building the other three is nearly identical.

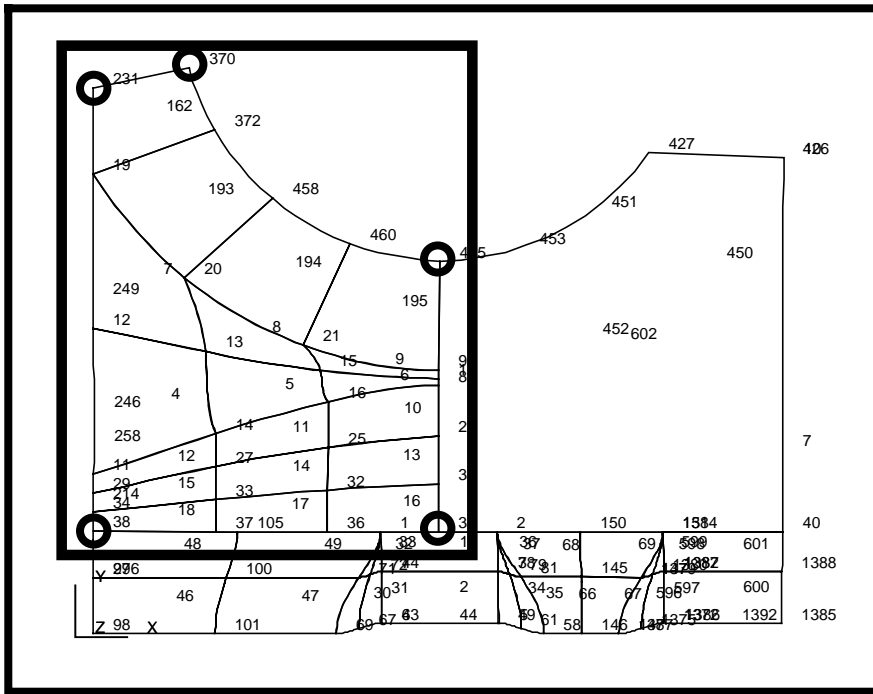
5. Create a composite surface for the surfaces in the upper left quarter of the model.

Surface List:

select surfaces in the upper left quarter of the model

Vertex List:

select the 5 points which form the outside corners of the selected surfaces



Options ...

Defaults

OK

The reason you are resetting the tolerances to the default is as follows: Suppose somewhere in you model there were gaps that were intentional. If the gap and cleanup tolerance is set too high, it is

possible that PATRAN will simply close these gaps in an attempt to “clean up” the model. By resetting the tolerances to the obviously small default tolerance, you can view each of the gap instances as they arise. This way, all gap closures are completely intentional.

Preview Boundary

Clear the tolerance question message, accepting the new suggested tolerance:

Yes

There are no interior gaps (white lines), so continue with the process.

Reset

Apply

A message will appear, stating that PATRAN believes it has found a better view to edit the model from. Ignore this suggestion.

No

Another message will appear, asking if you wish to delete the original surfaces. Respond **Yes**.

Yes

Clean up the display with the following toolbar icon



Refresh Graphics

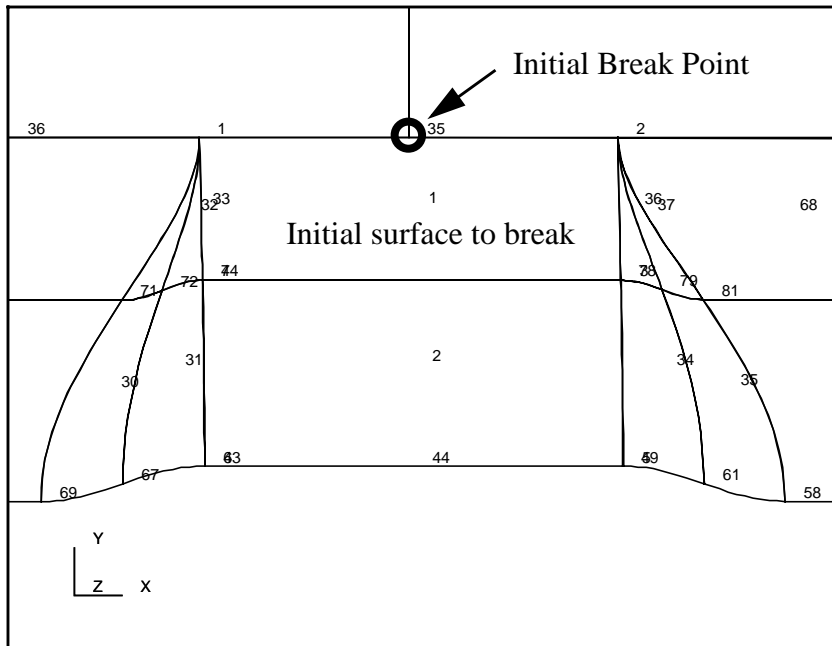
6. Break the middle surface at the bottom of the model in order to create the bottom two quarters.

Zoom in on the bottom middle surfaces of the model using the following toolbar icon:



View Corners

You should see the following in your viewport:



Action:

Edit

Object:

Surface

Method:

Break

Option:

Point

Surface List:

1

Break Point List:

35

A message will appear, asking if you wish to delete the original surfaces. Respond **Yes**.

Yes

Surface List:

2

Break Point List:

1393 (newly created point!)

Another message will appear, asking if you wish to delete the original surfaces. Respond **Yes**.

Yes

It is very important that as you break the surfaces, you start with one break point (in this case, Point 35) and continue to use the points generated by the breaking for the next surface break point. This insures that the surfaces are connected at the generated points.

Redisplay the model using the following toolbar icon:



Fit View

7. Create a composite surface for the lower right quarter of the model.

Action:

Create

Object:

Surface

Method:

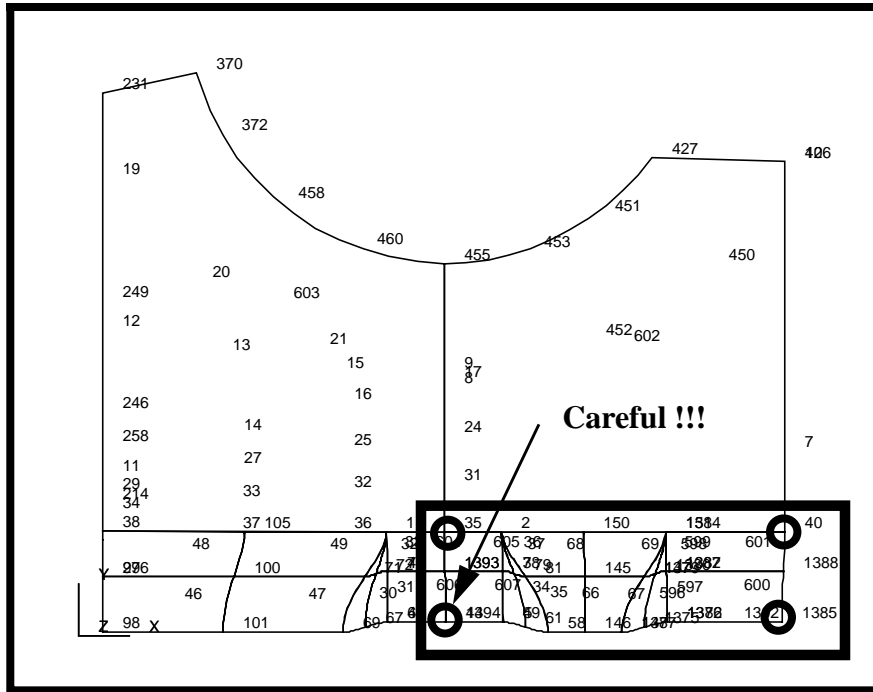
Composite

Surface List:

select surfaces in the lower right quarter of the model

Vertex List:

select the 4 points which form the outside corners of the selected surfaces (be sure to select the newly created Point 1394 for the lower left!)



Options ...

Defaults

OK

Preview Boundary

Clear the tolerance question message, accepting the new suggested tolerance:

Yes

In order to better see the edges you will have to remove, zoom in on that region using the following toolbar icon:



View Corners

Modify Boundary:

◆ Remove

Edge List:

69.2 598.4 67.2 596.4
(the white surfaces that form
an internal gap)

Apply

A message will appear, stating that PATRAN believes it has found a better view to edit the model from. Ignore this suggestion.

No

Another message will appear, asking if you wish to delete the original surfaces. Respond **Yes**.

Yes

Clean up the display with the following toolbar icon



Refresh Graphics

Redisplay the model using the following toolbar icon:



Fit View

8. Create a composite surface for the lower left corner of the model.

Action:

Create

Object:

Surface

Method:

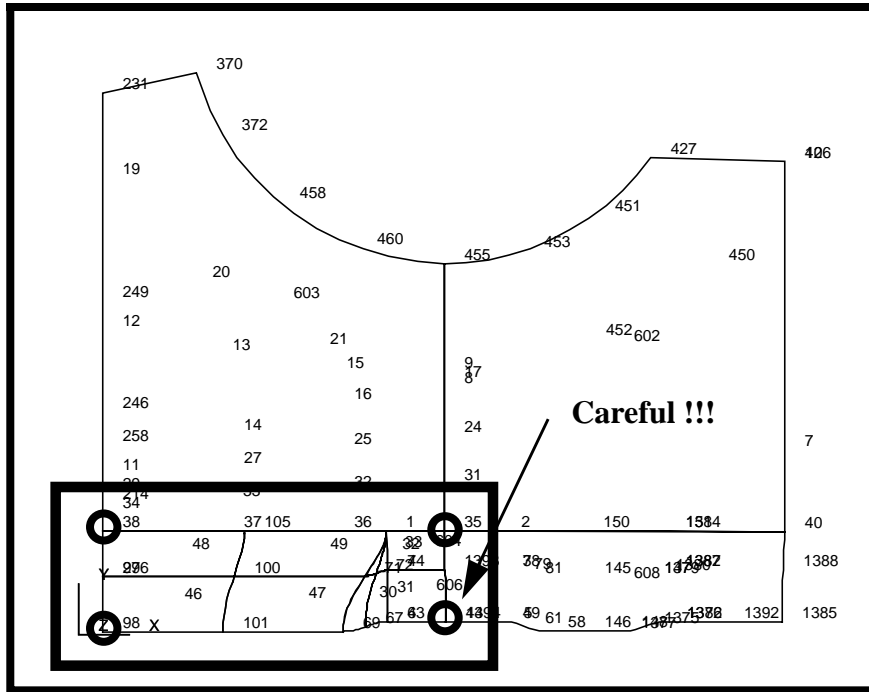
Composite

Surface List:

select surfaces in the lower left
quarter of the model

Vertex List:

select the 4 points which form
the outside corners of the
selected surfaces (be sure to
select the newly created Point
1394 for the lower right!)



Options ...

Defaults

OK

Preview Boundary

Clear the tolerance question message, accepting the new suggested tolerance:

Yes

There are no interior gaps (white lines), so continue with the process.

Reset

Apply

A message will appear, stating that PATRAN believes it has found a better view to edit the model from. Ignore this suggestion.

No

Another message will appear, asking if you wish to delete the original surfaces. Respond **Yes**.

Yes

Clean up the display with the following toolbar icon



Refresh Graphics

Now change the view using the following toolbar icon:



Iso2 View

9. Check the model once again to verify that there are no geometric incongruities.

Action:

Verify

Object:

Surface

Method:

Boundary

Surface List:

select all surfaces on screen

You should now see red lines surrounding each of the four newly created composite surfaces. Clear the markers from the view.

Update Graphics ...

Erase Markers

OK

Reset the display to **Front View** using the following toolbar icon:



Front View

10. Create mesh seeds for the model.

◆ Finite Elements

Composite Trimmed Surfaces

Action:

Create

Object:

Mesh Seed

Method:

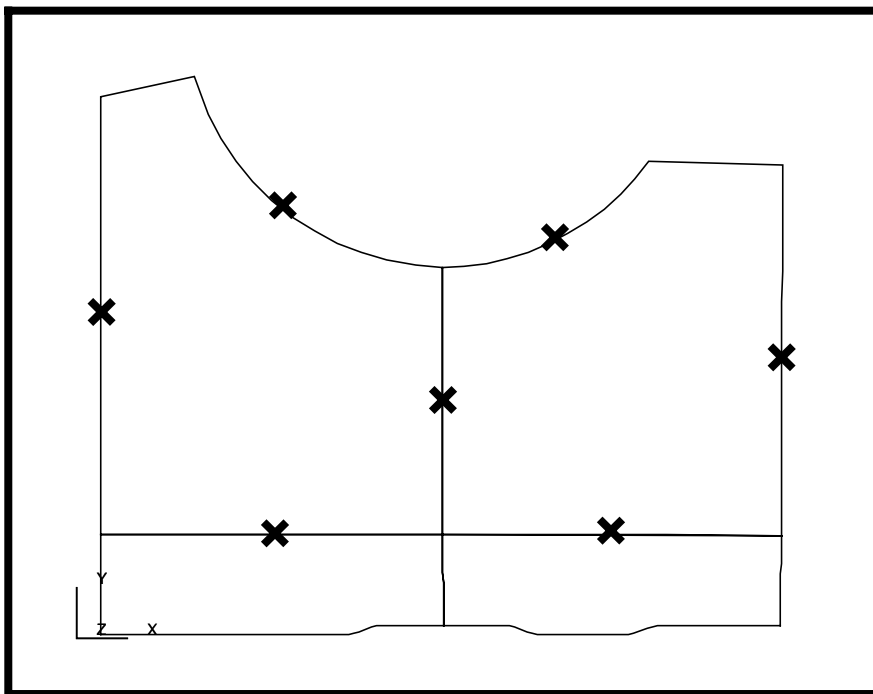
Uniform

Number of Elements:

10

Curve List:

select the 7 big edges (see the picture)



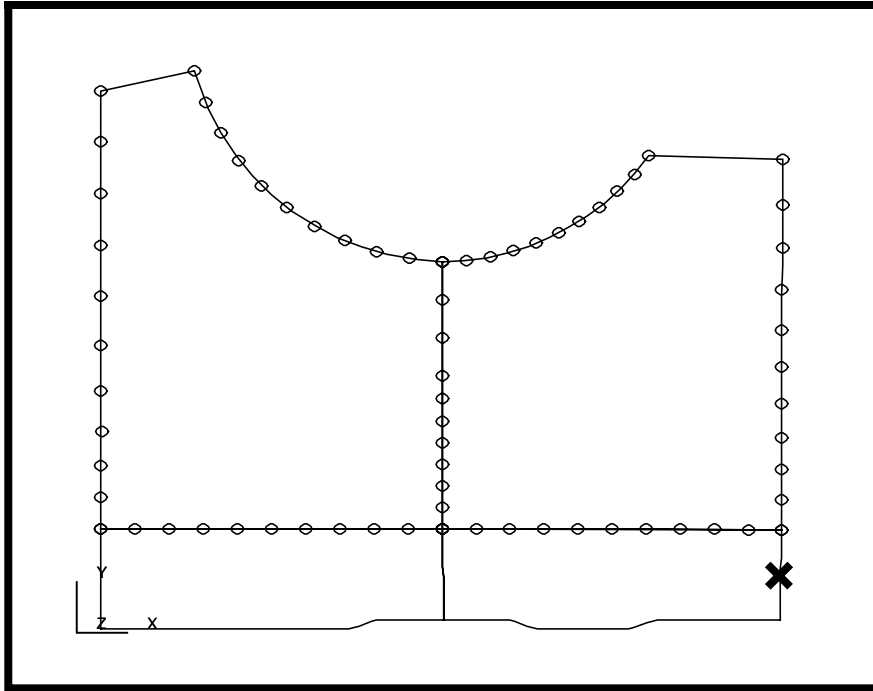
Apply

Number of Elements:

4

Curve List:

select the lower right green edge (see the picture)



Apply

11. Create the mesh for the model.

First, make sure the entity labels are turned off by using the following toolbar icon:



Hide Labels

Then, create the mesh for the top surfaces using **Paver**.

Action:

Create

Object:

Mesh

Method:

Surface

Global Edge Length:

5.0

Mesher:

◆ **Paver**

Paver Parameters ...

■ **Use Desired Edge Lengths**

Min. Edge Length:

4.8

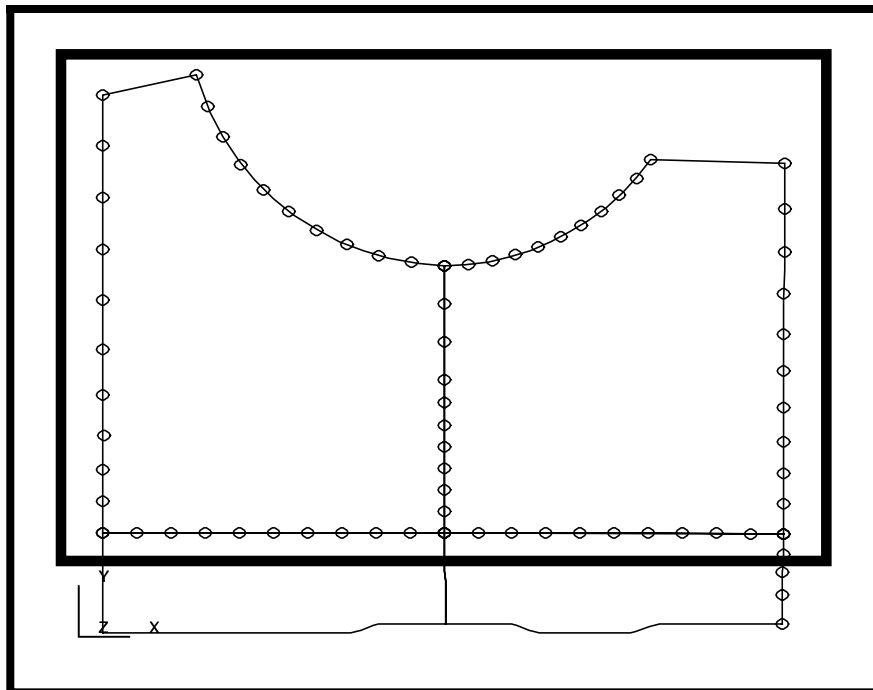
Max. Edge Length:

5.2

OK

Surface List:

select the two top (magenta) surfaces



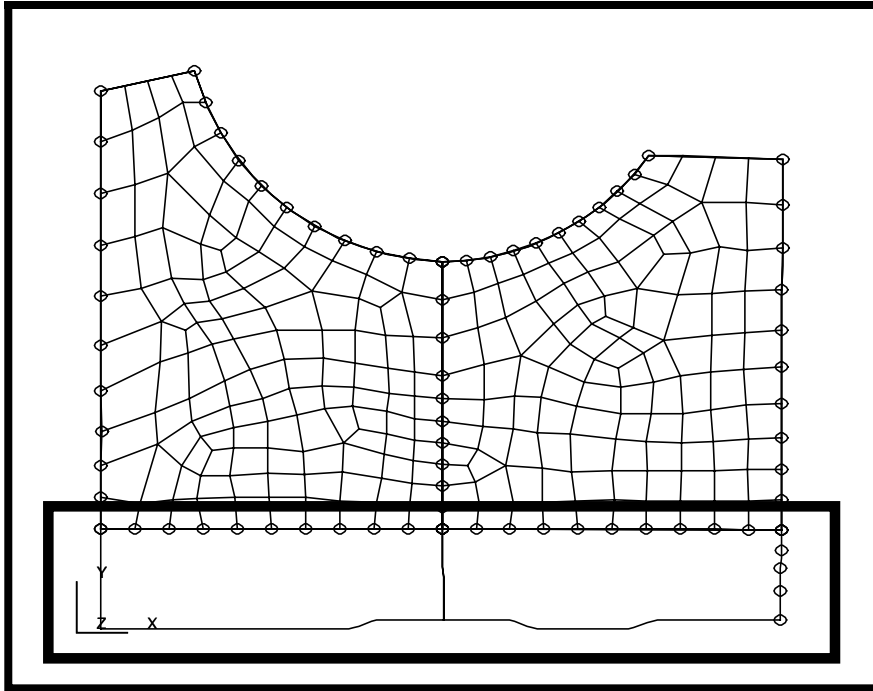
Apply

Mesher:

◆ IsoMesh

Surface List:

select the two bottom (green) surfaces



Apply

12. Equivalence the mesh.

Action:

Equivalence

Object:

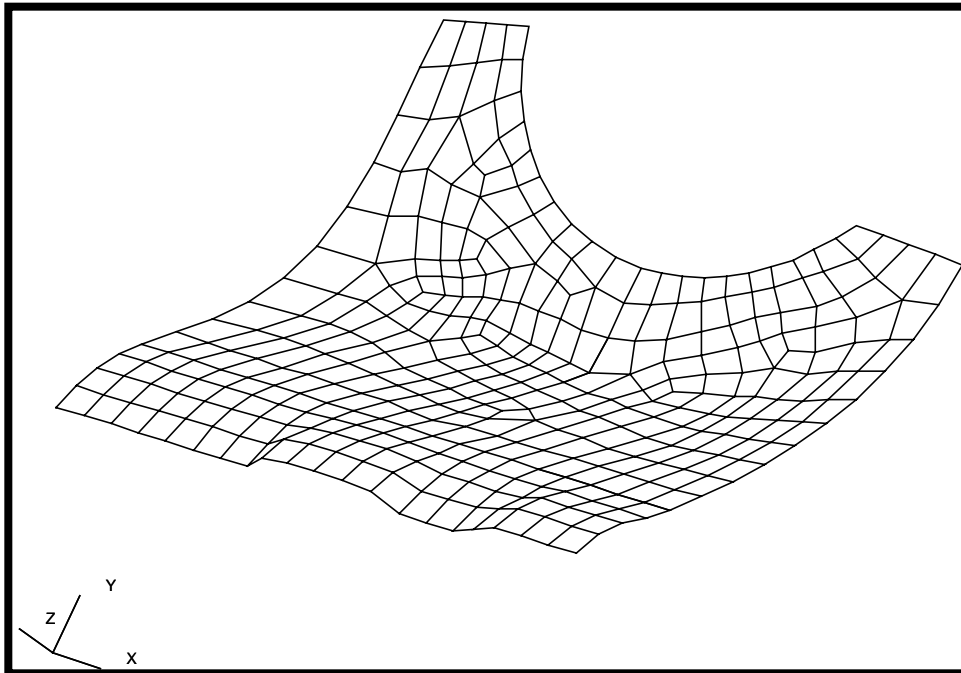
All

Method:

Tolerance Cube

Apply

You now have one fluid, consistent mesh for the oilpan.



To clear the equivalenced node markers, simply re-equivalence:

Apply

To get a good perspective on the results of your efforts, change the view by doing the following:

Display / Plot/Erase ...

Erase All Entities

Plot All Posted FEM

OK

Viewing/Angles ...

Angles:

-27 -31 -29

Apply

Cancel

Display/Light Sources ...

Post/Unpost Light Sources:

directional_1
directional_3

NOTE: Use <ctrl> clicking to individually select/deselect the light sources.

Apply

Cancel

Now, plot the mesh in a smooth, shaded render style by using the following toolbar icon:



Smooth Shaded

To see how closely this mesh approximates the geometry, do the following:

Display / Plot/Erase ...

Erase All Entities

Plot All Posted Geometry

OK

This ends the exercise.