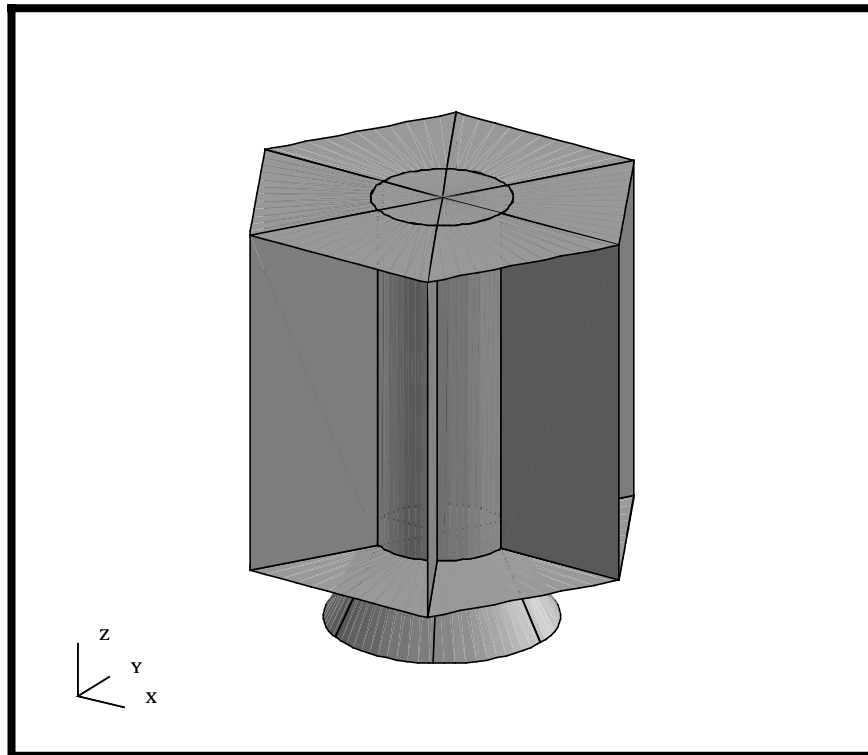

LESSON 1

Geometry Model of a Space Satellite



Objectives:

- Create the geometry for Satellite.
- Create group for each part of the Satellite.
- Change the graphics display.

Model Description:

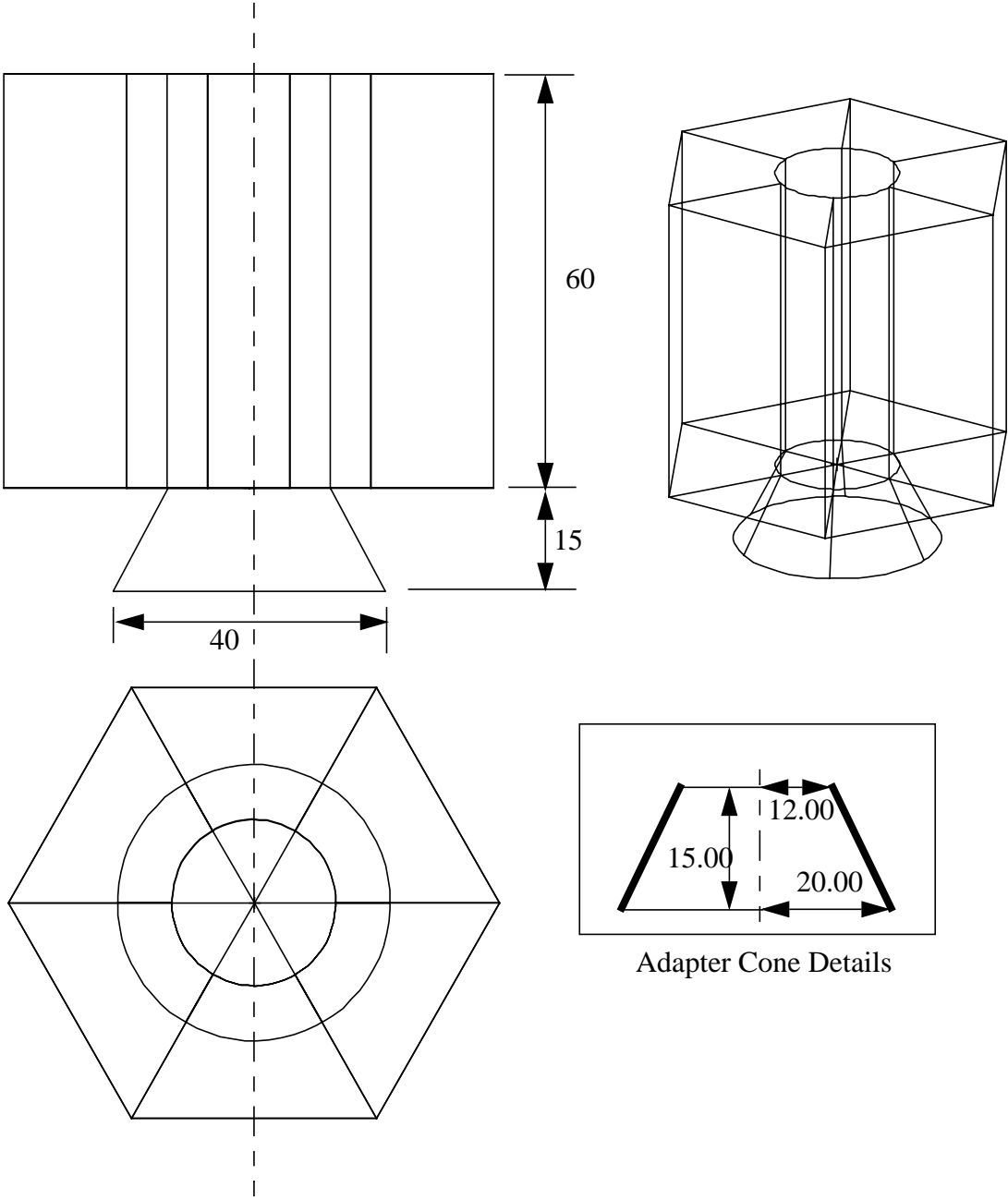
Shown below is a drawing of the Satellite you will be building as well as the suggested exercise steps. The concept for the Satellite series of exercises was presented to MSC by Carl Woo of TRW Space and Communications, El Segundo. The Satellite is made of many thin structures, which will be idealized as plate elements in later exercises. Some of the secondary structures, such as the propulsion module, navigational platform, and science experiments, will be idealized as lumped masses with the supporting structure. Thus, for modeling purposes, this model is composed primarily of surfaces. The model will be initially broken up into 6 groups, each representing a separate piece of the structure. These groups include:

- Lower Platform
- Upper Platform
- Adapter Cone
- Shear Panels
- Central Cylinder
- All Geometry

In this exercise, you will create the geometry for a Satellite by defining MSC/PATRAN points, curves, surfaces and two user defined coordinate systems; one coordinate system locates the vehicle for On-Orbit and the other locates the vehicle for Launch. Throughout this exercise, you will become familiar with the use of the MSC/PATRAN *Geometry* and *Group* menus. You will also be introduced to *Viewing* methods and shown how to change your model's render style.

In later exercises, we will mesh the geometry with Quad and Bar elements, and assigning appropriate properties and materials. We will use MSC/PATRAN to verify the model mass properties and elements to ensure model integrity. We will be submitting and analyzing the model using MSC/NASTRAN. The final step will be reviewing the result using MSC/PATRAN. Therefore, do not delete the model database when you are finished with this exercise. We will be utilizing the model again for later exercises.

Figure 1.1. Geometry specifications for the Satellite.



Suggested Exercise Steps:

- Create a new database and name it as **satellite.db**.
- Create a group for the Lower Platform.
- Build 1/6 surface for the Lower Platform.
- Complete the Lower Platform surfaces by rotating the surface you just created with an angle of 60 degrees and with a repeat factor of 5.
- Create a group for the Upper Platform.
- To create the Upper Platform, transform the Lower Platform surfaces with 60 units in the +Z direction.
- Create a group for the Central Cylinder.
- Build the Central cylinder surfaces by connecting two inner curves of the Lower and Upper Platforms together.
- Create a group for the Shear Panels.
- Extruding the radial lines of the Lower Platform to complete the Shear Panels surfaces. The extrude distance is 60 units in the +Z direction.
- Create a group for the Adapter Cone.
- Create 1/6 surface for the Adapter Cone by defining an axisymmetric slice and revolving it 60 degrees.
- Complete the Adapter Cone geometry by revolving 1/6 created surface with an angle of 60 degrees and with a repeat factor of 5.
- Create a group that contains all the geometry.
- Write out an IGES file of the geometry.
- Close the database and Quit MSC/PATRAN.

Exercise Procedure:

*Note: In most MSC/PATRAN forms, the default setting for the **Auto Execute** button is on; thus, you do not need to press **Apply**.*

Open a New Database

1. Create a new database and name it as **satellite.db**.

File/New...

New Database Name

satellite

OK

New Model Preferences

Tolerance

Default

OK

2. The first component you shall build is the Lower Platform. Let's create a group for it.

There are many ways of grouping entities inside MSC/PATRAN. The method used in this exercise is to create groups prior to building any entities. This way, any new entities will automatically be placed into the current group.

Group/Create...

New Group Name

Lower Platform

Make Current

Unpost All Other Groups

Apply

Cancel

3. Before we get started, we will change the view using the Toolbar to an Isometric view



Isometric View 3

Reset the View

Create Curves Using XYZ Method

4. Create the geometry for Lower Platform. We will start by creating two curves that represent a radial slice.

◆ Geometry

*Action:***Create***Object:***Curve***Method:***XYZ***Vector Coordinates List***<12, 0, 0>***Origin Coordinates List***[0, 0, 0]****Apply**

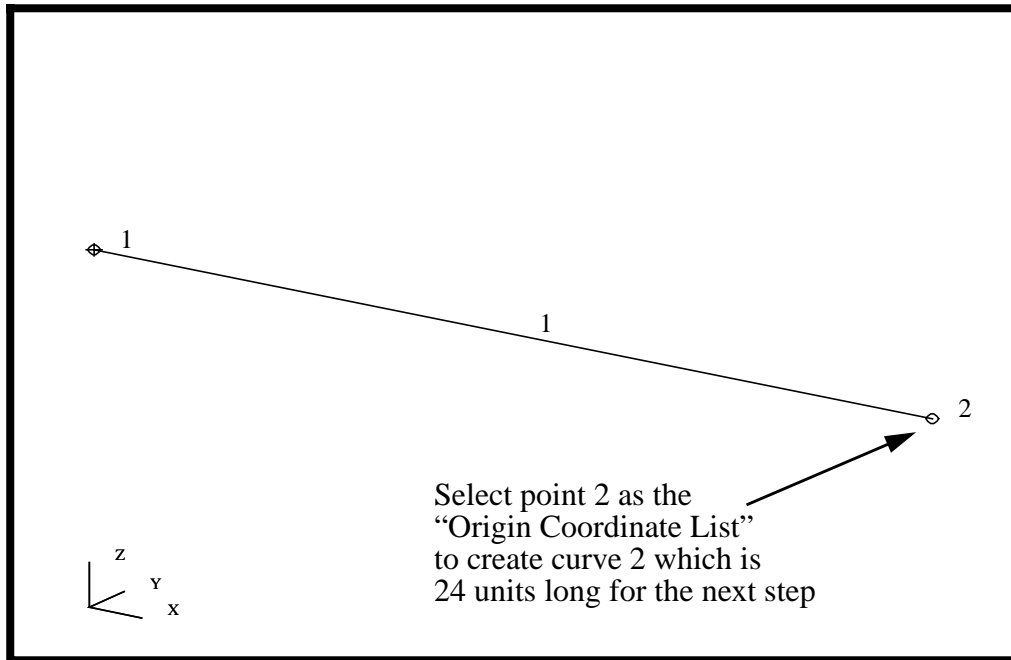
This automatically creates the curve with two end points. To see the newly created points a more clearly, simply increase the point size using the Toolbar icon.

**Point Size**

Also turn on the Show Labels using the following toolbar icon.

**Show Labels**

Figure 1.2. The first radial line for the Lower Platform.



We will create the second portion of slice by extending the curve, from point 2, for 24 units.

Action:

Create

Object:

Curve

Method:

XYZ

Vector Coordinates List

<24, 0, 0>

Origin Coordinates List

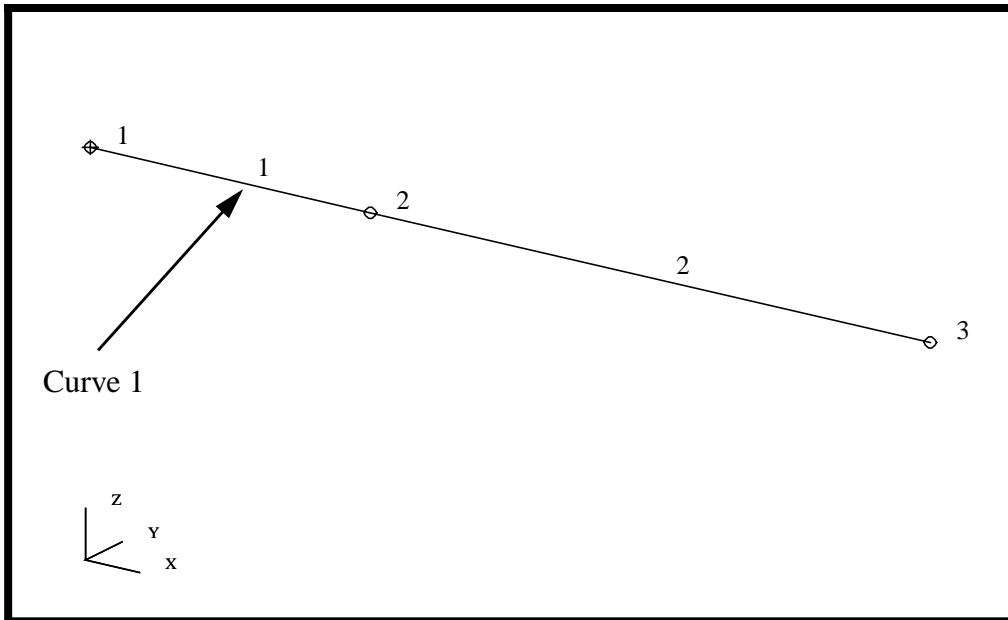
Point 2

Note: This point can be selected using your mouse as shown in the Figure 1.2

In most MSC/PATRAN forms the default setting for the **Auto Execute** button is On. If the **Auto Execute** button is on, the curve will be automatically created. If the **Auto Execute** switch is off and the point has been selected, hit:

Apply

Figure 1.3. The completed radial slice of the Lower Platform.



5. Create the first 1/6 surface of the Lower Platform by revolving Curve 1 with an angle of 60 degrees.

Action:

Create

Object:

Surface

Method:

Revolve

Total Angle

60

Curve List

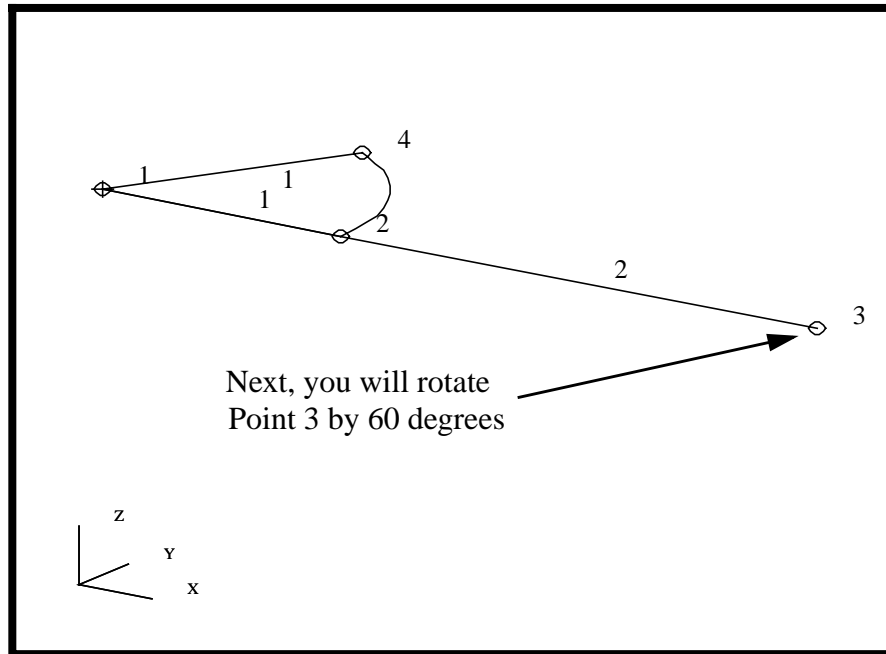
Curve 1 

Note: This curve can be selected using your mouse, see Fig. 1.3

Creating 1/6 of the Lower Platform

Again, if the **Auto Execute** button is on, you do not need to press **Apply**.


Curves 1 & 2 and Surface 1 can now be seen in the Viewport
Figure 1.4. The first surface of the Lower Platform.



You will now use Point Transform to create the vertex for the outer edge of the satellite by radially rotating Point 3 by 60 degrees

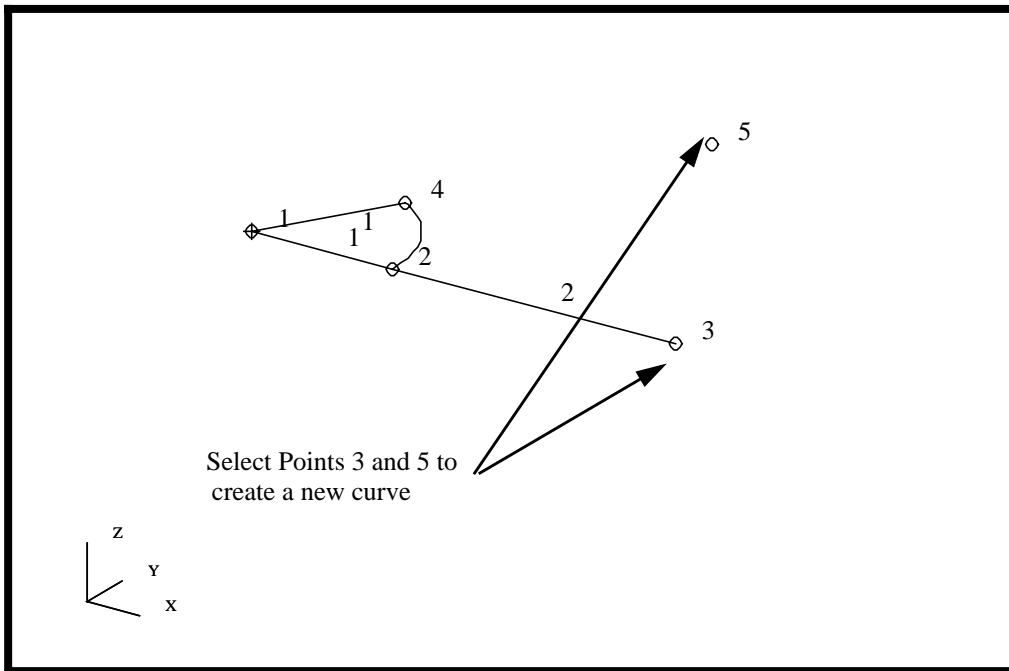
This process was rather simple, since the desired coordinate system and axis were already defined by the defaults for the form.

Transform a Point by Rotation

<i>Action:</i>	Transform
<i>Object:</i>	Point
<i>Method:</i>	Rotate
<i>Rotation Angle</i>	60
<i>Repeat Count</i>	1
<i>Point List</i>	Point 3 (see Figure 1.4) 

Again, if the **Auto Execute** button is on, you do not need to press **Apply**.

Figure 1.5. Selected points to create the out edge of the Lower Platform

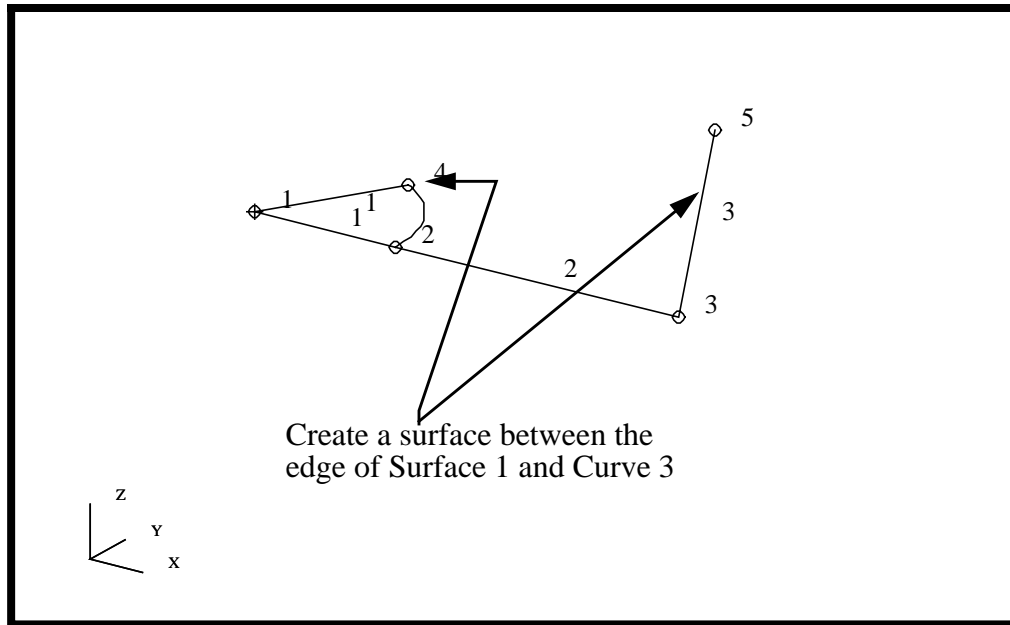


Next, we will connect Point 3 and 5 to create an outer edge curve for 1/6 Lower Platform.



<i>Action:</i>	Create
<i>Object:</i>	Curve
<i>Method:</i>	Point
<i>Option:</i>	2 Point
<i>Starting Point List</i>	Point 3
<i>Ending Point List</i>	Point 5

Your model should now look like the figure below.

Figure 1.6. Selected edges to make the remainder of the 1/6 slice of the Lower Platform.



Finally, we will create the last surface to complete 1/6 segment of the Lower Platform. The curve will be constructed by using the newly created curve and the edge of Surface 1.

<i>Action:</i>	Create
<i>Object:</i>	Surface
<i>Method:</i>	Curve
<i>Option:</i>	2 Curve
<i>Starting Curve List</i>	See Fig. 1.6 
<i>Ending Curve List</i>	See Fig. 1.6 

To better visualize the surfaces, you can turn off the labels, reset the point size, and turn on the smooth shaded render style from the toolbar.



Labels Off



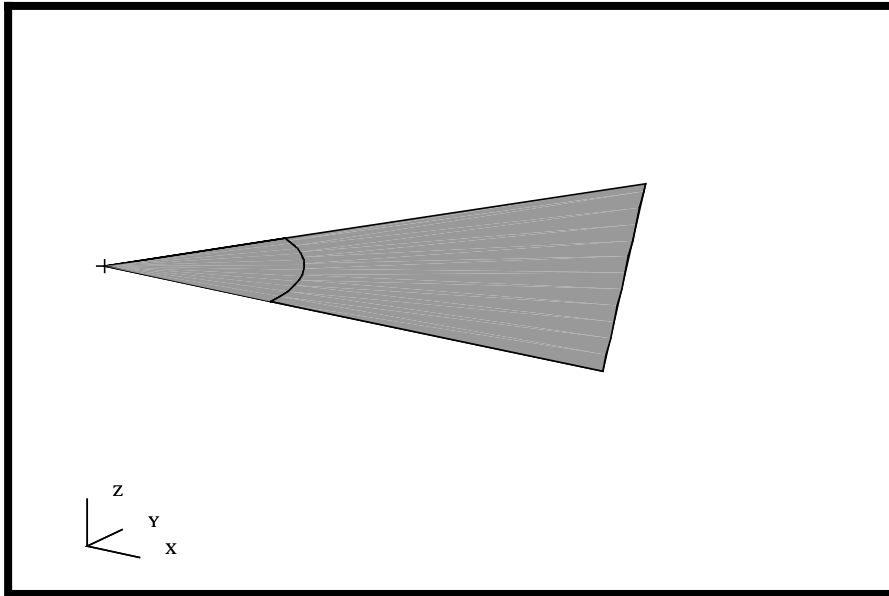
Point Size



Shaded Smooth

Your model should now look like the figure below.

Figure 1.7. 1/6 slice of the Lower Platform.



6. We will create the remaining surfaces for the Lower Platform. These surfaces will be created by rotating the slice just created with an angle of 60 degrees and five times.

Action:

Transform

Object:

Surface

Method:

Rotate

Rotation Angle

60

Repeat Count

5

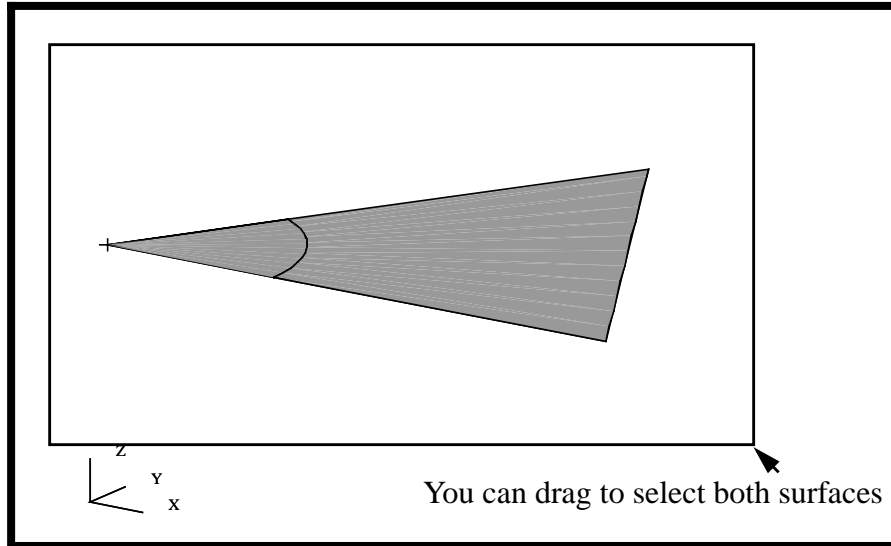
Surface List

Select all posted surfaces
(see Figure 1.8)

**Create the
Remainder
of the Lower
Platform**

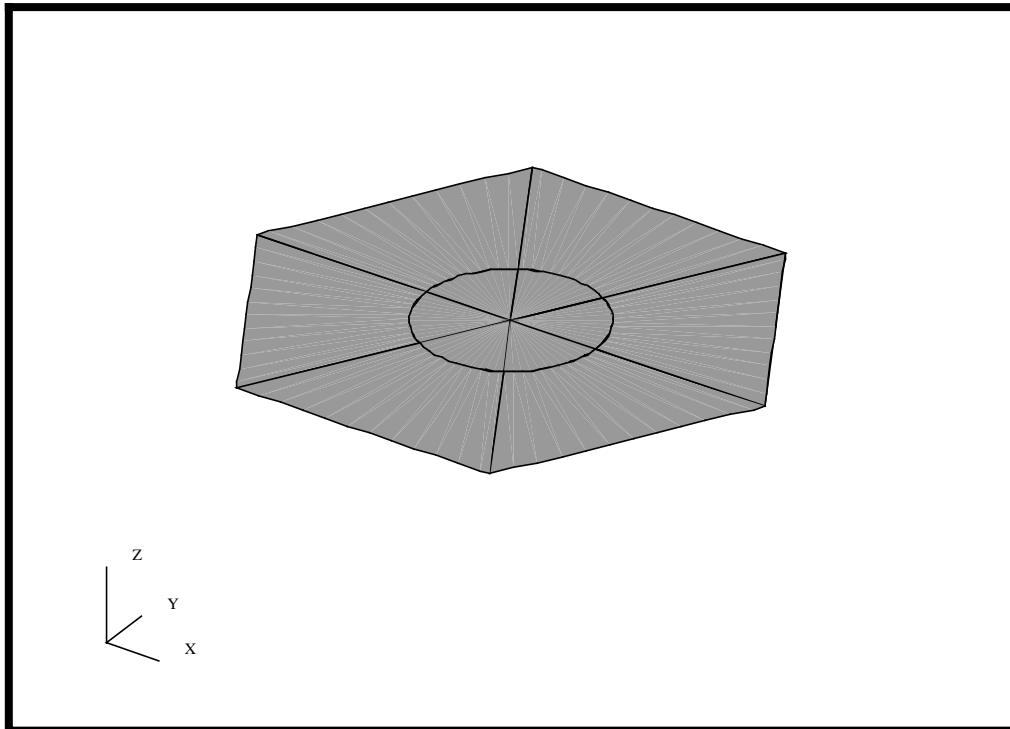
Note: You can drag select both surfaces using a rubberband pick as shown below

Figure 1.8. Using the rubberband pick method to select all the surfaces



You have now completed the creation of all the surfaces for the Lower Platform. We will use the surfaces from the Lower Platform to create the Upper Platform in the next step. Your model should now look like the figure below.

Figure 1.9. Lower Platform geometry in shaded image.



7. In this step, we will create a group for the Upper Platform.

Again, we will create a group prior to the creation of any new geometry. This way, any new entities will automatically be placed into the current group.

Create a Group for the Upper Platform

Group/Create...

New Group Name

Upper Platform

- Make Current**
- Unpost All Other Groups**

Apply

Cancel

8. We will create the geometry for the Upper Platform which is located 60 units above the Lower Platform by transforming the Lower Platform surface geometry.

Let's change the render style back to Wireframe using the Toolbar icons shown below.

Create the Geometry for the Upper Platform



Wireframe

We will now create the Upper Platform by transforming the all the Lower Platform surfaces in the +Z direction 60 units as follows:

Action:

Transform

Object:

Surface

Method:

Translate

Translation Vector

<0, 0, 60>

Repeat Count

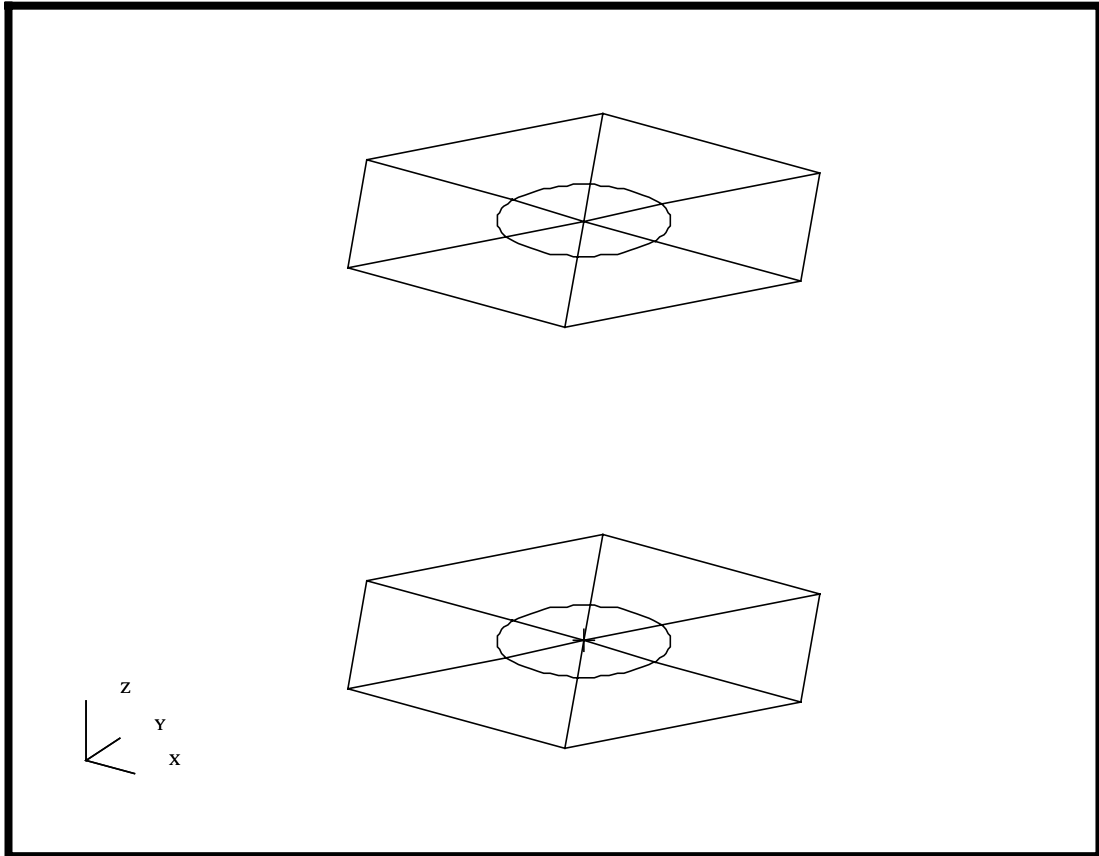
1

Surface List

Select all posted surfaces

Your model should now look like the figure below.

Figure 1.10. The Lower and Upper Platforms in wireframe.



Create a Group for the Central Cylinder

9. In this step, we will create a group for the Central Cylinder.

Again, this group will be created prior to the creation of any geometry. This way, any new entities will automatically be placed into the current group.

Group/Create...

New Group Name

Central Cylinder

Make Current

Unpost All Other Groups

Apply

Cancel

10. In this step, we will use 6 circular edges of the Lower and Upper Platform to create the surfaces for the Central Cylinder by using the *2 Curve* option.

Create the Geometry for the Central Cylinder



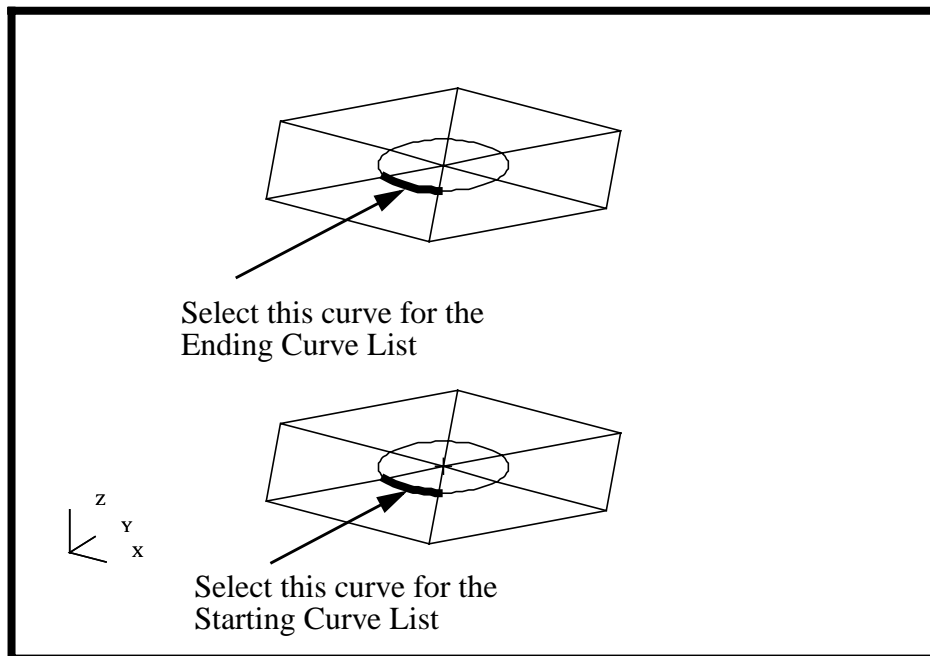
<i>Action:</i>	Create
<i>Object:</i>	Surface
<i>Method:</i>	Curve
<i>Option:</i>	2 Curve
<i>Starting Curve List</i>	See Figure 1.11 
<i>Ending Curve List</i>	See Figure 1.11 

Figure 1.11. The selected curves to create the Central Cylinder surfaces.



Repeat this step for the remaining 5 sets of Lower and Upper Platforms curve pairs to complete the Central Cylinder surfaces. As long as the Auto Execute is on, you can consecutively pick the inside edges and they will be extruded automatically.

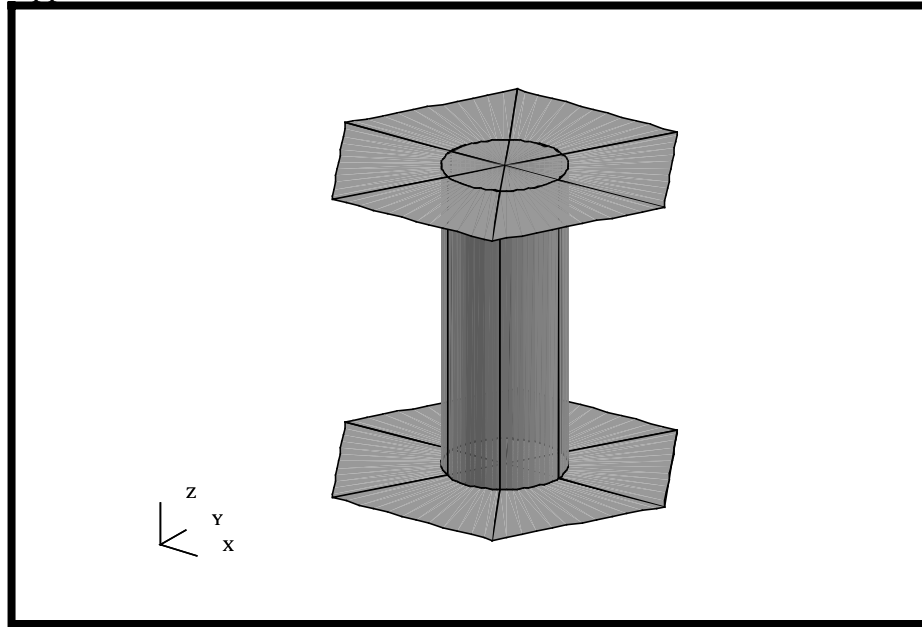
Again, to better visualize the surfaces, turn on the Smooth shaded render style from the Toolbar icons.



Smooth shaded

Your model should now look like the figure below.

Figure 1.12. The completed Central Cylinder surfaces shown with the Upper and Lower Platforms.



Let's change the render style back to Wireframe using the Toolbar icon shown below before we continue.



Wireframe

Create a Group for the Shear Panels

11. In this step, we will create a group for all the Shear Panels so any new entities will be automatically added to this group.

Group/Create...

New Group Name

Shear Panels

Make Current

Unpost All Other Groups

Apply

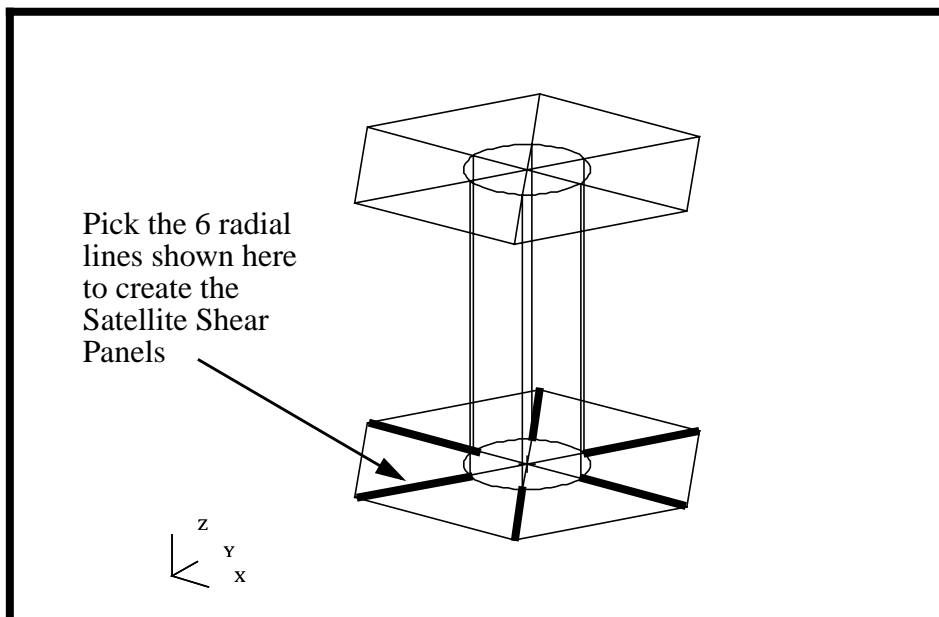
Cancel

12. We will use the 6 outer radial lines of the Lower Platform geometry to create the surfaces for the Central Cylinder. We could have created these surfaces using a 2 curve approach. To illustrate a different approach, we will use the Surface Extrude option to create the surfaces. We will define the Translation Vector of 60 units in the Z direction

Create the
Geometry
for the
Shear
Panels

<i>Action:</i>	Create
<i>Object:</i>	Surface
<i>Method:</i>	Extrude
<i>Translation Vector</i>	<0, 0, 60>
<i>Curve List</i>	see Figure 1.13 

Figure 1.13. The extruding radial lines to create the Shear Panels.



As long as the **Auto Execute** is on, you can consecutively pick the inside edges and they will be extruded automatically.

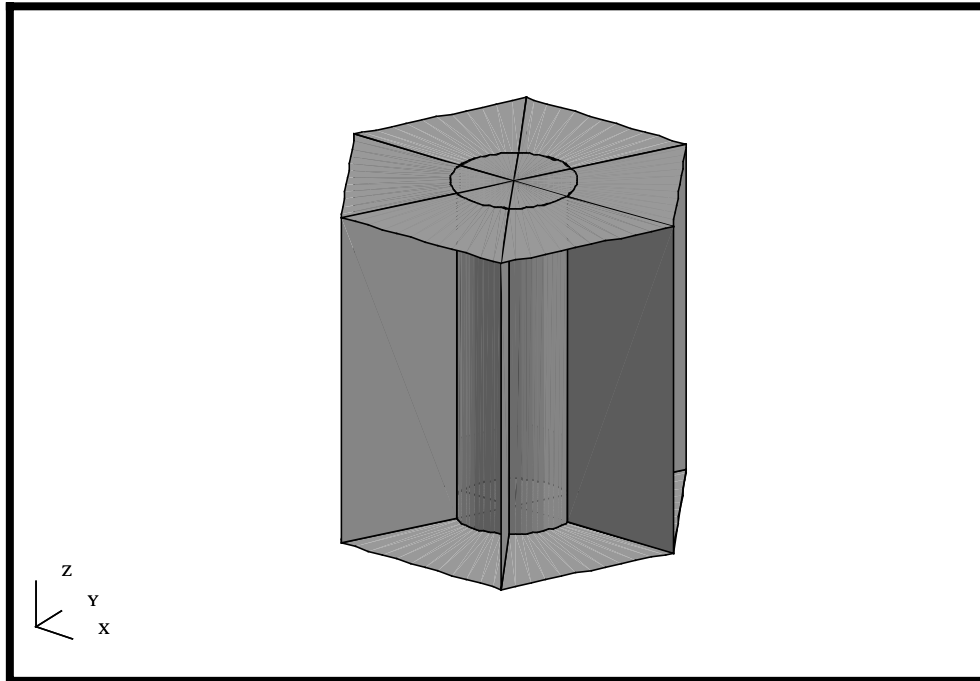
Again, to better visualize the surfaces, turn on the Smooth shaded render style from the Toolbar.



Smooth shaded

Your model should look like the figure below.

Figure 1.14. Shear Panels, Central Cylinder and Upper and Lower Platform.



Create a Group for the Adapter

13. In this step, we will create a group for the Adapter Cone.

To reduce the amount of clutter on the screen, we will display only the Lower Platform.

Group/Post...

Select Groups to Post

Central Cylinder

Lower Platform

Shear Panels

Upper Platform

default_group

Apply

Prior to Apply, only the Lower Platform should be highlighted. Once applied, the Lower Platform will be the only entity displayed in your graphics window.

While you are still in the **Group** form, change the action from Post to Create so that any Adapter entities created will be automatically added.

Action:

Create

New Group Name

Adapter

Make Current

Unpost All Other Groups

Apply

Cancel

14. In this step, we will create the geometry for the Adapter. We will first create a curve that represents an axisymmetric slice of the cone. Then we will revolve this curve to create a surface.

Before we go on to the next step, we will change the view, renderstyle and the point size using the Toolbar.

Create a
Slice the
Adapter
Cone



Front View



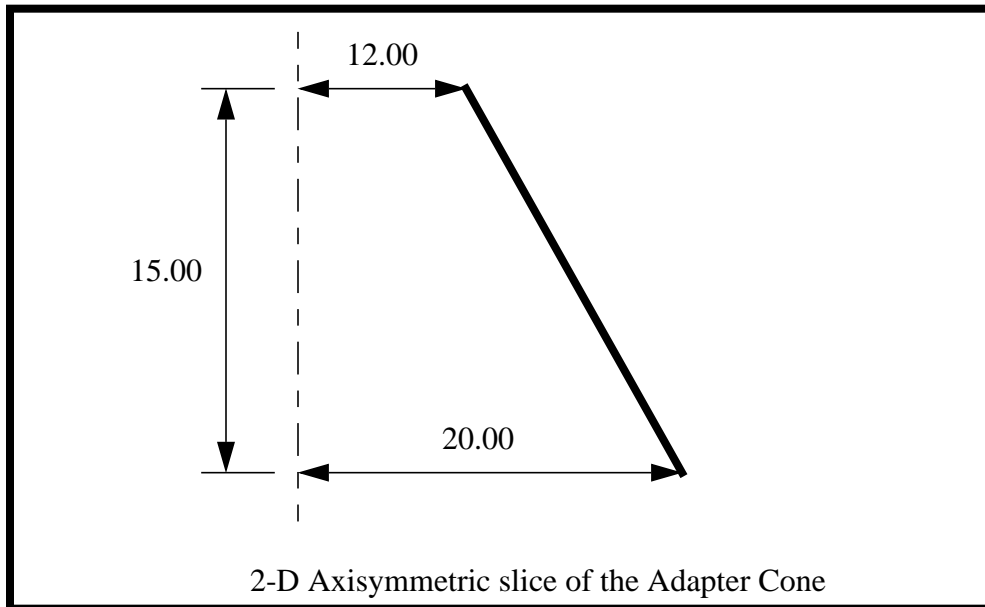
Point Size



Wireframe

The geometry for the curve that defines an axisymmetric slice of the Adapter Cone is shown below. We will create this curve using a simple XYZ construct method.

Figure 1.15. Adapter's geometry specifications.



We will create this curve using a simple XYZ construct method.

Action:

Create

Object:

Curve

Method:

XYZ

Vector Coordinates List

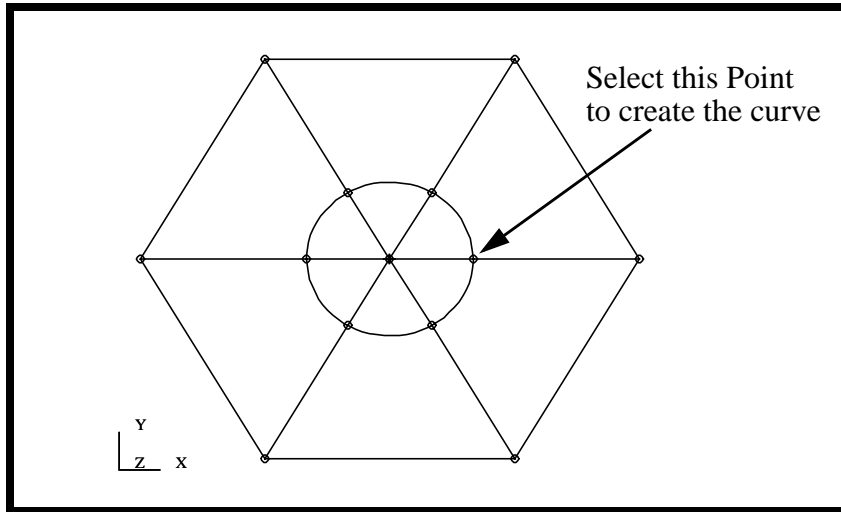
<8, 0, -15>

Origin Coordinates List

See Figure 1.16



Figure 1.16. Selected point to create the Adapter curve.



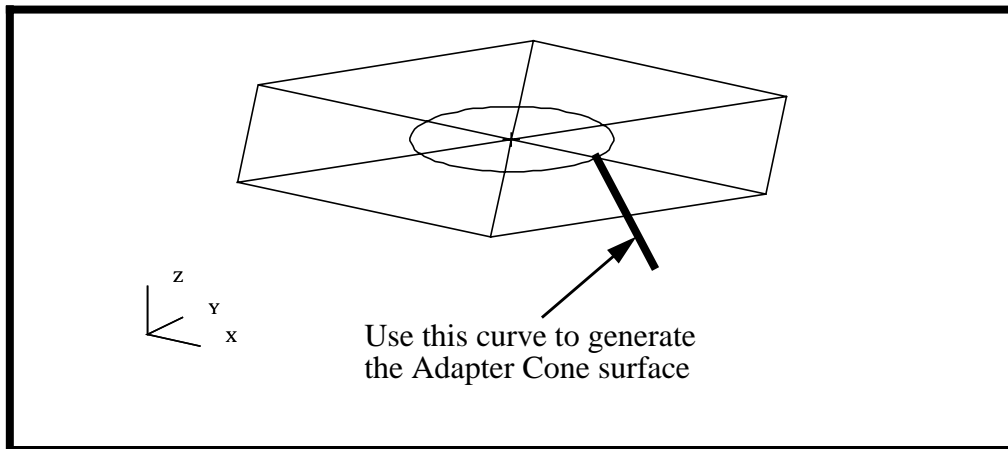
Change the view back to the Isometric view using the Toolbar icons.



Isometric View 3


Your model should look like the figure below

Figure 1.17. Your Adapter curve should be similar to the one shown below.



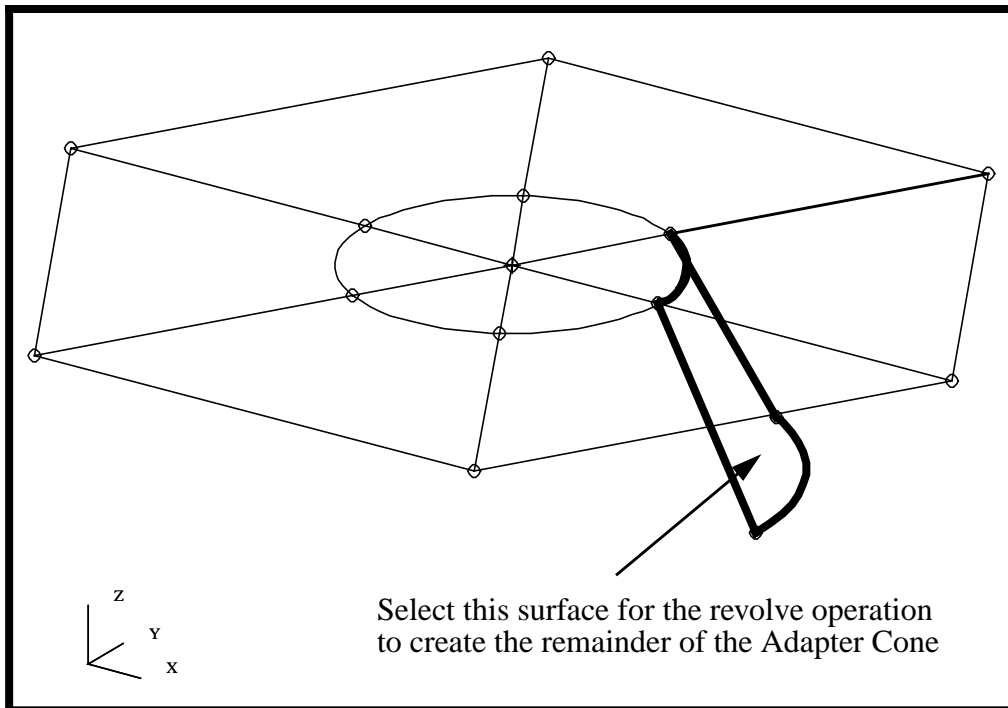
**Create 1/6
Surface of
the Adapter
Cone**

We shall revolve the newly created curve to create the Adapter Cone surface with an angle of 60 degrees.

<i>Action:</i>	Create
<i>Object:</i>	Surface
<i>Method:</i>	Revolve
<i>Total Angle</i>	60
<i>Curve List</i>	See Figure 1.17 

Your model should look like the figure below

Figure 1.18. 1/6 slice of the Adapter Cone shown with the Lower Platform



**Create the
Remainder
of the
Adapter
Cone**

- Finally, we will complete the remainder of the Adapter Cone surfaces by rotating the newly created surface with an angle of 60 degrees and a repeat count of 5.

<i>Action:</i>	Transform
<i>Object:</i>	Surface
<i>Method:</i>	Rotate
<i>Rotation Angle</i>	60
<i>Repeat count</i>	5

Surface List

See Figure 1.18

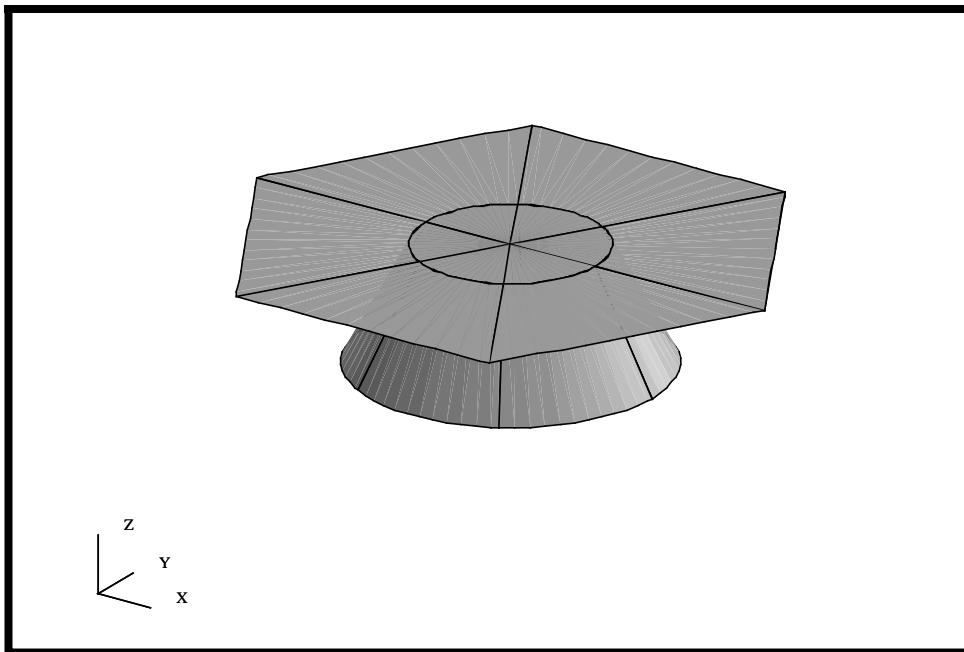
Change the model's render style to Smooth shaded using Toolbar icons.



Smooth Shaded

Your model should look like the figure below.

Figure 1.19. The Adapter Cone and Lower Platform geometry



16. In this step, we will create a group for all geometry.

Group/Create...

New Group Name

All Geometry

Make Current

Unpost All Other Groups

Group Contents:

Add All Geometry

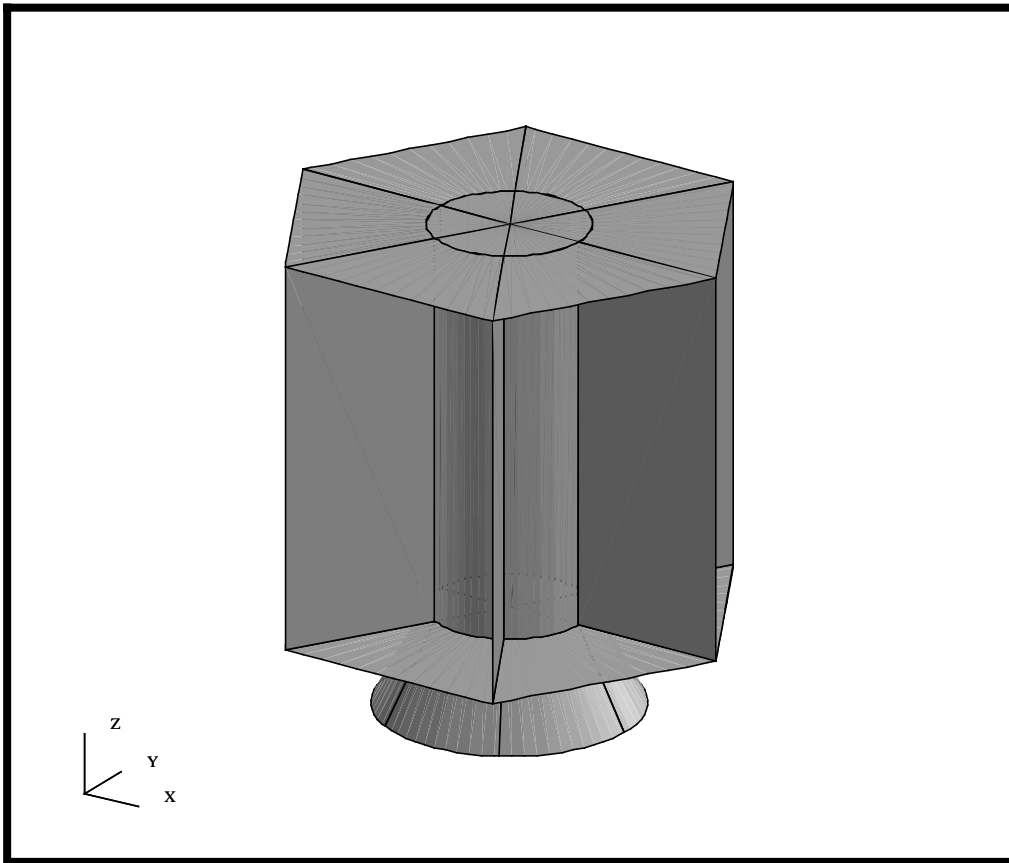
Apply

Cancel

Create a Group for the All Geometry

Your model should look like the figure below.

Figure 1.20. The satellite model geometry.



Export an IGES file of All the Geometry

17. As an additional step, we will have you exercise the IGES export option from within MSC/PATRAN. Often times this is useful for transferring the geometry from MSC/PATRAN to another software package or using this as a geometric backup.

The creation of IGES entities is an additional step that you may want to perform. This step will take you through the procedure for creating an IGES file.

File/Export...

Format

IGES

Create New File

satellite.igs

Apply

MSC/PATRAN is capable of exporting every piece of the geometry that can be created inside MSC/PATRAN, except for the Composite Trimmed Surface and Solids. In the case of solids, the faces are exported instead. For a further discussion on the specific IGES entities supported, please refer to the documentation.

Once the export is completed, you will be shown a Summary Window that lists the number and type of exported entities from MSC/PATRAN to IGES. Press OK to confirm the export.

IGES Export Summary

OK

In your UNIX window, you should see a **satellite.igs.01** file.

18. To complete this exercise, you will close the database.

File/Quit

This will exit MSC/PATRAN and close your file. Do not delete the database from your directory since you will use it for future exercises.

It should be noted that all changes made to the database are automatically saved. Therefore, there is no need to perform a save operation.

**Close the
Database
and Quit
Patran**

