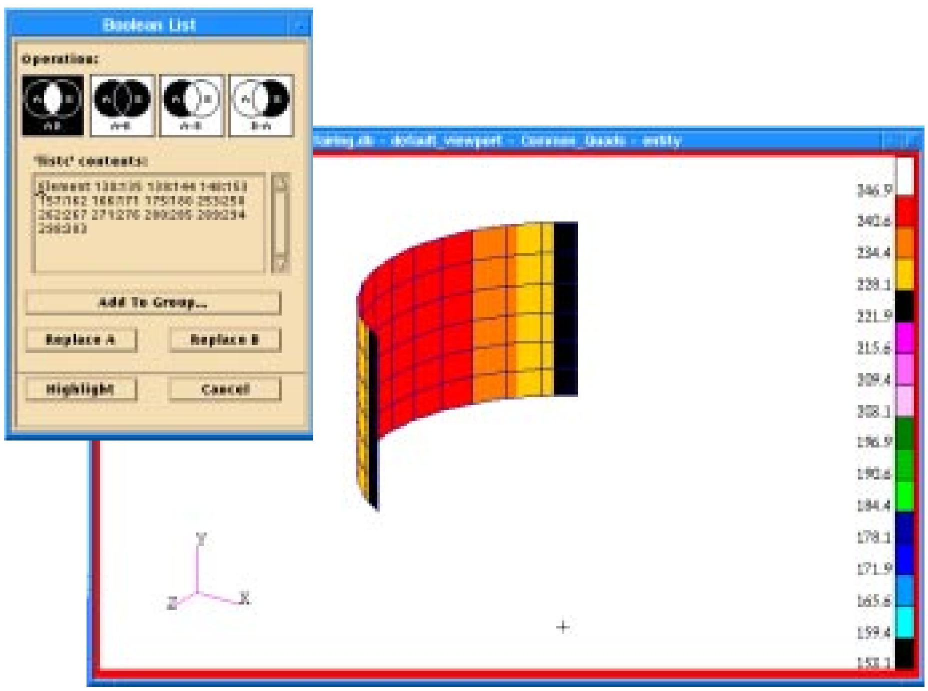
WORKSHOP 15

Using Groups and Lists



Objectives:

- Build a finite element model that includes element properties and boundary conditions.
- Use lists to identify parts of the model with specified attributes.
- Explore the Group Display mode.

Model Description:

In this exercise you will construct a portion of a fairing. Shown below is a drawing of the assembled structure and its dimensions. Use curves and surfaces to define the fairing geometry. The finite element model will consist of 2-dimensional elements with 1-dimensional elements applied at various edges of the geometry. The 1-dimensional elements will represent stiffeners for the structure.

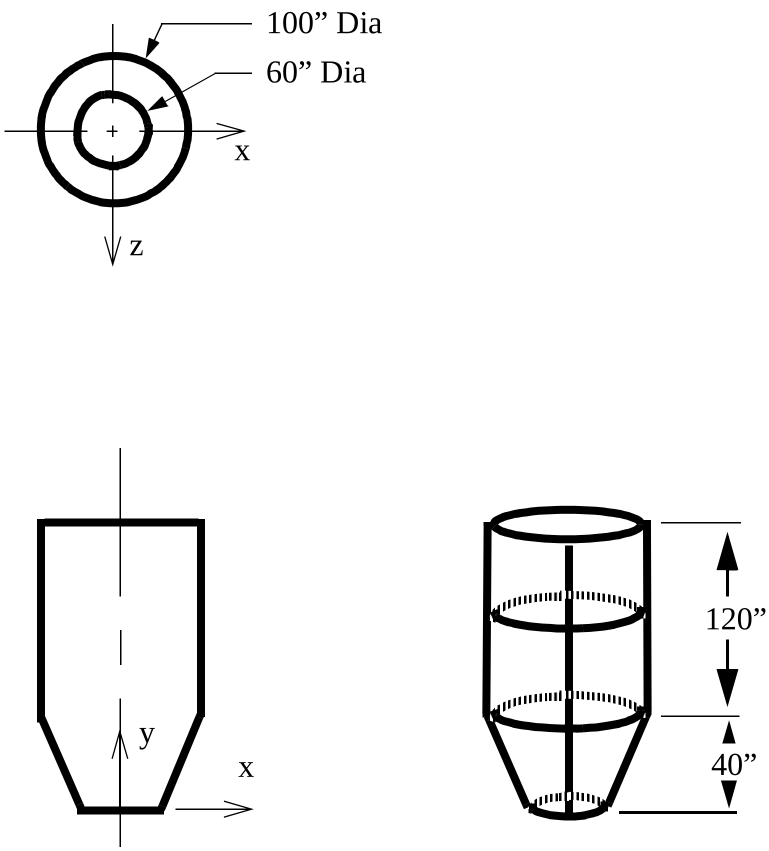


Figure 15-1

Analysis Code	P3/FEA	
Element Types	Bar2 (horizontal fairing edges)	
	Quad4 (fairing surface)	
Material Name	Alum_1	Alum_2
Modulus of Elasticity, E (psi)	1.05E7	1.18E7
Poisson’s Ratio, ν	0.33	0.33
Density, ρ (lb/in3)	2.6E–4	2.4E–4
Model Thickness	1.5 - Y/160.	
Model Temperature Distribution	200.-(150./160.)X	

Table 15-1

Suggested Exercise Steps:

- Create a new database and name it **fairing.db**. Select **Default** for the *Tolerance* and **MSC/NASTRAN** for the *Analysis Code.*
- Create the model using Figure 15-1.
- Create the points and curves that represent the outline of the fairing.

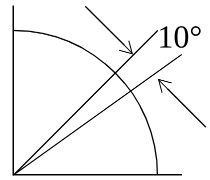
  Point 1 (XYZ method): [30,0,0];

  curve 1 (XYZ method): vector length=<0,120,0>; origin=[50,40,0]

  curve 2 (point method): between points 1 and 2.

- Sweep Curves 1 & 2 through 360^{o} angles about the centerline of the fairing in 4 steps using the Surface Revolve method.

a) Seed the circumference of the fairing at the upper edge with 9 nodes per quarter of the circumference.



b) Create non-uniform seed distributions along the vertical edge of the fairing represented by Curve 1 &2..

Curve 1, L2 = 10, L1 = 7

Curve 2, L2 = 7, L1 = 4

c) Create the mesh for the surface using Quad4 elements.

d) Create Bar2 elements along the circumference representing the edges of the upper cylinder of the lower cone.

- Create a group containing only the finite element model. Name the group FEM. Post only that group to the viewport.
- Create the materials for the fairing. Materials **alum_1** and **alum_2** will be applied to the top (cylindrical) and bottom (tapered) portions of the fairing respectively. Use Table 15-1 to define the Material Properties.
- Define fields that represent the varying **thickness** and **temperature** distribution. Use Table 15-1 to define the fields.
- Create the element properties which include the material definitions and the varying thickness. Use the names **prop_1** and **prop_2** for the element property names.
- Define the model's varying temperature distribution. Use the name **temp** for the temperature set name.
- Use Lists and Groups to display the Quad elements that have the following attributes:

  Material:alum_1

  Thickness:> 0.98

  Temperature: > 230.0

Create a new group named **Common_Quads** and add these elements to that group. Plot the temperature contours on these elements. Reset Graphics.

- Post only the group named FEM and change the render style to hidden line (the bars will disappear).
- Create a group containing only the bar elements. Name the group **BARS**.
- Change to group display mode and modify the FEM and BARS render style as follows:

Group	Render Style	Shade Color	Entity Labels
FEM	**Hidden Line**	**Cyan**	**Off**
BARS	**Wireframe**	**Yellow**	**Off**

- Change the render style for the group BARS to **Wireframe/Accurate**.

Exercise Procedure:

1. Create a new database and name it **fairing.db**. Select **Default** for the *Tolerance* and **MSC/NASTRAN** for the *Analysis Code*.

File/New...

New Database Name — **fairing**

OK

New Model Preference

Tolerance — ◆ **Default**

Analysis Code: — **MSC/NASTRAN**

OK

2. Create the points and curves that represent the outline of the fairing.

   Point 1 [30,0,0];
   Curve 1: vector length=<0,120,0>; origin=[50,40,0]

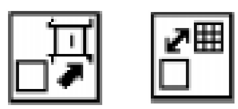
   Curve 2: between points 1 and 2.

◆ **Geometry**

Action:	**Create**
Object:	**Point**
Method:	**XYZ**
Point Coordinate List	**[30, 0, 0]**

Apply

Turn on labels and display lines using the **Show Labels** and **Display Lines** icons,



Now you will create curves that represent the profile of the fairing. They will be swept to create the fairing’s surface.

Action:	**Create**
Object:	**Curve**
Method:	**XYZ**
Vector Coordinate List	**<0, 120, 0>**
Origin Coordinate List	**[50, 40, 0]**

Apply

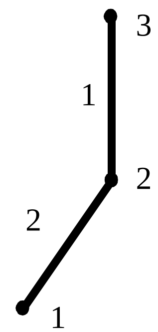
Next change the *Method* option menu to **Point**.

Action:	**Create**
Object:	**Curve**
Method:	**Point**
Starting Point List	**Point 1**

Ending Point List	**Point 2**

Apply

Your model should appear as follows:



3. Create the fairing from an assembly of quarter circular surfaces defined by revolving curves 1 and 2 about the fairing's vertical center line.

Action:	**Create**
Object:	**Surface**
Method:	**Revolve**
Surface Type	**PATRAN 2 Convention**
Axis	**Coord 0.2**
Total Angle	**360**
Surface per Curve	**4**
Curve List	**Curve 1, 2**

Apply

Change the view *Angle* to **30 0 0**

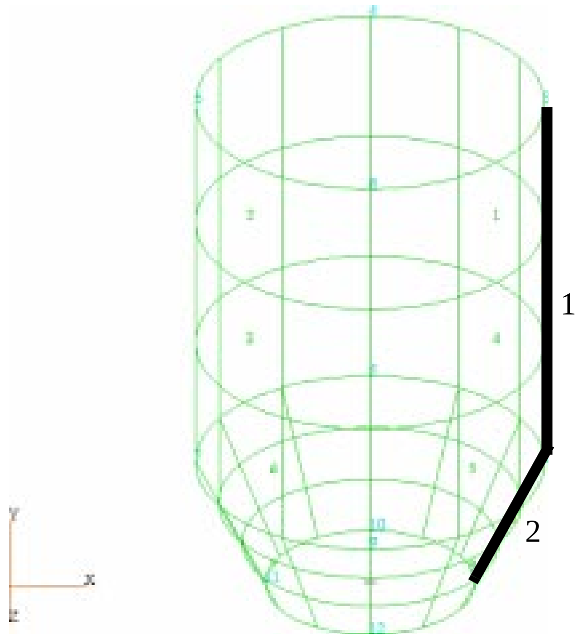
Viewing/Angles...

Angles	**30, 0, 0**

Apply

Cancel

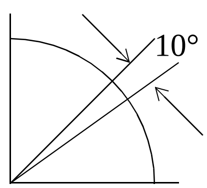
Your model should appear as follows:



4. Create a finite element mesh that has the following attributes:

Create Mesh Seeds

Along the circumferential edges create 4 node Quad elements every 10°



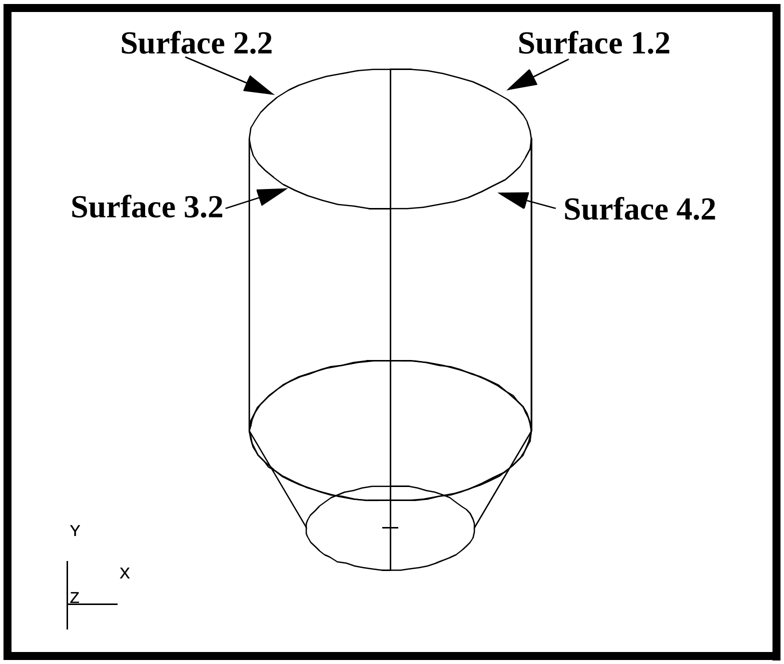
◆ **Finite Elements**

Action:	**Create**
Object:	**Mesh Seed**
Type:	**Uniform**

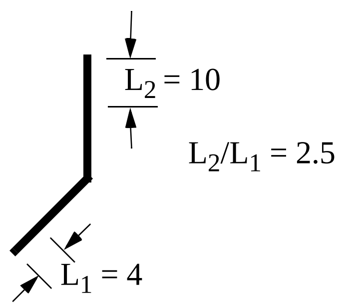
◆ **Number of Elements**

Number =	**9**
Curve List	Select the Upper Circumferential Edges of Surfaces 1 through 4. See the figure below

Apply



In the vertical direction (y-direction), define a smoothly transitioning mesh density, the elements along the top of the cylinder are 2.5 times as large as those along the bottom edge (tapered end) of the fairing.



Action:	**Create**
Object:	**Mesh Seed**
Type:	**One Way Bias**

◆ **L1 and L2**

L1 =	**7**
L2 =	**10**
Curve List	**Curve 1**

Apply

Action:	**Create**
Object:	**Mesh Seed**
Type:	**One Way Bias**

◆ **L1 and L2**

L1 =	**4**
L2 =	**7**
Curve List	**Curve 2**

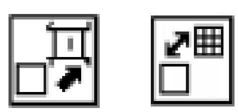
Apply

Now that the seed has been created you will mesh the model.

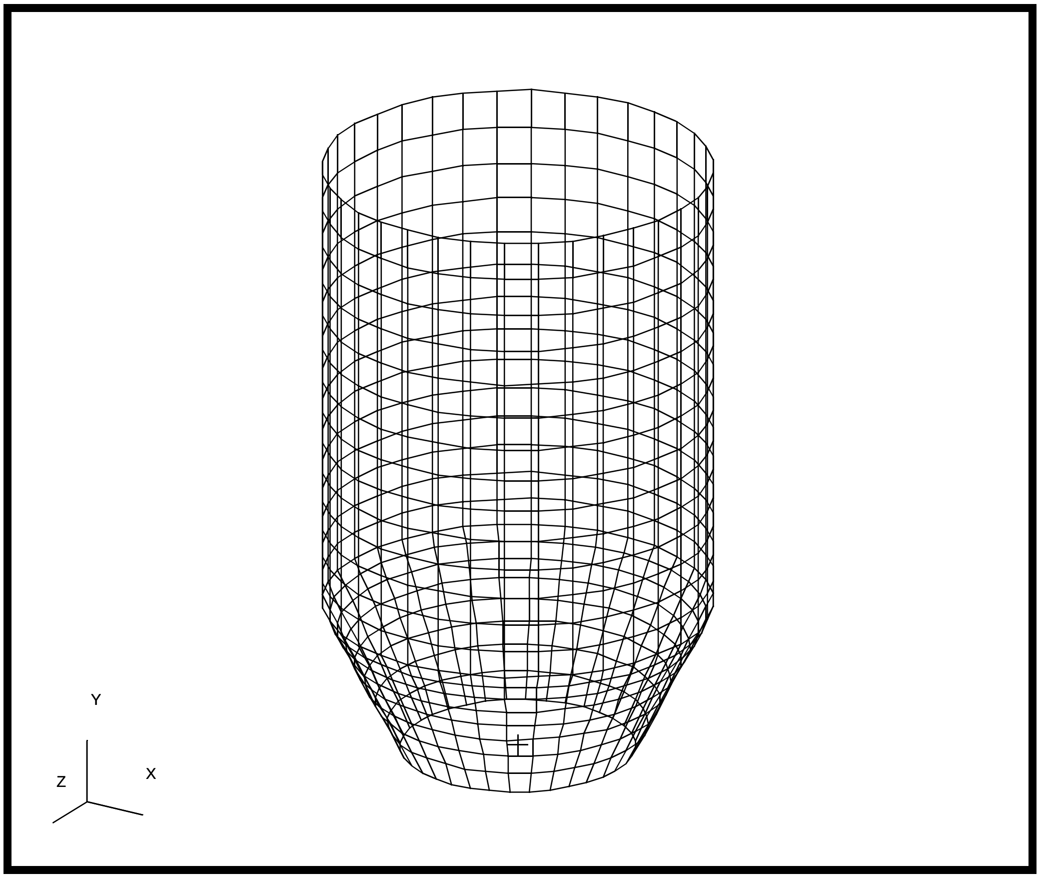
Action:	**Create**
Object:	**Mesh**
Type:	**Surface**
Element Topology	**Quad 4**
Surface List	Select All Surfaces

Apply

Turn of display lines and labels by using the appropriate icons.



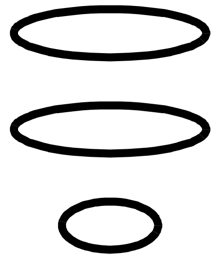
Your model should appear as follows:



Mesh the horizontal (circumferential) edges of each surface with two-noded bar elements.

Action:	**Create**
Object:	**Mesh**
Type:	**Curve**
Element Topology	**Bar 2**
Curve List	

Select the surface edges shown below. A hint on selecting the appropriate edges. Set the view to the default, then use click and drag picking technique.



Also you may want to Erase all FEM in **Display/Plot/Erase...** to make the selection easier.When you are done remember to replot the FEM.

Apply

Equivalence the Finite Elements to reduce the number of elements by eliminating duplicate nodes.

Action:	**Equivalence**
Object:	**All**
Type:	**Tolerance Cube**

Apply

Create Groups

5. Create a group containing only the finite element model. Name the group FEM. Post only that group to the viewport

Group/Create...

New Group Name	**FEM**

Unpost All Other Groups

Group Contents	**Add All FEM**

Apply

Cancel

Create Material Properties

6. Create the materials for the fairing. Materials **alum_1** and **alum_2** will be applied to the top (cylindrical) and bottom (tapered) portions of the fairing respectively. Use Table 15-1 to define the Material Properties.

◆ **Materials**

Action:	**Create**
Object:	**Isotropic**
Method:	**Manual Input**
Material Name	**alum_1**
Input Properties...	
Constitutive Model:	**Linear Elastic**
Elastic Modulus	**1.05E7**
Poisson's Ratio	**0.33**
Density	**2.6E-4**
Apply	

Action:	**Create**
Object:	**Isotropic**
Method:	**Manual Input**
Material Name	**alum_2**
Input Properties...	
Constitutive Model:	**Linear Elastic**
Elastic Modulus	**1.18E7**
Poisson's Ratio	**0.33**
Density	**2.4E-4**
Apply	

Create Fields

7. Define fields that represent the varying thickness and temperature distribution. Use Table 15-1 to define the fields.

◆ **Fields**

Action:	**Create**
Object:	**Spatial**
Method:	**PCL Function**
Field Name	**thickness**
Scalar Function	**1.5-'Y/160**

Apply

Action:	**Create**
Object:	**Spatial**
Method:	**PCL Function**
Field Name	**temperature**
Scalar Function	**200.-(150./160.)*'X**

Apply

Create Element Properties

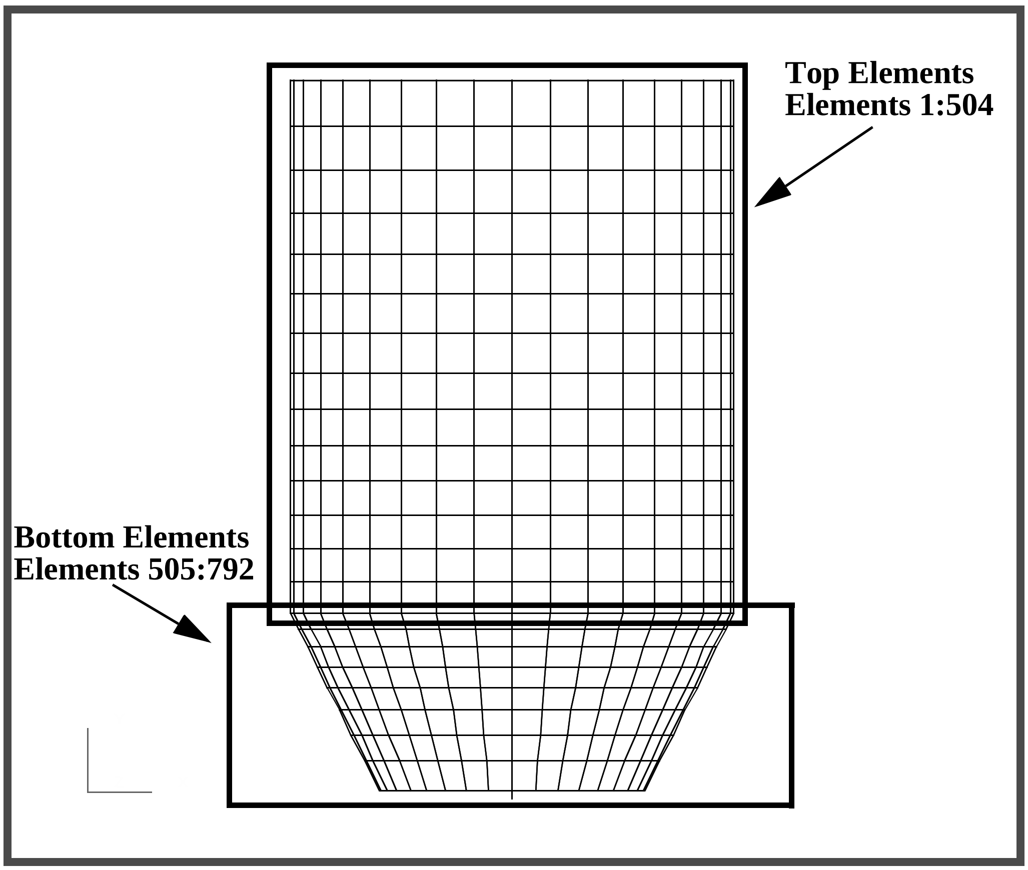
8. Create the element properties which include the material definitions and the varying thickness. Use the names **prop_1** and **prop_2** for the element property names.

Click on the **Properties** radio button in the *Main Form*. Using the information on Table 15-1 create element properties **prop_1** and **prop_2** for the top (cylindrical) and bottom (tapered) portions of the fairing respectively. Apply the element properties to the Quad elements. Use the **thickness** field you defined earlier to represent the varying shell thickness and materials **alum_1** and **alum_2** for the top and bottom portions of the model respectively.

◆ **Properties**

Action:	**Create**
Dimension:	**2D**
Type:	**Shell**
Property Set Name	**prop_1**
Options:	**Homogeneous**
	Standard Formulation

Input Properties...	
Material Name	**m:alum_1**
Thickness	**f:thickness**
OK	
Select Members	Select the Top Elements of the Model. See figure below.
Add	
Apply	



Action:	**Create**
Dimension:	**2D**
Type:	**Shell**
Property Set Name	**prop_2**

Options:	**Homogeneous**
	Standard Formulation
Input Properties...	
Material Name	**m:alum_2**
Thickness	**f:thickness**
OK	
Select Members	Select the Bottom Elements of the Model. See figure on previous page.
Add	
Apply	

Create Temperature Boundary Conditions

9. Define the model's varying temperature distribution. Use the name **temp** for the temperature set name.

◆ **Load/BCs**

Action:	**Create**
Object:	**Temperature**
Type:	**Nodal**
New Set Name	**temp**
Input Data...	
Temperature	**f:temperature**
OK	
Select Application Region...	
Geometry Filter	◆ **FEM**
Select Nodes	Select All Nodes
Add	
OK	
Apply	

Turn off the temperature labels

Display/Load/BC/El. Props...

Loads/BCs ❑ **Temperature**

Apply

Cancel

10. Use Lists and Groups to filter then group the quad elements that have the following attributes:

Material:alum_1

Thickness:> 0.98

Temperature: > 230.0

Create Lists

Add to *List A* the elements which have the alum_1 material as one of their attributes.

Tools/List/Create...

Model:	**FEM**
Object:	**Element**
Method:	**Attribute**
Attribute	**Material**
Existing Materials	**alum_1**
Target List	◆ **A**

Apply

Next, you will define *List B* to include only the Quad elements that have a ***thickness greater than 0.98***.

◆ **Properties**

Action:	**Show**
Existing Properties	**Thickness**
Display Method	**Scalar Plot**
Select Groups	**FEM**

Apply

Tools/List/Create...

Model:	**FEM**
Object:	**Element**
Method:	**Attribute**
Attribute	**Fringe Value**
Fringe Tools:	**default_Fringe**
F >	**0.98**
Target List	**B**

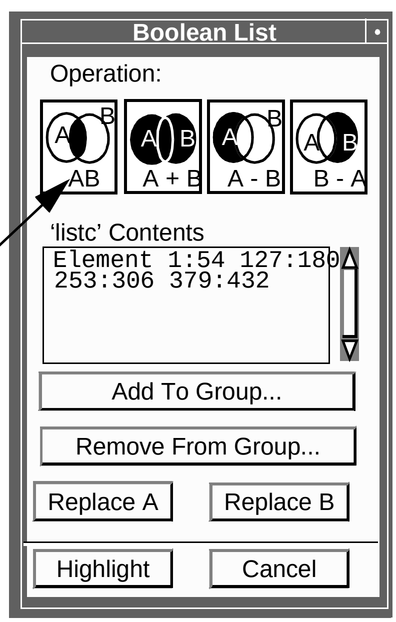
Apply

Intersect Lists

Next, you will intersect Lists A and B and replace the contents of List A with the elements found in the intersection.

Tools/List/Boolean...

On the form that appears click on the intersect icon. The form should appear as follows:



To transfer the contents of List C to List A, click on the **Replace A** button in the *Boolean List* form.

List A currently satisfies the first two of our three conditions: Quad elements associated with material alum_1 and having thickness > 0.98.

Now you will perform a final classification of the elements. You will isolate those elements that satisfy the third condition of applied temperature load > 230.0.

◆ **Load/BCs**

Action:	**Plot Contours**
Object:	**Temperature**
Existing Sets	**temp (TEMPN.1.1)**
Select Data Variable	**Temperature**
Select Groups	**FEM**

Apply

Tools/List/Create...

Model:	**FEM**
Object:	**Element**
Method:	**Attribute**
Attribute	**Fringe Value**
Fringe Tools:	**default_Fringe**
F > ▭	**230.0**
Target List	◆ **B**

Click on the **Clear** button in the *List B* form.

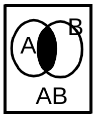
Apply

Add List to Group

In the last portion of this step, you will intersect Lists A and B again to create List C. This will provide you with a list of elements that satisfy all 3 of the conditions. You will then put the contents of List C into the **common_quads** group.

Tools/List/Boolean...

Click on the *intersect* icon.



Add To Group...

Group Name **common_quads**

Apply

Cancel

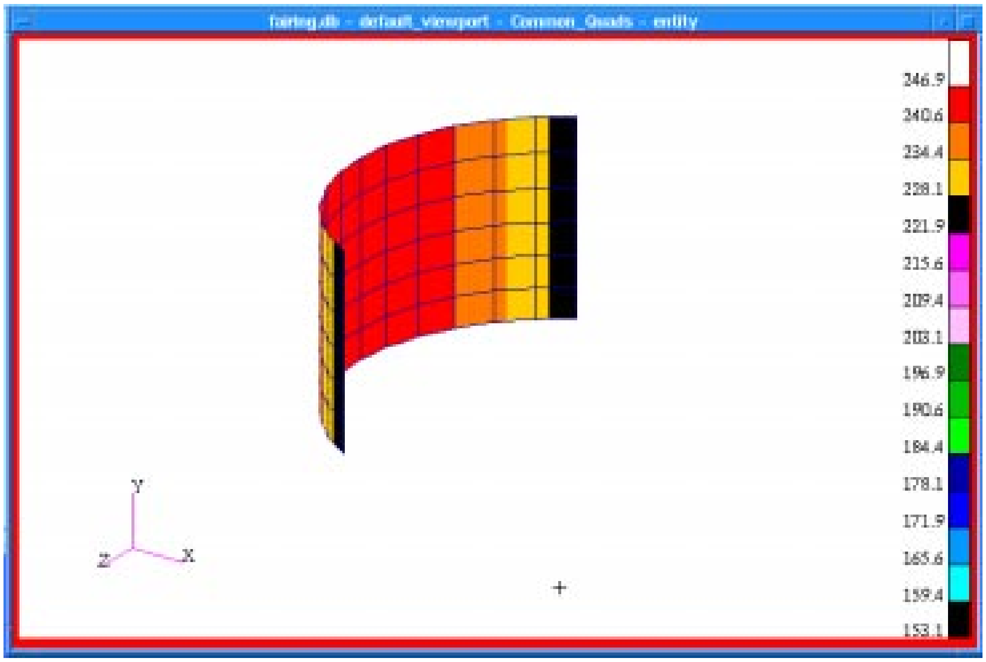
Finally click on **Group** in the *Main Form*.

Group/Post...

Select Groups to Post **common_quads**

Apply

In the *Load/Boundary Conditions* form rerender the temperature contours and Your model should appear as follows:



On the *Load/Boundary Conditions* form, click on the **Reset Graphics** button.

Create and Group Display Method

11. Create two groups by properties containing **prop_1** and **prop_2** respectively. In this step, you will be introduced to Group display mode concept. You will practice how to change the display attributes of a group of entities that represents a collection of different entity types (i.e. quad and bar elements). A major usage of this feature is demonstrated through displaying the same set of entities placed in two different groups in different render styles.

Group/Create...

New Group Name	**prop1_group**
Group Contents:	**Add Entity Selection**

Apply

Now to add the contents to the group you must create a list.

Tools/List/Create...

Model:	**FEM**
Object:	**Element**

Method:	**Attribute**
Attribute	**Property Set**
Existing Property Sets	**prop_1**

Apply

Next on the **List A** form select:

Add To Group...

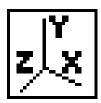
Group Name	**prop1_group**

Apply

Cancel

Repeat this process. Label the next group **prop2_group** and select **prop_2** from the *Existing Property Set*. Be sure to clear **List A** before you select **Apply** on the *List Create* form.

Change the view to **Isometric View 1**.



Now render each group with different render styles.

Display/Entity Color/Label/Render...

Entity Coloring and Labeling	◆ **Group**
Target Group	**prop1_group**
Render Style	**Hidden Line**

Apply

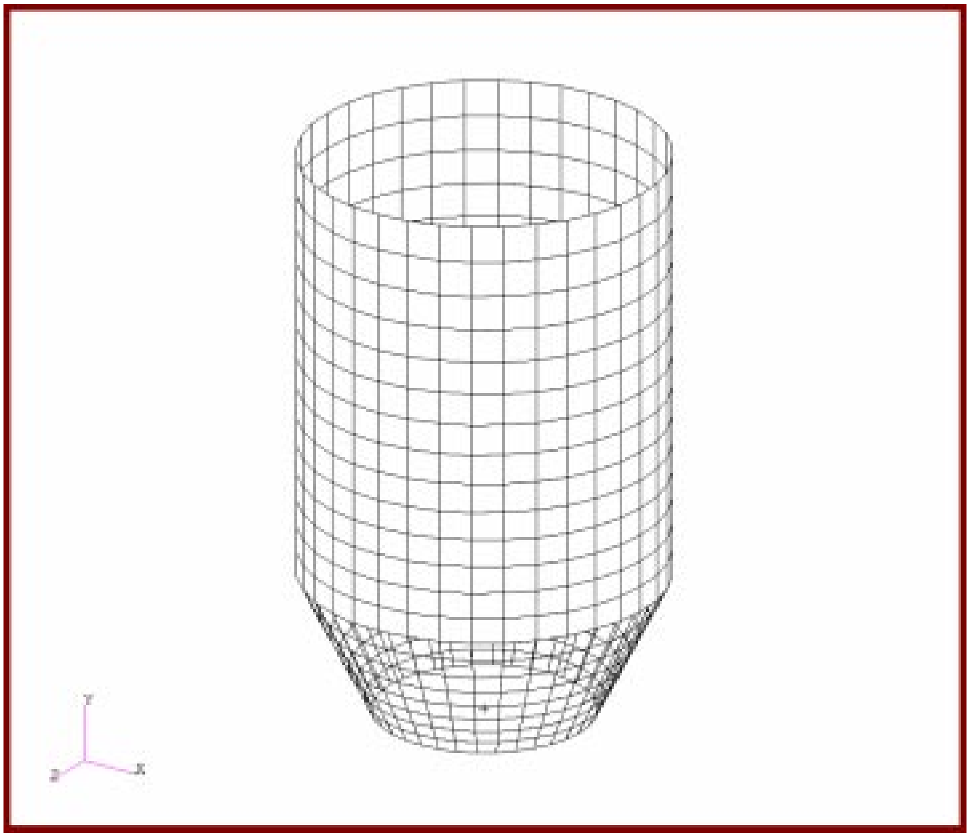
Now that MSC.Patran is in group display mode, you can modify each group’s display properties individually.

Target Group	**prop2_group**
Render Style	**Wireframe**
Shade Color:	**Yellow**

Apply

Display each group separately using **Group/Post...** Note how the same set of entities can be displayed in different render styles. This feature proves to be extremely useful in the results post-processing. An example would be to display different results on the same set of finite elements, such as stress and temperature.

This figure shows both groups posted at once.



File/Quit...