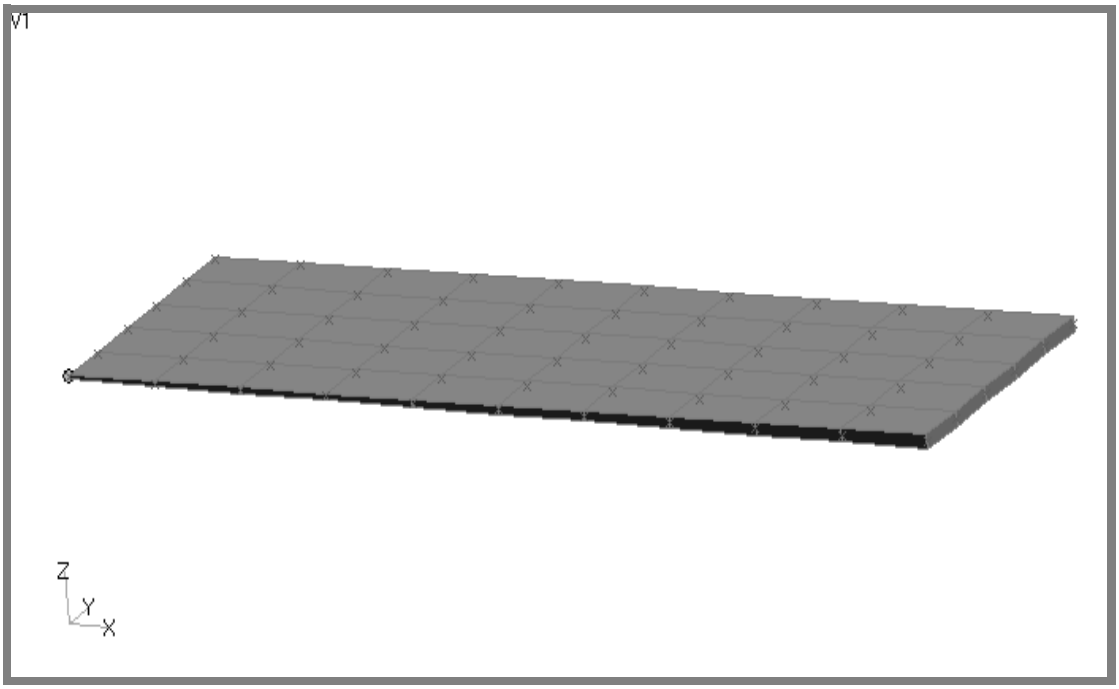
WORKSHOP 26a

Plate w/Varying Thickness-Tapered



Objectives:

- Create a geometric representation of a flat rectangular plate.
- Use the geometry model to define an analysis model comprised of plate elements.
- Use a function to vary thickness and make a tapered model.

Model Description:

In this exercise, we will create a 30 in x 10 in plate with varying thickness. MSC.Nastran for Windows V4.0 will be used to create the varying thickness by inputting a function of 0.1+0.01x, where x is the x-coordinate of the Node ID. This exercise will create a tapered section for a plate.

Figure 26a.1 - Grid Coordinates and Element Connectivity

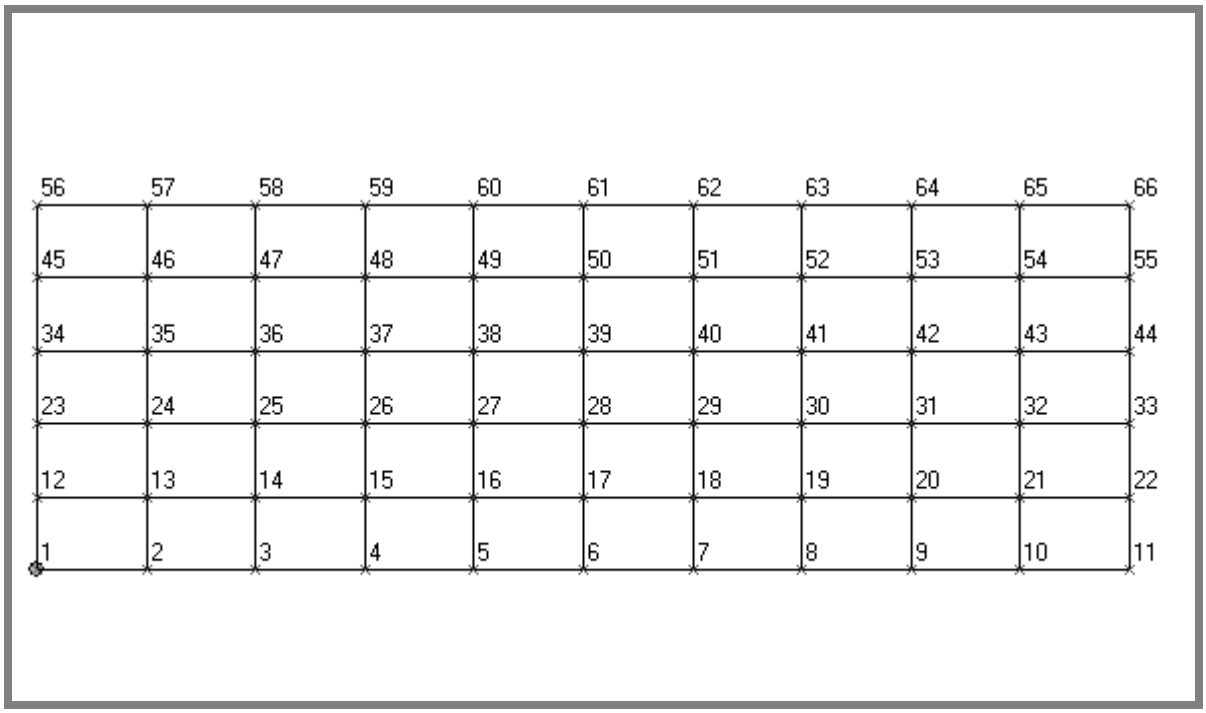


Table 26a.1 - Material Properties

Length (a):	**30 in**
Height (b):	**10 in**
Youngs Modulus:	**10E+06 lb/in^2**
Poisson's Ratio:	**0.3**
Weight Density:	**0.1 lb/in^3**

Exercise Procedure:

1. Start up MSC.Nastran for Windows V4.0 and begin to create a new model.

   Double click on the icon labeled **MSC.Nastran for Windows V4.0**.

   On the *Open Model File* form, select **New Model.**

Open Model File:	**New Model**

2. Create a material called **mat_1**.

   From the pulldown menu, select **Model/Material.**

   Model/Material...

Title:	**mat_1**
Youngs Modulus:	**10E6**
Poisson's Ratio:	**0.3**
Mass Density:	**0.1**

   OK

   Cancel

3. Create a property called **plate** to apply to the members of the plate itself.

   From the pulldown menu, select **Model/Property**.

   Model/Property...

Title:	**plate**

   To select the material, click on the **list** icon next to the databox and select **mat_1.**

Material:	**1..mat_1**

   OK

   Cancel

4. Create the Nastran geometry for plate.

NOTE: In this exercise, we are generating the finite element model explicitly, and we will not create or need geometry.

Mesh/Between...

To select the property, click on the **list** icon next to the databox and select **plate**.

Property:	**1..plate**
Mesh size/ # Nodes/ Dir 1:	**11**
Mesh size/ # Nodes/ Dir 2:	**6**

OK

	X:	*Y:*	*Z:*
Corner 1:	**0**	**0**	**0**

OK

Repeat this process for the other 3 corners.

X:	*Y:*	*Z:*	
30	**0**	**0**	**OK**
30	**10**	**0**	**OK**
0	**10**	**0**	**OK**

5. Create loads and constraints set. Since we will not actually analyze this model, we will just create arbitrary load and constraint sets so that we will be able to write a Nastran input deck.

Model/Constraint/Set...

Title:	**constraint**

OK

Model/Load/Set...

Title:	**load**

OK

To fit the display onto the screen, use the **Autoscale** feature.

View/Autoscale... (Ctrl-A)

6. Turn off the workplane.

View/Options...

Category: ● **Tools and View Style**

Under *Options* highlight **Workplane and Rulers**.

Workplane and Rulers

☐ **Draw Entity**

OK

7. Apply an equation that will vary the thickness.

Modify/Update Elements/Adjust Plate...

Select All

OK

Under *Method* input the following:

● **Equation or Constant**

ID Variable: **i**

Value: **0.1 + 0.01* XND(! i)**

Under *Update* select the following:

● **Thickness**

OK

8. Get a better view of the thickness.

View/Rotate... (F8)

ZX Front

OK

9. Show the varying thickness.

View/Options... (F6)

Under *Category* select the following:

● **Labels, Entities and Color**

Highlight **Element-Orientation/Shape.**

Options: **Element-Orientation/Shape**

Under *Element Shape*, highlight the following:

1..Show Fiber Thickness

OK

10. Zoom in for a closer look.

View/Magnify...

Magnification Factor: **1.5**

OK

As you can see, the thickness increases constantly with a taper. In the Nastran bulk data file, the CQUAD4 card allows for this taper.

11. Write the Nastran bulk data file.

File/Export/Analysis Model...

OK

Change the directory to **c:\temp**.

File Name: **taper**

Write

OK

Save the model.

File/Save As...

File Name: **taper**

Save

12. View the Nastran bulk data file.

Minimize Nastran for Windows and open Notepad. Change to the c:\temp directory and open **taper.dat**. Your file will contain CQUAD4 cards like shown below which determine the varying thicknesses of the model.

```
CQUAD4     1     2     1     2     13     12          +EL    1
+EL    1           0.1    0.13    0.13    0.1
CQUAD4     2     3     2     3     14     13          +EL    2
+EL    2           0.13    0.16    0.16    0.13
CQUAD4     3     4     3     4     15     14          +EL    3
+EL    3           0.16    0.19    0.19    0.16
CQUAD4     4     5     4     5     16     15          +EL    4
+EL    4           0.19    0.22    0.22    0.19
CQUAD4     5     6     5     6     17     16          +EL    5
+EL    5           0.22    0.25    0.25    0.22
```

Typically, for constant thickness plate elements, the thickness is reported on the PSHELL card. When the thickness is varied, it has to be reported on the CQUAD4 card as thickness at the individual nodes.

This concludes the exercise