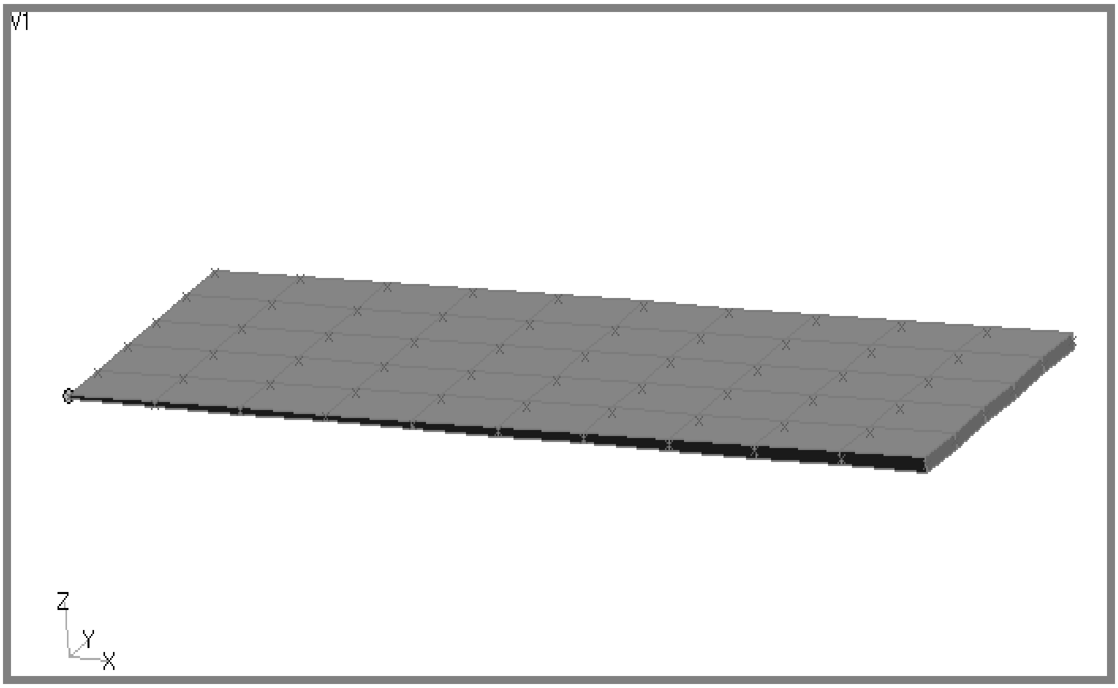
APPENDIX B

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 V3.0 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 B.1 - Grid Coordinates and Element Connectivity

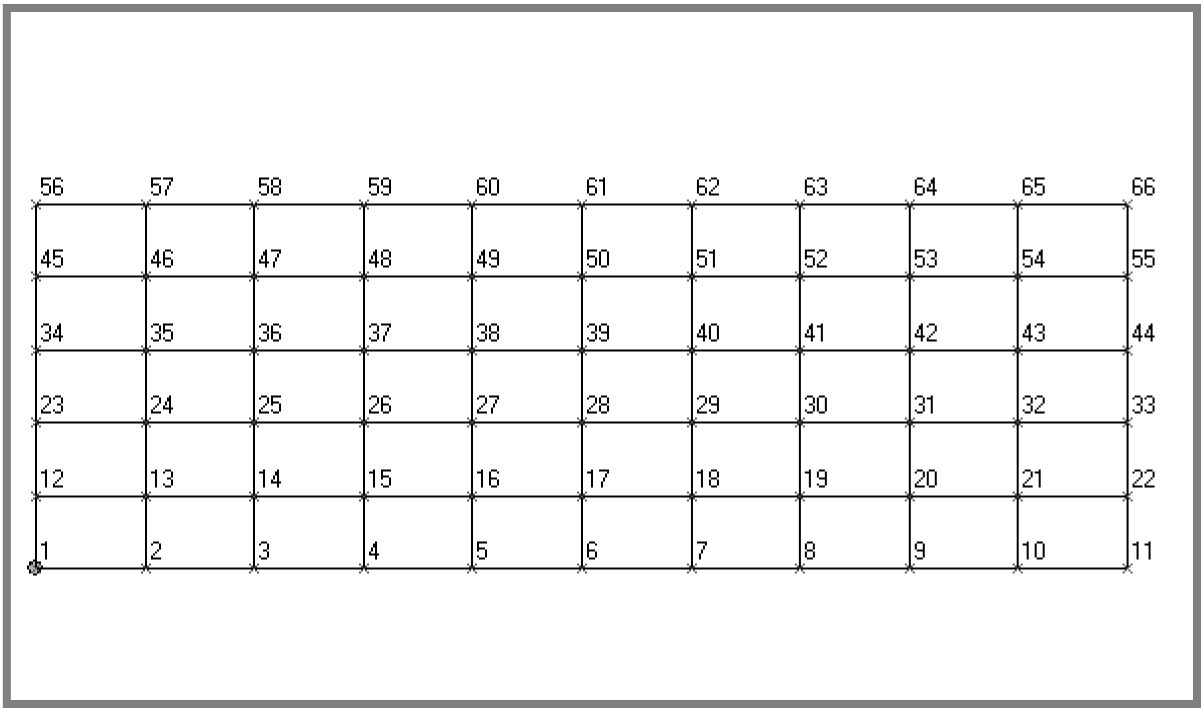


Table B.1 - Material Properties

Length (a)	**30 in**
Height (b)	**10 in**
Weight Density	**0.1 lb/in^3**
Young's Modulus	**10E6 lb/in^2**
Poisson's Ratio	**0.3**

Exercise Procedure:

1. Start up MSC/NASTRAN for Windows V3.0 and begin to create a new model.

Double click on the icon labeled **MSC/NASTRAN for Windows V3.0**.

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.

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/Constraint/Nodal...

Title: **load**

OK

Cancel

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

View/Autoscale

7. Turn off the workplane.

View/Options...

● **Tools and View Style**

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

Workplane and Rulers

☐ **Draw Entity**

OK

8. Apply an equation that will vary the thickness.

Modify/UpdateElements/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

9. Get a better view of the thickness.

View/Rotate...

ZX Front
OK

10. Show the varying thickness.

View/Options...

Under *Category* select the following:

● **Labels, Entities and Color**

Highlight **Element-Orientation/Shape.**

Element-Orientation/Shape

Under *Element Shape*, highlight the following:

1..Show Fiber Thickness

OK

11. 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.

12. 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

13. 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 varing 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
```

This concludes the exercise