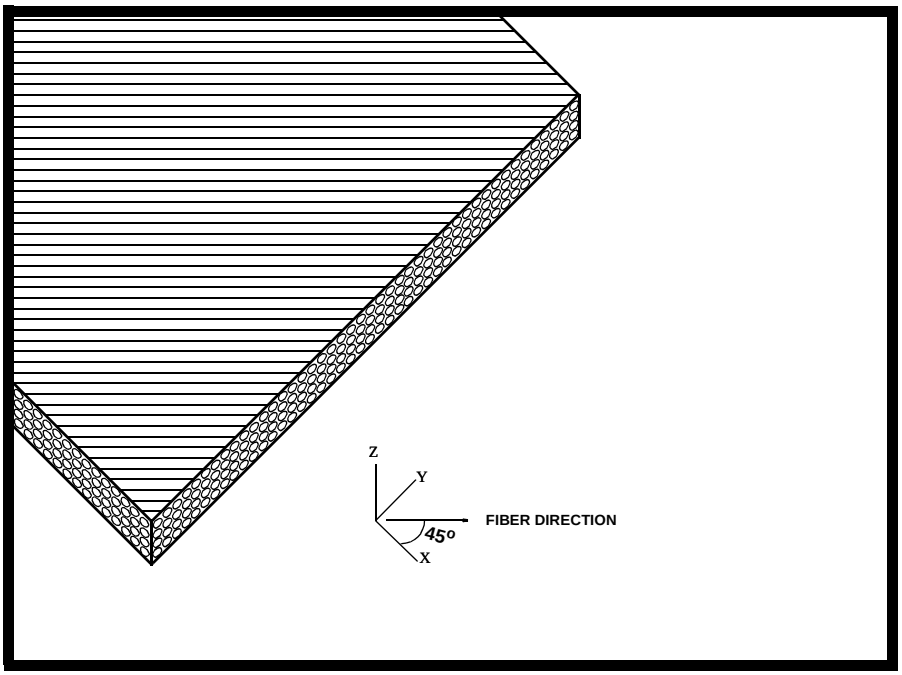
WORKSHOP PROBLEM 1c

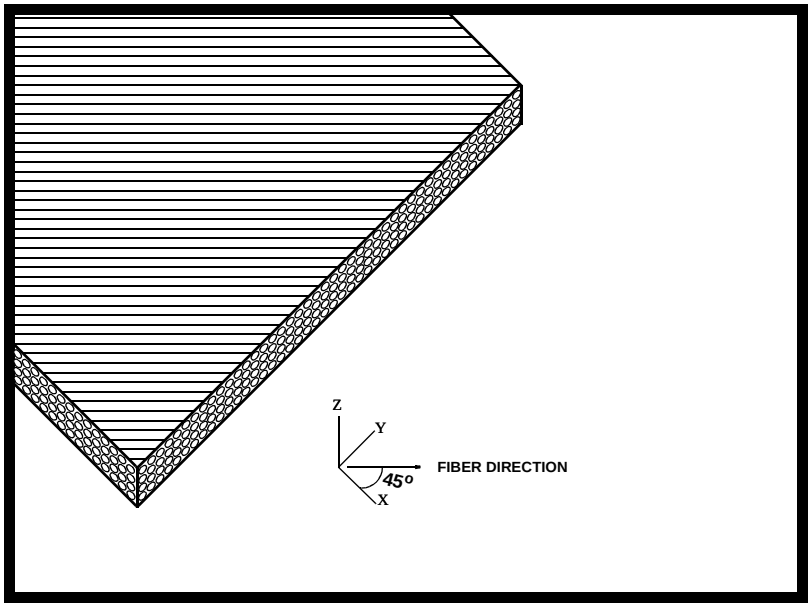
Uniaxial Loading of a Laminar Composite Plate (Part III)



Objectives:

- Specify stacking sequence of lamina.
- Create a MSC/NASTRAN input file directly or by using MSC/PATRAN.
- Run the analysis using MSC/NASTRAN.
- Review results.

UNBALANCED



A balanced layup is where there is an equal number of positive angled plies as negative angled plies. As can be seen in the above figure, this layup is unbalanced because there is only a positive angled ply, and no negative angled ones.

The ply orientation angle is the angle from Xm (x-axis of the material coordinate system) to the 1 direction of the ply coordinate system (ply fiber direction).

In order to properly model the fiber direction shown in the above figure, the proper sign of the ply orientation angle must be determined.

The Nastran definition of the positive ply orientation is the angular direction going from the Xm to the Ym, or in other words, a rotation around Zm that follows the “right hand rule”.

Pic 5b and 6b shows Xm and Zm respectively, thus, the proper ply orientation angle is -45 degrees.

1. Submit the model for a linear static analysis.

   Click on the **Analysis** radio button on the **Top Menu Bar** and complete the entries as shown here

   ◆ **Analysis**

Action:	**Analyze**
Object:	**Entire Model**
Method:	**Analysis Deck**
Job Name:	**prob1c**

Apply

An MSC/NASTRAN input file called **prob1c.bdf** will be generated. This process of translating your model into an input file is called the Forward Translation. The Forward Translation is complete when the Heartbeat turns green.

MSC/PATRAN Users should proceed to **Step 13**.

Generating an input file for MSC/NASTRAN Users:

2. MSC/NASTRAN users can generate an input file using the data from 1-3. The result should be similar to the output below (**prob1c.dat**):

```
ASSIGN OUTPUT2 = 'prob1c.op2', UNIT = 12
ID SEMINAR, PROB1C
SOL 101
TIME 5
CEND
TITLE = PROB 1C
DISP = ALL
STRESS = ALL
FORCE = ALL
STRAIN = ALL
SPCFORCE = ALL
SPC = 1
LOAD = 1
BEGIN BULK
PARAM, POST, -1
PARAM, PATVER, 3.
PARAM, AUTOSPC, YES
GRID, 1,  , 0., 0., 0.
GRID, 2,  , .5, 0., 0.
GRID, 3,  , 1., 0., 0.
GRID, 4,  , 0., .5, 0.
GRID, 5,  , .5, .5, 0.
GRID, 6,  , 1., .5, 0.
GRID, 7,  , 0., 1., 0.
GRID, 8,  , .5, 1., 0.
GRID, 9,  , 1., 1., 0.
CQUAD4, 1, 1, 1, 2, 5, 4
CQUAD4, 2, 1, 2, 3, 6, 5
CQUAD4, 3, 1, 4, 5, 8, 7
CQUAD4, 4, 1, 5, 6, 9, 8
PCOMP, 1
+, 1, .0054, 45., YES
MAT8, 1, 2.+7, 2.+6, .35, 1.+6
SPC1, 1, 123, 1
SPC1, 1, 13, 7
SPC1, 1, 1, 4
SPC1, 1,  3, 3
FORCE, 1, 3, 0, 7.5, 1., 0., 0.
FORCE, 1, 9, 0, 7.5, 1., 0., 0.
FORCE, 1, 6, 0, 15., 1., 0., 0.
ENDDATA
```

SUBMITTING THE INPUT FILE FOR MSC/NASTRAN and MSC/PATRAN USERS:

3. Submit the input file to MSC/NASTRAN for analysis.

   3a. To submit the MSC/PATRAN **.bdf** file, find an available UNIX shell window. At the command prompt enter **nastran prob1c.bdf scr=yes**. Monitor the run using the UNIX **ps** command.

4. MSC/NASTRAN Users have finished this exercise. MSC/PATRAN Users should proceed to the next step.

5. Proceed with the Reverse Translation process, that is, importing the **prob1c.op2** results file into MSC/PATRAN. To do this, return to the **Analysis** form and proceed as follows:

◆ **Analysis**

Action:	**Read Output 2**
Object:	**Result Entities**
Method:	**Translate**

Select Results File...

Selected Results File	**prob1c.op2**

Apply

Before postprocessing the results, clear the LBC markers from the screen by selecting the following main menu icon:

Reset Graphics

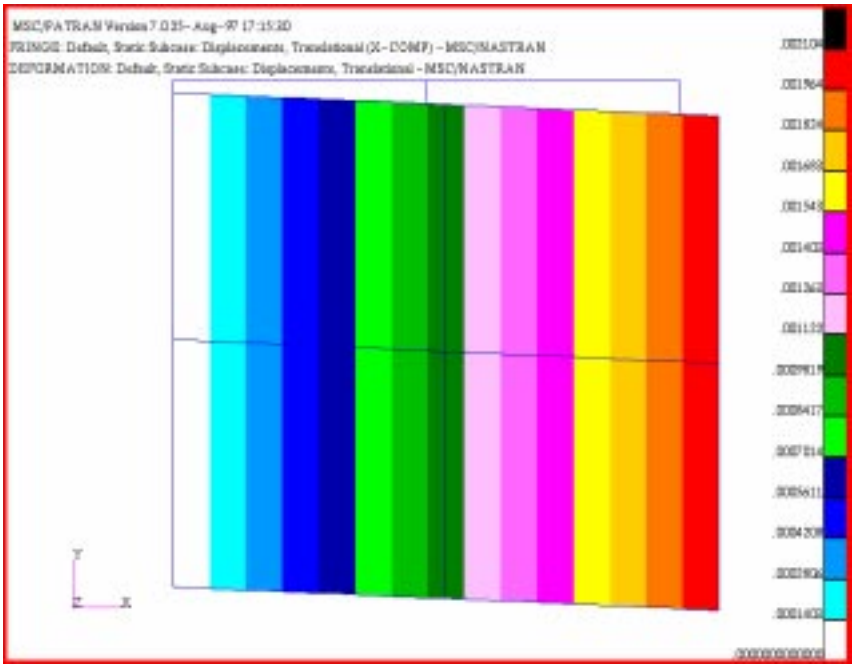
6. When the translation is complete and the Heartbeat turns green, bring up the **Results** form.

◆ **Results**

Form Type:	**Basic**
Select Result Cases:	**Default, Static Subcase**
Select Fringe Result:	**Displacements,Translational**
Result Quantity:	**X Component**
Select Deformation Result:	**Displacements,Translational**

Apply

Figure 1c-6: Fringe plot of X Displacement



It should be no surprise that the model has no x-displacement on the left edge, and the greatest on the right; after all; the LBCs fixed the left edge.

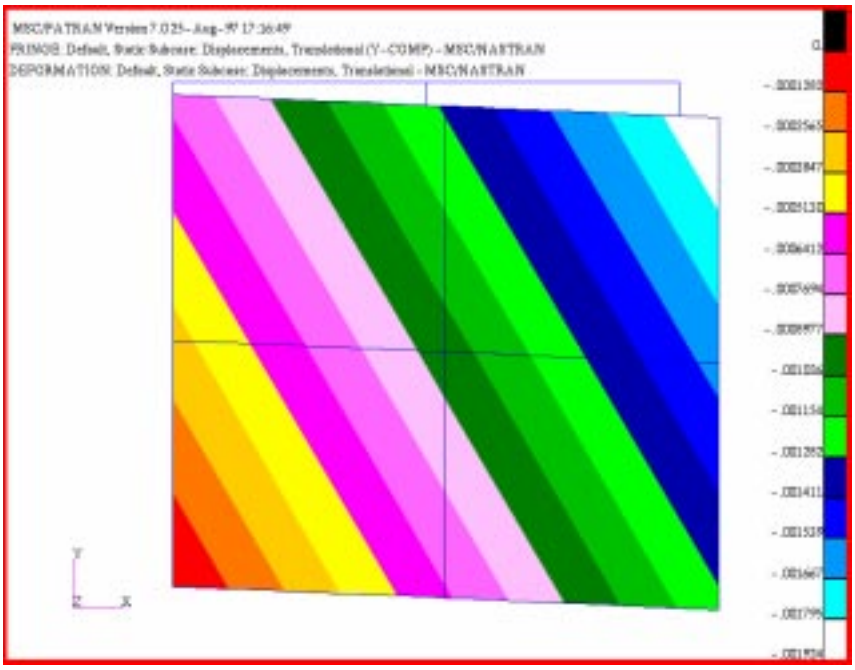
However, you can see from the deformation that, despite the purely x-directional loading, there is definite y-directional deformation.

Create a fringe plot of the y deformation in the model.

Result Quantity: **Y Component**

Apply

Figure 1c-7: Fringe plot of Y Displacement



The 45 degree orientation of the model is responsible for the shear displacement seen in Figure 10b. The secondary direction of the material feels the same loading as the primary direction of the model, 0.707 times the applied load. This secondary direction, however, has a modulus 10 times less than that of the primary direction, and therefore yields much easier. Notice that the deformation tends towards -45 degrees, the same orientation as the secondary direction.

If you wish, you may view the z-displacement of the model. You will find, however, that there is none because the laminate is symmetric with respect to its center line.

Quit MSC/PATRAN when you have completed this exercise.

Figure 1a-6: Material orientation angle shown.

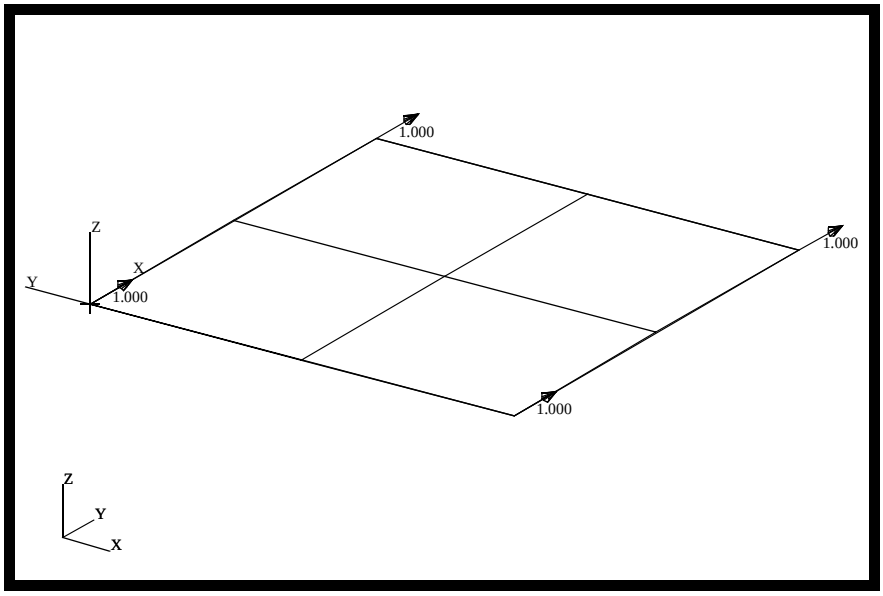


Figure 1a-4: Normal vectors displayed.