# 3.0> Ply Representation of a Layup ("fairing")

This example illustrates the advantages of the ply-based description of the composites model as used by the MSC/ PATRAN LAMINATE MODELER. These include intuitive generation of the analysis model, rapid modification of the layup, and consistent visualisation of ply results.
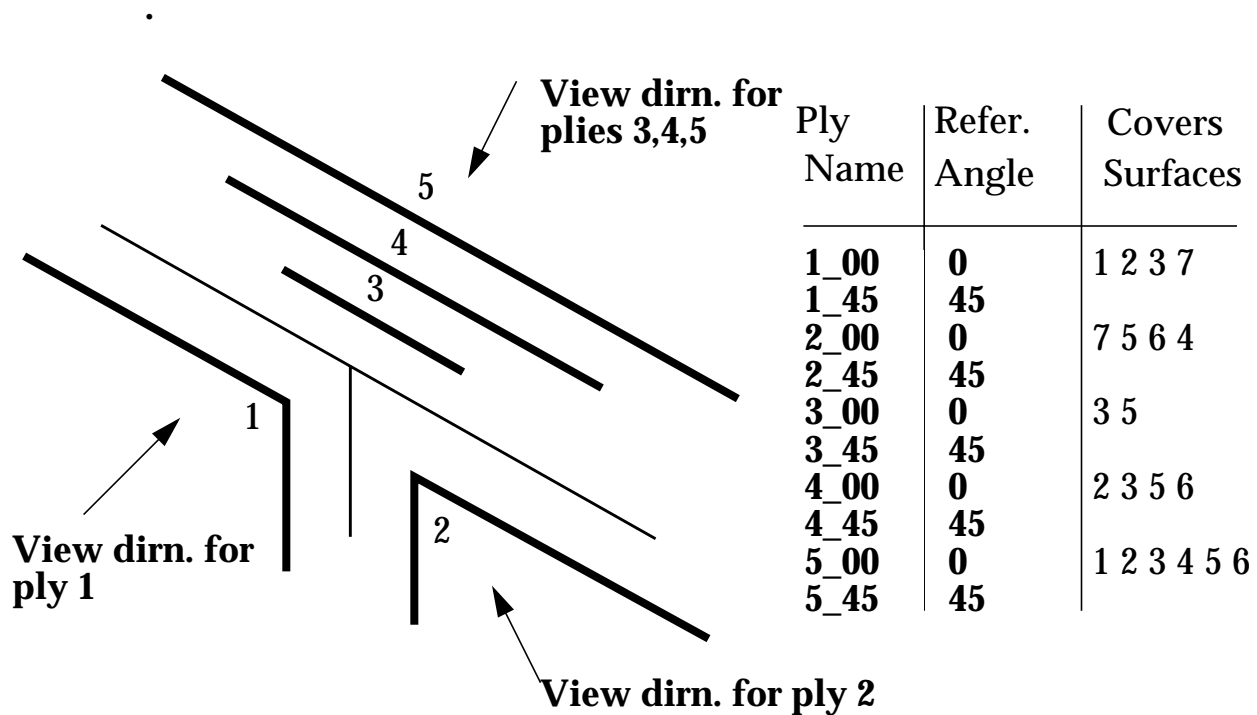
1. Open a new database using the default template database.
   - File New...
     - New Database Name : fairing.db
     - Ok

2. Generate the geometry and mesh by playing a session file.
   - File Session Play
     - Play from file : fairing_geom.ses
     - Apply

3. Apply the loads and boundary conditions.
   - Loads/BCs
     - Create Displacement Nodal
       - New Set Name : d1
       - Input Data...
         - Translations : <0,0,0>
         - Ok
       - Select Application Region...
         - Application Region : Surface 7.3
         - Ok
     - Apply

<0,, > "d2"

<0, 0, 0> "d1"
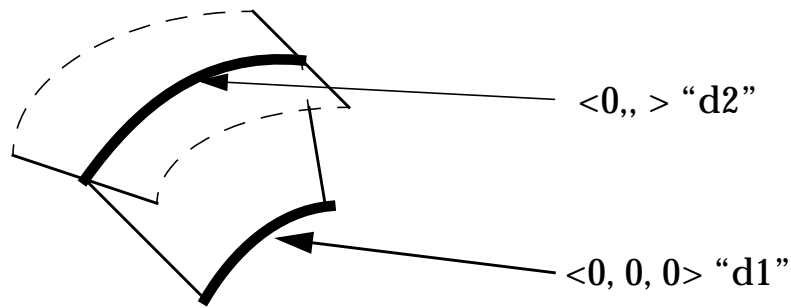
- Create Displacement Nodal
  - New Set Name : d2
  - Input Data...
    - Translations : <0,,>
    - Ok
  - Select Application Region...
    - Application Region : Surface 7.1
    - Ok
  - Apply
- Create Pressure Element Uniform
  - New Set Name : p1
  - Target Element Type : 2D
  - Input Data...
    - Top surf pressure : 0.1
    - Ok
  - Select Application Region...
    - Application Region : Surface 1:6
    - Ok
  - Apply

4 Define ply material properties.
  - File Session Play...
    - Play from file : materials.ses

- Apply

5   Open the LAMINATE MODELER tool.
- Tools LAMINATE MODELER...
  - New Layup File...
    - Layup File Name : fairing.Layup
    - Ok

6   Define the LAMINATE MODELER material
- Create LM_Material Add
  - Analysis Material : ud_t300_n5208
  - Thickness : 0.25
  - Apply

7   Create the LAMINATE MODELER plies
- First, change the viewing angle by selecting Viewing Angles... from the top menu
  - Model Absolute
  - Angles : -100 -10 40
  - Apply
  - Cancel
- Create LM_Ply Add
  - LM_Ply Name : 1_00
  - Select LM_Material : SC_Mat_1
  - Start Point : Node 75
  - Reference Direction : Along fairing, e.g. from Node 75 to Node 108
  - Select Area : Surface 1 3 2 7
  - Apply
- Repeat generation with an offset of 45 deg.
  - Create LM_Ply Add
    - LM_Ply Name : 1_45
    - Reference Angle : 45

- Apply
- Repeat generation for plies 2_00 through 5_45 as described in the Figure below
  - Change the viewing direction as indicated by rotating the model and selecting the start point again. This will reset the fiew direction into the screen
  - The viewing direction is significant for defining angular rotations and the side on which the ply is added during manufacture

.

View dirn. for plies 3,4,5

View dirn. for ply 1

View dirn. for ply 2

Ply Name	Refer. Angle	Covers Surfaces
1_00	0	1 2 3 7
1_45	45	
2_00	0	7 5 6 4
2_45	45	
3_00	0	3 5
3_45	45	
4_00	0	2 3 5 6
4_45	45	
5_00	0	1 2 3 4 5 6
5_45	45	

Naming convention: Ply 2_45 is ply2 with a 45 reference angle

- Create the LAMINATE MODELER layup
  - Create LM_Layup Add
    - Layup Definition...
      - Add 8 x ply 1_XX
        - [1_00/1_45/1_00/1_45/1_45/1_00/1_45/1_00]
      - Add 8 x ply 2_XX
        - [2_00/2_45/2_00/2_45/2_45/2_00/2_45/2_00]

- Add 8 x ply 3_XX
  - [3_00/3_45/3_00/3_45/3_45/3_00/3_45/3_00]
- Add 8 x ply 4_XX
  - [4_00/4_45/4_00/4_45/4_45/4_00/4_45/4_00]
- Add 8 x ply 5_XX
  - [5_00/5_45/5_00/5_45/5_45/5_00/5_45/5_00]
- Ok
- Analysis Model : True
- Apply
- Select 2D_Stan. Lam. Plate
- Accept suggested number of laminates and properties.

8 Close the LAMINATE MODELER tool.
- Close
- Cancel

9 Verify that laminate materials and properties have been created.

10 Create an analysis input deck.
- Analysis
  - Analyze Entire Model Analysis Deck
    - Subcase Create...
      - Available Subcases : select Default
      - Output Requests...
        - Form Type : Advanced
        - Output Requests : select STRESS
        - Composite Plate Opt : Ply & Elem. Stress
        - Modify
        - Ok
      - Apply
      - Cancel
    - Apply

11 Runthe analysis.

- In your Unix shell window, type nastran fairing.bdf
- After completion, mv fairing.op2 to fairing_res.op2

12 Read in Analysis Results

- Analysis
  - Read Output2 Result Entities Translate
    - Select Results File...
      - Selected Results File : fairing_res.op2
      - Ok
    - Apply

13 Open the LAMINATE MODELER tool.

- Tools LAMINATE MODELER...
  - Open Layup File...
    - Layup File Name : fairing.Layup
    - Ok
  - Create LM_Results LM_Ply Sort
    - Select Loadcase : Default
    - Select Subcase : Static Subcase
    - Select Layered Result : Stress Tensor
    - Apply

14 Close the LAMINATE MODELER tool.

- Close
- Cancel

15 View Failure Results

- Results
  - Basic
    - Select Result Cases : Default, Static Subcase
    - Select Result : LM_Sort (Margin of Safety)
    - Result Position : Layer 1

- Apply

16 Repeat for Layers 9, 17, 25 and 33. Note that these correspond to the rows of the LM_Layup spreadsheet.

If your have difficulty with this exercise, examine or play the session file fairing.ses after opening a new database.