

# NX Laminate Composites

Efficient simulation of laminate composite structures

NX

## fact sheet

Siemens PLM Software

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### ► Summary

NX™ Laminate Composites software is a modular NX simulation toolset for laminate composite structures. Easy-to-use ply and laminate definition tools enable you to quickly create finite element models representing your laminate composite design. NX Laminate Composites helps you create, optimize and validate composite structures using NX Nastran, MSC.Nastran, Ansys, Abaqus, or LS-DYNA as your solver. Advanced functionality, such as ply-based modeling, draping, and flat pattern creation, is integrated to support CAE-centric workflows. Post-processing and advanced reporting tools allow you to efficiently identify problem areas from your simulation results.

### Benefits

Reduce laminate model creation time by choosing between ply-based modeling or physical property creation using the graphical modeler, or by using both approaches

Improve finite element modeling accuracy by accounting for distorted fiber orientations

Enhance manufacturability by assessing and controlling fiber shear

Quickly assess viability using advanced post-processing tools

### Features

Assign laminate plies to CAD geometry and let the software compute physical properties automatically, or define the properties yourself with the graphical modeler

Account for changes in fiber orientation and assess fiber shear when draping fabric or tape on undevelopable surfaces. Introduce cuts and export ply flat patterns

Validate the laminate properties

Improve laminate properties by optimizing ply materials, orientations and thicknesses

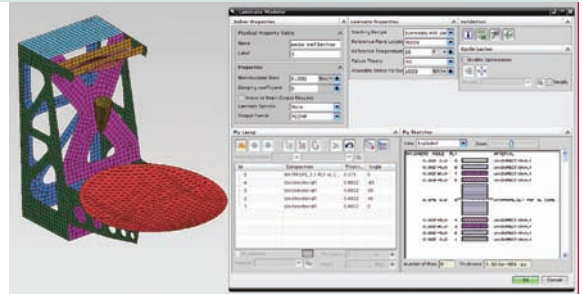
Assign laminates to your NX Nastran, MSC.Nastran, Ansys, Abaqus, or LS-DYNA finite element model

Solve and review solution results and assess the laminate performance using enveloping, filtering and sorting tools

### Ply-based modeling

NX Laminate Composites enables you to create global plies, assign them to surfaces, and define ply orientations. You can use NX to stack the plies in the layup modeler and optionally define ply angular offsets. NX automatically computes zones of elements that share identical laminate

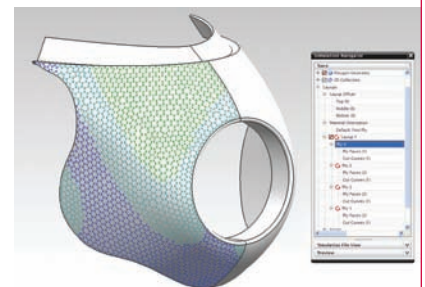
physical properties. You can view the element zones and the assigned laminate property and create element groups from the zones. NX enables you to select a ply to define material orientation, pick a vector at the mesh level, or define material orientations at the element level.



### Draping

NX draping algorithms predict the fiber orientations and shear as the ply is draped on doubly-curved, or undevelopable, surfaces. NX enables you to specify a draping start point and a lock angle, which will be used to display the fiber shear. You can reduce fiber shear by changing the start point or by introducing cut curves. NX allows you to view the ply flat patterns and export them as Parasolid® files. NX draping supports the following fiber types:

- Unidirectional
- Woven



### Laminate physical properties

An interactive graphical modeler helps you to create and stack laminated composite plies efficiently. You can use standard pre-defined stacking sequences and/or ply groups to minimize the effort required to create and modify complex, multi-ply laminates.

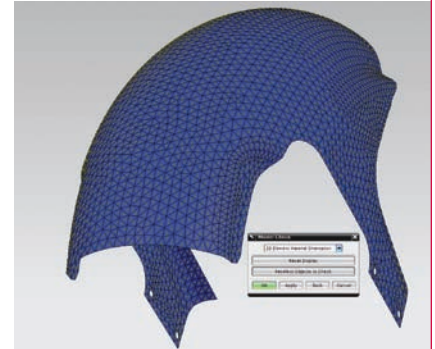
NX Laminate Composites automatically evaluates the laminate prior to solution, enabling you to make changes to the properties of any ply material after the laminate has been created.

You can also define your laminate in Microsoft Excel, and directly import it into NX. Conversely, you can export a laminate defined in NX to Excel. This facilitates in-house or other industry-specific calculations.

### Ply materials

You can combine fiber and matrix properties to create ply materials, which can be used in the laminate stack just like standard NX materials. Micromechanics theories allow you to create ply materials with the following types of fibers:

- Unidirectional
- Woven (you can specify the angle between the warp and weft fibers)
- Particulate
- Randomly oriented short fiber



### Optimization

NX laminate optimization allows you to improve the fundamental properties of your laminate: This capability is complementary to FEM-based optimization tools like NX Nastran solution 200. You can optimize a laminate physical property to meet stiffness, stability, strength or mass objectives. The genetic optimizer handles continuous variables (such as an orientation angle and ply thickness), as well as discrete variables, such as the existence of a ply, ply material, thickness and orientation. The software provides five laminate definitions that come the closest to meeting these objectives. You can select one of the five to replace the original laminate.

### Laminate validation

The laminate stiffness matrices (A, B, D and S) can be displayed in both Excel and text formats. Similarly, equivalent engineering constants can also be displayed, allowing you to assess the characteristics of your laminate prior to solution. You can apply loads and temperatures to your laminate and review the ply stresses, strains, failure indices and margins of safety. NX Laminate Composites supports the following failure theories:

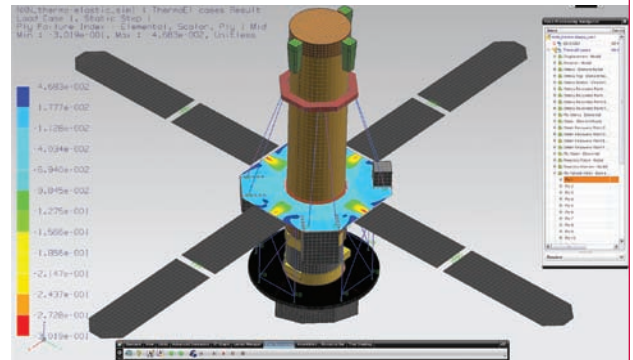
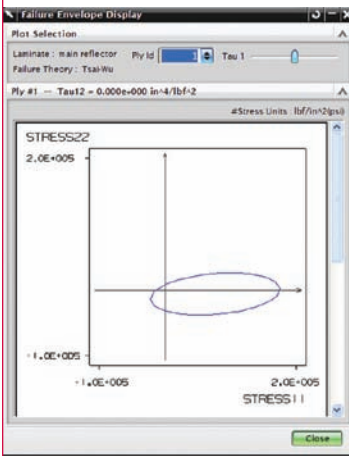
- Maximum stress
- Maximum strain
- Hill
- Hoffman
- Tsai-Wu

Through-the-thickness ply stress and strain charts, as well as ply failure envelopes, allow you to assess the viability of your laminate.

### Solver support

Laminates can be assigned to shell or solid elements. NX supports the following solvers:

- Nastran
  - PCOMP – MEM/BEND/SMEAR/SMCORE
  - PSHELL



**Ansys**

- 2D  
SHELL181, SHELL99, SHELL91, SOLSH190
- 3D  
SOLID186, SOLID191, SOLSH190

**Abaqus**

- 2D  
S8R, S8R5, S4, S4R, STRI65, S3, S3R
- 3D  
C3D8, C3D8R, C3D8I, C3D20, C3D20R, C3D20I, C3D6, C3D15

**LS-DYNA**

- 2D  
Element shell
- 3D  
Element Tshell

Solver-specific properties can be defined directly in the laminate modeler. For example:

- PSHELL or PCOMP format for Nastran solution
- Failure criteria definition for Ansys

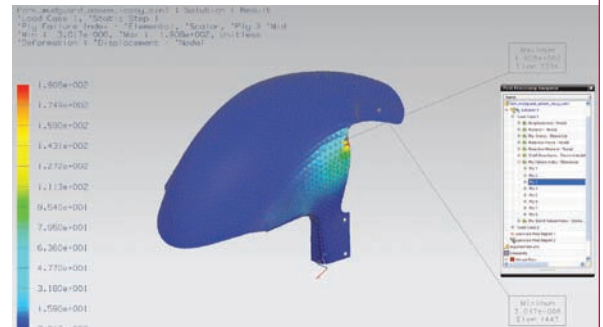
**Post-processing**

NX Laminate Composites post reporting allows you to view shell stress resultants, ply stresses, ply strains, as well as ply failure indices (ply and bond).

NX provides enveloping, filtering and sorting tools that allow you to quickly identify the critical element and ply over many solutions, including imported results. NX reads solver shell stress resultants and/or ply stresses, and computes ply strains, stresses, ply failure indices and margins of safety.

NX graphical post reporting uses a meta-solution to provide access to enveloped laminate results. You can view the ply data that envelopes several load cases and the element data that envelopes the ply results. Spreadsheet post reporting allows you to export specific ply data to Excel, as well as to sort and filter the data. Summary tables can help you to quickly identify the critical areas in your model.

NX post reporting uses the laminate properties in your active finite element model, so that you can switch failure theories and even modify your laminates after the solution to perform what-if analyses. NX reporting will update draping and zones if required, prior to accessing your results.

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