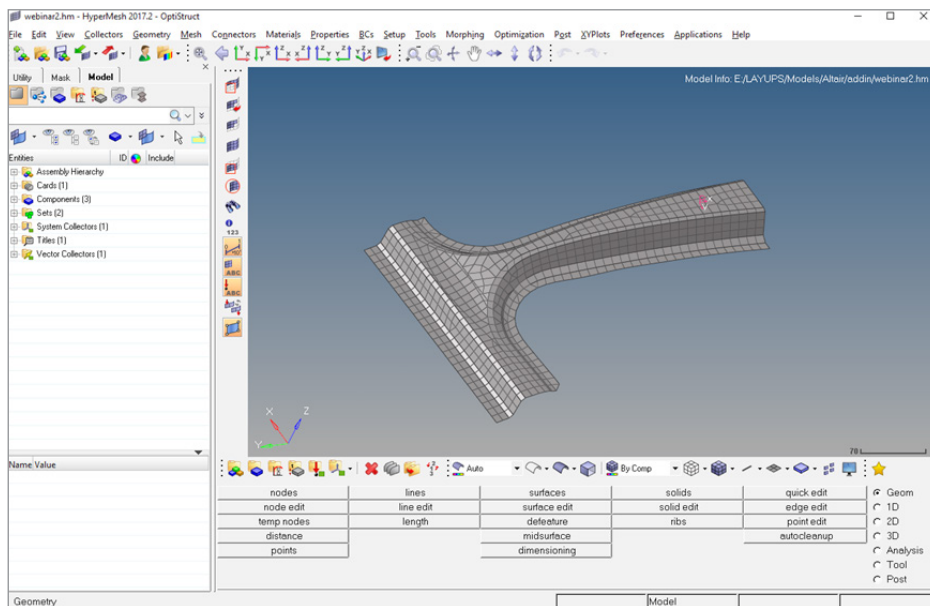anaglyph | △ Altair

An Efficient Workflow for Composites Design & Analysis Using LAP, CoDA & Laminate Tools with HyperMesh

Executive Summary

The task is to define optimal composite material and laminate property data, using HyperMesh in combination with Anaglyph's composites design and analysis software tools.

Introduction

LAP, Laminate Analysis Program, is based on Classical Laminate Theory, it can be used to analyze any type of composite laminate subjected to in-plane and transverse loads and moments. The flat laminate has no fixed size apart from its thickness, so that the analysis can be applied to any composite component, at specific locations where loadings or deformations are known. LAP is used in preliminary design for tailoring a stacking sequence, then analyzing the composite component with other methods such as finite elements, and finally optimizing the design by inspecting the laminate behavior layer by layer.

CoDA, Component and Composites Design Analysis, can be used to undertake preliminary analysis of sub-components with Plate, Beam, Joint, Flange or Laminate geometries. CoDA can also synthesize the properties of composite materials, laminates and sandwich structures, which can be used in a seamless manner within the design modules. Both LAP and CoDA are available on the APA platform.

Laminate Tools addresses the entire Design-Analysis-Check-Manufacture group process of structural design, but focuses on the composite material features. Stand alone, Laminate Tools interfaces with all industry standard be it CAD or FEA, ensuring the most flexible workflow.

In this paper, we will show how all these tools can be used with HyperMesh for composites design. The latest version of HyperMesh includes a new interface giving access to a number of Laminate Tools functions from inside of the HyperMesh environment, including draping simulation, accurate property tables and easy export to Laminate Tools of the finalized ply configuration for later post processing, and easy export of manufacturing data.

We start with LAP to generate suitable laminates, then test laminates in LAP and CoDA, build draped plies in HyperMesh using the Laminate Tools add-in, use HyperMesh to create the STACK and finally use Laminate Tools for final details.

LAP Usage

Having the shape and the loadings, for instance from an FEA analysis, we want to build the structure out of composite material. We want to find out what thickness, what type of layers, where, what coverage and what stacking sequence. We first generate laminates to satisfy the structural requirements:

a) Select the candidate materials and typical design loads;

b) Set the stiffness/strength requiremnts;

c) Select fiber angles to be considered, plus many more criteria;

d) SOLVE to get the final stacking sequences, satisfying all requirements;

e) Confirm laminate suitability further; and

f) Export laminates, import in HyperMesh.
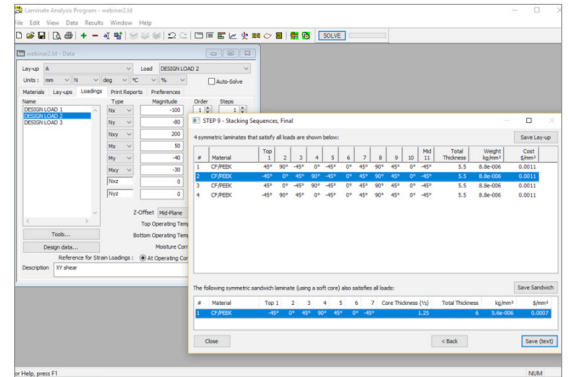
CoDA Usage

We then test design laminates in various configurations under load. CoDA offers a 3D solution through the thickness of the laminate.

a) Import candidate laminates from LAP (simply drag and drop);

b) Try a flange (corner) configuration for a candidate laminate;

c) Loads must match those in original design loads;

d) Confirm that failure indices remain acceptable; and

e) May also try other structural configurations such as panels and joints.
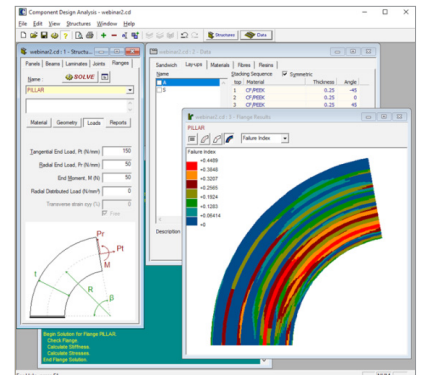
Laminate Tools Usage via HyperMesh

Create realistic manufacturing data for our structure, including layer patterns - flat for cutting/manufacturing, or draped orientation of the fibers - for an accurate analysis in HyperMesh.

a) Assigning material orientation is optional...

b) ...Needed for PCOMPs from LAP;

c) Alternatively, create a ply, assign a material and thickness as defined in LAP, as well as orientation, and finally select the ply coverage; and

d) Confirm that failure indices remain acceptable;

e) Using the Laminate Tools Drape add-in, define ply application point and reference direction for the fibers to obtain the draped ply;
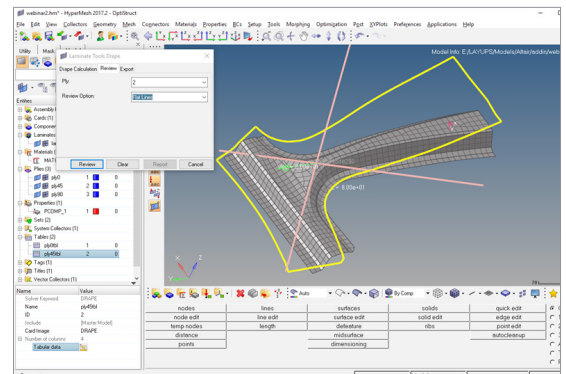
f) Preview the draped lines and flat pattern;

g) A table is created for each ply, defining all fiber orientations in the structure, both on the surface and through the thickness;

h) Build a laminate (STACK); and

i) Analyze and optimize.

Finalize with **Laminate Tools**:
Laminate Tools can perform more advanced draping functions to optimize the structure, i.e. reducing high sheer strain by adding splits or darts, as well as other functions listed below:

Design:
a) Build detailed ply data;

b) Build accurate layup (STACK);

c) Visualize all aspects;and

d) Generate full property data.

Post Processing:
a) Post-process FEA results, with a focus on composites properties, layer-by-layer.

Manufacturing:
a) Build detailed ply patterns;

b) Export electronic ply-books;

c) Export laser projection data; and

d) Interface with PlyMatch.

More on: www.anaglyph.co/uk/laminate_tools.htm

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