I-DEAS® Laminate Composites

for the design and evaluation of laminate composite structures

Laminate Composite Design and Analysis

I-DEAS® Laminate Composites software provides an integrated capability uniquely tailored to the productive design and evaluation of laminate composite structures. Extensive use of graphics greatly assists in all aspects of the model building and results review process.

Ply Property Definition

Ply properties can be obtained from an external data source or calculated internally.
•Input through ASCII SDRC universal file or I-DEAS relational database.
•Direct keyboard entry.
•Calculated using selection of micromechanics theories, including:
  •Halpin-Tsai
  •Mechanics of materials
  •Composite cylinder assemblage
  •Gough-Tangorra
  •Akasaka-Hirano
•Calculation of thermal expansion properties:
  •Levin's solution
  •Energy theory
•User-defined property determination using mathematical function expression.
•Stores orthotropic or anisotropic material properties.

Laminate Property Definition

Laminates can be built from a series of plies. Constitutive equations (equivalent stiffness properties) can be calculated directly or obtained from external data sources.
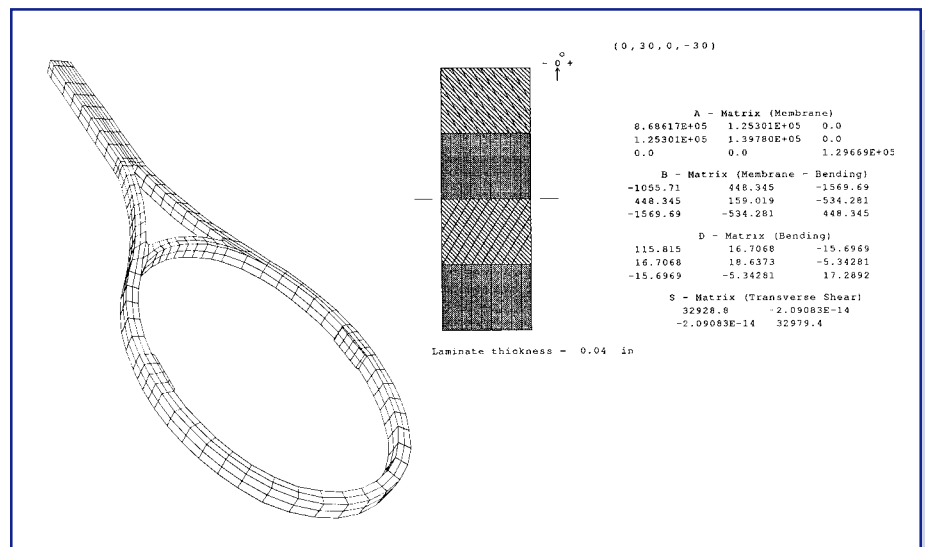•Interactive laminate buildup:
  •Definition of stacking sequence including ply materials, ply thickness, and material orientation.
  •Replication of plies or groups of plies in repeated, symmetric, or anti-symmetric form.
  •Link to standard laminate stacking notation.
•Definition of bottom fiber distance to reference plane.

•Definition of failure theory and necessary terms:
  •Maximum stress
  •Maximum strain
  •Hill
  •Hoffman
  •Tsai-Wu
  •User-defined failure criteria using mathematical function expression.
•Definition of allowable stress for bonding failure.
•Graphical display of laminate:
  •Ply orientation angle display.
  •Ply relative thickness display.
  •Color coding of plies.
•Interactive editing of individual plies or groups of plies to modify or replace any entity attribute (e.g., orientation, thickness, material).
•Calculation of A, B, D, and S constitutive matrices (equivalent stiffness properties).
•Ability to access constitutive matrices from external data sources through the ASCII SDRC universal file or I-DEAS relational database software.
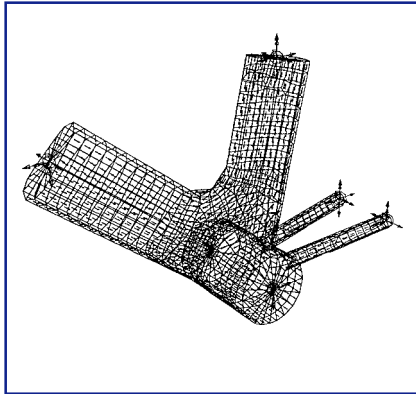•Direct keyboard entry of constitutive matrices.

Loads Analysis

Before committing to a full-scale finite element analysis, it is usually desirable to perform a basic analysis on a laminate. A capability is provided to determine laminate failure based on a point stress analysis.
•Extension and bending loads created interactively, obtained from I-DEAS Finite Element Modeling software or read from an external system through an I-DEAS universal file.
•Load application to determine total ply failure.
•Evaluation of failure safety margins, stress, and strain.

Laminate composite construction can be defined graphically, analysis is accomplished, and results are reviewed in I-DEAS software.

Laminate orientation can be defined with respect to part geometry.

Laminate Attachment to Finite Element Model

For analysis, the laminate definition must be mapped to finite elements with the proper orientation. I-DEAS software provides a variety of ways to accomplish this task.
•Orientation of individual elements through key-in.
•Use of global or local coordinate systems (Cartesian, cylindrical, spherical) to orient entire model or selected groups.
•Orientation through tangency to specified geometry (e.g., curve):
  •Static curve tangent.
  •Rotated curve tangent to simulate filament winding.
•Mapping to parametric geometry (e.g., stretch over a surface).
•Orientation for shell and solid finite elements.

Finite Element Analysis

•Analysis using laminate orthotropic or anisotropic shell and orthotropic solid elements available directly in I-DEAS Model Solution™ software.
•Interface to NASTRAN, ANSYS, and ABAQUS for analysis and recovery of results.
•All model data available in ASCII universal file and the I-DEAS relational database for access by other analysis programs.

Post-Processing

Results review for laminate composite structures involves sorting through large amounts of data. Information must be available not only for each finite element but also for all plies in the laminates. I-DEAS provides capabilities for sorting and displaying results in an understandable form.

•Display of ply-by-ply results using all the facilities of I-DEAS Finite Element Modeling™ including contours, arrows, criterion and XYZ graphing:
  •Stress
  •Strain
  •Failure indices (ply and bonding)
  •Interlaminar shear stress
•Two-dimensional display of ply failure envelopes with multiple plies identified with color and/or symbols (e.g., triangles).
•Display of stress or strain through the thickness of a laminate in XY form.
•Tracking of individual plys across elements describing structure for post-display understanding.
•Direct access to results from I-DEAS Model Solution.
•Results, including previously generated laminate models, recovered from NASTRAN, ANSYS, and ABAQUS.
•Results data is available in SDRC universal file and I-DEAS relational database form for recovery of results from other analysis programs.

Prerequisite

Core Simulation

For More Information

For more information, contact your local SDRC representative or call 1-800-848-7372.