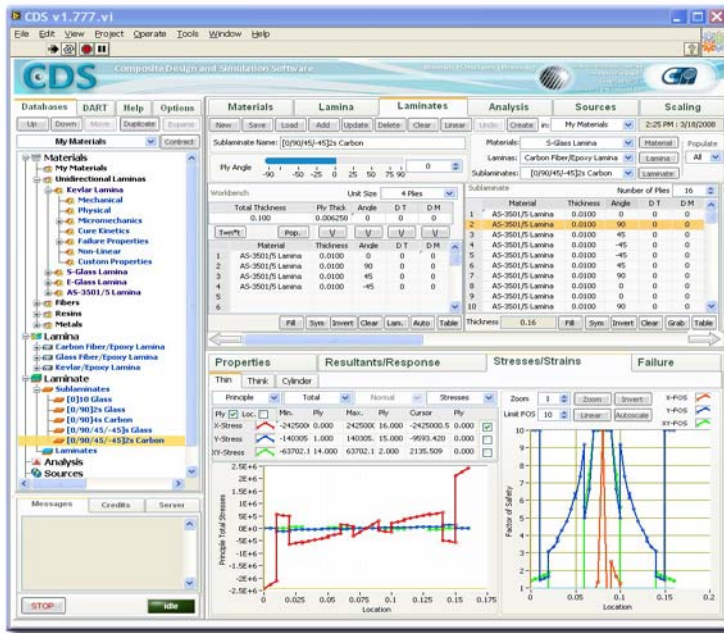


COMPOSITE TECH BRIEF

COMPOSITE DESIGN AND SIMULATION SOFTWARE - CDS



CCM has been creating design and analysis software for composite structures for more than two decades. The software is continuously upgraded to reflect new research findings as well as to capitalize on advances in computing technology. The latest release of this suite called Composite Design and Simulation (CDS) software consolidates all existing applications into a single environment which incorporates effective property prediction, structural mechanics and failure analysis for composite laminates with integrated material property management, process simulation and real time design features.

The key to the success of the new CDS software is the menu-tree/menu-based interface which enables the user to work in an intuitive

environment for design and optimization of the entire range of composite structures from thin laminates to thick sections to cylinders. Each section builds upon data generated in the previous hierarchy, thus ensuring continuity and ease of use in the analysis environment.

At the heart of this environment is a new materials database structure that captures all of the features of the original database software while adding such new attributes as material tracking, property locking features, and real-time design. The materials database tree also allows creation of sub-databases that can be used to store fiber and matrix properties. Users can create and manipulate material databases that store a wide range of material

information. Each material currently stores 170 material property values, each of which also contains source, date, and unit information. Properties include mechanical and physical properties, micromechanics parameters, cure kinetics, and damage and failure properties, as well as non-linear and MAT162 (LS-DYNA) properties. A custom units section is also available for users to add their own material fields. The user can modify properties "on the fly" and see laminate effective properties, stresses, strains, and progressive failure in real time. Material property sources and units are tracked to ensure validity during analysis and can be exported to third-party FEA packages for further design and analysis.

Micromechanics calculations include continuous laminas, SMC, particulate reinforcement, random mat and short fiber composites. The next release of the software slated this summer will also incorporate fabric micromechanics. Lamina properties are generated in real time and can be used in laminate structural design and optimization allowing the user to try various materials, vary fiber volume fraction or architecture.

The laminate workbench in the new environment has been greatly improved and allows easy creation of sub-laminates within laminates. Users can quickly create and manipulate up to 100 unique laminates while generating real-time effective properties and resulting stresses, strains, and displacements as well as progressive

CDS - MENU DRIVEN ENVIRONMENT



- **Materials:** The material tree and associated window is the core location of all properties used within the CDS environment.
- **Laminas:** The lamina tree and window contains fiber, matrix, and filler information used to calculate the effective properties of a lamina using various micromechanics models.
- **Laminates:** The laminate tree is where all sub-laminates and laminates are created, stored and evaluated.
- **Analysis:** The analysis tree and window is where users define a structure type: thin, thick-section composite plate or cylinder and then applies thermal, mechanical, or moisture loading to the structure.
- **Sources:** This area is where users store material property "templates" which can be used to quickly assign source information to any material property
- **Scaling:** This area is where material property and analysis scaling is defined when varying input conditions to all available parameters within the CDS environment

failure by simply clicking on each laminate during an analysis. This allows easy comparison and ranking of materials for down-selection in design.

The analysis environment allows users to virtually apply thermal, mechanical or moisture loading and observe laminate response. This environment also allows incorporation of additional modules such as discontinuous sandwich analysis and laminates with compliant interlayers. The global load vectors are dependent on the type of structure under investigation, and all results from loading are displayed in real time. Progressive failure tables identify the failure ply, mode and load at failure for a number of common failure theories.

Material property source information is as important to the analysis as the property data itself and is can be applied to every value of every material in all databases. Source 'templates' can also be used to quickly assign source information to property data sets and date stamping is also available.

The CDS Suite is available to industrial consortium members through consortium agreements tailored to program requirements and

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duration of contracts. CCM researchers will work in parallel with consortium members with the design and analysis phase so that members learn to successfully use this software independently on current or future projects. Demonstration versions of the CDS suite will be made available to potential members with training workshops at CCM or online through web meetings. An online comprehensive guide and software support will also be made available to allow consortium members to use CDS both independently and to encourage future partnerships on new projects.

In summary, being a consortium member allows a company to leverage existing CDS software applications with future projects and future software development that is tailored to industrial member requirements.

To learn more about specific CDS applications, visit
www.ccm.udel.edu/Tech/CDSindex.html

