

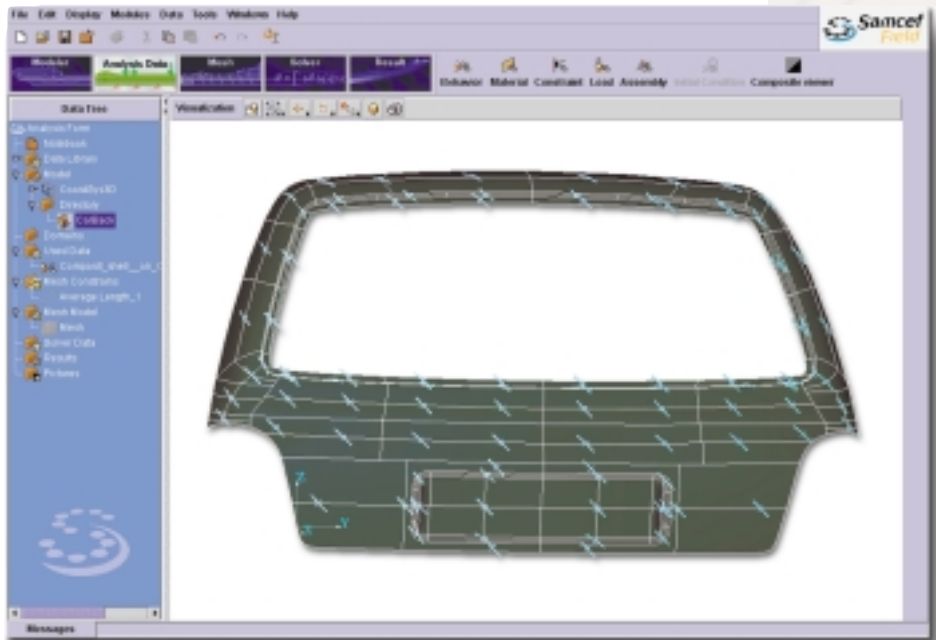
# COMPOSITES ANALYSIS WITH SAMCEF Field

## OVERVIEW

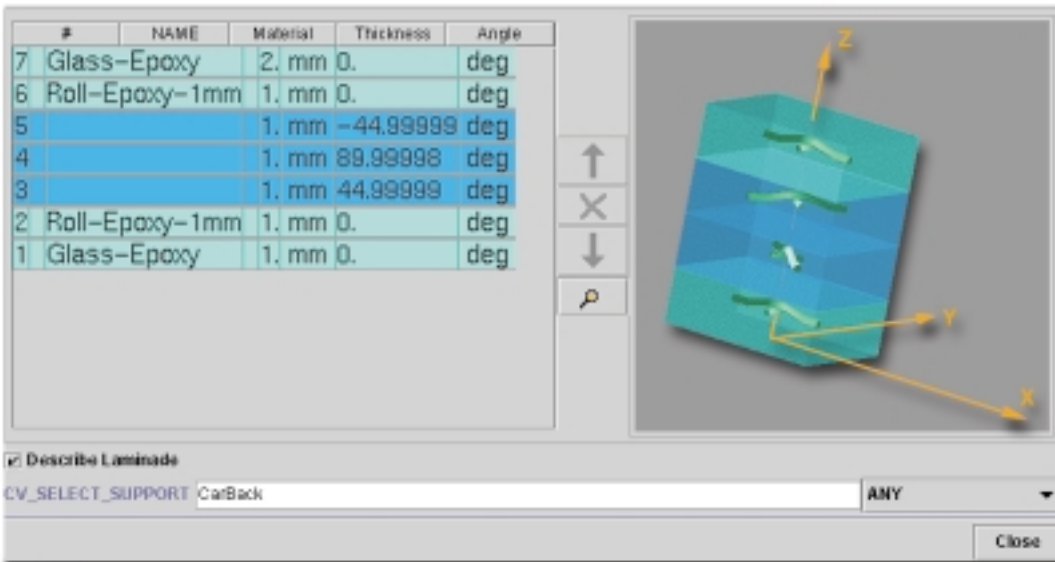
Composite materials are increasingly used in diverse industrial sectors as automobile, rail, ship and aeronautics industries, building, mechanics, leisure and sports, etc., but they confront designers and stress engineers with a series of specific problems:

- High degree of anisotropy
- Low secondary strength
- Sensitivity to stress concentration
- Huge amount of data and results processing

SAMCEF Field numerous facilities for modeling and analyzing composite materials structures provide the structural analyst with the appropriate solution to the above concerns.



Composites viewer



## SPECIALIZED ELEMENTS

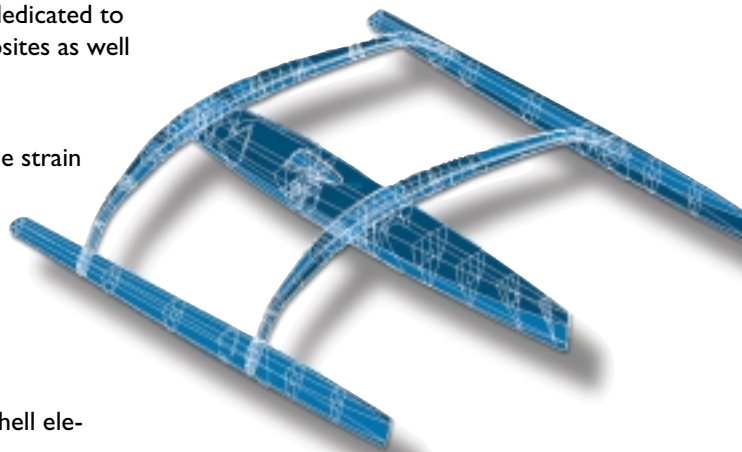
SAMCEF Field includes a comprehensive library of multilayered elements dedicated to the modeling of laminated composites as well as sandwich constructions:

### Laminated Structures

- 2-D plane and generalized plane strain elements
- Thin shell (Kirchhoff)
- Thick shell (Mindlin)
- Membrane elements
- Thin walled beam elements

### Sandwich Constructions

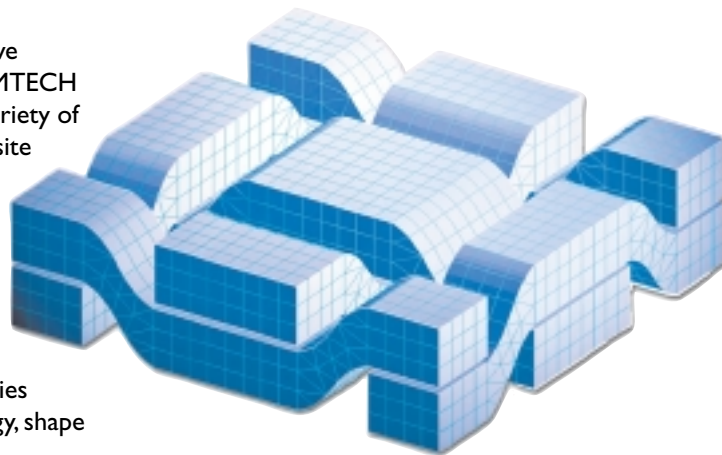
- Transverse shear deformable shell elements (Mindlin)



## STRUCTURAL ANALYSIS

SAMCEF Field is an open and interactive environment. Its interfaces with all SAMTECH software tools give access to a wide variety of thermo-mechanical analyses of composite material structures, including:

- Linear static
- Non-linear static (material and geometrical non-linearities)
- Modal analysis
- Linear and incremental stability
- Optimization with BOSS quattro (plies thickness, fiber orientations, topology, shape and size optimization)



### Key Features

- Computation of interlaminar stresses based on local equilibrium equations per ply
- Modified Von-Mises elastoplastic model for adhesive materials
- Temperature dependent material properties
- Numerical homogenization of periodic composite material properties

### Material Behavior

Various models are available to simulate the material behavior before degradation.

- Linear elastic, either isotropic or orthotropic
- Law of mixture
- Non-linear (hyperelastic, elastoplastic, viscoelastic, viscoplastic)
- Sandhu (irreversible non-linear behavior)
- Multilinear material model (i.e. behaving differently in tension and compression)

Transverse matrix cracking is supposed to initialize the degradation process, when the selected failure criterion is satisfied.

The transverse material properties are softened accordingly and total failure is said to occur when the fibers break in turn.

### Failure Theories

- Maximum stress
- Maximum strain
- Tsai-Hill
- Tsai-Wu
- Hashin



## PRE- AND POST-PROCESSING

The analysis of composite materials structures entails processing of a huge amount of data and results.

In this regard, SAMCEF Field provides you with advanced visualization tools allowing very efficient and straightforward pre- and post-processing of composite materials structural analyses.

These specific features are integrated in the data tree; in the preprocessing stage, they allow the analyst to examine:

- Plies, lay-ups, and materials location
- Plies thickness
- Distribution of fibers orientation on the geometry

In the post-processing session, the following results may be accessed:

- Generalized stress/strain results over the shell thickness
- Local stress/strain tensors for a particular ply
- Critical ply according to the selected failure theory
- Failure criteria and associated safety factors

The above results can be displayed and animated simultaneously with the deformation of the geometry.

Using a specific composite data viewer, it is also possible to select a particular shell element and to visualize the results distribution through the thickness, including transverse shear stress (3-D visualization).

SAMCEF Field modeling capabilities are close to manufacturing process, namely including an automatic draping procedure, which allows to simulate the laying-out operation, and generate the fibers orientation distribution, from a user selected starting point.



#### samtech s.a.

Parc Scientifique du Sart-Tilman  
rue des Chasseurs-Ardennais 8  
B-4031 Angleur-Liège BELGIUM  
Tel. : +32-(0)4-361 69 69  
Fax : +32-(0)4-361 69 80  
<http://www.samcef.com>