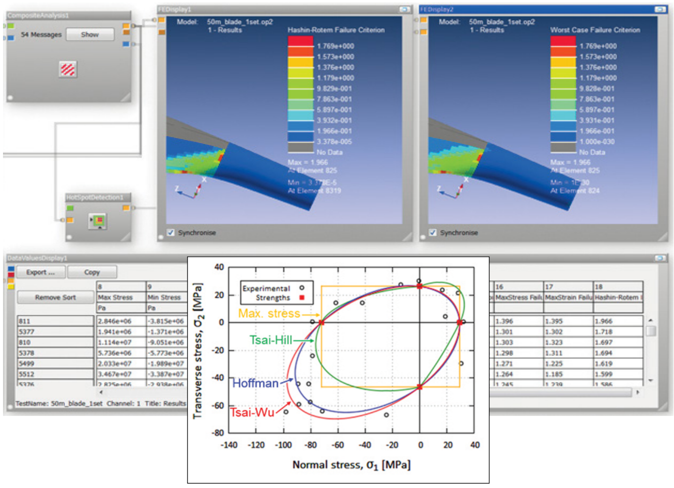
Prenscia HBM

DesignLife

Advanced Analysis of Composite Materials

Composite materials offer many advantages that are leading to rapidly increasing use in various industries. Effective use of materials and efficient development of new designs require CAE simulation techniques capable of modeling structural performance and possible failure modes, including fatigue. The composite focused modules in nCode DesignLife™ aim to provide design analysts with easy-to-use post-processing tools to help improve and optimize the durability of composite components.



	8	9	16	17	18
	Max Stress	Min Stress	MaxStress Failu	MaxStrain Failu	Hashin-Rotem
	Pa	Pa			
811	2.846e+06	-3.815e+06	1.396	1.395	1.966
5377	1.941e+06	-1.371e+06	1.301	1.302	1.718
810	1.114e+07	-9.051e+06	1.303	1.323	1.697
5378	5.736e+06	-5.773e+06	1.298	1.311	1.694
5499	2.033e+07	-1.989e+07	1.271	1.225	1.619
5512	3.467e+07	-3.387e+07	1.264	1.185	1.599
5376	2.825e+06	-2.938e+06	1.245	1.239	1.586

TestName: 50m_blade_1set Channel: 1 Title: Results

Composite Analysis

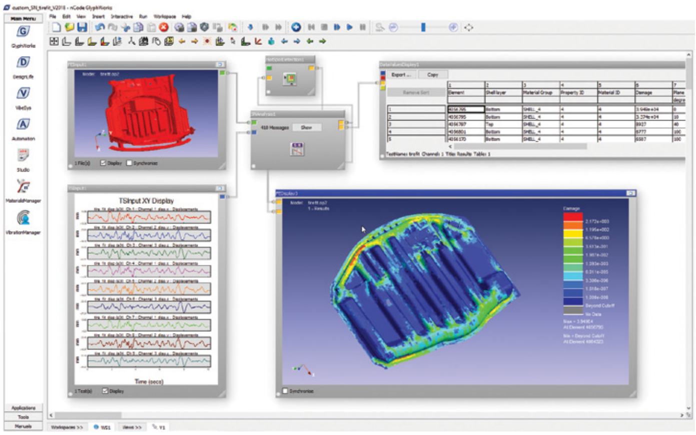
The CAE Composite Solver allows users to evaluate the strength of a structure against industry standard composite failure criteria. Rather than limiting this evaluation to a small number of load cases or steps, stresses can be assessed by using the chosen failure criteria throughout realistic duty cycles (quasistatic or dynamic), allowing critical locations, load combinations and associated design reserve factors to be readily identified. In addition, selected location loading paths may be visually compared with the material failure envelope.

Composite Analysis features:

The following methods can be used individually or combined to give the most conservative result:

- Maximum stress
- Maximum strain
- Norris
- Hoffman
- Tsai-Hill
- Tsai-Wu
- Franklin-Marin
- Hashin
- Hashin-Rotem
- Hashin-Sun
- Modified NU
- Norris-McKinnon
- Christensen
- User-defined custom methods via Python

DesignLife product options for the analysis of composite materials



In injection molded fibre reinforced materials, the flow of material into the mold results in partial alignment of the fibres. The alignment of the fibres controls the stiffness and strength (static and fatigue) of the material and will generally vary continuously throughout the structure. This distribution of fibre orientations can be predicted in the form of an orientation tensor with the use of molding simulation tools. The more fibres that are aligned in a particular direction, the stronger the material will be in that direction. As a result, it's clear that the material properties will differ at every point in the model, and the relative orientation of the fibres and stresses is very important. The effects of these variations can be addressed with nCode DesignLife.

Short Fibre Composite

The Short Fibre Composite option uses a stress-life approach for the analysis of anisotropic materials such as glass fibre filled thermoplastics. The stress tensor for each layer and section integration point throughout the shell thickness is read from FE results. The material orientation tensor describing the "fibre share" at each calculation point and direction is provided by mapping a manufacturing simulation to the finite element model. This orientation tensor can be read from the FE results file or supplied from an ASCII file.

Short Fibre Composite analysis requires standard materials data of two or more SN curves for differing fibre orientations. DesignLife uses this data to calculate an appropriate SN curve for each calculation point and orientation. DesignLife capabilities such as multiple variable amplitude loads and duty cycles are also supported for composites.

Short Fibre Composite module features:

- Simulate complex loading scenarios using any time domain method (static or modal superposition, duty cycles, etc.)
- Simulate vibration tests driven by random (PSD), swept sine, sine dwell or sine-on-random loading
- Predict damage and life per layer and integration point
- Incorporate results of manufacturing simulation including fibre orientation tensors or residual stresses
- Model local fatigue properties based on microstructure (orientation tensor) and stress state
- Calculate fatigue based on principal stresses or critical plane — including stresses calculated from FE-Digimat and multiaxial stress states
- Choice of fatigue property model - SN curve interpolation or interface to Digimat
- Use of homogenized matrix or fibre stresses as well as typical composite ones