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Ingenuity for life

Simcenter 3D Advanced Durability

In-depth fatigue and life analysis

Benefits

- Improves product design robustness by determining the life of product designs
- Reduces physical testing costs by enabling you to analyze product life in a virtual environment
- Accelerates product development by enabling you to quickly perform "what-if" re-analysis of new designs to understand the impact of design changes on product durability

Summary
Simcenter™ 3D Advanced Durability software helps to validate a product's structural integrity over its entire lifecycle under either simple or complex loading conditions. Expert analysts use this solution to perform in-depth fatigue analysis and life calculations to help them determine product durability based on Simcenter™ Nastran®, Simcenter 3D Response Dynamics, MSC Nastran, ANSYS® and Abaqus™ solutions. Simcenter 3D Durability is provided as an add-on module to Simcenter 3D Engineering Desktop or Simcenter 3D Structures.

An advanced toolset for determining product life and fatigue damage
Simcenter 3D Durability provides a set of analytical tools to predict the life of products and evaluate their fatigue resistance when they are subjected to prescribed stress and/or strain histories residing in Simcenter 3D structural solutions. Advanced Durability can estimate the damage incurred during single or multiple events. Damage and life results are displayed as contour plots on your model for intuitive interpretation.

The durability meta-solution process can contain multiple static and transient events. An event is comprised of:

- A Simcenter 3D or imported stress analysis solution
- Durability solver settings
- Element and material selection

The durability solution process can calculate the strength and fatigue results for:

- Each event separately
- All the active events in the durability meta-solution process

There are three types of events.

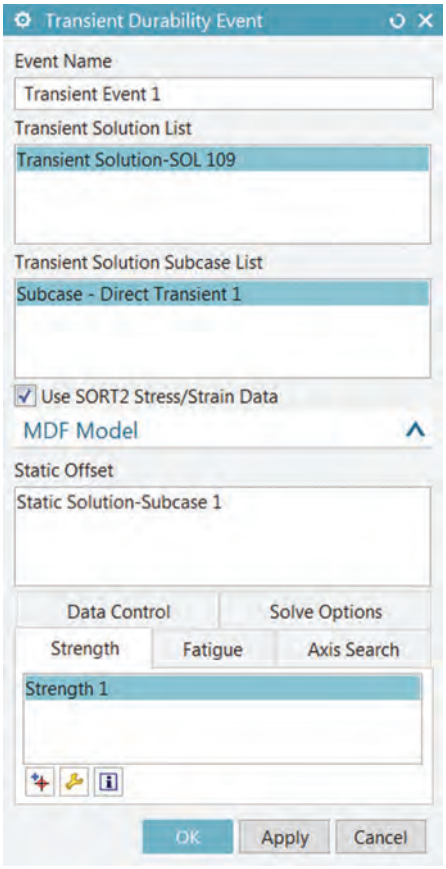
Static events, which determine the strength safety factors, fatigue safety factors and fatigue life of your structural model with respect to a static solution on which predetermined cyclical loading patterns are superimposed. A static event references stress and strain results from the following solutions:

- Simcenter Nastran or MSC Nastran: SESTATIC 101 – single constraint and SESTATIC 101 – multi-constraint
- ANSYS: linear statics
- Abaqus: static perturbation

Transient events, which determine the strength safety factors, fatigue safety factors and fatigue life of your structural model with respect to time-domain transient loading. A transient event references results from the following solutions:

- Simcenter Nastran: SEDTRAN 109 and SEMTRAN 112
- Simcenter 3D Response Dynamics (.rs2 files that contain geometry information)

Simcenter 3D Advanced Durability



- Simcenter Nastran SEMODES 103: flexible body solution with the flexible body recovery option defined
- Simcenter Nastran advanced nonlinear: ADVNL 601,129 and ADVNL 701 (linear stresses and strains)
- Multibody dynamics simulation: ADAMS and Recurdyn .mdf files

Random events, where expected fatigue damage and life are calculated for random excitation specified through a Power Spectral Density (PSD). Simcenter 3D Response Dynamics random events are used as input.

Strain gage durability
Leg strain data from strain gage rosettes may be used to compute fatigue damage using the Strain Gage Rosette Analyzer and Evaluate Damage commands. The strain gage rosettes may be real strain gage rosettes generating measurement data or virtual rosettes simulated within Simcenter 3D Response Dynamics.

Simcenter 3D Durability supports the following:

Life criteria
- Stress life (including Dang Van multiaxial fatigue)
- Strain life
- Smith-Watson-Topper
- Weld life (BWI and TWI)
- Plate thickness correction for stress life and weld life
- User-defined stress life and strain life curves supported

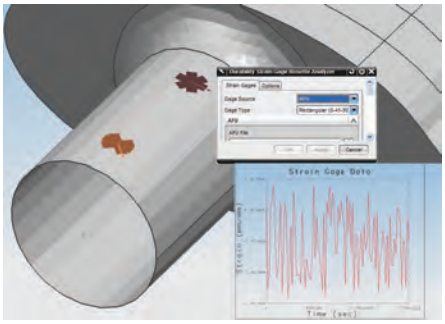
Stress direction approaches
- Principal axes
- Maximum damage
- Critical plane
- Stress/strain states
- Uniaxial
- Biaxial

Mean stress effects
- Goodman
- Morrow
- Soderberg
- Gerber

Notch effects
- Neubers method
- Fuchs method

Cyclic stress-strain relations
- Ramberg-Osgood
- Power hardening
- Linear

Rainflow cycle counting
- Range-mean matrices written to spreadsheet



Random fatigue methods
- Narrow band (Miles)
- Wide band (Dirlik)

Simcenter integration
- Leverages geometry associativity to quickly evaluate the impact of changing geometrical features on fatigue resistance
- Includes Simcenter 3D Durability Wizard

Postprocessing
- Contour plots for fatigue life, damage and safety factors
- Durability reports
- Crack initiation direction

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