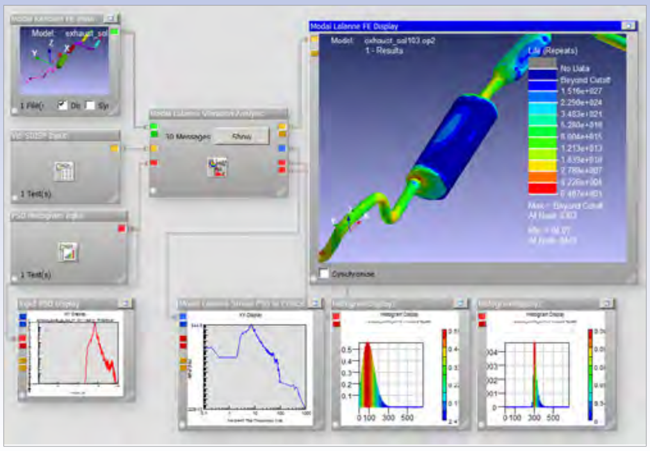
nCode DesignLife™ 11

Product Details

Streamlining the CAE Durability Process

nCode DesignLife is an up-front design tool that identifies critical locations and calculates realistic fatigue lives from leading finite element (FE) results for both metals and composites. Users can go beyond performing simplified stress analysis and avoid under- or over-designing products by simulating actual loading conditions to avoid costly design changes.

DesignLife features advanced capabilities for virtual shaker testing simulation, welds, vibration, crack growth, composites, and thermo-mechanical fatigue analysis.



Product benefits:

- **Reduce reliance on physical tests** and avoid costly design and tooling changes
- **Perform smarter and quicker** physical tests by simulating first
- **Reduce warranty claims** by reducing failures
- **Reduce cost and weight** by assessing more design options
- **Improve consistency and quality** with standardized analysis processes
- **Correlate directly** with physical test data

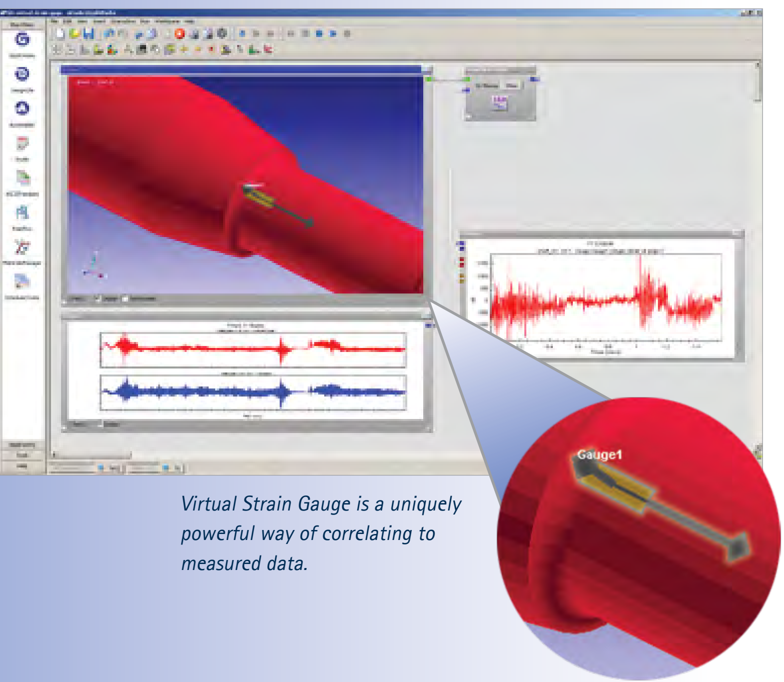
Product features:

- **Advanced technology** including multi-axial, welds, short-fibre composite, vibration, crack growth, thermo-mechanical fatigue...
- **Intuitive and easy to use** software for performing fatigue analysis from finite element models
- **Direct support for leading FEA results data** including ANSYS, Nastran, Abaqus, Altair OptiStruct, LS-Dyna and others
- **Efficiently analyze** large finite element models and complete usage schedules using multi-threaded and distributed processing
- **Highly configurable** for the expert user
- **Single environment** for both test and CAE data
- **Enables standardization** of analysis processes and reporting

nCode DesignLife™

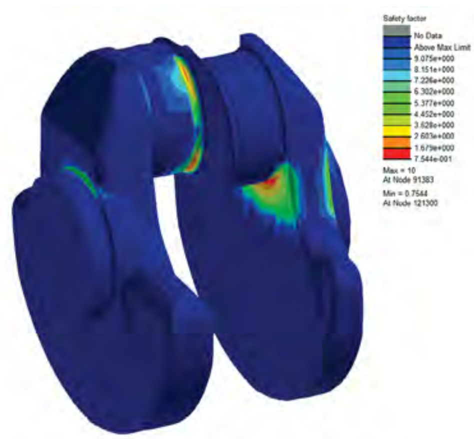
HBM

Core Functionality for Advanced Fatigue Analysis



Virtual Strain Gauge is a uniquely powerful way of correlating to measured data.

nCode DesignLife shares an environment with nCode GlyphWorks, a graphical test data processing software – providing an unparalleled integration of test and CAE data. Both DesignLife and GlyphWorks have specific application to fatigue and durability analysis and can be purchased separately or together. They can also be accessed through nCode CDS, a licensing system that provides flexible access to all of the nCode desktop products.



Core Functionality

Virtual Strain Gauge
Enables correlation between test and finite element results. Single or rosette gauges may be graphically positioned and oriented on finite models as a post-processing step. Time histories due to applied loads can then be extracted for direct correlation with your measured strain data. It also facilitates the reconstruction of applied load histories from measured strain gauge data on a component.

Crack Growth
Provides a complete fracture mechanics capability using industry standard methodologies for specified locations on FE model. Built-in growth laws include NASGRO, Forman, Paris, Walker and more. Select from a provided library of geometries or supply custom stress intensity factors.

Python Scripting
Unique capability that enables Python scripting to be used to extend existing analysis capabilities rather than needing to code fatigue analysis from scratch. Perfect for proprietary methods or research projects.

Signal Processing
nCode GlyphWorks Fundamentals is included for basic data manipulation, analysis and visualization.

Schedule Create
Select and build multiple cases that define a duty cycle through an intuitive interface. This feature makes it easy to create a complete durability schedule.

Materials Manager
Enables materials data to be added, edited and plotted. A default database with fatigue properties for many commonly used materials is also provided.

Product Options

Stress-Life (SN)

The primary application of the **Stress-Life** method is high-cycle fatigue (long lives) where nominal stress controls the fatigue life. A wide range of methods are provided for defining the SN curves, including the ability to interpolate multiple material data curves for factors such as mean stress or temperature. Further options are also provided to account for stress gradients and surface finishes. For ultimate flexibility, Python scripting enables the definition of custom fatigue methods and material models.

Material models

- Standard SN
- SN Mean multi-curve
- SN R-ratio multi-curve
- SN Haigh multi-curve
- SN Temperature multi-curve
- Bastenaire SN
- Custom SN using Python scripting

Stress combination methods or critical plane analysis

Back calculation to target life

Multiaxial Assessment

- Biaxial
- 3D Multiaxial
- Auto-correction

Mean stress corrections

- FKM Guidelines
- Goodman
- Gerber
- Interpolate multiple curves

Stress gradient corrections

- FKM Guidelines
- User defined

Strain-Life (EN)

The **Strain-Life** method is applicable to a wide range of problems including low-cycle fatigue where the local elastic-plastic strain controls the fatigue life. The standard E-N method uses the Coffin-Manson-Basquin formula, defining the relationship between strain amplitude ε_a and the number of cycles to failure N_f. Material models can also be defined using general look-up curves. This enables the ability to interpolate multiple material data curves for factors such as mean stress or temperature.

Material models

- Standard EN
- EN Mean multi-curve
- EN R-ratio multi-curve
- EN Temperature multi-curve

Strain combination methods or critical plane analysis

Stress-strain tracking for accurate cycle positioning

Back calculation to target life

Multiaxial Damage Models

- Wang Brown
- Wang Brown with Mean

Mean stress corrections

- Morrow
- Smith Watson Topper
- Interpolate multiple curves

Plasticity Corrections

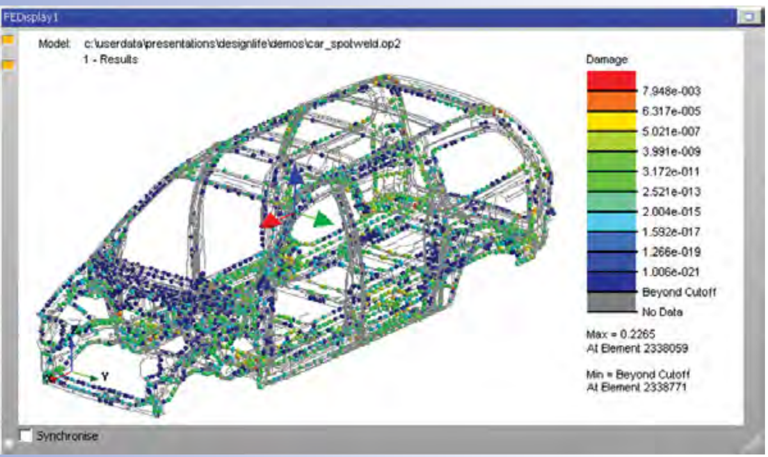
- Neuber
- Hoffman-Seeger
- Seeger-Heuler

Multiaxial Assessment

- Biaxial
- 3D Multiaxial
- Auto-correction

State-of-the-art complement of CAE durability tools.

Product Options



Locate critical weld failures

before you even have a prototype.

Spot Weld

The **Spot Weld** option enables the fatigue analysis of spot welds in thin sheets. The approach is based on the LBF method (see SAE paper 950711) and is well-suited to vehicle structure applications. The spot welds are modeled by stiff beam elements (e.g., NASTRAN CBAR) and the creation of these welds in this form is supported by many leading FE pre-processors. CWELD and ACM formulations using solid element representation are also supported. DesignLife can automatically identify all the related model information from these welds to make job setup and solution quick and simple. Cross-sectional forces and moments are used to calculate structural stresses around the edge of the weld. Life calculations are made around the spot weld at multiple angle increments and the total life reported includes the worst case. Materials data that is provided can be generally applied to many spot weld cases. Python scripting also enables modelling of other joining methods such as rivets or bolts.

Seam Weld

The **Seam Weld** option enables the fatigue analysis of seam welded joints, including fillet, overlap and laser welds. The method is based on the approach developed by Volvo (see SAE paper 982311) and validated through years of use on vehicle chassis and body development projects. Stresses can either be taken directly from FE models (shell or solid elements) or calculated from grid point forces or displacements at the weld.

DesignLife provides methods to intelligently identify weld lines in the FE model, thus simplifying the process of setting up the fatigue job. General material data for seam welds for both bending and tension conditions are supplied with the software. The approach is appropriate for weld toe, root and throat failures. Thick welds can also be assessed using the stress integration method outlined in ASME Boiler & Pressure Vessel Code VIII (Division 2) standard. Corrections are also available for sheet thickness and mean stress effects. The BS7608 welding standard is also supported, together with required material curves.

Adhesive Bonds

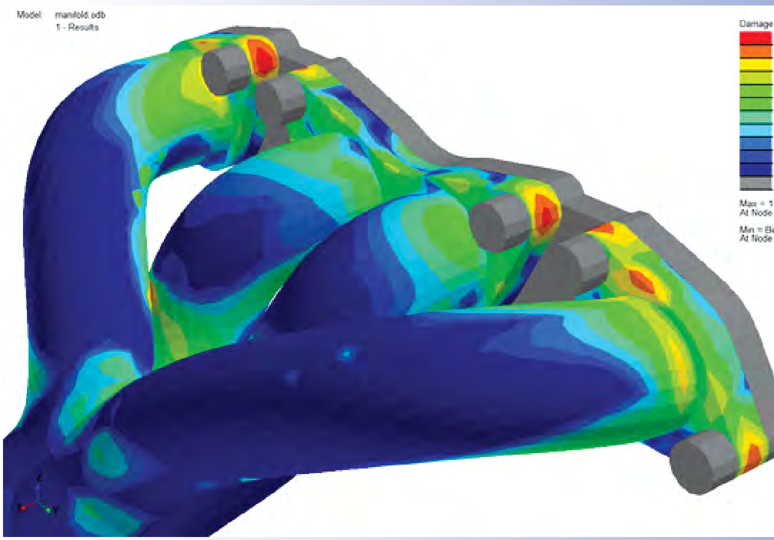
Adhesive bonding is increasingly used in the development of lightweight vehicle bodies to give improved structural rigidity with good durability. DesignLife uses a fracture mechanics-based method to assess which joints in the structure are most critically loaded. **Adhesive bonds** are modeled with beam elements and grid point forces are used to determine line forces and moments at the edge of the glued flange. This enables approximate calculations of the strain energy release rate (the equivalent J-integral) to be made at the edge of the adhesive and, by comparison to the crack growth threshold, a safety factor (design reserve factor) may also be calculated. J-integral values calculated for different geometries and loadings have been shown to provide good correlation for the durability of joints, particularly at longer lives, enabling useful estimations of joint durability to be made.

Product Options

Thermo-Mechanical Fatigue

Components in high temperature operating environments such as engine pistons, exhaust systems and manifolds can suffer from complex failure modes. The **Thermo-Mechanical Fatigue (TMF)** option provides solvers for high temperature fatigue and creep by using stress and temperature results from finite element simulations. Mechanical loads that vary at a different rate to the temperature variations can also be combined. Required material data is derived from standard constant temperature fatigue and creep tests.

Includes **high temperature fatigue methods** Chaboche and ChabocheTransient. Creep analysis methods include Larson-Miller and Chaboche creep.

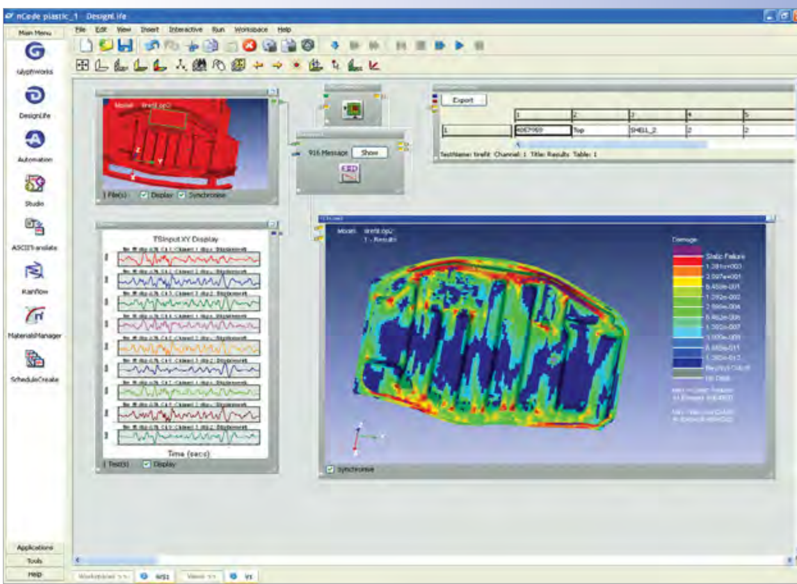


Gain insight into new material performance and **reduce development time.**

Short Fibre Composite

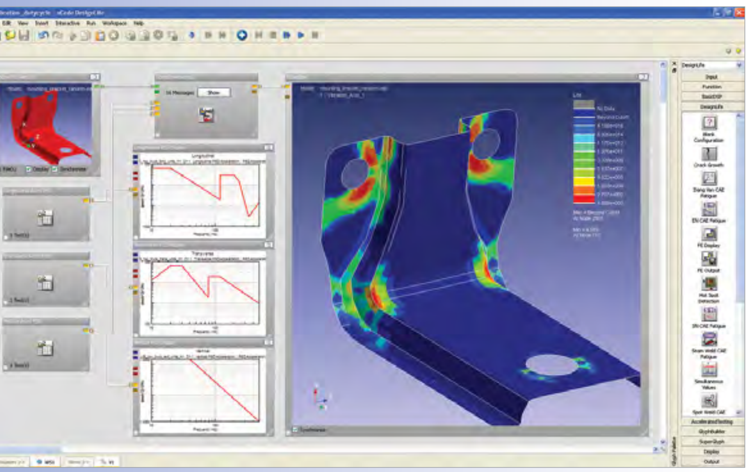
The **Short Fibre Composite** option uses a stress-life approach for the analysis of anisotropic materials such as glass fibre filled thermoplastics. The stress tensor for each layer and section integration point through the thickness is read by DesignLife from FE results. The material orientation tensor 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.

The Short Fibre Composite analysis requires standard materials data of typically 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.



nCode DesignLife™

Product Options



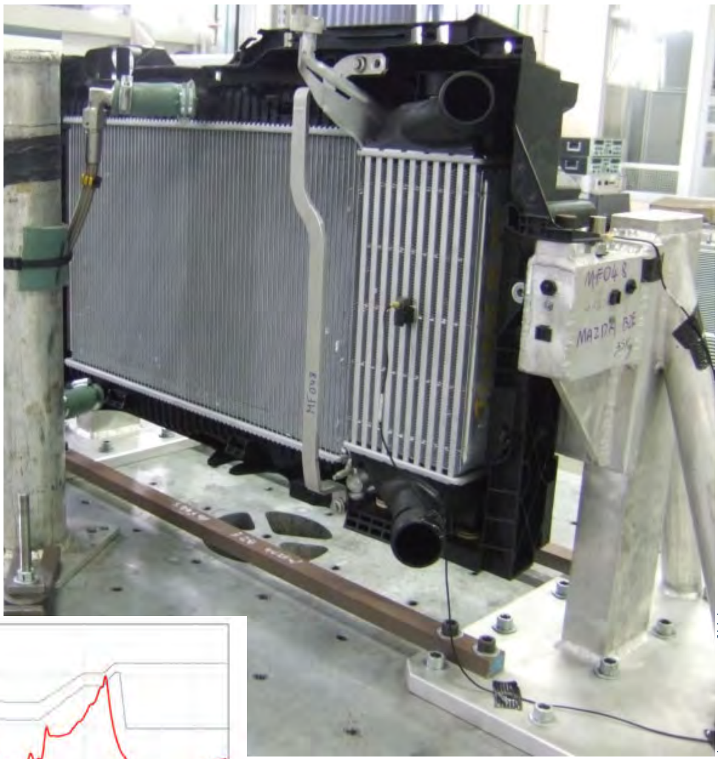
Fatigue and durability analysis provides valuable prediction of product life in the real usage environment. nCode DesignLife provides the opportunity to design for fatigue early in the design cycle by predicting structural performance directly from FE models – minimizing prototype tests and design costs.

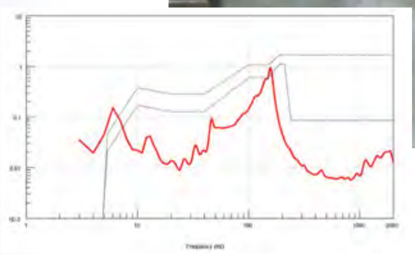
Fast and direct simulations of shaker tests in the frequency domain.

Vibration Fatigue

The **Vibration Fatigue** option enables the simulation of vibration shaker tests driven by random (PSD), swept-sine, sine-dwell or sine-on-random loading. It provides the capability to predict fatigue in the frequency domain and it is more realistic and efficient than time-domain analysis for many applications with random loading such as wind and wave loads. Finite element models are solved for frequency response or modal analysis and the vibration loading is defined in DesignLife. This can include the effect of temperature, static offset load cases and complete duty cycles of combined loading.

The perfect add-on product to Vibration Fatigue is **Accelerated Testing** for the ability to create a representative PSD or swept-sine shaker vibration test based on measured data. It enables the combination of multiple time or frequency domain data sets into representative test spectra that accelerates the test without exceeding realistic levels.



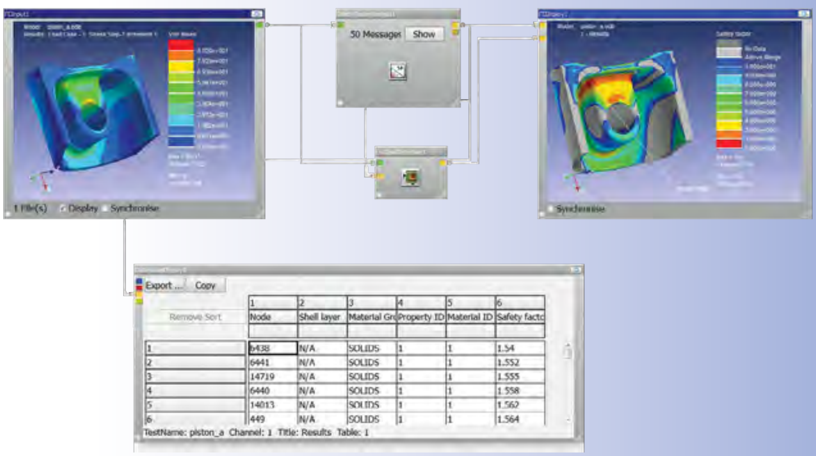


Images courtesy of Valeo

Radiator set up in fixture for bench testing with realistic test specification (red) overlaid on generic specification (blue & green)

Dang Van

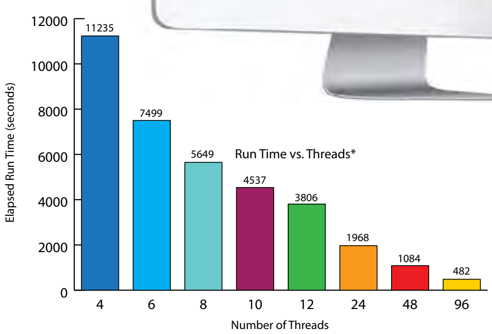
Dang Van is a multi-axial fatigue limit criterion and is a method of predicting the endurance limit under complex loading situations. The output from the analysis is expressed as a safety factor and not a fatigue life. It uses specific material parameters calculated from tensile and torsion tests. Manufacturing effects can also be accounted for by using equivalent plastic strain in the unloaded component.



Safety Factor

Safety Factor enables the calculation of stress based factors of safety. It uses standard mean stress corrections or user-specified Haigh diagrams to assess durability. This method is widely used as a key design criteria for engine and powertrain components.

Rapidly improve designs by taking advantage of hardware scalability.



*Actual reduction in run-time depends on specific job

Increase simulation throughput by adding computing resources

Processing Thread Option

DesignLife can parallel process on machines with multiple processors. Each **Processing Thread** license allows another core to be utilized. Since the fatigue calculation at each model location is effectively independent, the benefit to adding additional processing threads is very scalable. This option means spending less time to go directly from raw inputs to finished results.

Distributed Processing Option

Distributed Processing enables a DesignLife analysis running in batch mode to be distributed across multiple computers or nodes of a compute cluster. It uses the MPI standard common in high performance computing environments so that even the largest of finite element simulations can be completed efficiently. This scalability enables you to rapidly solve jobs by using the combined processors of many machines.

About HBM-nCode

nCode products are provided by HBM, a world-wide technology and market leader, offering products and services across the entire measurement spectrum, from virtual to physical. Since 1982, nCode is the leading brand for durability and data analysis solutions. Its technologies help customers understand product performance, accelerated product development, and improve design. The power and ease of use of HBM technologies is a direct result of its world-class development process, expertise, and in-depth experience of a broad range of industries. nCode product development is ISO9001 certified. Product support is available through HBM-nCode offices in Europe, North America, and Asia.

For more information, visit our website at www.ncode.com or find 'hbmncode' on:

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