nCode DesignLife™ 8

nCode

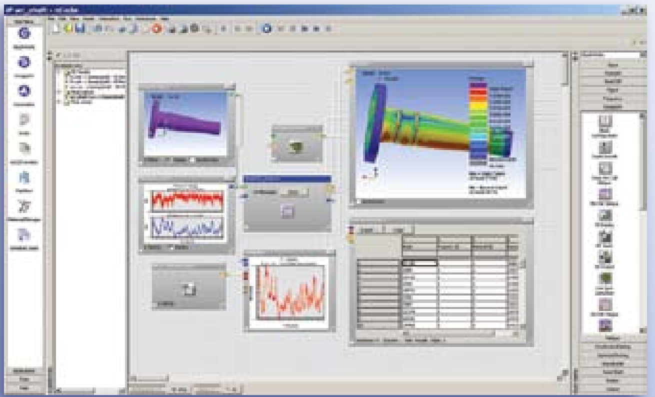
Product Details

Product Overview:

nCode DesignLife provides fatigue life prediction from finite element results to answer the question **"how long will it last?"** or **"will it pass the test?"** before you even have a prototype. Go beyond simplified stress analysis and avoid under- or over-designing your products by simulating actual loading conditions.

For over 25 years, nCode products have established a reputation for leading fatigue technology, pioneering the first commercial off-the-shelf FEA-based fatigue tool in the early 1990's. Since then, nCode products have continued to evolve, staying ahead of the competition. nCode DesignLife is optimized for today's large model sizes and realistic loading schedules.

nCode DesignLife can also be accessed through nCode Complete Durability System (nCode CDS), a licensing system providing flexible use of all nCode desktop products.



Key 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

Key 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, LS-Dyna, RADIOSS and others
- **Efficiently analyze** large finite element models and complete usage schedules
- **Highly configurable** for the expert user
- **Single environment** for both test and CAE data
- **Enables standardization** of analysis processes and reporting

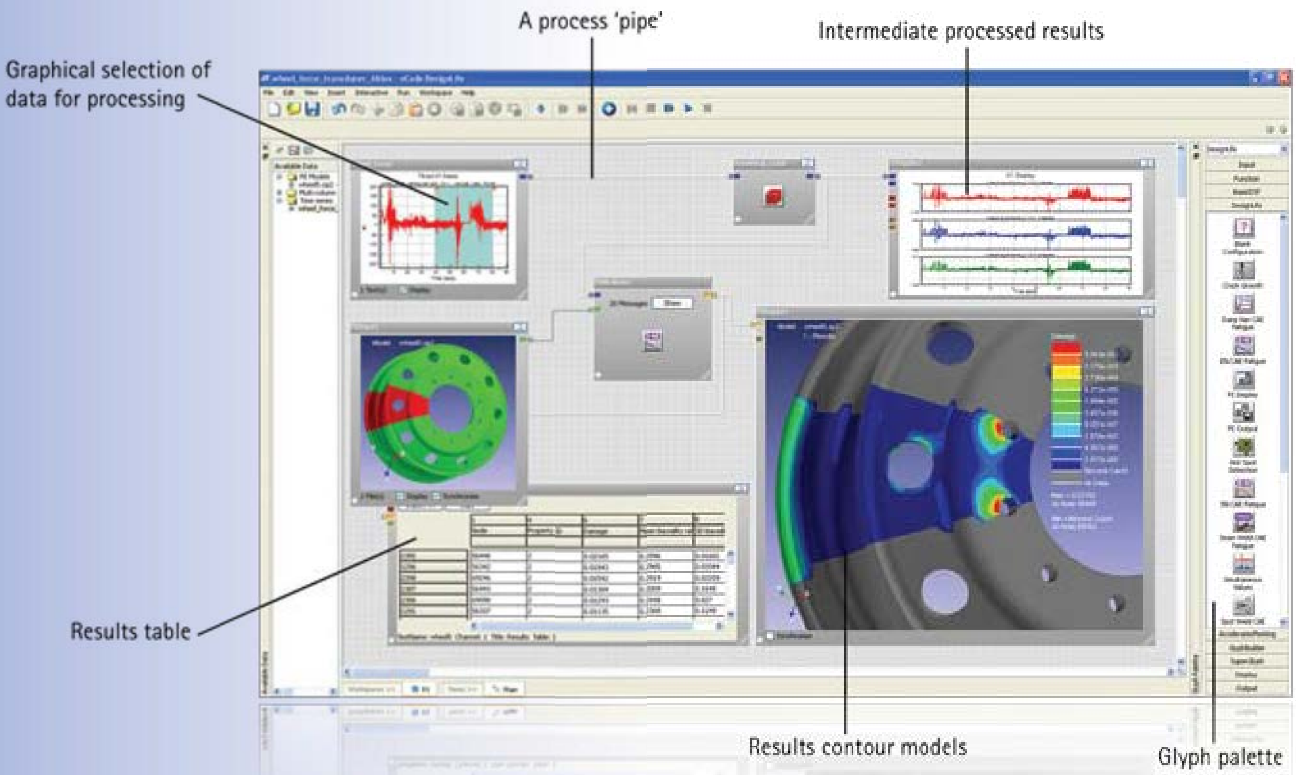
nCode DesignLife™

Streamlining the CAE Durability Process

HBM

Core Functionality for Advanced Fatigue Analysis

nCode DesignLife is the next generation CAE fatigue and durability analysis tool that works with all leading FE codes and produces realistic predictions of fatigue hotspots and fatigue life. DesignLife shares the nCode GlyphWorks architecture – providing an unparalleled integration of test and CAE data. DesignLife can be purchased separately or together with GlyphWorks.



DesignLife comes with many features as part of the core functionality including:

- **Virtual Strain Gauge –** enables you to correlate test with 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. Assessing correlation has never been this easy!
- **Schedule Create –** lets you build and process multiple cases that model a duty cycle. Through an intuitive interface, this feature makes it easy to create a complete durability schedule.
- **Signal Processing –** includes GlyphWorks Fundamentals functionality for basic data manipulation, analysis and visualization.
- **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.
- **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.
- **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.

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 is 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.

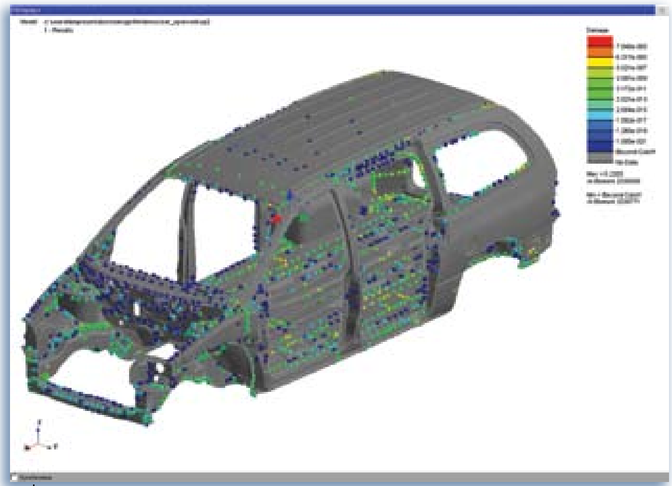
- Material models
  Standard EN
  EN Mean multi-curve
  EN R-ratio multi-curve
  EN Temperature multi-curve
- Strain combination methods or critical plane analysis
- Stress-strain tracking for accurate cycle positioning
- Back calculation to target life
- Multiaxial Damage Models
  Wang Brown
  Wang 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

Product Options

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 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 and the approach is appropriate for weld toe, root and throat failures. Corrections are also available for sheet thickness and mean stress effects. The BS7608 welding standard is also supported, together with required material curves.

Locate critical weld failures before you even have a prototype



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.

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 other jointing methods such as rivets or bolts.

Thermo-Mechanical Fatigue

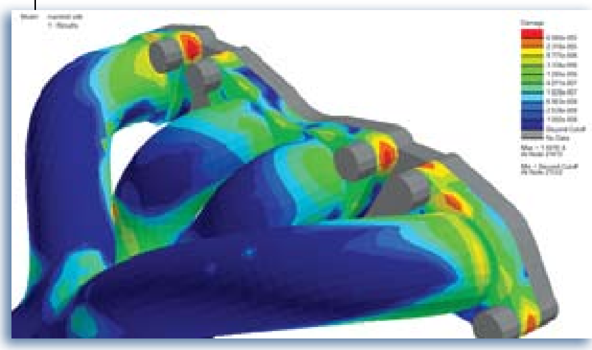
Components in high temperature operating environments such as engine pistons, exhaust systems and manifolds can suffer from complex failure modes. The Thermo-Mechanical Fatigue (TMF) option provides solvers for high temperature fatigue and creep by using stress and temperature results from finite element 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.

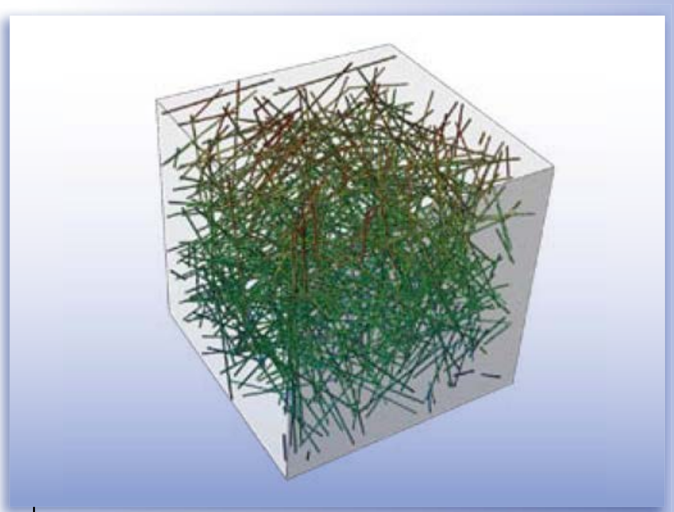
High temperature fatigue methods:

- Chaboche method is a stress-life approach that can use stresses from FE and either a constant or cycle-by-cycle temperature correction.
- ChabocheTransient method accounts for temperature by normalizing the stress history prior to cycle counting. This method has particular application for finite element analysis where the temperature and stress variation is closely correlated.

Creep analysis methods:

- Larson-Miller uses a master creep curve that is either a paired X-Y curve or a polynomial function to calculate damage per time increment of applied load.
- Chaboche creep is a non-linear damage summation approach that uses a set of creep curves, where each curve is for a specific temperature.





Courtesy of e-Xstream engineering

Short Fibre Composite

The fatigue of composites poses particular challenges for engineers because the properties of the constituent parts, polymer matrix and fibres, interact to determine the fatigue properties, which vary in each location and direction. 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.

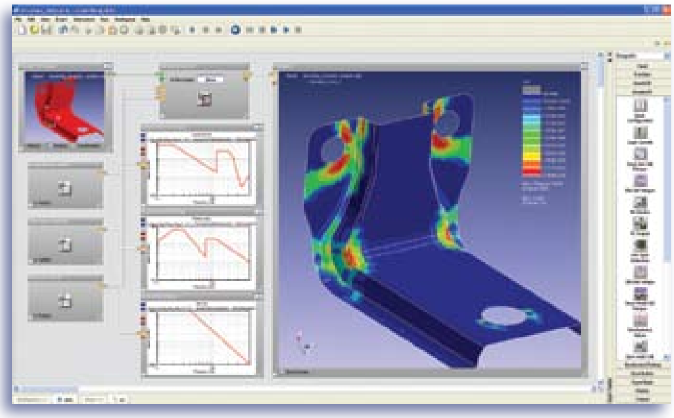
Product Options

Vibration Fatigue

The Vibration Fatigue option enables the simulation of vibration shaker tests driven by random (PSD) or swept-sine 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 analysis and the vibration loading is defined in DesignLife. This can include 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.

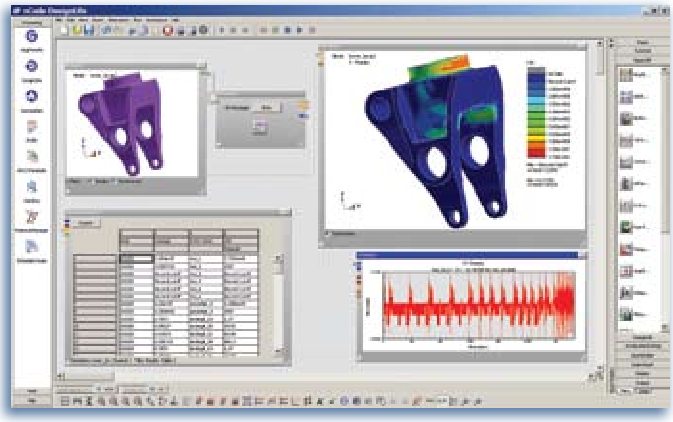
For more information, see the Accelerated Testing module details sheet.



Fast and direct simulations of shaker tests in the frequency domain

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. Dang Van is primarily used for engine and powertrain-type applications where there are very large numbers of loading cycles of combined loading such as bending and torsion, producing multi-axial stress states.



Powerful for the fatigue expert, easy to use for the novice

Processing Thread Option

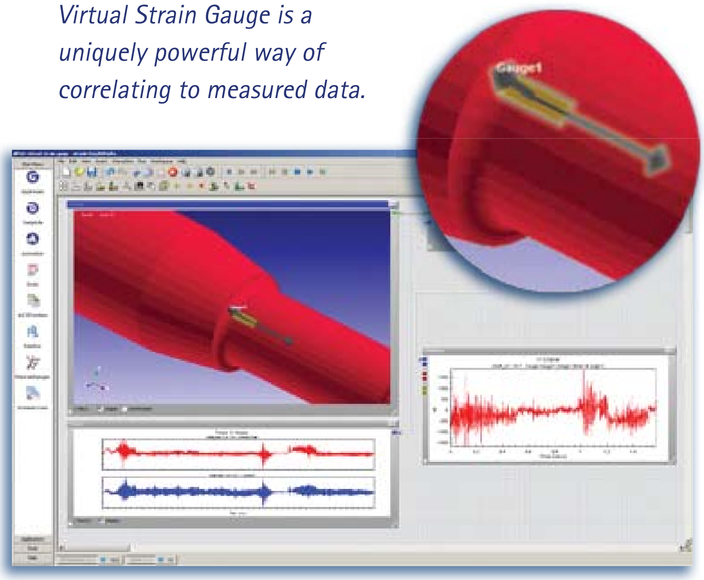
DesignLife can parallel process on machines with multiple processors. Each Processing Thread license allows another core to be utilized. Since the fatigue calculation at each model location is effectively independent, the benefit to adding additional processing threads is very scalable. This option means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

nCode DesignLife Technical Features

nCode DesignLife provides:

- Selection of model subsets for analysis by property id, material group or user-defined set
- Multiple analysis types within the same job
- Multi-stage analyses to focus on critical areas quickly
- Identification of critical areas and hotspots automatically
- Robust multiaxial assessment methodology
- Looping on input data for multiple calculations
- Support for parallel processing (SMP)
- Interactive or batch mode processing
- Percent certainty of survival using material scatter data

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



FE Results Import

- Abaqus .fil & .odb, ANSYS .rst, LS-Dyna, NASTRAN .op2, PAM-CRASH .erfh5, RADIOSS .op2, SDRC .unv
- Large file support
- Stresses from 2-D, 3-D solids, shell and membrane elements
- Element centroid, nodal averaged, nodal unaveraged stresses
- Load results from multiple FE results files in the same job
- Linear static, modal or transient/time-step or frequency response FE results
- Identify surface nodes and resolve stresses to surface plane for efficient multiaxial processing
- Determine surface normal stress gradients
- Steady-state or time-varying temperatures

Loading Inputs

- Linear superposition, time step, constant amplitude, duty cycle, aero spectrum input, random (PSD) and swept sine loading inputs
- Hybrid load provider allows superposition of time series, transient, constant amplitude loads, and temperature
- Loading inputs in all nCode supported formats
- Read .laf (load association) files
- Read nCode GlyphWorks schedule files
- Use duty cycles for all analysis types:
  - Use different channels in different events
  - Mix different types of event within a duty cycle
  - Nesting of duty cycles
  - Loading sequence
- Duty cycle processing options:
  - Calculate event damage independently
  - Logically concatenate schedule
  - Fast approach including consideration of residuals
- Filter loading inputs for efficient processing
- Functions for import, display, and manipulation of loading inputs

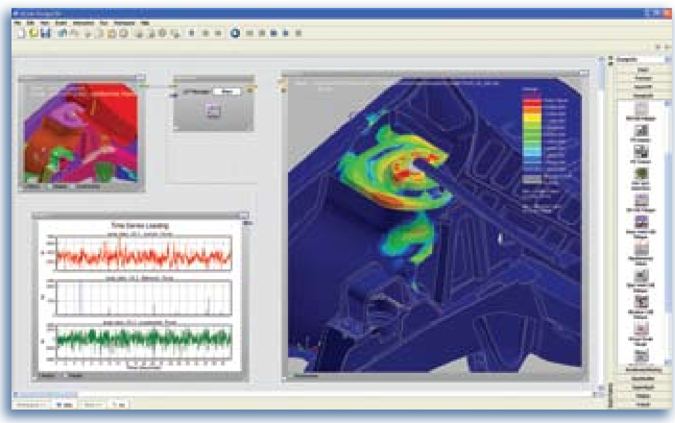
nCode DesignLife Technical Features

Solver Capabilities

- Stress-Life (SN)
- Strain-Life (EN)
- Dang Van
- Spot Weld
- Adhesive Bond
- Seam Weld
- Vibration Fatigue
- Short Fibre Composite
- Thermo-mechanical Fatigue
- Virtual Strain Gauge correlation tool
- Crack Growth linear fracture mechanics
- Python scripting for customization
- Additional processing threads for parallel processing

Results Output

- Output results to Abaqus .odb, Hypermesh results file, I-deas .unv, Medina .bof, nCode .fer and .CSV, and PATRAN .fef
- Output time histories or PSDs from any location (e.g., from critical areas or gauge locations)
- Multiple sort and filter results for smarter post-processing (e.g., by part or panel ID)



nCode DesignLife™

Post-processing

- Post-process fatigue and stress analysis results in FE Display
  - Make contour and marker plots
  - Quickly identify hotspots
  - Cursor pick results
- Tabulate, sort, and manipulate results
- Produce report pages automatically using the Studio glyph

Managing Materials

- Import material maps from file (e.g., a bill of materials) or from pipe
- Define complete material mapping for each group from an external .CSV or multi-column input pipe
- Import part numbers and other information for improved post-processing
- Database of commonly used material properties with examples to support all analysis types
- Materials database manager – create, edit or import material data
- Tabulate and graphically display material curves
- Estimate fatigue properties from monotonic data
- Estimate effects of surface condition on fatigue performance
- FKM guideline method used for roughness and treatment
  - Use descriptive or quantitative roughness value
  - User input correction factor
  - Method applicable to all SN and EN calcs

Platform Support

- 32-bit: Windows XP®, Windows Vista®, and Windows® 7
- 64-bit: Windows XP, Windows Vista, and Windows 7, Red Hat® Enterprise 5 Linux®, SUSE® Linux® 10.2

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