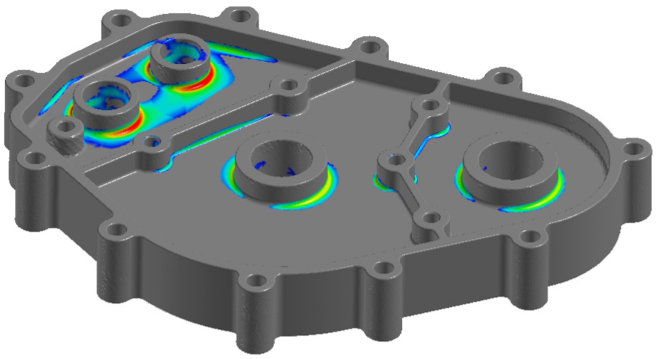
Ansys nCode DesignLife

STRUCTURES

Ansys partnered with HBK to bring unparalleled simulation-based durability technology to the Ansys Workbench Platform with the intention of providing end-to-end solutions to customers for whom fatigue failure is a challenge.

/ Industry Benefits

- **End-to-end durability solution on one platform**
- **Simulation-led design — reduces reliance on physical testing**
- **Flexible and easy-to-use user interface**
- **Reduction in overall product development and validation costs**
- **Unparalleled accuracy and technology**



/ Powerful and Efficient User Interface/Experience

Embedded - The all new Ansys nCode DesignLife user interface on the Ansys Workbench Platform provides end-to-end solutions in a single interface. Because it is natively integrated with other Ansys products on the Workbench Platform, you don't need to exit the Ansys Mechanical User Interface for pre/post-processing — you can run the powerful nCode solver engine in the background.

Integrated - Customized nCode DesignLife workflows are well-integrated with other Ansys products on the Workbench Platform, so you can transfer FEA result files directly to the nCode user interface. You can also perform parametric studies by linking nCode integrated workflows with Ansys DesignXplorer or Ansys optiSLang.

Independent - Access nCode's user interface directly from the Ansys Workbench Platform and easily access results from Ansys, Glyphworks and FEA coming from other tools.

/ Product Packaging and Licensing

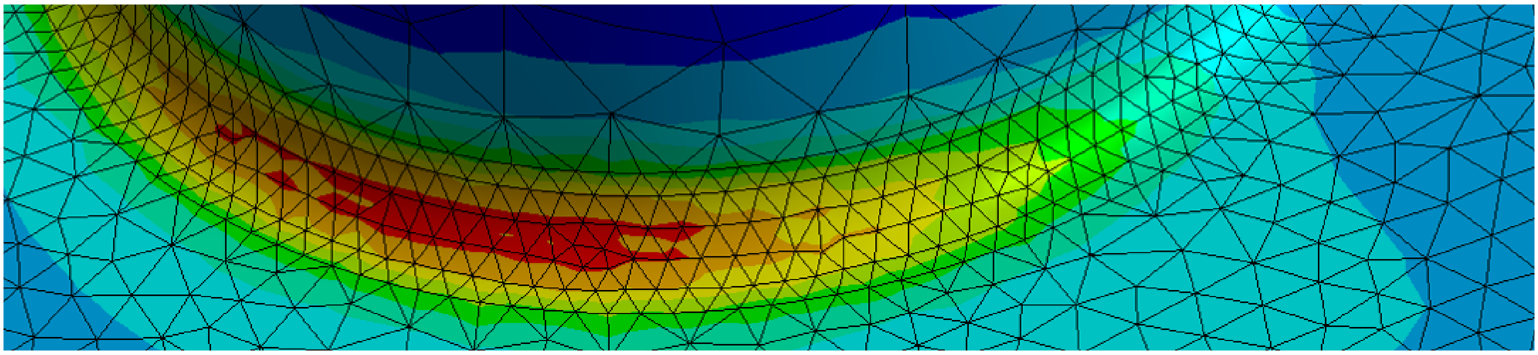
PRO - Stress life and strain life competency (limited) on Ansys nCode DesignLife embedded user interface + nCode material library

PREMIUM - Core functionality + Solver Engines–Standard + Solver Engines–Additional on all available user interface

ENTERPRISE - Core functionality + Solver Engines–Standard + Solver Engines–Additional + Solver Engines-Advanced on all available user interfaces

PARALLEL

- **Processing Threads** can work in parallel on machines with multiple processors.
- **Distributed Processing** enables an analysis running in batch mode to be distributed across multiple computers or nodes of a compute cluster.



/ Core Functionality

Virtual Strain Gauge and Virtual Sensor - Enables correlation between test and FEA results. Gauges (single or rosette) or displacement sensors may be graphically positioned and oriented on FEA models as a post-processing step. Time histories due to applied loads can be extracted for direct correlation with measured strain data and displacement data.

Signal Processing - Enables basic data manipulation, analysis and visualization. Duty cycles can be defined by selecting from and building multiple cases. Composite duty cycle with repeats can be created.

Crack Growth - Enables fracture mechanics analysis using industry standard methodologies for specified locations on the FEA 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.

FEA Display - Enables the graphical display of FEA models with contours of stress results. Animates displacements from FEA results or generates an animation file to understand the deformed shape under loading.

Custom Analysis - Enables Python or MATLAB scripts to be used to extend existing analysis capabilities — perfect for proprietary methods or research projects.

Materials Manager - Enables material data to be added, edited and plotted. A standard database with fatigue properties for many commonly used materials is included.

Vibration Manager - Enables vibration specification data to be entered, edited and viewed. A standard database with over 100 vibration entries is included.

/ Solver Engines – Standard

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 EN method uses the Coffin-Manson-Basquin formula, defining the relationship between strain amplitude ε^a and the number of cycles to failure Nf. Material models can also be defined using general look-up curves. This enables you to interpolate multiple material data curves for factors such as mean stress or temperature.

Stress-Life (SN) - The primary application of the Stress-Life (SN) method is high-cycle fatigue (long lives), where nominal stress controls the fatigue life. Includes 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. Python scripting is also available for defining custom fatigue methods and material models.

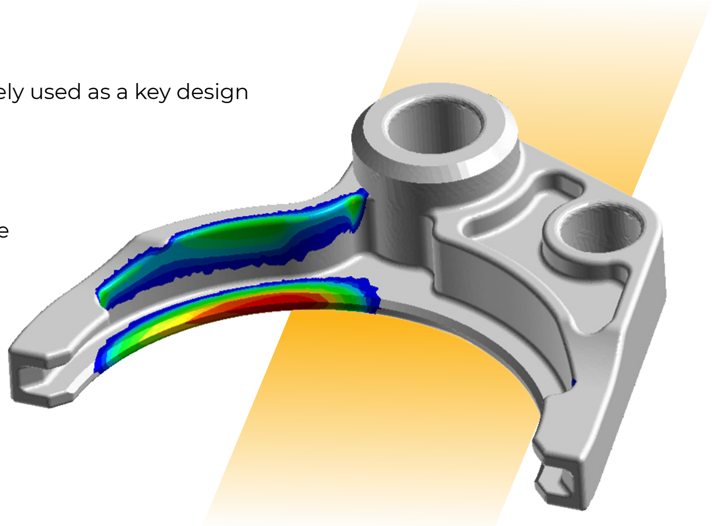
/ Solver Engines – Additional

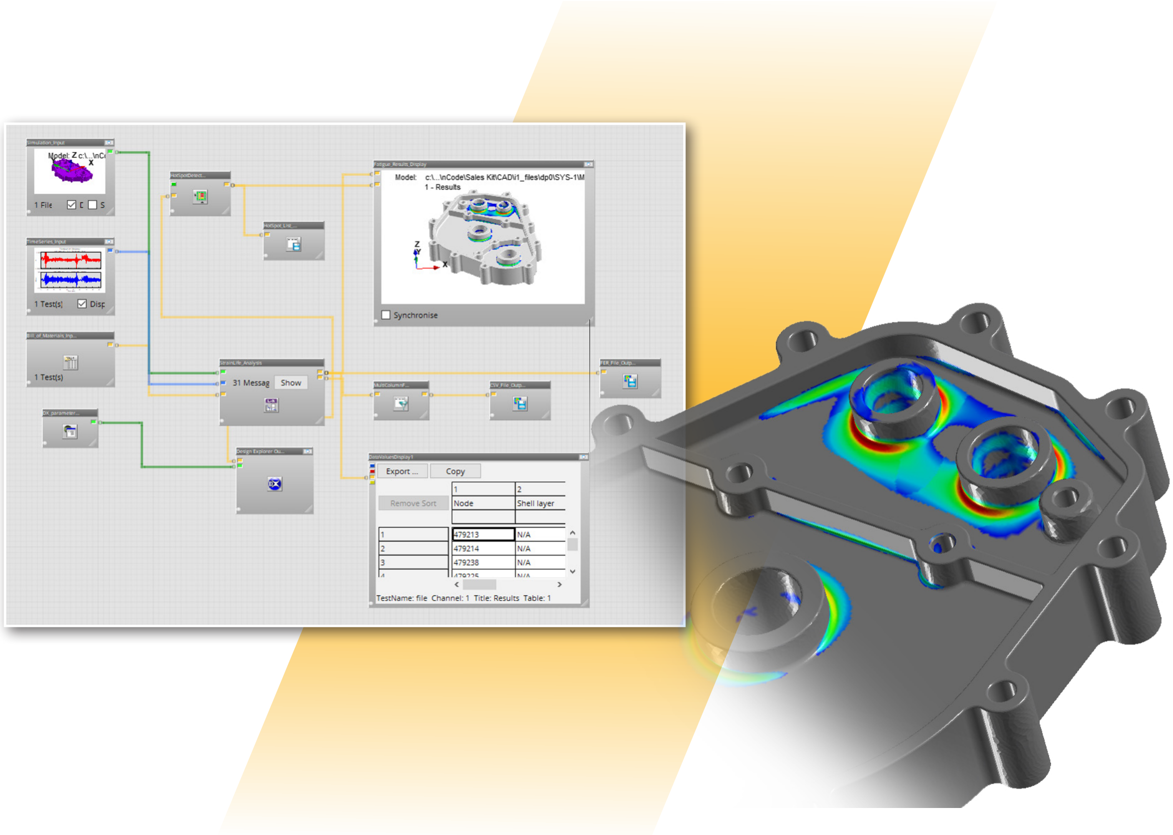
Strain Gauge Positioning - Calculates the optimum position and number of gauges required to enable the subsequent reconstruction of applied load histories.

The Loads Reconstruction feature uses the virtual strains created by unit loads along with the measured strain histories from gauges matching the virtual gauges to reconstruct the force histories that caused the measured strains.

Safety Factor
Enables the calculation of a stress-based factor of safety. Widely used as a key design criterion for engine and powertrain components.

Dang Van
Multiaxial fatigue limit criterion used to predict the endurance limit under complex loading situations. Produces a safety factor as output. Utilizes material parameters calculated from tensile and torsion tests, and can account for manufacturing effects by using equivalent plastic strain in the unloaded component.





Solver Engines – Advanced

Seam Weld - Simplifies the process of setting up fatigue analysis of seam welds by intelligently identifying weld lines in the FEA Model. Covers seam welded joints including fillet, overlap and laser welded joints. This method is based on the approach developed by Volvo (see SAE paper 982311). Stresses can either be taken directly from FEA models (shell or solid elements) or calculated from grid point forces or displacements at the weld. The approach is appropriate for weld toe, root and throat failures. Thick welds are assessed using the stress integration method outlined in ASME Boiler & Pressure Vessel Code VIII (Division 2) standard. The BS7608 welding standard is also supported, together with required material curves.

Spot Weld - Enables fatigue analysis of spot welds in thin sheets. This method is based on the LBF method (SAE paper 950711). Cross sectional forces and moments are used to calculate structural stress around the edge of the weld. Life calculations are made around a spot weld at multiple angle increments and the total life reported includes the worst case. Python scripting enables modeling of other joining methods such as rivets or bolts.

Vibration Fatigue - Enables prediction of fatigue in the frequency domain and is more realistic and efficient than time-domain analysis for many applications with random loading, such as wind and wave loads. Simulates vibration shaker tests driven by random PSD, swept-sine, sine-dwell or sine-on-random loading. Vibration fatigue loads can be used for SN, EN, seam weld or spot weld. Vibration loading can include the effect of temperature, static offset load cases and complete duty cycles of combined loading.

Thermomechanical Fatigue - Enables high temperature fatigue and creep analysis by using stress and temperature results from finite element simulations. Mechanical loads that vary at a different rate than the temperature variations can also be combined. Applications include components that are both mechanically and thermally loaded such as vehicle exhaust systems and manifolds. TMF includes high temperature fatigue methods such as Chaboche and Chaboche Transient and Creep analysis methods, Larson-Miller and Chaboche creep.

Adhesive Bonds - Enables fracture-mechanics-based method to assess which joints in the structure are most critically loaded. The Adhesive Bonds option enables durability calculations on adhesive joints in metallic structures. 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. Approximate calculations of the strain energy release rate are made at the edge of the adhesive and, by comparison to the crack growth threshold, a safety factor is calculated. The theoretical basis of the method was developed by the Volvo Group and the testing and software implementation was carried out as part of a collaborative research project with partners including Jaguar Land Rover, Coventry University and Warwick University.

Available with both Stress Life and Strain Life
Available with only Stress Life
Available with only Strain Life

	Durability Capability Chart	Ansys nCode DesignLife		
		PRO	PREMIUM	ENTERPRISE
Material Models	Standard	Yes	Yes	Yes
	Mean Multi-Curve	Yes	Yes	Yes
	R-Ratio Multi-Curve	Yes	Yes	Yes
	Temperature Multi-Curve	Yes	Yes	Yes
	Haigh Multi-Curve	No	Yes	Yes
	Bastenaire	No	Yes	Yes
	Gray Iron	No	Yes	Yes
	Custom using Python Scripting	No	Yes	Yes
Load Data Handling	Transient	Yes	Yes	Yes
	Constant Amplitude/Time Step/Time Series	Yes	Yes	Yes
	Duty Cycle	Yes	Yes	Yes
	Aero Spectrum Input	No	Yes	Yes
	Random Vibration (PSD)	No	Yes	Yes
	Swept Sine Loading	No	Yes	Yes
	Hybrid Load Provider (superposition of time series, transient, constant amplitude loads)	No	Yes	Yes
	Filter loading inputs for efficient processing	No	Yes	Yes
	Functions for import, display, manipulation of loading inputs	No	Yes	Yes
	Duty Cycle Options Different channels for different events, mix different types of event within duty cycle, nesting of duty cycles, loading sequence Duty Cycle Processing Options	No Nesting	Yes	Yes
	Calculate event damage independently, logically concatenate schedule, fast approach including consideration of residuals	Yes	Yes	Yes
Multi-Axial Assessment	Biaxial	Yes	Yes	Yes
	Multiaxial	No	Yes	Yes
	Auto-Correction	Yes	Yes	Yes
Mean Stress Corrections	FKM Guideline	Yes	Yes	Yes
	Goodman & Goodman Tension Only	Yes	Yes	Yes
	Gerber & Gerber Tension Only	Yes	Yes	Yes
	Soderberg	No	No	No
	Walker	No	Yes	Yes
	ASME Elliptical	No	No	No
	Morrow	Yes	Yes	Yes
	Smith Watson Topper	Yes	Yes	Yes
	Interpolate multiple curves	Yes (EN not Available)	Yes	Yes

Notch Correction (Stress Gradient Corrections)	FKM Guidelines	No	Yes	Yes
	User Defined	No	Yes	Yes
	Critical Distance	No	Yes	Yes
Multiaxial Damage Models	Wang Brown	No	Yes	Yes
	Wang Brown with Mean	No	Yes	Yes
Plasticity Corrections	Neuber	Yes	Yes	Yes
	Hoffman-Seeger	Yes	Yes	Yes
	Seeger-Heuler	No	Yes	Yes
	Utilize Elasto-Plastic Stress/Strain without	No	Yes	Yes
	Plasticity Corrections		Yes	Yes
Automatic Stress Combination		Yes	Yes	Yes
Critical Plane Analysis		Yes	Yes	Yes
Stress-strain tracking for accurate cycle positioning		Yes	Yes	Yes
Back Calculation to Target Life		Yes	Yes	Yes
Safety Factor Solver		No	Yes	Yes
Dang Van Solver		No	Yes	Yes
Spot Weld Fatigue		No	No	Yes
Seam Weld Fatigue		No	No	Yes
Vibration Fatigue		No	No	Yes
Multi-Load Vibration Fatigue		No	No	Yes
Thermo Mechanical Fatigue		Limited	Limited	Yes
Adhesive Bond Fatigue		No	No	Yes
Parallel Processing		2 Cores (Requires Parallel License for more) SMP & Distributed	2 Cores (Requires Parallel License for more) SMP & Distributed	2 Cores (Requires Parallel License for more) SMP & Distributed
Fatigue failure or coupled mechanical-fatigue analysis		No	No	No
Animation for fatigue damage development/Smart		No	No	No
Initial fatigue damage ratio or damage summation/crack growth		No	Limited	Limited
Combing damage ratio from material model		No	No	No
Virtual Strain Gauge and Virtual Sensor/ Strain Gauge Positioning		No	Yes	Yes
nCode DesignLife Interface		No	Yes	Yes
Windows/Linux		Windows	Yes	Yes

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