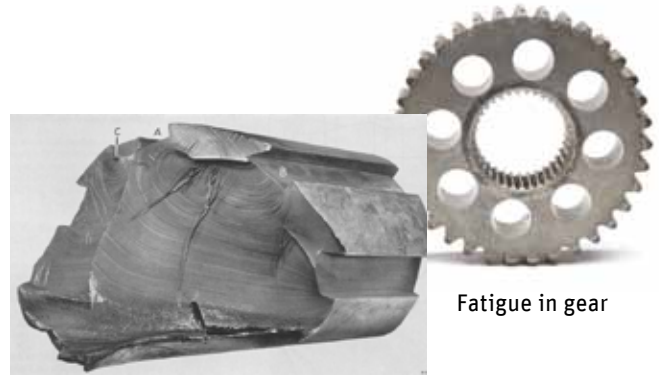


Realize Your Product Promise™

**ANSYS®**

# Fatigue Products



## Ensure product integrity by designing for durability with ANSYS fatigue software.

Understanding if and when a product can fail reduces product – and organizational – risk and cost.

The ultra-competitive nature of today’s economy has steered product development organizations to reduce costs, improve time to market, build in innovation and design for sustainability. And now there’s a new push: prolonging product life and ensuring durability.

Recent headlines highlight the massive costs of product recalls, warranties, environmental remediation and regulatory penalties. But these pale compared to the impact on corporate brand image and consumer confidence.

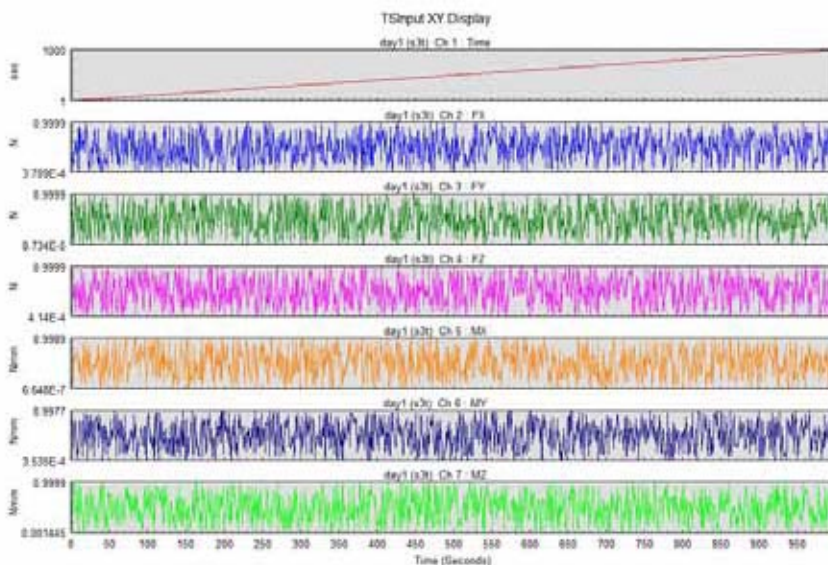
As a result, making informed design decisions to improve your product’s durability is increasingly important. Product failure can result in recalls, high repair costs, legal liabilities, and damaged brand and corporate reputations.

Designs that are too conservative are costly to manufacture, and they may not be competitive. On the other hand, designs that are not conservative enough may fail under normal – let alone unanticipated – usage. Reaching the right product integrity balance is critical to your success.

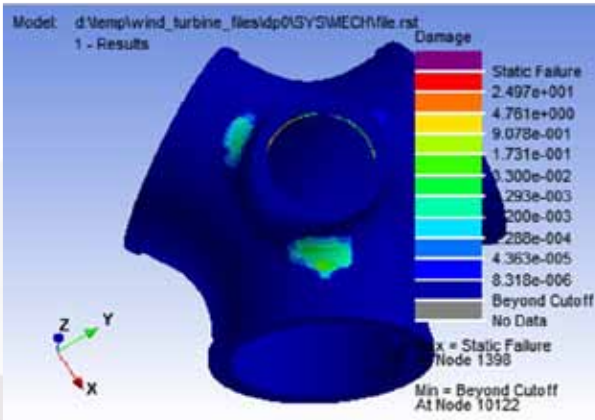
Fatigue is a major source of product failure. Most products exposed to repeated cyclic loadings will eventually fail. Caused by repeated or otherwise varying loads, fatigue is a result of repetitive stress over time, as microscopic changes become cracks that cause malfunction. Optimizing a product’s shape, size and material via simulation is the most cost-effective way to arrive at the desired product life.

### Beyond Structural Mechanics Analysis

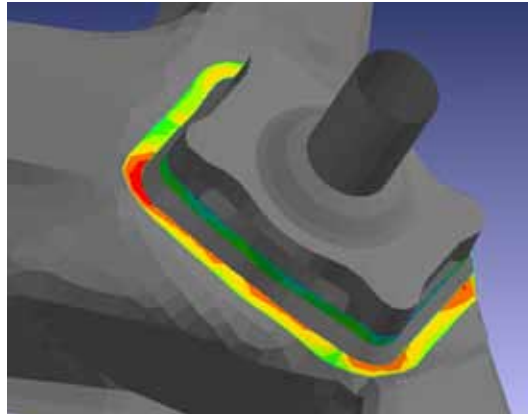
Engineers design today’s products using structural mechanics solutions that compute the response to applied forces and displacements. Fatigue simulation expands on structural analysis to account for extended real-life loadings. To determine when failure will occur, you can use the



Multi-axial stress loading history



Multi-axial stress fatigue life



Seam weld fatigue life

structural results that define maximum stress in conjunction with fatigue material properties and a loading history.

The combination of reliable ANSYS structural mechanics technology and industry-leading simulation software with time-tested durability capabilities from HBM delivers a product that is ideal for predicting product life. ANSYS nCode DesignLife™ enables you to evaluate product life using a complete fatigue simulation progression. The process includes interfaces to CAD geometry, materials selection from engineering data in the ANSYS Workbench™ material library, automatic meshing, convenient application of initial conditions, simulation of the response of the structure, and transfer of this information to the ANSYS nCode DesignLife module, where product life is determined and optimization can occur.



Bicycle crank shaft broken due to fatigue





Life contour of a trailer hitch identifies the shortest life spot.

## Apply our accurate, reliable technology to a wide range of fatigue scenarios.

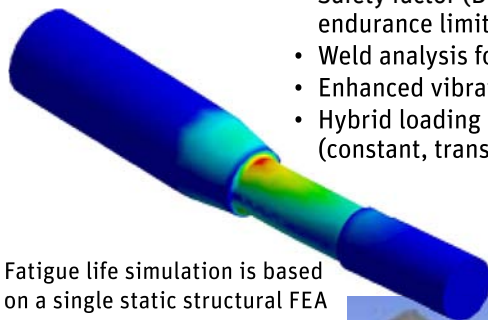
### Reliable Durability Technology

ANSYS nCode DesignLife software delivers modern, industry-proven fatigue capabilities. You can simulate all types of exposure to damage from fatigue, including:

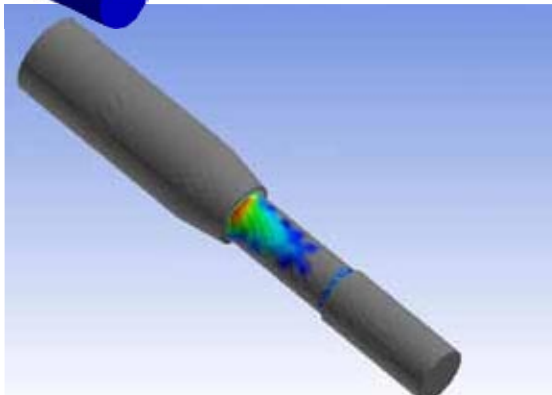
- Stress life (SN) for high-cycle fatigue
- Strain life (EN) for low- and high-cycle fatigue
- Crack growth
- Safety factor (Dang Van) for predicting endurance limit under complex loadings
- Weld analysis for spot and seam welds
- Enhanced vibration analysis including PSD
- Hybrid loading to combine loads (constant, transient, time series, etc.)

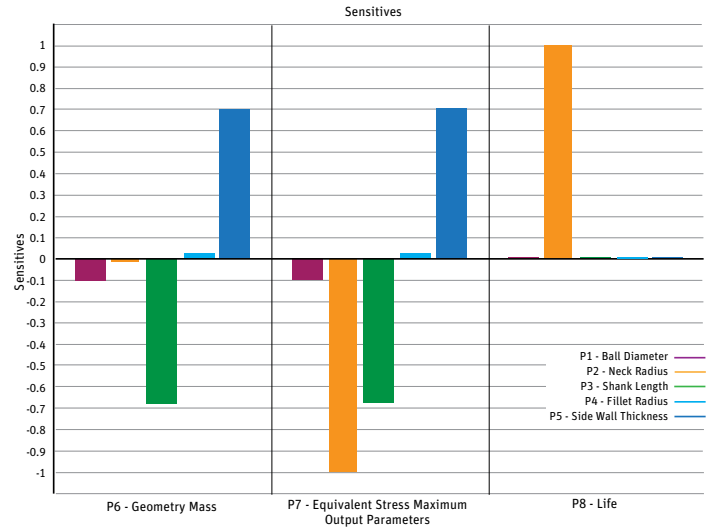
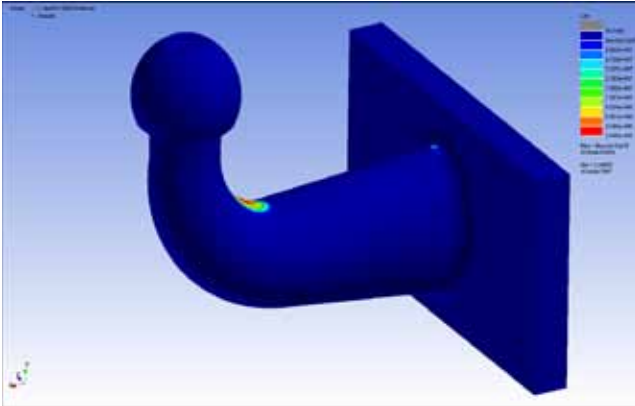
To facilitate your workflow, we offer a number of advanced yet user-friendly capabilities for simulating large and complex models with the least amount of effort.

- Python scripting for adding new or proprietary SN methods
- High configurability for expert users
- 64-bit versions for analyzing larger models
- Automated selection of calculation method based on multi-axial stress state assessment
- Critical area and hot-spot identification
- Process encapsulation and integrated reporting
- Standardized fatigue analysis processes to improve consistency and quality
- Direct support for multi-curve stress-life and strain-life material curves and methods, such as Haigh diagrams, FKM guidelines
- Single environment for test and CAE data



Fatigue life simulation is based on a single static structural FEA result and an expected loading history while the part is in use. Engineers have used the ANSYS Fatigue module for simple geometries and loadings for many years. For the majority of realistic geometries and real-life loading histories, ANSYS nCode DesignLife is the ideal choice. Images show static structural results (above) and fatigue life results (right).



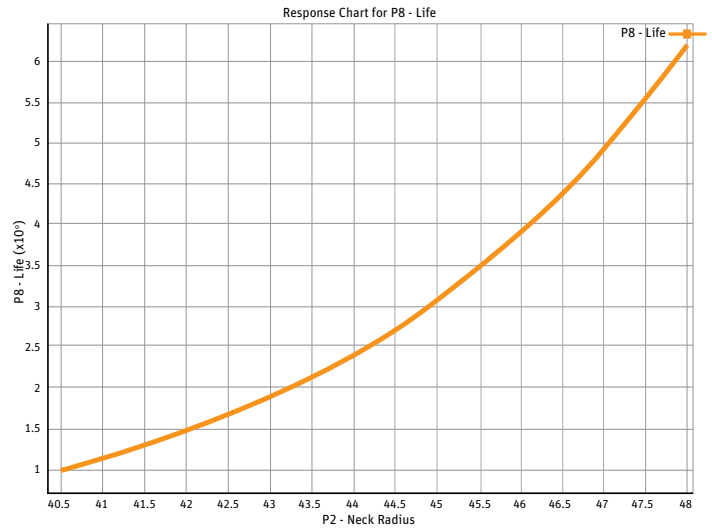


The optimized hitch has double the fatigue life of the original part.

A sensitivity chart demonstrates how input parameters influence output parameters. Using this tool, a user can focus on parameters with the greatest improvement on fatigue life and least impact on product weight.

### Correlation with Test Data

ANSYS nCode DesignLife includes tools to help combine and correlate test data with simulation results. A wide range of data processing functions enable manipulation, editing and display of measured data. Virtual strain gauges can be positioned on the finite element model, and a stress or strain time series can be extracted, providing a direct correlation to help validate material models. This time series data can also be used for crack growth analysis, employing linear elastic fracture mechanics to predict how a crack will grow after initiation.



Fatigue life as a function of geometry



## Our efficient workflow process delivers overall product confidence with less effort.



ANSYS fatigue technology is one part of our suite that delivers state-of-the-art functionality — depth, breadth, a plethora of advanced capabilities and integrated multiphysics — providing confidence that your simulation results reflect real-world outcomes. The comprehensive range of engineering simulation solutions provides access to virtually any field of engineering simulation that a design process requires. Organizations around the world trust ANSYS to help them realize their product promises.

### Efficient Fatigue Workflow Process

ANSYS nCode DesignLife is fully integrated within the ANSYS Workbench environment, so it delivers a complete fatigue process that, once you define it, you can apply repeatedly. A click of a mouse delivers complete analysis results for a series of design variations. Using this workflow process and performing design exploration through parametric simulation, you can optimize a complex structure for the desired product life — and save valuable engineering and design time.

Leveraging Workbench in this way means you can standardize your durability process as well as results reporting.

- Easily repeatable streamlined fatigue analysis
- Efficient tools for design exploration and optimization
- Clear identification of problem areas in a complex structure
- Material fatigue properties
- Bidirectional parametric associativity with CAD designs
- Ability to handle all types of fatigue exposure
- Sensitivity chart to enable optimization of parameters with the greatest effect

### More Compute Power for Complex Problems

Fatigue analysis in ANSYS nCode DesignLife has been optimized for today's large model sizes and realistic, complex loading histories. You can simulate extremely large models by taking advantage of parallel processing that applies multiple cores to a single problem.

nCode DesignLife takes full advantage of parallel processing with linear improvements in turn-around time. For example, using 32 cores will reduce the run time for a 30-minute simulation to just one minute.

## ANSYS Fatigue

### CAD



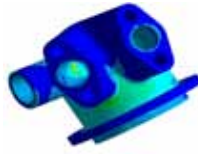
*CAD geometry for manifold imported into Workbench*

### Meshing



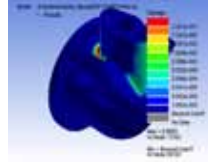
*Automatically generated mesh for finite element analysis*

### Stress Calculation



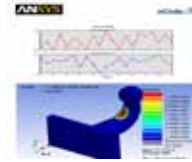
*Stresses calculated in ANSYS Structural™*

### Fatigue Life



*Fatigue life based on loading history used from ANSYS nCode DesignLife*

### Report Generation



*Trailer hitch simulation report*

## Pre-Processing

## Simulation

## Post-Processing

## Archive

## Other ANSYS Engineering Simulation Capabilities

### CAD



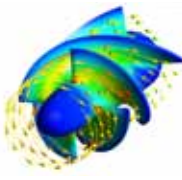
ANSYS DesignModeler™ and ANSYS SpaceClaim DirectModeler provide modeling and geometry-creation functions as well as tools for importing CAD data from various sources. In addition, we collaborate with leading CAD developers to ensure an efficient workflow.

### Integration



ANSYS Workbench is the framework for the industry's broadest and deepest suite of advanced engineering simulation technology. It delivers unprecedented productivity, enabling Simulation-Driven Product Development™.

### Multiphysics



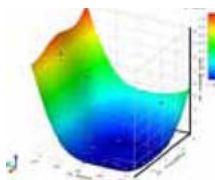
To help ensure a successful product, R&D teams must accurately predict how complex products will behave in a real-world environment. The ANSYS suite captures the interaction of multiple physics: structural, fluid dynamics, electromechanics and systems interactions. A single, unified platform harnesses the core physics and enables their interoperability.

### HPC



High-performance computing enables creation of large, high-fidelity models that yield accurate and detailed insight. ANSYS offers scalable solutions and partners with hardware vendors to ensure that you get the power and speed you need.

### Design Optimization



Good design starts with identifying the relationship between performance and design variables. ANSYS DesignXplorer™ enables engineers to perform design of experiments (DOE) analyses, investigate response surfaces, and analyze input constraints in pursuit of optimal design candidates.

### Data Management



ANSYS EKM™ addresses critical issues associated with simulation data, including backup and archival, traceability and audit trail, process automation, collaboration and capture of engineering expertise, and IP protection.

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ANSYS is dedicated exclusively to developing engineering simulation software that fosters rapid and innovative product design. Our technology enables you to predict with confidence that your product will thrive in the real world. For more than 40 years, customers in the most demanding markets have trusted our solutions to help ensure the integrity of their products and drive business success through innovation.

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