I-DEAS® Advanced Durability

for predicting the fatigue damage and life of products due to static or transient loading

I-DEAS® Advanced Durability software provides a set of analytical tools to predict life and fatigue damage of products subjected to prescribed loading histories and duty cycles. The loading histories may be generated from test measurements or analytical methods. The life of the product is calculated using strain or stress from finite element solution. Both uniaxial and biaxial loading are considered for various life criteria.

I-DEAS Advanced Durability software provides static and transient fatigue analysis capabilities.

Static Fatigue Analysis

Static fatigue analysis is used to evaluate durability of a general FE model, when a set of time-variant static loads is applied sequentially or simultaneously. You can use either linear or nonlinear FE results for static fatigue analysis.

One typical application of static fatigue analysis is to assess the durability of an automobile engine undergoing cyclical loading. Since engines are block-type structures, the dynamic effects do not exist in low-frequency ranges. In this case, the critical fatigue areas are normally around the loading points due to the static loading cycles. Another application of static loads is thermal loads. An engine block would be subjected to both mechanical and thermal loads. The thermal and mechanical stress/strain may be combined for fatigue analysis in I-DEAS Advanced Durability.

Static fatigue analysis can linearly combine FE static results to generate a strain (or stress) history for fatigue assessment. It allows you to use geometry-based loads (e.g., pressure, edge, or surface) or FE-based loads for linear superposition. It can also take a set of strain or stress results defined in their sequential order for fatigue calculations. This is particularly useful for fatigue analysis using nonlinear FE results.

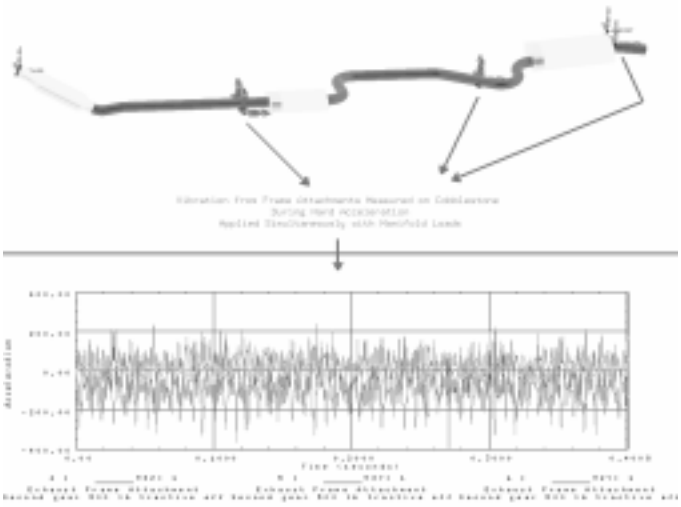
You can use I-DEAS Model Solution™, I-DEAS Variational Analysis, or external solvers (e.g., Nastran, Abaqus, or Ansys) to prepare linear or nonlinear strain/stress results for static fatigue analysis.

Transient Fatigue Analysis

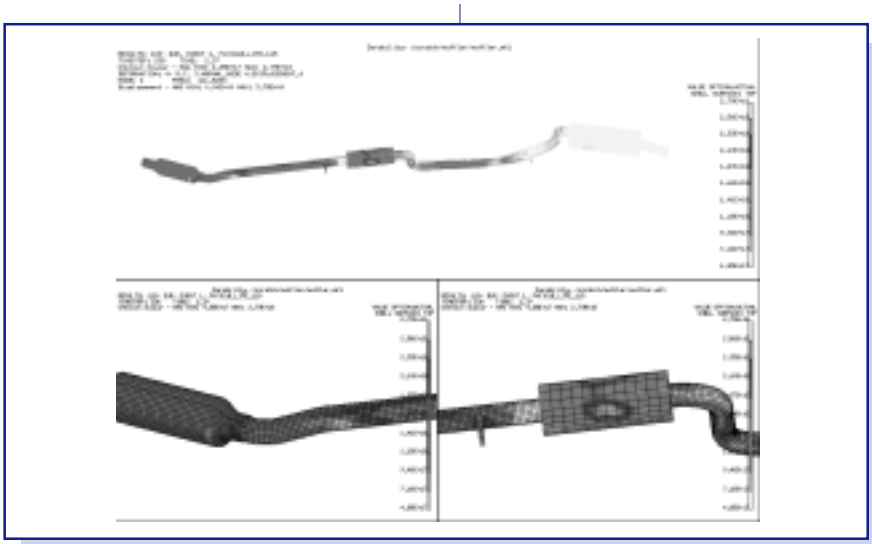
Transient fatigue analysis is used to calculate dynamic stress and strain histories, and thus, life and damage of a general FE model, when a set of time domain transient loads is applied.

One typical application of transient fatigue analysis is to assess the durability of a car body subjected to a road profile. The loadings to the car body are measured or calculated attachment points between the suspension system and the body in terms of forces or enforced motion. Since car bodies are normally thin-shell structures, the dynamic effects are significant in low-frequency, high-magnitude normal modes. In this case, the stress cycles due to elastic vibration may be significant. Therefore, fatigue may occur in the area away from the attachment (loading) points due to the dynamic effects.

Transient fatigue analysis uses either the mode acceleration method or the mode display method to generate dynamic strains/stresses for fatigue analysis. You can use I-DEAS Model Solution or external solvers to generate modal models for transient fatigue analysis.



I-DEAS Advanced Durability includes the capability to apply multiple static or dynamic load cases simultaneously to accurately reproduce the operating enviornment, or duty cycles, to which a specimen is subjected. In this instance, measured road loads accessed directly from MTS Test are applied to obtain the dynamic response of this exhaust system.



The life of the exhaust system due to the applied loads is evaluated, then displayed graphically using the robust post-processing in I-DEAS Simulation software.

Capability Summary

• Fatigue evaluation is used to estimate the life and damage due to the various loading events, and the total damage due to a duty cycle containing multiple events of multiple occurrences. The damage and life results are displayed as contour or arrow plots. You can select either FE stress or FE strain to perform fatigue evaluation.
• Stress and strain functions used for cycle counting and fatigue evaluation can also be generated and stored. You can use them to perform test/analysis correlation, or you can export them for external fatigue analysis.
• Import, manage and display fatigue properties and S-N curves.
• The loading axes can be determined by:
  •statistics (for non-proportional long-history loading); or
  •searching (for non-proportional loading); or
  •critical (maximum shear) plane (for proportional loading).
• The following fatigue algorithms are supported for both uniaxial and biaxial cycles:
  •stress life (Goodman, Gerber, Soderberg, Morrow)
  •strain life (Morrow, Smith-Watson-Topper, Brown-Miller) ASME (Boiler and Pressure Vessel Code)
  •welds (British Weld Institute Formulation)
  •user-defined S-N curves (stress or strain)
• Quality checks to test validity of fatigue results.
• Fatigue histogram analysis can be applied not only on FE strains/stresses, but on imported strain or stress functions;
• Data-Processing Tools

Prerequisites

I-DEAS Durability

For More Information

For more information, contact your local SDRC representative or call 1-800-848-7372.