Design for Durability is a technical concept class that explores the steps necessary to approach product design, development, analysis and testing from the perspective of durability.

Class time is split between lectures and hands-on sessions where you will put the concepts into action using nCode and ReliaSoft software. Case studies are shared to highlight practical applications of theory.

The course is aimed at engineers and managers involved in structural durability, loads collection, fatigue life estimation and validation testing. It is assumed that attendees are familiar with material behavior and general structural mechanics, typical of most practicing engineers.

Learning objectives

- Understand methods, terms and metrics used in durability
- Know when to apply particular tools during the product development cycle and the associated benefits and drawbacks of each
- Explore best practices required to make your product meet life cycle targets

Topics included - 3 days

- Introduction to Durability
  - Common product failure modes
  - Designing to improve durability
  - Setting durability requirements and goals

- The Importance of In-Service Loading
  - Understanding and quantifying in-service usage conditions
  - Field testing of systems, subsystems, and components
  - Measuring load, temperature, acceleration, etc. using data acquisition hardware
    - Transducer selection
    - Sampling rates
    - Data quantity
  - Assessing and improving the quality of measured data
  - Digital signal processing and loads analysis

- Structural Response
  - Experimental stress analysis techniques
  - Analytical finite element (FE) stress analysis techniques

- Fatigue Life Estimation
  - The roadmap to fatigue life analysis
  - Analyzing fatigue in different life regimes:
    - Short life
    - Long life
    - Infinite life
  - Important analysis techniques and inputs

- Interpreting Fatigue Analysis Results
  - Defining failure
  - Deterministic vs. probabilistic views of life

- Material Behavior
  - Material testing with durability in mind
  - Material response under fatigue loading
  - Characterizing material fatigue behavior
  - Creating stress-life (SN) and strain-life (EN) curves
  - Factors that influence material fatigue characteristics

- Validation Testing
  - Physical testing to verify product life
  - Testing systems, sub-systems, and components
  - Methods of defining test specifications:
    - Cyclic testing
    - Time domain
    - Frequency domain
  - Uniaxial vs. multiaxial loading
  - Test acceleration methods:
    - Fatigue damage equivalence
    - Reducing test duration

Understanding the statistical significance of life predictions

Correlating Analytical vs. Actual Durability Life

Gaining confidence in analytical modelling
Methods of correlating analytical vs. test
Correlation bounds and statistical significance
Improving modeling techniques based on physical measurements