

PD231
Shock and Vibration Analysis

Day One

- Introduction
- Single-degree-of-freedom systems (SDOF)
 - Free Vibration: Natural frequencies and critical damping
 - Forced Vibration: Harmonic, transient, and impulse forces
 - Base excitations: response spectra
 - Dynamic amplification factors
 - Resonance
 - Equivalent Static Load
 - Torsional vibration
 - How to reduce vibration levels in SDOF
- Shock spectrum
 - How to develop shock spectra from force time histories
 - How to use shock spectra to compute dynamic response to shock loads
- Multiple-degrees-of-freedom systems (MDOF)
 - Natural frequencies and mode shapes
 - Direct Time-history response analysis
 - Modal Time-history response analysis
 - Shock spectrum method of response analysis
 - Comparison of Methods: Relative advantages, accuracy and suitability
 - How to reduce vibration levels in MDOF

Day Two

- Earthquakes and Other Base Excitations
 - Load specification
 - Time-History Analysis
 - Response Spectrum Analysis
 - Design Aspects
- Finite Element Analysis (FEA)
 - Basic concepts, assumptions and limitations
 - Guidelines to FE modeling (keys to successful analysis)
 - Example FE models and results
- Modal testing of equipment and structures
 - Definitions
 - Practical aspects
- Test-Analysis Correlation
 - Sources of errors in test results
 - Sources of errors in analysis
 - Test-analysis correlation of natural frequencies

- Fine-tuning analysis models using test-analysis correlations
- Torsional vibrations (shafts, disks, and rotors)

Day Three

- Vibration Absorbers (Tuned-Mass Dampers)
 - Basic Concepts
 - Analysis and design
 - Where used?
 - Advantages and disadvantages
- Vibration Isolation
 - Basic Concepts
 - Design
 - Where used?
 - Advantages and disadvantages
- Transportation of Sensitive Equipment
 - Forces during transportation (oscillatory, shock and drop forces)
 - Qualification by analysis
- Vibration of Rotating Equipment
 - Forces acting on rotating equipment
 - Response computation
 - Design to meet manufacturer or operator specifications
- Foundations for Rotating Equipment
 - Harmonic forces due to operation of rotating machines
 - Modeling foundation stiffness and damping
 - Design to avoid resonance and/or large displacements
- Flow-Induced Vibrations
 - Vibration mechanisms
 - Design against vortex shedding
 - Vortex suppressors
- Machinery Vibration Monitoring and Problem Diagnosis
 - Periodic and continuous vibration monitoring
 - Methods and equipment
 - “Symptoms” and diagnosis
- Worked-out Numerical Examples
 - 32, detailed, step-by-step, worked-out examples of analysis and design are presented in the various chapters
- Case Histories
 - Five case histories are presented to demonstrate how the various concepts and methods presented in the course are applied in complex vibration projects