

Industrial Finite Element Analysis with Femap V10.1.1 and NX Nastran V7.0

An introduction to Femap and NX Nastran using a blend of theory and practice that will allow the student to quickly grasp the nuances of building accurate FE models.

Four Day Introductory Class with sufficient material for six days of lectures.

Revised 2010

Course Outline:

I. Introduction to Finite Element Analysis

- a.) The concept of finite element analysis - nodes, DOF, elements
- b.) Basic element types - a quick overview
- c.) Linear, elastic FEA
- d.) $F = K*U$
- e.) Workshop using Femap and NX Nastran
 - Introduction to Femap / Panes / Toolbars / Preferences / Etc
 - Simple Solid Model Stress Analysis

II. Theory and Usage of Finite Elements

- a.) Beam Elements:
 - i) Theory
 - ii) Workshop
- b.) Isoparametric Elements (plate and solid):
 - i) Theory
 - ii) Workshops

Course Outline (continued):

III. Foundations of FE Analysis and Modeling

a.) Units

b.) Surface modeling (plate elements)

- i) Techniques of working with geometric surfaces and plate models
- ii) Workshop – basic surface modeling concepts / linear elastic analysis
- iii) Techniques of simplifying structures into FE models (use of mass elements and rigid links)
- iii) Workshop – mid-surfacing geometry / vibration analysis

c.) Application of loads to FEA models

- i) Utilization of pressure loads for pressure vessels and bearing loads
- ii) Workshop – surface modeling of thin walled structures / pressure load
- iii) Workshop – working with solid models to create bearing loads (simple versus data surfaces)

d.) Constraints

- i) Theory on the application of symmetry: geometry and loads
- ii) Workshop

Course Outline (continued):

IV. Assembly Modeling

- a.) Standard, linear connection technologies (rigid links)
 - i) Technology review and commentary
 - ii) Workshop
- b.) Advanced NX Nastran connection technologies
 - i) Technology of surface-to-surface glued versus surface contact.
 - ii) Workshops – glued connection and surface-to-surface

V. Results Validation

- a.) Definition of von Mises stress scalar and max/min principal stresses
- b.) Interpretation of stress results w.r.t. to von Mises and principal stresses
- c.) Fatigue in FEA
- d.) Using Free-Body-Diagrams (FBD) to check loading and load path

Course Outline (continued):

VI. Advanced Femap Modeling Topics

- a.) Mesh Repair
 - i) Technology and Commentary
 - ii) Workshop – mesh repair and introduction to Data Table
- b.) Hexing Solids
 - i) Theory and Background
 - ii) Workshop – hex meshing with introduction to master/slave pairing
- c.) Advanced surfacing techniques
 - i) Theory behind surfacing within Femap
 - ii) Workshop – using Solid Geometry menus for surfacing operations.
- d.) Femap Program Files
 - i) Theory and limitations of Femap macro creation
 - ii) Workshop – create simple macro and user-defined toolbar.
- e.) Application Programming Interface (API)
 - i) Introduction to Femap's API for customization and automation of repetitive modeling tasks. Discussion of "Custom Tools".
 - ii) Workshop – Create simple API and place in user-defined toolbar.

Course Outline (continued):

VII. Advanced Analysis Topics

- a.) Geometric and Material Nonlinearities
- b.) Dynamics: Modal and Transient
 - i) Introduction to Eigenvalue/Normal Modes Analysis
 - ii) Workshop – Basis Normal Modes with Optimization

VIII. Troubleshooting and Modeling Guidelines

- a.) Understanding online Help Documentation.
- b.) Femap and NX Nastran Error Messages
 - i) Theory/Background on error messages
 - ii) Workshop – Debug FEA model using error messages with online help
- c.) Modeling guidelines and best practices
 - i) Discussion of element quality indicators
 - ii) Workshop – contouring element Jacobian over mesh
- d.) Open discussion / Comments