

CVEN 6525-001

Finite Element Analysis of Structures

Spring 2002

Instructor: Kaspar Willam

Office: ECOT 456, Hours MWF 10:00 - 11:00 a.m.

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Prerequisites: Mechanics of Materials, Matrix Analysis of Structures

Course Work:

- Lectures: TR 3:30-4:45 pm, ECCR 110
- Assignments (20 %): Homework Problems.
- Midterm Examination (20 %): Take-Home Exam.
- Computer Term Project (20 %), Presentation (10 %): May 2, 2002.
- Final Examination (30 %): Wednesday, May 8, 2002, 1:30 - 4:00 pm

Software Platforms:

- MATLAB, MATHEMATICA, Structures Programs
- ABAQUS (HKS), DYNA3D (LSTC)
- FEAP (R.L. Taylor UC-Berkeley)

Reference Texts:

- Cook, R.D., Malkus, D.S., Plesha, M.E., Witt, E.J.,
“Concepts and Applications of Finite Element Analysis”,
John Wiley & Sons, Inc., New York, Fourth Edition 2002.
- Hughes, T.J.R.,
“The Finite Element Method”,
Prentice-Hall, Englewood Cliffs, NJ 1987(out-of-print)
Dover Publications Inc, Mineola, NY 2000.
- Willam, K., CVEN 6525 Class Notes: FEA of Structures.

Course Outline

1. Preliminaries Jan. 15 - Jan. 24, 2002
 - Matrix Analysis
 - Equations of 3-d Linear Elasticity
 - The Principle of Virtual Work

2. Finite Element Analysis Jan. 29 - Feb. 28, 2002
 - The Finite Element Displacement Approach
 - The Isoparametric Element Description (2-d, 3-d)
 - Consistent Mass and Distributed Loads
 - Internal Force, Elastic Stiffness and Initial Loads
 - Full, Selective and Reduced Integration
 - Structural Assembly, Residual Load Equations
 - Direct and Iterative Solvers, Eigenvalues and Vectors
 - Partitioning of DOF, Substructure Analysis and Domain Decomposition

3. Structural Finite Elements March 5 - March 21, 2002
 - Mixed Finite Elements (Hu-Washizu Variational Principle)
 - Kinematic Constraints (Locking Problems)
 - Frame Elements (EB vs Timoshenko Beam Elements)
 - Plate Elements (PK vs Reissner/Mindlin Plate Elements)
 - Shell Elements (Love vs Degenerate Solid Elements)

4. Dynamic Analysis April 2 - April 18, 2002
 - Finite Element Equations of Motion
 - Modal and Proportional Damping
 - Spectral Analysis and Modal Synthesis
 - Explicit Solvers (Central Difference Approach)
 - Implicit Solvers (Newmark and Hilber-Hughes)
 - Numerical Damping and Dispersion

5. Stability Analysis April 23 - May 2, 2002
 - Elastic Stability
 - Bifurcation Analysis of Elastic Buckling
 - Nonlinear Deformation Analysis (Beam-Column Approach)