

CE474 – STRUCTURAL ANALYSIS II [Spring 2006]

MWF 1:30-2:20pm, CIVL1252
<http://bridge.ecn.purdue.edu/~ce474>

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PREREQUISITES

CE371; good understanding of mechanics of materials, calculus, matrix algebra.

Working level of computer skills (Mathcad, Matlab, or similar) would help. Willingness to learn and study – must.

DESCRIPTION

Basic concepts of structural analysis; virtual work principles; displacement based matrix structural analysis (linear, static); derivation of element stiffness matrices, assembly procedures, solution methods; special topics in structural analysis; approximate methods of analysis; [optional] introduction to nonlinear structural analysis (static); [optional] introduction to structural dynamic analysis (linear). Our concentration will be on analysis of plane truss and frame structures.

OUTLINE

Introduction and Summary of Basic Concepts

- Terminology
- Methods of structural analysis
- Structural idealization
- Matrix methods of analysis for discrete structures

Virtual Work Principles Based on Virtual Displacements

- Virtual work
- The principle of virtual displacements
- Virtual displacements of a particle and external virtual work
- Virtual Displacements of a Deformable Body and Internal Virtual Work

Direct Stiffness Analysis of 2D and 3D Framed Structures

- Review of matrix algebra
- Formation of the global analysis equations
- The general assembly procedure
- Stiffness properties of a 1D (bar/rod), 2D (beam) structural elements
- Coordinate transformations
- Direct stiffness analysis of planar truss systems, frame systems

Special Issues in Stiffness Analysis of Structures

- Thermal and initial strain (temperature change and misfit)
- Displacement boundary conditions
- Shear deformation
- Flexible joints; finite size joints (rigid zones at member ends)
- Static condensation of stiffness matrices; substructuring for large structures

Approximate Methods of Multi-Story Frame Analysis

- Portal method; cantilever method

Nonlinear Analysis of Framed Structures for Large Deflections [Optional]

- Stiffness analysis for large deflections; geometric stiffness for truss and beam elements
- Stability analysis of truss structures, frame structures (elastic critical loading)

Introduction to Finite Element Analysis [Optional]

- 2-node truss finite element; 2-node classical beam finite element
- Planar element formulation (membranes, plates, shells)

Introduction to Structural Dynamic Linear Analysis [Optional]

- Basic concepts
- Single-degree-of-freedom, multi-degree-of-freedom modeling and analysis

GRADING

Homework: 25%

2 Term Exams: 20% each

Final Exam: 35%

Average of all three exams must be at least 60/100 to receive a passing grade.

Final grades will be based on standard catalogue grade division at the discretion of the instructor:

$A \geq 90$ | $90 > B \geq 80$ | $80 > C \geq 70$ | $70 > D \geq 60$ | $60 > F$

HOMEWORKS

Homeworks will be due at the beginning of class one week from hand-out date; no late homeworks.

Your write-up should be intelligible and of professional quality. Use engineering paper. Do not crowd solutions into a single page (i.e. each solution should have its own start-page). Draw your illustrations neatly (use of a straight edge is encouraged) and mark relevant parameters on your illustrations. State your assumptions where not obvious. Your answer should be identifiable; no multiple answers.

COLLABORATION POLICY

Homeworks: Solve homework problems on your own. You are NOT allowed to solve together with someone else or let someone solve for you. You may NOT compare the solution steps. You may discuss with your fellow classmates applicable general concepts. Your solution and write-up should be, by definition, yours. Zero-tolerance against transgressions.

Exams: No collaboration or sharing of any kind is allowed. Zero-tolerance against transgressions.

TEXTBOOK

Matrix Structural Analysis – W. McGuire, R.H. Gallagher, R.D. Ziemian. 2nd ed., J. Wiley and Sons, 2000. (Engineering library will have two copies under course-reserve listing.)

REFERENCE BOOKS

- *Structural Analysis: A Unified Classical and Matrix Approach* – A. Ghali and A.M. Neville. 2nd ed., Chapman and Hill, 1978 (newer ed. exists)
- *Theory of Matrix Structural Analysis* – J.S. Przemieniecki. Dover, 1985 (1968 McGraw-Hill ed.)
- *Matrix Structural Analysis* – R.L. Sack. PWS-KENT Publishers, 1989
- *Matrix Structural Analysis* – M.D. Vanderbilt. QPI Press, 1974
- *Intermediate Structural Analysis* – C.K. Wang. International ed., McGraw-Hill, 1983 (other ed.)