

## CE474 – STRUCTURAL ANALYSIS II [Spring 2009]

MWF 1:30-2:20pm, EE117  
<http://cobweb.ecn.purdue.edu/~ce474>

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CIVL 4117

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### PREREQUISITES

- CE371
- Good understanding of statics, mechanics of materials, physics, calculus, and linear algebra (inc. matrix methods).

### DESCRIPTION

Basic concepts of structural analysis; approximate methods of analysis; virtual work principles; displacement based matrix structural analysis (linear, static): derivation of element stiffness matrices, assembly procedures; special topics in structural analysis. Emphasis will be on analysis of plane truss and plane frame structures.

### OUTLINE

#### Review of Basic Concepts in Structural Analysis

- Equilibrium conditions
- Statical determinacy/indeterminacy
- Kinematic determinacy (degree of freedom)

#### Approximate Methods in Structural Analysis

- Approximate analysis of trusses
- Approximate analysis of moment-frame building systems for vertical loads
- Approximate analysis of moment-frame building systems: portal method and cantilever method

#### Work-Energy Methods in Structural Analysis

- Conservative systems
- Strain energy due to axial, bending, shear, torsional forces and deformation
- Using real work to find real deflections

#### Virtual Work Methods in Structural Analysis

- Principle of virtual forces; using virtual forces to find real deflections (dummy load/unit load method)
- Deflections due to temperature changes, member misfits
- Betti's law & Maxwell's law of reciprocal deflections
- Principle of virtual displacements; using virtual displacements to find real forces
- Use of virtual displacements in plastic (limit state) analysis

#### Displacement Method (Stiffness Method) of Structural Analysis

- Quick review of matrix algebra
- Truss element; beam element; frame element
- Stiffness influence coefficients
- Local coordinates versus global coordinates; coordinate transformations
- Fixed end forces/moments
- Formation of the global analysis equations
- General assembly procedure
- Direct stiffness analysis of planar truss systems, frame systems

#### Special Issues in Stiffness Analysis of Structures

- Finite size joints (rigid zones at member ends); flexible joints
- Stiffness influence coefficients of shearwall elements

## **GRADING**

Homework: 10%

Two term exams: 25% each

Final exam: 40%

Arithmetic average of three exams needs to 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 are due at the beginning of class one week from hand-out date; no late homeworks.

Homeworks will be distributed in class and posted on the course website. If you miss the hand-out in class, it is your responsibility to get it from the website.

Homework solutions should be intelligible and of professional quality. Use engineering paper. Do not crowd solutions into a single page (i.e. start each solution on a separate page). Draw your illustrations neatly (use of a straight edge/ruler is encouraged) and mark relevant parameters on your illustrations (labels, degrees of freedom, coordinate system, etc.). State your assumptions where not obvious. Your final answer should be identifiable; no multiple answers.

You will get full credit for each problem you submit a relevant and intelligible solution for. Otherwise, you will get zero credit. The TA will provide feedback about the quality and correctness of your solution. It is up to you to make sure you study and learn, i.e. understand, the concepts and steps involved in each problem. Solutions will be posted on the course website after the homework due date.

## **COLLABORATION POLICY**

*Homeworks:* It is encouraged that you solve the homework problems on your own. In any case, your solution write-up should be, by definition, yours.

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

## **TEXTBOOK (Recommended)**

- *Structural Analysis*, R. C. Hibbeler, 6<sup>th</sup>/7<sup>th</sup> ed., Pearson/Prentice Hall, 2006/2008.

## **REFERENCE BOOKS**

- *Structural Analysis: A Unified Classical and Matrix Approach* – A. Ghali and A.M. Neville. 2<sup>nd</sup> ed., Chapman and Hill, 1978 (newer ed. exists)
- *Matrix Structural Analysis* – W. McGuire, R.H. Gallagher, R.D. Ziemian. 2<sup>nd</sup> ed., J. Wiley and Sons, 2000 (relatively advanced)
- *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.)

Name and Surname: \_\_\_\_\_

**MAKE-UP/TUTORIAL CLASS/OFFICE HOUR CONFLICT CHECK**

Please mark your class hours only; if possible please provide the course codes.

	Monday	Tuesday	Wednesday	Thursday	Friday
8:30-9:20					
9:30-10:20					
10:30-11:20					
11:30-12:20					
12:30-1:20					
1:30-2:20					
2:30-3:20					
3:30-4:20					
4:30-5:20					

