The Pennsylvania State University
CE 340.002 –Structural Analysis
Spring Semester 2003
TR 2:30-3:45, 108 Sackett Bldg.

Prerequisites: E MCH 013

Objectives:

1. To be able to set up any given structural analysis problem in an organized manner (including the use of accurate free body diagrams).
2. To have a general understanding of the basic types of structural systems.
3. To be able to draw shear and moment diagrams effectively.
4. To be able to identify an efficient method to analyze determinant and indeterminate structures and to analyze non-complex structural engineering problems without a computer.
5. To be able to judge the validity of results obtained from computer-based structural analysis.
6. To have a greater appreciation of structures and structural engineering.

Textbooks: Structural Analysis, 5th Ed., R.C. Hibbeler

References: Fundamentals of Structural Analysis, 2nd. Ed., H.H. West and L.F. Geschwindner
Structural Analysis, 2nd Ed., A. Kassimali

Instructor: Dan Linzell (dlinzell@engr.psu.edu, 3-8609)
231L Sackett Building (Mailbox 216 Sackett)

Office Hours: MW 9-11 a.m. or by Appointment

Tentative Schedule:

I.	Introduction to Structural Systems	*2 Lectures*
II.	Basic Analysis Concepts	*2 Lectures*
III.	Analysis of Statically Determinate Trusses	*2 Lectures*
IV.	Analysis of Statically Determinate Beams and Frames	*3 Lectures*
V.	Deflections	*4 Lectures*
VI.	Analysis of Statically Indeterminate Structures – Force Method	*3 Lectures*
VII.	Analysis of Statically Indeterminate Structures – Slope Deflection Method	*3 Lectures*
VIII.	Analysis of Statically Indeterminate Structures – Moment Distribution	*3 Lectures*
IX.	Introduction to Matrix Methods of Structural Analysis (Stiffness Method)	*2 Lectures*
X.	Introduction to Structural Analysis Computer Programs (STAAD/Pro)	*1 Lecture*
XI.	Influence Lines	*3 Lectures*
		28 Lectures

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Grading:	Exam 1 (Tues., Oct. 7th, 6:30-7:45, 162 Willard)	20%
	Exam 2 (Thurs., Nov. 6th, 6:30-7:45, 162 Willard)	20%
	Final (Mon., December 15th, 2:30-4:30, Rm. TBA)	25%
	Homework	25%
	Final Project	10%
		100%

Tentative Outline:

NOTE – listed reading should be completed PRIOR to class lectures, students are encouraged to read other sections of text and references, supplemental handouts may be distributed in class.

I. Introduction to Structural Systems

Reading: Hibbeler 1.1-1.4

- Types of structures
  - Framing systems
  - Concrete structures
  - Steel structures
  - Structures of other materials (masonry, timber, etc.)
- The relation of structural analysis to the design process
- Loads
  - Tributary areas
  - Load factors, codes
- Computers in structural analysis
- Proper problem setup and the free body diagram

II. Basic Concepts for Analysis

Reading: Hibbeler 2.1-2.5

- Simplifications for analysis
- Types of supports and reaction forces
- Superposition
- Statical determinacy and stability
- Computation of reactions using equations of equilibrium
- Condition equations

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Tentative Outline (cont.):

III. Analysis of Statically Determinate Trusses

Reading: Hibbeler 3.1-3.5

- Types of trusses and truss classification
- Statical determinacy and stability
- Sign convention and force representation
- Method of joints
- Zero-force members
- Method of sections

IV. Analysis of Statically Determinate Beams and Frames

Reading: Hibbeler 4.1-4.5

- Internal forces and sign convention
- Load, shear and bending moment relationships
  - Formal integration
  - Incremental change method
- Axial, shear and moment diagrams for a beam
- Qualitative deflected shapes
- Axial, shear and moment diagrams for a frame
- Use of superposition

V. Deflections

Reading: Hibbeler 8.1-8.4, 8.7-8.10

- Principle of virtual work
- Axial force-deformation relationships
- Truss deflections by complementary virtual work
- Flexural force-deformation relationships
- The double integration method
- Beam and frame deflections by complementary virtual work
- Axial, shear and torsional deformations
- (Reference handout for Moment-Area method, Section 8.4)

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VI. Analysis of Statically Indeterminate Structures by the Force Method

Reading: Hibbeler 9.1-9.6

- Advantages and disadvantages of statically indeterminate structures
- Types of analysis
- Redundants
- General procedure for the force method
- Analysis of beams
- Support settlement and elastic supports
- Analysis of frames
- Analysis of trusses

VII. Analysis of Statically Indeterminate Structures by the Slope Deflection Method

Reading: Hibbeler 10.1-10.5

- Displacement method of analysis
- Slope deflection equation
- Analysis of beams
- Analysis of frames
    - No sidesway
    - Sidesway

VIII. Analysis of Statically Indeterminate Structures by Moment Distribution

Reading: Hibbeler 11.1-11.5

- Definitions
- Moment distribution for beams
- Modified stiffnesses
- Moment distribution for frames
    - No sidesway
    - Sidesway

IX. Introduction to Matrix Methods (Stiffness Method)

Reading: Hibbeler Chs. 13-15

- Member stiffnesses
- Structure and member coordinate systems
- Generating the structure stiffness matrix
- Basic application of the stiffness method

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X. Introduction to Computer Programs for Structural Analysis

- STAAD/Pro

XI. Influence Lines

Reading: Hibbeler 6.1-6.8, 9.10-9.11

- Description of influence lines
- Constructing influence lines for beams (determinate or indeterminate)
- Qualitative influence lines (Müller-Breslau principle)
- Use of influence lines to find maximum response
- Absolute maximum shear and moment
- Influence lines for trusses

Academic Integrity:

From the PSU web site (http://www.psu.edu/ufs/policies/):

49-20 Academic Integrity
Definition and expectations: Academic integrity is the pursuit of scholarly activity in an open, honest and responsible manner. Academic integrity is a basic guiding principle for all academic activity at The Pennsylvania State University, and all members of the University community are expected to act in accordance with this principle. Consistent with this expectation, the University's Code of Conduct states that all students should act with personal integrity, respect other students' dignity, rights and property, and help create and maintain an environment in which all can succeed through the fruits of their efforts.

Academic integrity includes a commitment not to engage in or tolerate acts of falsification, misrepresentation or deception. Such acts of dishonesty violate the fundamental ethical principles of the University community and compromise the worth of work completed by others.

To protect the rights and maintain the trust of honest students and support appropriate behavior, faculty and administrators should regularly communicate high standards of integrity and reinforce them by taking reasonable steps to anticipate and deter acts of dishonesty in all assignments (Senate Policy 44-40: Proctoring of Examinations). At the beginning of each course, it is the responsibility of the instructor to provide students with a statement clarifying the application of University and College academic integrity policies to that course

Homework:

All homework should be completed in a neat and orderly fashion on engineering paper and in pencil. Homework is typically assigned weekly. Problems are to be submitted at the beginning of class typically one week after their assignment. Late homework can be submitted at the beginning of the class period immediately following the due date with a *10% penalty* being assessed. Solutions to the assigned homework problems will be available on the web after they are returned (**http://www.engr.psu.edu/ce/Divisions/Structure/Linzell/PSU%20Web%20Page/index.html**). Once graded homework is returned, you have 24 hrs. after receiving it to question the grades that were given. All questions and concerns must be submitted in writing.

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Exams:

Two mid-term and one final examination are scheduled as shown on sheet 2. The final will be cumulative. **NO** make-up exams will be given except as required by University policy. See me at least 24 hrs. *prior* to any anticipated absence. You have 24 hrs. after receiving a graded exam to question the grade that was given. All questions and concerns must be submitted in writing.

Project:

A design project involving analyzing a structure on campus will be assigned towards the end of the semester. It should be completed in a neat and orderly fashion on engineering paper and in pencil. Project deadlines will be established when the assignment is distributed.