FALL SEMESTER 2014

THE PENNSYLVANIA STATE UNIVERSITY
Department of Architectural Engineering

AE 430 - INDETERMINATE STRUCTURES

Instructor: Heather A. Sustersic, P.E.
215 Engineering Unit A
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Class Time/Location: Tuesday/Thursday 11:15 AM – 12:30 PM, 203 EE West Building; Appt.

Office Hours: Mon. 1:30 PM – 3:00 PM
(or by Appointment)

Prerequisites: AE 308 (or CE 340)

Teaching Intern: Caroline Klatman (cjk5258@psu.edu)

Teaching Assistant: Tyler Poff (tap5211@psu.edu)

Catalog Description:
Classical methods of analysis for beams, arches, and secondary stresses as applied to buildings; introduction to modern methods.

Course Learning Objectives:
Upon completion of this course, students will be able to:
- Calculate and distribute lateral loads to building structures,
- Interpret building code provisions for lateral loads,
- Solve determinate structures using analysis methods not covered in prerequisite courses,
- Solve indeterminate structural systems such as continuous beams, moment resisting frames, and indeterminate structures using hand calculations and structural analysis software,
- Discern the most efficient method to solve a given structural analysis problem considering the desired output.

Text Requirements:

Additional Reference Material:
Available at Engineering Library on 2 hour reserve:
1) “Understanding the world's greatest structures: science and innovation from antiquity to modernity” by Stephen J Ressler. TA630.U52 2011 (DVD and Booklet)
2) Indeterminate Structural Analysis, by Joseph Sterling Kinney. TG260.K465
Available on the PSU AE network drive:

1) International Building Code (IBC) 2012 by the ICC. (O:\Books and Manuals\eQuest)
2) ASCE 7-10, wind and seismic provisions (O:\Structural\ASCE7-10)
3) Structural Load Determination Under 2006 IBC and ASCE/SEI 7-05 by David A. Fanella. (O:\Books and Manuals\Structural Load Determination)

Grading:
Exam 1 20%
Exam 2 20%
Final Exam 25%
Homework 20%
Project 5%
Class Participation/Quizzes 10%

Examinations and Quizzes:
There will be two evening mid-term exams and one final exam. Tentative mid-term examination dates are provided under the “Course Schedule” section and are subject to change based on proctor availability.

Quizzing will be used throughout the semester. In-class quizzes will not be announced in advance. To account for occasional absences, each student’s quiz score will be increased by 10% in calculating the final grade.

Quizzes are open book/open notes. Exams are closed book, closed notebook. You may bring (1) 8.5x11 sheet of paper to each exam with your notes on it. You may write on both sides. This sheet will be turned in along with your exam submission.

Class Participation:
See the “Class Participation” rubric for more detail on this portion of your grade.

Homework:
There will be regular homework assignments for this course, typically due 7-10 days after assigned. You are expected to read the book sections that are assigned and come prepared to class with questions you may have about the material in the book.

Some homework problems are to be checked using an approved computer analysis software or spreadsheet as part of the assignment. The computer analysis shall be submitted with the homework such that there is both a manual analysis solution and a computer analysis solution. Some assignments, such as spreadsheets, are easier to grade by reviewing your excel file rather than a printout. Specific instructions for submitting electronic assignments will be provided when the assignment is issued.

Please follow these guidelines for manually calculated homework submissions:
- Use engineering paper;
- Write on one side only;
- Start each problem on a new page;
- Show the final answers in a box or clearly underline;
- Put your name on all pages;
- Staple all pages together.

Additionally, each computer solution must include the following (NO snips please!):
- A thorough sketch of the structural model showing member numbers, joint numbers, and coordinate system, etc;
- A complete record of inputs;
- All relevant parts of the output file;
- A summary comparison of the manual analysis and the computer analysis results with explanation for differences observed.

Homework sets shall be graded based on the following:
- **Solution** – reasonable work can get some credit even if final solution is incorrect. Problems may be weighted differently in proportion to required difficulty/effort;
- **Professionalism** – unprofessional (messy, incomplete, illegible) submissions will not be reviewed.
- **Late submissions will be reviewed for content only.** Extenuating circumstances leading to late submissions must be discussed with the instructor BEFORE the assignment due date. The definition of “extenuating” is at the discretion of the instructor.

### Expected Outcome (for ABET accreditation evaluations)

<table>
<thead>
<tr>
<th>Expected Outcome</th>
<th>Emphasis in this course</th>
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<tbody>
<tr>
<td>(a) an ability to apply knowledge of mathematics, science and engineering</td>
<td>3</td>
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<tr>
<td>(b) an ability to design and conduct experiments, as well as to analyze and interpret data</td>
<td>3</td>
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<tr>
<td>(c) an ability to design a system, component, or process to meet desired needs</td>
<td>2</td>
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<tr>
<td>(d) an ability to function on multi-disciplinary teams</td>
<td>3</td>
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<tr>
<td>(e) an ability to identify, formulate, and solve engineering problems</td>
<td>3</td>
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<td>(f) an understanding of professional and ethical responsibility</td>
<td>2</td>
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<tr>
<td>(g) an ability to communicate effectively</td>
<td>2</td>
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<tr>
<td>(h) the broad education necessary to understand the impact of engineering solutions in a global and societal context</td>
<td>1</td>
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<tr>
<td>(i) a recognition of the need for, and ability to engage in life-long learning</td>
<td>2</td>
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<td>(j) a knowledge of contemporary issues</td>
<td>1</td>
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<tr>
<td>(k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice</td>
<td>3</td>
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**Emphasis:** 3 – Strong; 2 – Moderate; 1 – Little; Blank – Nothing specific expected

### Academic Integrity Policy

When you earn an Architectural Engineering degree from Penn State, the University is certifying that you are capable of performing structural engineering duties at a professional level. Course grades are the sole basis on which the College of Engineering certifies your degree with the assumption that your course grades are a valid assessment of your own knowledge and abilities. If you have cheated, you have falsified that credential. Therefore, we must have academic integrity expectations to ensure the validity of your grade and your degree.

When you conduct yourself with academic integrity in this class, you can be confident that you will develop all skills necessary to properly perform lateral and gravity analysis of determinate and indeterminate structures and make recommendations that your employer will trust to benefit your company.

Specifically for this course, cheating on any assignment, in class or out of class, will not be tolerated. Working together is encouraged, but you must complete your own work. DO NOT submit the same computer analysis printout – this is cheating. DO NOT write down the same numbers that your colleague got without running the calculations on your own – this is cheating. DO NOT loan your work to another student for them to copy – this is cheating.

The University defines academic integrity as the pursuit of scholarly activity in an open, honest and responsible manner. 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 (refer to Senate Policy 49-20). Dishonesty of any kind will not be tolerated in this course.
Dishonesty includes, but is not limited to, cheating, plagiarizing, fabricating information or citations, facilitating acts of academic dishonesty by others, having unauthorized possession of examinations, submitting work of another person or work previously used without informing the instructor, or tampering with the academic work of other students. Students who are found to be dishonest will receive academic sanctions and will be reported to the University’s Office of Student Conduct for possible further disciplinary sanctions (refer to Senate Policy G-9).

Disability Access Statement
Penn State welcomes students with disabilities into the University's educational programs. Every Penn State campus has an office for students with disabilities. The Office for Disability Services (ODS) Web site provides contact information for every Penn State campus: http://equity.psu.edu/ods/dcl. For further information, please visit the Office for Disability Services Web site: http://equity.psu.edu/ods.

In order to receive consideration for reasonable accommodations, you must contact the appropriate disability services office at the campus where you are officially enrolled, participate in an intake interview, and provide documentation: http://equity.psu.edu/ods/doc-guidelines. If the documentation supports your request for reasonable accommodations, your campus’s disability services office will provide you with an accommodation letter. Please share this letter with your instructors and discuss the accommodations with them as early in your courses as possible. You must follow this process for every semester that you request accommodations.

Lecture Topics:
There will be two 75-minute lectures per week. Tentative topics are as follows:
1. Determinate vs. Indeterminate; Stable vs. Unstable.
2. Structural Analysis Using a Commercial Computer Program (Computer analysis will be part of the course throughout the semester).
3. Distribution of Lateral Loads
   a. Introduction to Lateral Load Resisting Systems
   b. Wind Lateral Loads
   c. Seismic Lateral Loads
   d. Distribution of Lateral Loads to Stories
   e. Distribution of Story Lateral Forces to Lateral Load Resisting Systems
4. Deflection of Determinate Beams and Frames
   a. Review of Conjugate Beam Method
   b. Virtual Work Method
5. Complementary Virtual Work applied to Calculation of Truss Deflection
6. Analysis of Indeterminate Trusses, Beams, and Frames Using the Method of Consistent Deformations (Flexibility Method)
7. Analysis of Indeterminate Beams and Frames Using the Method of Slope Deflection
8. Analysis of Indeterminate Beams and Frames Using the Method of Moment Distribution
9. Approximate Methods of Analysis
10. Miscellaneous Topics in Structural Analysis (Influence Lines, Temperature Effects, Cables, Arches, etc. as time permits)

Course Schedule:
9/1 – Labor Day – No class
9/23 – AE Career Fair – No Class, but complete assignment
10/2 – Evening Exam #1 – 8:15 – 10:15 PM, 360 Willard Building
11/13 – Evening Exam #2 – 8:15 – 10:15 PM, 360 Willard Building
11/25 & 11/27 – Thanksgiving Break – No Class
Final exam to be scheduled during finals week!

NOTE: The syllabus is subject to change.