INSTRUCTORS:
Clay J. Naito, Assistant Professor of Civil Engineering
ATLSS, H-Bldg. Rm. B-206, 758-3081
Fritz Lab Rm. 404

Peter Mueller, Associate Professor of Civil Engineering
Fritz Lab, Rm. 403 758-3531

COURSE DESCRIPTION:

This first course in structural design will cover the analysis and design of reinforced concrete and structural steel members. Topics covered in the course include: (1) introduction to the structural design process, uncertainty and structural safety concepts; (2) material characteristics and basic mechanical properties; (3) analysis and design of tension members; (4) analysis and design of flexural members; (5) analysis and design of compression members; (6) analysis and design of combined axial and flexural loading (i.e., beam-columns). The course will consist of both theory and practical design examples.

Course Conduct:

The course is divided equally between coverage of reinforced concrete structural members and structural steel members. Two professors will teach the course, one will cover the reinforced concrete part and the other the structural steel part. The course material will be presented in 42 lectures of 50-minute duration. There are also 14 recitation periods of three-hour duration. Each of these recitation periods will be used as a combined lecture period (about 1 hour) and session for problem solving and supervised work on assigned problems.

Textbooks:

*Design of Concrete Structures*, by Nilson
*Design of Steel Structures*, by Gaylord

GRADING:

Homework Assignments and Instructor’s evaluation 20%
Exam 1 – Reinforced Concrete 20%
Exam 2 – Structural Steel 20%
Final Exam – Reinforced Concrete and Structural Steel 40%

NOTES:

1. **Attendance**: The University attendance regulations and CEE Department attendance will be followed in CE 160. Attendance will be taken in all lectures and recitations. Make-up privileges for missed examinations are based on
reasons for absence. In general, the opportunity for make-up is granted only when there are extenuating circumstances or compelling reasons.

2. **Format for homework problems:**
   A) **Neatness is of essence.** Use of 8.5x11-in. engineering paper, write on one side, show all calculations, use a straightedge. Multiple pages should be stapled at the top left corner. Name, date, course number, and homework problem set number should be placed at the top of each page.
   B) Each problem should consist of: (1) Given data, (2) statement of what is to be found, (3) solution, and (4) answer.
   C) Homework submitted after due date and time will be graded, but only partial credit will be given.
   D) Homework solutions will be placed on reserve in the Fairchild-Martindale Library.
CE 160 - Structural Design

C.J. Naito - ATLSS B206 x8-3081 Office hours 11-12 M-F
Fritz Lab

Secretary - Prisca Vindale 203 Fritz Lab x8-3530

TA / Grader -

Course Breakdown - 1st Half (now until Early march) (Naito)
2nd Half (Prof. Mueller)

REVIEW Syllabus

Pre-Requisites:

CE 159 Structural Analysis I
Given: beams, frames, columns, trusses, loading
Find: reactions, moments, shears, deflections

CE 160 - Structural Design
Given: Purpose for structure and structural components
A) Bridges (highway, railway, pedestrian)
B) Buildings (office, residential, warehouse, sports arena)
C) Towers (electrical transmission, oil platform)
D) Dams

Design: To develop a safe and economical structure to serve intended purpose

Design Process
1) Planning - Establish purpose of structure
2) Set criteria for optimum design
   A) Minimum cost
   B) Minimum weight
   C) Minimum construction time
   D) Minimum labor
   E) Maximum efficiency of operation for owner

   - Owners like minimum cost
   - Minimum weight is often emphasized
   - Life-cycle cost is recently given more emphasis, (A) & (E)

3) Preliminary Structural configuration
   - Selection of structural system
   - Selection of materials
   - Selection of layout - column locations, floor heights, building dimensions

4) Establish loads
   - American Society of Civil Engineers (ASCE)
   Minimum design loads for buildings and other structures (ASCE 7-95)
5) Preliminary member selection (sizing)

6) Analysis to obtain moments, forces, shears, deflections

7) Evaluation: Check strength criteria and serviceability requirements

8) Redesign if necessary (if criteria not met, if design not efficient)

LOADINGS

Type: A) Dead Loads - Self weight and portions of structure that remain fixed throughout the life of the structure (plumbing)
- Concrete $\gamma = 150$ pcf
- Steel $\gamma = 490$ pcf
- More important in concrete structures because of the strength to weight ratio.

B) Live Loads - Movable loads, people, unattached equipment, vehicles, stored goods, furniture.
- Studies were conducted on a large number of buildings and the averages were standardized by ANSI.

C) Environmental Loads

C1) Wind - Pressure, $P = qCeCgCp$

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\begin{align*}
CE &= \text{Exposure Factor (Type of Terrain)} \\
Cg &= \text{Gust Response Factor} \\
Cp &= \text{External Pressure coef. (Dependent on shape)} \\
q &= 0.0026V^2 \\
V &= \text{Wind velocity in MPH based on 1:50 chance of being exceeded/year.}
\end{align*}
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C2) Snow Loads

C3) Earthquake Loads, shear, $V = CSW = W \times (1.2AvS) / (RT^{2/3})$

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\begin{align*}
W &= \text{Weight of Structure} \\
Av &= \text{Effective Peak Acceleration Coefficient} \\
S &= \text{Soil site coefficient} \\
R &= \text{Ductility} \\
T &= \text{Structural Period}
\end{align*}
\]