CE6193 WIND AND EARTHQUAKE ENGINEERING

Department of Civil and Urban Engineering
NYU Tandon School of Engineering
Course Outline
Spring 2018

Adjunct Professor J. Jong Lou, Ph.D., P.E.
Thursdays 6:00-8:30 PM; Rm 213

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Course Pre-requisites
Students must have completed CE2123 (Mechanics of Materials), CE3122 (Structural Dynamics), CE3133 (Structural Analysis), and CE3143 (Steel Design) and/or CE4183 (Reinforced Concrete Design). This course builds on the above-mentioned introductory courses. Some practical engineering design knowledge and experience is considered necessary though not mandatory. Basic proficiency in computer software such as: STAAD-III, ETABS, SAP2000, MATLAB, Mathcad, Excel, and AutoCAD is required.

Course Description
The course is critical for the design and analysis of Building and/or Bridge structures subjected to Wind and Earthquake Loads – Lateral Loads. It integrates the theory & practice for Lateral Forces Resisting Systems (LFRS) of structures, together with Gravity Loads Resisting Systems. It provides basic seismological background and atmospheric wind characteristics, their effects and mitigation on structures.

Course Objectives
Students are expected to understand the following:

Structural Dynamics:

Earthquake Engineering:
- Seismic Response Spectra (Displacement, Velocity, Acceleration), Seismic Design Response Spectra; Time Series Analysis
- Linear Static Seismic Lateral Force Procedures - Code treatments
- Lateral Force Resisting Systems (LFRS), Rigid Diaphragm, Center of Rigidity, Eccentric (Torsional) Moment, Story Drift, Ductility, Seismic Fuse
- Seismic Isolation - Theoretical Treatment (Transmissibility); Seismic Retrofit
- Basics of Earthquake on Bridges (Non-building structures) – One Introductory session only

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**Wind Engineering:**
- Meteorology, Atmospheric Boundary Layer, Wind Speed/Profile
- Basic Bluff-Body Aerodynamics, Wind Pressures/loads
- Code Treatments of Wind Loads and their Effects on Structures

**Course Structure**
The class will be comprised of a total of 16 sessions: 12 Lectures, One (1) Special Workshop session on the design and analysis of Project Building - a 13-story building located in New York City (Moderate Seismic and Wind region), Miami (Hurricane region), or Los Angeles (Strong Earthquake region) and Three (3) Exams.

**Readings**
The required textbooks for the course are:


**References:**


The governing code for Wind and Earthquake loads is ASCE 7-15, “Minimum Design Loads for Buildings and Other structures,” therefore it is necessary to have this code for the class. The 7-10 edition is acceptable. Note Edition 7-05 is based on ASD concept - Allowable Stress Design, which also serves as a valuable reference.

Even with a good understanding on course theory, it’s not guaranteed that you can solve practical engineering problems. The design & analysis of Project Building and References No. 3 and 6 prepare you for a hands-on approach to solutions.

**Course requirements**
Class preparation and participation are important for this course and will be factored into your final grade. Students must read the required text and articles in advance and be prepared for class Question/Answer drills throughout the semester.
Class attendance is crucial in keeping up with the continuity and content of course work. Missing two (2) lecture sessions will gravely hinder achieving the Course Objectives as outlined above. Students who are absent for three (3) lecture sessions shall be regarded as academically delinquent with implications of either a Withdrawal or Fail grade.

In addition to class participation, students will analyze and design a real-life 13-story building, take one in-class diagnostic mini-midterm exam, one full-fledged midterm exam, and one final exam. The Project Report, consisting of design calculations and drawings for the Project Building shall be submitted no later than the final exam day.

**Course Pre-requisite Test – 1st Midterm Exam (1 hour), February 15 (10% of final grade)**
This will be a close-book exam with one formula info sheet permitted. The purpose of the exam is diagnostic in nature. The course work is demanding in knowledge of structural analysis & design (Free Body Diagrams) and structural dynamics. Students with poor performance are advised to come out with detailed study program to better prepare themselves for the course or, in special case, to withdraw.

**2nd Midterm Examination (2-hour), March 22 (25% of final grade)**
This will be a timed, close-book examination which will cover all topics up to date. Two (2) formula info sheets are permitted during the exam.

**Final Examination (2 ½-hour), May 10 (35% of final grade)**
This will be a timed, close-book examination with 3 info-sheets permitted.

**Homework & Special Assignment - due one week after assigned (20% of final grade)**
It is important to do your own homework on a timely basis. Homework must use Microsoft Word engineering typing (or Mathcad), Excel, and AutoCAD. There’s no copying of other’s work and no lending of work to others. No late or missing homework is permitted. Students who are found copying others’ work or lending work to others for copying, and/or with late/missing submission of assigned work shall be regarded as academically delinquent if with a total combined three (3) offenses. Hardcopy of assigned work is due a week after it is posted and shall be email-able. You are asked to email your homework or assignment by Monday for professor’s preview and comment.

**Project Building - Design and Analysis of a 13-story Apartment/office/hotel building (10% of final grade)**
The building project builds on the subjects discussed in the lectures, and the design runs parallel to each lecture topic. Students will submit results as special assignment, to be incorporated into the final Project Report. Giving up on Project Building work is not acceptable, which will result in a penalty of -10%.

**Lecture Sessions**

Jan 25  Course Pre-requisites and Review – Structural Dynamics (Vibration)
            Equation of Motion (EOM), SDOF System, Undamped Free Vibration
• Farzad Naeim Chapter 4 (Not quite useful) and Reference #1 (highly recommended)

Feb 1  Damped Free Vibration, Undamped Harmonic Loading, Damped Harmonic Loading, Response, Response Spectra
• Farzad Naeim Chapter 4 and Reference #1

Feb 8  Earthquakes, Loads - Lateral Force Procedures – Intro (ASCE 7-10) and Static Force Procedures (NYC Local Law 17/95)
• Farzad Naeim Chapter 5 and ASCE 7-10 Chapters 11 & 12

Feb 15  Pre-requisite 1st Midterm Examination (one hour); (continued) Lateral Force Procedures
ASCE 7-10

Feb 22  Review of Solutions to the Pre-requisite Mini Exam.
• Farzad Naeim Chapter 4 and ASCE 7-10 Chapters 11 & 12

Mar 1  Structural Systems - Lateral Force Resisting Systems (LFRS): Diaphragm and Center of Rigidity/Center of Gravity
• Farzad Naeim et al Chapter 8

Mar 8  Concrete/Steel Frames - OMF, SMRF; Braced Frames/EBF; Shear Walls; Dual System; Story Drift
• Farzad Naeim Chapters 9 & 10

Mar 15  Spring Recess (No class)

Mar 22  2nd Mid-term Exam (Tentative – may be moved to before Spring Recess)

Mar 24  (Saturday) Review of 2nd Mid-term Results;
Special Session for Project Building - Framing Layout (Gravity Loads Resisting Systems and LFRS); Tabulation of Seismic Loads; Over-turning Moment; Sliding; ETABS Lateral Load Analysis

Mar 29  Seismic Detailing Requirements - Ductility, Connections, Seismic Fuse, Architectural or Non-structural Components
• Farzad Naeim Chapters 6, 7 and 13

Apr 5  Seismic Isolation (Transmissibility); Seismic Retrofit
• Farzad Naeim Chapter 14 (Introductory portion only; Professor Lou’s Lecture Notes)

(Note: This session may be moved to the last session for technical reason.)
Apr 12 Wind Characteristics - Atmospheric Motions and Boundary Layer; Power Law; Turbulence; Bernoulli’s Equation; Renold’s Number, Bluff Body Aerodynamics, Wind Pressure/Suction
  • Simiu and Scanlan Part A; Professor Lou’s Lecture Notes

(Note: Sessions on Jan 25, Feb 1, Mar 1, Mar 8 are common & applicable to Wind Engineering.)

Apr 19 Code Treatments of Wind Loads on Structures – Main Wind Force Resisting System (MWFRS), Components and Cladding
  • ASCE 7-10 Chapter 26

  • Simiu and Scanlan Part B; Professor Lou’s Lecture Notes

  Simiu and Scanlan Part B; Professor Lou’s Lecture Notes

May 10 Final Exam (two and a half hours) and Project Design Package Due

Moses Center Statement of Disability

If you are student with a disability who is requesting accommodations, please contact New York University’s Moses Center for Students with Disabilities (CSD) at 212-998-4980 or mosescsd@nyu.edu. You must be registered with CSD to receive accommodations. Information about the Moses Center can be found at www.nyu.edu/csd. The Moses Center is located at 726 Broadway on the 2nd floor.

NYU School of Engineering Policies and Procedures on Academic Misconduct

A. Introduction: The School of Engineering encourages academic excellence in an environment that promotes honesty, integrity, and fairness, and students at the School of Engineering are expected to exhibit those qualities in their academic work. It is through the process of submitting their own work and receiving honest feedback on that work that students may progress academically. Any act of academic dishonesty is seen as an attack upon the School and will not be tolerated. Furthermore, those who breach the School’s rules on academic integrity will be sanctioned under this Policy. Students are responsible for familiarizing themselves with the School’s Policy on Academic Misconduct.
B. Definition: Academic dishonesty may include misrepresentation, deception, dishonesty, or any act of falsification committed by a student to influence a grade or other academic evaluation. Academic dishonesty also includes intentionally damaging the academic work of others or assisting other students in acts of dishonesty. Common examples of academically dishonest behavior include, but are not limited to, the following:

1. Cheating: intentionally using or attempting to use unauthorized notes, books, electronic media, or electronic communications in an exam; talking with fellow students or looking at another person’s work during an exam; submitting work prepared in advance for an in-class examination; having someone take an exam for you or taking an exam for someone else; violating other rules governing the administration of examinations.

2. Fabrication: including but not limited to, falsifying experimental data and/or citations.

3. Plagiarism: intentionally or knowingly representing the words or ideas of another as one’s own in any academic exercise; failure to attribute direct quotations, paraphrases, or borrowed facts or information.

4. Unauthorized collaboration: working together on work that was meant to be done individually.

5. Duplicating work: presenting for grading the same work for more than one project or in more than one class, unless express and prior permission has been received from the course instructor(s) or research adviser involved.

6. Forgery: altering any academic document, including, but not limited to, academic records, admissions materials, or medical excuses.