

WEST VIRGINIA UNIVERSITY
DEPARTMENT OF CIVIL AND ENVIRONMENTAL ENGINEERING

Course Title: **STRUCTURAL DESIGN FOR DYNAMIC LOADS**
 CE 765, Sec. 01
 Fall Semester, 2010

Time & Place: Tuesday & Thursday, 9:30 A.M. - 10:45 A.M.
 Room 249A ESB

Instructor: **Dr. Udaya B. Halabe**, CEE, Structures Group
 Room 613 ESB, Phone: 304-293-9934

Office Hours: Tuesday & Thursday, 11:00 A.M. – 12:15 P.M.

Objective: The primary objective of this course is to study the behavior of structures under wind (including hurricane and tornado) and earthquake loading, and to study the latest principles and procedures for wind and earthquake resistant design. The design procedures are based on the International Building Code (IBC) 2006, which incorporates the ASCE/SEI 7-05 Standard.

Textbook: A comprehensive list of references, including the latest design codes, is attached. **Students are required to have “ASCE/SEI 7-05 (ASCE Standard No. 7-05) – Minimum Design Loads for Buildings and Other Structures.”** Lecture notes and other informative material will be made available to the students in several installments during the semester as hard copies or in PDF format.

Computer Program: NONLIN Computer Program (to be provided free of cost by the instructor) will be used for the analysis of elastic and inelastic response of single degree of freedom systems subjected to time varying loads and ground motions from past earthquakes. This analysis serves the basis for analyzing multistory (multiple degrees of freedom) systems.

Policies and Guidelines:

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|------------------------|-------------------|------------------------|
| <u>Grading:</u> | Attendance | 15%* |
| | Homework/Projects | 25% |
| | Exam 1 | 30% |
| | Exam 2 | 30% |
| | TOTAL | ----- 100% ----- |

* Each **unexcused** absence will result in 0.5% reduction (i.e., your attendance grades will be **zero** if you miss 30 class lectures).

Final grades will be based on the following scale: 90% and above - A, between 80 and 90% - B, between 70 and 80% - C, between 60 and 70% - D, and below 60% - F. However, the instructor reserves the right to curve up (i.e., reduce the grade cut-off boundaries and award higher grades than earned on this scale).

Homework/Projects: You may discuss the problems with others to facilitate your understanding, but **you are not allowed to copy**. Identical homework will be given a score of zero. Group Projects, on the other hand, are expected to be based on every group member's contribution, and all group members in a given group will receive the same score. Late homework/projects will not be accepted unless prior approval of the instructor is obtained.

All submitted work should be neat, concise, clear and well organized, and should be presented on standard size paper (8.5" x 11"). No off-size papers will be accepted. Please staple all sheets together before submitting.

Exams: Two exams (approximately 60 to 70 minutes each) will be given during class hours on pre-announced days. The exams will be closed book, and only pens and calculators will be permitted. Any unexcused absence during exam days will result in a score of zero. Make-up exams will be permitted only for medical reasons or in case of emergencies.

Academic Honesty: You are bound by the University Honor Code. It is your responsibility to know the code and the risks of violations (please see Graduate Catalog, 2008-2010, pages 41-42).

Some Suggestions: You are encouraged to ask questions in the class to clarify any doubts. Review your class notes as soon as possible. Try to be up-to-date on all lectures. Lack of understanding of current topics may hinder future learning as well. So get help wherever you can, from fellow students, senior students, libraries, and your instructor.

Social Justice Statement: West Virginia University is committed to social justice. I concur with that commitment and expect to foster a nurturing learning environment based upon open communication, mutual respect, and non-discrimination. Our University does not discriminate on the basis of race, sex, age, disability, veteran status, religion, sexual orientation, color or national origin. Any suggestions as to how to further such a positive and open environment in this class will be appreciated and given serious consideration.

If you are a person with a disability and anticipate needing any type of accommodation in order to participate in this class, please advise me and make appropriate arrangements with Disability Services (304-293-6700).

Days of Special Concern: WVU recognizes the diversity of its students and the needs of those who wish to be absent from class to participate in Days of Special Concern, which are listed in the Schedule of Courses. ***Students should notify their instructors by the end of the second week of classes or prior to the first Day of Special Concern, whichever is earlier, regarding Day of Special Concern observances that will affect their attendance.*** Further, students must abide by the attendance policy of their instructors as stated on their syllabi. Faculty will make reasonable accommodation for tests or field trips that a student misses as a result of observing a Day of Special Concern.

Topics:

- Introduction to International Building Code (IBC) 2000, 2003, 2006 and 2009
- Introduction to Design of Wind and Earthquake Resistant Structures
- Dynamic Analysis of Single Degree of Freedom Systems (SDOF)
- Lessons Learned from Past Disasters (hurricane damage in U.S. and earthquake damage around the world)
- Basic Principles and Latest Design Philosophies for Structures subjected to Wind, Hurricane, and Tornadoes (including glass cladding and missile impact design)
- Design Provisions of ASCE 7-98/7-02/7-05, the Latest Code for Wind Resistant Design (including design examples)
- Basic Principles (including modal analysis of multiple degree of freedom or MDOF system, response spectrum analysis and nonlinear time history analysis) and Latest Design Philosophies for Earthquake Resistant Design of Structures
- Design Provisions of IBC 2006, the Latest Code for Earthquake Resistant Design (including design examples and reference to ACI 318-05 and AISC Provisions)

Note: The International Building Code (IBC) 2000 was released in Spring 2000, and incorporated the provisions of ASCE 7-98 (by reference) for Wind Resistant Design and NEHRP 1997 for Earthquake Resistant Design. ASCE 7-98 was later revised, and the latest version is ASCE 7-05. IBC 2000 was later revised as IBC 2003 followed by IBC 2006, and incorporates (by reference) ACI and AISC Design Codes. The later versions (e.g., ASCE 7-05 and ACI 318-05) are referenced in IBC 2006.

Recently, IBC has released the 2009 version of the building code and ASCE released the ASCE 7-10 standard. However, design guides for these latest versions are not yet available (may become available over the next 2 to 4 years).

References:

- (1) Chopra, A. K., *Dynamics of Structures, Theory and Application to Earthquake Engineering*, Prentice Hall, NJ, Second edition, 2001.
- (2) National Research Council, *Living on an Active Earth – Perspectives on Earthquake Science*, The National Academies Press (www.nap.edu), Washington, D.C., 2003.
- (3) IBC 2000, IBC 2003, IBC 2006, and IBC 2009, *International Building Code*.
- (4) IRC 2000, IRC 2003, IRC 2006, and IRC 2009, *International Residential Code*.
- (5) ASCE/SEI 7-05 & 7-10, *Minimum Design Loads for Buildings and Other Structures*, ASCE.
- (6) Mehta, K. C., and Colbourne, W. L., *Guide to the Use of the Wind Load Provisions of ASCE 7-05*, 2010.
- (7) Charney, F. A., *Seismic Loads: Guide to the Seismic Load Provisions of ASCE 7-05*, 2010.
- (8) NEHRP (National Earthquake Hazards Reduction Program) *Recommended Provisions for Seismic Regulations for New Buildings and Other Structures, Part 1 - Provisions*, FEMA 302, 1997 Edition (February 1998). (**Note: This publication was later revised and published as NEHRP 2000**).
- (9) *NEHRP Recommended Provisions for Seismic Regulations for New Buildings and Other Structures, Part 2 - Commentary*, FEMA 303, 1997 Edition (February 1998). (**Also see Commentary for NEHRP 2000**).
- (10) *NEHRP Guidelines for the Seismic Rehabilitation of Buildings*, FEMA-273, October 1997. (**Now replaced by ASCE/SEI 41-06 - Seismic Rehabilitation of Existing Buildings, ASCE 2006**).
- (11) *NEHRP Commentary on the Guidelines for the Seismic Rehabilitation of Buildings*, FEMA-274, October 1997.
- (12) *NEHRP Handbook for the Seismic Evaluation of Existing Buildings*, FEMA-178, June 1992.
- (13) *Rapid Visual Screening of Buildings for Potential Seismic Hazards: Supporting Documentation*, FEMA 155, September 1988.
- (14) *Guide to Application of the 1991 NEHRP Recommended Provisions in Earthquake Resistant Building Design*, FEMA-140, September 1995.
- (15) *AISC's Seismic Design Manual*, AISC 327-05, 2005.
- (16) AISC 325-05, *AISC's Steel Construction Manual*, (ASD & LRFD Manuals Combined in one volume), Thirteenth Edition, 2005.
- (17) ACI 318-08, *Building Code Requirements for Structural Concrete and Commentary*, 2008 (Chapter 21 of ACI 318-08 covers *Special Provisions for Seismic Design*).

Notes:

- The International Codes (Items 3 and 4) can be obtained from International Conference of Building Officials (ICBO), Whittier, CA.
- Federal Emergency Management Agency (FEMA) Publications can be obtained by calling 1-800-480-2520 or downloaded from <http://www.conservantech.com/FEMA-publications/FEMA.htm>.