

CIVL 7119/8119
EARTHQUAKE ENGINEERING
Spring 2006
THE UNIVERSITY OF MEMPHIS

Instructor's Name: Dr. Shahram Pezeshk; Office EN108C
Phone: 901-678-4727, Email: spezeshk@memphis.edu

Date: January 18 2006

Hours Credit: 3 Semester Hours

Prerequisites: CIVL 7119/8119

Office Hour: "open door policy"

Course Meetings: 5:30 - 6:55, MW, Room EN114

COURSE DESCRIPTION

Mechanics of earthquakes and strong motion; Seismic design criteria; Building codes and Applied Technology Council's publications.

GRADING

The final grades for the course will be based on the following percentages:

Homework	25%
Project(s)	20%
Mid-Term Exam	25%
Final Exam	30%
Total	<hr/> 100%

ATTENDANCE

Regular attendance is necessary to maintain pace with the lectures and the progress of the class. If you must be absent, please make sure you know the assignment for the following class meeting and turn in any work due that day.

MAKE-UP WORK

Generally, if a student misses an exam or a homework assignment a score of zero will be awarded. However, the student may be allowed to make-up an exam or turn in their homework late if a valid reason for the absence is presented to the instructor at the next class meeting. If the student must miss an exam because of a conflict in his/her schedule the student must notify the instructor in writing at least two days prior to the absence.

ATTENDANCE

Regular attendance is necessary to maintain pace with the lectures and the progress of the class. If you must be absent, please make sure you know the assignment for the following class meeting and turn in any work due that day.

COURSE OUTLINE

- . *The nature and physics of earthquakes*
 - Introduction to earthquakes
 - Causes of earthquake
 - Seismic waves
 - Factors affecting earthquake motion at a site
 - Prediction of motion at a site
 - Recording and processing of earthquake ground motion

- . *Response of structures to earthquake ground motion*
 - Review of theory of vibration of elastic structures
 - Calculation of dynamic response of elastic structures
 - Inelastic dynamic response of structures
 - Response spectrum analysis of elastic and inelastic structures
 - Transient response analysis for complex structures
 - Normalization procedures for earthquakes

- . *Design specifications for buildings and other structures*
 - General background and philosophy
 - Development of design spectra
 - Uniform Building Code and “Blue Book” approach
 - Selecting the structural configuration for a building
 - Design and behavior of irregular structures
 - Material specifications and detailing requirements

- . *Design and behavior of special structures.*

Final Exam: May 3, Wednesday, 5:30pm - 7:30pm

List of References

- Paulay, T. and M.J.N. Priestley. (1992). "Seismic Design of Reinforced Concrete and Masonry Buildings." Wiley Interscience, New York.
- Cheng, F.Y. (2000). "Matrix Analysis of Structural Dynamics: Application and Earthquake Engineering." Marcel Dekker, Inc., New York.
- Minoru Wakabayashi. (1986). "Design of Earthquake-Resistant Buildings," McGraw-Hill Book Company, New York.
- Emilio Rosenblueth. (1981). "Design of Earthquake-Resistant Structures," John Wiley & Sons, New York.
- N.M. Newmark, and E. Rosenblueth, (1971). "Fundamentals of Earthquake Engineering," Prentice-Hall, Inc., Englewood Cliffs, N.J.
- A.K. Gupta. (1990). "Response Spectrum Method In Seismic Analysis and Design of Structures," Blackwell Scientific Publications, Boston.
- Bolt, B.A. (1978). "Earthquake: A Primer," W.H. Freeman and Company, New York.
- Algermissen, S.T. (1983), "An Introduction to the Seismicity of the United States," EERI, Berkeley.
- Hudson, D.E. (1979). "Reading and Interpreting Strong Motion Accelerograms," EERI, Berkeley.
- Newmark, N.M. and W.J. Hall. (1982). "Earthquake Spectra and Design," EERI, Berkeley.
- Housner, G.W. and P.C. Jennings. (1982). "Earthquake Spectra and Design," EERI, Berkeley.
- Chopra, A.K. (1981). "Dynamics of Structures," EERI, Berkeley.
- Berg, G.V., (1983), "Seismic Design Codes and Procedures," EERI, Berkeley.
- Seed, H.B. and I.M. Idriss. (1982), "Ground Motions and Soils Liquefaction During Earthquakes," EERI, Berkeley.
- Dowrick, D.J. "Earthquake Resistant Design for Engineers and Architects," 2nd Edition, Wiley.
- Priestly, M.J.N., F. Seible, and G.M. Calvi. "Seismic Design and Retrofit of Bridges," Wiley Interscience.
- Hu, Y.-X., S-C. Liu, and W. Dong. "Earthquake Engineering," E& FN Spon, an Imprint of Chapman and Hall.
- Berg, Glenn. "Seismic Design Codes and Procedures," Earthquake Engineering Research Institute, Oakland, 1983.
- Biggs, John. "Introduction to Structural Dynamics," McGraw-Hill Co., 1964.
- Blume, J. A., N. M. Newmark, and L. H. Corning, "Design of Reinforced Concrete Buildings for Earthquake Motions," Portland Cement Association, Skokie, 1961.
- Chopra, Anil. "Dynamics of Structures: Theory and Applications to Earthquake Engineering," Prentice-Hall, Upper Saddle River, New Jersey, 2000.

Clough, Ray W. and Joseph Penzien, "Dynamics of Structures," McGraw-Hill, New York, 1993.

Craig, Roy R. Jr., "Structural Dynamics: An Introduction to Computer Methods," John Wiley and Sons, New York, 1981.

Hartog, J.P. Den "Mechanical Vibrations," Dover Publications, New York, 1985.

Fanella, D. "Seismic Detailing of Concrete Buildings," Portland Cement Association, Skokie, 2000.

Fanella, D. and J. A. Munshi, "Design of Concrete Buildings for Earthquake and Wind Forces According to the 1997 Uniform Building," Portland Cement Association, Skokie, 1998.

Fanella, D. and J. A. Munshi, "Design of Low Rise Concrete Buildings for Earthquake Forces," Portland Cement Association, Skokie, 1992.

Garcia, L. E. "Dinamica Estructural Aplicada al Diseno Sismico," Santa Fe de Bogota, 1998.

Housner, G. W. and P. C. Jennings, "Earthquake Design Criteria," Earthquake Engineering Research Institute, Oakland, 1982.

Jacobsen, L. S. and R. S. Ayre, "Engineering Vibrations with Applications to Structures and Machinery," McGraw-Hill Book Co., New York, 1958.

Kramer, S. "Geotechnical Earthquake Engineering," Prentice-Hall, Upper Saddle River, New Jersey, 1996.

Meirovitch, L. "Analytical Methods in Vibrations," The MacMillan Co., London, 1971.

Naeim, F. "Seismic Design Handbook," Van Nostrand Reinhold, New York, 1989.

Naeim, F. "Seismic Design Handbook," Second Edition, Van Nostrand Reinhold, New York, 2001.

Newmark, N M and W. J. Hall, "Earthquake Spectra and Design," Earthquake Engineering Research Institute, Oakland, 1982.

Paz, Mario. "Structural Dynamics: Theory and Computation," Van Nostrand Reinhold Co., New York, 1980.

Rayleigh, J. W. "The Theory of Sound," Dover Publications, 1945.

Sarria, A. "Ingenieria Sismica," Santa Fe de Bogota, 1997.

Tedesco, J. W. et al., "Structural Dynamics: Theory and Applications," Addison Wesley Longman, Menlo Park, 1999.

Thompson, W. T. "Vibration Theory and Applications," Prentice-Hall Inc., Englewood Cliffs, New Jersey, 1965.

Timoshenko, Stephen. "Vibration Problems in Engineering," Van Nostrand Co., Toronto, 1951.

Wakabayashi, M. "Design of Earthquake Resistant Buildings," McGraw-Hill, New York, 1986.

Wiegel, R. L. "Earthquake Engineering," Prentice-Hall, Englewood Cliffs, 1970.

REFERENCE TEXTS ON GEOLOGY, SEISMOLOGY, AND STRONG MOTION

- Algermissen, T. "An Introduction to the Seismicity of the United States," Earthquake Engineering Research Institute, Oakland, 1983.
- Allegre, Claude. "The Behavior of the Earth: Continental and Seafloor Mobility," Harvard University press, 1988.
- Boltz, Bruce. "Earthquake: a Primer," W. H. Freeman & Co., New York, 1978.
- Chopra, A. "Dynamics of Structures, a Primer," Earthquake Engineering Research Institute, Oakland, 1981.
- Clark, Sidney P. "Structure of the Earth," Prentice-Hall, Englewood Cliffs, 1971.
- Dobbins, David "Seismology and Plate Tectonics," Cambridge University Press, 1990.
- Hudson, D. "Reading and Interpreting Strong Ground Motion," Earthquake Engineering Research Institute, Oakland, 1974.
- Kearey, Philip and F. J. Vein, "Global Tectonics," Blackwell, London, 1996.
- Lay, Thorn and Terry C. Wallace, "Modern Global Seismology," New York, Academic Press, 1995.
- Moore, Eldridge N. "Shaping the Earth: Tectonics of Continents and Oceans," W. H. Freeman & Co., New York, 1990
- Richter, Charles F. "Elementary Seismology," W. H. Freeman & Co., San Francisco, 1958.
- Schultz, Christopher H. "The Mechanics of Earthquakes and Faulting," Cambridge University Press, 1990.
- Scientific American, "Earthquakes and Volcanos," W. H. Freeman & Co., San Francisco, 1988
- Vogel, Shawna. "Naked Earth: The New Geophysics," Dutton, 1995.
- Wegener, Alfred. "The Origin of Continents and Oceans," Dover Publications, New York, 1966.
- Yeats, R. S., Terry Sieh, and C. R. Allen, "The Geology of Earthquakes," Oxford University Press, 1997.

CIVL 7119/8119 EARTHQUAKE ENGINEERING

Semester Project Topics

1. Research the design and detailing requirements, analysis procedures, experimental determination of behavior under cyclic loads and the expected behavior under earthquake excitation for one of the structural types listed below. A minimum of six to eight technical papers or reports should be studied and cited in your paper. The paper should be about ten to twenty pages in length excluding figures, tables and references. The structure may be chosen from the following list or from another source after consulting with Prof. Pezeshk: steel eccentric or concentric braced frames (SMRSF) of steel or concrete or masonry; intermediate moment resisting space frame (IMSRF) of steel or concrete; dual system with shear wall and concrete SMRSF or IMRSF; dual system with masonry shear wall and SMRSF or IMRSF; steel eccentric braced frame or concentric braced frame with steel SMRSF or IMRSF; liquid storage tank; water tank; earth dam; concrete arch dam; suspension bridge; cable-stayed bridge; others.

2. Review reports of damage to structures from past earthquakes and write a paper on the lessons learned from the event.

3. Read technical papers and reports on one of the following topics and write a paper summarizing these works; torsional response of buildings; diagrams on the translational and torsional response of buildings; seismic design of retaining walls; seismic design of cooling towers; effects of soft soil sediments on the ground motion at a site; others.

4. Write a computer program to calculate the dynamic response of a single-degree-of-freedom system with bilinear or degrading bilinear hysteretic behavior and perform a parameter study.

5. Using computer simulations, investigate the effects of flexible diaphragms on the elastic or/and inelastic response of building to earthquake.

6. Using computer simulations, investigate the effects of mass or stiffness discontinuities on the elastic and/or inelastic response of buildings to earthquakes.

7. Using computer simulation, investigate the effects of various types and depths of soil layers on the earthquake motion at a site.

8. Comparison of some aspects of different earthquake codes. (ANSI, NEHRP, SEAOC, ATC, and UBC).