University of Connecticut
Department of Civil &
Environmental Engineering

CE 5090 Advanced Topics in Civil Engineering
Seismic Design of Bridge Structures

Fall 2017

Instructor Arash E. Zaghi, PhD, PE, SE (California, Connecticut, Nevada)
Storrs Campus: CAST, Room 117

Class Hours WeFr 11:15AM - 12:30PM

Office Hours With prior arrangement.

Email arash.esmaili_zaghi@uconn.edu (Please include **CE 5090** in the subject line)

Texts

Required:

- Class notes and handouts

Recommended (not required):

M. J. N. Priestley, F. Seible and G. M. Calvi (1996) *Seismic Design and Retrofit of Bridges*. John Wiley & Sons, Inc.

(Available Online through Library)

References:

- AASHTO (2012), *Guide Specifications for LRFD Seismic Bridge Design, 2nd Edition*
- FHWA (2014), *LRFD Seismic Analysis and Design of Bridges Reference Manual*, Publication No. FHWA-NHI-15-004.
- Caltrans (2015), *Bridge Design Practices*, *Chapter 4, Structural Modeling and Analysis,* California Department of Transportation, Sacramento.
- Caltrans (2015), *Bridge Design Practices*, *Chapter 21, Seismic Design of Concrete Bridges,* California Department of Transportation, Sacramento.
- Caltrans (2013) SDC: *Caltrans seismic design criteria* version 1.7, California Department of Transportation, Sacramento.

Prerequisites Design of Steel Structures, Design of Reinforced Concrete Structures, Structural Analysis, Earthquake Engineering or Structural Vibration

Attendance Students are expected to attend all classes. There will be no makeup for the worked missed during the class.

Goals In this course, we will discuss key concepts of seismic design of bridge structures. The course is expected to provide you with an in-depth understanding of capacity design. This knowledge is critical for you when performing advanced analyses, such as nonlinear analysis. This course relies heavily on project-based learning.

Tentative Grading Distribution

Homework	20%
Term Project	60%
Final Defense (in person, individual)	20%

Final Defense After the submission of your final project, I will meet with you individually and ask questions about the projects, assumptions you made, your approach, etc. By that, I verify that you were fully involved and you have a good understanding of the concepts.

Homework The due dates will be defined on the homework statements. Late submissions will not be accepted. Your presentation, format and neatness count toward your grade.

Term Project You will be designing the substructure and abutments of a real bridge in California. The project will be done by pre-assigned teams of two students. More details about the term project are presented in a separate handout.

Cell Phones **Cell phones are not permitted to be used during the lecture.** Laptops or tablets may ONLY be used to take notes or for class activities. Please be advised that texting and using laptops for other reasons distracts me and others; therefore, I may ask you to leave the classroom.

Software We will be using CSiBridge v. 19. One group will also use OpenSees for some of the analyses.

Course Content

1- Introduction
2- Lessons Learned from Past Earthquakes
3- Seismic Design Concepts
    a. Chain Analogy for Capacity-Protected Design
    b. Force-Based Method (FBM)
    c. Displacement-Based Method (DBM)
4- Sections Analysis
    a. Material Properties
    b. Moment-Curvature Analysis
    c. Interaction of Axial Forces and Bending Moments
5- Plastic Displacements
    a. Plastic Hinge Length
    b. Yield and Ultimate Displacements
    c. Pushover Analysis
6- Design Displacement, Elastic Analysis Method

   a. Uniform Load Method
   b. Single Mode Spectral Method
   c. Multi-Mode Spectral Method

7- Caltrans SDC1.7
8- Nonlinear Time History Analysis
9- Design of Abutments
10- Pipe-Pin Design
11- In-Span Hinge Design