University of Connecticut
Department of Civil &
Environmental Engineering

CE 5620: Advanced Steel Structures

Fall 2016

Instructor Arash E. Zaghi, PhD, PE (California, Connecticut)
Storrs Campus: ITE, Room 336

Class Hours Wednesdays 4:45 – 6:00, 15-min break, 6:15 – 7:30

Office Hours Wednesdays 12:00-2:00, or with prior arrangement

Email arash.esmaili_zaghi@uconn.edu (Please include the **CE 5620** in the subject line)

Texts

Required:

- Class notes and handouts

Recommended (not required):

- Bruneau, M.; Uang, C; and Sabelli, R. (2011) *Ductile Design of Steel Structures, 2nd Edition,* Published by McGraw-Hill Professional

References:

- Chakrabarty, J. (2010) *Applied Plasticity (Second Edition)*, published by Springer
- AISC (2011) *Steel Construction Manual, 14th Edition*, American Institute of Steel Construction.
- Chen, W. F., Han, D. J. (1988) *Plasticity for Structural Engineers*, Published by Springer-Verlag
- Neal, B. G., (1985) *The Plastic Methods of Structural Analysis*, Published by Chapman & Hall; 3rd Edition
- Baker, J., Heyman, J. (1980) *Plastic Design of Frames: Fundamentals, Volume 1,* Published by CUP Archive
- American Institute of Steel Construction,Inc. (2006) *Seismic Design Manual, Third Printing*
- Paik, J. K., Thayamballi, A. K. (2006) *Ultimate Limit State Design of Steel-Plated Structures*, published by Wiley

Prerequisites Design of Steel Structure, Structural Analysis (students who do not have the background will face difficulty following the material of this course.)

Attendance Students are expected to attend all the classes. There will be no makeup exams. Only works missed by absence resulting from co–curricular activities performed in the interest of the university and/or those that support the scholarly development of the student or documented medical emergency will be accommodated. Students involved in such activities should inform me in writing prior to the anticipated absence and take the initiative to make up the missed work in a timely fashion.

Goals In this course, we discuss key concepts that underlay many of the current steel design formulations and methodologies. We will not discuss any specific structural design problems. The course is expected to provide you with an in-depth understanding of plastic design and design for stability. This knowledge is critical for you when performing advanced analyses, such as nonlinear analysis and capacity design. You will be introduced to seismic resistant systems, prequalified seismic connections, and the concept of design for stability.

Tentative Grading Distribution

Homework	20%
Term Project	25%
Midterm exam (one)	20%
Final Exam	35%

Midterm Exam There will be one 1.5-hr midterm exams during the class time. The date and the content of the midterm exam will be announced.

Final Exam The 2-hr final exam covers the entire content of the course. It includes concept questions and problems. To be successful in the exams, you need to take note of the lectures and discussions in the class and become comfortable with solving the homework problems.

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 investigate a practical topic related to seismic design that will be assigned to you. The project will be done by pre-assigned teams of three students. More details about the term project are presented on the last page.

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

Software We will use a structural analysis software which is complementary to the theoretical material and hand calculations. You need to install the software on your laptop and bring your laptop to the class on the days that will be announced in advance. More details about the software and the installation are included in this document.

Course Content

1- Introduction
2- Plasticity for Steel Material
    a. Uniaxial and hysteresis behavior of steel
    b. Yield criteria for multiaxial stress states
    c. Hardening models
3- Plastic Analysis of Cross Sections
    a. Plastic Moment and Plastic Modulus of a Section
    b. Plastic Axial Load-Bending Moment Interaction
    c. Application of Software in Calculation of Interaction Curves
4- Plastic Analysis of an Element
    a. Plastic Hinging
    b. Energy Method for Plastic Analysis of Beams
    c. Plastic Analyses of Multi-Element Structures
    d. Application of Software in Plastic Analysis
5- Seismic Design of Steel Structures
    a. Concept of Ductile Design
    b. Seismic Design Considerations
    c. Seismic Load Resisting Systems
6- Buckling and Design for Stability
    a. Linear (Eigenvalue) Buckling Analysis
    b. AISC Chapter C: Design for Stability
    c. First- and Second-Order Analyses
    d. Design for Stability using Software

MASTAN2 Software

Is an easy to use interactive structural analysis program. We will use this software in different components of the course and some of the HW problems to verify the hand calculations and to solve more complex problems. Several resources, including YouTube videos, detailed instruction, are examples available to you that make it very easy to learn how to work with the software.

To download the software, go to: http://www.mastan2.com/download.html. I suggest that you install Version 2 that does not require access to MATLAB on your computer.

Tutorial: http://www.mastan2.com/tutorial.html

Term Projects:

Topic 1: Prequalified Proprietary Beam-to-Columns Connection (three details)

Topic 2: Prequalified Non-Proprietary Beam-to-Columns Connection (three details)

Topic 3: Passive Energy Dissipating Devices for Seismic Design of Steel Structures (three types)

Topic 4: Recentering Seismic Resisting Systems (two systems)

Teams:

Topic 1	Topic 2	Topic 3	Topic 4
O'Brien, Caitlin	Basar, Raymond	Harris, Michael	Enos, Ryan
Buyonje, Joseph	Galgowski, David	Bergeron, Ryan	Hain, Alexandra
Landry, Taylor	Nicholas, Jennifer	Giulietti, Diana	Bugbee, Michael

Deliverables:

1- A professionally developed paper-style report (10-15pages) that describes the project scope, background and history, motivation and advantages of the details/systems/devices, experimental and analytical research, underlying design concepts and detailing considerations, the design procedure and formulation for one of the details, with a design example.
2- A 25-minute presentation on the last week of the class (25-30 slides).

Your project should reflect the effort and intellectual contribution of a team of three graduate students.

Assignment: Each student needs to do a brief research and send me a 250-word description about the details/system by noon on Wednesday 7th.