

USC Viterbi

School of Engineering
*Sonny Astani Department
of Civil and Environmental
Engineering*

CE 539 Advanced Steel Structures

Units: 4

Fall 2023

Lectures: MW 12:00 – 1:50 pm

Location: OHE 136

Instructor: Sifat Muin, Ph. D.

Office: KAP 230D

Email: muin@usc.edu

Course Description

Steel is widely used in structural design and construction due to its strength and ductility. Its high strength-to-weight ratio makes it a preferred choice for numerous large-scale construction projects, including tall buildings, bridges, stadiums, power transmission towers, liquid and gas reservoirs, and industrial facilities. Steel is utilized in structural design to create resilient structures due to its high ductility and reduced susceptibility to brittle failure when exposed to extreme loads such as earthquakes.

In this course, students will learn about the material properties of steel and the design principles involved in constructing typical steel buildings. They will delve into the behavior of steel structures during seismic events and learn strategies for incorporating seismic-resistant design elements. The course curriculum will consist of problem sets, a final exam, and a group project that simulates a steel structure's seismic performance using a computational platform.

Learning Objectives

By the end of this course, the student should be able to:

1. Understand the material characteristics of steel and how material characteristics affect the performance of steel structures under extreme loading
2. Analyze and design gravity force-resisting systems in steel buildings
3. Analyze and design lateral force-resisting systems in steel buildings and evaluate options available in each lateral force-resisting system
4. Analyze and design connections in steel buildings
5. Complete a steel design Course Project that incorporates the topics covered throughout the semester into a real-world design project

Prerequisite(s): Basic concepts of design of structural system

Recommended Preparation: CE 207L, CE 225, CE 358, CE 457.

Readings and Supplementary Materials

Recommended Text: Steel Structures: Design and Behavior
Salmon, C. G., and Johnson, J. E. (2008) 5th Edition, HarperCollins
ISBN-13: 978-0131885561
ISBN-10: 0131885561

Steel Structures Design for Lateral and Vertical Forces
Alan Williams, Second Edition, McGraw Hill
ISBN: 978-1-25958-801-3

References: AISC Seismic Design Manual
Undergraduate Steel Design Book
AISC Steel Manual

All lecture notes, assignments, and any suggested additional reading for this class, will be posted on the Blackboard site.

Description and Assessment of Assignments

There will be 5 problem sets, due at about two weeks intervals. These will assess the basic concepts covered in class. Assignments will include both the analysis and design of structural elements and assemblies of structural elements. Assignments will be individual assignments, and the students should not collaborate on assignments. Assignments should be handed in before the lecture on the day they are due. Late assignments will be penalized at a 10% credit reduction per day except with a medical excuse.

The bulk of the assessment will be done through a course project and the final exam. In the design project, students in teams will develop a structural model on OpenSees. They will analyze, design, and model components of that structure for earthquake loads. Students will form teams of 2/3 (based on total number of students) students and start working together from week 2. Project progress reports are due every two weeks and a mid-presentation is due at week 8. The final project presentation and report will be due on week 15. A comprehensive final will be held at the end of the semester.

Grading Breakdown

Assessment Tool (assignments)	% of Grade
Class Participation	05
Problem Sets	20
Project	40
Final	35
TOTAL	100

Tentative Course Schedule: A Weekly Breakdown

	Topics	Activities	Deliverables
Week 1	Introduction & Overview Review – Steel, Steel framing, Loads	Assignment #1 assigned	
Week 2	Tension Members Compression Members	Project introduction and group formation	
Week 3	Flexural Members Shear Design	Assignment #2 assigned	Assignment #1 due
Week 4	Torsion Beam- Columns	Project discussion	Project report part 1 due
Week 5	Simulation Principles and Tools Seismic analysis	Assignment #3 assigned	Assignment #2 due
Week 6	Inelastic analysis Seismic Provisions	Project discussion	Project report part 2 due
Week 7	Steel Lateral Force Resisting Systems Special Moment Resisting frames	Midterm discussion	Assignment #3 due
Week 8	Midterm Fall Recess	Group presentation	
Week 9	Concentric braced frames (CBF)	Assignment #4 assigned	
Week 10	Eccentric braced frames (EBF)	Project discussion	Project report part 3 due
Week 11	Buckling restrained braced frames	Project discussion	
Week 12	Special Plate Shear Wall	Assignment #5 assigned	Assignment #4 due
Week 13	Welds and bolts Connection design	Project discussion	Project report part 4 due
Week 14	Resiliency-based design	Project Discussion	Assignment #5 due
Week 15		Final group presentations and demo	Final Project report due
FINAL	Final exam		Date: For the date and time of the final for this class, consult the USC <i>Schedule of Classes</i> at classes.usc.edu/ .

Statement on Academic Conduct and Support Systems

Academic Conduct:

Plagiarism – presenting someone else’s ideas as your own, either verbatim or recast in your own words – is a serious academic offense with serious consequences. Please familiarize yourself with the discussion of plagiarism in SCampus in Part B, Section 11, “Behavior Violating University Standards” policy.usc.edu/scampus-part-b. Other forms of academic dishonesty are equally unacceptable. See additional information in SCampus and university policies on scientific misconduct, policy.usc.edu/scientific-misconduct.

Students and Disability Accommodations:

USC welcomes students with disabilities into all of the University’s educational programs. The Office of Student Accessibility Services (OSAS) is responsible for the determination of appropriate accommodations for students who encounter disability-related barriers. Once a student has completed the OSAS process (registration, initial appointment, and submitted documentation) and accommodations are determined to be reasonable and appropriate, a Letter of Accommodation (LOA) will be available to generate for each course. The LOA must be given to each course instructor by the student and followed up with a discussion. This should be done as early in the semester as possible as accommodations are not retroactive. More information can be found at osas.usc.edu. You may contact OSAS at (213) 740-0776 or via email at osasfrontdesk@usc.edu.

Support Systems:

Student Health Counseling Services - (213) 740-7711 – 24/7 on call
engemannshc.usc.edu/counseling

Free and confidential mental health treatment for students, including short-term psychotherapy, group counseling, stress fitness workshops, and crisis intervention.

National Suicide Prevention Lifeline - 1 (800) 273-8255 – 24/7 on call
suicidepreventionlifeline.org

Free and confidential emotional support to people in suicidal crisis or emotional distress 24 hours a day, 7 days a week.

Relationship and Sexual Violence Prevention Services (RSVP) - (213) 740-4900 – 24/7 on call
engemannshc.usc.edu/rsvp

Free and confidential therapy services, workshops, and training for situations related to gender-based harm.

Office of Equity and Diversity (OED) | Title IX - (213) 740-5086
equity.usc.edu, titleix.usc.edu

Information about how to get help or help a survivor of harassment or discrimination, rights of protected classes, reporting options, and additional resources for students, faculty, staff, visitors, and applicants. The university prohibits discrimination or harassment based on the following protected characteristics: race, color, national origin, ancestry, religion, sex, gender, gender identity, gender expression, sexual orientation,

age, physical disability, medical condition, mental disability, marital status, pregnancy, veteran status, genetic information, and any other characteristic which may be specified in applicable laws and governmental regulations.

Bias Assessment Response and Support - (213) 740-2421

studentaffairs.usc.edu/bias-assessment-response-support

Avenue to report incidents of bias, hate crimes, and microaggressions for appropriate investigation and response.

The Office of Disability Services and Programs - (213) 740-0776

dsp.usc.edu

Support and accommodations for students with disabilities. Services include assistance in providing readers/notetakers/interpreters, special accommodations for test taking needs, assistance with architectural barriers, assistive technology, and support for individual needs.

USC Support and Advocacy - (213) 821-4710

studentaffairs.usc.edu/ssa

Assists students and families in resolving complex personal, financial, and academic issues adversely affecting their success as a student.

Diversity at USC - (213) 740-2101

diversity.usc.edu

Information on events, programs and training, the Provost's Diversity and Inclusion Council, Diversity Liaisons for each academic school, chronology, participation, and various resources for students.

USC Emergency - UPC: (213) 740-4321, HSC: (323) 442-1000 – 24/7 on call

dps.usc.edu, emergency.usc.edu

Emergency assistance and avenue to report a crime. Latest updates regarding safety, including ways in which instruction will be continued if an officially declared emergency makes travel to campus infeasible.

USC Department of Public Safety - UPC: (213) 740-6000, HSC: (323) 442-120 – 24/7 on call

dps.usc.edu

Non-emergency assistance or information.