CE 405: Design of Steel Structures

1.0 General Information

Class Room	1235 Anthony Hall	
Class Hours	MWF 8:00 - 8:50 a.m	
Instructors	Ronald S. Harichandran	Prof. and Chair, Dept. of Civil & Env. Eng.
	Amit H. Varma	Asst. Prof., Dept of Civil & Env. Eng.
Office	3546 Engineering Bldg.	
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Office Hours	T-Th 4:00 - 5:00 p.m.	Use as often as required
Teaching Assistant	Sangdo (Victor) Hong	Grad. Student, Dept. of Civil & Env. Eng.
Office	2453 Engineering Bldg.	
Phone	(517) 355-5038	
Email	hongsang@msu.edu	
Office Hours	WF 10:00 – 11:00 a.m.	Use as often as required.
Class Web Sites		www.egr.msu.edu/classes/ce405/harichan/ www.egr.msu.edu/~ahvarma/CE405

2.0 Course Objectives

CE405 is an introductory course in the design of steel structures. This course is recommended for *seniors* in the civil engineering program at MSU who are interested in learning the design of steel structures. The objectives of this course are:

1. To learn the *behavior* and design of structural steel components, for example, members and connections in two - dimensional (2D) truss and frame structures.
2. To gain an educational and comprehensive experience in the design of simple steel structures.

3.0 Course Materials and References

1. The course will follow the contents of the book:

   Segui, W.T. (1999). *LRFD Steel Design*. 2nd Edition, Brooks/Cole Publishing Company, Pacific Grove, California.
2. Steel structures will be designed according to:

   AISC (1999). *Load and Resistance Factor Design Specification for Structural Steel Buildings*, American Institute of Steel Construction, Chicago, IL.
3. Specific structural steel components will be selected using:

AISC (2001). *Manual of Steel Construction – Load and Resistance Factor Design*, Third Edition, American Institute of Steel Construction, Chicago, IL.

4. Some other books and references on the behavior and design of steel structures that are on reserve in the engineering library are:
   a) Salmon, C.G. and Johnson, J.E. (1996). *Steel Structures: Design and Behavior, Emphasizing Load and Resistance Factor Design*, 4th Edition, Harper College Publishers, New York, NY.
   b) Galambos, T.V, Lin, F.J., and Johnston, B.G. (1996). *Basic Steel Design with LRFD*, Prentice Hall, New Jersey.
   c) AISC (1994). *Manual of Steel Construction – Load and Resistance Factor Design*, Second Edition, American Institute of Steel Construction, Chicago, IL.
   d) ASCE 7-98. (2000). *Minimum Design Loads for Buildings and Other Structures: Revisions of ANSI/ASCE 7-95.* American Society of Civil Engineers. Reston, VA
   e) ICC (2000). *International Building Code*, International Code Council. Falls Church, VA.

4.0 Course Framework

1. CE 405 will consist of 15 weeks of lectures (including holidays and breaks).
2. Students will be assigned homeworks, exams, and a group design project.
3. The final grades will be based on the homeworks, exams, and design project as follows:
   - Homework = 15 %
   - Exam 1 = 20%
   - Exam 2 = 20%
   - Final Exam = 30%
   - Design Project = 15%
4. The final grades will be assigned on a straight scale, with some adjustment for the level of difficulty of the exams and overall class performance. If no adjustments are required then the final grades will be assigned as follows:
   - Score $\geq 90 \equiv 4.0$ $85 \leq$ Score $< 90 \equiv 3.5$ $80 \leq$ Score $< 85 \equiv 3.0$
     $75 \leq$ Score $< 80 \equiv 2.5$ $70 \leq$ Score $< 75 \equiv 2.0$ $60 \leq$ Score $< 65 \equiv 1.0$
     Score $\leq 60 \equiv 0.0$

5.0 Course Policies

1. Attendance policy - Students are expected to attend all the lectures. They are also expected to adequately perform all the work assigned by the instructor.
2. Tardy policy - All the assigned work must be submitted by the due date and time. Submissions that are 0 - 24 hours late will be penalized for 25% of the grade. Submissions that are 24 - 48 hours late will be penalized for 50% of the grade. After 48 hours, submissions will neither be accepted nor graded. Exceptions can be made for students with emergencies or special circumstances.

3. Make-up policy - Students are expected to take the exams on the assigned dates and times. Make-up exams may be arranged for students with emergencies or special circumstances.
4. Quality of Submissions - Students are encouraged to submit their work on engineering paper or clean white paper. Please explain and show all your calculations. Include appropriate references to the AISC specifications and final drawings of designed structures.

6.0 Relevant University Policies and Procedures

1. *Academic Honesty:* Article 2.3.3 of the Academic Freedom Report states that "the student shares with the faculty the responsibility for maintaining the integrity of scholarship, grades, and professional standards." In addition, the Dept. of Civil and Environmental Engineering at MSU adheres to the policies on academic honesty as specified in General Student Regulations 1.0, Protection of Scholarship and Grades, and in the all-University Policy on Integrity of Scholarship and Grades, which are included in *Spartan Life; Student Handbook and Resource Guide*. Students who plagiarize may receive a 0.0 on the assignment or fail the course.
2. The last day to drop this course with a 100 percent refund and no grade reported is Thursday 09/14/2003. The last day to drop this course with no refund and no grade reported is Tuesday 10/14/2002. You should immediately make a copy of your amended schedule to verify you have dropped this course.
3. *Religious Observance:* If you wish to be absent from class to observe a religious holiday, make arrangements in advance with the instructor.
4. *Missing Class to Participate in a Required Activity:* To be excused from this class to participate in a required activity for another course or a university-sanctioned event, you must provide the instructor with adequate advanced notice and a written authorization from the faculty member of the other course or from a university administrator
5. *Commercialized Lecture Notes:* Commercialization of lecture notes and university-provided course materials is not permitted in this course.

7.0 Important Dates

Classes begin	Monday, August 25, 2003
Holiday – University closed	Monday, September 1, 2003
End of tuition refund	Thursday, September 18, 2003
Middle of semester	Tuesday, October 14, 2003
Holiday – University closed	Thursday, November 27, 2003 Friday, November 28, 2003
Classes end	Friday, December 5, 2003
Final Exam	Friday, December 12, 2003 at 7:45 – 9:45 a.m.

8.0 Course Syllabus and Outline

Chapter 1. *Estimating design forces for members of a structure*

Given the structural layout, plan, and elevations of a 3D structure, you will learn to:

(1) Identify the types of 2D structural frames that are assembled into a 3D structure
(2) Determine the nominal dead loads, live loads, snow and roof loads, and wind loads acting on the 3D structure
(3) Distribute the nominal loads to the 2D structural frames of the 3D structure
(4) Perform linear-elastic structural analysis to determine the internal axial, shear, and bending moments in all the members of the 2D frames
(5) Identify the design forces and moments for all members of the 2D frames

Chapter 2a: *Designing beams for flexural yielding*

In this section, you will learn:

(1) The behavior of a laterally supported beam subjected to flexural loading
(2) To calculate the yield moment, elastic section modulus, plastic moment, and the plastic section modulus
(3) To calculate the design strength of a laterally supported beam
(4) To design the beam using the AISC manual to have adequate strength at factored load
(5) To design the beam using the AISC manual to have adequate stiffness at service loads

Chapter 2b: *Designing beams for lateral torsional buckling*

In this section, you will learn:

(1) The local buckling behavior of beams and the difference between slender, compact, and non-compact sections
(2) To design beams considering the local buckling limit state using the AISC manual
(3) The lateral torsional buckling behavior of beams and the difference between slender, compact, and non-compact *members*
(4) To design beams considering lateral torsional buckling and the effects of moment gradient through the use of C_b and the AISC manual
(5) To complete the design of steel beams considering all flexural limit states

Chapter 3: *Designing compression member or columns*

In this section, you will learn:

(1) The elastic and the inelastic buckling behavior of compression members or columns
(2) To calculate the strength of a compression member depending on the end conditions
(3) To design a compression member using the AISC manual
(4) To determine the effective length of a compression member that is part of a frame using the alignment chart method
(5) To design columns in braced or unbraced frames using the AISC manual

Chapter 4: *Designing tension members*

Given the design tension force for a member, you will learn to:

(1) Calculate the gross yield strength of a tension member
(2) Calculate the net section fracture strength of the tension members
(3) Calculate the effective net area of the tension members
(4) Calculate the block shear rupture strength of a tension member
(5) Design the tension member using the AISC manual

Chapter 5: *Designing bolted connections*

In this section you will learn:

(1) The behavior and various possible failure modes of bolted connections
(2) To calculate the shear strength, bearing strength, and minimum edge distance and spacing requirements for bolted connection
(3) To design a bolted connection and gusset plate for given design forces
(4) The behavior of a slip-critical connection and how to calculate the slip-strength of a fully tensioned bolted connection
(5) To design a slip-critical bolted splice connection for a tension member

Chapter 6: *Designing welded connections*

In this section you will learn:

(1) Different types of welding procedures, welds, and welded connection
(2) To calculate the shear strength of a fillet weld considering weld and base metal strength
(3) To design a fillet welded connection considering issues such as minimum weld size, maximum weld size, etc.