

### CE 415 (BEHAVIOR AND) DESIGN OF STEEL STRUCTURES

The objective of CE 415 is to develop the ability to model, analyze, and interpret the behavior of steel structures and the elements and connections these structures are composed of. Students are required to demonstrate proficiency in the analysis and design of composite beams, plate girders, torsion members, slender column elements, braced frames, unbraced frames subject to sidesway, framed beam connections, eccentric connections, and moment connections. The course also will investigate the buckling and post-buckling strength of stiffened and unstiffened plate elements and members; torsional behavior and design of beams; and additional topics in steel behavior and design. By improving their understanding of the behavior of steel members and systems, students will be prepared to take advanced courses in the design of steel structures, including earthquake resistant design. In addition, students will gain a further appreciation of how behavior and design issues impact the field of structural engineering.

**Prerequisite:** The ability to calculate forces, moments and deflections in statically determinate beams and frames. The ability to analyze and design steel tension, compression, flexural, and combined bending members and simple bolted connections. This course builds on the structural analysis and steel knowledge learned in CE 311.

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**Lecture:** TR 1:15 p.m. – 2:30 p.m., AEC 327

**Office Hours:** MW 2:30 p.m. – 4:00 p.m. and TTh 4:00 p.m. – 5:00 p.m.

**Required Textbooks:**

*Manual of Steel Construction, 13<sup>th</sup> Edition* by AISC. This text is available from AISC at a student discounted rate. If you do not have a copy of the 13<sup>th</sup> edition manual, please let Prof. Raich know.

*Unified Design of Steel Structures*, L. F. Geschwindner, Wiley, John & Sons, 1<sup>st</sup> ed., 2007, ISBN: 9780471475583

**Exam I:** Thursday, March 3, 2011 (Evening Exam – 7:00 pm to 9:00 pm)

**Exam II:** Thursday, April 14, 2011 (Evening Exam – 7:00 pm to 9:00 pm)

**Final Exam:** T.B.A.

Note: For exams you may use the AISC Manual and bring one sheet of original notes. This includes any notes you make in the manual (there are blank pages throughout the manual just for this purpose).

**Grade Distribution:** Homework ( $\cong$  10): 25% Exam I: 20% Final Exam: 30%  
Class Participation: 5% Exam II: 20%

**Final Grading Scale:** A  $\geq$  93; 93 > A-  $\geq$  90; 90 > B+  $\geq$  87; 87 > B  $\geq$  83; 83 > B-  $\geq$  80; 80 > C+  $\geq$  77; 77 > C  $\geq$  73; 73 > C-  $\geq$  70; 70 > D  $\geq$  60; F < 60

**Expected Workload:**

This course will have approximately ten homework sets assigned during the semester. The homework sets will become longer toward the end of the semester, since these homework assignments will involve obtaining results through both hand calculations and computer analysis. The main purpose of the homework is to help you learn to how to analyze and design a broad range of steel beams, columns, frames, connections, and systems. Many of the homework problems will be fairly open-ended since they involve the process of design and will require a working knowledge of the advanced behavior and design concepts covered in class. You should expect to spend up to 10 hours each week working on and solving the homework problems, including reworking problems that you have trouble with (recommended because often these types of problems appear on the exams).

**Attendance and Participation:**

Regular and on-time class attendance *is required*, although no grade is assigned for attendance. Class participation is expected and provides an opportunity to ask *your* questions, which serve the class at large in learning the course material. You are responsible for all material covered in class, even if absent for authorized activities.

**Academic Integrity Statement:** “Students are expected to be honorable, ethical, and mature in every regard” No form of scholastic misconduct will be tolerated. Academic dishonesty includes cheating, fabrication, falsification, multiple submissions, plagiarism, complicity, copying homework, etc. It is the student’s responsibility to comply with the *Lafayette College Student Handbook* (download a copy from <http://studentlife.lafayette.edu/>) and to be familiar with the *Principles of Intellectual Honesty* (<http://www.lafayette.edu/academics/honesty.pdf>). Violations will be handled in accordance with the Procedural Standards in Disciplinary Proceedings outlined in the *Student Handbook*.

**Students with Disabilities:** The Americans with Disabilities Act (ADA) is a federal anti-discrimination statute that provides comprehensive civil rights protection for persons with disabilities. Among other things, this legislation requires that all students with disabilities be guaranteed a learning environment that provides for reasonable accommodation of their disabilities. If you believe you have a disability requiring an accommodation or require assistance with academic concerns/accommodations, please contact the the Dean of the College (610-330-5080).

#### Homework Policy:

- Homework is generally collected at the beginning of the class meeting on the due date, unless otherwise specified. Late homework will be accepted **only** by making a **prior** arrangement with the instructor either during office hours or by email, subject to Lafayette College Dean’s Excuse Policy outlined in section 7.3.2 of the Faculty Handbook under the heading Class Attendance.
- This class emphasizes developing professional analysis and design skills. All homework should be submitted on engineering paper (one side only) in a professional manner, which includes neat handwriting and organization. The detail of work you provide should allow another engineer to review your work without having to ask you any questions. When you work in a design office or elsewhere, your calculations will be checked internally by another engineer for small projects, and externally by peer review committees for large projects. In either case, easy to understand assumptions, calculations, and results are required. Therefore, neatness does count and messy, unorganized problem solutions will result in lower grades. The following should be provided in the homework:
  - Provide a brief written description of the problem being solved and the result requested.
  - Provide well-drawn sketches.
  - Clearly identify the analysis steps and calculations.
  - Provide a summary of your final answers and box them. Check your units!
  - Check your answers to make sure they seem reasonable, sometimes with another method.
  - Staple homework pages together before submitting homework.
- Unless otherwise stated, all homework in this class is expected to be individual work. Copying the work of others, including homework, is in violation of the College’s Principles of Intellectual Honesty, which can be accessed at <http://www.lafayette.edu/academics/honesty.pdf>. You may discuss the homework assignments with other students. All work submitted, however, must be your own and it is your responsibility to properly acknowledge the source of ideas and facts received from others, including other students. A student who commits academic dishonesty is subject to a range of penalties, including suspension or expulsion.
- Discussions about re-grading of homework or exams are not conducted in person or by email. If you would like to request re-grading, attach a signed statement to your work that details where you feel you lost points and submit it to the professor within one week after the homework or exam has been returned.

#### Software Used for this Class:

Students can check their homework solutions using MATLAB, SAP 2000, ETABS, or any other useful program. The department computers provide access to many of these programs. As engineers you will continually be looking for new tools to learn and apply that make your life easier. Therefore, you are encouraged to try to use some of the programs to help solve the homework. Several homework assignments will require the use of Excel to develop spreadsheet programs to aid in the design process. You can also check your work using any spreadsheet or analysis program available or developed by you.

Visit [www.structuremag.org](http://www.structuremag.org) for a free publications including Structure Magazine

Visit [www.AISC.org](http://www.AISC.org) for a free subscription of Modern Steel Construction and free membership in AISC

Visit [www.gostructural.com](http://www.gostructural.com) for a free copy of Structural Engineer Magazine

“Strive for perfection in everything you do. Take the best that exists and make it better. When it does not exist, design it” – Sir Henry Royce

Class		Date	Tentative Topic (subject to change)	Geschwindner Text
1	T	1/25	Introduction to Course/Review of Steel Design Concepts	6.1 – 6.5
2	R	1/27	Review of Beam Design (LTB, Yielding, FLB, WLB)	6.6 – 6.8
3	T	2/1	Built-Up and HSS Beams w/ Non-compact or Slender Elements	6.10 and 6.13
4	R	2/3	Composite Beams	9.1 – 9.5
5	T	2/8	Composite Beams	9.5 – 9.7
6	R	2/10	Composite Design Issues/Design of Floor & Roof Systems	9.9 – 9.10
7	T	2/15	Buckling Behavior of Plates	
8	R	2/17	Plate Girder Behavior	7.1 – 7.2
9	T	2/22	Plate Girder Behavior	7.3
10	R	2/24	Plate Girder Design	
11	T	3/1	Plate Girder Design Issues/Stiffeners	7.4
	R	3/3	EXAM I – Evening Exam (7 - 9 pm)	
12	R	3/3	Concentrated Loads & Stiffeners	6.14
13	T	3/8	Biaxial Bending/General Flexure	6.12
14	R	3/10	Torsion	
	T	3/15	SPRING BREAK	
	R	3/17	SPRING BREAK	
15	T	3/22	Torsion	
16	R	3/24	Torsion	
17	T	3/29	Torsion	
18	R	3/31	Review of Column Design	5.1 – 5.5 and 5.7
19	T	4/5	Slender Elements in Column Design	5.6 and 5.10
20	R	4/7	Beam-Columns	8.1 – 8.4
21	T	4/12	Beam-Columns/Frame Behavior	8.5 – 8.7
	R	4/14	EXAM II – Evening Exam (7 - 9 pm)	
22	R	4/14	Braced Frames & Unbraced Frames	10.1 – 10.11
23	T	4/19	Bolted/Welded Connections	11.1 – 11.2
24	R	4/21	Framed Beam Connections	11.3 – 11.9
25	T	4/26	Eccentric Connections	
26	R	4/28	Eccentric Connections	
27	T	5/3	Moment Connections	12.1 – 12.3
28	R	5/5	Moment Connections/Splices/Frames for Seismic Resistance	12.4, 8.11, 13.1–13.4
<b>FINAL EXAM - TBA</b>				

Note: Other resources and textbook chapters will be provided throughout the semester to cover those areas that the Geschwindner text does not cover in depth.