CEE 6527 Advanced Structural Steel Design Spring 2021

Instructor

Professor Don White
School of Civil and Environmental Engineering, Mason 5139B
678-895-5451 (cell), dwhite@ce.gatech.edu

TAs (Mason 5139)

Mr. Ajit Kamath, ajit.kamath@gatech.edu, Mason 5139

Class Session Time

MW 8:00 to 9:15 am, Mason 5134

Office Hours TBA

Mode of Instruction: Hybrid. The class instruction will be in a hybrid "touch point" mode. Lectures will be delivered asynchronously (streamed on-line and made available through Canvas). We will meet at the classroom for discussions and work on assignments in a flipped classroom format, ***with protections and social distancing***. Attendance at these classroom meetings is strongly encouraged.

Students interested in taking the class fully remotely are allowed to do so. No formal justification is needed. An e-mail to me requesting permission to attend the class remotely is enough.

Course Learning Objectives

Upon completion of this course, the student will be able to:

1) Explain the underlying behavior and intelligently apply the AISC Specification and other related standards for the design of a wide range of structural steel components.
2) Apply fundamental principles of mechanics and modern computational methods to efficiently design steel structures.
3) Develop framing schemes and execute safe, efficient and constructable designs of various structural systems in steel.
4) Critically evaluate structural steel components and framing systems based on fundamental principles.

Textbooks

AISC (2016) Manual and Specification (available at a heavily discounted cost of $135 on-line from AISC… Order/Payment instructions are posted on Canvas)

A wide range of additional materials will be provided on the course web site, including:

White, D.W., Jeong, W.Y. and Slein, R. (2020). *Design of Frames Using Non-Prismatic Members*, AISC/MBMA Design Guide 25, 2nd Edition, American Institute of Steel Construction, Chicago, IL.

Griffis, L.G. and White, D.W. (2013). *Stability Design of Steel Buildings*, AISC Design Guide 28, American Institute of Steel Construction, Chicago, IL.

White, D.W. (2012). "Structural Behavior of Steel," Volume 4, *Steel Bridge Design Handbook*, National Steel Bridge Alliance, Chicago, IL.

White, D.W. (2010). "Beams," *Stability Design Criteria for Metal Structures*, Chapter 5, Structural Stability Research Council, Wiley, NY.

I will be asking you to perform a number of the assignments in the course using MathCAD. Extensive on-line MathCAD help materials are available, and are usually the best resource.

Tools

MathCAD, Mastan, SABRE2, & RAM Elements (available on mycloud.gatech.edu, and/or in some cases, stand-alone).

Prerequisites

It is expected that you have had a prior class in structural steel design and in intermediate structural analysis at the undergraduate level. You must understand and have a complete command of your Strength of Materials basics!!!!!!!

Grading

Exam 1 on Modules 1 - 3 (closed book, open Manual, two pages of summary notes)	Week 9, Wednesday, March 10	25 %
Exam 2 on Modules 3 – 4 (Team design synthesis problem assignment DP6, oral exam)	Week 12, Monday, April 5	25 %
Final Exam, Cumulative with emphasis on latter material (closed book, open Manual, four pages of summary notes)	Week 16, Wednesday, May 5 8:00 am to 10:50 am	25 %
HW & Design Problem (DP) Assignments (individual & group based)	Tentatively two HW & nine DP problem assignments	25 %

Your individual grade for the group-based DP assignments will be weighted using the IndividualEffortRating form provided under the General References module on Canvas.

Grading Scale

Your final grade will be assigned as a letter grade according to the following scale:

A 85-100%
B 75-85%
C 65-75%
D 55-65%
F 0-55%

If you are close to a letter grade boundary at the completion of the term, class participation (contributing to discussions and/or being attentive with questions throughout the term, regular on-time and complete submittals of Coursework Exercises) and special circumstances (e.g., one or a few low grades due to special circumstances) will be considered in lowering a boundary to elevate you one letter grade.

According to policy, grades at Georgia Tech are interpreted as follows:

A Excellent (4 quality points per credit hour)
B Good (3 quality points per credit hour)
C Satisfactory (2 quality points per credit hour)
D Passing (1 quality point per credit hour)
F Failure (0 quality points per credit hour)

See http://registrar.gatech.edu/info/grading-system for more information about the grading system at Georgia Tech.

Extra Credit Opportunities

No extra credit opportunities are available in this class. Please focus on the doing your best on each of the assignments throughout the term.

Course Expectations & Guidelines

Health-Related Considerations

In short, ***Jackets protect Jackets***. We are in this together, and the objective is to maximize learning and productivity while maintaining a high level of safety practices.

Please see Covid-19 Information for Students, for current information regarding Covid-19, including what you should do if you are sick. First rule, if you are potentially sick, do not come to class. The course is set up to accommodate your participation online.

Materials for sanitizing your workspace around you in the classroom will be available.

USG Language for Cloth Face Coverings

University System of Georgia (USG) institutions require all faculty, staff, students, and visitors to wear an appropriate face covering while inside campus facilities/buildings where six feet social distancing may not always be possible. All members of the campus community will be provided reusable cloth face coverings.

Face covering use will be in addition to and is **not** a substitute for social distancing. Anyone not using a face covering when required will be asked to wear one or must leave the area. Refusal to comply with the requirement may result in discipline through the applicable conduct code for faculty, staff or students.

Policies and Operating Procedures

1. Attendance at all class sessions is mandatory (in person or on-line). If you must be absent, you must notify me in advance. If you are potentially sick, or if you are uncomfortable with coming to class because of any health-related concerns, do not come to class. Students taking the class sessions remotely, or who cannot attend for other reasons, can connect to the live class sessions via the link provided under Canvas CEE-6527-A/BlueJeans.
2. DO NOT BE LATE to class.
3. Turn off your cell phones in class!
4. Out of class assignments will include a range of reading, viewing of streamed videos (short streamed lectures, UTube videos, and working of tutorials, in addition to Design Problem and Individual HW Assignments)
5. Class sessions will include a diversity of activities, including: lectures, quizzes, group & class-based discussions, and group project work. ***Generally, you should bring your Manuals & laptops to class.***
6. Information regarding streamed lectures will be forthcoming.
7. All on-line class-related discussions will be conducted in Piazza (www.piazza.com). Piazza is a question-and-answer platform specifically designed to get you answers fast. This type of platform works much better than e-mail in that it serves as a class forum and discussion space.
8. I will be organizing you into teams after the 2nd week of the term. All *Design Problem* Assignments are to be solved by your team, and a single team solution submitted.
9. Design Problem and Individual Assignments HW must adhere to good professional office design practice…. clear indications of assumptions and the order/progression of the solution to the problem, highlighting of intermediate steps and final design recommendations, ample white space (different parts of your work not crowded together). All submission will be electronic via Canvas. ***A grade deduction up to 20 % may be applied to solutions that do not meet this standard.***
10. All "hand" assignments are to be scanned and submitted as a pdf file. If you do not have a flatbed scanner, phone apps are available that permit generation a pdf file from photos of your work.
11. Assignments must be submitted by the start of class on the date they are due unless noted otherwise.
12. Solutions to the assignments will be posted under the course Modules page one day after the due date.
13. Generally, you should submit all portions of the work you have completed at the due date. A 10 % penalty will be applied to work submitted late. A 50 % penalty will be applied to work submitted more than one day late. These penalties may be waived given a valid excuse.
14. Example exams will be provided on the course web site one week in advance of Exam 1 and in advance of the final exam.
15. Your cumulative course grade and the division lines for the different letter grade standings will be posted after Exam 1, and just prior to the Final Exam. The letter grade boundaries will not be raised after the last posting just prior to the final.

Academic Integrity

Georgia Tech aims to cultivate a community based on trust, academic integrity, and honor. Students are expected to act according to the highest ethical standards. For information on Georgia Tech's Academic Honor Code, please visit http://www.catalog.gatech.edu/policies/honor-code/ or http://www.catalog.gatech.edu/rules/18/. Your **signature(s)** on all Homeworks and Exams assures me of your full compliance.

Any student suspected of cheating or plagiarizing assignment will be reported to the Office of Student Integrity, who will investigate the incident and identify the appropriate penalty for violations.

I strongly encourage you to work on additional problems from the resources on your own, and to ask lots of questions! You are allowed (and encouraged) to work together with other students on homework, as long as you write up and turn in your own solutions. Design Problem (DP) assignments are all *team based*. You should submit one solution from your entire team for these assignments. In-class tests and exams are to be your work alone. All in-class tests and exams will be closed book, with the exception of the summary notes as indicated above. For any questions involving these or any other Academic Honor Code issues, please consult me and/or the above web sites.

Digital proctoring

If you are taking the course fully on-line, Honorlock will proctor your Exam 1 and Final Exam this semester. If you are taking the in a hybrid mode, the exams will be in person. We have a room that is large enough to fit the number of students in the class with social distancing.

For Honorlock, you DO NOT need to create an account, download software or schedule an appointment in advance. Honorlock is available 24/7 and all that is needed is a computer with a microphone, a working webcam, and a stable Internet connection.

Honorlock is not compatible with Linux OS, Virtual Machines, tablets, or smartphones

To get started, you will need Google Chrome and to download the Honorlock Chrome Extension. You can download the extension at www.honorlock.com/extension/install

When you are ready to test, log into Canvas, go to your course, and click on your exam. The examinations in the course will be delivered using the Quiz function in Canvas. Clicking "Launch Proctoring" will begin the Honorlock authentication process, where you will take a picture of yourself, show your ID, and complete a scan of your room. If your webcam is mounted on a desktop computer that cannot be moved, please hold up a mirror to your webcam to show the room surroundings.

Honorlock will be recording your exam session by webcam as well as recording your screen. Honorlock also has an integrity algorithm that can detect search-engine use, so please do not attempt to search for answers. I will build in enough time in the exams to accommodate this start up procedure.

Good luck! Honorlock support is available 24/7/365. If you encounter any issues, you may contact them via live chat.

If you experience any problems, please let me know.

Accommodations for Students with Disabilities
If you are a student with learning needs that require special accommodation, contact the Office of Disability Services at (404)894-2563 or http://disabilityservices.gatech.edu/, as soon as possible, to make an appointment to discuss your special needs and to obtain an accommodations letter. Please also e-mail me as soon as possible in order to set up a time to discuss your learning needs.

Active Participation
You are highly encouraged to attend the class sessions unless you have a compelling reason not to do so, or you are taking the class fully remotely. If you are not attending the class session in person, you should connect to the class via the BlueJeans link on Canvas.

You will be assigned a numbered seat in the classroom, and you must only use that seat. This is essential for contact tracing should any of us become ill.

Student-Faculty Expectations Agreement
At Georgia Tech we believe that it is important to strive for an atmosphere of mutual respect, acknowledgement, and responsibility between faculty members and the student body. See this catalog page for an articulation of some basic expectations you can have of me and that I have of you. In the end, simple respect for knowledge, hard work, and cordial interactions will help build the environment we seek. Therefore, I encourage you to remain committed to the ideals of Georgia Tech while in this class.

Digital Etiquette: For synchronous (live) online meetings via BlueJeans, please turn off you camera and mic except when you are talking. This avoids distracting background noise and helps minimize any potential internet bandwidth problems.

Diversity Statement

I consider the class environment to be a place where you will be treated with respect, and I welcome individuals of all ages, backgrounds, beliefs, ethnicities, genders, gender identities, gender expressions, national origins, religious affiliations, sexual orientations, ability – and other visible and nonvisible differences. All members of this class are expected to contribute to a respectful, welcoming and inclusive environment for every other member of the class.

Disclaimer

When appropriate or necessary, the instructor reserves the right to adjust, amend, or otherwise modify the information presented on this syllabus at any time. Any changes will be posted prominently to the Canvas site.

DESIGN GROUPS

I will be grouping you into Design Teams after HW 2. My aim in forming design groups (3 to 4 members per team) is to achieve a project-based cooperative learning environment. The benefits of cooperative learning methods include:

Improved

- Information retention
- Academic achievement
- Higher-level thinking skills
- Motivation to learn subject
- Teamwork, interpersonal skills
- Understanding of professional environment
- Communication skills
- Level of anxiety (due to lower emphasis on competition)
- Test grades

Why it works:

- Active learning
- Using your group to get to the bottom of the problems.
- Students see and learn alternative problem-solving skills
- More and better question generation
- Learning best what you teach

SELF-INTRODUCTION

Please respond to the CEE 6527 Self-Introduction assignment on Canvas by 5 pm on Friday, 01/22. This will help me to know you better and to make the Design Team assignments. I cannot guarantee I can match you up with your best meeting times, team member preferences, etc., but I'll do my best.

COURSE MODULES

1. Second-Order Analysis – Getting it Right (Weeks 1 – 2)

    - State-of-the-art, amplified 1^{st}-order analysis procedures
    - Intelligent use of amplification factors
    - State-of-the-art, general purpose matrix structural analysis methods
    - Intro to Mastan and RAM Elements software
    - Limitations of various methods … avoiding the pitfalls
    - Ensuring sufficient analysis accuracy

2. Introduction to the AISC Direct Analysis Method (the DM) (Weeks 3 – 4)

- Key concepts – what's it all about?
- AISC Chapter C general requirements and sanctioned methods for stability design
- Specific requirements for stability critical vs. stability non-critical frames
- Handling of non-sway beam-column limit states
- Consideration of out-of-plumb (out-of-alignment) and other geometric imperfections
- Various introductory application examples, having a range of complexities

3. Advanced Steel Column Design (Weeks 5 – 6)

- Design of slender element columns
- Column inelastic stiffness reduction concepts & calculations
- Introduction to SABRE2 software
- Axial capacity of tapered members
- Column bracing design
- Use of computational methods to facilitate design

4. Advanced Steel Flexural Member Design (Weeks 7 – 10)

- Flexural design of general I-section members
- Shear buckling and post-buckling strength design of general I-section members
- Inelastic stiffness reduction concepts for LTB
- Tapered member strength in flexure
- Bracing design
- Advanced LTB calculations … use of computational tools to facilitate design

5. Design of Multi-Story Steel Buildings, Composite Floor Systems (Weeks 11 – 12)

- Composite beam flexural behavior and design
- Intelligent use of AISC Manual Composite Beam Design Aids
- Construction considerations for composite floor systems
- Design for control of floor vibrations

6. Design of Multi-Story Steel Buildings, Lateral Framing System Design (Weeks 13 – 15)

- Smart live load reduction
- Estimating sidesway amplification based on wind drift, seismic drift and seismic P-Δ limits
- Lateral drift design
- Advanced beam-column design … out-of-plane resistance of I-section beam-columns loaded in-plane, resistance of singly-symmetric beam-columns, inelastic stiffness reduction concepts & beam-column design
- Preliminary design and intelligent use of the AISC Manual Section 6

TENTATIVE COURSE OUTLINE/SCHEDULE

Mod	Wk	Date	Topic & Assignment Due Dates	Topics
1	1	1-20	1	1) P-δ amplification 2) P-Δ amplification 3) Application of B1 & B2 4) Ensuring accuracy of internal force calculations
	2	1-25	1, HW1	
		1-27	2 & 3	
	3	2-01	3 & 4	
2		2-03	1 & 2, HW2	1) Key concepts of stability design 2) AISC stability design methods 3) Single-story moment frame example 4) Stability off the hook 5) In-plane stability of an arch 6) Column relative bracing, relationship to the DM
	4	2-08	3	
		2-10	4 & 5, DP1	
	5	2-15	6	
3		2-17	1 & 2	1) Column design curves 2) General column buckling modes 3) Effect of plate local buckling on column strength 4) Column inelastic stiffness reduction factors 5) Column nodal bracing, relationship to buckling models & SRFs 6) Lean-on bracing example & arch example, comparison of DM & inelastic buckling approaches 7) Design of nonprismatic column members, traditional and SRF based approaches
	6	2-22	3, DP2	
		2-24	4 & 5	
	7	3-01	6 & 7	
4	8	3-03	1 & 2, DP3	1) Unified I-section flexural resistance equations 2) Elastic LTB equations for I-section members 3) Unified method flowcharts 4) Calculation of key design parameters: R_{pc}, R_{pg}, R_h, C_b & K 5) Resistance of composite members in negative bending 6) LTB stiffness reduction factors 7) Design of nonprismatic flexural members, traditional & SRF based approaches 8) I-section shear resistances and consideration of potential M-V interaction
		3-08	3 & 4	
	9	3-10	Exam 1, Mod 1-3, HW 1 & 2, DP 1 - 3	
		3-15	4, DP4	
	10	3-17	5, 6 & 7	
		3-22	8, DP5	
		3-24	Break	
5	11	3-29	1	1) Representative multi-story steel office building 2) Composite beam resistance & design 3) Constructability considerations for composite floor systems 4) Design of composite floor systems to control floor vibration
		3-31	2 & 3	
	12	4-5	Exam 2 (DP6), Mod 4	
		4-7	4	
6	13	4-12	1 & 2, DP7	1) Design of braced lateral framing systems 2) Design of sideway moment lateral framing systems 3) I-section beam-column in-plane resistances 4) I-section beam-column out-of-plane resistances 5) Streamlined design using the AISC Manual Section 6 6) SRF approach to design of non-prismatic I-section members subjected to axial load and bending 7) Lateral stability of I-section members in tension and bending 8) Beam-column stability behavior of singly-symmetric members (e.g., Tee section members)
		4-14	3 & 4	
	14	4-19	5, DP8	
		4-21	6 & 7	
	15	4-26	Final Instructional Class Day 8, DP9	