CEE 8813D – INTRODUCTION TO BRIDGE ENGINEERING
Fall 2013, T TH 12:05 to 1:25, Mason 2117

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Textbook: Grubb, M.A. et al. (2010). *Analysis and Design of Skewed and Curved Steel Bridges with LRFD*, FHWA-NHI-10-086 & 87, December (PDF file) + various supplementary materials

Prerequisites: CEE 4510, Structural Steel Design, or equivalent

Learning Outcomes:
- Understand and apply the AASHTO Service and Strength Design criteria
- Describe the analysis, design, fabrication and construction processes for skewed and horizontally-curved steel I-girder superstructures and for horizontally-curved steel box-girder superstructures. These structure types constitute a major portion of the steel bridge market in the United States.
- Evaluate the response of various girder bridge components and structural systems
- Summarize the unique considerations for the design of skewed and/or curved bridge superstructures
- Apply the AASHTO LRFD Specifications to the analysis and design of skewed and curved steel bridge superstructures, including erection and construction considerations
- Obtain a basic understanding of the performance of bridges under seismic loading
- Discuss recent advancements in code-based provisions for seismic design of bridges

Outline:

I. Introduction

II. Fundamentals
   1. System and Girder Behavior in Combined Flexure and Torsion
   2. Loads and Force Effects
   3. Influence Lines
   4. Influence Surfaces

III. Structural Analysis
   1. General Considerations
   2. Analysis of Thermal Expansion, Articulation and Design of Bridge Bearings
   3. Line-Girder Based Methods of Analysis
   4. Grid Methods of Analysis
   5. 3D Finite Element Analysis
   6. Proper Selection of Analysis Methods

IV. Design
   1. Layout Considerations in Preliminary Design
   2. Girder Selection and Proportioning in Preliminary Design
   3. Design for Constructability
   4. Service Limit State Design
   5. Design for Fatigue Resistance
   6. Composite I-Girder Flexural Resistance in Negative Bending
   7. Composite I-Girder Flexural Resistance in Positive Bending
   8. I-Girder Shear Resistance
   9. Shear Connector Design
   10. Design of Cross-Frame Members
   11. Design of Bolted Splices
   12. Box (Tub) Girder Design

V. Seismic Design (Prof. DesRoches)
   1. Code-Based Seismic Design of Bridges
      a. LRFD Seismic Design Manual
      b. Bearings and Substructures
      c. Abutments and Foundations
      d. Bent Caps, Columns and Piers
   2. Seismic Retrofit Code
      a. Restrainer Cables and Dampers for Bridges
      b. Isolation Bearings, Shear Keys and Transverse Restraints
      c. Column Jackets, Seat Extenders and Bumpers
      d. Foundations and Abutments

VI. Fabrication and Construction
   1. Fabrication of Curved I-Girders
   2. Detailing of Cross-Frames
   3. Shop-Fit and Assembly Considerations
   4. Contractor's Construction Plan
   5. Design Engineer's Construction Plan

Grading:

Exam 1 (Week 7, Thursday, Oct 3)	25%	Assignments	25%
Final Exam (Week 16, Tuesday, Dec 10)	25%	Project	25%

Policies and Operating Procedures

1. Working together on assignments is encouraged, but your individual homework (unless marked as Team based) must be completed in your own "hand."
2. Attendance at all lectures is mandatory. If you must be absent, you should contact me in advance.
3. DO NOT BE LATE to class.
4. Turn off your cell phones in class!
5. Homework solutions 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…. one side of the paper only for any manual work or printed hardcopy, ample white space (don't crowd the different parts of your work together). ***A 10 % grade deduction will be applied to solutions that do not meet this standard. Zero credit will be given for multiple-sided solutions or for pages torn out of spiral notebooks. A 5 % grade deduction will be applied for homework that is not stapled.***
6. Homework must be submitted by the start of class on the date they are due. Generally, you should submit all portions of the homework you have completed at the due date. ***A 10 % penalty is assigned per day for late homework, including weekends.*** You may slide any late assignments under the door to 5139 Mason on weekends. Indicate the day that you submit the late HW (otherwise, we I record the date when I receive it).
7. Example exams will be provided on the course web site one week in advance of the exams.
8. The Course Project will be Team Based. I'll ask you to give me self-selected recommendations for team members as get close to the mid-term.

GT Honor Code

I expect compliance with the GT Academic Honor Code; please read and understand this document, available at www.honor.gatech.edu. Your **signature** on all Homework and Exams assures me of your full compliance. ***You are encouraged to work together*** *with other students on individual-based HW assignments, as long as you write up and turn in your own solutions. I strongly encourage you to work on additional problems from the books, etc., on your own, and to ask lots of questions!* In-class tests and exams are to be your work alone. All in-class tests and exams will be closed book and notes, with the exception of 2 pages (one side) of any notes you would like to bring. *For any questions involving these or any other Academic Honor Code issues, please consult me, the TAs, or* www.honor.gatech.edu.

Disclaimer

When appropriate or necessary, the instructor reserves the right to adjust, amend, or otherwise modify the information presented in the syllabus.

Tentative Topics for Each Class Session, Reading, & Assignments

Session	Date	Topics	Reading (complete prior to lecture)
1	8/20	PW1.1 Opening Remarks & Introduction PW1.2 Course Introduction & Overview	RM1.1 (47 pp)
2	8/22	Torsion of TWOS beams handout **HW1** (Analysis of single I-section member subjected to torsion; hand analysis, Mastan analysis, LARSA analysis)	Handout
3	8/27	PW2.1 System Behavior & Torsion	
4	8/29	PW2.2 Limit States, Loads & Load Combinations **HW2** (Load Combos)	RM1.3 (51 pp) ALRFD1.3
5	9/3	PW2.3 Live Load Force Effects	RM2.1 (49 pp) ALRFD3.6
6	9/5	PW3.1 General Analysis Considerations **HW3** (Live Load Calcs… centrifugal force, superelevation effects; General Analysis Considerations… handling uplift)	
7	9/10	PW3.2 Bearing Constraints	RM2.2 (36 pp)
8	9/12	**HW4** (Bearing calcs; conjugate beam method calcs)	
9	9/17	PW3.3 Approximate Methods of Analysis	RM2.3 (33 pp)
10	9/19	PW3.3b Distribution Factors **HW5** (Basic V-load analysis of FHWA Test Bridge)	ALRFD4.6
11	9/24	Overview of FHWA curved test bridge	Jung & White SSRC paper
12	9/26	**HW6** (Basic grid analysis of FHWA Test Bridge)	
13	10/1	PW3.4 2D Refined Methods of Analysis	RM2.4 (22 pp)

14	10/3	EXAM 1 (PW1.1 through PW 3.3b)	
15	10/8	NCHRP Findings regarding 2D Analysis Methods	Excerpts from AASHTO/NSBA G13.1
16	10/10	PW3.5 3D Refined Methods of Analysis **HW7** (Modifications to basic 2D grid model of the FHWA test bridge; Modeling of Cross-frames)	RM 2.5 (63 pp … 21 pp on FE fundamentals)
	10/15	FALL BREAK	
17	10/17	Introduction to LARSA & Term Project **HW8** (Modeling of two-girder example case of PW3.5 in LARSA)	
18	10/22	PW4.1 Preliminary Design Decisions	RM 3.1 (129 pp)
19	10/24	PW4.1 **HW9** (Term Project preliminary design proportioning)	
20	10/29	PW4.1	
21	10/31	PW3.6 Recommended Level of Analysis **HW10** (Term Project Girder Design)	RM 2.6 (85 pages), Excerpts from AASHTO/NSBA G13.1
22	11/5	PW4.2 Girder Design Verifications	RM Sections 3.2.1 through 3.2.3 (36 pages)
23	11/7	PW4.2	RM Sections 3.2.4 & 3.2.5 (64 pages)
24	11/12	PW4.2	RM Section 3.2.6 (79 pages)
25	11/14	PW4.2	
26	11/19	PW4.3 Design of Detail Items	RM Sections 3.3.1 through 3.3.2 (20 pages)
	11/21	Seismic Design **HW11** (Term Project Detail Items Design)	
27	11/26	Seismic Design	
28	11/28	THANKSGIVING BREAK	
29	12/3	PW6.1 Fabrication Issues	RM Section 4.1 (53 pages)
30	12/5	PW6.2 Construction Issues	RM Section 4.2 (40 pages)