CE 5318: Bridge Engineering
Department of Civil Engineering

General Information

Instructor: Jeff Weidner, Ph.D.
Office: A-222
Lab: E-214
Office Phone: (915)-747-6913
Email: jweidner@utep.edu
Office Hours: By appointment – www.jeffreyweidner.com/schedule

Meeting Time and Location: Tuesday/Thursday: Classroom Building 304 - 4:30PM to 5:50PM

Final Exam: None

Course Description: From the university course catalog:

> General considerations for design and load capacity evaluation of highway bridges. Introduction to load and resistance factor design (LRFD) philosophy. Bridge loads. Influence lines. Grillage analysis of bridges. Reinforced and prestressed concrete bridges. Composite steel bridges. Bridge substructures. Load rating. Introduction to seismic analysis and design.

My description:

> A broad approach to bridge engineering encompassing the full lifecycle of a structure. This course will cover the analysis, design, evaluation, management, maintenance, and preservation of bridges. The focus of the course will be standard, steel multi-girder bridges but other bridge types will be discussed. Hand analysis approaches as well as software analysis will be covered. The primary reference will be the American Association of State Highway and Transportation Officials (AASHTO) LRFD Bridge Design Specification, 2010 (5th Edition).

Class Approach: Course Blocks: The course will be split into five blocks of roughly 3 weeks each. In each five-week block, you will have at most one block project and at least one homework due. In total, there are four block projects planned.

Communication: I will utilize Blackboard as a file repository for the class. I will also post grades on Blackboard.

Lectures: I plan to give lectures in several formats including traditional PowerPoint presentations, chalkboard lectures, iPad lectures, and interactive discussions. I will make lecture resources available via Blackboard as I see fit.

Much of the course material was developed by Matthew Yarnold, Ph.D. P.E., a professor at Texas A&M and is being adapted with his permission.

Periodically I will seek your opinion on the class and my approach through anonymous surveys. I encourage you to be open and honest in the surveys.

Textbook: R.M. Barker and J.A. Puckett, Design of Highway Bridges (3rd Edition)
Note that this book is available electronically through the UTEP Library system (http://0-ebookcentral.proquest.com.lib.utep.edu/lib/utep/detail.action?docID=861697)

Course Objectives: By the end of this course you should:

1. Understand the lifecycle of a bridge and the role of engineers in the analysis, design, evaluation, management, maintenance, and preservation of bridges
2. Be proficient at identifying bridge type and components and describing bridges in technical vernacular
3. Have a strong understanding of design theory for bridges
4. Have a strong understanding of load rating approaches
5. Understand and be able to calculate demands on a bridge
6. Be able to conduct simple analyses of bridges, where appropriate, without the aid of software
7. Be able to conduct complex analyses, where appropriate, with the aid of software.
8. Be able to design Steel and Concrete Superstructure Elements
9. Be able to navigate the AASHTO LRFD Bridge Design Specification
10. Be aware of issues with curved bridges, skewed bridges, fatigue and fracture, fit up, temperature loading, and other higher-level considerations.
11. Understand the process of bridge management, including inspection and evaluation, rating and posting, maintenance practice and challenges, bridge preservation, and challenges with replacement
12. Be capable of developing a finite element model of a bridge.

Class Policies

Honor Code: Students are expected to adhere to the Honor Code of the Department of Civil Engineering, which can be found here (http://ce.utep.edu/honorcode.htm). Instances of suspected cheating or other violations of the Honor Code will be handled according to the procedures in the UTEP Handbook of Procedures.

Attendance Policy: I do not take attendance during class. Your work is your responsibility, and you make the decision to show up in person or not. See the class approach for information about online resources. Student athletes should speak with me at the start of the term to work out a plan for expected absences.

Neatness Policy: Part of being an engineer is executing tasks in a neat, understandable and repeatable manner. This is a critical aspect of engineering education that is often overlooked. I accept both handwritten and digital homework. Handwritten homework can be completed using pen and paper, or on an iPad. Handwritten homework can be submitted electronically. Digital homework applies to solutions which make use of Microsoft Excel, MathCAD or MatLab. All homework will be submitted electronically through Blackboard.

For handwritten homework:

- Complete homework assignments on engineering paper (available in the bookstore or on Amazon). **Loose-leaf paper is not permitted.** Any work submitted on paper that is not engineering paper will be deducted 25%.
- Use sharp pencils and a straight-edge for your work. Write precisely and neatly.
- Include your name on every page of your homework.
- Number, title and date the pages of your homework.
- Clearly sketch out any diagrams with labels as required.
- Box answers so they can be readily identified.
- List any external references used in the homework (i.e., textbook tables)

For digital homework:

- Include your name on every page of your homework.
- Number, title and date the pages of your homework.
- Clearly sketch out any diagrams with labels as required using an appropriate software tool.
- Box, underline or highlight answers so they can be readily identified.
- List any external references used in the homework (i.e., textbook tables)
- Be sure to comment and explain actions and calculations that are not immediately interpretable. Do this liberally.
- For software like Microsoft Excel, be sure that each calculation is commented and explained.

All electronic submissions (Handwritten or digital) should follow these conventions:

- Preferred format is PDF, with original files for MathCAD, MatLab, Excel or any FE software attached as well.

- Filename should follow this format: LastnameFirstInitial_Assignment#

Group Work Policy: Working in groups is encouraged for homework assignments, but everyone must submit their own work. Blatant copying is not permitted and both the copier and the person who provided their work to be copied will lose credit for the assignment.

Software: This term we will use LARSA 4D. LARSA is the premiere structural analysis software used by large design firms. They provides students access to their 4D Bridge Plus package which is the complete suite of software tools. In order to use LARSA, please go to https://www.larsa4d.com/support/register.aspx and sign up for a 4D Web Account using your UTEP email and affiliation. This will provide access to their support products.

Coursework and Grading Expectations

Grading: Grade Breakdown:

Exams:	10% for Mid-term
Project 1:	10%
Project 2:	10%
Project 3:	20%
Project 4:	40%
Homework:	10%

Final Grade Thresholds:
$A \geq 89.5$
$89.5 > B \geq 79.5$
$79.5 > C \geq 69.5$
$69.5 > D \geq 59.5$
$59.5 > F$

Exams: Exams will be in-class and closed book. Makeup exams are only provided after **advance** discussion with me. If you miss an exam due to unexpected circumstances (e.g., car crash, family emergency, etc), notify me immediately and we will discuss options.
Extended exams (longer than the allotted class period) are only provided through the Center for Accommodations and Support Services. This includes exceptions that result from acute events that occur throughout the term.

Homework: The homework assignments will be conceptual and comprehensive problems that you will solve completely and I will grade. These will be challenging and time-consuming. Your work must adhere to the neatness policy provided above. Work must be done on an individual basis, within the confines of the group work policy.

Block Project #1: Article Review	Due Date: End of Block #1 – September 17, 2019 Project Description: Review an article from a trade magazine describing a bridge construction, rehabilitation, retrofit or replacement project and extract from the article the primary design challenges and how they were addressed. From that, you are to develop a short document providing a review of the article with discussion on the design challenges and how they were addressed. You are only required to use the one source provided, but you are free to do additional research if desired. You will be graded on your ability to construct a cohesive picture of the project and the design challenges. Submission: You will submit a short (less than 5 pages) document in PDF format electronically.
Block Project #2: Essay	Due Date: End of Block #2 – October 8, 2019 Project Description: For this project, you are to identify a journal paper focused on bridges. You will read the paper, ingest it and produce your own summary. You should not simply parrot back what the author says. Provide your take on the research, the approach, and the benefits. You will produce a short presentation on the paper, and a one-page written summary. Do not review a paper written by Dr. Weidner. Good journals to consider that are available from the UTEP Library: • ASCE Journal of Bridge Engineering • ASCE Journal of Structural Engineering • ASCE Journal of the Performance of Constructed systems • Engineering Structures • Frontiers: Bridge Engineering (Open Access) Submission: You will present a brief overview of the paper to the class explaining the hypothesis, the research approach proposed, the implementation of the project, the results, and the effects of those results on practice. When you present you will also submit a one-page written summary of the journal paper.
Block Project #3: National Bridge Inventory Data Analysis	Due Date: End of Block #3 – October 29, 2019 Project Description: Using the publicly available National Bridge Inventory data housed on the Federal Highway Administration website, you will prove or disprove a hypothesis. You can look at the national level or at one or more specific states. You can focus on all bridges, or a single type of bridge. You could focus on a particular time period. Here are a few example hypotheses: • Steel bridges are more common than concrete bridges • States with colder climates tend to have more bridges with low condition ratings • Interstate bridges are in better condition that local bridges • Bridges with low clearance height tend to have lower superstructure condition ratings. You are encouraged to develop your own questions or modify the ones above. You will be graded on your arguments for the selected questions, your presentation, and your data visualization. Submission: You will submit a short (less than 5 pages) document in PDF form electronically. This document will present the answer to the question you

selected, including arguments for why, and data visualizations that summarize the NBI Analysis.

Block Project #4: Bridge Design

Due Date: End of Block #5 – December 5, 2019

Project Description: Design a *safe and efficient* steel rolled beam alternative for a simple span bridge. The design requirements will be provided separately. Each member of the team is responsible for one design alternative. Additionally, each member of the team is responsible for checking the design calculations of the other team member. The marked-up calculations must be kept and included in the report appendices. Both team members are responsible for all design calculations and the report. ***Note that this is a two-block project and it is worth 40% of your final grade.***

Submission: Each team of two will submit one report. The report will include cover page, a write-up explaining the design process, the final design results, and appendices with marked-up and final calculations for both alternatives. These calculations must be well organized with clear indicators of what the calculations is doing, who was the designer, and who was checking.