

## Structural and Geotechnical Engineering Capstone Project

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Office Hours:	WF 12:00-1:00	Office Hours:	TBA
Class Sessions:	2:30-4:20 PM, Monday and Wednesday, 234 More Hall		
Class Website:	<a href="http://faculty.washington.edu/eberhard/teaching.htm">http://faculty.washington.edu/eberhard/teaching.htm</a>		
Final Exam Periods:	Tuesday, June 5 <sup>th</sup> , 2:30-4:20 Thursday, June 7 <sup>th</sup> , 2:30-4:20		

### Introduction

This course is directed towards seniors in civil and environmental engineering who have already taken at least two senior courses in structural and/or geotechnical engineering.

The goal of this course is to provide students with experience in structural and geotechnical engineering design practice. Students will (1) gain an appreciation for some of the numerous technical and non-technical factors that can impact a project, (2) apply engineering principles obtained in other classes to the design of structural and geotechnical engineering systems, (3) improve their written and oral communication skills, and (4) gain experience working in groups.

To simulate professional practice, the class work will be conducted in a manner as similar as possible to that expected in professional engineering offices. Each group will form a consulting firm, which will be expected to produce a series of professional-quality letters, presentations, design calculations, drawings and reports. The class will not have formal lectures and written exams. Instead, class sessions will be used for seminars, questions, discussions, group work and coordination among teams and among team members.

### Project Description

This quarter, the teams will develop structural and geotechnical solutions to the Alaskan Way Viaduct replacement. Professor Eberhard and Holtz will act as prominent and wealthy citizens that are sponsoring a multi-team investigation into a variety of solution schemes.

At first, the project activities will have a broad scope, and groups will need to identify and communicate the wide range of design constraints, criteria and other considerations that might impact the final design. This level of inquiry is necessary before specific schemes can be selected by each team. Within a few weeks, each group will select a particular scheme to develop conceptually. The groups will then develop a preliminary design for a portion of the corridor, followed eventually by a more detailed design.

By the end of the quarter, each team will make a comprehensive written report and an oral presentation of this work. This report will provide a complete engineering and evaluation of the design of the proposed solution. Because of the time limitations, the design will not require a complete set of construction drawings. However, the report must be sufficiently complete that

all major members, connections, footings, walls and other structural and geotechnical elements will be sized and defined and illustrated in drawings. The report and drawings must be sufficiently complete that an engineer or contractor should be able to understand the project requirements and make an approximate cost estimate for construction of the project.

Professor Eberhard and Holtz recognize that the limited time, resources and experience available to each team make it impossible for any group to produce a technically defensible solution that would address all the technical complexities and details of a two-mile long structure. As the quarter progresses and groups identify obstacles, the instructors will work with the teams to identify representative portions of the structure to design and to make simplifying assumptions.

### Benchmarks

It is important that all students and teams participate in the project and make progress in a timely manner, and so milestones and progress presentations are used as benchmarks to aid in moving through your project. These presentations will help to assure that each team is progressing toward completion of their project, and they provide a forum for discussion of your work, for asking questions, and for obtaining information that is needed to complete your work. Presentations and reports of this type will be a major element of your future engineering career.

The following is a list of benchmarks for the course. Revisions may be required during the quarter. In particular, the schedule will vary with the availability of guest speakers.

**Submission of Initial Proposal to Perform Work** - You must submit a proposal letter to Professor Eberhard and Holtz regarding your proposed participation in this design project. This is not a technical proposal but a contract proposal that is normally required for engineering contracts. This letter must be deposited in Professor Eberhard's mailbox in the outer office of 233 More by **5:00PM of Thursday, March 29<sup>th</sup>**.

This proposal letter should include:

- A statement of qualifications (real ones, not pretend),
- a total cost estimate and the rates of key employees for your proposed work. (No, you won't be paid to do this project, but if you hope to be paid in the future, this is an important document for achieving this),
- a preliminary description of scheduling and individual team member responsibilities, and
- One page resumes for each team member. All of you have prepared (or will prepare) resumes in preparation for graduation, and this will be practice for that effort.

**Presentation of Initial Design Criteria (Week #2, Wednesday, April 4<sup>th</sup>)** – This oral and written progress report (6-8 pages) should establish the basic design constraints, criteria and considerations for your project. Each team should have an initial picture of:

- The design criteria that they will use for their project for determination of loads, design of components, and so forth.
- Subsurface conditions with general comments on their potential impact on the project.
- A series of structural and geotechnical systems to be considered for the project. You may not have decided which system you will use, but you should have some candidates in mind. There are likely to be several alternatives under consideration at this stage of the work.
- Advantages and disadvantages of the various design options

- What engineering tasks does your team need to complete for this project. This should be illustrated by a revised list of participant responsibilities and a revised times schedule.
- What information the team needs to complete the project.

Please note that you are not expected to have sized members or even defined the magnitude of member or structural loads. You are expected to have considered what types of systems are appropriate for this project, and what codes, specifications or other information you will use or need to evaluate them. The instructors and practitioners will make comments about the progress and direction of the work. They will be able to provide information that you may need to proceed. Two copies of your progress report should be available at the time of the presentation.

**Conceptual Design Presentation and Report (~Week #5)** - It is expected that the concept, preliminary structural system and layout should be complete. All loads and load distribution should be finalized, and preliminary member sizes should be selected. As a minimum, the presentation should show

- Subsurface conditions beneath the structure.
- The structural system for resisting gravity and lateral loads and the foundation or footing system should be clearly defined and discussed. This should include initial estimates force distributions of forces and moments.
- A brief summary of all design loads and estimated structural weight should be provided.
- Floor plans and elevations of major structural members. These drawings should clearly and neatly show dimensions, sizes and configurations. Connections, detailed member sizes and details of that type are not expected by this presentation.
- Any information required by that team to complete their work should be identified.

These results and requirements should be summarized in a brief letter report. At this time you may be given some additional information regarding how the system was actually designed so that you can decide if you want to make any final changes to the system.

**Oral and Written Progress Report on Detailed Design (~Week #8)** -- It is expected that the design of all major members and components should be complete. Connection design and details of this type should be well under way. Final drawings may not be complete, but there should be a very good series of sketches that illustrate the structure and its foundations. This information and progress should be presented. Are there questions that you have about what you are doing? This is a good time to discuss them. A written report should be provided. This is a good time to have questions prepared.

**Oral Progress Report (~Week #10).** At this point all major members and typical connections should be designed and completed. All major structural and geotechnical questions should be addressed. The written report and drawings are unlikely to be complete, and details of the engineering work are likely to remain. This work and progress should be presented. Are there any last minute questions or concerns? This presentation is expected to be a preparation for closing the project up. This will be the last time we have for discussing any details, coordination, and requirements for your individual parts of the project. However, it is getting late for basic questions.

**Final Exam Period Oral and Written Reports** - Two final exam periods are available for this class, because it meets for two hours on two days. Because of the size of the class, we may need to use both time blocks. Each team will make an oral presentation of their project and turn a Final Bid Package on their project. This package will include good drawings, which should show the structural system, members, foundations, structural layout, typical connections and details. The written report should be typed and describe the structure, the work performed, and special concerns or limitations of the design. This should be adequate so that the owner can get bids on the project. The presentation should summarize this information. It should provide good detail, but it should not be tedious or boring.

#### Notes on Group Work

We hope that all teams will work productively and collegially together. Group work is essential to completing this project successfully (and to success in engineering practice), so part of your grade will be determined by the products produced by the group, and part of the grade will be determined by your fellow students' evaluation of your contributions to the group project. Each team member is expected to make significant contributions to their team project. If problems within a group cannot be resolved through internal discussions, an instructor can help mediate disputes.

#### Notes on Oral Presentations

This course provides opportunities for students to develop their skills in oral presentation of technical information. These skills are vital to success in engineering practice. For this reason, the oral presentations should be taken seriously - the group presentations should be well-organized and well-coordinated, and should be delivered in a professional manner. A laptop and data projector will be made available for display of presentation materials (PowerPoint and/or other graphics). You may bring your own computer for the presentation or provide the Powerpoint files to Professor Eberhard by one half hour prior to the class.

It is essential that each student presentation be well prepared, clear and concise. Time limitations will be enforced strictly. **Every student for each team must participate in at least two presentations during the course of the quarter.**

#### Guest Speakers

To provide context and technical information, the class will host a series of guest speakers that have experience that relates to the AWW challenge. These will include speakers from WSDOT, include the manager for the corridor, consulting firms involved in this project and similar ones, and from UW faculty. The specific schedule is still being developed. As you might imagine, the major players in the Alaskan Way Viaduct corridor studies have been quite busy lately.