Response to ABET Statement:
Revisions to CE 190, Senior Class Project
2010 – 2011 Academic Year

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Background
The Engineering Accreditation Commission (EAC) of ABET conducted a program evaluation of the College of Engineering during the 2009-2010 academic year. There final findings are described in a Summary of Accreditation Actions, dated July 26, 2010 (please see Attachment 1). Accreditation was granted to the Civil Engineering program through September 30, 2012. Three weaknesses in the Civil Engineering program were identified:

1. **Criterion 2. Program Educational Objectives** — The EAC considers this weakness resolved.
2. **Criterion 3. Program Outcomes** — The EAC considers this weakness resolved.
3. **Criterion 5. Curriculum** — The EAC considers this weakness unresolved.

The identified weakness in the program’s curriculum is associated with the capstone class, CE 190, Senior Project. The Civil Engineering Department submitted a “Due-Process Response” to this identified weaknesses (please see Attachment 2). Our response included a proposal to add a second major design experience to the curriculum to address the weakness associated with Criterion 5. However, after much reflection, the Department has implemented a somewhat different approach. A detailed description of this approach is the subject of this document.

Description of Unresolved Weakness (Criterion 5 - Curriculum)
The unresolved weakness identified in the Summary of Accreditation Actions is associated with the Departments’ capstone class, CE 190, Senior Project. The Summary of Accreditation Actions reads in part:

> The students, however, are not required to complete the full process of design including the production of design calculations, the process of analysis and optimization, and the generation of corresponding detailed plans and specifications. The major design experience is lacking in the application of science, mathematics, and engineering science to optimally convert resources to meet these stated needs.

The document further states:

> In preparation for the next review, the EAC anticipates evidence that the proposed curricular changes have been implemented and that all graduates experience “a major design experience based on the knowledge and skill acquired in earlier course work and incorporating appropriate engineering standards and multiple realistic constraints.”
CE 190, Senior Project, Prior to the 2010-2011 Academic Year

The university catalog description for CE 190 is as follows:

*Completion of a conceptual design and evaluation of alternatives under realistic constraints for proposed infrastructure projects. Students work in teams with practicing professionals providing mentoring. Draws upon full educational experience to date.*

This description has remained unchanged for some years. There is currently no plan to revise it.

The actual project assigned to each of the student teams was strongly based on a real project, local to the Sacramento area. The completion of a “conceptual design” typically necessitated that the students’ efforts be focused on an early phase in the project planning process. See Figure 1 for a flowchart representing the required student deliverables during the 2009-2010 academic year.

From the standpoint of the unresolved weakness identified in the Summary of Accreditation Actions, this approach to the class has a number of drawbacks:

1. While the students typically have to prepare a design calculations in the course of exploring project alternatives, those calculations and associated analyses are not explicitly required in the project submittals.
2. Because the projects focus on the early stages of the planning process, the production of detailed plans has not been a course requirement.
3. The class places a great deal of emphasis on alternative selection and optimization (requiring the application of science, mathematics, and engineering science). Said application, however, is not explicitly represented in the project submittals.

The general model for the class continues to enjoy enthusiastic support from our industry partners and most of our graduating seniors. Key to this model, are the following features:

1. The course requires students to synthesize their engineering knowledge and skill in a comprehensive manner, incorporating numerous realistic constraints.
2. The course requires the students to accomplish this synthesis without explicit direction from the instructor.
3. The course creates a highly realistic project environment.
4. The course requires students to function as an effective team.
5. The course maintains a high level of contact and coordination with local industry professionals.

The Department believes that these features of the class provide a unique and valuable learning experience for our students. While the Department has already made a number of significant changes to the CE 190 curriculum to address the outstanding weakness identified by the EAC, it remains resolute that these features be maintained.

A representative course syllabus and “Request For Proposal” from a semester prior to the 2010-2011 academic year can be found in Attachment 3.
CE 190, Senior Project, 2010-2011 Academic Year

In response to the outstanding weakness identified in the Summary of Accreditation Actions, the Department made a number of important changes to the course during the 2010 – 2011 academic year. While these changes were substantial, the course content remained consistent with the university catalog and the key features of the course model discussed in the previous section.

Major changes to the course include:

1. Instead of working towards a single Preliminary Design Report, students now prepare two major reports: a Preliminary Design Report (called a “Project Report” in the student contract in Attachment 4), and a technical report.
2. The scope of the deliverables associated with the Preliminary Design Report has been reduced to allow for the preparation of the technical report.
3. Students receive mentoring on their technical reports from local industry professionals. This is in addition to the mentoring provided by industry professionals role playing as “clients” for the production of Preliminary Design Report.

See Figure 2 for a flowchart representing the required student deliverables during the 2010-2011 academic year.

The Preliminary Design Report provides a means of assessing the following course objectives:

1. Analyze multiple realistic constraints.
2. Apply appropriate engineering standards.
3. Optimally convert resources to meet project constraints.
4. Apply knowledge and skill acquired in earlier course work.
5. Synthesize engineering knowledge and skill in a comprehensive manner.

The preliminary design report, in particular, supports the five key features of the course model described in the previous section.

The Technical Report provides a means of assessing the following course objectives:

1. Apply appropriate engineering standards.
2. Apply knowledge and skill acquired in earlier course work.
3. Produce design calculations.
4. Analyze and design an engineering system subject to realistic constraints.
5. Prepare preliminary contract documents (e.g. plans, specifications, engineering estimates).
6. Apply science, mathematics, and engineering science to meet the project goals.

It was necessary to adjust the nature of the project for CE 190 in order to incorporate both a Preliminary Design Report and a Technical Report. In particular, the class project is now based on a local civil engineering project that has completed at least some preliminary engineering. This allows the students to develop realistic technical design documents while still exploring various project alternatives. At the
same time, it is important to select a project that is not so far advanced that all major decisions have already been made (and are publicly available).

The CE 190 projects for the Fall 2010 semester were based upon a bridge replacement and road improvement project on the border of Marysville and Yuba City in California. At the time of the class, Dokken Engineering was preparing the preliminary engineering documents for the project for Yuba City. Staff from Dokken Engineering served as technical mentors for the CE 190 students. Each student team produced a “Project Study Report” (a type of project initiation document for transportation projects in California) and a technical report. The technical report for each group was either a geotechnical design report, a structure type selection report, a geometric approval drawing, or a hydraulic study.

The CE 190 projects for the Spring 2011 semester were based upon a new interchange project in Chico, California, that included extensive work on a local expressway. At the time of the class, Mark Thomas and Company was preparing the preliminary engineering documents for the City. Staff from Mark Thomas served as technical mentors for the CE 190 students. Each student team produced a “Project Report” (a detailed scoping document for transportation projects in California) and a technical report. The technical report for each group was a geometric approval drawing for various portions of this large project.

Please see Attachment 4 for the course syllabus and student “contract” for the Spring 2011 semester. Please see Attachment 5 for a representative Project Design Report and Technical Report from the same semester.
**CE 190 Future Semesters**

The Department plans to continue to plan and conduct CE 190, Senior Project, in a manner consistent with the class structure utilized during the 2010 – 2011 academic year. Industry support of the class remains strong, even in the continuing poor economy.
Attachment 1 – Summary of Accreditation Action
Attachment 3 – Course Syllabus and Student “Request For Proposal” – Fall 2009
Attachment 4 - Course Syllabus and Student “Contract” – Spring 2011