



2012-2013 ANNUAL ASSESSMENT REPORT FOR M.S. IN CIVIL ENGINEERING

PREPARED FOR:

Office of Academic Program Assessment
Office of Academic Affairs

SUBMITTED BY:

Department of Civil Engineering
College of Engineering and Computer Science

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To: Office of Academic Program Assessment (OAPA), Office of Academic Affairs

From: Department of Civil Engineering

Subject: Annual Assessment Report for M.S. in Civil Engineering

Date: July 1, 2013

CC: College of Engineering and Computer Science

The 2012-2013 Annual Assessment Report for Department of Civil Engineering is based on the learning outcome assessment template prepared by the Office of Academic Affairs. This memo offers a summary of the assessment strategies used to assess program learning outcomes and feedback from the Office of Academic Affairs for improving the department's assessment practices.

The Civil Engineering – Graduate Program (Program) provides graduate level degree for practicing engineers in the greater Sacramento area. As such, the Program is unique because it is the only program in Northern California that offers graduate level studies for practicing engineers. Civil Engineering includes five major areas: 1) Environmental, 2) Geotechnical, 3) Structural, 4) Transportation, and 5) Water Resources. Typically, graduates of Bachelor's degree in Civil Engineering are hired at an entry level position in an agency or a consulting engineering firm. To succeed in practice in specialty firms (in one of the five major areas of CE), engineers are expected to get a graduate degree so that they can tackle more complicated engineering problems by improving their skills in one of the specialty areas. The graduate students in the program are typically working full-time as professional engineers while they are taking courses in the program.

The graduate program in Civil Engineering has a direct impact on the quality of education in the undergraduate program in two main ways: 1) the graduate program is attractive feature in the Department for recruiting highly qualified and motivated faculty, 2) the ability of faculty to stay current in their field through their research and working with graduate students makes their teaching current through research.

1. ***As a result of last year's assessment effort, have you implemented **any changes for your assessment including learning outcomes, assessment plan, assessment tools (methods, rubrics, curriculum map, or key assignment etc.), and/or the university baccalaureate learning goals?*****
- a. *If so, what are those changes? How did you implement those changes?*
- b. *How do you know if these changes have achieved the desired results?*
- c. *If no, why not?*

The MS Program in Civil Engineering curriculum is continuously updated to meet the demands of a constantly-changing field and marketplace. Due to limited resources, most graduate courses are taught on a two- or three-year course-alternating cycles, they are updated continuously to reflect currency in the state of the practice with the latest technology. These revisions or updates originate from a range of sources, including but not limited to: faculty participation in industry workshops, feedback from focus groups or industry advisory committees, part-time instructors and students who enter the Program with practical experience, guest lecturers from local industry and government agencies, and review of comparable civil engineering programs at other public universities in California.

Last year's assessment efforts were limited during an academic year when no new graduate students were admitted to the program for budgetary reasons, a large amount of energy was spent managing the graduate program instead of assessing its effectiveness. Furthermore, the graduate coordinator was on sabbatical in Fall 2012 while the department chair served as interim graduate coordinator. A new graduate coordinator started in Spring 2013.

Despite these challenges, the Department made significant strides in its assessment efforts by developing a set of program learning outcomes (three total) and developing a set of outcomes in all five graduate discipline areas in civil engineering areas (structural, geotechnical, transportation, water resources, and environmental). These outcomes have each been mapped to the graduate Program Learning Outcomes, discussed later in this document. These program learning goals are attached at the end of this document.

2. *As a result of last year's assessment effort, have you implemented **any other changes at the department, the college or the university, including advising, co-curriculum, budgeting and planning?***
 - a. *If so, what are those changes? How did you implement those changes?*
 - b. *How do you know if these changes have achieved the desired results?*
 - c. *If no, why not?*

A welcoming e-mail was sent to all incoming graduate students, and, for the first time, a graduate student welcome orientation is planned for this coming fall. These efforts are aimed at improving advising for graduate students. We will know if these changes met their desired results for students to meet their advisor and develop a graduation plan (as much as possible) before their first day in the program.

3. *What **PROGRAM** (not course) learning outcome(s) have you assessed this academic year?*

The program learning outcomes (PLO) are a set of outcomes that the Department expects of its graduates to achieve after completing the graduate program. That is, upon graduation, the students in the graduate program will be able to:

1. Succeed in professional employment in their chosen specialty of environmental, geotechnical, structural, transportation, or water resources engineering.
2. Identify, analyze, and solve complex practical civil engineering problems in their chosen field of specialty.
3. Communicate effectively about technically complex engineering problems to peers, other professionals, decision makers, and the general public, in the conduct of their work.

These PLOs are consistent with the mission of the university and of the program that targets practicing professional engineers in the community¹. These educational objectives are patterned after the educational objectives for the undergraduate program that were developed for ABET accreditation.

All graduates of the MS CE program must complete a culminating requirement. During the 2012-2013 academic year, the Department started to assess the programmatic learning outcome #2, the student's ability to *identify, analyze, and solve complex practical civil engineering problems in their chosen field of specialty*. The Department evaluated the program's curriculum, focusing on Independent Study (CE 299) and the Graduate Culminating Experience (CE 500). Clarification was provided regarding how CE 299 can be related to CE 500 along with the different CE 500 plans options. A draft of these options is shown in Table 1.

¹ The mission and educational objectives of the Program are consistent with the mission of the University. By preparing students to "*succeed in professional employment and/or graduate study in Civil Engineering*," the program offers individuals the opportunity to realize their highest aspirations. By preparing students to identify, analyze, and solve complex practical civil engineering problems in their chosen field of specialty, the program emphasizes the development of a critical thought process. Finally, by preparing students to "*communicate effectively with their peers, other professionals, decision makers, and the general public, in the conduct of their work*;" and to "*practice civil engineering in a professionally responsible and ethical manner*," the program enables graduates to become active and involved citizens for the good of the individual and society.

Table 1. Culminating Requirement (CE 500) Options (Draft)

Plan A	Plan B	Plan C
Master's Thesis (3-6 units) Approval by the faculty thesis advisor and by a second faculty or an expert in the area of study is required. A presentation is also required. The thesis must comply with University standards for format and is filed in the University Library. The Master's Thesis should be the written product of a systematic study of a significant problem. It identifies the problem, states the major assumptions, explains the significance of the undertaking, sets forth the sources for and methods of gathering information, analyzes the data, and offers a conclusion or recommendation. The finished product evidences originality, critical and independent thinking, appropriate organization and format, and thorough documentation. The work should be associated with engineering research or innovation. No more than 3 units may be awarded for a topic directly related to a topic studied for CE 299.	Master's Project (3-6 units). Approval by the faculty project advisor and by a second faculty or an expert in the area of study is required. A presentation is also required. A Master's Project should be a significant undertaking appropriate to the engineering profession. It evidences originality and independent thinking, appropriate form and organization, and rationale. It is described and summarized in a written report that includes a discussion of the project's significance, objectives, methodology, and a conclusion or recommendation. The work should be associated with practical engineering applications. The report should comply with University standards for format and will be filed in the University Library. No more than 3 units may be awarded for a topic directly related to a topic studied for CE 299.	Directed Study and Examination (3 units). Approval of one faculty member is required for Directed Study. The directed study will be a written report related to a current topic in civil engineering in the form of a comprehensive literature search or experimental data analysis. The topic should be directly related to the student's course of graduate study. The examination is administered by a committee of three faculty members, which will determine a single pass / fail grade for the examination.

This culminating requirement effectively reduces the number of coursework units required for the program and allows students to work closely with their advisors or an industry partner to ensure that they are engaging in advanced-level work. Requiring all students to complete a culminating requirement maintains a standard within the program, because students are required to be not only proficient in coursework but also be able to conduct an independent project and communicate the importance of the work and the significance of the results. CE graduates are required to be able to evaluate project scope and develop appropriate methods for investigation and solution of a significant civil engineering problem. These qualities and skills are developed when working closely with the experienced faculty. MS graduates are expected to be project leaders when they are in industry and must have the experience of independently investigating a significant problem.

4. What method(s)/measure(s) have you used to collect the data?

Most of the discussion last year focused on clarifying the requirements, and assessment efforts next year will be to develop a standardized method and to collect data to assess this PLO. The Department is currently working on a rubric, shown in Table 2, to evaluate this PLO across all CE 500 plans. Currently, CE 500 evaluations (written and presentation) are used to evaluate this learning outcome and are evaluated by the faculty advisor or a faculty committee.

Table 2. Scoring Rubric – Graduate Culminating Requirement (Draft)

	Exceeded Expectations	Met Expectations	Did Not Met Expectations
	2	1	0
EFFECTIVENESS: Written reports contain a thought and insightfulness, main idea, position, or claim that is sustained throughout the report.	Written report is clear, insightful and thought-provoking, and is sustained consistently throughout the report.	Written report is clear and plausible. It is sustained consistently throughout the paper.	Written report is weak or absent. It is not sustained throughout the paper.
FOCUS: Written reports are expected to address the topic and issues set forth in the assignment and address all aspects of the writing task. Usually requires some discussion and refutation of an opposing view point.	Written report responds to the assignment and addresses the topic and issues. Discussion of a counterargument is included when appropriate.	Written report responds to the assignment and addresses the topic and issues. Some discussion of a counter-argument is included when appropriate.	Written report does not respond to the assignment or treats the assignment in a superficial, simplistic, or disjointed manner. Little or no discussion of a counter-argument is included.
SUPPORT: Written reports are expected to provide support for main points with reasons, explanations, and examples that are appropriate for intended audience.	Written report is fully and convincingly developed, supported with good reasons, explanations and examples.	Written report is adequately developed, supported with reasons, explanations, and examples.	Written report is inadequately developed, unsupported with reasons, explanations, and examples.
ORGANIZATION: Written reports are expected to be well-organized, in both overall structure & paragraphs.	Written report is well-structured; its form contributes to its purpose. Paragraphs are well-organized and carefully linked to the report.	Written report is generally well structured, with only a few flaws in overall organization. Paragraphs are adequately organized and generally linked to the report.	Written report is poorly structured; organizational flaws undermine its effectiveness. Paragraphs are not well organized; nor are they linked to the report.
STYLE: Written reports are expected to be stylistically effective – that is, to contain well-structured sentences, well-chosen words, and an appropriate tone, as a means of achieving its purpose.	The sentence structure, word choice, fluency, and tone of the paper enhance its effectiveness and reinforce its purpose.	The sentence structure, word choice, fluency, and tone of the paper contribute to its effectiveness and adequately support its purpose.	The sentence structure, word choice, fluency, and tone of the paper detract from its effectiveness or are inappropriate to its purpose.
GRAMMAR AND MECHANICS: Written reports are expected to maintain sentence level correctness in terms of syntax, grammar, spelling, punctuation, and format.	Written report is correct in terms of its syntax, grammar, spelling, punctuation, and format.	Sentence level errors do not seriously detract from the paper's effectiveness.	Sentence level errors are so frequent and disruptive that they detract from the paper's effectiveness.

5. *What are the criteria and/or standards of performance for the program learning outcome?*

The project scoring rubric and presentation evaluations will be used to evaluate this program outcome. All students will be required to meet or exceed expectations in this rubric.

6. *What data have you collected? What are the results and findings, including the percentage of students who meet each standard?*

- a. *In what areas are students doing well and achieving the expectations?*
- b. *In what areas do students need improvement?*

This rubric is still being developed and has not been implemented to collect data or assess this PLO.

7. *As a result of this year's assessment effort, do you anticipate or propose any changes for your program (e.g. structures, content, or learning outcomes)?*

- a. *If so, what changes do you anticipate? How do you plan to implement those changes?*
- b. *How do you know if these changes will achieve the desired results?*

Assessment efforts are scheduled to increase over the next two academic years. Along with finalizing a rubric to assess the Culminating Requirement (CE 500), a detailed assessment plan will be developed for the Structural Engineering graduate program in Fall 2013. The program will be expanded to include all five civil engineering areas in 2014. This plan will ultimately include:

- A formal library of syllabi for each course in the civil engineering graduate program. Each syllabus will include a detailed list of course learning outcomes.
- Each of the course learning outcomes will be mapped to the overall area Engineering Outcomes, which in turn will be mapped to the graduate Program Learning Objectives.
- One or more assessment of each course learning outcome will be logged and used to assess the course learning outcomes, the area specific Engineering Outcomes, and the graduate Program Learning Objectives.
- At least once per year, each faculty area lead will convene an area specific assessment meeting with other area faculty, the graduate coordinator, and the department chair. The meeting participants will review the compiled assessment results within their area and will make recommendations for immediate revisions to the related course content.
- At least once per year, the graduate coordinator will convene a general assessment meeting with each of the area leads and the department chair. The purpose of the meeting will be to assess the overall effectiveness of each of the area specific programs in meeting the graduate program Educational Objectives. The meeting participants will make recommendations as to how each of the area program Engineering Objectives and

related courses might be improved in order to better meet the graduate Program Learning Objectives.

8. Which program learning outcome(s) do you plan to assess next year? How?

Table 3 shows the assessment activities planned for the next two academic years (AY 2013/2014 and AY 2014/2015) for the graduate program. During the next academic year, the Department started to assess the Program Learning Outcome #3, the student's ability to: *communicate effectively about technically complex engineering problems to peers, other professionals, decision makers, and the general public, in the conduct of their work*. This outcome will be evaluated by focusing on the written reports and presentations – and evaluations by faculty and industry partners. Program Learning Outcome #1 will be assessed the following year. In addition, the Department will continue to host a focus group of alumni and industry employers and will conduct a survey of our graduates in each of those years. The Department is planning to hold a focus group meeting for alumni and employers in the Environmental Engineering area. Subsequent meetings are planned for next four years to cover other areas of specialty in Civil Engineering including geotechnical, structural, transportation, and water resources, respectively.

Table 3. On-Going Assessment Plan for the Graduate Civil Engineering Program

AY 2013/2014	AY 2014/2015
1. Focus group of employers (Environmental Engineering), summer 2014 2. Assessment of educational objective #3 (<i>communicate effectively about technically complex engineering problems to peers, other professionals, decision makers, and the general public, in the conduct of their work.</i>) 3. Graduate survey 4. Alumni Focus Group – Spring 2014	1. Focus group of employers (Structural Engineering), summer 2015 2. Assessment of educational objective #2 (Identify, analyze, and solve practical civil engineering problems in their chosen field of specialty.) 3. Graduate Survey 4. Alumni Focus Group – Spring 2015

On-going assessment efforts by the Department include the following: 1) direct assessment, 2) indirect assessment, and 3) focus group meetings.

1. **Direct Measures.** The Department plan for assessment includes direct measure for its Educational Objective 2 stated in the self-study as: *Identify, analyze, and solve complex practical civil engineering problems in their chosen field of specialty*. The Department gathered data from projects and assignment in a range of graduate courses. A five-point rubric is used for the assessment of the activities, and the

Department considers that 70% of the students should be in the range of 4 and 5 as an acceptable criterion for this learning outcome.

2. **Indirect Measures** - A Graduate Alumni Survey is being prepared using the StudentVoice website and will be e-mailed to alumni.
3. **Focus Group Meetings** – The Department is planning to hold a focus group meeting for alumni and employers in the Environmental Engineering area. Subsequent meetings are planned for next four years to cover other areas of specialty in Civil Engineering including geotechnical, structural, transportation, and water resources, respectively.

Appendix. Educational Objectives by Discipline (Draft)

	Educational Objectives:			
Environmental Engineering Outcomes	<i>1. Prepare graduates to utilize state of the art engineering in professional practice.</i>	<i>2. Prepare graduates to apply knowledge to practical engineering applications.</i>	<i>3. Prepare graduates to synthesize sophisticated solutions to complex engineering problems.</i>	<i>4. Prepare graduates to apply master's level knowledge in a specialized area of engineering related to the program area.</i>
1) Succeed as a practicing environmental engineer				
2) Identify, formulate, analyze, and solve practical environmental engineering problems using appropriate tools including modern computation tools				
3) Apply knowledge in physical, chemical, and biological processes to model/design environmental natural/engineered systems				
4) Design a sampling plan to achieve a set objective; analyze and interpret data set using statistical methods				
5) Apply a system approach to devise an optimal solution to environmental problems subject to constraints				
6) Communicate effectively to technical and non-technical audience				

Figure 1. Environmental Engineering Educational Objectives

	Educational Objectives		
Geotechnical Engineering Outcomes	<i>1. Prepare graduates to utilize state of the art engineering tools in professional practice.</i>	<i>2. Prepare graduates to synthesize sophisticated solutions to complex engineering problems.</i>	<i>3. Prepare graduates to apply master's level knowledge in a specialized area of engineering related to the program area.</i>
1) Succeed as a practicing geotechnical designer			
2) Obtain a Geotechnical Engineering License			
3) Identify and analyze practical geotechnical analysis problems using hand calculation techniques.			
4) Identify and analyze practical geotechnical analysis problems using experimental and computational techniques.			
5) Apply knowledge to design of multiple types of geotechnical systems.			
6) Analyze site stability and practical geotechnical systems for their dynamic responses to earthquakes using computational and experimental techniques.			
7) Apply knowledge to design of geotechnical foundation systems (shallow and deep foundations).			
8) Communicate effectively via detailed technical writing.			

Figure 2. Geotechnical Engineering Educational Objectives

	Educational Objectives:			
Structural Engineering Outcomes	<i>1. Prepare graduates to utilize state of the art engineering in professional practice.</i>	<i>2. Prepare graduates to apply knowledge to practical engineering applications.</i>	<i>3. Prepare graduates to synthesize sophisticated solutions to complex engineering problems.</i>	<i>4. Prepare graduates to apply master's level knowledge in a specialized area of engineering related to the program area.</i>
1) Succeed as a practicing structural designer				
2) Obtain a Structural Engineering License				
3) Identify and analyze practical structural analysis problems using hand calculation techniques.				
4) Identify and analyze practical structural analysis problems using computational techniques.				
5) Apply knowledge to design of multiple types of structural systems, possibly including: structural concrete, structural steel, structural timber, and structural masonry.				
6) Analyze practical structural systems for their dynamic responses to earthquakes using computational techniques.				
7) Apply knowledge to design of structural foundation systems.				
8) Communicate effectively via detailed technical writing.				

Figure 3. Structural Engineering Educational Objectives

	Program Learning Objectives		
Transportation Engineering Outcomes	<i>1. Prepare graduates to utilize state of the art engineering tools in professional practice.</i>	<i>2. Prepare graduates to synthesize sophisticated solutions to complex engineering problems.</i>	<i>3. Prepare graduates to apply master's level knowledge in a specialized area of engineering related to the program area.</i>
1) Succeed as a practicing Transportation engineer			
2) Identify, formulate, analyze, and solve practical transportation engineering problems using appropriate tools including modern computation tools			
3) Design a sampling plan to achieve a set objective; analyze and interpret data set using statistical methods			
4) Apply systems analysis approach to maximize benefits or minimize cost of transportation problems			
5) Communicate effectively to technical and non-technical audience			
6) Obtain a certification as a PTP or PTOE			

Figure 4. Transportation Engineering Educational Objectives

	Program Learning Objectives			
Water Resources Engineering Outcomes	<i>1. Prepare graduates to utilize state of the art engineering in professional practice.</i>	<i>2. Prepare graduates to apply knowledge to practical engineering applications.</i>	<i>3. Prepare graduates to synthesize sophisticated solutions to complex engineering problems.</i>	<i>4. Prepare graduates to apply master's level knowledge in a specialized area of engineering related to the program area.</i>
1) Succeed as a practicing Water Resources engineer				
2) Identify, formulate, analyze, and solve practical water resource engineering problems using appropriate tools including modern computation tools				
3) Apply knowledge in modeling both surface and subsurface hydrology using hydraulic and stochastic methods				
4) Design a sampling plan to achieve a set objective; analyze and interpret data set using statistical methods				
5) Apply systems analysis approach to maximize benefits or minimize cost of water resources problems				
6) Communicate effectively to technical and non-technical audience				

Figure 5. Water Resources Engineering Educational Objectives