Program: Civil Engineering – Master’s and Graduate Certificate Program

Department: Civil Engineering

Number of students enrolled in the program in Fall, 2011: 84

Faculty member completing template: Ramzi J. Mahmood Date: 2/6/2012

Period of reference in the template: 2006-07 to present

1. Please describe your program’s learning-outcomes trajectory since 2006-07: Has there been a transformation of organizational culture regarding the establishment of learning outcomes and the capacity to assess progress toward their achievement? If so, during which academic year would you say the transformation became noticeable? What lies ahead; what is the next likely step in developing a learning-outcomes organizational culture within the program?

[Please limit your response to 200 words or less]

Civil Engineering encompasses a broad range of professional activities. The four years of undergraduate preparation for the Bachelor of Science degree are devoted to fundamental analytical principles and basic design applications. For technical competence in specialized areas and continued effectiveness on the job, graduate study is becoming increasingly necessary. In 2007, the American Society of Civil Engineers (ASCE) adopted a Policy Statement (PS) 465 in which the master’s degree in Civil Engineering is established as the minimum requirement for the entry to the profession of Civil Engineering (ASCE, 2008). ASCE established a 15-year implementation plan for the policy. That is, once the states adopt the policy, then it becomes required for any Civil Engineering program to offer a master’s degree so that its graduates can qualify for the professional engineer (PE) license. Note that the PS 465 allows other pathways (through qualified experience) to reach licensure eligibility. The Department also started the certificate program to meet the needs of practicing professionals. In ever increasing demand for Civil Engineers to improve their advanced skills, practicing engineers need to take advanced courses and not necessarily a master’s degree. Accordingly, the Department established the certificate in anticipation for this demand. Agencies such as Army Corps of Engineers in Sacramento were instrumental in the development of the certificate program. The learning outcomes were developed based the learning outcomes established for the undergraduate program and to meet the needs of the practicing Civil Engineers. Currently, the graduate program is not ABET accredited. Dual accreditation (BS and MS) was not allowed until recently by ABET. The graduate program may pursue ABET accreditation if policy 465 is implemented by the State.

The learning outcomes were developed last year as part of the program evaluation. The Department may pursue ABET accreditation in the next five to ten years. The assessment plan for the graduate program is shown below.
The master’s program and the graduate certificate program are lumped in this report. The certificate program is part of the graduate program. The students enrolled in this must be admitted as graduate students and they will take four appropriate graduate courses (or Civil Engineering Senior Electives). The details of the certificate program in Civil Engineering are shown in the attachment.

### Table 1. Five-Year Assessment Plan for CE Graduate Program

<table>
<thead>
<tr>
<th>Activity</th>
<th>AY10/11</th>
<th>AY11/12</th>
<th>AY12/13</th>
<th>AY13/14</th>
<th>AY14/15</th>
</tr>
</thead>
<tbody>
<tr>
<td>Direct measures</td>
<td>Technical competence for solving complex problems*</td>
<td>Communication Skills</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Graduate Survey</td>
<td>Every semester</td>
<td>Every Semester</td>
<td>Every Semester</td>
<td>Every Semester</td>
<td>Every Semester</td>
</tr>
<tr>
<td>Alumni Survey</td>
<td></td>
<td></td>
<td></td>
<td>Fall 2013</td>
<td>Fall 2015</td>
</tr>
</tbody>
</table>

* This will be area specific in core courses.

2. Please list in prioritized order (or indicate no prioritization regarding) up to four desired learning outcomes (“takeaways” concerning such elements of curriculum as perspectives, specific content knowledge, skill sets, confidence levels) for students completing the program. For each stated outcome, please provide the reason that it was designated as desired by the faculty associated with the program.

The program educational objectives are a set of outcomes that the Department expects our graduates to achieve after completing the graduate program. That is, upon graduation, the students in the graduate program will be able to:

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

[Please limit your response per outcome to 300 words or less]

These educational objectives are consistent with the mission of the program that targets practicing professional engineers in the community. These educational objectives are patterned after the educational objectives for the undergraduate program that were developed for ABET accreditation. Our master’s and certificate programs are designed for practicing Civil Engineers in the greater Sacramento area.

Practicing civil engineers typically finish their undergraduate degree and start working in one of
the five mains areas of civil engineering (geotechnical, environmental, structural, transportation, and water resources). This group is majority of the graduates of Civil Engineering program. A smaller number of graduates of the undergraduate Civil Engineering program pursue careers in construction or general civil engineering practice. The latter group typically does not pursue any graduate studies. The former group of our graduates pursues a graduate degree and it is necessary for their success in the field. The graduate degree offers the practicing engineers an opportunity to improve their skills to tackle more complex and specialized problems. The students can either pursue their master’s degree or certificate program. The certificate program is designed for students who are interested in specializing in one area by taking 12 units from the courses in the master’s program. Outcomes 1 and 2 were developed to assess the success of the graduate program.

Outcome 3 is designed specifically for our graduates to communicate effectively, with peers, other professionals, decision makers, and the general public – Effective communication is essential in Civil Engineering to be considered as a competent engineer. Civil Engineers deal with the general public, decision makers, and other engineers as they navigate through planning and design phase of infrastructure projects.

3. **For undergraduate programs only**, in what ways are the set of desired learning outcomes described above aligned with the University’s Baccalaureate Learning Goals? Please be as specific as possible.

   [Please limit your response to 400 words or less]

   NA

4. **For each** desired outcome indicated in item 2 above, please:
   a) Describe the method(s) by which its ongoing pursuit is monitored and measured.
   b) Include a description of the sample of students (e.g., random sample of transfer students declaring the major; graduating seniors) from whom data were/will be collected and the frequency and schedule with which the data in question were/will be collected.
   c) Describe and append a sample (or samples) of the “instrument” (e.g., survey or test), “artifact” (e.g., writing sample and evaluative protocol, performance review sheet), or other device used to assess the status of the learning outcomes desired by the program.
   d) Explain how the program faculty analyzed and evaluated (will analyze and evaluate) the data to reach conclusions about each desired student learning outcome.

   [Please limit your response to 200 words or less per learning outcome]

   *(If the requested data and/or analysis are not yet available for any of the learning outcomes, please explain why and describe the plan by which these will occur. Please limit your response to 500 words or less.)*

The assessment program for the graduate program in Civil Engineering started last year. The Department developed a five-year plan for assessment (see Item 1). The Department is
planning to use direct and indirect measure, focus groups, graduating student survey, and alumni survey for its assessment (similar to its well established assessment as part of ABET accreditation). One of the challenges that the Department faces in the assessment of the graduate program is the relatively smaller sample that can be obtained in the assessment. Accordingly, the Department is planning to accumulate the data for multiple-year assessment to be able to make any firm conclusions. This is an area that the Department will investigate as it collects the assessment data.

5. Regarding each outcome and method discussed in items 2 and 4 above, please provide examples of how findings from the learning outcomes process have been utilized to address decisions to revise or maintain elements of the curriculum (including decisions to alter the program’s desired outcomes). If such decision-making has not yet occurred, please describe the plan by which it will occur.

[Please limit your response to 200 words or less per item]

a) Outcome 1 – Succeed in professional employment at their chosen specialty of environmental, geotechnical, structural, transportation, or water resources engineering – This outcome will be assessed by using the alumni survey for the graduate program and the focus groups. The survey instrument for the alumni survey and the questionnaire for the focus groups are shown in the attachment.

b) Outcome 2 – Identify, analyze, and solve complex practical civil engineering problems in their chosen field of specialty – This outcome is assessed by direct measure. The department has developed a five-point scale rubric for grading specific assignments or projects. The data are collected from graduate courses. Example of the data collected in Fall 2010 is shown below. The data were collected from the following courses: ENGR203 – Engineering Statistics; CE231A – Computer Methods of Structural Analysis I; CE252A – Environmental Quality Processes I – Water Chemistry; CE272 – Advanced Hydraulics; and CE280B – Advanced Soil Mechanics and Foundation Engineering II. The Department developed a criterion of achieving the learning outcomes of 80% of the students to be in the score category of 4 and 5. The Department used JMP software for analyzing the data.

c) Outcome 3 – Communicate effectively about technically complex engineering problems to peers, other professionals, decision makers, and the general public, in the conduct of their work.
6. Has the program systematically sought data from alumni to measure the longer-term effects of accomplishment of the program’s learning outcomes? If so, please describe the approach to this information-gathering and the ways in which the information will be applied to the program’s curriculum. If such activity has not yet occurred, please describe the plan by which it will occur.

[Please limit your response to 300 words or less]
The assessment program for the graduate program started in Fall 2010. The feedback that the Department received is through its advisory committees. The Department has the Civil Engineering Program Advisory Committee (CEPIAC), the Environmental/Water Resources Graduate Advisory Committee (EWRGAC), and the Structural Engineering Advisory Committee. The first two committees are very active committees (meet at twice a semester). The latter is not very active (meet occasionally). The EWRGAC advisory committee has a standing subcommittee on curriculum. This advisory committee gives feedback on the curriculum on the graduate courses in environmental and water resources area. Meeting minutes are available if requested.

7. Does the program pursue learning outcomes identified by an accrediting or other professional discipline-related organization as important? Does the set of outcomes pursued by your program exceed those identified as important by your accrediting or other professional discipline-related organization?

[Please limit your response to 300 words or less]
The graduate program is not accredited by an outside agency. As mentioned in Item 1, that in the next five to ten years, the Department may seek accreditation if the ASCE policy statement 465 is adopted by the State.

8. Finally, what additional information would you like to share with the Senate Committee on Instructional Program Priorities regarding the program’s desired learning outcomes and assessment of their accomplishment?

[Please limit your response to 200 words or less]
The Department offers a master’s degree (and certificate program within the graduate program) to practicing professional engineers. The program at Sacramento State is a unique program in Northern California. Chico State has no graduate program; Fresno State has a very small program that cannot be sustained by the number of students available. Sacramento State is the only viable program that can meet the needs of practicing professionals.
Focus Group Questions:
For each specialty area, a focus group will be assembled. The participants will be asked the following questions. All the responses will be documented. The focus groups will be run once a year in spring semester.

1. What CSUS learning experiences were most valuable to you in your career?
2. What knowledge and skills that you acquired during your education have you used most?
3. What knowledge and skills that you acquired during your education have you used the least?
4. What do you wish you had learned in graduate school but did not?
5. What are the emerging and expanding fields in your area of civil engineering?
6. What critical skills and knowledge do engineers need for the future?
7. For managers: What are the strengths and what are the weaknesses of our graduates of the master’s degree in CE program?

Alumni and Graduate Surveys
An annual survey will be gathered from every graduating student. The survey will be sent to the alumni of the graduate program also according to the assessment plan (Fall 2013 and 2015). The survey instrument is:

Part 1 – Background information

1. Name – optional
2. Year and semester graduated
3. Area of Employment, give a list with other (Environmental, Geotechnical, Structural, Transportation, Water Resources, other)
4. Undergraduate School,
5. PE license
6. Date of getting the PE license
7. How often do you use your PE stamp?
8. Type of work, design, planning, operation, construction, other
9. Number of years with current employer
10. Title
11. Member of ASCE, WEB, SEAOC, APWA, CEWA, other
12. Percentage of time spent on communicating with peers
13. Percentage of time spent on communicating with other professionals
14. Percentage of time spent on communicating with the public/decision makers

Part 2 – Assessment Information

1. In what way did the master’s degree help you? (Select all that applies)
   a. Better salary
   b. Handle more complex projects and problems
   c. Personal goal
2. How was your graduate degree supported?
   a. Personal finance
   b. Financial loan
   c. Employer supported
   d. Other (specify)
3. Did the graduate program help you in improving your communication skills (rate 1 through 5)
4. Did the graduate program improve your analytical skills (rate 1 through 5)
5. Would you recommend the program to others in your field (rate 1 through 5)
6. Provide suggestions on improving the program in the area of communication skills
7. Provide suggestions on improving the program in the area of the technical skills
8. What was your least favorite course? Why?
9. Can you suggest ways to improve the least favorite course?
10. What was your most favorite course? Why?
11. Provide us with suggestions to improve the graduate program.

The Department will use direct mail to collect the survey data through Student Voice software. The Department has been successful using Student Voice with its undergraduate surveys.
Graduate Certificate Program in Civil Engineering

The graduate certificate program in Civil Engineering is designed to recognize students who have completed core graduate courses in a specialty area in Civil Engineering. This program meets the need of professional engineers that are interested in sharpening their skills in their specialty area. The certificate program is available to matriculated students in the Civil Engineering Graduate Program. A grade point average of 3.0 must be attained for all courses taken in the program. Certificates in the following areas are offered:

### Environmental Engineering:

**Geo-Environmental Certificate**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
<th>Notes</th>
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</thead>
<tbody>
<tr>
<td>CE 181</td>
<td>Geoenvironmental Engineering</td>
<td>3</td>
<td>(CE 171A or instructor permission)</td>
</tr>
<tr>
<td>CE 252A</td>
<td>Environmental Quality Processes I</td>
<td>3</td>
<td>(CE 170 or equivalent)</td>
</tr>
<tr>
<td>CE 255</td>
<td>Transport of Chemicals in Soil Systems</td>
<td>3</td>
<td>(MATH 45, graduate status)</td>
</tr>
<tr>
<td>ENGR 203</td>
<td>Engineering Statistics</td>
<td>3</td>
<td>(ENGR 115 or equivalent)</td>
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**Treatment Systems Certificate**

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<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
<th>Notes</th>
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</thead>
<tbody>
<tr>
<td>CE 252A</td>
<td>Environmental Quality Processes I</td>
<td>3</td>
<td>(CE 170 or equivalent)</td>
</tr>
<tr>
<td>CE 252B</td>
<td>Environmental Quality Processes II</td>
<td>3</td>
<td>(CE 170 or equivalent; CE 252A recommended, or instructor permission)</td>
</tr>
<tr>
<td>CE 252C</td>
<td>Environmental Quality Processes III</td>
<td>3</td>
<td>(CE 170 or equivalent; CE 252A recommended, or instructor permission)</td>
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<tr>
<td>ENGR 203</td>
<td>Engineering Statistics</td>
<td>3</td>
<td>(ENGR 115 or equivalent)</td>
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**Water Quality Certificate**

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<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
<th>Notes</th>
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<tbody>
<tr>
<td>CE 250</td>
<td>Systems Analysis of Resources Development</td>
<td>3</td>
<td>(Graduate status or instructor permission)</td>
</tr>
<tr>
<td>CE 252A</td>
<td>Environmental Quality Processes I</td>
<td>3</td>
<td>(CE 170 or equivalent)</td>
</tr>
<tr>
<td>CE 254</td>
<td>Water Quality Management</td>
<td>3</td>
<td>(CE 170 or equivalent; CE 252A recommended, or instructor permission)</td>
</tr>
<tr>
<td>ENGR 203</td>
<td>Engineering Statistics</td>
<td>3</td>
<td>(ENGR 115 or equivalent)</td>
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### Geotechnical Engineering:

**Foundation Engineering Certificate**

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<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>CE 280A</td>
<td>Advanced Soil Mechanics and Foundation Engineering I</td>
<td>3</td>
<td>(CE 171A or equivalent)</td>
</tr>
<tr>
<td>CE 280B</td>
<td>Advanced Soil Mechanics and Foundation Engineering II</td>
<td>3</td>
<td>(CE 171A or equivalent)</td>
</tr>
<tr>
<td>CE 280C</td>
<td>Advanced Soil Mechanics Laboratory</td>
<td>2</td>
<td>(CE 280A; Corequisite: CE 280B)</td>
</tr>
<tr>
<td>CE 284</td>
<td>Soil Dynamics and Earthquake Engineering</td>
<td>3</td>
<td>(CE 171A or equivalent)</td>
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**Ground Modification Certificate**
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<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Prerequisites</th>
</tr>
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<tbody>
<tr>
<td>CE 283</td>
<td>Ground Modification Engineering (CE 171A or equivalent)</td>
<td></td>
</tr>
<tr>
<td>CE 285</td>
<td>Geosynthetics I (CE 171A or instructor permission)</td>
<td></td>
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<tr>
<td>CE 286</td>
<td>Geosynthetics II (CE 171A or instructor permission)</td>
<td></td>
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<tr>
<td>ENGR 203</td>
<td>Engineering Statistics (ENGR 115 or equivalent)</td>
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### Structural Engineering:

Structural Engineering Certificate

- **CE 231A** Computer Methods of Structural Analysis I (CE 161)
- **CE 232** Stability of Structures (CE 231A or instructor permission)
- **CE 234** Dynamics and Earthquake Response of Structures (Knowledge of the stiffness method of structural analysis)
- **CE 266** Advanced Design in Reinforced Concrete (CE 161, CE 163, CE 164)

### Transportation Engineering:

Transportation Planning Certificate

- **CE 250** Systems Analysis of Resources Development (Graduate status or instructor permission)
- **CE 261** Transportation Planning (CE 148 or instructor permission)
- **CE 262** Advanced Transportation Facility Design (CE 147 or instructor permission)
- **ENGR 203** Engineering Statistics (ENGR 115 or equivalent)

Transportation/Traffic Engineering Certificate

- **CE 250** Systems Analysis of Resources Development (Graduate status or instructor permission)
- **CE 263** Traffic Flow Theory (CE 147 or CE 148; ENGR 203 or instructor permission)
- **CE 265** Analysis and Control of Traffic Systems (CE 147 or CE 148; CE 263 or instructor permission)
- **ENGR 203** Engineering Statistics (ENGR 115 or equivalent)

### Water Resources Engineering:

Engineering Hydraulics Certificate

- **CE 272** Advanced Engineering Hydraulics (CE 137 or equivalent)
- **CE 274** Hydrologic Modeling (CE 272 or equivalent; instructor permission)
- **CE 276** Groundwater Hydrology (CE 137 or instructor permission)
(3) **ENGR 203**  Engineering Statistics ([**ENGR 115** or equivalent)

**Water Resources Planning Certificate**

(3) **CE 250**  Systems Analysis of Resources Development (Graduate status or instructor permission)

(3) **CE 251**  Water Resources Planning ([**CE 250** or instructor permission]

(3) **CE 271**  Modern Hydrologic Techniques ([**CE 137** or **CE 138** and [**ENGR 203** or instructor permission]

(3) **ENGR 203**  Engineering Statistics ([**ENGR 115** or equivalent)