This document describes the evaluation of ABET Program Educational Objectives (PEOs) and Student Outcomes for the Civil Engineering undergraduate program for 2014-15. Data were collected throughout the year and evaluated by the CEE Assessment Committee (Drs. Barr, Dupont, McNeill, and Tullis) in January and May 2015.

**Program Educational Objectives**
The Civil Engineering (CE) Program Educational Objectives (PEOs) are reviewed by each of the program’s three constituencies (Table 1).

Table 1: PEO Review Process and Schedule for CE Program Constituency

<table>
<thead>
<tr>
<th>Constituency</th>
<th>Review opportunity</th>
<th>Frequency</th>
<th>Most recent reviews</th>
<th>Date of next review</th>
</tr>
</thead>
<tbody>
<tr>
<td>Students</td>
<td>Freshman Orient. (CEE 1880)</td>
<td>Every freshman class (Fall and Spring)</td>
<td>Spring semester 2015</td>
<td>Fall semester 2015</td>
</tr>
<tr>
<td></td>
<td>Junior design course (CEE 3880)</td>
<td>Every junior class (Spring)</td>
<td>Spring 2015</td>
<td>Spring 2016</td>
</tr>
<tr>
<td></td>
<td>Senior exit interview</td>
<td>Every graduating class (Fall and Spring)</td>
<td>April 2015</td>
<td>November 2015</td>
</tr>
<tr>
<td>Employers</td>
<td>Advisory Board meeting</td>
<td>Annually (typically late Fall)</td>
<td>November 2014</td>
<td>November 2015</td>
</tr>
<tr>
<td>Faculty</td>
<td>CEE Faculty Retreat</td>
<td>Annually (August)</td>
<td>August 2014</td>
<td>August 2015</td>
</tr>
</tbody>
</table>

**Students:** The PEOs are introduced to the freshman class in CEE 1880 as part of a lecture on the accreditation and licensing processes (see the slides in Appendix A). The CEE Assessment Committee met in January 2015 to evaluate assessment results from the Fall 2014 semester. With respect to students and PEOs, the committee recommended that the PEOs be introduced in the first class of the capstone design sequence (CEE 3880) beginning Spring semester 2015. This will remind continuing students about the PEOs and also allow transfer students (who typically do not take CEE 1880) to see the PEOs. Finally, as part of the senior exit interview process, graduating seniors are given an opportunity to review the PEOs in an effort to establish some big picture career goals. Student comments related to the PEOs (Appendix B) were generally positive.

**CEE Advisory Board:** The CEE Advisory Board met on November 7, 2014 (see Appendix C for meeting minutes). The Advisory Board unanimously approved keeping the current PEOs. The PEOs will continue to be reviewed and discussed at all future annual Advisory Board Meetings.

**Program Faculty:** The PEOs are reviewed and discussed with the program faculty at the annual faculty retreat, which takes place every August just prior to the Fall semester. The faculty unanimously approved keeping the current PEOs during the 2014 faculty retreat (see Appendix D for meeting minutes). The PEOs will continue to be reviewed and discussed at all future annual faculty retreats.
**Student Outcomes**

Evaluation of the Student Outcome attainment is conducted by the CEE Assessment committee on a specified schedule with approximately one-third of the Student Outcomes assessed every year (Table 2). When deficiencies are identified, recommendations are made to fix specific problems and support continuous improvement. For example, Outcome f was re-assessed this year because the program did not meet the performance goals in 2013-14.

<table>
<thead>
<tr>
<th>Evaluation Date</th>
<th>School Year</th>
<th>Outcomes evaluated</th>
</tr>
</thead>
<tbody>
<tr>
<td>May 2015</td>
<td>2014-15</td>
<td>a, b, c, d, f</td>
</tr>
<tr>
<td>May 2016</td>
<td>2015-16</td>
<td>e, f, g</td>
</tr>
<tr>
<td>May 2017</td>
<td>2016-17</td>
<td>h, i, j, k</td>
</tr>
<tr>
<td>May 2018</td>
<td>2017-18</td>
<td>a, b, c, d</td>
</tr>
<tr>
<td>May 2019</td>
<td>2018-19</td>
<td>e, f, g</td>
</tr>
<tr>
<td>May 2020</td>
<td>2019-20</td>
<td>h, i, j, k</td>
</tr>
</tbody>
</table>

The assessment process uses data from three sources: student coursework, FE Exam results, and senior exit interviews. The 2014-15 Assessment of Student Outcomes includes data from Fall 2014 and Spring 2015.

**Student Coursework:** Outcomes a, b, c, d, and f were reviewed in 2014-15 (Table 2). Assessment data are summarized in Table 3 and Figure 1; detailed evaluation of each outcome is presented in Appendix E. Student assignments are evaluated on a 0-1-2 scale, which corresponds to the student’s performance not meeting, partially meeting, and meeting the Outcome Objective, respectively. The CE program has two goals for student performance:

- Goal 1: a minimum of 70% of the students will perform at a 2 level
- Goal 2: a minimum of 80% of the students will perform at the 1 or 2 level.

Note the “sample size” in Table 3 refers to the number of individual examples of student work that were assessed for each outcome, not the number of students.

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Sample size</th>
<th>2</th>
<th>1</th>
<th>0</th>
<th>Sum of 1&amp;2</th>
</tr>
</thead>
<tbody>
<tr>
<td>a</td>
<td>772</td>
<td>72%</td>
<td>17%</td>
<td>11%</td>
<td>89%</td>
</tr>
<tr>
<td>b</td>
<td>204</td>
<td>68%</td>
<td>20%</td>
<td>12%</td>
<td>88%</td>
</tr>
<tr>
<td>c</td>
<td>397</td>
<td>79%</td>
<td>12%</td>
<td>9%</td>
<td>91%</td>
</tr>
<tr>
<td>d</td>
<td>226</td>
<td>85%</td>
<td>12%</td>
<td>3%</td>
<td>97%</td>
</tr>
<tr>
<td>f</td>
<td>229</td>
<td>72%</td>
<td>25%</td>
<td>3%</td>
<td>97%</td>
</tr>
</tbody>
</table>
Both goals were met for Outcomes a, c, d, and f, but Goal 1 (≥ 70% performing at the 2 level) was not met for Outcome b. As noted in the 2013-14 report, previous assessment for Outcome b focused on students’ ability to conduct experiments and analyze/interpret data, but not on design of experiments. Based on the Assessment Committee’s recommendation, during 2014-2015 we intentionally introduced assignments requiring students to design (not just conduct) experiments. While the performance on Outcome b in CEE 2240 (Surveying) was lower than desired, this is a sophomore-level class with a significant portion of students who do not continue in the CE program, so the results are not surprising. An experimental design exercise was also added to CEE 5070 (Steel Design) for the first time, and performance was lower than desired. This exercise will be refined for future years. In addition, an experimental design exercise will be added to the CEE 3160 (Material Science) and CEE 3500 (Fluid Mechanics) classes for next year.

During the 2013-14 evaluation of Outcome f (ethics), it was noted that 94% of student assessments rated a 1 or 2, which met Goal 2. However, Goal 1 was not met, as only 66% of the students performed at a 2 level. This was mainly due to poorer performance on the ethics quiz in CEE 3880 (Design I). Based on this evaluation, we added additional information on professional ethics and brought in a guest speaker from the Utah Division of Occupational and Professional Licensing for the Fall 2014 CEE 4870 (Design II) class. During 2014-15, student performance on Outcome f was improved and both goals were met.
**Fe Exam:** Our goal is to have 100% pass rate on the FE exam; our minimum acceptable level of performance is a pass rate at or above the national average. Table 4 summarizes the FE results for the past six years, including the percentage of students who had passed the FE exam by the time of graduation. The USU CE pass rate has been between 90% and 100%, with the exception of 2009-10 when we were just above the national average.

Table 4: CE Graduates Passing FE Exam vs. National Pass Rate

<table>
<thead>
<tr>
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</tr>
</thead>
<tbody>
<tr>
<td>Total CE degrees</td>
<td>60</td>
<td>64</td>
<td>50</td>
<td>43</td>
<td>56</td>
<td>61</td>
</tr>
<tr>
<td>% graduates passing FE</td>
<td>75%</td>
<td>94%</td>
<td>90%</td>
<td>95%</td>
<td>93%</td>
<td>100%</td>
</tr>
<tr>
<td>National CE pass rate</td>
<td>74%</td>
<td>75%</td>
<td>74%</td>
<td>74%</td>
<td>72%</td>
<td>70%</td>
</tr>
</tbody>
</table>

FE Exam performance by topic for first-time test takers is summarized in Figure 2. Students performed at the national average on all sections except Probability and Statistics. Overall, the fact that nearly all CE students continue to pass the FE exam is a strong, independent, external indicator for meeting Student Outcomes a and f. It is also a strong indication of a good foundation for life-long (independent) learning skills.

![Figure 2: Scaled Fe Exam results (math, science, engineering fundamentals). Error bars represent uncertainty range for scaled scores.](image)
**Senior exit interview:** During the Fall 2014 semester, the senior exit interview process was updated and converted to an online format. At this time, the Student Outcomes assessment method was updated to the 0-1-2 method to be consistent with the other assessment (0 = outcome not met, 1 = outcome partly met, 2 = outcome fully met). The performance goal is to have at least 80% of the students rating their attainment as “fully met” (2) or “partly met” (1), which was achieved for all five outcomes (Figure 3). We do note, however, that 35% of the students rated Outcome c (design) as only “partly met”. This is likely due to changes implemented in the junior/senior design capstone sequence; the instructor will continue to revise those design classes. Acknowledging that this is a subjective self-evaluation, these exit interview results are taken as a general indication that students feel they are meeting the outcomes.

![Figure 3: Student exit interview ratings of progress on Outcomes a, b, c, d, and f](image)

**Summary:** The CEE Assessment Committee met in January and May 2015 and evaluated all of the assessment data presented herein.

The evaluation of student work, FE Exam results, and senior exit interviews indicates that Outcomes a, c, d, and f are being met. Performance on Outcome f was improved due to inclusion of additional material on ethics and professional licensure in senior design.

Goal 1 for student coursework (≥ 70% performing at the 2 level) was not met for Outcome b, although Goal 2 was met. Based on last year’s results, students seem to be adequately prepared to ‘conduct experiments’ and ‘analyze and interpret data’ but are lacking in the area of ‘experimental design.’ A new experimental design exercise was implemented in CEE 5070; it was moderately successful and the instructor plans to revise for next year.
Recommendations
Evaluate Outcomes a, c, and d as planned during the 2017-18 school year, and evaluate Outcome f as planned in the 2015-16 school year. Add new experimental design activities to CEE 3160 and CEE 3500, and revise activity in CEE 5070. Consider not evaluating experimental design in CEE 2240. Re-evaluate Outcome b during the 2015-16 school year.
Appendix A
Slides from CEE 1880
(introducing freshmen students to ABET PEOs and outcomes)

- Bachelor of Science Accredited Degree
  - Civil Engineering
  - Environmental Engineering
- Master's Degrees
- Doctor of Philosophy Degree (Ph.D.)

ABET Accreditation is important:
- Accreditation Board of Applied Sciences, Computing, Engineering, and Technology
- Required ABET degree to achieve a Professional Engineers License (PE) to practice as a professional engineer.

New Engineering Building at Utah State University

Western Schools with ABET Accredited Degrees in both Civil and Environmental Engineering:
- Oregon State University
- University of California at Berkeley
- University of Nevada at Reno
- Colorado State University
- University of Colorado
- United States Air Force Academy
- California Polytechnic State University
- University of Southern California
- North Carolina State University
- University of Oklahoma
- University of Texas at Austin
ABET is a voluntary, non-governmental organization that accredits colleges and universities for the education of the students in engineering, engineering technology and computer science programs. ABET is an independent, non-profit, non-governmental organization that establishes and maintains criteria for the accreditation of degree-granting programs in engineering, engineering technology, and computer science. ABET accreditation signifies that an institution is meeting the standards for providing quality education. It is recognized by the Council for Higher Education Accreditation (CHEA).

Program Educational Objectives:
- Prepare graduates for careers in environmental engineering, water resource management, and water quality management.
- Develop an understanding of the principles and applications of environmental engineering.
- Foster an appreciation for the ethical and social implications of engineering.
- Encourage participation in professional organizations and activities.

Market Outcomes:
The Civil Engineering and Environmental Engineering Program at Utah State University prepares students to be effective engineers in the field of civil and environmental engineering. Graduates of the program are prepared to work in a variety of industries, including construction, environmental consulting, and government agencies. The program emphasizes the development of technical skills, the ability to work in teams, and the ability to communicate effectively.

ABET Accreditation at Utah State University leads to proficiency in the areas of Civil and Environmental Engineering:
- Civil Engineering
- Geotechnical Engineering
- Hydraulic and Fluid Mechanics
- Water Resources
- Transportation Engineering
- Environmental Engineering

Utah State University Mission Statement:
The mission of Utah State University is to provide a world-class education and research experience, to foster a vibrant and diverse community, to serve our state and region, and to engage the world in solving complex problems.
Code of Ethics (from ASCE)

Fundamental Principles

Engineers uphold and advance the integrity, honor and dignity of the engineering profession by:

using their knowledge and skill for the benefit of humanity and the environment;
being honest and impartial, and serving the public, their employers, and clients;
attaining to the highest competence and integrity of the engineering profession; and
supporting the professional and technical activities of their discipline.

Fundamental Canons (from ASCE)

- Engineers shall hold paramount the safety, health and welfare of the public and shall perform services with knowledge, integrity, and impartiality in the performance of their professional duties.
- Engineers shall perform services only in areas of their competence.
- Engineers shall issue professional opinions only in those areas in which they have knowledge and skill.
- Engineers shall act in professional matters for each employer or client in a faithful manner and shall maintain the utmost of integrity.
- Engineers shall maintain their professional reputation through careful attention to their services and shall not associate with those engaged in practices that are unsound.
- Engineers shall act in such a manner as to credit and enhance honor, integrity, and dignity of the engineering profession.

And after graduation, becoming a Licensed Professional Engineer

- Obtain a degree in engineering from an ABET accredited program.
- Pass the Fundamentals of Engineering exam.
- Obtain Professional Engineering license from the state where you will practice.
- Obtain Professional Civil Engineer license.
Appendix C
Minutes of the CEE Advisory Board Meeting
Nov 7, 2014

Hardcopy of meeting minutes is available in the ABET Binder

Appendix D
CEE Annual Faculty/Staff Retreat Minutes
August 18, 2014

Hardcopy of meeting minutes is available in the ABET Binder

Appendix E
Detailed Evaluation for Outcomes a, b, c, d, and f

Hardcopies of evaluations are available in the ABET Binder