This document describes the evaluation of ABET Program Educational Objectives (PEOs) and Student Outcomes for the Civil Engineering undergraduate program for 2015-16. Data were collected throughout the year and evaluated by the CEE Assessment Committee (Drs. Barr, Dupont, McNeill, and Tullis) in January and May 2016.

**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 2016</td>
<td>Fall semester 2016</td>
</tr>
<tr>
<td></td>
<td>Junior design course (CEE 3880)</td>
<td>Every junior class (Spring)</td>
<td>Spring 2016</td>
<td>Spring 2017</td>
</tr>
<tr>
<td></td>
<td>Senior exit interview</td>
<td>Every graduating class (Spring)</td>
<td>April 2016</td>
<td>April 2017</td>
</tr>
<tr>
<td>Employers</td>
<td>Advisory Board meeting</td>
<td>Annually (typically late Fall)</td>
<td>November 2015</td>
<td>November 2016</td>
</tr>
<tr>
<td>Faculty</td>
<td>CEE Faculty Retreat</td>
<td>Annually (August)</td>
<td>August 2015</td>
<td>August 2016</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). PEOs are again shown to the juniors in CEE 3880. This reminds continuing students about the PEOs and allows 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 very positive.

**CEE Advisory Board**: The CEE Advisory Board met on November 3, 2015 (see Appendix C for meeting minutes). The PEOs were reviewed and discussion included the desire for the program to encourage students to improve their communication skills (PEO1) and support for including “sustainability considerations” in PEO2. 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 2015 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**

Assessment 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 b was re-assessed this year because the program did not meet the performance goals in 2014-15.

<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</td>
</tr>
<tr>
<td><strong>May 2016</strong></td>
<td><strong>2015-16</strong></td>
<td><strong>b, e, f, g</strong></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 2015-16 Assessment of Student Outcomes includes data from Fall 2015 and Spring 2016.

**Student Coursework:** Outcomes b, e, f, and g were reviewed in 2015-16 (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 ratings</th>
</tr>
</thead>
<tbody>
<tr>
<td>b</td>
<td>149</td>
<td>64%</td>
<td>31%</td>
<td>5%</td>
<td>95%</td>
</tr>
<tr>
<td>e</td>
<td>787</td>
<td>72%</td>
<td>19%</td>
<td>9%</td>
<td>91%</td>
</tr>
<tr>
<td>f</td>
<td>205</td>
<td>67%</td>
<td>31%</td>
<td>2%</td>
<td>98%</td>
</tr>
<tr>
<td>g</td>
<td>669</td>
<td>80%</td>
<td>17%</td>
<td>3%</td>
<td>97%</td>
</tr>
</tbody>
</table>

Table 3: Aggregated Assessment Results for CE Classes, Fall 2015 and Spring 2016
Both goals were met for Outcomes e and g, but Goal 1 (≥ 70% performing at the 2 level) was not met for Outcomes b and f. Continuing from the 2013-14 and 2014-15 reports, assessment for Outcome b is looking at students’ ability to design experiments, as well as to conduct experiments and analyze/interpret data. Based on the Assessment Committee’s recommendation, during Fall 2015 we intentionally introduced assignments requiring students to design (not just conduct) experiments to the CEE 3160 (Material Science) and CEE 3500 (Fluid Mechanics) classes. Goal 2 was met with 95% of student work rating a 1 or 2, but the 64% performance on Goal 1 was slightly under the target of 70% rating a 2. Although both goals were not met, overall performance was pretty good considering this was the first time these exercises were done in these classes. We feel that we continue to make progress on having students design experiments, and these exercises will be refined for future years.

Student attainment on Outcome f (ethics) was assessed in the introductory seminar class (CEE 1880) through a group writing assignment on the ethics associated with an engineering failure and a quiz about the code of ethics in CEE 3610. Goal 2 was met with 98% of student work rating a 1 or 2, but the 67% performance on Goal 1 was slightly under the target of 70% rating a 2. Although both goals were not met, overall performance was pretty good considering this was the first time these exercises were done in these classes. We feel that we continue to make progress on having students design experiments, and these exercises will be refined for future years.

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Figure 1: Aggregated Assessment Results for CE Classes for Fall 2015 and Spring 2016

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**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%, well above the national average.

<table>
<thead>
<tr>
<th></th>
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<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>% graduates passing FE</td>
<td>94%</td>
<td>90%</td>
<td>95%</td>
<td>93%</td>
<td>100%</td>
<td>98%</td>
</tr>
<tr>
<td>National CE pass rate</td>
<td>75%</td>
<td>74%</td>
<td>74%</td>
<td>72%</td>
<td>70%</td>
<td>69%</td>
</tr>
</tbody>
</table>

FE Exam performance by first-time test takers for various engineering topics is summarized in Figures 2, 3, 4, and 5. During the Fall 2015 and Spring 2016 testing periods, USU CE students performed at or above the national average on all engineering topics (including the uncertainty range). Overall, the fact that nearly all CE students continue to pass the FE exam is a strong, independent, external indicator for meeting Student Outcomes e and f. It is also a strong indication of a good foundation for life-long (independent) learning skills.

![Figure 2: Scaled Fe Exam results (statics, dynamics, mechanics, and materials). Error bars represent uncertainty range for scaled scores.](image-url)
Figure 3: Scaled Fe Exam results (structural analysis and design, geotechnical engineering, transportation engineering). Error bars represent uncertainty range for scaled scores.

Figure 4: Scaled Fe Exam results (fluids, hydraulics, environmental engineering). Error bars represent uncertainty range for scaled scores.
Figure 5: Scaled Fe Exam results (ethics and professional practice). Error bars represent uncertainty range for scaled scores.

**Senior exit interview:** Graduating seniors complete an anonymous online exit interview to provide feedback about the CE program. The performance goal is to have at least 80% of the students rating their attainment as “met (2)” or “partly met (1)”, which was achieved for all four outcomes (Figure 6). 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 outcome.
Summary: The CEE Assessment Committee met in January and May 2016 and evaluated all of the assessment data presented herein.

The evaluation of student work, FE Exam results, and senior exit interviews indicates that Outcomes e and g are being met. Goal 1 for student coursework (≥ 70% performing at the 2 level) was not met for Outcomes b and f, although Goal 2 was met and the goals for the FE Exam and exit interviews were met.

Recommendations
Evaluate Outcomes e and g as planned during the 2018-19 school year. Instructors in CEE 3160 and CEE 3500 will continue to refine the “design an experiment” exercises in their classes, and Outcome b will be re-evaluated in the 2016-17 school year. Outcome f (ethics) will also be re-evaluated in 2016-17 school year.
Appendix A
Slides from CEE 1880
(introducing freshmen students to ABET PEOs and outcomes)
ABET is a respected, professional organization that accredits college and university programs in the disciplines of Applied Science, Computing disciplines, Engineering, Engineering Technology, Entrepreneurship, and Health Sciences. The ABET recognizes programs that meet high standards of quality and value. It ensures that programs prepare students with the knowledge and skills necessary to enter the profession.

Program Educational Objectives
Program Educational Objectives (PEO) are broad statements that describe what graduates are expected to achieve within the years of graduation.

Utah State University Mission Statement:
The mission of Utah State University is to be one of the nation's leading land-grant institutions, providing world-class education, research, and service. We are committed to excellence, diversity, and inquiry by focusing on our land-grant mission, our students, faculty, and staff, and our service to the state, region, and world.

College of Engineering Mission Statement:
The mission of the College of Engineering is to be a leader in the advancement of engineering and technology education and research. We are committed to providing our students with the knowledge and skills necessary to be successful in their careers and to contribute to the advancement of society.

Market Outcomes
The Civil Engineering and Environmental Engineering Programs at Utah State University lead to proficiency in at least 4 areas of Civil and Environmental Engineering:

- Structural Engineering
- Geotechnical Engineering
- Hydraulics and Fluid Mechanics
- Water Resources
- Transportation Engineering
- Environmental Engineering

ABET Accreditation as Utah State University leads to proficiency in at least 4 areas of Civil and Environmental Engineering.
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 enhancement of human welfare and the environment;
  - Acting honorably and responsibly and serving with fidelity the public, their employers and clients;
  - Working to increase the competence and prestige of the engineering profession; and
  - Supporting the professional and technical standards of their disciplines.

Fundamental Canons (from ASCE):
- Engineers shall hold paramount the safety, health and welfare of the public and shall perform services only in connection with the proper design, construction and operation of structures and systems that constitute a substantial development in the performance of their professional duties.
- Engineers shall perform services only in areas of their competence.
- Engineers shall issue professional opinions only in good faith and in a courteous, honest and truthful manner.
- Engineers shall act in professional matters for each employer or client as faithful agents or trustees, and shall avoid conflicts of interest.
- Engineers shall cultivate their professional reputation on the merit of their services and shall not compete unfairly with others.
- Engineers shall act in such a manner as to conduct and maintain their honor, integrity, and dignity of the engineering profession.
- Engineers shall continue their professional development throughout their careers and shall provide opportunities for the professional development of their associates and their employees.
Appendix B
Student Comments on PEOs from Exit Interviews

I feel that all PEOs were either explicitly or implicitly worked towards through my classes. It would be beneficial to include a discussion of these PEOs in the Introduction to Engineering and Design classes if that does not already happen.

I respect these goals, they envelope multiple aspects of entering a career field.

These are great goals. I also hope to achieve these goals within five years.

I feel like each one of these PEO’s are satisfied.

these are excellent objectives ... I think it would have been cool to know these department had these objectives before I was graduating

There were a few things I learned from my job/internship I would have liked to learned more about in school. Things such as the various types of engineering firms and jobs a civil engineering graduate can have.

I think the program has done a great job at getting me prepared to accomplish the desired PEOs. I feel that they have done more than expected to help all students succeed. The care and support that was shown did not only apply to in class learning but after hours as well.

They sound good to me. I hope it works out this way.
Appendix C
Minutes of the CEE Advisory Board Meeting
Nov 3, 2015

Hardcopy of meeting minutes is available in the ABET Binder

Appendix D
CEE Annual Faculty/Staff Retreat Minutes
August 19, 2015

Hardcopy of meeting minutes is available in the ABET Binder

Appendix E
Detailed Evaluation for Outcomes b, e, f, and g

Hardcopies of evaluations are available in the ABET Binder