Civil Engineering
ABET Evaluation Summary
2015-2016

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 2: Evaluation Schedule for Student Outcomes

<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 3: Aggregated Assessment Results for CE Classes, Fall 2015 and Spring 2016

<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>
Both goals were met for Outcomes e and g, but Goal 1 ($\geq 70\%$ 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.

Unfortunately, this outcome was not assessed in the junior design class as originally planned, so we cannot evaluate performance of upper-level students. These results do not mean our students are unethical (in fact they performed above-average on the FE Exam; see next section), but rather is due to lack of assessment in a sufficient number of appropriate classes. We must assess Outcome f in the junior design class, and encourage faculty to design ethics assignments for other classes as well.
**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>Table 4: CE Graduates Passing FE Exam vs. National Pass Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>----------</td>
</tr>
<tr>
<td>Total CE degrees</td>
</tr>
<tr>
<td>% graduates passing FE</td>
</tr>
<tr>
<td>National CE pass rate</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.

![Scaled Fe Exam results](image)
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.
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)

- Bachelor of Science
  - Civil Engineering
  - Environmental Engineering
- Master's Degrees
- Doctor of Philosophy Degree (PhD)

ABET Accreditation is important:
- Accreditation Board of Applied Sciences, Computing, Engineering, and Technology
- Required ABET degree to achieve a Professional Engineer License (PE) to practice as a professional engineer
ABET is a non-profit, not-for-profit organization that accredits college and university programs in the disciplines of Applied Science, Computing, Engineering, and Engineering Technology. UAEU Engineering and Technology is an ABET-accredited program, which means that the program meets the criteria established by the profession for which the program is accredited and is in good standing.

Utah State University Mission Statement:
The mission of Utah State University is to be one of the nation’s premier land-grant institutions committed to excellence in teaching, learning, research, and community engagement.

College of Engineering Mission Statement:
The mission of the USU College of Engineering is to provide excellent education and research opportunities for students and faculty, with the necessary tools and facilities to be leaders of innovation in creating new technological solutions that are needed.

Program Educational Objectives:
Program educational objectives (PEOs) are broad statements that describe what graduates are expected to achieve within five years of graduation.

The USU College of Engineering has achieved PEOs within the past five years of graduation:
- PEO 1: Graduates will be able to perform well in their chosen profession.
- PEO 2: Graduates will have a strong understanding of the design and analysis of engineering systems.
- PEO 3: Graduates will have the ability to apply their knowledge to new situations.
- PEO 4: Graduates will have the ability to communicate effectively in their chosen profession.
- PEO 5: Graduates will have the ability to work effectively in teams.
- PEO 6: Graduates will have the ability to engage in lifelong learning.

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- PEO 4: Graduates will have the ability to communicate effectively in their chosen profession.
- PEO 5: Graduates will have the ability to work effectively in teams.
- PEO 6: Graduates will have the ability to engage in lifelong learning.

Market Outcomes:
The Civil Engineering and Environmental Engineering Program at Utah State University prepares students to excel in the program educational objectives. By the time of graduation, students will have:
- Effective technical knowledge of mathematics, science, and engineering
- The ability to apply technical knowledge in solving real-life problems
- The ability to communicate effectively
- The ability to work in a team environment
- The ability to engage in lifelong learning

ABET Accreditation at Utah State University leads 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

USU graduates will achieve proficiency in at least 4 areas of Civil and Environmental Engineering.
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

- Laurie McNeill-ABET
  - Process:
    - Fall 2013-Spring 2014: self-study report
    - Submitted and had a site visit in Sept 2014 by program evaluators
    - January 2015 received draft report from evaluators
    - Feb 2015 and May 2015 CEE submitted responses to the draft report
  - Did we pass?
    - YES!
      - Accredit to September 20, 2021
        - Maximum time period offered by ABET
  - Deficiency: criterion, policy, procedure is not satisfied
  - Weakness: program lacks the strength of compliance with a criterion, policy, or procedure to ensure the quality of the program will not be compromised
  - Concern: program currently satisfies a criterion policy, or procedure
    - Continuous improvement: the program must regularly use appropriate, documented processes for assessing and evaluation the extent to which student outcomes are being attained
    - We received a concern in each area, and are working to improve everything we can
  - Student coursework, FE exam results
    - We can pick out how well or poor students do in certain areas of the exam
    - Student exit interviews
  - Outcome F
    - Understanding of professional and ethical responsibility
    - We now have guest speakers attend classes and give real life examples of ethics, etc
  - Outcome B
    - Ability to design and conduct experiments, as well as analyze and interpret data
    - Marc Maguire is addressing this in his class
  - To do list
    - Keep assessing one outcome in e,f,g categories
    - Keep implementing structural design
    - Program educational objectives
      - Are these still things we should be expecting from our students?
• Email feedback
  ▪ Abet wants the advisory board to make sure we are all on the same page
    ▪ Allow to take PE exam early
    ▪ Can we track who’s graduated, and is professional?
      ○ Alumni survey
      ○ How many pass the PE, but not individual identifiers
  ▪ How is PEO 1 tracked?
    ▪ We aren’t required to formally track them
    ▪ Do we want to track these officially?
  ▪ PEO 2
    ▪ Report issued annually
    ▪ Depending on if you have a sustainability program in place, it benefits individual businesses
  ▪ Oral communication is extremely important, and people don’t do this anymore
    ▪ Don’t be shy about selling yourself!
      ○ It’s your opportunity to show what you’re able to do
    ▪ Give them the opportunity to interact with other people face to face
Note: non-ABET related items have been removed from these minutes

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

ABET evaluation: Laurie

- Did we pass?
  - We don’t know…
  - Handout
  - There is no formal process to evaluate PEOs, but no comments from faculty now
  - Breaking up A-K

- Student course work:
  - Rating scale: 0-2
  - Performance goals
  - Student outcome
    - Outcome B

- Not necessarily worried
  - Wording out outcome is design and conducted experiments
    - We didn’t have them design experiments
    - “how would you collect the data”?
    - New thing that we’re continuing to implement

- FE Exam
  - Goal 100% pass rate
  - Wanting to be above national average
  - 93% last year
  - Probability and statistics is below zero
    - Maybe because we no longer offer 3030?
  - Otherwise above or at zero axis
  - Water, transportations, surveying divisions are above average

- Senior exit interviews
  - Response rate has improved
  - Online survey has helped
  - 80% met or partly met goal
  - Indication of their self-assessment is positive!
• To do
  o Outcomes E,F,G in all UG classes, each time taught
  o Keep implementing experimental design activities

• In the doghouse:
  o Jim Bay
  o Gilberto Urroz
Appendix E
Detailed Evaluation for Outcomes b, e, f, and g

See following pages
Civil Engineering
ABET Outcome Summary
2015-2016

Outcome b: an ability to design and conduct experiments, as well as to analyze and interpret data

Student Course Work Assessment

Student work is rated on a 0 – 1 – 2 scale:

0 = student did not understand the fundamental principle or component
1 = student applied some but not all of the fundamental principles in their solution
2 = student applied the correct fundamental principles in their solution

The CE program has two goals for student performance for student course work assessment:

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.

This outcome was assessed in three lab- and lecture-based courses (see Table B-1 on the next page), using 149 samples of student work. Continuing from the 2013-14 and 2014-15 reports, assessment 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 (Figure B-1).

Figure B-1: Summary of ratings of student work on Outcome b
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.
Table B-1: List of student work assessed for Outcome b

<table>
<thead>
<tr>
<th>Class</th>
<th>Name</th>
<th>Instructor</th>
<th>Term</th>
<th>Enrol.</th>
<th>Method</th>
<th>Description</th>
<th>2</th>
<th>1</th>
<th>0</th>
</tr>
</thead>
<tbody>
<tr>
<td>CEE</td>
<td>CE Materials</td>
<td>Maguire</td>
<td>F2015</td>
<td>41</td>
<td>lab exercise</td>
<td>design experiment to test concrete</td>
<td>69</td>
<td>22</td>
<td>9</td>
</tr>
<tr>
<td>CEE</td>
<td>Fluid Mechanics</td>
<td>Rahmeyer</td>
<td>F2015</td>
<td>77</td>
<td>desktop design</td>
<td>design expt to relate n to flow, vel, depth</td>
<td>53</td>
<td>47</td>
<td>0</td>
</tr>
<tr>
<td>CEE</td>
<td>Hydraulics</td>
<td>Urroz</td>
<td>Sp2016</td>
<td>69</td>
<td>lab exercise</td>
<td>expt on valve loss coeff and pump curve dev</td>
<td>66</td>
<td>29</td>
<td>6</td>
</tr>
</tbody>
</table>
**FE Exam Results**

Not applicable to this outcome.

**Senior Exit Interviews**

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 with 69% of students rating Outcome b as “met” and 28% as “partly met” for a total of 97% (Figure B-2). 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.

![Outcome b](image)

Figure B-2: Student exit interview ratings of progress on Outcome b

**Summary**

The evaluation of student work indicates that goals related to Outcome b are not being met. However, this is only the second year of assessing if students are adequately prepared to ‘design experiments’ as well as to ‘conduct experiments’ and ‘analyze and interpret data.’ New experimental design exercises were implemented in CEE 3160 and 3500; these were fairly successful and the instructors plan to revise for next year.

**Recommendations**

Continue to revise experimental design activities in CEE 3160 and CEE 3500. Also be sure to assess students’ ability to conduct experiments and analyze data. Re-evaluate Outcome b during the 2016-17 school year.
Civil Engineering
ABET Outcome Summary
2015-2016

Outcome e: an ability to identify, formulate, and solve engineering problems

Student Course Work Assessment

Student work is rated on a 0 – 1 – 2 scale:

0 = student did not understand the fundamental principle or component
1 = student applied some but not all of the fundamental principles in their solution
2 = student applied the correct fundamental principles in their solution

The CE program has two goals for student performance for student course work assessment:

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.

This outcome was assessed in 18 classes, ranging from 2000-level sophomore courses to 5000-level upper-division classes, using 787 samples of student work including homework and exams (see Table E-1 on the next page). Student performance met both goals, with 72% of students rating a 2 and 91% rating a 1 or 2 (Figure E-1).

![Figure E-1: Summary of ratings of student work on Outcome e](image-url)
<table>
<thead>
<tr>
<th>Class</th>
<th>Name</th>
<th>Instructor</th>
<th>Term</th>
<th>Enrol.</th>
<th>Method</th>
<th>Description</th>
<th>2</th>
<th>1</th>
<th>0</th>
</tr>
</thead>
<tbody>
<tr>
<td>CEE 2870</td>
<td>Intro to Programming</td>
<td>Urroz</td>
<td>F2015</td>
<td>97</td>
<td>HW</td>
<td>calc discharge and velocity in pipeline</td>
<td>98</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>CEE 3020</td>
<td>Structural Analysis</td>
<td>Halling</td>
<td>Sp2015</td>
<td>52</td>
<td>HW</td>
<td>moment dist method to analyze frame</td>
<td>62</td>
<td>31</td>
<td>8</td>
</tr>
<tr>
<td>CEE 3020</td>
<td>Structural Analysis</td>
<td>Halling</td>
<td>Sp2015</td>
<td>52</td>
<td>HW</td>
<td>portal method to analyze frame structure</td>
<td>56</td>
<td>35</td>
<td>10</td>
</tr>
<tr>
<td>CEE 3020</td>
<td>Structural Analysis</td>
<td>Halling</td>
<td>Sp2015</td>
<td>52</td>
<td>HW</td>
<td>cantilever method to analyze frame</td>
<td>54</td>
<td>35</td>
<td>12</td>
</tr>
<tr>
<td>CEE 3020</td>
<td>Structural Analysis</td>
<td>Halling</td>
<td>Sp2016</td>
<td>67</td>
<td>HW</td>
<td>beam deflection and rotation</td>
<td>40</td>
<td>34</td>
<td>25</td>
</tr>
<tr>
<td>CEE 3210</td>
<td>Intro to Transportation</td>
<td>Song</td>
<td>Sp2016</td>
<td>79</td>
<td>exam</td>
<td>system optimal traffic flow distribution</td>
<td>68</td>
<td>30</td>
<td>1</td>
</tr>
<tr>
<td>CEE 3430</td>
<td>Engineering Hydrology</td>
<td>Tarboton</td>
<td>Sp2016</td>
<td>73</td>
<td>HW</td>
<td>design det basin for flash flooding</td>
<td>70</td>
<td>20</td>
<td>11</td>
</tr>
<tr>
<td>CEE 3510</td>
<td>Hydraulics</td>
<td>Urroz</td>
<td>Sp2016</td>
<td>69</td>
<td>HW</td>
<td>rating curve for irreg x-sect open channel</td>
<td>78</td>
<td>10</td>
<td>12</td>
</tr>
<tr>
<td>CEE 3610</td>
<td>Environmental Management</td>
<td>McNeill</td>
<td>F2014</td>
<td>67</td>
<td>HW</td>
<td>risk analysis - calc risk from chem expos</td>
<td>85</td>
<td>6</td>
<td>9</td>
</tr>
<tr>
<td>CEE 3610</td>
<td>Environmental Management</td>
<td>McNeill</td>
<td>F2015</td>
<td>72</td>
<td>HW</td>
<td>calc oxygen demand from organic sample</td>
<td>89</td>
<td>7</td>
<td>4</td>
</tr>
<tr>
<td>CEE 5070</td>
<td>Steel Design</td>
<td>Maguire</td>
<td>F2015</td>
<td>31</td>
<td>HW</td>
<td>yield on gross section, rupture on section</td>
<td>52</td>
<td>29</td>
<td>19</td>
</tr>
<tr>
<td>CEE 5220</td>
<td>Traffic Engineering</td>
<td>Song</td>
<td>F2015</td>
<td>4</td>
<td>exam</td>
<td>highway capacity procedure to solve LOS</td>
<td>100</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>CEE 5240</td>
<td>Urban/Regional Transp Plan</td>
<td>Chen</td>
<td>F2015</td>
<td>5</td>
<td>exam</td>
<td>model for travel demand forecasting</td>
<td>100</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>CEE 5350</td>
<td>Foundation Analysis/Design</td>
<td>Rice</td>
<td>F2015</td>
<td>33</td>
<td>HW</td>
<td>cone penetrometer to assess elastic settlement</td>
<td>52</td>
<td>26</td>
<td>23</td>
</tr>
<tr>
<td>CEE 5430</td>
<td>Groundwater Engineering</td>
<td>Kaluarachichi</td>
<td>F2015</td>
<td>6</td>
<td>exam</td>
<td>well hydraulics in groundwater eng</td>
<td>67</td>
<td>33</td>
<td>0</td>
</tr>
<tr>
<td>CEE 5540</td>
<td>Hydraulic Structure Design</td>
<td>Tullis</td>
<td>F2014</td>
<td>7</td>
<td>HW</td>
<td>rating curve for open channel with irregular cross-section</td>
<td>100</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>CEE 5540</td>
<td>Hydraulic Structure Design</td>
<td>Tullis</td>
<td>F2014</td>
<td>7</td>
<td>HW</td>
<td>rating curve for open channel with irregular cross-section</td>
<td>100</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>CEE 5540</td>
<td>Hydraulic Structure Design</td>
<td>Tullis</td>
<td>F2015</td>
<td>18</td>
<td>HW</td>
<td>solving weir-flow design</td>
<td>85</td>
<td>15</td>
<td>0</td>
</tr>
</tbody>
</table>
FE Exam Results

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 E-2 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 E-2: CE Graduates Passing FE Exam vs. National Annual Pass Rate

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Total CE degrees</td>
<td>64</td>
<td>50</td>
<td>43</td>
<td>56</td>
<td>61</td>
<td>53</td>
</tr>
<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 E-2, E-3, and E-4. 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 Outcome e. It is also a strong indication of a good foundation for life-long (independent) learning skills.

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

Figure E-4: Scaled Fe Exam results (fluids, hydraulics, environmental engineering). Error bars represent uncertainty range for scaled scores.
**Senior Exit Interviews**

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 with 92% of students rating Outcome e as “met” and 5% as “partly met” for a total of 97% (Figure E-5). 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.

![Outcome e](image)

**Summary**

The evaluation of student work, FE Exam results, and senior exit interviews indicates that Outcome e is being met.

**Recommendations**

Evaluate Outcome e as planned during the 2018-19 school year.
Civil Engineering
ABET Outcome Summary
2015-2016

Outcome f: an understanding of professional and ethical responsibility

Student Course Work Assessment

Student work is rated on a 0 – 1 – 2 scale:

0 = student did not understand the fundamental principle or component
1 = student applied some but not all of the fundamental principles in their solution
2 = student applied the correct fundamental principles in their solution

The CE program has two goals for student performance for student course work assessment:

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.

Student attainment 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 (205 samples of student work; see Table F-1). 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. This was largely due to mixed performance in the Fall 2015 CEE 1880 class – not surprising given this is a freshmen class. Unfortunately, this outcome was not assessed in the junior design class as originally planned, so we cannot evaluate performance of upper-level students.

Figure F-1: Summary of ratings of student work on Outcome f
Table F-1: List of student work assessed for Outcome f

<table>
<thead>
<tr>
<th>Class</th>
<th>Name</th>
<th>Instructor</th>
<th>Term</th>
<th>Enrol.</th>
<th>Method</th>
<th>Description</th>
<th>2</th>
<th>1</th>
<th>0</th>
</tr>
</thead>
<tbody>
<tr>
<td>CEE</td>
<td>CEE Orientation</td>
<td>Rahmeyer</td>
<td>F2015</td>
<td>73</td>
<td>group report</td>
<td>summarize ethics of an eng failure</td>
<td>39%</td>
<td>61%</td>
<td>0%</td>
</tr>
<tr>
<td>CEE</td>
<td>CEE Orientation</td>
<td>Rahmeyer</td>
<td>Sp2016</td>
<td>60</td>
<td>group report</td>
<td>summarize ethics of an eng failure</td>
<td>68%</td>
<td>32%</td>
<td>0%</td>
</tr>
<tr>
<td>CEE</td>
<td>Environmental Management</td>
<td>McNeill</td>
<td>F2015</td>
<td>72</td>
<td>quiz</td>
<td>quiz on code of ethics</td>
<td>94%</td>
<td>0%</td>
<td>6%</td>
</tr>
</tbody>
</table>
**FE Exam Results**

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 F-2 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>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Total CE degrees</td>
<td>64</td>
<td>50</td>
<td>43</td>
<td>56</td>
<td>61</td>
<td>53</td>
</tr>
<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 on the ethics and professional practice section is summarized in Figure F-2. Students performed at or above the national average, considering the uncertainty range (error bars). Overall, the fact that nearly all CE students continue to pass the FE exam is a strong independent external indicator for meeting Student Outcome f. It is also a strong indication of a good foundation for life-long (independent) learning skills.

![Scaled Fe Exam results for ethics and professional practice. Error bars represent uncertainty range for scaled scores.](image-url)
Senior Exit Interviews
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 with 85% of students rating Outcome f as “met” and 13% as “partly met” for a total of 98% (Figure F-3). 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.

<table>
<thead>
<tr>
<th>Rating</th>
<th>Outcome met</th>
<th>Outcome partly met</th>
<th>Outcome not met</th>
</tr>
</thead>
<tbody>
<tr>
<td>100%</td>
<td>85%</td>
<td>13%</td>
<td>2%</td>
</tr>
</tbody>
</table>

Figure F-3: Student exit interview ratings of progress on Outcome f

Summary
Evaluation of FE exam results and senior exit interviews indicate that Outcome f goals are being met, but evaluation of course assessment data shows that Goal 2 was met while Goal 1 was not. This is not because our students are unethical, but rather due to lack of assessment in a sufficient number of appropriate classes. We must assess Outcome f in the senior design class, and encourage faculty to design ethics assignments for other classes as well.

Recommendations
Re-evaluate Outcome f during the 2016-2017 school year.
Outcome g: an ability to communicate effectively

Student Course Work Assessment

Student work is rated on a 0 – 1 – 2 scale:

0 = student did not understand the fundamental principle or component
1 = student applied some but not all of the fundamental principles in their solution
2 = student applied the correct fundamental principles in their solution

The CE program has two goals for student performance for student course work assessment:

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.

Written and oral communication skills are emphasized throughout the curriculum, starting with the freshman orientation seminar (CEE 1880) and continuing into upper-division classes and the capstone design sequence. Outcome g was assessed in 16 different classes, with 669 samples of student work (see Table G-1 on the next page). Student performance is satisfactory and meets both Goal 1 and Goal 2 (Figure G-1). Since Spring 2014, students in the CE program have been taking a new college-specific course, ENGR 3080 – Technical Communication, which replaced the broader ENGL 3080 class. The consensus from students and faculty is that the ENGR 3080 class is a great success and is improving communication skills.

---

Figure G-1: Summary of ratings of student work on Outcome g
Table G-1: List of student work assessed for Outcome g

<table>
<thead>
<tr>
<th>Class</th>
<th>Name</th>
<th>Instructor</th>
<th>Term</th>
<th>Enrol.</th>
<th>Method</th>
<th>Description</th>
<th>2</th>
<th>1</th>
<th>0</th>
</tr>
</thead>
<tbody>
<tr>
<td>CEE 1880</td>
<td>CEE Orientation</td>
<td>Rahmeyer</td>
<td>F2014</td>
<td>62</td>
<td>group project</td>
<td>written report</td>
<td>79</td>
<td>19</td>
<td>2</td>
</tr>
<tr>
<td>CEE 1880</td>
<td>CEE Orientation</td>
<td>Rahmeyer</td>
<td>F2014</td>
<td>62</td>
<td>group project</td>
<td>powerpoint slides</td>
<td>92</td>
<td>6</td>
<td>2</td>
</tr>
<tr>
<td>CEE 1880</td>
<td>CEE Orientation</td>
<td>Rahmeyer</td>
<td>F2014</td>
<td>62</td>
<td>group project</td>
<td>oral presentation</td>
<td>85</td>
<td>11</td>
<td>3</td>
</tr>
<tr>
<td>CEE 3610</td>
<td>Environmental Management</td>
<td>McNeill</td>
<td>F2014</td>
<td>67</td>
<td>essay HW</td>
<td>summarize EIS - language mechanics</td>
<td>88</td>
<td>0</td>
<td>12</td>
</tr>
<tr>
<td>CEE 3610</td>
<td>Environmental Management</td>
<td>McNeill</td>
<td>F2015</td>
<td>72</td>
<td>essay HW</td>
<td>summarize EIS - language mechanics</td>
<td>81</td>
<td>15</td>
<td>4</td>
</tr>
<tr>
<td>CEE 3640</td>
<td>Water and Wastewater Trt</td>
<td>McNeill</td>
<td>Sp2016</td>
<td>21</td>
<td>essay HW</td>
<td>ethical issues in Flint, MI drinking water</td>
<td>76</td>
<td>24</td>
<td>0</td>
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<tr>
<td>CEE 3640</td>
<td>Water and Wastewater Trt</td>
<td>McNeill</td>
<td>Sp2016</td>
<td>21</td>
<td>group project</td>
<td>water master plan for local community</td>
<td>57</td>
<td>43</td>
<td>0</td>
</tr>
<tr>
<td>CEE 3640</td>
<td>Water and Wastewater Trt</td>
<td>Dupont</td>
<td>Sp2016</td>
<td>21</td>
<td>group project</td>
<td>wastewater design for local community</td>
<td>52</td>
<td>38</td>
<td>10</td>
</tr>
<tr>
<td>CEE 3780</td>
<td>Solid and Haz Waste Mgmt</td>
<td>Dupont</td>
<td>F2015</td>
<td>43</td>
<td>group project</td>
<td>oral presentation</td>
<td>100</td>
<td>0</td>
<td>0</td>
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<tr>
<td>CEE 3780</td>
<td>Solid and Haz Waste Mgmt</td>
<td>Dupont</td>
<td>F2015</td>
<td>43</td>
<td>group project</td>
<td>written report</td>
<td>69</td>
<td>19</td>
<td>12</td>
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<tr>
<td>CEE 3880</td>
<td>CEE Design I - CE</td>
<td>Peralta</td>
<td>Sp2016</td>
<td>71</td>
<td>group project</td>
<td>written report</td>
<td>62</td>
<td>38</td>
<td>0</td>
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<tr>
<td>CEE 4870</td>
<td>CEE Design II - CE</td>
<td>Peralta</td>
<td>F2015</td>
<td>51</td>
<td>group report</td>
<td>oral presentation</td>
<td>84</td>
<td>16</td>
<td>0</td>
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<tr>
<td>CEE 4880</td>
<td>CEE Design III - CE</td>
<td>Peralta</td>
<td>Sp2016</td>
<td>52</td>
<td>group report</td>
<td>written report</td>
<td>79</td>
<td>21</td>
<td>0</td>
</tr>
<tr>
<td>CEE 5540</td>
<td>Hydraulic Structure Design</td>
<td>Tullis</td>
<td>F2014</td>
<td>7</td>
<td>report</td>
<td>written report on hydraulic structure design</td>
<td>100</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>CEE 5635</td>
<td>Env Eng in Devel Countries</td>
<td>Adams</td>
<td>F2015</td>
<td>4</td>
<td>oral presentation</td>
<td>disease/health issue in developing world</td>
<td>75</td>
<td>25</td>
<td>0</td>
</tr>
<tr>
<td>CEE 5860</td>
<td>Air Quality Management</td>
<td>Martin</td>
<td>F2015</td>
<td>12</td>
<td>group project</td>
<td>oral presentation on group project</td>
<td>100</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>
FE Exam Results
Not applicable to this outcome.

Senior Exit Interviews
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 with 82% of students rating Outcome g as “met” and 15% as “partly met” for a total of 97% (Figure G-2). 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 evaluation of student work and senior exit interviews indicates that Outcome g is being met.

Recommendations
Evaluate Outcome g as planned during the 2018-19 school year.