

## Civil Engineering ABET Evaluation Summary 2016-2017

This document describes the evaluation of ABET Program Educational Objectives (PEOs) and Student Outcomes for the Civil Engineering undergraduate program for 2016-17. Data were collected throughout the year and evaluated by the CEE Assessment Committee (Drs. Barr, Dupont, McNeill, and Tullis) in June 2017.

### 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

Constituency	Review opportunity	Frequency	Most recent reviews	Date of next review
Students	Freshman Orient. (CEE 1880)	Every freshman class (Fall and Spring)	Spring semester 2017	Fall semester 2017
	Junior design course (CEE 3880)	Every junior class (Spring)	Spring 2017	Spring 2018
	Senior exit interview	Every graduating class (Spring)	April 2017	April 2018
Employers	Advisory Board meeting	Annually (typically late Fall)	November 2016	November 2017
Faculty	CEE Faculty Retreat	Annually (August)	August 2016	August 2017

**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 8, 2016 (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 2016 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, Outcomes b and f were re-assessed this year because the program did not meet the performance goals in 2015-16.

Table 2: Evaluation Schedule for Student Outcomes

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

The assessment process uses data from three sources: student coursework, FE Exam results, and senior exit interviews. The 2016-17 Assessment of Student Outcomes includes data from Fall 2016 and Spring 2017.

**Student Coursework:** Outcomes b, f, h, i, j, and k were reviewed in 2016-17 (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 2016 and Spring 2017

Outcome	Sample size	2	1	0	Sum of 1&2 ratings
b	244	80%	18%	2%	98%
f	298	72%	22%	6%	94%
h	459	80%	16%	4%	96%
i	291	85%	8%	7%	93%
j	485	72%	22%	6%	94%
k	525	86%	12%	2%	98%

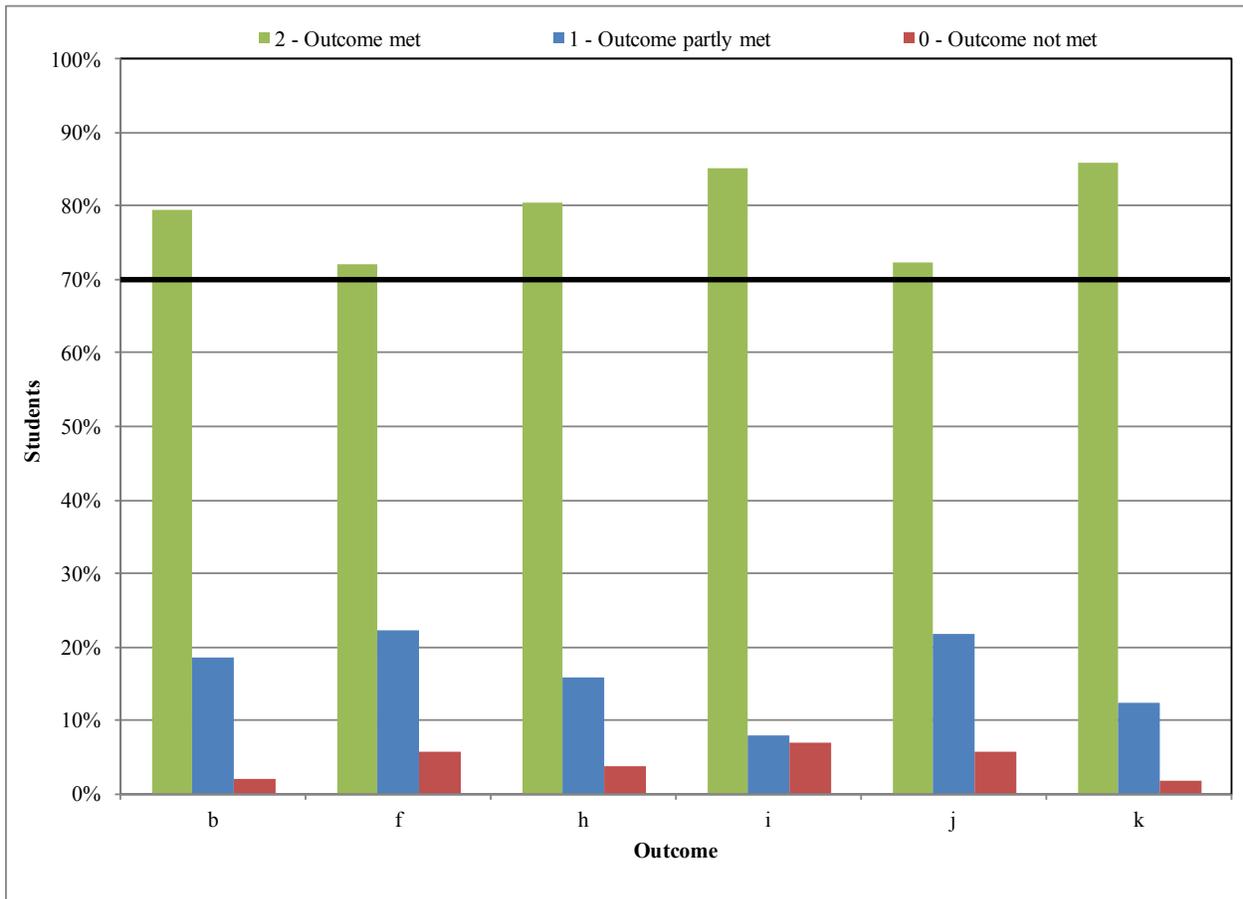


Figure 1: Aggregated Assessment Results for CE Classes for Fall 2016 and Spring 2017

Both goals were met for all Outcomes b, f, h, i, j, and k. Continuing from previous years, assessment for Outcome b is looking at students' ability to design experiments, as well as to conduct experiments and analyze/interpret data. The introduction of assignments requiring students to design (not just conduct) experiments to the CEE 3160 (Material Science) and CEE 3500 (Fluid Mechanics) classes has been very successful. We have also been able to successfully demonstrate student achievement on outcome f (ethics) after failing to meet our goals the past two years. It's not that our students were unethical in the past; rather, we were not properly assessing ethics. That has now been rectified.

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

	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17
Total CE degrees	50	43	56	61	53	55
% graduates passing FE	90%	95%	93%	100%	98%	100%
National CE pass rate	74%	74%	72%	70%	69%	69%

FE Exam performance by first-time test takers for various engineering topics is summarized in Figures 2, 3, 4, and 5. During the Fall 2016 and Spring 2017 testing periods, USU CE students performed at or above the national average (including the uncertainty range) on all engineering topics, with the exception of Dynamics (Fall 2016, Figure 2) and Fluid Mechanics (Spring 2017, Figure 4). The low scores on these topics seems to be an outlier, as performance was improved in subsequent semesters. Overall, the fact that nearly all CE students continue to pass the FE exam is a strong, independent, external indicator for meeting Student Outcomes b, f, and k. It is also an indication of a good foundation for life-long (independent) learning skills.

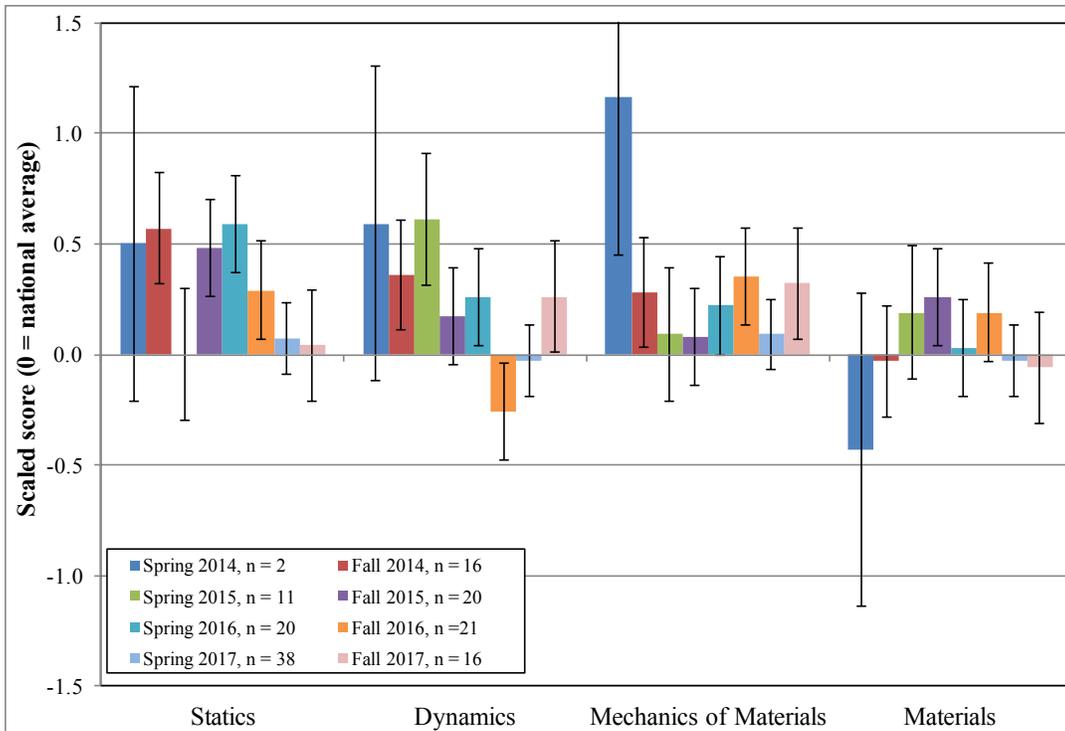


Figure 2: Scaled Fe Exam results (statics, dynamics, mechanics, and materials). Error bars represent uncertainty range for scaled scores.

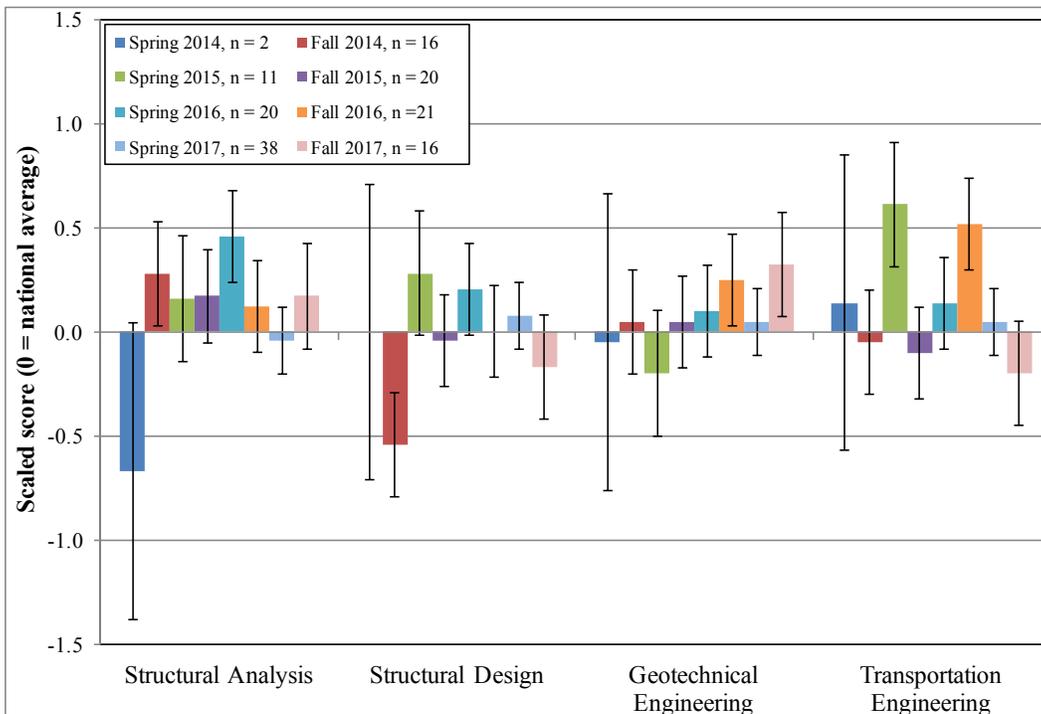


Figure 3: Scaled Fe Exam results (structural analysis and design, geotechnical engineering, transportation engineering). Error bars represent uncertainty range for scaled scores.

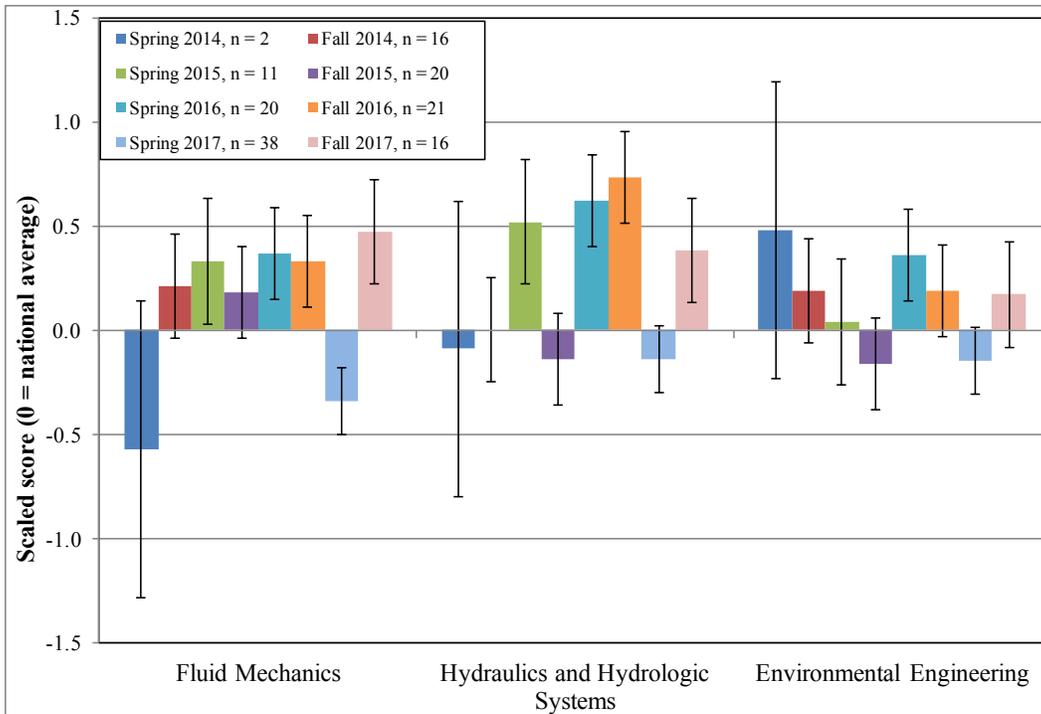


Figure 4: Scaled Fe Exam results (fluids, hydraulics, environmental engineering). Error bars represent uncertainty range for scaled scores.

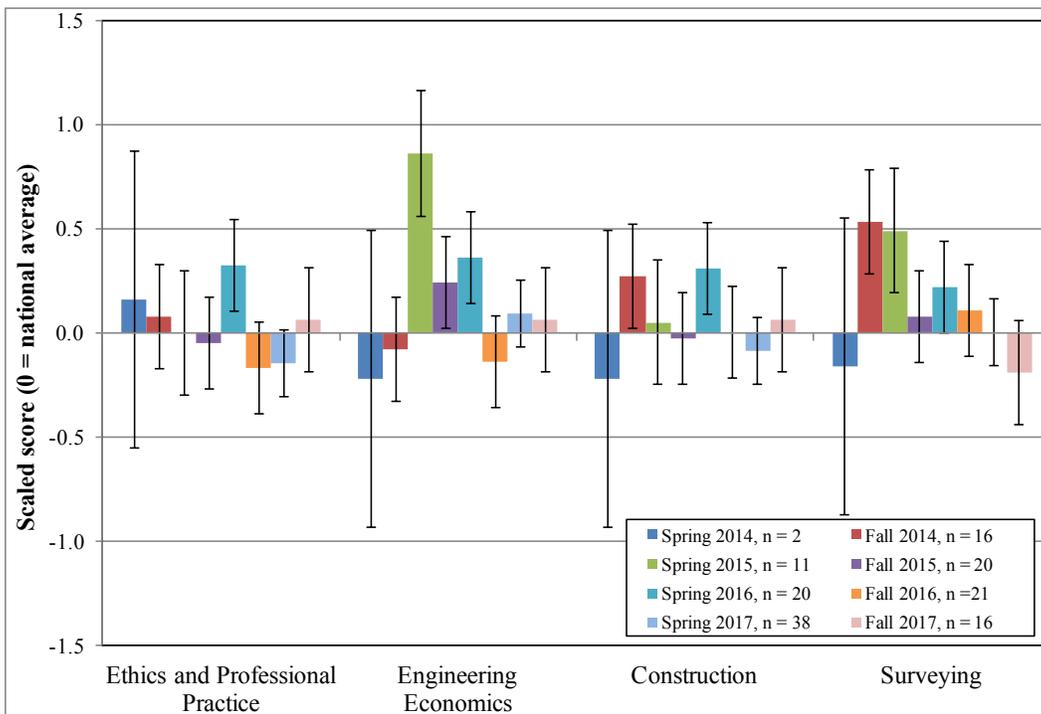


Figure 5: Scaled Fe Exam results (ethics and professional practice, economics, construction, surveying). Error bars represent uncertainty range for scaled scores.

**Senior exit interview:** Graduating seniors complete an anonymous online exit interview to provide feedback about the CE program and rate their perceived progress in meeting each of the outcomes. 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 six 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.

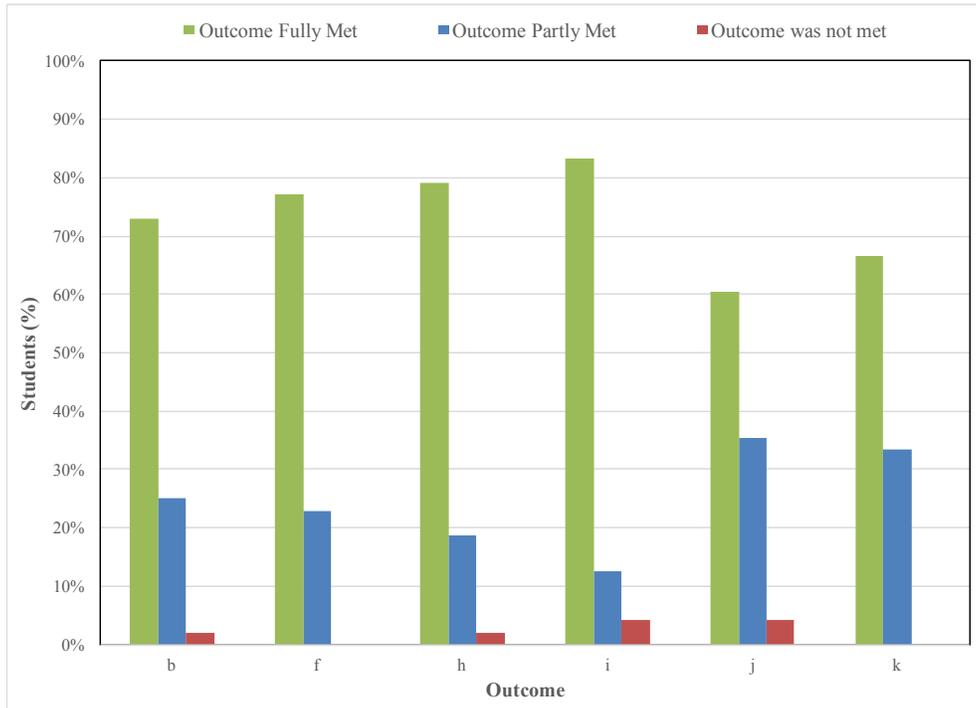


Figure 6: Student exit interview ratings of progress on Outcomes b, e, f, and g

**Summary:** The CEE Assessment Committee met in June 2017 and evaluated all of the assessment data presented herein.

The evaluation of student work, FE Exam results, and senior exit interviews indicates that all Outcomes b, f, h, i, j, and k are being met. Outcomes b and f were re-assessed due to not meeting our performance goals last year, and student performance this year (2016-17) is satisfactory.

**Recommendations**

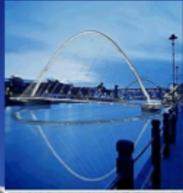
Evaluate Outcomes a, b, c, and d as planned during the 2017-18 school year.

## Appendix A Slides from CEE 1880

(introducing freshmen students to ABET PEOs and outcomes)

**CEE Degrees offered at USU**

- Bachelor of Science Accredited Degrees
  - Civil Engineering
  - Environmental Engineering
- Masters Degrees
- Doctor of Philosophy Degrees (PhD)



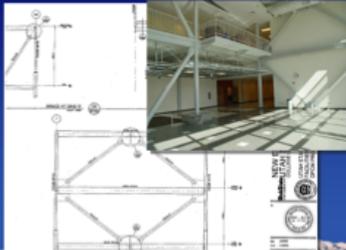
**ABET Accreditation is important**

- 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**




**New Engineering Building at Utah State University**

**NEW ENGINEERING BUILDING  
UTAH STATE UNIVERSITY**

COLLEGE OF ENGINEERING    LOGAN, UTAH 84322-4100

UTAH STATE DIVISION OF  
FACILITIES CONSTRUCTION & MANAGEMENT  
DFCM PROJECT NO. 01020300



**Western Schools with ABET Accredited Degrees in Both Civil and in Environmental Engineering**



- Oregon State University
- Utah 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
- Northern Arizona University
- University of Oklahoma
- University of Texas at Austin



ABET is a nonprofit, non-governmental organization that accredits college and university programs in the disciplines of applied science, computing, engineering, and engineering technology. ABET accredits over 3,300 programs at more than 600 colleges and universities in 24 countries. ABET provides specialized, programmatic accreditation that evaluates an individual program of study, rather than evaluating an institution as a whole.

ABET accreditation, which is voluntary and achieved through a peer review process, provides assurance that a college or university program meets the quality standards established by the profession for which the program prepares its students. ABET is recognized by the Council for Higher Education Accreditation (CHEA).



#### Utah State University Mission Statement

The mission of Utah State University is to be one of the nation's premier student-centered and grant and space-grant universities by fostering the principles that academics value first, by cultivating diversity of thought and culture, and by serving the public through learning, discovery, and engagement.

#### College of Engineering Mission Statement

The mission of the USU College of Engineering is to foster a diverse and creative learning environment that will empower students and faculty with the necessary knowledge and facilities to be international leaders in creating new technologies and services that will improve.

#### Program Educational Objectives

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

The PEOs for the **Civil Engineering Program** are that within five years of graduation:

PEO 1: Graduates will be successfully employed in civil engineering or related careers and will become independent thinkers and effective communicators, team members, and decision makers.

PEO 2: Graduates will incorporate economic, environmental, social, ethical, and sustainability considerations into the practice of civil engineering and will promote public health and safety.

PEO 3: Graduates will engage in life-long learning by pursuing advanced degrees or additional educational opportunities through coursework, professional conferences and training, or participation in professional societies.

PEO 4: Graduates will pursue professional licensure or other appropriate certifications.

#### Program Educational Objectives

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

The PEOs for the **Environmental Engineering Program** are that within five years of graduation:

PEO 1: Graduates will be successfully employed in environmental engineering or related careers and will become independent thinkers and effective communicators, team members, and decision makers.

PEO 2: Graduates will incorporate economic, environmental, social, ethical, and sustainability considerations into the practice of civil engineering and will promote public health and safety.

PEO 3: Graduates will engage in life-long learning by pursuing advanced degrees or additional educational opportunities through coursework, professional conferences and training, or participation in professional societies.

PEO 4: Graduates will pursue professional licensure or other appropriate certifications.

#### Student Outcomes

The Civil Engineering and Environmental Engineering Programs use 11 student outcomes to prepare graduates of the programs to attain the program educational objectives. By the time of graduation, students will have:

- (a) an ability to apply knowledge of mathematics, science, and engineering
- (b) an ability to design and conduct experiments, as well as to analyze and interpret data
- (c) an ability to design a system, component, or process to meet desired needs
- (d) an ability to function on multi-disciplinary teams
- (e) an ability to identify, formulate, and solve engineering problems
- (f) an understanding of professional and ethical responsibility
- (g) an ability to communicate effectively
- (h) the broad education necessary to understand the impact of engineering solutions in a global and societal context
- (i) the recognition of the need for, and an ability to engage in life-long learning
- (j) a knowledge of contemporary issues
- (k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice

#### 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

Most USU graduates will achieve proficiency in 5 to 6 areas

### 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;
- being honest and impartial and serving with fidelity the public, their employers and clients;
- striving to increase the competence and prestige of the engineering profession; and
- supporting the professional and technical societies of their disciplines.



### Fundamental Canons (from ASCE)

- Engineers shall hold paramount the safety, health and welfare of the public and shall strive to comply with the principles of sustainable development in the performance of their professional duties.
- Engineers shall perform services only in areas of their competence.
- Engineers shall issue public statements only in an objective 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 build 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 uphold and enhance the 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 those engineers under their supervision.



### And after graduation, becoming a Licensed Professional Engineer



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graph TD; A["Graduation with a Bachelor's degree in Civil and/or Environmental Engineering from an ABET accredited degree program"] --> B["FE (Fundamentals of Engineering) exam"]; B --> C["Experience working for a licensed engineer"]; C --> D["PE exam (Professional Engineer) Given by the state where you will practice"]; D --> E["Licensed Professional Civil Engineer"];
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**Graduation** with a Bachelor's degree in Civil and/or Environmental Engineering from an **ABET accredited degree program**

**FE (Fundamentals of Engineering) exam**

**Experience** working for a licensed engineer

**PE exam (Professional Engineer)**  
Given by the state where you will practice

**Licensed Professional Civil Engineer**



## **Appendix B**

### **Student Comments on PEOs from Exit Interviews**

- I agree with all of the PEO's.
- I agree with all of these and plan to pursue the four options listed after graduation.
- I think it would be beneficial to have a class on ethics and responsibility, maybe in tandem with the business college. To help prepare students for the world of business and for working with businesses.
- I think that the courses taken here allow us to get a very big picture of what gets done all around the world. However, I don't think that it is possible to get our feet wet enough in all aspects of design to fully prepare us for the real world.
- I think these objectives are realistic and what makes a professional engineer.
- I think they are great.
- No. They all look great!
- Not sure the curriculum can meet all these objectives. PEO 3 involve conferences and professional societies that are not introduced by professors. I did not have any idea about group like the young member forum in the ASCE until this semester. I am sure introductory course to CEE can also focus on groups and opportunities that are available. The word "continue" implies that I have already been involved with conferences and societies during my education, which is not fully true.
- PEO 3 was not particularly met. USU did not set me up well for graduate study, and professors rarely, if ever, discussed graduate-level research.
- Sound good. How will they be tracked?
- The objectives are well defined.
- There needs to be way more focus on learning how to used software more effectively to solve problems (Excel, Smath Studio, etc.) and practical design/problem solving after the fundamentals classes. Also, most professors cover theory in class then assign math problems for homework and exams. So students have to spend time learning how to work engineering problems they weren't taught how to solve. Theory should be assigned outside of class, and problems should be worked in class.
- These all sound like great objectives!
- These PEO's are great goals and have been helped.
- They sound like great objectives, but I literally was not aware that they existed until I took this survey.
- I think those are excellent goals, but I also don't see them displayed anywhere else but here. If they became a part of the classes, even if just for a day, you'd probably be more likely to actually achieve them. If that's the goal here. If they just exist for show, then yeah, they sound great! I hope to follow those things, for the record.
- Don't really have any comment. Really hoping I can accomplish all of these in 5 years, though finding a job is beginning to be increasingly difficult.
- USU should provide more training in standard programs used in the Civil field. Programs such as CAD, Microstations, etc.

Note: non-ABET related items have been removed from these minutes

## Appendix C Minutes of the CEE Advisory Board Meeting Nov 8, 2016

### Intro

- Fall 2016
  - Passing FE exam is now a requirement
  - FE exam now has more civil based updates
  - Civil pass rate : 95%
  - CEE 1880 is taught both spring and fall
    - ♣ Freshman class is the same size as sophomore class
    - ♣ Our department is growing
      - Worried about maintaining quality of one on one connection
    - ♣ This is why we are meeting with CEE 1880 classes
      - Gives the students an opportunity to meet and ask questions
    - ♣ Questions for the students
      - Why did you decide to study CEE?
      - What is your biggest difficulty being a CEE student so far?
      - What has been your best experience so far as a CEE student?
      - What improvements to the program can you suggest?

### ABET-Laurie

- Review of PEOs
  - Program educational objectives
  - What our students will be able to do 5 years out
  - Feedback from advisory board?
    - ♣ Professional licensure?
      - Yes/no-we get aggregate stats on our students; just a number who passed the PE and FE exams
      - EnvE students are tracked since there are so few
    - ♣ No additional comments
  - Student outcome ratings
    - ♣ rated from 0-2
      - 0-didn't understood
      - 1-kind of understood
      - 2-completely understood
    - ♣ Goal to have more than 70% at the "2" level
    - ♣ Is there a better time to evaluate different outcomes?
      - We're looking at evaluating different classes
    - ♣ EnvE was successful with all student outcomes measured
  - Fe exam pass rate
    - ♣ Goal is to have 100% pass rate
    - ♣ CEE is above the national average
  - Outcomes B&F are being reevaluated along with H,I,J, & K

- Questions/Comments
  - ♣ Engineers view ethics differently than other professionals
    - It would have been helpful to know that not all professionals have such a strong view on ethics
      - Attorneys' allegiance is to their clients-engineers are more honest with their evaluations, etc.
      - Information can easily be taken, twisted, and turned
    - You can't under-teach ethics. I applaud any effort you make to be sure our students leave with a firm code of ethics.
  - ♣ What happens to students who don't pass the FE exam?
    - We offer resources and help to be sure that our students pass. Even if it's not on the first, or second time
    - "I would never change the requirement on passing the FE exam"

Note: non-ABET related items have been removed from these minutes

**Appendix D**  
**CEE Annual Faculty/Staff Retreat Minutes**  
**August 22, 2016**

Laurie-ABET

- Review program (PEO)
- To-do list for this year

PEO handout

- Changes?
  - What are students doing 5 years after graduation?
- Criteria 4
  - Student coursework
  - FE exam
  - Exit interview results
- Outcome of student schedule
  - Each year we review a subset of the outcomes
  - Subsets B,E,F,G
- Student course work rating scale
  - 0,1,2 rating scale
  - We need at least 70% at the 2 level
  - 80% at performing level (1-2)
  - Summary
    - ♣ E outcome met
    - ♣ G outcome met
    - ♣ B goal was not met (design and conduct)
    - ♣ F goal not met (ethics)
    - ♣ Environmental met all goals =]
- FE Exam
  - 100% pass rate
  - Minimum goal is to be at or above national pass rate
  - CE 98% pass rate
    - ♣ 69% nationally
  - Environmental
    - ♣ 78% pass rate
      - 76% nationally
  - Last year, we were above, or within, the error bar of national average for performance
  - Bottom line:
    - ♣ All students scored at or above on all FE exam topics
- Senior exit interviews
  - Self assessment for students
  - We would like to see that 80% are understanding curriculum
    - ♣ All students feel they met expectations
- Evaluation
  - Student course work: goals met for outcomes E,G but not for B, F
  - Outcomes B,F need to be redone

- ♣ We didn't assess enough classes
- Evaluation schedule
  - ♣ H,I,J,K plus B,F
  - ♣ Assess two outcomes in all required UG classes
- Outcome B
  - ♣ Design and conduct experiments
    - Materials
    - Fluids
    - Soils
    - Hydraulics
    - Others?
  - ♣ We've failed the last two years with outcome B
- Outcome F
  - ♣ Ethics
    - This can be done in any and all of our classes
    - The challenge is assessing....
      - [www.asce.org/ethics](http://www.asce.org/ethics)
      - Case studies and ethically considered column
      - Ideas for classes
- Outcomes H,I,J
  - ♣ Outcome H
    - Anything beyond the textbook
  - ♣ Outcome I
    - CEE orientation
    - EnvE sophomore seminar
    - Junior/senior design
    - Others?
  - ♣ Outcome J
    - Knowledge of contemporary issues
      - Everyone!
  - ♣ Outcome K
    - Ability to use techniques and skills for modern engineering
      - Anyone using software, design codes
      - May have to rely on elective classes
      - CEE 4870/4880?
- Program criteria for CE
  - ♣ Probability and statistics
  - ♣ Include principles of sustainability in design
  - ♣ Explain basic concepts in project management, business, public policy, and leadership
- These don't need to be formally assessed, but we do have to discuss where the students are getting these concepts in our curriculum.

**Appendix E**  
**Detailed Evaluation for Outcomes b, f, h, i, j, and k**

See following pages

**Civil Engineering  
ABET Outcome Summary  
2016-2017**

**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 244 samples of student work. 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. Last year (2015-2016), we met Goal 2 but did not meet Goal 1, with just under 70% of students rating a 2. This year, instructors refined their ‘design an experiment’ exercises and student performance improved. Goal 1 was met with 80% of student work rating a 2 and Goal 2 was met with 98% of student work rating a 1 or 2 (Figure B-1). In fact, these exercises are popular with students and we are pleased with their incorporation into the curriculum.

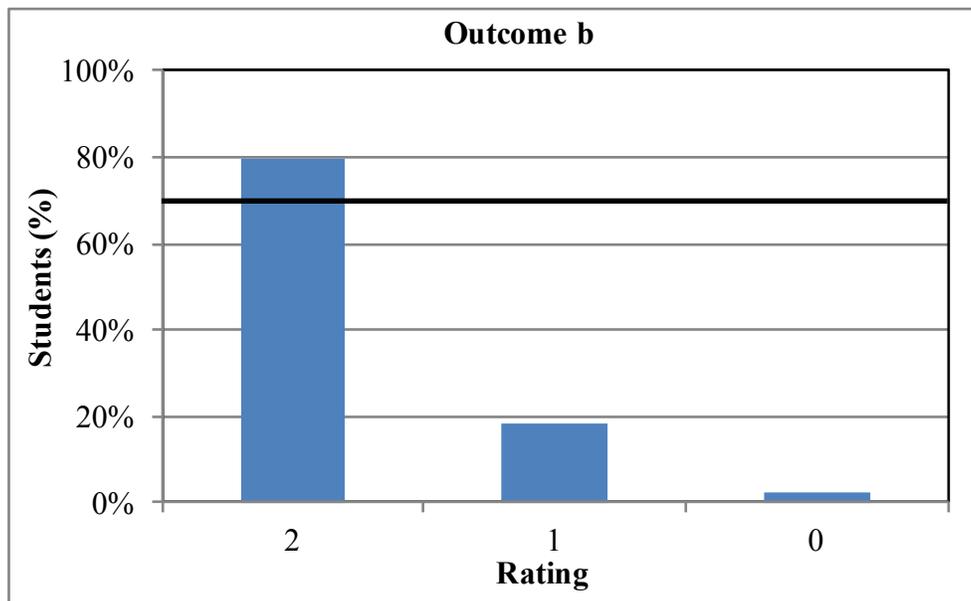


Figure B-1: Summary of ratings of student work on Outcome b

Table B-1: List of student work assessed for Outcome b

<b>Class</b>		<b>Name</b>	<b>Instructor</b>	<b>Term</b>	<b>Enrol.</b>	<b>Method</b>	<b>Description</b>	<b>2</b>	<b>1</b>	<b>0</b>
CEE	2240	Surveying	Caliendo	F 2016	121	lab	surveying traverse special problem	70%	30%	0%
CEE	3160	Civil Engineering Materials	Sorensen	F 2016	52	lab exercise	design expt to test diff materials under loading	90%	10%	0%
CEE	3510	Hydraulics	Urroz	Sp 2017	71	lab exercise	expt on pipeline losses and pump curves	87%	6%	7%

### ***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 and rate their perceived progress in meeting each of the outcomes. The performance goal is to have at least 80% of the students rating their attainment as “met” or “partly met”, which was achieved in 2016-2017 with 73% of students rating Outcome b as “met” and 25% as “partly met” for a total of 98% (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.

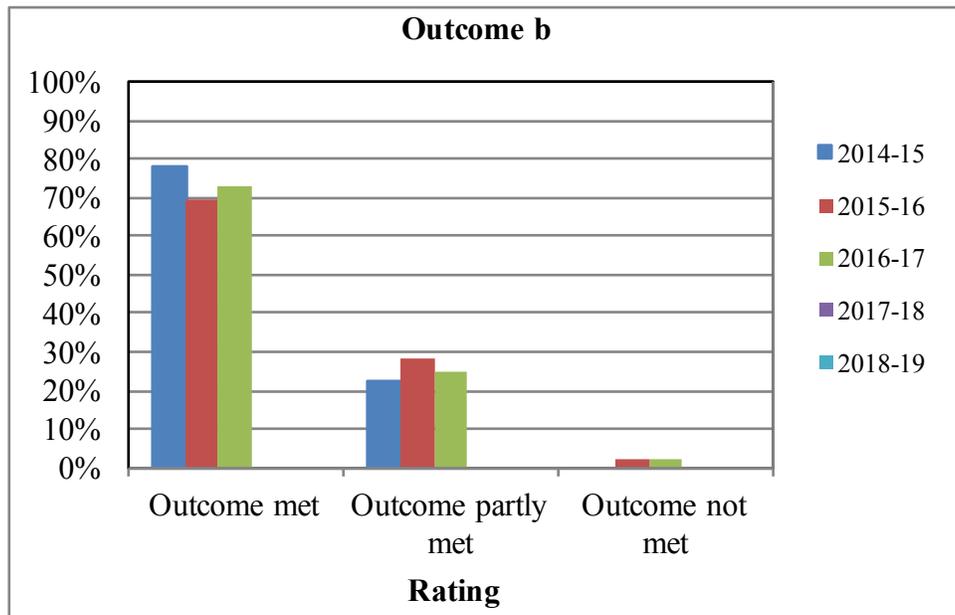


Figure B-2: Student exit interview ratings of progress on Outcome b

### ***Summary***

The evaluation of student work indicates that goals related to Outcome b are being met. We are pleased that students are prepared to ‘design experiments’ as well as to ‘conduct experiments’ and ‘analyze and interpret data.’

### ***Recommendations***

Continue to revise experimental design activities in CEE 3160 and CEE 3500. Add an exercise in CEE 3510. Re-evaluate Outcome b as planned during the 2017-18 school year.

**Civil Engineering  
ABET Outcome Summary  
2016-2017**

**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.

Last year (2015-2016) this outcome was not assessed in as many classes as originally planned, so we renewed our efforts for this year. Student attainment was assessed in the introductory seminar class (CEE 1880) through a group writing assignment on the ethics associated with an engineering failure, homework exercises in CEE 3640 and CEE 3780, and a quiz about the code of ethics in CEE 4870 (298 samples of student work; see Table F-1). Both goals were met with 72% of student work rating a 2 and 98% of student work rating a 1 or 2.

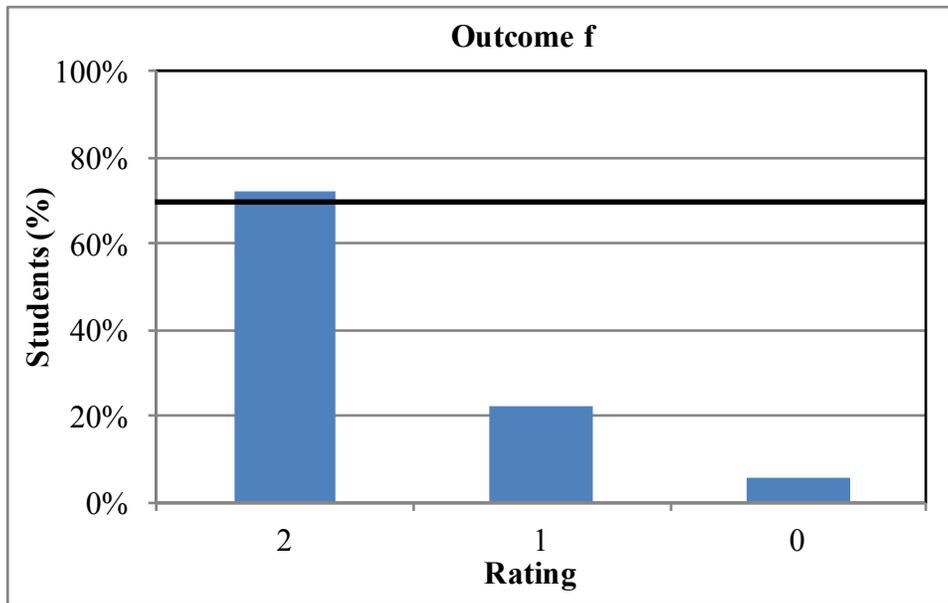


Figure F-1: Summary of ratings of student work on Outcome f

Table F-1: List of student work assessed for Outcome f

<b>Class</b>		<b>Name</b>	<b>Instructor</b>	<b>Term</b>	<b>Enrol.</b>	<b>Method</b>	<b>Description</b>	<b>2</b>	<b>1</b>	<b>0</b>
CEE	1880	CEE Orientation	Rahmeyer	F 2016	73	group report	summarize ethics of an eng failure	67%	33%	0%
CEE	1880	CEE Orientation	Rahmeyer	Sp 2017	65	group report	summarize ethics of an eng failure	72%	18%	9%
CEE	3640	Water Treatment	McNeill	Sp 2017	32	HW	essay on Flint, MI drinking water scandal	91%	9%	0%
CEE	3780	Solid and Haz Waste Mgmt	Dupont	F 2016	53	HW	ethics of LEED design	64%	26%	9%
CEE	4870	Civil Engineering Design II	Peralta	F 2016	75	quiz	ethics and professional responsibility	75%	17%	8%

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

	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17
Total CE degrees	50	43	56	61	53	69
% graduates passing FE	90%	95%	93%	100%	98%	100%
National CE pass rate	74%	74%	72%	70%	69%	68%

FE Exam performance by first-time test takers on the ethics and professional practice section is summarized in Figure F-2. Students performed equivalent to 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.

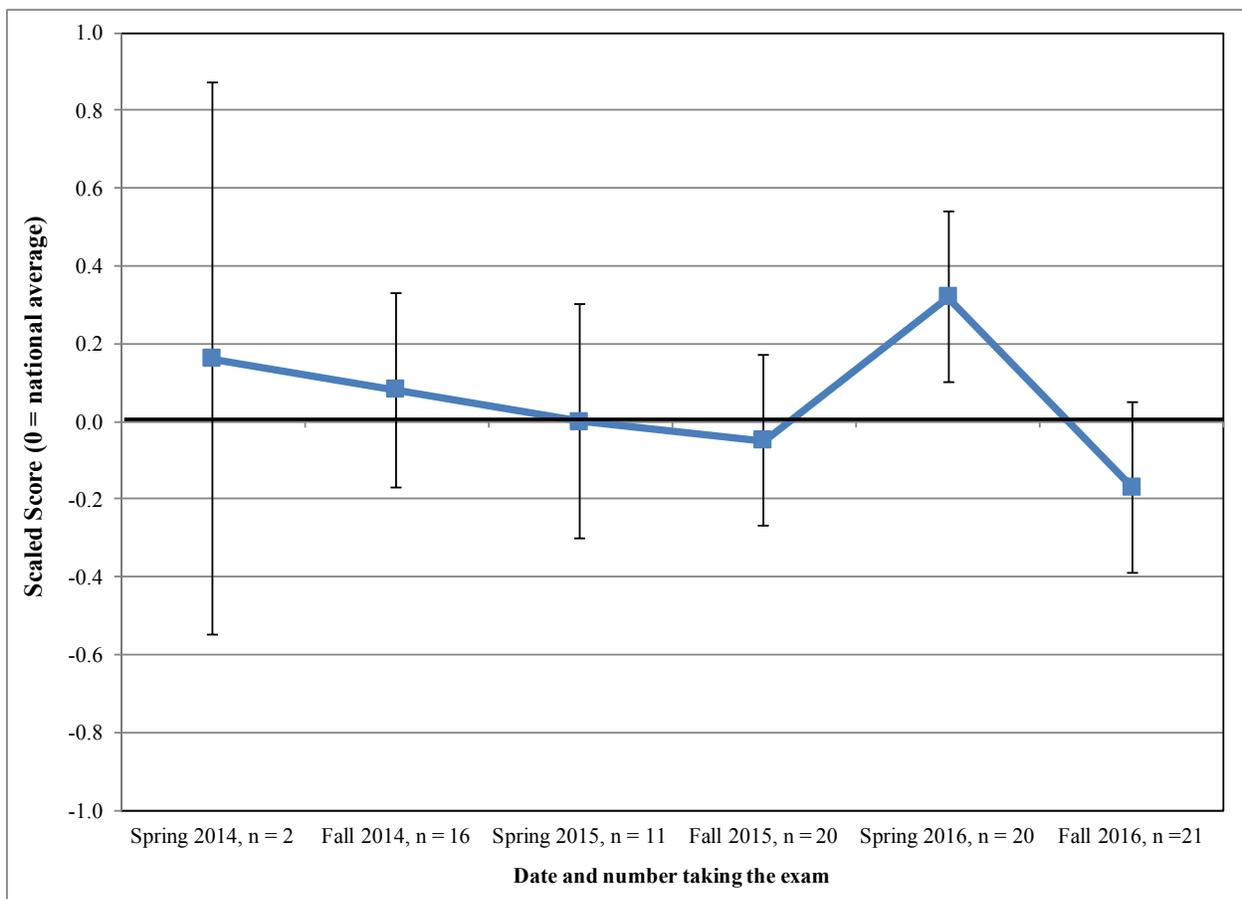


Figure F-2: Scaled Fe Exam results for ethics and professional practice. Error bars represent uncertainty range for scaled scores.

**Senior Exit Interviews**

Graduating seniors complete an anonymous online exit interview to provide feedback about the CE program and rate their perceived progress in meeting each of the outcomes. The performance goal is to have at least 80% of the students rating their attainment as “met” or “partly met”, which was achieved with 77% of students rating Outcome f as “met” and 23% as “partly met” for a total of 100% (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.

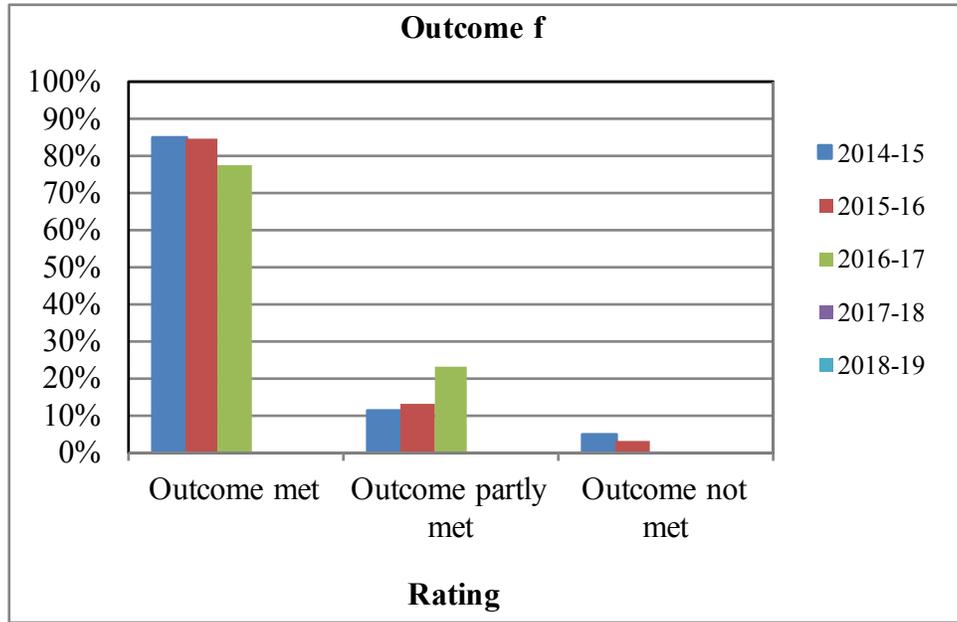


Figure F-3: Student exit interview ratings of progress on Outcome f

**Summary**

Evaluation of course assessment data, FE exam results, and senior exit interviews indicate that Outcome f goals are being met.

**Recommendations**

Evaluate Outcome f as scheduled during the 2018-2019 school year.

**Civil Engineering  
ABET Outcome Summary  
2016-2017**

**Outcome h: the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context**

*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.

As recommended by the Assessment Committee the last time this outcome was evaluated (2013-2014), the number of assessments for this outcome has increased. Student performance on this outcome has been assessed through seven assignments in four different courses (459 samples of student work; see Table H-1), and student performance satisfactorily meets both Goal 1 and Goal 2 (Figure H-1).

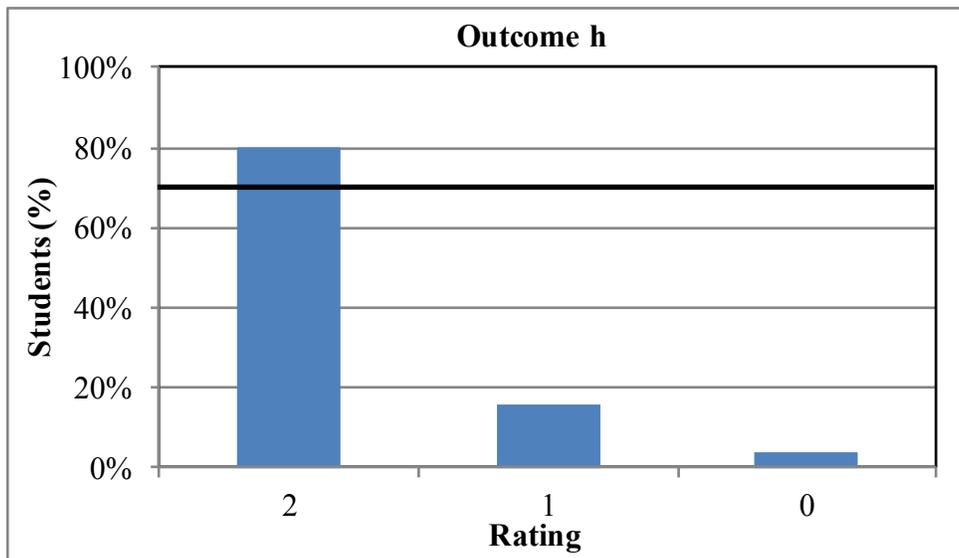


Figure H-1: Summary of ratings of student work on Outcome h

Table H-1: List of student work assessed for Outcome h

Class		Name	Instructor	Term	Enrol.	Method	Description	2	1	0
CEE	3080	Reinforced Concrete Design	Barr	Sp 2017	59	HW	cost/economics in column design	82%	5%	13%
CEE	3610	Environmental Management	McNeill	F 2016	79	essay HW	summarize EIS - env, econ, societal	76%	22%	3%
CEE	3610	Environmental Management	McNeill	F 2016	79	essay HW	summarize TMDL - env, econ, societal	92%	8%	0%
CEE	3610	Environmental Management	McNeill	F 2016	79	essay HW	summarize Superfund site - env, econ, societal	67%	30%	3%
CEE	3610	Environmental Management	McNeill	F 2016	79	field trip report	env, econ, societal consid of WWTP	78%	16%	5%
CEE	3650	Wastewater Treatment	Dupont	Sp 2017	7	mini-design	Env and cost impacts of TMDL	57%	29%	14%
CEE	4200	Engineering Economics	Alminagorta	F 2016	76	exam	economic impact of eng solutions	89%	11%	0%

### ***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 and rate their perceived progress in meeting each of the outcomes. The performance goal is to have at least 80% of the students rating their attainment as “met” or “partly met”, which was achieved with 79% of students rating Outcome f as “met” and 19% as “partly met” for a total of 98% (Figure H-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.

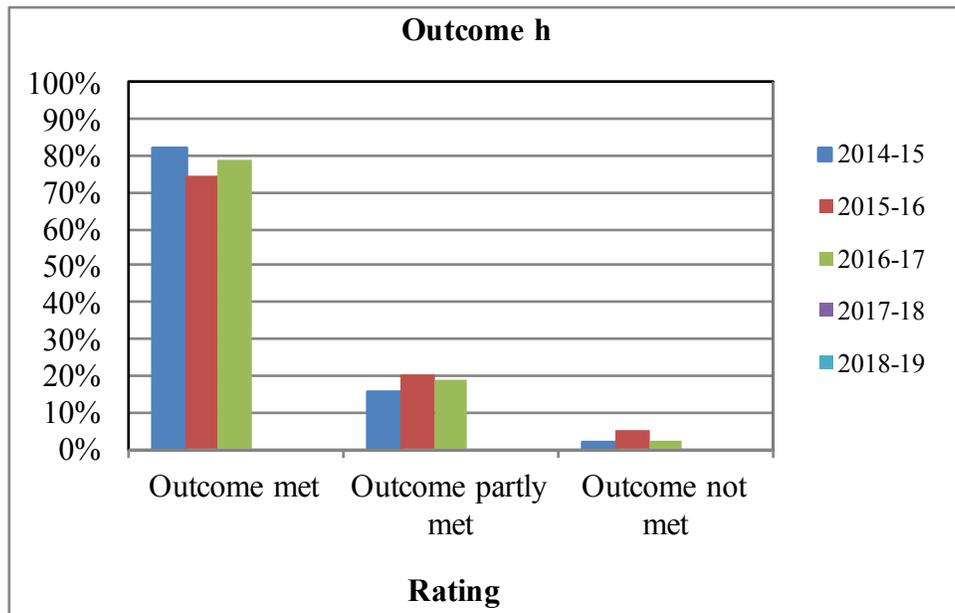


Figure H-2: Student exit interview ratings of progress on Outcome h

### ***Summary***

The evaluation of student work and senior exit interviews indicates that Outcome h is being met.

### ***Recommendations***

Evaluate Outcome h as planned during the 2019-20 school year.

**Civil Engineering  
ABET Outcome Summary  
2016-2017**

**Outcome i: a recognition of the need for, and an ability to engage in life-long learning**

***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 is assessed in the freshman orientation class and the second and third classes of the capstone design sequence (291 samples of student work; see Table I-1 on the next page). Student attainment is demonstrated through a memo on the importance of life-long learning, a quiz on professional registration requirements (including associated continuing education requirements), and an essay on a guest speaker’s discussion of this topic. Student performance is satisfactory and meets both Goal 1 and Goal 2 (Figure I-1). To additionally reinforce this idea in the capstone design sequence, since the 2014-2015 academic year, all guest speakers who are professional engineers are requested to include the topic of life-long learning in their presentation.

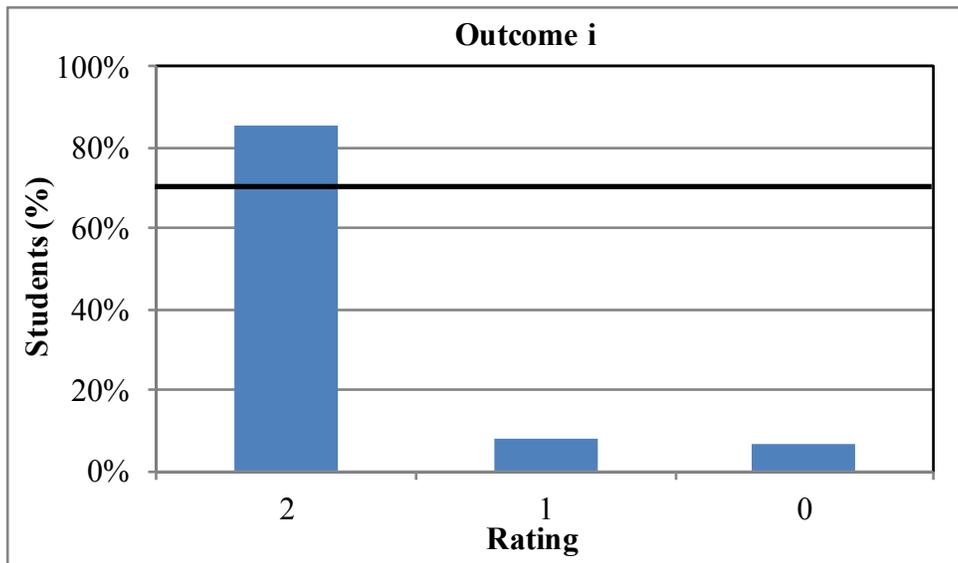


Figure I-1: Summary of ratings of student work on Outcome i

Table I-1: List of student work assessed for Outcome i

<b>Class</b>		<b>Name</b>	<b>Instructor</b>	<b>Term</b>	<b>Enrol.</b>	<b>Method</b>	<b>Description</b>	<b>2</b>	<b>1</b>	<b>0</b>
CEE	1880	CEE Orientation	Rahmeyer	F 2016	73	group HW	rules for professional licensure	100%	0%	0%
CEE	1880	CEE Orientation	Rahmeyer	Sp 2017	65	group HW	rules for professional licensure	83%	15%	2%
CEE	4870	Civil Engineering Design II	Peralta	F 2016	75	quiz	quiz on continuing ed requirements	75%	17%	8%
CEE	4880	Civil Engineering Design III	Peralta	Sp 2017	75	quiz	quiz on lifelong learning in Code of Ethics	83%	0%	17%

**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 and rate their perceived progress in meeting each of the outcomes. The performance goal is to have at least 80% of the students rating their attainment as “met” or “partly met”, which was achieved with 83% of students rating Outcome f as “met” and 13% as “partly met” for a total of 96% (Figure I-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.

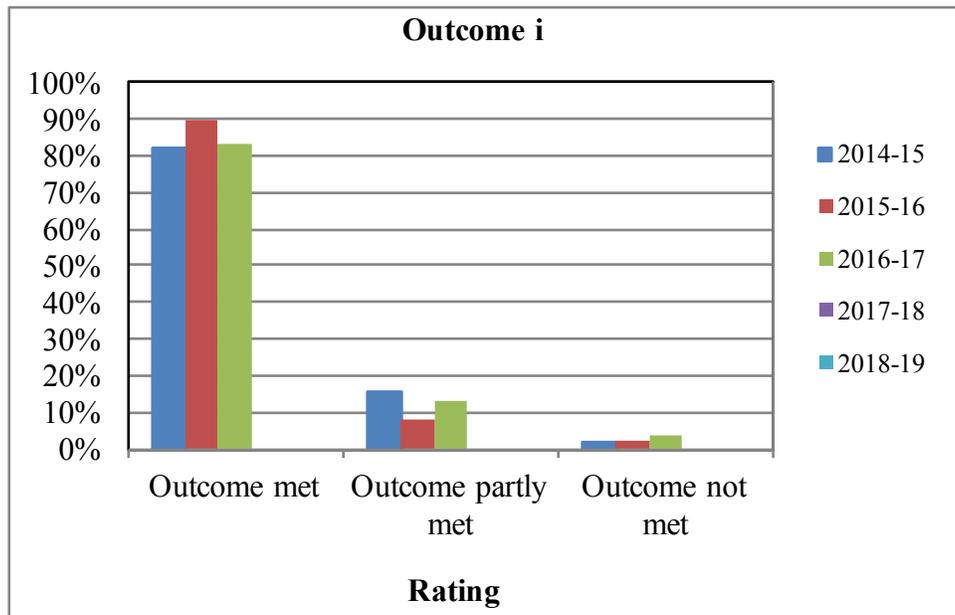


Figure I-2: Student exit interview ratings of progress on Outcome i

**Summary**

The evaluation of student work and senior exit interviews indicates that Outcome i is being met.

**Recommendations**

Evaluate Outcome i as planned during the 2019-20 school year.

**Civil Engineering  
ABET Outcome Summary  
2016-2017**

**Outcome j: a knowledge of contemporary issues**

***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 multiple classes by having students demonstrate knowledge of contemporary issues through HW, writing assignment, or exam (485 samples of student work; see Table J-1 on the next page). Student performance is satisfactory and meets both Goal 1 and Goal 2 (Figure J-1).

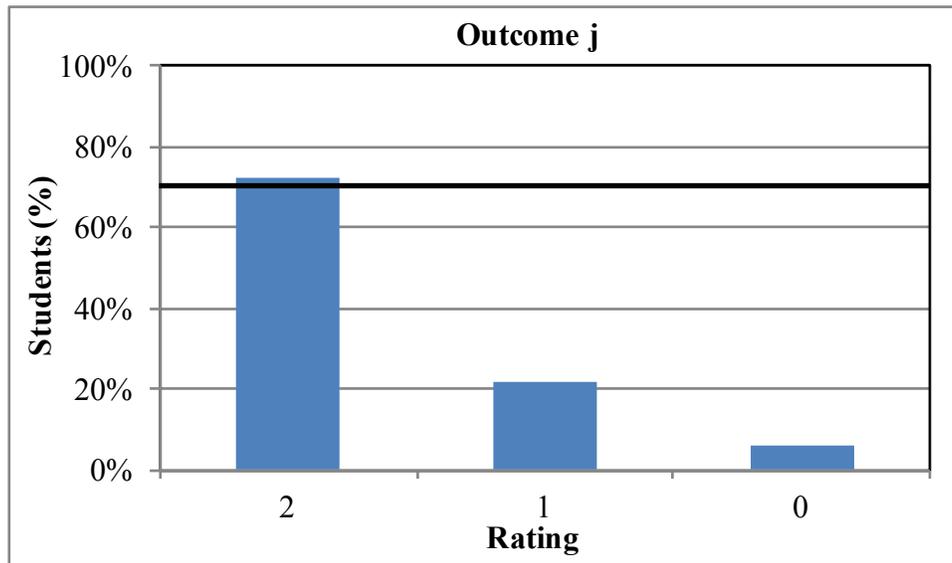


Figure J-1: Summary of ratings of student work on Outcome j

Table J-1: List of student work assessed for Outcome j

Class		Name	Instructor	Term	Enrol.	Method	Description	2	1	0
CEE	1880	CEE Orientation	Rahmeyer	F 2016	73	group HW	group essay on contemporary issues	89%	11%	0%
CEE	1880	CEE Orientation	Rahmeyer	Sp 2017	65	group HW	group essay on contemporary issues	91%	8%	2%
CEE	3020	Structural Analysis	Halling	Sp 2017	71	quiz	role of structural codes in modern building	11%	59%	30%
CEE	3610	Environmental Management	McNeill	F 2016	79	HW	Cache Valley PM2.5 issue	89%	5%	6%
CEE	3610	Environmental Management	McNeill	F 2016	79	field trip report	solid waste mgmt current issues in CV	73%	27%	0%
CEE	3610	Environmental Management	McNeill	F 2016	79	field trip report	current issues in Logan City drinking water	73%	25%	1%
CEE	3640	Water Treatment	McNeill	Sp 2017	32	HW	ethical issues in Flint, MI drinking water scandal	91%	9%	0%
CEE	3650	Wastewater Treatment	Dupont	Sp 2017	7	group project	contemp issues for WWTP	57%	43%	0%

### ***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 and rate their perceived progress in meeting each of the outcomes. The performance goal is to have at least 80% of the students rating their attainment as “met” or “partly met”, which was achieved with 60% of students rating Outcome f as “met” and 35% as “partly met” for a total of 95% (Figure J-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. It is interesting to note that while student performance in coursework is very good (see previous section), more students are rating their own attainment as only “partly met” here in the exit interview. Perhaps they do not understand what is meant by “contemporary issues” when asked in this context.

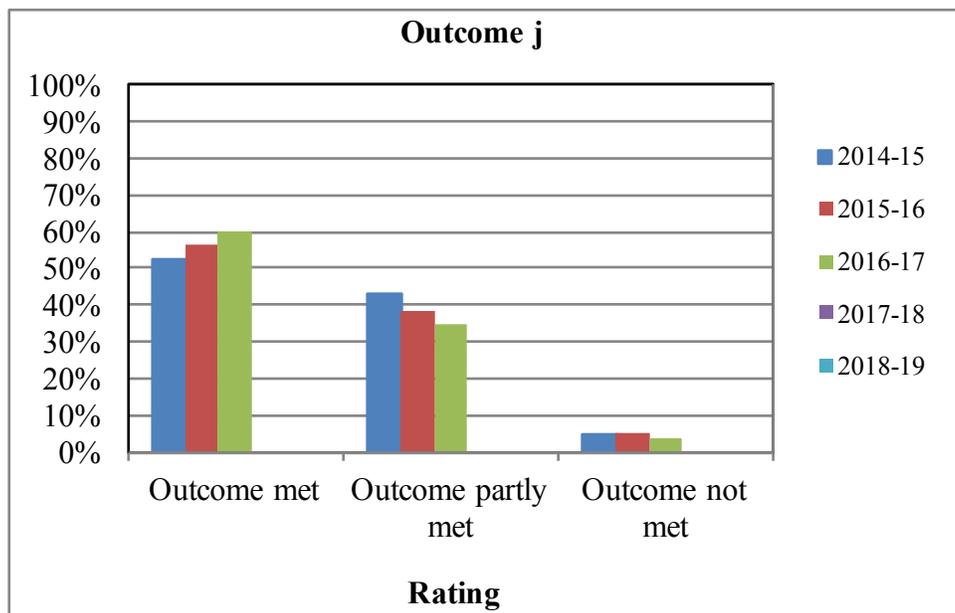


Figure J-2: Student exit interview ratings of progress on Outcome j

### ***Summary***

The evaluation of student work and senior exit interviews indicate that Outcome j is being met.

### ***Recommendations***

Evaluate Outcome j as planned during the 2019-20 school year.

**Civil Engineering  
ABET Outcome Summary  
2016-2017**

**Outcome k: an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice**

***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.

Multiple classes across the curriculum assess students' ability to use modern tools including surveying equipment and various software programs like excel/VBA, HEC-HMS, SAP2000, and EPANET (525 samples of student work; see Table K-1 on the next page). Overall, student performance is satisfactory and meets both Goal 1 and Goal 2 (Figure K-1).

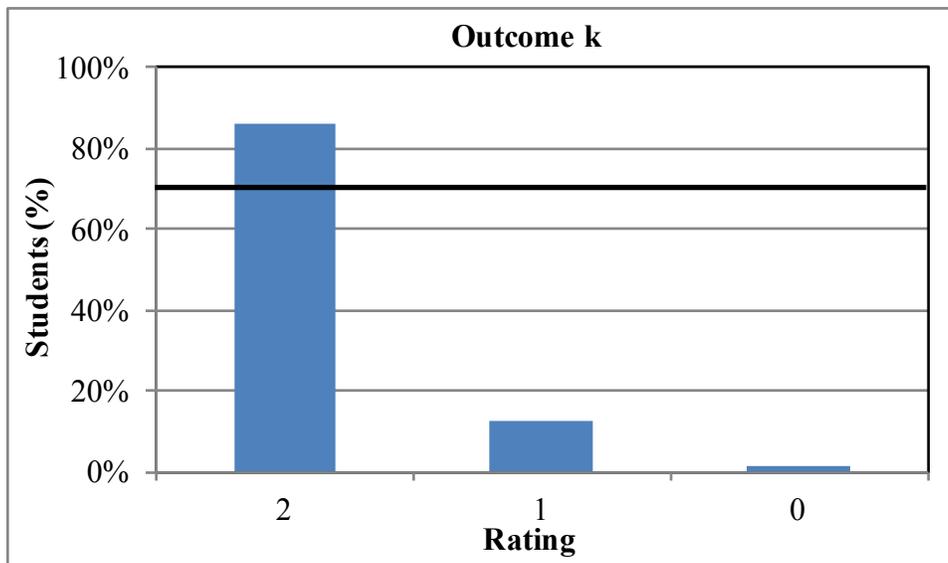


Figure K-1: Summary of ratings of student work on Outcome k

Table K-1: List of student work assessed for Outcome k

Class		Name	Instructor	Term	Enrol.	Method	Description	2	1	0
CEE	2240	Surveying	Caliendo	F 2016	121	lab	surveying traverse special problem	70%	30%	0%
CEE	2870	Intro to Programming	Urroz	F 2016	102	HW	use VBA and spreadsheet to calc flow in open channel	93%	3%	4%
CEE	3430	Engineering Hydrology	Urroz	Sp 2017	81	HW	use excel and HEC-HMS to find hydrograph	89%	7%	4%
CEE	3510	Hydraulics	Urroz	Sp 2016	69	exam	EPANET 2.0 for analysis of pipe network	86%	14%	0%
CEE	3510	Hydraulics	Urroz	Sp 2017	71	exam	EPANET 2.0 for analysis of pipe network	97%	3%	0%
CEE	3780	Solid and Haz Waste Mgmt	Dupont	F 2016	53	exam	spreadsheet: effect of recycling on landfill	89%	8%	4%
CEE	5001	Field Irrigation Systems	Torres-Rua	F 2016	7	exam	remote sensing applications	100%	0%	0%
CEE	5010	Matrix Analysis of Structures	Barr	F 2016	22	exam question	use SAP2000 to solve truss, beam, frame and 2-D elements	80%	20%	0%

***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 K-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%, with the exception of 2009-10 when we were just above the national average.

The fact that nearly all of the CE students pass the FE exam is a strong, independent, external indicator for meeting Student Outcomes a, e, f, and k. It is also a strong indication of a good foundation for life-long (independent) learning skills.

**Table K-2: CE Graduates Passing FE Exam vs. National Annual Pass Rate**

	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17
Total CE degrees	50	43	56	61	53	55
% graduates passing FE	90%	95%	93%	100%	98%	100%
National CE pass rate	74%	74%	72%	70%	69%	69%

***Senior Exit Interviews***

Graduating seniors complete an anonymous online exit interview to provide feedback about the CE program and rate their perceived progress in meeting each of the outcomes. The performance goal is to have at least 80% of the students rating their attainment as “met” or “partly met”, which was achieved with 67% of students rating Outcome f as “met” and 33% as “partly met” for a total of 100% (Figure K-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. Several students commented on the exit interview that they wanted to learn additional software tools such as Civil 3D and other programming languages (R, Matlab). We will investigate the possibility of adding these topics into the curriculum.

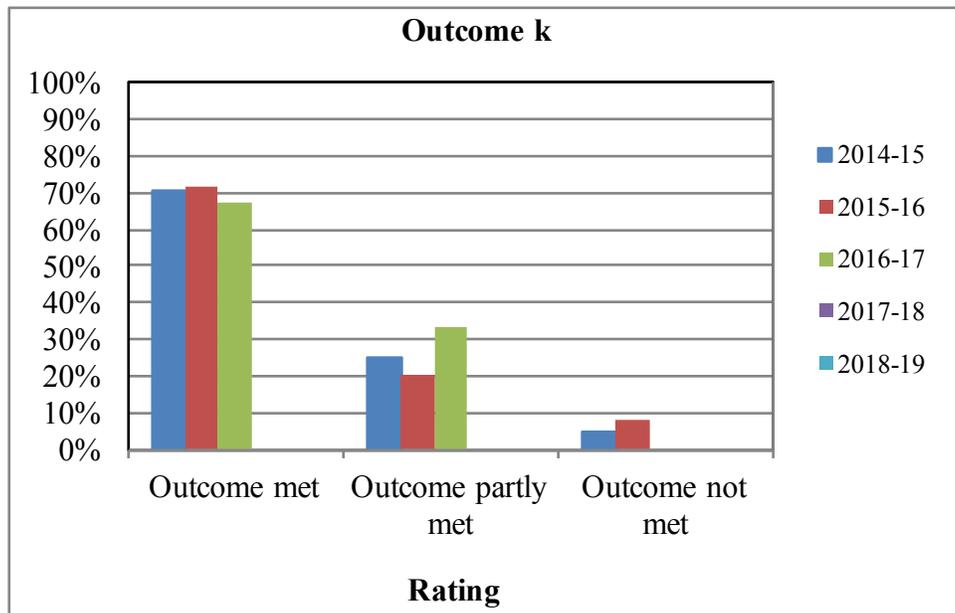


Figure K-2: Student exit interview ratings of progress on Outcome k

***Summary***

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

***Recommendations***

Evaluate Outcome k as planned during the 2019-20 school year. Evaluate opportunities to add additional software tools and programming languages into the curriculum.