

## **2019-2020: Civil and Environmental Engineering BS**

### **Definition of Unit:**

#### **Providing Department:**

Civil and Environmental Engineering BS

#### **Department/Unit Contact:**

Ben Mohr

### **Mission/Vision Statement:**

The mission of the civil engineering program is to offer the strong academic content necessary to produce well-educated graduates who become innovative and productive members of society. Graduates will possess both the problem solving skills and the fundamentals of critical thinking and analysis that are crucial for success within the framework of the civil and environmental engineering profession.

## **Student Outcomes**

### **Define Goal:**

Program Educational Objectives:

1. Graduates should demonstrate the ability for early career professional growth based on their grasp of fundamental concepts in civil engineering.
2. Graduates should utilize knowledge and skills to participate in civil engineering design and/or management processes.
3. Graduates should develop professionally through a commitment to life-long learning.

### **Intended Outcomes / Objectives:**

Students should demonstrate...

1. an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics
2. an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors
3. an ability to communicate effectively with a range of audiences
4. an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts

5. an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives
6. an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions
7. an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

Attainment of PEO 1 is supported by Student Outcomes: 1,2,4,6

Attainment of PEO 2 is supported by Student Outcomes: 3,4,5

Attainment of PEO 3 is supported by Student Outcome: 7

DRILL DOWN-----

RELATED ITEM LEVEL 1

## **Assessment Methods**

### **Frequency of Assessment:**

Each semester

### **Rationale:**

CEE the assessment metrics are as follows:

1. Course Components are grades on a specific, recurring assignment or collection of assignments in a specific The assignment must be common to all faculty who teach the course.
2. FE Exam provides a measure of Civil Engineering content knowledge. The FE Exam topic area ratio scores provided to CEE by the National Council of Examiners for Engineering and Surveying. CEE requires all students to take the FE exam, so our scores are representative of all students.
3. Final Course Grades are accumulated across a graduating class. That is, the average grade in a specific course for all the students who graduated in a given term.
4. Course Instructional Outcome Surveys and Senior Exit Surveys are Likert scale survey questions. All have 4 answers: Strongly Disagree, Disagree, Agree, and Strongly Agree. CEE is experimenting with annual alumni surveys due to low response rates.

Expected Levels of Attainment:

Because of scale differences between metrics, CEE has implemented color-coding to aid in the review process. The color coding and the criteria used in its application are found below:

## SO Attainment Color Coding Criteria

Color Code			
Attainment Level	Unacceptable	Acceptable	Excellent
Metric	Criteria		
Course Components (Out of 100)	Average < 70	Average ≥ 70	Average ≥ 80
FE Exam Ratio Scores (CEE Performance Index / Comparator)	Ratio Score < 0.80	Ratio Score ≥ 0.80	Ratio Score ≥ 0.90
Final Course Grades (4-Point Grading Scale)	Average < 2.50	Average ≥ 2.50	Average ≥ 2.75
Course Instructional Outcome Surveys (Out of 4)	Average < 2.50	Average ≥ 2.50	Average ≥ 2.75
Senior Exit Surveys (Out of 4)	Average < 2.50	Average ≥ 2.50	Average ≥ 2.75

The faculty chose to include multiple metrics for each SLO. Multiple metrics help the faculty to avoid unneeded reactions to statistical outliers that occur during any evaluation. As such, the occurrence of a single Low or Unsatisfactory rating will not necessarily require a response.

The thresholds for a required response are:

- Multiple metrics in the red in a single academic year for a given outcome
- Single metrics in the red in consecutive academic years for a given outcome
- Multiple metrics that remain “in the yellow” (i.e., satisfactory) in multiple academic years for a given outcome. Yellow followed by red and vice versa are considered multiple “satisfactory” years as well as single years in the red.

In addition to these required responses, there are three additional ways in which responses may be initiated. During their reviews of the metrics, the Chair, the Faculty, or the Advisory Board can request action or further investigation even if all the metrics are Excellent. This flexibility allows the opportunity to begin investigations before they are required, hopefully reducing our response time in applying improvements. It also allows for improvements even when there are no issues.

## **Results: SO 1**

### **Results:**

#### **SO 1. An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics**

In order to capture all parts of an engineering problem (and identify any potential issues) as indicated in SO1, the outcome was broken up into three parts:

1. "Identify" – the CEE 4950 Interim 1 Technical Report grade was used as it would be expected that students have successfully identified the engineering problem
2. "Formulate" – the CEE 4950 Interim 2 Technical Report grade was used as, at this point, students would have devised a methodology for solving the engineering problem
3. "Solve" – the CEE 4950 Final Report grade should give an indication regarding the students' ability to solve the engineering problem

**ABET 1. an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics**

	2015-16		2016-17		2017-18		2018-19		2019-20	
	Fall	Spr								
<b>CEE 4950 Senior Design Course Components</b>										
Mentor (Technical) Grade on Interim Report 1 - Identify		81.0	86.8	84.1	86.8	86.6	83.4	81.6	81.2	
Mentor (Technical) Grade on Interim Report 2 - Formulate		83.3	88.7	86.0	88.6	88.0	91.7	85.6	84.4	
Mentor (Technical) Grade on Final Report - Solve		88.6	86.0	76.4	87.0	90.2	89.6	93.5	88.5	87.6
<b>Senior Exit Surveys</b>										
Survey question - (1a) Identify								3.64	3.83	3.68
Survey question - (1b) Formulate								3.54	3.75	3.63
Survey question - (1c) Solve								3.62	3.63	3.68
Survey Question - Combined					3.74	3.55	3.57			
<b>FE Exam Ratio Scores</b>										
Engineering Mechanics (Statics)	0.91	0.80	0.83	0.97	1.10	0.98	0.98	0.95	0.96	
Environmental Engineering	0.94	1.02	0.92	0.93	1.80	1.00	1.02	1.07	0.99	
Soil Mechanics & Foundations (Geotechnical)	0.87	0.85	0.92	0.96	0.99	0.98	0.96	1.13	1.01	
Hydraulics & Hydrologic Systems	1.01	0.93	0.95	0.98	0.99	0.96	1.01	0.93	1.02	
Transportation Engineering	1.02	1.08	0.89	1.03	1.02	1.07	1.08	1.04	1.07	
Structural Analysis	0.95	0.90	0.87	0.99	1.10	1.02	1.01	1.02	0.94	
Structural Design	0.96	0.99	1.01	1.07	1.11	0.99	1.07	1.00	1.03	
Materials	0.86	1.01	1.01	1.04	0.91	1.03	0.97	0.96	1.01	
<b>Final Course Grades</b>										
CEE 2110 Statics	2.61	2.13	2.93	2.96	2.95	3.31	3.07	3.33	3.24	3.08
CEE 3020 Surveying	3.11	2.95	3.20	3.30	2.91	3.45	3.33	3.46	3.57	3.30
CEE 3413 Environmental Engineering	2.68	2.85	2.75	2.96	2.86	3.17	2.89	3.23	2.91	2.82
CEE 4310 Steel Design	2.80	2.95	3.27	3.00	2.91	3.15	2.39	2.15	2.43	2.61
CEE 4320 Concrete Design	2.84	2.55	2.44	2.64	2.10	2.72	2.50	2.15	2.61	2.78
CEE 4630 Traffic Engineering	2.57	3.00	3.00	2.75	3.60	3.17	2.67	3.33	4.00	2.50
CEE 4800 Geotechnical Engineering	3.20	2.70	3.00	2.81	3.09	2.97	2.72	2.77	2.91	2.85
ENGR 1110 Engineering Graphics	3.31	2.63	3.17	3.15	3.19	3.27	3.25	3.23	2.63	2.92
ENGR 1120 Programming	2.59	2.71	2.67	2.84	2.81	2.89	2.61	3.42	2.86	2.74
<b>Course Instructional Outcome Surveys</b>										
CEE 2110 Statics	2.70		3.18	3.73	3.46	3.52	3.57	3.28	3.62	
CEE 3413 Environmental Engineering	3.49	3.49	3.59	3.24	3.47	2.70	3.33	3.35	3.62	
CEE 4800 Geotechnical Engineering	3.65	3.64	3.67	3.52	3.84	3.80	3.67	3.72	3.65	
CEE 4950 Senior Design	3.77	3.80	3.60	3.77	3.54	3.88	3.40	3.69	3.74	
CEE 3020 Surveying	3.39		3.51	3.61	3.52	3.45	3.57	3.49	3.37	
CEE 4310 Steel Design	3.06	3.83	3.66	3.76	3.75	3.52	3.66	3.68	3.81	
CEE 4320 Concrete Design	2.69	3.60	3.68	3.78	3.67	3.54	2.34	3.07	3.13	
CEE 4630 Traffic Engineering	3.22		3.01		3.82		3.32			

CEE 4310 Steel Design and CEE 4320 Concrete Design final course grades are moving towards improvement. The multiple red metrics were due to the departure of two structural faculty in 2016-2017. New faculty members are now in place and metrics seem to be improving. We will continue to monitor progress on these metrics. No other metrics met the threshold for required action.

**Attachments:**

RELATED ITEM LEVEL 2

## **Results: SO 2**

### **Results:**

**SLO 2. An ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors**

In order to capture different parts of SO 2, the outcome was split into two parts, with their respective direct assessment metric.

1. “an ability to apply engineering design to produce solutions” – Similar to SO 1, the CEE 4950 Final Technical Report Grade was used as the main goal of the course is to perform engineering design to fit a stated need.
2. “...with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors.” – This portion of the outcome presented more issues as nothing was previously assessed that could be tied to these needs and As such, a new assignment and associate metric was added. As part of the CEE 4950 final report, a new section was added that required students to state how their engineering design consider public health, safety, and welfare in addition to how the considered any global, cultural, social, environmental, and economic factors. Both the mentors and faculty graded this section separately from the rest of the technical report.

All metrics for this outcome are shown in the table below:

ABET 2. an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors											
		2015-16		2016-17		2017-18		2018-19		2019-20	
		Fall	Spr								
<b>CEE 4950 Senior Design Course Components</b>											
	Mentor (Technical) Grade on Final Report - Solve	88.6	86.0	76.4	87.0	90.2	89.2	93.5	86.0	87.6	
	CEE 4950 Assessment of Needs Assignment - NEW									92.0	
<b>Senior Exit Surveys</b>											
	Single survey question covers "Apply engineering design"								3.50	3.58	3.65
	Single survey question covers "consideration of..."								3.50	3.71	3.72
	Single survey question covers "...factors"								3.31	3.50	3.48
<b>Average Grades on Course Components</b>											
	CEE 4380 Bridge Design Project	90.6		87.6							
	CEE 4640 Highway Design Project*			80.3		86.1					
	CEE 4950 Senior Design Project Technical	88.6	86.0	76.4	87.0	90.2	89.6	93.5	88.5	87.6	
<b>Final Course Grades</b>											
	CEE 3020 Surveying	3.18	3.42	3.40	3.47	3.63	3.21	3.57	3.30	3.62	3.18
	CEE 4310 Steel Design	2.80	2.95	3.27	3.00	2.91	3.15	2.39	2.15	2.43	2.61
	CEE 4320 Concrete Design	2.84	2.55	2.44	2.64	2.10	2.72	2.50	2.15	2.61	2.78
	CEE 4630 Traffic Engineering	2.57	3.00	3.00	2.75	3.60	3.17	2.67	3.33	4.00	2.50
	ENGR 1110 Engineering Graphics	3.31	2.63	3.17	3.15	3.19	3.27	3.25	3.23	2.63	2.92
	ENGR 1120 Programming	2.59	2.71	2.67	2.84	2.81	2.89	2.61	3.42	2.86	2.74
<b>Course Instructional Outcome Surveys</b>											
	CEE 4380 Bridge Design	3.63		3.65		3.68		3.69		3.63	
	CEE 4640 Highway Design		3.88		3.16		3.70				
	CEE 4950 Senior Design	3.77	3.80	3.60	3.77	2.68	3.89	3.40	3.69	3.74	
	CEE 3020 Surveying	3.39		3.51	3.61	3.52	3.37	3.57	3.49	3.37	
	CEE 4310 Steel Design	3.06	3.83	3.66	3.76	3.75	3.52	3.66	3.68	3.81	
	CEE 4320 Concrete Design	2.69	3.60	3.68	3.78	3.69	3.54	2.34	3.07	3.13	
	CEE 4630 Traffic Engineering	3.22		3.01		3.82		3.32			
* This course is typically offered only during spring semesters. First, data were not tabulated prior to spring 2017. Second, the course was not											

As discussed on SO 1, CEE 4310 Steel Design and CEE 4320 Concrete Design final course grades are moving towards improvement as new faculty are in place and acclimating. We will continue to monitor progress on these metrics.

Students demonstrated excellent outcomes on the new CEE 4950 component related to global, cultural, social, environmental, and economic factors. Since this is a new metric, despite new issues being identified thus far, it is anticipated that the assessment will continue to be tweaked and modified in addition to increased focused throughout the course and curriculum regarding these needs and factors.

No other metrics met the threshold for required action.

## Attachments:

RELATED ITEM LEVEL 2

**Results: SO 3**

**Results:**

**SO 3. An ability to communicate effectively with a range of audiences**

Communication skills are assessed separately for both oral and written in CEE 4950. Written communication skills are directly measured for both the technical report and poster presentation. The oral presentation component has been separated out as “Presentation Skills”. The “Quality of Slides” component functions as a measure of both written and oral communication skills.

All metrics for this outcome are shown in the table below:

ABET 3. an ability to communicate effectively with a range of audiences [G]		2015-16		2016-17		2017-18		2018-19		2019-20	
		Fall	Spr								
<b>CEE 4950 Senior Design Course Components</b>											
	CEE 4950 Senior Design - Written Report (Technical Writing)	81.4	83.0	74.8	86.0	80.1	87.4	86.5	84.4		
	CEE 4950 Senior Design - Oral Presentation (Presentation Skills)			89.9		93.0		90.0		93.3	
	CEE 4950 Senior Design - Oral Presentation (Quality of Slides)			91.9		93.8		89.3		95.2	
	CEE 4950 Senior Design - Poster Presentation		91.0	92.4	88.2	93.2	90.2	91.6	90.7	90.1	
<b>Senior Exit Surveys</b>											
	Single survey question covers (3) - Writing								3.35	3.38	3.48
	Single survey question covers (3) - Oral								3.29	3.50	3.36
<b>Course Instructional Outcome Surveys</b>											
	CEE 4950 Senior Design - Oral Communication	3.82	3.72	3.70	3.81	3.69	3.90	3.38	3.82	3.70	
	CEE 4950 Senior Design - Written Communication	3.82	3.90	3.43	3.78	3.61	3.90	2.88	3.59	3.52	
<b>Final Course Grades</b>											
	PC 2500 - Oral Communication	4.00	3.86	4.00	3.82	4.00	4.00	4.00	4.00	3.64	3.60
	SPCH 2410 - Oral Communication	3.50	3.20	3.20	3.14	2.89	3.23	3.00	3.50	3.71	3.33

All metrics met the excellent threshold for the 2019-2020 year. Students continue to demonstrate strong communication skills.

**Attachments:**

RELATED ITEM LEVEL 2

## Results: SO 4

### Results:

#### SO 4. An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts

In order to capture different parts of SO 4, the outcome is split into two parts, with their respective direct assessment metric.

1. "an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments..."
2. "...which must consider the impact of engineering solutions in global, economic, environmental, and societal "

For both parts of SO 4, CEE 4920 Professionalism and Ethics was used.

All metrics for this outcome are shown in the table below:

ABET 4. an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts		2015-16		2016-17		2017-18		2018-19		2019-20	
		Fall	Spr								
<b>FE Exam Ratio Scores</b>											
	Ethics & Business Practices	1.06	0.96	0.81	1.01	1.01	0.96	1.01	1.06	0.84	
<b>Instructional Outcome Survey Question(s)</b>											
	CEE 4920 Professionalism and Ethics	3.77	3.71	3.67	3.74	3.79	3.62	3.62	3.79	3.35	
<b>Senior Exit Surveys</b>											
	Single survey question covers "ethical and professional responsibilities..."								3.57	3.57	3.54
	Single survey question covers "make informed judgments..."								3.50	3.57	3.44
<b>Final Course Grades</b>											
	CEE 4920 Professionalism and Ethics	3.95	4.00	3.88	3.92	3.68	3.90	3.61	3.69	3.91	3.57
<b>Course Instructional Outcome Surveys</b>											
	CEE 4950 Senior Design	3.77	3.80	3.60	3.77	3.54	3.88	3.40	3.69	3.74	

For the Spring 2020 semester, two new assignments were planned to be given to students in order to more directly assess this outcome. Unfortunately, due to the COVID situation and transition to online course content, these assessments were not conducted but are planned for future semesters.

Given the current metrics, none met the threshold for a required action.

**Attachments:**

RELATED ITEM LEVEL 2

**Results: SO 5**

**Results:**

**SO 5. An ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives**

SO 5 is broken into three parts for assessment.

1. "an ability to function effectively on a team whose members together provide leadership..." – CEE 4950 Senior Design focuses on leadership.
2. "...create a collaborative and inclusive environment..." – Peer evaluations are a part of our CEE 4950 Senior Design grading scheme. Students directly assess each other regarding their group.
3. "...establish goals, plan tasks, and meet objectives..." – Students are assessed on management principles in CEE 4950 Senior Design, which will continue under the new student outcomes.

ABET 5. an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives [D]											
		2015-16		2016-17		2017-18		2018-19		2019-20	
		Fall	Spr								
<b>CEE 4950 Senior Design Course Components</b>											
	CEE 4950 Senior Design - Leadership paper		82.0	73.6	85.0	79.7	77.0	92.6	75.0	95.0	
	CEE 4950 Senior Design - Management paper		75.0	72.8	91.0	85.7	79.0	77.0	88.0	93.0	
	CEE 4950 Senior Design - Project Mgmt (MS Project)									80.0	
	CEE 4950 Senior Design Project (Peer Eval)	87.4	88.0	88.0	91.0	77.3	92.0	81.6	95.0	94.7	
<b>Instructional Outcome Survey Question(s)</b>											
	CEE 4950 Senior Design <sup>4</sup>	3.77	3.80	3.60	3.77	3.54	3.88	3.40	3.69	3.69	
<b>Senior Exit Surveys</b>											
	Single survey question covers leadership								3.36	3.46	3.52
	Single survey question covers collaborative and inclusive environment								3.46	3.58	3.5
	Single survey question covers "establish goals, plan tasks, and meet objectives"								3.50	3.67	3.48

A new assessment was added in Fall 2019 to support student application of management principles. In addition, to increase focus on these management principles, in Fall 2019, students were required to further apply this portion of the student outcome by creating a project management schedule in Microsoft Project. This schedule was assessed by both mentors and faculty. Students demonstrated strong performance in the new assessment. The metric will continue to be improved upon in future semesters.

No metrics fell below the excellent threshold for 2019-2020.

**Attachments:**

## Results: SO 6

### Results:

#### SO 6. An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions

In order to capture different parts of SO 6, the outcome was split into three parts, with their respective direct assessment metric. Previously, assessment was conducted primarily using the final course grade or final lab component grade for those courses containing a laboratory component. In essence, all parts of the student outcome were lumped together. In order to extrapolate any potential issues, an attempt was made to focus exclusively on four lab-based courses where formal lab reports are submitted by the students. Therefore, for each of the four courses, the final lab report was chosen as the most appropriate measure, broken down into three parts.

1. "an ability to develop and conduct appropriate experimentation, ..." – The Introduction and Methodology sections were chosen to represent the "develop and conduct" portions of this student outcome.
2. "...analyze and interpret data..." – The Results and Discussion section(s) of respective lab reports were chosen to represent the "analyze and interpret" portions of this student outcome.
3. "...and use engineering judgment to draw conclusions." – The Conclusion section was used to assess this portion of the student outcome.

ABET 6. an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions											
		2015-16		2016-17		2017-18		2018-19		2019-20	
		Fall	Spr	Fall	Spr	Fall	Spr	Fall	Spr	Fall	Spr
<b>Average Course Component Grades</b>											
<b>"Develop and Conduct" - Introduction and Methodology</b>											
New	CEE 3030										
New	CEE 3040									3.57	3.33
New	CEE 3120								3.63		3.58
New	CEE 3430							3.67	3.75	3.52	3.13
<b>"Analyze and Intrepret" - Results and Discussion</b>											
New	CEE 3030										
New	CEE 3040									3.20	2.80
New	CEE 3120								3.53		3.49
New	CEE 3430							3.52	3.81	3.86	3.82
<b>"Use Eng. Judgment" - Conclusions</b>											
New	CEE 3030										
New	CEE 3040									3.20	3.24
New	CEE 3120								3.53		3.39
New	CEE 3430							3.37	3.8	3.81	3.68
<b>Senior Exit Surveys</b>											
	Single survey question covers "develop and conduct"								3.14	3.50	3.38
	Single survey question covers "analyze and interpret"								3.50	3.67	3.56
	Single survey question covers "draw conclusions"								3.21	3.75	3.60

Because of the differences between labs and faculty teaching those labs, coordination of activities took longer than the other student outcomes. By the beginning of January 2020, all labs had a plan for documenting this student outcome; however, due to COVID, not all labs were conducted and subsequently, data are unavailable for some labs. At the same time, some data

could be collected from prior semesters. Moving forward, it is expected that all data will be collected.

**Attachments:**

RELATED ITEM LEVEL 2

**Results: SO 7**

**Results:**

**SO 7. An ability to acquire and apply new knowledge as needed, using appropriate learning strategies**

ABET 7. an ability to acquire and apply new knowledge as needed, using appropriate learning strategies [I]											
		2015-16		2016-17		2017-18		2018-19		2019-20	
		Fall	Spr								
<b>CEE 4950 Senior Design Course Components</b>											
	CEE 4950 Mentor final technical grade - "Acquire and Apply"	88.6	86.0	76.4	87.0	90.2	89.6	93.5	88.5	87.6	
<b>Senior Exit Surveys</b>											
	Single survey question covers "acquire"								3.64	3.67	3.56
	Single survey question covers "apply"								3.64	3.75	3.52
<b>FE Exam Ratio Scores</b>											
	Overall FE Exam Pass Rate	0.66	0.58	0.42	0.84	1.01	0.90	1.00	0.94	1.06	

In order to “apply” new knowledge (as needed for CEE 4950), it is implied that students must “acquire” that knowledge first. Thus, the department considered separating out (and directly assess) the “acquire” and apply” portions of this student outcome for CEE 4950. While multiple metrics were considered, the department could not identify an appropriate way to get a valid direct assessment in CEE 4950. In other words, assessment data could be produced; however, due to the variability in CEE 4950 design projects, student backgrounds, and mentor/faculty reviews, no rubric could be produced that would be particularly valid. In the case that any of the assessment metrics indicate a need for review and/or improvement, this topic will be revisited. Currently, all metrics meet the excellent threshold.

**Attachments:**