**Civil Engineering**
**Undergraduate Assessment**

## Bachelor of Science

1. Student Learning Outcomes (SLOs)
The student learning outcomes describe what students are expected to know and be able to do at the time of graduation. They are:

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, societal, and environmental context
i. a 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, particularly recognizing the integral role of computers in engineering and the rapid expansion of resources on the Internet.

2. The SLOs are published on the department's web page.

3. Table 1 shows the linkages between the curriculum and program outcomes. Courses are linked to the program outcomes using a scale based on the contribution of each course.

**Table 1 Core curriculum linkages to program outcomes**

| Semester | Outcomes / Course | a | b | c | d | e | f | g | h | i | j | k |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Freshmen Fall | Eng 100 | | | | | | 1 | 3 | 2 | | | 2 |
| | Math 241 | 3 | | | | | 1 | | | | | 2 |
| | Chem 161 & 161L | 3 | 2 | | | | 1 | | | | | 1 |
| | Sp 251 | | | | | | 1 | 3 | 2 | | | |
| | CEE 123 | 3 | | | | 1 | 1 | 2 | 1 | | | 3 |
| Freshmen Spring | Math 242 & 242L | 3 | | | | | 1 | | | | | 2 |
| | Phys 170 & 170L | 3 | 3 | | | | 1 | | | | | 2 |
| | Chem 162 | 3 | | | | | 1 | | | | | 1 |
| | EE 160 | 3 | | 1 | | | 1 | | 1 | | | 3 |
| Sophomore Fall | CEE 270 | 3 | | 1 | | 1 | 1 | | | | | 2 |
| | Math 243 | 3 | | | | | 1 | | | | | 2 |
| | Phys 272 & 272L | 3 | 3 | 1 | | | 1 | | | | | 2 |
| | Hist 151 | | | | | | 1 | | 3 | | | |
| | Humanities elective | | | | | | 1 | | 3 | | 3 | |
| Sophomore Spring | CEE 271 | 3 | | 1 | | 3 | 1 | 1 | | 1 | | 1 |
| | Math 244 | 3 | | | | | 1 | | | | | 2 |
| | CEE 211 | 3 | 3 | | | 2 | 1 | 1 | 3 | 2 | 2 | 2 |
| | Hist 152 | | | | | | 1 | | 3 | | | |
| | Economics elective | | | | | | 1 | | 3 | | 3 | |
| | Social science elective | | | | | | 1 | | 3 | | 3 | |
| Junior Fall | CEE 305 | 3 | 1 | 1 | | 2 | 1 | | 1 | | | 1 |
| | CEE 320 | 3 | 3 | 1 | 1 | 3 | 1 | 3 | 1 | 3 | 1 | 1 |
| | CEE 361 | 3 | 1 | 2 | | 2 | 1 | | 2 | | 1 | 2 |
| | CEE 370 & 370L | 2 | 3 | 1 | 1 | 2 | 1 | | | | 1 | 2 |
| | Math 302 or ME 403 | 3 | | | | | 1 | | | | | 2 |
| Junior Spring | CEE 330 | 3 | 2 | 1 | 1 | 2 | 1 | 1 | 2 | 1 | 2 | 3 |
| | CEE 355 | 3 | 3 | 2 | 3 | 3 | 1 | 3 | 1 | 1 | 1 | 3 |
| | CEE 375 | 1 | 3 | 2 | 1 | 1 | 1 | 1 | 1 | 2 | 2 | 2 |
| | CEE 381 | 3 | | 1 | | 3 | 1 | 1 | 1 | 2 | | 3 |
| Senior Fall | CEE 421 | 3 | 3 | 3 | 1 | 3 | 1 | 2 | 2 | 2 | 1 | 3 |
| | CEE 431 | 3 | 1 | 3 | 1 | 3 | 1 | 2 | 3 | 2 | 3 | 3 |
| | CEE 462 or | 3 | 1 | 2 | 2 | 2 | 2 | 3 | 3 | 2 | 2 | 3 |
| | CEE 464 | 3 | 1 | | 2 | 2 | 1 | 3 | 3 | 1 | 1 | 2 |
| | CEE 472 or | 1 | | 1 | 1 | 1 | 2 | 2 | 3 | 3 | 2 | 2 |
| | CEE 473 or | 1 | | 2 | | 1 | 1 | 1 | 1 | 2 | 2 | 1 |
| | CEE 474 | 1 | 1 | 2 | | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| | CEE 485 | 3 | 2 | 3 | 1 | 3 | 1 | 1 | | 1 | | 1 |
| Senior Spring | CEE 455 | 3 | 1 | 2 | 1 | 2 | 2 | | | | 1 | 1 |
| | CEE 490 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 2 | 2 | 2 | 3 |
| | Biological science elective | 3 | | | | | 1 | | 3 | | | |

Note: "blank" = no emphasis; 1 = some emphasis; 2 = moderate emphasis; 3 = significant emphasis

4. Each outcome is assessed using multiple (at least 2) methods as shown in Table 2. The Department's four assessment tools are described in this section.

**Table 2** Mapping of program educational outcomes and assessment methods

| PROGRAM OUTCOMES (ABBREVIATED FORM OF a THROUGH k FROM ABOVE) | Exit Surveys | Exit Interviews | F.E. Exam | Design Portfolios |
|---|---|---|---|---|
| a. math, science & engineering | X | | X | X |
| b. design & conduct experiments | X | X | | |
| c. design system, component, process | X | | | X |
| d. function on multi-disciplinary teams | X | | | X |
| e. identify, formulate & solve eng. problems | X | | | X |
| f. professional & ethical responsibility | X | X | X | |
| g. communicate effectively | X | X | | X |
| h. understand impact in global & societal context | X | | | X |
| i. life-long learning | X | X | | |
| j. knowledge of contemporary issues | | X | | X |
| k. use techniques, skills and tools for eng. practice | X | | X | X |

A. Exit Surveys

Exit surveys have been distributed to graduating students since Fall 1998. The initial survey was a general questionnaire regarding students' perceptions of their undergraduate program and their preparedness for engineering employment. The survey instrument was revised in 2000 and again in 2002 to provide more direct feedback on the program outcomes. The current exit survey consists of a one-page questionnaire (Figure 1) that asks all graduating seniors to share their perception of the level of personal achievement of outcomes *a* through *k* after going through our program (the earlier survey instruments will be available for review at the site visit). Students are also asked to provide additional comments on the program. From Fall 1998 through 2002, the return rate was 52%.

B. Exit Interviews

Exit interviews are conducted as a follow-up to exit surveys. This involves a group face-to-face dialog with all seniors a few days prior to graduation. The focus of the exit interview is to request for students to expand on outcomes b, f, g, i and j.

**Exit Survey**

The following statements cover general skills for entry-level civil engineers.
Please indicate how well you feel you have been prepared in these skills by the CE Bachelor's degree program:

When graduating _____ semester _____ (year)

| | | Very High | High | Average | Low | Very Low |
|---|---|---|---|---|---|---|
| A | Ability to apply knowledge of mathematics, science and engineering | | | | | |
| B | Ability to design and conduct experiments, and analyze and interpret data | | | | | |
| C | Ability to design a system, component, or process to meet desired needs | | | | | |
| D | Ability to function on multi-disciplinary teams | | | | | |
| E | Ability to identify, formulate, and solve engineering problems | | | | | |
| F | Understanding of professional and ethical responsibility | | | | | |
| G.1 | Ability to communicate effectively through writing, e.g., memos, letters, proposals, etc. | | | | | |
| G.2 | Ability to communicate effectively through oral presentations and public speaking | | | | | |
| H | Broad education necessary to understand the impact of engineering solutions in a global, societal and environmental context | | | | | |
| I | Need for and ability to engage in life-long learning | | | | | |
| J | Knowledge of contemporary issues | | | | | |
| K | Ability to use the techniques, skills, and modern engineering tools necessary for engineering practice, particularly recognizing the integral role of computers in engineering and the rapid expansion of resources on the Internet | | | | | |
| L | Ability to develop computer code to perform routine design tasks. | | | | | |
| M | Ability to use computer-aided design (CAD). | | | | | |
| N | Sensitivity and respect for other cultures, genders and work styles. | | | | | |
| O | Major project-based open-ended design experience in the CE curriculum | | | | | |
| P | Level of exposure to practice through field trips and lectures by practicing engineers. | | | | | |

**Do you plan to pursue additional degree(s)?** Yes ☐ No
**If "Yes", which Universities are you considering?** UH ☐ Other: _____

**Have you taken the F.E. exam?** Yes ☐ No

**Please provide any other comments on the Bachelor's in CE program:**

_____

_____

_____

_____

**Figure 1** Exit survey instrument

Minutes of the exit interviews are recorded every spring and fall semester. Summer graduates participate in the spring interview. This assessment method was first performed during the Spring 2002 semester. Typically, about 90% of the graduating seniors attend the exit interview over lunch.

C. Commercial, Norm-referenced, Standardized Examinations

The Fundamentals of Engineering (FE) Exam is a nationally designed and administered exam that allows us to assess our students' capabilities, as they near graduation, relative to students across the U.S. From a civil engineering student's perspective, the FE is important because it is the first step towards licensure as a professional engineer (P.E.). The FE Exam is administered such that all students take a common general morning session, but the students have the option in the afternoon session of either additional general questions or civil engineering specific questions.

In 2001 and before, the FE exam was offered only in April in the State of Hawaii. Beginning in 2002, the FE exam is offered twice a year in both April and October. The exam is not required, but students are encouraged to take it. Evaluation of the scores provides a direct feedback regarding areas of study in which our graduates are competent, as well as areas that should be improved. The FE exam is used to assess outcomes a (math, science and engineering), f (professional and ethical responsibility) and k (techniques, skills and tools for engineering practice). The Department is considering making this exam mandatory for graduation.

D. Design Portfolios

These are collections of all work compiled during the capstone course (CEE 490) that is mandatory for all students in their senior year. Therefore, the portfolios are used to assess outcomes close to graduation. Multiple outcomes can be assessed using design portfolios. We use portfolios to assess outcomes a, c, d, e, g, h, j and k. Assessment is performed by a panel of six professional practitioners. The evaluation form used in shown in Figure 2. The results of this rating are then reported to the program assessment committee. One advantage of using design portfolios is that it minimizes test anxiety and other "one shot" measurement problems.

Evaluation Scale: Very good (5), Good (4), Adequate (3), Poor (2), or Very poor (1)

| **The following PROGRAM OUTCOMES represent the skills, knowledge, and behavior that students need to acquire in the CEE program. Please rate the student team's ability in the following areas:** | Score |
|---|---|
| 1. Applying knowledge of mathematics, science, and engineering | |
| 2. Design of a system, component, or process to meet desired needs | |
| 3. Functioning on multi-disciplinary teams | |
| 4. Identifying, formulating, and solving engineering problems | |
| 5. Effective written and oral communication | |
| 6. Understanding the impact of engineering solutions in a global, societal, and environmental context | |
| 7. Knowledge of contemporary issues | |
| 8. Using the techniques, skills, and modern engineering tools necessary for engineering practice, particularly recognizing the integral role of computers in engineering and the rapid expansion of resources on the Internet | |

**Figure 2** CEE 490 Senior Design Project portfolio evaluation form

**Plan for Assessment of Program Outcomes**

Evaluation of the program outcomes is facilitated using the four assessment methods as shown in Table 2. Steps in the evaluation process are as follows:

1. Set the performance criterion – The performance criterion for each outcome varies depending on the assessment method. A summary of the various performance criteria is given in Table 3.
2. Strategy for assessment – The strategy for assessment is through written exit surveys, in-person exit interviews, evaluation of FE Exam results, and evaluation of capstone design course portfolios.
3. Frequency of assessment - The frequency of assessment is every semester with the exception of the design portfolio, which is performed during each spring semester.
4. Responsibility for assessment – Different faculty members are assigned as champions for each assessment method (see Table 3).
5. Reporting of assessment results – The assigned champions report the assessment results to the Department's program assessment committee.
6. Recommendations and action – The program assessment committee makes a report and recommendations to the faculty for maintaining, modifying or improving the curricula and the assessment process including modifications to the program objectives and/or outcomes. The Department reviews the report and acts on the recommendations. This iterative process results in continuous quality improvement.

**Table 3a** Assessment matrix for outcome "a. An ability to apply knowledge of mathematics, science, and engineering"

| Performance Criteria | Strategy | Assessment Methods | When assessed? | Who will assess? |
|---|---|---|---|---|
| Mean score from exit survey must equal or exceed 3 on a scale of 1 to 5. | Questionnaire | Exit survey | Every semester just prior to graduation | IR |
| If the mean F.E. exam score for UHM students fall below 0.9 times the mean national average, the performance criterion is not met. | Standardized exam | F.E. exam | Last semester prior to graduation | RR, PP |
| Mean score from technical panel must equal or exceed 3 on a scale of 1 to 5. | CEE 490 course | Design portfolio | Every spring semester when CEE 490 is offered | RB, IR |

**Table 3b** Assessment matrix for outcome "b. An ability to design and conduct experiments, as well as to analyze and interpret data"

| Performance Criteria | Strategy | Assessment Methods | When assessed? | Who will assess? |
|---|---|---|---|---|
| Mean score from exit survey must equal or exceed 3 on a scale of 1 to 5. | Questionnaire | Exit survey | Every semester just prior to graduation | IR |
| General consensus from the graduating seniors that specified changes are warranted | Meeting in a group | Exit interview | Every semester just prior to graduation | RB, PO |

**Table 3c** Assessment matrix for outcome "c. An ability to design a system, component, or process to meet desired needs"

| Performance Criteria | Strategy | Assessment Methods | When assessed? | Who will assess? |
|---|---|---|---|---|
| Mean score from exit survey must equal or exceed 3 on a scale of 1 to 5. | Questionnaire | Exit survey | Every semester just prior to graduation | IR |
| Mean score from technical panel must equal or exceed 3 on a scale of 1 to 5. | CEE 490 course | Design portfolio | Every spring semester when CEE 490 is offered | RB, IR |

**Table 3d** Assessment matrix for outcome "d. An ability to function on multi-disciplinary teams"

| Performance Criteria | Strategy | Assessment Methods | When assessed? | Who will assess? |
|---|---|---|---|---|
| Mean score from exit survey must equal or exceed 3 on a scale of 1 to 5. | Questionnaire | Exit survey | Every semester just prior to graduation | IR |
| Mean score from technical panel must equal or exceed 3 on a scale of 1 to 5. | CEE 490 course | Design portfolio | Every spring semester when CEE 490 is offered | RB, IR |

**Table 3e** Assessment matrix for outcome "e. An ability to identify, formulate, and solve engineering problems"

| Performance Criteria | Strategy | Assessment Methods | When assessed? | Who will assess? |
|---|---|---|---|---|
| Mean score from exit survey must equal or exceed 3 on a scale of 1 to 5. | Questionnaire | Exit survey | Every semester just prior to graduation | IR |
| Mean score from technical panel must equal or exceed 3 on a scale of 1 to 5. | CEE 490 course | Design portfolio | Every spring semester when CEE 490 is offered | RB, IR |

**Table 3f** Assessment matrix for outcome "f. An understanding of professional and ethical responsibility"

| Performance Criteria | Strategy | Assessment Methods | When assessed? | Who will assess? |
|---|---|---|---|---|
| Mean score from exit survey must equal or exceed 3 on a scale of 1 to 5. | Questionnaire | Exit survey | Every semester just prior to graduation | IR |
| General consensus from the graduating seniors that specified changes are warranted | Meeting in a group | Exit interview | Every semester just prior to graduation | RB, PO |
| If the mean F.E. exam score for UHM students fall below 0.9 times the mean national average, the performance criterion is not met. | Standardized exam | F.E. exam | Last semester prior to graduation | RR, PP |

**Table 3g** Assessment matrix for outcome "g. An ability to communicate effectively"

| Performance Criteria | Strategy | Assessment Methods | When assessed? | Who will assess? |
|---|---|---|---|---|
| Mean score from exit survey must equal or exceed 3 on a scale of 1 to 5. | Questionnaire | Exit survey | Every semester just prior to graduation | IR |
| General consensus from the graduating seniors that specified changes are warranted | Meeting in a group | Exit interview | Every semester just prior to graduation | RB, PO |
| Mean score from technical panel must equal or exceed 3 on a scale of 1 to 5. | CEE 490 course | Design portfolio | Every spring semester when CEE 490 is offered | RB, IR |

**Table 3h** Assessment matrix for outcome "h. The broad education necessary to understand the impact of engineering solutions in a global, societal, and environmental context"

| Performance Criteria | Strategy | Assessment Methods | When assessed? | Who will assess? |
|---|---|---|---|---|
| Mean score from exit survey must equal or exceed 3 on a scale of 1 to 5. | Questionnaire | Exit survey | Every semester just prior to graduation | IR |
| Mean score from technical panel must equal or exceed 3 on a scale of 1 to 5. | CEE 490 course | Design portfolio | Every spring semester when CEE 490 is offered | RB, IR |

**Table 3i** Assessment matrix for outcome "i. A recognition of the need for, and an ability to engage in life-long learning"

| Performance Criteria | Strategy | Assessment Methods | When assessed? | Who will assess? |
|---|---|---|---|---|
| Mean score from exit survey must equal or exceed 3 on a scale of 1 to 5. | Questionnaire | Exit survey | Every semester just prior to graduation | IR |
| General consensus from the graduating seniors that specified changes are warranted | Meeting in a group | Exit interview | Every semester just prior to graduation | RB, PO |

**Table 3j** Assessment matrix for outcome "j. A knowledge of contemporary issues"

| Performance Criteria | Strategy | Assessment Methods | When assessed? | Who will assess? |
|---|---|---|---|---|
| General consensus from the graduating seniors that specified changes are warranted | Meeting in a group | Exit interview | Every semester just prior to graduation | RB, PO |
| Mean score from technical panel must equal or exceed 3 on a scale of 1 to 5. | CEE 490 course | Design portfolio | Every spring semester when CEE 490 is offered | RB, IR |

**Table 3k** Assessment matrix for outcome "k. An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice, particularly recognizing the integral role of computers in engineering and the rapid expansion of resources on the Internet"

| Performance Criteria | Strategy | Assessment Methods | When assessed? | Who will assess? |
|---|---|---|---|---|
| Mean score from exit survey must equal or exceed 3 on a scale of 1 to 5. | Questionnaire | Exit survey | Every semester just prior to graduation | IR |
| If the mean F.E. exam score for UHM students fall below 0.9 times the mean national average, the performance criterion is not met. | Standardized exam | F.E. exam | Last semester prior to graduation | RR, PP |
| Mean score from technical panel must equal or exceed 3 on a scale of 1 to 5. | CEE 490 course | Design portfolio | Every spring semester when CEE 490 is offered | RB, IR |

5. Improvement actions are summarized in Table 4 below. Improvement actions resulted from assessment of our program educational objectives as well as our program learning outcomes.

**Table 4 Summary of Improvements Made as a Result of Assessment Results**

| Item Assessed | Assessment Method | Comment | Improvement Action |
|---|---|---|---|
| Objectives[1] 1, 2, 3 and 4 | IAC[2] Sep. 8, 2000 Sep. 14, 2001 Mar. 22, 2002 | ● Require CAPSTONE course. | ● CEE 490 made mandatory in Fall 2002 |
| Objectives[1] 1, 2, 3 | IAC[2] Sep. 14, 2001 | ● Keep curriculum generalist but allow specialist tracks. | ● Structural track added in Fall 2001. Environmental track was added in Fall 2003. |
| Objective[1] 4 | IAC[2] Mar. 22, 2002 | ● Ethics should be incorporated into courses. | ● CEE 490 covers ethics extensively and is now mandatory. |
| Outcome a | F.E. Exam | ● Engineering Economics scores below national average | ● Critical aspects of Engineering Economics are now covered in CEE 490, a mandatory course for all CE graduates. |
| Outcome f | Exit Interview | ● Not every one has been exposed to a code of ethics.<br><br>● Not every student has exposure to:<br>(a) procurement of work<br>(b) bidding versus quality based selection process<br>(c) how design and construction people interact<br>(d) importance of licensure<br><br>● Seminars on professional and ethical responsibility by practicing engineers is a good idea | ● Not everyone at that time was required to take CEE 490. Now CEE 490 is mandatory.<br><br>● Most students take CEE 472, and now all students are also required to take CEE 490.<br><br>● CEE 490, which is now required, includes one or more seminars on professional and ethical responsibility |
| Outcome g | Exit Interview | ● Inadequate TA feedback on lab reports. | ● Mandatory TA training implemented in Fall 2003. |
| | Exit Interview | ● Writing intensive CEE courses keep changing. Some students have to take additional courses to satisfy the 5 Writing Intensive course requirement. | ● CEE 320, CEE 330, CEE 355 and CEE 370 are now permanently Writing Intensive. |
| | Exit Interview | ● Student writing skills are deficient. | ● CEE 320, CEE 330, CEE 355 and CEE 370 are now permanently Writing Intensive. |

| | | | |
|---|---|---|---|
| Outcome j | Exit Interview | ● Students were exposed to contemporary issues in CEE 305, CEE 330, CEE 355, and CEE 431. Students indicated that the best way to acquire awareness is to incorporate in CEE 490, term projects or participate in field trips. | ● Not everyone at that time was required to take CEE 490. Now CEE 490 is mandatory. |

Notes:

1. The program educational objectives are also published on the department's webpage.
2. IAC = industry advisory committee

6. The Manoa General Education Program's requirements are satisfied by all students who go through the curriculum outlined in Table 5. The general education program represents 20% of the total credit requirement for graduation. Students are proficient in problem-solving (outcome e above) and oral communication skills (outcome g above). Outcome "e" is assessed using exit surveys and design portfolios. In addition to taking Speech 251, oral communication is assessed in great detail in CEE 490, a mandatory course and is described in detail under design portfolios above. Students are required to take 6 lab courses, in which they learn to process and present engineering data. Students actively engage in scholarship when going through our ABET accredited program. Multiple classes require open-ended projects, and the assessment of the students' ability to handle open-ended design problems culminates in CEE 490 – Senior Design Project.

**Table 5** Curriculum for Bachelor of Science in Civil Engineering

| Semester | Course (Department, Number, Title) | Category (Credit Hours) | | | |
|---|---|---|---|---|---|
| | | Math & Basic Sciences | Engineering Topics *Check if Contains Significant Design* (✔) | General Education | Other |
| Freshmen Fall | Eng 100 Composition I | | ( ) | 3 | |
| | Math 241 Calculus I | 4 | ( ) | | |
| | Chem 161 & 161L General Chemistry I and Lab | 4 | ( ) | | |
| | Sp 251 Principles of Effective Public Speaking | | ( ) | 3 | |
| | CEE 123 Computer-Aided Design and Drafting | | 1 ( ) | | |
| Freshmen Spring | Math 242 & 242L Calculus II and Computer Lab | 4 | ( ) | | |
| | Phys 170 & 170L General Physics I and Lab | 5 | ( ) | | |
| | Chem 162 General Chemistry II | 3 | ( ) | | |
| | EE 160 Programming for Engineers | | ( ) | 4 | |
| Sophomore Fall | CEE 270 Applied Mechanics I | | 3 ( ) | | |
| | Math 243 Accelerated Calculus I | 3 | ( ) | | |
| | Phys 272 & 272L General Physics II and Lab | 4 | ( ) | | |
| | Hist 151 World Civilization | | ( ) | 3 | |
| | Humanities elective | | ( ) | 3 | |
| Sophomore Spring | CEE 271 Applied Mechanics II | | 3 ( ) | | |
| | Math 244 Calculus IV | 2 | ( ) | | |
| | CEE 211 Surveying I and Lab | | 3 ( ) | | |
| | Hist 152 World Civilization | | ( ) | 3 | |
| | Economics elective | | ( ) | 3 | |
| | Social science elective | | ( ) | 3 | |
| Junior Fall | CEE 305 Applied Probability and Statistics | | 3 ( ) | | |
| | CEE 320 Fluid Mechanics Fundamentals | | 4 ( ) | | W |
| | CEE 361 Fundamentals of Transportation | | 3 ( ) | | W |
| | CEE 370 & 370L Mechanics of Materials and Lab | | 4 ( ) | | |
| | Math 302 Introduction to Differential Equations I or[1]<br>ME 403 Advanced Mathematics for Engineers I | 3 | ( ) | | |
| Junior Spring | CEE 330 Environmental Engineering | | 3 ( ) | | W |
| | CEE 355 Geotechnical Engineering I | | 4 ( ) | | |
| | CEE 375 Construction Materials | | 3 ( ) | | |
| | CEE 381 Structural Analysis | | 3 ( ) | | |
| Senior Fall | CEE 421 Engineering Hydraulics | | 3 ( ) | | |
| | CEE 431 Water and Wastewater Engineering | | 3 (✔) | | |
| | CEE 462 Traffic Engineering[1],<br>CEE 464 Urban and Regional Transportation Planning or<br>CEE 465 Traffic Network Simulation | | 3 (✔)<br>3 ( )<br>3 ( ) | | O<br>W |
| | CEE 472 Construction Management[1],<br>CEE 473 Construction Equipment and Methods or<br>CEE 474 Construction Estimating and Bidding | | 3 ( )<br>3 ( )<br>3 ( ) | | |
| | CEE 485 Reinforced Concrete Design | | 3 (✔) | | |
| Senior[4] Spring | CEE 455 Geotechnical Engineering II | | 3 (✔) | | |
| | CEE 490 Senior Design Project | | 3 (✔) | | E,O,W |
| | Technical CEE elective I | | 3 ( ) | | |
| | Technical CEE elective I | | 3 ( ) | | |
| | Biological science elective | 3 | ( ) | | |
| TOTALS | | 35 | 64 | 25 | 0 |
| OVERALL TOTAL FOR DEGREE | | 124 | | | |
| PERCENT OF TOTAL | | 28% | 52% | 20% | 0% |
| ABET requirements - Totals must satisfy one set | Minimum semester credit hours | 32 hrs | 48 hrs | | |
| | Minimum percentage | 25% | 37.5% | | |

Notes: 1. If more than one course is in each row, students are required to take only one of the courses in that row.

2. E = ethics designation; O = oral intensive, W = writing intensive

**Civil Engineering**
**Graduate Assessment**

## Master of Science

1. Student Learning Outcomes (SLOs)
The student learning outcomes are 1) attainment of in-depth technical knowledge in subdiscipline of specialization; 2) an ability to perform engineering with enhanced technical proficiency in subdiscipline of specialization; 3) an ability to present work orally and in written form; and 4) an ability to perform either original research, possibly with direction, and/or detailed, open-ended project work.

2. The SLOs are published on the department's web page.

3. Each subdiscipline establishes a sequence of courses to achieve SLOs 1 and 2. To achieve SLO 3, every student is required to take a seminar course, where they are required to make an oral presentation. Also, every student defends orally during the final examination their thesis (Plan A) or project work (typical for Plan B). To achieve SLO 4, each student must complete successfully either a research-oriented thesis (Plan A) or a research or practice-oriented project paper (Plan B).

4. All M.S. students are included in the population.

5. Assessment events include course midterms, final exams, and course projects. Plan A students must complete successfully a thesis. Plan B students must complete a project paper. The student's final assessment is the responsibility of the student's individual committee, consisting of at least 3 faculty members (2 of which must be from the department). The committee evaluates the student's academic achievement as well as the written and oral presentation of the thesis/project paper.

6. Graduate students attend and present their work at conferences as funding and opportunities allow. This is less common at the MS level than at the PhD level. Faculty actively encourage students to publish their work.

7. No formal monitoring of post-graduate professional activities is done by the department. Individual faculty typically monitor their students' careers. Most graduates work in the civil/environmental/structural engineering industry, although some work in other areas (e.g., computer industry).

8. Our course requirements were recently changed to reduce the seminar requirement from two courses to one course as a result of the department assessment but students are now required to make an oral presentation during this course (it was previously at the discretion of the instructor). In addition, the Plan B credit requirements were reduced to bring them in parity with the Plan A requirements.

**Ph.D.**

1. Student Learning Outcomes (SLOs)
The student learning outcomes are 1) attainment of further in-depth technical knowledge in subdiscipline of specialization; 2) an ability to perform engineering utilizing state-of-the-art research and techniques in area of specialization; 3) proficiency in oral and written communication; 4) obtain experience in teaching at the university level; and 5) an ability to carry out independently original research in area of expertise.

2. The SLOs are published on the department's web page.

3. Each subdiscipline establishes a sequence of courses to achieve SLOs 1 and 2. To achieve SLO 3, every student is required to take a seminar course, where they make an oral presentation, and every student must write a dissertation, which they defend orally during the final examination. To achieve SLO 4, each student is required to complete at least one semester as a teaching assistant. To achieve SLO 5, each student must complete successfully a research-oriented dissertation.

4. All Ph.D. students are included in the population.

5. Assessment events include course midterms, final exams, and course projects. Students must complete successfully a dissertation involving original research. Students must pass a qualifying exam that is both written and oral. If deficiencies are identified, the qualifying exam committee develops a required course of action to remove the deficiency. Students must also pass a written and oral comprehensive exam (typically after most if not all course work is completed). The comprehensive exam assesses the student's academic achievements to date, and is individually tailored to the student. Each student has an individual comprehensive examination committee consisting of at least 5 faculty. The student's final assessment is the responsibility of the student's dissertation committee, consisting of at least 5 members (3 of which must be from the department). The committee focuses primarily on the original research and dissertation. The student is required to defend orally the dissertation.

6. Graduate students attend and present their work at conferences as funding and opportunities allow. A recent PhD student won the best student paper at the last American Geophysical Union conference, a very prestigious accomplishment. Faculty actively encourage students to publish their work.

7. No formal monitoring of post-graduate professional activities is done by the department. Individual faculty typically monitor their students' careers. Most graduates work in the civil/environmental/structural engineering industry, and some in academics.

8. Our course requirements were recently changed to reduce the seminar requirement from two courses to one course as a result of the department assessment but students are now required to make an oral presentation during this course (it was previously at the discretion of the instructor).