# Bachelor of Science in Civil Engineering

# Academic Assessment Plan

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**Adopted by**

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Mission Statement

***The mission of the Civil Engineering Department, through its undergraduate and graduate education programs, its professional development programs, its research, and its service is to advance the civil engineering profession in Alaska and elsewhere for building a sustainable civilization with utmost respect for the well-being of its peoples and the environment.***

Program Introduction

The B.S. Civil Engineering program prepares students to work within the civil engineering profession, in Alaska or elsewhere, by offering a program accredited by ABET, Inc., the accrediting body for engineering programs. The program first admitted students in 1978, and has maintained continuous accreditation since its initial accreditation in 1986 by ABET. Without an ABET-accredited engineering degree, it is difficult if not impossible for individuals to qualify for licensure as a professional engineer in the United States – hence it is of paramount importance to the Department to maintain this continued accreditation.

In October 2012 ABET performed an “Interim Visit” to check on our progress in correcting “weaknesses” and “concerns” that had been raised by ABET two years earlier, and at this juncture we are confident, based on ABET’s “exit interview,” that most if not all have been adequately addressed. It should be noted that “weaknesses” and “concerns” do not threaten accreditation status, as would any “deficiency,” of which none were reported.

Assessment Process Introduction

During the period between the initial accreditation in 1986 and the present, ABET has performed periodic full reviews and interim visits, in which all CE faculty, the School’s administration, other campus units such as the Library and the College of Arts and Sciences, the Office of Academic Affairs, and the Chancellor’s Office have all played roles. ABET also interacts with students, and employers of our graduates as they assess the suitability of our program for continued accreditation.

The requirements for ABET accreditation continue to evolve, and so the Department’s response to assessment has periodically been updated to reflect the latest philosophy and thinking about program assessment. The general process that has been followed is to develop an assessment process that meets ABET criteria, and then articulating the process in a manner consistent with UAA’s reporting needs. The CE Department has several faculty, including the Department Chair, on an Assessment Committee, which prepares the assessment plans for presentation and ultimately ratification by the Department’s faculty.

The ABET process requires that we ensure that our graduates who enter the engineering profession meet program “objectives,” which are currently the following (adopted by CE faculty 1/6/11):

The curriculum of the UAA CE program is designed to produce graduates who, within five years of graduation, will:

1. Practice with “responsible charge” in the civil engineering sub-disciplines of water resources, geotechnical, structural, transportation, and environmental engineering; with emphasis on cold regions issues. “Responsible charge” is as defined by the Alaska Professional Engineering licensing regulations.
2. Make contributions in project planning, preparation, implementation, design, and presentation in a team environment in sub-discipline areas.
3. Demonstrate and update their competency via professional registration, continuing education, graduate study, and professional service to their communities.
4. Exemplify the ethical standards of the profession.

Faculty have broad latitude in defining these objectives, which can vary widely among various programs.

The student learning outcomes for the program, presented in the next section, are for all practical purposes prescribed by ABET and ASCE (the American Society for Civil Engineers), although it is possible for the Department to make modifications as deemed necessary.

Student Learning Outcomes

The EAC adopted a new set of criteria in October 2017 for Student Outcomes. The old (a)-(k) will be replaced by (1)-(7). It is a custom practice for each CE department to adopt the new outcomes and the CE Department at UAA is at no exception. The Civil Engineering Faculty and Advisory Board will be convened to approve the adoption of the new Student Outcomes at a meeting in May 2018.

The old SLO’s require that the graduates of the BSCE have:

(1) An ability to apply knowledge of mathematics through differential equations, probability and statistics, calculus-based physics, and general chemistry;

(2) An ability to apply knowledge in a minimum of four (4) recognized major civil engineering areas;

(3) An ability to design and conduct experiments, as well as to analyze and interpret data in more than one of the recognized major civil engineering areas;

(4) An ability to design a civil engineering system, component, or process to meet desired needs;

(5) An ability to function on multi-disciplinary teams;

(6) An ability to identify, formulate, and solve engineering problems;

(7) An understanding of professional and ethical responsibility;

(8) An ability to communicate effectively;

(9) The broad education necessary to understand the impact of engineering solutions in a global and societal context;

(10) A recognition of the need for, and an ability to engage in life-long learning;

(11) A knowledge of contemporary issues in professional practice; and

(12) An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

The new SLO’s require that the graduates of the BSCE program have:

1. an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics;
2. an ability to apply civil engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as cold regions, 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; and
7. an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

**A mapping of the old SLOs to the new SLOs is provided below. The assessment data collected according to the old SLOs will be mapped to the new SLOs according to this map.**

**Table 1:** Mapping of the old SLOs (a)-(k) to the new SLOs (1)-(7)



Table 1: Association of Assessment Measures to Student Learning Outcomes

| Outcome | CLA | Capstone Course | FE Results | Surveys |
| --- | --- | --- | --- | --- |
| An ability to apply knowledge of mathematics through differential equations, probability and statistics, calculus-based physics, and general chemistry | 1 | 1 | 1 | 1 |
| An ability to apply knowledge in a minimum of four (4) recognized major civil engineering areas; | 1 | 1 | 0 | 1 |
| An ability to design and conduct experiments, as well as to analyze and interpret data in more than one of the recognized major civil engineering areas; | 1 | 1 | 0 | 1 |
| An ability to design a civil engineering system, component, or process to meet desired needs; | 1 | 1 | 0 | 1 |
| An ability to function on multi-disciplinary teams; | 1 | 1 | 0 | 1 |
| An ability to identify, formulate, and solve engineering problems; | 1 | 1 | 1 | 1 |
| An understanding of professional and ethical responsibility | 0 | 1 | 1 | 1 |
| An ability to communicate effectively | 1 | 1 | 0 | 1 |
| The broad education necessary to understand the impact of engineering solutions in a global and societal context | 1 | 1 | 0 | 1 |
| A recognition of the need for, and an ability to engage in life-long learning | 0 | 1 | 0 | 1 |
| A knowledge of contemporary issues in professional practice | 1 | 1 | 0 | 1 |
| An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice | 1 | 1 | 0 | 1 |

Assessment Measures

A description of the measures used in the assessment of the student learning outcomes and their implementation are summarized in Table 2 below. The measures and their relationships to the student learning outcomes are listed in Table 1.

There is a separate appendix for each measure that shows the measure itself and describes its use and the factors that affect the results.

Table 2: Assessment Measures and Administration

| **Measure** | **Description** | **Frequency/ Start Date** | **Collection Method** | **Administered by** |
| --- | --- | --- | --- | --- |
| Course Level Assessments (CLA) | Each CE course produces a subset of the outcomes listed in Table 1. The CLA quantifies the instructor’s assessment of how well each pertinent outcome was achieved. | At least every other year | Submission by individual faculty | Individual faculty |
| Capstone Course | Of all courses in the curriculum, the capstone course has special significance because of the outcomes that may only be achieved at the terminal point in the curriculum. | Every semester when offered | Submission by individual faculty | Individual faculty with direct oversight of CE Department Chair |
| FE Exam | Summary of UAA CE student performance in individual subject areas contained on the national Fundamentals of Engineering (FE) exam is given to the SOE Dean biannually.  | Every other year, beginning 1986 | Dean’s office passes results to Department Chair | Assessment Committee or its designee analyzes the results annually |
| Surveys | Surveys of alumni, faculty, and employers are performed to gauge perception of attainment of each program outcome. | Every other year, beginning 2011 | Combination of online and paper surveys | Assessment Committee or its designee |

The Department also performs surveys related to assessment of attainment by our 1-5 year graduates of program objectives in Spring of even-numbered years. The next revision of program objectives and outcomes is scheduled for Fall 2021, as shown in Table 4.

A sample of the program educational objective results from the Spring 2012 survey is included as Table 3. The full version included in the assessment spreadsheet submitted separately.

Table 3: Sample of B.S.C.E. program objectives assessment performed in Spring 2012

Assessment Process

General Implementation Strategy

The CE Department has successfully created and implemented assessment plans to maintain continuous ABET accreditation since 1986 using a variety of strategies that have changed to meet changing ABET requirements, and changing needs of the Department. The current implementation strategy, presented to ABET in their October 2012 interim visit, is shown schematically in Figure 1.

The timeline for implementation extends over 10-year cycles beginning in 2011, as shown in Table 3. Within a 10-year cycle some assessment measures – for example, course level assessments – are performed every semester, while others, such as employer surveys, are performed less frequently. In the view of the CE faculty this implementation timeline is more than adequate to meet ABET requirements, and provides ample data for consideration of curricular changes.

The Department Chair leads implementation of the plan, with primary responsibility for each task listed in the last column of Table 3.

Description of Faculty Involvement

In general, CE faculty are involved in assessment as follows:

* Participating in the Fall CE Department Retreat, which sets the stage for all assessment activities during the coming year
* Performing course level assessments for all classes
* Participating in monthly CE faculty meeting in which assessment updates are periodically made
* Reviewing any proposed modifications to the current assessment plan
* Participating in the Spring CE annual meeting, in which the Assessment Committee presents assessment results for evaluation, and the Curriculum Committee presents recommended changes

In particular, the Department Chair will package the assessment results that have been determined at the Spring annual meeting for action by the faculty beginning at the annual Fall retreat.

All faculty are welcome to participate in activities of the Assessment Committee, which in appointed with faculty approval early in the Fall semester.

The CE program at UAA has the following subdisciplines: Transportation, Environmental, Geotechnical, Structural, and Water Resources. Each subdiscipline has a Coordinator, appointed by the Chair, who has the responsibility for ensuring that courses within each subdiscipline are adequately reviewed, with results reported by Dec. 15th for Fall, and May 1st for Spring.

Modification of the Assessment Plan

Changes to the assessment plan may be suggested by any faculty member, and will be considered at the annual CE Department meeting in Spring. Faculty could initiate and recommend a change at the Spring meeting, or suggest that it be brought forward in the Fall CE retreat. Approval could only occur at the Department level with the majority vote of a quorum of faculty at a regularly scheduled meeting.



Figure 1

Implementation strategy for educational effectiveness assessment

of the B.S. Civil Engineering program

Table 4: Civil Engineering B.S. program assessment timeline



Appendix A: Course Level Assessments

Measure Description:

Course level assessment is essentially the same as program level assessment in that it uses a variety of assessment tools to determine the effectiveness of a course relative to the course’s published outcomes. The results of the course level outcomes assessment are translated/mapped to the program’s outcomes for use in program level assessment. The resulting course contributions to program outcomes for all courses in a program (or some subset of the courses in a program) are combined to get an indication of how the program outcomes are being met from a course perspective.

One side benefit from this process is that a “gap analysis” results from the table that combines course contributions to program outcomes. A view of the table will show where the curriculum is the strongest and where there may be “gaps” in content.

Factors that affect the collected data:

The course level assessment is strongly influenced by the instructor’s perceptions since this is the individual supplying the data. This is tempered somewhat if one of the course level assessment tools is a student perception survey. The factors that affect the results depend, in large measure, on the assessment tools used by the instructor. Some factors that influence the collected data include:

* The standard set by the instructor. A low standard tends to result in fairly high values in course level assessments. Students will not know if the standard was appropriately set until they leave the course and have to apply the knowledge and skills learned so both the student perceptions and the instructor introduced measures may tend to be higher than is reasonable if the standards are set too low. The opposite effect is seen when the standards are set too high. The level of the standard should be determined by the program faculty so that comparison between instructors is valid. Variability of standards makes data combination and comparison questionable.
* The number and detail of assessments used in the course. For example, a single exam is often not a good indicator of performance for a variety of reasons (must be comprehensive, does not account for students that “have a bad test”, etc.). The fewer the assessments and the less detailed the assessments, the less reliable the results.

How to interpret the data:

Care should be taken to investigate and discuss the factors influencing the results before interpreting the outcome. The results of course level assessments should also be compared against other measures to get good picture of program performance.

Sample program level use of course level assessment

The following example tables include the resulting course level assessment table from a course, the conversion of the course level assessments to program level, and the combination of several course results for inclusion in the program assessment.

This example uses a course that has four outcomes listed in its Course Content Guide (CCG). In this case the instructor uses six assessments of student performance. Note that not all assessments assess all outcomes. The “%” refers to the percentage of the students that attain this course outcomes satisfactorily.

#### Course Level Assessment Report for Sample Course #1



The weighting factors have been added because the instructor decided that not all of the measures are equally as strong of an indicator of certain outcomes. This allows the instructor to put more weight on the more significant measures. If weighting is not an issue, then put “1” in as the weighting factor for all weights that have a corresponding attainment value. A blank or “0” is to be placed in weight cells that do not have a corresponding value.

Translation of Course Outcomes Results to Program Outcomes

Our hypothetical program has eight published outcomes. The following table takes the results from the example course and translates them to the corresponding program outcomes. To understand the mapping, you would need to see the description of each course and program outcome so that you could see the relationships. These are not provided in this example. The relationship between published (CCG) course outcomes and program outcomes is instructor independent. The associations in this table should be determined by the program faculty as a whole.

**Sample Course #1 Assessment of Program Outcomes**



Note that not every course will address every program outcome. Also, most course outcomes will only address a few program outcomes. One of the side benefits of this process is the data provides a “gap” analysis. You will be able to see if there are any gaps in your program when no or few courses serve a particular program outcome. Weighting factors can be used if there is a weak correlation between a given course outcome and a given program outcome.

Combining Course Level Results

The values in the yellow cells are now combined with similar results from the other courses that make up the course level assessment. The yellow cells below correspond to the yellow cells in the above table. The other values come from the assessment of the other indicated courses.

Mapping of CLA data to the Student Learning Outcomes



This table accumulates the results from each of the course assessments. The average percentage of attainment is computed for each outcome. The average (in green cells) is the performance indicator result that is transferred to the single column devoted to the Course Level Assessment on the Program Level Assessment Table.

**Appendix B: Capstone Course Assessment**

Measure Description:

Although the tools of course level assessment (Appendix A) will be used for the capstone course, particular emphasis is placed on this course because 1) it is the final course required in the sequence of core technical courses, and 2) some outcomes are assessed most effectively at this stage in the curriculum.

The capstone course (CE 438) is intended to provide the students with the opportunity to apply their education to the planning and design of a Civil Engineering System. The project is chosen by the faculty with an effort to obtain a “real” client with a project that involves as many of the Civil Engineering disciplines as possible. The class is organized to simulate a multi-disciplinary Civil Engineering design consulting firm. A students is assigned to a position to lead the project as “project Manager”, two are assigned for leadership positions as “Project Engineers” others as technical team leaders for the different sub-disciplines. The ”Project Manager” will develop a scope of work with the ““Project Engineers” and Principal Engineer (the instructor) and then undertake to complete the work within the semester. The technical teams include design teams (structural, transportation, water resources, foundations, etc.) and support groups (geotechnical, environmental, cost estimating, contract and specifications, etc.). The end product is generally a design report from each group, drawings and specifications that are about 75% - 85% complete. The final project delivery is submitted to the client for assessment and feedback to be considered in the course assessment.

The intent is to maintain a consistent standard so that the average course outcome attainment can be tracked over time. The course instructor provides a report at the end of each semester concerning his/her subjective observations about the class performance relative to specific goals. This report is to specifically list the class performance on each goal and identify general deficiencies that may require some adjustment to the curriculum.

Factors that affect the collected data:

Factors that influence the class GPA include:

* The grading philosophy of the instructor. This course, historically, has a high GPA, in part because the level of effort of the students is a significantly weighted part of the grading formula in most years.
* The simple GPA of the course is influenced by a number of factors besides technical competence. The course attainment also includes factors that account for a student’s work ethic, ability to function in groups, and ability to work with incomplete information.

How to interpret the data:

The GPA is a very “broad brush” tool. The resulting GPA covers many areas of ability and, as a result, is of limited use in evaluating specific outcomes. It is a good indicator of general overall preparation and ability of the graduating class.

The faculty member’s assessment by outcome is of more use in assessing the outcomes.

Appendix C: FE Exam Results Analysis

Measure Description:

The Fundamentals of Engineering (FE) exam is a national licensing exam, administered by the State of Alaska, for entry level engineers. Upon successful completion of the exam, an engineer is given the title “Engineer in Training” (EIT). The FE exam is a preliminary exam to the Professional Engineering (PE) exam. Because the FE exam is a national exam its results can be used to compare the training of UAA Engineering students with similar students across the country. The purpose of the exam is to certify that an engineer has achieved some level of competency. The intent is to ensure public health and safety. The exam is particularly applicable for engineers regularly engaged in design practice.

The Civil Engineering program does not require that students take the FE exam, however almost all of the students do take the exam prior to Graduation. The individual results from the exam are not available to the School. The state licensing board does, however, provide us with pass rate and subject group performance information for our students that take the exam.

Factors that affect the collected data:

There are many factors that influence indicator results. A few are listed below:

* Licensure is not required by all segments of the industry so not all students take the exam. (From 2006-2011 84% of our students took the exam).
* The students have a choice of one of two exams to take. Some UAA students take the “General” exam which focuses more on the first two years of the program, whereas others take the “Civil” exam which has more focus on the upper division material.
* Students may take the exam whenever they have finished 75% of the program requirements. Students out of sequence may not have completed some of the lower division courses covered by the exam.
* We have no control over the questions that are presented to the students. There are areas of competency that are tested that are not emphasized (intentionally) within our program. This mismatch tends to lower the scores in some specialty areas.

How to interpret the data:

The performance of our students in each of the subject areas of the exam is compared with the performance of civil engineering students nationally, and also with civil engineering students in Carnegie comparator institutions. The results are summarized in a report that is discussed by CE faculty in the annual spring meeting. Subject areas in which UAA students consistently underperform would suggest the need for program modifications.

Appendix D: Surveys

Measure Description:

As shown in Figure 1, a number of surveys are performed at periodic intervals to gather input from graduating students, faculty, alumni, and employers relative to how well they feel the program performed in meeting the published outcomes and objectives. All are in the form of Likert scale surveys.

Graduating students take an exit survey to rate how well the program met each of the program outcomes. Faculty, alumni and employers rate performance of the program in meeting both outcomes and objectives. An example Exit Survey is attached at the end of this document.

Factors that affect the collected data:

A number of factors need to be taken into consideration when analyzing the data. The following factors are those that we have identified.

* Low return rates. It has proven difficult get a good return rate from the employers, even with follow up phone calls. This reduces the accuracy of the results.
* Some classification groups have not responded to the survey. The result is that the data is skewed to the viewpoint of a subset of the employers of our graduates.
* It may be possible that the employer is not aware of all the UAA graduates in their employ. This leads to an assessment that is not representative across the group.

How to interpret the data:

The evaluation of all survey data is performed annually at the spring faculty meeting, as shown in Table 3. Consistently low ratings for any outcome or objective would suggest the need for curricular modification.















