

**Submission date:** January 31, 2020

**Program/s in this review:** Civil Engineering (BS)

**Specialized accrediting agency (if applicable):** ABET

**Campuses where the program is delivered:** UAA's Anchorage campus as well as unlimited distance delivery

**Members of the program review committee:**

- Joey Yang, Professor & Department Chair, Program Committee Chair, UAA
- Tom Ravens, Professor, UAA

### **1. Centrality of Program Mission and Supporting Role (700 words or less)**

Preceded by two decades of engineering professional development graduate courses, a write-in crusade of prospective students, engineer employers, and other Anchorage residents led to the creation of the BS Civil Engineering (BSCE) program at UAA in 1981 and graduation of the first BSCE students in 1983. The BSCE program was created by the community and serves to meet the communities' needs for highly qualified civil engineers, therefore directly supporting UAA's mission "...UAA is committed to serving the higher education needs of the state, its communities and its diverse peoples..." The BSCE program also directly aligns with the mission of the College of Engineering "...to provide high-quality, hands-on undergraduate and graduate engineering education to Alaskan students, to meet industry's need for well-trained engineers and to provide continued professional training..."

The civil engineering profession is critical to the development of Alaska infrastructure, and BSCE education is essential to its practice. As a result, civil and environmental engineers (a CE sub-discipline) are in high demand in Alaska. Based on data from the Alaska Department of Labor for the period between 2016 and 2022, there are 1,031 civil engineers and 346 environmental engineers in the state. The average salaries of civil and environmental engineers are \$60.32 and \$56.10, respectively, with both higher than the national averages. While the growth between 2016 and 2026 for both civil and environmental engineers was within 1%, the annual average job openings are 74 and 22, respectively, due to labor force exit and occupational transfer. The BSCE program at UAA is meeting 1/3 of the annual needs. Based on exit survey data, over 70% of UAA BSCE taking the senior design class students get at least a job offer before graduation, and about 20% choose to attend graduate schools.

The BSCE program serves to meet one of the highest demands for engineering disciplines in Alaska, and the demand for civil engineers is concentrated in Anchorage. The UAA BSCE program accommodates 40-50% place-bound part-time students who study part-time while working to support families and education expenses. Over 90% claim residence in Alaska and most of those in Anchorage and vicinity. Engineering companies and agencies of Anchorage employ part-time BSCE students that contribute valuable career training during their study at UAA, and most of them continue to stay and help drive Alaska's economic development.

The BSCE program collaborates closely with public and private sector partners to maintain and develop our programs supporting high-demand careers. The BSCE program is closed knitted with the professional community and every year, many engineers from agencies and companies like Alaska Department of Transportation & Public Facilities, Alaska Railroad Company, Muni of Anchorage, among others, volunteer to serve as professional mentors to teach our seniors before they enter the workforce. The CE faculty also works closely with our counterpart in Fairbanks to offer shared courses to support the BSCE and graduate programs at UAF.

### **2. Program Demand (including service to other programs), Efficiency, and Productivity (7 year trend; 1400 words or less)**

In general, the BSCE program produces a steady supplier of entry-level engineers for the state. Based on the data from the last seven years, as shown in the first table, the program, on average, enrolls 165 students and awards 31

BSCE degrees per year. The enrollment for the last three years vary between 222 and 224 students, and the degrees awarded vary between 29 and 37, demonstrating the remarkable stability of this program.

The CE or AE courses enjoy pass rates of higher than 95% in the last three years, while some lower-level foundational courses such as those with ES or ENGR prefix have pass rates of as low as 74%. The slight drop in the pass rate of the lower-level courses such as ES 100-299 may be due to the discussion of a deep budget cut that negatively impacted the confidence of the freshman and sophomore to UAA. This shows, however, if resources are devoted to those lower-level courses, the retention has room to improve.

The internal demand data from IR shows significant variability year to year, but the data from the last three years exhibit stability. Again, a slight dip could be observed in the last data point, possibly due to the talk about a deep budget cut that negatively impacted the confidence of students to UAA.

Based on the Instructional Productivity data for the last four years, the BSCE program produces an average of 2725 SCH with an average class size of 22.8, which is above the national average for engineering colleges (about 20). The average Cost/SCH is \$321.5, while the tuition revenue/SCH is \$265.1. More importantly, the tuition revenue is nicely converging to the cost, indicating the healthy financial status of this program.

### 3. Program Quality, Improvement and Student Success (1500 words or less)

The BSCE program was initially accredited by the ABET in 1983 and has since been continuously accredited for the last 37 years. The last ABET accreditation site visit was 2016, and the next one will be in 2022.

The uniqueness of this program lies in that, besides the body of knowledge required by other civil engineering programs in the lower 48, our BSCE program also offers our students a unique perspective on cold regions engineering. Many design courses incorporate cold-temperature engineering practices. Besides, the BSCE curriculum includes CE A403 Arctic Engineering, which is also required for licensure in the State of Alaska. Also, most technical elective classes of the BSCE program are stacked with graduate versions to serve the MSCE program and meet the continuing education needs from the professional community.

Many junior-level and most of, if not all, technical elective classes are offered via both f2f and distance delivery modes to accommodate a diverse student body, many of which work while attending school. No formal assessment of the online offering has been conducted, but anecdotal evidence shows that many part-time students welcome the flexibility offered by synchronous and asynchronous online offerings.

The BSCE program has a rigorous assessment plan in place, as required by the ABET requirement. The program strictly follows this plan in collecting data to evaluate how the Program Student Learning Outcomes (SLO's) are delivered and mastered. Findings from the assessment activities are used to guide curriculum improvement. The program uses data from three major activities, i.e., Course Level Assessment, Graduate Exit Survey, and Faculty Assessment. Besides, a Civil Engineering Department Advisory Committee is regularly consulted for program assessment.

As part of a continuous improvement process implemented for the BSCE program, significant curriculum changes, including the adoption of PHIL A305 – Professional Ethics and the implementation of a team-teaching approach for the capstone course, were adopted since 2016. The adoption of PHIL A305 was to for enhancing the student learning outcomes related to the understanding of professional, legal, and ethical responsibilities. The team-teaching model for the capstone course was to enhance students' ability to function on civil engineering multidisciplinary teams. Historically, the capstone course was taught by a single instructor, and the projects selected tended to be more focused on the specialty area of the instructor. To promote learning in an interdisciplinary team environment, the faculty implemented a **team-teaching model**, which consists of a lead instructor and four additional faculty members with expertise encompassing all five sub-discipline areas team-taught this class, and a suite of projects including all five sub-disciplines. This team, together with a suite of projects covering multiple sub-disciplines, provides a truly

multi-discipline learning environment. Feedback from the students was very positive. We believe this approach is also more sustainable.

The satisfaction of meeting students' education goals by the BSCE program are reflected from the exit survey among the students enrolled in the capstone class. One of the questions was explicitly designed to collect data on the students' satisfaction with SLO's. The survey assesses both Student Mastery and Quality of Instruction of SLO's. For the last three academic years, the average satisfaction rates for Student Mastery of SLO's were 97%, 98%, and 93.4%, while the average satisfaction rates for Quality of Instruction were 84%, 94%, and 90%. Both show that the students are highly satisfied with the instruction and mastery of the SLO's.

The BSCE program emphasizes student success. The high satisfaction rates of both Quality of Instruction and Student Mastery of the SLO's translate into student success. Besides efforts devoted to improving the quality of instruction quality, the program promotes mandated advising for all students. For the freshman, a dedicated advising center is available to help students sign up for appropriate classes. All BSCE students start to see their assigned academic advisor starting in their sophomore year. This practice has been proven to be very effective in ensuring students taking classes in the right order and help identify student issues early in time so that they can be addressed timely and adequately.

One example to exemplify the focus of student success is undergraduate research. Many BSCE undergraduate students are involved in CE faculty-led community- or commercially sponsored research in service of the Alaska public, including: clean drinking water in rural and urban Alaska, development of ports and harbors in cold climate, testing alternative materials for cold regions construction, renewable energy from tides, river currents, and wind, responses to coastal and riverine erosion, adaptation to climate change, design of Arctic offshore structures, cost-effective design of roads in cold regions, innovative solutions for wind turbine towers and other structures in thawing permafrost, and soil and structure response to earthquakes. From 2014 to 2019, CE faculty, together with our students, authored 36 project reports and 128 peer-reviewed conference or journal articles, the majority of which have student co-authors.

Another great example to showcase how the BSCE program promotes Student Success is the capstone course. The program has established a strong partnership with the local community. As a result, we solicit design projects from the community and invite professional engineers to serve as mentors for our seniors. This has become a tradition of the BSCE program, which is much appreciated by the students. On the one hand, the students get to work with practicing engineers to solve real engineering problems, an experience that significantly helps to transition our graduates into professional. On the other hand, they have great opportunities to interact and connect with the professional community, which often lands them jobs before they graduate. It is therefore not surprising that all UAA BSCE graduates get engineering jobs within 6 months of graduation.

In summary, as stated by one of the BSCE advisory board members and also employers of our students, *"Overall quality of graduates from [the BSCE program of] UAA are as good as or better than graduates from lower 48 schools."* Engineer employers consistently state that UAA graduates are valued because they are well-prepared Alaskans and are more likely to stay in Alaska than are employees recruited from the lower 48.

Here are a few highlights of our student accomplishments:

- All UAA BSCE graduates in the labor market get engineering jobs within 6 months of graduation.
- The capstone course maintains a 100% pass rate for the last ten years.
- A BSCE student filed and was issued a US patent on "Hydro-powered fish grinder" based on the results from an honors project.
- The student chapter of ASCE has regularly participated in the ASCE Pacific-Northwest Student Conference and the AISC Student Steel Bridge Competition.
  - UAA placed First in Stiffness twice and won the Aesthetics award three years in a row at the Regional Competition in the recent five years.
  - The team placed third in the region and advanced to the National Competition, where they placed 16th out of 42 teams nationally in 2019.

- Students from the BSCE enjoys a Fundamentals of Engineering (FE) exam pass rate above the national average.

#### **4. Program Duplication / Distinctiveness (300 words or less)**

There is a Civil and Environmental Engineering program at UAF. However, we don't view our program as a duplication of the one at UAF. On the contrary, the two programs complement each other and the faculty work together to address the high demand for civil and environmental engineers in the State of Alaska.

Anchorage has an extraordinary concentration of engineers employed by companies and agencies with their largest offices here. These employers support UAA BSCE students with internships, summer jobs, participation in the curriculum, and donations for scholarships, equipment, and other needs of the UAA BSCE program. Almost all of our junior and seniors hold have internship experience, and nearly 50% work part-time to support their educational expenses and families. For comparison, the UAA BSCE program consistently has 50% or more enrollment than the similar program at UAF.

While distance delivery provides choices for course work, advising, supervision of community engagement projects, service learning, group efforts, team-based learning, and networking with fellow professionals are all most economical and effective in Anchorage at UAA.

Meanwhile, the BSCE program at UAA works very closely with our counterpart in Fairbanks. The BSCE program from UAA shares many technical electives with UAF, and vice versa. Together we are producing about 50 graduates annually, meeting just half of the annual needs of the state.

#### **5. Summary Analysis (500 words or less)**

Civil engineering as a profession is critical to the development of Alaska infrastructure, and ABET-accredited BSCE education is essential to its practice. In fact, an ABET-accredited BSCE degree is required for Professional Engineer (PE, civil) registration in all states of the US. The UAA BSCE program has been continuously accredited by ABET for the last 37 years. Our mature program provides specialization in structural, water resources, transportation, geotechnical, and environmental engineering, encompassing the essential expertise for care and expansion of Alaska infrastructure and for natural resource development.

Being the BS program with the longest history within the College of Engineering, the BSCE program has a very stable enrollment and steadily produces civil and environmental engineers to meet the state's high-demand of engineers, an overwhelming concentration of which are in Anchorage and will be here for decades to come. Our students highly value this mature, high-quality, hometown program, while the community provides them with abundant internship and employment opportunities. In essence, the UAA BSCE program is not a simple duplication of the one at UAF. Instead, the BSCE programs at UAA and UAF are great partners working together to serve the state's needs for civil and environmental engineers.