ABET

Self-Study Report

for the

Construction Engineering Program

at

University of Utah

Salt Lake City, Utah

July 1, 2021

CONTENTS

Program Self-Study Report
for
EAC of ABET
Accreditation or Reaccreditation

BACKGROUND INFORMATION

A. Contact Information

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B. Program History

The Construction Engineering Program (CEP) at the University of Utah was approved by the Utah State Board of Regents and the Northwest Commission on Colleges and Universities (NWCCU) in 2016. The inaugural semester was fall 2016. The CEP is one of two BS programs offered by the Department of Civil and Environmental Engineering (CVEEN) at the University https://www.civil.utah.edu/degrees/.

From 2016 until the present, Dr. Michael E. Barber has served as the department chair. Currently, the CEP is undergoing continued and moderate growth with the hiring of a new CEP faculty. During this ABET review cycle, two new full-time faculty have joined the CEP. These are Dr. Abbas Rashidi (https://faculty.utah.edu/u6013686-Abbas_Rashidi/research/index.hml) and Dr. Jianli Chen (https://faculty.utah.edu/u6031298-JIANLI_CHEN/teaching/index.hml). In addition to these, other CvEEN faculty offer courses that support the CEP and are primarily: Dr. Steven F. Bartlett, Dr. Pedro Romero, Dr. Chris Pantelides, and Dr. Xiaoyue Liu. Advising for the CEP is performed by Wendy McKenney (https://www.civil.utah.edu/staff/). Dr.Bartlett acts as the CEP ABET coordinator. Dr. Rashidi is the chair of the CEP curriculum committee.

During this ABET review cycle, several new full-time faculty have joined CVEEN Department. These include: Dr. Roshina Babu (UAC/ General CVEEN), Dr. Edward Cazalas (Nuclear), Dr. Jianli Chen (Construction Faculty), Dr. Nickolas Jovanovic (UAC/ General CVEEN), Dr. Nickola Markovic (Transportation), Dr. Tara Mastren (Nuclear), Dr. Carlos Oroza, (Water/ Cyberinfrastructure), Dr. Ge (Gaby) Ou (Structures), Dr. Abbas Rashidi (Construction), Dr. Jennifer Weidhaas (Environmental), Dr. Xianfeng (Terry) Wang (Transportation), Dr. Xuan (Peter) Zhu (Structures/ Cyberinfrastructure).

The following full-time faculty have left CVEEN during this review cycle: Dr. Amanda Bordelon (Materials), Dr. Janice Chambers (Retired, Structures), Dr. Daniel Fagnant (Transportation), Dr. Tatjana Jevremovic (Nuclear), Dr. Azaree Lintereur (Nuclear), Dr. Richard J. Porter (Transportation).

The following staff members have left CVEEN during this review cycle: Ashley Arpero (Administrative Program Manager), Alexi Crabb (Undergraduate Advisor), Colleen Gilman (Undergraduate Advisor), Bonnie Ogden (Graduate Advisor), Andrea Gallegos (Administrative Program Manager), Ryan Schow (Reactor Supervisor).

The following administrative staff have joined CVEEN or have changed administrative positions during this cycle: Cathy Merkel (Accountant), Olivia Calvillo (Undergraduate Advisor), Wendy McKenney (Undergraduate Advisor), Courtney Phillips (Graduate Advisor), Kelsey Arnold (Marketing & Communications Specialist), Steven Pappas (Reactor Supervisor).

C. Options

Students in either Program (civil or construction) have the opportunity to obtain a double major. Also, the Department offers a minor in Nuclear Engineering. The following describes these options and other program options

1. Double Major with Civil Engineering Program

CEP students can make themselves more marketable by double majoring in Civil Engineering and Construction Engineering, expanding their options, increase their value, and allowing career adaptability to the ever-changing needs of the world. Students pursuing both degrees develop the technical skills and communication needed to work on design-build projects from concept to construction. Students can complete both degrees with five courses beyond the CEP or CVEEN degree, respectively. Additional information about this Program may be found at https://www.civil.utah.edu/double-major/.

2. Minor in Nuclear Engineering

Students pursuing a BS degree in CEP have the opportunity to complete a minor in Nuclear Engineering from the Utah Nuclear Engineering Program (UNEP). A UNEP minor in Nuclear Engineering requires the courses shown in the table below. The elective courses may be selected either from UNEP courses or from CVEEN department major courses approved by the UNEP Director. Students must maintain a cumulative GPA of 2.85 or higher and a minor GPA of 3.0 or higher. Additional information may be found at https://www.civil.utah.edu/nuclear-minor/.

Course Number	Credit Hours	Course Title
NUCL 3000	3	Nuclear Principles in Engineering & Science
NUCL 3100	3	Radiation Interactions
NUCL 3200	3	Radiochemistry
NUCL 4000	1	Nuclear Laboratory
Two 3-credit Elective Courses	6	

In addition, CVEEN students not seeking a Nuclear Engineering minor may take NUCL 3000 and NUCL 3100 as technical electives in the CEP.

3. FASTRAX Program

The FASTRAX Program is an undergraduate option that allows undergraduate students with an Engineering GPA of 3.2 or higher to start working on their MS degree during their senior year of their BS degree. Through the FASTRAX program, students can complete the MS degree within three additional semesters of full-time study (9 graduate credit hours) following completion of the BS degree. Students who have an Engineering GPA of 3.2 or higher apply to the FASTRAX program during the second semester of their Junior. FASTRAX students are required to take five technical electives, instead of 6 at the undergraduate level, and complete a graduate-level course (i.e., 6000-level or higher) to apply toward their MS degree (https://www.civil.utah.edu/fastrax/). Students must maintain continuous enrollment with no gap semester or break between degrees.

4. College of Engineering (COE) Math Sequence

Students have a choice to take either a traditional math sequence that consists of Math 1210 (Calc. I), Math 1220 (Calc. II), Math 2220 (Calc. III), and Math 2250 (ODEs) or they can take a COE math sequence. The COE math sequence courses required for CVEEN students are: Math 1310 (Calc. I), Math 1320 (Calc. II), Math 2250 (Calc. III w/ ODEs). Transfer students into CVEEN are required to complete, or have completed the following sequence of courses or its equivalent: Math 1210 (Calc. I), Math 1220 (Calc. II), Math 2220 (Calc. III), Math and 2250 (ODEs).

The COE math sequence provides a streamlined calculus presentation by deemphasizing proofs and to connect the mathematics to practical applications. The COE math sequence is 12 units, the traditional is 15. The two sequences share one course, MATH 2250: Linear Algebra and Differential Equations. Most transfer students follow the traditional track because the engineering path is not available at two- and four-year colleges in Utah. Most U of U engineering students pursue the engineering track. The traditional math sequence is typically completed in four semesters, the engineering math sequence may be completed in three semesters.

5. Graduate Courses Taken As An Undergraduate

The CVEEN Department allows undergraduates to take 6000-level graduate courses to fulfill the Department's undergraduate technical elective requirements. The following requirements are placed on students wishing to complete this option.

- A minimum engineering GPA of 3.20 is required
- Instructor permission to enroll
- All CVEEN undergraduate requirements must be met, including the requirement for courses with significant design content (i.e., commonly called "design" courses.
- The form required for this process is found at: https://www.civil.utah.edu/request-to-enroll-in-graduate-course-as-undergraduate/.

6. Honors in Engineering

The Honors in Engineering Program in the COE is designed to provide a challenging, individualized educational experience to high-achieving students and promote lifelong learning throughout their careers. The objective is to challenge top students by offering them access to more advanced levels of study, facilitating the fullest possible use of their creative abilities, encouraging a sustained interest in advanced education and basic research, and fostering leadership and fellowship within the engineering community https://www.coe.utah.edu/students/future/honors-in-engineering/.

7. **University Honors**

The University Honors Program is sponsored by the Honors College and has a long and distinguished history of excellence in undergraduate education. The centerpiece of Utah's Honors College is Engaged Learning Opportunities — a signature experience that brings together students and community partners to collaborate on research that results in real-world applications. For more information, see http://honors.utah.edu/.

D. Program Delivery Modes

The Department of Civil & Environmental Engineering offered courses in two modes: (1) day and (2) evening. Day courses are offered in the standard University format with three 50-minute classes or two 50-minute classes, depending on the semester hours associated with the class. There are also offerings given in twice-a-week format with two 75-minutes sessions per week. Evening courses begin at 4:35 pm, or later. Four required laboratory courses are offered during a 3-hour period during the week in the afternoon. These laboratory sessions are typically offered 3 to 4 times a week.

Typically, the Department offers an average of five evening courses each fall and spring semester. Many of these evening courses are advanced technical courses (i.e., 5000-level) and include topics desired by working professionals or part-time students. Additional classes are offered in the late afternoon, and a few classes are taught at 7:30 am to accommodate working professionals and part-time students.

Before the COVID pandemic, all department courses were offered in person. However, since the outbreak, the mode of program delivery has changed significantly.
https://attheu.utah.edu/facultystaff/fall-2020-instructional-guidelines/

For the second half of spring semester 2020, 100% of courses were offered virtually, with approximately 50% of them provided live through interactive video conferencing and 50% of them taught asynchronously. During the fall semester of 2020, 34% of courses were taught in person, 38% were taught through interactive video conferencing (IVC), 11% were conducted in a hybrid format consisting of in-person and IVC, and 8% were taught online with no specific meeting time. During the spring semester of 2021, 25% of courses were taught in person, 54% were taught through interactive video conferencing (IVC), 3% were taught as hybrid courses, 1% were conducted in a hybrid format consisting of in-person and IVC, and 15% were taught online with no specific meeting time.

For fall semester 2021, the University has set the goal to have 75 percent of the courses taught in-person. No social distancing in the classrooms or laboratories will be required. However, masks will be required for students and faculty. Also, student requests for online exceptions will be denied due to accreditation rules, faculty workload, and State of Utah legislative mandates.

E. Program Locations

The CEP of the CVEEN Department is delivered at the University of Utah, Salt Lake City campus located at the Meldrum Civil Engineering Bldg., 110 Central Campus Dr., Salt Lake City, UT 84112.

F. Public Disclosure

The Program Education Objectives (PEOs), Student Outcomes (SOs), annual student enrollment, and graduation data specific to the Program is posted and made accessible to the public at the following: https://www.civil.utah.edu/abet-accreditation/.

G. Deficiencies, Weaknesses or Concerns from Previous Evaluation(s) and the Actions Taken to Address Them

This is the first review of the CVEEN Construction Engineering Program.

GENERAL CRITERIA

CRITERION 1. STUDENTS

For the sections below, attach any written policies that apply.

A. Student Admissions

Admissions to the University

Beginning with summer of 2013 admissions, the University of Utah (U of U) began using a holistic review process to admit all incoming freshman students regardless of major. The University's holistic review process helps ensure that all students are given the best opportunity to present a complete picture of their qualifications. Beginning with fall 2021 admissions, the U of U is test-optional for freshman applications. ACT/SAT scores are not required for admission, merit scholarships (including department scholarships), or direct admission programs (including Engineering). The holistic review includes consideration of the standards summarized in Table 1.1 (https://admissions.utah.edu/admission-standards/). Some applicants not meeting the admission standards may be considered for admission on a case-by-case basis if their special talents or diversity enhances the institution's life and character.

Academic Preparation & Performance (Primary Factors)	Personal Achievements & Characteristics (Secondary Factors)
• Rigorous course selection throughout high school career (i.e., Honors, AP, IB, and Dual/Concurrent Enrollment courses) • Grade trends • Cumulative unweighted GPA. • Excellence in academic achievement, intellectual pursuits, and creative endeavors • Satisfactory completion of high school core course requirements	• Academic achievements and awards or distinctions • Involvement in student clubs and organizations, athletics, and other extracurricular activities or work • Familial responsibilities • Extraordinary circumstances • A significant commitment to community engagement, citizenship, and leadership • Ability to contribute to and benefit from a culturally and intellectually diverse learned community

To be admitted to the U of U on a transfer basis, the following requirements must be met (these requirements are published on the University's website at https://admissions.utah.edu/apply/transfer/):

- Applicants are expected to have a transferable GPA of 2.6 or higher with 30 completed semester hours

- Students who have completed fewer than 30 semester hours or 45 quarter hours deemed transferable by the University of Utah, are also required to submit an official final high school transcript and have the option of submitting ACT or SAT scores.
- Students who have completed an Associates of Arts or Associates of Science degree are admissible with a 2.35 GPA or higher.
- Transferable GPA does not include remedial courses, credit received from non-regionally accredited institutions, or credit awarded by exam (AP, IB, CLEP, FLATS, etc.).
- Applicants transferring from another college or university are expected to have previously graduated from an accredited high school. Applicants who attended a home school, non-accredited US institution, or obtained a US GED must submit an official ACT or SAT test score.

Transfer students are also reviewed holistically based on the criteria summarized below.

Academic Factors	Non-Academic Factors
• Cumulative transferable GPA. • Rigor of course selection • Grade trend • Academic awards	• Involvement in student organizations, athletics, or other extracurricular activities • Significant commitment to community engagement and volunteer work • Familial and financial responsibilities • Work experience • Extraordinary circumstances • Ability to contribute to and benefit from a culturally and intellectually diverse learning community

Admission to the Civil and Environmental Engineering Major

Students admitted to the University and are interested in the major degrees in Civil and Environmental Engineering (CVEEN) Department are either admitted directly to major status at the time of admission to the University or evaluated for promotion to major status following the completion of several preparatory classes (described later). Students applying for major status normally complete this after two semesters. Without major status, a student must obtain special permission to take most CVEEN classes at or above the 2000 level.

Direct Admission of Incoming Freshman

Students apply to the University of Utah and indicate interest in one of the 11 College of Engineering degrees. The Office of Admissions then determines if students meet *one* of the following three criteria necessary for Direct Admission into the College of Engineering:

Criteria 1: Unweighted GPA of 3.6, ACT of 26, and ACT Math 28
Criteria 2: Unweighted GPA of 3.8, ACT of 27, and ACT Math 26 taking AP CALC A/B or higher

Criteria 3: Please note that the exception about "C" grades is to specifically address students who perhaps did not start strong in high school but have demonstrated a significant, positive change over time.

1) MUST have a 3.8 Unweighted GPA
2) PREFER ONLY A's and B's in all Math and Science courses.
   a. C's or lower in any Math or Science courses are not preferred. But if someone has, perhaps, one "C" early on in high school, but you see a steep upward trend in STEM grades over time, we can consider them.
3) MUST have taken a full year of at least two of the following science courses: Biology, Chemistry, and Physics
   a. C's or lower in any Math or Science courses are not preferred. But if someone has, perhaps, one "C" early on in high school, but you see a steep upward trend in STEM grades over time, we can consider them
   b. Can be taken at the high school level or with Dual Enrollment
4) Readiness for Calculus includes any of the following:
   a. CALCULUS ONLY at any level in high school or Dual Enrollment
      i. COE has requested that we not direct admit anyone who has not completed/in-progress with Calculus.
      ii. COE will not accept Pre-Calculus or lower for Direct Admit to COE.
   b. International Baccalaureate (IB): Math SL OR Math HL with marks of 5, 6, or 7
      i. IB Math Studies is NOT acceptable for Direct Admission
   c. International students from most national curricula with the equivalent of an A or B
      i. Students on a trade school or technical school track in high school, such as the BTEC in the UK, are not ready for Calculus.
      ii. COE has requested that if the Math course is not labeled "Calculus" on the transcript, we must verify that the Math course taken includes Calculus concepts.

Those students who meet one of these criteria are then given "Engineering" status at orientation. Incoming Civil Engineering students that have been offered direct admission into the College of Engineering are also directly admitted to the Civil and Environmental Engineering program. This process occurs within the first two weeks of the new semester.

Major Status

Admission to major status is granted to a student after completion of at least three classes from which the technical GPA for admission is calculated (see table below). The classes must be completed with satisfactory grades (a C grade or better in each class and at least a 2.50 weighted average GPA in the classes). In addition, the overall university GPA must be above 2.00.

Table 1.3. Courses required for CVEEN major status. Students must complete 3.

MATH 1210 or MATH 1310	Calculus I
Math 1220 or MATH 1320	Calculus II
CHEM 1210	General Chemistry I
PHYS 2210	Physics for Scientists and Engineers I

B. Evaluating Student Performance

How student performance is evaluated and progress is monitored

Students in the CVEEN Program are evaluated on an ongoing basis with several key milestones in their progression to graduation. The first major milestone for a new student is to gain admission to the University of Utah (described above under Admission to the University Section). The second major milestone occurs at the advancement to major status (described above under the Promotion from Pre-major to CVEEN Major Status Section). The third milestone occurs when the student applies for graduation in the semester before commencement (described below under the Graduation Requirements Section). The final milestone occurs when all CVEEN graduation requirements are cleared, and the University completes its review for all bachelor requirements.

While there are four major milestones, we also examine student grades, GPAs, and course repeats each year to determine if there are any violations of departmental policies as described in the excerpt below taken from the undergraduate handbook (located at https://www.civil.utah.edu/wp-content/uploads/2020/06/2020-2021-Civil-Engineering-Handbook-Combined.pdf).

An undergraduate advisor reviews semester grades and overall GPA of all major status students to determine which students, if any, need to be notified of an academic issue. Students found to be out of compliance are sent written instruction on how to return to good standing.

Continuing Performance

The University requires all students to maintain a cumulative GPA of 2.00 or higher. Students must also have a minimum of a 2.00 cumulative GPA to graduate. A student admitted to major status must maintain an engineering GPA (EGPA) of 2.50 or higher. Engineering GPA is defined as courses counted towards the major with the exception of all general education courses (e.g., LEAP 1500/1501) and CVEEN 1000 and 2000. For repeated EGPA courses, the second letter grade received will be counted as the official grade for the EGPA calculation.

A grade of C or higher must be met for the following courses:

- All Mathematics (MATH 1210/1310, 1220/1320, 2210, 2250)
- All Chemistry (CHEM 1210, 1215, 1220, 1225)
- All Physics (PHYS 2210, 2215, 2220, 2225)
- CVEEN 2010, 2140, 2300, and 2310.

For all other CVEEN courses, a grade of “C-“ or higher is required. Generally, a student may repeat these technical courses only once, and the second grade received will be counted for the requirement.

Probation

A student who fails to maintain an engineering grade point average (EGPA) of 2.50 or higher will be removed from major status and will be placed on academic probation. While on probation, students will not be allowed to take any new CVEEN classes and will have three consecutive semesters to retake courses or take additional non-CVEEN courses to bring their

EGPA to 2.50 or higher. While on academic probation, the student will meet with an academic advisor at the end of every semester to review their progress. If after the three semesters (e.g., fall, spring, summer), the student fails to raise their EGPA to 2.50 or higher, their progress will be evaluated by the Undergraduate Committee and, if no progress is shown, the student will be dismissed from the program. Students that have been placed on probation 8 for more than 3 semesters, even if non-consecutive, will also be evaluated by the Undergraduate Committee to determine if they should be allowed to remain in the program. A student who fails to maintain a cumulative grade point average of 2.00 or higher will also be on probation with the Department.

Repeat and Withdrawal Policies

A student can take an engineering GPA (EGPA) course for grade only twice at the University. Students withdrawing from an EGPA course are allowed three attempts, including the withdrawal. Any student who takes a required class twice and does not have a satisfactory grade the second time, will be removed from major status and will not be allowed to take any new CVEEN classes until they meet with an academic advisor, develop a plan, and petition the Undergraduate Committee requesting that a third attempt at the class be allowed. The Undergraduate Committee, after reviewing the petition and other relevant facts, shall make the final decision to allow or not allow the further attempt and shall communicate that decision to the student in writing.

Attempts of courses taken at transfer institutions count as one attempt. This means a student may take the course only one time at the University of Utah.

When retaking an EGPA course, if the course was taken at the University of Utah, it must be retaken at the University of Utah. For example, students cannot count a grade obtained in a class taken at another institution to replace a low grade obtained in a class previously taken at the University of Utah.

This repeat policy does not apply to courses taken to satisfy Intellectual Exploration and lower division Writing requirements.

How the Program ensures and documents that students are meeting prerequisites

The College of Engineering participates in the University of Utah's prerequisite check system that is part of the registration system software. This system enforces the necessity of students to progress through their classes in an orderly fashion. All classes in our major have a published set of prerequisite and corequisite requirements that must be met in order to enroll in the class. The system checks for successful completion of any listed prerequisite class taught at the University of Utah and most of the state schools that we articulate with. The system allows each department to set the minimum passing grade, which for Civil and Environmental Engineering is the following:

A grade of “C” or higher must be met for the following courses:

- All Mathematics (MATH 1210/1310, 1220/1320, 2210, 2250)
- All Chemistry (CHEM 1210, 1215, 1220, 1225)

- All Physics (PHYS 2210, 2215, 2220, 2225)
- CVEEN 2010, 2140, 2300, and 2310

For all other major courses, a grade of “C-“ or higher is required.

Besides the College of Engineering, a number of different departments also use the system. Currently, in the College of Science, the Math and Chemistry departments are using this system to make sure students do not take a class without the appropriate prerequisite work. In the case that the system doesn't automatically accept the prerequisite work (typical for transfer students coming from outside of the state articulation system), the system does allow the use of permission codes to bypass the prerequisites. Departments are free to determine for their classes how these permission codes are distributed to students. For CVEEN, we have an online tool where a student requests the permission code for a specific class. The site asks for documentation that allows the department advisors to decide concerning the preparation of the student.

C. Transfer Students and Transfer Courses

Procedure for Processing Non-Articulated Credit

Students wishing to apply credit from another school for any technical class which is not included in the College of Engineering Articulation Agreement must submit a Transfer Course Evaluation form along with thorough supporting documentation (course descriptions at a minimum while syllabi and example work may be required at times). Only after the petition has been approved by the department’s Director of Undergraduate Studies will transfer technical credit be allowed toward completion of the BS degree in Civil and Environmental Engineering. This applies even to classes that have been accepted by the university for credit; the classes must still be submitted for departmental acceptance for transfer credit toward the degree by petition (unless they appear on the Articulation Agreement, where approval is automatic).

D. Advising and Career Guidance

Freshmen engineering students entering the University of Utah typically have their first interaction with an academic advisor during their freshman orientation, followed up with an additional, required advising session in their first semester. This advising can occur with a college advisor for students unsure of which engineering path to pursue or with an advisor in the Civil and Environmental Engineering program (described in detail below).

Students planning to transfer into the Civil and Environmental Engineering program are encouraged to meet with a department advisor early in their college experience to make a smooth transition to the University of Utah.

Starting in fall semester 2007, The University of Utah created four purposeful and essential advising points for students. During that time, students must meet with an advisor to continue enrolling in classes at the University of Utah. These points are Student Orientation and Advising (before first semester), Freshman Advising (1^{st} semester), Second Year Advising (4^{th} semester), and Undeclared Advising (undeclared undergraduates over 90 credit hours).). These advising time points work well with Civil and Environmental Engineering as they overlap with the key milestones that students have to hit as they progress towards their degree

Student Orientation

The first contact most students who attend the University of Utah have with their pre-major advisor is during orientation. All students attending the University of Utah must participate in orientation before they are able to register for classes. One part of student orientation is to meet with an advisor from their choice of major. In this meeting, the advisor describes:

- Degree requirements and course flowchart
- How to declare the major and requirements to declare
- Engineering GPA and how it is calculated
- Review of the Degree Audit Report
- Overview of Department policies
- Development of a semester schedule and registration in courses

Freshman Advising and Priority Registration

The first University mandated advising session occurs during the first semester just before enrollment starts for the following semester. Students then meet with a program advisor to go their next semester (or more) and discuss how the student is progressing in the first semester. At this point, any issues can be diagnosed and appropriate recommendations made about approaches to academic success (like tutoring which the college provides) for the remainder of the semester and what classes should be contemplated for the coming semester.

An incentive for new students to meet early in the first semester is the priority registration program. This Program allows students in their first semester at the University to have registration dates for 1000 and 2000 level classes at the same time as seniors do. To qualify, the students have to meet with their advisor before the enrollment cycle begins. This helps further ensure that students are getting to an advisor early enough in the first semester to get additional help if needed.

Introduction to Civil & Environmental Engineering and Sophomore Seminar Classes

Two of the more beneficial advising opportunities for the students are the required freshman class called Introduction to Civil and Environmental Engineering (CVEEN 1000) and the required sophomore class Seminar (CVEEN 2000). These courses provide students with a better understanding of what career avenues exist for a CVEEN major. Each course aims to help the students determine what area to focus on in civil engineering. In CVEEN 1000, students are exposed to course modules covering each of the major subdisciplines in CVEEN: structural, geotechnical, transportation, water resources, environmental, and construction engineering. Each module contains introductory material, an opportunity to perform basic engineering analysis and calculations, and a guest speaker from industry that works in the respective subdiscipline. In the CVEEN 2000 seminar, each week a different guest lecturer presents information about his or her field to the students and provides a roadmap leading to his or her specific career. The students find these classes beneficial, and many have chosen a different career path than what they had intended to do when starting the class.

Advising Tools Available to Students

Some important tools to help the students better manage their academic progress include the Department's undergraduate handbook (https://www.civil.utah.edu/wp-content/uploads/2020/06/2020-2021-Civil-Engineering-Handbook-Combined.pdf) and the Degree Audit Report System (DARS: described below). Also, the Department's website (https://www.civil.utah.edu/) provides additional information students may need, including sources of scholarships, career insights, and faculty research interests.

Degree Audit Report System

The Registrar's Office of the University of Utah uses a system called the Degree Audit Report System (DARS) as its primary tool for tracking students' progress toward graduation. Students can access DARS through their personal registration panel on the University of Utah website at any time. The DARS report is customized to every program of study, allowing students to track their progress in a Civil and Environmental Engineering degree or any other major or minor of their choosing. The Degree Audit system is the primary tool used to determine if a student will be ready to graduate at the end of the following semester of study. To help students understand their DARS reports, they are first introduced to DARS in the student orientation and advising session that they have to complete before being able to enroll at the University. The training includes how to generate a DARS report and how to determine progress towards graduation. Students are encouraged to generate a DARS report for their own records after the completion of each academic semester and at any point when taking a leave of absence.

Sample Degree Audit:
Green checks indicate completion of various program requirements.

Civil Engineering
University of Utah - Degree Audit

Prepared On	05/21/2021 07:50 PM	**Program Code**	MJ-CVEN	**Catalog Year**	Fall 2018
Student ID	01140046	**Job ID**	2114119502570347		

Open All Sections   Close All Sections   Printer Friendly

```
** WARNING: FEDERAL LAW PROHIBITS TRANSMITTAL TO A THIRD PARTY **

*****************************************************************
**     This report is NOT an Official Transcript of Grades     **
*****************************************************************

This report has been designed to assist you with planning
courses to complete all University degree requirements. Every
effort has been made to insure its accuracy; however, you have
the responsibility to determine whether or not you have
completed all degree requirements. Final confirmation of degree
requirements is subject to University approval.

Codes assigned to REPEATED Courses:
>R = Repeatable Course, Credit/GPA retained
>D = Course not repeatable for credit, Repeat currently in
     progress, No credit awarded, GPA retained
>X = No Credit/GPA awarded, Course not repeatable for credit

Term values for courses:    FA = Fall
                            SP = Spring
                            SU = Summer
                            WI = Winter
```

******* ALL REQUIREMENTS IDENTIFIED BEOW HAVE BEEN MET *******

Inquiries concerning University general requirements should be directed to the Academic Advising Center (581-8146). Inquiries about specific major requirements should be directed to the department offering the major.

GENERAL EDUCATION AND BACHELOR'S DEGREE REQUIREMENTS

✔ **PRIOR CREDENTIAL**

✔ COMPLETED INTERSTATE PASSPORT AT UNIVERSITY OF UTAH

✔ **MINIMUM U OF U GPA REQUIREMENT**

EARNED: *3.613 GPA*

✔ **TOTAL HOUR REQUIREMENT**

EARNED: 157.50 HOURS

✔ U OF U COURSE CREDIT HOURS THAT WERE COUNTED TOWARDS THE 122 TOTAL HOURS REQUIRED

120.50HOURS EARNED

✔ ACCEPTED TEST CREDIT COUNTED TOWARDS REQUIRED HOURS

34.00 HOURS EARNED

TRANSFER COURSE CREDIT HOURS COUNTED TOWARDS THE 122 TOTAL HOURS REQUIRED

3.00 HOURS EARNED

******* REPEATED COURSES AND/OR COURSES WITH CR GRADES *******
******* TAKEN AT THE UNIVERSITY OF UTAH *******

REPEATED COURSES

COURSES WITH CR GRADES

https://dars.sys.utah.edu/selfservice/audit/read.html?id=JobQueueRun!!!!ISEhIWludFNlcU5vPTY3NDA4NA==   1/8

✔ **UPPER DIVISION HOURS**

EARNED: 56.00 HOURS

✔ SU19	PHIL 3520 HF	3.0	A	Bioethics
FA19	CVEEN3210 QI	3.0	A	Struct Loads & Anal
FA19	CVEEN3410 QI	3.0	A	Hydraulics
FA19	CVEEN3415	1.0	A-	Hydraulics Lab
FA19	CVEEN3510	3.0	A	Civil Engrg Matls
FA19	CVEEN3515	1.0	A-	Civil Materials Lab
FA19	CVEEN3520	3.0	A-	Transportation Engg
SP20	CVEEN3100 CW	3.0	A	Tech Comm for Engrs
SP20	CVEEN3610	3.0	A	Environmental Engg I
SP20	CVEEN3615	1.0	A-	Envrionmental Lab
SP20	CVEEN4222	3.0	A	Steel Design I
SP20	CVEEN5420	3.0	A	Open Channel Flow
SP20	GEO 3030 IRSF	3.0	A	Living with Quakes
FA20	CVEEN4221	3.0	A-	Concrete Design I
FA20	CVEEN4900	3.0	A-	Professional Practice
FA20	CVEEN5240	4.0	C-	Masonry/Timber Design
SP21	CVEEN3310 QI	3.0	B	Geotechnical Engg I
SP21	CVEEN3315	1.0	A	Geotechnical I Lab
SP21	CVEEN4910	3.0	B+	Pro Pract. & Design
SP21	CVEEN5220	3.0	B	Concrete Design II
SP21	CVEEN5500	3.0	A	Sustainable Materials

✔ **RESIDENCE HOUR REQUIREMENT**

****

**** This requirement is only relevant within the last ****

**** 30 hours prior to graduation ****

****

This requirement does not classify residency status for tuition purposes.

✔ COMPLETED MINIMUM OF 30 HOURS OF COURSE WORK TAKEN IN RESIDENCE AT THE UNIVERSITY OF UTAH.

(120.50 HRS COMPLETED)

✔ A minimum of 20 out of the last 30 hours must be taken in residence at the University.

No more than 10 out of the last 30 hours may be taken as transfer, test, special credit, correspondence, or challenge credit.

(29.00 HRS COMPLETED)

SP21	CVEEN5500	3.0	A	Sustainable Materials
SP21	CVEEN5220	3.0	B	Concrete Design II
SP21	CVEEN4910	3.0	B+	Pro Pract. & Design
SP21	CVEEN3315	1.0	A	Geotechnical I Lab
SP21	CVEEN3310 QI	3.0	B	Geotechnical Engg I
FA20	MUSC 2100 FF	3.0	A	Hist of Rock'n Roll
FA20	CVEEN5240	4.0	C-	Masonry/Timber Design
FA20	CVEEN4900	3.0	A-	Professional Practice
FA20	CVEEN4221	3.0	A-	Concrete Design I
SP20	GEO 3030 IRSF	3.0	A	Living with Quakes

✔ If you are within the last 30 hours prior to graduation contact the graduation division of the Registrar's Office regarding this requirement.

(3.00 HRS COMPLETED)

SU20	MG EN2400	3.0	A-	SURVEYING FOR CIVIL ENGINEERS SLCC: CEEN 2240

GENERAL EDUCATION REQUIREMENTS

✔ **AMERICAN INSTITUTIONS (AI)**

✔ COMPLETED REQUIREMENT

SP19	HIST 1700 AI	3.0	A	American Civilization

✔ **WRITING REQUIREMENT (WR2)**

✔ COMPLETED REQUIREMENT

FA17 WRTG 2010 WR2 3.0 A- Intermediate Writing

✔ **QUANTITATIVE REASONING REQUIREMENT (QA)**

✔ QA - COMPLETED REQUIREMENT

SP18 MATH 1320 QR 4.0 B- Engineering Calculus II

✔ **QUANTITATIVE REASONING REQUIREMENT (QB)**

✔ QB - COMPLETED REQUIREMENT

SP15 MATH 1210 QR 4.0 AP AP CR: AP0005MCAB QR

INTELLECTUAL EXPLORATION REQUIREMENT
COMPLETE 2 COURSES IN EACH AREA

✔ **FINE ARTS IE AREA (FF)**

SP18	ARCH 1615 FF	3.0	A-	Intro To Architecture
FA20	MUSC 2100 FF	3.0	A	Hist of Rock'n Roll

✔ **HUMANITIES IE AREA (HF)**

SP18	LEAP 1500 DVHF	3.0	A-	LEAP Sem Humanities ENG
SU19	PHIL 3520 HF	3.0	A	Bioethics

✔ **SOCIAL SCIENCE IE AREA (BF)**

FA17	LEAP 1501 BF	3.0	A	Social & Ethical Eng
SU19	ANTH 1000 BF	3.0	A	Intro to Anthropology

UNIVERSITY BACHELOR DEGREE REQUIREMENTS

✔ **COMMUNICATION/UPPER DIVISION WRITING REQUIREMENT (CW)**

✔ COMPLETED REQUIREMENT

SP20 CVEEN3100 CW 3.0 A Tech Comm for Engrs

✔ **DIVERSITY REQUIREMENT (DV)**

✔ COMPLETED REQUIREMENT

SP18 LEAP 1500 DVHF 3.0 A- LEAP Sem Humanities ENG

✔ **INTERNATIONAL REQUIREMENT (IR)**

✔ COMPLETED REQUIREMENT

SP20 GEO 3030 IRSF 3.0 A Living with Quakes

✔ **B.S. DEGREE - QUANTITATIVE INTENSIVE REQUIREMENT (QI)**

✔ COMPLETED REQUIREMENT

2 COURSES TAKEN

FA19	CVEEN3210 QI	3.0	A	Struct Loads & Anal
FA19	CVEEN3410 QI	3.0	A	Hydraulics

MAJOR REQUIREMENTS
COLLEGE OF ENGINEERING
CIVIL ENGINEERING
CATALOG YEAR: FA2018 - SU2019

Civil Engineering
www.civil.utah.edu
Meldrum Civil Engineering Building, Rm 2012
801-581-6931
••••• •••••

••••• •••••

✔

Engineering GPA
Students must maintain a minimum Engineering GPA of 2.50

*****Students are only allowed to repeat an Engineering GPA course once, the grade earned the second time is used to compute the GPA upon which Major Status and graduation decisions are based. *****

EARNED: *3.530 GPA*

✔

SP15	MATH 1210 QR	4.0	AP	AP CR: AP0005MCAB QR
SP16	MATH 1210	4.0	AP	AP CR: AP0005MCBC QR
SP16	MATH 1210 QR	4.0	AP	AP CR: AP0005MCAB QR
SP16	MATH 1220	4.0	AP	AP CR: AP0005MCBC QR
FA17	CHEM 1210 SF	4.0	B-	General Chemistry I
FA17	CHEM 1215	1.0	A	General Chemistry Lab I
SP18	MATH 1320 QR	4.0	B-	Engineering Calculus II
SP18	PHYS 2210	4.0	A	Phyc For Scien & Eng. I
FA18	CVEEN2010	3.0	B+	Statics
FA18	CVEEN2310	3.0	A	Probability/Statistics
FA18	MATH 2250 QR	4.0	B-	Diff Equ & Lin Algebra
FA18	PHYS 2220 SF	4.0	A-	Phyc For Scien & Eng II
FA18	PHYS 2225	1.0	A	Physics Lab II for S&E
SP19	CVEEN1400	3.0	A	Computer-Aided Design
SP19	CVEEN2140	3.0	B+	Strength Of Materials
SP19	CVEEN2300	2.0	B+	Engineering Economics
SP19	CVEEN2750	2.0	A	Computer Tools
SP19	ME EN2030	3.0	A	Dynamics
FA19	CVEEN3210 QI	3.0	A	Struct Loads & Anal
FA19	CVEEN3410 QI	3.0	A	Hydraulics
FA19	CVEEN3415	1.0	A-	Hydraulics Lab
FA19	CVEEN3510	3.0	A	Civil Engrg Matls
FA19	CVEEN3515	1.0	A-	Civil Materials Lab
FA19	CVEEN3520	3.0	A-	Transportation Engg
SP20	CVEEN3100 CW	3.0	A	Tech Comm for Engrs
SP20	CVEEN3610	3.0	A	Environmental Engg I
SP20	CVEEN3615	1.0	A-	Envrionmental Lab
SP20	CVEEN4222	3.0	A	Steel Design I
SP20	GEO 3030 IRSF	3.0	A	Living with Quakes
SU20	MG EN2400	3.0	A-	SURVEYING FOR CIVIL ENGINEERS SLCC: CEEN 2240
FA20	CVEEN4221	3.0	A-	Concrete Design I
FA20	CVEEN4900	3.0	A-	Professional Practice
FA20	CVEEN5240	4.0	C-	Masonry/Timber Design
SP21	CVEEN3310 QI	3.0	B	Geotechnical Engg I
SP21	CVEEN3315	1.0	A	Geotechnical I Lab
SP21	CVEEN4910	3.0	B+	Pro Pract. & Design
SP21	CVEEN5220	3.0	B	Concrete Design II
SP21	CVEEN5500	3.0	A	Sustainable Materials

✔ **Mathematics Requirements**
Math Courses Must be Completed with a C or Better

SP16	MATH 1220	4.0	AP	AP CR: AP0005MCBC QR >>MATCHED AS: AP0005MCBC

✔ Math sequence for students with a 5 on AP CALC BC exam

2 COURSES TAKEN

SP18	MATH 1320 QR	4.0	B-	Engineering Calculus II
FA18	MATH 2250 QR	4.0	B-	Diff Equ & Lin Algebra

✔ **Science Requirements**
Science Courses Must be Completed with a C or Better

✔ Complete the following courses

9.00 HOURS EARNED 3 COURSES TAKEN

FA17	CHEM 1210 SF	4.0	B-	General Chemistry I
FA17	CHEM 1215	1.0	A	General Chemistry Lab I
SP18	PHYS 2210	4.0	A	Phyc For Scien & Eng. I

✔ Complete at least one of the following courses

4.00 HOURS EARNED 1 COURSE TAKEN

FA18	PHYS 2220 SF	4.0	A-	Phyc For Scien & Eng II
FA18	PHYS 2225	1.0	A	Physics Lab II for S&E

✔ **Additional Science Requirement**

✔ Earn at least 3 credits with a C- or better from the following repeated from previous requirements.

3.00 HOURS EARNED

SP20	GEO 3030 IRSF	3.0	A	Living with Quakes

✔ **Lower-Division Engineering Requirements**

✔ Earn a minimum grade of C in each of the following

11.00 HOURS EARNED 4 COURSES TAKEN

FA18	CVEEN2010	3.0	B+	Statics
FA18	CVEEN2310	3.0	A	Probability/Statistics
SP19	CVEEN2140	3.0	B+	Strength Of Materials
SP19	CVEEN2300	2.0	B+	Engineering Economics

✔ Earn a minimum grade of C- in each of the following

13.50 HOURS EARNED 6 COURSES TAKEN

FA17	CVEEN1000	2.0	A-	Intr Civil Envirnm Engg
FA18	CVEEN2000	0.5	A	Seminar
SP19	CVEEN1400	3.0	A	Computer-Aided Design
SP19	CVEEN2750	2.0	A	Computer Tools
SP19	ME EN2030	3.0	A	Dynamics
SU20	MG EN2400	3.0	A-	SURVEYING FOR CIVIL ENGINEERS SLCC: CEEN 2240

✔ **Upper-Division Engineering Requirements**

✔ Earn a minimum grade of C- in each of the following

31.00 HOURS EARNED 13 COURSES TAKEN

SP20	CVEEN3100 CW	3.0	A	Tech Comm for Engrs
FA19	CVEEN3210 QI	3.0	A	Struct Loads & Anal
SP21	CVEEN3310 QI	3.0	B	Geotechnical Engg I
SP21	CVEEN3315	1.0	A	Geotechnical I Lab
FA19	CVEEN3410 QI	3.0	A	Hydraulics
FA19	CVEEN3415	1.0	A-	Hydraulics Lab
FA19	CVEEN3510	3.0	A	Civil Engrg Matls
FA19	CVEEN3515	1.0	A-	Civil Materials Lab
FA19	CVEEN3520	3.0	A-	Transportation Engg
SP20	CVEEN3610	3.0	A	Environmental Engg I
SP20	CVEEN3615	1.0	A-	Envrionmental Lab
FA20	CVEEN4900	3.0	A-	Professional Practice
SP21	CVEEN4910	3.0	B+	Pro Pract. & Design

✔ **Primary Technical Electives**
Complete a minimum of 3 courses out of the 5 areas from the following options:

✔ Design Courses
Must be taken in different areas

2 COURSES TAKEN

SP20	CVEEN4222	3.0	A	Steel Design I
SP20	CVEEN5420	3.0	A	Open Channel Flow

✔ Total Primary Courses (Including Design Couses)

3 COURSES TAKEN

SP20	CVEEN4222	3.0	A	Steel Design I
SP20	CVEEN5420	3.0	A	Open Channel Flow
SP21	CVEEN5500	3.0	A	Sustainable Materials

✔ **Secondary Technical Electives**

✔ Earn at least 9 credits from the following courses
-Only 1 Course can be Taken from Construction (CVEEN 5710, 5720, 5730, or 5750)
-Courses used to complete the Primary Technical Elective requirements can't be used to satisfy the Secondary Technical Elective requirement.

10.00 HOURS EARNED

FA20	CVEEN4221	3.0	A-	Concrete Design I

SP21	CVEEN5220	3.0	B	Concrete Design II
FA20	CVEEN5240	4.0	C-	Masonry/Timber Design

✔ **ABET SCIENCE AND MATH CREDIT HOUR REQUIREMENT**

✔ 44.00 HOURS EARNED

SP15	MATH 1210 QR	4.0	AP	AP CR: AP0005MCAB QR
SP16	MATH 1210	4.0	AP	AP CR: AP0005MCBC QR
SP16	MATH 1210 QR	4.0	AP	AP CR: AP0005MCAB QR
SP16	MATH 1220	4.0	AP	AP CR: AP0005MCBC QR
FA17	CHEM 1210 SF	4.0	B-	General Chemistry I
FA17	CHEM 1215	1.0	A	General Chemistry Lab I
SP18	MATH 1320 QR	4.0	B-	Engineering Calculus II
SP18	PHYS 2210	4.0	A	Phyc For Scien & Eng. I
FA18	CVEEN2310	3.0	A	Probability/Statistics
FA18	MATH 2250 QR	4.0	B-	Diff Equ & Lin Algebra
FA18	PHYS 2220 SF	4.0	A-	Phyc For Scien & Eng II
FA18	PHYS 2225	1.0	A	Physics Lab II for S&E
SP20	GEO 3030 IRSF	3.0	A	Living with Quakes

GENERAL ELECTIVES
****** COURSES NOT USED IN GENERAL EDUCATION, ******
****** BACHELOR'S DEGREE REQUIREMENTS, OR MAJOR ******

SP15	MATH 1XXX	2.0	AP	AP CR: AP0005MCAB QR
SP16	MATH 1210	4.0	AP	AP CR: AP0005MCBC QR
SP16	MATH 1210 QR	4.0	AP	AP CR: AP0005MCAB QR
SP16	MATH 1XXX	2.0	AP	AP CR: AP0005MCAB QR
SP16	PHYS 1010 SF	3.0	AP	AP CR: AP0003PHYS2SF
SP16	PHYS 1XXX	1.0	AP	AP CR: AP0003PHYS2SF
SP16	PHYS 2010 SF	3.0	AP	AP CR: AP0004PHYS1SF
SP16	PHYS 2015 SF	1.0	AP	AP CR: AP0004PHYS1SF
SP17	MATH 1XXX QB	3.0	AP	AP CR: AP0004STAT QB

SUMMARY OF ALL AP, CLEP, SPECIAL CREDIT AND PLACEMENT SCORES

AP, IB, CLEP & SPECIAL CREDIT

34.00 HOURS EARNED

SP15	MATH 1210 QR	4.0	AP	AP CR: AP0005MCAB QR
SP15	MATH 1XXX	2.0	AP	AP CR: AP0005MCAB QR
SP16	MATH 1210	4.0	AP	AP CR: AP0005MCBC QR
SP16	MATH 1210 QR	4.0	AP	AP CR: AP0005MCAB QR
SP16	MATH 1220	4.0	AP	AP CR: AP0005MCBC QR
SP16	MATH 1XXX	2.0	AP	AP CR: AP0005MCAB QR
SP16	PHYS 1010 SF	3.0	AP	AP CR: AP0003PHYS2SF
SP16	PHYS 1XXX	1.0	AP	AP CR: AP0003PHYS2SF
SP16	PHYS 2010 SF	3.0	AP	AP CR: AP0004PHYS1SF
SP16	PHYS 2015 SF	1.0	AP	AP CR: AP0004PHYS1SF
SP17	MATH 1XXX QB	3.0	AP	AP CR: AP0004STAT QB
FA17	MATH QA	3.0	SC	MATH INT: MATH QA

PLACEMENT SCORES

FA15	ACT 0002CTEXT	0.0	AT	ACT SCR: ACT 0002CTEXT
FA15	ACT 0030ELA	0.0	AT	ACT SCR: ACT 0030ELA
FA15	ACT 0030MATH	0.0	AT	ACT SCR: ACT 0030MATH
FA15	ACT 0032STEM	0.0	AT	ACT SCR: ACT 0032STEM
FA15	ACT 0033COMP	0.0	AT	ACT SCR: ACT 0033COMP
FA15	ACT 0033READ	0.0	AT	ACT SCR: ACT 0033READ
FA15	ACT 0033SCIRE	0.0	AT	ACT SCR: ACT 0033SCIRE
FA15	ACT 0035ENGL	0.0	AT	ACT SCR: ACT 0035ENGL
SP17	UWP 0002SCORE	0.0	IX	UWP SCR: UWP 0002SCORE

SUMMARY OF TRANSFER CREDIT

EARNED: 3.00 HOURS *3.700 GPA*

TRANSFER COURSES

3.00 HOURS EARNED

SU20	MG EN2400	3.0	A-	SURVEYING FOR CIVIL ENGINEERS SLCC: CEEN 2240

SUMMARY OF COURSES TAKEN AT THE UNIVERSITY OF UTAH

ALL UNDERGRADUATE U OF U COURSES

120.50HOURS EARNED

SU19	ANTH 1000 BF	3.0	A	Intro to Anthropology
SP18	ARCH 1615 FF	3.0	A-	Intro To Architecture
FA17	CHEM 1210 SF	4.0	B-	General Chemistry I
FA17	CHEM 1215	1.0	A	General Chemistry Lab I
FA17	CVEEN1000	2.0	A-	Intr Civil Envirnm Engg
SP19	CVEEN1400	3.0	A	Computer-Aided Design
FA18	CVEEN2000	0.5	A	Seminar
FA18	CVEEN2010	3.0	B+	Statics
SP19	CVEEN2140	3.0	B+	Strength Of Materials
SP19	CVEEN2300	2.0	B+	Engineering Economics
FA18	CVEEN2310	3.0	A	Probability/Statistics
SP19	CVEEN2750	2.0	A	Computer Tools
SP20	CVEEN3100 CW	3.0	A	Tech Comm for Engrs
FA19	CVEEN3210 QI	3.0	A	Struct Loads & Anal
SP21	CVEEN3310 QI	3.0	B	Geotechnical Engg I
SP21	CVEEN3315	1.0	A	Geotechnical I Lab
FA19	CVEEN3410 QI	3.0	A	Hydraulics
FA19	CVEEN3415	1.0	A-	Hydraulics Lab
FA19	CVEEN3510	3.0	A	Civil Engrg Matls
FA19	CVEEN3515	1.0	A-	Civil Materials Lab
FA19	CVEEN3520	3.0	A-	Transportation Engg
SP20	CVEEN3610	3.0	A	Environmental Engg I
SP20	CVEEN3615	1.0	A-	Envrionmental Lab
FA20	CVEEN4221	3.0	A-	Concrete Design I
SP20	CVEEN4222	3.0	A	Steel Design I
FA20	CVEEN4900	3.0	A-	Professional Practice
SP21	CVEEN4910	3.0	B+	Pro Pract. & Design
SP21	CVEEN5220	3.0	B	Concrete Design II
FA20	CVEEN5240	4.0	C-	Masonry/Timber Design
SP20	CVEEN5420	3.0	A	Open Channel Flow
SP21	CVEEN5500	3.0	A	Sustainable Materials
SP20	GEO 3030 IRSF	3.0	A	Living with Quakes
SP19	HIST 1700 AI	3.0	A	American Civilization
SP18	LEAP 1500 DVHF	3.0	A-	LEAP Sem Humanities ENG
FA17	LEAP 1501 BF	3.0	A	Social & Ethical Eng
SP18	MATH 1320 QR	4.0	B-	Engineering Calculus II
FA18	MATH 2250 QR	4.0	B-	Diff Equ & Lin Algebra
SP19	ME EN2030	3.0	A	Dynamics
FA20	MUSC 2100 FF	3.0	A	Hist of Rock'n Roll
SU19	PHIL 3520 HF	3.0	A	Bioethics
SP18	PHYS 2210	4.0	A	Phyc For Scien & Eng. I
FA18	PHYS 2220 SF	4.0	A-	Phyc For Scien & Eng II
FA18	PHYS 2225	1.0	A	Physics Lab II for S&E
FA17	WRTG 2010 WR2	3.0	A-	Intermediate Writing

************************* END OF ANAYSIS *********************

Legend

- ✔ - Complete
- 📅 - Planned
- *** - In Progress
- ✖ - Unfulfilled

Undergraduate Advisors in the Department of Civil and Environmental Engineering

The Department Advisors are:

Olivia Calvillo
Academic Advisor
Email: olivia.calvillo@utah.edu
Tel: 801.581.6932
Office: 2012 MCE

Wendy McKenney
Academic Advisor
Email: wendy.mckenney@utah.edu
Tel: 801.581.8517
Office: 2016 MCE

Pedro Romero
Associate Professor
Director of Undergraduate Advising
Tel: 801-587-7225
Email: Romero@civil.utah.edu
Office: 2131 MCE

Engineering Advising for Undecided Engineering Majors

Students who have not yet decided upon a specific engineering program meet with a college advisor to review college-wide options. The advisors for the College of Engineering are:

Emily Howsley
Academic Advisor
Email: emily.howsley@utah.edu
Tel: 801-581-8575
Office: 1706 WEB

Sierra Whipple-Padgen
Academic Advisor
Email: s.whipple-padgen@utah.edu
Office: 1818 WEB

E. Work in Lieu of Courses

Course credit or waivers for work experience is not permitted in the CEP program.

Advanced Placement Credit (AP Credit)

The College of Engineering has a policy in place regarding Advanced Placement (AP) credit. The table below indicates the AP tests that can be taken for credit towards the completion of engineering requirements. Additional AP exam snot on this list may count towards completion of certain university requirements.

EXAM & SCORE	SATISFIES	PLACEMENT
Biology – 4 or 5	Additional Science Requirement	Additional Science Requirement
Chemistry – 3	-	CHEM 1210
Chemistry – 4	CHEM 1210	CHEM 1220
Chemistry – 5	CHEM 1220	-
Calculus AB – 3	-	MATH 1210 or MATH 1310
Calculus AB – 4 or 5	MATH 1210	MATH 1310 or MATH 1220
Calculus BC - 3	MATH 1210/1310	MATH 1220 or MATH 1320
Calculus BC – 4 or 5	MATH 1210/1310 and MATH 1220	MATH 1320 or MATH 1321 or MATH 2210
Physics C (Mechanics) – 3	-	PHYS 2210
Physics C (Mechanics) – 4 or 5	PHYS 2210	PHYS 2220
Physics C (Electricity & Magnetism) - 3	PHYS 2210	PHYS 2220
Physics C (Electricity & Magnetism) – 4 or 5	PHYS 2220	-
Statistics – 4 or 5	CVEEN 2310	-

F. Graduation Requirements

The graduation requirements in terms of the curriculum are shown in Criterion 5.

Graduation requirements consist of successful completion of a minimum of 126.5 semester hours of the following requirements: (1) the University's General Education and Bachelor Degree Requirements; (2) Mathematics and Science; (3) the CVEEN Core; and, (4) CVEEN Electives. Each class taken to satisfy CVEEN program requirements in mathematics, chemistry, physics, biology, CVEEN core, and CVEEN electives must be passed with a grade of C or C- or better, depending on the course (see the Continuing Performance above for details). A student may repeat the courses only once with the second grade being counted for the requirement. In addition, the students must graduate with a cumulative GPA at or above 2.00 and an engineering GPA at or above 2.50. If the requirements for repeats, grades, or overall GPA are not met, a student can petition for a variance from published requirements. These petitions are reviewed by the Associate Chair in consultation with other members of the undergraduate committee.

To apply for graduation, a student completes the Application for Graduation online tool. Final graduation approval is fully automated using the Degree Audit Reporting System (DARS). The student must fulfill the listed requirements fully to be awarded a Bachelor of Science in Civil and Environmental Engineering. Provided that the student has met all of the University course requirements and completed the CEP program requirements in mathematics, chemistry, physics, biology, CEP core, and CEP electives with a C or C- grade or better and has achieved an overall GPA that is 2.00 or higher, and an engineering GPA of 2.50 or higher, the system will automatically clear the student to graduate with the B.S. degree in the CEP. In cases where the student doesn't clear, we receive a notification back from the registrar to determine what issues need to be resolved. Once issues are identified, plans are put in place on how to help the student progress towards graduation. Once completed, the student reapplies for graduation.

G. Records of Student Work/Transcripts

The Program will provide records of academic work (transcripts) that certify completion of all program requirements and include the name of the Program (major, field of study) the degree awarded, and the date the degree was awarded.

The program name and degree awarded must be shown in English exactly as they appear on the Request for Evaluation accepted by ABET. (See 2021-22 APPM, Section 1.C.2.b)

Transcripts must also provide at a minimum the following:

1) The name and address of the institution
2) The name and other identification as appropriate of the student
3) A record of academic work pursued at the institution, including identification of courses and/or credits attempted, academic years of each attempt, grade or other evaluation for each attempt, and an indication of all required work attempted, and
4) A list of required courses and/or credits for which academic work pursued at another institution(s) was accepted to meet the requirements of the Program. (See 2021-2022 APPM, Section I.C.2.a.)

The team chair will specify which transcripts to provide. New programs requesting retroactive accreditation for two academic years prior to the onsite review must provide transcripts from graduates for both academic years. Transcripts should be accompanied by copies of degree audits and/or other explanations for interpreting the transcripts. (See 2021-2022 APPM, Section I.E.3.a.)

CRITERION 2. PROGRAM EDUCATIONAL OBJECTIVES

A. Mission Statement

Mission Statement University of Utah

The University of Utah fosters student success by preparing students from diverse backgrounds for lives of impact as leaders and citizens. We generate and share new knowledge, discoveries, and innovations, and we engage local and global communities to promote education, health, and quality of life. These contributions, in addition to responsible stewardship of our intellectual, physical, and financial resources, ensure the long-term success and viability of the institution.

Mission Statement College of Engineering

To prepare students for leadership and professional positions in academia, industry, and government; to improve the productivity, health, safety, and enjoyment of human life through leading-edge research; and to stimulate and grow the economy by providing qualified engineering professionals and by transferring the technologies developed in College of Engineering research to the private sector.

B. Program Educational Objectives

1. CVEEN Construction Engineering graduates will be engaged in the practice of construction engineering or a related field or will be pursuing advanced knowledge through post-graduate study and research.
2. CVEEN Construction Engineering graduates will be entering professional practice and on a path towards professional licensure when appropriate. They will be collaborating on diverse project teams applying engineering, communication, and management skills and utilizing their accumulated education and experience to address complex societal issues for the community's broader good.
3. CVEEN Construction Engineering graduates will be ascending into leadership roles by advocating for their profession, being active in professional organizations, seeking professional development opportunities, and participating in their profession's betterment by applying ethical engineering practices.

   https://www.civil.utah.edu/abet-accreditation/

C. Consistency of the Program Educational Objectives with the Mission of the Institution

The mission of the University includes "preparing students from diverse backgrounds for lives of impact as leaders and citizens," emphasizes engagement of "local and global communities to promote education, health, and quality of life." The mission of the College of Engineering includes the preparation for leadership in professional, industry, and government. The CEP educational objectives refine these goals by emphasizing preparing students to be on the path for entering professional and ultimately obtaining professional licensure.

The mission of the University speaks of "engaging local and global communities to promote education, health, and quality of life." The mission of the College of Engineering speaks of the preparation of students to improve the productivity, health, safety, and enjoyment of human life. The CEP educational objectives address these objectives by encouraging graduates to ascend into leadership roles by advocating for their profession, being active in professional organizations, seeking professional development opportunities, and participating in their profession's betterment by applying ethical engineering practices.

D. Program Constituencies

The primary requirement-generating constituencies of the CVEEN Department are:

- CVEEN faculty
- CEP faculty
- CEP Industrial Advisory Board (IAB) (https://www.civil.utah.edu/industrial-advisory-board/)

These constituencies are called "requirement-generating," because they initiate or sponsor initiatives that directly affect the Program and its requirements. Other stakeholders that provide feedback at the program level are:

- Engineering National Advisory Council (ENAC) (https://www.coe.utah.edu/enac)
- CVEEN alumni board
- Former CEP students (1 to 5 years post graduation)

These stakeholders provide feedback regarding the Program Education Objectives, academic requirements, and curriculum; however, they do so in an advisory role.

CEP Program Education Objective 1 meets the mission of the COE to provide engineers prepared to enter the workforce of the State of Utah. As a state-funded school, the COE, CVEEN, and CEP have an obligation to provide an educated workforce to assist in the economic and social development of the State. In addition, because the University of Utah is a Research 1 institution, CEP also has an obligation to provide a select handful of undergraduate students that are prepared to enter graduate school and fulfill the Department's research mission. CEP Program Education Objective addresses the need to provide qualified engineers active in professional organizations (e.g., ASCE) and that continue in seeking professional development throughout their careers. The achieving of this objective is important to all constituencies of CEP. The obtainment of professional licensure is important to CEP graduates in terms of employment opportunity and career progression, to the Department and University in terms of reputation and stature, and to the engineering profession in terms of maintaining a professional and uniform standard of care. Professional licensure provides this uniformity of engineering in the public arena by enforcing standards and restricting by unqualified individuals. In addition, it is vital to professional societies and industry that CEP graduates seek membership in such organizations and continue their education. This membership improves the influence of these organizations and enhances the state of engineering practice by providing a venue for networking and sharing of knowledge and by providing a venue for life-long learning by courses, seminars, and conferences organized or sponsored by these organizations. Such continuing education is also a requirement for continued professional licensure. CEP provides to its graduates the foundation for continuing education by providing critical reasoning, analysis, and communication skills through the formal educational process offered by the University. CEP Education Objective 3 expresses the need to have CEP graduates engaged in society through leadership and advocacy for their profession. This meets the needs of the constituency of CEP by offering leadership and problem-solving skills to address 21st-century challenges,

E. Process for Review of the Program Educational Objectives

The COE ABET committee meets monthly to discuss ABET-related issues. It is chaired by the COE Associate Dean of Academic Affairs. This committee provides feedback, guidance, and recommendations to CVEEN and the CEP regarding its program objectives, ABET processes and review, and other accreditation topics. The CEP objectives were drafted by the CEP committee and were amended and approved in the CVEEN faculty meeting during spring 2021. The CEP IAB also reviewed the objectives during that same semester.

The CEP has strong participation from its Industrial Advisory Board, composed of consulting, industry, and public-sector engineers. The CEP and CVEEN seek comments from the IAB regarding the CEP program objectives. The current board members are:

- Jeremy Blanck, Okland Construction
- Scott Braithwaite, Jacobsen Construction
- Paul Edwards, StacyWitbeck
- Joshua Haines, Layton Construction
- Forrest McNabb, Big D Construction
- Scott Parson, Staker/Parson Companies
- Kevin Smith, Lakeview Rock Products
- Brandon Squire, Ralph L. Wadsworth Construction
- Jason Klaumann, Granite Construction
- Travis Taylor, Haskell
- Rich Thorn, AGC of Utah
- John Tripi, Ames Construction
- Guy Wadsworth, Wadsworth Brothers Construction
- Guy Wollam, Wollam Construction

The PEOs are reviewed and revised on a 6-year cycle—the next scheduled review will be in Fall 2026. However, because the CEP IAB meets quarterly, recommendations to change that PEOs could originate earlier if there is a compelling reason to amend the PEOs

The CEP IAB also advises the CVEEN Chair and faculty regarding the state of practice regarding private and public infrastructure. This review is done so that CVEEN can better meet the needs of the State and its citizens. The IAB also helps in curriculum review and development and strategic plan. IAB meeting minutes and recommendations are routinely discussed in subsequent faculty meetings and acted upon as appropriate when faculty concurrence is reached. The IAB also assists CVEEN in fundraising and public relations and disseminates CVEEN related information to the State legislature, agencies, counties, and cities.

CRITERION 3. STUDENT OUTCOMES

A. Student Outcomes

The CEP was initiated in Fall 2016. The assessment of Student Outcomes a-k was done by the CVEEN civil engineering program because the curriculum for both the construction and civil engineering programs is essentially identical for the first 2.5 years. The CEP adopted Student Outcomes 1-7 and started its own assessment of these outcomes during Fall 2020.

The student outcomes for the CEP are listed below. They are also found at: https://www.civil.utah.edu/abet-accreditation/. The CEP has decided not to add to or modify these criteria.

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.

B. Relationship of Student Outcomes to Program Educational Objectives

The relationship between program educational objects and CVEEN student outcomes is shown and discussed in the following table.

Table 3-1 Relation of PEO and SO for CEP

Program Educational Objectives	Student Outcomes	Comments
CVEEN Construction Engineering graduates will be engaged in the of construction engineering or a related field or will be pursuing advanced knowledge through post-graduate study and research.	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	These student outcomes support the preparation of the CEP graduate to apply the knowledge of civil engineering. This is done by preparation in mathematics, science, experimentation, design, teaming, problem solving and communication.

Program Educational Objectives	Student Outcomes	Comments
CVEEN Construction Engineering graduates will be entering professional and on a path towards professional licensure when appropriate. They will be collaborating on diverse project teams applying engineering, communication, and management skills and utilizing their accumulated education and experience to address complex societal issues for the community's broader good.	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 7.an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.	These student outcomes prepare the CVEEN graduate for profession practice in terms of licensure, ethics, life-long learning and professional engagement.
CVEEN graduates are encouraged to seek leadership roles and to be advocates for their profession in solving complex societal issues for the broader good of the community.	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	These student outcomes prepare the CVEEN graduate for community involvement and leadership beyond the of civil engineering. Also, training relating to business practice is given (i.e., management, business)

CRITERION 4. CONTINUOUS IMPROVEMENT

A. Student Outcomes

Introduction

The program regularly uses a documented processes for assessing and evaluating the extent to which the student outcomes are being attained, as explained in this section. The student outcome evaluations are used as input for the program's continuous improvement actions, as described in Section 4B – Continuous Improvement.

The CEP is one of two BS programs offered by the Department of Civil and Environmental Engineering (CVEEN) at the University. The other program is in civil engineering (CvEP). The CvEP has been accredited for many years. The CvEP received its Civil Engineering ECPD accreditation in 1936, the first year for this accreditation was offered.

The inaugural semester of the construction engineering program (CEP) began in Fall 2016 in the CVEEN Department. Most of the students that started the CEP are now reaching their senior year. One student has completed graduation during the Spring 2021 semester. More students will be applying for graduation during the Fall 2021 semester.

The first 2.5 years of course study in the CEP or CvEP are essentially the same. The only significant difference is that CEP students take microeconomics instead of engineering dynamics. Therefore, from a student outcome assessment standpoint, the CEP chose to rely on the CvEP student outcome 1-7 assessment for these formative courses. However, informal reviewers have informed that CEP and CvEP student scores or achievements should be disaggregated in making these evaluations. The CEP will ensure that the instructors do this as we go into the next ABET review cycle.

Nonetheless, for the 2020-2021 academic year, CEP has performed student outcome assessments on junior and senior-level courses for courses primarily taken by CEP students. These assessments are included in this self-study report. The assessment assignments are shown in Table 4-1. Examples of the assessment method used are found in Attachment 1. The following sections further describe the implementation of assessment, evaluation, and continuous improvement adopted by the CEP.

CEP Method of Assessing and Evaluating Student Outcomes

Definitions

Student Outcomes – Student outcomes describe what students are expected to know and do by graduation. These relate to students' knowledge, skills, and behaviors as they progress through the program.

Assessment – Assessment is one or more processes identifying, collecting, and preparing data to evaluate student outcomes. A practical assessment uses relevant direct, indirect, quantitative, and qualitative measures to measure the outcome. Appropriate sampling methods may be used as part of an assessment process.

Evaluation – Evaluation is one or more processes for interpreting the data and evidence accumulated through assessment processes. Evaluation determines the extent to which student outcomes are being attained. These processes result in decisions and actions regarding program improvement.

CEP Student Outcome Assessment and Evaluation Process

The student outcomes are listed in Criterion 3A. These outcomes describe what items students are expected to know or be able to perform by the time of graduation. These relate to the knowledge, skills, and aptitudes (KSAs) students should acquire as they progress through the program. The CEP is responsible for gathering assessment data regarding students' performance regularly, evaluating these data, and making recommendations for curriculum and instructional improvements when required.

Table 4-1 shows the curriculum map developed specifically for the CEP program. This map identifies the curriculum that contributes to the development or achievement of the student outcomes. Each student outcome has been aligned with one or more required courses or academic activities (e.g., laboratory, project, etc.). Also, the map conveys Bloom's Taxonomy (i.e., cognitive level desired at graduation. For more information, see https://en.wikipedia.org/wiki/Bloom%27s_taxonomy.

The CEP summative courses address the student outcome at the cognitive level desired at graduation. Most of these courses are at the junior, senior, or senior technical elective level (i.e., 3000 to 5000-course level). CEP faculty members selected these courses as representative candidates for evaluating student outcome performance.

Table 4-1 CEP Student Outcome Curriculum Map

ABET student outcomes (a) through (k) and ASCE outcome (l) with the expected Bloom's Taxonomy[1] for level of achievement by graduation: (Co = comprehension, Ap = application, An = analysis, Ev = evaluation, Sy = synthesis). (●) = summative course of primary importance in achieving student outcome at the desired cognitive level at graduation	(1) Engineering Problems (Ap)	(2) Engineering Design (Sy)	(3) Communications (An)	(4) Responsibilities, Impacts (An)	(5) Teams (Ap)	(6) Experiments (Ev)	(7) Self Learning (Ap)
CVEEN 3100 Technical Communication			●		●		
CVEEN 3510 Materials	●						
CVEEN 3515 Material Lab						●	
CVEEN 4222 Steel Design 1	●	●		●			
CVEEN 5740 Horizontal Construction							●
CVEEN 4920 Design Capstone		●	●		●		
CVEEN 5780 Façade Engineering I							●
CVEEN 5790 Vertical Construction				●			

Roles and Responsibilities

The program assessment and evaluation of student outcomes require faculty participation to be valuable as a tool for continuous improvement. To this end, each student outcome is evaluated by the instructor (i.e., evaluator), CEP Undergraduate Committee (i.e., reviewer), and the CEP ABET advisor (Table 4-2). These individuals and committees are to work with course instructors to develop assessment methods for the student outcomes and take the lead in producing evaluation reports for each outcome. The critical elements of this are:

1) Development of performance indicators
2) Adopting a performance goal
3) Development of outcome assessment activities or methods
4) Assessment of outcome
5) Evaluation of outcome
6) Reporting

ABET student outcomes must be evaluated at the program level. Nonetheless, assessment information and student work products from CEP courses are generally be required to complete program-level assessments and evaluations. In this regard, individual course instructors are requested to assist the CEP Reviewers in implementing the assessment and evaluation plan according to the CEP Curriculum Map. The CEP Undergraduate Committee takes the lead in developing this plan with the respective course instructor(s) and the CEP Advisor. Such coordination is especially required when students' work products from specific courses (e.g., exam problems, homework assignments, projects, etc.) are used for continuous improvement.

As the assessment information becomes available, the CEP Undergraduate Committee reviews the work products from the course instructor(s) and evaluates this information. Lastly, this committee transmits the evaluation and recommendations for potential improvement in a brief report to the ABET Advisor for review and possible action by the CEP undergraduate committee. This evaluation and its supporting information and data become part of the CEP ABET self-study report as required by Criterion 4 (i.e., Continuous Improvement) of this report.

The CEP Advisor assists the evaluators and reviewers in developing assessment activities, their implementation, subsequent evaluation, and reporting. From these evaluations, potential action items are considered by the CEP undergraduate committee regarding curriculum improvement as part of the ABET continuous improvement process. The Advisor oversees these activities to provide uniformity of process throughout the Department. The advisor is also responsible for preparing the ABET self-study report, which is required as part of the accreditation process. This report includes a summary of the evaluations of student outcomes and the continuous improvement activities.

Table 4-2 Student Outcome Evaluation

ABET Student Outcome	Evaluator	Reviewer	Advisor
(1) Engineering Problems	Instructor(s)	CEP UG committee	Bartlett
(2) Engineering Design	Instructor(s)	CEP UG committee	Bartlett
(3) Communications	Instructor(s)	CEP UG committee	Bartlett
(4) Responsibilities, Judgment & Impacts	Instructor(s)	CEP UG committee	Bartlett
(5) Teams	Instructor(s)	CEP UG committee	Bartlett
(6) Experiments	Instructor(s)	CEP UG committee	Bartlett
(7) Self-Learning	Instructor(s)	CEP UG committee	Bartlett

Guidance on Development of Performance Indicators

Student outcomes describe what students are expected to know and can do at the time of graduation. These relate to the knowledge, skills, or aptitudes that students should be able to perform. **Performance indicators** consist of measurable statements identifying the performance required to meet the student outcome and are confirmable through evidence (i.e., data). The primary difference between student outcomes and performance indicators is that student outcomes are intended to provide general information about the focus of student learning and are broad statements of the expected learning or knowledge.

In contrast, performance indicators are concrete, measurable performances or objectives that students must meet to achieve the desired outcome. Furthermore, performance indicators facilitate program and course curriculum development and help define and focus the data collection process. Performance indicators should be communicated to CEP students and stated in terms that inform the students about the general purpose of the program and faculty's expectations.

Performance indicators consist of two main elements: (1) action verb (mapped to Bloom's Taxonomy) to describe the depth or level of learning and (2) content (i.e., the focus of instruction). For example, a generic performance indicator associated with ABET student outcome (b) might be written as: "*CEP students can demonstrate the ability to develop or follow an experiment plan or procedure (knowledge), acquire data on appropriate parameters (application) and compare experimental data and results to theoretical or empirical models (synthesis)*." A performance indicator written for a specific course might be: "*CVEEN 3315 students can conduct laboratory 1D consolidation testing on clayey soils and analyze and compare experimental data to theoretical or empirical models and create input parameters required for settlement calculations for foundation design*."

When writing performance indicators, the following action verbs are useful for the levels of Bloom's Taxonomy (bolded): (1) Knowledge – list, recite, define, (2) Comprehension – explain, describe, characterize, (3) Application – apply, solve, (4) Analysis – analyze, formulate, (5) Synthesis – design, create, (6) Evaluation – assess, evaluate. More about these cognitive levels can be found at https://en.wikipedia.org/wiki/Bloom%27s_taxonomy.

Adopting a Performance Goal

A performance goal must be established for each performance indicator. CEP faculty have agreed that initially, the program should strive to have 80 percent, or higher, of the CEP students, achieve the performance indicator at a satisfactory level.

For example, a reasonable performance goal might state that it is desired that at least 80 to 85 percent of the assessed students meet the performance indicator at a satisfactory level or higher. For example, a performance goal might be stated as: *"It is desired that 80 percent, or higher, of CVEEN 3315 students be able to analyze and compare experimental data to theoretical or empirical models and create input parameters required for settlement calculations for foundation design."*

Outcome Assessment Activities or Methods

The outcome assessment activity or method may consist of exams, quizzes, homework, project work, questionnaires, etc., or other direct measures of students' performance. It should not consist of grades for a course. Further, each student is to be assessed as an individual and not as a group. The assessment activity/method should be standardized as much as possible so that it can be used to track trends over multiple semesters and years. The CEP reviewers and advisor should coordinate with the various course instructors to develop the assessment activity/method for their assigned outcomes.

Assessment of Outcomes

The instructor completes the assessment of the students' work associated with a performance indicator for summative courses corresponding to solid red circles in Table 4-1. Quantitative, evidence-based assessment of students' work is vital, including the supporting data. Also, instructors and subcommittees should strive to achieve standardization in the assessment tool and its scoring. In addition, it is recommended that the subcommittees develop a rubric for qualitative assessment activities to help quantify students' performance. These rubrics should be standardized, and evaluation criteria should be included for systematic ranking student performance.

Evaluation of Outcomes

The evaluation consists of interpreting and making judgments about the assessment data and its scorings in terms of meeting performance goals for the respective performance indicator. As experience grows with the performance indicator, benchmarks or thresholds should be adjusted for the program that defines satisfactory performance. Evaluations should be regular, systematic, and documented according to the schedule given in Table 4-3. If performance is unsatisfactory, then recommendations should be made about ways or methods of improving the program. Example evaluations are found in Attachment 1.

Reporting

The assessment results, evaluation, and recommendations for improvement should be given to the CEP ABET advisor for future potential action by the CEP undergraduate committee. Reporting requirements are made on the form below. These are done on an annual basis. Results of student outcome assessments and evaluations are stored in UBOX for faculty review.

Table 4-3 Student Outcome Evaluation Schedule

Student Outcome	**(1) Engineering Problems**	**(2) Engineering Design**	**(3) Communications**	**(4) Responsibilities, Impacts**	**(5) Teams**	**(6) Experiments**	**(7) Self Learning**
CVEEN 3100 Technical Communication			F, Sp		F, Sp		
CVEEN 3510 Materials	F, Sp						
CVEEN 3515 Material Lab						F, Sp	
CVEEN 4222 Steel Design 1	F, Sp	F, Sp		F, Sp			
CVEEN 5740 Horizontal Construction							Sp
CVEEN 4920 Design Capstone		Sp	Sp		Sp		
CVEEN 5780 Façade Engineering I							Sp
CVEEN 5790 Vertical Construction			F				

F = Fall Semester
Sp = Spring Semester

ABET Student Outcome:
Performance Indicator:
(i.e., specific course activity or outcome that address the Student Outcome:

Semester/Year:
Course:
Instructor:

Instructions: This form will be completed by the course instructor at the conclusion of each semester and submitted to the appropriate student outcome evaluation committee for inclusion in their program-level assessment. Provide a minimum of 5 examples of student work.

Brief statement describing the specifics of the assignment, quiz, exam, problem, etc. used to assess this performance indicator.

Statement of how the problem addresses the performance indicator.

Use the table below to determine if the student was successful in achieving the performance indicator. For example, the CvEEN Department generally sets a performance goal that 80 percent, or higher, of the students achieve satisfactory performance on the performance indicator.

Exemplary	**Mature**	**Satisfactory**	**Developing**	**Beginning**
Greatly exceeded expectations	Exceeded expectations	Met expectations	Partially met expectations but deficient in important aspects	Significant improvement needed to meet expectations
No to minor mistakes. Significant additional quality above the minimal standard	Some minor mistakes, no significant conceptual mistakes. Additional quality above minimal standard	Some mistakes, including minor conceptual mistakes; however, able to use generally accepted methods. Quality met the minimal standard.	Demonstrated some general knowledge of the topic. Work included many mistakes, including conceptual mistakes. Quality was substandard.	No response or participation, or completely incorrect in response or participation.
score = 5	score = 4	score = 3	score = 2	score = 1
grade = A	grade = B	grade = C	grade = D	grade = E
Percentage > 90%	80 to 89%	70 to 79%	60 to 69%	< 60%
Exemplary	Mature	Satisfactory	Developing	Beginning

Tabulate the distribution of student grades on the problem/assignment. Include the total number of students who were assessed and the total number of students who met the performance objective.

Description of how the students successfully met the performance indicator.

Description of how the students didn't successfully meet the performance indicator.

Conclusion (supported by data).

Recommendations to improve the achievement of this outcome.

B. Continuous Improvement

The primary individuals, groups, and committees of CVEEN involved in the continuous improvement process of the CEP curriculum and program are: (1) course instructors, (2) discipline groups (i.e., Construction Engineering), (3) Undergraduate Committee (UG), (4) CVEEN Chair and the CVEEN EXCOM committee, (5) CEP students and (6) CEP IAB.

Motions to make changes to the CEP can come from these various individuals, groups, and committees. These are documented using the form included in this section. For example, an individual course instructor, based on a course-level assessment and evaluation, may recommend potential changes to course content by discussing the motion within their discipline group. If favorable, the recommendation, or motion, is brought by the discipline group representative to the CEP committee for further deliberations and potential action. If approved, the CEP brings the motion to the faculty body for additional discussion and potential approval.

Course syllabi are reviewed and integrated with the expectations of prerequisite knowledge and with the expected outcomes necessary to serve more advanced courses in the Program. A course coordinator/instructor is assigned to each course to select textbooks and course activities (e.g., lectures, lab, field experiences, etc.). At the end of each semester, student outcomes are evaluated using course data, student evaluations, peer evaluations, exit interviews, etc. When improvements in quality are identified, efforts are made to improve the course, and structural changes are considered using the processes described in the previous paragraphs.

The CEP and UG Committees meet monthly and serve as the primary vehicle for evaluating the CEP and CVEEN undergraduate program regarding developing or modifying degree requirements. Activities of this committee often include: offering improvements to the curriculum, reviewing academic requirements, assisting in the accreditation process, and reviewing petitions submitted to the Department by undergraduate students.

The discipline groups with CVEEN meet monthly to discuss various issues brought forth by group members, or by CVEEN IAB, or by the department chair. These groups also review graduate student applications for admissions into the University

The CVEEN Executive Committee (EXCOM) is responsible for identifying and advancing opportunities to improve departmental operations, including, but not limited to, developing new and modifying existing departmental policies and procedures concerning faculty and students consistent with College and University guidelines.

The faculty meet as a body once a month to discuss and approve or deny motions brought forth by other groups or committees. In the case of curriculum modifications, these are approved by a majority vote of the faculty. All faculty body actions are documented in monthly faculty meeting minutes, which are available to the review team upon request.

The following form is used to document continuous improvement recommendations and actions.

ABET Continuous Improvement Form:

Date:
Group/Committee/Person(s) making recommendation:
Course(s) affected (as applicable):

Short title for recommendation:

Recommended for implementation (y/n?)
Date of implementation (as applicable):

ABET criterion outcome affected by recommendation:

1. Students
2. Program Educational Objectives
3. Student Outcomes
4. Continuous Improvement
5. Curriculum
6. Faculty
7. Facilities
8. Institutional Support

Brief discussion of the recommendation:

Brief discussion of action or improvement as approved by the UG committee and CEP Faculty:

Brief discussion of implementation strategy and timeline:

Summary of Evaluations

The table below summarizes the assessment results and any changes (whether or not effective) in those cases where the evaluations has been completed. Also, any significant future program improvement plans are discussed based upon recent evaluations. This information supporting this table is found in this report in Attachment 1 – Student Outcome Assessment.

SO	Date Recommended	Recommendation	Action/Rationale	Implemented / Date
1	Spring 2021 CVEEN 3510	All the students completed the problem. Part of the reason for a great success rate that the problem was very similar to those covered in class.	Continue to solve as many problems in class as possible. Another possible solution would be to issue a problem that uses the concepts required, but is not very similar to that given in class.	Action pending CEP committee review
1	Fall 2020 CVEEN 3210	The average for the exercise, including the student who did not solve it, was 7.9. The standard deviation was 3.1. Therefore, the problem was considered a success in terms of students' understanding. However, some students could not connect the fact that an overturning moment failure mode may be more critical when the gravitational loads are smaller, not larger.	Most of the student were able to connect the dots, and understand that they should include load combinations that had reduced gravity load. This led to an average of almost 80% for the exercise.	Action pending CEP committee review. The instructor recommends to provide more exercises of this type in HW and midterm assignments.
2	Spring 2021 CVEEN 4222	Only one student did not meet the expectations, but it is not clear whether he/she did not have time to complete his examination, or had not understood the corresponding discussions.	No action required.	NA
2	Spring 2021 CVEEN 4920	All students met the performance indicator.	No action required.	NA
3	Spring 2021 CVEEN 3100	Students typically have four weeks from when the	This assignment works well as the first major	NA

		assignment is assigned until it is due to complete all required components. Because of the multiple types of feedback, they receive throughout the process (e.g. one-on-one instructor consultation, instructor comments on rough drafts, and 1-2 rounds of peer review), students typically have no problem achieving the performance indicator.	assignment of the semester. No action required.	
3	Spring 2021 CVEEN 3100	The majority of students enrolled in this class have no problem completing this assignment and achieving the minimum performance indicator. It is not a difficult assignment so long as the students follow the rubric closely (which is provided to them when the technical memo is assigned). This assignment is used as in introduction to expectations of the class and some of the parameters required of written technical communication. One of the six students did not achieve the minimum performance indicator; the majority students who do not achieve the minimum performance level simply because they did not follow the parameters outline in the rubric, e.g.: not using the proper citation style, including too much summary information instead of analysis, and not proofreading closely enough for grammatical errors.	This is the first technical writing assignment students are asked to submit during the semester. Most students respond well to the assignment; as such, this assignment continues to prove to be a good foray into technical communication writing, either as a refresher for some of the class and an introduction for the remai nder of this class. No action required.	NA
3	Spring 2021 CVEEN 4920	Both teams meet the minimum expectations for this	1. Provide better instructions for the	NA

		outcome. However, the instructor believes that more course instruction would be beneficial.	content of the technical proposal. 2. Provide written technical proposal to attendee reviewers. 3. Provide guidance on how to respond to questions during presentation No action required by CEP committee. These are instructional improvements and not curriculum improvements.	
4	Fall 2020 CVEEN 3210	All students met the performance goal except the two students who did not attempt to solve the HW.	No action required.	NA
5	Spring 2021 CVEEN 3100	Greatly exceeded expectations; no to minor mistakes; and significant additional quality above the minimal standard as describe just above. All construction students enro lled this semester successfully met the performance indicator. Note: SP 2021 was the third semester affected by the COVID-19 pandemic; this course occurred online in an online format.	No action required.	NA
5	Spring 2021 CVEEN 4920	All students met the performance goal	No action required.	NA
6	Spring 2021 CVEEN 3515	Students met the performance indicator by writing a laboratory report. All the students met expectations for this particular lab report. The instructor will further evaluate contributions of individual team members to ensure that each student has made a substantial contribution.	No action required by CEP committee. These are instructional improvements and not curriculum improvements	NA

7	Spring 2021 CVEEN 5780	students achieved >=80% score, which shows most of students have successfully met the performance goal. The short-term and long-term goal of students are clear. All students show strong interest as a civil engineer. The students have presented clear thinking, plans and interest of being a civil engineer in the future. A few students are not reflecting enough to continuing education, peer groups and the review process.	No action required.	NA

C. Additional Information

Copies of any of the assessment instruments or materials referenced in 4.A and 4.B will be available electronically at the time of the visit. Other information, such as minutes from meetings from the CVEEN committees where the assessment results were evaluated and where recommendations for action were made, will also be included.

CRITERION 5. CURRICULUM

A. Program Curriculum

The University operates on a semester basis. It has two fourteen-week semesters (i.e., fall and spring) and one eleven-week summer term.

Table 5-1 describes the curriculum plan for the CEP students. Flowcharts showing this same information and the recommended schedule are also presented. These are used in advising CEP students to help them optimize their program completion date. Table 5-1 also shows the maximum section enrollments for courses in the Program for the last two terms taught.

The CEP has only one path or track through the Program. However, most students complete the College of Engineering "Engineering Math Sequence," whereas transfer students may have completed a "Traditional Math Sequence." The former requires 12 semester hours of coursework, where the latter requires 15 semester hours. We have provided flow charts for both math sequences. Also, Table 5-1 has been completed and the total Math & Basic Sciences credit summed using the "Engineering Math Sequence" because it gave the least amount of Math & Basic Sciences credits that a student could take.

1. Describe how the curriculum aligns with the program educational objectives (PEOs).

Table 5-2 describes the relationship between the PEOs and the CEP curriculum. The primary courses that address each PEO are presented in this table.

The CEP curriculum and its sequencing for the freshman and sophomore years are highly structured, emphasizing engineering science, mechanics, and other fundamentals (e.g., economics, computing tools, and communication). These foundational courses prepare the students for core CEP courses that occur in the junior and senior years. Courses shared by the CEP with civil engineer graduates are CVEEN 3210 (Structural Loads & Analysis), CVEEN 3310 and CVEEN 3315 (Geotechnical Engineering and Lab), CVEEN 3510 and 3515 (Civil Engineering Materials and Lab), CVEEN 3520 (Transporation Engineering), and CVEEN 4221 (Concrete Design I). The faculty deemed these civil courses to be most beneficial to practicing construction engineers. The remaining 3000, 4000, and 5000-level courses all focus on topics important to construction engineers. These are CVEEN 3700 (Principles of Construction Engineering), CVEEN 3710 (Contract Specifications), CVEEN 5720 (Project Scheduling), CVEEN 5740 (Horizontal Construction), CVEEN 5780 (Façade Engineering), CVEEN 5790 (Vertical Construction); CVEEN 4920 (Capstone Design). In addition, other technical electives can be taken in topics such as cost estimation, proposal writing, project and contract management, engineering law and contracts, and other civil design courses,

2. Describe how the curriculum and its associated prerequisite structure support the attainment of the student outcomes.

   See Table 5-3. See also Table 5-1 for specific requirements and the required number of semester hours.

3. Attach a flowchart or worksheet that illustrates the prerequisite structure of the Program's required courses.

   The flowcharts included in this section show the prerequisite structure of the CEP. Table 5-4 also gives more details about this structure.

4. Describe how the Program meets the requirements in terms of hours and depth of study for each subject area (Math and Basic Sciences, Engineering Topics) specifically addressed by either the general criteria or the program criteria.

   See Table 5-1 for the general criteria. The program criteria requirements are discussed in the PROGRAM CRITERIA section of this report.

5. Describe the broad education component and how it complements the technical content of the curriculum and how it is consistent with the program educational objectives.

   The CEP curriculum for the freshman and sophomore year is similar to that of a civil engineering curriculum which emphasis engineering mechanics, economics, computing tools, and communication. These are foundational courses for the training of future graduates in the practice of construction engineering or a related field or for pursuing advanced knowledge through post-graduate study and research.

   The CEP curriculum incorporates the science and practice of engineering through an integrated curriculum that mixes theory with practice. Engineering students need to plan, analyze, design, construct, and operate engineered systems. These activities require creative thinking, theoretical and practical knowledge, problem-solving, self-confidence, teamwork, professional ethics, and social responsibility.

   Theoretical knowledge is the <u>science</u> of engineering and permits one to explore the reasonableness of assumptions and to generalize or extrapolate ideas to new situations with greater confidence. This knowledge is obtained from the principles of mathematics, physics, mechanics, dynamics, chemistry, geology, etc., and is used to explain the fundamental behavior of engineered systems. However, theoretical knowledge is not sufficient to practice engineering. Applied learning, or <u>engineering judgment</u>, is also needed. A skilled engineer must develop a sense of proportion and reasonableness of his or her design based on precedent and available construction techniques. Thus, a contemporary engineer must know modern materials, equipment, and construction practices to be successful.

6. Describe the major design experience that prepares students for engineering practice. Describe how this experience is based upon the knowledge and skills acquired in earlier coursework and incorporates appropriate engineering standards and multiple design constraints.

   The major design experience is CVEEN 4920 Capstone Design and is described below.

   Course Description
   Culminating open-ended design project involving writing, project scheduling, cost estimating, preparation of construction-related documents, and review of as-built engineering plans.

   Prerequisites
   CVEEN 3100, CVEEN 3700, CVEEN 4221, CVEEN 5720 AND one additional Design Technical Elective course completed AND Full Major Status in Construction Engineering AND Senior Standing within the Civil and Environmental Engineering Department.

   Objectives
   Students need to learn to tackle complex, real-world problems, which have more than one possible solution. This capstone course is designed to give students this experience.

   Instructor's Credentials
   The instructor, Steven Peterson, has been a licensed Professional Engineer (174368-2202) in Utah since August 1995.

   The instructor's credentials meet the requirement that "the majority of faculty teaching courses that are primarily design in content are qualified to teach the subject matter by virtue of professional licensure…).

   Instructor's Role
   For most of the project, the instructor will assume the role of the contractor's manager responsible for responding to RFQs, with the teams reporting to the manager. For the technical proposal, proposal presentation, and price proposal, the instructor will assume the role of the owner's personnel responsible for scoring the proposals.

   Capstone Project
   The students will be divided into teams of three to four students. The teams will respond to a two-phase, best-value, design-build proposal to design and construct a hypothetical precast concrete parking structure at a park-and-ride. In the first phase, the teams will respond to a Request for Qualifications (RFQ). In the second phase, the teams will respond to a Request for Proposals (RFP). Finally, the teams will prepare the construction documents needed for the garage's construction.

"Basic concepts in construction project management include … project delivery systems (e.g., … design-build …). Incorporating the response to a design-build proposal into the project measures the students' understanding of construction project management. Working as a group on the project allows measurement of the students' "… 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" (Student Outcome 5).

Statement of Qualifications (SOQ)

The SOQ consists of a letter of introduction and team members' resumes. The letter and resume are written to the non-construction and non-engineering professional.
This deliverable measures the students' ability "to communicate effectively with a range of audiences" (Student Outcome 3).

At this point, the owner selects three to five contractors to submit proposals. All teams will move on to the proposal phase.

Work Breakdown Structure (WBS)

Each team will prepare a WBS, a hierarchical list of all deliverables needed to complete the project's design and construction. Teams will use the WBS as an outline for preparing the estimate and schedule.

"Engineering design problems are generally ill-defined. As part of their design experience, students should have an opportunity to define a problem, to include determining the problem scope and design objectives"). This deliverable measures the students' ability to define the scope of the design problem.

Code Review

Each team will identify the 2018 International Building Code sections that need to be incorporated into the project's design.

This deliverable measures the students' engineering design abilities. "Engineering design is a process of devising a system, component, or process to meet desired needs and specifications within constraints. … For illustrative purposes only, examples of possible constraints include … codes …". Engineering standards and realistic constraints are critical in construction engineering design. … In construction engineering, the most common types of standards are codes and regulations.". Given that students have not taken a course in codes, this deliverable will measure the students' "ability to acquire and apply new knowledge as needed, using appropriate learning strategies" (Student Outcome 7)

Preliminary Design

Each team will prepare several preliminary designs that explore alternative designs for the project. The teams will evaluate the designs based on average travel time and cost. Each team will select one of their preliminary design to pursue.

This deliverable measures the students' ability to perform a cost analysis. ABET requires that the "The Program must prepare graduates to … analyze and design construction processes and systems in a construction engineering specialty field applying knowledge of … cost analysis; …).

Proposed Design
Each team will prepare a design for the parking garage that is 30 to 50 percent complete, including floor plans, footing plan, sections, exterior elevations, site plan, and outline specifications.

This deliverable measures the students' "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" (see Student Outcome 2). "Engineering design is a process of devising a system, component, or process to meet desired needs and specifications within constraints. … For illustrative purposes only, examples of possible constraints include accessibility, aesthetics, codes …).

This deliverable also gives students experience with "Engineering design problems are generally open-ended. They have no single correct answer, but rather a range of possible solutions".

Proposed Design Review
After submitting the proposed design, the teams will meet with the instructor (via Zoom) and go over their submissions. The instructor, acting as their manager, will identify the required design changes, including changes needed to meet the RFP requirements, building codes, or aesthetic reasons.

Proposed Design Revisions
The teams will resubmit the proposed design, incorporating the required changes.
The Preliminary Design, Proposed Design, and Proposed Design Revision deliverables allow students to "experience some iterative design in the curriculum."

Estimate
Each team will prepare an estimate for its proposed design.
This deliverable measures the students' understanding of construction project management. "Basic concepts in construction project management include … estimating construction costs …".

Schedule
Each team will prepare a schedule for the proposed design.
"The program must prepare graduates to … analyze and design construction processes and systems in a construction engineering specialty field applying knowledge of … planning, scheduling …". This deliverable measures the students' understanding of construction project management. "Basic concepts in construction project management include … planning, scheduling …".

Project Staging Plan
Each team will prepare a staging plan showing how they plan to coordinate site activities. *"[E]ngineering design includes design of systems and processes. In construction, the construction engineer is involved in the design of the construction process and the design of systems (for example, safety systems) for execution of that process. Just as costs, specifications, materials, and coordination are part of the appropriate experience of the traditional design engineer for the facility, they are also part of the appropriate experience of the construction engineer"*. This deliverable measures the students' abilities to coordinate onsite construction activities."

Technical proposal
Each team will submit a technical proposal to the owners in response to the RFP. The technical proposal is written to the non-construction professional. The technical proposal addresses the design, sustainability, schedule, construction risk, and quality control. This deliverable measures the students' "ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics" (see Student Outcome 1).

This deliverable measures the students' ability "to communicate effectively with a range of audiences" (see Student Outcome 3).

This deliverable's inclusion of sustainability measures the students' "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" (see Student Outcome 4).

This deliverable's inclusion of quaintly control measures the students' "ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions" (see Student Outcome 6). "In a construction engineering context, this level of achievement can be demonstrated through laboratory experiences that are consistent with the standards-based testing used in the construction engineering profession. For example, a program might require students to develop a quality control testing program for some aspect of a construction project, through the selection and application of appropriate published standards. Thus, for example, the program might involve determining the type and frequency of ASTM tests to be performed on fresh and hardened concrete during the construction of a building or highway").

Proposal Presentation
The teams will present their proposals to the project's owner (the instructor) via Zoom. This deliverable measures the students' ability "to communicate effectively with a range of audiences" (Student Outcome 3).

Price Proposal
Each team will submit a separate price proposal.

At this point, the owner scores the technical proposal and presentation. After the technical proposal and presentation are scored, the price is incorporated into the score. The contractor with the highest score is selected as the design-build contractor for the project. All teams will move on to the construction phase.

Project Buyout
The project buyout includes issuing purchase orders and subcontracts for a portion of the work.

"The program must prepare graduates to … explain basic legal and ethical concepts … in the construction industry…"). This deliverable measures the students' ability to apply the basic legal concepts to a construction project.

Shop drawings
Each team should review and make corrections to the rebar or precast concrete shop drawings.

The course description includes a "review of as-build engineering plans." This deliverable gives students experience reviewing drawings prepared by the contractor.

Precast Concrete Placement Plan
Each team should prepare a placement plan for the precast concrete members showing the order in which the members will be placed, locations of the crane used for placement, and the crane's requirements (for example, capacity, boom length, and so forth). ″[E]ngineering design includes design of systems and processes. In construction, the construction engineer is involved in the design of the construction process and the design of systems (for example, safety systems) for execution of that process. Just as costs, specifications, materials, and coordination are part of the appropriate experience of the traditional design engineer for the facility, they are also part of the appropriate experience of the construction engineer"). "Engineering design does not necessarily involve the devising of a complete system. The design of a … subsystem (e.g., equipment mix needed for an earthmoving activity) constitutes an acceptable design experience". This deliverable measures the students' abilities to coordinate the erection of the precast parking structure and design a subsystem (e.g., select an appropriate crane for the erection of the precast concrete).

7. If the Program allows cooperative education to satisfy curricular requirements specifically addressed by either the general or Program criteria, describe the academic component of this experience and how it is evaluated by the faculty.
   The CEP of CVEEN does not have a cooperative education component.

8. Describe the materials that will be available for review during and/or prior to the visit to demonstrate achievement related to this criterion. (See 2021-2022 APPM Section I.E.5.b.(2))

The syllabi in Appendix A from our core CEP classes contain information about what is covered in each core class and identifies which student outcomes are covered in them. Representative student work products from CVEEN 4920 Capstone Design will be available for the evaluation team. Furthermore, representative work for each course used to assess the achievement of student outcomes will also be available for review.

B. Course Syllabi

Appendix A contains syllabi for each course required in the CVEEN program, as well as those used for to fulfil the technical electives in our program.
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Table 5-1 Curriculum

Construction Engineering Program

Course (Department, Number, Title) List all courses in the Program by term starting with the first term of the first year and ending with the last term of the final year.	Indicate whether course is Required, Elective or a Selected Elective by an R, an E or an SE.[1]	Subject Area (Credit Hours) Math & Basic Sciences	Engineering Topics; Check if Contains Significant Design (√)	Other	Last Two Terms the Course was Offered: Year and, Semester, or Quarter	Maximum Section Enrollment for the Last Two Terms the Course was Offered[2]
CVEEN 1000, Intro to Civil and Environmental Engineering	R		2		Fall 2020 Fall 2019	Lecture: 92 Lecture: 96
CHEM 1210, General Chemistry I	R	4			Spring 2021 Fall 2020	Lecture: n/a Discussion: 300 Lecture: 1042 Discussion: 69
CHEM 1215, General Chemistry I Lab	R	1			Spring 2021 Fall 2020	Lecture: 460 Lab: 20 Lecture: 360 Lab: 20
Engineering Math Sequence						
MATH 1310, Engineering Calculus I	R	4			Spring 2021 Fall 2020	Lecture: 70 Discussion: 35 Lecture: 143 Discussion: 40
MATH 1320, Engineering Calculus II	R	4			Spring 2021 Fall 2020	Lecture: 110 Lab: 30 Lecture: 60

						Lab: 36
MATH 2250, Diff Equations & Linear Algebra	R	4			Spring 2021 Fall 2020	Lecture: 112 Lab: 35 Lecture: 140 Lab: 45
Traditional Math Sequence (Alternative to Engineering Sequence)						
MATH 1210, Calculus I	SE				Spring 2021 Fall 2020	Lecture: 175 Lab: 35 Lecture: 141 Discussion: 35
MATH 1220, Calculus II	SE				Spring 2021 Fall 2020	Lecture: 180 Lecture: 165
MATH 2210, Calculus III	SE				Spring 2021 Fall 2020	Lecture: 110 Lecture: 110
MATH 2250, Diff. Equations & Linear Algebra	SE				Spring 2021 Fall 2020	Lecture: 112 Lab: 35 Lecture: 140 Lab: 45
WRTG 2010, Intermediate Writing: Academic Writing and Research	R			3	Spring 2021 Fall 2020	
PHYS 2210, Physics for Scientists and Engineers I	R	4			Spring 2021 Fall 2020	Lecture: 202 Discussion: 50 Lecture: 206 Discussion: 51
*CHEM 1220, General Chemistry II or PHYS 2220	R	4			Spring 2021 Fall 2020	Lecture: n/a Discussion: 250 Lecture: 207 Discussion: 69
*PHYS 2215, Physics I Lab or PHYS 2225 or CHEM 1225 Lab	R	1			Spring 2021 Fall 2020	Lecture: n/a Discussion: 250; Lecture: 207

						Discussion: 69 Lab: 26 Lab: 24; Lecture: 500 Lab: 20 Lecture: 280 Lab: 20
CVEEN 1400, Computer-Aided Design	R		3		Spring 2021, spring 2020	46, 45
CVEEN 2010, Statics	R		3		spring 2021, spring 2020	50, 40
CVEEN 2000, Sophomore Seminar	R		.5		Fall 2020, fall 2019	55, 55
CVEEN 2300, Engineering Economics	R		2		spring 2021, fall 2020	50, 42
ECON 2010 Principles of Microeconomics	R			3	N/A	N/A
CVEEN 2310, Probability & Statistics	R	3			spring 2021, fall 2020	50, 40
MG EN 2400, Surveying or CVEEN 2410 Geomatics	R		3		N/A	N/A
ARCH 1615, Intro. to Architecture (FF)	R			3	N/A	N/A
GEO 1100 Evolving Earth	R	3			N/A	N/A
CVEEN 2140, Strength of Materials	R		3		fall 2020, spring 2021	30, 50
CVEEN 2750, Computer Tools	R		2		Spring 2021, spring 2020	60, 45
CVEEN 3100, Technical Communication	R			3	fall 2020, spring 2021	40, 40
CVEEN 3210, Structural Analysis I	R		3		fall 2020, spring 2021	40, 50
CVEEN 3310, Geotechnical Engineering I	R		3		Fall 2020, spring 2021	45, 40

CVEEN 3315, Geotechnical I Lab	R		1		Fall 2020, spring 2021	10, 10
CVEEN 3510, Materials	R		3		Spring 2021, fall 2020	36, 36
CVEEN 3515, Material Lab	R		1		Spring 2021, fall 2020	12, 12
CVEEN 3520, Transportation Engineering I	R		3		Spring 2021, fall 2020	50, 45
CVEEN 3700, Principles of Construction Engineering	R		3		Fall 2020, Fall 2019	15,20
CVEEN 3710, Contract Specifications	R		3		Spring 2021, fall 2020	12, 10
CVEEN 4221, Concrete I	R		3 (√)		Fall 2020, fall 2019	35, 65
CVEEN 5720, Project Scheduling	R		3		Fall 2020, fall 2019	20, 20
CVEEN 5740, Horizontal Construction	R		3		N/A, Spring 2021	--,22
CVEEN 4920 Design Capstone	R		3		N/A, Spring 2021	--,6
CVEEN 5780, Façade Engineering I	R		3		N/A, Spring 2021	--,12
CVEEN 5790, Vertical Construction	R		3		NA	NA
*Design Technical Elective (take one of the following)	SE		3 (√)			
*CVEEN 5510, Highway Design	SE				Spring 2021, spring 2020	30, 39
*CVEEN 5305, Intro to Foundations	SE				Fall 2020, fall 2019	18, 55
** Primary Technical Elective (take one of the following)	SE		3			

**CVEEN 5710, Cost Estimation and Proposal Writing	SE				Fall 2020, fall 2018	10, 25
**CVEEN 5730, Project Management and Contract Administration	SE				Spring 2021, spring 2020	21, 28
**CVEEN 5750, Engineering Law and Contracts	SE				Summer 2020, summer 2018	30, 18
*** Other Technical Electives (take 1 of following or complete additional Design or Primary Technical Elective)	SE		3		See Below	See Below
***CVEEN 4222, Steel I	SE				Spring 2021, spring 2020	40, 40
***CVEEN 5240, Masonry/Timber Design	SE				Fall 2020, fall 2019	28, 35
***CVEEN 5500, Sustainable Materials	SE				Spring 2021, spring 2020	30, 25
*** ARCH 6371, Innovative Materials and Construction	SE				N/A	N/A
*** Any 3000+ Level from ABET Program	SE				N/A	N/A
General Education						
General Ed Requirement	SE			3	N/A	N/A
General Ed Requirement	SE			3	N/A	N/A
Intellectual Exploration/DV	SE			3	N/A	N/A
Intellectual Exploration/IR	SE			3	N/A	N/A
American Institutions	SE			3	N/A	N/A
Add rows as needed to show all courses in the curriculum.						
TOTALS (in terms of semester credit hours)		32	65.5	27		

OVERALL TOTAL CREDIT HOURS FOR COMPLETION OF THE PROGRAM		124.5					
Percent of Total			25.7%	52.6%	21.7%		
Total must satisfy minimum credit hours	Minimum Semester Credit Hours		30 Hours	45 Hours			
	Minimum Percentage		23.7%	35.6%			

1. **Required** courses are required of all students in the Program, **Elective** courses (often referred to as open or free electives) are optional for students, and **Selected Elective** courses are those for which students must take one or more courses from a specified group.
2. For courses that include multiple elements (lecture, laboratory, recitation, etc.), indicate the maximum enrollment in each element. For Selected Elective courses, indicate the maximum enrollment for each option.

Table 5-2 Relation between PEOs and CEP Curriculum

Program Educational Objectives	CEP Courses Supporting Program Educational Objectives
1) CVEEN Construction Engineering graduates will be engaged in the practice of construction engineering or a related field or will be pursuing advanced knowledge through post-graduate study and research.	Every course in the CEP curriculum (Table 5.1, Figure 5-1) is designed to prepare our students to engage in construction engineering or a related field or pursue post-graduate research. Therefore, all CVEEN designated courses focus on knowledge or skills required to become practicing engineering. Also, because general education mathematics, science, and communications courses are required, students are prepared to pursue related fields or post-graduate study, if desired, because of their general academic preparation. The CEP curriculum for the freshman and sophomore year is similar to that of a civil engineering curriculum which emphasis engineering mechanics, economics, computing tools, and communication. In the junior and senior year, CEP students are required to take CVEEN 3210 (Structural Loads & Analysis), CVEEN 3310 (Geotechnical Engineering), CVEEN 3510 (Civil Engineering Materials), CVEEN 3520 (Transporation Engineering), and CVEEN 4221 (Concrete Design I). The faculty deemed these civil courses to be most beneficial to practicing construction engineers. The remaining 3000, 4000, and 5000-level courses all focus on topics important to construction engineers. These are CVEEN 3700 (Principles of Construction Engineering), CVEEN 3710 (Contract Specifications), CVEEN 5720 (Project Scheduling), CVEEN 5740 (Horizontal Construction), CVEEN 5780 (Façade Engineering), CVEEN 5790 (Vertical Construction); CVEEN 4920 (Capstone Design). In addition, other technical electives can be taken in topics such as cost estimation, proposal writing, project and contract management, engineering law and contracts, and other civil design courses.
2) CVEEN Construction Engineering graduates will be entering professional practice and on a path towards professional licensure when appropriate. They will be collaborating on diverse project teams	The curriculum that most directly supports this PEO is: *Professional Practice:* (see description for PEO 1 above) *Professional Licensure:* CVEEN 1000 (Intro.), CVEEN 2000 (Seminar), CVEEN 4920 (Capstone Design) *Teams and Leadership:* all CVEEN lab courses require working in teams and taking turns assuming leadership roles,

applying engineering, communication, and management skills and utilizing their accumulated education and experience to address complex societal issues for the community's broader good.	CVEEN 3100 (Technical Communication) and CVEEN 4920 (Capstone Design) also focus on teamwork and developing team deliverables. *Communication:* Communications skills are learned in WRTG 2010 (Intermediate Writing), CVEEN 1400 (CADD), CVEEN 3100 (Technical Writing), CVEEN 4920 (Capstone Design) *Management Skills;* CVEEN 3100 (Technical Communications), CVEEN 4920 (Capstone Design), CVEEN 3710 (Contract Specifications), CVEEN 5720 (Project Scheduling), CVEEN 5710 (Cost Estimation and Proposal Writing), CVEEN 5720 (Project Management & Contract Administration), CVEEN 5750 (Engineering Law & Contracts). *Betterment of Society by Solving Complex Societal Issues:* CVEEN 4920 (Capstone Design), and all 4000 and 5000 technical elective courses.
3) CVEEN Construction Engineering graduates will be ascending into leadership roles by advocating for their profession, being active in professional organizations, seeking professional development opportunities, and participating in their profession's betterment by applying ethical engineering practices.	*Leadership Role:* (see *Teams* and *Leadership* and *Management Skill*s in PEO 2 above). *Professional Development:* CVEEN 1400 (CAD), CVEEN 2140 (Statics), CVEEN 2140 (Strength of Materials), CVEEN 2300 (Econ), ECON 2010 (Microeconomics), CVEEN 2310 (Prob & Statistics), CVEEN 2750 (Comp. Tools), CVEEN 4920 (Capstone Design), *Betterment of Profession:* CVEEN 1000 (Intro.), CVEEN 2000 (Seminar), CVEEN 4920 (Capstone Design).

Table 5-3 Relation between SOs and CEP Curriculum

Student Outcome	Supporting Curriculum
SO1. an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics	*Science* CHEM 1210, 1215, 1220, 1225; PHYS 2210, 2215, 2220, 2225 GEO 1110 (Evolving Earth) *Mathematics* Math 1310, 1320, 2250 OR Math 1210, 1220, 2210, 2250, CVEEN 2310 (Probability and Statistics) *Engineering Problem Solving* CVEEN 2010 (Statics) MG EN 2400 (Surveying) CVEEN 2300 (Engineering Economics) CVEEN 2750 (Computer Tools) CVEEN 3210 (Structural Analysis) CVEEN 3310 (Geotechnical Engineering) CVEEN 3510 (Materials) CVEEN 3520 (Transportation Engineering) CVEEN 4221 (Concrete Design) CVEEN 5740 (Horizontal Construction) CVEEN 4920 (Capstone Design) CVEEN 5780 (Façade I) CVEEN 5790 (Vertical Construction)
SO2. 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	*Required Design Courses* CVEEN 1000 (Intro. to CvEEN Engr.) CVEEB 3700 (Principles of Const. Engr.) CVEEN 4221 (Concrete Design) CVEEN 5510 (Highway Design) CVEEN 5305 (Foundation Design) CVEEN 4920 (Capstone Design) *Other Optional Design Course* CVEEN 4222 (Steel 1) CVEEN 5240 (Reinforced Timber/Masonry)
SO3. an ability to communicate effectively with a range of audiences	*Writing* WRTG 2010 (Intermediate Writing) *Writing and Oral Presentation* CVEEN 3100 (Technical Communication) CVEEN 4920 (Capstone Design)

	Graphical Communication CVEEN 1400 (CADD) CVEEN 2750 (Computer Tools)
SO4. 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	*Ethical and Professional Responsibilities* CVEEN 1000 (Intro. to CvEEN Engr.) CVEEN 2000 (Engr. Seminar) CVEEN 2300 (Engr. Economics) CVEEN 5740 (Horz. Construction) CVEEN 5780 (Façade Engr.) CVEEN 5790 (Vertical Construction) CVEEN 4920 (Capstone Design) *Other Optional Courses* CVEEN 5730 Prog. Mngt. & Contract Admin. CVEEN 5750 (Engr. Law & Contracts)
SO5. 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	*Teams and Leadership* CVEEN 1000 (Intro. to CvEEN Engr.) CVEEN 3100 (Technical Communication) CVEEN 4920 (Capstone Design)
SO6. an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions	*Experiments and Data Evaluations* CVEEN 3515 (Materials Engr. Lab) CVEEN 3315 (Geotech. Engr. Lab) CVEEN 4920 (Capstone Design)
SO7. an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.	CVEEN 5740 (Horz. Construction) CVEEN 5780 (Façade Engr.) CVEEN 5790 (Vertical Construction)

Table 5-4 Prerequisite Structure of CEP

Course	Name	Prerequisites
CVEEN 1000	Intro to Civil and Enviro Eng.	none
CHEM 1210	General Chemistry I	MATH(1050 OR 1080 OR 1210 OR 1220 OR 1250 OR 1260 OR 1310 OR 1320 OR 1311 OR 1321 OR 2250)
CHEM 1215	General Chemistry I LAB	Corequisites: (CHEM 1210 OR CHEM 1211) OR AP Chem score of at least 4.
CHEM 1220	General Chemistry II	CHEM 1210 OR CHEM 1211) OR AP Chem score of at least 4.
CHEM 1225	General Chemistry II LAB	CHEM 1070 OR CHEM 1215 OR CHEM 1240). Corequisites: C- or better in (CHEM 1220 OR CHEM 1221) OR AP Chemistry score of at least 5.
MATH 1310	Engineering Calculus I	MATH 1050 AND 1060) OR MATH 1080 OR (MATH 1060 AND (Accuplacer AAF score of 263+ OR Accuplacer CLM score of 80+ OR IB Standard Level Math score of 5+))) OR AP Calc AB score of 3+ OR Accuplacer AAF score of 276+ OR Accuplacer CLM score of 90+ OR ACT Math score of 28+ OR SAT Math score of 650+ OR Department Consent.
MATH 1320	Engineering Calculus II	MATH 1310 OR MATH 1311) OR AP Calc BC score of 3 or better OR Department Consent.
MATH 2250	Diff. Eqs. & Linear Algebra	MATH 2210 OR MATH 1260 OR MATH 1280 OR MATH 1321 OR MATH 1320 OR ((MATH 1220 OR MATH 1250 OR MATH 1270 OR MATH 1311 OR AP Calculus BC score of 5) AND PHYS 2210 OR PHYS 3210))
MATH 1210	Calculus I	MATH 1050 AND 1060) OR (MATH 1060 AND (AccuplacerAAF 263+ OR AccuplacerCLM 80+ OR IB Math 5+)) OR (MATH 1080 OR 1210 OR 1310) OR AP CalcAB 3+ OR AccuplacerAAF 276+ OR AccuplacerCLM 90+ OR ACT Math 28+ OR SAT Math 650+.
MATH 1220	Calculus II	MATH 1210 OR MATH 1250 OR MATH 1270 OR MATH 1311 OR MATH 1310) OR AP Calculus AB score of at least 4 OR AP Calculus BC score of at least 3 or IB Higher Level Math score of at least 5.

MATH	2210	Calculus III	MATH 1220 OR MATH 1250 OR MATH 1320) OR AP Calculus BC score of at least 4.
WTRG	2010	Intermediate Writing	WRTG 1010 OR WRTG 1009 OR EAS 1060 OR a WR1) OR (score of at least 3 in (AP Lang/Comp OR AP LIt/Comp OR AP Comp/Read)) OR Writing Placement score of at least 2 OR Wrtg Placement Essay score of at least 3.
PHYS	2210	Physics for Scientists and Engineers I	MATH 1210 OR MATH 1250 OR MATH 1310 OR MATH 1311 OR MATH 1220 OR MATH 1320) OR AP Calc AB score of 4+ OR AP Calc BC score of 3+
PHYS	2215	Physics I Lab	PHYS 2210 OR PHYS 3210) OR AP Physics C Mech score of 4+.
PHYS	2220	General Physics for Scientists and Engineers II	HYS 2010 OR PHYS 2210 OR PHYS 3210) OR AP Physics 1 score of 4+ OR AP Physics C Mech score of 4+.
PHYS	2225	General Physics II Lab	PHYS 2215. Corequisites: C- or better in (PHYS 2220 OR PHYS 3220) OR AP Physics C E &M score of 4+.
CVEEN	1400	Computer-Aided Design	none
CVEEN	2010	Statics	MATH 1210 or MATH 1310 or MATH 1311, PHYS 2210 (Co.), Major Status
CVEEN	2000	Soph. Seminar	none
CVEEN	2300	Engineering Economics	Major Status
ECON	2010	Microeconomics	none
CVEEN	2130	Probability & Statistics	MATH 1210 or MATH 1310 or MATH 1311, Major Status
MG EN	2400	Introductory Surveying	MATH 1060 OR MATH 1080 OR MATH 1210 OR MATH 1220 OR MATH 1310 OR MATH 1320.
CVEEN	2410	Geomatics	none
ARCH	1615	Intro. to Architecture	none
GEO	1100	Evolving Earth	MATH 1210 AND CHEM 1210
CVEEN	2140	Strength of Materials	CVEEN 2010, Major Status
CVEEN	2750	Computer Tools	MATH 1210 or MATH 1310 or MATH 1311
CVEEN	3100	Tech. Communications	WRTG 2010 or ESL 1060, Major Status
CVEEN	3210	Structural Analysis I	CVEEN 2140, Major Status
CVEEN	3310	Geotechnical Engineering, I	CVEEN 2140, CVEEN 2310, CVEEN 3310 AND Major Status
CVEEN	3315	Geotechnical Engineering I Lab	CVEEN 2140 AND (CVEEN 2310 OR CVEEN 2130 OR ME EN 2550)) AND Major status. Corequisites: CVEEN 3310.

CVEEN	3510	Civil Engineering Materials	CVEEN 2140, CVEEN 2310, CVEEN 3515 (Co.), AND Major Status
CVEEN	3515	Materials Lab	CVEEN 2140 AND (CVEEN 2310 OR CVEEN 2130 OR ME EN 2550)) AND Major status. Corequisites: CVEEN 3515.
CVEEN	3520	Transportation Engineering	CVEEN 2140, CVEEN 2310, Major Status
CVEEN	3700	Principles of Construction Engineering	CVEEN 2750 AND Major Status
CVEEN	3710	Contract Specifications	Major Status
CVEEN	4221	Concrete Design I	CVEEN 3210, Major Status
CVEEN	5720	Project Scheduling	CVEEN 3100, Major Status
CVEEN	5740	Horizontal Construction	CVEEN 3310 AND CVEEN 3315) AND MAJOR STATUS
CVEEN	4920	Capstone Design	CVEEN 3100, CVEEN 3700, CVEEN 4221, CVEEN 5720 AND one additional Design Technical Elective course completed AND Full Major Status.
CVEEN	5780	Façade Engineering I	CVEEN 3210, Major Status
CVEEN	5790	Vertical Construction	CVEEN 3210, Major Status
CVEEN	5510	Highway Design	CVEEN 3520, Major Status
CVEEN	5305	Intro. To Foundation Eng.	CVEEN 3310, CVEEN 3315, Major Status
CVEEN	5710	Cost Est./Proposal Writing	CVEEN 3100, Major Status
CVEEN	5730	Proj. Mang./Contract Admin.	CVEEN 3100, Major Status
CVEEN	5750	Eng. Law	CVEEN 3100, Major Status
CVEEN	4222	Steel Design I	CVEEN 3210, Major Status
CVEEN	5240	Masonry/Timber Design	CVEEN 3210, Major Status
CVEEN	5500	Sustainable Materials	CVEEN 3510, CVEEN 3515, Major Status
ARCH	6371	Innovative Materials	none

Major Status

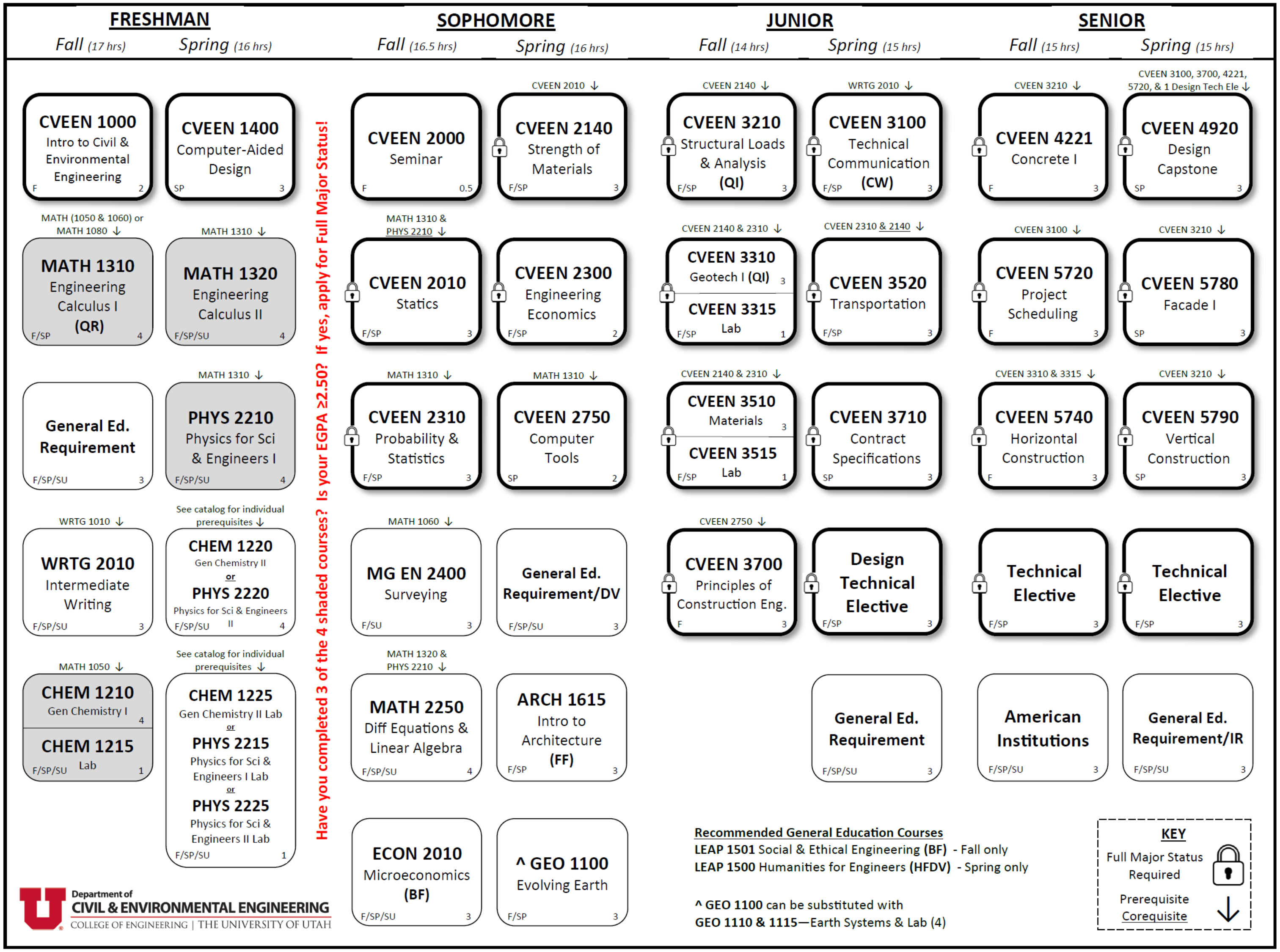
The Department utilizes the Degree Audit Report (DARS) system to ensure that students have cleared all Bachelor of Science in Construction Engineering requirements. This procedure is also used for the Dual Degree Program. Upon applying for graduation, the system runs a report on each student's DARS to confirm they have met every requirement in their degree program.

Other pre-engineering students can apply for major status for those students who did not qualify for direction admission (https://www.civil.utah.edu/major-status-form/). Successful completion (C or higher) of three of the following four courses:

MATH 1210 or 1310 - Calculus I
MATH 1220 or 1320 Calculus II
PHYS 2210 Physics for Scientists and Engineers I
CHEM 1210/1215 General Chemistry I and Lab

A grade of "C" or higher must be met for the following courses: •All Mathematics (MATH 1210/1310, 1220/1320, 2210, 2250) •All Chemistry (CHEM 1210, 1215, 1220, 1225) •All Physics (PHYS 2210, 2215, 2220, 2225)•CVEEN 2010, 2140, 2300, and 2310. For all CVEEN courses, a grade of "C-" or higher is required.

B.S. CONSTRUCTION ENGINEERING – ENGINEERING MATH 2020



Updated May 17, 2021

Total Required Credit Hours: 124.5

TECHNICAL ELECTIVE COURSES

Students must complete **three** technical elective courses.

To graduate with a Bachelor of Science Degree in Construction Engineering you must:

1. Complete at least **one** course from the Primary section.
2. Complete at least **one** Design course from the Secondary Section. These are designated by a **shaded box**. *Example: CVEEN 5510*

As long as these requirements are satisfied, you may take the remaining **one** technical elective from either section.

PRIMARY TECHNICAL ELECTIVES

CVEEN 3100 ↓
CVEEN 5710
Cost Estimation & Proposal Writing
F 20/22 3

CVEEN 3100 ↓
CVEEN 5730
Project Management & Contract Admin.
SP 20/22 3

CVEEN 3100 ↓
CVEEN 5750
Engineering Law & Contracts
SU 20/22 3

SECONDARY TECHNICAL ELECTIVES

Structures

CVEEN 3210 ↓
CVEEN 4222
Steel I
SP 3

CVEEN 3210 ↓
CVEEN 5240
Reinforced Timber/Masonry
F 4

Transportation

CVEEN 3520 & 2140 ↓
CVEEN 5510 (shaded)
Highway Design
SP 3

Geotech & Materials

CVEEN 3310 & 3315 ↓
CVEEN 5305 (shaded)
Introduction to Foundations
F 3

CVEEN 3510 & 3515 ↓
CVEEN 5500
Sustainable Materials
SP 3

Architecture

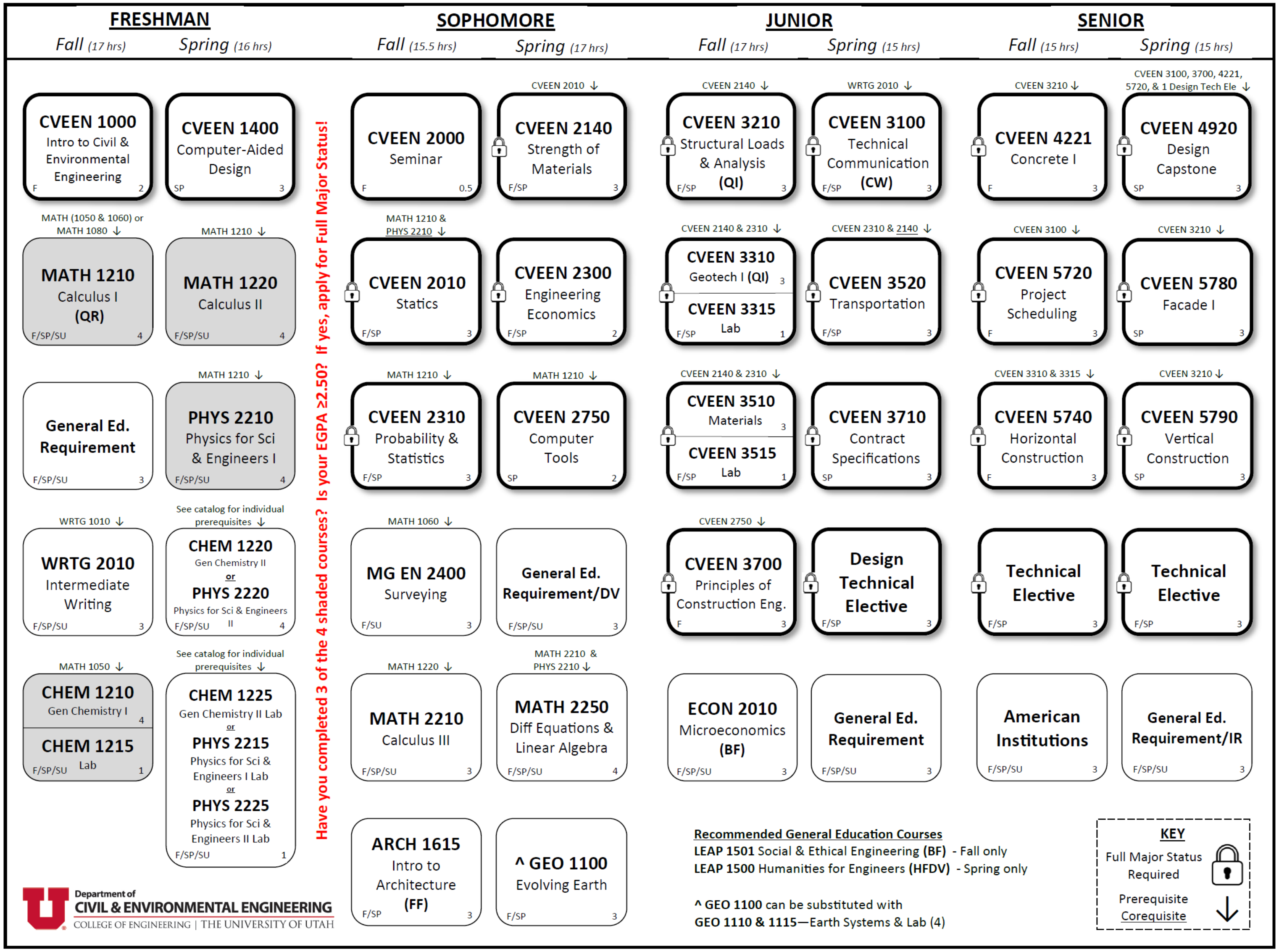
ARCH 6371
Intensive Materials & Construction
F 3

Other (Max 1)

Any 3000+ level course from the College of Engineering or an ABET accredited program
3+

Caveat: Semester availability is subject to change at the discretion of the department and does not create a binding contractual nexus or obligation between the student and the University of Utah

B.S. CONSTRUCTION ENGINEERING – TRADITIONAL MATH 2020



Updated May 17, 2021

Total Required Credit Hours: 127.5

TECHNICAL ELECTIVE COURSES

Students must complete **three** technical elective courses.

To graduate with a Bachelor of Science Degree in Construction Engineering you must:

1. Complete at least **one** course from the Primary section.
2. Complete at least **one** Design course from the Secondary Section. These are designated by a **shaded box**. *Example: CVEEN 5510*

As long as these requirements are satisfied, you may take the remaining **one** technical elective from either section.

PRIMARY TECHNICAL ELECTIVES

CVEEN 3100 ↓
CVEEN 5710
Cost Estimation & Proposal Writing
F 20/22 3

CVEEN 3100 ↓
CVEEN 5730
Project Management & Contract Admin.
SP 20/22 3

CVEEN 3100 ↓
CVEEN 5750
Engineering Law & Contracts
SU 20/22 3

SECONDARY TECHNICAL ELECTIVES

Structures

CVEEN 3210 ↓
CVEEN 4222
Steel I
SP 3

CVEEN 3210 ↓
CVEEN 5240
Reinforced Timber/Masonry
F 4

Transportation

CVEEN 3520 & 2140 ↓
CVEEN 5510 (shaded)
Highway Design
SP 3

Geotech & Materials

CVEEN 3310 & 3315 ↓
CVEEN 5305 (shaded)
Introduction to Foundations
F 3

CVEEN 3510 & 3515 ↓
CVEEN 5500
Sustainable Materials
SP 3

Architecture

ARCH 6371
Intensive Materials & Construction
F 3

Other (Max 1)

Any 3000+ level course from the College of Engineering or an ABET accredited program
3+

Caveat: Semester availability is subject to change at the discretion of the department and does not create a binding contractual nexus or obligation between the student and the University of Utah

CRITERION 6. FACULTY

A. Faculty Qualifications

Describe the qualifications of the faculty and how they are adequate to cover all the curricular areas of the Program and also meet any applicable program criteria. This description should include the composition, size, credentials, and experience of the faculty. Complete Table 6-1. Include faculty resumes in Appendix B.

The qualifications, workload, and professional development activities of the faculty are included in Tables 6-1, 6-2, and 6-3. Finally, 15 of the 29 CVEEN full-time faculty (1 UAC faculty) and one CVEEN part-time faculty have professional registrations (e.g., S.E. or P.E.). These faculty members have various levels of professional experience with consulting engineering firms, construction companies, public agencies, and industry. Only faculty with professional registrations teach courses that are designated to contain significant design content. Furthermore, lead instruction of the professional practice and design classes (4900/4910, 4920) is always conducted by a licensed professional engineer.

Currently, the Construction Engineering Program (CEP) in CVEEN is undergoing continued and moderate growth with the hiring of a new CEP faculty. During this ABET review cycle, two new full-time faculty have joined the CEP. These are Dr. Abbas Rashidi (https://faculty.utah.edu/u6013686-Abbas_Rashidi/research/index.hml) and Dr. Jianli Chen (https://faculty.utah.edu/u6031298-JIANLI_CHEN/teaching/index.hml). In addition to these, other CvEEN faculty offer courses that support the CEP and are primarily: Dr. Steven F. Bartlett, Dr. Pedro Romero, Dr. Chris Pantelides, and Dr. Xiaoyue Liu. Dr.Bartlett acts as the CEP ABET coordinator.

The competency and expertise of the entire CVEEN Departmental faculty constitute the core to the success of the Program (http://www.civil.utah.edu/faculty). CVEEN faculty are accomplished, dedicated instructors that teach and mentor undergraduate students. Their expertise encompasses a broad spectrum of civil engineering in structural engineering and mechanics, transportation, water resources and hydrology, environmental engineering, geotechnics, construction materials, methods and technologies, and engineering management. Table 6-1 summarizes CVEEN faculty qualifications.

In structural engineering and mechanics, the department has 7 core faculty: Drs. Babu, Ibarra, Jovanovic, Ou, Pantelides, Schmucker, and Zhou. These faculty provide expertise in structural analysis and design about steel and concrete structures, seismic design concerning critical facilities such as nuclear reactors, systems, and interim waste storage facilities, biomimetic structures, parallel supercomputing, and sensor networks. Adjunct Assistant Professor Dr. Johnson, S.E., provides expertise in masonry and timber design and is a principal engineer with Reaveley and Associates in Salt Lake City, Utah.

In transportation engineering and planning, the department has 3 core faculty: Drs. Liu, Markovic, and Yang. These faculty have expertise in transportation operations and planning, systems, and transit. Adjunct Lecturer, Scott Shea, P.E. provides expertise in highway design and is a senior traffic engineer at AECOM.

In water resource and environmental engineering, CVEEN has eigh core faculty: Drs. Barber, McPherson, Oroza, Pomeroy, Hong, Goel, Marron, and Weidhaas. The water resource faculty provide expertise in fluid mechanics, hydraulics, surface and groundwater hydrology, water management, sustainability, sensor networks, remote sensing, robotics, and machine learning. The environmental faculty provide expertise in wastewater treatment, bioremediation, tertiary treatment, soil and brownfield remediation, and environmental assessment.

In geotechnical engineering and construction materials, CVEEN has four core faculty and 1 faculty emeritus (who was teaching active during the 2020-2021 academic year): Drs. Bartlett, Lawton, Mohamadi, Romero, and Roshankhah. The geotechnical faculty have expertise in soil mechanics, geotechnical investigations, design, and construction of foundation systems, soil improvement, and seismic design. The materials faculty have expertise in material characterization (i.e., concrete and asphalt), evaluations, sustainable infrastructure, and design. Dr. Lawton was granted emeritus standing in spring semester 2021 and will not be teaching after that semester.

The department also houses a Construction Engineering program (Drs. Chen and Rashidi) and a Nuclear Engineering Program (Drs. Cazalas, Mastren, McDonald, and Sjoden).

B. Faculty Workload

Complete Table 6-2, Faculty Workload Summary, and describe this information in terms of workload expectations or requirements.

CVEEN full-time faculty members are expected to teach at least three 3-semester hour courses during an academic year (Table 6-2). In addition to teaching (45% of assignment), tenured and tenure-track faculty members conduct extramural funded research (45% of assignment) and provide service to the profession and community (10% of assignment). However, junior faculty members are typically assigned a lower teaching workload in the first two years of their career, and tenure or tenure track faculty may substitute additional research for one course per year.

Full-time lecturing faculty are expected to teach six 3-semester hour courses per academic year. The part-time and adjunct faculty contracts vary, but the teaching load is seldom above 2 courses per academic year.

C. Faculty Size

The CVEEN departmental faculty consists of 21 full-time equivalents (FTE) on the Salt Lake City Campus, two full-time FTE associated with the UAC one part-time faculty, two positions associated with the construction program, and four FTE positions associated with the NEUP (Table 6-1). In addition to these, CVEEN 3100 (Technical Communication) is currently taught by Dr. Joshua Lenart, who is an instructor in the COE CLEAR program. Also, there are other adjunct lecturers, professors, and instructors who instruct CVEEN undergraduate technical electives (i.e., non-required 4000- to 5000-level) courses on an as-needed basis. These are Dr. Jared Johnson (CVEEN 5240 – Timber and Masonry), Scott Shea (CVEEN 5510 – Highway Design), Steven Peterson (CVEEN 5710 –Cost Estimating and Proposal Writing), and Travis Davis (CVEEN 5730 – Project Management).

D. Professional Development

All faculty members are engaged in state, national and international professional service through technical committees, training of licensed engineers, and professional leadership roles. Many of the younger faculty members have participated in the ASCE ExCEEd program (http://www.asce.org/exceed/), which focuses on helping young faculty to become better teachers. Table 6-3 shows a tally of the professional development activities completed by the faculty during this review cycle. Additional discussion of CVEEN support for faculty development activities is provided in Section 8E.

E. Authority and Responsibility of Faculty

The academic program in civil engineering at the University of Utah is the responsibility of the members of the faculty of the Department of Civil and Environmental Engineering (U of U Policy 6-100) (http://regulations.utah.edu/academics/6-100.php) consistent with the mandate by the faculty senate approved program. On an annual basis, CVEEN faculty and staff conduct a review and evaluation of the existing undergraduate curriculum, resources, and goals of the program. Pedagogical advances, student ratings, exit interview comments, and technical changes in the profession are considered in this review and evaluation. The review and subsequent discussions in the annual fall semester Faculty Retreat lead to improvements in existing courses, greater horizontal and vertical integration of course content, the addition of new technical electives, and the evaluation of existing standards for progress and graduation.

Where course modification, creation, or deletion is desired, the faculty members submit a request to the Department’s Undergraduate Committee. Upon approval of the Undergraduate Committee, the potential changes are considered and approved or denied by faculty vote. When a new course is being created, or significant changes to the course are being considered, in that case, the CVEEN approval is forwarded by the chair with these endorsements to the College curriculum committee. This body considers the merits of the new listing or modifications and votes to approve/disapprove the new course or add changes. These actions are then forwarded to the faculty senate for final approval.

Table 6-1. Faculty Qualifications

Civil & Environmental Engineering and Construction Engineering BS

Faculty Name	Highest Degree Earned- Field and Year	Rank [1]	Type of Academic Appointment[2] T, TT, NTT	FT or PT[3]	Years of Experience			Professional Registration/ Certification	Level of Activity[4] H, M, or L		
					Govt./Ind. Practice	Teaching	This Institution		Professional Organizations	Professional Development	Consulting/summer work in industry
Babu, Roshina	Ph. D, Civil Eng., 2019	AST	NTT	FT	0	11	1		L	M	L
Barber, Michael Ernest	Ph.D., Civil Eng., 1992	P	T	FT	12	31	9	P.E.	H	L	L
Bartlett, Steven F (CVEEN & Construction)	Ph.D., Civil Eng., 1992	ASC	T	FT	17	22	22	P.E.	M	L	H
Cazalas, Edward	Ph. D., Nuclear Eng., 2015	AST	TT	FT	0	5	3		M	L	M
Chen, Jianli (Construction)	Ph. D., Building Construction, 2018	AST	TT	FT	2	1	1		L	L	L
Goel, Ramesh	Ph.D., Enviro. Eng., 2003	P	T	FT	7	22	16		H	L	L
Hong, P. K. Andy	Ph.D., Enviro. Eng., 1987	P	T	FT	8	35	35	P.E.	M	L	H
Ibarra, Luis Francisco	Ph.D., Civil Eng., 2004	ASC	T	FT	17	13	12	P.E.	M	M	L
Jovanovic, Nickolas	Ph. D., Engineering, 1998	P	NTT	FT	7	27	1	P.E.	M	M	M

Johnson, Jerod	Ph.D., Civil Eng., 2012	A	NTT	PT	28	16	16	P.E., S.E.	M	L	L
Lawton, Evert C	Ph.D., Civil Eng., 1986	P	T	FT	13	38	31	P.E.	M	L	M
Lenart, Josh	Ph.D., English, 2013	I	NTT	FT	0	15	14		L	L	L
Liu, Xiaoyue Cathy	Ph.D., Transportation Eng., 2013	AST	TT	FT	10	10	9	P.E.	H	M	L
Markovic, Nikola	Ph. D., Transportation Eng., 2013	AST	TT	FT	3	8	3		L	L	L
Marron, Emily	Ph.D., Civil Eng., 2020	AST	TT	FT	1	1	0		L	L	L
McDonald, Luther	Ph.D., Analy. And Radiochemistry, 2013	AST	TT	FT	13	9	8		H	M	L
McPherson, Brian James	Ph.D., Geophysics., 1996	P	T	FT	13	26	16		L	L	L
Mohamadi, Kami	Ph.D.,Civil Eng., 2015	AST	TT	FT	6	3	0	P.E.	M	M	L
Oroza, Carlos	Ph.D., Civil Eng., 2017	AST	TT	FT	3	8	3		M	M	L
Ou, Ge	Ph. D., Civil Eng., 2016	AST	TT	FT	0	12	5		M	L	L
Pantelides, Chris	Ph.D., Civil Eng., 1987	P	T	FT	9	34	31	P.E., S.E.	H	M	L
Peterson, Steven (Construction)	M.S., Civil Eng. 2018, MBA, 1999	A	NTT	PT	15	22	1	P.E.	H	M	M
Pomeroy, Christine	Ph.D., Civil Eng., 2007	ASC	NTT	FT	13	15	15	P.E.	M	L	L
Rashidi, Abbas (Construction)	Ph.D., Civil Eng., 2014	AST	TT	FT	5	13	4	C.P.C., P.E.	H	L	M
Romero, Pedro	Ph.D., Civil Eng., 1996	ASC	T	FT	13	22	22	P.E.	H	H	M
Roshankhah, Shahrzad	Ph.D., Civil Eng., 2015	AST	TT	FT	11	2	0	P.E.	M	M	L
Shea, Michael	M.S., Civil Eng, 2011	I	NTT	PT	7	4	3	P.E.	M	L	NA

Schmucker, Douglas	Ph.D., Structural Eng., 1996	P	NTT	FT	11	23	9	P.E.	M	M	M
Sjoden, Glenn	Ph. D., Nuclear Eng., 1997	P	T	FT	17	17	2	P.E.	L	L	L
Weidhaas, Jennifer	Ph. D., Civil Eng., 2006	ASC	T	FT	10	11	5	P.E.	M	L	L
Yang, Terry	Ph. D., Civil Eng., 2015	AST	TT	FT	0	6	4		M	L	L
Zhu, Xuan	Ph. D., Structural Eng., 2016	AST	TT	FT	0	5	3		M	L	L

Instructions: Complete table for each member of the faculty in the program. Add additional rows or use additional sheets if necessary. Updated information is to be provided at the time of the visit.

1. Code: P = Professor ASC = Associate Professor AST = Assistant Professor I = Instructor A = Adjunct O = Other
2. Code: T = Tenured TT = Tenure Track NTT = Non-Tenure Track
3. FT = Full-Time Faculty or PT = Part-Time Faculty
4. The level of activity (high, medium or low) should reflect an average over the three years prior to the visit.

Table 6-2. Faculty Workload Summary

Construction Engineering Program

Faculty Member (name)	PT or FT [1]	Classes Taught (Course No./Credit Hrs.) Term and Year[2]	Program Activity Distribution[3]			% of Time Devoted to the Program[5]
			Teaching	Research or Scholarship	Other[4]	
Babu, Roshina	FT	CVEEN 2140 (3) Fall 2020 CVEEN 2010 (3) Fall 2020 CVEEN 2130 (3) Fall 2020 CVEEN 2140 (3) Spring 2021 CVEEN 2750 (2) Spring 2021 CVEEN 3210 (3) Spring 2021	95	0	5	100
Barber, Michael Ernest	FT	CVEEN 2000 (0.5) Fall 2020	30	45	25	100
Bartlett, Steven F	FT	CVEEN 1400 (3) Spring 2021 CVEEN 2000 (0.5) Spring 2021 CVEEN 6330 (3), Fall 2020	45	30	25	100
Burian, Steven John	FT	CVEEN 2300 (2) Fall 2020 CVEEN 4900 (3) Fall 2020	60	30	10	100
Cazalas, Edward	FT	NUCL 6030 (3) Fall 2020 NUCL 5900/6900 (1-3) Spring 2021 NUCL 7100 (3) Spring 2021	45	45	10	100
Chen, Jianli	FT	CVEEN 5790(3) Fall 2020	45	45	10	100

		CVEEN 5780 (3) Spring 2021				
Goel, Ramesh	FT	CVEEN 3610 (3) Fall 2020 CVEEN 3615 (1) Fall 2020	45	45	10	100
Hong, P. K. Andy	FT	CVEEN 2310 (3) Fall 2020 CVEEN 5610(3) Fall 2020 CVEEN 2300 (2) Spring 2021	45	45	10	100
Ibarra, Luis Francisco	FT	CVEEN 3210 (3) Fall 2020 CVEEN 4222 (3) Spring 2021	45	45	10	100
Jovanovic, Nickolas	FT	CVEEN 2300 (3) Fall 2020 CVEEN 1000 (3) Spring 2021 CVEEN 2010 (3) Spring 2021 CVEEN 3520 (3) Spring 2021	95	0	5	100
Johnson, Jerod	PT	CVEEN 4221 (3) Fall 2020 CVEEN 5240 (3) Fall 2020	100	0	0	100
Lawton, Evert C	PT	CVEEN 3310 (3) Fall 2020 CVEEN 3315 (1) Fall 2020 CVEEN 5305 (3) Fall 2020	50	50	0	100
Lenart, Joshua	FT	CVEEN 3100 (3) Fall 2020 & Spring 2021	100	0	0	50
Liu, Xiaoyue Cathy	FT	CVEEN 4900 (3) Spring 2021 CVEEN 5560(3) Spring 2021	45	45	10	100
Markovic, Nickola	FT	CVEEN 2310 (3) Spring 2021 CVEEN 3510 (3) Spring 2021 CVEEN 3515 (1) Spring 2021	45	45	10	100

McDonald, Luther	FT	NUCL 3000 (3) Fall 2020 NUCL 3200 (3) Spring 2021 NUCL 5900/6900 (1-3) Spring 2021 NUCL 7110 (3) Spring 2021	45	45	10	100
McPherson, Brian James	FT		0	100	Sabbat ical	100
Oroza, Carlos	FT	CVEEN 5410 (3) Fall 2020 CVEEN 2750 (2) Spring 2021	45	45	10	100
Ou, Ge	FT	CVEEN 2010 (3) Fall 2020 CVEEN 1400 (3) Spring 2021	45	45	10	100
Pantelides, Chris	FT	CVEEN 2140 (3) Spring 2021 CVEEN 5220(3) Spring 2021	45	45	10	100
Peterson, Steven	PT	CVEEN 4920 (3) Spring 2021	90	0	10	100
Pomeroy, Christine	FT	CVEEN 4910 (3) Fall 2020 CVEEN 5420 (3) Spring 2021	80	0	20	100
Rashidi, Abbas	FT	CVEEN 5740 (3) Spring 2021	45	45	10	100
Romero, Pedro	FT	CVEEN 3510 (3) Fall 2020 CVEEN 3515 (1) Fall 2020 CVEEN 5570 (3) Fall 2020 CVEEN 5500 (3) Spring 2021	45	45	10	100
Shea, Michael Scott	PT	CVEEN 5510 (3) Spring 2021	100	0	0	100
Schmucker, Douglas	FT	CVEEN 2140 (3) Fall 2020 CVEEN 3210 (3) Spring 2021 CVEEN 4910 (3) Spring 2021	90	0	10	100

Sjoden, Glenn	FT	NUCL 4900 (1-3) Fall 2020 & Spring 2021 NUCL 6050 (3) Fall 2020 NUCL 5900/6900 (1-3) Spring 2021 NUCL 6060 (3) Spring 2021	45	45	10	100
Weidhaas, Jennifer	FT	CVEEN 1000 (3) Fall 2020 CVEEN 5605 (3) Fall 2020 CVEEN 3610 (3) Spring 2021 CVEEN 3615 (1) Spring 2021	45	45	10	100
Yang, Terry	FT	CVEEN 3520 (3) Fall 2020 CVEEN 3520 (3) Spring 2021	45	45	10	100
Zhu, Xuan	FT	CVEEN 2010 (3) Spring 2021 CVEEN 5210 (3) Spring 2021	45	45	10	100

1. FT = Full-Time Faculty or PT = Part-Time Faculty, at the institution
2. For the academic year for which the Self-Study Report is being prepared.
3. Program activity distribution should be in percent of effort in the Program and should total 100%.
4. Indicate sabbatical leave, etc., under "Other."
5. Out of the total time employed at the institution.

Table 6-3 Summary of Faculty Professional Development Activities

Faculty	Conference		Workshop/Seminar		Instructional Training	Educational Development	Sabbatical	Other
	Attendance	Presenter	Attendance	Presenter				
Babu, Roshina	6	6	0	0	2	2	0	0
Barber, Michael	15	7	5	5	3	0	0	0
Bartlett, Steven	10	6	2	1	3	0	0	0
Cazalas, Edwards	5	2	2	2	0	0	0	0
Chen, Jianli	4	4	1	1	0	0	0	0
Goel, Ramesh	20	15	5	5	0	0	0	0
Hong, P. K. Andy	9	8	2	2	0	0	0	0
Ibarra, Luis	22	19	6	4	0	0	1	0
Jovanovic, Nickolas	5	2	2	0	1	6	0	0
Johnson, Jerod	0	0	0	0	1	0	0	0
Lawton, Evert	0	0	0	0	0	0	0	0
Lenart, Josh	6	6	0	0	0	0	0	0
Liu, Xiaoyue Cathy	15	7	16	16	0	0	0	0
Markovic, Nikola	3	3	0	0	0	0	0	0
Marron, Emily	3	3	1	0	0	0	0	0
McDonald, Luther	19	10	26	29	0	0	0	0
Mastren, Tara	3	3	3	3	1	0	0	0
McPherson, Brian James	25	17	5	2	0	0	1	0
Mohammadi, Kami	8	8	5	5	2	2	0	0
Oroza, Carlos	3	3	1	1	0	2	0	0
Ou, Ge	10	7	1	1	0	0	0	0
Pantelides, Chris	22	20	0	0	0	0	1	0
Pomeroy, Christine	4	1	2	1	0	0	1	0
Rashidi, Abbas	7	5	0	0	1	1	0	0
Romero, Pedro	18	11	4	2	2	1	0	0
Roshankhah, Shahrzad	7	7	15	15	2	3	0	0

Shea, Michael	5	5	0	0	0	0	0	0
Schmucker, Douglas	5	2	1	0	1	1	0	0
Sjoden, Glenn	3	3	8	8	0	0	0	0
Weidhaas, Jennifer	7	7	8	8	5	0	0	0
Yang, Xianfeng Terry	9	5	4	3	0	0	0	0
Zhu, Xuan Peter	8	8	11	11	0	0	0	0

CRITERION 7. FACILITIES[1]

A. Offices, Classrooms, and Laboratories

Salt Lake City Campus

The Department of CVEEN is housed in the Meldrum Civil Engineering (MCE) Building (Figure 7-1, 7-2) within the COE campus at the University of Utah in Salt Lake City. CVEEN also has laboratories in the adjacent HEDCO Building (Figure 7-3) and the Merrill Engineering Building (MEB, Figure 7-4) and instructional classrooms in the Warnock Engineering Building (WEB, Figure 7-5).

The MCE Building has two floors, part of which house CVEEN. Facilities and offices within MCE consist of department offices, faculty offices, undergraduate student study areas. CVEEN administrative offices are located on the 2nd floor of MCE in room 2000B. Individual offices for faculty are also located on the 2nd floor of this building. In addition to these, there are conference rooms for faculty and student meetings (Lund Faculty Conference Room and Tikalsky Department Chair Conference), also located on the 2nd floor.

The first floor of the MCE Building is primarily undergraduate study and meeting areas consisting of the: Geneva Rock Study Room (undergraduate study area, Figure 7-6), CRS Design Center (capstone design, Figure 7-7), Kiewit Mentoring Room (graduate TA desks and undergraduate advising rooms, Figure 7-8), Dunn Commons Lounge (student lounge area, Figure 7-9), and Layton Conference Room (capstone design, Figure 7-10).

Figure 7-1. Meldrum Civil Engineering Building (MCE) North Entrance

Figure 7-2. Meldrum Civil Engineering Building (MCE) South Entrance

Figure 7-3. HEDCO Building East Entrance

Figure 7-4. Merrill Engineering Building (MEB)South Entrance

Figure 7-5. Warnock Engineering Building (WEB)

Figure 7-6. Geneva Rock Study Room in MCE Bldg.

Figure 7-7. CRS Design Center for Capstone Design in MCE Bldg.

Figure 7-8.Kiewit Mentoring Center in MCE Bldg.

Figure 7-9. Dunn Commons Student Lounge in MCE Bldg.

Figure 7-10. Layton Conference Room (Capstone Design) in MCE Bldg.

University of Utah Asia Campus

The Construction Engineering Program is not offered at the University of Utah Asia Campus.

B. Computing Resources

Salt Lake City Campus

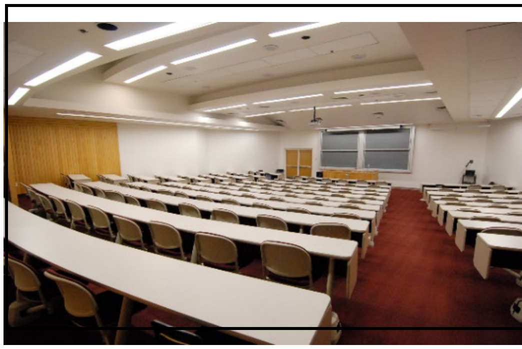
Classrooms and Instructional Facilities

The majority of the College of Engineering undergraduate classes are held in classrooms located in the Warnock Engineering Building (WEB) or the Merrill Engineering Building (MEB). The two buildings are adjacent to one another and connected via an underground tunnel. The capacity of the classrooms varies between 20 students, for more intimate classroom settings, to 262 students for large lectures. The Warnock Building is a premier teaching facility that has enabled our faculty to advance pedagogy and deliver high-quality education.

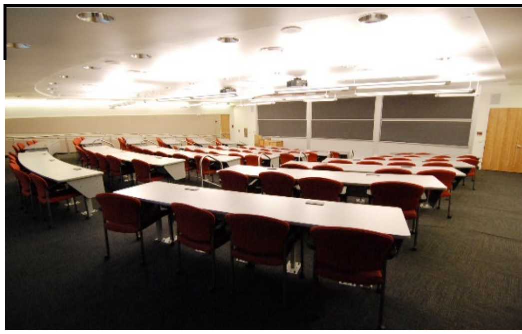
In general, the classrooms broadly fall into three separate categories shown in Table 7-1. The majority of engineering classes are held in the lower level of the WEB. This lower level was part of the old Engineering and Mines Classroom Building (EMCB) structure, which was designed solely for use as a classroom building. When WEB was constructed, the two buildings were integrated into a single building. The WEB classrooms all have air conditioning, carpeting, data projectors, disabled access, video projection, chalkboards and/or whiteboards. Many of the rooms include TV and VCR projection and tiered seating. Lecture halls are provided with a network computer connection, a public address system, a projection booth, an overhead projector, a videotape player, and a ceiling-mounted LCD projector.

There were concerns in the past about scheduling conflicts for classrooms that required some classes to be held in other buildings on campus. Such issues were largely mitigated after WEB was constructed and became available years ago. Renovation of MEB and other buildings on campus has also added classrooms. The ongoing construction of new buildings on campus will further increase classroom availability as non-engineering classes move into these new buildings and out of the engineering classrooms.

Table 7-1. Classrooms



Classroom Type:	WEB Lecture Hall
Number Avail:	5
Capacity:	93-262
Audio Visual:	LCD Projector, VCR, Overhead, Microphone
Wireless:	Yes



Classroom Type:	WEB Large Classroom
Number Avail:	4
Capacity:	74-92
Audio Visual:	2 LCD Projectors, VCR, Overhead, Microphone
Wireless:	Yes

Classroom Type:	WEB Standard Classroom
Number Avail:	6
Capacity:	40-60
Audio Visual:	LCD Projector, VCR, Overhead
Wireless:	Yes

Undergraduate Laboratories

The CEP laboratories are located in the HEDCO Building, which houses the undergraduate laboratory for Construction Materials (CVEEN 3515, Figure 7-11) and Geotechnical Engineering (CVEEN 3315, Figure 7-12). These areas are extensively used and contribute greatly to the quality of education at the undergraduate level. The equipment used in these laboratories is listed in Appendix C.

Research laboratories are separated from undergraduate laboratories in these buildings. However, in some instances, undergraduate students benefit from seeing more advanced research equipment or experiments. Hence, our research labs enhance undergraduate education.

Figure 7-11. CVEEN Materials Laboratory in HEDCO Bldg.

Figure 7-12. CVEEN Geotechnical Laboratory in HEDCO Bldg.

C. Guidance

Computing

Instruction for the use of most Civil Engineering-specific software is primarily done at the course level by the respective instructor or teaching assistant. However, there is curriculum-wide software training that is required for all CVEEN students. The first required course, CVEEN 1400, Computer-Aided Design provides instruction on the use of software to depict engineering designs involving 2- and 3- D model development and topographic mapping in AutoCAD and AutoCAD Civil 3D. The second required course, CVEEN 2750, Computer Tools, provides instruction on use of Microsoft Excel including programming in VBA with excel, databases using Microsoft Access using SQLite, and 3D design and Building Information Management using Revit.

For CVEEN students using the computer laboratories offered by the College of Engineering (e.g., CADE and Engman Labs), IT Support is available during most business hours http://www.cade.utah.edu/.

Tools, Equipment & Laboratories

Proper use and operation of facilities and laboratory safety are emphasized by CVEEN. The overall safety of the department laboratories is overseen by Mark Bryant in conjunction with the laboratory supervisors associated with each laboratory (i.e., Dr. Bartlett – Geotechnical Laboratory, Dr. Romero- Materials Laboratory. At the beginning of each semester, students enrolled in the laboratories are given a safety briefing and are required to certify that they have had such briefing. This includes:

- planning and conducting operations in accordance with practices and procedures established in the Safety Plan
- using equipment for its designed purposes only
- being familiar with emergency procedures, including knowledge and location of emergency equipment for the laboratory, as well as how to obtain additional help in an emergency
- knowing the type of protective equipment available and using the proper type for each procedure
- being alert to unsafe conditions and actions and calling attention to them so corrections can be made a soon as possible

Attachment 2 is an example safety plan used by CVEEN to promote a culture of safety and appropriate use of equipment in the environmental laboratory.

CVEEN students are instructed in the use, operation and handling of tools and equipment by the course instructors, teaching assistants and CVEEN safety and laboratory manager (Mark Bryant). Laboratory procedures have been developed for each major laboratory exercise. These are assigned reading for the students and the instructor or laboratory T.A. reviews these procedures with the students prior to conducting the exercise. An example laboratory procedure is attached in Attachment 3.

D. Maintenance and Upgrading of Facilities

The undergraduate teaching laboratories in CVEEN are supported by three major funding sources. These are: (1) a lab fee associated with each lab course to support the purchase of consumable goods required for the lab experience, (2) state provided funds cover the maintenance of existing capital equipment, and (3) an annual state Equipment Fund (BEEF) to provide up to $100k per year for the purchase of new capital equipment- requires that 33% matching funds are provided by external sources. The laboratory maintenance and consumables budget is managed by the faculty teaching the course in conjunction with the laboratory manager, Mark Bryant. Capital equipment is proposed by faculty responsible for specific undergraduate laboratories, endorsed by the chair/executive committee and funds requested from the COE Dean's office.

F. Library Services

The University library system is adequate to support undergraduate teaching and the research needs of faculty and graduate students. The University of Utah has three libraries on its campus: Faust Law Library, Spencer S. Eccles Health Sciences Library, and J. Willard Marriott Library. The Marriott Library is the library used most by engineering faculty and students.
The Marriott Library currently has more than 3.6 million books and over 10,500 serials subscriptions with access to nearly 70,000 titles including access to collections in engineering, computing, technology, and science societies/organizations such as ACM, ACS, AMS, ASCE, ASM, ASME, ASTM, IEEE, IOP, and many more. Through the regional Utah Academic Library Consortium students, faculty, and staff have reciprocal borrowing privileges at other colleges and universities throughout the state of Utah. The library is 10 to 15 minutes walking distance from the various buildings that house the College of Engineering (Merrill, Warnock, Rio Tinto Kennecott, Meldrum, and Sorenson). Normally, the library is open 104 hours per week as follows: Monday-Thursday 7am-12am, Friday 7am-8pm, Saturday 9am-8pm, and Sunday noon-12am.

The Marriott Library provides access to numerous online resources. These resources include article and physical-property databases, digital full-text journals, and a collection of e-materials to support campus and distance education. The library's ebook collection is extensive. Databases and resources that are purchased by University Libraries to support the College of Engineering include IEEE Xplore (IEEE Electronic Library), Inspec, Scopus (Compendex and the Compendex Archive), ProQuest Dissertations and Theses Global, ProQuest Materials Science and Engineering Collections, Scifinder, etc. Engineering related materials are found in all of these collections.

Since the last review, the University Libraries have purchased access to new resources to support the College of Engineering including subscriptions to Web of Science, ASTM Compass, Science of Synthesis, Materials ConneXion, Anatomy.TV (especially useful for biomedical, engineering students needing knowledge of human anatomy and physiology), GDC Vault, Embase, electronic backfiles to journals, and Patsnap. Further, the Marriott Library has repurposed spaces to support the College of Engineering and our nationally ranked Entertainment Arts & Engineering program by creating VR classrooms and ProtoSpace™. ProtoSpace™ includes spaces for VR development (the library has over 60 VR headsets for use), gaming spaces, and 3D printing (with a fleet of more than 40 printers available that can print jobs in various sizes). Additionally, our Health Sciences Library also provides support to the College of Engineering and has the Gary L. Crocker Innovation & Design Lab. We believe that this space which received ISO:13485 certification in June 2017 may be one of the "first Academic institution in the United States, if not the world, to receive this designation. This allows us to train students and develop projects under quality control protocols, providing quality management system instruction and easing the transition to market for projects."

The library's Interlibrary Loan and Document Delivery (ILL)Department will borrow almost anything the user might need upon request to support their academic program and research. The ILL department provides electronic delivery of requested articles and book chapters to the patron usually within 24-48 hours. It also has a policy of quickly obtaining copies of almost any engineering standard needed by faculty or graduate students (ANSI, ASME, ISO, etc.). Engineering standards are purchased as needed via TechStreet.

In addition to borrowing materials via Interlibrary Loan, students, staff, and faculty can order materials (books, ebooks, media, etc.) in a variety of ways. The libraries will automatically purchase any monograph or print item up to $250.00, no questions asked via a "Suggest a Purchase" form or contacting their library liaison. For items over $250.00, we order materials if three or more librarians concur. A second option we offer is the ability for students, staff, and faculty to request the purchase of books via our library catalog and have them available in less than two weeks (demand driven acquisition). For rush orders, we have the ability to purchase materials and make them available in less than a week; for some of our vendors, materials can be made available in two or less business days. We have access to several catalogs to find materials including our own library catalog, WorldCat, HathiTrust, and the Library of Congress. Also, we can purchase media in a variety of formats and offer access in a variety of ways—including online streaming. Due to the pandemic, engineering librarians have proactively bought electronic access to textbooks and other materials to support remote learning and research.

The University Libraries have a team of librarians that support the College of Engineering called the Science, Health, Engineering, and Mines (SHEM) team. The SHEM team works together on collection development and outreach. For example, we did a self-study of our collection and when we noticed gaps in the collection and prioritized the purchase of expensive engineering volumes and sets over the past three years.

These and other librarians promote information literacy, critical thinking, and digital fluency. We offer in-depth research consultations for faculty, staff and students. Several librarians are actively engaged in supporting our nationally recognized LEAP program for first-year students. Librarians are actively engaged in supporting undergraduate engineering students in their capstone courses. Further, library liaisons work closely with graduate students, faculty, staff, research associates, post-docs, to support their teaching and research needs. Librarians provide in-class, hybrid, hyflex, and online instruction for library research and writing assignments, and have created many dozens of online guides to assist students with all aspects of library research and the use of information technology, including the Marriott Library One-Stop Resource, an online course for library research support for faculty and their graduate and undergraduate students.

We have several librarians who support entrepreneurship and innovation on-campus. As Utah's Patent and Trademark Resource Center, we have two librarians that support IP, patent, and trademark resources and services. They frequently guest-lecture about patent searching in several College of Engineering courses, including BioInnovate and Materials Innovation. Additionally, our Libraries Innovation Team includes of librarians from all three libraries who support transdisciplinary, interdisciplinary, and "wicked problems" research. The libraries work closely to support entrepreneurial engineering students who are in the Lassonde Entrepreneur Institute and entrepreneurial faculty through I-Corps, Vice President of Research Office, and Pivot Center programs. Notably, three librarians (Tallie Casucci, Harish Maringanti, and Donna Ziegenfuss) have worked with Engineering faculty on University and national grants.
Other examples of library support include LabArchives, the semi-annual Dissertation Boot camp for students writing theses or dissertations, creation of the quiet Graduate Reading Room and presentation practice rooms, including the One-Button Studio, where students, faculty and staff can record sessions (audio and/or video), up to one hour long, anytime the library is open. Also, the library houses the University Writing Center, tutoring spaces, and a Statistics consultation service. The library has provided space to create a Faculty Center for programs that serve faculty and students. Services within the Faculty Center include the Teaching and Learning Technologies, and The Center for Teaching and Learning Excellence. The Faculty Center provides teaching faculty with technical assistance in creating online course content. The Faculty Center works with faculty to create the exact course content requested, including content from new audio and video studios. It helps instructors with all course-related uses of Canvas (the online-course software of the University).

In addition to ProtoSpace™, the "Knowledge Commons" in the Marriott Library offers computing resources, technology equipment, printing, reference, scanning, and audiovisual assistance. More than 250 networked PC and Mac computers offer high speed internet access and advanced software packages, including the Adobe suite, AutoCAD, Maple, MATLAB, Mathematica, and SAS. This group helps support our 7 computer equipped classrooms, 11 classrooms with lecture-style or table seating, and 28 group study rooms. The library also operates three campus computing labs across campus. Additionally, the library offers nearly 1400 laptops, 200 wireless hotspots, and a wide variety of other equipment to check out to students. The Marriott Library and all the computing labs work closely with faculty to purchase media-materials and software to support course curricula in animation, gaming, programming and engineering.

Librarians and Library Staff that support the College of Engineering,

- Tallie Casucci, Assistant Librarian, Head of Science, Health, Engineering, & Mines (SHEM) Team, tallie.casucci@utah.edu
- Mark England, Librarian, Head of Collection Management, mark.england@utah.edu
- April Love, Associate Librarian, Faculty Services, april.love@utah.edu
- Alfred Mowdood, Librarian, Head of Faculty Services, Patent & Trademark Resource Center Representative, alfred.mowdood@utah.edu
- Carly Anderson, Collection Services Project Manager, carly.anderson@utah.edu
- Susan Brusik, ILL/Document Delivery Services Manager, susan.brusik@utah.edu
- Erika Church, Design & Technology Specialist, erika.church@utah.edu

- TJ Ferrill, Assistant Head Creative Spaces, thomas.ferrill@utah.edu
- Ian Godfrey, Assistant Dean, Library Facilities Director, ian.godfrey@utah.edu
- Mary Ann James, Electronic Resources Manager, maryann.james@utah.edu
- Dale Larsen, Librarian, Interim Head of Graduate & Undergraduate Services, dale.larsen@utah.edu
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- Donna Ziegenfuss, Associate Librarian, Faculty Services, donna.ziegenfuss@utah.edu

Engineering-Related Specialty Software

Software support is provided for over 350 software packages, including the ones with engineering applications. Besides major software suites from major software publishers such as Microsoft and Adobe, the library purchases many specialty software programs to enhance all stages of knowledge creation and presentation. The table below provides a selected list of specialty software supporting engineering.

Select engineering software supported by the Marriott Library.

Autodesk 3ds Max - 3D modeling & animation
Autodesk AutoCAD - Computer-aided design & drafting
Autodesk Inventor - 3d mechanical CAD
Autodesk Maya - 3D modeling & animation
Autodesk Mudbox - Digital sculpting tool
Blender - 3D modeling
Bricksmith - Virtual Lego modeling
Cantor - Statistical analysis
ChemBioDraw - Chemical structure modeling
Dia Diagram Editor - Diagramming, charting, & visualization
FlatRedBall - Game development platform
GameMaker: Studio - Game development platform
IBM SPSS - Statistical analysis
IBM SPSS Amos - Structural equation modeling
Integrated Data Viewer (IDV) - Geoscience data analysis & visualization
KaleidaGraph - Graphing & statistical analysis
KAlgebra - Graph calculator
Kalzium - Periodic table of elements
Keynote - Presentation creation
LabVIEW - Graphical development environment
MakerBot Desktop - G-code generator for 3D printing
Maple - Computer algebra system
Mathematica - Automated computation system
Mendeley Desktop - Organize & share research
Microsoft Project - Project management
Minitab - Statistical analysis
Mplus - Statistical analysis
NVivo - Qualitative analysis
OmniGraffle Professional - Diagramming, charting, & visualization
OmniPlan - Project management
Paraview - Scientific data visualization
Phase Equilibria Diagrams Database - Ceramic & inorganic phase diagrams
POWERPREP II - GRE test preparation
Prezi Desktop - Presentation creation
PSPP - Statistical analysis
ReadCube - Reference manager, Nature Group
SAS - Statistical analysis
SketchUp - 3D modeling
Slic3r - G-code generator for 3D printing
SolidWorks - 3D mechanical CAD
Stata - Statistical analysis
StatPlus - Statistical analysis
STELLA - Modeling & simulation
Unreal Engine - Game development platform
Vectorworks - CAD & Building Information Modeling
Wings3D - 3D modelling

CRITERION 8. INSTITUTIONAL SUPPORT

A. Leadership

The department has established different tiers of leadership within the program. The top level of leadership consists of the Executive Committee. The committee is compiled of the chair of the three teaching/research groups, Undergraduate and Graduate Directors, Associate Chair, and Chair of the Department. This committee is where new ideas are brought forth, discussed and determined what can be done with it. The answer is typically one of three responses: take to faculty for a vote, send to a committee for more discussion, or no further action.

The next level of leadership comes through in the form of the Undergraduate and Graduate Studies Committees. These groups consist of members of all the teaching/research groups and have a chair of the committee. The committee evaluates curriculum, student petitions, determines best practices for the program, and work toward any directive that the Chair or larger committee has requested assistance.

The base tier of leadership comes the Teaching/Research Group. The groups (Environmental and Water Resources, Pavement Materials and Transportation, and Infrastructure (which encompasses Structures and Geotechnical)) meet to discuss topics affecting their areas. This includes, but is not limited to, recommending course offerings and instructors to the Chair, review ABET outcomes and course criteria's, course curriculum evaluation, and work toward any directive that the Chair or larger committee has ask for assistance.

Teaching research groups, and all department committees can bring ideas up to the faculty in Executive Committee meetings as well as faculty meetings. Faculty meetings are held monthly during the academic year and allow for dissemination of University changes or events. This is also used to help discuss items that the committees need to be voted on by the faculty.

Having the tiered structure of leadership enables all faculty to contribute to the progress of the department. Faculty will be able to give input at the group level, and depending on the topic at their committee meeting and finally at faculty meeting, when a vote or additional discussion occurs. The tiers of leadership have allowed the faculty to go into very detailed discussions for the issues that affect the program.

B. Program Budget and Financial Support

Program Budget

The University of Utah is the flagship higher education institution of the State of Utah. It is largely supported by state higher education funds appropriated each fiscal year through the legislative process, student tuition payments, and special fees. Funding levels for the entire higher education system are established during the legislative session, and changes are passed to the university presidents who, in consultation with their vice presidents, allocate resources to individual college deans. Deans work with the department chairs to develop budget recommendations and departmental budget priorities that are then submitted back up the chair for final approvals. Subsequently, the SVPAA and members of the College Budget Advisory Committee meet with College Deans to review budget recommendations and discuss specific programs, concerns and critical unmet needs. Final approval is usually communicated by the end of May of each year and the approved budget is posted at the beginning of the fiscal year in July. Employee tax and benefit costs are reimbursed to department accounts on a 1:1 basis from centrally administered benefit pool funds.

The departmental budget for any new fiscal year typically consists of the base budget from the previous year plus cost-of-living and/or merit increases approved by the Legislature. In recent years, these increases have typically ranged from 1% to 2% of ongoing budget lines (e.g. "filled" positions). Unfortunately for the 2021 fiscal year, the university was assessed a 2.5% budget cut (based on the FY 2020 budget) instead of an increase by the Legislature, in anticipation of decreased tax revenues due to the COVID-19 pandemic. The university absorbed 0.5% centrally and passed on a 2.0% budget cut to colleges and departments. The budget for the 2022 fiscal year has recently been appropriated and will be a 3.0% increase.

As shown in the budget transfer summaries in Figure 8-1, the majority of the budget is reflected in the Base Budget and Benefit Pool transfers, augmented by both ongoing and one-time support provided by (a) the SVPAA's office (diversity increments, Presidential Teaching award increments, promotion increments, etc.), (b) College supplemental funding (retention increments, service awards, and other program support transfers from college-held funds), (c) Differential Tuition transfers (based on assessments of all students who take upper division or graduate engineering courses), (d) Incentive Fund transfers (based on a general pool that is allocated based on relative SCH taught (40%), program enrollments (40%) and degrees awarded (20%), determined by taking a two-year moving average overall the totals for each category, over the entire University.

One of the most successful programs to grow the annual number of engineering graduates is the Engineering Initiative Program. Since the 2015 Initiative, the College of Engineering has received two additional initiatives (2017: $3,080,000; 2019: $5,200,000), which include a 50% match by the central administration.

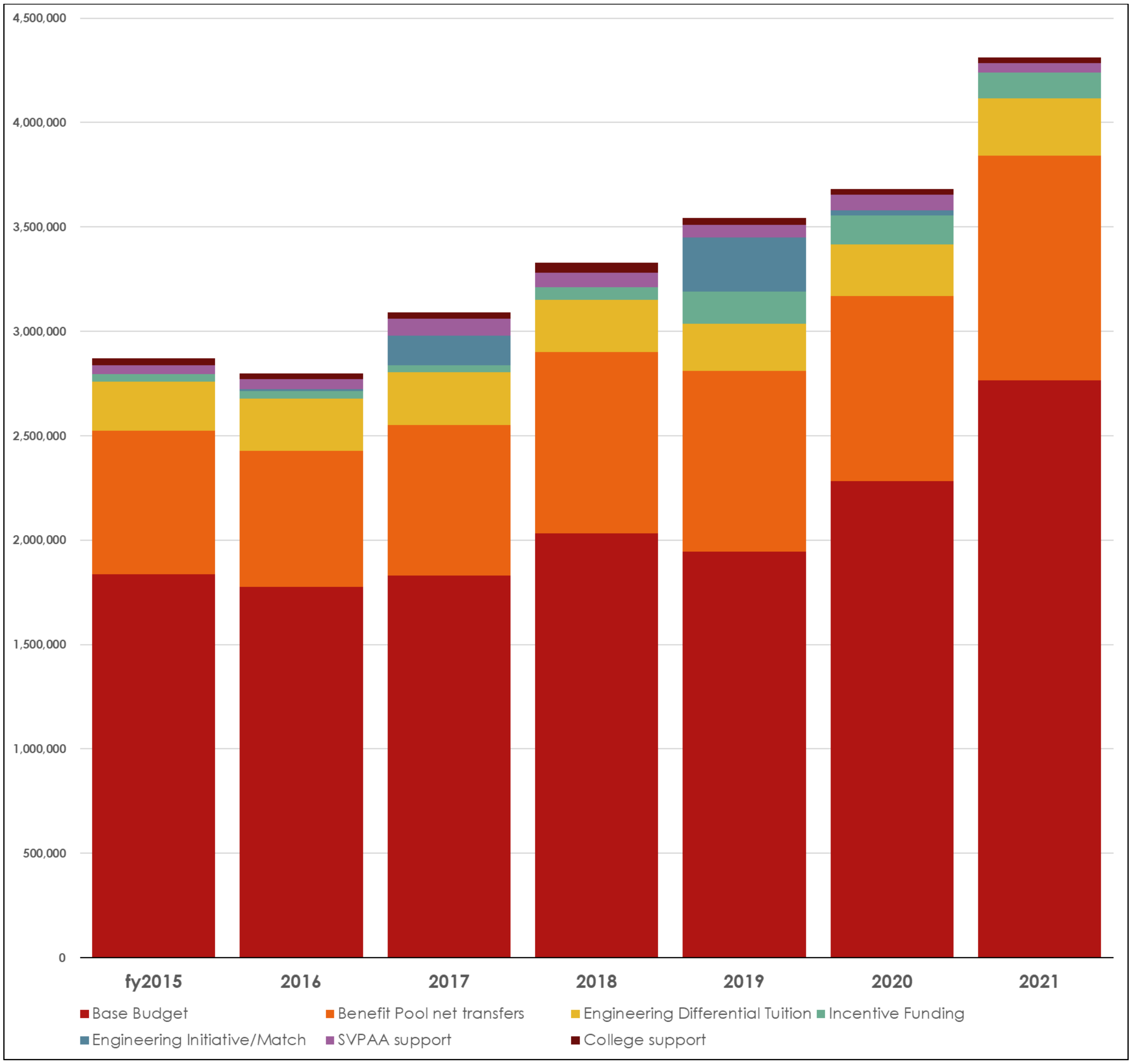


Figure 8-1. CVEEN budget transfer summary.

Support for Teaching

Requests for teaching assistants (TAs) are sent to the Department Chairman from the Goup Leads each semester. Due to the fiscal year 2021 budget cuts all there is no budget in our department for TAs through state appropriations. The funding for TAs for the department are allocated through the differential tuition fee associated with the upper division classes. The responsibilities of teaching assistants are customized by course instructors, but may include maintaining office hours, holding review sessions, and providing homework and exam grading. For the Fall 2020 semester there were 16 full-time TAs erd three students that provided part-time grader. For the Spring 2021 semester there were 16 full-time TAs, one part-time TA and one part-time grader.

In the 2019 Engineering Initiative request the College requested funds to hire tutors for the introductory courses for the program. In spring 2020 we implemented the tutoring program with the hiring of the first two tutors. Tutors hosted their open drop-in tutoring hours in our designated tutoring space within our building. This occurred for the first few weeks of the Spring 2020 semester before COVID-19 closed campus. For the first three semesters of the program, tutors scheduled and hosted virtual tutoring appointments through Zoom. Our tutors were available to students on a by-appointment bases with hours offered throughout the week and limited hours available on weekend mornings.

Tutoring sessions typically run one hour and students can make as many appointments as needed with the tutors each week. When campus opens in the fall the Tutoring Center will be open 12-5 Monday through Thursday for walk-in assistance.

Acquisition, Maintenance, and Upgrading of Facilities and Equipment

The College has set aside $320,000 of basic engineering equipment funding (BEEF) to assist with the acquisition of Undergraduate Teaching Lab equipment annually. Proposals are submitted each year in May, with awards usually made by the beginning of summer to allow the departments time to acquire the new equipment in time for Fall semester. Partnering with industry and donors to help leverage these funds is highly encouraged and has allowed the departments to maintain and improve the equipment available in the labs to serve their classes and students.

Academic Year	Amount	Labs Supported
2015/2016	43,266	Geotechnical Lab
2016/2017	0	No BEEF Funding Received
2017/2018	50,000	Environmental Lab (Creation)
2018/2019	58,500	Hydraulics Lab
2019/2020	75,000	Materials Engineering
2020/2021	75,000	Hydraulics Lab, Environmental Lab

The College also maintains, separately, several large computing labs. In addition to on-going base funding (over $800K in salaries and benefits) and one-time allocations of both student computing fee income ($150-$250K per year) and other available funding (from open lines, etc.), state-of-the art computing facilities have provided critically-needed computing resources available to all programs within the college.

A $4 million-dollar renovation effort has been planned for the HEDCO Building. This renovation will create new teaching spaces and modernize the undergraduate construction materials laboratory and the undergraduate water/hydrology laboratory. The south-east part HEDCO, which is currently a storage and concrete mixing laboratory will be converted into two levels. The bottom level will house the water/hydrology laboratory as well as a modern concrete mixing space. The top level will house two new spaces, one termed “The Makers Lab” where undergraduate students will design and construct models that better illustrates the concepts they are learning through a hands-on approach and a small “Cyber Infrastructure” space expected to be used for research in sensor and cyber infrastructure technology. To the west, on the first floor, the Construction Materials Laboratory will be fully renovated to allow a separate entrance and greater space for students to mix and test different construction materials using $80,000 worth of new equipment that was acquired prior to the pandemic. The new spaces will allow for greater flexibility in providing students with emerging technologies in support of advances in the profession. The renovation will also address issues such as lack of modern restroom, seismic upgrades, and appropriate egress routes to comply with the latest safety codes. The College has approved initial funding and the final design is being finalized. It is expected that construction will start late in the Fall 2021.

Adequacy of Resources for Attaining Student Outcomes

The adequacy of resources available in the CVEEN program to attain is evaluated based on human resources (faculty, staff, TA support), physical resources (classrooms, laboratories, computers), and continuous improvements.

As discussed in Section 6.C, the number of faculty has increased since the last review, from 17 to 21 including three new faculty starting Fall 2021. This number is adequate to cover all of the classes while maintaining a reasonable teaching load. Junior level (3000-level) classes are taught both Fall and Spring semesters and primary technical electives are taught once a year with the rest scheduled by the groups based on needs. This arrangement ensures a reasonable flow of students and maintains a classroom size that encourages the learning process. Table 6-1 also shows that the faculty are experts in their field and have the required qualifications to ensure quality instruction to meet program objectives. Thanks to the Engineering Initiative, there is an opportunity for faculty size to increase through new hires; however, such growth needs to be balanced against the resources available in terms of office space and cost of start-up package.

As discussed in Section 7.A, the classroom and equipment available allow for proper instruction. There are 4 laboratories dedicated to undergraduate instruction: Materials and Geotechnica. These facilities allow the program meet the requirements of having the students conduct laboratory experiments or tests in at least two technical areas. As discussed in the budget section, there is available funding to periodically improve the equipment. There are spaces dedicated to the capstone design where students can meet in teams and work on their project. Additional spaces are also dedicated for mentoring and tutoring. Ancillary support facilities are further discussed in Section 7.B and 7.E, computers and library, respectively.

As discuss in Sections 7.D and shown in section 8.B.1, there is available funding for maintenance and upgrading of laboratory and facilities. It is understood that all equipment and facilities are subjected to wear-and-tear and obsolescence. Furthermore, the faculty leading the labs is aware of the most up to date equipment that is being used in the field. Thus, in as much as the laboratories and equipment serve in meeting the student's outcomes, they are upgraded on a regular basis. Nonetheless, the program recognizes that new spaces are still needed to better attain the student outcomes, all part of the continues improvement discussed in Section 4.

Overall, the resources are adequate to meet current demands to attain student outcomes and the institutional support allows for future expansion.

C. Staffing

The faculty and staff in CVEEN are primarily located on the second floor of the MCE Building. The offices house the Department Chair (Michael Barber), Graduate Academic Advisor (Courtney Phillips), Undergraduate Academic Advisors (Olivia Calvillo and Wendy McKenney), Accountant (Cathy Merkel), Marketing and Communications Specialist (Kelsey Arnold), and Departmental Administrative Manager (Tiffany Horton). The laboratory technician (Mark Bryant) is housed in HEDCO. Funds in the 2019 Engineering Initative also provided suport to hire one additional technician to assist with adding technology into the classes. This hire had to be put on hold due to the University's hiring freeze but the plan is to start the search for this position in early fall 2021.

The administrative staff provides logistical support along with services related to budgets, payroll, contract management, proposal generation, and purchasing. As the faculty size and student body have increased in the last decade so have the demands on the front office staff. The department has been able to restructure the office staff to better accommodate the needs of the faculty since the last review to the growing needs of the faculty and students within the department.

Administrative staff members are provided training opportunities for continuing education through University Administration. Several types of classes are offered throughout the year for staff to maintain existing knowledge and to be introduced to new University practices and policies. The administrative staff receives on-line training on the Family Educational Rights and Privacy Act (FERPA) and they are required to pass an associated test. The staff also attends Research Administrative Support Training (RATS) on Export Controls (once a year) to get updates on all policies and to stay compliant with federal guidelines. The administrative staff also meets with the Office of Sponsored Projects (OSP) to discuss best practices and to streamline proposal/grant procedures. The academic advisors are able to attend University inservises on current practices of the profesion. The department has provided them funding to attend the state-wide advising conference to continue their knowledge of best practices within the profession. For both groups, the Human Resources Department has various trainings that are offered and staff are encourage to attend classes and trainings to stay engaged and broaden their skillsets for possible advancement.

D. Faculty Hiring and Retention

Hiring

The CVEEN Strategic Planning Committee discusses and selects the specific areas for each search. These results of these meetings are transparent and discussions with faculty are held in the discipline group and in general faculty meetings. The selected areas with desired research qualifications are presented to the entire faculty for discussion and vote at the monthly faculty meeting. With the approval of the faculty, a search committee of 3 to 4 faculty members is created, a position description is written and ads are placed in national and international publications and web sites

The search committees are instructed on permitted and prohibited pre-employment questions, strategies on application assessment, strategies for conducting a Skype interview, and the expectations for on-campus interviews. The application process is managed using a University on-line Application Tracking System. All applicants submit the required documents through the on-line system. Application review begins in early December and a short list of 10 – 15 candidates is selected for Skype interviews, which typically take place in January. Letters of recommendation are requested for each person on the short list; those letters are also directly uploaded to the on-line system. Using all available data, three candidates are selected for on-campus interviews.

On campus interviews for each candidate take two days. Activities planned for each candidate include: 1) breakfast with the Chair on day one, 2) present a research seminar, 3) meet with students and present a short lecture to demonstrate teaching competency, 4) meet with all Department faculty members one-on-one or in small groups, 5) meet with the Dean, 6) meet with possible collaborators outside the department, 7) have an exit interview with the Chair. On-campus interviews for all three candidates in a specific search are scheduled to take place within a two-week period.

Feedback from all individuals that have met a candidate is solicited. The search committee prepares a report that summarizes the pros and cons of each candidate, the feedback they received, and their ranking of the candidates. This report is presented at a faculty meeting and a vote of the full faculty is taken. By policy, the faculty must vote on the "acceptability" of each candidate, the rank order of the acceptable candidates, and the rank (assistant, associate, or full professor) of the position that can be offered to each candidate. The ranking of the acceptable candidates is a recommendation to the Chair. Following the faculty meeting, the Chair begins the process of negotiating terms with a candidate for a formal offer.

Retention of Faculty

Strategies used to retain current qualified faculty members include creating an environment that is open, collegial, supportive, and inclusive and by providing resources to facilitate their success.

- Teaching load – the typical teaching load is three courses per year. Research active faculty members typically have their teaching load reduced to two courses per year.
- Raises - High achieving faculty members are rewarded with raises well above the percentage provided in the raise pool.
- Junior faculty workload – non-tenured faculty members have a reduced teaching and service load, as determined by the Department Chair.
- Resources – start-up packages are at the national average. Lab space is not shared and is viewed by the chair as adequate for all research active faculty members.
- Collegial atmosphere – considerable effort has gone into creating and maintaining a collegial atmosphere. Collaboration is encouraged. A supportive and collegial positive workplace is a major factor in faculty members having a positive attitude toward the department.
    - Shared governance – a shared governance administration has been cultivated. Faculty, either individually or through committees, are involved in all major decisions.

- Administrative transparency – the Chair has operated with as much transparency as is possible. Budgets, including income sources and expenditures, are presented to the faculty each year and in an as-need basis at other times.
- Achievement recognition – major accomplishments, such as honors, awards, and new grants, are recognized through announcements, publications, and on-line articles. The intent is to create a positive atmosphere within the faculty awards – The chair selects and recognizes awards given to outstanding teacher and researchers of the year.

E. Support of Faculty Professional Development

Faculty in the Department of Civil Engineering at the University of Utah is expected to grow their professional interests and expertise throughout their careers. There is an expectation that they use good pedagogy in teaching and develop their teaching techniques to keep pace with the profession and the best standards of practice.

Each faculty member annually submits a plan for developing their expertise as a faculty member, professional career and expectations for the coming year. This is submitted with Faculty Activity Report (FAR). The faculty members are provided a written evaluation from the chair annually which evaluates their teaching, mentoring, and research and other service activities. The evaluation and developmental plan is discussed in a 30 to 45-minute meeting with the chair and resources are allocated for professional development in this meeting. Other requests are granted throughout the year.

In addition, the University Retention, Promotion and Tenure (RPT) Standards Committee has adopted guidelines for departments in determining their criteria and indicators of good teaching for use in RPT decisions. "Evaluation of teaching effectiveness should not consist solely of student evaluations, though student satisfaction with teaching methods and course administration is one component of effective teaching.

The College of Engineering periodically invites Richard Felder and Rebecca Brent to present their two-day workshop on effective teaching, with the most recent workshops held in 2018 and 2020. The participants of this workshop learn to (i) use a wide variety of effective teaching strategies, and (ii) find resources for continuing to improve their teaching. These meetings are well-attended by faculty from CVEEN. While new faculty are specifically encouraged to attend, many senior faculty have also participated in, and benefitted from, these workshops

The Center for Teaching and Learning Excellence (http://ctle.utah.edu/) at the University offers resources on all aspects of teaching, including assessment. Faculty members are also eligible to apply for teaching grants from the Teaching Committee at the University of Utah.

A comprehensive sabbatical leave program allows faculty to pursue teaching and research interests in locations outside of the University.

PROGRAM CRITERIA

The program criteria have been prepared by the ASCE Committee on Curriculum and Accreditation (CC&A) with the assistance of the ASCE-CI Construction Engineering Education Committee and updated and maintained by ASCE's Committee on Accreditation Operations. These criteria are given as guidance to construction engineering program evaluators by clarifying and amplifying the Construction Engineering Program Criteria to be utilized in association with the ABET/EAC Criteria for Accrediting Engineering Programs.

1. Curriculum

The program must prepare graduates to apply knowledge of mathematics through differential and integral calculus, probability and statistics, general chemistry, and calculus-based physics; analyze and design construction processes and systems in a construction engineering specialty field applying knowledge of methods, materials, equipment, planning, scheduling, safety, and cost analysis; explain basic legal and ethical concepts and the importance of professional engineering licensure in the construction industry; and explain basic concepts of management topics such as economics, business, accounting, communications, leadership, decision and optimization methods, engineering economics, engineering management, and cost control.

2. Faculty

The program must demonstrate that the majority of faculty teaching courses that are primarily design in content are qualified to teach the subject matter by virtue of professional licensure, or by education and design experience. The faculty must include at least one member who has had full-time experience and decision-making responsibilities in the construction industry.

The following describes how the Program satisfies any applicable program criteria.

1. Curriculum

Apply Knowledge of Mathematics through differential and integral calculus

This is met by CEP curriculum which includes the following mathematics sequence: Engineering Calculus I (MATH 1310, or MATH 1210 or MATH 1311, as alternatives), Engineering Calculus II (MATH 1320, or MATH 1220, or MATH 1321, as alternatives), and Differential Equations & Linear Algebra (MATH 2250).

Probability and Statistics

CEP students are required to take Probability and Statistics (CVEEN 2310). The course teaches students to address uncertainty by introducing set terminology and theory, fundamental axioms of probability, conditional probability, statistical independence, Bayes' theorem, deMorgan's rule, random variables, probability mass, density and distribution functions, moments, measures *of central tendency and dispersion, common discrete and continuous probability functions, data compression, frequency distributions, point estimation, and confidence intervals.*

General Chemistry and Calculus-Based Physics

This requirement is met by CEP curriculum which includes the following sequence and options. Students must take CHEM 1210, CHEM 1215, PHYS 2210 (after MATH 1210) and CHEM 1220 or PHYS 2220. Students must take one additional lab course which includes CHEM 1225, PHYS 2215 or PHYS 2225. Students are advised to check with their faculty advisor to see which of these options is best for their curriculum development plan.

Design construction processes and systems in a construction engineering

This criterion is addressed by the required courses, CVEEN 1000 (Intro. to CvEEN Engr.), CVEEN 3700 (Principles of Const. Engr.), CVEEN 4221 (Concrete Design), CVEEN 5510 (Highway Design), CVEEN 5305 (Foundation Design) and CVEEN 4920 (Capstone Design). Other optional Design Course include CVEEN 4222 (Steel 1) and CVEEN 5240 (Reinforced Timber/Masonry).

This criterion includes the following subtopics: methods, materials, equipment, planning, scheduling, safety and cost analysis

The application of knowledge of methods, materials, equipment, planning, scheduling, safety, and cost analysis is covered in CVEEN 3700 (Principles of Construction Engineering), CVEEN 3710 (Contract Specifications), CVEEN 5720 (Project Scheduling), CVEEN 5740 (Horizontal Construction, CVEEN 5780 (Façade I) and CVEEN 5790 (Vertical Construction), CVEEN 5710 (Cost Estimation and Proposal Writing) (Primary Technical Elective), CVEEN 5730 (Project Management & Contract Administration (Primary Technical Elective), CVEEN 5750 (Engineering Law and Contracts) (Primary Technical Elective).

Ultimately, the students are evaluated on the application of these topics in CVEEN 4920 (Design Capstone) as briefly summarized below. For more details regarding this course, see Criterion 5A. In CVEEN 4920, the students are divided into teams of three to four students. The teams will respond to a two-phase, best-value, design-build proposal to design and construct a hypothetical precast concrete parking structure at a park-and-ride. In the first phase, the teams will respond to a Request for Qualifications (RFQ). In the second phase, the teams will respond to a Request for Proposals (RFP). Finally, the teams will prepare the construction documents needed for the garage's construction.

The following items and deliverables are covered in this course.

- *Statement of Qualifications (SOQ)*
- *Work Breakdown Structure (WBS)*
- *Code Review (IBC 2018)*
- *Preliminary Design*
- *Proposed Design, Review and Revisions*
- *Cost Estimate*
- *Project Schedule*

- *Project Staging Plan*
- *Technical Proposal*
- *Proposal Presentation*
- *Price Proposal*
- *Project Buyout*
- *Shop Drawings*
- *Concrete Placement Plan*

In addition to CVEEN 4920, the following courses also address safety in design and construction practices. The specifics of how safety is addressed is found in the course syllabi).

- *CVEEN 3210, CVEEN 4222, CVEEN 5305, CVEEN 5510, CVEEN 5570, CVEEN 5740.*

Basic legal and ethical concepts

This requirement is addressed by Student Outcome 4 (see Criterion 3 of this report) which states: "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."

The importance of legal and ethical behavior is introduced in CVEEN 2000 (Seminar) using the ASCE Code of Ethics. These concepts further address in CVEEN 3700 (Principles of Construction Engineering), CVEEN 4920 (Design Capstone) and CVEEN 5750 (Engineering Law and Contracts) (Primary Technical Elective).

Importance of professional engineering licensure

The importance of licensure is introduced in CVEEN 1000 (Introduction to Civil and Environmental Engineering and CVEEN 2000 (Seminar).

CVEEN Construction Engineering students developing a personal, professional development plan for the early part of their career including the requirements of professional licensure. This plan also includes the following sections: (1) interests (curiosity), (2) career objectives (initiative), (3) short-term and long-term goals with timeline (independence), (3) continuing education plan (independence), (4) time management and prioritization system (transfer), (5) peer/support group (reflection), and (6) annual review, reflection and renewal (reflection). This is assessed as part of Student Outcome 7.

Management Topics

The forms of business and accounting relevant to construction engineering are construction project management and asset management.

Economics

This topic is covered in CVEEN 2300 (Engineering Economics) and ECON 2010 (Microeconomics).

Business and Accounting
These topics are addressed in CVEEN 5730 (Project Management and Contract Administration) and CVEEN 4920 (Design Capstone).

Communications
This topic is covered in WRTG 2010 (Intermediate Writing), CVEEN 3100 (Technical Communications) and CVEEN 4920 (Design Capstone)

Leadership
All CVEEN lab courses require working in teams and taking turns assuming leadership roles, CVEEN 3100 (Technical Communication) and CVEEN 4920 (Capstone Design) also focus on leadership, teamwork and developing team deliverables.

Decision and Optimization methods
For construction engineering this includes basic concepts include optimizing life-cycle performance, minimizing life-cycle costs, achieving maximum benefit, and the use of appropriate equipment, tools and techniques.

These topics are included in CVEEN 2300 (Engineering Economics), CVEEN 4920 (Design Capstone) and CVEEN 5730 (Project Management and Contract Administration).

Engineering economics

This topic is covered in CVEEN 2300 (Engineering Economics) and ECON 2010 (Microeconomics).

Cost control

This topic is covered in CVEEN 4920 (Design Capstone) and CVEEN 5730 (Project Management and Contract Administration).

Management Topics (Additional Technical Elective Courses)

In addition to the courses discussed above, the additional technical elective courses support management topics: CVEEN 5710 (Cost Estimation and Proposal Writing); CVEEN 5730 (Project Management & Contract Administration); CVEEN 5750 (Engineering Law & Contracts)

2. Faculty

The program must demonstrate that the majority of faculty teaching courses that are primarily design in content are qualified to teach the subject matter by virtue of professional licensure, or by education and design experience.

The CVEEN Department has the policy that instruction of design technical elective courses must be conducted by licensed professional (P.E.) or structural engineers (S.E.). Instruction of Design

Capstone (CVEEN 4920) is conducted by a licensed professional engineer (i.e., instructor Steven Peterson). Faculty professional qualifications are shown in Table 6-1.

The faculty must include at least one member who has had full-time experience and decision-making responsibilities in the construction industry.

This requirement is met by the management and construction experience of Steven J. Peterson, MBA, MS, PE. His non-academic experience includes:

2008-2020, Principle, Peterson Construction Consulting Services, LLC
1999-2000, Senior Project Manager, Aspen Construction
1995-99, Project Manager, Pentalon Construction
1991-95, Site Engineer, Envirocare of Utah
1989-91, Engineer, Utah Department of Environmental Quality
1985-89, Estimator, Thiede Construction Corporation

Mr. Peterson is also a registered Professional Engineer, Utah, No. 174368-2202. His complete vitae is included in Appendix B.

ACCREDITATION POLICIES AND PROCEDURES MANUAL

University Directive on Safety Practices

Safety Committees were required to be established in all campus colleges and institutes in January 2021. The directive to form these committees came from the Vice President for Research in response to a commitment made to the State of Utah following a 2019 audit of laboratory safety. The Office of Environmental Health and Safety (EHS) currently provides the primary support to these committees.

Although the committees were originally established by the VPR with a focus on research laboratories, campus "safety" crosses boundaries between academics, research, hospital/clinics, and facility operations both on and off campus, and impacts students, faculty, staff, and the surrounding community – it therefore requires a collaborative, holistic approach to be effective. A joint memo was issued from the VPR and the Office of the Chief Safety Officer (available at /4-Other Program Attributes/Safety Culture/) to direct colleges and institutes to empower their safety committees to be the local advocates of safety in all its forms to support an overall culture of safety across the University.

Active and empowered local safety committees are a way for the University to move from a reactive safety posture to a proactive one. As an organization, the University of Utah is transitioning from responding and reacting to past incidents, to focusing on anticipating and preventing future ones. Working safely, being safe, is not a "thing" to be accomplished or a box to be checked – it's a process, a way of thinking, a culture. It is an expectation that the local college safety committees will be the primary "boots on the ground" in this endeavor, helping translate words and policies into actions and behaviors at the college and institute level.

To further this goal, EHS will be joined by several campus partners in actively supporting the safety committees. University Public Safety, composed of Police, Security, and Emergency Management, as well as UHealth Emergency Management, will routinely participate in the quarterly meetings of the safety committee chairs and provide guidance, resources, coordination, and training focused on creating and nurturing an overall culture of safety. On the college/institute side, the composition and scope of the safety committees should consider and reflect the wide range of safety concerns and diversity of stakeholders.

Current Practices

The Department of Civil and Environmental Engineering, the College of Engineering, and the University of Utah take the safety and health of our students, faculty, and staff seriously and acknowledge that it is a prerequisite for teaching and learning. Especially in the past few years, we have embraced the APLU's initiative to build and maintain a culture of safety in teaching and research laboratories and have worked with the University Environment, Health, and Safety (EHS) Department to upgrade our procedures for establishing, maintaining, and verifying safe environments and activities in our teaching and learning environments.

In the case of normal classrooms, few novel or enhanced risks are present compared to home or office spaces. Typical hazards such as tripping, fire code, and electrical equipment are monitored by facilities, the campus fire marshal, and Department faculty and staff and corrective actions taken whenever issues are identified.

We recognize that, if not planned and managed correctly, hands-on laboratory classes and spaces may present enhanced risks including but not limited to electrical, machinery and tools, high speeds and forces, high temperatures / flames, dust/particulates, and exposure to harmful chemicals or materials. Therefore, the instructors of courses and Department staff have carefully planned learning activities and set up and maintained safe teaching laboratories to eliminate or mitigate risks to all persons and the environment. We also provide training as part of the learning experience on how to conduct the work in safe manners.

Some specific examples in our Department are:

- In CVEEN 3515, Civil Engineering Materials Lab, all students are provided with a Laboratory Resource Manual that outlines the safety procedures to be observed while in the lab. The manual explains requirements such as wearing proper footwear, safety glasses, and overall professional behavior. Prior to the first lab, students must watch two safety videos, one put on by the College of Engineering that discusses general laboratory safety procedures and another done specifically for the lab which demonstrates emergency procedures. Following the videos, they must take and pass a quiz on CANVAS with questions related to safety. The video and quiz are available for review.
- Attachment 2 – Sample Safety Plan for Geotechnical Engineering Lab
- Attachment 3 – Sample Laboratory Procedure

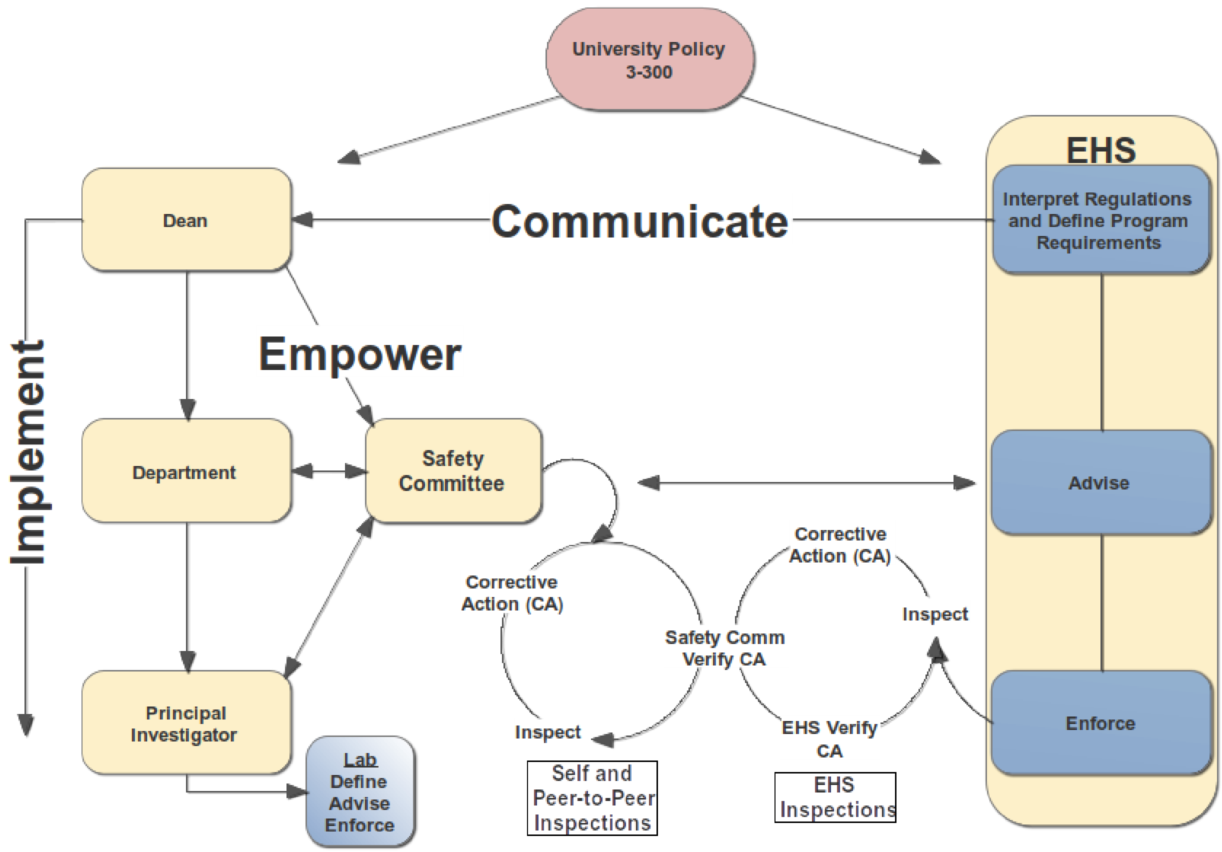
At the University of Utah, the instructor of a course, the Department, College, and EHS share responsibility for assuring safety in all learning and research environments. Our safety framework (including EHS record keeping) uses the term "principle investigator" or PI in the context of research facilities; in the context of dedicated teaching labs or facilities, the instructor and/or responsible Department staff play the role of the front-line manager who is primarily responsible for assuring safety during all hands-on activities. To avoid diffusion of responsibility, each teaching space (lab or facility) has been assigned one faculty or staff member as primarily responsible for the space. This individual is responsible for ensuring the space and equipment in it are safe. In the case where an instructor specifies equipment or activities as part of a course, the instructor is responsible for ensuring those are selected and conducted safely. This includes specifying and providing any needed training, information/procedures, equipment, and procedures for students or others involved (e.g. TAs). Such training and procedures must be documented and provided to learners – verbal training is insufficient. Examples may include instructions and standard operating procedures for equipment, training documents and videos, laboratory handouts and procedures, and assigned, provided, and documented trainings on general laboratory safety or specific hazard classes. The instructor may delegate authority for carrying out training and teaching to staff or TAs but safety must be ensured by the instructor (who holds the position of front line manager in the University organizational structure). In general, activities with unnecessary or more than minimal risks are not assigned to students;

choices of activities and how to carry them out are made considering both pedagogical utility and safety risks and alternatives are found whenever an undue risk may occur.

At the University of Utah, our first choice is to conduct activities with no risk, then those with low risk, then to mitigate any remaining risk using procedures and engineering controls (instructions and warnings to prevent risk, shields, ventilation, etc). Finally, and only as a last line of defense, personal protective equipment (PPE) may be required. Any required items of PPE are specified according to risk assessment for specific activities by the instructor or PI/lab manager and verified by EHS. Default University policy states that any space designated as a laboratory or where laboratory-like activities are occurring (whether research or teaching) requires the following PPE: lab coat, disposable gloves, and safety glasses; individual spaces including sub-spaces within laboratories and or activities occurring in one space may be assigned enhanced or reduced PPE by the PI/lab manager after a documented risk assessment is submitted to EHS as part of the overall safety plan for the space. EHS and the Department assist the instructor in making such decisions.

The Department has responsibility for ensuring that all spaces and activities under its jurisdiction are carried out safely, and each department has established a safety committee consisting of faculty and staff to provide assistance and assurance of health and safety at the department level. The Dean of the College of Engineering holds responsibility for oversight over all Departments and facilities, and both assists and assures safe teaching environments through their designees such as Associate Deans for Space/Budget, Research, and Academic Affairs. A College Safety Committee has been established to assist with assuring learning activities and environments are safe. The University EHS Department serves dual purposes in working with instructors, staff, faculty, Departments, and College to set up and maintain safe learning environments, but also to periodically inspect and enforce any needed corrective actions. The PI / manager of each learning space is responsible for carrying out self-inspections according to EHS's checklist at least yearly, and EHS inspects each space on a schedule according to ongoing risk assessment. EHS maintains the Safety Administrative Management (SAM) electronic database system to track documents and inspections for all physical spaces used for research and teaching. The PI/manager of the space is responsible for keeping updated records of procedures related to safety in that space; of course, instructors must thus keep the PI/manager up to date on any new or changed equipment, procedures, controls, and PPE present or required in that space and help to complete and submit documentation.

The graphic below illustrates the roles and responsibilities within the University with regards to both teaching and research facilities ("lab" at bottom left in this context). In the context of learning environments, the instructor for the course and/or the PI/manager of the space take the role of "PI" depicted on this chart.



University Policy
3-300
EHS
Interpret Regulations and Define Program Requirements
Communicate
Dean
Empower
Implement
Department
Safety Committee
Advise
Corrective Action (CA)
Corrective Action (CA)
Inspect
Safety Comm Verify CA
Principal Investigator
Inspect
EHS Verify CA
Enforce
Lab
Define
Advise
Enforce
Self and Peer-to-Peer Inspections
EHS Inspections

APPENDIX A – COURSE SYLLABI

CVEEN 1000: Introduction to Civil and Environmental Engineering

2. 2 Credits, two 80-minute seminars per week, Engineering Topics

3. Instructor: Jennifer Weidhaas

4. Textbook: Penn, M.R. and Parker, P.J. 2012. Introduction to Infrastructure: An Introduction to Civil and Environmental Engineering. John Wiley & sons, Inc.

5. Specific course information:
   a. An overview of the profession of civil and environmental engineering, including the major elements of the profession, a basic understanding of the core disciplines, and ideas surrounding design. Emphasis is placed on improvements of writing, speaking, and teamwork skills.
   b. No Prerequisites.
   c. Required

6. Course Learning Outcomes:
   a. Upon successful completion of the course, students will be able to:
      - DESCIRBE the core principles that comprise the Civil and Environmental Engineering profession
      - DESCRIBE elements of the ASCE code of ethics and ethical considerations for Civil and Environmental Engineers (ABET student outcome 4)
      - DISCUSS the relationship of the practice of the profession to society, the inherent service nature of the profession, and how the nature of that service influences the nature of practice
      - DEMONSTRATE ability to work in teams, assisting in keeping the team on track and exhibiting relevant knowledge, skills and aptitudes (ABET student outcome 5)
      - DEMONSTRATE ability to write and orally communicate CVEEN concepts
   b. Outcomes:
      - 4a: Describes elements of the ASCE code of ethics.
      - 5a: Contributes to team work, constructively interacts with teammates, assists in keeping the team on track, expects quality work, and exhibits relevant knowledge, skills, and aptitudes

7. Brief list of topics to be covered:
   - Introduction CVEEN; What is design?
   - Intro to natural environment
   - History and heritage
   - Infrastructure systems
   - Ethics
   - Environmental Applications
   - Security considerations
   - Low impact development

- Introduction to Transportation
- Guest lecture-Salt Lake City Engineers
- Introduction to Geotech
- Economic considerations
- Professional development-writing/presenting
- Professional development-resumes/jobs/internships
- Introduction to water resources
- Guest lecture-Construction
- Introduction to Structures
- Energy Infrastructure
- Introduction to Environmental Engineering
- Construction principles
- Guest lecture-Nuclear Engineering

CHEM 1210, General Chemistry I

1. 4 credits, Class/laboratory schedule: Three 50-minute lectures per week; discussion sections, Math & Basic Science

2. Instructor: Jeff Statler

3. Textbooks and/or other required material: Zumdahl and Zumdahl, *Survival Guide for General Chemistry with Math Review and Proficiency Questions, 2nd edition*
Zumdahl and Zumdahl, *Chemistry an Atoms First Approach*
Cengage Learning OWL access

4. General Catalog Course Description: Fundamentals of chemistry emphasizing descriptive and modern applied chemistry for science and engineering majors. Topics include atomic theory, molecular bonding, and reaction chemistry.
    a. Prerequisites: CHEM 1200, or MATH 1050 or equivalent, or placement.
    b. Designation: Required

5. Course learning outcomes:
    - Developing molecular-level critical thinking skills
    - Solving quantitative-reasoning problems
    - Knowing the time, length, and energy scales on which chemical processes occur
    - Understanding the meaning of measurements and types of error
    - Explaining and predicting trends in atomic properties and chemical bonding
    - Explaining and predicting molecular bonding and structure
    - Connecting common approximation methods, such as molecular orbital theory, to standard chemical conceptual frameworks
    - Connecting molecular properties to the behavior of collections of molecules, such as gases, liquids, and solids.
    - Formulating a framework for explaining chemical dynamics, kinetics, and thermodynamics
    - Connecting fundamental chemical principles to modern chemistry applications
    - Speaking and writing the language of chemistry

6. Topics covered in the course:
    - Chemical foundations
    - Atomic structure and periodicity
    - Atoms to molecules
    - Bonding: general concepts
    - Molecular structure and orbitals
    - Chemical energy
    - Gases
    - Liquids and solids
    - Stoichiometry
    - Types of chemical reactions and solution stoichiometry

CHEM 1215, General Chemistry Laboratory I

1. 1 credit, Class/laboratory schedule: One 50-minute lecture per week; one 3-hour lab per week, Math & Basic Science

2. Instructor: Sushma Saraf

3. Textbooks and/or other required material: Chemistry 1215 lab manual, *Experiments in General Chemistry Featuring MeasureNet®, 2nd edition*

4. General Catalog Course Description: One lecture and one 3-hour lab per week. Must be taken concurrently with CHEM 1210.
   a. Corequisites: CHEM 1210
   b. Designation: Required

5. Course Learning Outcomes:
   - Through participation in virtual and at-home laboratory experiments, have an enhanced understanding of core General Chemistry I concepts.
   - Be able to selectively employ basic laboratory techniques in conjunction to answer "open-ended" questions.
   - Be competent with the application of general chemistry I laboratory techniques
   - Be able to analyze data and draw reasonable conclusions pertaining to overarching question(s)
   - Be able to employ scientific writing to communicate experimental results and their meaning
   - Understand proper laboratory safety and best practices

6. Topics Covered:
   - Density
   - Stoichiometry
   - Titrations
   - Gas Laws
   - Emission Spectroscopy
   - Absorption Spectroscopy
   - Chromatography
   - Reactions in Aqueous Solutions
   - Calorimetry/Specific Heat

MATH 1310, Engineering Calculus I

1. 4 credits, class/laboratory schedule: Four 50-minute lectures per week, one 50-minute lab per week, Math & Basic Science

2. Course Coordinator: Will Nesse

3. Textbook: Calculus 4th edition 2010 by Stewart

4. General Catalog Description: Differential and integral calculus with a focus on engineering applications and projects: functions and models; rates of change in science and engineering, limits and derivatives; related rates; derivatives and shapes of graphs; optimization; Newton's method; definite integrals, anti-differentiation and Fundamental Theorem of Calculus; techniques of integration; numerical and symbolic integration with software; arclength, area and volumes via integration.
    a. Prerequisite: C or better in (MATH 1050 AND 1060) OR (MATH 1060 AND (AccuplacerAAF 263+ OR AccuplacerCLM 80+ OR IB Math 5+) OR AP CalcAB 3+ OR AccuplacerAAF 276+ OR AccuplacerCLM 90+ OR ACT Math 28+ OR SAT Math 650+ OR Department Consent
    b. Designation: Required

5. Course Learning Outcomes:
    - Students will understand how to transform functions into other functions through x- and y- translations and rescaling, re-parameterizations, and function composition. Students will also know the properties of special classes of functions including logarithms, exponential functions, polynomials, and rational functions; and know how to obtain function inverses f^{-1}(y)=x when they exist.
    - Students will master the concept of a limiting value of a function f(x)=y when x approaches a value c, know when limits exists, utilize limit laws, how the property of continuity of a function at c relates to its limiting value, how asymptotic behavior can be described by limits, and how limiting values can be specified even when the f(c) is not defined.
    - Students will understand how to use limits to compute the derivative of a function f' that describe or rate of change of a function f. Students will be able to utilize derivatives to model how two related quantities change with respect to each other, including motion of objects by in terms of velocity and acceleration. Students will also learn the methods of differentiation for different classes of functions including exponential and logarithmic functions, trigonometric and inverse trigonometric functions, power functions, and compositions, sums, products, and quotients of functions, as well as differentiating functions that are only implicitly defined by an equation. Students will also be able to utilize the derivative in applied contexts, including function approximation, and how the average slope of a function relates to the derivative through the mean value theorem. If two quantities are related by an equation, students will be able to obtain the derivative of one quantity by knowing the derivative of the other. Students will know how to utilize linear approximations to perform numerical/algorithmic equation solving via Newton's method. Also, students

will be able to utilize the derivative to find maximum, minimum, or otherwise "optimal" input values for equations important in science, business, and engineering.

- Students will understand the definition of the integral of a function as the limiting value of an increasingly large average of function values. They will be able to relate the integral to anti-differentiation, when appropriate, through the fundamental theorem of calculus. Students will also be able to relate the integral to the area under the function's curve, know how to approximate the integral by a finite sum, and how to integrate over infinite-length domains. Specific integration techniques will also be mastered, including substitution, integration-by-parts, and partial fractions. Finally, students will understand the key concept underlying integration, that it computes the net accumulation of a quantity through summation of the change in the quantity amount per unit of time or space, over an specified interval of time or space.
- Students will also improve problem solving fluency, to read and interpret problem objectives, be able to select and execute appropriate methods to achieve the aforementioned objectives, and be able to interpret and communicate result.

6. Topics covered in the course:
    - Functions, Compositions, Exponentials, Logarithms, Inverses
    - Parametric Curves, Velocity, Limits, Limit Laws
    - Continuity, Derivatives, Rate of Change
    - Relationship between a Function and its Derivative
    - Derivatives of Polynomials, Exponentials, Products and Quotients
    - Derivatives of Trig Functions, Chain Rule, Implicit Differentiation
    - Inverse Trig Functions, Logs and their Derivatives, Applications
    - Linear Approximation, Differentials, Related Rates, Max/Min
    - Shapes of Curves, Graphing, l'Hopital's Rule
    - Optimization, Newton's Method, Anti-derivatives
    - Areas, Distances, Evaluating Definite Integrals
    - Fundamental Theorem of Calculus, Substitution, Integration by Parts
    - Integration Techniques, Approximate Integration
    - Improper Integrals, Areas Between Curves, Volumes via shells, cylinders

MATH 1311: Accelerated Engineering Calculus I

1. 4 credits, Class/laboratory schedule: Four 50-minute lectures and one 50-minute problem session per week, Designation: Math & Basic Science

2. Course Coordinator: Will Nesse

3. Textbook: Calculus 4th edition 2010 by Stewart

4. Course Description: Math 1311 and 1321 together are equivalent to the three semester sequence Math 1210, Math 1220, and Math 2210. This sequence is intended for engineering majors. Review of introductory calculus, applications of differential and integral calculus, introduction to differential equations, conic sections and polar coordinates, numerical approximation, sequences and series, power series.
   a. Prerequisite: AP Calculus AB score of 4 or better OR AP Calc BC score of 3 or better
   b. Designation: Required

5. Course Learning Outcomes:
   - Students will understand how to transform functions into other functions through x- and y- translations and rescaling, re-parameterizations, and function composition. Students will also know the properties of special classes of functions including logarithms, exponential functions, polynomials, and rational functions; and know how to obtain function inverses f^{-1}(y)=x when they exist.
   - Students will master the concept of a limiting value of a function f(x)=y when x approaches a value c, know when limits exists, utilize limit laws, how the property of continuity of a function at c relates to its limiting value, how asymptotic behavior can be described by limits, and how limiting values can be specified even when the f(c) is not defined.
   - Students will understand how to use limits to compute the derivative of a function f' that describe or rate of change of a function f. Students will be able to utilize derivatives to model how two related quantities change with respect to each other, including motion of objects by in terms of velocity and acceleration. Students will also learn the methods of differentiation for different classes of functions including exponential and logarithmic functions, trigonometric and inverse trigonometric functions, power functions, and compositions, sums, products, and quotients of functions, as well as differentiating functions that are only implicitly defined by an equation. Students will also be able to utilize the derivative in applied contexts, including function approximation, and how the average slope of a function relates to the derivative through the mean value theorem. If two quantities are related by an equation, students will be able to obtain the derivative of one quantity by knowing the derivative of the other. Students will know how to utilize linear approximations to perform numerical/algorithmic equation solving via Newton's method. Also, students will be able to utilize the derivative to find maximum, minimum, or otherwise "optimal" input values for equations important in science, business, and engineering.

- Students will understand the definition of the integral of a function as the limiting value of an increasingly large average of function values. They will be able to relate the integral to anti-differentiation, when appropriate, through the fundamental theorem of calculus. Students will also be able to relate the integral to the area under the function's curve, know how to approximate the integral by a finite sum, and how to integrate over infinite-length domains. Specific integration techniques will also be mastered, including substitution, integration-by-parts, and partial fractions. Finally, students will understand the key concept underlying integration, that it computes the net accumulation of a quantity through summation of the change in the quantity amount per unit of time or space, over an specified interval of time or space.
- Students will be skilled in using integration to compute problems important in physics and engineering. Students will know how to compute of an average value of a function using the mean value theorem for integrals, the center of mass for objects, and the computation of energy as a force integrated over a distance.
- Students will be able to utilize physical laws to formulate differential equations that solve for the motion of masses by forces of gravitation, friction, and electrostatics.
- Students will also improve problem solving fluency, to read and interpret problem objectives, be able to select and execute appropriate methods to achieve the aforementioned objectives, and be able to interpret and communicate result.

6. Topics covered in the course:
   - Functions, Compositions, Exponentials, Logarithms, Inverses
   - Parametric Curves, Velocity, Limits, Limit Laws
   - Continuity, Derivatives, Rate of Change
   - Relationship between a Function and its Derivative
   - Derivatives of Polynomials, Exponentials, Products and Quotients
   - Derivatives of Trig Functions, Chain Rule, Implicit Differentiation
   - Inverse Trig Functions, Logs and their Derivatives, Applications
   - Linear Approximation, Differentials, Related Rates, Max/Min
   - Shapes of Curves, Graphing, l'Hopital's Rule
   - Optimization, Newton's Method, Anti-derivatives
   - Areas, Distances, Evaluating Definite Integrals
   - Fundamental Theorem of Calculus, Substitution, Integration by Parts
   - Integration Techniques, Approximate Integration
   - Improper Integrals, Areas Between Curves, Volumes via shells, cylinders
   - Differential equations, exponential growth and decay, separability.

MATH 1320: Engineering Calculus II

1. 4 credits, Class/laboratory schedule: Four 50-minute lectures and one 50-minute problem session per week, Math & Basic Science

2. Course Coordinator: Will Nesse

3. Textbooks: Calculus 4th edition 2010 by Stewart

4. Course Description: Differential and Integral Calculus II, with a focus on applications and projects for engineers: integral expressions for moments, centers of mass, and work; infinite series and sequences; power series and Taylor series; vectors, dot and cross products, and the geometry of space; the calculus of vector functions and particle motion in space; differential calculus for functions of several variables, including linear approximation, partial and directional derivatives, chain rule, and
    a. Prerequisite: C or better in (MATH 1310 OR MATH 1311) OR AP Calc BC score of 3 or better OR Department Consent
    b. Designation: Required

5. Course Learning Outcomes:
    - Students will be skilled in using integration to compute problems important in physics and engineering. Students will know how to compute of an average value of a function using the mean value theorem for integrals, the center of mass for objects, and the computation of energy as a force integrated over a distance.
    - Students will become skilled in computations and applications of infinite sequences and sums. Students will become familiar with the properties of infinite sums to either converge to a finite value or diverge to an infinite value, and will learn about methods to determine convergence. Students will be able to represent functions as a Taylor series, and use Taylor's theorem to approximate functions and estimate error from using finitely many terms of the Taylor series.
    - Students will learn important tools of calculus in higher dimensions. Students will become familiar with 2- and 3-dimensional coordinate systems, vectors and vector operations including the dot and cross product, and equations of lines, planes, and other surfaces. Students will also learn how to represent motion of objects in 3D using vector functions, how to represent velocity and acceleration using vector projections into tangential and centripetal coordinates of acceleration, and how to characterize curves in space by computing arc length and curvature. For functions of 3D surfaces, students will be able to characterize aspects of surfaces and volumes using partial derivatives and the gradient vector. Partial derivatives will also be used to describe approximating tangent planes to points on surfaces, and how to compute derivatives of multi-dimensional function compositions can be performed using a multi-dimensional version of the chain rule.
    - Students will also learn the elementary procedures of multivariable integration on varied 2D domains using cartesian and polar coordinates. Students will learn applications of double integrals including center-of-mass, moments, and probability.

- Students will also improve problem solving fluency, to read and interpret problem objectives, be able to select and execute appropriate methods to achieve the aforementioned objectives, and be able to interpret and communicate result.

6. Topics
   - Volumes, Arc length, Average Values,
   - Applications of Integration in Physics and Engineering, Modeling with Differential Equations
   - Sequences, Series, Convergence Tests for Series
   - Sums, Power Series, Representing Functions with Power Series
   - Taylor and Maclaurin Series, Applications of Taylor Polynomials
   - Three Dimensional Coordinates, Vectors, Dot Product
   - Cross Product, Equations of Lines and Planes
   - Functions and Surfaces, Vector Functions, Space Curves
   - Derivatives and Integrals of Vector Functions, Arc Length, Curvature
   - Velocity, Acceleration, Parametric Surfaces
   - Functions of Several Variables, Limits, Partial Derivatives
   - Tangent Planes, Linear Approximation, Chain Rule
   - Directional Derivative, Gradient Vector, Maximum and Minimum Values, Lagrange Multipliers
   - Integration of multivariable functions with double integrals in Cartesian and polar coordinates, and double integral center of mass and probability applications.

MATH 1321: Accelerated Engineering CALC II

1. 4 credits, Class/laboratory schedule: Four 50-minute lectures and one 50-minute problem session per week, Math & Basic Science

2. Course Coordinator: Will Nesse

3. Textbook: Calculus 4th edition 2010 by Stewart

4. Course Description: Completion of Math 1321 is equivalent to completing the entire three semester Calculus I, II, III sequence. Vectors in the plane and in 3-space, differential calculus in several variables, integration and its applications in several variables, vector fields, and line, surface and volume integrals, Green's and Stokes Theorems.
   a. Prerequisite: C or better in MATH 1311 OR AP Calculus BC score of 4 or better
   b. Designation: Required

5. Course Learning Outcomes:
   - Students will become skilled in computations and applications of infinite sequences and sums. Students will become familiar with the properties of infinite sums to either converge to a finite value or diverge to an infinite value, and will learn about methods to determine convergence. Students will be able to represent functions as a Taylor series, and use Taylor's theorem to approximate functions and estimate error from using finitely many terms of the Taylor series.
   - Students will learn important tools of calculus in higher dimensions. Students will become familiar with 2- and 3-dimensional coordinate systems, vectors and vector operations including the dot and cross product, and equations of lines, planes, and other surfaces. Students will also learn how to represent motion of objects in 3D using vector functions, how to represent velocity and acceleration using vector projections into tangential and centripetal coordinates of acceleration, and how to characterize curves in space by computing arc length and curvature. For functions of 3D surfaces, students will be able to characterize aspects of surfaces and volumes using partial derivatives and the gradient vector. Partial derivatives will also be used to describe approximating tangent planes to points on surfaces, and how to compute derivatives of multi-dimensional function compositions can be performed using a multi-dimensional version of the chain rule.
   - Students will also learn the techniques multivariable integration on varied 2- and 3D domains using cartesian, polar, cylindrical, and spherical coordinates. Students will learn applications of double and triple integrals including center-of-mass, moments, probability, density, and volume.
   - Students will study the properties of vector field functions in 2- and 3D and compute work/energy done by the vector fields on directed paths using contour integration. Students will also learn the properties of conservative vector fields, the relationship to gradient fields of potential functions, independence of path, and how to determine if and where a field is conservative. Students will also learn essential descriptors of Curl and Divergence of vector fields and their physical meanings.

- Students will learn how to compute area of and the flux of a vector field through a surface using parameterization function of a surface and double integration. Students will also learn the fundamental vector calculus theorems that relate work- and flux-integrals—the divergence, Green's and Stokes' theorems.
- Students will also improve problem solving fluency, to read and interpret problem objectives, be able to select and execute appropriate methods to achieve the aforementioned objectives, and be able to interpret and communicate result.

6. Topics covered in the course:
   - Sequences, Series, Convergence tests for series, Estimating sums
   - Power series, Representing functions with power series
   - Taylor and Maclaurin series, Applications of Taylor Polynomials three dimensional coordinates
   - Vectors, Dot product, Cross product, Equations of lines and planes, Functions and surfaces
   - Vector functions, Space curves, Derivatives and integrals of vector functions, Arc length, Curvature, Velocity, Acceleration
   - Parametric surfaces, Functions of several variables, Limits, Partial derivatives, Tangent planes
   - Linear approximation, Chain rule, Directional derivative, Gradient vector, Maximum and minimum values
   - Lagrange multipliers, Double integrals, Iterated integrals, Integration over general regions
   - Integrals in polar coordinates, Applications, Surface area, Triple integrals
   - Cylindrical/Spherical coordinate integrals, Change of variables, Jacobians
   - Vector fields, Line integrals, Fundamental Theorem of Line integrals, surface integrals, surface area, flux integrals
   - Green's Theorem, Curl and Divergence, Surface integrals, Stokes' Theorem, Divergence Theorem

Math 2250: Differential Equations and Linear Algebra

1. 4 credits, Class/laboratory schedule: Four 50-minute lectures and one 50-minute problem session per week, Math & Basic Science

2. Course Coordinator: Will Nesse

3. Textbook: Differential Equations and Linear Algebra 4th edition 2018 by Edwards

4. Course Description: This is a hybrid course which teaches the allied subjects of linear algebra and differential equations. These topics underpin the mathematics required for most students in the Colleges of Science, Engineering, Mines & Earth Science.
   a. Prerequisite: "C" or better in (MATH 2210 OR MATH 1260 OR MATH 1280 OR MATH 1321 OR MATH 1320 OR ((MATH 1220 OR MATH 1250 OR MATH 1270 OR MATH 1311 OR AP Calculus BC score of 5) AND PHYS 2210 OR PHYS 3210))
   b. Designation: Required

5. Course Learning Outcomes:
   - Be able to model dynamical systems that arise in science and engineering, by using general principles to derive the governing differential equations or systems of differential equations. These principles include linearization, compartmental analysis, Newton's laws, conservation of energy and Kirchoff's law.
   - Learn solution techniques for first order separable and linear differential equations. Solve initial value problems in these cases, with applications to problems in science and engineering. Understand how to approximate solutions even when exact formulas do not exist. Visualize solution graphs and numerical approximations to initial value problems via slope fields.
   - Become fluent in matrix algebra techniques, in order to be able to compute the solution space to linear systems and understand its structure; by hand for small problems and with technology for large problems.
   - Be able to use the basic concepts of linear algebra such as linear combinations, span, independence, basis and dimension, to understand the solution space to linear equations, linear differential equations, and linear systems of differential equations.
   - Understand the natural initial value problems for first order systems of differential equations, and how they encompass the natural initial value problems for higher order differential equations and general systems of differential equations.
   - Learn how to solve constant coefficient linear differential equations via superposition, particular solutions, and homogeneous solutions found via characteristic equation analysis. Apply these techniques to understand the solutions to the basic unforced and forced mechanical and electrical oscillation problems.
   - Learn how to use Laplace transform techniques to solve linear differential equations, with an emphasis on the initial value problems of mechanical systems, electrical circuits, and related problems.
   - Be able to find eigenvalues and eigenvectors for square matrices. Apply these matrix algebra concepts to find the general solution space to first and second order constant

coefficient homogeneous linear systems of differential equations, especially those arising from compartmental analysis and mechanical systems.

- Understand and be able to use linearization as a technique to understand the behavior of nonlinear autonomous dynamical systems near equilibrium solutions. Apply these techniques to non-linear mechanical oscillation problems and other systems of two first order differential equations, including interacting populations. Relate the phase portraits of non-linear systems near equilibria to the linearized data, in particular to understand stability.
- Students will also improve problem solving fluency, to read and interpret problem objectives, be able to select and execute appropriate methods to achieve the aforementioned objectives, and be able to interpret and communicate result.

6. Topics covered in the course:
    - Differential equations, mathematical models, integrals as a general or particular solution, slope field, separable differential equations
    - Linear differential equation, LR and RC circuits, mixture model, population model, cascades, equilibrium solution, stability, acceleration-velocity models
    - Escape velocity, Jules Verne problem, numerical solutions
    - Linear systems, matrices, Gaussian elimination, reduced row echelon form
    - Matrix operations, matrix inverses, determinants
    - Vector spaces, linear combinations in Rn , span and independence, subspaces
    - Bases and dimension, abstract vector spaces and solution space of a DE, second-order linear DE, general solutions, superposition
    - Constant coefficients, mechanical vibrations, pendulum model, particular solutions to non-homogeneous problems, circuits
    - Forced oscillations, resonance and mechanical vibrations, Laplace transforms, solving a DE with transforms
    - Partial fractions and translations, unit step, ramp, convolution, impulse response
    - Eigenvalues and eigenvectors, diagonalization, power method, first-order systems of ODE
    - Matrix systems of DE, eigenanalysis method, spring systems, forced undamped systems
    - Systems and practical resonance, equilibria, stability, phase portraits for non-linear systems
    - Populations and ecological models, nonlinear mechanical systems

MATH 1210: Calculus I

1. 4 credits, Class/Laboratory Schedule: Four 50-minute lectures and one 50-minute problem session, Math & Basic Science

1. Course Coordinator: Matt Cecil

2. Textbook: Calculus 9th edition 2007 by Varberg

3. Course Description: Functions and their graphs, differentiation of polynomial, rational and trigonometric functions. Velocity and acceleration. Geometric applications of the derivative, minimization and maximization problems, the indefinite integral, and an introduction to differential equations. The definite integral and the Fundamental Theorem of Calculus.
   a. Prerequisite: C or better in ((MATH 1050 AND MATH 1060) OR MATH 1080 OR (MATH 1060 AND (Accuplacer AAF 263+ OR Accuplacer CLM 80+))) OR AP Calc AB 3+ OR Accuplacer AAF 276+ OR Accuplacer CLM 90+ OR ACT Math 28+ OR SAT Math 650+
   b. Designation: Required

4. Course Learning Outcomes:
   - Take limits of algebraic and trigonometric expressions of the form 0/0 (that simplify), non-zero number over 0, including limits that go to (positive or negative) infinity, limits that don't exist and limits that are finite.
   - Use and understand the limit definitions of derivative for polynomial, rational and some trigonometric functions; understand the definition of continuity and consequences.
   - Differentiate all polynomial, rational, radical, and trigonometric functions and compositions of those functions; perform implicit differentiation and compute higher order derivatives.
   - Use differentiation to find critical points and inflection points, the signs of the first and second derivatives, and domain and limit information to determine vertical and horizontal asymptotes. Then use all of that information to sketch the graph of $y = f(x)$.
   - Apply differentiation to optimization, related rates, linear approximation, and problems involving differentials.
   - Compute indefinite integrals and find antiderivatives, including finding constants of integration given initial conditions.
   - Compute definite integrals using the definition for simple polynomial functions. Compute definite integrals using the power rule, basic u-substitution, and the Fundamental Theorems of Calculus.
   - Apply the definite integral to compute area between two curves, volumes of solids of revolutions, arc length, surface area for surfaces of revolution, and work problems.

5. Topics covered in the course:

- Functions and their graphs, limits of functions
- Differentiation of polynomial, rational and trigonometric functions
- Velocity and acceleration
- Geometric applications of the derivative, minimization, and maximization problems.
- The indefinite integral, definite integral and the Fundamental Theorem of Calculus. Applications of integration.

MATH 1220: Calculus II

2. 4 credits, Class/ Laboratory Schedule: Four 50-minute lectures, Math & Basic Science

3. Course Coordinator: Matt Cecil

4. Textbook: Calculus 9th edition 2007 by Varberg

5. General Course Catalog Description: Geometric applications of the integral, logarithmic, and exponential functions, techniques of integration, conic sections, improper integrals, numerical approximation techniques, infinite series and power series expansions, differential equations (continued).
    a. Prerequisite: C or better in (MATH 1210 OR MATH 1250 OR MATH 1270 OR MATH 1311 OR MATH 1310) OR AP Calculus AB score of 4+ OR AP Calculus BC score 3+ OR IB Math score of 5+
    b. Designation: Required

6. Course Learning Outcomes:
    - Compute derivatives and integrals for exponential, logarithmic, hyperbolic functions, and inverse trigonometric functions.
    - Integrate integrable functions using integration by parts, u-substitution, trigonometric substitutions, rationalizing substitutions, partial fraction decomposition, and trigonometric identities. This includes knowing which techniques to apply to a given integral.
    - Use L'Hopital's Rule to calculate indeterminate-type limits and also know what limits are the non-indeterminate forms and how to compute those limits.
    - Compute improper integrals.
    - Understand the difference between an infinite sequence and infinite series and determine if a sequence converges or diverges.
    - Determine whether or not an infinite series of numbers converges or diverges using a variety of tests.
    - Understand what it means for a Power Series to converge or diverge and be able to find the Taylor Series for a given function. Determine how closely a Taylor polynomial approximates a function using Taylor's Remainder Theorem.
    - Differentiate and integrate functions in polar coordinates.

7. Topics covered in the course:
    - Transcendental Functions
    - Techniques of Integration
    - Indeterminate forms and improper integrals
    - Infinite Series
    - Conics & Polar Coordinates

Math 2210: Calculus III

1. 3 credits, Class/ Laboratory Schedule: Three 50-minute lectures, Math & Basic Science

2. Course Coordinator: Matt Cecil

3. Textbook: Calculus 9th edition 2007 by Varber

4. Course Description: Vectors in the plane and in 3-space, differential calculus in several variables, integration and its applications in several variables, vector fields and line, surface, and volume integrals. Green's and Stokes' theorems.
   a. Prerequisite: C or better in (MATH 1220 OR MATH 1250 OR MATH 1320) OR AP Calculus BC score of at least 4
   b. Designation: Required
5. Course Learning Outcomes:
   - Perform basic vector computations, as well as dot and cross products of two vectors and projection of one vector onto another vector.
   - Convert between cylindrical, rectangular and spherical coordinates. Understand when it's prudent to switch to one coordinate system over another in computing an integral.
   - Determine the equation of a plane in 3-d, including a tangent plane to a surface in 3-d.
   - Find the parametric equations of a line in 3-d.
   - Perform calculus operations on functions of several variables, including limits, partial derivatives, directional derivatives, and gradients; understand what the gradient means geometrically.
   - Find maxima and minima of a function of two variables; use Lagrange Multipliers for constrained optimization problems.
   - Understand divergence and curl of a vector field.
   - Compute double and triple integrals in rectangular, spherical and cylindrical coordinates; proper use of double or triple integrals for finding surface area or volume of a 3-d region.
   - Compute line and surface integrals.
   - Determine if a vector field is conservative and if so, find the corresponding potential function.
   - Use and understand when to apply Green's Theorem, Gauss' Divergence Theorem and Stokes Theorem.

6. Topics covered in the course:
   - Parametric Curves, Three Dimensional Coordinates, Vectors
   - Dot Product, Cross Product
   - Vector Valued Functions, Curvilinear Motion, Three Dimensional Lines and Tangent Lines, Three Dimensional Surfaces
   - Spherical and Cylindrical Coordinates
   - Functions of Several Variables, Partial Derivatives, Limits and Continuity
   - Differentiability, Directional Derivative, Gradients

- Chain Rule, Tangent Plane, Approximations, Maxima and Minima
- Lagrange Multipliers
- Double Integrals, Iterated Integrals, Integration over General Regions
- Double Integrals in Polar Coordinates, Surface Area, Triple Integrals
- Integrals in Cylindrical/Spherical Coordinates, Change of Variables, Jacobian
- Line Integrals
- Independence of Path, Green’s Theorem, Surface Integrals
- Gauss’s Divergence Theorem, Stokes’ Theorem

WRTG 2010: Intermediate Writing: Academic Writing and Research

1. 3 credits, Three 50-minute lectures per week

2. Instructor: Varies

3. Barnett and Bedau, *Current Issues and Enduring Questions, 9th edition*
   Jordan, *Open2010*

4. Specific course information:
   a. Writing in undergraduate academic contexts. Students practice analytical and persuasive writing that addresses various academic audiences in a research university. Emphasis on writing for learning, textual analysis, writing from research, and collaborative writing. To be taken Freshman year.
   b. Prerequisites: WRTG 1010 or placement into WRTG 2010
   c. Required

5. Course Learning Outcomes
   a. Write Academic Arguments
      - Write for a particular purpose, context, and audience
      - Situate an argument in current research on the topic of the paper
      - Synthesize the current research on the topic
      - Contribute to an ongoing conversation
      - Develop an argument using good evidence
      - Edit and proofread according to the conventions of Standard Written English
   b. Develop Information Literacy
      - Conduct secondary research to write in an academic context
      - Use research databases and other online search tools
      - Identify and use reliable sources that are appropriate to the topic and audience
      - Demonstrate flexibility using a variety of online genres and source types
      - Write using digital media appropriate to the rhetorical context
   c. Develop Strategies for Working with Genre and Academic Conventions
      - Compose in multiple genres, both academic to nonacademic
      - Use visual elements to support the purpose and/or argument of the text
      - Write well-formed sentences, with strong clausal organization that follow the expectations of Standard Written English
      - Write paragraphs that are structured to develop ideas and make connections between the paragraphs
      - Use a citation style consistently, attributing words and/or ideas to the appropriate author
   d. Collaborate

- Collaborate with peers to research a problem or topic
- Write collaboratively to create persuasive and informative messages

6. Brief list of topics to be covered:
    a. Emphasis on writing for learning
    b. textual analysis
    c. writing from research
    d. collaborative writing

PHYS 2210, Physics for Scientists and Engineers I

1. 4 credit lecture, Class/laboratory schedule: 3 hours lecture, 2 hours discussion, Math & Basic Science

2. Instructors: Anthony Pantziris, Claudia De Grandi

3. Textbooks and/or other required material: Physics for Scientists and Engineers: A Strategic Approach with Modern Physics, 4th Edition by Randall D. Knight

4. General Catalog Course Description: Three lectures and two recitations weekly. Designed to give science and engineering students a thorough understanding of the basic physical laws and their consequences. Classic mechanics will be introduced, including methods of energy, momentum, angular momentum, and Newtonian gravity. Applications will include mechanical oscillations, sound, and wave motion. Those engineering students who have not had calculus before (high school or college-level course), need to see an engineering advisor.
    - Prerequisites: "C-" or better in (MATH 1210 OR MATH 1250 OR MATH 1310 OR MATH 1311 OR MATH 1220 OR MATH 1320) OR AP Calc AB score of 4+ OR AP Calc BC score of 3+.
    - Designation: Required

5. Course Learning Outcomes:
    - Help students understand and solve problems in a broad range of scientific and engineering fields.
    - Teach students the fundamental principles of physics
    - Teach student how to describe real world phenomena quantitatively
    - Teach problem-solving skills that can be applied to other areas of science, engineering, and life.

6. Topics covered in the course:
    - Mechanics includes motion in multiple dimensions
    - Forces and the laws of motion, energy, momentum, rotational motion
    - Motion of rigid objects
    - Angular momentum
    - Oscillations and waves.

CHEM 1220, General Chemistry II

1. 4 credits, Class/laboratory schedule: Three 50-minute lectures per week, discussion sections, Math & Basic Science

2. Instructor: Jeff Statler

3. Textbooks and/or other required material: Zumdahl and Zumdahl, *Chemistry an Atom's First Approach, 1st edition*

4. General Catalog Course Description: Three lectures and two discussions weekly. A continuation of CHEM 1210, exploring further problem-solving within an applications-oriented framework, although significantly more in-depth. Topics covered include colligative properties, chemical kinetics, general equilibrium, acid-base equilibrium, thermodynamics and electrochemistry. It is very beneficial to take CHEM 1220 in expedient succession following CHEM 1210.
   a. Prerequisites: C- or better in (CHEM 1210 OR CHEM 1211) OR AP Chem score of at least 4.
   b. Designation: Selected Elective

6. Course Learning Outcomes:
   - Understanding the time, length, and energy scales on which chemical processes occur
   - Understanding the differences between classical and quantum mechanics
   - Connecting operators to observables
   - Distinguishing probabilities, amplitudes, averages, expectation values, and observables
   - Understanding the origin and implications of quantum coherence
   - Interpreting spectra
   - Connecting common approximation methods to standard chemical frameworks (Born-Oppenheimer, molecular orbitals)
   - Developing molecular-level critical thinking skills

7. Topics covered in the course:
   - Solids, Liquids, Phase Changes
   - Properties of Solutions
   - Chemical Kinetics
   - The Nucleus: A Chemist's View
   - Chemical Equilibrium
   - Acids and Bases
   - Acid-Base Equilibria
   - Solubility and Complex Ion Equilibria
   - Spontaneity, Entropy, and Free Energy
   - Electrochemistry

PHYS 2220, 2225 Physics for Scientists and Engineers II, Physics for Scientists and Engineers II Laboratory

1. 4 credits, Class/laboratory schedule: Three 50-minute lectures per week; two discussion sections, Basic Math & Science

2. Instructor: Kevin Davenport, Ramón Barthelemy, Gernot Laicher (Lab)

3. Textbooks and/or other required material: Serway & Jewett, Jr., *Physics for Scientists and Engineerins (with Modern Physics), 9th edition*

4. General Catalog Course Description: Three lectures and two recitations weekly. The continuation of PHYS 2210. Electrostatics, electric fields, and potential. Magnetic fields and Faraday's law. Current flow, resistance, capacitance and inductance. Electric circuits and electromagnetic oscillations. Electromagnetic waves, geometric and physical optics.
    a. Prerequisites: "C-" or better in (((MATH 1220 OR MATH 1250 OR MATH 1311 OR MATH 1320 OR MATH 2210) OR AP Calculus BC score of 4+) AND ((PHYS 2210 OR PHYS 3210) OR AP Physics C Mech score of 4+)).
    b. Designation: Selected Elective

5. Course Learning Outcomes:
    - Appreciate the power of physics and mathematics to deepen your scientific understanding of some of the physical phenomena we observe everyday.
    - Identify, apply and master problem solving strategies to reach a quantitative understanding in a variety of circumstances.
    - Monitor your learning process, understand your mistakes, and develop strategies for success and improvement.
    - Collaborate productively in a group and learn from your peers

6. Topics covered in the course:
    - Electric fields
    - Electric currents
    - Magnetic fields
    - Induced currents
    - Electromagnetic waves and optics

PHYS 2215, Physics Laboratory for Scientists and Engineers I

1. 1 credit, Class/laboratory schedule: 3 hours of lab weekly, Math & Basic Science

2. Instructor: Gernot Laicher

3. Textbooks and/or other required material: Instructional material provided, MatLab, webcam and microphone, internet connection

4. General Catalog Course Description: Teaches laboratory skills needed by scientists and engineers. Measurement, data analysis, computer graphics display, experimental design and report writing, experimental procedures and results. Experiments in mechanics and waves. Laboratory designed to accompany PHYS 2210.
    a. Pre/Coquisites: PHYS 2210
    b. Designation: Selected Elective

5. Course Learning Outcomes:
    - Critically think through, design, and implement experimental procedures and measurements.
    - Analyze measurements and present discussion and results, generally in form of a MatLab live script.
    - Perform basic MatLab coding/analysis.
    - Create some mathematically models in MatLab to simulate the behavior of physical systems.

6. Topics covered in the course:
    - MatLab Exercises; Measurements
    - One and Two Dimensional Motion, Relative Motion
    - Forces-Static Equilibrium
    - Projectile Motion; Dynamics- Forces, Work, Energy
    - Collisions- Momentum, Impulse, and Energy
    - Hooke's Law, Mass-Spring Oscillator
    - Damped and Driven Oscillators

CHEM 1225, General Chemistry Laboratory II

1. 1 credit, Class/laboratory schedule: One 50-minute lecture per week; one 3-hour lab per week, Math & Basic Science

2. Instructor: Sushma Saraf

3. Textbooks and/or other required material: Chemistry 1225 lab manual *Experiments in General Chemistry Featuring MeasureNet, 2nd edition*

4. General Catalog Course Description: One lecture per week, one three-hour laboratory/discussion per week.
    a. Co-requisites: CHEM 1220
    b. Designation: Selected Elective

5. Course Learning Outcomes:
    - Through participation in virtual and data analysis experiments, have an enhanced understanding of core General Chemistry II concepts.
    - Be able to selectively employ basic laboratory techniques in conjunction to answer "open-ended" questions.
    - Be able to analyze data and draw reasonable conclusions pertaining to overarching question(s).
    - Be able to employ scientific writing to communicate experimental results and their meaning.
    - Communicate (both oral and written) in a respectful and professional manner as well as learn time-management skills (meeting deadlines and completing assignments on time).

6. Topics covered:

- Colligative Properties: FP Depression
- Changes in Thermal Energy
- Kinetics
- Rxn Equilibrium
- Le Chatlier's
- Determining Ka

CVEEN 1400: Computer-Aided Design Spring 2021

1. 3 credit hours, two 50-minute lectures per week; one 50-minute lab, Engineering Topics

2. Instructor: Dr. Gaby Ou

3. Textbook: The Hitchhiker's Guide to AutoCAD Basics: Tutorial Guide to AutoCAD (2017/2018/2019). Author: Shawna Lockhard, Perfect Paperback: 700 pages, Publisher: SDC Publications (May 25, 2016), Language: English. ISBN-10: 9781630570439. ISBN-13: 978-1630570439. ASIN: 1630570435
   a. AutoCAD Civil 3D 2016 Essentials: Autodesk Official Press. Author: Eric Chappell, Pages: 416 pages, Publisher: Sybex 2015-06-02, Language: English. ISBN-10: 1119059593. ISBN-13: 9781119059592

4. Specific course information:
   a. Computer-aided design (CAD) is the use of computer systems to aid in the creation, modification, analysis, or optimization of the design. CAD software is used to increase the productivity of the designer, improve the quality of design, improve communications through documentation, and to create a database for manufacturing.
   b. No prerequisites or co-requisites
   c. Required

5. Course Learning Outcomes:
   a. To enhance the comprehension of undergraduate students about civil engineering projects, and to reduce the gap between undergraduate level education and industry expectation, this course will:
      - introduce computer-aided design (CAD), with a particular focus on using software AutoCAD and AutoCAD Civil 3D. AutoCAD Civil 3D software permits the rapid development of alternatives through its model-based design tools.
      - Students will learn techniques enabling them to organize project data, work with points, create and analyze surfaces, model road corridors, create parcel layouts, perform grading and volume calculation tasks, and layout pipe networks.
   b. Outcomes:
      - 3a (Nontechnical): An ability to communicate effectively with None-Technical audiences, a) Writing conforms to appropriate technical style format appropriate to the Public audience, appropriate use of graphics, mechanics & grammar.
      - 3a (Technical): An ability to communicate effectively with Technical audiences, a) Writing conforms to appropriate technical style format appropriate to the Public audience, appropriate use of graphics, mechanics & grammar.

- 7a: An ability to acquire and apply new knowledge as needed, using appropriate learning strategies. a) Able to find information relevant to problem solution without guidance.

6. Brief list of topics to be covered:
   - Introduction to AutoCAD
   - Basic drawing, editing, manipulating, preparing plots function of AutoCAD
   - Orthographic Drawings
   - AutoCAD Civil 3D
   - Be able to deliver orthographic drawings of objects
   - Understand points and point groups
   - Understand, Create, edit, view, and analyze surfaces
   - Understand, Create and edit alignments
   - Understand sites, profiles, and cross-sections
   - Understand, create assemblies, corridors, and intersections
   - Understand, create grading solutions
   - Understand, create a gravity fed and pressure pipe networks
   - Perform quantity takeoff and volume calculations

CVEEN 2010: Statics

1. 3 credits, three 50-minute lectures per week, Engineering Topics

2. Instructor: Xuan 'Peter' Zhu

3. Textbook: Engineering Mechanics: Statics, Meriam, Kraige, Bolton, Wiley. 8th Ed, one of the formats: Bundle of hard bound Text, e-text, or WileyPLUS 9th Ed, one of the formats: Bundle of hard bound Text, e-text, or WileyPLUS
    a. Materials:
        i. Engineering computation paper
        ii. NCEES FE Exam Approved Calculator

4. Specific course information:
    a. Forces, moments and couples; resultants and static equilibrium of general force systems; statically equivalent force systems, center of gravity and center of pressure; friction; free body method of analysis; trusses and frames; internal forces (shearing forces and bending moments); tensile and compressive axial forces; applications to simple engineering problems.
    b. Prerequisites: "C" or better in ((MATH (1210 OR 1310 OR 1311)) OR AP Calc AB score of 4+ OR AP Calc BC score of 3+) AND Full Major status in (CVEEN OR Construction Engineering). Corequisites: "C" or better in PHYS 2210 OR AP Phy ME score of 4+.
    c. Required

5. Course Learning Outcomes:
    a. Upon successful completion of this course, the student will be able to:
        - Develop free body diagrams for bodies in static equilibrium
        - Calculate the external reactions for bodies in static equilibrium
        - Determine internal forces and forces on pins in trusses, beams, machines, and frames
        - Find geometric properties of areas and forces (centroids, moments of inertia, etc.)
        - Determine the effect of friction between connecting parts or at support surfaces.
    b. Outcomes:
        - 1a: Writing conforms to appropriate technical style format appropriate to the audience, appropriate use of graphics, mechanics & grammar.
        - 1b: Oral content is appropriate for audience, body language and clarity of speech enhances communication.
        - 7a: Able to find information relevant to problem solution without guidance

6. Brief list of topics to be covered:
    a. Forces, moments, and couples
    b. Resultants and static equilibrium of general force systems

c. Statically equivalent force systems, center of gravity and center of pressure; friction
d. Free body method of analysis
e. Trusses and frames
f. Internal forces (shearing forces and bending moments)
g. Tensile and compressive axial forces
h. Applications to simple engineering problems.

CVEEN 2000: Seminar (formerly CVEEN 3000 and CVEEN 4000)

1. 0.5 credits, one 50-minute seminar per week, Engineering Topics

2. Instructor: Michael E. Barber

3. No textbook
    a. Outside Speakers

4. Specific course information:
    a. Selected presentations from individuals who deal with different aspects of the practice of civil and environmental engineering.
    b. No prerequisites or co-requisites
    c. Required

5. Course Learning Outcomes:
    a. Students in this course will be able to:
        - explain professional practice, expectations, opportunities, and responsibilities of Civil and Environmental Engineers.
        - The seminar also addresses contemporary issues and professionalism.
    b. Outcomes:
        - 4a: Describes elements of the ASCE code of ethics

6. Brief list of topics to be covered:
    - Variable depending on actual speakers/companies participating with the goal of covering as wide a spectrum of Civil/Environmental Engineering as possible (i.e., Environmental, Geotechnical, Structures, Construction, Transportation, Water Resources, Graduate School, and Career Services).
    - Speakers are requested to consider integrating a few comments concerning one or all of the following topics (as appropriate):
    - The value of internships during their undergraduate studies
    - The value of a broad-based undergraduate curriculum
    - The value of experiencing leadership opportunities during their school years
    - The need for continuous learning throughout their careers
    - The value of graduate school

- The need to become a licensed engineer (FE and PE).

ECON 2010 Principles of Microeconomics

2. Credits, contact hours, and categorization of credits in Table 5-1
   3 credits, 45 contact hours, other topic

3. Instructor's or course coordinator's name
   Catherine Ruetschlin

4. Text book, title, author, and year
   Goodwin, Neva, Jonathan M. Harris, Julie A. Nelson, Pratistha Joshi Rajkarnikar, Brian Roach, and Mariano Torras. *Microeconomics in Context, Fourth Edition.* New York: Routledge, 2019.

5. Specific course information
   a. brief description of the content of the course (catalog description)
      Principles of Microeconomics presents the fundamental tools of analysis for understanding economic decision making among individuals, firms, and organizations, whose collective decisions determine how resources are allocated in a capitalist economy. Students will engage with the basic analytic tools of modeling and critical thinking. The tools presented include supply and demand analysis, theories of consumer and producer behavior, analysis of competition and market power, and their application to social welfare and public policy.
   b. prerequisites or co-requisites
      None
   c. indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program
      Required

6. Specific goals for the course
   a. specific outcomes of instruction
      - Understand the role of markets in modern society
      - Build and manipulate the basic microeconomic model of supply and demand
      - Apply and interpret the economic logic of basic models of international trade, environmental resource management, and other contemporary public policy issues
      - Identify the properties of competitive markets and those with market power
   b. explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.

7. Brief list of topics to be covered
   Markets & society
   Production possibilities and international trade
   Trade policy
   Supply and demand
   Elasticity
   Welfare analysis

Taxes and tax policy
Externalities and the environment
Public goods
Production costs
Perfect competition
Monopoly markets
Monopolistic competition and oligopoly

CVEEN 2300: Engineering Economics

2. 2 credit hours, two 50-minute lectures per week, Engineering Topics

3. Instructor: Steven J. Burian

4. Textbook: Newnan, D.G., Eschenbach, T.G., Lavelle, J.P., and Lewis, N.A. (2020). Engineering Economic Analysis, 14th Ed. Oxford University Press.

5. Specific course information:
    a. Fundamental engineering economics topics, including equivalence, compound interest and discount rate factors, nominal and effective interest rates, cash flow diagrams, capitalized cost, net present worth analysis, equivalent uniform annual cost, internal rate of return, benefit-cost analysis, basic microeconomics, cost estimation, and cost indexes.
    b. Prerequisites: Major Status in (Civil Engineering OR Construction Engineering).
    c. Required

6. Course Learning Outcomes:
    a. Upon successful completion of this course the student will be able to:
        - Explain engineering economics concepts to decision makers
        - Apply computer tools, especially Microsoft Excel, to analyze the engineering economics of a project.
        - Use factor notation and compound interest tables to organize and complete economic analyses.
        - Choose the appropriate analysis technique and apply to solve an engineering economics problem
        - Evaluate engineering work by ethically using an economic basis
        - Judge multidimensional projects considering a benefit/cost analysis

7. Brief list of topics to be covered:
    - Making Economic Decisions
    - Engineering Costs and Cost Estimating
    - Interest and Equivalence
    - Equivalence for Repeated Cash Flows
    - Present Worth Analysis
    - Annual Worth Analysis
    - Rate of Return Analysis
    - Choosing the Best Alternative
    - Other Analysis Techniques
    - Economic Analysis in the Public Sector

ECON 2010: Principles of Microeconomics

2. Credits, contact hours, and categorization of credits in Table 5-1
   3 credits, 45 contact hours, other topic

3. Instructor's or course coordinator's name
   Catherine Ruetschlin

4. Text book, title, author, and year
   Goodwin, Neva, Jonathan M. Harris, Julie A. Nelson, Pratistha Joshi Rajkarnikar, Brian Roach, and Mariano Torras. *Microeconomics in Context, Fourth Edition.* New York: Routledge, 2019.

5. Specific course information
   a. brief description of the content of the course (catalog description)
      Principles of Microeconomics presents the fundamental tools of analysis for understanding economic decision making among individuals, firms, and organizations, whose collective decisions determine how resources are allocated in a capitalist economy. Students will engage with the basic analytic tools of modeling and critical thinking. The tools presented include supply and demand analysis, theories of consumer and producer behavior, analysis of competition and market power, and their application to social welfare and public policy.
   b. prerequisites or co-requisites
      None
   c. indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program
      Required

6. Specific goals for the course
   a. specific outcomes of instruction
      - Understand the role of markets in modern society
      - Build and manipulate the basic microeconomic model of supply and demand
      - Apply and interpret the economic logic of basic models of international trade, environmental resource management, and other contemporary public policy issues
      - Identify the properties of competitive markets and those with market power
   b. explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.

7. Brief list of topics to be covered
   Markets & society
   Production possibilities and international trade
   Trade policy
   Supply and demand
   Elasticity
   Welfare analysis

Taxes and tax policy
Externalities and the environment
Public goods
Production costs
Perfect competition
Monopoly markets
Monopolistic competition and oligopoly

CVEEN 2310: Probability and Statistics

2. 3 credit hours, three 50-minute lectures per week, Engineering Topics

3. Instructor: Nikola Markovic

4. Textbook: Introduction to Probability, Bertsekas, D.P. and Tsitsiklis, 2008

5. Specific course information:
    a. Introductory probability and statistics topics that are relevant to civil and environmental engineering, including set terminology and theory, fundamental axioms of probability, conditional probability, statistical independence, Bayes' theorem, deMorgan's rule, random variables, probability mass, density and distribution functions, moments, measures of central tendency and dispersion, common discrete and continuous probability functions, data compression, frequency distributions, point estimation, and confidence intervals.
    b. Prerequisites: "C" or better in ((MATH 1210 OR MATH 1310 OR MATH 1311) OR AP Calc AB score of 4+ OR AP Calc BC score of 3+) AND Full Major status in (Civil Engineering OR Construction Engineering)
    c. Required.

6. Course Learning Outcomes:
    a. Upon successful completion of this course, the student will be able to:
        - Derive basic properties of the Bernoulli, Binomial, Geometric, Uniform, Exponential, Poisson, Normal and other distributions and use them in different engineering applications [ABET (a)].
        - Apply knowledge of basic statistical methods (e.g., interval estimation, hypothesis test) and simulation (e.g., random number generators, inverse transform method) for decision making [ABET (a, b)].
        - Use R programming language to summarize a data set via box plot or a histogram, perform hypothesis testing, and apply linear regression [ABET (a, b, k)].
    b. Outcomes:
        - 1a: Problem statement shows understanding of the problem (identify)
        - 1b: Applies engineering, science, or mathematical principles or numerical solution to model equations (formulate & solve)
        - 7a: Able to find information relevant to problem solution without guidance.

7. Topics covered in the course:
    - Discrete and continuous random variables, confidence intervals, hypothesis tests, data processing in R.

MGEN 2400: Surveying

2. 3 credits, Lecture (3 hr), Laboratory (0 hrs)

3. Instructor: Dana J. Johnson

4. Text book: None
    a. Handouts, Canvas PPT lectures and Kaltura videos

5. Specific course information
    b. This course introduces basic surveying skills important for mining engineers. These skills included; how to operate an engineer's level, total station, and GPS. These skills are learned (machine use, notebook keeping and data reduction) and how they are applied to fundamental surveying applications.
    c. Prerequisites: Trigonometry
    d. Required course: Math 1050 or higher

6. Specific goals for the course

    By the end of this course, student will be able to:
    e. Operate an engineer's level, total station, and have a working knowledge of how GPS is used in surveying work.
    f. Understanding the mathematics in reducing survey data. The making of maps and a survey report.

    Contributes to Outcome: 3

CVEEN 2410: GEOMATICS

2. 3 Credits, two 80-minute lectures per week, Engineering Topics

3. Instructor: Steven F. Bartlett

4. Textbook: Ghilani, Charles D. and Wolf, Paul R., 2014. Elementary Surveying: An Introduction to Geomatics. Pearson Higher Ed.

5. Specific course information
    a. An introduction to principles of measurement science, geometry of spatial measurement, spatial data, reference systems and datums, coordinate systems, surveying principles and instrumentation, interpretation of maps and plans in three dimensions, surveying software, spreadsheets, introduction to fields of Geomatics and Geographic Information Systems (GIS).
    b. No Prerequisites.
    c. Optional course in the program

6. Specific goals for the course
    a. Upon successful completion of this course, students will be able to:
        i. Define Geomatics and understand the general relation between the fields of geomatics as well as know the various types of surveying technologies
        ii. Know how to measured distances, angles and understand Cartesian Coordinates
        iii. Know how to make maps, elevation and terrain models
        iv. Know how to make X-sections and how to identify and adjust for error,
        v. Know how to make 3D models from drone surveys,
        vi. Know how to use LiDAR data and GIS and how it is applied.
    b. Outcomes:
        i. 1a: Problem statement shows understanding of the problem (identify).
        ii. 1b: Applies engineering, science or mathematical principles to achieve analytical or numerical solution to model equations (formulate & solve).
        iii. 5a: a. Contributes to team work, constructively interacts with teammates, assists in keeping the team on track, expects quality work, and exhibits relevant knowledge, skills, and aptitudes

7. Brief list of topics to be covered
    - Introduction to Units and Significant Figures and Field Notes
    - Theory of Errors in Observations, Leveling - Theory, Methods, and Equipment
    - Distant Measurements, Angles, Azimuths, and Bearings
    - Total Station Instruments and Angle Observations
    - Traversing, Computations, Coordinate Geometry in Survey Calculations,
    - GPS Introduction and Principles, Adjustments by Least Squares, Mapping, and Mapping Surveys, Terrain Modeling Using UAVs (Unmanned Aerial Vehicles),
    - Introduction to LiDAR Data and Terrain Models Construction Surveys

CVEEN 2140: Strength of Materials

2. 3 credit hours, three 50-minute lectures per week, Engineering Topics

3. Instructor: Chris Pantelides

4. Textbook: Hibbeler, R.C., 2017, Mechanics of Materials, 10th Edition, Pearson, ISBN-13: 978-0-13-432118-9
    a. Materials:
        i. Straight Edge and French curve
        ii. Engineering computation paper
        iii. Access to structural analysis software of your choice, e.g. Visual analysis Educational (https://www.iesweb.com/edu/) (Free software)
        iv. NCEES FE Exam Approved Calculator (See https://ncees.org/exams/calculator)

5. Specific course information:
    b. Concept of stress, axial stress and strain, torsion, pure bending, transverse loading, transformations of stress and strain, design of beams and shafts for strength, deflection of beams, columns.
    c. Prerequisites: "C" or better in (CVEEN 2010 OR ME EN 2010) AND Full Major Status in (Civil Engineering OR Construction Engineering).
    d. Required

6. Course Learning Outcomes:
    a. Upon successful completion of this course the student will be able to:
        - Derive and apply basic models of stress and strain for structural components
        - Model the state of stress at a point and determine maximum normal and shear stresses; Assess the adequacy of axially, transversely, and/or torsionally-loaded members
        - Calculate elastic and thermal strains and deflections of a member
        - Analyze simple statically indeterminate members.
    b. Outcomes:
        - 1a: Writing conforms to appropriate technical style format appropriate to the audience, appropriate use of graphics, mechanics & grammar.
        - 1b: Oral content is appropriate for audience, body language and clarity of speech enhances communication.
        - 7a: Able to find information relevant to problem solution without guidance

7. Brief list of topics to be covered:
    - Concepts of stress
    - Axial stress and strain
    - Torsion
    - Pure bending
    - Transverse loading,

- Transformation of stress and strain
- Engineering design
- Deflection of beams and columns

CVEEN 2750: Computer Tools

2. 2 credits, two 50-minute lectures per week, Engineering Topics

3. Instructor: Carlos Oroza

4. No textbook required

5. Specific course information:
    a. Applications of computer tools in Construction and Civil Engineering: Building Information Management, VBA Programming, SQL Databases, 3D modeling.
    b. Prerequisites: C or better in ((MATH 1210 OR MATH 1310 OR MATH 1311) OR AP Calc AB score of 4+ OR AP Calc BC score of 3+).
    c. Required

6. Course Learning Outcomes:
    a. Upon successful completion of this course, students will be able to:
        - Understand fundamental concepts about computing and processing systems
        - Use advanced spreadsheet skills to answer engineering problems
        - Develop fundamental programming skills to make spreadsheets more efficient and powerful
        - Use database management techniques to effectively work with large amounts of complex data; Master essential skills with BIM software
    b. Outcomes:
        - 1a: Writing conforms to appropriate technical style format appropriate to the audience, appropriate use of graphics, mechanics & grammar.
        - 1b: Oral content is appropriate for audience; body language and clarity of speech enhances communication.
        - 7a: Able to find information relevant to problem solution without guidance

7. Brief list of topics to be covered
    - Fundamental principles of computer processing
    - Data validation
    - Indexing
    - Conditional formatting
    - What-if analysis and problem solving (Goal Seek, Scenario Manager, Solver etc.)
    - Macros
    - Controls
    - VBA Programming
    - SQL
    - 3D modeling/BIM

CVEEN 3100: Technical Communication for Engineers

7. 3 credits, two 80-minute lectures per week, Engineering Topics

8. Instructor: Joshua Lenart

9. A Guide to Writing as an Engineer, D. Beer and D. McMurrey, 2014.
   Supplementary materials:
   a. Cannibals with Forks: The Triple Bottom Line of 21st Century Business, J. Elkington, 1999.
   b. So, You Have to Write a Literature Review: A Guided Workbook for Engineers, C. Berdanier and J. Lenart, 2020.

10. Specific course information:
    a. Learning to communicate orally and in writing is an essential component of an undergraduate engineering education. The course addresses the fundamentals of writing and reviewing technical documents, presenting scientific information through graphs and tables, and preparing technical presentations.
    b. Prerequisites: C- or better in ((WRTG 2010 OR EAS 1060 OR HONOR 2211) OR AP Lit Comp score of 4+ OR AP Lang Comp score of 4+) AND Full Major Status in (Civil Engineering OR Construction Engineering).
    c. Required

11. Course Learning Outcomes
    a. This course is designed through project-based learning principles in order to guide students in improving their technical writing and speaking faculties. At the end of the course, students will be able to:
       - Demonstrate revision and writing skills related to academic engineering
       - Demonstrate peer-review and self-review strategies for writing
       - Synthesize relevant literature related to a research topic for a literature review
       - Evaluate academic engineering written and oral communication
       - Translate research findings to a variety of stakeholders
    b. Outcomes:
       - 3a (Technical): Writing conforms to appropriate technical style format appropriate to the audience, appropriate use of graphics, mechanics & grammar
       - 3b (Technical): Oral content is appropriate for audience, body language and clarity of speech enhances communication.
       - 3a: (Non-Technical): Writing conforms to appropriate technical style format appropriate to the audience, appropriate use of graphics, mechanics & grammar
       - 3b: (Non-Technical): Oral content is appropriate for audience, body language and clarity of speech enhances communication.

- 5a: Contributes to teamwork, constructively interacts with teammates, assists in keeping the team on track, expects quality work, and exhibits relevant knowledge, skills, and aptitudes.

12. Brief list of topics to be covered:
    a. Resumes, CVs, and cover letters
    b. Technical memos, proposals, and reports
    c. Grammar, style, and editing
    d. Team writing
    e. Feasibility studies
    f. Triple bottom line methodology
    g. Literature reviews
    h. Public speaking
    i. Professional presentations and partnerships

CVEEN 3210: Structural Loads and Analysis

1. 3 credits, two 80-minute lectures per week, Engineering Topics

2. Instructor: Dr. Doug Schmucker, PhD

3. Textbook: Structural Analysis: Skills for Practice, 1/e, Jim Hanson, Pearson, 2019
   a. Materials:
      - Access to structural analysis software of student's choice, e.g., Visual Analysis Educational (http://www.edu.iesweb.com/index.htm) (free software)

4. Specific course information:
   a. Introduction to structural design loads, structural systems, and load paths; theoretical, numerical, and approximate models of structural response; internal and external effects in structures.
   b. PREREQUISTES: CVEEN 2140 (Strength of Materials) and AND Full Major status in CvEEN
   c. Required

5. Course Learning Outcomes:
   a. Upon successful completion of this course, the student will be able to:
      - Identify and classify structural systems, sub-systems, and components.
      - Identify the participants and roles of responsibilities in civil engineering design.
      - Compute internal forces for members and support reactions in a variety of determinate structural systems.
      - Construct internal force diagrams for members in a variety of structural systems.
      - Create models for and calculate anticipated deflections of structures and their components.
      - Estimate structural analysis results and evaluate the reasonableness of the estimates and results.
   b. Outcomes:
      - 1a: Problem statement shows understanding of the problem (identify).
      - 1b: Applies engineering, science or mathematical principles to achieve analytical or numerical solution to model equations (formulate & solve).
      - 4b: Evaluates conflicting/competing global, economic, environmental, and societal issues in order to make informed decisions about an engineering solution & incorporates that sensitivity into the design process.

6. Brief list of topics to be covered:
   - Introduction to Structural Systems and Design
     - Structure Idealization and Structural Systems
     - Load Paths and Load Types
     - Design, Participants, Safety, and Professional Responsibility

- Models, Estimation, and Structural Intuition
    - Trusses
    - Beams and Frames
    - Computer-based
- Deformation Models
- Approximate Methods

CVEEN 3310: Geotechnical Engineering

2. 3 credit hours, three 50-minute lectures per week, Engineering Topics

3. Instructor: Evert Lawton

4. Textbook: An Introduction to Geotechnical Engineering by R. D. Holtz, W. D. Kovacs, & T. C. Sheahan, 2nd edition, Pearson, Upper Saddle River, New Jersey, 2011. ISBN-13: 978-0-13-249634-6.

5. Specific course information:
   a. An introduction to the fundamental geologic and engineering properties of sills and basic soil mechanics. Topics include geologic soil processes, phase relations, grain-size distribution, clay mineralogy, clay-water interaction, consistency limits, fabric and structure, classification, compaction, swelling, shrinkage, slaking, collapse, permeability, one- and two-dimensional flow, liquefaction, consolidation and settlement, and shearing strength of cohesionless soils.
   b. Prerequisites: "C" or better in (CVEEN 2140 AND (CVEEN 2310 OR CVEEN 2130 OR ME EN 2550)) AND Full Major status in (Civil Engineering OR Construction Engineering). Corequisites: CVEEN 3315
   c. Required.

6. Course Learning Outcomes:
   a. Upon successful completion of the course, the student will be able to:
      *Understand how geologic processes form and affect soil behavior.
      *Gain knowledge of soil properties and geotechnical materials.
      *Foster and develop the engineering judgment required to the practice of geotechnical engineering.
      - To gain a detailed knowledge of:
        - Index and Classification Properties of Soils,
        - Soil Classification,
        - Clay Mineral and Soil Structure,
        - Compaction,
        - Capillarity, Shrinkage, Swelling, Frost Action,
        - Permeability, Seepage, Effective Stress,
        - Consolidation and Consolidation Settlement
        - Time Rate of Consolidation
      - Perform engineering calculations related to compaction, effective vertical stress, seepage, consolidation and time rate of consolidation
   b. Outcomes:
      - 1a: Problem statement shows understanding of the problem (identify).
      - 1b: Applies engineering, science or mathematical principles to achieve analytical or numerical solution to model equations (formulate & solve).
      - 4b: Evaluates conflicting/competing global, economic, environmental, and societal issues in order to make informed decisions about an engineering solution & incorporates that sensitivity into the design process.

7. Brief list of topics to be covered
    - Geologic soil processes
    - Phase relations
    - Grain-size distribution
    - Clay mineralogy, clay-water interaction
    - Consistency limits, fabric and structure
    - Classification
    - Compaction, swelling, shrinkage
    - Slaking, collapse, permeability
    - One- and two-dimensional flow
    - Liquefaction, consolidation and settlement
    - Shearing strength of cohesionless soils.

CVEEN 3315: Geotechnical Engineering Lab

1. 1 credit, one 3-hour lab per week, Engineering Topics

2. Instructor: Evert Lawton

3. Textbook: None – handouts on laboratory procedures and other details can be downloaded from CANVAS)

4. Specific course information:
    a. An introduction to the fundamental geologic and engineering properties of sills and basic soil mechanics. Topics include geologic soil processes, phase relations, grain-size distribution, clay mineralogy, clay-water interaction, consistency limits, fabric and structure, classification, compaction, swelling, shrinkage, slaking, collapse, permeability, one- and two-dimensional flow, liquefaction, consolidation and settlement, and shearing strength of cohesionless soils.
    b. Prerequisites: "C" or better in (CVEEN 2140 AND (CVEEN 2310 OR CVEEN 2130 OR ME EN 2550)) AND Full Major status in (Civil Engineering OR Construction Engineering). Corequisites: CVEEN 3310
    c. Required.

5. Course Learning Outcomes:
    a. Upon successful completion of the course, the student will be able to:
        - Understand how geologic processes form and affect soil behavior.
        - Gain knowledge of soil properties and geotechnical materials.
        - Foster and develop the engineering judgment required to the practice of geotechnical engineering.
        - To gain a detailed knowledge of:
            1. Index and Classification Properties of Soils,
            2. Soil Classification,
            3. Clay Mineral and Soil Structure,
            4. Compaction,
            5. Capillarity, Shrinkage, Swelling, Frost Action,
            6. Permeability, Seepage, Effective Stress,
            7. Consolidation and Consolidation Settlement
            8. Time Rate of Consolidation
        - Perform engineering calculations related to compaction, effective vertical stress, seepage, consolidation and time rate of consolidation
    b. Outcomes:
        - 6a: Determines data that are appropriate to collect and selects appropriate equipment, protocols, etc. for measuring the appropriate variables to get required data
        - 6b: Observes good lab practice and operates instrumentation with ease
        - 6c: Uses appropriate tools to analyze data, verifies and validates experimental results, and draws conclusions.

6. Brief list of topics to be covered:
    - Geologic soil processes
    - Phase relations
    - Grain-size distribution
    - Clay mineralogy, clay-water interaction
    - Consistency limits, fabric and structure
    - Classification
    - Compaction, swelling, shrinkage
    - Slaking, collapse, permeability
    - One- and two-dimensional flow
    - Liquefaction, consolidation and settlement
    - Shearing strength of cohesionless soils.

CVEEN 3510: Civil Engineering Materials

1. 3 credit hours, two 80-minute lectures per week, Engineering Topics

2. Instructor: Nikola Markovic

3. Textbook: Materials for Civil and Construction Engineers, fourth edition, Mamlouk and Zaniewski (2017)

4. Specific course information:
   a. The course presents the concepts of basic behavior and properties of common civil engineering materials. Topics include material variability, laboratory analysis, evaluation of aggregates, design of portland cement and asphalt concrete, metals, and characteristics of wood.
   b. Prerequisites: "C" or better in (CVEEN 2140 AND (CVEEN 2310 OR CVEEN 2130 OR ME EN 2550)) AND Full Major status in (Civil Engineering OR Construction Engineering). Corequisites: CVEEN 3515
   c. Required.

5. Course Learning Outcomes:
   a. Upon successful completion of the course, the student will be able to:
      - Identify the need to modify the properties of Portland cement concrete in the field
      - Formulate a plan to use chemical admixtures
      - Develop a recommendation on how admixtures can be used to solve specific engineering problems
      - Use admixtures to create concrete mixture
      - Model mechanical and nonmechanical properties of materials, apply statistical analysis to explore material variability
      - Understand sustainability related issues of civil engineering materials.
   b. Outcomes:
      - 1a: Problem statement shows understanding of the problem (identify).
      - 1b: Applies engineering, science or mathematical principles to achieve analytical or numerical solution to model equations (formulate & solve).
      - 4b: Evaluates conflicting/competing global, economic, environmental, and societal issues in order to make informed decisions about an engineering solution & incorporates that sensitivity into the design process.

8. Brief list of topics to be covered:
   - Material properties
   - Atomic bonding
   - Composites
   - Aggregates
   - Concrete
   - Wood

- Asphalt
- Metals

CVEEN 3515: Civil Engineering Materials

1. 1 credit, one 3-hour lab per week, Engineering Topics

2. Instructor: Nikola Markovic

3. Textbook: Materials for Civil and Construction Engineers, fourth edition, Mamlouk and Zaniewski (2017)

4. Specific course information:
    a. The course presents the concepts of basic behavior and properties of common civil engineering materials. Topics include material variability, laboratory analysis, evaluation of aggregates, design of Portland cement and asphalt concrete, metals, and characteristics of wood.
    b. Prerequisites: "C" or better in (CVEEN 2140 AND (CVEEN 2310 OR CVEEN 2130 OR ME EN 2550)) AND Full Major status in (Civil Engineering OR Construction Engineering). Corequisites: CVEEN 3510
    c. Required.

5. Specific goals for the course.
    a. Upon successful completion of the course, the student will be able to:
        - Conduct laboratory experiments and prepare laboratory reports
        - Understand material variability, apply statistical hypothesis tests, design control charts
        - Evaluate the effect of different constituents in the performance of various materials (e.g., Portland cement concrete)
    b. Outcomes:
        - 6a: Determines data that are appropriate to collect and selects appropriate equipment, protocols, etc. for measuring the appropriate variables to get required data
        - 6b: Observes good lab practice and operates instrumentation with ease
        - 6c: Uses appropriate tools to analyze data, verifies and validates experimental results, and draws conclusions.

6. Brief list of topics to be covered:
    - Material Variability and Laboratory Procedures
    - Unit Weight and Specific Gravity
    - Portland Cement Mortar
    - Portland Cement Concrete
    - Portland Cement Admixtures
    - Origin and characteristics of asphalt binder

CVEEN 3520: Transportation Engineering

1. 3 credit hours, two 80-minute lectures per week, Engineering Topics

2. Instructor: Terry Yang

3. Textbook: Fred L. Mannering & Scott S. Washburn. Principles of Highway Engineering and Traffic Analysis, 6th Edition, 2016 (preferred) or 5th Edition, 2013.

4. Specific course information:
   - Virtually every aspect of modern economies, and the ways of life they support, can be tied directly or indirectly to transportation. Transportation engineering is definitely one of the most important subjects for modern society. This course introduces important concepts and fundamental knowledge in transportation engineering, including transportation planning and travel demand forecast methods, traffic flow concepts, level of service analysis, intelligent transportation systems, traffic signal control, vehicle dynamics, geometric design, and management of transportation systems. Recommendations for further study on specific areas are also provided.
   - Prerequisites: "C" or better in CVEEN 2140 AND (CVEEN 2310 OR CVEEN 2130) AND Full Major status in Civil Engineering.
   - Required

5. Course Learning Outcomes:
   - By the end of this course, students will:
     - Identify the role and significance of transportation engineering in society and within the civil engineering profession
     - Learn fundamental concepts of transportation engineering that align with the main phases of every civil engineering project: planning, design, implementation, operations, and maintenance
     - Apply calculus, geometry, differential equations, physics, and probability and statistics to solve highway and traffic engineering problems
     - Solve highway and traffic engineering problems similar in scope to problems encountered on the transportation portions of the Fundamentals of Engineering (FE) and Principles and Practice of Engineering (PE) exams.
   - Outcomes:
     - 1a: Problem statement shows understanding of the problem (identify).
     - 1b: Applies engineering, science or mathematical principles to achieve analytical or numerical solution to model equations (formulate & solve).
     - 4b: Evaluates conflicting/competing global, economic, environmental, and societal issues in order to make informed decisions about an engineering solution & incorporates that sensitivity into the design process.

6. Brief list of topics to be covered:
   - Trip Generation

- Trip Distribution
- Mode Choice
- Traffic Flow Theory
- Queuing Theory
- Shockwave Theory
- Vertical Alignment
- Combined Vertical Curves
- Horizontal Alignment
- Supperelevation
- Road Vehicle Performance
- Traffic Signal Control
- Traffic Signal Timing
- Signal Coordination
- Software Applications
- Level of Service
- Smart Mobility Systems

CVEEN 3610: Introduction to Environmental Engineering I

1. 3 Credits, two 80-minute lectures per week, Engineering Topics

2. Instructor: Jennifer Weidhaas

3. Textbook: Davis M.L, DA Cornwell, 2012, Introduction to Environmental Engineering, 5th Edition, McGraw Hill, New York, NY, pp 1040

4. Specific course information:
    - Overview of the environmental engineering profession, environmental quality measurements, regulatory overview, water and wastewater quality, environmental chemistry, air quality, design of municipal water treatment systems.
    - Prerequisites: "C" or better in CVEEN 2140 AND CHEM 1210 AND full major status in Civil Engineering
    - Required

5. Course Learning Outcomes:
    - Upon successful completion of this course, students will be able to:
        - DESCRIBE pertinent air and water quality parameters and DESIGN, CONDUCT and ANALYZE associated measurement techniques
        - DESCRIBE how environmental engineering concepts and laws apply to all sub-disciplines of Civil Engineering and more broadly affect society
        - SOLVE mass/material balances for environmental systems
        - RECOMMEND appropriate unit processes for water and wastewater treatment
        - DESIGN solid waste and hazardous waste management systems.
    - Outcomes:
        - 1a: Problem statement shows understanding of the problem (identify).
        - 1b: Applies engineering, science or mathematical principles to achieve analytical or numerical solution to model equations (formulate & solve).
        - 4b: Evaluates conflicting/competing global, economic, environmental, and societal issues in order to make informed decisions about an engineering solution & incorporates that sensitivity into the design process.

6. Brief list of topics to be covered:
    - Environmental laws
    - Chemistry in water
    - Alkalinity
    - BOD/COD/TOC
    - Water quality
    - Risk assessment
    - Groundwater resources
    - Reactions

- Drinking water treatment
- Wastewater treatment
- Air pollution
- Solid waste management
- Hazardous waste management

CVEEN 3615: Introduction to Environmental Engineering Laboratory

1. 1 credit, one 3-hour lab per week, Engineering Topics

2. Instructor: Jennifer Weidhaas

3. Textbook: Lab manual

4. Specific course information:
    - Overview of the environmental engineering profession, environmental quality measurements, regulatory overview, water and wastewater quality, environmental chemistry, air quality, design of municipal water treatment systems.
    - Prerequisites: "C" or better in CVEEN 2140 and CHEM 1210 AND full major status in Civil Engineering, corequisite CVEEN 3610
    - Required

5. Course Learning Outcomes:
    - Upon successful completion of the course, students will be able to:
        - ANALYZE water samples for oxygen demanding material, chlorine, alkalinity, nitrogen species, fecal indicator organisms, hardness, turbidity
        - DESIGN experiments to determine alum dosages for water using jar testing apparatus
        - CALCULATE mass balances in water systems based on water analysis results.
    - Outcomes:
        - 6a: Determines data that are appropriate to collect and selects appropriate equipment, protocols, etc. for measuring the appropriate variables to get required data
        - 6b: Observes good lab practice and operates instrumentation with ease
        - 6c: Uses appropriate tools to analyze data, verifies and validates experimental results, and draws conclusions.

6. Brief list of topics to be covered:
    - Gravimetric analysis
    - Oxygen demanding materials by BOD/COD/TOC
    - Nitrogen species
    - Fecal coliforms and plate counts
    - Chlorine determination
    - Jar testing

CVEEN 4221: Concrete Design I

1. 3 Credits, two 80-minute lectures per week, Engineering Topics – Significant Design

2. Instructor: Jerod G. Johnson

3. Textbook: Building Code Requirements for Structural Concrete (ACI 318-19)
   Note: Student Price is about $99 (retail is $240). Look for ACI 31819STU and connect with bkstore@concrete.org if you're interested in getting a copy.
   - Wight, Reinforced Concrete Mechanics & Design Seventh Edition. Note: upon registering for this course you should have been charged for an electronic copy of this book ($54) through the University's Inclusive Access Program. This is a very good price. If you drop the course within the first two weeks or opt-out, you will receive a refund.
   - Course Notes, Canvas.

4. Specific course information:
   - Design of concrete structural elements: Concrete and reinforcing bar properties, design of beams and slabs for flexure and shear. Design of columns, footings, and retaining walls. Evaluation of deflections and serviceability. Extensive use of the American Concrete Institute building code.
   - Prerequisites: "C-" or better in CVEEN 3210 AND Full Major status in (Civil Engineering OR Construction Engineering).
   - Selected Elective, Significant Design

5. Course Learning Outcomes:
   - The primary objective of the course is to provide the student with a solid background in the fundamentals of design using reinforced concrete for typical civil engineering structures such as beams, columns, slabs, walls and footings. The course addresses the design of individual structural elements, the interface of structural elements, and the assemblage of elements and connections into complete structural systems. At the end of this course, the successful student will be able to size basic concrete elements and assemble typical complete structures. The stated objective will be accomplished through instruction and practice in the areas listed on the course outline
   - Outcomes:
     - 2a: Produces a clear and unambiguous design project needs statement that identifies relevant public health, safety, and welfare, global, cultural, social, environmental, and economic factors.
     - 2b: Identifies constraints on the design problem, and establishes criteria for acceptability and desirability of solutions accounting for identified needs.
     - 2c: Applies engineering design and evaluates the ability of the design to meet the identified project needs.

- 4b: Evaluates conflicting/competing global, economic, environmental, and societal issues in order to make informed decisions about an engineering solution & incorporates that sensitivity into the design process.

6. Brief list of topics covered:
    - Loads and strengths, load combinations, load calculation (beams, girders, columns)
    - Reinforcement, development
    - Hooks, clear cover
    - Flexural design concept, flexural failure mechanisms
    - Net tensile strain
    - Compression reinforcement in beams
    - One-way slab design
    - T-beam design
    - Shear design
    - Load/shear envelope
    - Limit states
    - Compression reinforcement
    - Strength v. serviceability
    - Long term deflections
    - ACI design coefficients
    - Column fundamental concept/interaction, interaction diagram development
    - Round columns
    - Design aids
    - Ties and confinement
    - Simple footings
    - Eccentrically loaded footings
    - Mat foundations
    - Retaining walls
    - Braced foundation walls
    - Counterforts
    - Diaphragms
    - Concrete walls
    - Slender wall procedure
    - Seismic shear walls

CVEEN 4900: Professional Practice and Design I

1. Time: 3 credits, two 2-hour seminars per week, Engineering Topics, Significant Design

2. Instructor: Dr. Doug Schmucker, PhD

3. Text: Hansen, K.L. and Zenobia, K.E., Civil Engineer's Handbook of Professional Practice, John Wiley & Sons, Inc. and ASCE Press, 2011
    a. Software and tools pertinent to the project, e.g., AUTO-CAD, Civil3D, etc.

4. Specific course information:
    a. The focus of the course is on key aspects of the functioning of the civil engineering professional in the consulting design environment. A comprehensive Capstone Design Project serves as a vehicle and context for delivery of the key concepts.
    b. Prerequisites: "C-" or better in CVEEN 3100 AND Full Major status in Civil Engineering. To be taken in the last year of the program after a minimum of one of two design technical electives have been completed.
    c. Required

5. Course Learning Outcomes:
    a. Upon successful completion of this course, the student will be able to:
        - Describe the civil engineering design process and how it is paramount to include multiple stakeholders in the process, design phases, and provide examples of project delivery schemes.
        - Participate in the design of an engineering system or component that meets open-ended challenges, incorporates zero emissions goals, integrates sustainability, access, safety, and equity for society within the influence of a civil engineer.
        - Prepare an engineering design report and orally present an engineering project in a way that demonstrates commitment to protecting the health, safety, and welfare of the public as well as the environment.
        - Identify characteristics of effective team members, leaders, and organizations.
        - Demonstrate self-sufficiency to learn a new topic.
        - Discuss the business of consulting practice including: marketing, finance, management, business development, and technical; and, discuss the impact of that practice on the health, safety, and welfare of the public and environment.
        - Identify the connections between civil engineering projects, public policy, licensure, ethics, service, and professional responsibility.
        - Identify the ethical, legal, and professional responsibilities of professional engineers.
    b. Outcomes:

- 2a: Produces a clear and unambiguous design project needs statement that identifies relevant public health, safety, and welfare, global, cultural, social, environmental, and economic factors.
- 2b: Identifies constraints on the design problem, and establishes criteria for acceptability and desirability of solutions accounting for identified needs.
- 3a: (Non-Technical): Writing conforms to appropriate technical style format appropriate to the audience, appropriate use of graphics, mechanics & grammar
- 3b: (Non-Technical): Oral content is appropriate for audience, body language and clarity of speech enhances communication.
- 5a: Contributes to teamwork, constructively interacts with teammates, assists in keeping the team on track, expects quality work, and exhibits relevant knowledge, skills, and aptitudes.

6. Brief list of topics to be covered:
    - The design process and its various stages
    - Team organizational structure and functioning
    - Development of reports
    - Consulting practice
    - Sustainability, equity, access, and safety
    - Project execution
    - Civil engineering business concepts
    - Professional, Ethical, and Legal responsibilities of professional engineers.

CVEEN 4910: Professional Practice and Design II

1. Time: 3 credits, two 2-hour seminars per week, Engineering Topics, Significant Design

2. Instructor: Dr. Doug Schmucker, PhD

3. Text: Choi, Principles of Applied Civil Engineering Design, ASCE Press, 2004
    a. Software and tools pertinent to the project, e.g., AUTO-CAD, Civil3D, etc.

4. Specific course information
    a. This course is part two of a two-course sequence (4900/4910) that provides a year-long design project experience. The second course focuses on development and delivery of preliminary and final engineering design documents. Both courses are experientially and team based, meaning learn by doing.
    b. Prerequisites: “C-” or better in CVEEN 4900 AND two departmental design electives.
    c. Required course in the program

5. Course Learning Outcomes:
    a. Upon successful completion of this course, the student will be able to:
        - Describe the civil engineering design process and its phases.
        - Participate in the design of an engineering system or component.
        - Prepare an engineering design report, drawings, and specifications and orally present work for an engineering project.
        - Identify characteristics of effective team members, leaders, and organizations.
        - Demonstrate self-sufficiency to learn independently.
        - Identify the connections between civil engineering projects, public policy, licensure, ethics, service, sustainability, and professional responsibility.
        - Identify the ethical, legal, and professional responsibilities of professional engineers.
    b. Outcomes:
        - 2c: Applies engineering design and evaluates the ability of the design to meet the identified project needs.
        - 3a (Technical): Writing conforms to appropriate technical style format appropriate to the audience, appropriate use of graphics, mechanics & grammar
        - 3b (Technical): Oral content is appropriate for audience, body language and clarity of speech enhances communication.
        - 5a: (if not explicitly included in cohort’s 4900 experience) Contributes to teamwork, constructively interacts with teammates, assists in keeping the team on track, expects quality work, and exhibits relevant knowledge, skills, and aptitudes.

6. Brief list of topics to be covered
    a. The design process and its various stages

b. Team organizational structure and functioning
c. Development of reports
d. Consulting practice
e. Sustainability, equity, access, and safety
f. Project execution
g. Design communication
h. Professional, Ethical, and Legal responsibilities of professional engineers.

CVEEN 4222: Steel Design 1

1. 3 credit hours, two 80-minute lectures per week, Engineering Topics, Significant Design

2. Instructor: Luis Ibarra

3. Textbook: Unified Design of Steel Structures by L.F.Geschwindner, Judy Liu, and Charles J. Carter. 3rd Ed., Providence Engineering, 2017.
    - AISC (2016) "Steel Construction Manual." 15th Ed.

4. Specific course information:
    - Design of steel structural elements: tension and compression members, beams, and beam-columns. Bolted and welded simple connections. Extensive use of the American institute of Steel Construction steel design manual. Analysis of structural steel systems.
    - Prerequisites: "C-" or better in CVEEN 3210 AND Full Major status in (Civil Engineering OR Construction Engineering).
    - Selected Elective

5. Course Learning Outcomes:
    - The student will design structural steel members under tensile, compression, flexural, and combined loads, as well as welded and bolted connections, according to the AISC Specification for Structural Steel Buildings. The main learning objectives are:
        - To understand the main elements conforming typical steel frames.
        - To apply external loads on steel buildings to obtain member demands.
        - To design steel members under different loads or load combinations for different limit states.
        - To perform basic design of steel buildings.
    - Outcomes:
        - 2a: Produces a clear and unambiguous design project needs statement that identifies relevant public health, safety, and welfare, global, cultural, social, environmental, and economic factors.
        - 2b: Identifies constraints on the design problem, and establishes criteria for acceptability and desirability of solutions accounting for identified needs.
        - 2c: Applies engineering design and evaluates the ability of the design to meet the identified project needs.
        - 4b: Evaluates conflicting/competing global, economic, environmental, and societal issues in order to make informed decisions about an engineering solution & incorporates that sensitivity into the design process.

6. Brief list of topics:
    - Steel building materials
    - Steel components under tension loading

- Connections with structural bolts
- Wielded connections
- Steep components under compression loading
- Steel components under bending loading
- Steel components under combined loads
- Moment resisting frames

CVEEN 5210: Structural Analysis II

1. 3 credit hours, two 80-minute lectures per week, Engineering Topics

2. Instructor: Peter Zhu

3. Textbook: Structural Analysis: Skills for Practice, 1/e, Jim Hanson, Pearson, 2019, ISBN 978-0133128789
    a. Hibbeler R.C. "Structural Analysis," 10th Edition. Editorial prentice Hall. 2017.
    b. Leet, K.M., and Uang, C.M. "Fundamentals of Structural Analysis." Ed. McGraw Hill.
    c. Materials:
        - Engineering computation paper for hand calculations
        - NCEES FE Exam Approved Calculator (see https://ncees.org/exams/calculator/)

4. Specific course information
    a. Reviews the analytical techniques presented in Structural Analysis I pertaining to truss and beam structures, and expands them to structures with several redundancies. A major portion of the course is devoted to linear analysis of truss and frame structures using the stiffness method.
    b. Prerequisites: "C-" or better in CVEEN 3210 AND Full Major status in Civil Engineering.
    c. Selected Elective

5. Course Learning Outcomes:
    a. Upon successful completion of this course, the student will be able to:
        - Analyze indeterminate structures using the techniques of the:
            1. Force Method (Method of Consistent Deformations)
            2. Displacement Method (Slope-Deflection and Moment Distribution)
            3. Direct Stiffness Method
    b. Outcomes:
        - 1a: Writing conforms to appropriate technical style format appropriate to the audience, appropriate use of graphics, mechanics & grammar.
        - 1b: Oral content is appropriate for audience, body language and clarity of speech enhances communication.
        - 7a: Able to find information relevant to problem solution without guidance

6. Brief list of topics to be covered:
    - Review of Structural Analysis I
    - Flexibility Method of Analysis
    - Slope-deflection Method
    - Moment Distribution Method
    - Stiffness Method of Analysis

CVEEN 5220: Concrete Design II

1. 3 credit hours, two 80-minute lectures per week, Engineering Topics

2. Instructor: Chris Pantelides

3. Textbook: Wight, J.K., Reinforced Concrete Mechanics and Design, Pearson Education, 7th Edition, 2016.
    a. ACI, ACI 318-14 Building Code Requirements for Structural Concrete
    b. Materials:
        - Engineering computation paper
        - Access to structural analysis software of your choice, e.g. Visual analysis Educational (https://www.iesweb.com/edu/) (Free software)
        - NCEES FE Exam Approved Calculator (See https://ncees.org/exams/calculator)

4. Specific course information:
    a. Advanced topics in concrete design; design of two-way slabs, torsional resistance design; concrete structural systems; slender columns; seismic design considerations using the ACI code.
    b. Prerequisites: "C-" or better in CVEEN 4221 AND Full Major status in Civil Engineering.
    c. Selected Elective

5. Course Learning Outcomes:
    a. Upon successful completion of this course the student will be able to:
        - Derive and apply models for reinforced concrete structural components
        - Numerical analysis and design of reinforced concrete frames using commercial software
        - Assess the adequacy of axially, transversely, and/or torsionally-loaded reinforced concrete members and beam-column joints
        - Use strut-and-tie models for the design of deep beams, beam-column joints, and shear walls
        - Perform analysis of reinforced concrete components for seismic resistant design
    b. Outcomes:
        - 1a: Writing conforms to appropriate technical style format appropriate to the audience, appropriate use of graphics, mechanics & grammar.
        - 1b: Oral content is appropriate for audience, body language and clarity of speech enhances communication.
        - 7a: Able to find information relevant to problem solution without guidance

6. Brief list of topics to be covered:
    - Advanced topics in concrete design;
    - Design of two-way slabs, torsional resistance design;
    - Concrete structural systems;

- Slender columns;
- Seismic design considerations using the American concrete institute 318 code.

CVEEN 5240/6240: Reinforced Mason/Timber Design

2. 4 credit hours, two 140-minute lectures per week, Engineering Topics

3. Instructor: Jerod Johnson

4. Textbook: 2016 Masonry Standards Joint Committee, Building Code Requirements and Specifications for Masonry Structures. A.K.A. TMS 402/602-16, ACI 530 (older versions available online).
    a. 2018 NDS National Design Specification, American Forest and Paper Association
    b. Reinforced Masonry Engineering Handbook: Clay and Concrete Masonry – 7th edition (Howchwalt, Amrhein, MIA, ICC).
    c. Design of Wood Structures ASD/LRFD FYI , 7 th Edition (Breyer, Fridley, Cobeen, Polluck)

5. Specific course information:
    a. Reinforced masonry design, including properties and performance of masonry materials, design criteria and methods in reinforced masonry, and design examples including reinforced masonry walls, masonry columns and pilasters, and rectangular beams. Design of beams, columns, trusses, and diaphragms in wood. Design of glue-laminated beams. Design of wood connections. Use of timber design codes and uniform building code.
    b. Prerequisites: "C-" or better in CVEEN 3210 AND Full Major status in (Civil Engineering OR Construction Engineering).
    c. Selected Elective

6. Course Learning Outcomes:
    a. This is a design-oriented course. Its fundamental purpose is to equip students with the necessary skills to effectively design typical masonry and wood structures for compliance with contemporary building codes. The objectives will be realized through instruction, homework, in class discussion, development of the course project and through formal and informal review.
    b. Outcomes:

        1a: Writing conforms to appropriate technical style format appropriate to the audience, appropriate use of graphics, mechanics & grammar.1b: Oral content is appropriate for audience; body language and clarity of speech enhances communication; 7a: Able to find information relevant to problem solution without guidance

7. Brief list of topics to be covered:
    a. Properties and performance of masonry materials
    b. Design criteria and methods in reinforced masonry and design examples including reinforced masonry walls, masonry columns and pilasters, and rectangular beams
    c. Design of beams, columns, trusses, and diaphragms in wood
    d. Design of glue-laminated beams. Design of wood connections
    e. Use of timber design codes and uniform building code.

CVEEN 5305: Introduction to Foundation Engineering

1. 3 credit hours, two 80-minute lectures per week, Engineering Topics, Significant Design

2. Instructor: Evert Lawton

3. Textbook: The Engineering of Foundations by Rodrigo Salgado, McGraw-Hill, 2008, ISBN 9780072500585

4. Specific course information:
    - An introduction to the field of foundation engineering concentrating on the geotechnical background necessary for foundation analysis and design. Topics include shear strength of granular, cohesive and partially saturated soils; subsurface exploration and testing; lateral earth pressures and retaining walls; slope stability; settlement and ultimate bearing capacity of shallow foundations; seepage forces and filters.
    - Prerequisites: "C-" or better in (CVEEN 3310 AND CVEEN 3315) AND Full Major status in (Civil Engineering OR Construction Engineering).
    - Selected Elective

5. Course Learning Outcomes
    - Upon successful completion of the course, students will be able to:
        - Analyze the state of stress for a 2D solid
        - Know if the state of stress has reached a failure condition using Mohr-Coulomb theory
        - Analyze the direct shear and triaxial test to determine total and effective stress parameters for unconsolidated-undrained, consolidated-undrained and consolidated drained tests
        - Understand how to obtain shear strength and elastic parameters from in situ tests
        - Analyze the immediate and consolidation settlement for shallow foundations
        - Analyze the factor of safety against failure for shallow footings
        - Analyze the active and passive earth pressure against wall using Rankine and Coulomb theory
        - Analyze the factor of safety against failure for sliding and overturning of a cantilevered retaining wall,
        - Analyze the factor of safety against failure for homogeneous finite, planar and circular slopes
        - Apply the method of slices to calculate the factor of safety against failure for heterogeneous slopes.
    - Student Outcomes:
        - 2a: Produces a clear and unambiguous design project needs statement that identifies relevant public health, safety, and welfare, global, cultural, social, environmental, and economic factors.

- 2b: Identifies constraints on the design problem, and establishes criteria for acceptability and desirability of solutions accounting for identified needs.
- 2c: Applies engineering design and evaluates the ability of the design to meet the identified project needs.
- 4b: Evaluates conflicting/competing global, economic, environmental, and societal issues in order to make informed decisions about an engineering solution & incorporates that sensitivity into the design process.

6. Brief list of topics to be covered
    - Topics include shear strength of granular, cohesive and partially saturated soils
    - Subsurface exploration and testing; lateral earth pressures and retaining walls
    - Slope stability
    - Settlement and ultimate bearing capacity of shallow foundations
    - Seepage forces and filters

CVEEN 5500: Sustainable Materials

1. 3 credits, two 80-minute lectures per week, Engineering Topics

2. Instructor: Pedro Romero, Ph.D. P.E.

3. Textbook:Engineering Applications in Sustainable Design and Development. Striebig, B.A., Ogundipe, A.A., and Papadakis, M. 2015
    a. Materials:
        - Our Common Future: Report of the World Commission on Environment and Development. Gro Harlem Brundtland, Oslo, 20 March 1987

4. Specific course information:
    a. This course presents the concepts necessary to evaluate, select, and design materials in civil engineering applications to be energy-, cost-, and eco-efficient while durable and high performing.
    b. Prerequisites: "C-" or better in CVEEN 3510 AND 3315
    c. Selected Elective

5. Course Learning Outcomes:
    a. specific outcomes of instruction
        - Define sustainability and use quantitative analysis to evaluate the impact of civil engineering processes,
        - predict criticality/exhaustion of a resource (e.g., crude oil),
        - identify different phases in the life of a structure or product,
        - perform simple life-cycle assessment to estimate the total energy- and carbon-footprint of a civil engineering system,
        - calculate material indices and select the best materials (with optimum mechanical, durability, and eco-performance) for a project,
        - design efficient cross sections for structural members,
        - calculate the effective properties of composite materials, and
        - explain various techniques for designing green concrete materials
    b. Outcomes:
        - 1a: Writing conforms to appropriate technical style format appropriate to the audience, appropriate use of graphics, mechanics & grammar.
        - 1b: Oral content is appropriate for audience, body language and clarity of speech enhances communication.
        - 7a: Able to find information relevant to problem solution without guidance

6. Brief list of topics to be covered:
    - Sustainability
    - Carbon/energy footprint
    - Life-cycle cost

CVEEN 5510/6510: Highway Design

1. 3 credits, two 80-minute lectures per week, Engineering Topics, Significant Design

2. Instructor: Scott Shea, P.E.

3. Textbook: AASHTO, A Policy on Geometric Design of Highways and Streets, 7th Edition, 2018.
   - Materials:
     - UDOT, Roadway Design Manual of Instruction, May 2007 (updated September 2019). Available at https://www.udot.utah.gov/main/f?p=100:pg:0:::1:T,V:1498,
     - UDOT, 2017 Standard and Supplemental Drawings, Available at https://www.udot.utah.gov/main/f?p=100:pg:0:::1:T,V:4715,
     - UDOT, Environmental Process Manual of Instruction, August 2019. Available at https://www.udot.utah.gov/main/f?p=100:pg:0:::1:T,V:1328,
     - Leisch, J. Freeway and Interchange Geometric Design Handbook, Institute of Transportation Engineers, 2005.
     - Highway Capacity Manual, Transportation Research Board of the National Academies, Washington, D.C., Sixth Edition 2016.
     - AASHTO, Highway Safety Manual, 2010.
     - FHWA, Manual on Uniform Traffic Control Devices, 2009. Available at http://mutcd.fhwa.dot.gov/
     - Bentley, MicroStation and InRoads V8i.
     - FHWA, Interactive Highway Safety Design Model 9.0.0.

4. Specific course information
   - Design and layout of roadway systems: horizontal and vertical alignment, phasing, design of intersections, earthwork optimization.
   - Prerequisites: "C-" or better in CVEEN 3520 AND Full Major status in (Civil Engineering OR Construction Engineering).
   - Selected Elective

5. Course Learning Outcomes:
   - By the end of this course, students will:
     - Identify and describe technical topics and decision processes associated with the design of highway facilities.
     - Explain the theoretical concepts and historical practices that underpin current highway design principles.
     - Solve highway design problems similar to and advanced of those encountered on the Fundamentals of Engineering (FE) and Principles and Practice of Engineering (PE) exams.
     - Analyze transportation outcomes and societal tradeoffs associated with highway design decisions.
     - Demonstrate effective written and oral communication skills.

- Outcomes:
  - 2a: Produces a clear and unambiguous design project needs statement that identifies relevant public health, safety, and welfare, global, cultural, social, environmental, and economic factors.
  - 2b: Identifies constraints on the design problem, and establishes criteria for acceptability and desirability of solutions accounting for identified needs.
  - 2c: Applies engineering design and evaluates the ability of the design to meet the identified project needs.
  - 4b: Evaluates conflicting/competing global, economic, environmental, and societal issues in order to make informed decisions about an engineering solution & incorporates that sensitivity into the design process.

6. Brief list of topics to be covered:
   - Alignment and stationing review
   - Design controls and criteria
   - Horizontal alignment
   - Vertical alignment
   - Operational analysis
   - Superelevation cross sections
   - Safety analysis in design
   - Design consistency
   - Intersection designs
   - Freeway and interchange designs
   - Multimodal design.

CVEEN 5560/6560: Transportation Planning

2. 3 credit, two 80-minute lectures per week, Engineering Topics

3. Instructor: Xiaoyue Cathy Liu, Ph.D., P.E.

4. Textbook: Juan de Dios Ortúzar and Luis Willumsen, Modelling Transport, New York: John Wiley & Sons.
    a. NCHRP Report 716: Travel Demand Forecasting: Parameters and Techniques http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_716.pdf
    b. Fred L. Mannering, Walter P. Kilareski, and Scott Washburn. Principles of Highway Engineering and Traffic Analysis. Chapter 8: Travel Demand and Traffic Forecasting.

5. Specific course information
    a. This course introduces students to transportation planning and provides an understanding of transportation planning models and data collection processes. Upon successful completion of the course, students should be able to serve as transportation consultants or transportation planners, who are responsible for estimating where future travel will occur, by what modes, and on what routes. The course will also discuss how to utilize available tools to evaluate the future demand for travel in our communities.
    b. Prerequisites: "C-" or better in CVEEN 3520 AND Full Major status in Civil Engineering
    c. Selected Elective

6. Course Learning Outcomes:
    a. Student will be able to:
        - Perform travel demand forecasting for a specific region using 4-step planning model
        - Student will understand the modeling techniques, data collection and mining process for conducting travel demand forecasting
        - Student can serve as a transportation consultant or planner to evaluate future demand for travel in a study community
    b. Outcomes:
        - 1a: Writing conforms to appropriate technical style format appropriate to the audience, appropriate use of graphics, mechanics & grammar.
        - 1b: Oral content is appropriate for audience, body language and clarity of speech enhances communication.
        - 7a: Able to find information relevant to problem solution without guidance

7. Brief list of topics to be covered:
    - Overview of transportation planning characteristics, institutions, regulations and issues.
    - Exploration of decision-making processes and introduction to transportation systems.

- Analysis of the environmental and socioeconomic impacts of transportation systems.
- Investigation of the transportation-land use relationship and associated models.
- Estimation of transportation costs, prioritization of projects, programming and implementation.
- Study of transportation data collection methods and performance measurement.
- Introduction to transportation demand forecasting, including trip generation, trip distribution, mode choice, traffic assignment, and agent-based modeling.
- Study the statistical modeling techniques on the basis of the theories introduced for conducting demand forecasting.

CVEEN 5570 Pavement Design

1. 3 credits, two 80-minute lectures per week, Engineering Topic, Significant Design

2. Instructor: Pedro Romero, Ph.D. P.E.

3. Textbook: Pavement Engineering: Principles and Practice. R.B. Mallick and T. El-Korchi, 2013
    - Materials:
        - AASHTOWare Pavement ME® software.

4. Specific course information
    - This course presents the concepts of mechanistic pavement design for flexible and rigid pavements. It introduces the students to the analysis of stresses and deflections in multilayered pavement systems. It evaluates existing pavement design methods including the Mechanistic Empirical Pavement Design Guide (MEPDG) and reviews factors that affect pavement performance
    - Prerequisites: "C-" or better in (CVEEN 3510 AND CVEEN 3515 AND CVEEN 3520) AND Full Major status in (Civil Engineering OR Construction Engineering).
    - Selected Elective

5. Course Learning Outcomes:
    - Upon successful completion of this course, students will be able to:
        - Explain the different pavement systems and their function; give examples.
        - Calculate the stresses and deformations in rigid and flexible pavements.
        - Describe the relation between material selection and pavement performance.
        - Design a pavement system using mechanistic methods.
        - Recognize common pavement distresses and their cause.
    - Outcomes:
        - 2a: Produces a clear and unambiguous design project needs statement that identifies relevant public health, safety, and welfare, global, cultural, social, environmental, and economic factors.
        - 2b: Identifies constraints on the design problem, and establishes criteria for acceptability and desirability of solutions accounting for identified needs.
        - 2c: Applies engineering design and evaluates the ability of the design to meet the identified project needs.
        - 4b: Evaluates conflicting/competing global, economic, environmental, and societal issues in order to make informed decisions about an engineering solution & incorporates that sensitivity into the design process..

6. Brief list of topics to be covered:
    - Pavement Analysis
    - Pavement Design

- Pavement Maintenance

CVEEN 5740: Horizontal Construction

1. 3 Credit, two 80-minute lectures per week, Engineering Topics

2. Instructor: Abbas Rashidi

3. Textbook: Construction Methods and Management by S.W. Nunnally, 8th edition, Pearson Prentice Hall, ISBN-13: 978-0135000793 (required textbook)
    - Materials
        - Lecture notes and slides posted by the instructor, online materials, etc.

4. Specific course information:
    - This is a heavy/highway construction course that teaches the basics of major construction equipment and earthwork operations. It is intended for all construction students and highly recommended for those who expect to work in transportation and mining related projects in the future, either from design, construction and/or operation perspectives.
    - Prerequisites: "C-" or better in (CVEEN 3310 AND CVEEN 3315) AND Full Major status in (Construction Engineering OR Civil Engineering).
    - Selected Elective

5. Course Learning Outcomes:
    - Upon completion of this course, the student is expected to be able to:
        - Understand the types and functions of the most commonly used equipment in heavy construction.
        - Plan and sequence safe site development, earthwork, and rock excavation operations.
        - Optimize a spread of multiple types of equipment to perform specific earthmoving operations under schedule and cost constraints.
        - Design compressed air and water systems based on site constraints and requirements.
        - Understand the very basics of procedures and equipment involved for procuring, batching, transporting, and placing concrete from a contractor's viewpoint.
    - Outcomes:
        - 1a: Writing conforms to appropriate technical style format appropriate to the audience, appropriate use of graphics, mechanics & grammar.
        - 1b: Oral content is appropriate for audience, body language and clarity of speech enhances communication.
        - 7a: Able to find information relevant to problem solution without guidance

6. Brief list of topics to be covered:
    - Site development, Earthmoving materials
    - Earthmoving materials, volumetric calculations using AutoCAD and Civil 3D

- Volumetric calculations, topographic surveying and mapping using advanced technologies
- Excavations
- Safety and Stability of excavations
- Loading and hauling, part 1
- Loading and hauling, part 2
- Compacting and finishing
- Cranes and lifting operations
- Rock excavation
- Production of aggregate and concrete, paving
- Equipment Economics
- Compressed air and water systems

CVEEN 5780: Façade Engineering

1. 3 credits, two 80-minute lectures per week, Engineering Topics

2. Instructor: Jianli Chen, PhD

3. Textbook: Eric F. P. Burnett; *Building Science for Building Enclosures, Building Science Press, 2005, ISBN 978-0975512746.*

4. Specific course information:
   a. The course help students learn the topics relevant to building facade, including basics of building walls, roofs, floors and windows with their construction and associated physics., to help student develop the fundamental understandings of current practice of façade construction and how building façade serves required functions. In addition, the students will also develop the hand-on experience of façade design through this course.
   b. Prerequisites: “C-” or better in CVEEN 3210 AND Full major status in Construction Engineering OR Civil Engineering as pre-requisites
   c. Selected Elective

5. Course Learning Outcomes:
   a. Upon successful completion of this course, students will be able to:
      - Develop basic understanding of building enclosures, mainly including exterior walls, roof, floor, and building fenestrations
      - Understand the construction and building physics of building enclosure to serve required functions
      - Perform hand calculation and utilize software to identify and solve practical issues in building enclosure design
      - Conduct building envelope retrofit project
      - Demonstrate the ability to share and communicate in class
   b. Outcomes:
      - 1a: Writing conforms to appropriate technical style format appropriate to the audience, appropriate use of graphics, mechanics & grammar.
      - 1b: Oral content is appropriate for audience, body language and clarity of speech enhances communication.
      - 7a: Able to find information relevant to problem solution without guidance

6. Brief list of topics to be covered:
   - Introduction of Building Enclosure and history
   - Environmental Loads on Building Enclosure
   - Fundamentals for Building Enclosure Science
   - Building Enclosure Heat and Moisture
   - Envelope Design Practice
   - Air Movement in Building Enclosure
   - Fenestration and Roofing

CVEEN 5790: Vertical Construction

2. 3 credits, two 80-mintues lectures per week, Engineering Topics

3. Instructor: Jianli Chen, PhD

4. Textbook: Temporary Structure Design, Chris Souder, Wiley, ISBN 978-1-118-90558-6 (required)
    a. Principles and Practices of Commercial Construction (10th Edition), ISBN 978-0134704661 (Optional)

5. Specific course information:
    a. The course helps students learn the topics relevant to vertical construction, including basics of temporary structure systems, concrete formwork and falsework, excavation and shoring system, scaffolding design etc., to support the construction practice. In addition, the students will also develop the understanding of opportunities and challenges of sustainable buildings through this course.
    b. C- or better in (CVEEN 3210) AND Full Major status in Construction Engineering OR Civil Engineering.
    c. Selected Elective

6. Course Learning Outcomes:
    a. Upon successful completion of this course, students will be able to:
        - Develop basic understanding of vertical construction practice, such as temporary structures establishment and building construction and management
        - Understand the opportunities and challenges of building sustainability
        - Perform hand calculation to solve practical engineering problems of vertical construction
        - Demonstrate the ability to share and communicate in class
    b. Outcomes:
        i. 1a: Writing conforms to appropriate technical style format appropriate to the audience, appropriate use of graphics, mechanics & grammar.
        ii. 1b: Oral content is appropriate for audience, body language and clarity of speech enhances communication.
        iii. 7a: Able to find information relevant to problem solution without guidance

7. Brief list of topics to be covered:
    - Structure design basics
    - Scaffolding System
    - Trench and Excavation
    - Formwork Design
    - Building Systems and Sustainability

CVEEN 5810: Cost Estimating and Proposal Writing

2. Credits and contact hours: Credits: 3; Contact Hours: 1 150 minute classe per week

3. Instructor's or course coordinator's name: K. Ament

4. Text book: *Marketing Handbook for the Design & Construction Professional – SMPS Building Estimator's Reference Book - Walker - 28th Edition*

5. Specific course information

a. Catalog Description: Meets with CVEEN 6810. Quantity take-off; cost indexing; determination of construction, project, and indirect costs; development of bid proposals. Development of cost proposals for engineering project management services. Survey of cost estimating/project management software tools.

b. Prerequisite(s): C- or better in CVEEN 3100 AND Full Major status in Civil Engineering.

c. Elective – none

6. Specific goals for the course

a. Outcomes of instruction

The student will be able to explain basic concepts in marketing that lead to successful proposal writing.
The student will use written, and graphical communication skills to develop an effective proposal.
The student will comprehend basic construction cost estimation skills.
The student will practice proposal writing and construction cost estimation under realistic constraints such as economic, environmental, constructability, and sustainability constraints.

b. Student outcomes addressed by this course:

Outcome	Role of CVEEN 5810
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 .	students will be able to explain basic concepts in marketing and management related to cost estimating and proposal writing.

7. Topics:

Marketing professional services to include ethical issues
Contemporary marketing for the design and construction professional
Sales and business development
Marketing strategies
Proposal writing

Marketing image and communications
Marketing management
Introduction to estimating
Measuring quantities, site work, utilities, landscaping and such
Construction materials and configurations
Internal climate, mechanical and electrical functioning, and other considerations.
Other aspects of general building – pricing the estimate

CVEEN 5820: Project Scheduling

2. Credits and contact hours: Credits: 3; Contact Hours: 1 150-minute classe per week

3. Instructor's or course coordinator's name: D. Petersen

4. Text book: Text: Mubarek, Saleh, *Construction Project Scheduling and Control*
Software: *Microsoft Project 2007 Standard Edition*

5. Specific course information
a. Catalog Description: Meets with CVEEN 6820. Critical path methods, resource balancing, influence of probability on time and cost (PERT), network techniques, case studies, computer applications.

b. Prerequisite(s): C- or better in CVEEN 3100 AND Full Major status in Civil Engineering.

c. Elective – none

6. Specific goals for the course
a. Outcomes of instruction
The students will become familiar with the methodology, processes, and tools used in project scheduling as well as the different methods of scheduling and the pro's and con's of each.

b. Student outcomes addressed by this course:

Outcome	Role of CVEEN 5820
(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	an ability to explain and apply basic concepts in management related to project scheduling and cost control

7. Topics:
Activity sequencing and basic networks
Resource allocation and activity duration estimating
Critical path method
Bar charts
Float and resource leveling
Schedule control
Schedule updating
Schedule compression
Earned Value Analysis
PERT, GERT and LSM
Project presentations

CVEEN 5830: Project Management and Contract Administration

2. Credits and contact hours: Credits: 3; Contact Hours: 1 150-minute classe per week

3. Instructor's or course coordinator's name: D. Petersen

4. Text book: Project Management for Engineering and Construction, 2nd Ed., Garold D. Oberlender

5. Specific course information

a. Catalog Description: Meets with CVEEN 6830. Construction management processes; basic time and cost methodologies for planning; scheduling and controlling the use of labor, equipment, and materials; financial and accounting systems used in the construction industry..

b. Prerequisite(s): C- or better in CVEEN 3100 AND Full Major status in Civil Engineering.

c. Elective – none

6. Specific goals for the course

a. Outcomes of instruction

Students will learn how to initiate, plan, execute, control and close engineering and construction projects. Students will become proficient at putting together project plans and will learn how to follow those plans during engineering and construction processes. Emphasis will be placed on leadership, teambuilding and communication throughout the course.

b. Student outcomes addressed by this course:

Outcome	Role of CVEEN 5830
(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	an ability to explain basic concepts in management and business related to project management and contract administration.

7. Topics:

Introduction to project management/definitions
Working with project teams
Developing project plans
Defining scope and work breakdown structures
Schedule management
Cost management
Quality management
Risk management
Communications management

Procurement management and contracting methods
Engineering and Design management
Construction management
Monitoring progress
Closing projects

CVEEN 5850 –Engineering Law and Contracts

2. Credits and contact hours: Credits: 3; Contact Hours: 1 150-minute class per week

3. Instructor's or course coordinator's name: C. Coburn

4. Text book: none

5. Specific course information

a. Catalog Description: Meets with CVEEN 6850. Designed to provide science and engineering students with a sufficient knowledge of law to enable them to recognize and deal with legal problems which may arise in the fields of science, engineering, or technical management. Topics covered include courts, trial procedures, evidence, contract law, engineering contracts, agency, patents, trademarks, copyrights, trade secrets, product liability, employer/employee law, business law including corporations, partnerships, joint ventures, etc.

b. Prerequisite(s): C- or better in CVEEN 3100 AND Full Major status in Civil Engineering.

c. Elective – none

6. Specific goals for the course

a. Outcomes of instruction

The students will become sensitized to the legal environment in which consulting engineers practice their profession.
The students will learn the fundamental principles of risk management.
The students will learn the legal principles applicable to professional liability claims.
The students will learn how these principles apply to the practice of consulting engineers.
The students will obtain a practical knowledge on managing liability risks inherent in design professional practice.

b. Student outcomes addressed by this course:

Outcome	Role of CVEEN 5850
(l) an ability to explain basic concepts in management, business, public policy, and leadership; and explain the importance of professional licensure.	(l) an ability to explain basic concepts in management, business as related to contracts and contract law.

7. Topics:

Risk management fundamentals
Theories of design professional liability (contract, tort, and agency law)
Licensing
Business organization.
Client/project selection
Procurement of design professional services
Owner-engineer agreements
Engineer-subconsultant agreements

Insurance
Construction project organization and delivery
Procurement of construction labor and materials
Contract documents
Changed conditions
Changes
Contract/project time: delay, disruption, suspension, and acceleration
Contract price and payment
Default; termination
Construction defects, warranties
Construction bonding
Project administration, communication, and documentation
Dispute resolution
Statutes

APPENDIX B – FACULTY VITAE

1. Name: Roshina Babu, Ph.D.

2. Education
    - Ph.D., Civil Engineering, Dong-A University, Republic of Korea, 2019
    - Master of Technology, Civil Engineering, National Institute of Technology, Calicut, India, 2008
    - Bachelor of Technology, Civil Engineering, RIT Kottayam, India 2006

3. Academic Experience
    - University of Utah Asia Campus, Assistant Professor (Lecturer), 2020-present, Full-time
    - Dong-A University, Republic of Korea, Graduate Assistant, 2016-2019
    - Department of Technical Education, Kerala, India, Assistant Professor, 2014-2016, Full-time
    - Indian Institute of Space Science and Technology, India, Reader, 2009-2014, Full-time
    - Toc H Institute of Science and Technology, India, Lecturer, 2008-2009, Full-time

4. Non-academic experience - (none)

5. Certifications or professional registrations - (none)

6. Current membership in professional organizations - (none)

7. Honors and awards - (none)

8. Service activities
    - Significantly modified the courses for online conversion:
        - CVEEN 2750-301: Computer Tools (Spring 2020)
        - CVEEN 2010-301: Statics (Spring 2020)
        - CVEEN 2140-301: Strength of Materials (Fall 2020)
        - CVEEN 2310-301: Probability and Statistics (Fall 2020)
    - The Kingdom of Tonga, Pacific Island: Developed and tested the groundwater modeling component of ToGWIS (Tonga Groundwater Information System), a smart water monitoring system for groundwater management in the face of climate change and increasing water demands.

9. Selected publications
    - Roshina Babu, Namsik Park and Byunghee Nam, Regional and well-scale indicators for assessing the sustainability of small island fresh groundwater lenses under future climate conditions, Environmental Earth Sciences, 2020, 79(1), 47.

- Roshina Babu, Namsik Park, Sunkwon Yoon and Taaniela Kula, Sustainability of freshwater lens in small islands under anthropogenic and climate change stresses: Tongatapu Island, 8th International Association for Hydro-Environment Engineering and Research (IAHR) Groundwater Symposium, Nanjing, China, 17-20 October 2018.
- Roshina Babu, Namsik Park, Sunkwon Yoon and Taaniela Kula, Numerical modeling of groundwater resources for drought preparedness in small Pacific Island of Tongatapu, 45th International Association of Hydrogeologists (IAH) Congress, Daejeon, Republic of Korea, 9-14 September 2018.
- Roshina Babu, Namsik Park, Sunkwon Yoon and Taaniela Kula, Optimal management of freshwater lens for extreme droughts in Tongatapu Island, 25th Salt Water Intrusion Meeting (SWIM), Gdansk, Poland, 17-22 June 2018.
- Roshina Babu, Namsik Park, Sunkwon Yoon and Taaniela Kula, Sharp interface approach for regional and well scale modeling of small island freshwater lens: Tongatapu Island, Water, 2018, 10, 1636.
- Namsik Park, Chi Woong Jang and Roshina Babu, Development of minimum-salinity feedwater for reduction of unit production cost of reverse-osmosis desalination plants, Journal of Korea Water Resources Association, 2016, 49(5), 431-438.

10. Professional Development

2020 Boot Camp on Teaching Online: Center for Teaching and Learning Excellence, The University of Utah from 6 July to 10 July (Online)

1. Name: Michael E. Barber, Ph.D., P.E.

2. Education
    - Ph. D., Civil Engineering, University of Texas at Austin, 1991.
    - M. S., Civil Engineering, Purdue University, 1983.
    - B. S., Civil Engineering, University of New Hampshire, 1981.

3. Academic experience
    - University of Utah, Professor, Chair, 2013-Present, full time.
    - Washington State University, Professor, 2008 – 2013, full time.
    - Washington State University, Associate Professor, 1999 – 2008, full time.
    - Washington State University, Assistant Professor, 1994 – 1999, full time.
    - Tulane University, Assistant Professor, 1991-1994, full time.

4. Non-academic experience
    KKBNA Consulting Engineers, 1983-1988, full time.

5. Certifications or professional registrations
    Registered Professional Engineer, Colorado, No. 24415.

6. Current membership in professional organizations
    American Society of Civil Engineers

7. Honors and awards
    - AWRA Utah Section Outstanding Service Award 2020
    - Regional NIWR Representative, 2011-2013
    - Elected President, UCOWR, 2009-2010
    - Elected Secretary NIWR, 2005-2009

8. Service activities (selected recent)
    - UNLV Graduate Program Review Committee Member 2021
    - USDA Panel Manager for Water in Agriculture RFA, 2019-20
    - University of Utah College of Engineering Executive Committee, 2013-present
    - Faculty Mentoring Committee for several Assistant/Associate Professors

9. Selected publications
    - M.M. Hasan, C. Strong, A.K. Kochanski, S.J. Burian and M.E. Barber, (2020). "Validating Dynamically Downscaled Climate Projections for Mountainous Watersheds Using Historical Runoff Data Coupled with the Distributed Hydrologic Soil Vegetation Model (DHSVM)." Water, 12(5), 1389; doi:10.3390/w12051389.
    - Hasan, M., Burian, S., Barber, M. (2020). Determining the Impacts of Wildfires on Peak Flood Flows in High Mountain Watersheds. Int. J. Environ. Impacts, 3(4), 339-351.

- H. Li, A. Alsanea, M. Barber, and R. Goel, (2019). "High-throughput DNA Sequencing Reveals the Dominance of Pico- and other Filamentous Cyanobacteria in an Urban Freshwater Lake." Science of the Total Environment, 661:465-480, doi.org/10.1016/j.scitotenv.2019.01.141.
- H.E. Tavakol-Davani, H. Tavakol-Davani, S.J. Burian, B.J. McPherson, and M.E. Barber, (2019). "Green Infrastructure Optimization to Achieve Pre-Development Conditions of a Semiarid Urban Catchment." Environmental Science: Water Research & Technology, 5:1157-1171, doi:10.1039/c8ew00789f.
- S. Dhungel and M.E. Barber, (2018). "Estimating Calibration Variability in Evapotranspiration Derived from a Satellite-based Energy Balance Model." Remote Sensing, 10, 1695, doi:10.3390/rs10111695.
- K. Rajagopalan, K. Chinnayakanahalli, C. Stockle, R. Nelson, C. Kruger, M. Brady, K. Malek, S. Dinesh, M.E. Barber, G. Yorgey and J. Adam, (2018). "Impacts of near-term Regional Climate Change on Agriculture in the Columbia River Basin." Water Resources Research, 54, https://doi.org/10.1002/2017WR020954.
- H. Li, C. Hansen, N. Von Stackelberg, R. Goel, S. Burian, and M. Barber, (2018). "Assessing and Modeling Climate Change Impacts on Cyanobacteria in Utah Lake." 2018 UCOWR/NIWR Annual Water Resources Conference, Oral Presentation, Pittsburgh, PA, June 2018.
- Z. Rakib, M. Barber, and R. Mahler, (2017). "Climate Change Impacts on Urban Stormwater Best Management Practices," International Journal of Sustainable Development and Planning, 12(1):155-164.
- M.G. Barik, J.C. Adam, M.E. Barber, and B. Muhunthan, (2017). Improved Landslide Susceptibility Prediction for Sustainable Forest Management in an Altered Climate. Engineering Geology, 230:104-117.
- R. Mahler and M. Barber, (2017). "Using Benthic Macro Invertebrates to Assess Water Quality in 15 Watersheds in the Pacific Northwest, USA," International Journal of Sustainable Development and Planning, 12(1):51-60.
- G.K. Gould, M. Liu, M. Barber, K.A. Cherkauer, P. Robichaud, and J. Adam, (2016). "The Effects of Climate Change and Extreme Wildfire Events on Runoff Erosion over a Mountain Watershed," Journal of Hydrology, 536:74-91.

10. Most recent professional development activities
    - Attended/Presented at the 10th International Conference on Sustainable Water Resources Management in Alicante Spain, 2019.
    - Attended ASCE National Department Heads Conference in Dallas Texas 2019
    - Attended and Presented at the 3rd International Conference on Design, Construction, Maintenance, Monitoring and Control of Urban Water Systems in Venice Italy, 2016.

1. Name: Steven F. Bartlett, Ph.D., P.E.

2. Education
    - Ph.D., Civil Engineering, Brigham Young University, 1992
    - BS, Geology, Brigham Young University, 1993

3. Academic experience
    - The University of Utah, Associate Chair Civil and Envn. Eng. Asia Campus, 2019-Present
    - The University of Utah, Assoc. Professor, Civil and Environmental Engineering, 2007-Present
    - The University of Utah, Assist. Professor, Civil and Environmental Engineering, 2000-2006

4. Non-academic experience
   Oracle Group Inc., 2010-present, part-time

5. Certifications or professional registrations
   Registered Professional Engineer, Utah, No. 178935

6. Current membership in professional organizations
    - American Society of Civil Engineers (ASCE)
    - Earthquake Engineering Research Institute (EERI)

7. Honors and awards
    - 2001, 2007, 2005, 2010 Deans List for Top Instructors in College of Engineer
    - 2015 Finalist for ASCE OCEA Award Colton Crossing Flyover
    - 2011 ACEC Engineering Excellence Grand Award I-15 Widening
    - 2010 APWA National Project of the Year, Beck Street Structure
    - 2010 ASCE Local Outstanding Civil Engineering Award SR 519
    - 2002ASCE OCEA Award I-15 Reconstruction

8. Service activities (within and outside of the institution)
   University/College/Department Level
    - 2016-present, Senate Advisor Committee on Budget and Planning, University of Utah
    - 2013-2019, CVEEN ABET Coordinator
    - 2013-2019, Chair of CVEEN Undergraduate Committee

   International/National/State Level
    - 2003-present, Chair, Utah Liquefaction Advisory Group
    - 2013-present, Member, NGL Pacific Earthquake Engineering Research Center
    - 2015-present, Member ASCE Gas and Liquids Fuels Subcommittee

9. Selected publications

- Sharifi-Mood, M., Gillins, D. T., Olsen, M. J., Franke, K. W. and Bartlett, S. F., "A Geotechnical Database for Utah (GeoDU) Enabling Quantification of Geotechnical Properties of Surficial Geologic Units for Geohazards Assessments" Earthquake Spectra, 2020.
- Dangol, S. Ibarra L. F., Bartlett S. F., Pantelides, C. P., 2018, 'Soil Effects on the Response of Free-Standing Dry Storage Casks," 16th European Conference on Earthquake Engineering, June 18th -21st, 2018.
- Sharifi-Mood, M., Gillins, D. T., Franke, K. W., Harpert, J. N., Bartlett, S.F. and Olsen, M. J., 2018, "Probabilistic Liquefaction-Induced Lateral Spread Hazard Mapping and its Applications to Utah County, Utah," Engineering Geology, 237(2018)76-91.
- Aabøe, R, Bartlett, S. F., Duškov, M., Frydenlund, T. E., Mandal, J. N., Negussey, D., Özer, T. A., Hideki, T., Vaslestad, J., 2018, "Geofoam Blocks in Civil Engineering Applications," 5th International Conference on the Use of Geofoam Blocks in Construction Applications, Kyrenia, Northern Cyprus, May 9th – 11th, 2018.
- Bartlett, S. F., Amini, Z., 2018, "Design and evaluation of seismic stability of free-standing EPS embankment for transportation systems," 2018, 5th International Conference on the Use of Geofoam Blocks in Construction Applications, Kyrenia, Northern Cyprus, May 9th – 11th, 2018.
- Vaslestad, J., Bartlett, S. F., Aabøe, R, Burkart, H., Ahmed, T., Arellano, D. A., 2018, "Bridge Foundations Supported by EPS Geofoam Embankments on Soft Soil", 5th International Conference on the Use of Geofoam Blocks in Construction Applications, Kyrenia, Northern Cyprus, May 9th – 11th, 2018.
- Haghighi, N., Fayyaz S. K., Liu, X. C. and Bartlett, S. F., 2017, "Identifying Network-Wide Critical Transportation Links Under Disaster Disruptions: A Multi-Scenario and Probability-Based Simulation Approach, 96th Transportation Research Board Annual Meeting, Washington, D.C., January 2017, 21 p.
- Farnsworth, C. B., Bartlett, S. F., and Lawton E. C., 2016 "Development of a Multiflow In Situ Permeameter," ASCE Geo-Chicago 2016, August 14th-18th, 2016, Chicago, Illinois, ASCE GSP 272, pp. 487-496.

10. Most recent professional development activities - (none)

1. Name: Steve Burian, Ph.D., P.E.

2. Education
    - PhD, Civil Engineering, University of Alabama, 1999
    - MS, Environmental Engineering, University of Alabama, 1995
    - BS, Civil Engineering, University of Notre Dame, 1993

3. Academic experience
    - The University of Utah, Director, Water Center, 2017-Present
    - The University of Utah, Professor, Civil and Environmental Engineering, 2016-Present
    - The University of Utah, Assoc. Professor, Civil and Environmental Engineering, 2009-2016
    - The University of Utah, Assist. Professor, Civil and Environmental Engineering, 2003-2009
    - The University of Arkansas, Assist. Professor, Civil and Env. Engineering, 2000-2003

4. Non-academic experience
    - Harit Solutions Consultants, 2010-present, part time
    - Los Alamos National Laboratory, 1998-1999, full time

5. Certifications or professional registrations
   Registered Professional Engineer, Utah, No. 24415

6. Current membership in professional organizations
    - American Geophysical Union
    - American Society of Civil Engineers
    - American Society for Engineering Education
    - American Water Resources Association
    - American Water Works Association
    - Chi Epsilon (National Civil Engineering Honor Society)
    - Water Environment Federation

7. Honors and awards
    - 2020 Excellence in Global Engagement Award, University of Utah
    - 2019 Outstanding Professor of the Year, Dept of Civil and Env. Eng., University of Utah
    - 2019 Awarded Pakistan Civil Award "Sitara-i-Imtiaz" by President of Pakistan
    - 2016 Outstanding Teacher, College of Engineering, University of Utah
    - 2012 AWRA Utah Section, Outstanding Service in the Academic Sector
    - 2011 Glen L. Martin Best Paper Award for the Civil Engineering Division of ASEE

8. Service activities (within and outside of the institution)

University/College/Department Level

- 2012-present, Assoc. Director, Global Change and Sustainability Center, University of Utah
- 2007-present, Member, Department Executive Committee
- 2011-2014, Co-Director, Sustainability Curriculum Development, University of Utah
- 2005-present, Faculty Advisor, American Water Resources Association Student Chapter
- 2015-present, Faculty Advisor, Engineers Without Borders Student Chapter
- International/National/State Level
- 2020-present, Chair, Civil Engineering Division, ASEE
- 2016-present, Associate Editor, Journal of Water Resources Planning and Management
- 2016-2020, Associate Editor, Smart Water Journal
- 2007-present, AWRA Utah Section Executive Board
- 2019-2020, Conference Program Chair, Civil Engineering Division, ASEE
- 2005-2012, Mentor and Assistant Mentor, ASCE ExCEEd Teaching Workshop

9. Selected publications
    - Shin, S., Lee, S., Burian, S.J., Judi, D., and McPherson, T. (2020). "Evaluating resilience of water distribution networks to operational failures from cyber-physical attacks." Journal of Environmental Engineering, 146(3), https://doi.org/10.1061/(ASCE)EE.1943-7870.0001665
    - Lee, S. and Burian, S.J. (2020). "Triple top line-based identification of sustainable water distribution system conservation targets and pipe replacement timing." Urban Water Journal, 16(9), 642-652, DOI: 10.1080/1573062X.2020.1713383.
    - Hansen, C.H., Burian, S.J., Dennison, P.E., and Williams, G.P. (2019). "Evaluating historical trends and influences of meteorological and seasonal climate conditions on lake chlorophyll a using remote sensing." Lake and Reservoir Management, DOI: 10.1080/10402381.2019.1632397.
    - Tavakol-Davani, He., Tavakol-Davani, Ha., Burian, S.J., McPherson, B.J., Barber, M.E. (2019). "Green infrastructure optimization to achieve pre-development conditions of a semiarid urban catchment." Environmental Science: Water Research & Technology, 5, 1157 – 1171, DOI: 10.1039/c8ew00789f.
    - Shin, S., Lee, S., Burian, S.J., Judi, D., McPherson, T., Parvania, M., and Goharian, E. (2018). "Comprehensive review and needs assessment for resilience measures of water infrastructure systems." Water, 10, 262, doi:10.3390/w10030262.
    - Goharian, E. and Burian, S.J. (2018). "Developing an integrated framework to build a decision support tool for urban water management." Journal of Hydroinformatics, available online 8 February 2018, jh2018088; DOI: 10.2166/hydro.2018.088.
    - Sowby, R.B. and Burian, S.J. (2017). "A survey of energy requirements for public water supply in the United States." Journal of the American Water Works Association, 109(7), E320-E330, DOI: 10.5942/jawwa.2017.109.0080.

- Hansen, C.H., Burian, S.J., Dennison, P., Williams, G. (2017). "Spatiotemporal variability of lake water quality in the context of remote sensing models." Remote Sensing, 9 (5), 409, doi:10.3390/rs9050409.

10. Most recent professional development activities
    Developed and delivered the National Faculty Development Program for the Higher Education Commission of Pakistan (February 2020 to present)

1. Name: Edward Cazalas, Ph.D.

2. Education
    - Ph.D., Nuclear Engineering, Pennsylvania State University, 2015
    - M.S., Nuclear Engineering, Oregon State University, 2009
    - B.S., Astrophysics, Pennsylvania State University, 2007
    - B.A., Philosophy, Pennsylvania State University, 2007

3. Academic experience
    - University of Utah, Assistant Professor, 2018-present, Full-time
    - Air Force Institute of Technology (AFIT), Post-Doctoral Researcher, 2016-2018, Full-time
    - RAND Corporation, Stanton Nuclear Security Post-Doctoral Fellow, 2015-2016, Full-time

4. Non-academic experience - (none)

5. Certifications or professional registrations - (none)

6. Current memberships in professional organizations
    - Institute of Electrical and Electronics Engineers (IEEE)
    - American Nuclear Society (ANS)

7. Honors and awards
    Stanton Nuclear Security Fellowship

8. Service activities
    - Committee membership: Graduate Committee (2019-present), Cyber Infrastructure Committee (2018-present), Faculty Awards Committee (2018-2019).
    - University of Utah TRIGA Reactor Peer Review (2020)
    - ANS University of Utah Chapter Faculty Advisor (2020-present).
    - Chair of Radiation Effects Technical Committee of ANS (2020-present).
    - Reviewer to Journals: Nuclear Instruments and Methods in Physics Research A; Materials Chemistry and Physics; Solid State Electronics; Nanoscale; Nature Scientific Reports; IEEE Electron Device Letters; Springer Nature: Applied Sciences.

- Reviewer to Conferences: University of Utah Virtual Undergraduate Research Symposium Poster Evaluator (2020); IEEE Symposium of Radiation Measurement and Applications Conference (SORMA, Berkley, CA, 2020).
- Reviewer to Proposals: NNSA MSIPP (2020); DOE SBIR (2019); University of Utah Seed Grant (2019).

9. Selected publications
    - T. Quist, E. Cazalas, "MCNP modeling of a multi-volume neutron spectrometer," American Nuclear Society Winter Conference, online presentation, Nov. 16-19, 2020.
    - K. Powell, M. Lund, M.-J. Wang, Y. Qian, D. Magginetti, M. Reese, E. Cazalas, G. Sjoden, H. Yoon, "Photovoltaic Response of Thin-Film CdTe Solar Cells under Accelerated Neutron Radiation in a TRIGA Reactor," Electronic Materials Symposium, National Science Foundation (Jun. 2020).
    - E. Cazalas, M.R. Hogsed, S. Vangala, M.R. Snure, J.W. McClory, "Gamma-ray radiation effects in graphene field effect transistors with h-BN nanometer film substrates," Applied Physics Letters, 115, 223504 (Nov. 2019).
    - M. Recker, E. Cazalas, J.W. McClory, J.E. Bevins, "Comparison of SiPM and PMT performance using Cs2LiYCl6:Ce3+ (CLYC) scintillator with two optical windows", IEEE Transactions on Nuclear Science, 66, 8, 1959-1965 (Jul. 2019).
    - W. Erwin, E. Cazalas, A. Cahill, J.A. Clinton, J.W. McClory, "The gamma emission spectrum from the Fast Burst Reactor," Journal of Radiation Effects and Engineering, 37 (1), 50-56 (2019).
    - E. Cazalas, "Defending cities against nuclear terrorism: Analysis of a radiation detector network for ground based traffic", Homeland Security Affairs Journal (2018).
    - M.C. Recker, E. Cazalas, J.W. McClory, "Pulse shape discrimination with a low-cost digitizer using commercial off-the-shelf components," Nuclear Instruments and Methods in Physics Research Section A, 954, 161479 (Feb. 2020, originally online Oct. 2018).
    - W. Erwin, E. Cazalas, J.W. McClory, A.W. Decker, "Development of radiation protection factors with gamma and neutron spectroscopy using a plutonium-beryllium source," Journal of Radiation Effects and Engineering, 36 (1), 81-86 (2018).
    - B.K. Sarker, E. Cazalas, T.F. Chung, I. Childres, I. Jovanovic, Y.P. Chen, "Position-dependent and millimeter-range photodetection in phototransistors with micrometer-scale graphene on SiC," Nature Nanotechnology, 12 (7), 668 (2017).
    - E. Cazalas, B.K. Sarker, I. Childres, Y.P. Chen, I. Jovanovic, "Modulation of graphene field effect by heavy charged particle irradiation," Applied Physics Letters, 109 (25), 253501 (2016).
    - E. Cazalas, B.K. Sarker, M.E. Moore, I. Childres, Y.P. Chen, I. Jovanovic, "Position sensitivity of graphene field effect transistors to X-rays," Applied Physics Letters, 106 (22), 223503 (2015).

10. Most recent professional development activities - (none)

1. Name: Jianli Chen, Ph.D.

2. Education
    - 08/2014-08/2018 - Georgia Institute of Technology
      Ph.D. in Building Construction
      Minor on Statistics and High-Performance Building
    - 05/2016-12/2017 - Georgia Institute of Technology
      MS in Computational Science and Engineering
    - 08/2012-05/2014 - Virginia Polytech Institute and State University
      MS in Civil Engineering (Construction Engineering and Management)
      Thesis: Utilization of Dynamic BIM and Wearable Technology for Infrastructure Management
    - 09/2007-07/2012 - Dalian Jiaotong University
      Bachelor of Engineering in Civil Engineering and Computer Engineering

3. Academic experience
    - 08/2020- Assistant Professor (Department of Civil and Environmental Engineering) - the University of Utah
    - 11/2018-08/2020 Post Doc at US National Renewable Energy Lab

4. Non-academic experience - (none)

5. Certifications or professional registrations - (none)

6. Current membership in professional organizations - (none)

7. Honors and awards
    - 06/2016 Georgia Tech Student Honor Society
    - 12/2013 4th Place in 2013 International Student Competition on Cold-Formed Steel Design
    - 05/2013 Dean's List with Distinction Standing, Virginia Tech, College of Engineering
    - 03/2011 China National Encouragement Scholarship

8. Professional service
   Reviewer for Applied Energy, Building and Environment, Energy and Buildings, Energy Conservation and Management, Sustainable Cities and Society, Journal of Building Engineering, Building Simulation, Energies, Journal of Construction Engineering and Management.

9. Selected publications
    - Jianli Chen, Godfried Augenbroe, Zhaoyun Zeng, Xinyi Song. "Regional Difference and Related Cooling Electricity Savings of Air Pollutant Affected Natural Ventilation Across the US", Building and Environment (Jan 2020).

- Yanan Liu, Yimin Xiao*, Jianli Chen. "Nonlinear dynamic analysis of solution multiplicity of buoyancy ventilation in a typical underground structure", Building and Environment (Jan 2020).
- Jianli Chen, Xinghua Gao, Yuqing Hu*, Zhaoyun Zeng, and Yanan Liu. "A meta-model-based optimization approach for fast and reliable calibration of building energy models." Energy (Sep, 2019).
- Yanan Liu, Yimin Xiao*, Jianli Chen, Tiecheng Zhou, Godfried Augenbroe, Dong Yang, "A Network Model for Natural Ventilation Simulation in Deep-Buried Underground Structures", Building and Environment (Feb, 2019).
- Jianli Chen*, Gail Brager, Godfried Augenbroe and Xinyi Song. "Impact of Outdoor Air Quality on the Natural Ventilation Usage of Commercial Buildings in the US", Applied Energy (Nov, 2018).
- Jianli Chen*, Godfried Augenbroe, and Xinyi Song. "Light-weighted Model Predictive Control for Hybrid Ventilation Operation Based on Clusters of Neural Network Models". Automation in Construction (May, 2018).
- Jianli Chen*, Godfried Augenbroe, and Xinyi Song. "Evaluating the Potential of Hybrid Ventilation for Small to Medium sized Office Buildings with Different Intelligent Controls and Uncertainties in US Climates". Energy and Buildings (Jan, 2018).
- Jianli Chen*, Godfried Augenbroe, Qinpeng Wang, and Xinyi Song. "Uncertainty Analysis of Thermal Comfort in a Prototypical Naturally Ventilated Office Building and Its Implications Compared to Deterministic Simulation". Energy and Buildings (July, 2017).

10. Most recent professional development activities
    - 07/2017 Internship at Disney Research Lab China
    - Major Responsibility: Investigated the excessive energy consumption problem at the Disney Shanghai Park based on the past operation data and building simulation with calibration.
    - 10/2011 Internship at Fujian Provincial Institute of Communications Planning and Design
    - 09/2011 Internship at Longpu Expressway Project Department

1. Name: Ramesh K. Goel, Ph.D.

2. Education
    - 2005 - Post Doc, Environmental Engineering
      University of Wisconsin, Madison (With Dr. Daniel Noguera)
    - 2003 - Ph.D. in Environmental Engineering
      University of South Carolina, Columbia (With Dr. Joe Flora)
    - 1996 - Master of Science in Civil Engineering
      Jadavpur University, Kolkatta, India.
    - 1994 - Bachelor of Science in Civil Engineering
      Jadavpur University, Kolkatta, India

3. Academic experience
    - 2017- present: Professor- Civil & Environmental Engineering, University of Utah, Salt Lake City
    - July 2017 - present: Professor and Graduate Director, Civil & Environmental Engineering, U of Utah, Salt Lake)
    - July 2011 - present: Associate professor and Graduate Director, Civil & Environmental Engineering, U of Utah, Salt Lake)
    - January 2006 - June 2011: Assistant professor, Civil & Environmental Engineering, U of Utah, Salt Lake)
    - August 03 - December 05: Post Doc - Environmental Engineering, UW, Madison (With Dr. Daniel Noguera). Research Topics: (1) Enhanced biological phosphorus removal in Cannibal activated sludge process, (2) ecology of heterotrophic bacteria that colonize drinking water distribution systems.

4. Non-academic experience - (none)

5. Certifications and professional organizations
    - Member- AEESP
    - Member- International Water Association (IWA)
    - Member – American Society for Microbiology
    - Member-Water Environment Federation
    - Associate Member- American Society of Civil Engineers
    - Member-American Society for Engineering Education

6. Current membership in professional organizations - (none)

7. Honors and awards
    - Outstanding Faculty Member- Civil & Environmental Engineering Department, University of Utah- 2016, 2018 and 2019
    - AEESP Outstanding service award- 2018
    - NSF-CAREER Award (2011-2016)- Bacteriophages in engineered and natural systems.

- Outstanding Mentor- Civil & Environmental Engineering Department, University of Utah- 2014-2015, 2017
- Outstanding Researcher award- Civil & Environmental Engineering Department, University of Utah- 2008-2009
- Best Environmental Engineering Education paper award - American Society for Engineering Education conference, Atlanta-2013.
- Indo-US Professorship to India by American Society for Microbiology.
- Best teaching award for tenure track faculty - Civil & Environmental Engineering Department - 2007-2008.
- Faculty creative research grant- April 2007
- Best student advisor - Civil & Environmental Engineering Department, University of Utah-2009-2010
- Best poster award in WEFTEC 2008 conference in Chicago.
- Outstanding Graduate Student Award for 2002-2003 in the Department of Civil & Environmental Engineering, University of South Carolina

8. Service activities - (none)

9. Selected publications
    - Li, H., Barber, M., Lu, J. and Goel, R. (2020). Microbial community successions and their dynamic functions during harm ful cyanobacterial blooms in a freshwater lake. Water Research; 185: 116292.
    - Li, H., Hollstein, M., Podder, A., Gupta, V., Barber, M. and Goel, R. (2020). Cyanotoxin impact on microbial mediated nitrogen transformations at the interface of sediment-water column in surface water bodies. Environmental Pollution; 266: 115283.
    - Li, H., Barber, M., Jingrang, L. and Goel, R. (2020). Microbial community successions and their dynamic functions during harmful cyanobacterial blooms in a freshwater lake. Water research; 185: 116292.
    - Gilcrease, E., William, R. and Goel, R. (2020). Evaluating the effect of silver nanoparticles on bacteriophage lytic infection cycle-a mechanistic understanding. Water Research; https://doi.org/10.1016/j.watres.2020.115900.
    - Podder, A., Reinhart, D. and Goel, R. (2020). Nitrogen management in landfill leachate using single-stage anammox process-illustrating key nitrogen pathways under an ecogenomics framework. Journal of Bioresource Technology; https://doi.org/10.1016/j.biortech.2020.123578.
    - Su, J.-Y., Goel, R., Burian, S.J. and Barber, M.E. (2020). Assessing climate change linkages related to water quality trading effectiveness for incorporating ancillary benefits. International Journal of Environmental Impacts. Accepted, in print.
    - Jamal, R., Mubark, S., Sahulka, S.Q., Kori, J.A., Tajammul, A., Ahmed, J., Mahar, R.B., Olsen, M.S., Goel, R. and Weidhaas, J. (2020). Informing water distribution line rehabilitation through quantitative microbial risk assessment Science of the Total Environment Research Paper. In print in Science of the Total Environment.

- Podder, A., Reinhart, D. and Goel, R. (2020). Integrated leachate management approach incorporating nutrient recovery and removal. Waste Management; 102: 420-431.

10. Most recent professional development activities - (none)

1. Name: Luis Ibarra, Ph.D., P.E.

2. Education
    - Stanford University, Stanford, CA, Civil and Environmental Engineering, Ph.D. 2004
    - National Autonomous University of Mexico, Structural Engineering, M.E.1999
    - University of Sonora, Mexico, Civil Engineering, B.S. 1992

3. Academic experience
    - Associate Professor, Department of Civil and Environmental Engineering, University of Utah, Salt Lake City, Utah; July 2016 – Present.
    - Visiting Professor, Technical University of Vienna, Vienna, Austria; October 2017 – June 2018.
    - Visiting Researcher, Nagoya University, Japan; May 2017 – June 2017.
    - Assistant Professor, Department of Civil and Environmental Engineering, University of Utah, Salt Lake City, Utah; August 2010 – June 2016.

4. Non-academic experience
    - Senior Research Engineer, Center for Nuclear Waste Regulatory Analyses (CNWRA) in Southwest Research Institute (SwRI), San Antonio, TX, January 2004 – July 2010
        - Evaluation of seismic design and performance methodologies for nuclear facilities.
        - Nonlinear mechanical interaction of alloy materials under static and dynamic loading.
        - Structural and seismic analyses of nuclear engineered barrier systems.
        - Study of coupled mechanisms in nuclear-waste containers.
        - Structural evaluation of independent spent fuel storage installation.
        - Effect of aging of concrete on seismic performance of reinforced concrete structures.
        - Stanford University (research assistant):
        - Global collapse evaluation of frame structures subjected to extreme seismic demands
        - Development of deteriorating hysteretic models for nonlinear time history analysis
        - Development of a wood loading protocol for wood frames
        - National Autonomous University of Mexico (research assistant):
        - System identification studies of buildings
        - Study of reinforced concrete buildings with flat slabs under earthquake excitations
    - Structural Design Engineer, Grupo Puebla, Mexico, March 1993 – July 1996

5. Certifications or professional memberships
    - Member of the ASCE, AISC, EERI, ASEE, and ACI associations
    - Reviewer of technical papers for the following journals: ASCE J. of Structural Engineering, Engineering Structures, Earthquake Engineering and Structural Dynamics, Engineering Structures, Earthquake Spectra, ASCE Journal of Bridge Engineering, The Structural Design of Tall and Special Buildings J. (Technical Board Member), Nuclear Engineering and Design, Engineering Structures, Revista de Ingenieria Sismica, and Structures and Buildings J.

6. Current membership in professional organizations - (none)

7. Honors and awards - (none)

8. Service activities - (none)

9. Selected Publications
    - Uribe R., S. Sattar, M.S. Speicher, L. Ibarra (2019) "Effect of Common U.S. Ground Motion Selection Methods on the Structural Response of Steel Moment Frame Buildings." Earthquake Spectra Journal. Volume 35, No. 4, pages 1611–1635, November 2019.
    - Upadhyay A, CP Pantelides, L Ibarra (2019) "Residual drift mitigation for bridges retrofitted with buckling restrained braces or self-centering energy dissipation devices." Engineering Structures, https://doi.org/10.1016/j.engstruct.2019.109663.
    - Wang Y, L Ibarra, C. Pantelides (2019) "Collapse capacity of reinforced concrete skewed bridges retrofitted with buckling-restrained braces." Journal of Engineering Structures. https://doi.org/10.1016/j.engstruct.2019.01.033.
    - Wang Y, L Ibarra, and C Pantelides (2016) "Seismic Retrofit of a Three Span Bridge with Buckling Restrained Braces." ASCE Journal of Bridge Engineering, 04016073. May 2016.
    - Parks JE, CP. Pantelides, L Ibarra, DH Sanders (2020) "Cyclic Tests and Modeling of Stretch Length Anchor Bolt Assemblies for Dry Storage Casks." ACI. Accepted for Publication, June 2020.
    - Tsantaki, S., Adam, C. & Ibarra, L.F. (2017) "Intensity measures that reduce collapse capacity dispersion of P-delta vulnerable simple systems". Bulletin of Earthquake Engineering, 2017, 15: 1085. doi:10.1007/s10518-016-9994-4
    - Tsantaki S, L Ibarra, C Adam (2015) "Effect of Aleatory and Epistemic Uncertainties on Collapse Capacity Spectra." Bulletin of Earthquake Engineering. Vol. 13, Issue 4 (2015), Page1205-1225.

10. Most recent professional development activities - (none)

1. Name: Jerod G. Johnson, Ph.D., S.E., S.E.C.B.

2. Education
    - Ph.D. Civil & Environmental Engineering, University of Utah, 2012
    - M.S. Civil & Environmental Engineering, University of Utah, 1999
    - B.S. Civil & Environmental Engineering, University of Utah, 1996

3. Academic experience
    - May 2014 – Present, Adjunct Assistant Professor, Department of Civil & Environmental Engineering, University of Utah, Salt Lake City, Utah.
    - January 2012 – May 2014, Associate Instructor, Department of Civil & Environmental Engineering, University of Utah, Salt Lake City, Utah.
    - January 2000 – May 2007 – Associate Instructor, Department of Civil & Environmental Engineering, University of Utah, Salt Lake City, UT
    - Courses: Introduction to Concrete Design, Concrete Design I, Masonry Design, Timber Design, Guest Lecturer. Professional Experience

4. Non-Academic experience
    - March 1996 – Present, Principal, Reaveley Engineers
    - June 1994 – March 1996, Assistant Project Engineer, Layton Construction
    - March 1993 – March 1994, Surveyor, Hall Engineering & Construction

5. Certifications or p rofessio nal Registration
    - Registered Professional Structural Engineer: Utah, Hawaii, Guam
    - Registered Professional Engineer: Texas, Montana, Louisiana, Virginia, North Dakota, Colorado, Arizona.
    - Certified - Structural Engineering Certification Board (SECB)
    - Structural Engineers Association of Utah Structural Engineers Association of Northern California Earthquake Engineering Research Institute United States Resiliency Council

6. Current membership in professional organizations - (none)

7. Honors and awards
    - 2011 – Recognized among Utah's Top 40 Business Professionals Under 40, Utah Business Magazine.
    - 2013 – Structural Engineers Association of Utah – Engineer of the Year
    - Professional Service Activities
    - 2009 – 2017, Member of Salt Lake City and County Building Conservancy Committee, Committee Chair.
    - 2008-2011, Board Member – Structural Engineers Association of Utah.
    - 2012 – Appointed Associate Member ASCE 7-16 Subcommittee on Seismic Loads
    - 2013-2016, Board Member – Structural Engineers Association of Utah
    - 2014-2015, President – Structural Engineers Association of Utah

- 2014-2016, Board Member – Earthquake Engineering Research Institute – Utah Chapter
- 2020-Present, Chair – ACEC Utah Chapter DFCM Committee Training ATC 20 – Current as of May, 2015

8. Service activities
    - Utah State Capitol Seismic Isolation and Renovation City County Building Seismic Isolation System Upgrade, Salt Lake City, UT
    - Lord Strathcona Seismic Isolation Peer Review, Vancouver, BC
    - Salt Palace Expansion, Phase II, Salt Lake City, UT Southtowne Exposition Center, Sandy, UT
    - Novell Building H, Provo, UT
    - Mexico City Temple Renovation, LDS Church City and County Building Isolation Study, Salt Lake City, UT
    - Daybreak Corporate Center, South Jordan, UT
    - Thatcher Building for Biological and Biophysical Chemistry, University of Utah
    - Salt Lake Public Library, Salt Lake City, UT
    - Provo Recreation Center, Provo, UT
    - Park City History Museum, Park City, UT
    - Marriott Library Renovation, University of Utah
    - Marriott Center Renovation, Brigham Young University
    - Huntsman Arena Renovation Phase I, University of Utah
    - Huntsman Cancer Institute, Salt Lake City, UT
    - Tooele High School, Tooele, UT
    - Salem High School, Salem, UT
    - Spencer and Cleone Eccles Football Center, University of Utah
    - Second District Juvenile Court Ogden, UT Provo
    - Power, Administration & Warehouse Crocker Science Center Seismic Upgrade and Expansion, University of Utah
    - Fourth District Court, Provo, UT
    - Central Campus Parking Garage, University of Utah
    - Health Science Campus Parking Garage, University of Utah
    - Clyde Building Evaluation, Brigham Young University Provo
    - City Hall & Public Safety Building, Provo Utah (under construction)
    - Primary Childrens Medical Center Lehi, UT (under construction)

9. Selected Publications
    - "Modern Solutions to Historic Problems," Volume 9, p. 52-56, Utah Preservation Magazine
    - Featured Technical Author – NCSEA – Structure Magazine

10. Most recent professional development activities - (none)

1. Name: Nickolas S. Jovanovic, Ph.D., P.E.

2. Education
    - Ph.D., Engineering and Applied Science, Yale University, 1998.
    - M.Phil., Engineering and Applied Science, Yale University, 1993.
    - M.S., Engineering and Applied Science, Yale University, 1992.
    - M.S., Mechanical Engineering, Rensselaer Polytechnic Inst., 1988.
    - B.S., Mechanical Engineering, Northwestern University, 1982.

3. Academic experience
    - University of Utah Asia Campus (UAC), Incheon, South Korea.
    - Dept. of Civil and Environmental Engineering, 2020-present.
    - Professor Lecturer, University of Arkansas at Little Rock (UALR), Little Rock, Arkansas
    - Donaghey College of Engineering and Information Technology DCEIT Assessment and Accreditation Coordinator, 2015-2019.
    - Dept. of Construction Mgmt. & Civil and Construction Engineering, 2010-2020.
    - Dept. of Systems Engineering, 1999-2010.
    - Dept. of Engineering Technology, 1996-1999.
    - Yale University, New Haven, Connecticut. Dept. of Mechanical Engineering.
    - Part-Time Acting Instructor, 1994-1996.
    - Teaching Fellow, 1990-1994.

4. Non-academic experience
    - U.S. Naval Submarine School, Groton, Connecticut, Leadership and Management Education and Training Division, Full-Time Instructor, 1987-1990.
    - U.S.S. Providence (SSN 719), Nuclear Submarine, Groton, CT. Division Officer, 1984-1987.
    - U.S. Navy Submarine Officer School, New London, CT, 1983-1984.
    - U.S. Navy Nuclear Prototype, West Milton, New York, 1983-1983.
    - U.S. Navy Nuclear Power School, Orlando, Florida, 1982-1983.

5. Certifications or professional registrations
   Professional Engineer, State of Arkansas license number 9149.

6. Current membership in professional organizations
    - Accreditation Board for Engineering and Technology (ABET)
    - American Society of Civil Engineers (ASCE)
    - American Society of Engineering Education (ASEE)

7. Honors and awards
    - Outstanding Teaching Award, Department of Engineering Technology, 1999.
    - UALR Faculty Excellence Award in Teaching for DCISSE, 2000.

8. Service activities

- Faculty Senate, senator from EIT, meets monthly, 2005-present.
- Undergraduate Council, member from EIT, meets weekly, 2010-2018.
- Council of Core Curriculum and Policies, member from EIT, meets weekly, 2013-2018.
- Honors and Awards Committee, chairperson, 2010-2017.
- Planning and Finance Committee, member, 2010-2017.
- DCEIT Assessment and Accreditation Coordinator, 2015-2019.
- DCISSE and DCEIT Dean Search Committees, member (1999 and 2014).
- DCISSE Assembly, vice president (multiple years).
- Policy and Personnel Committee, member (multiple years).
- Program Coordinator
    - Civil and construction engineering program coordinator, 2010-2019.
    - Architectural and construction engineering program coordinator, 2012-2019.
    - Advise all students (approximately 120 students), 2010-2017, approve all degree plans for graduating students.
    - Coordinate significant aspects of the ABET review process.
    - Develop and implement program and curriculum changes, develop and coordinate program assessment.
    - Recruit professional engineers from industry to sponsor senior design projects.

9. Selected publications
    - H. C. Patangia, P. Warrick, N. S. Jovanovic, and J. Urbina, Exploring Engineering Through Project-Based Experiential Learning for Pre-College Educators, Proceedings of the 2004 ASEE Annual Conference, June 2004.
    - B. A. Kucera, D. Morton, R. Edberg, N. Jovanovic, Expanding the AG Community in a Closed Universe, Proceedings of AG Technical Retreat 2001, Argonne, Illinois, January 30-31, 2001.
    - Selected Scholarly Presentations
    - N. S. Jovanovic, The Virtual Classroom and Laboratory for Thermodynamics Education, presented at the 2000 ASEE Annual Conference, St. Louis, Missouri, June 18-21, 2000.
    - N. S. Jovanovic, Using World Wide Web Course Tools (WebCT) for Close Learning, presented at the 2000 ASEE Annual Conference, St. Louis, Missouri, June 18-21, 2000.
    - Z. R. Kaufmann, N. S. Jovanovic, and L. W. Laettner, Undergraduate Research Participation: Designing and Building a New Generation Beowulf-Class PC Cluster, presented at the 2000 ASEE Annual Conference, St. Louis, Missouri, June 18-21, 2000.

10. Most recent professional development activities - (none)

1. Name: Evert C. Lawton, Ph.D., P.E.

2. Education
    - 1986: Graduated in December from Washington State University with a Doctor of Philosophy in Civil Engineering. Emphasis: Geotechnical.
    - 1983: Graduated in May from San Diego State University with a Master of Science in Civil Engineering. Emphasis: Geotechnical.
    - 1980: Graduated in January from the University of Virginia with a Master of Engineering in Civil Engineering. Emphasis: Structural.
    - 1977: Graduated with honors in May from the University of Virginia with a Bachelor of Science in Civil Engineering. Emphasis: Structural.

3. Academic experience
    - Department of Civil & Environmental Engineering, University of Utah, Salt Lake City, Utah
    - July 2002 – Present: Professor;
    - December 1994 – August 2002 and May 2012 – June 2013: Associate Chair;
    - July 1994 – June 2002: Associate Professor;
    - August 1991 - June 1994 Assistant Professor
    - January 1987 - August 1991; Assistant Professor - Department of Civil & Architectural Engineering, University of Miami, Coral Gables, Florida
    - June 1984 – December 1986; Teaching and Research Assistant - Washington State University, Pullman, Washington
    - May 1985 - August 1985 Construction Manager - Schnabel Foundation Company, Dallas, Texas
    - June 1982 - May 1984 Geotechnical Engineer - Bridge Division, Virginia Department of Highways and Transportation, Richmond, Virginia
    - June 1977 - August 1981 Structural Engineer - Bridge Division, Virginia Department of Highways and Transportation, Richmond, Virginia

4. Non-academic experience - (none)

5. Certifications or professional registrations
    - California Professional Engineer License No. C039328
    - Florida Professional Engineer License No. 37850 (currently inactive)
    - Utah Professional Structural Engineer License No. 190745-2203
    - Virginia Professional Engineer License No. 13774 (currently inactive)
    - Washington Professional Engineer License No. 22069

6. Current membership in professional organizations
    - American Society of Civil Engineers (currently inactive)
    - International Society for Soil Mechanics and Geotechnical Engineering (currently inactive)

7. Honors and awards

- 2017 Nominated by ASCE for Utah Engineering Educator of the Year Award
- 2012 University Distinguished Teaching Award, University of Utah 2007-08 Outstanding Teacher Award for Tenured Professors, students of Department of Civil and Environmental Engineering, University of Utah.
- 2005 Utah Engineering Educator of the Year, Utah Engineers Council
- 2005 Engineering Educator of the Year, American Council of Engineering Companies of Utah
- 1999-2000 Educator of the Year, Student Chapter of ASCE, University of Utah
- 1999-2000 Engineering Educator of the Year, Utah Section of the American Society of Civil Engineers

8. Service activities (within and outside of the institution)
    - Professional Societies Transportation Research Board, Committee A2J02, Chemical and Mechanical Stabil ization of Soils, Member, January 1999 – June 2007.
    - American Society of Civil Engineers, Soil Properties Committee and Unsaturated Soils Subcommittee, Member, 1994 - 2007.
    - American Society of Civil Engineers, Utah Section, Geotechnical Engineering Group. Chair of the Educational Committee (1992-95).
    - Florida Engineering Society, Engineers in Education Practice Section. Secretary/Treasurer, Second Vice-Chairman, First Vice Chairman, and Chairman (1987-1991).
    - Journal reviewer for: the Journal of Geotechnical and Geoenvironmental Engineering Transportation Research Record, Geotechnical Testing Journal, Canadian Geotechnical Journal, and Geotextiles and Geomembranes.

9. Selected publications
    - Farnsworth, C.B., Bartlett, S.F., and Lawton, E.C. (2016). “Development of a Multiflow In Situ Permeameter.” ASCE Geo-Chicago, Chicago, Illinois, ASCE Geotechnical Special Publication 272, August, pp. 487-496.
    - Bartlett, S.F., Lawton, E.C., and Gibbs, Z.M. (2016). “Evaluation of Secondary Consolidation Settlement Associated with Embankment Construction for Fast-Paced Transportation Projects.” Prepared for Utah Department of Transportation Research Division, Salt Lake City, August, 472 pp.
    - Burns, H., Lawton, E., and Romero, P. (2020), “Forensic Evaluation of Geogrid-Reinforced Flexible Pavement Sections on SR-10 Near Emery, Utah.” Report No. UT-20/05, Utah Department of Transportation, March, 346 pp.
    - Platt, M. R., Lawton, E.C., and Bartlett S.F. (2020). “Instrumentation and Settlement Analysis of Approach Embankment for SR-77/1500 West Bridge in Springville, Utah.” Report No. UT-20.??, February, in publication.

10. Briefly list the most recent professional development activities - (none)

1. Name: Joshua Lenart, Ph.D.

2. Education
    - Ph.D., University of Utah, 2013
    - MA, Montana State University, 2005
    - BA, The Ohio State University, 2001

3. Academic experience
    - University of Utah, CLEAR Program, Associate Instructor, 2014-Present
    - Westminster College, Professional Communication Program, Adjunct Faculty, 2013-2014
    - University of Utah, Department of Rhetoric and Writing Studies, Graduate Teaching Fellow, 2007-2013
    - Hawaiʻi Pacific University, Department of English, Adjunct Instructor, 2006-2007
    - Montana State University, Department of English, Graduate Teaching Assistant, 2003-2006

4. Non-academic experience
   Utah DWR Central Region Advisory Council, Councilmember, 2017-Present

5. Certifications or professional registrations - (none)

6. Current membership in professional organizations
    - Association of Business Communication
    - American Society for Engineering Education
    - IEEE Professional Communication Society
    - National Council of Teachers of English
    - Research Network Forum

7. Honors and awards
    - 2020 Utah's Watershed Restoration Initiative Restoration Grant, Contributor
    - 2015 Chair's Award for Best Informational Design for Research Poster Presentation, Conference on College Composition and Communication
    - 2015 Global Learning Across the Disciplines Teaching Grant

8. Service activities
    - 2015-present, Center for Infrastructure Transformation & Education, Contributor/ Peer Reviewer
    - 2019 Environmental Rhetoric and Advocacy Special Interest Group, Conference on College Composition & Communication, Organizer
    - 2017-2019, IEEE Professional Communication Society, Contributor/ Peer Reviewer
    - 2020-present Backcountry Hunters & Anglers, Policy Advisor
    - 2016-2020, Backcountry Hunters & Anglers, Utah Chapter Chair

- 2017-present, Utah DWR Central Region Advisory Council, Councilmember
- 2019-2020, Utah DWR Mule Deer Management Plan, Committee Member

9. Selected publications
    - Berdanier, C.G. and Lenart, J. (October 2020). So, You Have to Write a Literature Review: A Guided Workbook for Engineers. Hoboken, NJ: Wiley-IEEE Press https://www.wiley.com/en-us/searchpq=catherine%20berdanier%7Crelevance.
    - Richards, J.L., Lenart, J., Sumner, D., and Christensen, D. (November 2018). "From Big Ag to Campus Cafeterias: Intersections of Food-Supply Networks as Technical Communication Pedagogy." Open Library of Humanities, 4(2), DOI: http://doi.org/10.16995/olh.381.
    - Lenart, J. and Berdanier, C. G. (July 2017). "Development of a Genre Analysis Framework to Investigate Engineering Literature Reviews." IEEE Professional Communication Society, Madison, WI, https://ieeexplore.ieee.org/document/8013956.
    - Lenart, J. (October 2016). "An Examination of a Federal Land Transfer from a Civil and Environmental Engineering Perspective: Evaluating the Triple Bottom Line." IEEE Professional Communication Society, Austin, TX. https://ieeexplore.ieee.org/document/7740481.
    - Schmucker, D., Lenart, J., Burian, S., and Motlagh, A. M. (June 2016). "A Civil Infrastructure System Perspective –Not Just the Built Environment." American Society for Engineering Education, New Orleans, LA. https://www.asee.org/public/conferences/64/papers/16261/view.
    - Burian, S., Schmucker, D., Lenart, J., Tavakoldavani, H., Romero, P., and Barber, M. (June 2016). "Developing Global Learning Outcomes in a Civil Engineering Program." American Society for Engineering Education, New Orleans, LA. https://www.asee.org/public/conferences/64/paper.

10. Most recent professional development activities
    - October 2020, "Team Writing & the Triple Bottom Line: A Collaboration with the Forest Service for Enhancing Workplace Preparedness," Assoc. of Business Comm. Conference
    - November 2018, "Don't Tread on Me: Infrastructure Development, Resource Conflict, and the Outdoor Recreation Industry in Lands Adjacent to Bears Ears and Grand Staircase-Escalante National Monuments," National Communication Association
    - June 2018, "A Feasibility Assessment of Infrastructure Development on Rural Communities, Resources, and the Environment on Federal Public Lands Outside Bears Ears and Grand Staircase-Escalante National Monuments," Internat'l. Assoc. for Society & Natural Resources
    - March 2018, "Landscape-Scale Understanding of Wildlife & Habitat on Utah's Public Lands," Symposium on Hunting, Fishing & Conservation, Utah State University
    - July 2017, "A Genre Analysis of Graduate Student Literature Reviews in Engineering: Toward Understanding Patterns of Disciplinary Argumentation," IEEE Professional Communication Society

1. Name: Xiaoyue Cathy Liu, Ph.D., P.E.

2. Education
   - Ph.D. Transportation Engineering, June 2013 - Department of Civil and Environmental Engineering, University of Washington, Seattle
   - M.S. Transportation Planning and Management, May 2009 - Department of Transportation Studies, Texas Southern University, Houston, Texas
   - B.S. Electronics and Electrical Engineering (with honors), July 2006 - Department of Electronics and Electrical Engineering, Beijing Jiaotong University, Beijing, China

3. Academic experience
   - University of Utah, Salt Lake City, UT, (06/2019-Present)
     Associate Professor, Department of Civil & Environmental Engineering
   - University of Utah, Salt Lake City, UT, (07/2013-06/2019)
     Assistant Professor, Department of Civil & Environmental Engineering
   - Smart Transportation Applications and Research (STAR) Laboratory, University of Washington, Seattle, WA, (06/2013-08/2013), Research Associate
   - Washington State Department of Transportation, (03/2013-06/2013)
     Traffic Engineering at Urban Planning Office
   - Smart Transportation Applications and Research (STAR) Laboratory, University of Washington, Seattle, WA, (04/2009-06/2013), Graduate Research Assistant
   - Texas Southern University, Houston, TX, (08/2006-12/2008)
     Graduate Research Assistant

4. Non-academic experience - (none)

5. Certification or professional registration
   - Professional Engineer, State of Utah
   - Graduate Certificate in Global Trade, Transportation, and Logistics Studies, University of Washington

6. Current membership in professional organizations
   - Transportation Research Board; Institute of Transportation Engineers; American Society of Civil Engineers

7. Honors and awards
   - 2019 Outstanding Reviewer ASCE Journal of Transportation Engineering, Part A: Systems
   - 2017 Outstanding Educator Award, Western ITE
   - 2017 Faculty Fellow Awards, University of Utah
   - 2016 Nominee for Utah Engineering Council Educator of the Year
   - 2016 Utah ITE Educator of the Year

8. Service activities

- 2019 ─ Now: Chair, Transportation Research Board ACP40 Highway Capacity Quality of Service Committee Technology Transfer Subcommittee
- 2019 ─ Now: Transportation Research Record Handling Editor
- 2019: Guest Editor for IEEE Transactions on ITS – Special Issue on Public Transit Planning and Operation in the Era of Automation, Electrification and Personalization
- 2019 ─ Now : Affiliated faculty member for Data Science Center, School of Computing, University of Utah
- 2018 ─ Now: Editorial Board, Computers, Environment and Urban Systems
- 2016 ─ 2019: Committee Member, Transit Capacity and Quality of Service, Transportation Research Board
- 2016 ─ 2019: Member and Paper Review Coordinator Highway Capacity Quality of Service (HCQS), Transportation Research Board
- 2010 ─ 2019: Committee Member, Transportation Research Board (TRB) Committee on Managed Lanes (AHB35)

9. Selected publications
    - Yirong Zhou, Xiaoyue Liu, Ran Wei and Aaron Golub, Bi-Objective Optimization for Battery Electric Bus Deployment Considering Cost and Environmental Equity. IEEE Transactions on Intelligent Transportation Systems, doi: 10.1109/TITS.2020.3043687, 2020.
    - Zhiyan Yi, Xiaoyue Liu, Jeff Phillips, and Nikola Markovic. Inferencing Hourly Traffic Volume Using Data-Driven Machine Learning and Graph Theory. Computers, Environment and Urban Systems. Vol 85, 2020.
    - Zhuang Dai, Xiaoyue Liu, Xi Chen, and Xiaolei Ma. Joint optimization of scheduling and capacity for mixed traffic with autonomous and human-driven buses: A dynamic programming approach. Transportation Research Part C: Emerging Technologies. Volume 114, pp 598-619, 2020.
    - Yongping Zhang, Diao Lin, and Xiaoyue Liu. Biking Islands in Cities: An Analysis Combining Bike Trajectory and Percolation Theory. Journal of Transport Geography. Vol 80, 2019.
    - Zhuang Dai, Xiaoyue Liu, Zhuo Chen, Ren-yong Guo, and Xiaolei Ma. A Predictive Headway-based Bus-holding Strategy with Dynamic Control Point Selection: A Cooperative Game Theory Approach. Transportation Research Part B: Methodological. Vol 125, pp 29-51, 2019.
    - Zhuo Chen, Xiaoyue Liu, and Ran Wei. Agent-based Approach to Analyzing the Effects of Dynamic Ridesharing in a Multimodal Network. Computers, Environment and Urban Systems. Vol 74, pp 126-135, 2018.
    - Zhuo Chen and Xiaoyue Liu. Roadway Asset Inspection Sampling using High-Dimensional Clustering and Locality-Sensitivity Hashing. Computer-Aided Civil and Infrastructure Engineering. Vol 34, Issue 2 pp. 116-129, 2018.

10. Most recent professional development activities - (none)

1. Name: Nikola Markovic, Ph.D.

2. Education
    - Doctor of Philosophy, Civil Engineering, University of Maryland, 2013
    - Master of Science, Civil Engineering, University of Maryland, 2010
    - Bachelor of Science, Transportation Engineering, University of Belgrade, 2009

3. Academic experience
    - University of Utah, Assistant Professor, 2018-present
    - University of Maryland, Faculty Assistant, 2015-2018
    - University of Maryland, Postdoctoral Fellow, 2013-2015

4. Non-academic experience - (none)

5. Certifications or professional registrations - (none)

6. Current membership in professional organizations
    - Transportation Research Board
    - Institute for Operations Research and Management Science (INFORMS)

7. Honors and awards
   2015 Glover-Klingman Prize for best paper published in Networks in 2015

8. Service activities
    - Member of numerous University of Utah committees
    - Reviewer for numerous journals

9. Selected publications
    - Data-drive robust resource allocation with isotonic cost functions. Operations Research. 2021.
    - Scaling GPS trajectories to match point traffic counts: A convex programming approach and Utah case study. Transportation Research Part E.
    - A deep convolutional neural network based approach for vehicle classification using large-scale GPS trajectory data. Transportation Research Part C.
    - Estimating historical hourly traffic volumes via machine learning and vehicle probe data: A Maryland case study. Transportation Research Part C.
    - Applications of Trajectory Data from the Perspective of a Road Transportation Agency: Literature Review and Maryland Case Study. IEEE Transactions on ITS.
    - Evasive flow capture: A multi-period stochastic facility location problem with independent demand. European Journal of Operational Research.

10. Most recent professional development activities
    INFORMS meeting, 2019.

1. Name: Emily Marron, Ph.D.

2. Education
    - Ph.D., Civil & Environmental Engineering, University of California Berkeley, 2020
    - MS, Environmental Chemistry, ETH Zürich, 2014
    - BS, Civil & Environmental Engineering, The Ohio State University, 2012

3. Academic experience
    - University of Utah CvEEN Department: Asst. Professor, 2021-present
    - Stanford University Woods Institute for the Environment, Postdoctoral Scholar, 2020-2021

4. Non-academic experience
    - Malcolm Pirnie (now Arcadis), Wastewater Treatment Team, Technical Intern, 2011
    - Ohio Environmental Protection Agency, Division of Air Pollution Control, College Intern, 2010

5. Certifications or professional registrations - (none)

6. Current membership in professional organizations
    - Member, American Chemical Society, 2014-present
    - Member, American Water Works Association, 2017-present

7. Honors and awards
    - AWWA Academic Achievement Award – 2nd Place Dissertation (National Competition), 2021
    - AWWA Academic Achievement Award – 1st Place Dissertation (CA-NV Section), 2020
    - UC Berkeley Outstanding Graduate Student Instructor Award, 2018
    - ETH Zurich Excellence Scholar and Opportunity Program, 2012-2014
    - National Science Foundation Graduate Research Fellowship, 2012
    - Ohio State Women in Engineering Leadership Award, 2012
    - Ohio Environmental Protection Agency Environmental Engineering Scholar, 2012
    - Ohio State College of Engineering Honors Undergraduate Research Scholar, 2012
    - Ohio State Department of Civil & Environmental Engineering Carolyn J. Merry Scholar, 2012

8. Service activities
    - Reviewer, Water Research, Environmental Science and Technology
    - Reviewer, National Science Foundation, Environmental Chemical Sciences Division
    - Volunteer, Bay Area Scientists in Schools (BASIS), 2018-2020

- Outreach Committee member, Student Diversity & Inclusion Initiative, ReNUWIt, 2019
- Co-chair, Gordon Research Seminar, Environmental Sciences: Water, 2018
- UC Berkeley Student Representative, Student Leadership Council, ReNUWIt, 2017
- Volunteer, ReNUWit Ingenuity Lab at Lawrence Hall of Science, 2016-2018

9. Selected publications
    - Marron, E. L.; Van Buren, J.; Cuthbertson, A. A.; Darby, E.; von Gunten, U.; Sedlak, D. L. Reactions of α,β-Unsaturated Carbonyls by Free Chlorine, Free Bromine, and Combined Chlorine. Environmental Science & Technology. 2021, 55(5), 3305-3312.
    - Marron, E. L.; Van Buren, J.; Prasse, C.; Sedlak, D. L. Formation and Fate of Carbonyl Compounds in Potable Water Reuse. Environmental Science & Technology. 2020, 54 (17), 10895-10903.
    - Van Buren, J.; Prasse, C.; Marron, E. L., Skeel, B.; Sedlak, D. L. Ring-Cleavage Products Produced During the Initial Phase of Oxidative Treatment of Alkyl-Substituted Aromatic Compounds. Environmental Science & Technology. 2020, 54 (13), 8352-8361.
    - Marron, E. L.; Mitch, W. A.; von Gunten, U.; Sedlak, D. L. A Tale of Two Treatments: the Multiple Barrier Approach to Removing Chemical Contaminants during Potable Water Reuse. Accounts of Chemical Research. 2019, 52 (3), 615-622.
    - Janssen, E. M.; Marron, E. L.; McNeill, K. Aquatic photochemical kinetics of benzotriazole and structurally related compounds. Environmental Science: Processes & Impacts. 2015.17 (5), 939-946.

    Presentations
    - Marron, E. L., Van Buren, J., Cuthbertson, A. A., Darby, E., von Gunten, U., Sedlak, D. L. Formation and fate of carbonyl compounds during potable water reuse. American Chemical Society. August 2020. Oral Pres.
    - Marron, E. L., Van Buren, J., Darby, E., Sedlak, D. L. Transformation of α,β-unsaturated carbonyl compounds by free and combined chlorine: a mechanistic study. GRC: Disinfection, Byproducts, and Health. July 2019. Oral Pres.
    - Marron, E. L., Van Buren, J., Prasse, C., Sedlak, D. L. Formation and fate of aldehydes during potable water reuse systems. American Association of Env. Engineering and Science Professors. Phoenix, AZ. May 2019. Poster.
    - Marron, E. L., Van Buren, J., Prasse, C., Sedlak, D. L. Aldehydes in advanced wastewater treatment for potable reuse. Gordon Research Conference, Environmental Sciences: Water. Holderness, NH. June 2018. Poster.
    - Marron, E. L., Prasse, C., Sedlak D. L. Aldehydes in closing the TOC mass balance in RO permeate. IWA Water Reuse. Long Beach, CA. July 2017. Oral Pres.
    - Marron, E. L., Bonvin, F., Sedlak D. L. Low molecular weight compounds in potable water reuse. Gordon Research Conference, Environmental Sciences: Water. Holderness, NH. June 2016. Poster.

- Bonvin, F., Marron, E. L., Sedlak, D. L., Odorous compounds: A barrier to DPR? Oral presentation at 19th Annual Water Reuse and Desalination Research Conference, Huntington Beach, CA. May 2015. Oral Pres.

10. Most recent professional development activities
    Conference and workshop attendance every year

1. Name: Luther McDonald IV, Ph.D.

2. Education
    - Post-Doctoral Fellow, Environmental Chemistry, Pacific Northwest National Laboratory, 2013
    - Ph.D., Radiochemistry Washington State University, 2013
    - B.S., Chemistry University of West Florida, 2009

3. Academic experience
    - University of Utah, Associate Professor, 2020-present, Full-time
    - University of Utah, Assistant Professor, 2014-2020, Full-time
    - Washington State University - TriCities, Adjunct Professor, 2013, Part-time

4. Non-academic experience - (none)

5. Current memberships in professional organizations
    - American Chemical Society (ACS)
    - Materials Research Society (MRS)
    - Institute of Nuclear Materials Management (INMM)

6. Professional registrations - (none)

7. Honors and awards
    - Top 15% of undergraduate instructors in the University of Utah College of Engineering for the course Undergraduate Radiochemistry, Spring 2020
    - Top 15% of undergraduate instructors in the University of Utah College of Engineering for the course Nuclear Principles in Science and Engineering, Fall 2018
    - Top 15% of graduate instructors in the University of Utah College of Engineering for the course Analytical Nuclear Forensics, Spring 2018
    - Top 15% of undergraduate instructors in the University of Utah College of Engineering for the course Undergraduate Radiochemistry, Spring 2018
    - Top 15% of undergraduate instructors in the University of Utah College of Engineering for the course Nuclear Principles in Science and Engineering, Fall 2017
    - Forbes “30 under 30 in Science,” 2017
    - Top 15% of undergraduate instructors in the University of Utah College of Engineering for the course Undergraduate Radiochemistry, Spring 2017
    - Latter-day Saint Student Association (LDSSA) Excellence in Education Recognition Award, 2017

8. Service Activities
    - Panel Review Expert for the U.S. Department of Energy's Office of Defense Nuclear Nonproliferation R&D project: "Molecular and Microstructural Provenance of Uranium and Plutonium Oxides," 2020

- Technical Reviewer for Department of Energy – Nuclear Energy University Proposals, 2020.
- Panel Review Expert for U.S. Department of Energy's Office of Defense Nuclear Nonproliferation R&D on Project: "Morphological Provenance Signatures," 2019.
- Symposia Chair of the Session "Crosscutting Research in Environmental Radiochemistry and Nuclear Forensics" at the Spring American Chemical Society National Meeting 2019.
- Technical Reviewer for Department of Energy – Nuclear Energy University Proposals, 2019.
- Technical reviewer for Department of Energy – Basic Energy Sciences Proposals, 2019.
- Panel Review Expert for Los Alamos National Laboratory Directed Research and Development on the project "The Fundamental Physical Interpretation and Exploitation of Stable Isotope Fractionation," 2019.

9. Selected publications
    - Nizinski1, C. A., Hanson1, A. B., Fullmer2, B. C., Mecham2, N. J., Tasdizen, T., & McDonald IV, L. W. 2020. Effects of process history on the surface morphology of uranium ore concentrates extracted from ore. Minerals Engineering, 156, 106457.
    - Ly1, C., Vachet, C., Schwerdt, I., Abbott1, E., Brenkmann2, A., McDonald, L. W., & Tasdizen, T. 2020. Determining uranium ore concentrates and their calcination products via image classification of multiple magnifications. Journal of Nuclear Materials, 152082.
    - Hanson1, A.B.., Nichols3, R., Schwerdt1, I.J., Vachet, C., Tasdizen, T., and McDonald IV, L.W., 2019. Quantifying the Impacts of Impurities on Morphological Features, Analytical Chemistry.
    - Heffernan2, S.T., Ly1, N.C., Mower3, B.J., Vachet, C., Schwerdt1, I.J., Tasdizen, T. and McDonald IV, L.W., 2019. Identifying Surface Morphological Characteristics to Differentiate Between Mixtures of U3O8 synthesized from Ammonium Diuranate and Uranyl Peroxide. Radiochimica Acta.
    - Abbott1, E.C., Brenkmann3, A., Galbraith3, C., Ong3, J., Schwerdt1, I.J., Albrecht, B.D., Tasdizen, T. and McDonald IV, L.W., 2019. Dependence of UO2 surface morphology on processing history within a single synthetic route. Radiochimica Acta.

10. Professional Development
    2014 Workshop on nuclear forensics for nonproliferation – Next Generation Safeguards Initiative, Oak Ridge National Laboratory

1. Name: Kami Mohammadi, Ph.D., P.E.

2. Education
    - Ph.D., Civil and Environmental Engineering (Geotechnical Engineering), Georgia Institute of Technology, 2015.
    - M.Sc., Civil and Environmental Engineering (Geotechnical Engineering), University of Tehran, 2006.
    - B.Sc., Civil Engineering, Chamran University of Ahvaz, 2003.

3. Academic experience
    - University of Utah, Assistant Professor, Jul. 2021 – on, Full time.
    - California Institute of Technology, Postdoctoral Scholar, Jan. 2016 – Jun. 2021, Full time.
    - Georgia Institute of Technology, Graduate Research Assistant, Aug. 2010 – Dec. 2015, Full time.

4. Non-academic experience
    - Gamanehkav Consultant Engineers, Associate geotechnical earthquake engineer, Principal investigator for preparation of a national technical standard (guidelines of liquefaction assessment) project led a team of geotechnical earthquake experts from academia and industry, 2008-2010
    - Saahel Consultant Engineers, Senior geotechnical earthquake engineer, Responsible for geotechnical/earthquake analyses and designs of land-based and near-shore infrastructures, 2006-2008
    - Darya Khak Pay Consultants, Staff Geotechnical Engineer, Responsible for geotechnical analysis and design of structures, preparation of national seismic hazard zonation maps.

5. Certifications or professional registrations
    - Professional Engineer (Civil and Geotechnical Engineering) in Utah (passed the exams and soon will have the registration ID#).
    - Certificate for Academic Writing. Center for Enhanced Teaching and Learning (CETL). Georgia Institute of Technology. Fall 2012.
    - Distributed Acoustic Sensing (DAS) Virtual Workshop and Tutorial, 2020, Aug. 10,12, and 17, Incorporated Research Institutions for Seismology (IRIS).

6. Current membership in professional organizations
   ASCE (includes GI and EMI), ISSMGE, SSA, AGU, EERI.

7. Honors and awards
    - WPI STEM Faculty Launch, Worcester Polytechnic Institute, Merit-based, NSF-funded travel grant.
    - NHERI Summer Institute, University of Texas at San Antonio, Merit-based, NSF/NHERI-funded travel grant.
    - Outstanding graduate student (Georgia Tech), MS and Ph.D. degrees with Summa Cum Laude.

8. Service activities
    - Mentoring graduate and undergraduate research assistants (Georgia Tech & Caltech), 2012–2020.
    - GaTech GeoSoeciety (Association of Geosystems Graduate Students), Participated in all technical seminars and networking activities.
    - Reviewer for the following technical journals and conferences since 2015: Bulletin of Seismological Society of America, Geophysical Journal International, Canadian Geotechnical Journal, Gotechnique Letters, Seismological Research Letters, Soil Dynamics and Earthquake Engineering, Journal of Geotechnical and Geoenvironmental Engineering, Numerical and Analytical Methods in Geomechanics.

9. Selected publications
    - Ayoubi, P., Mohammadi, K., and Asimaki, D. (2021). "Basin Effects: Investigating the Effects of Different Parameters on Surface Ground Motion." Soil Dynamics and Earthquake Engineering, 141, 106490.
    - Asimaki, D., Mohammadi, K., Ayoubi, P., Mayoral, M. J., and Montalva, G. (2020). "Investigating the Spatial Variability of Ground Motions During the 2017 MW 7.1 Puebla-Mexico City Earthquake via Idealized Simulations of Basin Effects." Soil Dynamics and Earthquake Engineering, 132, 106073.
    - Roshankhah, S., Mohammadi, K., and K-Nejad, A. (2020) "Characteristics of Hydraulic Fractures in Terms of the Matrix Permeability and the Natural Fracture Density." Proceedings of the ARMA/DGS/SEG International Geomechanics Symposium, Nov. 3-5.
    - Roshankhah, S. and Mohammadi, K. (2020) "Fabric-dependent Hydro-Mechanical Behavior of Pre-fractured Rocks." Geocongress 2020, Feb. 25-28, Minneapolis, MN.
    - Asimaki, D., Mohammadi, K. (2018). "On the Complexity of Seismic Waves Trapped in Two-Dimensional Topographies." Invited paper: Soil Dynamics and Earthquake Engineering, 114, 424-437.
    - "Interaction of Seismic Waves with Geomaterial Heterogeneity: From Multi-Scale Scattering Mechanisms to Dynamic Response of Geostructures" Department of Mechanical and Civil Engineering, California Institute of Technology, Apr. 30, 2020.
    - "Seismic Wave Interaction with Geostructures: To Understand the Involved Mechanisms at Various Scales and to Determine the Dynamic Response " Department of Civil and Environmental Engineering, University of Utah, Mar. 19, 2020.

10. Most recent professional development activities
    - Initiated collaborations with researchers in the US, Japan, and Mexico on seismic wave propagation in geostructures.
    - Attended technical lectures and workshops on the integration of Geoinformatics and Geoengineering in 2020 – on.
    - Obtaining the PE registration in the state of UT.

1. Name: Brian McPherson, Ph.D.

2. Education
   Ph.D. in Geophysics, 1996, University of Utah, Salt Lake City.

3. Academic experience
   USTAR Professor, July, 2013 - Present, Department of Civil and Environmental Engineering, University of Utah

4. Non-academic experience - (none)

5. Certifications or professional registrations - (none)

6. Current membership in professional organizations
   American Geophysical Union, American Association of Petroleum Geologists

7. Honors and awards - (none)

8. Service activities
   - Geothermics Editorial Board Member
   - National Risk Assessment Partnership (US Dept of Energy) – Stakeholder Advisory Board Chair
   - American Geophysical Union – Hydrology Program Committee Member

9. Selected publications: * Indicates senior author of publication is McPherson student advisee or co-advisee.
   - *Patil, V. & McPherson, B. (2020). Identifying Hydrogeochemical Conditions for Fault Self-Sealing in Geological Storage. Water Resources Research. Vol. 56, e2018WR024436.
   - Dai, Zhenxue & Xu, L., Xiao, T., McPherson, B., Zhang, X., Zheng, L., Dong, S., Yang, Z., Soltanian, M. R., Yang, C., Ampomah, W., Jia, W., Yin, S., Xu, T., Bacon, D., Viswanathan, H., (2020). Reactive chemical transport simulations of geologic carbon sequestration: Methods and applications. Earth-Science Reviews. Vol. 208, 103265-103280. https://doi.org/10.1016/j.earscirev.2020.103265
   - *Xiao, T. & Xu, H., Moodie, N., Esser, R., Jia, W., Zheng, L., Rutqvist, J., McPherson, B. (2020). Chemical-mechanical impacts of CO2 intrusion into heterogeneous caprock. Water Resources Research. Vol. 56, e2020WR027193.
   - *Patil, V. (2020). Modeling Coupled Reactive Transport Through Fault-zones: A Critical Review. Environmental Engineering Science. Vol. 10, 44-88. https://www.essoar.org/doi/10.1002/essoar.10504444.1
   - *Xiao, T. & McPherson, B., Esser, R., Dai, Z., Chu, S., Pan, F., Jia, W., Viswa nathan, H. (2020). Chemical impacts of potential CO2 and brine leakage on groundwater quality with quantitative risk assessment: A case study on the Farnsworth Unit. Energies. Vol. 13: 6574-6588 https://www.mdpi.com/1996-1073/13/24/6574

- *Moodie, Nathan; Ampomah, William; Jia, Wei; Heath, Jason; McPherson, Brian; (2019) Assignment and calibration of relative permeability by hydrostratigraphic units for multiphase flow analysis, case study: CO2-EOR operations at the Farnsworth Unit, Texas; International Journal of Greenhouse Gas Control 81:103-114
- *Xiao, Ting; McPherson, Brian; Esser, Richard; Jia, Wei; Moodie, Nathan; Chu, Shaoping; Lee, Si-Yong; (2019) Forecasting commercial-scale CO2 storage capacity in deep saline reservoirs: Case study of Buzzard's bench, Central Utah; Computers & geosciences 126:41-51
- Tavakol-Davani, Hessam E; Tavakol-Davani, Hassan; Burian, Steven J; McPherson, Brian J; Barber, Michael E; (2019) Green infrastructure optimization to achieve pre-development conditions of a semiarid urban catchment; Environmental Science: Water Research & Technology 5(6): 1157-1171
- Lei, Gang; Cao, Nai; McPherson, Brian J; Liao, Qinzhuo; Chen, Weiqing; (2019) A novel Analytical Model for pore Volume compressibility of fractal porous Scientific Reports Volume 9: Article number: 14472 (2019) https://www.nature.com/articles/s41598-019-51091-2
- Tavakol-Davani, Hassan; Rahimi, Reyhaneh; Burian, Steven J; Pomeroy, Christine A; McPherson, Brian J; Apul, Defne; (2019) Combining Hydrologic Analysis and Life Cycle Assessment Approaches to Evaluate Sustainability of Water Infrastructure: Uncertainty Analysis, Water 11(12): 2592

10. Most recent professional development activities - (none)

1. Name: Carlos A. Oroza, Ph.D.

2. Education
    - University of California, Berkeley, Berkeley, California, Mechanical Engineering, BS 2010
    - University of California, Berkeley, Berkeley, California, Civil Engineering, MS 2012
    - University of California, Berkeley, Berkeley, California, Civil Engineering, Ph.D. 2017
    - University of California, Berkeley, Berkeley, California, Civil Engineering, Postdoctoral 2018

3. Academic experience
    - August 2018 Assistant Professor, Civil Engineering University of Utah
    - 2017-2018 Postdoctoral Researcher UC Berkeley
    - 2013-2017 Graduate Student Researcher UC Berkeley

4. Non-academic experience
    - Assisted with PCARI Wireless Sensor Network Workshop: 2-day hands-on tutorial teaching students from the University of the Philippines, Los Banos how to use wireless-sensor networks to acquire and manage data. August 22-23, 2017 at the University of California, Berkeley.
    - Contributor to the open-source Sensor Object Library software, a system developed by the REALMS team at INRIA for the acquisition of sensor data and network statistics from wireless-sensor networks. Source code available at: github.com/realms-team/sol
    - Received Signal Strength (RSSI) from wireless-sensor networks in complex terrain: a publicly accessible database of RSSI measurements from the American River Hydrologic Observatory. Annotated with path properties and used to train the machine-learning-based path-loss model in the journal article: "A machine-learning based connectivity model for complex terrain large-scale low-power wireless deployments." Data are accessible at: github.com/realms-team/ARHO_RSSI_DATA

5. Certifications or professional registrations - (none)

6. Current membership in professional organizations
   IEEE, member; AGU, member

7. Honors and awards - (none)

8. Service Activities
   Department Service

- Chair, Cyber & Technology Coordinator Search Committee
- Member, Digital Engineering Search Committee
- Member, Geotechnical/Geoinformations Search Committee
- Chair, Cyber & Technology Integration Committee. 08/15/2019 - present.
- Member, Cyber & Technology Integration Committee. 08/15/2018 - 08/15/2019.
- Member, Graduate Committee. 08/01/2018 - present

External Service

- Editorial Roles: Associate Editor, Journal of Hydrology
- Journal Peer Reviewer: Journal of Hydrology, Water Resources Research, ASCE Journal of Infrastructure Systems, IEEE Transactions on Vehicular Technology, IEEE Access, Smart Water

9. Selected publications
    - Ahmed, W., Rahimoon, Z. A., Oroza, C. A., Sarwar, S., Qureshi, A. L., Punthakey, J. F., & Arfan, M. (2020). Modelling Groundwater Hydraulics to Design a Groundwater Level Monitoring Network for Sustainable Management of Fresh Groundwater Lens in Lower Indus Basin, Pakistan. Applied Sciences. (2020)
    - Haruko Wainwright, Dajie Sun, Carlos A. Oroza, Akiyuki Seki, Satoshi Mikami, Hiroshi Takemiya, Kimiaki Saito. Optimizing Long-term Monitoring of Radiation Air-Dose Rates after the Fukushima Daiichi Nuclear Power Plant. Journal of Environmental Radioactivity. (2020)
    - F. Avanzi, R. Johnson, C. A. Oroza, H. Hirashima, S. Yamaguchi, “Predicting daily preferential-flow discharge from seasonal snow with Random Forest,” Water Resources Research, 2019, doi: 10.1029/2019WR024828
    - C.A. Oroza, R.C. Bales, E.M. Stacy, Z. Zheng, and S. D. Glaser, “Long-term variability of soil moisture in the Southern Sierra: Measurement and prediction,” Vadose Zone Jornal, 2018, doi:10.2136/vzj2017.10.0178.
    - Zeshi Zheng, Noah P. Molotch, Carlos A. Oroza, Martha H. Conklin, Roger C. Bales, “Spatial snow water equivalent estimation for mountainous areas using wireless-sensor networks and remote-sensing products,” Remote Sensing of Environment, 2018, doi: 10.1016/j.rse.2018.05.029.
    - Bales, R., Stacy, E., Safeeq, M., Meng, X., Meadows, M., Oroza, C., Conklin, M., Glaser, S., and Wagenbrenner, J.: Spatially distributed water-balance and meteorological data from the rain-snow transition, southern Sierra Nevada, California, Earth Syst. Sci. Data Discuss., https://doi.org/10.5194/essd-2018-69, 2018.
    - C. A. Oroza, Z. Zhang, T. Watteyne, and S. D. Glaser, “A machine-learning based connectivity model for complex terrain large-scale low-power wireless deployments,” IEEE Transactions on Cognitive Communications and Networking, 2017, doi: 10.1109/TCCN.2017.2741468
    - S. Malek, F. Avanzi, K. Brun-Laguna, T. Maurer, C. A. Oroza, P. Hartsough, T. Watteyne, and S. D. Glaser, “Real-time alpine measurement system using wireless sensor networks,” Sensors, 2017, doi: 10.3390/s17112583

- C. A. Oroza, Z. Zheng, S. D. Glaser, D. Tuia, and R. C. Bales, “Optimizing embedded sensor network design for catchment-scale snow-depth estimation using LIDAR and machine learning,” Water Resources Research, 2016, doi: 10.1002/2016WR018896
- D. E. Rheinheimer, R. C. Bales, C. A. Oroza, J. R. Lund, and J. H. Viers, “Valuing year-to-go hydrologic forecast improvements for a peaking hydropower system in the Sierra Nevada,” Water Resources Research, 2016, doi: 10.1002/2015WR018295

10. Most recent professional development activities - (none)

1. Name: Ge (Gaby) Ou, Ph.D.

2. Education
   - Ph.D. Purdue University, U.S., Lyles School of Civil Engineering, Aug. 2016 Dissertation: Robust Real Time Hybrid Simulation Techniques Incorporating Model Updating, Advisor: Professor Shirley J. Dyke
   - B.E. The University of Sydney, Sydney, Australia, Civil Engineering, Jul. 2010
   - B.S. Harbin Institute of Technology, Harbin, China. Theoretical and Applied Mechanics, Jun. 2010

3. Academic experience
   - Assistant Professor, University of Utah, US, Aug.2016 – Present
   - Research Assistant, Purdue University, US, Aug. 2010 – Aug. 2016
   - Visiting Scholar, University of Western Sydney, AU, May. 2010 – Aug. 2010
   - Visiting Scholar, University of Western Australia, AU, Nov. 2008 – Feb. 2009

4. Non-academic experience - (none)

5. Certifications or professional registrations - (none)

6. Current membership in professional organizations
   - American Society of Civil Engineers, 2012-present.
   - Earthquake Engineering Research Institute, 2012-present.
   - Engineering Mechanics Institute, 2012-present.
   - Institute of Electrical and Electronics Engineers, 2017-present.

7. Honors and Awards
   - Travel grant awardee at NEHRI Summer Institute, National Science Foundation, San Antonio, TX, July 25-28, 2017.
   - Resilience Best Paper Award (1st place in 2020 Engineering Mechanics Institute Conference student competition), 2020.07.

8. Services
   - Member of Editorial Board Journal of Low Frequency Noise, Vibration & Active Control 2020-Present.
   - Guest Editor for Journal of Low Frequency Noise, Vibration & Active Control, Special Issue, Towards smart buildings and structures: condition monitoring, assessment and control, 2017-2018.
   - Reviewer for Smart Structures and Systems; Journal of Performance of Constructed Facilities; Journal of Structural Integrity and Maintenance; Journal of Reliability Engineering & System Safety; Journal of Low Frequency Noise, Vibration & Active Control; Journal of Earthquake Engineering; Journal of Structural Control and Monitoring; Journal of Earthquake Engineering and Structural Dynamics; Journal of Engineering Mechanics; Journal of Bridge

Engineering; Journal of Structural Health and Monitoring; Frontiers in Built Environment;
- ASCE - Structural Health Monitoring and Control (SHMC) committee, 2017-present.
- NSF-Multi-hazard Engineering Hybrid Simulation (MECHS) committee, 2017-present.
- Co-director of WeatherG Initiative (http://weatherg.utah.edu/), University of Utah, 2018-present.
- Faculty Senate Advisory Committee on Student Course Feedback, University of Utah, 2019-present.
- College of Engineering Scholarship Committee, University of Utah, 2017-present.
- Scholarship Committee chair, Department of Civil and Environmental Engineering, 2017-present.

9. Selected publications: Underline indicates advised student, * indicates corresponding author.
    - G. Ou*, S.J. Dyke, and A. Prakash, "Real time hybrid simulation with online model updating: An analysis of accuracy", Mechanical Systems and Signal Processing, 84(B), 2017: 223-240. (IF 6.471)
    - M.L. Brodersen*, G. Ou, J. Høgsberg, and S.J. Dyke, "Analysis of hybrid viscous damper by real time hybrid simulations", Journal of Engineering Structures. 126 (2016): 675-688. (IF: 3.775)
    - Z. Sun*, G. Ou, S.J. Dyke and C. Lu, "A state estimation method for wireless structural control systems", Journal of Structural Control and Health Monitoring. 2017 Jun 1: 24(6). (IF 3.499)
    - Yang G*, Wu B, Ou G, Wang Z, Dyke S. "HyTest: Platform for Structural Hybrid Simulations with Finite Element Model Updating". Advances in Engineering Software. 112 (2017): 200-210. (5 year IF: 5.513)
    - An, Y.*, Wang, Z., Ou, G., Pan, S., & Ou, J. (2019). Vibration Mitigation of Suspension Bridge Suspender Cables Using a Ring-Shaped Tuned Liquid Damper. Journal of Bridge Engineering, 24(4), 04019020. (IF 1.84)
    - Z. Xiang, A. Rashidi, and G. Ou, "States of Practice and Research on Applying GPR Technology for Labeling and Scanning Constructed Facilities" Journal of Performance of Constructed Facilities, 33 (5), 03119001 (IF 1.542)
    - A. I. Ozdagli*, W. Xi, G. Ou, L. Bo, S. J. Dyke, D. Yong, G. Xu, T. Wang, B. Wu, J. Zhang, "Experimental Verification of a Geographically-Distributed Real-time Hybrid Simulation Platform", Structural Control and Health Monitoring 27 (2), e2483 (IF 3.499)
    - Sang, Y., Xue, J., Sahraei-Ardakani, M.*, and Ou, G., "Reducing Hurricane-induced Power Outages through Preventive Operation". in IEEE Systems Journal, 2019. (IF 2.063)
    - Z. Xiang*, G. Ou, and A. Rashidi "An automated process to simultaneously determine 3D location and size of rebar in GPR data", Journal of Performance of Constructed Facilities, Published, 2020 (IF 1.542)

10. Most recent professional development activities

- Ge (Gaby) Ou, MECHS Webinar | Anatomy of a Hybrid Simulation/Real-time Hybrid Simulation, June 8, 2018, https://www.youtube.com/watch?v=uIhqwlndjPg

1. Chris P. Pantelides, Ph.D., P.E., S.E., FACI

2. Education
    - Ph. D. Civil Engineering, Missouri S&T, Dec. 1987
    - M. Sc. Civil Engineering, Missouri S&T, Jul. 1983
    - B. E. Civil Engineering, American University of Beirut, Jun. 1980

3. Academic experience
    - University of Utah, Salt Lake City, Utah
        - 8/2013-present: Professor, Dept. of Civil and Env. Eng.
        - 7/2012-7/2013: Interim Chair, Dept. of Civil and Env. Eng.
        - 8/2002-6/2012: Associate Chair, Dept. of Civil and Env. Eng.
        - 7/1999-7/2002: Professor, Dept. of Civil and Env. Eng.
        - 7/1995-6/1999: Associate Professor, Dept. of Civil and Env. Eng.
        - 9/1991-6/1995: Assistant Professor, Dept. of Civil and Env. Eng.
    - 1/1988-8/1991: Assistant Professor, Department of Civil Engineering, Missouri S&T, Rolla, Missouri.

4. Non-academic experience
    - 1/1981-7/1982: Construction Bridge Engineer, Odon & Odostromaton, S.A., Jeddah, Saudi Arabia.
    - 6-12/1980: Design Structural Bridge Engineer: Dar-Al-Handasah Consultants, Beirut, Lebanon.

5. Certifications or professional registrations
   Professional Engineer

6. Current membership in professional organizations - (none)

7. Honors and awards
    - 2019 Outstanding Reviewer, Journal of Structural Engineering, ASCE.
    - 2018 Academy of Civil Engineers, Missouri S&T.
    - 2018 American Concrete Institute Fellow.
    - Technology Implementation Group – (2003) - AASHTO: Selected as new technology for implementation: Fiber Reinforced Polymer Repair of Overhead Sign Structure (OSS) Trusses.
    - ASCE Best Applied Research Paper Award, Journal of Composites for Construction

8. Service activities
    - Department of Civil & Environmental Engineering: RPT Committee, Chair 2021-2022; Graduate Recruitment Committee, Member 2018-present; Graduate Committee, Member 2016-present; Infrastructure Group Co-coordinator, 2013-2018; Structures/Geotechnical Group Co-coordinator, 2006-2012. 2013-present.
    - TRB Committee AFF50, Seismic Design and Performance of Bridges, 2012-present.

- ACI Committees: Performance Based Seismic Design of Concrete Buildings, ACI 374, Member, 1999-present; Joints and Connections in Monolithic Concrete Structures, ACI 352, Joint ACI-ASCE, Member, 2016-present; Nuclear Structures-Anchorage, ACI 349-0C, Member, 2014-present; ACI 440F Co-Leader Subcommittee Task Group on FRP composite retrofit of joints, 2002-present
- National Science Foundation: Reviewer for Career, Small Business Innovative Research, Civil and Mechanical Systems, 1999-present.
- Editor: Journal of Architectural Engineering, ASCE, 2019-present; Construction and Building Materials, 2018-present.
- National Hazards Engineering Research Infrastructure/National Research Institute for Earth Science and Disaster E-Defense Meeting, Tokyo, Japan, Oct. 31 – Nov. 1, 2017.

9. Selected publications
    - Aghababaei, M., Okamoto, C., Koliou, M., Nagae, T., Pantelides, C.P., Ryan, K.L., Barbosa, A.R., Pei, S., van de Lindt, J.W., and Dashti, S. (2021). "Full-scale shake table test damage data collection using terrestrial laser-scanning techniques." J. Structural Engineering, ASCE, 10.1061/(ASCE)ST.1943-541X.0002905, 04020356.
    - Parks, J.E., Pantelides, C.P., Ibarra, L., and Sanders, D.H. (2020). "Cyclic tests and modeling of stretch length anchor bolt assemblies for dry storage casks." ACI Structural J., Nov., 117(6), 225-236.
    - Wang, Y., Ibarra, L., and Pantelides, C.P. (2020). "Effect of incidence angle on the seismic performance of skewed bridges retrofitted with buckling-restrained braces." Engineering Structures, 211, 110411.
    - Upadhyay, A., Pantelides, C.P., and Ibarra, L. (2019). "Residual drift mitigation for bridges retrofitted with buckling restrained braces or self-centering energy dissipation devices." Engineering Structures, 199, 109663.
    - Wu, R.Y., and Pantelides, C.P. (2019). "Seismic evaluation of repaired multi-column bridge bent using static and dynamic analysis." Construction and Building Materials, 208, 792-807.
    - Wang, Y., Ibarra, L., and Pantelides, C.P. (2019). "Collapse capacity of reinforced concrete skewed bridges retrofitted with buckling-restrained braces." Engineering Structures, 184, 99-114.
    - Moran, D.A., Pantelides, C.P., and Reaveley, L.D. (2019). "Mohr-Coulomb model for rectangular and square FRP-confined concrete." Composite Structures, 209, 889-904.
    - Murphy, C., Pantelides, C.P., Blomgren, H.-E., and Rammer, D. (2020). "Development of Timber Buckling-Restrained Brace." Department of Civil and Environmental Engineering, University of Utah, Salt Lake City, Utah, August 2020, 67 pages.
    - Pantelides, C.P. (2020). NSF Award 1829412: "RAPID/Collaborative Research: Japan-U.S. Collaboration on the Seismic Resilience of Wood-frame Building Systems."

10. Most recent professional development activities - (none)

1. Steven J. Peterson, MBA, MS, PE

2. Education
   M.S. Civil and Environmental Engineering, University of Utah, 2018
   MBA, University of Utah, 1988
   B.S. Mining Engineering, University of Utah, 1986

3. Academic experience
   Weber State University, Professor, 2009-Present
   Weber State University, Chair of Dept. of Construction Management Technology, 2011-14
   Weber State University, Chair of General Education Improvement and Assessment, 2012-13
   Weber State University, Associate Professor, 2004-09
   Weber State University, Assistant Professor, 2000-04

4. Non-academic experience
   2008-2020, Principle, Peterson Construction Consulting Services, LLC
   1999-2000, Senior Project Manager, Aspen Construction
   1995-99, Project Manager, Pentalon Construction
   1991-95, Site Engineer, Envirocare of Utah
   1989-91, Engineer, Utah Department of Environmental Quality
   1985-89, Estimator, Thiede Construction Corporation

5. Certifications or professional registrations
   Registered Professional Engineer, Utah, No. 174368-2202

6. Current membership in professional organizations
   Design-Build Institute of America (DBIA)

7. Honors and awards
   2011 Associated Schools of Construction (ASC) Region 6 Outstanding Educator Award

8. Service activities (within and outside of the institution)
   2019, Author, Parson Construction Management's Strategic Programming Report (SPR)

9. Most important publications from the past five years
   1. Peterson, Steven J., *Construction Accounting and Financial Management*, Fourth Edition, Prentice-Hall, 2020.
   2. Dagostino, Frank R. (deceased) and Peterson, Steven J., *Estimating in Building Construction*, Ninth Edition, Prentice-Hall, 2019.
   3. Peterson, Steven J., *Construction Estimating using Excel*, Third Edition, Prentice-Hall, 2018.
   4. Peterson, Steven J., *Pearson's Pocket Guide to Construction Management*, Prentice-Hall, 2012.
   5. Peterson, Steven J., (2015). Benchmarking Student Learning Outcomes using Shewhart Control Charts, presented at 51st Associated Schools of Construction (ASC) Annual International Conference, College Station, Texas, 2015.

6. Peterson, Steven J., 2018, ‘Reducing Project Delays Due To Utility Relocations,’ master’s thesis, University of Utah, Salt Lake City.

10. Most recent professional development activities
    1. 2021, ACCE Midyear Conference
    2. 2021, Intro to eLearning
    3. 2020, ACCE Midyear Conference
    4. 2019, Design-Build Institute of America’s Design-Build Conference & Expo.
    5. 2019, Progressive Design-Build Done RightTM workshop, Design-Build Institute of America
    6. 2019, Creating Wicked Students workshop by Paul Hanstedt
    7. 2018, Design-Build Institute of America’s Design-Build Conference & Expo.
    8. 2018, Machine Learning, Stanford Online
    9. 2018, Transportation Research Board 97th Annual Meeting
    10. 2017, Transportation Research Board 96th Annual Meeting
    11. 2016, Design-Build Institute of America’s Design-Build Conference & Expo.
    12. 2016, Transportation Research Board 95th Annual Meeting

1. Name: Christine A. Pomeroy, Ph.D., P.E.

2. Education
    - 2007, Colorado State University, Fort Collins, Colorado, Ph.D. Civil Engineering –Hydraulics
    - 2004 Colorado State UniversityFort Collins, Colorado, M.S. Civil Engineering – Hydraulics
    - 1995, Michigan State UniversityEast Lansing, Michigan, B.S. Civil Engineering – Environmental Emphasis

3. Academic experience
    - Associate Professor, Lecturer (7/2020 – present), Associate Professor (7/2013 – 6/2020), Assistant (8/2007 – 6/2013), Department of Civil & Environmental Engineering, University of Utah, Salt Lake City, UT.
    - Consulting Engineer (8/2001 – 9/2007), CDM, Fort Collins, CO.
    - Research Associate (2/2007 – 9/2007), Department of Civil & Environmental Engineering, Colorado State University, Fort Collins, CO.
    - Graduate Research Assistant (8/2001 – 1/2007), Department of Civil & Environmental Engineering, Colorado State University, Fort Collins, CO.
    - Graduate Teaching Assistant (1/2006 – 5/2006, 1/2005-5/2005, 1/2004-5/2004), Department of Civil & Environmental Engineering, Colorado State University, Fort Collins, CO.

4. Non-academic experience
    - Project Manager (11/1998 – 7/2001), Project Engineer (05/1995 – 10/1998), CDM, Detroit, MI.
    - Environmental, Health, and Safety Co-op (8/1992 – 8/1994), General Electric Motors, Fort Wayne, IN

5. Certifications or professional registrations
    Professional Engineer (P.E.), Michigan, License #6201045548

6. Current membership in professional organizations
    American Society of Civil Engineers

7. Honors and awards
    - 2020 Educator of the Year, American Society of Civil Engineers Utah Section
    - 2019 Outstanding Faculty Advisor. American Society of Civil Engineers
    - 2017 Outstanding Faculty Award, Department of Civil & Environmental Engineering, University of Utah
    - 2017 Outstanding Leadership Award, iUTAH EPSCoR
    - 2005 Borland Graduate Student Scholarship, Department of Civil & Environmental Engineering, Colorado State University
    - 2005 Jen Song Wang Memorial Scholarship, Department of Civil & Environmental Engineering, Colorado State University

8. Service activities
    - Professional Service: American Society of Civil Engineers (ASCE) Environmental Water Resources Institute (EWRI), Urban Water Resources Research Council, Various Subcommittee Roles (2007-present), National Science Foundation, Panelist (2016 (3), 2011 (1)), State of Utah Nutrient Advisory Committee, Member (2011-present).
    - University of Utah Service: Rio Mesa Center Advisory Committee, Member (2011 – 2016), Global Change and Ecosystem Center, Department Representative (2010 – 2016), College of Engineering Alternate Representative (2011-2014).
    - University of Utah College of Engineering Service: Women in Engineering Program, Faculty Coordinator, (2015-2016); Teaching in Excellence Committee, Member (2017-present).
    - University of Utah Department of Civil & Environmental Engineering Service: Scholarship Committee, Chair (2009-2011), Member (2012-present); Undergraduate & ABET Committee, Member (2012-2018), Co-Chair (2018-present), ASCE Student Chapter, Co-Advisor (2013-2017), Advisor (2017-present), ASCE Rocky Mountain Region Student Conference, Advisor (2015-2017), Outreach Committee, Member (2007-2008, 2017-present)

9. Selected publications
    - Lee, S., Burian, S.J. Pomeroy, C.A. 2021. Setting Future Water Rates for Sustainability of a Water Distribution System. Journal of Water Resources Planning and Management. 147(2).
    - Tavakol-Davani, H., Rahimi, R., Burian, S.J., Pomeroy, C.A., McPherson, B.J., Apul, D. 2019. Combining Hydrologic Analysis and Life Cycle Assessment Approaches to Evaluate Sustainability of Water Infrastructure: Uncertainty Analysis. Water, 11(12), 2592.
    - Lee, S., Pomeroy, C.A., Burian, S.J. 2020. Introducing a Hybrid-System Dynamics Model for Sustainability based Financial Planning of Water Distribution System. World Environmental and Water Resources Congress. Henderson, NV, May 17-21, 2020. (oral presentation)
    - Pomeroy, C. 2020. Community-enabled Lifecycle Analysis of Stormwater Infrastructure Costs (CLASIC). World Environmental and Water Resources Congress. Henderson, NV, May 17-21, 2020. (oral presentation)
    - Zhang, H., Dell, T., Pomeroy, C., Eagan, J. 2019. Community-enabled Lifecycle Analysis of Stormwater Infrastructure Costs (CLASIC). WEFTEC 2019. Chicago, IL, September 22-25, 2019. (oral presentation)
    - Pomeroy, C. 2019. Community-enabled Lifecycle Analysis of Stormwater Infrastructure Costs (CLASIC). Enabling Future Generations to Solve our Planet's Grand Challenges, The 19th Annual Meeting of the American Ecological Engineering Society. Asheville, North Carolina, June 3-6, 2019. (oral presentation)

10. Most recent professional development activities - (none)

1. Name: Abbas Rashidi, Ph.D., CPC, P.E.

2. Education
   - PhD, Civil Engineering, Georgia Institute of Technology, 2014
   - MS, in Electrical and Computer Engineering, Georgia Institute of Technology, 2013
   - MS, Civil Engineering, Amirkabir University of Technology, 2004
   - BS, Civil Engineering, Amirkabir University of Technology, 2001

3. Academic experience
   - The University of Utah, Associate Chair Civil and Envn. Eng. Asia Campus, 2019-Present
   - The University of Utah, Assoc. Professor, Civil and Environmental Engineering, 2007-Present
   - The University of Utah, Assist. Professor, Civil and Environmental Engineering, 2000-2006

4. Non-academic experience
   President, Rashidi Consulting Group, LLC, 2014-present, part-time

5. Certifications or professional registrations
   Certified Professional Constructor (CPC), American Institute of Constructors (AIC)

6. Current membership in professional organizations
   - American Society of Civil Engineers (ASCE)
   - Acoustical Society of America (ASA)
   - European Group for Intelligent Computing in Engineering (EG-ICE)

7. Honors and awards
   - 2018, Best Presentation Award, 20th International Conference on Occupational Health and Safety (ICOHS 2018), Miami, FL
   - 2015, 2016, 2017, Outstanding Reviewer Award, ASCE Journal of Construction Engineering and Management
   - 2017, Outstanding Reviewer Award, ASCE Journal of Computing in Civil Engineering
   - 2014, Ira Hardin Fellowship, School of Civil and Environmental Engineering, Georgia Institute of Technology
   - 2013, Best Paper Award, 5th International Conference on Construction Engineering and Project Management (ICCEPM)

8. Service activities (within and outside of the institution)
   - 2017- present, Chair of construction undergraduate committee
   - 2017-2019, Member, Strategic Planning and Hiring Committee
   - 2017-present, Assistant Specialty Editor and Member of Editorial Board, ASCE Journal of Construction Engineering and Management

- 2015-present, Associate Editor and Member of Editorial Board, ASCE Journal of Performance of Constructed Facilities

9. Selected publications
    - Hassandokht, A., Farhadmanesh, M., Rashidi, A. and Markovic, N. "State-of-the-Art Methods in Estimating Freeway Workzones Capacity: A Literature Review" Transportation Research Record, Journal of the Transportation Research Board, Volume 2215, 2021
    - Farhadmanesh, M., Cross, C., Hassandokht, A., Rashidi, A. and Wempen, J. "Use of Mobile Photogrammetry Method for Highway Asset Management" Transportation Research Record, Journal of the Transportation Research Board, Volume 2215, 2021
    - Xiang, Z., Ou, G. and Rashidi, A. "Robust Cascaded Frequency Filters to Recognize Rebar in GPR Data with Complex Signal Interference" Journal of Automation in Construction, Volume 124, 2021
    - Xiang, Z., Ou, G. and Rashidi, A. "Integrated Approach to Simultaneously Determine 3D Location and Size of Rebar in GPR Data" ASCE Journal of Performance of Constructed Facilities, Volume 34, Issue 5, 2020
    - Lee, Y., Shariatfar, M., Rashidi, A., and Lee, H. W. "Evidence-Driven Sound Event Detection Frameworks for the Prenotification and Rapid Identification of Construction Safety Hazard and Accidents" Journal of Automation in Construction, Volume 113, 2020
    - Sherafat, B., Ahn, C., Akhavian, R., Behzadan, A.H., Golparvar-Fard, M., Kim, H., Lee, Y., Rashidi, A., and Rezazadeh Azar, E. "Automated Methods for Activity Recognition of Construction Workers and Equipment: A State-of-the-Art Review" ASCE Journal of Construction Engineering and Management, Volume 146, Issue 6, 2020
    - Sabillon, C., Rashidi, A., Samanta, B., Davenport, M. and Anderson, D. "Audio-Based Bayesian Model for Productivity Estimation of Cyclic Construction Activities" ASCE Journal of Computing in Civil Engineering, Volume 34, Issue 1, 2020
    - Sherafat, B., Rashidi, A., Lee, Y. and Ahn, C. "A Hybrid Acoustic-Kinematic System for Activity Detection of Construction Equipment." Sensors, Volume 19, Issue 19, 2019
    - Xiang, Z., Rashidi, A., and Ou, G. "States of Practice and Research on Applying GPR Technology for Labeling and Scanning Constructed Facilities" ASCE Journal of Performance of Constructed Facilities, Volume 33, Issue 5, 2019
    - Cheng, C., F., Rashidi, A., Davenport, M. and Anderson, D. "Evaluation of Software and Hardware Settings for Audio-Based Analysis of Construction Operations." International Journal of Civil Engineering, Volume 17, Issue 9, 2019
    - Adhikari, A., Mitra, A., Rashidi, A., Ekpo I., Schwartz, J., and Doehling, J. "Field evaluation of N95 filtering facepiece respirators on construction jobsites for protection against airborne nanoparticles and ultrafine particles" International Journal of Environmental Research and Public Health, Volume 15, Issue 9, 2018

- Rashidi, A., and Karan, E., "Video to BrIM: Automated Generation of As-Built Documents for Bridges." ASCE Journal of Performance of Constructed Facilities, Volume 32, Issue 3, 2018

10. Most recent professional development activities - (none)

1. Name: Pedro Romero, Ph.D., P.E.

2. Education
    - Doctor of Philosophy, Civil Engineering, Penn State University, 1995
    - Master of Science, Civil Engineering, Penn State University, 1991
    - Bachelor of Science, Civil Engineering, US Coast Guard Academy, 1989

3. Academic experience
    - The University of Utah, Associate Professor, Associate Chair, (2007 – Present)
    - The University of Utah, Assistant Professor, (2000-2007)

4. Non-academic experience
    - Soil and Land Use Technology, On-site Contract Manager, (1999 – 2000)
    - FHWA Turner-Fairbank Highway Research Center, COTR Laboratory Technical Manager (1995 – 2000)
    - EBA Engineering, Inc. Laboratory Technical Manager (1995 – 1997)
    - The Pennsylvania Transportation Institute, Research Assistant (1990 – 1995)

5. Certifications or professional registrations
   Registered Professional Engineer, Maryland 200343

6. Current membership in professional organizations
   Transportation Research Board

7. Honors and awards
    - Utah Department of Transportation Trailblazer Awards (2017)
    - Walter J. Emmons Award for best paper presented at the 2019 meeting of the Association of Asphalt Paving Technologist

8. Service activities (within and outside of the institution)
    - Associate Chair, Department of Civil and Environmental Engineering (2014 – Present)
    - Director of Undergraduate Advising (2012 – Present)
    - Member, Department Executive Committee (2014 – Present)
    - Member, Department Undergraduate Curriculum Committee (2005 – 2007, 2010 - present)
    - Member, College of Engineering Diversity Committee (2020 – present)
    - Member, College of Science Academic Appeals and Misconduct Committee (2018-2021)

- Member, University Parking Appeals Committee (2012 – Present)
- Member, University Academic Appeals and Misconduct Committee (2008 – 2012)
- Member, University Diversity Committee (2005 – 2007, 2010 – 2012, 2014 - 2016)
- Member, College of Engineering Council (2010 – 2013)
- Member, Department Graduate Committee (2012 – 2016)
- Member, Department Scholarship Committee (2004 – 2006 and 2010 - 2012)
- Member, Education Committee, Utah Asphalt Pavement Association (2010 – present)
- Member, Transportation Research Board Committee on Asphalt Materials (AFK20) (2008 – 2017)
- Member, Transportation Research Board Committee on Characteristics of Bituminous Materials to Meet Structural Requirements (AFK50) (1997 – 2006)
- Member, Transportation Research Board Subcommittee on Latin American Activities (under Committee on International Activities, A0010) (2000 – 2012)
- Paper Reviewer: Transportation Research Board committees A0010, AFK20, AFK50, AFK50(1), AFK50(2), and AFH60
- Paper Reviewer: ASCE Journal of Materials in Civil Engineering ASCE Journal of Transportation

9. Selected publications
    - Han, D., Kim, W., Lee, S., Kim, H., and Romero.P.: "Assessment of Gamma Radiation Shielding Properties of Concrete Containers Containing Recycled Coarse Aggregates." Journal of Construction and Building Materials, Elsevier Volume 163 Pp 122-138 (February 2018)
    - Mora, E., Gonzalez, G., Romero, P., and Castellon, E.: "Control of Water Absorption in Concrete Materials with Hybrid Hydrophoic Silica Particles." Journal of Construction and Building Materials, Elsevier Volume 221 Pp 210-218 (2019)
    - Asib, ASM., Romero, P., and Safdazadeh, F: "An equivalence between methods of aging for determining the low-temperature performance of hot-mix asphalt concrete mixtures containing reclaimed asphalt pavement." Journal of Construction and Building Materials, Elsevier Volume 223 Pp 198-209 (2019)
    - Gao, Y., Romero, P. Zhang, H., Huang, M., and Lai, F.: "Unsaturated polyester resin concrete: A review." Journal of Construction and Building Materials, Elsevier Volume 228 Article 116709 (2019)
    - Mogawer, W., Austerman, A., Stuart, K., Zhou, F., and Romero, P.: "Balanced Mix Design Sensitivity to Production Tolerance Limits and Binder Source." Walter J. Emmons Award for the best paper presented at the 2019 Annual Meeting of the Association of Asphalt Paving Technologist.
    - Kim, H., Han, D., Kim, K., and Romero, P. "Performance Assessment of Repair Material for Deteriorated Concrete Slabs Using Chemically Bonded Cement". Article 117468 Journal of Construction and Building Materials Volume 237, Elsevier (March 2020)

10. Most recent professional development activities
    American Society of Civil Engineers: Civil Engineering Educational Summit: Mapping the Future of Civil Engineering Education Dallas, TX (May 2019)

1. Name: Shahrzad Roshankhah, Ph.D., P.E.

2. Education
   - Ph.D., Civil and Environmental Engineering (Geotechnical Engineering), Georgia Institute of Technology, 2015.
   - MSc, Civil and Environmental Engineering (Geotechnical Engineering), Amirkabir University of Technology, 2007.
   - BSc, Civil Engineering, Semnan University, 2003.

3. Academic experience
   - University of Utah, Assistant Professor, Jul. 2021 – on
   - California State University Long Beach, Lecturer, Aug. 2019 – May 2021
   - California State Polytechnic University Pomona, Lecturer, Aug. – Dec. 2019
   - California Institute of Technology, Research Scientist, Aug. 2019 – Dec. 2020
   - California Institute of Technology, Postdoctoral Scholar, Feb. 2016 – Jul. 2019
   - Georgia Institute of Technology, Graduate Research Assistant, Aug. 2011 – Dec. 2015

4. Non-academic experience
   - Imen Saazeh Fadak Consultants, Senior Engineer, 2006-2010
   - Prozheh Saaz Consultants, Staff Engineer, 2003-2005

5. Certifications or professional registrations
   - Professional Engineer (Civil and Geotechnical Engineering) in California and Utah (passed the exams and soon will have the registration ID#).
   - Certificate for Online Learning and Alternative Mode of Instruction, California State University Long Beach, July-August 2020.
   - Mentoring Certificate: Caltech's 2nd Annual Conference on Mentoring Undergraduate Researchers: Mentoring Across Differences, May 2017.
   - Teaching Certificate: Caltech's 4th Annual Teaching Conference, September 2016.
   - Certificate for Operating SEM and Micro-analyses, Nanotechnology, GaTech, 2015.

6. Current membership in professional organizations
   - ASCE (includes GI and EMI), ISSMGE, ARMA (includes ISRM), USUCGER. SPE, AGU, SWE, Sigma Xi.

7. Honors and awards
   - ARMA 2020 Future Leader Award
   - WPI STEM Faculty Launch Fellowship
   - NHERI Summer Institute Fellowship
   - The Woman of Distinction - outstanding PhD student (Georgia Tech)
   - Outstanding Master's student (Tehran Polytechnic)
   - Outstanding Undergrad Civil Engineering Student (Semnan University)

8. Service activities
    - Mentoring undergrad research assistants (Georgia Tech & Caltech), 2013–2019.
    - Technical session developer, chair, and reviewer for the 55th US Rock Mechanics and Geomechanics Symposium, to be held in June 2021.
    - Technical session developer, chair, and reviewer for the 2nd International Conference on Energy Geotechnics, to be held in September 2022.
    - Technical session chair for 2017 Engineering Mechanics Symposium, June 2017.
    - Reviewer for the following technical journals and conferences since 2015: JGR, Solid Earth; GRL; JGGE; Int. JSDEE; Geotechnique Letters; Computers & Geotechnics; The Geocongress; Int. Conf. Energy Geotech; US Rock Mechanics & Geomechanics Symp.; Int. Geomechanics Symp.; Int. Foundations Congress & Equipment Expo.
    - K-5 outreach: organizing chair of SMART Night, Hamilton Elementary School, Apr. 2019.

9. Selected publications
    - Roshankhah, S., Garcia, A. V., and Santamarina, J. C. (2021) "Thermal Conductivity of Sand-Silt Mixtures." Journal of Geotechnical and Geoenvironmental Engineering, 147(2).
    - Roshankhah, S., Mohammadi, K., and K-Nejad, A. (2020) "Characteristics of Hydraulic Fractures in Terms of the Matrix Permeability and the Natural Fracture Density." Proceedings of the ARMA/DGS/SEG International Geomechanics Symposium, Nov. 3-5.
    - Roshankhah, S. and Mohammadi, K. (2020) "Fabric-dependent Hydro-Mechanical Behavior of Pre-fractured Rocks." Geocongress 2020, Feb. 25-28, Minneapolis, MN.
    - "Geo-engineering for Modern Energy Geo-systems" CEE, Univ. Utah, Mar. 30, 2021.
    - "Geo-engineering for Energy Geo-structures" CEE, Univ. Houston, Jan. 12, 2021.
    - "Characteristics of Hydraulic Fractures in Terms of the Matrix Permeability and the Natural Fracture Density." The 1st ARMA/DGS/SEG International Geomechanics Symposium, Nov. 4, 2020, Online.
    - "Fabric-dependent Hydro-Mechanical Behavior of Pre-fractured Rocks." Geocongress 2020, Feb. 27, 2020, Minneapolis, MN.
    - "Tailoring the Behavior of Geomaterials to Design Sustainable Geo-Energy Infrastructure." CEE, Rutgers University, Feb. 05, 2020.

10. Briefly list the most recent professional development activities
    - Attended over 300 hours of technical lectures on energy geomechanics in 2020 – on.
    - Proposed and developed technical sessions in two specialized symposia.

1. Name: Douglas G. Schmucker, Ph.D., P.E.

2. Education
    - Ph.D. Stanford University 1996
    - M.S. Stanford University 1991
    - B.S. Valparaiso University (High Distinction and Christ College Associate) 1990

3. Academic experience
    - University of Utah, Salt Lake City, UT, Professor – Lecturer, 2020 – present
    - University of Utah, Salt Lake City, UT, Associate Professor – Lecturer, 2013 – 2020
    - Northeastern University, Boston, MA, On-line, Part-time Lecturer, 2012 – present
    - Private Structural Consultant, 2000 – present
    - Olivet University, Dover Plains, NY, On-line, Part-time Lecturer, 2016 – 2017
    - Zahl-Ford, Inc., Oklahoma City, Oklahoma, Senior Engineer & Project Manager, 2009 –2011
    - Trine University, Angola, Indiana, Associate Professor, 2006 – 2009
    - Western Kentucky University, Bowling Green, Kentucky, Assistant Professor, 2003 – 2006
    - Valparaiso University, Valparaiso, Indiana, Assistant Professor, 1998 – 2003
    - Pennsylvania State University, University Park, Pennsylvania, Assistant Professor, 1995 – 1998

4. Non-academic experience
    - Structural models that appropriately capture large deformation, buckling and/or other non-linear behavior in the dynamic or static domains
    - Evaluation of existing structures including failure investigation, historic preservation, and structural performance assessment
    - Field investigation with a focus on cause and extent of damage related to property investigation (residential, commercial, and industrial)
    - Client management including initial interactions, development of proposed scope of work, and execution of contracts
    - Expert witness testimony and support of litigation and subrogation.

5. Certifications or professional registrations
    Professional Engineer

6. Current membership in professional organizations - (none)

7. Honors and awards
    - ASEE Rocky Mountain Section Teacher of the Year Award, 2018
    - NEU COE Online Educator Award, 2018
    - University of Utah, College of Engineering, Top 15% Teachers (3 times), 2013 - 2019

- Premier Award for Excellence in Engineering Education Courseware Winner, CATME/Team-maker (member of multi-university collaborative team), 2009
- Tri-State University's McKetta-Smith Excellence in Teaching Award, 2008

8. Service Activities
    - SEAU, Technical Committee, Member, 2019 – present
    - SEAU, Organizing Committee, 2021 Special Session, 2019 – 2021
    - ASCE, YMF, PE Exam Preparation Course, Structures Review, Presenter, 2016 – 2019
    - ASCE, WFB, Monthly Meetings, Presenter, 2014 – 2019
    - ASCE, Journal of Pro. Issues in Engineering Ed. and Practice, Reviewer, 2015 - 2018
    - Center for Infrastructure Transformation and Education, Bridge Group, 2015 – 2018
    - ASEE, CE Division, Annual Conference Paper Reviewer, 1999 – 2018
    - American Concrete Institute-Oklahoma (ACI-OK), Chapter President 2011 – 2012
    - FIRST Lego Robotics Utah State Competition (volunteer) 2019
    - ASCE Wasatch Front Branch (Presenter multiple times) 2016 - 2018
    - ASEE Rocky Mountain Section Annual Conference (Presenter multiple times) 2016

9. Selected publications
    - Schmucker, D.G., Lenart, J., and Burian, S.J., "A Civil Infrastructure System Perspective – Not just the Built Environment" Proceedings of the 2016 ASEE Annual Conference and Exposition
    - Burian, S.J, Schmucker, D.G., and Lenart, J., "Developing Global Learning Outcomes in a Civil Engineering Program," Proceedings of the 2016 ASEE Annual Conference and Exposition
    - Ohland, M.W., M.L. Loughry, D.J. Woehr, C.J. Finelli, L.G. Bullard, R.M. Felder, R.A. Layton, H.R. Pomeranz, and D.G. Schmucker, "The Comprehensive Assessment of Team Member Effectiveness: Development of a Behaviorally Anchored Rating Scale for Self and Peer Evaluation." Academy of Management: Learning & Education, Manuscript ID: AMLE-RR-2010-0056.
    - Ohland, Matthew W., Lisa G. Bullard, Richard M. Felder, Cynthia J. Finelli, Richard A. Layton, Misty L. Loughry, Hal R. Pomeranz, Douglas G. Schmucker, David J. Woehr, "The Comprehensive Assessment of Team Member Effectiveness: Development of a Behaviorally Anchored Rating Scale for Self and Peer Evaluation," Academy of Management 2010 Annual Meeting, paper #13912
    - Bullard, L.F., R.L. Carter, R.M. Felder, C.J. Finelli, R.A. Layton, M.L. Loughry, M.W. Ohland, and D.G. Schmucker "The Comprehensive Assessment of Team Member Effectiveness: A New Peer Evaluation Instrument," Proc. Amer. Soc. Eng. Ed., Chicago, IL, June 2006.

10. Most recent professional development activities - (none)

1. Name: Michael Scott Shea, P.E.

2. Education
   - Doctor of Philosophy Candidate, Civil Engineering, Anticipated 2021, University of Utah, Salt Lake City, UT. Dissertation working title: Statistical Road Safety Modeling Approaches for Estimating Road, Vehicle, and Driver Effects on Crash Type and Severity Outcomes at Intersections. Co-Advisors: Juan Medina (currently Research Asst. Professor, University of Utah, Salt Lake City, UT); Richard Jon (RJ) Porter (currently Highway Safety Engineer at VHB, Raleigh, NC).
   - Master of Engineering, Civil Engineering, 2011, Brigham Young University, Provo, UT. Thesis: Hydraulic Conductivity of Cement-Treated Soils and Aggregates After Freezing. Advisor: W. Spencer Guthrie (currently Professor of Civil Engineering, Brigham Young University, Provo, UT).
   - Bachelor of Science, Civil Engineering, Minors in Math, Business, and Asian Studies, 2008, Brigham Young University, Provo, UT.

3. Academic experience
   - Adjunct Lecturer, Department of Civil and Environmental Engineering, University of Utah, Salt Lake City, UT, (Spring 2017, Fall 2017, Spring 2018, Spring 2020, Spring 2021)
   - Adjunct Lecturer, Department of Civil and Environmental Engineering, Brigham Young University, Provo, UT, (Winter 2021)
   - Graduate Research Assistant, Department of Civil and Environmental Engineering, University of Utah, Salt Lake City, UT, (August 2013-present)
   - Research Assistant, Brigham Young University, Provo, UT, (May 2008-January 2011)

4. Non-academic experience
   - Senior Traffic Engineer, AECOM, Salt Lake City, UT, (January 2021-present)
   - Transportation Manager, CRS Engineers, Salt Lake City, UT, (April 2018-January 2021)
   - Traffic Engineer, Avenue Consultants, Inc. Taylorsville, UT, (February 2013-September 2013)
   - Assistant Quality Assurance Manager, Raba-Kistner Infrastructure, Orem, UT, (May 2010-December 2012)
   - Project Engineer, LEI Engineers, Spanish Fork, UT (June 2006 – May 2008)

5. Certifications or professional registrations
   - Professional Engineer, Utah 2016 Expires March 2022 and Texas. 2012 Expires Sept 2021

6. Current membership in professional organizations
   - Member, Institute of Transportation Engineers, (2010-present)
     - University of Utah ITE Student Chapter Secretary, (2013-2014)
     - University of Utah ITE Student Chapter Vice President, (2014-2015)
     - University of Utah ITE Student Chapter President, (2015-2016)

- Member, American Society of Civil Engineers, (2004-2018)
- Member, American Concrete Institute, (2010-2015)
- Lifetime Member, Tau Beta Pi National Engineering Society, (November 2016)

7. Honors and awards
   - Best Paper (out of 38 papers), Transportation Research Board's Geometric Design Committee (AFB10), 2015 Annual Meeting of the Transportation Research Board
   - Dwight David Eisenhower Transportation Fellowship, Universities and Grants Programs, Federal Highway Administration, Washington, D.C., (2015-2016 and 2016-2017)
   - Wayne Brown Fellowship, Department of Civil and Environmental Engineering, University of Utah, Salt Lake City, UT, (2013-2015)
   - Ellis L Matthes Scholarship, ITE Intermountain Section (Idaho, Montana, Nevada, Utah), Jackson, WY, (2009 and 2014)
   - Point B Scholarship, University of Utah Transportation Student Group, University of Utah, Salt Lake City, UT, (2013)

8. Service activities
   - Committee Member, Performance Effects of Geometric Design [AKD10], 2018-Present
   - Peer Reviewer, Geometric Design Committee [AFB10/AKD10], (2014-2021)
   - Peer Reviewer, Operational Effects of Geometrics [AHB65], (2014-2018)
   - Peer Reviewer, Bicycle Transportation [ANF20], (2016-2018)

9. Selected publications (*indicates primary speaker)
   - Medina, J.C., Shea, M.S., and Azra, N. "Safety Effects of Protected and Protected/Permissive Left-Turn Phases." Utah Department of Transportation Research Division, December 2018 Report No. UT-19.04
   - Burbidge, S. K., and Shea, M.S. "Measuring Systemic Impacts of Bike Infrastructure Projects." Utah Department of Transportation Research Division, November 2017. Report No. UT-16-8290.
   - Medina, J.C., Shea, M.S., and Azra, N. "Safety Effects of Protected and Protected/Permissive Left-Turn Phases." Utah Department of Transportation Research Division, December 2018 Report No. UT-19.04
   - Burbidge, S. K., and Shea, M.S. "Measuring Systemic Impacts of Bike Infrastructure Projects." Utah Department of Transportation Research Division, November 2017. Report No. UT-16-8290.
   - Shea, M. S.*, and Porter, R. J. "Exploring Effects of Urban Design Qualities on Multimodal Safety." 10th University Transportation Center (UTC) Spotlight Conference: Bicycles and Pedestrians, Washington D.C., December 2016. [poster presentation]
   - Shea, M. S.*, and Medina, J. C. "Approach-Level Safety Comparison of Permissive-Protected and Protected Left Turn Phasing to Flashing Yellow Arrows," Accepted for presentation at the 97th Annual Meeting of the Transportation Research Board, Washington, D.C., January 2018. [poster presentation]

10. Most recent professional development activities - (none)

1. Name: Glenn E. Sjoden, Ph.D., P.E.

2. Education
   - Ph.D., Nuclear Engineering, Pennsylvania State University, University Park, Pennsylvania, 1997
   - M.S., Nuclear Engineering, Air Force Institute of Technology, WPAFB Ohio, 1992
   - B.S., Nuclear Engineering, Texas A&M University, College Station, Texas, 1984

3. Academic experience
   - Professor and Energy Solutions Presidential Endowed Chair, Nuclear Engineering Program, August 2019 to Present, University of Utah, Salt Lake City, Utah.
   - Professor and Director, Radiation Science and Engineering Laboratory, Nuclear and Radiological Eng. Program (NRE), November 2010 to 2014, Georgia Institute of Technology, Atlanta, Georgia.
   - Associate Professor and Florida Power and Light Endowed Term Chair (2007-2010), Department of Nuclear and Radiological Engineering (NRE), March 2004 to October 2010, University of Florida, Gainesville, Florida.
   - Associate Professor of Mathematical Sciences, USAF Academy, Colorado Spring, CO, US Air Force Officer (1997- 2000), also USAF Academy Instructor and Assistant Professor, USAF Officer, (1992-1994);

4. Non-academic experience
   - Chief Scientist, Air Force Technical Applications Center (AFTAC), Rank: Senior Executive Service (SES), DISL IP-00, June 2014 to July 2019, Patrick AFB, Florida.
   - Research Consultant to various Government Agencies and Corporations, 1997 to 2014, and 2019-Present; Licensed consultant to US Gov't (DOE, NNSA, DHS, DNI, CIA, NCPC, INL, LANL, LLNL, ORNL, PNNL, DOD, FBI), Delta Air Lines, Zel-Tech.
   - Deputy Director of Materials Technology, Deputy Director for Technology and Research, April 2001 to March 2004, Air Force Technical Applications Center, US Air Force, Patrick AFB, Florida.
   - Chief, Molecular Sciences Division, US Air Force, February 2000 to April 2001, Directorate of Materials Technology, Air Force Technical Applications Center, Patrick AFB, Florida.
   - Other Assignments Spanning 1984-2000, Active Duty, US Air Force; Lt Col USAF (retired).

5. Certifications or professional registration
   Licensed Professional Nuclear Engineer, P.E. #44144 (Florida), 1991-Present, DOE Q Clearance (active)

6. Current membership in professional organizations
   American Nuclear Society (ANS); Institute of Nuclear Materials Management (INMM)

7. Honors and awards
    - 2019: Air Force Meritorious Civilian Service Award, AFTAC, Patrick AFB, Florida
    - 2018: Presidential Rank Award, USAF (IP-00 DISL) Senior Leader Award for Exceptional Public Service, awarded by Pres. Trump, The Pentagon, Washington D.C. (presented June 14, 2019).
    - 2018: Air Combat Command (ACC) winner, ACC nominee: USAF Harold Brown Award for Innovative R&D, Patrick AFB, Florida

8. Service activities
    - Director of the Nuclear Engineering Program, and Interim Level II Supervisor/Reactor Director, Utah TRIGA Facility (2020-Present)
    - Member, University of Utah Radiation Safety Committee, (2020 – Present)
    - Chair, Civil and Environmental Engineering Safety Committee (2019-Present)
    - Hiring committee chair, Nuclear Reactor Supervisor and Nuclear Research Scientist positions, (Fall 2020)
    - Evaluator, Peer Teaching/RPT Evaluations: Chemical & Nuclear Engineering, (Fall 2020).
    - Factory Acceptance Testing reviewer and installation supervisor, new Thermo-Fisher Reactor Control System, University of Utah TRIGA Reactor (2020-2021).
    - INMM University of Utah Chapter Faculty Advisor (2020-Present)

9. Selected publications
    - L. Albright, N. Andrews, L. Humphries, M. Piro, G. Sjoden, D. Luxat, T. Jevremovic, "Material Interactions in Severe Accidents – Benchmarking the MELCOR V2.2 Eutectics Model for a BWR-3 Mark-I Station Blackout: Part I – Single Case Analysis," submitted, Nuclear Engineering and Design, Jan. 2021
    - M. Wang, G. Sjoden, et. al., "Assessment of an HPGe Detector using SN and Monte Carlo Transport with Experiments", RPSD 2020, accepted, January 2021.
    - V. Wang, G. Sjoden, A. Foley, and S. Mohanty, "3D SN and Monte Carlo Calculations of the Utah TRIGA Reactor Core using PENTRAN and MCNP6," submitted, Annals of Nuclear Energy, September, 2020.

10. Most recent professional development activities
    - Special consultant: National Academies of Science, Engineering, and Medicine (2019-Present); DOE/Pacific Northwest National Laboratory; Q-cleared (Fall 2019-Present)
    - Reviewer: ANS Mathematics and computation Division International Meeting (2021); National Academies of Science, Engineering, and Medicine (2020-Present); IEEE Transactions in Nuclear Science (2020-Present); IEEE Transactions in Nuclear Science (2020-Present); Laboratory Directed Research and Development, Los Alamos National; Geophysics Journal International, (2020-Present)
    - Member, Nuclear Science and Engineering Journal Editorial Advisory Board (Fall 2020 – Present).

- Laboratory, “Hyperspectral X-Ray Imaging” (August 2020); “Integrated Nuclear Detonation Detection”, (March 2020).

1. Name: Jennifer Weidhaas, PhD, PE

2. Education
    - University of California-Davis, Civil and Environmental Engineering
    - Designated Emphasis in Biotechnology, PhD, 2006
    - University of California-Davis, Civil and Environmental Engineering, MS, 2002
    - Montana State University. Civil Engineering
    - Emphasis in Bio-Resources Engineering, BS, 1999

3. Academic experience
    - 2016-current - Associate Professor, University of Utah, Civil and Environmental Engineering
    - 2010–2016 - Assistant Professor, West Virginia University, Civil and Environmental Engineering

4. Non-academic experience
    - 2005–2010 - Environmental Engineer, North Wind, Inc., Idaho Falls, ID
    - 2000 - Environmental Engineer, Idaho National Lab, Idaho Falls, ID

5. Certifications or professional registrations
   Professional Engineer, Environmental Engineering, State of Idaho, License # 12525

6. Current membership in professional organizations
    - American Society for Engineering Education [ASEE]-member since 2010
    - Association for Women in Science [AWIS]-member since 2010
    - Association of Environmental Engineering and Science Professors [AEESP] - member since 2010
    - American Chemical Society [ACS]-member since 2014

7. Honors and awards
    - 2018 - Outstanding Mentor, Dept of Civil and Environmental Engineering, Univ of Utah
    - 2018 - Career and Professional Development Center Faculty Recognition Award, Univ of Utah
    - 2017 - Best Paper, American Society of Engineering Education, Rocky Mountain Section Conference, Brigham Young University, Provo, UT, September 22-23
    - 2017 - Ben Jacobsen Kingfisher Bend Ranch Award for Exceptional Effectiveness in Teaching, Univ of Utah

8. Service activities

- 2019-2020 - Elementary school Dream Big outreach—Presentation of hands on STEM activity in 35 fifth grade elementary classrooms reaching ~1000 students
- June 2017 - Presenter “Exploring Engineering Day”—University of Utah, College of Engineering (47 students)
- March 2017 - Presenter “Pi Day”—Central Valley Junior High, Salt Lake City, UT (300 students)
- 2016, 17, 19 - Trainer—US-Pakistan Center for Advanced Studies in Water at Mehran University of Engineering and Technology (MUET), Jamshoro, Pakistan

9. Selected publications

- Pecson, BM, et al, in press, Environmental Science: Water Research & Technology
- Jamal *, R, X. Li, J. Weidhaas, 2021, Journal of Microbiological Methods, https://doi.org/10.1016/j.mimet.2021.106146.
- Jamal, R*, et al., 2020, Science of the Total Environment, 10.1016/j.scitotenv.2020.140021
- Mehmood, R, U Iran, A Ullah, J.L. Ullman, J. Weidhaas, 2020, Environmental Science and Pollution Research, doi: 10.1007/s11356-020-08705-4
- Imran, U, J Weidhaas, A. Ullah, K Shaikh, 2020, Human and Ecological Risk Assessment: An International Journal, doi.org/10.1080/10807039.2020.1729090
- Imran, U, M Khan, R Jamal, S Sahulka, R Goel, R Mahar, J. Weidhaas, 2020, Ecotoxicology and Environmental Safety, 191: https://doi.org/10.1016/j.ecoenv.2020.110233
- Acharya, SP *, J. Johnson *%, J. Weidhaas, 2020, Journal of Environmental Sciences, 89:23-34, https://doi.org/10.1016/j.jes.2019.09.022
- Deng, D, O. Lin, A. Rubenstein, J. Weidhaas, L-S Lin, 2019, Chemical Engineering Journal, 358: 1208-1217, https://doi.org/10.1016/j.cej.2018.10.030
- Clark, GG #, R. Jamal *, J. Weidhaas, 2019, Science of the Total Environment, 651(1), 1011-1019, doi.org/10.1016/j.scitotenv.2018.09.277
- Boney, J, J. Jaczynski, JL Weidhaas, A Bergeron, J Moritz, 2018, Journal of Applied Poultry Research, pfy052, 1-11, http://dx.doi.org/10.3382/japr/pfy052
- Acharya, SP*, J Weidhaas, 2018, Chemosphere, 211:1018-1024, doi.org/10.1016/j.chemosphere.2018.08.024
- Weidhaas, JL, A. Anderson*, R. Jamal*, 2018, Appl. Enviro. Microbiol, 84(6): DOI: 10.1128/AEM.02510-17
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10. Most recent professional development activities - (none)

1. Name: Xianfeng (Terry) Yang, Ph.D.

2. Education
    - University of Maryland, Civil and Environmental Engineering, Ph.D., 2015
    - University of Maryland, Civil and Environmental Engineering, MS, 2012
    - Tsinghua University, Civil Engineering, BS, 2009

3. Academic experience
    - 2017-current - Assistant Professor, University of Utah, Civil and Environmental Engineering
    - 2015–2017 - Assistant Professor, San Diego State University, Civil, Construction and Environmental Engineering

4. Non-academic experience - (none)

5. Certifications or professional registrations
   Engineer in Training, Civil Engineering, State of Maryland

6. Current membership in professional organizations
    - American Society for Engineering Education [ASEE]
    - American Society of Civil Engineers [ASCE]
    - Institute for Operations Research and the Management Sciences [INFORMS]
    - Transportation Research Board [TRB]

7. Honors and awards
    - 2018 Transportation Research Part A Outstanding Reviewer, University of Utah
    - 2018 Transportation Research Part C Outstanding Reviewer, University of Utah
    - 2018 Transportation Research Part E Outstanding Reviewer, University of Utah
    - 2018 ASCE Journal of Transportation Outstanding Reviewer, University of Utah
    - 2017 NSF CPS program workshop travel award, University of Utah

8. Service activities (within and outside of the institution)
    - 2021 – present: Paper review coordinator and Member, Committee on Disaster Response, Emergency Evacuations, and Business Continuity (AMR 20), TRB
    - 2020 – present: Secretary & Voting member, ASCE Artificial Intelligence Committee
    - 2020 – present: Associate Editor, ASCE Journal of Urban Planning and Development
    - 2019 – present: Vice Chair, INFORMS-SIG-Intelligent Transportation Systems Committee
    - 2019 – present: Associate Editor, IEEE OJ-Intelligent Transportation Systems
    - 2019 – present: Handling Editor, Transportation Research Record
    - 2018 – 2021: Member, Emergency Evacuation Committee (ABR 30), TRB
    - 2018 – present: Editorial Board Member, ASCE Journal of Urban Planning and Development

- 2017 – present: Member, Traffic Signal System Committee (AHB 25), TRB

9. Selected publications
    - Qinzheng Wang, Xianfeng Yang*, (2021)," Adaptive and Multi-path Progression Signal Control under Connected Vehicle Environment", Transportation Research Part C, Vol 124, 102965.
    - Chenfeng Xiong, Xianfeng Yang, Minha Lee, Lei Zhang (2020)," An integrated modeling framework for active traffic management and its applications in the Washington D.C. area", Journal of Intelligent Transportation System. Accepted.
    - Zhao Zhang and Xianfeng Yang, (2020)," Analysis of highway performance under mixed connected and regular vehicle environment", Journal of Intelligent and Connected Vehicle. Accepted.
    - Wei Hao*, Li Liu, & Xianfeng Yang, (2020), "Reducing CACC Platoon Disturbances Caused by State Jitters by Combining Two Stages Driving State Recognition with Multiple Platoons' Strategies and Risk Prediction' Strategies and Trajectory Prediction", IEEE Transactions on ITS. Accepted.
    - Zhao Zhang, Runan Yang, Glenn Blackwelder, & Xianfeng Yang*, (2020) "Examining Driver Injury Severity in Left-turn Crashes using Hierarchical Ordered Probit Models", Traffic Injury Prevention, accepted.
    - Zhao Zhang & Xianfeng Yang*, (2020) "Freeway Traffic Speed Estimation by Regression Machine Learning Techniques Using Probe Vehicle and Traffic Sensor Data", Journal of Transportation Engineering. Vol. 146(12).
    - Xianfeng Yang, Ke Huang*, Zhehao Zhang, & Zhao Zhang, (2020), "Eco-Driving System for Connected Automated Vehicles: Multi-Objective Trajectory Optimization", IEEE Transactions on Intelligent Transportation System. In press.
    - Zhao Zhang, &Xianfeng Yang*, (2020) "Freeway Traffic Speed Estimation in Traffic Monitoring Systems using a Hybrid Machine Learning Approach", Journal of Transportation Research Board: Transportation Research Record, Vol. 2674(10), pp. 68-78
    - Qinzheng Wang, Xianfeng Yang*, Blaine D. Leonard, & Jamie Mackey, (2020), "Field Evaluation of Connected Vehicle-based Transit Signal Priority System under Two Different Signal Base Plans", Journal of Transportation Research Board: Transportation Research Record, Vol. 2674:(7), pp. 172-180
    - Yongjie Lin, Xianfeng Yang*, & Qinzheng Wang (2020), "New transit signal priority scheme for intersections with nearby bus rapid transit median stations", IET Intelligent Transport Systems, Vol. 14(12), pp. 1606-1614.
    - Qinzheng Wang, Xianfeng Yang*, Zhitong Huang, & Yun Yuan, (2020), "Multi-vehicle Trajectory Optimization for Cooperative Adaptive Cruise Control (CACC) Platoon Formation", Journal of Transportation Research Board: Transportation Research Record, Vol. 2674(4), pp. 30-41.

10. Most recent professional development activities - (none)

1. Name: Xuan ‘Peter’ Zhu, Ph.D

2. Education
    - Ph.D., Structural Engineering, University of California, San Diego, U.S., 2016
    - M.S., Civil Engineering, University of Pittsburgh, U.S., 2010
    - B.S., Mechanical Engineering, Beihang University, China, 2008

3. Academic experience
    - Assistant Professor, Civil & Environmental Engineering, University of Utah, 2018-present
    - Visiting scholar, Earth & Environmental Sciences, Los Alamos National Laboratory, 07/2018
    - Post-doctoral research associate, Civil & Environmental Engineering, University of Illinois at Urbana-Champaign, 2017-2018
    - Post-doctoral Researcher, Structural Engineering, University of California, San Diego, 2016-2017

4. Honors & awards
    - ASNT Faculty Grant, the American Society for Nondestructive Testing, 2020
    - Dissertation Fellowship, University of California, San Diego, 2016
    - NSF Scholarship, University of Illinois at Urbana-Champaign, Asia-Pacific Summer School in Smart Structures Technology, 2015
    - Charles Lee Powell Fellowship Jacobs School of Engineering, UCSD, 2011-2012
    - Pre-Doctoral Fellowship, University of Pittsburgh, 2010
    - Second Prize in FengRu Cup, Tech invention competition top 5%, 2007
    - Excellent Volunteer, Beihang University, 2007

5. Certifications or professional registrations - (none)

6. Current membership in professional organizations - (none)

7. Honors and awards - (none)

8. Services activities
    - URS Poster evaluator, Undergraduate Research Symposium, University of Utah, 2020
    - Event host, Engineering Day Research Symposium, COE, 2020
    - Committee member: UAC instructor search committee, CVEEN department, 2020; Technology coordinator search committee, CVEEN department, 2020; Graduate student recruitment committee, CVEEN department, 2019-present; ABET & Undergraduate committee, CVEEN department, 2018-present; Cyber technology integration committee, CVEEN department, 2018-present; Strategic hiring & planning committee, CVEEN department, 2018-present; Joint committee of Structural Health Monitoring, AHD30(3), Transportation Research Board, 2019-present

- National Science Foundation Reviewer, 2021
- Review editor on the Editorial Board of Frontiers in Built Environment, 2020-present
- Grant reviewer: DOE-NE Consolidated Innovative Nuclear Research, 2020-present; DOE Small Business Innovation Research, 2020
- Organizing member, 7th International Conference on Experimental Vibration Analysis for Civil Engineering Structures, University of California San Diego, La Jolla, CA, July 12-14, 2017
- Chairing Sessions: "Smart Sensing and Signal Processing for Diagnostics", SPIE Smart Structures/NDE, Portland, OR, March 2017; "Guided Waves I: Civil Infrastructures Monitoring", SPIE Smart Structures/NDE, Portland, OR, March 2017
- Reviewer for several journals including: Journal of Performance of Constructed Facilities, Applied Sciences, Sensors, Functional composites and structures, Experimental Mechanics, Ultrasonics, Journal of Intelligent Material Systems and Structure, Smart Materials and Structures

9. Selected publications: * indicates the paper I served as corresponding author.
    - Zhou, Z., Li, J., Xia, W., Zhu, X., Sun, T., Cao, C., & Zhang, L. (2020). "Enhanced piezoelectric and acoustic performances of poly (vinylidene fluoride-trifluoroethylene) films for hydroacoustic applications," Physical Chemistry Chemical Physics, 22(10).
    - Tarokh, A., Makhnenko, R.Y., Kim, K., Zhu, X., Popovics, J. S., Segvic, B., Sweet, D. E.. "Influence of CO2 injection on the poromechanical response of Berea sandstone," International Journal of Greenhouse Gas Control, 95
    - Hu, H., Zhu, X., Zhang, L., Li, X., Sternini, S., Lanza di Scalea, F., Xu, S. "Stretchable ultrasonic transducers for three-dimensional imaging on complex surfaces," Science Advances, 4 (3), aar3979.
    - Lanza di Scalea, F., Zhu, X., Sternini, S., Capriotti, M., Liang, A., Mariani, S. (2018) "Passive extraction of dynamics transfer function from ambient excitations: applications to high-speed rail inspection," Journal of Nondestructive Evaluation, Diagnostics and Prognostics of Engineering Systems, ASME, 1(1), 011005.
    - Mariani, S., Nguyen, T. V., Zhu, X., Lanza di Scalea, F. (2017) "Field test performance of non-contact ultrasonic rail inspection system," J. Transp. Eng. ASCE, Part A: Systems, Vol.143, 5. DOI: http://dx.doi.org/10.1061/JTEPBS.0000026.
    - Zhu, X., Lanza di Scalea, F. (2017) "Thermal stress measurement in continuous welded rails using the hole-drilling method," Experimental Mechanics, Vol. 57, 1, pp 165-178. DOI: 10.1007/s11340-016-0204-8.
    - Zhu, X., Lanza di Scalea, F. (2016) "Sensitivity to axial stress of electro-mechanical impedance measurements," Experimental Mechanics, Vol. 56, 9, pp 1599–1610. DOI:10.1007/s11340-016-0198-2.
    - Kijanka, P., Packo, P., Zhu, X., Staszewski, W., Lanza di Scalea, F. (2015) "Three-dimensional temperature effect modelling of piezoceramic transducers

used for Lamb wave based damage detection," Smart Materials and Structures, Vol. 24, 6, 0605005. DOI: 10.1088/0964-1726/24/6/065005.

- Tippmann, J. D., Zhu, X., Lanza di Scalea, F. (2015) “Application of damage detection methods using passive reconstruction of impulse response functions,” Philos Trans A Math Phys Eng Sci. , 373, 2035. DOI: 10.1098/rsta.2014.0070.

10. Most recent professional development activities - (none)

APPENDIX C – EQUIPMENT

Geotechnical/Soil Mechanics Lab – Sent to Bartlett for review 5/18/21
ELE Triaxial Compression Apparatus
ELE Direct Shear Machine Apparatus
Drying Ovens
Sieve Shakers
Digital scales
Hydrometer test equipment
manually operated unconfined compression, and CBR system
Bench top oedometers
compression frame
Procter hammers and molds
Liquid Limit Devices
Bench top permeameters
Tremble GHX GPS Survey System
Sokkia SDL50 Digital Level and Rod
Cirrus CR800A Sound Level Meter

Materials/Concrete Lab
Instron 400 Compression Machine
20' Drop Hammer
Troxler asphalt Gyratory Compactor
Concrete Mixers (4) 3.6cuFt
Water curing tanks
Concrete air meters
Concrete slump and unit weight devices
Mortar cube molds
Concrete shrinkage measuring device
Digital balances (multiple)
Asphalt concrete portable mixers
Water tank specific gravity setup
Ignition oven
Large capacity ovens
Rotating viscometer
Bending beam rheometer
Freezer/warm bath unit
Semi-circular bend compression machine
Asphalt Mixture Performance Tester triaxial machine
Charpy v-notch testing machine
Creep testing machine
Electromechanics compression machine

Misc. Other Equipment
Humidified concrete curing room
MTS FlexTest 40, 50 kip Hydraulic Frame

radar gun
video camera
Elmo - document camera
picture tel
smart board

APPENDIX D – INSTITUTIONAL SUMMARY

1. The Institution

a. University of Utah
    a. 201 Presidents Circle, Room 201
    b. Salt Lake City, UT 84112

b. Michael L. Good
    a. Interim President
    b. Office of the President
    c. Park Building
    d. 201 S. President's Circle, Room 203
    e. Salt Lake City, UT 84112

c. Richard B. Brown, Dean
    a. College of Engineering
    b. 72 S. Central Campus Drive, Room 1692
    c. Salt Lake City, UT 84112

d. The University of Utah has been continuously accredited by Northwest Commission on Colleges and Universities since 1933. The most recent evaluation was successfully completed mid-cycle in 2018, and notice was received in 2019. The next evaluation is in 2022.

2. Type of Control

The University of Utah is a state institution under the jurisdiction of the Utah State Board of Regents, whose members are appointed by the Governor of the State of Utah and confirmed by the Legislature. The Regents appoint a Commissioner of Higher Education who, with his staff, has the responsibility of coordinating policy, programs and budgets for higher education state-wide. The President of the university reports to the Board of Trustees, which reviews and approves the policies, programs, budgets and personnel actions of the University.

3. Educational Unit

From an organizational standpoint, the college consists of a college level administration and seven academic units including the Departments of Biomedical Engineering, Chemical Engineering, Civil and Environmental Engineering, Electrical and Computer Engineering, Materials Science and Engineering, Mechanical Engineering and the School of Computing. The Construction Engineering Program is part of the Civil and Environmental Engineering.

4. Academic Support Units

Mathematics: Davar Khoshnevisan, Chair; Aaron Bertram
Physics: Christoph Boehme, Chair; Ben Bromley, Associate Chair

Chemistry: Matthew S. Sigman, Chair; Vahe Bandarian, Associate Chair

5. Non-academic Support Units

Library Support for the College of Engineering (April Love, Associate Librarian)
The University of Utah has three libraries on its campus: S. J. Quinney Law Library, Spencer S. Eccles Health Sciences Library, and J. Willard Marriott Library. In additional to these, a graduate mathematics library, which is operated by the Marriott Library, is located in the Mathematics Department. Only the Marriott Library is discussed in this self-study, since it is the library used most by engineering faculty and students.

Computer Facilities (Steven Dean, Director): The College of Engineering maintains four general usage computer labs that provide access to academic software and file storage for instructional usage. The college computing facility also provides a comprehensive collection of software that is available for instructional use.

Tutoring (ADVISOR or April Vrtis-Curran Academic Program Manager): The College of Engineering offers help for all engineering students, particularly freshman and sophomores. The goal is to help our engineering students through difficult engineering classes, so that they will be better prepared for junior and senior level coursework. Each department is responsible for hiring, supervising and training the tutors for their courses. For engineering courses, fellow Engineering students serve as tutors, so students can get help and information from peers who have "been there and done that." In addition, faculty and teaching assistants from the Department of Math hold extensive office hours in the Warnock Engineering Building. Not only do students receive help completing homework, but also have the opportunity to gain a better understanding as to how that subject actually fits into their engineering coursework and future profession.
The Living and Learning Community (Morgan Boyack, Academic Program Coordinator): The College of Engineering offers two Living & Learning Communities for our students. The College of Engineering Living & Learning Community is open to all first-year engineering students. The Kennecott house, is also open to continuing students as well. Resident selection is done by the College of Engineering Dean’s Office who gives preference to out-of-state students and strives to create a diverse community. There are activities and value-added programming for the Engineering Floor.

The College of Engineering Living & Learning Community opened Fall 2005 in the University of Utah Residence Halls. Located in Kahlert Village, this community offers residents the opportunity to live with other students in the College of Engineering who share their academic and career goals. This community is open to first year students who appreciate the benefit of living in a community, which fosters academic excellence within the rigorous engineering curriculum. Mentoring: There are two Resident Advisors (RA) who live on the floor. These RA’s are upper division engineering students selected by the College. The RA’s help with any problems or concerns while providing leadership and mentoring, as well as a connection to the College of Engineering Dean’s Office. Study sessions and tutoring help ensure academic success, while interaction with engineering faculty, staff, and alumni help further professional development. The Floor: A total of 76 engineering students are selected to live in the community in single, single-deluxe, double and double-deluxe suites. A large and well-equipped study room is available on the floor, providing an ideal setting for group study, teamwork, and collaboration. To view floor plans, please visit the Housing and Residential Education website at https://housing.utah.edu/housing-map-content/uofu-kahlert-village/

The Kennecott House in Officers' Circle houses 12 students. The RA for this community is an upper-division engineering student and residents have the opportunity to participate in programming offered in conjunction with the Dean's Office. The students living in this community participate in faculty presentations, field trips and alumni dinners. Students are selected to live in the community by the College of Engineering Dean's Office. Priority is given to Kennecott Scholars and students from the College of Engineering. To view information about the Kennecott House, please visit the Housing and Residential Education website at http://housing.utah.edu/options/living-learning-communities/officers-circle/611/.

The CLEAR Program (Communication Leadership, Ethics, And Research) (Sneha Kasera, Associate Dean): The CLEAR program was designed to ensure that engineering graduates can communicate clearly in both oral and written form, participate on teams productively, recognize ramifications of decisions they will make in the global marketplace, and develop a sophisticated understanding of ethical dilemmas which regularly follow engineering industry trends. The CLEAR Program is unique and innovative due to its: (1) emphasis on speaking, writing, teamwork, and ethics, (2) integrated professional skills instruction, and (3) situated, developmental approach to teaching and learning. In short, engineering undergraduates at the University of Utah are continually exposed to communication and ethics throughout their engineering training. As a result, students are better prepared for the transition from the university to the workplace.

Academic Advising Center (Beth Howard, Associate Dean): At the Academic Advising Center undeclared and pre-major students learn about academic programs, University policies and procedures, selecting classes, exploring majors, and other education- related concerns.

Career Services (Stan Inman, Director): Career Services has an office in the Warnock Engineering Building (within the Dean's Office), where career counselors meet with undergraduate and graduate students five days a week. This arrangement allows them to interact with a larger number of students, since the Warnock Building is also where a large fraction of engineering classes are held. Career Services also hosts an official database, Handshake, that helps students and employers find one another. It also allows Career Services to communicate with students about events such as career fairs, job postings, and interview schedules. Career Coaches also attend the College of Engineering's First-Year Orientations where they do a 25-minute presentation on how students can utilize the Career & Professional Center early on in their academic careers.

Counseling Center (Lauren Weitzman, Director): The University has a Counseling Center to assist students, staff, and faculty with a variety of personal, academic and career concerns. Its approach is collaborative, goal-oriented, and multi-culturally sensitive. The center attempts to help individuals develop more personal awareness and to learn skills necessary for success at the University of Utah.

In 2020, the College of Engineering partnered with the Counseling Center to hire their first Embedded Engineering Counselor. This counselor works with College of Engineering and its student 3 days a week. This counselor not only meets with students, but hosts a drop-in hour every week to support faculty and staff who have questions or concerns regarding working with students. Additionally, this counselor works with departments to create programming focused on supporting College of Engineering students, faculty and staff.

Disability Center (Scott McAward, Director): The Center for Disability Services provides accommodations and support for the educational development of students with disabilities. It strives to improve understanding and acceptance of students with disabilities throughout the University community. The center gives direct assistance to students to encourage and enhance their independence, works continually to develop and maintain an accessible physical environment, and endeavors to create a supportive psychological environment so that students can achieve their educational objectives.

6. Credit Unit

One semester credit normally represents one class hour or three laboratory hours per week. One academic year represents two 14-week semesters (i.e., fall and spring) and one 10-week summer term, exclusive of final examinations.

7. Tables

(See below.)

Table D-1. Program Enrollment and Degree Data

Name of the Program

	Academic Year		Enrollment Year					Total Undergrad	Total Grad	Degrees Awarded			
			1st	2nd	3rd	4th	5th			Associates	Bachelors	Masters	Doctorates
Current Year	20-21	FT	31	44	32	81	4	192	64	n/a			
		PT	0	3	8	41	1	53	26		33		
1 year prior to current year	19-20	FT	37	28	32	86	4	187	62	n/a	48	23	3
		PT	0	2	9	30	2	43	36				
2 years prior to current year	18-19	FT	26	23	28	88	5	170	65	n/a	52	23	9
		PT	0	4	9	32	2	47	31				
3 years prior to current year	17-18	FT	19	24	37	103	4	187	65	n/a	61	20	8
		PT	0	4	11	31	5	51	30				
4 years prior to current year	16-17	FT	21	20	34	108	10	193	72	n/a	64	31	10
		PT	4	6	12	46	5	73	31				

Give official fall term enrollment figures (head count) for the current and preceding four academic years and undergraduate and graduate degrees conferred during each of those years. The "current" year means the academic year preceding the on-site visit.

FT—full-time
PT—part-time

Table D-2. Personnel

Construction Engineering Program
Year[1]: Fall 2020

	HEAD COUNT		FTE[2]
	FT	PT	
Administrative[2]	1	0	0.50
Faculty (tenure-track)[3]	18	2	18.46
Other Faculty (excluding student Assistants)	1	3	2.68
Student Teaching Assistants[4]	0	18	7.02
Technicians/Specialists	1	0	1.00
Office/Clerical Employees	5	0	4.10
Others[5]	0	0	0.00

Report data for the program being evaluated.

1. Data on this table should be for the fall term immediately preceding the visit. Updated tables for the fall term when the ABET team is visiting are to be prepared and presented to the team when they arrive.

2. Persons holding joint administrative/faculty positions or other combined assignments should be allocated to each category according to the fraction of the appointment assigned to that category.

3. For faculty members, 1 FTE equals what your institution defines as a full-time load

4. For student teaching assistants, 1 FTE equals 20 hours per week of work (or service).

5. Specify any other category considered appropriate, or leave blank.

SUBMISSION ATTESTING TO COMPLIANCE

Only the Dean or the Dean's Delegate can electronically submit the Self-Study Report.

ABET considers the online submission as equivalent to that of an electronic signature of compliance attesting to the fact that the Program has conducted an honest assessment of compliance and has provided a complete and accurate disclosure of timely information regarding compliance with ABET's *Criteria for Engineering Programs* to include the General Criteria and any applicable Program Criteria, and the ABET *Accreditation Policy and Procedure Manual*.

ATTACHMENT 1 – STUDENT OUTCOME ASSESSMENTS

Assessment Summary – Student Outcome 1

Outcome: Engineering Problems– 1
Performance Indicator: Applies engineering, science or mathematical principles to achieve analytical or numerical solutions to model equations (formulate & solve).

Semester/Year: Spring 2021
Course: CVEEN 3510 – Civil Engineering Materials
Instructor: Dr. Nikola Markovic

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1. Brief statement describing the specifics of the assignment, quiz, exam, problem, etc. used to assess this performance indicator.

   A homework assignment was used to assess this performance indicator

   Problem 8:

   A load of 100 N was applied for 100 seconds and then released. The material is known to behave as a Burger's model with the following constants:

   k_1 = 20 N/mm k_2 = 50 N/mm

   β_3 = 5000 N s/mm β_4 = 10000 N s/mm

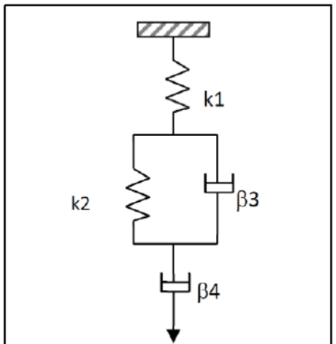
   Based on the information given

   1) Make a plot showing deformation as a function of time from 0 to 100 seconds.

   2) What is the instantaneous deformation?

   3) What is the maximum deformation?

   4) What is the permanent deformation (deformation at time = infinity)?



Problem 4 - Burger Rheological Model

2. Statement of how the problem addresses the performance indicator.

   The homework problem is concerned with development of a rheological model, which requires students to formulate the model employing mathematical/physical modeling and then solve it using numerical methods. As a result, the assigned homework problems enables a direct assessment of the specific performance indicator.

3. Describe the criteria used to determine if the student was successful in achieving the performance indicator (i.e., achieving a score of > 70% on the assignment, quiz, exam, problem, etc. or some other metric)

   The performance indicator is pass or fail on the quiz question.

4. Tabulate the distribution of student grades on the problem/assignment. Include the total number of students who were assessed and the total number of students who met the performance objective.

Total students	Pass	Fail
34	34	0

5. Description of how the students successfully met the performance indicator.

   All the students completed the problem. Part of the reason for a great success rate that the problem was very similar to those covered in class.

6. Description of how the students didn't successfully meet the performance indicator.

   In this case, all the students met the objective because the homework problem was similar to the material covered in class.

7. Conclusion (supported by data).

   All students were able to meet the requirement because very similar problems were covered in class.

8. Recommendations to improve achievement of this outcome.

   Continue to solve as many problems in class as possible.

Assessment Summary – Student Outcome 1 (continued)

This form will be completed by the course instructor at the conclusion of each semester and submitted to the appropriate student outcome evaluation committee for inclusion in their program-level assessment. Provide a minimum of 5 examples of student work.

Outcome: Engineering Problems– 1a
Performance Indicator: Problem statement shows understanding of the problem (identify).

Semester/Year: Fall 2020
Course: CVEEN 3210 – Structural Loads and Analysis
Instructor: Professor Luis Ibarra

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1. Brief statement describing the specifics of the assignment, quiz, exam, problem, etc. used to assess this performance indicator.

 Several exercises in HW and exam assignments address the indicator of students understanding the posed problem. The example selected here is the following problem of the first midterm:

Overturning moment is a building's global failure mode in which the moment caused by a lateral load around point 0 in the lower corner, exceeds the moment resistance created by the gravitational weight force also around point 0. In the figure below, overturning occurs when

$$M_{0,lat}=F(h/2)$$ M0,lat=Fh/2

is larger than

$$M_{0,self-w}=P_g(b/2)$$ M0,self−w=Pgb/2

. Where

F F

represent the lateral load (wind or earthquake force),

P_g Pg

the gravitational force,

h h

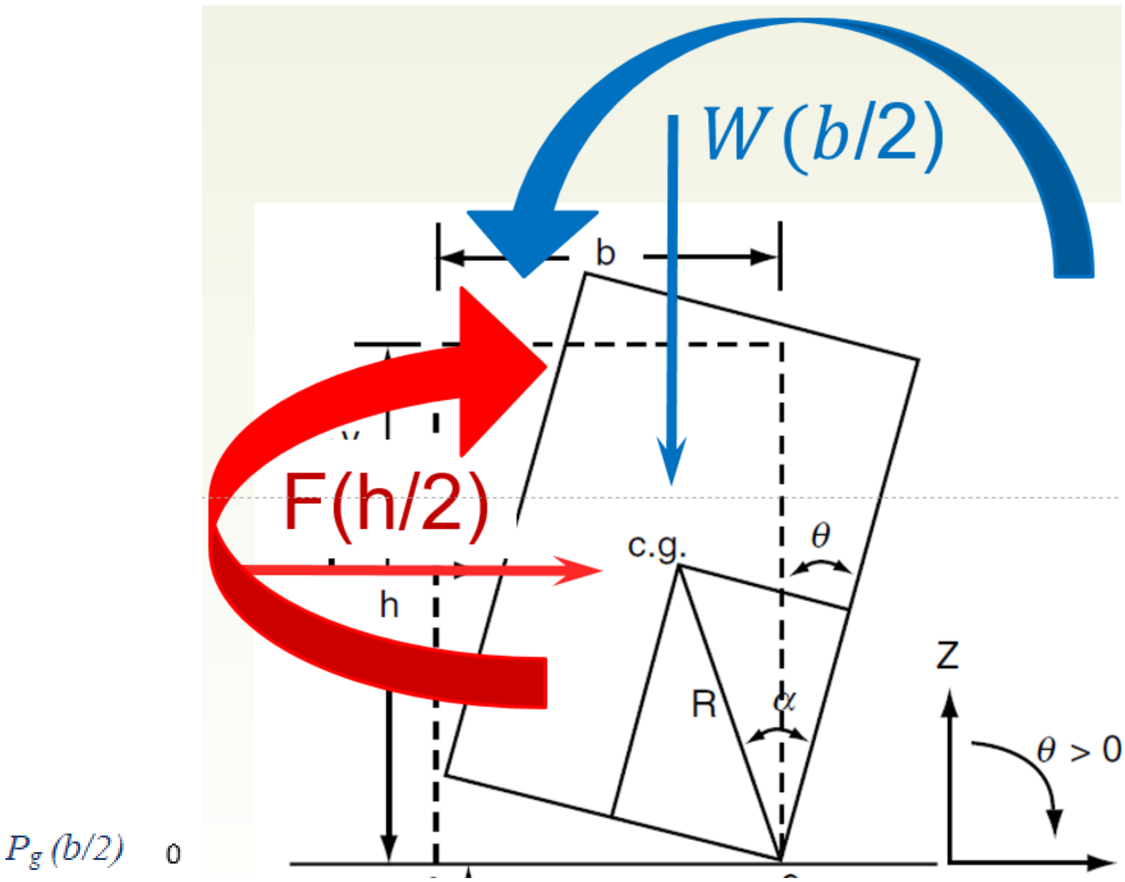
is the building's height, and

b b

is the building's width.

What load combination(s) would you use to analyze/design for this failure mode?

Explain why your selected load combination(s) are conservative. You can use a mathematical justification or present an objective, rationale justification **[10 points]**.

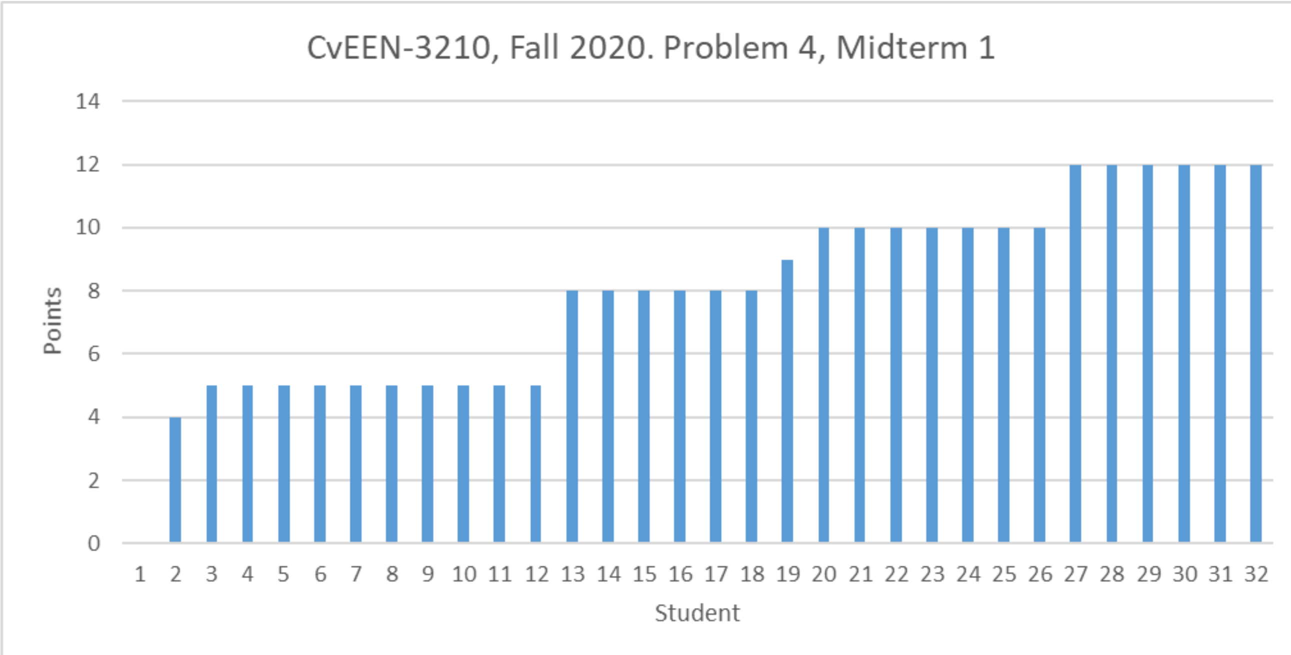


2. Statement of how the problem addresses the performance indicator.
The topic is load combinations. The list of combinations was provided in a HO, and there was a brief discussion. However, no specific examples were provided. This exercise is trying to determine whether student can link a specific set of loads to the appropriate load combination cases of ASCE 7-16.

3. Describe the criteria used to determine if the student was successful in achieving the performance indicator (i.e., achieving a score of > 70% on the assignment, quiz, exam, problem, etc. or some other metric)

The exercise was one of four problems in the first midterms, which needed a score of 70% to be considered passed. This problem only was worth 10 out of 100 points.

4. Tabulate the distribution of student grades on the problem/assignment. Include the total number of students who were assessed and the total number of students who met the performance objective.
There were 35 students in the class, but three of them took a different test in a subsequent days. One of the 32 evaluted students did not attempt to solve the exercise. Also, five of them provided additional insights and I gave them a couple of extra-points. I typically do not give extra-points for regular exercises.



5. Description of how the students successfully met the performance indicator.
   The average for the exercise, including the student who did not solve it, was 7.9. The standard deviation was 3.1. Therefore, the problem was considered a success in terms of students' understanding.

6. Description of how the students didn't successfully meet the performance indicator.
   Some student could not connect the fact that an overturning moment failure mode may be more critical when the gravitational loads are smaller, not larger.

7. Conclusion (supported by data).
   Most of the student were able to connect the dots, and understand that they should include load combinations that had reduced gravity load. This lead to an average of almost 80% for the exercise.

8. Recommendations to improve achievement of this outcome.
   To provide more exercises of this type in HW and midterm assignments.

LOAD COMBO CHOICE:

4: $1.2D + 1W + L + 0.5(L_r \text{ or } S \text{ or } R)$

5: $0.9D + 1W$

6: $1.2D + E_v + E_h + L + 0.2S$

7: $0.9D - E_v + E_h$

I would analyze these load combinations b/c I want to know how the building would fare with wind/seismic loads since those loads could lead to an overturning moment. for combo, 5 and 7 I want to make sure that even if the dead load is an overestimate that the building would still not overturn with wind or an earthquake.

12/10

Great answer

Problem 4.

The load combinations in a situation of building tip

Wind/seismic: This is the force causing the building to overturn; so we consider it

Dead/Live: This is the force causing the building to stay in place. Thus we consider it.

Snow: Unless the building has snow (not explicitly stated) we don't consider it.

5/10

find a load comb that reduces the gravity load to make the gravity mom smaller (e.g., 0.9D + 1.0 W) you would use a load combination that describes the moment around O

1.5E + 1.2W + DL + LL

This factors extra safety in the event of an earthquake or bad wind storm.

The idea is correct, but you should have selected load combinations from ASCE

8/10

Something like .9D + 1.0W or 1.2D + 1.0W + L + 0.5(Lr)

.9D + 1.0W is Very Worst Case scenario Since the Dead load is reduced It would Illustrate a very strong wind surge

correct. For earthquakes you would use 0.9D + E

1.2D + 1.0W + L + 0.5(Lr) is more descriptive of the Loads on the building and is expecting disproportionate wind speeds to the weight of the building

10/10

8

The load combination I would use would be

1.2D + E_v + E_h + L + 0.2S

It would be a little conservative because E_v & E_h would account for the vertical and horizontal movements. But it might not account for the rotation.

you need to reduce the gravity moment to be conservative, use combs 5 and 7

5/10

Assessment Summary – Student Outcome 2

This form will be completed by the course instructor at the conclusion of each semester and submitted to the appropriate student outcome evaluation committee for inclusion in their program-level assessment. Provide a minimum of 5 examples of student work.

Outcome: Design – 2
Performance Indicator: Produces a clear and unambiguous design project needs statement that identifies relevant public health, safety, and welfare, global, cultural, social, environmental, and economic factors.

Semester/Year: Spring 2021
Course: CVEEN 4222 – Steel Design I
Instructor: Professor Luis Ibarra

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1. Brief statement describing the specifics of the assignment, quiz, exam, problem, etc. used to assess this performance indicator.

During the first lectures, students learn the overall objectives of a building design, which is expected to achieve:
- Safety
- Functionality
- Economy

As part of the first HW, students:

- Defined the three basic goals of a consulting team, when designing a building.
- Provide a simple definition of structural design.
- Describe the difference between a strength limit state of a structure and a serviceability limit state.
- Give a description of both the LRFD and ASD design approaches. What is the fundamental difference between the methods?

2. Statement of how the problem addresses the performance indicator.

Students learn that the three aforementioned design factors are interconnected, and change from place to place based on technological, cultural, and socioeconomic factors. Ultimately, the basic limit states (e.g., serviceability conditions and collapse prevention) have to be satisfied at all times.

3. Describe the criteria used to determine if the student was successful in achieving the performance indicator (i.e., achieving a score of > 70% on the assignment, quiz, exam, problem, etc. or some other metric).

This performance indicator was part of HW-1, and it was not independently graded. The mean grade for HW 1 was 90 for the class.

A similar question was included in the first exam, where the class average grade was 84 for the entire exam.

4. Tabulate the distribution of student grades on the problem/assignment. Include the total number of students who were assessed and the total number of students who met the performance objective.

The results from the specific exam question (1a) about Outcome: Design – 2a are:

Student 1	4
Student 2	4
Student 3	4
Student 4	4
Student 5	4
Student 6	4
Student 7	0
Student 8	3
Student 9	4
Student 10	4
Student 11	4
Student 12	4
Student 13	4
Student 14	4
Student 15	4
Student 16	4
Student 17	4
Student 18	4
Student 19	4
Student 20	4
Student 21	4
Student 22	4
Student 23	4
Student 24	4
Student 25	4
Student 26	4
Student 27	4
Student 28	4
Student 29	3

Only one of the 29 students who answer this question did not reach the performance objectives.

5. Description of how the students successfully met the performance indicator.

The idea of steel design and its implications is easy to understand at the high order level, because it can be reduce to the concept of demands being less than system capacities. The students who were attending the first classes did not have problem with this assignement.

6. Description of how the students didn't successfully meet the performance indicator.

Only one student did not meet the expectations, but it is not clear whether he did not have time to complete his examination, or had not understood the corresponding discussions.

7. Conclusion (supported by data).
The overall idea of steel design and its implications for society was clearly understood.

8. Recommendations to improve achievement of this outcome.
Try to add even more real examples of steel design in the first section of the class.

Assessment Summary – Student Outcome 2 (continued)

Course Number: CVEEN 4920 Construction Capstone Semester: Spring 2021

Number of students in course: Six Number of students assessed in assignment: Six, two teams of three

Description of assignment: Prepare a response to a design-build request for proposal (RFP). The assignment included preparing a work breakdown structure (WBS), identifying the building code requirements for the project, preparing preliminary designs for potential alternatives, evaluating the preliminary designs based on cost and level of service (LOS), and developing 30-percent design documents.

	Greatly Exceeded Expectations (5)	**Exceeded Expectations** (4)	**Met Expectations** (3)	**Partially Met Expectations** (2)	**Significant Improvement Needed** (1)	**Comments**
Problem Definition: Prepare a work breakdown structure (WBS)	Problem scope is clearly defined, appropriate level of detail	Minor mistakes in problem scope, appropriate level of detail	Some mistakes in problem scope and/or insufficient level of detail in part of the scope	Several mistakes in problem scope and/or insufficient level of detail	No response, incorrect response, or significantly incomplete response	See Attachment A for sample work. No curricular or pedagogical changes needed at this time.
		2 of 2 teams				
Research, Data Collection, Design Requirements: Identify project's building code requirements	Identified most of the applicable building codes, moderate interpretation their effects on design	Identified most of the applicable building codes, limited interpretation their effects on design	Identified most of the applicable building codes	Missing several of the applicable building codes	No response, incorrect response, or significantly incomplete response	See Attachment B for sample work. No curricular or pedagogical changes needed at this time.
			2 of 2 teams			
Alternative Development: Prepare a preliminary design of potential alternatives	Developed ≥ 5 alternatives, explores a wide variety of solutions, includes an innovative solution	Developed ≥ 5 alternatives, explores a wide variety of solutions	Developed ≥ 5 alternatives, alternatives are similar	Explored <5 alternatives	No response, incorrect response, or significantly incomplete response	See Attachment C for sample work. No curricular or pedagogical changes needed at this time.
	2 of 2 teams					
Testing of Alternatives: Evaluation of cost and level of service (LOS)	Minor mistakes in evaluation of cost and LOS, uses creative approach to assessing LOS	Minor mistakes in evaluation of cost and LOS	Some mistakes in evaluation of cost and LOS	Several mistakes in evaluation of cost and LOS	No response, incorrect response, or significantly incomplete response	See Attachment C for sample work. No curricular or pedagogical changes needed at this time.
	1 of 2 teams	1 of 2 teams				
Design Development: Development of proposed design to 30% of design	All drawings are included and provides additional detail	All drawings are included, and has minor drafting mistakes or missing detail	All drawing are included, and has some drafting mistakes or missing detail	Missing drawings or insufficient level of detail	No response, incorrect response, or significantly incomplete response	See Attachment D for sample work. No curricular or pedagogical changes needed at this time.
	1 of 2 teams	1 of 2 teams				

How did this cohort perform compared to previous cohorts on this outcome?

This class was the first cohort, so that no comparison can be made.

Recommendations for change or improvements to course or assignment?

More focus on the interpretation of the building code's effects on the design.

More focus on the preconstruction process for a design-build project early during the development of the WBS.

Attach 5 examples of supporting data, as applicable with this evaluation metric?

Samples from both teams are included in the Attachments.

Assessment Summary – Student Outcome 3

This form will be completed by the course instructor at the conclusion of each semester and submitted to the appropriate student outcome evaluation committee for inclusion in their program-level assessment. Provide a minimum of 5 examples of student work.

Outcome: Communication – Non-Technical 3
Performance Indicator: Writing conforms to appropriate technical style format appropriate to the audience, appropriate use of graphics, mechanics & grammar.

Semester/Year: Spring 2021
Course: CVEEN 3100 – Technical Communication
Instructor: Professor Joshua Lenart

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1. Brief statement describing the specifics of the assignment, quiz, exam, problem, etc. used to assess this performance indicator.

The Job Document assignment offers students the opportunity to create or improve on a cover letter, resume, and/or curriculum vitae (CV). Each of these job documents are unique forms of communication that reflect a student's professional identity while conforming to particular genre conventions. This assignment is designed to help students construct professional-quality, reader-friendly documents by targeting specific employment criteria as well nontechnical audiences, such as human resource (HR) personnel. After a student identifies a position (job, internship, co-op, or graduate program) for which to apply, they will then complete the following five steps:

- Document planning phase
- Conduct research
- Create a cover letter and resume or CV
- Schedule a consultation with your instructor
- Offer and receive feedback from a peer

2. Statement of how the problem addresses the performance indicator.

Assignment deliverables include the following:

1. a cover memo explaining to the instructor the submitted documents and a brief account of why he/she chose this particular position
2. a final draft of the cover letter
3. a final draft of the resume or CV
4. a rough draft of the cover letter and resume
5. the job, internship, or co-op posting
6. any additional research materials gathered while researching the position
7.

To achieve the minimum performance indicator, students must proceed through each of these steps while also conforming to the rubric(s) for both the resume and cover letter portions of the assignment, which helps ensure successful completion of the performance indicator.

3. Describe the criteria used to determine if the student was successful in achieving the performance indicator (i.e., achieving a score of > 70% on the assignment, quiz, exam, problem, etc. or some other metric)

This assignment is scored out of 100 points, with the following breakdown:

- Cover Memo (____ / 5)
- Cover Letter (____ / 42)
- Resume (____ / 42)
- Rough Drafts of each document (2x) (____ / 6)
- Job or Position Posting (____ / 5)
- Final (____ / 100)

Additionally, the following two rubrics are used to evaluate the cover letter and resume:

COVER LETTER RUBRIC					
	7	5	3	1	0
Overall Appearance/Style	Fills page, not crowded. Consistent in font style and layout. Information is clear. Centered on page and good choice of font and type size. Structure has clear purpose.	Consistent in style but has some uneven white space or does not fill up a page. Important information may not stand out clearly to reader.	Unnecessarily run onto second page. Appearance may lack appropriate use of bold/italics, font, bullet points or margins.	Format is not appealing. Information is not laid out in a clear format.	Does not draw attention and has lack of structure.
Paragraph Organization	Paragraph organization is excellent. Most important items are listed on the top half. Paragraphs include enough information within each to substantiate its need.	Paragraph organization is well defined and order of information on page is good.	Paragraphs may need to be structured differently to be more effective.	Lacking appropriate paragraphs or paragraphs is unclear.	Does not include paragraphs.
Professional Experience	Excellent account of experience. Strong verbs and appropriate verb tense is used. Does not over use "I" construction (e.g. I did this, I did that). Claims are supported with relevant examples	Appropriate account of experience. No sentence fragments. Descriptions may not be result oriented or verbs may be weak. Not enough use of examples	Too much or too little experience is included. Verbs may be weak and verb tense may be incorrect. Important information may be missing.	Descriptions are not detailed and offer no illustration of what was done.	No type of experience (work, volunteer, leadership or other) is listed.
Education/ Scholastic Experience	Honors, awards, and scholarships are discussed. Important information is highlighted.	Education is mentioned but necessary information could be expanded. Most important information does not stand out.	Additional information may need to be included to increase length of letter or too much information may be included.	Section lacks information and format.	Section is not included or crucial information is missing.
Typos/Spelling Errors	No or extremely minor errors (Capitalization, spelling, grammar).	Few errors, shows but consistent pattern. Information may be abbreviated when it should be spelled out.	Shows a persistent pattern of error or contains a number of varied mechanical errors	Mechanical errors are so widespread that they are distracting	Difficult to read because of mechanical errors.
Additional Sections: Ex. Skills/Activities	Included additional section with relevant, well organized, and easy to understand information. If appropriate, leadership roles and related activities are indicated.	Included additional section with relevant information, and minimal flaws; skills or activities may not be properly defined.	Additional section is missing key information.	Included additional section, but information is weak or irrelevant.	Additional sections are missing.

RESUME RUBRIC					
	7	**5**	**3**	**1**	**0**
Overall Appearance/Style	Fills page, not crowded. Consistent in font style and layout. Information is clear. Centered on page and good choice of font and type size. Structure has clear purpose.	Consistent in style but has some uneven white space or does not fill up a page. Important information may not stand out clearly to reader.	Unnecessarily run onto second page. Appearance may lack appropriate use of bold/italics, font, bullet points or margins.	Format is not appealing. Information is not laid out in a clear format.	Does not draw attention and has lack of structure.
Category Selection	Choice of subject headers is excellent. Most important items are listed on the top half. Categories selected include enough information within each to substantiate the need for the heading.	Category selection is well defined and order of information on page is good.	Categories may need to be structured differently to be more effective.	Lacking appropriate categories or category selection is unclear	Resume does not include subject headers
Experience	Appropriate experience listed with organization name, title, dates, and location. Sentence fragments are concise, direct, and accomplishment oriented; strong verbs and appropriate verb tense is used. Results are quantified. Listed in correct chronological order	Appropriate experience listed. Sentence fragments are used, but descriptions may not be result oriented or verbs may be weak.	Too much or too little experience is included. Verbs may be weak and verb tense may be incorrect. Descriptions may not be in the form of bullets. Important information may be missing.	Descriptions are not detailed and offer no illustration of what was done.	No type of experience (work, volunteer, leadership or other) is listed.
Education	Degree and major are listed with graduation month and year, name and location of school. If GPA is listed it is over a 3.0. Honors and Scholarships are included here or in their own section if more appropriate. Important information is highlighted.	Degree is listed with necessary information but section could be expanded. Most important information does not stand out.	Additional information may need to be included to increase length of resume or too much information may be included.	Section lacks information and format.	Section is not included or crucial information is missing.
Typos/Spelling Errors	No or extremely minor errors (Capitalization, spelling, grammar).	Few errors, shows but consistent pattern. Information may be abbreviated when it should be spelled out.	Shows a persistent pattern of error or contains a number of varied mechanical errors	Mechanical errors are so widespread that they are distracting	Difficult to read because of mechanical errors.
Additional Sections: Ex. Skills/Activities	Included additional section with relevant, well organized, and easy to understand information. If appropriate, leadership roles and related activities are indicated.	Included additional section with relevant information, and minimal flaws; skills or activities may not be properly defined.	Additional section is missing key information.	Included additional section, but information is weak or irrelevant.	Additional sections are missing.

4. Tabulate the distribution of student grades on the problem/assignment. Include the total number of students who were assessed and the total number of students who met the performance objective.

6 total students were enrolled in this course; 6 students (or 100% of the total) achieved
> 70% on this assignment.

5. Description of how the students successfully met the performance indicator.

Students typically have four weeks from when the assignment is assigned until it is due to complete all required components. Because of the multiple types of feedback, they receive throughout the process (e.g. one-on-one instructor consultation, instructor comments on rough drafts, and 1-2 rounds of peer review), students typically have no problem achieving the performance indicator.

6. Description of how the students didn't successfully meet the performance indicator.

N/A. All students achieved the minimum performance indicator.

7. Conclusion (supported by data).

Students have told me anecdotally nearly every semester I have taught this assignment how much they value it and how it has helped them get a job or get into a graduate program. The success of the assignment, and how well it resonates with students, attest to its value.

8. Recommendations to improve achievement of this outcome.

None. This assignment works well as the first major assignment of the semester.

Assessment Summary – Student Outcome 3 (continued)

This form will be completed by the course instructor at the conclusion of each semester and submitted to the appropriate student outcome evaluation committee for inclusion in their program-level assessment. Provide a minimum of 5 examples of student work.

Outcome: Communication – Technical 3
Performance Indicator: Writing conforms to appropriate technical style format appropriate to the audience, appropriate use of graphics, mechanics & grammar.

Semester/Year: Spring 2021
Course: CVEEN 3100 – Technical Communication
Instructor: Professor Joshua Lenart

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1. Brief statement describing the specifics of the assignment, quiz, exam, problem, etc. used to assess this performance indicator.

Write a technical memo from the perspective of a civil and environmental engineering student. This assignment is designed to help students stay current and up-to-date with local, contemporary engineering issues involving the field writ large while addressing a technical-oriented audience. Engineering firms across the region are responsible for an array of projects that span the Intermountain West; as such, this assignment is designed to help students familiarize with changing practices within the field as well as within higher education to address systemic changes occurring across the country. For this assignment, students are asked to read and respond to a recent, engineering-centric article(s) as it relates to the various fields of civil and environmental engineering, e.g.: structural, geotechnical, construction materials, transportation, and/or water resource engineering.

2. Statement of how the problem addresses the performance indicator.

This memo demonstrates a student's familiarity, beyond a cursory level, with the technical topic and related issues as well as incorporates correct IEEE citation format. Additionally, the memo requires students to include the following components:

- One direct quote from the assigned article and one direct quote from another (related) engineering article
- Proper IEEE in-text references to all authors, article titles, and news sources
- A bibliographic reference included either as an end note or works cited
- An analysis of the pros and cons of the local engineering issue
- A well-developed discussion/conclusion section
- Grammatical correctness

3. Describe the criteria used to determine if the student was successful in achieving the performance indicator (i.e., achieving a score of > 70% on the assignment, quiz, exam, problem, etc. or some other metric)

This memo is evaluated on a 10-scale using the following grading rubric:

- Short summary of both/either article (1-2 sentences) (1pt)
- Analysis of the local engineering issue:
  Pros (1.5 pts)
  Cons (1.5 pts)
- Direct quote from either article as well as another appropriate source (2 pts)
- Well-developed Discussion/Conclusion section (2 pts)
- IEEE Reference style/Works Cited (1 pt.)
- Word count (.5 pts)
- Grammatical correctness (.5 pt.)

4. Tabulate the distribution of student grades on the problem/assignment. Include the total number of students who were assessed and the total number of students who met the performance objective.

6 total students were enrolled in this course; 5 students (or 83% of the total) achieved
> 70% on this assignment.

5. Description of how the students successfully met the performance indicator.

The majority of students enrolled in this class have no problem completing this assignment and achieving the minimum performance indicator. It is not a difficult assignment so long as the students follow the rubric closely (which is provided to them when the technical memo is assigned). This assignment is used as in introduction to expectations of the class and some of the parameters required of written technical communication.

6. Description of how the students didn't successfully meet the performance indicator.

1 of the 6 students did not achieve the minimum performance indicator; the majority students who do not achieve the minimum performance level simply because they did not follow the parameters outline in the rubric, e.g.: not using the proper citation style, including too much summary information instead of analysis, and not proofreading closely enough for grammatical errors.

7. Conclusion (supported by data).

This is the first technical writing assignment students are asked to submit during the semester. Most students respond well to the assignment; as such, this assignment continues to prove to be a good foray into technical communication writing, either as a refresher for some of the class and an introduction for the remainder of this class.

8. Recommendations to improve achievement of this outcome.

None. This assignment functions well and as it should

Assessment Summary – Student Outcome 3 (continued)

This form will be completed by the course instructor at the conclusion of each semester and submitted to the appropriate student outcome evaluation committee for inclusion in their program-level assessment. Provide a minimum of 5 examples of student work.

Outcome: Communication – Technical 3
Performance Indicator: Writing conforms to appropriate technical style format appropriate to the audience, appropriate use of graphics, mechanics & grammar.

Semester/Year: Spring 2021
Course: CVEEN 4920 Capstone Design
Instructor: Steven Peterson

Course Number: CVEEN 4920 Construction Capstone Semester: Spring 2021

Number of students in course: Six Number of students assessed in assignment: Six, two teams of three

Description of assignment: Prepare and present a technical proposal for a design-build request for proposal (RFP).

	Greatly Exceeded Expectations (5)	**Exceeded Expectations** (4)	**Met Expectations** (3)	**Partially Met Expectations** (2)	**Significant Improvement Needed** (1)	**Comments**
Written Communication of Results: Response to RFP (technical proposal)	Complete response to RFP, uses persuasive writing, minor writing mistakes	Complete response to RFP, minor writing mistakes	Complete response to RFP, some writing mistakes	Incomplete response to RFP and/or extensive writing mistakes	No response, incorrect response, or significantly incomplete response	See Attachment A for sample work. No curricular or pedagogical changes needed at this time.
		2 of 2 teams				
Verbal Communication of Results: Presentation of technical proposal	Focuses on the project, persuasive presentation, good response to questions	Focuses on the project, persuasive presentation, adequate response to question	Focuses on the project, informative presentation, adequate response to question	Limited focus on the project or poor presentation or poor response to questions	No response, incorrect response, or significantly incomplete response	See Attachment B for sample work. No curricular or pedagogical changes needed at this time.
			2 of 2 teams			

How did this cohort perform compared to previous cohorts on this outcome?

This class was the first cohort, so that no comparison can be made.

Recommendations for change or improvements to course or assignment?

Provide better instructions for the content of the technical proposal.

Provide the written technical proposal to the presentation attendee before the presentation.

Provide guidance regarding responding to question to the students before the presentation.

Attach 5 examples of supporting data, as applicable with this evaluation metric?

Samples from both teams are included in Attachments.

Assessment Summary – Student Outcome 4

This form will be completed by the course instructor at the conclusion of each semester and submitted to the appropriate student outcome evaluation committee for inclusion in their program-level assessment. Provide a minimum of 5 examples of student work.

Outcome: Ethics – 4
Performance Indicator: Evaluates conflicting/competing global, economic, environmental, and societal issues in order to make informed decisions about an engineering solution & incorporates that sensitivity into the design process.

Semester/Year: Fall 2020
Course: CVEEN 3210 – Structural Loads and Analysis
Instructor: Professor Luis Ibarra

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1. Brief statement describing the specifics of the assignment, quiz, exam, problem, etc. used to assess this performance indicator.

   This performance indicator is better covered in design courses, where students have the opportunity of optimizing the design of a structure based not only on technical considerations, but also economic, environmental, labor availability.
   Still, ethical decisions are discussed in Loads and Structural Analysis I because the student has to understand the balance between a safe, economic, and functional design.
   The students have several HW and quizzes during lectures (16 in Fall 2020), addressing several questions that are related to ethical decisions in structural engineering. I'm showing the results for the HW on gravitational loads.

2. Statement of how the problem addresses the performance indicator.

   We talked during lectures about selection of loads, and how they carry factors that account for uncertainty in the loading. We mention these loads may not be exceeded during the lifetime of a given system, but the responsibility of the engineer is to account for every situation that is considered possible above a certain threshold. Thus, students need to understand that the minimum loads provided in ASCE 7-16 need to be used to ensure safety, unless case studies are provided.

3. Describe the criteria used to determine if the student was successful in achieving the performance indicator (i.e., achieving a score of > 70% on the assignment, quiz, exam, problem, etc. or some other metric)

   Students need a minimum of 70% to have a passing grade.

4. Tabulate the distribution of student grades on the problem/assignment. Include the total number of students who were assessed and the total number of students who met the performance objective.

HW 2 - DL and LL Out of 130
113
120
121
117
101
114
120
120
111
122
0
128
129
118
88
114
117
122
118
116
92
107
125
117
120
115
0
116
120
125
128
117
117
119

The average of the students who solved the HW (two students did not submit it), was 116 points out of 130, for an average of 90%.
All students obtained a passing grade, except the two students who did not attempt to solve the HW.

5. Description of how the students successfully met the performance indicator.
They applied the material discussed in class. This topic is self-contained, and the students do not need knowledge from previous engineering courses.

6. Description of how the students didn't successfully meet the performance indicator.
Students missed classes, or were unattentive.

7. Conclusion (supported by data).

Students understood the need to provide gravitational loads that are in accordance with current codes and standards.

8. Recommendations to improve achievement of this outcome.

Students are understanding the reasons for having a systematic approach to analysis and design of structures. For subsequent courses, I wil linclude exercises that more directly address these ethical considerations.

Assessment Summary – Student Outcome 5

This form will be completed by the course instructor at the conclusion of each semester and submitted to the appropriate student outcome evaluation committee for inclusion in their program-level assessment. Provide a minimum of 5 examples of student work.

Outcome: Teams – 5a
Performance Indicator: Contributes to team work, constructively interacts with teammates, assists in keeping the team on track, expects quality work, and exhibits relevant knowledge, skills, and aptitudes.

Semester/Year: Spring 2021
Course: CVEEN 3100 – Technical Communication
Instructor: Professor Joshua Lenart

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1. Brief statement describing the specifics of the assignment, quiz, exam, problem, etc. used to assess this performance indicator.

Students researched and designed a chapter of
a feasibility assessment report on several proposed water infrastructure projects across the state. Students enrolled in CVEEN 3100 (SP 2021) utilized multi-participant analysis to analyze stakeholder input, resource impacts, and conflicts associated with several proposed infrastructure projects while striving to enhance meaningful collaboration between resource management agencies at local, state, and federal levels to bolster community sustainability and land use adaption.

2. Statement of how the problem addresses the performance indicator.

Students worked in teams of up to four members to compose a report on a specific civil and environmental-related topic. Students first write a proposal to propose the work they intend to do both as an individual and as a member of a team. This proposal acts as a team working agreement which guides all the work that follows. Students then submit a research outline, and a 30%, 60%, and 90% draft, before submitting the final draft of their reports. Structuring the assignment in this way helps scaffold the assignment for students so that they remain in close contact with one another to ensure that the work is evenly divided and that every team member contributes equally to the project. Students are also required to give two oral presentations (a shorter, informal presentation and a longer, more formal presentation) which creates accountability for maintaining high-quality work. I encourage students to select research topics based on their own professional interest which helps them adapt their unique knowledge, skill, and abilities to the assignment.

3. Describe the criteria used to determine if the student was successful in achieving the performance indicator (i.e., achieving a score of > 70% on the assignment, quiz, exam, problem, etc. or some other metric)

The following rubric is used to determine the assessment criteria for students successfully achieving the performance indicator:

- Explains beyond a cursory-level individual issue(s) pertinent to your chapter (____ / 20)
- Develops research question that explores multiple dimensions of your topic (____ / 10)

• Accounts for validity/invalidity of varying sides within broader contexts (____ / 20)
• Incorporates concrete civil and/or environmental engineering examples (____ / 20)
• Poses a concrete solution/conclusion/recommendation for your chapter (____ / 20)
• Correct formatting/grammatical correctness/citations/ tables and figures (____ / 10)
Feasibility Report (____ / total 100)

4. Tabulate the distribution of student grades on the problem/assignment. Include the total number of students who were assessed and the total number of students who met the performance objective.

6 total construction students were enrolled in this course; 6 students (or 100% of the total) achieved
> 70% on this assignment.

5. Description of how the students successfully met the performance indicator.

Greatly exceeded expectations; no to minor mistakes; and significant additional quality above the minimal standard as describe just above.

6. Description of how the students didn't successfully meet the performance indicator.

All construction students enrolled this semester successfully met the performance indicator. Note: SP 2021 was the third semester affected by the COVID-19 pandemic; this course occurred online in an online format.

7. Conclusion (supported by data).
Because of the highly-structured drafting process I require of the assignment (5 primary drafts prior to the final draft submission), the final report tends to achieve a high-performance indicator for all students who submit the final draft.
8. Recommendations to improve achievement of this outcome.

None. Students respond well to this assignment and produce high quality work.

Assessment Summary – Student Outcome 5 (continued)

Course Number: CVEEN 4920 Construction Capstone Semester: Spring 2021

Number of students in course: Six Number of students assessed in assignment: Six

Description of assignment: Evaluation of the student's performance on their team. The evaluations included a self-evaluation, an evaluation by team members, and an evaluation by the instructor.

Skill	Advanced: Exceeds expectations 4	Competent: Meets expectations 3	Progressing: Does not fully meet expectations 2	Beginning: Does not meet expectations 1	Comments
Contribution	Contributed more than a fair share of the work	Contributed a fair share of the work	Contributed less than a fair share of the work	Contributed little or none to the work	No curricular or pedagogical changes needed at this time.
		6 of 6			
Participation	Participates in all group meetings	Participates in most group meetings	Participates in some group meetings	Seldom participates in group meetings	No curricular or pedagogical changes needed at this time.
	6 of 6				
Commitment	Completes all assignments on time	Completes most assignments on time	Completes some assignments on time	Seldom completes assignments on time	No curricular or pedagogical changes needed at this time.
	5 of 6	1 of 6			
Collaboration	Worked with others to produce five or more project deliverables	Worked with others to produce three or four project deliverables	Worked with others to produce one of two project deliverables	Did not work with others	No curricular or pedagogical changes needed at this time.
	6 of 6				
Leadership	Assumed leadership for two or more project deliverables and allowed others the opportunity to lead	Assumed leadership for one project deliverable	NA	Did not assume leadership for any project deliverable or did not allow others the opportunity to lead	No curricular or pedagogical changes needed at this time.
	4 of 6	2 of 6			
Communication	Always listens to, shares with, and supports teammates	Usually listens to, shares with, and supports teammates	Often listens to, shares with, and supports teammates	Seldom listens to, shares with, and supports teammates	No curricular or pedagogical changes needed at this time.
	2 of 6	4 of 6			
Professionalism	Work always is neat, organized, accurate, and indicative of a civil engineering professional	Work usually is neat, organized, accurate, and indicative of a civil engineering professional	Work often is neat, organized, accurate, and indicative of a civil engineering professional	Work seldom is neat, organized, accurate, and indicative of a civil engineering professional	No curricular or pedagogical changes needed at this time.
	5 of 6	1 of 6			

How did this cohort perform compared to previous cohorts on this outcome?

This class was the first cohort, so that no comparison can be made.

Recommendations for change or improvements to course or assignment?

No changes are recommended at this time.

Attach 5 examples of supporting data, as applicable with this evaluation metric?

The evaluations are included in the Attachment.

Assessment Summary – Student Outcome 6

Outcome #6: An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions
Performance Indicator 6a: Perform the experiment by collecting data using appropriate measurement equipment based on the given procedures and following experimental designs learned in Chemistry/Physics lab

Semester/Year: Spring 2021
Course: CVEEN 3515 – Civil Engineering Materials Laboratory
Instructor: Dr. Nikola Markovic

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1. Brief statement describing the specifics of the assignment, quiz, exam, problem, etc. used to assess this performance indicator.

   Prior to attending lab #2, students were required to watch a video that explained the procedures based on ASTM C29. Then the students formed groups of 3 where they performed the experiment and then wrote a report.

2. Statement of how the problem addresses the performance indicator.

   An ASTM standard is followed as part of this lab and students must demonstrate that they are capable of performing the lab.

3. Describe the criteria used to determine if the student was successful in achieving the performance indicator (i.e., achieving a score of > 70% on the assignment, quiz, exam, problem, etc. or some other metric)

   A score greater than 60% was considered as 'meeting expectations' while a score greater than 80% was considered as 'exceeding expectations'

4. Tabulate the distribution of student grades on the problem/assignment. Include the total number of students who were assessed and the total number of students who met the performance objective.

   A total of 33 students were evaluated with the following results

Exceeded Expectations	85%
Met Expectations	15 %
Did not Meet Expectations	0%

5. Description of how the students successfully met the performance indicator.

Students met the performance indicator by writing a laboratory report.

6. Description of how the students didn’t successfully meet the performance indicator.

   All the students met expectations for this particular lab report.

7. Conclusion (supported by data).

   All the students met expectation for this particular lab report.

8. Recommendations to improve achievement of this outcome.

   The instructor will further evaluate contributions of individual team members to ensure that each student has made a substantial contribution.

Assessment Summary – Student Outcome 7

This form will be completed by the course instructor at the conclusion of each semester and submitted to the appropriate student outcome evaluation committee for inclusion in their program-level assessment. Provide a minimum of 5 examples of student work.
ABET Student Outcome:
Performance Indicator:
(i.e., specific course activity or outcome that address the Student Outcome:

Semester/Year: Spring 2021
Course: CVEEN 5780 Façade Engineering
Instructor: Jianli Chen

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1. Brief statement describing the specifics of the assignment, quiz, exam, problem, etc. used to assess this performance indicator.

2. Statement of how the problem addresses the performance indicator.

   CVEEN Construction Engineering students will show the ability to engage in life-long learning by developing a personal, professional development plan for the early part of their career. This plan will include the following sections: (1) interests (curiosity), (2) career objectives (initiative), (3) short-term and long-term goals with timeline (independence), (3) continuing education plan (independence), (4) time management and prioritization system (transfer), (5) peer/support group (reflection), and (6) annual review, reflection and renewal (reflection).

3. Describe the criteria used to determine if the student was successful in achieving the performance indicator

   Each section listed above (in problem 2) will be assessed using the criteria listed below. The total score is 30.

4. Tabulate the distribution of student grades on the problem/assignment. Include the total number of students who were assessed and the total number of students who met the performance objective.

Exemplary	**Mature**	**Satisfactory**	**Developing**	**Beginning**
Greatly exceeded expectations	Exceeded expectations	Met expectations	Partially met expectations but deficient in important aspects	Significant improvement needed to meet expectations
No to minor mistakes. Significant additional quality above the minimal standard	Some minor mistakes, no significant conceptual mistakes. Additional quality above minimal standard	Some mistakes, including minor conceptual mistakes; however, able to use generally accepted methods. Quality met the minimal standard.	Demonstrated some general knowledge of the topic. Work included many mistakes, including conceptual mistakes. Quality was substandard.	No response or participation, or completely incorrect in response or participation.
score = 5	score = 4	score = 3	score = 2	score = 1
grade = A	grade = B	grade = C	grade = D	grade = E
Percentage > 90%	80 to 89%	70 to 79%	60 to 69%	< 60%
Exemplary	Mature	Satisfactory	Developing	Beginning

These scores are for student either only in construction or double majors (civil engineering + construction). The score 28, 26, 25, 28, 26, 27, 23, 24, 24, 25, 27.
Total Average = 25.72

5. Description of how the students successfully met the performance indicator.

   10/11 students achieved >=80% score, which shows most of students have successfully met the performance indicator. The short-term and long-term goal of students are clear. All students show strong interest as a civil engineer.

6. Description of how the students didn't successfully meet the performance indicator.

   Few students are not reflecting enough to continuing education, peer groups and the review process.

7. Conclusion (supported by data).

   The students have presented clear thinking, plans and interest of being a civil engineer in the future.

8. Recommendations to improve achievement of this outcome.

   None

ATTACHMENT 2 – SAMPLE SAFETY PLAN

SAFETY PLAN
GEOTECHNICAL LABORATORY
DEPARTMENT OF CIVIL AND ENVIRONMENTAL ENGINEERING
UNIVERSITY OF UTAH

INTRODUCTION

The **University of Utah** and the **Civil and Environmental Department** encourages and supports all programs which promote safety, good health, and well being of University faculty, staff, students, participants in University sponsored programs, and visitors. It is the policy of the University of Utah and the Civil and Environmental Engineering Department to provide safe and healthful conditions and to reduce injuries and illnesses to the lowest possible level. No task is so important and no service so urgent that it cannot be done safely. In keeping with this commitment, this Laboratory Safety Plan has been developed.

The Laboratory Safety Plan is designed to protect laboratory personnel from potential hazards associated with the use of **geotechnical laboratory**. The University requires that general standard operating procedures are outlined for all laboratories. Specific standard operating procedures developed by each lab for operations posing a special hazard must be developed by each department.

EMERGENCY CONTACTS

Fire/Ambulance/Police 585-2677
Utility Failure 581-7221
Utility Failure (off hours).. 581-8101
Poison Control 581-2151
University Hospital Emergency Department 581-2291
Spill Control 585-2677

You are located at HEDCO Room 108. The nearest telephone is in the hallway of the CME building 1st Floor by the elevators.

Stay on the telephone line if possible with the dispatcher. If you cannot stay on the line, tell the dispatcher the exact location of the emergency and the type of help needed.

The nearest fire alarm is located in the annex between the HEDCO and CME buildings. An emergency egress door is located next to the fire alarm.

I. GENERAL INFORMATION AND PROCEDURES

Maintaining a safe and healthy environment in the laboratory is ultimately the responsibility of the Supervisor of the Laboratory or Principal Investigator using the laboratory. However, each individual is expected to conduct all operations and procedures in a safe and prudent manner.

A. ROLES AND RESPONSIBILITIES

Lab Supervisor:	Dr. Steven F. Bartlett	phone: 435-841-9837 (mobile)
Alternate:	Mark Bryant	phone: 801-581-7057 (office)
Alternate:	Dr. Evert Lawton	phone: 801-585-3947 (office)
Alternate:	Civil Engineering Admin.	phone: 801-581-6931 (office)

The **laboratory supervisor** has responsibility for implementation of the Safety Plan in his/her laboratory. The laboratory supervisor shall:

- ensure that workers are trained and follow the plan outlined in this document;
- ensure that the necessary protective and emergency equipment is available, in working order, and that appropriate training has been provided;
- ensure that periodic laboratory inspections are performed;
- know current legal requirements concerning regulated substances;
- review and evaluate the effectiveness of the laboratory specific Standard Operating Procedures (SOP) at least annually and update as necessary.

The **laboratory employees or students** are responsible for:

- planning and conducting each operation in accordance with practices and procedures established in this Safety Plan.
- using equipment only for its designed purpose;
- being familiar with emergency procedures, including knowledge of the location and use of emergency equipment for the laboratory, as well as how to obtain additional help in an emergency;
- knowing the types of protective equipment available and using the proper type for each procedure;
- being alert to unsafe conditions and actions and calling attention to them so corrections can be made as soon as possible.

B. INFORMATION AND TRAINING

The laboratory supervisor shall ensure that information and training are provided at the time of an employee's or student's initial assignment to a hazardous work area. Refresher information and training shall be conducted at least annually and documented.

Information

All laboratory personnel shall be informed of:

- Requirements of the OSHA Standard, "Occupational Exposure to Hazardous Chemicals in Laboratories",
- The location of reference materials on the hazards, safe handling, storage and disposal of hazardous chemicals found in the laboratory including, but not limited to, Material Safety Data Sheets (MSDS's).

Training

Employee training or student training shall include:

- The physical and health hazards associated with devices, materials or chemicals stored and used in their work area,
- The contents of this Chemical Hygiene Plan, (if applicable)
- Methods and observations that may be used to detect the presence or release of a hazardous chemical; e.g., exposure monitoring conducted by the CHO, visual appearance or odor of hazardous chemicals when being released, etc. (if applicable)

C. PRIOR APPROVAL CIRCUMSTANCES

- Employees and students must obtain prior approval to proceed with a laboratory task from the laboratory supervisor or his/her designee when:
  - Devices with open flames or combustible materials are used,
  - Radioactive materials are used,
  - Hazardous chemicals are used,
  - Safety equipment has failed or is not present,
  - Other hazardous or unsafe conditions are noted

II. STANDARD OPERATING PROCEDURES

General Rules

A. Laboratory Experiment Procedures

- Employees and students are required to follow laboratory procedures as outlined in ASTM (American Society of Testing and Materials) or other procedures given to them by the Laboratory Supervisor or his or her designee.

B. Incident Reporting

- All injuries shall be reported to the Lab Supervisor or Teaching Assistant using the University Incident Report. The form is available on Environmental Health and Safety Web site (http://ehs.utah.edu/hazard-report-form).

- All "near misses" shall be reported to the Lab Supervisor and shall be analyzed by the affected personnel to determine the cause of the event and what controls, equipment or procedures should be implemented to prevent future occurrences.

C. Personal Protective Equipment and Dress

- Carefully inspect all protective equipment prior to use. Do not use defective equipment.

- Eye protection (safety glasses) shall be worn at all times when operating laboratory equipment or when standing near operating equipment This includes visitors. Ordinary prescription glasses are not considered effective eye protection since they lack necessary shielding.

- When working with corrosive, toxic, allergenic, or sensitizing chemicals, rough or sharp-edged objects, very hot or very cold materials, gloves made of material known to be resistant to permeation by the substance shall be worn. Leather gloves shall be worn when handling items from the ovens.

- Low-heeled shoes with fully covered uppers shall be worn at all times in the laboratory. Shoes or sandals with open toes shall not be worn.

- Long pants and long sleeves should be worn when working with or around chemicals.

- Long hair should be held in place behind the head.

- Loose clothing, especially loose trouser legs and sleeves, should not be worn in the laboratory.

- A full-body-length rubber, plastic, or neoprene apron appropriate for the material being handled should be worn if there is risk of chemical splash or spill.

- Employees and students are required to wear safety glasses while operating equipment in the laboratory. Gloves shall be worn when working with items stored in the drying ovens.

- Jewelry and loose clothing shall not be worn while operating equipment with moving parts.

- Shoes, shirts, pants and/or shorts shall be worn at all times in the laboratory

- Safety glasses, protective gowns, overalls and gloves will be made available upon request by the laboratory supervisor

D. Personal Conduct

- Horseplay or practical jokes will not be tolerated in the laboratory. Such actions are grounds from dismissal from the laboratory or termination.

E. Crush, Trip and Pinch Hazards

- Know the procedure and methods for correct use of all tools that you will be using in the laboratory. Do not operate tools and equipment that you are not familiar, or for which you have had no training.

- Know the pinch points and crush hazards for laboratory equipment that you will be operating. Establish a safety zone around such equipment, as appropriate. Do not locate such equipment in aisles, or other points of egress.

- Establish a safety zone around equipment with a pinch or crush hazard. Do not allow others to infringe the safety zone while the equipment is operating. Do not locate such equipment in aisles, or other points of egress.

F. Cuts

Cuts from broken glass objects or cutting instruments are among the most common injury in laboratories. Cuts can be minimized by the use of correct procedures, appropriate use of personal protective equipment, and by paying careful attention to handling and manipulations.

- Glass ware must be stored properly on it shelf or in containers
- Broken glass ware and sharp objects must be disposed in designated containers to prevent injury to lab personnel and custodial staff.

G. Electrical Safety

- Do not operate electrical equipment that has frayed or damaged power cords or connectors.

- All electrically operated equipment should be grounded.

- All strip outlets and surge protectors shall be UL listed and electrical equipment shall not exceed the amperage rating.

- Extension cords are only permissible for hand tools and cannot be placed near water or where they create a trip hazard.

- Except when running an experiment, computers and data acquisition systems should be turned off.

H. Fire Prevention and Safety

- Know all emergency egress doors for the laboratory. This consist of in order of preference and safety: (1) new door on south side of building (Figure 1), (2) door into Structures/Materials Research Laboratory, (3) door into Lawton/Bartlett Research Laboratory.

- Know the location of the nearest fire alarm. The nearest fire alarm is located in the ramp hallway between the HEDCO building and the EMRO building

- If an alarm occurs, evacuate immediately. Close the doors to the lab as you leave. Ask visitors and guest to leave also.

- Know the location of the nearest fire extinguisher. The nearest fire extinguishers are located in the structural laboratory, just outside the geotechnical laboratory. You must be trained in the proper use before using a fire extinguisher. Do not attempt to extinguish a chemical fire. Evacuate the laboratory, pull the fire alarm and call 5COPS (52677).

- If you have determined that you are capable of fighting the fire (no chemicals and the fire is not larger than trash can size), activate the fire alarm before attempting to fight the fire.

I. Chemical and Soil Handling and Disposal

- **No reactive, toxic or gaseous chemicals shall be used in the geotechnical laboratory** with the approval of the laboratory supervisor and the development of a **chemical hygiene plan** for the specific use of the chemical.

- No flammable liquids shall be stored within the laboratory.

- Handle reactive chemicals with all proper safety precautions. This includes designating a separate storage area, monitoring periodically for degradation, and using appropriate personal protection.

- For chemicals they are working with, all employees and students should know: (1) the chemical's hazards, as determined from a MSDS and other appropriate references; (2) appropriate safeguards for using that chemical, including personal protective equipment; (3) how to properly store the chemical when it is not in use; (4) proper chemical waste disposal procedures, (5) proper personal hygiene practices; (6) Appropriate procedures for emergencies, including first aid, evacuation routes, and spill cleanup procedures.

- Chemical containers should be regularly monitored for proper labeling and container integrity. Labels which are fading, falling off, or deteriorating must be promptly replaced. If abbreviations are used, they should be kept to a minimum and clearly identify the contents of the container as well as hazards associated with use. Improperly labeled or unlabeled chemicals make hazard identification and disposal difficult, and may create a hazard.

- Soil and chemicals shall not be washed down the sink, but shall be disposed of in approved containers

- All equipment and chemicals should be placed in their proper storage areas at the end of each workday. Equipment and chemicals shall not be stored on desks, laboratory bench tops, floors, fume hoods or in aisles.

E. Spills

- Mercury, which is contained in thermometers, is a hazardous chemical and prompt action is required if released by dropping a thermometer. In addition to mercury, the following should be followed if a spill of a hazardous substance is suspected:

- Attend to anyone who may have been contaminated.

- Notify occupants in the immediate area about the spill.

- Evacuate all nonessential personnel from the spill area.

- If the spilled material is flammable, turn off all ignition and heat sources; this includes magnetic stirrers.

- Avoid breathing vapors of the spilled material.

- Evacuate and contact EHS at x1-6590 or call University Police at 5-COPS (5-2677) after 5:00pm.

- Open windows where possible to increase exhaust ventilation.

- Secure cleanup supplies.

- Ensure protective apparel is resistant to the spill material.

- Confine or contain the spill to a small area.

F. Operating Hours and Laboratory Access

- Geotechnical Laboratory operating hours are 8:00 to 5:00 p.m., unless prior approval has been obtained from the laboratory supervisor.

- Laboratory ingress and egress is solely through the new door / entrance located on the south side of the building (Figure 1). This door can be opened using your student U-card. Only in the case of fire should egress be made through any other exit or door. No routine ingress or egress is allowed through the Structural/Materials Laboratory.

- Employees and students should avoid working alone. Arrangements should be made between individuals working in separate laboratories outside of regular working hours to cross check each other periodically. Experiments known to be hazardous should not be undertaken by an employee who is alone in the laboratory.

G. Personal Hygiene

- Wash promptly whenever a chemical has contacted your skin. Flush for at least 15 minutes prior to seeking medical attention.

- Avoid inhalation of chemicals. Do not "sniff" to test chemicals.

- Do not use mouth suction to pipette anything. Pipetting aids must be used at all times.

- Do not bring food (including gum and candy), beverages, tobacco, or cosmetic products into chemical storage or use areas.

- Eating, drinking, and applying cosmetics is allowed in desk or study areas only.

- Smoking is prohibited in all University facilities.

- Wash well with soap and water before leaving the laboratory. Avoid the use of solvents for washing skin. Solvents remove the natural protective oils from skin and can cause irritation and inflammation. In some cases, washing with solvent may facilitate absorption of toxic chemicals.

H. Housekeeping

Housekeeping is directly related to safety and must be given importance of equal value to other procedures. Lack of good housekeeping reduces work efficiency and may result in accidents. Laboratory personnel must adhere to the following:

- Access to emergency equipment, showers, eyewashes, fire extinguishers, exits and circuit breakers shall never be blocked or obstructed.
- Laboratory glass where (hydrometers and thermometers) must have a puncture resistant (e.g., cardboard) container specifically designated for glassware disposal.
- At the end of each workday, the contents of all unlabeled containers are to be considered waste and disposed of appropriately.
- Collection containers for wastes must be clearly labeled including hazard identification.
- All work areas, especially laboratory bench tops, should be kept clear of clutter.
- All doorways, aisles, corridors, stairs, and stairwells shall be kept clear of chemicals, equipment, supplies, boxes, and debris. No pinch, crush or trip hazards should be introduced in these places.
- Food and drink for human consumption shall not be kept in the same refrigerator used to store chemicals and laboratory samples. Eating and office areas must be clearly separated from laboratory and chemical storage areas.

I. Compressed Gas Cylinders

Use of compressed gases in the laboratory requires anticipating chemical, physical, and health hazards. Cylinders that are knocked over or dropped can be very dangerous. If a valve is knocked off, the cylinder can become a lethal projectile. Accidental releases may result in an oxygen depleted atmosphere or adverse health effects. In short, improper handling and use can cause structural damage, severe injury, and possibly death. The following guidelines will help ensure safe handling, use, and storage of compressed gas cylinders.

1. Receiving and Storage

- Be sure to arrange a return agreement with suppliers prior to purchase since disposal of compressed gas cylinders is difficult and very expensive.
- Cylinders should not be accepted unless the cylinder contents are clearly labeled. Color code only should not be accepted, since it does not constitute adequate labeling.
- Do not accept cylinders which are damaged or do not have a valve protection cap.

- All gas cylinders in use shall be secured in an upright position in racks, holders, or clamping devices. When cylinders are grouped together, they should be individually secured and conspicuously labeled on the neck area.

- Oxygen cylinders shall never be placed near highly combustible materials, especially oil and grease, or near stocks of carbide and acetylene or other fuel gas cylinders, nor near any other substance likely to cause or accelerate a fire. Systems and components used for other gases and purposes must never be used for oxygen or interconnected with oxygen.

- Cylinders should have current hydrostatic test date (normally less than 5 years old for steel and 3 years old for aluminum) engraved on the cylinder. Cylinders should be returned to the supplier for servicing prior to the expiration date.

- Do not place cylinders near heat, sparks, or flames or where they might become part of an electrical circuit.

- Do not store cylinders in exit corridors or hallways.

2. Handling and Use

- Only Compressed Gas Association fittings and components are permitted for use with gas cylinders. Only use regulators approved for the type of gas in the cylinder. Do not use adapters to interchange regulators.

- Open cylinder valves slowly and away from the direction of people (including yourself). Never force a gas cylinder valve. If the valve cannot be opened by the wheel or small wrench provided, the cylinder should be returned.

- No attempt shall be made to transfer gases from one cylinder to another, to refill cylinders, or to mix gases in a cylinder in the laboratory.

- All cylinders are to be considered full unless properly identified as empty by the user. Empty cylinders must be returned to the supplier and not accumulated.

- Compressed gases must not be used to clean your skin or clothing.

- Never heat cylinders to raise internal pressure.
- Do not use copper (>65%) connectors or tubing with acetylene. Acetylene can form explosive compounds with copper, silver, and mercury.
- Always leave at least 30 psi minimum pressure in all "empty" cylinders.

- Do not leave an empty cylinder attached to a pressurized system.

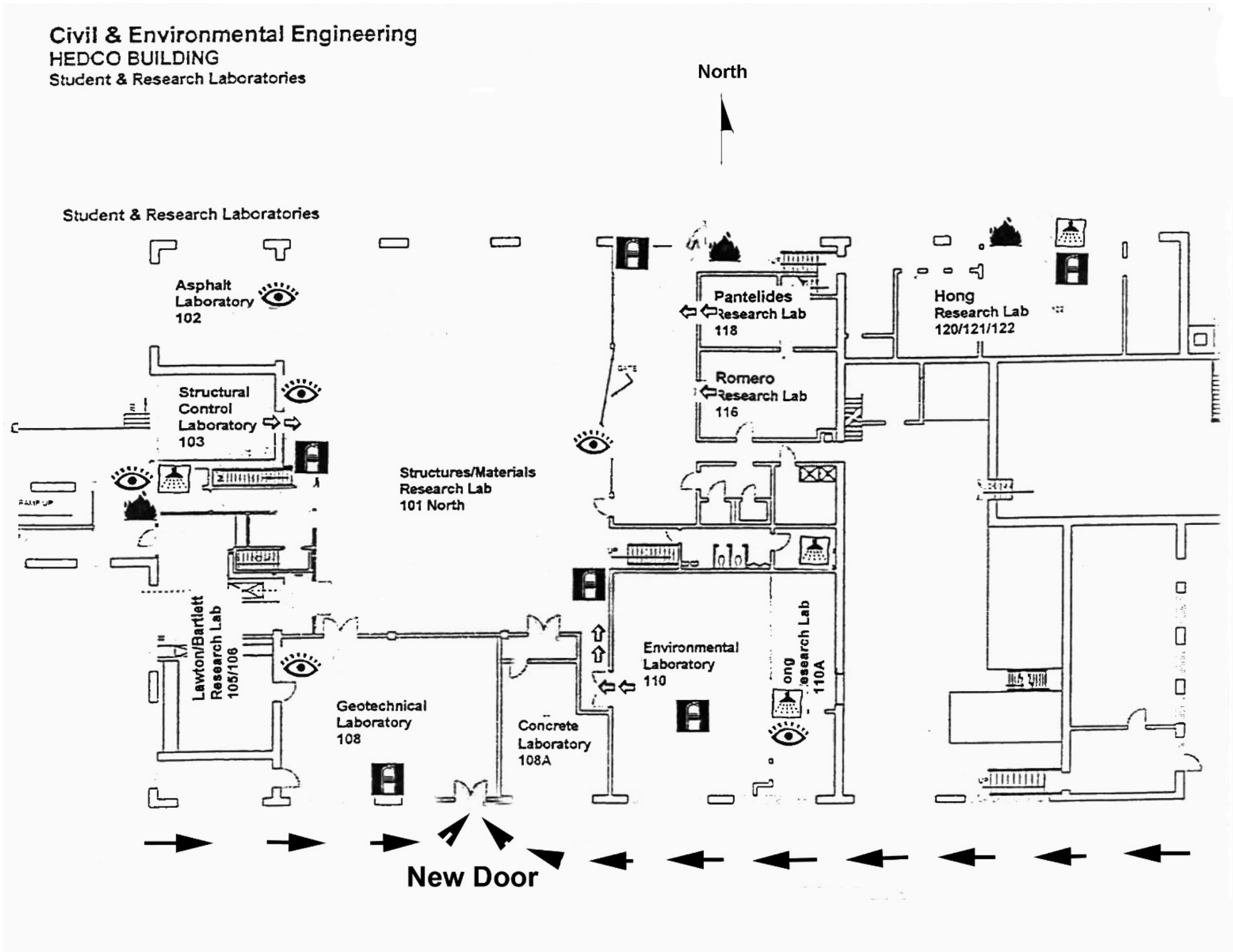

Figure 1 HEDCO Floor Plan with location of laboratories

CVEEN 3310 Geotechnical Laboratory Training Form (completed each semester by each student

The course instructor or laboratory teaching assistant has given me a safety briefing regarding safe conduct and my responsibilities to promote and ensure safety within the laboratory.

This has included:

- safe egress and ingress into the building using only approved door
- Housekeeping requirements in terms of preventing crush, pinch or trip hazards
- planning and conducting operations in accordance with practices and procedures established in the Safety Plan
- using equipment for its designed purposes only
- being familiar with emergency procedures, including how to egress safely from the laboratory, knowledge and location of emergency equipment for the laboratory, and how to obtain additional help in an emergency
- knowing the type of protective equipment available and using the proper type for each procedure
- being alert to unsafe conditions and actions and calling attention to them so corrections can be made a soon as possible

____________________________ ____________________________

Student's Name Student's Signature

ATTACHMENT 3 – SAMPLE LABORATORY PROCEDURE

1-D Consolidation Test

Geotechnical Engineering I, Laboratory #8

1. General Notes

- This test will take **two weeks** to complete all the readings. You will be required to come to the Geotechnical laboratory at odd times for the next two weeks. Coordination within each group and among the various groups is paramount to obtaining all the readings needed for this test.

- No readings should be taken after 5:30pm or on weekends. TA will take readings over the weekend.

- When coming back to the laboratory to take readings, **DO NOT** leave food, drinks, or other garbage in the lab. Litter will be cause for reduction in grade.

- While waiting between readings, **DO NOT** play with tools, equipment, or other tests running in the lab. Several classes and research for graduate students are occurring simultaneously. Messing with tools, equipment, etc. in the lab because you are bored may be cause for a reduction in your grade.

- All stations, benches, and tables must be cleaned before your group leaves the laboratory.

2. Procedures for System Compliance Tests

2.1. When a load is applied to a soil specimen using a consolidometer, all parts of the consolidometer are stressed and therefore deform. These deformations are essentially independent of the deformations of the soil specimen. Therefore, system compliance tests must be undertaken to determine how these deformations of the consolidometer affect the readings taken to determine the deformations of the soil specimen.

2.2. You will perform three system compliance tests for the consolidometer and loads you are using. These tests are conducted using the same loads, same consolidometer, and same setup as for the test on the soil specimen with one exception: A metal specimen, called a *dummy specimen*, is used in place of a soil specimen. This dummy specimen is usually made of steel or aluminum, has the same dimensions as those of the soil specimen, and will not undergo any measurable deformation under the loads that are typically applied to a soil specimen in a one-dimensional compression test. The readings from these three tests will be averaged and subtracted from the readings taken on the soil specimen to obtain the correct readings associated with deformation of the soil specimen.

2.3. The equipment, setup, and procedures for the system compliance tests will be exactly the same as for the test on the soil specimen; only the specimen will be different. The same porous stones and filter paper (if used) will be used. Water will be added to the chamber after the dummy specimen has been set up. The same loads are applied in the same sequence as in the test on the soil specimen. However, the system compliance deformations occur very quickly (usually within 30 seconds or less) and no time-rate readings are needed. Record final dial gage readings at each load level on the appropriate data sheet.

2.4. Once the first system compliance test is finished, all loading plates are removed from the loading platform, all water is removed from the chamber, and the setup of the dummy specimen is completely disassembled, including removal of filter papers (if any) and porous stones. The entire system compliance test then needs to be re-done starting from scratch. After disassembly upon completion of the second test, a third test is performed starting from scratch.

2.5. Refer to Section 3 for details on how to set up and load the dummy specimen. Ask the TA for clarification of any doubts or questions you have.

3. Procedures for Test on Soil Specimen

3.1 Several groups will work together to gather readings. This will help to ease the burden of taking time rate readings. Each group leader is responsible to coordinate the taking of readings and to correlate information with other groups.

3.2 Set Up

3.2.1 The TA will step you through the set up process. Please do not talk so everyone can hear the instructions.

3.2.2 Find the consolidation ring. Measure its inner diameter and height at three locations 120° apart, and record the values on the data sheet. Spray the entire inside of the ring with silicone or vegetable oil and wipe off excess liquid with a paper towel until it appears dry visually. Weigh the ring and record this value on the data sheet.

3.2.3 TA will provide an undisturbed Shelby Tube sample of Bonneville Clay or a remolded clay sample.

3.2.4 Take ring and push gently into the clay so that there is clay above and below the ring.

3.2.5 Use a wire cutter to trim the specimen flush with the ring. Carefully use a spatula to “butter” the surface on both sides to create a surface that is as flat and flush as possible.

3.2.6 Cut a piece of aluminum foil that is somewhat larger than the outer dimensions of the ring. Weigh this piece of foil and record the value on the data sheet. Carefully place the ring plus specimen on the foil, making sure that the specimen does not slide out of the ring.

3.2.7 Carefully pick up the piece of foil with the ring and specimen on it and, making sure that the ring does not fall off, carry it to the scale, gently place it on the scale, and weigh the foil + ring + moist specimen.

3.2.8 Weigh a moisture cup and use the cuttings as a moisture sample. Record the values on the data sheet.

3.2.9 Place a porous stone on the base of the containment chamber. Set a piece of filter paper on top of the porous stone. (Note: The filter paper at the bottom and top of the specimen may be eliminated from the process at the discretion of the TA.) Place the confining ring plus specimen on the base along with the rubber O-ring.

3.2.10 Assemble the rest of the containment chamber including another piece of filter paper and another porous stone on top of the specimen.

3.2.11 Place containment chamber on odeometer apparatus as in the swell and collapse tests.

3.2.11.1 Put a load cap on the porous stone and place load screw in female connection.

3.2.11.2 Make sure load arm is level and supported by the pin.

3.2.11.3 Place dial gauge on the top of the load screw.

3.2.11.4 Take a zero reading

3.2.11.5 Fill the containment chamber with **distilled** water.

3.3 Apply first load.

3.4 Start stop watch and release support rod simultaneously. Take readings of the dial gauge at the elapsed time intervals shown on the data sheet.

3.5 Loads

3.5.1 The applied loads will be 1/12, ¼ , ½ , 1, 2, 4, 8, 2, ½ , 1/12 tsf. Except for the first and last increments, the load is doubled each time the load is increased, and ¾ of the load is removed when the load is decreased.

3.5.2 Load plates are found on the floor by your odeometer.

3.5.3 After the last dial gage reading is taken for each loading increment, raise the support rod so that it just touches the loading arm. Watch the dial gage to make sure that the rod is not raised too far. (If the dial gage starts moving, immediately stop raising the support rod. Movement of the dial gage indicates that the support rod is pushing the loading arm upward.) When applying loads, do not remove previous plates, add the appropriate additional plates. Make sure to slide new plates on **gently**. Start stop watch and release support rod simultaneously. Take readings as before.

3.6 Minimum times to take readings

3.6.1 TA will demonstrate procedure to determine when load is ready to be changed.

3.6.2 1/12, ¼ tsf loads: Take readings for **at least** ½ hr before adding next plate.

3.6.3 ½ , 1 tsf: Take readings for **at least** 4 hr before adding new plates.

3.6.4 2, 4 tsf: Take readings **at least** 24 hr.

3.6.5 8 tsf: Take readings for a minimum of 48 hr (no more than 72 hr is necessary though).

3.6.6 Unloading 2, ½ , and 1/12 tsf: Keep load constant for 8 to 16 hr. For unloading, no time-rate calculations are necessary. However, final dial gage reading should be taken for each unloading increment.

3.6.7 All these times are guidelines only. TA will provide instructions on how to know when it is appropriate to change loads. You may need to keep the smaller loads applied longer. Longer is **better**, so please be patient.

3.7 After test

3.7.1 After the final dial reading has been taken for the last load (1/12 tsf), the specimen needs to be carefully removed from the chamber without changing its water content.

3.7.2 Using a squeeze bottle, extract the water from the chamber **before** removing the load. Remove the specimen ring from the chamber, and using a paper towel, **lightly** dab the top and bottom surfaces of the specimen to remove any excess moisture. (If the surfaces of the specimen are glossy, this indicates that there is excess moisture on the surfaces. When the surfaces are no longer glossy, all excess moisture has been removed.)

3.7.3 Weigh a piece of aluminum foil or a ceramic dish, which will be used to support the specimen during drying. Record this value on the data sheet. Carefully remove the **entire** specimen from the ring and place it on the foil or in the dish you just weighed. If any of the specimen sticks to the ring, carefully remove it using a metal spatula and place this soil on the foil or in the dish. Weigh the foil (or dish) plus wet specimen and record this value on the data sheet.

3.7.4 Place foil (or dish) plus specimen in the oven for at least 24 hr and preferably 48 hr, as directed by the TA. At the end of the drying period, weigh the foil (or dish) plus dry specimen and record this value on the data sheet.

3.7.5 Wash the ring and dry it using a paper towel. Allow the ring to air-dry for about 5 min, then weigh it and record the value on the data sheet.

3.7.6 Carefully wash and clean the porous stones. Dry all metal rings and equipment with paper towels. Return stones, rings, and equipment to staging area.

4. Calculations

4.1 Calculate the following index properties of the specimen at the beginning of the test: Void ratio, water content, degree of saturation, dry unit weight, and total unit weight. (Ask your TA for the value of specific gravity of soil solids to use). Note: Water content can be calculated two ways: (a) From the water content sample obtained from the cuttings, and
(b) from the total mass of the specimen at the beginning of the test and the mass of solids after oven drying (assuming that no soil was lost during the test or during the transfer to the foil or dish at the end of the test).

4.2 Calculate the following index properties of the specimen at the end of the test: Void ratio, water content, degree of saturation, dry unit weight, and total unit weight.

4.3 For each loading and unloading increment, plot void ratio vs. the logarithm of elapsed time and vertical strain vs. the logarithm of elapsed time. From each plot determine the time at which primary consolidation ended (t_p) and the corresponding magnitudes of the changes in equilibrium void ratio and equilibrium vertical strain for that loading increment.

4.4 From the values of changes in equilibrium void ratio and equilibrium vertical strain for each loading increment determined in part 4.3, construct laboratory consolidation curves of equilibrium vertical strain vs. logarithm of effective vertical stress, and equilibrium void ratio versus logarithm of effective vertical stress (2 separate plots, see Fig. 8.5 on p. 293 of the textbook).

4.5 Calculate the values of laboratory virgin compression index (C_c and $C_{c\varepsilon}$) for this specimen from the plots drawn in part 4.4.

4.6 Calculate the values of laboratory rebound/recompression index (C_r and $C_{r\varepsilon}$)for this specimen from the plots drawn in part 4.4.

4.7 Calculate separate values for effective preconsolidation pressure (σ'_p) using Casagrande's procedure and both plots you drew in part 4.4.

4.8 If the soil from which your specimen was obtained was located 36 feet below ground surface (or a depth specified by the TA) and the average unit weight of the soil is the same as your specimen, calculate the vertical effective overburden stress acting on your specimen in the field. The *GWT* was at a depth of 6.0 feet below ground surface at the time the specimen was obtained. Assume the total unit weight of the soil in the field was the same above and below the *GWT* .

4.9 Calculate the *OCR* of the soil with your calculated values of effective preconsolidation pressure (part 4.7) and effective overburden stress (part 4.8).

4.10 Determine the field values of virgin compression index (C_c and $C_{c\varepsilon}$) using Schmertmann's procedure (see Fig. 8.13 on p. 329 of the textbook).

4.11 For each loading and unloading increment, determine the coefficient of consolidation (c_v) using both Casagrande's logarithm of time method and Taylor's square root of time method. Plot c_v vs. logarithm of effective vertical stress for each method on one graph. Put separate curves through the data for the loading increments and the unloading increments.

4.12 Estimate the coefficient of permeability of the soil for each loading and unloading increment. Plot *k* vs. logarithm of effective vertical stress. Put separate curves through the data for the loading increments and the unloading increments.

4.13 Calculate the coefficient of secondary compression (C_α and $C_{\alpha\varepsilon}$) for each loading increment (not unloading increments) for which there is sufficient data to determine the values. Plot C_α and $C_{\alpha\varepsilon}$ vs. logarithm of effective vertical stress on one graph.

4.14 If we are to add a very wide, 25-ft thick embankment with a total unit weight of 135 pcf over the 36 ft (or other depth specified by the TA) of soil from above, estimate the ultimate primary consolidation settlement (S_c at $t = \infty$) and settlement from secondary compression (S_s) for this soil if the compressible soil layer extends from ground surface to the sample location. Assume the soil is homogeneous and isotropic.

5. Questions

5.1 Were the values of water content calculated for the specimen at the beginning of the test the same using both methods described in part 4.1? If not, provide possible reasons why they were different.

5.2 Are the relative values of void ratio, water content, degree of saturation, dry unit weight, and total unit weight at the beginning and end of the tests reasonable? Explain why or why not.

5.3 Are the calculated values of degree of saturation at the beginning and end of the test both 100%? If not, why not?

5.4 Compare values of σ'_p obtained from the two plots in part 4.7. Are they the same or nearly the same? If not, why not?

5.5 Compare the field values of C_c and $C_{c\varepsilon}$ calculated in part 4.10 with the laboratory values calculated in part 4.5. Which values are larger, field or laboratory values? If you used the laboratory values rather than the field values to estimate the primary consolidation settlement of a *NC* soil, would you overestimate or underestimate the settlement? Explain.

5.6 Based on your answer to the questions in part 5.5, do you think it is important to correct the laboratory consolidation curves to obtain the field values of C_c and $C_{c\varepsilon}$ are would it be acceptable to use the laboratory values? Explain.

5.7 How do the values of c_v for the loading increments compare to the values for the unloading increments for the same values of effective vertical stress? Based on these relative values, would primary consolidation settlement or primary consolidation heave occur faster?

5.8 How do the values of *k* for the loading increments compare to the values for the unloading increments for the same values of effective vertical stress?

5.9 Would the ultimate primary consolidation settlement underneath the <u>toe</u> of the embankment be the same as the ultimate primary consolidation settlement underneath the centerline of the embankment? Explain.

5.10 How is the soil specimen constrained so that the strains occur only in one dimension? In which direction do the strains occur?

5.11 Do the horizontal stresses in the specimen stay the same or change during the test? If they change, how do they change as the load is increased?

5.12 What compressed during the test - voids or soil particles? Explain.

5.13 What controls primary consolidation settlement - total or effective stress? Why?

5.14 Is the value of settlement you calculated for the embankment acceptable? Why?

1-D Consolidation Test Data Sheet

Ring and Specimen Weights, System Compliance Tests

Group Member Names: ______________________

____

____

Test Date : ______________________ **Odeometer # :** ______________________

Ring Dimensions

Measurement No.	Height	Inner Diameter
1		
2		
3		
Average		

Specimen and Ring Weights

Before Test		After Test		Oven Dry	
Ring =		*Ring =*			
Foil =		*Foil (or Dish) =*		*Foil (or Dish) =*	
Ring + Soil + Foil =		*Soil + Foil (or Dish) =*		*Soil + Foil (or Dish) =*	
Moist Specimen =		*Wet Specimen =*		*Dry Specimen =*	

Water Content of Specimen at Beginning of Test from Cuttings

Weights			Calculations		
Cup	Cup + Moist Cuttings	Cup + Oven Dry Cuttings	Moist Cuttings	Oven Dry Cuttings	Water Content

System Compliance Tests

Load *(tsf)*	Reading	Load *(tsf)*	Reading	Load *(tsf)*	Reading
0.00		0.00		0.00	
0.08		0.08		0.08	
0.25		0.25		0.25	
0.50		0.50		0.50	
1.00		1.00		1.00	
2.00		2.00		2.00	
4.00		4.00		4.00	
8.00		8.00		8.00	
4.00		4.00		4.00	
1.00		1.00		1.00	
0.08		0.08		0.08	

1-D Consolidation Test Data Sheet

Time Rate of Consolidation Readings

Group Member Names: ______________________________

____

____

Test Dates : ____________________ **Load (tsf) :** ____________________

Soil Description : ______________________________

Date	Elapsed Time Recommended (min)	Reading Time	Actual Elapsed Time (min)	Reading
	0.0		0	
	0.25 (15 sec)			
	0.5 (30 sec)			
	1			
	2			
	3			
	4			
	6			
	8			
	15			
	30			
	60 (1 hr)			
	120 (2 hr)			
	240 (4 hr)			
	960 (16 hr)			
	1440 (24 hr)			
	2880 (48 hr)			
	4320 (72 hr)			