

# Changes to the BS in Civil Engineering

Greg Macfarlane, Undergraduate Curriculum Coordinator

The university has approved a number of changes to the BS program in Civil Engineering. These are the largest curricular changes to the major in decades, and we hope this will implement a substantial shift in how you approach and think about your major in Civil Engineering.

The goals of the faculty in making this program change include:

- Increase personal agency and personal investment for students in the program by offering meaningful course options at several places.
- Introduce students to discipline areas earlier in the program.
- Allow students to complete either a broad civil engineering degree or develop targeted skills based on their interests and desires.
- Decrease the number of credit hours required for a degree to approximately 120 credit hours.
- Develop a framework that allows for new discipline area courses to seamlessly enter the program in response to changing industry needs.

A flowchart with the new major program is available [here](#).

## Motivation

In creating this proposal, the faculty was impressed by these two paragraphs from the Undergraduate – Depth section of [Aims of a BYU Education](#):

*Depth does not result merely from taking many courses in a field. Indeed, excessive course coverage requirements may discourage rather than enhance depth. Depth comes when students realize “the effect of rigorous, coherent, and progressively more sophisticated study.” Depth helps students distinguish between what is fundamental and what is only peripheral; it requires focus, provides intense concentration, and encourages a “lean and taut” degree that has a “meaningful core” and a purposefully designed structure (Memorandum to the Faculty No. 13). In addition to describing carefully structured academic majors, this description applies to well-designed BYU courses of all kinds.*

*The chief result of depth is competence. BYU’s students should be “capable of competing with the best students in their field” (Mission Statement). Even so, undergraduate study should be targeted at entrance-level, not expert-level, abilities. The desire for depth should*

*not lead to bachelor's degrees that try to teach students everything they will need to know after graduation. Students should be able to complete their degrees within about four years.*

## Summary of Changes

We recognize that not everyone finishes in exactly eight semesters, though we hope that number will increase due to these changes.

### Freshman Year

The purpose of your freshman year is to help you feel like you belong in the major, regardless of your background.

### CCE 102: Sustainable Infrastructure

This course replaces CCE 201, CCE 231, and some parts of CCE 101 (which is now optional).

We hope to create a targeted, “lean and taut” course that looks at global challenges to human prosperity and happiness, potential solutions to these challenges using built environments, and the responsibility of trained Latter-day Saints to find and implement solutions to these challenges. We hope that this class will set a tone for all the subjects students encounter through their programs. This class will count for the Global and Cultural Awareness GE requirement and is an elective course in Civic Engagement and Global Environmental Studies minors.

### Engineering Software

Previously we required students to take classes in either computer-aided drafting (CAD) or building information modeling (BIM), as well as in geographic information systems (GIS). Students may now choose one of the three: CAD, BIM, or GIS.

Students interested in pursuing careers or research in transportation, environmental, or water resources might prefer to take GIS. Students in transportation, structures, and geotechnical engineering might prefer to take CAD or BIM. But all classes will prepare you to understand what engineering software is, what it can do, and how to obtain help from documentation and web forums. These courses will also teach you how to learn new software. There are no wrong choices, and depending on where you end up, you will learn more software throughout your career.

## Engineering Measurements

CCE 120 is a one-credit hour class focused on surveying. We anticipate offering more measurements classes in the future that students can choose from.

## Sophomore Year

The purpose of your sophomore year is to begin applying physics, chemistry, and statistics to solve civil engineering problems and get a feel for which discipline classes you would like to take.

We have moved fluid mechanics (CE 232) up to pair with material mechanics (CCE 203) and swapped out the statistics class you will take (STAT 121). We have also moved back CCE 270 to be a sophomore-level class, which will focus a little less on spreadsheets and a little more on programming in python. Additionally, the problems will be drawn from all discipline areas (including construction).

We recommend you take the three-course Math sequence (MATH 213/215, 314, and 334) instead of the two-course sequence (MATH 302, 303). But it is your choice.

## Junior Year

The purpose of your junior year is for you to develop competence across a broad range of civil engineering disciplines.

### Civil Engineering Breadth Core

We presently offer introductory breadth courses in six areas of civil engineering:

- Materials (CE 304 / CE 306)
- Structural Analysis (CE 321)
- Hydrology (CE 331)
- Soil Mechanics (CE 341)
- Environmental Engineering (CE 351)
- Transportation Engineering (CE 361)

You are free to choose whichever four of these disciplines (12 credit hours) you would like to explore. Work with the faculty and with the CE advisor to help you select courses that meet your educational and career goals. Pay attention to the design classes you would like to take in your senior year; these all have prerequisites. We have prepared a set of cards that can help you choose based on the kinds of problems you want to solve, but these are templates only. The choice is yours.

And if you want to take more than four? The extras will count as technical electives.

## Advanced Science Elective

The university requires that you take a natural science course for the University Core. ABET requires that you have classes in “physics, chemistry, and either computer science, data science, or an additional area of basic science.” We have long required GEOL 330: Engineering Geology for this requirement. We are now giving you the flexibility to choose an additional science course you would like to take. If you are thinking about water treatment, you might consider organic chemistry. If you are doing sustainable structures, thermodynamics may be what would benefit you. Transportation and environmental engineers might like the class in energy and air quality. But again, the choice is yours. We will add to this list each year and are willing to entertain petitions for other suitable classes as well.

## Senior Year

The purpose of your senior year is to prepare for your next steps, whether they be a career as a civil engineer, or research in civil engineering, or whatever you feel the Spirit is guiding you towards.

## CE 471: Engineering Writing

The first half of capstone is being expanded to include discipline-specific instruction in writing. You may have heard this, but engineers write. A lot. Most engineers do more writing than they do mathematical problem solving. And we want you to be better at it, so we are moving it in-house and hiring people who have expertise teaching technical writing.

## Capstone 2

BYU places a strong emphasis on undergraduate education. Many of our students already participate in research that is publication-quality, or similar efforts. Going forward, we will allow students to petition to be excluded from capstone group projects to pursue faculty mentored research. The specifics of this are still being worked out, but students will need to demonstrate

1. they have a faculty mentor who is sponsoring the research,
2. the research can constitute “a culminating design experience” in the words of ABET,
3. and that the project will be done by April.

It will look a lot like an honors thesis, and honors theses will count for this experience. Students will then take either CE 472 (group projects), HONRS 499R (Honors Thesis) or CE 491R (guided research) in the Winter of their senior year.

## Frequently Asked Questions

### Will I be prepared for the FE with only four discipline classes?

Our students have been exceptionally well-prepared for the Fundamentals of Engineering (FE) exam. It is possible that depending on the courses students select and the specific makeup of their exams, students may encounter more or fewer problems that they are directly trained to solve. We anticipate that the FE review course will still be valuable. And if you want more preparation, taking additional CE breadth classes may be a good idea for many students.

### Why do you not require dynamics?

CE 204: Engineering Mechanics – Dynamics has long been an important basic class for civil and mechanical engineers, as it deals with the forces and reactions of moving elements. This is particularly important for structural engineers in seismic loading situations, and when dealing with structural vibrations. In the past, we required students to take both CE 204 and PHYSCS 123, which deals with optics, waves, and thermodynamics. When we switched to the Newtonian physics class, this introduced a great deal of duplicative content: The only learning outcome of CE 204 not in PHYSCS 121 is related to vibrations, but these require differential equations, and most CE 204 students have not yet studied differential equations.

Students who wish to study structural vibrations and seismic design of structures should take advanced classes in structural engineering, including CE 508 Structural Vibrations and CE 521 Advanced Structural Steel Design.

### What if I have already taken CCE 201 or CCE 231?

The learning outcomes for these courses have been combined into the new CCE 102 course. If you have already completed both, you will be automatically given credit for CCE 102 when you change to the new major. If you have completed only CCE 201 you will also receive credit for CCE 102, but you may need to complete an additional course that meets the University Core requirements for Social Sciences. If you have completed CCE 231 but not CCE 201, you will have to take CCE 102 to meet the learning outcomes related to sustainability in engineering contexts.

### What if I have already taken WRTG 316?

The new CCE 471 will count for the Advanced Written and Oral Communication GE but will be focused on writing done by civil engineers. If you have already taken WRTG 316, you

may do a couple of class activities more than once. But writing is a critical skill for engineers in practice, and our industry advisory board consistently says they would like more writing practice for our graduates.

## What if I have already taken a life science GE?

The ABET requirement beginning in 2024 is that an accredited curriculum must include *mathematics through differential equations, probability and statistics, calculus-based physics, chemistry, and either computer science, data science, or an additional area of basic science.*

The classes we have selected for the major in the life science category are all sufficient to be called a “basic science.” If you have taken a class that meets the life science GE and is not on the approved major list (BIO 100, CELL 120, HONRS 221, MMBIO 121, PWS 150), you may need to select GEOL 330 for your advanced science elective, or another course that can meet the ABET and ASCE requirements of a basic science. The ASCE commentary – which has not yet been updated to include ABET’s consideration of computer science and data science – on what is considered a “basic science” reads:

*For the additional area of basic science, programs may include areas such as biology, ecology, geology or meteorology, all areas of significant interest and increasing importance for civil engineers. This list is not inclusive, hence it is not necessary all students within a particular program’s curriculum take the same additional area of science. However, for topics other than those listed above, the program must demonstrate the selected area(s) of science provides breadth beyond physics and chemistry. In general, an advanced course in physics or chemistry (i.e., a course that is part of a sequence for which a course serves as a prerequisite) would not fulfill this requirement because such a course would provide additional depth rather than additional breadth.*