From:	Smith, Randy
To:	Lenhart, John; May, Andy
Cc:	Sutherland, Sue; Kwiek, Nicole; Reed, Katie; Smith, Randy; Duffy, Lisa; Hunt, Ryan; MacKay, Allison; Quinzon-Bonello, Rosario; Tomasko, David
Subject:	Proposal to revise the BS in Civil Engineering
Date:	Thursday, January 23, 2025 12:52:03 PM
Attachments:	image001.png

Andy and John:

The proposal from the Department of Civil, Environmental, and Geodetic Engineering to revise the Bachelor of Science in Civil Engineering was approved by the Council on Academic Affairs at its meeting on January 22, 2025. Thank you for attending the meeting to respond to questions/comments.

No additional level of internal review/approval is necessary. This action will be included in the Council's next Annual Activities Report to the University Senate (July 2025).

The Office of the University Registrar will work you with any implementation issues.

Please keep a copy of this message for your file on the proposal and I will do the same for the file in the Office of Academic Affairs.

If you have any questions please contact the Chair of the Council, Professor Sue Sutherland (.43), or me.

I wish you success with this important program development.

Randy

THE OHIO STATE UNIVERSITY

W. Randy Smith, Ph.D.
Vice Provost for Academic Programs
Office of Academic Affairs
University Square South, 15 E. 15th Avenue, Columbus, OH 43201
614-292-5881 Office
smith.70@osu.edu
Assisted by:
Katie Reed
Executive Assistant
(614) 292-5672

From: Kwiek, Nicole
To: Lenhart, John; Quinzon-Bonello, Rosario
Cc: Reed, Katie; Smith, Randy; Sutherland, Sue; Tolchin, Barry
Subject: RE: CAA: Proposal to revise the BSc in Civil Engineering
Date: Tuesday, January 21, 2025 12:31:14 PM
Attachments: image001.png

Thank you John! This all sounds great, and we should be set to go.

Katie, could you please attach those documents to the proposal?

Best,
Nicole

From: Lenhart, John <lenhart.49@osu.edu>
Sent: Tuesday, January 21, 2025 12:13 PM
To: Kwiek, Nicole <kwiek.1@osu.edu>; Quinzon-Bonello, Rosario <quinzon-bonello.1@osu.edu>
Cc: Reed, Katie <reed.901@osu.edu>; Smith, Randy <smith.70@osu.edu>; Sutherland, Sue <sutherland.43@osu.edu>; Tolchin, Barry <tolchin.5@osu.edu>
Subject: RE: CAA: Proposal to revise the BSc in Civil Engineering

Hello Nicole,

For your first question, please see attached spreadsheet that provides color coordinated accounting for the different curriculum components.

We anticipate needing to assist students navigating the curriculum and are working with our advising team to put together guidance documents that will provide clear directions. These will also be tailored to provide suggestions for students interested in specific area (e.g., structural engineering). I am attaching a template that we are using to assist with this. The advising team will take information from these templates and distill it into a form that they can share with the students.

Let me know if you have any additional questions.

John

From: Kwiek, Nicole <kwiek.1@osu.edu>
Sent: Monday, January 20, 2025 6:44 PM
To: Quinzon-Bonello, Rosario <quinzon-bonello.1@osu.edu>; Lenhart, John <lenhart.49@osu.edu>
Cc: Reed, Katie <reed.901@osu.edu>; Smith, Randy <smith.70@osu.edu>; Sutherland, Sue <sutherland.43@osu.edu>
Subject: CAA: Proposal to revise the BSc in Civil Engineering

Hi Rosie and John,
Happy MLK Day!

My name is Nicole Kwiek, and I am leading the CAA subcommittee reviewing the proposal to revise the BSc in Civil Engineering. **At your earliest convenience, could you please answer and/or pass along the following inquiries to the proposal's authors?** I just need to get a couple of minor questions answered before the meeting on Wednesday.

1. I am having some trouble differentiating the numerous curricular categories. **In the next day or so, could you please send me the credit hour requirements for each?** For instance, I know that the students will take 30 credit hours in Math and Basic Science, but it's not clear how many hours are required in the other categories.

2. It was difficult for our subcommittee to understand the seemingly complicated structure of the revised curriculum. Unfortunately, the diagram with the linked boxes didn't completely resolve that for us. For example, the Required Courses category is distinct from the Core Courses and Lab Courses, but all are required – that seems a little confusing.

    a. With that being said though, **do you anticipate that students will also have trouble discerning the different categories?**

I apologize for the late ask, but I was working on my notes wanted to make sure everything was accurate.

Thank you, and go Bucks!

Best,
Nicole

THE OHIO STATE UNIVERSITY

Nicole Cartwright Kwiek, PhD, FAPE
Senior Associate Dean for Academic Affairs and Educational Innovation
Clinical Professor of Pharmacy Education and Innovation
College of Pharmacy

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College of Engineering

Undergraduate Education & Student Services

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Memo

To: Randy Smith, Vice Provost for Academic Programs
From: Rosie Quinzon-Bonello, Assistant Dean for Curriculum and Assessment
Date: November 6, 2024

Re: Program Change to the BSc in Civil Engineering

On November 5, 2024, The College of Engineering Committee for Academic Affairs unanimously approved a proposal submitted by the Civil Engineering undergraduate program to revise its BSc. in Civil Engineering. The program redesign would allow the student more flexibility in moving through the curriculum.

There are multiple changes, but they involve many of the same courses, so these revisions should not exceed 50% of the curriculum. The overall number of credit hours to degree remains the same.

Rosie Quinzon-Bonello

THE OHIO STATE UNIVERSITY

John J. Lenhart, Ph.D.

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470 Hitchcock Hall, 2070 Neil Avenue
Columbus, OH 43210-1276

614-688-8157

lenhart.49@osu.edu

July 16, 2024

Dear Prof. Sandy Furterer,

The Department of Civil, Environmental, and Geodetic Engineering (CEGE) is submitting a revised curriculum for the Civil Engineering major. Based on discussions with the CEGE faculty and External Advisory Board members, we are revising the Civil Engineering curriculum to better prepare our students to obtain the skills, attributes, and knowledge necessary for the future of the profession.

Full details are provided in the attached proposal, but we highlight key elements here.
.

Rationale for Change

Civil Engineering, while a well-established field, is evolving in its practice. We believe that tomorrow's engineer will need to understand and leverage technology and data that differ from that used to create today's infrastructure. They will also need to provide systems-based solutions that address a range of issues, both technical and non-technical. Finally, civil engineering practice will be driven by overarching macrotrends, e.g., climate change; energy sources and distribution; materials and construction methodology; autonomous vehicles; sensors and urban environments. The changes discussed below are needed to better prepare our students to meet these demands.

Effective Date

Implementation of the updated curriculum is anticipated to be the Autumn 2025 semester.

Timeline of Revision Process

- Process initiation via discussion at faculty retreat in Fall 2019
- Follow-up discussion in CEGE Undergraduate Studies Committee in Fall 2019
- Formation of a CEGE Undergraduate Curriculum Renewal Committee in Spring 2020
- Development of Program Goals, Outcomes, and Proficiencies that graduates will achieve (i.e., backwards-design approach) in Fall 2020 & Spring 2021
- Development of curricular structure, while considering both internal (e.g., Program Goals, Outcomes, and Proficiencies) and external (e.g., OSU General Education requirements, College of Engineering requirements, ABET Program Criteria, ABET Student Outcomes) constraints in Fall 2021 through Fall 2023
- Periodic discussion with CEGE faculty and EAB members throughout the process
- Approval of the curricular structure by CEGE faculty in Spring 2024

Changes to be Made

The proposed changes are extensive and are discussed in greater detail in the attached proposal. We highlight considerations of specific questions immediately below:

New Course Development: The proposed curriculum structure does not necessitate the development of any new required courses. We have sufficient existing courses to populate the Core, Laboratory, and Design course categories from which students must take a specified number of courses. However, to enhance the offerings among the Core, Laboratory, and Design course categories, we are encouraging the faculty to brainstorm new courses that are appropriate for each category. Again, we do not need these courses to launch the proposed curriculum.

CIVLEN 2001: Introduction to Infrastructure (Section 2.3.1) is a new course that was developed in support of the proposed curriculum. This course has already been approved and is included in the current Civil Engineering curriculum.

Existing Course Modifications: The proposed curriculum structure does not require any course change requests, as the bulk of the content within our existing courses serves the needs of the proposed curriculum. The majority of changes to existing courses will be through the lens of assessment of the Program Proficiencies.

We do envision a modification to CIVILEN 3080: Engineering Economics and Optimization (Section 2.3.4 in the proposal). Briefly, this change will shift the focus of the course more broadly to systems-thinking and engineering decision-making, including not only economic considerations but also sustainability, societal, and ethical considerations. However, this course has been evolving in this desired direction over time.

Change in Overall Credit Hours: There is no net change in overall credit hours; the total remains at 131 for the proposed Civil Engineering program.

Transition Policy: Current students will be given the option to either continue on their current curriculum or shift entirely to pursuing the proposed curriculum. As noted in the attached proposal, many courses within the current curriculum will satisfy requirements as a Core, Laboratory, Design, Technical Elective, or Breadth Elective course. Students will be encouraged to meet with the CEGE academic advisors to discuss this decision.

Effects on Constituents outside CEGE: Impacts of this proposed curriculum change on other constituents exist. However, all required elements have already been approved by CAA (in Spring 2024):

- the change in the Math sequence;
- the requirement of ENGR 1300: Introduction to STEM Writing; and
- the formalization of the requirement of CONSYSM 2205: Introduction to Construction Systems Management.

Within the proposed curriculum, we are expanding the listing of courses that are acceptable as elective offerings (Section 2.8 of the proposal). Our preliminary list of courses, which have not yet been voted on by the CEGE faculty, includes more non-CEGE offerings than in the current curriculum. Some of the non-CEGE courses carry over from the current listing of Technical Electives, while others are courses that we have identified as Breadth Electives, or courses that complement the Civil Engineering degree. We cannot forecast the demand of Civil Engineering students for any of these elective courses, but we can disseminate the list of courses, once finalized, to other units from which we have identified elective courses, if the committee feels that it is appropriate.

Additional Resources from the Department: No additional departmental resources are needed to implement the new curriculum.

Inclusion of Specializations: Within the proposed curriculum, students inherently will have more freedom to tailor their degree path to satisfy their career goals. However, one potential challenge with freedom is a lack of a clear path through the degree. To address this challenge, we are working to develop guidance documentation that will aid students in navigating the freedom (which we allude to in Section 4 of the proposal). These documents focus towards specialization; for example, we have developed draft documents for students interested in pursuing careers in Structural Engineering, Geotechnical Engineering, Transportation Engineering, and Surveying, among others. At this time, we do not envision that these specialization pathways are codified in SIS, as their primary purpose is to provide students with sufficient information to make choices.

Addition of Technical Electives: The proposed structure expands the number of elective courses within the Civil Engineering curriculum (Section 2.8 in the proposal). The lists of courses from which a student may choose are under development, but briefly, these lists will include: 1) all courses from the Core, Laboratory, and Design course categories that have not been selected to meet those requirements; 2) all technical electives that currently existing within the Civil Engineering curriculum; and 3) courses that we identify outside of CEGE that we feel are complementary to the Civil Engineering degree (see above). We are not creating new technical electives in support of the proposed curriculum, but we anticipate that some new courses may be available in the near future, as the teaching responsibilities of our recent faculty hires expand towards a full teaching load.

Curricular "Bingo Sheets"
Visual representations comparing the differences in the curricula are provided below:

Current Civil Curriculum

Year	Autumn	Spring
1	___ MATH 1151 (Calculus 1)_____5 hr ___ ENGR 1181 *(Fundamentals of Engr 1)*_____2 hr ___ PHYSICS 1250 (Mechanics, Thermal, Waves) _5 hr ___ ENGR 1100 *(Engineering Survey)*_____1 hr ___ ENGR 1300[5] (*Introduction to Writing for STEM)*_3 hr ___ GEN Launch Seminar_____ 1 hr	___ MATH 1172 *(Engineering Math A)*_____5 hr ___ MECHENG 2010 *(Statics)*_____2 hr ___ ENGR 1182 *(Fundamentals of Engr 2)*_____2 hr ___ CIVILEN 2405 *(Graphics for CE)*_____1 hr ___ CIVILEN 2001 *(Intro to Infrastructure)*_____3 hr ___ GEN Citizenship for a Just, Diverse World 4 hr
2	___ MATH 2173[2] *(Math Topics for Engineers)*_____3 hr ___ MECHENG 2020 *(Mech of Materials*)_____3 hr ___ STAT 3450.0x[3] *(Prob & Data Interpretation)*____ 2 hr ___ CONSYSM 2205 *(Constr Engr & Mgmt)*_____3 hr ___ CHEM 1250[4] *(Gen Chemistry for Engineers)*____4 hr ___ ENGR 1221[1] *(Programming)*_____2 hr	___ MATH 2174[2] *(Math Topics for Engineers)*_____3 hr ___ CIVILEN 2060 *(Numerical Analysis Methods)*__ 4 hr ___ CIVILEN 3510 *(Civil Engineering. Materials)*___3 hr ___ CIVILEN 3310 *(Struct Engr. Principles)*_____3 hr ___ MECHENG 2030 *(Dynamics)*_____3 hr ___ CIVILEN 2090 *(Professional Aspects)*_____1 hr
3	___ CIVILEN 3700 *(Transp Engr & Analysis)*_____3 hr ___ CIVILEN 3130 *(Fluid Mechanics)*_____3 hr CIVILEN 2410 *(Intro to Geomatics/Surveying)*__ 3hr ___ ENVEN 3200 *(Fundamentals of Envir Engr)*____3 hr ___ CIVILEN 4320 *(Structural Steel Design)* ***OR*** CIVILEN 4350 *(Reinforced Concrete Design)*__3 hr	___ CIVILEN 3160 *(Water Resources Engr.)*_____3 hr ___ CIVILEN 3080 *(Economics & Optimization)*____3 hr ___ CIVILEN 3540 *(Geotech. Engineering)* ***AND*** ___ CIVILEN 3541 *(Geotechnical Engineering Lab)* 3 hr ___Technical Elective 1_____3 hr ___ Technical Elective 2_____3 hr
4	___ **CIVILEN 4001** ***(CE Capstone 1)***_____2 hr ___ Additional Science Elective _____4 hr ___Technical Elective 3_____3 hr ___ GEN Race, Ethnicity, Gender Diversity____3 hr ___ GEN Social and Behavioral Sciences_____3 hr ___ GEN Historical and Cultural Studies_____3 hr	___ **CIVILEN 4002** ***(CE Capstone 2)***_____2 hr ___ Technical Elective 4_____3 hr ___ Technical Elective 5_____3 hr ___ GEN Literary, Visual, Performing Arts ___3 hr ___ GEN Thematic Pathway_____4 hr

Proposed Civil Curriculum with Mark-up

Year	Autumn	Spring
1	___ MATH 1151 (Calculus 1)_____5 hr ___ ENGR 1181 *(Fundamentals of Engr 1)*_____2 hr ___ PHYSICS 1250 (Mechanics, Thermal, Waves) _5 hr ___ ENGR 1100 *(Engineering Survey)*_____1 hr ___ ENGR 1300[5] (*Introduction to Writing for STEM)*_3 hr ___ GEN Launch Seminar_____ 1 hr	___ MATH 1172 *(Engineering Math A)*_____5 hr ___ MECHENG 2010 *(Statics)*_____2 hr ___ ENGR 1182 *(Fundamentals of Engr 2)*_____2 hr ___ CIVILEN 2405 *(Graphics for CE)*_____1 hr ___ CIVILEN 2001 *(Intro to Infrastructure)*_____3 hr ___ GEN Citizenship for a Just, Diverse World 4 hr
2	___ MATH 2173[2] *(Math Topics for Engineers)*_____3 hr ___ MECHENG 2020 *(Mech of Materials)*_____3 hr ___ STAT 3450.0x[3] *(Prob & Data Interpretation)*___ 2 hr ___ CONSYSM 2205 *(Constr Engr & Mgmt)*_____3 hr ___ CHEM 1250[4] *(Gen Chemistry for Engineers)*____4 hr ___ ENGR 1221[1] *(Programming)*_____2 hr	___ MATH 2174[2] *(Math Topics for Engineers)*_____3 hr CE Core Selection 3 hr CE Core Selection 3 hr ___ CIVILEN 3510 *(Civil Engineering. Materials)*___3 hr ___ CIVILEN 2090 *(Professional Aspects)*_____1 hr
3	CE Design Elective 3 hr Technical Elective 3 hr CE Design Elective 3 hr CE Breadth Elective 3 hr ___ CIVILEN 3130 *(Fluid Mechanics)*_____3 hr CIVILEN 2410 *(Intro to Geomatics/Surveying)*__ 3hr	___ CIVILEN 3080 *(Economics & Optimization)*___3 hr ___Technical Elective_____3 hr ___ Technical Elective_____3 hr CE Lab Option 3 h CE Design Elective 3 h CE Breadth Elective 3 hr
4	**___ CIVILEN 4001** ***(CE Capstone 1)***_____2 hr ___ Additional Science Elective _____4 hr ___Technical Elective_____3 hr ___ GEN Race, Ethnicity, Gender Diversity____3 hr ___ GEN Social and Behavioral Sciences_____3 hr ___ GEN Historical and Cultural Studies_____3 hr	**___ CIVILEN 4002** ***(CE Capstone 2)***_____2 hr ___ Technical Elective_____3 hr ___ Technical Elective_____3 hr ___ GEN Literary, Visual, Performing Arts ___3 hr ___ GEN Thematic Pathway_____4 hr

Deleted: _ CIVILEN 2060 *(Numerical Analysis Methods)*_ 4 hr¶

Deleted: _ CIVILEN 3310 *(Struct Engr. Principles)*_3 hr¶

Deleted: _ MECHENG 2030 *(Dynamics)*_3 hr¶

Deleted: _ CIVILEN 3700 *(Transp Engr & Analysis)*_3 hr¶

Deleted: _ CIVILEN 3160 *(Water Resources Engr.)*_3 hr¶

Deleted: _ CIVILEN 3540 *(Geotech. Engineering)* ***AND***¶
_ CIVILEN 3541 *(Geotechnical Engineering Lab)* 3 hr¶

Deleted: 1

Deleted: 2

Deleted: _ ENVEN 3200 *(Fundamentals of Envir Engr)*_3 hr¶
_ CIVILEN 4320 *(Structural Steel Design)* ***OR***¶
CIVILEN 4350 *(Reinforced Concrete Design)*_3 hr¶

Deleted: 4

Deleted: 3

Deleted: 5

Proposed Civil Curriculum

						Total hours:	**131**
	Autumn				**Spring**		
	Number	Name	Hours		Number	Name	Hours
1	ENGR 1100	Engineering Survey	1		CIVILEN 2001	Introduction to Infrastructure	3
	ENGR 1181	Fundamentals of Engineering 1	2		CIVILEN 2405	Graphics for CE	1
	ENGR 1300	Intro. to STEM writing	3		ENGR 1182	Fundamentals of Engineering 2	2
	MATH 1151	Calculus I	5		MATH 1172	Engineering Math A	5
	PHYSICS 1250	Mechanics, Work, and Energy	5		MECHENG 2010	Statics	2
		Gen Ed - Opening Bookend	1			Gen Ed - Foundation	3
		Semester hours:	17			Semester hours:	16
2	CHEM 1250	Chem for Engineers	4		CIVILEN 3130	Fluid Mechanics	3
	ENGR 1221	Programming	2		CIVILEN 3510	Civil Eng. Materials	3
	MATH 2173	Engineering Math B	3		MATH 2174	Lin. Alg. and Diff. Eq.	3
	MECHENG 2020	Mechanics of Materials	3			CE Core Selection	3
	STAT 3450.0x	Basic Stats for Engineers	2			CE Core Selection	3
		Gen Ed - Foundation	3				
		Semester hours:	17			Semester hours:	15
3	CIVILEN 2410	Intro to Surveying	3			CE Lab Option	3
	CIVILEN 3080	Engineering Decision-Making	3			CE Design Elective	3
	CONSYSM 2205	Intro. to Constr. Sys. Manage.	3			Tech. Elective	3
		CE Design Elective	3			Tech. Elective	3
		Tech. Elective	3			Additional Science Elective	3
		Gen Ed - Foundation	3			Gen Ed - Foundation	3
		Semester hours:	18			Semester hours:	18
4	CIVILEN 4001	CE Capstone 1	2		CIVILEN 4002	CE Capstone 2	2
		CE Design Elective	3			Tech. Elective	3
		Tech. Elective	3			Tech. Elective	3
		Breadth Elective	3			Breadth Elective	3
		Gen Ed - Theme	4			Gen Ed - Theme	4
		Semester hours:	15			Semester hours:	15

Sincerely,

John J. Lenhart, Ph.D.
Professor and Associate Chair
Department of Civil, Environmental and Geodetic Engineering
Ohio State University

A Proposal for a New Structure in the Civil Engineering (CIVILEN) Curriculum

Contents

1. Background

During the Autumn 2019 faculty retreat, we, as a faculty, had a discussion that focused on the future of Civil and Environmental Engineering. Background reading for this discussion included:

1. Commentary from the CEGE External Advisory Board (EAB), who provided insights on both current gaps in preparation of our graduates and their projections about the Civil and Environmental Engineering practice in the next 5 – 10 years.
    a. Brief summary: Tomorrow's engineer will need to understand and leverage technology and data that differ from how today's infrastructure was created.
2. Sections from the National Academies of Science, Engineering, and Medicine report on Environmental Engineering for the 21st Century, focusing on future challenges to human society and the environment and how Environmental Engineering will play a role
    a. Brief summary: Systems-based solutions that address a range of issues will be required.
3. Materials from the ASCE Future World Vision, which provides future scenarios and how Civil Engineers will be involved.
    a. Brief summary: Practice will be driven by overarching macrotrends, e.g., climate change; energy sources and distribution; materials and construction methodology; autonomous vehicles; sensors and urban environments.

During our discussion, we brainstormed skills, attributes, and knowledge that should inform student training, which were captured on post-it notes and organized on large sheets of paper within the room.

Subsequent to this meeting, the CEGE Undergraduate Studies committee strategized the best way to proceed with merging those skills, attributes, and knowledge into the curriculum. Ultimately, a new committee was formed in early 2020: the Undergraduate Curriculum Renewal committee. This committee is comprised of Drs. John Lenhart (Chair; 2020 – 2022), Andy May (Chair; 2023 – present), Lisa Burris, Gil Bohrer (through 2023), Jordan Clark, Anthony Massari, and Daniel Pradel from the CEGE faculty, as well as Ms. Liz Riter and Mr. Barry Tolchin, the CEGE academic advisors. This committee received support from the Michael V. Drake Institute for Teaching and Learning, initially with the assistance of Dr. Teresa Johnson and then Dr. Larry Hurtubise, each of whom are experts in curriculum design.

The charge to the Undergraduate Curriculum Renewal committee from the CEGE Department Chair was as follows:

Evaluate and redesign undergraduate Civil and Environmental Engineering curricula to better prepare graduates for professional success by:

- Identifying Program Goals;
- Identifying Program Outcomes specific to Program Goals;
- Identifying Program Proficiencies specific to Program Outcomes; and
- Mapping Program Proficiencies to the existing curriculum and propose updates, as needed.

The goals represent higher-order learning objectives for the program, and the outcomes organize sets of knowledge and skills within each goal; proficiencies are learning objectives that can be assessed directly within the curriculum. Moreover, the goals, outcomes, and proficiencies are independent of any specific technical content, and they all apply to both the Civil Engineering and Environmental Engineering programs[*]. We developed these goals, outcomes, and proficiencies as a committee and received feedback from the full faculty during 2020 and 2021. From our mapping exercise, we determined that we do not currently meet all proficiencies within our existing curriculum. Hence, we embarked on the process of redesign.

[*] A separate committee comprised of Drs. Andy May (Chair), Karen Dannemiller, and Linda Weavers is working in parallel to develop a proposal for a new Environmental Engineering structure.

The five Program Goals that we defined are:

1. Students will be familiar with, and approaching proficiency in, state-of-the-art standards, protocols, modeling/simulation platforms, data analysis, numerical methods and physical experimentation used in civil and environmental engineering analysis and design.
2. Students will apply systems level thinking to solve complex civil and environmental engineering problems by integrating knowledge, tools, and problem-solving skills.
3. Students will be resilient, skilled in collaboration, and exhibit professionalism necessary for success in their careers.
4. Students will be able to communicate civil and environmental engineering concepts effectively, both orally, visually, and in writing, to a range of audiences.
5. Students will develop an identity within the fields of civil and environmental engineering.

Each Program Goal has 3 – 5 Program Outcomes, and each Program Outcome has at least 3 Program Proficiencies. A complete list of Program Outcomes and Program Proficiencies is included in Section 6.

Throughout the process, we received feedback from the CEGE EAB (at least annually) and from the CEGE faculty (primarily during faculty meetings). All feedback was discussed by the Undergraduate Curriculum Renewal Committee, which helped to shape the proposed structure herein.

2. The Proposed Curriculum Structure

This proposal focuses on the structure of a new undergraduate curriculum for Civil Engineering. Where appropriate, we have listed specific courses to satisfy requirements within this structure, but some listings are in active development at present. How those presently incomplete lists are populated by specific courses (e.g., Elective courses in Section 2.8) is irrelevant to the curriculum structure herein. A sample curriculum sheet for the proposed curriculum structure is provided in Section 3.

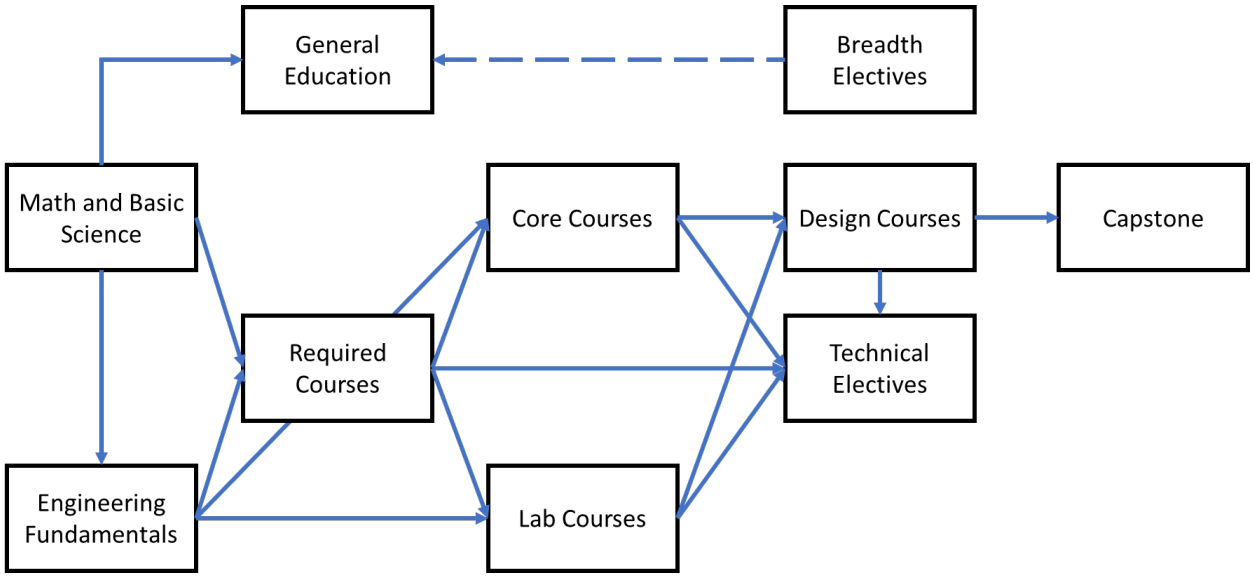
Within the structure, we describe different categories of courses. These categories were guided by ABET Student Outcomes, ABET Program Criteria[†], and the ASCE Commentary on ABET for Civil Engineering[‡], as well as internal constraints such as the OSU College of Engineering requirements (see Section 2.2.1) and the OSU General Education program requirements (see Section 2.9).

We view the curriculum as a "living" entity – in other words, it must evolve over time, adapting as Civil Engineering practice changes. The proposed curriculum structure enables this flexibility to evolve, in that we can modify course requirements without large-scale changes to the structure itself. A secondary outcome of this flexibility is that students can, to some extent, customize their degree program in alignment with their career goals (see Sections 2.3 and 2.8 for more discussion).

The following figure provides a visual representation of how the elements of the proposed structure are connected.

[†] 2024-2025 Criteria for Accrediting Engineering Programs: https://www.abet.org/accreditation/accreditation-criteria/criteria-for-accrediting-engineering-programs-2024-2025/

[‡] See https://www.asce.org/-/media/civil-engineering-program-criteria-commentary---feb-2024.pdf



2.1. Math and Basic Science

An ABET Program Criterion requires the "application of mathematics through differential equations, probability and statistics, calculus-based physics, chemistry, and either computer science, data science, or an additional area of basic science". Moreover, there must be a minimum of 30 credit hours across these topics in the curriculum. Our proposed math and science requirements for the new Civil Engineering curriculum is summarized in the following table.

Course	**Credit Hours**
MATH 1151	5
MATH 1172	5
MATH 2173	3
MATH 2174	3
PHYSICS 1250	5
CHEM 1250	4
STAT 3450	2
Other basic science	3
Total	**30**

This includes:

- MATH 1151: Calculus 1
- MATH 1172: Engineering Math A
- MATH 2173: Engineering Math B[§]
- MATH 2174: Linear Algebra and Differential Equations
- PHYSICS 1250: Mechanics, Work and Energy, Thermal Physics[**]

[§] An acceptable alternative pathway to MATH 2173 + MATH 2174 is MATH 2153 (Calculus 3), MATH 2568 (Linear Algebra), and MATH 2415 (Differential Equations). This pathway is most likely to apply to students transferring into the program from outside of the university.

[**] Equivalent alternatives include PHYSICS 1250H (Honors Physics: Mechanics and Conservation Laws; Special Relativity), PHYSICS 1260 (FEH Physics: Mechanics, Thermal Physics, Waves), and PHYSICS 1270 (Classical Mechanics, Conservation Laws, and Special Relativity for Majors)

- CHEM 1250: General Chemistry for Engineers[††]
- STAT 3450: Basic Statistics for Engineers

Students will have an option to select the "other basic science" course from a curated list. At present, this list is mainly comprised of courses related to earth science, and these courses do not need to include a laboratory component to meet the minimum of 30 credit hours. The Undergraduate Curriculum Renewal committee will propose this list to the Undergraduate Studies committee, who will maintain this list in the long term.

The above courses represent a combination of requirements within the current curriculum and changes that were approved by the CEGE faculty during Autumn 2023 for the current curriculum; moreover, those changes were approved by the OSU Committee on Academic Affairs for the curriculum. The requirement of STAT 3450 eliminates the need to continue teaching CIVILEN 2050: Probabilistic Applications and Data Interpretation in Civil and Environmental Engineering.

2.2. Engineering Fundamentals

This section represents courses that either are required by the OSU College of Engineering for all students (Section 2.2.1); represent a skill that the CEGE faculty agree that all students should have (Section 2.2.2); or are courses that partially satisfy an ABET Program Criterion (Section 2.2.3).

2.2.1. College of Engineering Requirements

Beyond MATH 1151 and PHYSICS 1250, the College of Engineering requires the following:

- ENGR 1100.xx: Introduction to Ohio State and Engineering
- ENGR 1181: Fundamentals of Engineering I[‡‡]
- ENGR 1182: Fundamentals of Engineering II

There is no proposed change associated with the College of Engineering requirements.

2.2.2. Computer Programming

We propose to maintain the requirement of ENGR 1221 (Introduction to Computer Programming in MATLAB for Engineers and Scientists), with CSE 1222 (Introduction to Computer Programming in C++ for Engineers and Scientists), CSE 1223 (Introduction to Computer Programming in Java), and CSE 1224 (Introduction to Computer Programming in Python) as acceptable alternatives. We would like our students to gain the skill of programming, but we do not want to prescribe a specific language.

The above decision was endorsed by the CEGE faculty in Autumn 2022.

2.2.3. Engineering Mechanics

Our students currently take MECHENG 2010 (Statics) and MECHENG 2020 (Introduction to Mechanics of Materials), which support subsequent coursework in several technical areas (e.g., CIVILEN 3130: Fluid Mechanics; CIVILEN 3310: Structural Engineering Principles; CIVILEN 3510: Civil Engineering Materials; and CIVILEN 3540: Geotechnical Engineering all list one of these courses as a pre-requisite). We propose to maintain these two courses as requirements for Civil Engineering students.

We propose to remove MECHENG 2030 (Dynamics) as a required course. It is no longer a pre-requisite for any course in our curriculum; we recently (ca. 2018) voted to remove MECHENG 2030 as a pre-

[††] An acceptable alternate is CHEM 1210: General Chemistry I
[‡‡] There are alternative pathways for, e.g., Honors students or transfer students.

requisite for CIVILEN 3130. The ASCE Commentary on ABET states that "a minimal sequence of engineering mechanics topics for most civil engineering programs would include courses that deal with the application of statics, mechanics of solids, and mechanics of fluids". In fact, in two different surveys of other Civil Engineering programs (Top 10 programs based on US News and World Report; other programs in Ohio) that we conducted, the three approaches implemented by these 15 schools are (in order of commonality): 1) dynamics is only a pre-requisite for fluid mechanics (or equivalent); 2) dynamics is not required; and 3) students are given an option to choose between dynamics and thermodynamics.

While Dynamics is on the Fundamentals of Engineering Exam for Civil, this section is tied for the lowest number of questions, of which content includes kinematics; mass moments of inertia; force acceleration; and work, energy, and power – these topics are largely covered in PHYSICS 1250.

If there is some connection between MECHENG 2030 and one of our courses, we propose that the relevant content should be taught within the appropriate context. For example, we include the conservation of linear momentum within the context of fluid mechanics in CIVILEN 3130, which mitigates the need for MECHENG 2030 as a pre-requisite. Likewise, if an understanding of vibrations is necessary for, e.g., a structures course, we propose including relevant content within that course.

Students will still have the option to take MECHENG 2030 as a technical elective (see Section 2.8.1).

2.3. Required Courses

Required courses are courses that we propose that any Civil Engineering graduate should have completed within the curriculum. These courses have been selected because they satisfy, at least partially, ABET Program Criteria and/or Student Outcomes. Moreover, we propose that these courses represent a combination of the minimum set of coursework for any career path in Civil Engineering. In combination, these courses will enable assessment of the majority of our identified Proficiencies.

Students will have the opportunity to choose courses that are not explicitly listed below within this section from different categories elsewhere in the curriculum – Core courses (Section 2.4), Laboratory courses (Section 2.5), Design courses (Section 2.6), or Elective courses (Section 2.8). With two exceptions (see Section 2.3.8), we do not propose to eliminate courses entirely within the new structure. We will develop guidance documentation to aid students in their navigation of the proposed curriculum in consultation both with faculty in different technical areas of the department and with the CEGE academic advisors.

Our proposed structure maintains breadth in Civil Engineering, as the combination of required courses and choices of proposed Core courses and proposed Laboratory courses will ensure that students will take courses in a minimum of six technical areas. The ABET Program Criterion related to breadth in Civil Engineering states that the curriculum must include "solution of complex engineering problems in at least four specialty areas appropriate to civil engineering", so we will continue to exceed the minimum requirement in this criterion.

2.3.1. CIVILEN 2001: Introduction to Infrastructure

Briefly, the course considers the role of both Civil and Environmental Engineers in infrastructure projects. It provides an overview of different technical areas (using broad categories of structural infrastructure, transportation infrastructure, and environmental infrastructure) within the programs; an introduction to analysis, design, and engineering drawings within the context of the programs; and an introduction to environmental, social, and economic factors that influence infrastructure projects. The course embeds professionalism and professional development, including the importance of licensure, both written and oral communication, and engineering ethics. Students will leave the course with an understanding of the role of Civil and Environmental Engineers in society, and ideally, a better sense of what they intend to do after

graduation. This will empower students to make choices within the curriculum to support their career goals. This course will partially satisfy the OSU General Education Embedded Literacy of technology and society (see Section 2.9).

The above requirement was approved by the CEGE faculty in Autumn 2023.

2.3.2. CIVILEN 2405: Graphics for Civil Engineering

As a committee, we are in unanimous agreement that there is a need for our students to learn how to create drawings. Moreover, feedback from employers, alumni, and the CEGE EAB emphasizes the need for students to have more skills related to engineering drawings. We propose to include visualization as a criterion for Design courses (see Section 2.6), so CIVILEN 2405 will support this criterion.

2.3.3. CIVILEN 2410: Introduction to Surveying

This course provides an opportunity for students to conduct field measurements and engage in spatial reasoning. Moreover, it requires students to process data and create drawings, the latter of which reinforces a key skill highlighted by interested parties (see Section 2.3.2). Moreover, field work, spatial reasoning, and data processing are skills that are translatable to any infrastructure project.

2.3.4. CIVILEN 3080: Engineering Economics and Optimization

This course helps to satisfy the ABET Program Criterion related to engineering economics. Moreover, there is an opportunity to modify this course to more broadly cover "engineering decision-making" content, which would include more sustainability, societal, and ethical considerations within the context of this course, all of which are related to other ABET Program Criteria and ABET Student Outcomes. Adding more ethics context to this course facilitates the cancellation of CIVILEN 2090 (see Section 2.3.8). This course will partially satisfy the OSU General Education Embedded Literacy of technology and society (see Section 2.9).

2.3.5. CIVILEN 3130: Fluid Mechanics

This course is complementary to the solid mechanics courses taken in MECHENG (MECHENG 2010 and MECHENG 2020). Moreover, the ASCE Commentary on ABET states that "a minimal sequence of engineering mechanics topics for most civil engineering programs would include … mechanics of fluids". This course not only serves as a pre-requisite for CIVILEN 3160: Water Resources Engineering but also complements other technical content in other technical areas, including Construction (e.g., site runoff), Geotech (e.g., groundwater flow), and Structures (e.g., hydrostatic and wind loads).

2.3.6. CIVILEN 3510: Civil Engineering Materials

The majority of infrastructure projects will result in either the creation of something new or modification of something existing within the built environment. Therefore, our students should understand materials used in construction for these infrastructure projects. Moreover, an ABET Program Criterion requires "materials science … relevant to civil engineering", which this course will readily address.

2.3.7. CONSYSM 2205: Introduction to Construction Systems Management

Inclusion of this course follows similar logic as CIVILEN 3510 – infrastructure projects often include some type of construction, so this course will provide our students with an understanding of this process. Moreover, this course includes planning, scheduling, estimating, safety, and ethics, all of which are relevant to any Civil Engineering graduate. Furthermore, this course supports the ABET Program Criterion of "concepts and principles in project management".

2.3.8. Additional Commentary

We propose the outright cancellation of only two courses herein: CIVILEN 2050 (see Section 2.1) and CIVILEN 2090 (Professional Aspects of Civil and Environmental Engineering). We propose that content

from the 1-credit CIVILEN 2090 course be distributed across CIVILEN 2001 (Section 2.3.1), CIVILEN 3080 (Section 2.3.4), Core courses (Section 2.4), and CIVILEN 4001/4002 (Section 2.7).

We propose that CIVILEN 2060: Numerical Analysis Methods for Civil and Environmental Engineering Applications will become an Elective course for students. We suggest that it be reduced to 3 credit hours and be re-branded to a title similar to "Software and Simulation for Civil and Environmental Engineering". The existing pre-requisite chain does not demonstrate a dependency on this course in our current curriculum. Nevertheless, we recommend that any required skills from CIVILEN 2060 be taught within the appropriate context of the course where those skills are needed, e.g., specific numerical methods for use in support of computational tools in Design courses (see Section 2.6). Where appropriate, CIVILEN 2060 could be included in guidance documentation for students interested in certain technical areas within the department.

2.4. Core Courses

We defined the features of a Core course using both a set of Proficiencies common to each of these courses (see table in Section 6) as well as additional criteria that a Core course must satisfy, as follows:

1) An explicit connection of the core course to both engineering licensure and engineering ethics will emphasize the importance of each within the context of the course's technical area.
2) There should be an explicit connection of the core course to other options within the curriculum. This could be as simple as discussing the courses that come next and how they relate to the core course during both the first and last lectures of the semester, or it could manifest as a thread throughout the semester. Regarding the latter, this could include highlighting limitations in the core course and how those limitations will be addressed in subsequent courses.
3) Core courses should be attainable through reasonable pre-requisites. We propose that core courses have no more than some combination of math, basic science, and engineering mechanics as pre-requisites. Exceptions will be reviewed by the departmental Undergraduate Studies Committee.

The above criteria were endorsed by the CEGE faculty in Autumn 2023.

The inclusion of ethics will partially address the ABET Program Criterion related to "application of an engineering code of ethics to ethical dilemmas" within an appropriate context. Moreover, this facilitates the cancellation of CIVILEN 2090.

We propose to maintain a list of Core courses, of which students will be required to choose two; the remaining course(s) will be available to students as Technical Electives (see Section 2.8.1). Our initial list includes the following three courses:

- CIVILEN 3310: Structural Engineering Principles
- CIVILEN 3700: Transportation Engineering and Analysis
- ENVENG 3200: Fundamentals of Environmental Engineering

We propose that Core, Laboratory (Section 2.5), and Design (Section 2.6) courses are mutually exclusive; that is, any given course may only be listed in one category, even if it satisfies all of the outlined criteria for all three categories. Imposing this requirement of mutual exclusivity aids in maintaining technical breadth throughout the curriculum.

2.5. Laboratory Courses

The ABET Program Criterion related to laboratory experiences in Civil Engineering requires that students "conduct experiments in at least two civil engineering contexts and report results". The laboratory experience should include the following (per the ASCE commentary on ABET for Civil Engineering):

1) Understand the objectives and procedures associated with an experiment
2) Conduct an experiment, including setup, measurement and data collection
3) Observe and document error and uncertainties in data collection procedures
4) Analyze data
5) Interpret experimental results, with appropriate conclusions and recommendations, and
6) Apply experimental procedures and analysis of results consistent with a real-world Civil Engineering problems or situations

We defined the features of a Laboratory course using both a set of Proficiencies common to each of these courses (see table in Section 6) as well as additional criteria that a Laboratory course must satisfy, as follows:

1) A direct connection to a technical area that will provide students with the proper context in their laboratory experiences.
2) The laboratory experiences should have a "hands-on" component. Two examples include a) physical experiments in which the students set up the experiments and conduct measurements to collect data; and b) numerical experiments in which the students configure the inputs to a software package and conduct simulations to obtain data (i.e., not just "clicking buttons")[§§].
3) The minimum amount of time devoted to the laboratory aspects of the course should be equivalent to 1 credit hour (i.e., 3 hours of student work per week). Within this 1 credit hour, the balance between "hands-on" experimentation (including both physical and computational), and subsequent data analysis, data interpretation, uncertainty analysis, and other supporting activities related to the hands-on experience will depend on the instructor and/or nature of the course content. To achieve this 1 credit hour requirement, we recommend a minimum of 36 hours to be spent over the semester associated with laboratory content.
4) The laboratory experiences should meet a consistent writing objective across all lab courses to build technical literacy skills. This will be defined through departmental Undergraduate Studies Committee efforts.

The writing objective will partially satisfy the OSU General Education Embedded Literacy in advanced writing (see Section 2.9).

The above criteria were endorsed by the CEGE faculty in Spring 2023.

Data analysis within these Laboratory courses will partially satisfy the ABET Program Criterion related to "application of numerical methods relevant to civil engineering". Data analysis will also satisfy the OSU General Education Embedded Literacy requirement in data analysis (see Section 2.9).

Together, the required CIVILEN 2410 and CIVILEN 3510 courses satisfy the ABET criterion for two contexts for laboratory experiences; student choice of one additional Laboratory course will maintain our current practice of exceeding this ABET criterion. Students will have the option to take additional Laboratory courses as Technical Electives (see Section 2.8.1). We propose an initial list of additional Laboratory courses that includes:

[§§] Virtual or computational lab experiences are acceptable, per the ASCE commentary. An evaluation of a virtual laboratory experience should consider such factors as:

1) Extent to which the subject matter lends itself to accurate simulation,
2) Extent to which the simulation replicates the actual physical experiences of setup, measurement, errors, and data collection,
3) Nature of student interaction with the simulation, and,
4) Students' abilities acquired through the simulation.

- CIVILEN 3160: Water Resources Engineering[***]
- CIVILEN 3540/1: Geotechnical Engineering

Additional Laboratory courses (whether newly-developed courses or modified from existing courses) across different technical areas would be welcome additions to this category.

2.6. Design Courses

The ABET criterion related to design requires "graduates to design a system, component, or process in at least two civil engineering contexts." The design experience should meet the following criteria (summarized from the ASCE commentary on ABET):

1) Include both analysis (the application of engineering tools and principles to predict performance) and synthesis (the creation of something new)
2) Include iterations
3) Require solutions to ill-defined and/or open-ended problems
4) Apply engineering standards and realistic constraints
5) Involve multi-disciplinary teams

Items 1) – 4) should be met by any design course, but item 5) is only required for Capstone courses (see Section 2.7).

We defined the features of a Design course using both a set of Proficiencies common to each of these courses (see table in Section 6) as well as additional criteria that a Design course must satisfy, as follows:

1) A design course should include content related to risk and uncertainty.
2) A design course should include the use of appropriate computational tools. We unanimously agree that computer-based calculations are an important aspect of student learning for the design process. The choice of these tools is up to the instructor and may include:
    a. Design software (e.g., RAM Structural Systems, HydroCAD, RocScience); or
    b. Parametric-based design in Excel, Matlab, or similar
3) The inclusion of visualization in the design. While this could be, e.g., Revit, Civil 3D, or other CAD-based tools, it could take the form of hand sketches or GIS-based efforts. 4000-level and above courses should use some computer-aided visualization approaches. This should build upon skills that students learned in CIVILEN 2405.
4) Design courses should include an individual project deliverable with a written component.
    a. This written component should meet a consistent writing objective across all design courses. This will be defined through departmental Undergraduate Studies Committee efforts.
    b. The written component should include discussion of at least:
        i. Constraints, and building codes or standards that were incorporated into the design.
        ii. Sequencing, specifications, and/or tolerances.
        iii. Risk and uncertainty.
        iv. Considerations related to sustainability and resilience.

We advise against team projects in these courses, because not all students will be responsible for all aspects of the projects. While oral communication is important, we should cover this elsewhere (e.g., with presentation deliverables in other courses). The writing objective will partially satisfy the OSU General Education Embedded Literacy in advanced writing (see Section 2.9).

[***] The instructors of this course would like to modify the course to include by physical experiments and computer simulations.

The above criteria were endorsed by the CEGE faculty in Spring 2023.

The inclusion of sustainability, risk, uncertainty, and resilience will partially satisfy the ABET Program Criterion related to "principles of sustainability, risk, resilience, diversity, equity, and inclusion to civil engineering problems". The use of computer-based calculations will satisfy the ABET Program Criterion related to "application of numerical methods relevant to civil engineering".

We propose that students take a minimum of three design courses from the following list, which was intentionally designed to include no more than two courses from a given technical area. This approach guarantees that students will have a design experience in at least two contexts, thereby satisfying the ABET Program Criterion. Each of these courses has a pre-requisite that can be satisfied through some combination of required courses, Core courses, and Laboratory courses, making these courses readily accessible within the proposed curriculum structure.

- Structures
  - CIVILEN 4320: Structural Steel Design
  - CIVILEN 4350: Reinforced Concrete Design
- Materials/Geotech
  - CIVILEN 4552: Design and Construction of Flexible and Rigid Pavements
  - CIVILEN 5571: Principles of Foundation Analysis and Design
- Transportation
  - CIVILEN 5730: Highway Location and Design
  - CIVILEN 5740: Design and Operation of Road Traffic Facilities
- Environmental
  - ENVENG 3210: Environmental Engineering Unit Operations
  - ENVENG 5110: Environmental Engineering Bioprocesses
- Water Resources
  - CIVILEN 5220: Open Channel Hydraulics
  - ENVENG 5760: Design of Urban Stormwater Control Measures

We recognize that there are additional courses that could satisfy these criteria for a design course that are not on this list. However, we intentionally avoided listing courses that have another design course as a pre-requisite, e.g., both CIVILEN 5350: Intermediate Reinforced Concrete Design and CIVILEN 5370: Prestressed Concrete Design list CIVILEN 4350 as a pre-requisite. Moreover, including a course like CIVILEN 5350 or CIVILEN 5370 in the above list would enable a student to satisfy the requirement of taking three design courses (e.g., CIVILEN 4320, CIVILEN 4350, CIVILEN 5370) without satisfying the ABET Program Criterion of two different contexts.

2.7. Civil Engineering Capstone

ABET Criterion 5 states that the curriculum must include "a culminating major design experience that 1) incorporates appropriate engineering standards and multiple constraints, and 2) is based on the knowledge and skills acquired in earlier coursework". A writing objective will partially satisfy the OSU General Education Embedded Literacy in advanced writing (see Section 2.9); this course will partially satisfy the OSU General Education Embedded Literacy of technology and society.

We propose to maintain our current offering of CIVILEN 4001: Civil Engineering Capstone I and CIVILEN 4002: Civil Engineering Capstone II as a two-semester sequence. As a committee, we agree that there is value in a two-semester sequence. This approach allows students more time to process their thoughts for both the alternatives (e.g., during CIVILEN 4001) and design development (e.g., during CIVILEN 4002),

leading to better final work products. Moreover, it provides more opportunity for students to interact with the consultants who support these courses (i.e., two semesters rather than just one semester).[†††]

However, we propose that both courses are offered during both semesters, with one instructor for each course. This will ensure that 1) students will have sufficient preparation prior to enrolling in CIVILEN 4001; 2) graduation will not be delayed by a full academic year if a student is unprepared by the Autumn term; and 3) the Capstone instructors will not be overburdened by managing two simultaneous Capstone sections.

The option for a student to complete the sequence of CIVILEN 4011: Civil Engineering Global Capstone I and CIVILEN 4012: Civil Engineering Global Capstone II will remain. However, we propose no change to the frequency at which these courses are offered, as they involve the option of a Study Abroad experience with international travel during the summer term.

2.8. Elective Courses

Elective courses represent choices that students can make to align coursework with their career goals. In our proposed structure, there are two categories of elective courses: Technical Electives (see Section 2.8.1) and Breadth Electives (see Section 2.8.2). Within the proposed structure, students will have the opportunity to take eight of these elective courses; we propose that a maximum of two can be from the Breadth Elective category, but if a student so chooses, they may complete all eight electives within the Technical Elective category.

We will present lists for consideration to the full faculty when they have been completed; the categorization of specific courses is irrelevant to the overall structure of the curriculum. Like the "Other Basic Science" list (Section 2.1), the Undergraduate Studies Committee will maintain these lists of electives.

2.8.1. Technical Electives

We define Technical Electives as courses that allow our students to gain additional technical knowledge – whether depth or breadth – within areas of Civil Engineering. The initial list of courses will include: 1) all Core, Laboratory, and Design Courses to allow students to take these courses beyond the minimum requirements specified in Sections 2.4 – 2.6.[‡‡‡]; 2) other existing courses that are not explicitly listed in our proposed lists in Sections 2.4 – 2.6 (e.g., those in our current technical elective list); and 3) additional courses that we identify as appropriate (e.g., CRPLAN 5320: Transportation Data Analytics for Planners; CRPLAN 5600: Advanced Urban Planning Survey Collection, Management, and Analysis Methods; EARTHSC 5655: Land Surface Hydrology).

We propose that a maximum of 3 credit hours of undergraduate research will be permitted in this category, because this experience will require students to apply their technical knowledge to address a research question.

2.8.2. Breadth Electives

We define Breadth Electives as courses that allow our students to expand their academic training – whether technical or non-technical – to disciplines that are complementary to Civil Engineering Practice. At present,

[†††] This is not a subtle attempt to imply that the committee views ENVENG 4090: Environmental Engineering Capstone Design as being inadequate. There are advantages and disadvantages to one-semester and two-semester models for Capstone courses, and we feel that both models within the department are successful.

[‡‡‡] In other words, all Core, Laboratory, and Design courses will be included in the list of Technical Electives. Courses not used to fulfill the Core, Laboratory, and Design requirements may be used to fulfill Technical Elective requirements, but no double-counting will be permitted.

this list includes courses from Architecture, Business, City and Regional Planning, Construction Systems Management, Computer Science, Earth Science, Geography, and Public Affairs, among others. Some of these courses may facilitate the completion of undergraduate minors, and others may facilitate the completion of the General Education Themes requirement (see Section 2.9).

We propose that a maximum of 3 credit hours of an internship experience will be permitted in this category; while students will apply some of their technical knowledge during this experience, they will gain professional skills that advance their career development.

2.9. General Education

ABET Criterion 5 states that the curriculum must include "a broad education component that complements the technical content and is consistent with the program educational objectives". Moreso, any OSU undergraduate student is required to complete General Education requirements, including the following:

- Gen Ed Bookends
  - Launch seminar (1 credit): GENED 1201 (GE Launch Seminar)
  - Reflection seminar (1 credit): Embedded within Capstone sequence

- Gen Ed Foundations
  - Historical or Cultural Studies (3 credit hours): student choice
  - Literary, Visual, and Performing Arts (3 credit hours): student choice
  - Mathematical and Quantitative Reasoning or Data Analysis (3 – 5 credit hours): MATH 1151
  - Natural Sciences (4 – 5 credit hours): PHYSICS 1250
  - Race, Ethnicity, and Gender Diversity (3 credit hours): student choice
  - Social and Behavioral Sciences (3 credit hours): student choice
  - Writing and Information Literacy (3 credit hours): ENGR 1300 (Introduction to Writing for STEM)[§§§]

- Gen Ed Themes
  - Citizenship for a Diverse and Just World (4 – 6 credit hours): Satisfied through student choice(s).
  - Additional Theme[****] (4 – 6 credit hours): Satisfied through student choice(s).[††††]

- Gen Ed Embedded Literacies
  - Data Analysis: Satisfied in laboratory courses
  - Advanced Writing: Satisfied in a thread including CIVILEN 2001, laboratory courses, design courses, and Capstone[‡‡‡‡]
  - Technology and Society: Satisfied through a combination of CIVILEN 2001, CIVILEN 3080, and Capstone

[§§§] This requirement was approved by the CEGE faculty in Autumn 2023 for the current curriculum.
[****] Additional themes include Sustainability; Lived Environments; Health and Well-Being; Migration, Mobility, Immobility; Number, Nature, Mind; Origins and Evolutions; and Traditions, Cultures, and Transformations
[††††] Options for the Sustainability Theme either currently exist or are under development within CEGE.
[‡‡‡‡] The Undergraduate Studies Committee is working to develop a set of writing objectives to be implemented within these courses across the curriculum.

3. Example Curriculum Sheet

The figure below provides a visual example of how the proposed structure fits together. We have been intentional to avoid overloading a single semester with 18 credit hours of STEM coursework in this guide. We anticipate that this example curriculum sheet represents a "generic" bingo sheet; student interests will drive different pathways. For example, a student interested in the Land Surveying minor would likely want to take CIVILEN 2410 in place of CIVILEN 3510 during the Spring of the 2nd year, and a student interested in either Geotech or Water Resources would likely prioritize taking the "CE Lab Option" earlier than the Spring of the 3rd year. After the structure is approved and after the Elective lists have been finalized, we will develop guidance documentation in consultation with different technical areas in the department to aid students in their navigation of this curriculum to meet their career goals.

						Total hours:	**131**
	Autumn				**Spring**		
	Number	Name	Hours		Number	Name	Hours
1	ENGR 1100	Engineering Survey	1		CIVILEN 2001	Introduction to Infrastructure	3
	ENGR 1181	Fundamentals of Engineering 1	2		CIVILEN 2405	Graphics for CE	1
	ENGR 1300	Intro. to STEM writing	3		ENGR 1182	Fundamentals of Engineering 2	2
	MATH 1151	Calculus I	5		MATH 1172	Engineering Math A	5
	PHYSICS 1250	Mechanics, Work, and Energy	5		MECHENG 2010	Statics	2
		Gen Ed - Opening Bookend	1			Gen Ed - Foundation	3
		Semester hours:	17			Semester hours:	16
2	CHEM 1250	Chem for Engineers	4		CIVILEN 3130	Fluid Mechanics	3
	ENGR 1221	Programming	2		CIVILEN 3510	Civil Eng. Materials	3
	MATH 2173	Engineering Math B	3		MATH 2174	Lin. Alg. and Diff. Eq.	3
	MECHENG 2020	Mechanics of Materials	3			CE Core Selection	3
	STAT 3450.0x	Basic Stats for Engineers	2			CE Core Selection	3
		Gen Ed - Foundation	3				
		Semester hours:	17			Semester hours:	15
3	CIVILEN 2410	Intro to Surveying	3			CE Lab Option	3
	CIVILEN 3080	Engineering Decision-Making	3			CE Design Elective	3
	CONSYSM 2205	Intro. to Constr. Sys. Manage.	3			Tech. Elective	3
		CE Design Elective	3			Tech. Elective	3
		Tech. Elective	3			Additional Science Elective	3
		Gen Ed - Foundation	3			Gen Ed - Foundation	3
		Semester hours:	18			Semester hours:	18
4	CIVILEN 4001	CE Capstone 1	2		CIVILEN 4002	CE Capstone 2	2
		CE Design Elective	3			Tech. Elective	3
		Tech. Elective	3			Tech. Elective	3
		Breadth Elective	3			Breadth Elective	3
		Gen Ed - Theme	4			Gen Ed - Theme	4
		Semester hours:	15			Semester hours:	15

4. Next Steps

If the proposed structure is approved, the next steps are as follows:

1. Complete the proposed lists for Basic Science, Technical, and Breadth Electives. These will be brought to the full faculty for discussion, following the protocol applied to the current curriculum.

2. Develop implementation strategies for Core, Laboratory, and Design courses.
3. Discuss course-specific modifications with the instructor(s), if needed.

5. Thematic Threads through the Curriculum

Throughout the curriculum, we have identified the following cross-cutting threads spanning different themes. These threads will satisfy some combination of ABET Program Criteria, ABET Student Outcomes, and the vision of the Department Chair and/or Undergraduate Curriculum Renewal Committee – each are important for the Civil Engineering of the future.

Writing	**Licensure**	**Ethics**	**Sust., Risk, Unc., Resil.**	**Diversity, Equity, Incl.**
ENGR 1300	CIVILEN 2001	CIVILEN 2001	CIVILEN 2001	Gen. Ed.
CIVILEN 2001	Core courses	CIVILEN 3080	CIVILEN 3080	CIVILEN 2001
Lab courses	Design courses	Core courses	Lab courses	CIVILEN 3080
Design courses	Capstone	Design courses	Design courses	Capstone
Capstone		Capstone	Capstone	

6. Proficiency Mapping

Below, we compile the list of Goals, Outcomes, and Proficiencies. The "Totals" column represents the total number of times that a given Proficiency will be assessed, but this does not account for the duplication in the Core courses (see Section 2.4) or the triplication in Design courses (see Section 2.6).

We acquired data for each course listed as follows:

- Proficiencies for CIVILEN 2001 were identified in parallel to course development.
- CIVILEN 2405, CIVILEN 3130, and CIVILEN 3510 data are based on the initial audit that we conducted early in our process in consultation with instructors.
- There are proposed additions to CIVILEN 3080 consistent with an expansion to include additional sustainability, society, and ethics content within that course (see Section 2.3.4).
- Proficiencies for CONSYSM 2205 are based upon the course syllabus.
- The Core, Lab, and Design courses are based on our specifications for these courses.
- We have expanded the list of what can be assessed in the Capstone courses.

Note that we are removing some Proficiencies (indicated by ~~strikethrough~~ text). While we feel that these removed Proficiencies have inherent value, assessment becomes challenging. For example, both Proficiency C.3.c: Mentor less experienced colleagues and Proficiency E.2.d: Apply academic knowledge in the field of civil or environmental engineering (e.g., internship or research experience) could be readily assessed in a co-curricular setting, but ensuring that opportunities exist for all students is an undertaking that we are unready to propose at this time. We have eliminated certain Proficiencies related to communication, because they imply student choice – specifically, D.1.h: Select the most appropriate mode and delivery approach for communicating specific content and D.2.d: Profile audience and identify appropriate communication techniques; again, we are unready to propose a modification to courses to enable the assessment of these.

	Total	CIVILEN 2001	CIVILEN 2405	CIVILEN 2410	CIVILEN 3080	CIVILEN 3130	CIVILEN 3510	CONSYSM 2205	Core	Lab	Design	Capstone
A. Civil and Environmental Engineering Standards, Tools and Techniques												
Goal: Students will be familiar and approaching proficiency with state-of-the-art standards, protocols, modeling/simulation platforms, data analysis, numerical methods and physical experimentation used in civil and environmental engineering analysis and design.												
Outcomes: Students will be able to:												
1. Apply branch-specific techniques to address engineering concerns												
(a) Identify appropriate technique (B)	3			X					X		X	
(b) Recognize the differences between controlled lab or desktop experiments and real-world measurements (I-1)	3						X		X	X		
(c) Utilize appropriate data collection techniques (I-2)	2						X			X		X

	Total	CIVILEN 2001	CIVILEN 2405	CIVILEN 2410	CIVILEN 3080	CIVILEN 3130	CIVILEN 3510	CONSYSM 2205	Core	Lab	Design	Capstone
(d) Research alternative techniques (I-3)	1											X
(e) Utilize appropriate analytical and computational methods (I-4)	6			X		X	X		X		X	X
(f) Collect and refine large data sets (I-5)	2						X					X
(g) Analyze and interpret experimental and/or computational results (A-1)	4			X			X			X		X
(h) Apply experimental or computational output to satisfy design and compliance criteria (A-2)	4		X				X				X	X
2. Utilize the appropriate tool to address an engineering problem												
(a) Identify tools appropriate for a particular problem (B)	6		X	X			X		X	X	X	X
(b) Define the conditions under which a certain tool will apply and the limits of its applicability (I-1)	4						X		X	X	X	X
(c) Explain the underlying theory, operating principle and proper application of a particular tool (A-1)	4			X			X		X	X	X	
(d) Research and be adaptable to alternative and new tools (I-2)	1						X					

	Total	CIVILEN 2001	CIVILEN 2405	CIVILEN 2410	CIVILEN 3080	CIVILEN 3130	CIVILEN 3510	CONSYSM 2205	Core	Lab	Design	Capstone
3. Combine multiple tools or techniques in analysis and design												
(a) Identify which combination of tools and techniques are suitable for a particular design problem (I-1)	2										X	X
(b) Apply a combination of tools and techniques to a particular design problem (I-2)	3			X							X	X
(c) Synthesize the output of multiple tools/techniques to solve a design problem (A)	1											X
4. Design using appropriate civil and environmental engineering codes, regulations, standards or protocols												
(a) Define the role that codes, regulations, standards or protocols play in civil and environmental engineering design (B/I)	2										X	X
(b) Identify the sources and locations of the latest applicable codes, regulations, standards or protocols (I-1)	2										X	X

	Total	CIVILEN 2001	CIVILEN 2405	CIVILEN 2410	CIVILEN 3080	CIVILEN 3130	CIVILEN 3510	CONSYSM 2205	Core	Lab	Design	Capstone
(c) Apply codes, regulations, standards or protocols (I-2)	4						X			X	X	X
(d) Recognize the limitations of regulatory standards and understand that there may be a need to design using alternative methods (A)	1										X	
B. Application of Knowledge and Skills to Problem Solving in Civil and Environmental Engineering												
Goal: Students will apply systems level thinking to solve complex civil and environmental engineering problems by integrating knowledge, tools, and problem-solving skills.												
Outcomes: Students will be able to:												
1. Establish the context of the problem being solved												
(a) Locate their portion of the greater engineering problem within the larger civil infrastructure system and the natural environment with which it interfaces (I-1)	2	X							X			

	Total	CIVILEN 2001	CIVILEN 2405	CIVILEN 2410	CIVILEN 3080	CIVILEN 3130	CIVILEN 3510	CONSYSM 2205	Core	Lab	Design	Capstone
(b) Understand the relationship between their work and that of other sub-disciplines of civil and environmental engineering as well as other disciplines (I-2)	1	X										
(c) Consider the impacts on sustainability, society, and other externalities (I-3)	4	X			X		X				X	
2. Identify and locate information necessary to set up engineering problems												
(a) Define the problem, question, goal and/or client needs (B-1)	7	X			X		X		X	X	X	X
(b) List applicable governing codes, standards, zoning and/or legal framework (A-1)	2										X	X
(c) Identify boundary conditions, loads, inputs, data, assumptions and/or design criteria (B-2)	5					X	X		X	X	X	X
(d) Identify and incorporate information needed from other disciplines, team members, and stakeholders (A-2)	2	X									X	
3. Solve engineering problems												

	Total	CIVILEN 2001	CIVILEN 2405	CIVILEN 2410	CIVILEN 3080	CIVILEN 3130	CIVILEN 3510	CONSYSM 2205	Core	Lab	Design	Capstone
(a) Identify appropriate approaches/methodologies and best practices/tools/techniques (B)	5					X	X		X		X	X
(b) Formulate a solution by implementing appropriate approaches/methodologies and best practices/tools/techniques (I-1)	4					X			X		X	X
(c) Communicate solutions clearly and in a professional manner (I-2)	5						X		X	X	X	X
4. Analyze solutions to engineering problems												
(a) Check solution is reasonable, troubleshoot problems, and iterate as necessary (I-1)	5				X		X		X	X	X	X
(b) Qualitatively evaluate and incorporate risk, reliability, and uncertainty analyses (A)	3						X			X	X	
(c) Ensure solution is in accordance with engineering code of ethics (B-1)	1											X
(d) Confirm client goals are aligned with the engineering solution (B-2)	2										X	X

	Total	CIVILEN 2001	CIVILEN 2405	CIVILEN 2410	CIVILEN 3080	CIVILEN 3130	CIVILEN 3510	CONSYSM 2205	Core	Lab	Design	Capstone
(e) Verify solution to the problem integrates into the larger civil infrastructure system, the natural environment, and/or society (A)	1											X
(f) Identify conditions that may affect longevity, testing, and maintenance schedule of successful design solutions.	2						X					X
C. Professionalism and Professional Development in Civil and Environmental Engineering												
Goal: Students will be resilient, skilled in collaboration, and exhibit professionalism necessary for success in their careers.												
Outcomes: The successful student will be able to:												
1. Successfully execute a project as a member of a team.												
(a) Suggest solutions and accept/adjust to feedback throughout a project (I-1)	3	X					X			X		X
(b) Demonstrate willingness to objectively consider other team	3	X					X			X		X

	Total	CIVILEN 2001	CIVILEN 2405	CIVILEN 2410	CIVILEN 3080	CIVILEN 3130	CIVILEN 3510	CONSYSM 2205	Core	Lab	Design	Capstone
members' ideas, including those that are non-traditional (I-2)												
(c) Identify organizational structure and distribution of tasks, knowledge and skills and advocate the importance of organization in large project planning (I-3)	2						X			X		X
(d) Identify strengths and weaknesses in order to understand personal contributions to team initiatives (I-4)	2	X										X
(e) Operate according to your role in a team, respect the chain of command and show leadership in team settings when appropriate (B)	3						X			X		X
2. Contribute to the acquisition, budgeting and follow-through of engineering contracts.												
(a) Develop an understanding of the job market and anticipated salary ranges of entry level and management engineering consultants (B)	2	X										X

	Total	CIVILEN 2001	CIVILEN 2405	CIVILEN 2410	CIVILEN 3080	CIVILEN 3130	CIVILEN 3510	CONSYSM 2205	Core	Lab	Design	Capstone
(b) Provide proper estimates of fees and time required for engineering services they will perform (I-1)	2							X				X
(c) Develop and understand the proposal process in obtaining work (I-2)	2						X					X
(d) Deliver expected project outcomes to clients in appropriate format (I-3)	8	X	X		X		X	X		X	X	X
3. Collaborate professionally with members of a diverse team (irrespective of race, color, religion, sex, sexual orientation or identity, national origin, disability, or veteran status).												
(a) Explain the value of having diverse teams, comprised of individuals with different backgrounds and perspectives (B)	1	?										
(b) Use appropriate etiquette in professional interactions (I)	2									X		X
~~(c) Mentor less experienced colleagues (A)~~	0											

	Total	CIVILEN 2001	CIVILEN 2405	CIVILEN 2410	CIVILEN 3080	CIVILEN 3130	CIVILEN 3510	CONSYSM 2205	Core	Lab	Design	Capstone
4. Recognize the importance of staying current with professional practice, obtaining licensure or other credentials, and finding resources to continue life-long learning.												
(a) Engage with engineering periodicals, design techniques, and building code changes (I-1)	1						X					
(b) Attend society meetings (I-2)	1						X					
(c) Recognize the importance and benefits of professional licensure in civil and environmental engineering (I-3)	2	X									X	
(d) Identify opportunities, and the need for, participation in post-graduate engineering training (e.g., ASCE Short Courses) (A-1)	2	X									X	
(e) List the requirements for maintaining technical knowledge required for professional licensure (A-2)	2	X									X	

	Total	CIVILEN 2001	CIVILEN 2405	CIVILEN 2410	CIVILEN 3080	CIVILEN 3130	CIVILEN 3510	CONSYSM 2205	Core	Lab	Design	Capstone
5. Understand the broader social, economic, ethical, and political context in which engineering decisions are made.												
(a) Identify how societal context may impact project goals and outcomes (A-1)	2	X			X							
(b) Explain the equity and sustainability consequences of engineering designs (I)	1	X										
~~(c) Demonstrate familiarity with infrastructure policy (A-2)~~	0											
(d) Describe the importance of ethics in engineering (B)	3	X						X	X			
D. Communication in Civil and Environmental Engineering:												
Goal: Students will be able to communicate civil and environmental engineering concepts effectively, both orally, visually, and in writing, to a range of audiences.												
Outcomes: Students will be able to:												

	Total	CIVILEN 2001	CIVILEN 2405	CIVILEN 2410	CIVILEN 3080	CIVILEN 3130	CIVILEN 3510	CONSYSM 2205	Core	Lab	Design	Capstone
1. Effectively utilize a variety of communication modes												
(a) Effectively present data and information in plots and figures (B)	7		X	X	X		X	X		X		X
(b) Create a visually effective presentation to accompany an oral presentation (I-1)	4	X					X	X				X
(c) Speak effectively in public (A-1)	2						X					X
(d) Document, present and discuss technical content in written format (I-2)	6	X			X		X			X	X	X
(e) Develop professional documents, such as resumes and cover letters (I-3)	1	X										
(f) Communicate through informal communication media (email, verbally in meetings, communication with colleagues and co-workers, “elevator” pitch) (A-2)	1	X										
(g) Respond to audience feedback and adapt as needed (A-3)	1											X
~~(h) Select the most appropriate mode and delivery approach for~~	0											

	Total	CIVILEN 2001	CIVILEN 2405	CIVILEN 2410	CIVILEN 3080	CIVILEN 3130	CIVILEN 3510	CONSYSM 2205	Core	Lab	Design	Capstone
~~communicating specific content (A-4)~~												
2. Tailor communication to a variety of audiences												
(a) Discuss civil (environmental) engineering concepts, tools, and processes with other professionals (B)	1											X
(b) Explain civil (environmental) engineering concepts and tools with an audience of non-experts (I-1)	2	X										X
(c) Communicate effectively with clients (I-2)	1											X
~~(d) Profile audience and identify appropriate communication techniques (I-3)~~	0											
3. Communicate as a team												
(a) Communicate effectively with team members (I)	4	X					X			X		X
(b) Communicate as a team, with a unified vision and goal (A)	4	X					X			X		X
4. Provide, receive, and respond to feedback												

	Total	CIVILEN 2001	CIVILEN 2405	CIVILEN 2410	CIVILEN 3080	CIVILEN 3130	CIVILEN 3510	CONSYSM 2205	Core	Lab	Design	Capstone
(a) Provide helpful feedback in a professional manner (I-1)	2						X					X
(b) React appropriately to, and integrate feedback from, various sources (I-2)	1						X					
(c) Ask appropriate questions to probe for new knowledge (B)	1											X
~~(d) Anticipate questions and respond gracefully to unanticipated questions (A)~~	0											
E. Civil and Environmental Engineering Professional Identity:												
Goal: Students will develop an identity within the fields of civil and environmental engineering.												
Outcomes: Students will be able to:												
1. Articulate the roles that civil and environmental engineers play in society												
(a) Explain the role of infrastructure in the public and private domain (I-1)	1	X										
(b) Describe the consequence of civil and environmental engineering success and failure (B)	3	X							X		X	

	Total	CIVILEN 2001	CIVILEN 2405	CIVILEN 2410	CIVILEN 3080	CIVILEN 3130	CIVILEN 3510	CONSYSM 2205	Core	Lab	Design	Capstone
(c) Explain the role of licensure/certification in ensuring public safety and developing public trust in civil and environmental engineers (I-2)	2	X							X			
~~(d) Recognize the responsibility of practicing civil and environmental engineers for contributing to code development and keeping them current and accurate (I-3)~~	0											
2. Discern among the technical specialties within Civil and Environmental Engineering												
(a) Identify types of problems specific to the field of civil and environmental engineering (B)	2	X							X			
(b) Identify the specialties needed for specific projects within the fields of civil and environmental engineering (I-1)	2	X						X				
(c) Discern the roles and responsibilities of civil or environmental engineers from those of other project contributors (I-2)	2	X						X				

	Total	CIVILEN 2001	CIVILEN 2405	CIVILEN 2410	CIVILEN 3080	CIVILEN 3130	CIVILEN 3510	CONSYSM 2205	Core	Lab	Design	Capstone
~~(d) Apply academic knowledge in the field of civil or environmental engineering (eg. internship or research experience) (I-3)~~	0											
(e) Identify the need and limitation of engineering certifications and licensure for specific tasks and roles in civil and environmental works and projects (I-4)	1	X										
		31	4	7	7	4	35	7	17	22	29	47

Track:

	Courses
Core Courses:	
1	
2	
Lab Course:	
1	
Design Courses	
1	
2	
3	
Science Elective:	
1	
Technical Electives:	(can include items from previous categories)
1	
2	
3	
4	
5	
6	
Breadth/Technical Electives:	(can be either currently approved, or new additions from other programs)
1	
2	
Alternative Electives:	(options students could supplement the electives with)
1	
2	
3	
4	
5	
6	
New Course Ideas?	
1	
2	
3	

Core Course Lists
- CIVILEN 3310: Structural Engineering Principles
- CIVILEN 3700: Transportation Engineering and Analysis
- ENVENG 3200: Fundamentals of Environmental Engineering

Current Lab Course List:
- CIVILEN 3160: Water Resources Engineering
- CIVILEN 3540/1: Geotechnical Engineering

Current Design Course Lists:
- CIVILEN 4320: Structural Steel Design
- CIVILEN 4350: Reinforced Concrete Design
- CIVILEN 4552: Design and Construction of Flexible and Rigid Pavements
- CIVILEN 5571: Principles of Foundation Analysis and Design
- CIVILEN 5730: Highway Location and Design
- ENVENG 3210: Environmental Engineering Unit Operations
- ENVENG 5110: Environmental Engineering Bioprocesses
- CIVILEN 5220: Open Channel Hydraulics
- ENVENG 5760: Design of Urban Stormwater Control Measures

Current Technical Electives Course Lists:
https://ceg.osu.edu/approved-technical-and-science-electives-civil-engineering-majors

Science Elective List:
- EARTHSC 2155: Energy and Environment
- EARTHSC 2203: Environmental Geoscience
- EARTHSC 2210: Energy, Mineral Resources, and Society
- EARTHSC 2911: The Climate Crisis: Mechanisms, Impacts, and Mitigation
- ENR 2100: Introduction to Environmental Science
- ENR 3000: Soil Science
- GEOG 1900: Extreme Weather and Climate
- GEOG 2960: Introduction to Physical Geography
- GEOG 3900: Global Climate Change: Causes and Consequences

Currently Approved Technical Electives

Infrastructure	Transportation and Geodetic Engineering	Water Resources and Environmental Engineering	Additional Technical Electives
CIVILEN 4310 - Structural Analysis	CIVILEN 5300 - Airport Planning and Design	CIVILEN 4210 - The Physics of Sustainable Buildings	CIVILEN / ENVENG 2193 or 4193 - Independent Study
CIVILEN 4320 - Structural Steel Design	CIVILEN 5400 - Introduction to Geographic Information Systems	CIVILEN 5220 - Open Channel Hydraulics	CIVILEN 4191.0X - Internship Course
CIVILEN 4350 - Reinforced Concrete Design	CIVILEN 5410 - Engineering Surveying	CIVILEN 5230 - Transport Phenomena in Water Resources Engineering	CIVILEN / ENVENG 4998 - Undergraduate Research, no thesis
CIVILEN 4552 - Design and Construction of Flexible Pavements	CIVILEN 5420 - Remote Sensing of Environment	CIVILEN 5610.02 - Safe Water on Tap	CIVILEN / ENVENG / MECHENG 4999(H) - Undergraduate Research with thesis
CIVILEN 5162 - Introduction to Laminated Composite Materials	CIVILEN 5441 - Introduction to GPS: Theory and Applications	ENVENG 3210 - Environmental Engineering Unit Operations	CIVILEN 5610.01 - Sustainable Infrastructure for Developing Rural Communities
CIVILEN 5168 - Introduction to Finite Elemental Method	CIVILEN 5461 - Geospatial Numerical Analysis	ENVENG 4218 - Measurement and Modeling of Climate Change	CIVILEN 5797.26 - Japanese American Design Experience
CIVILEN 5320 - Intermediate Structural Steel Design	CIVILEN 5700 - Urban Transportation Demand Forecasting	ENVENG 4400 - Integrated Environmental Chemical Fate and Transport	CONSYSM 5670 - Green Building Design and Sustainable Construction
CIVILEN 5350 - Intermediate Reinforced Concrete Design	CIVILEN 5720 - Transportation Engineering Data Collection Studies	ENVENG 5110 - Environmental Engineering Bioprocesses	ENGR 4850S - Translating Engineering Research to K-8 (TEK8)
CIVILEN 5360 - Bridge Engineering	CIVILEN 5730 - Highway Location and Design	ENVENG 5120 - Bioremediation of Groundwater and Soil	ENGR 5797.20 - Sustainable and Resilient Infrastructure in Italy
CIVILEN 5370 - Prestressed Concrete Design	CIVILEN 5740 - Design and Operation of Road Traffic Facilities	ENVENG 5140 - Air Quality in Engineering	ENGR 5797.21S - Sustainable and Resilient Tanzanian Communities - Engineering
CIVILEN 5510 - Durability and Condition Assessment of Reinforced Concrete Structures	CIVILEN 5750 - Instrumentation, Signals and Control in Transportation Applications	ENVENG 5170 - Sustainability and Pollution Prevention	ENGR 5797.24 - Sustainable Community Development - Honduras
CIVILEN 5571 - Principles of Foundations Analysis and Design	CIVILEN 5760 - Network Metrics and Control in Transportation Systems	ENVENG 5195 - Engineering Design for Environmental Health	FABENG 3120 - Thermodynamics in Food, Agricultural and Biological Engineering
CIVILEN 5581 - Numerical Methods in Geotechnical Engineering	CIVILEN 5770 - Urban Public Transportatoin	ENVENG 5600 - Science, Engineering, and Public Policy	FABENG 5200 - Appropriate Technologies for Developing Countries
CIVILEN 5840 - Construction Contracts and Claims		- (cross-listed with PUBAFRS)	MECHENG 3500 - Engineering Thermal Sciences
CONSYSM 3450 - Estimating for Construction		ENVENG 5718 - Aquatic Chemistry	NUCLREN 4505 - Introduction to Nuclear Science and Engineering
CONSYSM 3451 - Scheduling for Construction		ENVENG 5760 - Design of Urban Stormwater Control Measures	
CONSYSM 4641 - Construction Project Management		FABENG 5310 - Ecological Engineering and Science	
MECHENG 5139 - Applied Finite Element Method		PUBHEHS 7365 - Principles of Risk Assessment	
MECHENG 5144 - Engineering Fracture Mechanics			

Transportation and Geodetic Engineering
- CIVILEN / ENVENG 2193 or 4193 - Independent Study
- CIVILEN 4191.0X - Internship Course
- CIVILEN / ENVENG 4998 - Undergraduate Research, no thesis
- CIVILEN / ENVENG / MECHENG 4999(H) - Undergraduate Research with thesis
- CIVILEN 5610.01 - Sustainable Infrastructure for Developing Rural Communities
- CIVILEN 5797.26 - Japanese American Design Experience
- CONSYSM 5670 - Green Building Design and Sustainable Construction
- ENGR 4850S - Translating Engineering Research to K-8 (TEK8)
- ENGR 5797.20 - Sustainable and Resilient Infrastructure in Italy
- ENGR 5797.21S - Sustainable and Resilient Tanzanian Communities - Engineering
- ENGR 5797.24 - Sustainable Community Development - Honduras
- FABENG 3120 - Thermodynamics in Food, Agricultural and Biological Engineering
- FABENG 5200 - Appropriate Technologies for Developing Countries
- MECHENG 3500 - Engineering Thermal Sciences
- NUCLREN 4505 - Introduction to Nuclear Science and Engineering
- -

Infrastructure

COURSE #	COURSE TITLE	CR. HRS.	OFFERED*	PREREQUISITES
CIVILEN / ENVENG 2193 or 4193	Independent Study	3-Jan	AU24	Permission of instructor
CIVILEN 4191.0X	Internship Course	1 or 2	AU24	Approved request required:
CIVILEN / ENVENG 4998	Undergraduate Research, no thesis	3	AU24	Permission of instructor
CIVILEN / ENVENG / MECHENG 4999(H)	Undergraduate Research with thesis	3	AU24	Permission of instructor
CIVILEN 5610.01	Sustainable Infrastructure for Developing Rural Communities	3	AU24	Permission of instructor
CIVILEN 5797.26	Japanese American Design Experience	3	SU24	Approved education abroad application required
CONSYSM 5670	Green Building Design and Sustainable Construction	3	AU24	Junior or senior standing
ENGR 4850S	Translating Engineering Research to K-8 (TEK8)	3	AU24	ENGR 1182 or 1282H and permission of instructor (requires pre-approved summer research prior to)
ENGR 5797.20	Sustainable and Resilient Infrastructure in Italy	3	SU24	Application required; ENV 3200 or CIVILEN 3310
ENGR 5797.21S	Sustainable and Resilient Tanzanian Communities - Engineering	3	SP25	CIVILEN 4001; and (co-requisite) CIVILEN 4002; or permission of instructor; application required
ENGR 5797.24	Sustainable Community Development - Honduras	3	SP25	Application required
FABENG 3120	Thermodynamics in Food, Agricultural and Biological Engineering	4	AU24	MATHG 2177 or 2174 (or co-requisite)
FABENG 5200	Appropriate Technologies for Developing Countries	3	SP25	ENGR 1182.0X or 1282.0X; or permission of instructor
MECHENG 3500	Engineering Thermal Sciences	3	AU24	MATH 2174, 2177 or 2415 and PHYSICS
NUCLREN 4505	Introduction to Nuclear Science and Engineering	3	AU24	MATH 2173, 2177 or 2415; and PHYSICS 125
	(cross-listed in MECHENG)		SP25	
	(cross-listed in MECHENG)			

							Total hours:	131						Component	CR HR																			
	Autumn				Spring									Math & Science	30																		
	Number	Name	Hours		Number	Name	Hours																										
1	MATH 1151	Calculus I	5		MATH 1172	Engineering Math A	5							Required	38	All civil engineering students must take this																	
	ENGR 1181	Fundamentals of Engineering 1	2		ENGR 1182	Fundamentals of Engineering 2	2																										
	PHYSICS 1250	Mechanics, Work, and Energy	5		MECHENG 2010	Statics	2							Lab	3	Civil engineering students take 1 out of minimum 2 options																	
	ENGR 1100	Engineering Survey	1		ENGR 1221	Programming	2																										
	ENGR 1300	Intro. to STEM writing	3		CIVILEN 2405	Graphics for CE	1							Core	6	Civil engineering students take 2 of 3 options																	
		Gen Ed - Opening Bookend	1		CIVILEN 2001	Introduction to Infrastructure	3																										
		Semester hours:	17			Semester hours:	15							Design	9	Civil engineering students take 3 out of multiple options																	
2	MATH 2173	Engineering Math B	3		MATH 2174	Lin. Alg. and Diff. Eq.	3							Tech Elective	18	Civil engineering students take minimum of 5 (maximum 7) out of multiple options																	
	MECHENG 2020	Mechanics of Materials	3		CIVILEN 3510	Civil Eng. Materials	3																										
	CHEM 1250	Chem for Engineers	4		CONSYSM 2205	Intro. to Constr. Sys. Manage.	3							Breadth Elective	6	Civil engineering students take maximum of 2 (minimum 0) out of multiple options																	
	CIVILEN 3130	Fluid Mechanics	3			CE Core Selection	3																										
	STAT 3450.0x	Basic Stats for Engineers	2			CE Core Selection	3							Gen Ed	21	MATH 1151 is required by the College of Engineering, and students may use this to satisfy the GE Foundation in Mathematical and Quantitative Reasoning																	
																PHYSICS 1250 is required by the College of Engineering, and students may use this to satisfy the GE Foundation in Natural Sciences																	
		Semester hours:	15			Semester hours:	15									ENGR 1300 is required by the program, and students may use this to satisfy the GE Foundation in Writing and Information Literacy																	
3	CIVILEN 3080	Engineering Decision-Making	3			CE Design Elective	3																										
	CIVILEN 2410	Intro to Surveying	3			Tech. Elective	3							**Total**	**131**																		
		CE Design Elective	3			Tech. Elective	3																										
		Tech. Elective	3			CE Lab Option	3																										
		Tech. Elective	3			Additional Science Elective	3																										
		Gen Ed - Foundation	3			Gen Ed - Foundation	3																										
		Semester hours:	18			Semester hours:	18																										
4	CIVILEN 4001	CE Capstone 1	2		CIVILEN 4002	CE Capstone 2	2																										
		CE Design Elective	3			Tech. Elective	3																										
		Tech. Elective	3			Breadth Elective	3																										
		Breadth Elective	3			Gen Ed - Foundation	3																										
		Gen Ed - Theme	4			Gen Ed - Theme	4																										
		Gen Ed - Foundation	3																														
		Semester hours:	18			Semester hours:	15																										
			68				63																										