Department of Civil and Environmental Engineering

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The role of civil and environmental engineers, in the broadest sense, is to apply technology to develop sustainable solutions to meet society's needs. Civil engineers plan, design, construct, and operate facilities used daily by the public and industry, such as buildings, transportation networks, and water and wastewater systems. They work at the intersection of the built, natural, and information environments. Today's civil and environmental engineers are also called upon by government and industry to provide leadership on complex technical and societal issues such as demands for infrastructure improvement, remediation of hazardous waste sites, energy production, transmission and use, climate change adaptation, provision of safe drinking water, and incorporation of environmental safeguards in new infrastructure designs.

Civil and environmental engineering requires broad technical training and strong communication skills because of the complexity of large projects and the interactions with engineers in other fields, lawyers, public officials, and stakeholders. Carnegie Mellon's curriculum provides this versatility for professional practice in civil and environmental engineering and as a strong foundation for other professional pursuits.

The Department of Civil and Environmental Engineering offers a wide spectrum of opportunities for entry into the engineering profession, for graduate education in engineering, or entry into various other graduate and professional fields, including business, law, and medicine. While maintaining its emphasis on the fundamental understanding of the behavior of constructed facilities through the application of the physical sciences, biology, mathematics, and computing, the curriculum has continually evolved in directions that exploit advances in technology. The curriculum introduces the methods of engineering design in the first year and continues to emphasize them throughout the curriculum in both traditional and open-ended project-oriented courses. The basic undergraduate degree program leads to a B.S. in Civil Engineering. Students with a specific interest in Environmental Engineering are advised to complete the Minor in Environmental Engineering and Sustainability.

Central to the evolution of technology and its impact on engineering practice is the increased emphasis on the use of computers in engineering. Several courses on computer methods are required in the curriculum, and most courses offered by the department require the use of computers in applications of either analysis or design.

Our curriculum emphasizes the development of scientific inquiry in the context of applications in civil and environmental engineering. For B.S. graduates who wish to enter the engineering profession directly in such specialties as structural engineering, construction engineering, or environmental engineering, this approach to teaching allows application of the most advanced technological developments. Others who wish to pursue graduate study are prepared to engage in research on the highest level, either in traditional specialties or in emerging fields such as smart infrastructure, climate change adaptation, and micromechanics.

The Civil Engineering curriculum is intended to allow ample opportunity for students to pursue areas of personal interest. A student may choose to concentrate in a specialty area in civil engineering, to pursue a minor in one of the designated minor programs offered in the College of Engineering, or to pursue an additional major. Information on these options follows the description of the curriculum in this section. Students are encouraged to participate in research with department faculty members, explore their chosen field through internships, and take advantage of opportunities to study abroad and be exposed to other cultures.

In addition to providing a solid technical foundation, the program emphasizes the development of professional skills. We incorporate design and team experiences at regular intervals in the curriculum, and provide appropriate hands on experience in laboratory courses and projects. Students also get multiple opportunities to practice and improve their communication skills through written and oral reports.

Two common double-major options chosen by students in Civil Engineering are dual degrees in Biomedical Engineering or Engineering and Public Policy. Both programs are described in their departments' sections of the catalog. Other double-major programs selected by recent graduates include architecture, business, computer science, economics, history, mathematics, and foreign languages. Each student should have well-defined objectives in selecting courses leading to a specialty, a minor, or a double major. Faculty mentors and the Director of Undergraduate Programs are available to discuss students' educational goals and help define the path to reach them.

Educational Objectives

The objectives of the Bachelor of Science in Civil Engineering curriculum are to develop graduates who embody the following definitions:

- Graduates distinguish themselves within their organizations as individuals able to provide solutions to a wide range of conventional, cutting-edge, and emerging professional challenges related to one or more of the areas of the built, natural and information environments, considering sustainability principles;
- Graduates are innovative, proactive, and adaptive professionals, highly engaged in their professional communities; graduates are prepared to take on leadership positions within their organizations and communities; and
- Graduates are able to contribute and collaborate on developing solutions to local and global problems; graduates are able to cross geographic, cultural, and traditional discipline boundaries in developing solutions.

The Civil Engineering program is accredited by the Engineering Accreditation Commission of ABET, http://www.abet.org.

By the end of the B.S. program, students should have achieved the following student outcomes:

A. an ability to apply knowledge of mathematics, science and engineering
B. an ability to design and conduct experiments, as well as to analyze and interpret data
C. an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability
D. an ability to function on multidisciplinary teams
E. an ability to identify, formulate, and solve engineering problems
F. an understanding of professional and ethical responsibility
G. an ability to communicate effectively
H. the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context
I. a recognition of the need for, and an ability to engage in lifelong learning
J. a knowledge of contemporary issues relevant to engineering practice
K. an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice

The curriculum has been designed, and is periodically evaluated and refined, to provide students instruction and experiences that lead to the development of these abilities and skills.

Curriculum

Minimum units required for B.S. in Civil Engineering 379

Students entering the College of Engineering declare a major near the end of the first year. First-year students take two introductory engineering courses as well as some restricted technical electives within the common foundation specified for first-year engineering students. By the end of the sophomore year, a Civil Engineering major is expected to have completed the Restricted Technical Electives in the following list and 12-100 Introduction to Civil and Environmental Engineering.

Restricted Technical Electives		Units
09-101	Introduction to Experimental Chemistry	3
09-105	Introduction to Modern Chemistry I	10
15-110	Principles of Computing	10
21-120	Differential and Integral Calculus	10
21-122	Integration and Approximation	10
21-259	Calculus in Three Dimensions	9
21-260	Differential Equations	9
33-141	Physics I for Engineering Students	12
33-142	Physics II for Engineering and Physics Students	12

Notes on Math Requirements

1. All mathematics (21-xxx) courses required for the engineering degree taken at Carnegie Mellon must have a minimum grade of C in order to be counted toward the graduation requirement for the BS engineering degree.
2. A minimum grade of C must be achieved in any required mathematics (21-xxx) course that is a pre-requisite for the next higher level required mathematics (21-xxx) course.

Sample Curriculum

This section shows the recommended four-year program of study for the BS in Civil Engineering following a typical path. The curriculum for transfer students, students with advanced placement credit, and students planning to study abroad will not follow the same path. Students need to consult the department for appropriate advising and formulation of a plan to complete the degree within eight semesters.

First Year

Fall		Units
12-100	Introduction to Civil and Environmental Engineering	12
21-120	Differential and Integral Calculus	10
33-141	Physics I for Engineering Students	12
99-10x	Computing @ Carnegie Mellon	3
xx-xxx	General Education Course	9
		46

Spring		Units
xx-xxx	Introduction to Engineering (other than CEE)	12
21-122	Integration and Approximation	10
33-142	Physics II for Engineering and Physics Students	12
09-101	Introduction to Experimental Chemistry	3
xx-xxx	General Education Course	9
		46

Sophomore Year

Fall		Units
12-212	Statics	9
21-259	Calculus in Three Dimensions	9
15-110	Principles of Computing	10
09-105	Introduction to Modern Chemistry I	10
39-210	Experiential Learning I	0
xx-xxx	General Education Course	9
		47

Spring		Units
12-231	Solid Mechanics	9
12-232	Solid Mechanics Lab	3
12-271	Introduction to Computer Application in Civil & Environmental Engineering	9
21-260	Differential Equations	9
39-220	Experiential Learning II	0
xx-xxx	General Education Course	9
xx-xxx	Elective 1	9
		48

Junior Year

Fall		Units
12-301	Civil Environmental Engineering Projects	9
12-335	Soil Mechanics	9
12-336	Soil Mechanics Laboratory	3
12-355	Fluid Mechanics	9
12-356	Fluid Mechanics Lab	3
39-310	Experiential Learning III	0
xx-xxx	General Education Course	9
xx-xxx	Elective 2	9
		51

Spring		Units
12-351	Environmental Engineering	9
12-352	Environmental Engineering Lab	3
27-357	Introduction to Materials Selection	6
12-358	Materials Lab	3
36-220	Engineering Statistics and Quality Control	9
xx-xxx	Elective 3	9
xx-xxx	Elective 4	9
		48

Senior Year

Fall		Units
12-401	Civil & Environmental Engineering Design	15
12-411	Project Management for Construction	9
12-421	Engineering Economics	6
xx-xxx	General Education Course	9
xx-xxx	Elective 5	9
		48

Spring		Units
xx-xxx	General Education Course	9
xx-xxx	General Education Course	9
xx-xxx	Elective 6	9
xx-xxx	Elective 7	9
xx-xxx	Elective 8	9
		45

Notes on Electives

1. One elective must be in the basic sciences, from the following list:

03-121	Modern Biology	9
12-201	Geology	9

   Substitutions may be made only with the approval of the Department Head.
2. One elective course is restricted to a 600-level Civil Engineering course of at least 9 units, except 12-648 and 12-690. This Civil Engineering elective is a co-requisite for 12-401.
3. **Students are encouraged to take multiple 12-6xx courses to provide them with specific civil and environmental engineering domain depth in their field(s) of interest.**

Specialty Areas in Civil Engineering

Students may select a set of civil engineering and technical electives in the junior and senior years that enable them to concentrate in a specialty area, if they so desire. Some examples for grouping electives into specialty areas, together with representative course selections, are indicated below. Other possible groupings may be discussed with a faculty mentor. These specialty areas are not noted on the official transcript.

Structural Engineering

		Units
12-600	AutoCAD	3
12-631	Structural Design	12
12-635	Structural Analysis	9
12-636	Geotechnical Engineering	9
12-638	Special Topics: Behavior of Structural Systems	9
12-676	Special Topics: Fundamental Concepts and Methods of Structural Mechanics	12
12-686	Special Topics: Computational Materials Modeling for Structures	12
21-241	Matrices and Linear Transformations	10
24-351	Dynamics	10
		86

Environmental Engineering - Air Quality

09-106	Modern Chemistry II	10
12-651	Air Quality Engineering	9
12-679	Special Topics: Intro to Meteorology	12
24-425	Combustion and Air Pollution Control	9
		40

Environmental Engineering - Water Quality

03-121	Modern Biology	9
09-106	Modern Chemistry II	10
12-629	Environmental Microbiology for Engineers	9
12-702	Fundamentals of Water Quality Engineering	12

Environmental Engineering - Water Resources

12-636	Geotechnical Engineering	9
12-657	Water Resource Systems Engineering	9

Environmental Engineering - Energy

06-221	Thermodynamics	9
09-106	Modern Chemistry II	10
24-292	Renewable Energy Engineering	9
24-424	Energy and the Environment	9

Computing in Civil Engineering

12-600	AutoCAD	3
12-631	Structural Design	12
12-635	Structural Analysis	9
12-657	Water Resource Systems Engineering	9
12-659	Special Topics: Matlab	6

Construction Management

12-600	AutoCAD	3
12-631	Structural Design	12
12-635	Structural Analysis	9
12-636	Geotechnical Engineering	9

Double Majors and Minors

Civil Engineering students may pursue double majors and minors in a variety of subjects, taking advantage of the free elective courses to satisfy the requirements for the major or minor. The College of Engineering has added designated minors to promote flexibility and diversity among engineering students. Many Civil Engineering undergraduates pursue designated minors in such areas as Global Engineering or Environmental Engineering and Sustainability.

Internships and Co-Operative Education Program

Students in Civil Engineering are encouraged to undertake professional internships during summer breaks. In addition, a cooperative internship program is possible for either Jan-Aug or May-Dec in the junior year. Students undertaking these 8-month professional internships would ordinarily graduate after an additional semester of study.

Integrated B.S./M.S. Program

Interested undergraduates may plan a course of study that leads to both the BS in Civil Engineering and the MS in Civil and Environmental Engineering. This course of study will ordinarily require ten semesters of study, although advanced placement or other study may reduce this time. Students can apply appropriate units earned as undergraduates for their MS program as long as they are beyond the 379 units required for the BS in Civil Engineering degree. In the ninth semester of study, students must register in graduate status. Interested students should consult their academic advisor or the CEE Department office for information about admission to the MS program.

Faculty

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