Civil and Environmental Engineering

Courses offered by the Department of Civil and Environmental Engineering are listed under the subject code CEE on the Stanford Bulletin’s ExploreCourses web site.

The Department of Civil and Environmental Engineering (CEE) at Stanford conducts fundamental and applied research to advance the civil and environmental engineering professions, educate future academic and industry leaders, and prepare students for careers in professional practice. Civil and environmental engineers work to sustain the natural environment while creating and maintaining the built environment. Civil and environmental engineers are essential to providing the necessities of human life, including water, air, shelter, the infrastructure, energy, and food in increasingly more efficient and renewable ways.

Our department focuses on the theme of engineering for sustainability, including three core areas: built environment, environmental and water studies, and atmosphere/energy. The Sustainable Built Environment Program includes creating processes, techniques, materials, and monitoring technologies for planning, design, construction, and operation of environmentally sensitive, economically efficient, performance-based buildings and infrastructure, and managing associated risks from natural and man-made hazards. The Environmental and Water Studies Program includes creating plans, policies, science-based assessment models and engineered systems to manage water in ways that protect human health, promote human welfare, and provide freshwater and coastal ecosystem services. The Atmosphere/Energy Program includes studying fundamental energy and atmospheric engineering science and assessing energy-use effects on atmospheric processes and air quality, and analyzing and designing energy-efficient generation and use systems with minimal environmental impact.

The department oversees undergraduate programs in Civil Engineering and in Environmental Engineering. The department also hosts the School of Engineering undergraduate major in Architectural Design and the undergraduate major in Atmosphere/Energy; both of these programs lead to a B.S. in Engineering.

Mission of the Undergraduate Program in Civil Engineering

The mission of the undergraduate program in Civil Engineering is to provide students with the principles of engineering and the methodology needed for civil engineering practice. This pre-professional program balances the fundamentals common to many specialties in civil engineering and allows for concentration in structures and construction or environmental and water studies. Students in the major learn to apply knowledge of mathematics, science, and civil engineering to conduct experiments, design structures and systems to creatively solve engineering problems, and communicate their ideas effectively. The curriculum includes course work in structural, construction, and environmental engineering. The major prepares students for careers in consulting, industry, and government, as well as for graduate school in Engineering.

Mission of the Undergraduate Program in Environmental Engineering

The mission of the undergraduate program in Environmental Engineering is to equip students with the problem solving skills and knowledge necessary to assess and develop solutions to environmental problems impacting the biosphere, land, water, and air quality. The Environmental Engineering major offers a more focused program in Environmental and Water Studies than the Environmental and Water Studies concentration in the Civil Engineering degree program. Courses in the program are multidisciplinary in nature, combining fundamental principles drawn from physics, chemistry, geology, engineering, and biology. Students learn to apply analytical methods necessary to evaluate environmental changes and to design strategies to remediate problems that inevitably may have resulted from human activities. The program prepares students for careers in consulting, industry, and government, and for graduate school in engineering.

Learning Outcomes (Undergraduate)

Undergraduates in the Civil Engineering and the Environmental Engineering programs are expected to achieve the following learning outcomes through their major. These learning outcomes are used both in evaluating students and the department’s undergraduate program. Students are expected to demonstrate:

1. understanding of engineering principles as well as the analytical, problem solving, design, and communication skills necessary to succeed and continue learning in diverse careers.
2. preparation for successful engineering practice with a longer term perspective that takes into account new tools such as advanced information technology and biotechnology, and increasingly complex professional and societal expectations.
3. sufficient breadth and depth for graduate study in engineering or other professional fields.
4. the awareness, background, and skills necessary to become responsible citizens and leaders in service to society.

Learning Outcomes (Graduate)

The purpose of the master’s program is to provide students with the knowledge and skills necessary for a professional career or doctoral studies. Students are prepared through course work with specialization within one of three broad areas including the built environment, atmosphere and energy, and environmental and water studies. All graduate students must master three broad areas including the built environment, atmosphere and energy. The Ph.D. is conferred upon candidates who have demonstrated substantial contributions in Civil and Environmental Engineering and related fields.

Graduate Programs in Civil and Environmental Engineering

The Department of Civil and Environmental Engineering (CEE), in collaboration with other departments, offers graduate degrees structured in three degree programs.

- The Atmosphere/Energy Program offers degrees with the designation of Atmosphere/Energy.
- The Sustainable Built Environment Program offers degrees with five designations:
  - Construction Engineering and Management
  - Design-Construction Integration
  - Geomechanics
  - Structural Engineering
  - Sustainable Design and Construction.
• The Environmental and Water Studies Program offers degrees with two designations:
  • Environmental Engineering and Science
  • Environmental Fluid Mechanics and Hydrology

For detailed information on these programs and degree designations, see the "Programs of Graduate Study in Civil and Environmental Engineering" section of this bulletin.

Admissions and Financial Aid

Applications require online submission of the application form and statement of purpose, followed by three letters of recommendation, results of the General Section of the Graduate Record Examination, and transcripts of all courses taken at colleges and universities. See http://gradadmissions.stanford.edu. Policies for each of the department’s programs are available on the department website. See: http://cee.stanford.edu. Successful applicants are advised as to the degree and program for which they are admitted. If students wish to transfer from one CEE program to another after being accepted, an application for the intradepartmental change must be filed within the department; they will then be advised whether the change is possible. If, after enrollment at Stanford, students wish to continue toward a degree beyond the one for which they were originally admitted, a written application must be made to the Department of Civil and Environmental Engineering.

The department maintains a continuing program of merit-based financial aid for graduate students. MS and ENG applications for financial aid and assistantships should be filed by December 3, 2013; it is important that Graduate Record Examination scores be available at that time. MS and ENG applicants not requesting financial assistance have until February 4, 2014 to submit their online application. PHD applicants for financial aid and assistantships should be filed February 4, 2014. Merit-based financial aid consists of teaching assistantships and research assistantships for up to half-time work. Engineer and Ph.D. candidates may be able to use research results as a basis for their thesis or dissertation. Fellowship and scholarship awards or loans may supplement assistantships and other basic support. Continued support is generally provided for further study toward the Engineer or Ph.D. degree based on the student’s performance, the availability of research funds, and requisite staffing of current research projects.

Facilities

Research work and instruction under the three programs are carried out in these facilities: Building Energy Laboratory; Environmental Engineering and Science Laboratory; Environmental Fluid Mechanics Laboratory (EFML); Geotechnical Engineering Laboratory; Structural Engineering Laboratory; and water quality control research and teaching laboratories. The John A. Blume Earthquake Engineering Center conducts research on earthquake engineering including advanced sensing and control, innovative materials, and risk hazard assessment. Research and advanced global teamwork education is conducted in the Project Based Learning (PBL) Laboratory. In collaboration with the Department of Computer Science, the Center for Integrated Facility Engineering (CIFE) employs advanced CAD, artificial intelligence, communications concepts, and information management to integrate participants in the facility development process and to support design and construction automation. The Collaboratory for Research on Global Projects (CRGP) is a multi-school, multi-university research program aimed at improving the performance of global engineering and construction projects, with a special focus on sustainable infrastructure in developing countries. The Stanford Sustainable Systems Lab (S3L) aims to advance the state of the art in the design, monitoring and management of built environment systems, with a special focus on smart grid, smart buildings and smart infrastructures.

Programs of Graduate Study
in Civil and Environmental Engineering

Atmosphere/Energy Program

The Atmosphere/Energy Program in Civil and Environmental Engineering combines atmospheric science with energy science and engineering. The main goals of the program are to educate students and the public, through courses, research, and public outreach, about the causes of climate, air pollution, and weather problems and methods of addressing these problems through renewable and efficient energy systems. In addition, students learn about feedback between the atmosphere and renewable energy systems and the effects of the current energy infrastructure on the atmosphere.

Major focus areas of energy research include examining the resource availability of renewable energies, such as wind, solar, and wave, and studying optimal methods of combining renewable energies together to match energy supply with instantaneous demand. This type of work is generally done through a combination of data analysis, three-dimensional atmospheric computer modeling of wind, solar, wave, and hydroelectric power resources, and transmission load flow computer modeling. Other energy research, performed through three-dimensional computer modeling, focuses on the effects, for example, of hydrogen fuel cell vehicles on air pollution and the ozone layer and the effects of ethanol and diesel vehicles on air quality and climate. Studies also examine the feedback of wind turbines to the atmosphere and the effects of climate change on wind and solar energy resources.

Atmospheric research in the program generally involves laboratory work, field measurements, or three-dimensional computer modeling of the combined atmosphere, ocean, and land surface. An example of laboratory work includes measuring the properties of organic particulate matter that forms in the atmosphere. Examples of fieldwork include measuring exposures to secondhand smoke, allergens, and emissions from building materials.

Computer modeling is performed at a variety of spatial scales, from the globe down to the size of a building or smaller. Some examples of modeling studies include examining the effects of air pollution particles on clouds, rainfall, water supply, ultraviolet radiation, the stratospheric ozone layer, and climate, simulating the dispersion of toxic contaminants in an urban street canyon, studying the effects of aircraft exhaust and biomass burning on climate, studying the effects of carbon dioxide domes over cities on air pollution mortality, and studying the leading causes of global warming and their impacts.

Environmental and Water Studies Programs

Environmental and Water Studies include subprograms in environmental engineering and science and environmental fluid mechanics and hydrology, which includes environmental planning. Course offerings permit study in a single area or interrelated study between areas. Programs are flexible to foster interaction among students and encourage the development of individual programs. The Stanford laboratories for water quality control and environmental fluid mechanics are well equipped for advanced research and instruction.

Courses from other programs and departments complement our programs’ course offerings. Examples include Computer Science (numerical methods), Geological and Environmental Sciences (geostatistics, hydrogeology), Mechanical Engineering (applied math, experimental methods, fluid
Environmental Engineering and Science

The Environmental Engineering and Science (EES) subprogram offers courses in: environmental planning and impact assessment, environmental fluid mechanics, hydrology, and transport modeling. Course offerings include: the biological, chemical, and engineering aspects of water supply; the movement and fate of pollutants in surface and ground waters, soil, and the atmosphere; hazardous substance control; molecular environmental biotechnology; and water and air pollution. The subprogram also considers environmental and institutional issues involved in planning water resources development projects.

Environmental Fluid Mechanics and Hydrology

The Environmental Fluid Mechanics and Hydrology (EFMH) subprogram focuses on understanding the physical processes controlling the movement of mass, energy, and momentum in the water environment and the atmosphere. The subprogram also considers environmental and institutional issues involved in planning water resources development projects. Environmental fluid mechanics courses address: experimental methods; fluid transport and mixing processes; the fluid mechanics of stratified flows; natural flows in coastal waters, estuaries, lakes, and open channels; and turbulence and its modeling. Hydrology courses consider flow and transport in porous media, stochastic methods in both surface and subsurface hydrology, and watershed hydrology and modeling. Atmosphere courses deal with climate, weather, storms and air pollution and their modeling. Planning courses emphasize environmental policy implementation and sustainable water resources development.

The research of this group is focused in the Environmental Fluid Mechanics Laboratory, which includes the P. A. McCuen Environmental Computer Center.

Admission to environmental engineering and science, and environmental fluid mechanics and hydrology are handled separately; prospective students should indicate their preference on their application.

Sustainable Built Environment Program

The Sustainable Built Environment program includes subprograms in Construction Engineering and Management, Design-Construction Integration, Structural Engineering and Geomechanics, and Sustainable Design and Construction. These programs focus on educating practitioners and researchers to plan, design, build, and operate more sustainable buildings and infrastructure.

The Structural Engineering and Geomechanics (SEG) subprogram educates designers and researchers who want to progress beyond traditional life safety code-based design, to develop and disseminate performance-based structural and geotechnical engineering methods and tools that maximize the lifecycle economic value of facilities. The SEG subprogram prepares students for industrial or academic careers.

The Sustainable Design and Construction (SDC) subprogram provides courses in sustainable, multi-stakeholder design methods and tools that incorporate lifecycle cost analysis, project planning and entitlement, green architectural design, lighting, and energy analysis, power systems, transportation, water supply and wastewater treatment to educate students interested in promoting more sustainable development of buildings and infrastructure.

Admission is managed separately for these two subprograms; prospective students should indicate their preference on their application.

Structural Engineering and Geomechanics

The Structural Engineering and Geomechanics (SEG) subprogram encompasses teaching and research in structural design and analysis, structural materials, earthquake engineering and structural dynamics, advanced sensing and structural health monitoring, risk and reliability analysis, computational science and engineering, and geotechnical engineering including geomechanics. The SEG subprogram prepares students for industrial or academic careers.

Students can balance engineering fundamentals with modern computational and experimental methods to customize programs to launch careers as consultants on large and small projects, designers, and engineering analysts.

Structural design and analysis focuses on the conceptual design of structural systems and on computational methods for predicting the static and dynamic, linear and nonlinear responses of structures.

Structural materials research and teaching focuses on the design and analysis of high-performance as well as low-environmental impact materials.

Earthquake engineering and structural dynamics addresses earthquake phenomena, ground shaking, and the behavior, analysis, and design of structures under seismic and other dynamic forces.

Reliability and risk analysis focuses on advanced methods for structural safety evaluation and design, including methods for loss estimation from damage and failures of structures and lifeline systems.

Computational science and engineering emphasizes the application of modern computing methods to structural engineering and geomechanics and encompasses numerical, structural, and geotechnical analysis, including finite element analysis and boundary element methods.

In the area of geomechanics, students focus on the application of the principles of applied mechanics to problems involving geologic materials including theoretical soil and rock mechanics, computational methods, and analysis and design of foundations and earth structures.

Construction Engineering and Management

The Construction Engineering and Management (CEM) subprogram prepares technically qualified students for responsible engineering and management roles in all phases of the development of major constructed facilities. It emphasizes management techniques useful in organizing, planning, and controlling the activities of diverse specialists working within the unique project environment of the construction industry, and it covers construction engineering aspects of heavy, industrial and building construction.

The CEM subprogram offers courses in:

- building systems
- construction administration
- construction law
Earthquake engineering and structural dynamics addresses earthquake phenomena, ground shaking, and the behavior, analysis, and design of structures under seismic and other dynamic forces.

Reliability and risk analysis focuses on advanced methods for structural safety evaluation and design, including methods for loss estimation from damage and failures of structures and lifeline systems.

Computational science and engineering emphasizes the application of modern computing methods to structural engineering and geomechanics and encompasses numerical, structural, and geotechnical analysis, including finite element analysis and boundary element methods.

In the area of geomechanics, students focus on the application of the principles of applied mechanics to problems involving geologic materials including theoretical soil and rock mechanics, computational methods, and analysis and design of foundations and earth structures.

**Sustainable Design and Construction**

The Sustainable Design and Construction (SDC) subprogram prepares students for careers in planning, designing, building, and operating sustainable buildings and infrastructure to maximize their lifecycle economic value, their net contribution to environmental functions and services, and their social equity.

The subprogram offers courses in:

- project finance
- sustainable multidisciplinary
- multi-stakeholder planning and design processes
- green architecture
- performance-based structural design
- building energy systems
- renewable power generation and smart electrical grids
- water supply
- wastewater treatment
- transportation
- sustainable construction materials and processes
- cutting-edge information technology
- sensor networks embedded in intelligent buildings and infrastructure
- strategy, economics, entrepreneurship and organization design for new businesses
- corporate or governmental initiatives aimed at enhancing the sustainability of buildings and infrastructure

This subprogram is intended for students with undergraduate degrees in architecture, engineering, science, construction management, economics, or business who wish to pursue careers that enhance the sustainability of the built environment.

Employers of past SDC graduates include: architectural and engineering design firms, constructors, design-build firms and developers focused on delivering green buildings and infrastructure; energy and sustainability consultants; facility management or sustainability departments within large companies; clean-tech start ups, and clean-tech venture funds.

**Bachelor of Science in Civil and Environmental Engineering**

The B.S. in Civil Engineering and the B.S. in Environmental Engineering are ABET accredited programs, which place high priority on integrating research with engineering education. Any student wishing ABET accreditation for the Environmental Engineering major must graduate by
June 2015; after that date, only the Civil Engineering major will continue to be accredited.

Three educational objectives structure both degree programs. Graduates of the Civil and Environmental Engineering program are expected within a few years of graduation to have the ability to:

1. Establish themselves as practicing professionals in civil or environmental engineering or a related field.
2. Pursue graduate study in civil or environmental engineering or other fields.
3. Work effectively as responsible professionals alone or in teams handling increasingly complex professional and societal expectations.

Students who major in Civil Engineering or in Environmental Engineering must complete the appropriate requirements for the B.S. degree listed.

Each student has elective units, which may be used in any way the student desires, including additional studies in Civil and Environmental Engineering or any other school or department in the University. Because the undergraduate engineering curriculum provides breadth of study, students who intend to enter professional practice in civil or environmental engineering should plan to obtain their professional education at the graduate level.

A number of undergraduate programs at Stanford may be of interest to students seeking to specialize in environmental studies. In addition to the two majors offered in the department, students should examine related programs such as Earth Systems, Geological and Environmental Sciences, Atmosphere/Energy, Urban Studies, and Human Biology.

Civil Engineering (CE)

Completion of the undergraduate program in Civil Engineering leads to the conferral of the Bachelor of Science in Civil Engineering.

Mission of the Undergraduate Program in Civil Engineering

The mission of the undergraduate program in Civil Engineering is to provide students with the principles of engineering and the methodologies necessary for civil engineering practice. This pre-professional program balances the fundamentals common to many specialties in civil engineering and allows for concentration in structures and construction or environmental and water studies. Students in the major learn to apply knowledge of mathematics, science, and civil engineering to conduct experiments, design structures and systems to creatively solve engineering problems, and communicate their ideas effectively. The curriculum includes course work in structural, construction, and environmental engineering. The major prepares students for careers in consulting, industry and government, as well as for graduate studies in engineering.

Requirements

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<thead>
<tr>
<th>Mathematics and Science (45)</th>
<th>Units</th>
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<td>45 units minimum; see Basic Requirements 1 and 2</td>
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<th>Technology in Society (3-5)</th>
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<td>One course; see Basic Requirement 4</td>
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<th>Engineering Fundamentals (10-12)</th>
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<td>Three courses minimum, see Basic Requirement 3</td>
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<td>ENGR 14 Intro to Solid Mechanics</td>
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<td>Fundamentals Elective</td>
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<th>Engineering Depth (57-61)</th>
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<td>Minimum of 68 Engineering Fundamentals plus Engineering Depth; see Basic Requirement 5</td>
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| CEE 100 Managing Sustainable Building Projects | 4 |
| CEE 101A Mechanics of Materials | 4 |
| CEE 101B Mechanics of Fluids | 4 |
| CEE 101C Geotechnical Engineering | 4 |
| CEE 146A Engineering Economy | 3 |

Specialty courses in either:
- Environmental and Water Studies (see below)
- Structures and Construction (see below)

Other School of Engineering Electives 3-0

Total Units 115-123

Mathematics must include CME 100 Vector Calculus for Engineers/ CME 102 Ordinary Differential Equations for Engineers (or Math 51 Linear Algebra and Differential Calculus of Several Variables/ MATH 53 Ordinary Differential Equations with Linear Algebra) and a Statistics course. Science must include Physics 41 Mechanics; either ENGR 31 Chemical Principles with Application to Nanoscale Science and Technology, CHEM31A Chemical Principles I or CHEM 31X Chemical Principles; two additional quarters in either chemistry or physics and GES 1A Introduction to Geology; The Physical Science of the Earth (or GES 1B or 1C); for students in the Environmental and Water Studies track, the additional chemistry or physics must include CHEM 33; for students in the Structures and Construction track, it must include PHYSICS 43 or 45.

1. Chosen TiS class must specifically include an ethics component, such as STS 101 Science Technology and Contemporary Society, STS 110 Ethics and Public Policy, STS 115 Ethical Issues in Engineering.

2. CEE 100 meets the Writing in the Major (WIM) requirement.

Environmental and Water Studies

| ENGR 30 Engineering Thermodynamics | 3 |
| CEE 101D Computations in Civil and Environmental Engineering | 2 |
| CEE 160 Mechanics of Fluids Laboratory | 2 |
| CEE 161A Rivers, Streams, and Canals | 3-4 |
| CEE 166A Watersheds and Wetlands | 3 |
| CEE 166B Floods and Droughts, Dams and Aqueducts | 3 |
| CEE 171 Environmental Planning Methods | 3 |
| CEE 172 Air Quality Management | 3 |
| CEE 177 Aquatic Chemistry and Biology | 4 |
| CEE 179A Water Chemistry Laboratory | 3 |

Remaining specialty units from:

| CEE 63 Weather and Storms | 2 |
| CEE 64 Air Pollution and Global Warming: History, Science, and Solutions | 2 |
| CEE 109 Creating a Green Student Workforce to Help Implement Stanford’s Sustainability Vision | 2 |
| CEE 129 Climate Change Adaptation for Seaports: Engineering and Policy for a Sustainable Future | 3 |
| CEE 164 Introduction to Physical Oceanography | 4 |
| CEE 166D Water Resources and Water Hazards Field Trips | 2 |
| CEE 172A Indoor Air Quality | 2-3 |
| CEE 173A Energy Resources | 4-5 |
| CEE 176A Energy Efficient Buildings | 3-4 |
| CEE 176B Electric Power: Renewables and Efficiency | 3-4 |

_Stanford University_
Undergraduate Engineering Programs (UGHB) (http://ughb.stanford.edu).

For additional information and sample programs see the Handbook for Structures and Construction.

One of the following can also count as remaining specialty units:

- CEE 203
- CEE 199
- CEE 196
- CEE 195
- CEE 176B
- CEE 176A
- CEE 171
- CEE 161A
- CEE 160
- CEE 155
- CEE 151
- CEE 146A
- CEE 146B
- CEE 141A
- CEE 134B
- CEE 133B
- CEE 130
- CEE 129
- CEE 122B
- CEE 122A
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- CEE 4
- CEE 3
- CEE 2
- CEE 1

Environmental Engineering (ENV)

Completion of the undergraduate program in Environmental Engineering leads to the conferral of the Bachelor of Science in Environmental Engineering.

Mission of the Undergraduate Program in Environmental Engineering

The mission of the undergraduate program in Environmental Engineering is to equip students with the problem solving skills and knowledge necessary to assess and develop solutions to environmental problems impacting the biosphere, land, water, and air quality. The Environmental Engineering major offers a more focused program in Environmental and Water Studies than the Environmental and Water Studies concentration in the Civil Engineering degree program. Courses in the program are multidisciplinary in nature, combining fundamental principles drawn from physics, chemistry, geology, engineering, and biology. Students learn to apply analytical methods necessary to evaluate environmental changes and to design strategies to remediate problems that inevitably may have resulted from human activities. The program prepares students for careers in consulting, industry, and government, and for graduate school in engineering.

Requirements

Mathematics and Science (45)

See Basic Requirement 1 and 2

Technology in Society (TIS) (3-5)

One 3-5 unit course required, see Basic Requirement 4

Engineering Fundamentals (9-11)

Three courses minimum, including the two listed below; see Basic Requirement 3

ENGR 30 Engineering Thermodynamics

ENGR 90/CEE 70 Environmental Science and Technology

Environmental Engineering Depth (57)

Minimum of 68 units of Engineering Fundamentals plus Engineering Depth; see Basic Requirement 5

CEE 64 Air Pollution and Global Warming: History, Science, and Solutions

CEE 100 Managing Sustainable Building Projects

CEE 101B Mechanics of Fluids

CEE 101D Computations in Civil and Environmental Engineering

CEE 146A Engineering Economy

CEE 169 Mechanics of Fluids Laboratory

CEE 169A Rivers, Streams, and Canals

CEE 169B Floods and Droughts, Dams and Aqueducts

CEE 171 Environmental Planning Methods

CEE 172 Air Quality Management

CEE 177 Aquatic Chemistry and Biology

CEE 179A Water Chemistry Laboratory

CEE 179C Environmental Engineering Design (offered alt years)
construction engineering, construction management, structural/geotechnical

The department offers a minor in Civil Engineering and a minor in Environmental Engineering. Departmental expertise and undergraduate course offerings are available in the areas of architectural design, construction engineering, construction management, structural/geotechnical engineering, environmental engineering and science, environmental fluid mechanics and hydrology, and atmosphere/energy. The courses required for the minors typically have prerequisites. Minors are not ABET-accredited programs.

Civil Engineering (CE) Minor

The civil engineering minor is intended to give students a focused introduction to one or more areas of civil engineering. Departmental expertise and undergraduate course offerings are available in the areas of Architectural Design, Construction Engineering and Management, and Structural and Geotechnical Engineering. Students interested in Environmental and Water Studies should refer to the environmental engineering minor.

The minimum prerequisite for a civil engineering minor is MATH 42 Calculus (or MATH 21 Calculus ); however, many courses of interest require PHYSICS 41 Mechanics and/or MATH 51 Linear Algebra and Differential Calculus of Several Variables as prerequisites. The minimum prerequisite for a Civil Engineering minor focusing on architectural design is MATH 41 Calculus (or MATH 19 Calculus ) and a course in Statistics.

Students should recognize that a minor in civil engineering is not an ABET-accredited degree program.

Since undergraduates having widely varying backgrounds may be interested in obtaining a civil engineering minor, and the field itself is so broad, no single set of course requirements will be appropriate for all students. Instead, interested students are encouraged to propose their own set of courses within the guidelines listed below. Additional information, including example minor programs, are provided on the CEE web site (http://cee.stanford.edu/prospective/undergrad/minor_overview.html) and in Chapter 6 of the Handbook for Undergraduate Engineering Programs (http://ughb.stanford.edu ) .

General guidelines are:

1. A civil engineering minor must contain at least 24 units of course work not taken for the major, and must consist of at least six classes of at least 3 units each of letter-graded work, except where letter grades are not offered.
2. The list of courses must represent a coherent body of knowledge in a focused area, and should include classes that build upon one another.

Example programs are given on the CEE webpage.

Professor Anne Kiremidjian (kiremidjian@stanford.edu ) is the CEE undergraduate minor adviser in Structural Engineering and Construction Engineering and Management. John Barton (jhbarton@stanford.edu ) , Program Director for Architectural Design, is the undergraduate minor adviser in Architectural Design. Students must consult the appropriate adviser when developing their minor program, and obtain approval of the finalized study list from them.

Environmental Engineering (ENV) Minor

The Environmental Engineering minor is intended to give students a focused introduction to one or more areas of Environmental Engineering. Departmental expertise and undergraduate course offerings are available in the areas of environmental engineering and science, environmental fluid mechanics and hydrology, and atmosphere/energy. The minimum prerequisite for an Environmental Engineering minor is MATH 42 Calculus (or MATH 21 Calculus ); however, many courses of interest require PHYSICS 41 Mechanics and/or MATH 51 Linear Algebra and Differential Calculus of Several Variables as prerequisites. Students should recognize that a minor in Environmental Engineering is not an ABET-accredited degree program.

Since undergraduates having widely varying backgrounds may be interested in obtaining an environmental engineering minor, no single set of course

Honors Program

This program leads to a B.S. with honors for undergraduates majoring in Civil Engineering or in Environmental Engineering. It is designed to encourage qualified students to undertake a more intensive study of civil and environmental engineering than is required for the normal majors through a substantial, independent research project.

The program involves an in-depth research study in an area proposed to and agreed to by a Department of Civil and Environmental Engineering faculty adviser and completion of a thesis of high quality. A written proposal for the research to be undertaken must be submitted and approved by the faculty adviser in the fourth quarter prior to graduation. At the time of application, the student must have an overall grade point average (GPA) of at least 3.3 for course work at Stanford; this GPA must be maintained to graduation. The thesis is supervised by a CEE faculty adviser and must involve input from the School of Engineering writing program by means of ENGR 202S Writing: Special Projects or its equivalent. The written thesis must be approved by the thesis adviser. Students are encouraged to present their results in a seminar for faculty and students. Up to 10 units of CEE 199H Undergraduate Honors Thesis, may be taken to support the research and writing (not to duplicate ENGR 202S). These units are beyond the normal Civil Engineering or Environmental Engineering major program requirements.

For additional information and sample programs see the Handbook for Undergraduate Engineering Programs (UGHB) (http://ughb.stanford.edu ) .
requirements is appropriate for all students. Instead, interested students are encouraged to propose their own set of courses within the guidelines listed below. Additional information on preparing a minor program is available in Chapter 6 of the Handbook for Undergraduate Engineering Programs (http://ughb.stanford.edu) .

General guidelines are—

• An Environmental Engineering minor must contain at least 24 units of course work not taken for the major, and must consist of at least six classes of at least 3 units each of letter-graded work, except where letter grades are not offered.

• The list of courses must represent a coherent body of knowledge in a focused area, and should include classes that build upon one another. Example programs are available on the CEE web site (http://cee.stanford.edu/prospective/undergrad/minoroverview.html) .

Professor Lynn Hildemann (hildemann@stanford.edu) is the CEE undergraduate minor adviser in Environmental Engineering. Students must consult with Professor Hildemann in developing their minor program, and obtain approval of the finalized study list from her.

Coterminal B.S./M.S. Program in Civil and Environmental Engineering

Stanford undergraduates who wish to continue their studies for the Master of Science degree in the coterminal program at Stanford must have earned a minimum of 120 units towards graduation. This includes allowable Advanced Placement (AP) and transfer credit. Applicants must submit their application no later than the quarter prior to the expected completion of their undergraduate degree and are expected to meet the Department of Civil and Environmental Engineering application deadlines for all applicants for graduate study (January 17, 2014) to be considered for financial aid, and also if no financial aid is requested. Applications are considered once a year near the beginning of Winter Quarter. An application must display evidence of potential for strong academic performance as a graduate student.

It is recommended that students who contemplate advanced study at Stanford discuss their plans with their advisers in the junior year.

University requirements for the coterminal M.A. are described in the "Coterminal Bachelor's and Master's Degrees" section of this bulletin. For University coterminal degree program rules and University application forms, see the Stanford Undergrad Coterm Guide (http://undergrad.stanford.edu/advising/student-guides/coterm) .

Master of Science in Civil and Environmental Engineering

The following programs are available leading to the M.S. degree in Civil and Environmental Engineering:

• Atmosphere/Energy
• Construction Engineering and Management
• Design-Construction Integration
• Environmental Engineering and Science
• Environmental Fluid Mechanics and Hydrology
• Geomechanics
• Structural Engineering
• Sustainable Design and Construction

Students admitted to graduate study with a B.S. in Civil Engineering, or equivalent, from an accredited curriculum can satisfy the requirements for the M.S. degree in Civil and Environmental Engineering by completing a minimum of 45 units beyond the B.S. All 45 units must be taken at Stanford. A minimum 2.75 grade point average (GPA) is required for candidates to be recommended for the M.S. degree. No thesis is required.

The program of study must be approved by the faculty of the department and should include at least 45 units of courses in engineering, mathematics, science, and related fields unless it can be shown that other work is pertinent to the student’s objectives. Additional program area requirements are available on the department web site and from the department’s student services office (Y2E2 room 316).

Candidates for the M.S. in Civil and Environmental Engineering who do not have a B.S. in Civil Engineering may, in addition to the above, be required to complete those undergraduate courses deemed important to their graduate programs. In such cases, more than three quarters is often required to obtain the degree.

Engineer in Civil and Environmental Engineering

A student with an M.S. in Civil Engineering may satisfy the requirements of the degree of Engineer in Civil and Environmental Engineering by completing 45 unduplicated course work and research units for a total of 90 units. Engineer candidates must submit an acceptable thesis (12-15 units) and maintain a minimum GPA of 3.0. The program of study must be approved by a faculty member in the department.

This degree is recommended for those desiring additional graduate education, especially those planning a career in professional practice. The thesis normally should be started in the first quarter of graduate study after the M.S. degree. Programs are offered in the fields of specialization mentioned for the M.S. degree. The Engineer thesis topic, for students who will continue study toward a CEE Ph.D., must be significantly different from their doctoral research.

Graduate students who lack adequate background in their area of specialization (e.g. lack of prior degree in civil engineering, if required in their program) or who, for whatever reason, are not full-time students should expect to be enrolled for more than two years. Engineer degree candidates should develop individually tailored expected-progress timetables in consultation with their program advisers.

For graduate students not currently attending Stanford, admission to study for the Engineer degree in the Department of Civil and Environmental Engineering begins with the office of Graduate Admissions, see http://www.stanford.edu/home/admission/index.html.

If you are currently pursuing a graduate degree at Stanford, submit an Application for Post-Masters Study (available in the department office, Y2E2 Room 314). This form is typically filed during your second quarter of graduate study, preferably before January 1, so that your application may be reviewed during the normal admissions cycle. You may apply at a later date if your adviser feels that it is appropriate to do so.

A minimum of 90 quarter units of full-time graduate study (or equivalent part-time graduate study) is required for the Engineer degree. For most students, the master’s degree supplies 45 of these units.

If your master’s degree was obtained at another school, you can apply to transfer up to 45 quarter units of residency credit by completing an Application for Transfer Credit for Graduate Work Done Elsewhere. No units need to be transferred if you hold an M.S. degree from Stanford.
Doctor of Philosophy in Civil and Environmental Engineering

The Ph.D. is offered under the general regulations of the University as set forth in the “Graduate Degrees” section of this bulletin. This degree is recommended for those who expect to engage in a professional career in research, teaching, or technical work of an advanced nature. The Ph.D. program requires a total of 135 units of graduate study, at least 90 units of which must be at Stanford. Up to 45 units of graduate study can be represented by the M.S. program described above. Students must maintain a minimum GPA of 3.0 in post-M.S. course work. All candidates for the Ph.D. degree are required to complete CEE 200 in conjunction with a one-quarter teaching assistantship/course assistantship to gain training and instructional experience. Further information on Ph.D. requirements and regulations is found in the department handbook.

The program of study is arranged by the prospective candidate at the beginning of the second year with the advice of a faculty committee whose members are nearest in the field of interest to that of the student. The chair of the committee serves as the student’s interim adviser until such time as a member of the faculty has agreed to direct the dissertation research. Insofar as possible, the program of study is adapted to the interests and needs of the student within the framework of the requirements of the department and the University.

By the end of the second year of graduate study (or by the end of the first year for students who enroll at Stanford with an M.S.), the student is expected to pass the department’s General Qualifying Examination (GQE) to be admitted to candidacy for the doctoral degree. The purpose of the GQE is to ensure that the student is adequately prepared to undertake doctoral research and has a well planned research topic. The exam may take the form of (1) a written and/or oral general examination of the candidate’s major field, (2) a presentation and defense of the candidate’s doctoral research dissertation proposal, or (3) a combination research proposal and general examination. The GQE is administered by an advisory committee consisting of at least three Stanford faculty members, including a chair who is a faculty member in Civil and Environmental Engineering. All members are normally on the Stanford Academic Council. A petition for appointment of one advisory committee member who is not on the Academic Council may be made if the proposed person contributes an area of expertise that is not readily available from the faculty. Such petitions are subject to approval by the department chair. When the primary research adviser is not a member of the CEE Academic Council faculty, the committee must consist of four examiners, with two members from the CEE department.

Ph.D. Minor in Civil and Environmental Engineering

A Ph.D. minor is a program outside a major department. Requirements for a minor are established by the minor department. Acceptance of the minor as part of the total Ph.D. program is determined by the major department. Application for the Ph.D. minor must be approved by both the major and the minor department, and the minor department must be represented at the University oral examination.

A student desiring a Ph.D. minor in Civil and Environmental Engineering (CEE) must have a minor program adviser who is a regular CEE faculty member in the program of the designated subfield. This adviser must be a member of the student’s University oral examination committee and the reading committee for the doctoral dissertation.

The program must include at least 20 units of graduate-level course work (courses numbered 200 or above, excluding special studies and thesis) in CEE completed at Stanford University. The list of courses must form a coherent program and must be approved by the minor program adviser and the CEE chair. A minimum GPA of 3.0 must be achieved in these courses.


Chair: Stephen G. Monismith (on leave Autumn)

Acting Chair: Gregory G. Deierlein (Autumn)

Associate Chair: Sarah Billington


Associate Professors: Jack W. Baker, Alexandra B. Boehm, Jennifer Davis, David L. Freyberg, Oliver B. Fringer (on leave Aut, Win, Spr), Eduardo Miranda, William A. Mitch

Assistant Professors: Michael D. Lepech, Christian Linder, Ram Rajagopal

Courtesy Professors: Peter M. Pinsky, David D. Pollard

Courtesy Associate Professor: Margot G. Gerritsen

Courtesy Assistant Professor: Karen L. Casiotti


Consulting Associate Professors: Edward S. Gross, Gloria T. Lau, Karl Knapp, Colin Ong, Joel N. Swisher, Jie Wang

Consulting Assistant Professors: Pooya Sarabandi

Shimizu Visiting Professor: Darren Delai Sun

UPS Visiting Associate Professor: Richard Regueiro

* Recalled to active duty.

Overseas Studies Courses in Civil and Environmental Engineering

The Bing Overseas Studies Program (http://boсп.stanford.edu) manages Stanford study abroad programs for Stanford undergraduates. Students should consult their department or program’s student services office for applicability of Overseas Studies courses to a major or minor program.

The Bing Overseas Studies course search site (https://undergrad.stanford.edu/programs/boсп/explore/search-courses) displays courses, locations, and quarters relevant to specific majors.
For course descriptions and additional offerings, see the listings in the Stanford Bulletin’s ExploreCourses (http://exploreCourses.stanford.edu) or Bing Overseas Studies (http://bosp.stanford.edu).

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<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
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<tbody>
<tr>
<td>OSPAUSTL 10</td>
<td>Coral Reef Ecosystems</td>
<td>3</td>
</tr>
<tr>
<td>OSPAUSTL 25</td>
<td>Freshwater Systems</td>
<td>3</td>
</tr>
<tr>
<td>OSPAUSTL 30</td>
<td>Coastal Forest Ecosystems</td>
<td>3</td>
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<td>OSPPARIS 74</td>
<td>Climate Change Challenges in France and Europe: from Project to Policy</td>
<td>4</td>
</tr>
<tr>
<td>OSPSANTG 31</td>
<td>The Chilean Energy System: 30 Years of Market Reforms</td>
<td>5</td>
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Note: OSPAUSTL 10 may count towards the ENVEN-BS and the CE-BS with Specialty in Environmental & Water Studies, however it does not count towards the CE-BS with Specialty in Structures & Construction.