Mission of the Undergraduate Program in Civil Engineering

The mission of the undergraduate program in Civil 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.

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.

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/energy, and environmental and water studies. All graduate students must master the analytical, quantitative, and interpretive skills necessary for successful leadership in their chosen field.

The Ph.D. is conferred upon candidates who have demonstrated substantial scholarship and the ability to conduct independent research. Through course work and guided research, the program prepares students to make original 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 and Energy Program offers degrees with the designation of Atmosphere/Energy.
- The Built Environment Program offers degrees with five designations:
  - Construction Engineering and Management
  - Design/Construction Integration
  - Structural Engineering
  - Geomechanics
  - 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. Applications for financial aid and assistantships should be filed by December 4, 2012; it is important that Graduate Record Examination scores be available at that time. Applicants not requesting financial assistance have until February 5, 2013 to submit their online application. Merit-based financial aid consists of teaching assistantships and research assistantships for up to half-time work. Engineering 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 (CIPE) 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 feedbacks 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 mechanics, heat transfer), Energy Resources Engineering (reservoir engineering, well-test analysis), and Statistics (probability and statistics).

The major areas of specialization in the two subprograms, environmental engineering and science, and environmental fluid mechanics and hydrology, are described following. Admission to these subprograms are handled separately; prospective students should indicate their preference on their application.

Environmental Engineering and Science

The Environmental Engineering and Science (EES) subprogram emphasizes the chemical and biological processes involved in water quality engineering, pollution treatment, remediation, and environmental protection.

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. Companion courses in the Environmental Fluid Mechanics and Hydrology Program (EFMH) include environmental planning and impact assessment, and environmental fluid mechanics, hydrology, and transport modeling.

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.

Sustainable Built Environment Programs

The Sustainable Built Environment programs include 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 Construction Engineering and Management (CEM) subprogram prepares students for careers with progressive construction firms worldwide, interested in building more sustainable buildings and infrastructure using advanced modeling and visualization methods and tools known as virtual design and construction.

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 Design-Construction Integration (DCI) subprogram combines courses from CEM and SEG to educate and prepare students for design construction firms that provide integrated design-build project delivery, construction management, and pre-construction services.

The Sustainable Design and Construction (SDC) subprogram provides courses in sustainable, multi-stakeholder design methods and tools that incorporate lifecycle cost analysis, 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 each of these programs; prospective students should indicate their preference on their application.

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, project finance, accounting, real estate development, structural design, HVAC design and construction, equipment and methods, estimating, international construction, labor relations, managing human resources, planning and control techniques, productivity improvement, and project and company organizations. Additional related course work is available from other programs within the department, from other engineering departments, and from other schools in the University such as Earth Sciences and the Graduate School of Business.

The CEM program allows students substantial flexibility to tailor their program of study for careers with general contractors, specialty contractors, real estate, or infrastructure developers or facility owners and operators.

Design-Construction Integration

The Design-Construction Integration (DCI) subprogram prepares students for multidisciplinary collaborative teamwork in an integrated design and construction process. The subprogram extends a student’s design or construction background with core courses in each of these areas and develops the background needed to understand the concerns and expertise of the many project stakeholders. It includes a comprehensive project-based learning experience.

The subprogram in Design-Construction Integration is open to applicants with backgrounds in engineering and science. Applicants should also have a background in the planning, design, or construction of facilities by virtue of work experience and/or their undergraduate education. Knowledge in subjects from the traditional areas of civil engineering is necessary for
students to receive the degree and to satisfy prerequisite requirements for some of the required graduate courses.

Students with an undergraduate degree in Civil Engineering, and who expect to pursue careers with design or construction firms that emphasize design-build, EPC, or turnkey projects should consider DCT.

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.

Sustainable Design 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; and sustainable construction materials and processes. Classes on cutting-edge information technology, sensor networks embedded in intelligent buildings and infrastructure, strategy, economics, entrepreneurship and organization design for new businesses, and corporate or governmental initiatives aimed at enhancing the sustainability of buildings and infrastructure round out the subprogram.

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, contractors, 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.

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 to 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.

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. Four major objectives structure both degree programs:

1. To provide an understanding of engineering principles and the analytical, problem solving, design, and communication skills to continue succeeding and learning in diverse careers.
2. To prepare 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. To prepare for possible graduate study in engineering or other professional fields.
4. To develop the awareness, background, and skills necessary to become responsible citizens and leaders in service to society.

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, Urban Studies, and Human Biology.

Overseas Studies Courses in Civil and Environmental Engineering

For course descriptions and additional offerings, see the listings in the Stanford Bulletin’s ExploreCourses web site (http://explorecourses.stanford.edu) or the Bing Overseas Studies web site (http://bosp.stanford.edu). Students should consult their department or program’s
student services office for applicability of Overseas Studies courses to a major or minor program.

**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 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 Research in Civil and Environmental Engineering, 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.

**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 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.

**Requirements**

<table>
<thead>
<tr>
<th>Mathematics and Science (45)</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>45 units minimum; see Basic Requirement 1 and 2</td>
<td>45</td>
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<thead>
<tr>
<th>Technology in Society (3-5)</th>
<th>Units</th>
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<tbody>
<tr>
<td>One course; see Basic Requirement 4</td>
<td>3-5</td>
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</table>

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<thead>
<tr>
<th>Engineering Fundamentals (10-12)</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Three courses minimum, see Basic Requirement 3</td>
<td></td>
</tr>
<tr>
<td>ENGR 14 Intro to Solid Mechanics</td>
<td>4</td>
</tr>
<tr>
<td>ENGR 90 Environmental Science and Technology</td>
<td>3</td>
</tr>
<tr>
<td>Fundamentals Elective</td>
<td>3-5</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Engineering Depth (57-61)</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum of 68 Engineering Fundamentals plus Engineering Depth; see Basic Requirement 5</td>
<td></td>
</tr>
<tr>
<td>CEE 100 Managing Sustainable Building Projects</td>
<td>4</td>
</tr>
<tr>
<td>CEE 101A Mechanics of Materials</td>
<td>4</td>
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<tr>
<td>CEE 101B Mechanics of Fluids</td>
<td>4</td>
</tr>
<tr>
<td>CEE 101C Geotechnical Engineering</td>
<td>4</td>
</tr>
<tr>
<td>CEE 146A Engineering Economy</td>
<td>3</td>
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<tr>
<td>Specialty courses in either: Environmental and Water Studies (see below)</td>
<td>35-42</td>
</tr>
<tr>
<td>Structures and Construction (see below)</td>
<td></td>
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</tbody>
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<table>
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<tr>
<th>Other School of Engineering Electives</th>
<th>Units</th>
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</thead>
<tbody>
<tr>
<td>Total Units</td>
<td>115-123</td>
</tr>
</tbody>
</table>

1. 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.

2. 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.

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

**Environmental and Water Studies**

<table>
<thead>
<tr>
<th>Environmental and Water Studies</th>
<th>Units</th>
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</thead>
<tbody>
<tr>
<td>ENGR 30 Engineering Thermodynamics</td>
<td>3</td>
</tr>
<tr>
<td>CEE 101D Computations in Civil and Environmental Engineering</td>
<td>3</td>
</tr>
<tr>
<td>CEE 160 Mechanics of Fluids Laboratory</td>
<td>2</td>
</tr>
<tr>
<td>CEE 161A Rivers, Streams, and Canals</td>
<td>3-4</td>
</tr>
<tr>
<td>CEE 166A Watersheds and Wetlands</td>
<td>3</td>
</tr>
<tr>
<td>CEE 166B Floods and Droughts, Dams and Aqueducts</td>
<td>3</td>
</tr>
<tr>
<td>CEE 171 Environmental Planning Methods</td>
<td>3</td>
</tr>
<tr>
<td>CEE 172 Air Quality Management</td>
<td>3</td>
</tr>
<tr>
<td>CEE 177 Aquatic Chemistry and Biology</td>
<td>4</td>
</tr>
<tr>
<td>CEE 179A Water Chemistry Laboratory</td>
<td>3</td>
</tr>
<tr>
<td>Remaining specialty units from: CEE 63 Weather and Storms</td>
<td>3</td>
</tr>
<tr>
<td>CEE 64 Air Pollution and Global Warming: History, Science, and Solutions</td>
<td>3</td>
</tr>
<tr>
<td>CEE 109 Creating a Green Student Workforce to Help Implement Stanford’s Sustainability Vision</td>
<td>2</td>
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</tbody>
</table>
One of the following can also count as remaining specialty units.

CEE 203
CEE 199
CEE 196
CEE 195
CEE 176B
CEE 176A
CEE 173A
CEE 172A
CEE 171A
CEE 161A
CEE 160
CEE 155
CEE 154
CEE 153
CEE 152
CEE 151
CEE 142A
CEE 141A/141B
CEE 141A
CEE 134A
CEE 133A
CEE 132A
CEE 131A
CEE 130
CEE 110
CEE 109
CEE 108
CEE 107
CEE 106
CEE 105
CEE 104
CEE 103
CEE 102
CEE 101D
CEE 101B
CEE 101A
CEE 100
CEE 90/CEE 90B
CEE 89B
CEE 89A
CEE 88B
CEE 88A
CEE 87B
CEE 87A
CEE 86B
CEE 86A
CEE 77B
CEE 77A
CEE 76B
CEE 76A
CEE 75B
CEE 75A
CEE 74B
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CEE 14
CEE 13
CEE 12
CEE 11
CEE 10
CEE 9
CEE 8
CEE 7
CEE 6
CEE 5
CEE 4
CEE 3
CEE 2
CEE 1

Structures and Construction

Select one of the following:

ENGR 50 Introduction to Materials Science, Nanotechnology Emphasis
ENGR 50E Introduction to Materials Science - Energy Emphasis
ENGR 50M Introduction to Materials Science, Biomaterials Emphasis
CEE 102 Legal Aspects of Engineering and Construction
CEE 156 Building Systems
CEE 180 Structural Analysis
CEE 181 Design of Steel Structures
CEE 182 Design of Reinforced Concrete Structures
CEE 183 Integrated Civil Engineering Design Project
Remaining specialty units from:
ENGR 15 Dynamics
CME 104 Linear Algebra and Partial Differential Equations for Engineers
CEE 101D Computations in Civil and Environmental Engineering
CEE 122A Computer Integrated Architecture/Engineering/Construction
CEE 122B Computer Integrated A/E/C
CEE 129 Climate Change Adaptation for Seaports: Engineering and Policy for a Sustainable Future
CEE 141A/141B Infrastructure Project Development
CEE 142A Negotiating Sustainable Development
CEE 151 Negotiation
CEE 155 Introduction to Sensing Networks for CEE
CEE 160 Mechanics of Fluids Laboratory
CEE 161A Rivers, Streams, and Canals
CEE 171 Environmental Planning Methods
CEE 176A Energy Efficient Buildings
CEE 176B Electric Power: Renewables and Efficiency
CEE 195 Fundamentals of Structural Geology
CEE 196 Engineering Geology and Global Change
CEE 199 Undergraduate Research in Civil and Environmental Engineering
CEE 203 Probabilistic Models in Civil Engineering
One of the following can also count as remaining specialty units.
CEE 110 Building Information Modeling
CEE 130 Architectural Design: 3-D Modeling, Methodology, and Process

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

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Requirements

| Mathematics and Science (45) | 45 |
| See Basic Requirement 1 and 2 | 45 |
| Technology in Society (TIS) (3-5) | 3-5 |
| One 3-5 unit course required, see Basic Requirement 4 | 3-5 |
| Engineering Fundamentals (9-11) | 9-11 |
| Three courses minimum, including the two listed below; see Basic Requirement 3 | 9-11 |
| ENGR 30 Engineering Thermodynamics | 3 |
| ENGR 90/CEE 70 Environmental Science and Technology | 3 |
| Fundamentals Elective | 3-5 |
| Environmental Engineering Depth (57) | 57 |
| Minimum of 68 units of Engineering Fundamentals plus Engineering Depth; see Basic Requirement 5 | 57 |
| CEE 64 Air Pollution and Global Warming: History, Science, and Solutions | 3 |
| CEE 100 Managing Sustainable Building Projects | 4 |
| CEE 101B Mechanics of Fluids | 4 |
| CEE 101D Computations in Civil and Environmental Engineering | 3 |
| CEE 146A Engineering Economy | 3 |
| CEE 160 Mechanics of Fluids Laboratory | 2 |
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 and Management, and Structural and Geotechnical Engineering. Students interested in Environmental and Water Studies should refer to the environmental engineering 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.

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 (jbarton@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 requirements is appropriate for all students. Instead, interested students are encouraged to propose their own set of courses within the guidelines listed.

Minor in Civil Engineering or Environmental Engineering

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.
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/minor_overview.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 18, 2013) 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.S. 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 http://studentaffairs.stanford.edu/registrar/publications#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 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.

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. coursework. 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
Associate Chair: Sarah Billington
Associate Professors: Alexandria B. Boehm, Sarah L. Billington, Jennifer Davis, David L. Freyberg, Oliver B. Fringer, Eduardo Miranda
Assistant Professors: Jack W. Baker, Michael D. Lepech, Ram Rajagopal
Courtesy Associate Professor: Margot G. Gerritsen
Consulting Associate Professors: William J. Behrmann, Robert D. Bornstein, Edward S. Gross, Charles S. Han, Jonathan G. Koomey, Gloria T. Lau, Lisa V. Lucas, Karl Knapp, Colin Ong, Joel N. Swisher, Jie Wang, Jane Woodward
Consulting Assistant Professors: Murray D. Einaron, Calvin K. Kam, Neil E. Klepeis, Michael L. MacWilliams, Pooya Sarabandi
Shimizu Visiting Professor: John E. McCray
UPS Visiting Associate Professor: Geert Dewulf
* Recalled to active duty.

Overseas Studies Courses in Civil and Environmental Engineering

The Bing Overseas Studies Program (http://exploreddegrees.stanford.edu/schoolofengineering/civilandenvironmentalengineering/http://bosp.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 (http://bosp.stanford.edu/cgi-bin/course_search.php) displays courses, locations, and quarters relevant to specific majors.