CIVIL AND ENVIRONMENTAL ENGINEERING


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 protect and sustain the natural environment while creating and maintaining a resilient, sustainable built environment. Civil and environmental engineers are essential to providing the necessities of human life, including water, air, shelter, the infrastructure, and energy, in increasingly more efficient and renewable ways.

Research and teaching in the department focus on the theme of engineering for sustainability, including three core areas: built environment, environmental and water studies, and atmosphere/energy. In the area of sustainable built environments, the focus is on 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. In the area of environmental and water studies, the focus is on 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. In the atmosphere/energy area, research and teaching focus on fundamental energy and atmospheric engineering and science, assessment of energy-use effects on atmospheric processes and air quality, and analysis and design energy-efficient generation and use systems with minimal environmental impact.

The department oversees undergraduate programs in Civil Engineering and in Environmental Systems Engineering. The department also hosts the School of Engineering undergraduate major in Architectural Design and the undergraduate major in Atmosphere/Energy - both of which 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 equip students with the knowledge and skills needed for world-class civil engineering practice. This pre-professional program balances the fundamentals common to many specialties in civil engineering while allowing for concentration in structures and construction or in 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 science and engineering.

Learning Outcomes (Undergraduate)

Undergraduates in the Civil Engineering and the Environmental Systems 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 programs. Students are expected to demonstrate the ability to:

1. identify, formulate, and solve complex engineering problems by applying principles of engineering, science and mathematics.
2. apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors.
3. communicate effectively with a range of audiences.
4. recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts.
5. function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives.
6. develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions.
7. acquire and apply new knowledge as needed, using appropriate learning strategies.

Mission of the Undergraduate Program in Environmental Systems Engineering

The mission of the undergraduate program in Environmental Systems Engineering is to prepare students for incorporating environmentally sustainable design, strategies and practices into natural and built systems and infrastructure involving buildings, water supply, and coastal regions. Courses in the program are multidisciplinary in nature, combining math, science, and engineering fundamentals, and tools and skills considered essential for an engineer. Students can choose from one of three focus areas for more in-depth study: coastal environments, freshwater environments, or urban environments. The major offers the opportunity for a more focused curriculum than the Environmental and Water Studies concentration in the Civil Engineering degree program. The program of study, which includes a capstone experience, aims to equip engineering students to take on the complex challenges of the 21st century involving natural and built environments, in consulting and industry as well as in graduate school.

Learning Outcomes (Graduate)

The purpose of the master’s program is to equip students with the knowledge and skills necessary for a successful professional career or for the pursuit of doctoral studies. Students are prepared through course work that is organized into three broad areas including the built environment, atmosphere and energy, and environmental engineering. 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 original scholarship and the ability to conduct independent research. The Ph.D. program prepares students to make original contributions to the theory and practice of Civil and Environmental Engineering and related fields.
Graduate Programs in Civil and Environmental Engineering

The Department of Civil and Environmental Engineering (CEE) offers graduate degrees structured in three areas of study.

- The Atmosphere/Energy Program offers degrees with the designation of Atmosphere/Energy.
- The Sustainable Built Environment Program offers degrees with two designations:
  - Structural Engineering and Geomechanics
  - Sustainable Design and Construction
- The Environmental Engineering Program offers degrees with the designation of Environmental Engineering

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://gradmissions.stanford.edu. Policies for each of the programs in the department 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. If, after enrollment at Stanford, students wish to continue toward a degree beyond that 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. Merit-based financial aid consists of teaching assistantships and/or research assistantships for up to half-time work, with the assumption that students spend the rest of their time on coursework and research required for completion of the degree. 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.

Research Centers and Facilities

Research in the department related to environmental and water studies is conducted in the Bob and Norma Street Environmental Fluid Mechanics Laboratory (EFML) and the Environmental Engineering and Science Laboratory (EESL). The EESL is home to the National Science Foundation (NSF) supported Engineering Research Center for Re-inventing the Nation's Urban Water Infrastructure (ReNUWIT), a four-university consortium that seeks more sustainable solutions to urban water challenges in the arid west, and the William and Cloy Codiga Resource Recovery Center (CR2C), a new facility for pilot-scale testing of resource recovery technology. Other centers and groups in the department related to environmental engineering include the Environmental Informatics Group, the National Performance of Dams Program (NPDP), and the center for Sustainable Development and Global Competitiveness (SDGC). There is also extensive collaboration with research centers and groups throughout the university, including the Woods Institute for the Environment, the Stanford Program on Water, Health & Development, the Bill Lane Center for the American West, the Carnegie Institution, the Center for Innovation in Global Health, Stanford Bio-X, the Environmental and Natural Resources Law and Policy Program, the Freeman Spogli Institute for International Studies, and the Precourt Institute for Energy.

Several research centers in the department focus on improving the sustainability of the built environment. 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. The Center for Integrated Facility Engineering (CIFE) employs advanced information technologies and concepts to integrate the facility development process and enhance the usability, buildability, operability, and sustainability of the built environment. The Global Projects Center (GPC) is a multi-discipline, multi-university research program aimed at improving the performance of global engineering and construction projects, with a special focus on financing and governance of sustainable civil and social infrastructure projects. 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.
Students interested in the Atmosphere and also Clean Renewable Energy systems would most likely apply to the Atmosphere/Energy Program. Those interested in the Atmosphere and also Water systems would most likely apply to the Environmental Engineering Program. Those interested in Atmospheric topics alone (e.g. weather, climate, pollution and its impacts) could apply to either, depending on the courses of interest.

Environmental Engineering Program

The mission of the Environmental Engineering program is to develop state-of-the-art knowledge, models, and processes which form the core of environmental engineering practice, and to train and educate current and future academic and professional environmental leaders. We do this by synthesizing physical, biological, and chemical facets of engineering and science along with elements of the social sciences into our research and teaching. Ultimately, the goal is to protect and sustain our natural resources and human health and contribute to the sustainable development of physical infrastructure, including systems for wastewater treatment, water supply, renewable energy, and resilient coastal environments.

Research and coursework in the Environmental Engineering program are centered around the five focus areas which include:

- Environmental Modeling and Simulation
- Environmental and Geophysical Fluid Mechanics
- Hydrology and Water Resources
- Aquatic Chemistry and Biology and Process Engineering
- Human Health and the Environment

Research in the program spans the physical, chemical, and biological dimensions of Environmental Engineering. Research related to the physical aspects of environmental engineering is conducted in the Bob and Norma Street Environmental Fluid Mechanics Laboratory (EFML), whereas research on the chemical and biological aspects is conducted in the Environmental Engineering and Science Laboratory (EESL). The EESL is home to the National Science Foundation (NSF) supported Engineering Research Center for Re-inventing the Nation’s Urban Water Infrastructure (ReNUWIt), a four-university consortium that seeks more sustainable solutions to urban water challenges in the arid west, and the William and Cloy Codiga Resource Recovery Center (CR2C), a facility for pilot-scale testing of resource recovery technology. There is extensive crossover between the EFML and the EESL, reflecting the interdisciplinary nature of environmental engineering that seeks to quantify physical, biological, and chemical processes in the environment in an integrated way.

Environmental research is also conducted in numerous centers and groups in the department including the Environmental Informatics Group, the National Performance of Dams Program (NPDP), and the center for Sustainable Development and Global Competitiveness (SDGC). There is also extensive collaboration with research centers and groups throughout the university, including the Woods Institute for the Environment, the Bill Lane Center for the American West, the Carnegie Institution, the Center for Innovation in Global Health, Stanford Bio-X, the Environmental and Natural Resources Law and Policy Program, the Freeman Spogli Institute for International Studies, and the Precourt Institute for Energy.

Courses in the Environmental Modeling and Simulation, Environmental and Geophysical Fluid Mechanics, and Hydrology and Water Resources focus areas concentrate on developing an understanding of the physical processes controlling the movement of mass, energy, and momentum in aquatic environments and the atmosphere. Specific course topics include 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, flow and transport in porous media, stochastic methods in both surface and subsurface hydrology, watershed hydrology and modeling, global atmospheric circulation, the atmospheric boundary layer, air pollution from global to indoor scales, and wind energy.
Reliability and risk analysis focuses on assessing damage and losses to structures and lifeline systems under earthquakes, wind and other hazards, insights from these assessments are used to engineer more sustainable structures and more resilient communities.

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

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

**Sustainable Design and Construction**

The Sustainable Design and Construction (SDC) subprogram prepares students for careers in managing the planning, design, construction, and operation of sustainable buildings and infrastructure so that their lifecycle economic value, their net contribution to environmental functions and services, and their social equity are maximized. To give students the breadth and depth necessary to become leaders in practice or research in sustainable design and construction, the SDC program offers four tracks of study: construction, energy, structures, water and sustainable urban systems. In addition to providing critical skills and the necessary industry context, each track offers courses in the following areas of competency: Construction engineering and management; building and infrastructure development; structural performance, design, and analysis; infrastructure systems; energy systems, energy efficiency, and atmosphere.

Classes address advanced topics like modern company and project management methods; cutting-edge information technology, metrics and tools to enhance lifecycle sustainability of the built environment; sensor networks embedded in intelligent buildings and infrastructure; strategy, economics, entrepreneurship and organization design for new businesses; and corporate and governmental initiatives aimed at enhancing the sustainability of buildings and infrastructure.

The SDC 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 venture funds.

**SDC Construction (SDC-C)**

The SDC-C track includes courses in construction engineering and management and introduces advanced modeling and visualization methods and tools - including artificial intelligence and data science applications - known as virtual design and construction. This track prepares technically qualified students for leadership roles in engineering and management 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. 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. SDC-C 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.

**SDC-Energy (SDC-E)**

The SDC-Energy (SDC-E) track includes courses on design and construction of buildings and infrastructure systems to produce, distribute, and consume energy sustainably. SDC-E prepares students for careers in design and construction of building energy systems, renewable power generating systems, and smart power grids connected to smart buildings and infrastructure, cleantech venture capital, sustainability-focused public policy, green real estate development, and sustainability management positions.

SDC-E includes courses from the CEE department and several other departments at Stanford on sustainable HVAC design and construction of small scale and large structures, the planning, design and construction of renewable power systems, and sensing and control technologies to link integrated smart grids with intelligent buildings, data centers and infrastructure systems.

**SDC-Structures (SDC-S)**

The SDC-Structures (SDC-S) track includes courses from construction engineering and management and Structural Engineering and Geomechanics (SEG) to prepare students for careers in design and construction firms that provide integrated design-build project delivery, construction management, and pre-construction services.

This track 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 SDC-S track is intended for applicants with backgrounds in engineering and science. Applicants should also have a background in the planning, design, or construction of built structures 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 SDC-S.

**SDC-Sustainable Urban Systems (SDC-SUS)**

The SDC-Sustainable Urban Systems (SDC-SUS) track combines courses by several faculty from the Department of Civil and Environmental Engineering with courses on sustainable design and construction to focus on the urban scale of the built environment. The SDC-SUS track prepares students for careers in sustainable design, construction, and operation of infrastructure systems and communities.

This track offers courses in frameworks for urban-scale planning of infrastructure systems, technologies to model, simulate, analyze, and visualize the built environment at the urban scale, urban planning, and data analysis. The track includes a significant project-based experience on an actual project in a community.

This track is intended for students with a background in urban planning and systems-level understanding of the built environment from economic, environmental, or social perspectives with an interest to enhance the sustainability of the built environment through leadership roles in public agencies, city government, financial institutions, engineering firms, or technology providers.

**Bachelor of Science in Civil Engineering**

The B.S. in Civil Engineering is an ABET accredited program, which integrates research with engineering education. The B.S. in Civil Engineering offers the opportunity to focus on structures and construction, or on environmental and water studies. Three educational objectives structure the Civil Engineering degree program. Graduates of
Requirements for graduate studies in engineering attract students for careers in consulting, industry and government, as well as construction, and environmental engineering. The major prepares students for careers in civil engineering and allows for concentration in structures and construction or environmental and water studies. Students who major in Civil 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 the department of 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 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 Environmental and Water Studies track within the Civil Engineering major, students may consider related programs in the department such as Atmosphere/Energy and Environmental Systems Engineering, as well as programs offered in other departments and schools such as Earth Systems, Geological and Environmental Sciences, 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**

<table>
<thead>
<tr>
<th>Mathematics and Science</th>
<th>Units</th>
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<tbody>
<tr>
<td>45 units minimum; see Basic Requirements 1 and 2</td>
<td>45</td>
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**Technology in Society**

<table>
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<tr>
<th>One course required</th>
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<tr>
<td>CEE 102A Legal and Ethical Principles in Design, Construction, and Project Delivery</td>
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**Engineering Fundamentals**

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<th>Two courses required</th>
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<tbody>
<tr>
<td>ENGR 14 Intro to Solid Mechanics</td>
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<tr>
<td>ENGR 90/CEE 70 Environmental Science and Technology</td>
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</table>

**Engineering Depth**

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

| 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 146S Engineering Economics and Sustainability | 3 |

Specialty courses in either:

<table>
<thead>
<tr>
<th>Environmental and Water Studies (see below)</th>
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<tbody>
<tr>
<td>Structures and Construction (see below)</td>
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</table>

Total Units 116

1 Mathematics must include CME 100 Vector Calculus for Engineers and CME 102 Ordinary Differential Equations for Engineers (or MATH 51 Linear Algebra, Multivariable Calculus, and Modern Applications and Differential Calculus of Several Variables and 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, CHEM 31A Chemical Principles I or CHEM 31M Chemical Principles: From Molecules to Solids; two additional quarters in either chemistry or physics, and GEOLSCI 1 Introduction to Geology; for students in the Environmental and Water Studies track, the additional chemistry or physics must include CHEM 33 Structure and Reactivity of Organic Molecules; for students in the Structures and Construction track, it must include PHYSICS 43 Electricity and Magnetism or PHYSICS 45 Light and Heat. Note that the only quarter GEOLSCI 1 is offered for AY 2019-20 is Spring Quarter.

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

3 A course may only be counted towards one requirement; it may not be double-counted. All courses taken for the major must be taken for a letter grade if that option is offered by the instructor. Minimum Combined GPA for all courses in Engineering Fundamentals and Depth is 2.0.

**Environmental and Water Studies Focus**

<table>
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<tr>
<th>Units</th>
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<tbody>
<tr>
<td>ME 30 Engineering Thermodynamics</td>
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<tr>
<td>CEE 101D Computations in Civil and Environmental Engineering (or CEE 101S)</td>
</tr>
<tr>
<td>CEE 162E Rivers, Streams, and Canals</td>
</tr>
<tr>
<td>CEE 166A Watershed and Wetlands</td>
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<tr>
<td>CEE 166B Floods and Droughts, Dams and Aqueducts</td>
</tr>
<tr>
<td>CEE 172 Air Quality Management</td>
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<tr>
<td>CEE 177 Aquatic Chemistry and Biology</td>
</tr>
<tr>
<td>CEE 179A Water Chemistry Laboratory</td>
</tr>
<tr>
<td>CEE 179C Environmental Engineering Design</td>
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</tbody>
</table>

Remaining specialty units from:

| CEE 63 Weather and Storms | 3 |
| CEE 64 Air Pollution and Global Warming: History, Science, and Solutions | 3 |
| CEE 107A Understanding Energy | 3-5 |
| CEE 155 Introduction to Sensing Networks for CEE | 4 |
| CEE 162D Introduction to Physical Oceanography | 4 |
| CEE 162F Coastal Processes | 3 |
| CEE 165C Water Resources Management | 3 |
| CEE 275D Environmental Policy Analysis | 3-4 |
| CEE 172A Indoor Air Quality | 2-3 |
| CEE 174A Providing Safe Water for the Developing and Developed World | 3 |
Civil and Environmental Engineering

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 Directed Writing Projects or ENGR 199W Writing of Original Research for Engineers. 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 or ENGR 199W). These units are beyond the normal Civil Engineering or Environmental Systems Engineering major program requirements.

For additional information on the major, minor, honors and sample programs see the Handbook for Undergraduate Engineering Programs (UGHB) (http://ughb.stanford.edu).

Bachelor of Science in Environmental Systems Engineering

For undergraduate studies focusing on Environmental Engineering, two options are available. The undergraduate Civil Engineering major (which is ABET-accredited) offers an Environmental & Water Studies track, and the new Environmental Systems Engineering major (which is not ABET-accredited) offers a choice of focusing on coastal environments, freshwater environments, or urban environments.

Environmental Systems Engineering (EnvSE)

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

Mission of the Undergraduate Program in Environmental Systems Engineering

The mission of the undergraduate program in Environmental Systems Engineering is to prepare students for incorporating environmentally sustainable design, strategies and practices into natural and built systems and infrastructure involving buildings, water supply, and coastal regions. Courses in the program are multidisciplinary in nature, combining math/science/engineering fundamentals, and tools and skills considered essential for an engineer, along with a choice of one of three focus areas for more in-depth study: coastal environments, freshwater environments, or urban environments. This major offers the opportunity for a more focused curriculum than the Environmental and Water Studies concentration in the Civil Engineering degree program. The program of study, which includes a capstone experience, aims to equip engineering students to take on the complex challenges of the twenty-first century involving natural and built environments, in consulting and industry as well as in graduate school.

Requirements

Mathematics and Science

See Basic Requirement 1 and 2 \(^1\) 36

Technology in Society (TiS)

One 3-5 unit course required, course chosen must be on the SoE Approved Courses list at <ughb.stanford.edu> the year taken; see Basic Requirement 4

3-5

Engineering Fundamentals

Two courses minimum (see Basic Requirement 3), including:

Honors Program

This program leads to a B.S. with honors for undergraduates majoring in Civil Engineering or in Environmental Systems 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.

\(^1\) See Basic Requirement 1 and 2
Urban Environments Focus Area (37 units)

Required

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Units</th>
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<tbody>
<tr>
<td>CEE 100</td>
<td>Managing Sustainable Building Projects</td>
<td>4</td>
</tr>
<tr>
<td>CEE 101B</td>
<td>Mechanics of Fluids</td>
<td>4</td>
</tr>
<tr>
<td>CEE 146S</td>
<td>Engineering Economics and Sustainability</td>
<td>3</td>
</tr>
<tr>
<td>CEE 176A</td>
<td>Energy Efficient Buildings</td>
<td>3</td>
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</table>

Electives (at least two of the 4 areas below must be included with at least 3 units from 2nd area)

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Units</th>
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<tbody>
<tr>
<td>CEE 102A</td>
<td>Legal and Ethical Principles in Design, Construction, and Project Delivery</td>
<td>3</td>
</tr>
<tr>
<td>CEE 120B</td>
<td>Advanced Building Modeling Workshop</td>
<td>2-4</td>
</tr>
<tr>
<td>CEE 130</td>
<td>Architectural Design: 3-D Modeling, Methodology, and Process</td>
<td>5</td>
</tr>
<tr>
<td>or</td>
<td>CEE 131C</td>
<td></td>
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<tr>
<td>or</td>
<td>CEE 156</td>
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Building Systems

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Units</th>
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<tbody>
<tr>
<td>CEE 31Q</td>
<td>Accessing Architecture Through Drawing</td>
<td>5</td>
</tr>
<tr>
<td>ENGR 14</td>
<td>Intro to Solid Mechanics</td>
<td>3</td>
</tr>
<tr>
<td>ENGR 103P</td>
<td>The Art of Effective Speaking</td>
<td>3</td>
</tr>
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</table>

Specialty Courses, in either

Coastal environments (see below)
or freshwater environments (see below)
or urban environments (see below)

Total Units: 96-98

Math must include CME 100 Vector Calculus for Engineers (or MATH 51 Linear Algebra, Multivariable Calculus, and Modern Applications), and either a Probability/Statistics course or CME 102 Ordinary Differential Equations for Engineers (or MATH 53 Ordinary Differential Equations with Linear Algebra). Science must include PHYSICS 41 Mechanics; and either CHEM 31B Chemical Principles II or CHEM 31M Chemical Principles: From Molecules to Solids (or PHYSICS 43 Electricity and Magnetism, for Urban focus area only).

Fundamental tools/skills must include:

1. CEE 1 Introduction to Environmental Systems Engineering;
2. at least one visual communication class from CEE 31 Accessing Architecture Through Drawing / CEE 31Q Accessing Architecture Through Drawing, DESINST 270 Visual Design Fundamentals, ME 101 Visual Thinking, ME 110 Design Sketching, ARTSTUD 160 Intro to Digital / Physical Design, or OSPPARIS 44 EAP Analytical Drawing and Graphic Art;
3. at least one oral/written communication class from ENGR 103 Public Speaking, CEE 102W Technical and Professional Communication, ENGR 202W Technical Communication, CEE 151 Negotiation, EARTHSC 191 Concepts in Environmental Communication or ORALCOMM 117 The Art of Effective Speaking;
4. at least one modeling/analysis class from CEE 101D Computations in Civil and Environmental Engineering (or CEE 101S) if not counted as Math, CEE 120S Building Information Modeling Special Study (online only), CEE 146S Engineering Economics and Sustainability (online only), CEE 124X Shaping the Future of the Bay Area, CEE 155 Introduction to Sensing Networks for CEE, CEE 226 Life Cycle Assessment for Complex Systems, CME 211 Software Development for Scientists and Engineers, CS 102 Working with Data - Tools and Techniques, EARTHSC 140 Data science for geoscience, EARTHSC 142 Remote Sensing of Land, EARTHSC 144 Fundamentals of Geographic Information Science (GIS), or ESS 227 Decision Science for Environmental Threats.

A course may only be counted towards one requirement; it may not be double-counted. All courses taken for the major must be taken for a letter grade if that option is offered by the instructor. Minimum Combined GPA for all courses in Engineering Fundamentals and Depth is 2.0.
CEE 166A Watersheds and Wetlands 4
or
CEE 174A Providing Safe Water for the Developing and Developed World 3

Electives
CEE 162E Rivers, Streams, and Canals 3
CEE 162F Coastal Processes 3
CEE 165C Water Resources Management 3
CEE 166A Watersheds and Wetlands (if not counted as a req’d course) 4
CEE 166B Floods and Droughts, Dams and Aqueducts 4
CEE 136 Urban Development and Governance 3
or
CEE 275D Environmental Policy Analysis 3-4
or
CEE 273B The Business of Water 2

CEE 174A Providing Safe Water for the Developing and Developed World 3
CEE 174B Wastewater Treatment: From Disposal to Resource Recovery 3
CEE 175A California Coast: Science, Policy, and Law 3-4
CEE 177 Aquatic Chemistry and Biology 4
CEE 265E Adaptation to Sea Level Rise and Extreme Weather Events 3

CEE 272 Coastal Contaminants 3-4
BIHOJK 150H Ecological Mechanics 3
BIHOJK 163H Oceanic Biology 4

or
CEE 174A Providing Safe Water for the Developing and Developed World ((prereq: CHEM 31B) (if not counted as a Req’d course)) 3
CEE 175A California Coast: Science, Policy, and Law 3-4
CEE 177 Aquatic Chemistry and Biology 4
CEE 275D Environmental Policy Analysis 3-4

or
CEE 273B The Business of Water 2

BIO 30 Ecology for Everyone 4
or
BIO 81 Introduction to Ecology 4
or
BIHOJK 81 Introduction to Ecology 4
or
EARTHSYS 116 Ecology of the Hawaiian Islands 4
or
OSPANSTL 32 Coastal Ecosystems 3
or
OSPGEN 53 Corals of Palau: Ecology, the Physical Environment, and Reefs at Risk 2
or
OSPSTNG 85 Marine Ecology of Chile and the South Pacific 5

Capstone (1 class required)

CEE 141A Infrastructure Project Development (recom. pre-req. CEE 136 or CEE 171P) 3
CEE 179C Environmental Engineering Design (prereq: CEE 174A or CEE 166A) 5
CEE 218Y Shaping the Future of the Bay Area 1-5
CEE 218Z Shaping the Future of the Bay Area 1-5
CEE 325 CapaCity Design Studio 5
CEE 199 Undergraduate Research in Civil and Environmental Engineering (must petition CEE UG Committee for approval, prior to enrollment; must have completed greater than or equal to 6 focus area classes; excluding Breadth) 3-4

Coastal Environments Focus Area (40 units)
Required
CEE 70 Environmental Science and Technology 3
CEE 101B Mechanics of Fluids 4
CEE 162F Coastal Processes 3
CEE 162D Introduction to Physical Oceanography 4
or
CEE 175A California Coast: Science, Policy, and Law 3-4

Electives
CEE 162D Introduction to Physical Oceanography 4
CEE 162I Atmosphere, Ocean, and Climate Dynamics: the Ocean Circulation 3
CEE 166A Watersheds and Wetlands 4

CEE 136 Urban Development and Governance 3
or
CEE 275D Environmental Policy Analysis 3-4

or
CEE 273B The Business of Water 2
CEE 174A Providing Safe Water for the Developing and Developed World 3
CEE 174B Wastewater Treatment: From Disposal to Resource Recovery 3
CEE 175A California Coast: Science, Policy, and Law 3-4
CEE 177 Aquatic Chemistry and Biology 4
CEE 265E Adaptation to Sea Level Rise and Extreme Weather Events 3

EARTHSYS 141 Remote Sensing of the Oceans 3-4
EARTHSYS 151 Biological Oceanography 3-4
to be taken concurrently with
EARTHSYS 152 Marine Chemistry 3-4

Capstone (1 class required)

CEE 141A Infrastructure Project Development 3
CEE 179C Environmental Engineering Design 5
or
CEE 218Y Shaping the Future of the Bay Area 1-5
CEE 218Z Shaping the Future of the Bay Area 1-5
CEE 265E Adaptation to Sea Level Rise and Extreme Weather Events 3
CEE 325 CapaCity Design Studio 5
CEE 199 Undergraduate Research in Civil and Environmental Engineering 3-4
Honors Program
This program leads to a B.S. with honors for undergraduates majoring in Civil Engineering or in Environmental Systems 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 advisor 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 Directed Writing Projects or ENGR 199W Writing of Original Research for Engineers. 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 or ENGR 199W). These units are beyond the normal Civil Engineering or Environmental Systems Engineering major program requirements.

For additional information on the major, minor, honors, and sample programs see the Handbook for Undergraduate Engineering Programs (UGHB) (http://ughb.stanford.edu).

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 Systems Engineering minor.

The minimum prerequisite for a civil engineering minor is MATH 19 Calculus (or MATH 20 Calculus or MATH 21 Calculus); however, many courses of interest require PHYSICS 41 Mechanics and/or MATH 51 Linear Algebra, Multivariable Calculus, and Modern Applications as prerequisites. The minimum prerequisite for a Civil Engineering minor focusing on architectural design is MATH 19 Calculus (or MATH 20 Calculus or MATH 21 Calculus). 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) (http://www.stanford.edu/dept/registrar/bulletin/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 Systems Engineering (EnvSE) Minor
The Environmental Systems Engineering minor is intended to give students a focused introduction to one or more areas of Environmental Systems 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 Systems Engineering minor is MATH 19 Calculus (or MATH 20 Calculus or MATH 21 Calculus); additionally, many courses of interest require PHYSICS 41 Mechanics and/or MATH 51 Linear Algebra, Multivariable Calculus, and Modern Applications as prerequisites. Students should recognize that a minor in Environmental Systems Engineering is not an ABET-accredited degree program.

Since undergraduates having widely varying backgrounds may be interested in obtaining an Environmental Systems 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 below. Additional information on preparing a
A student with an M.S. in Civil Engineering may satisfy the requirements for the M.S. degree 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. For students who will continue study toward a CEE Ph.D., the Engineer thesis topic must be significantly different from their doctoral research.

Graduate students who lack adequate background in their area of specialization (e.g. lack a prior degree in civil engineering, if required in their program) or who 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 (http://www.stanford.edu/home/admission/index/html).

If you are currently pursuing a graduate degree at Stanford, and wish to apply for the Engineer degree program, 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, by
January 15, so that your application may be reviewed during the normal graduate admissions cycle. You may apply at a later date if your advisor 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. Additionally, up to 45 units of graduate study can be represented by the Engineer (ENG) program as described above if both the M.S. and ENG units were all completed at Stanford. 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 Graduate Handbook.

The program of study is arranged via consultation between the prospective candidate and their dissertation research advisor. This program of study considers the interests of the student, and the background needed for their thesis topic, within the framework of the requirements of the department and the University.

By the end of a student’s sixth quarter as an enrolled PhD student, excluding summers, the student is expected to pass both parts of 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 include (1) a written and/or oral general examination of the candidate’s doctoral 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, and the student’s doctoral advisor. When the primary advisor is not a member of the CEE faculty (CEE-Academic Council), there must be a CEE faculty (CEE-Academic Council) co-adviser, and the committee will consist of four examiners, with a minimum of two members who are Academic Council in the CEE department. All members are normally on the Stanford Academic Council. A petition for appointment of an 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 advisor is not a member of the CEE Academic Council faculty, there must be a CEE faculty (CEE-Academic Council) co-adviser, and the committee will consist of four examiners, with a minimum of two members who are Academic Council faculty in 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 advisor who is both a CEE faculty member and a member of the Academic Council. The faculty member must be in the program of the designated minor subfield of CEE. This advisor 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. Units taken for the minor cannot be counted as part of the 45 unduplicated units for the PhD major. The list of courses must form a coherent program and must be approved by the minor program advisor and the CEE chair. A minimum GPA of 3.0 must be achieved in these courses.

**Graduate Advising Expectations**

Faculty advisors serve as intellectual and professional mentors to their graduate students. They are expected to provide knowledgeable support concerning policies for graduate studies, help prepare students to be competitive for employment, maintain a high level of professionalism, and establish expectations concerning advisor/advisee relationship consistent with University and department standards. General University policies on advising and the conduct of research can be found at VPGE’s Advising and Mentoring (https://vpge.stanford.edu/academic-guidance/advising-mentoring) web site.

It is important to distinguish between master’s and doctoral advising. Master’s students are assigned academic program advisors randomly, unless they explicitly request a specific faculty to advise them. The process by which a master’s student can change advisors is flexible and can be done without any paperwork, provided that the change of advisor is made within the same program. The student, however, is expected to inform their old and new academic advisors, as well as the department’s students services office, of such a change. Doctoral students, on the other hand, are expected to be advised by the faculty who admitted them throughout the duration of their doctoral studies. Any change in advisor requires a formal admit letter from the new advisor that includes an explicit commitment to support the student financially throughout the duration of their doctoral studies.

Master’s students are expected to meet with their academic program advisors at the beginning of the school year to discuss their courses and proposed year-long academic plans. They are empowered to request an appointment with their advisor at any time throughout the school year to discuss any problems that arise with their studies, or changes with their academic plans.

Doctoral students and their faculty advisors are expected to discuss and agree on how regular meetings will be set up within a day or two of the student’s start as a Ph.D. student. The discussion should include meeting frequency and deliverables associated with any of those meetings. They should discuss and agree on how the degree progress will be monitored, for example, through a department annual review process or regular meetings with advisor and thesis committees. They should also discuss all the requirements of the Ph.D. degree, including expectations for the General Qualifying Examination, how and when to select and convene the dissertation reading or thesis committee, when and how to decide when a student is ready to graduate, and when to take the University Oral Examination.

For a statement of University policy on graduate advising, see the "Graduate Advising" section of this bulletin.

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Chair: Lynn M. Hildemann

Associate Chairs: Ronaldo I. Borja, Michael D. Lepech

Co-Directors of Graduate Studies: David L. Freyberg, Nicholas T. Ouellette


Associate Professors: David L. Freyberg, Michael D. Lepech, Christian Linder, Meagan Mauter, Nicholas T. Ouellette, Ram Rajagopal

Assistant Professors: Catherine Gorlé, Rishee Jain

Courtesy Professor: Margot G. Gerritsen, Peter M. Pinsky

Courtesy Associate Professor: Leif Thomas

Courtesy Assistant Professor: Jenny Suckale

Senior Lecturer: John Barton

Lecturers: Michael Azgour, Deborah Ballati, Thomas Beischer, Michael Bennon, Annalisa Boslough, Beverly Cho, Harris, Stanley Christensen, Daniel Colvard, Charles Debbas, Kyle Douglas, Derek Fong, Renate Fruchter, Diana Ginnebaugh, Darryl Goodson, Robert Groves, James Hawk, Kenneth Hayes, Daniel Johnson, Glenn Katz, David Kleiman, Drew Krafci, Nelson Koen Cohen, John Koester, Royal Kopperud, Amy Larimer, Eloï Laurent, Michael Lyons, Sophie Maisniser-Patin, René Morkos, Jose Luis Moscovitch, Brian O’Kelly, Derek Ouyang, Andrew Peterman, Allison Pieja, Alexander (Sandy) Robertson, Peter Rumsey, Bill Shelander, Robert Soden, Charlotte Stanton, J.B. Straubel, Hattie Stroud, Sebastien Tilmans, Isabella Tomanek, Michael Walton, Peter Williams, Sarah Willmer, Ethén J. Wood, Jon Wren

Adjunct Lecturers: Eduardo Vivanco Antolin, Leo Chow, Dimitris Farmakis, Erik Kolderup, Ashby Monk, Peter Rumsey, Mark Sarkisian, Bryan Shiles, Robert Soden, Kristen Stasic, Christopher Wasney, Allison Williams

Adjunct Professors: Howard Ashcraft, Vladimir Bazjanac, Terry Beaubois, James Cloern, Angelos Findikakis, Jack Fuchs, Robert Groves, Robert Hickey, Jeremy Isenberg, Calvin Kam, Michael Kavanaugh, Mike Lyons, Andrew Manning, Martin McCann Jr., William McDonough, Paul Meyer, Pedram Mokrian, Piotr Moncarz, Jose Luis Moscovitch, Wayne Ott, Paolo Parigi, Benedict Schwegler, Brian Sedar, Patrick Shiel, Michael Steep, Avram Tucker, Antonio Vives, Michael Walton, Jie Wang, Jane Woodward, Jon Wren

Adjunct Associate Professors: Jordan Brandt, Gloria T. Lau, Colin Ong

Adjunct Assistant Professor: Patrick Shiel

Visiting Professor: Colm-cille Caulfield

* Recalled to active duty.

**Overseas Studies Courses in Civil and Environmental Engineering**

The Bing Overseas Studies Program (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 (https://undergrad.stanford.edu/programs/bosp/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).

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
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<tbody>
<tr>
<td>OSPAUSTL 10</td>
<td>Coral Reef Ecosystems</td>
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<td>OSPAUSTL 28</td>
<td>Terrestrial Ecology and Conservation</td>
<td>3</td>
</tr>
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<td>Coastal Ecosystems</td>
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<td>OSPSANTG 85</td>
<td>Marine Ecology of Chile and the South Pacific</td>
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<tr>
<td>SINY 162</td>
<td>Sustainable and Resilient Urban Systems in NYC</td>
<td>3-4</td>
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Note: OSPAUSTL 10 and OSPAUSTL 28 may count towards the ENVSE-BS Breadth. OSPAUSTL 32 and OSPSANTG 85 may count towards the ENVSE-BS, Coastal Environments Focus Area Electives. SINY 162 may count towards the ENVSE-BS, Urban Environments Focus Area Electives. OSPParis 44 may count towards the ENVSE-BS, Fundamental Tools/Skills in visual, oral/written communication.