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# Civil Engineering

In the College of Engineering

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The undergraduate degree in Civil Engineering is accredited by the Accreditation Board for Engineering and Technology, Inc.

## Faculty

Emeritus: Chang, Chou, Johnson, Krishnamoorthy, McGhie, Noorany, Sharabi

Chair: Supernak

The AGC Paul S. Roel Chair in Construction Engineering and Management: Walsh

The William E. Leonhard, Jr. Chair in Civil and Environmental Engineering: Forman

Professors: Banks, Bayasi, Hayhurst, Ponce, Supernak, Westermo

Associate Professor: Walsh

Assistant Professors: Beighley, Forman, Valdes

Adjunct: Penchina, Won

## Offered by the Department of Civil and Environmental Engineering

Doctor of Philosophy degree in engineering sciences/applied mechanics.

Master of Science degree in civil engineering.

Concentration in environmental engineering.

Major in civil engineering with the B.S. degree.

## The Associated General Contractors (AGC) Paul S. Roel Chair in Construction Engineering and Management

The AGC-Paul S. Roel Chair in Construction Engineering and Management is funded with an endowment established by generous gifts from members of the Associated General Contractors in San Diego Chapter. Recognizing the need for expert construction professionals, the local construction community has invested considerable resources in this new degree program. In particular, the endowment is funded by a significant gift from Roel Construction, in honor of Paul S. Roel, the son of the company's founder and the man responsible for moving the family business to San Diego in 1959. The first appointee to the Chair, Dr. Kenneth D. Walsh, is an accomplished teacher-scholar, with a research background in improvement of production systems in construction in residential, commercial, and heavy civil settings.

## The William E. Leonhard, Jr. Chair in Civil and Environmental Engineering

The William E. Leonhard, Jr. Chair in Civil and Environmental Engineering is funded with an endowment created by generous gifts from William G. Leonhard, Jr. and his parents, William E. and Wyllis M. Leonhard. After Bill Leonhard graduated from San Diego State in 1964, he entered a career in the Air Force, rising to the rank of colonel. In January 1990, he retired from the Air Force, spent the next several years in private industry, and retired again in 1998. The first appointee to the Chair is Assistant Professor, Dr. Selena Forman, an expert in sediment water interactions, contaminated sediment transport, and river restoration design.

## Mission of the Department

The mission of the Department of Civil and Environmental Engineering is to provide a high quality undergraduate and graduate education in the civil and environmental engineering areas as well as the advising and other support needed to ensure the students' academic

success and preparation for a productive engineering career. In addition, through research and continuing professional development, the faculty produce, enhance and promote new developments within their areas of expertise for the benefit of society and the furtherance of their profession.

The objective of the program is to give the student a basic knowledge of civil and environmental engineering, as well as the interdisciplinary background and skills to meaningfully participate in and contribute technical advances toward this profession. The program integrates technical aspects with studies in the social sciences and humanities to ensure appropriate sensitivity to socially related problems.

Instruction is given both at the undergraduate level, leading to the bachelor's degree, and at the graduate level, leading to the master's or doctoral degrees. The undergraduate program builds upon concepts of mathematics, physics, chemistry and basic engineering with specialized study in civil and environmental engineering. Engineering design is emphasized, particularly in conjunction with computer utilization and practical civil and environmental engineering problems. Aspects of safety and engineering ethics are woven throughout the program. Breadth and depth of social science and humanities studies is assured by department approved courses. Completion of the undergraduate degree prepares the student for an entry-level professional position in addition to informal or formal graduate studies.

Many students who complete the civil or the environmental undergraduate program choose to continue their formal studies on a full or part-time basis at San Diego State University or at another institution. (See the *Bulletin of the Graduate Division* for additional information.) The objective of the graduate program is to broaden the student's technical competence and design abilities and allow for additional specialization.

The civil and environmental engineering program is enhanced through cooperation with the American Society of Civil Engineers, the American Public Works Association, the Associated General Contractors, the Chi Epsilon Civil Engineering Honor Society, and other national organizations who sponsor student chapters to further aid the student's professional development. The chapters at San Diego State University have won many awards in regional and national competition with other schools throughout the country.

## Educational Objectives

The objectives of the program are to prepare graduates to practice civil engineering in the areas of structures, geotechnical, water resources, transportation, environmental, and construction by providing them with the ability to apply the basic principles of the mathematical, physical, and social sciences to the analysis and solution of civil engineering problems including the design of civil engineering projects; to provide a basic understanding of issues faced during professional practice and a solid foundation for continuing education and graduate study.

## Transfer Credit

No credit will be given for upper division engineering coursework taken at an institution having an engineering program which has not been accredited by the Accreditation Board for Engineering and Technology, Inc., unless the student successfully completes the first 12 units of engineering work attempted at this university. At that time, and upon recommendation of the department, unaccredited work will be evaluated for full or partial credit.

**NOTE:** See the following chart for recommended sequence of courses for the major in civil engineering.

### CIVIL ENGINEERING MAJOR

FALL		FIRST YEAR		SPRING	
<b>SEMESTER 1</b>		<b>UNITS</b>	<b>SEMESTER 2</b>		<b>UNITS</b>
GE Composition		3	GE Intermediate Composition		3
GE Math/Major Prep:	<b>MATH 150</b>	4	GE Oral Communication		3
GE Phys Sci/Lab/Major:	<b>CHEM 200</b>	5	Major Preparation:	<b>MATH 151</b>	4
Major Preparation:	<b>CIV E 100</b>	1	Major Preparation:	<b>PHYS 195</b>	3
Major Preparation:	<b>CIV E 120</b>	3	Major Preparation:	<b>CIV E 121</b>	2
University Seminar		1			
Total Units		17	Total Units		15
Cumulative Total		17	Cumulative Total		32
FALL		SECOND YEAR		SPRING	
<b>SEMESTER 3</b>		<b>UNITS</b>	<b>SEMESTER 4</b>		<b>UNITS</b>
GE Humanities		3	GE Humanities		3
Major Preparation:	<b>MATH 252</b>	4	GE Life Science		3
Major Preparation:	<b>PHYS 196</b>	3	GE Social Science		3
Major Preparation:	<b>CIV E 160</b>	2	Major Preparation:	<b>CIV E 218</b>	3
Major Preparation:	<b>CIV E 220</b>	3	Major Preparation:	<b>ENGR 280</b>	3
Major Preparation:	<b>E M 200</b>	3	Major Preparation:	<b>E M 220</b>	3
Total Units		18	Total Units		18
Cumulative Total		50	Cumulative Total		68
FALL		THIRD YEAR		SPRING	
<b>SEMESTER 5</b>		<b>UNITS</b>	<b>SEMESTER 6</b>		<b>UNITS</b>
GE Humanities		3	GE Explorations: Humanities from different dept.		3
Major:	<b>CIV E 301</b>	3	GE Explorations: Social/Beh Science		3
Major:	<b>CIV E 302</b>	1	GE Explorations: Humanities		3
Major:	<b>CIV E 395</b>	2	Major:	<b>CIV E 321</b>	3
Major:	<b>E M 340</b>	3	Major:	<b>CIV E 481</b>	3
Major:	<b>E M 341</b>	1	Major:	<b>ENV E 355</b>	3
Major (Sci Elect):	<b>EE 204, ME 240 OR ME 352</b>	3			
Total Units		16	Total Units		18
Cumulative Total		84	Cumulative Total		102
FALL		FOURTH YEAR		SPRING	
<b>SEMESTER 7</b>		<b>UNITS</b>	<b>SEMESTER 8</b>		<b>UNITS</b>
Major:	<b>CIV E 401</b>	1	Major:	<b>CIV E 495</b>	3
Major:	<b>CIV E 444</b>	3	Civil Engineering Option Courses		6
Major:	<b>CIV E 462</b>	3	Professional Electives		6
Major:	<b>CIV E 463</b>	1	GE American Institutions		3
Civil Engineering Option Courses		6			
GE American Institutions		3			
Total Units		17	Total Units		18
Cumulative Total		119	Cumulative Total		137

### General Education

Students will complete a minimum of 50 units in General Education, to include a minimum of nine upper division units taken after attaining junior class standing. No more than twelve units may be used for General Education credit from any one department or academic unit. No more than 7 units from one department can be used in Sections II and IV combined (Foundations and Explorations), nor more than 10 units from one department in Sections II, III, and IV combined (Foundations, American Institutions, and Explorations).

- I. Communication and Critical Thinking:** 9 units  
You may **not** use Credit/No Credit grades in this section.
1. Oral Communication (3 units)
  2. Composition (3 units)
  3. Intermediate Composition and Critical Thinking (3 units)
- II. Foundations:** 29 units
- A. Natural Sciences and Quantitative Reasoning (17 units):
1. Physical Sciences (11 units)  
Engineering students will take Chemistry 200 which includes a laboratory (5 units).  
Physics 195 (3 units)  
Physics 196 (3 units)
  2. Life Sciences (3 units)
  3. Laboratory (satisfied under A.1. above)
  4. Mathematics/Quantitative Reasoning  
Engineering students will take Mathematics 150, 3 units applicable to General Education. You may **not** use Credit/No Credit grades.
- B. Social and Behavioral Sciences (3 units)
- C. Humanities (9 units)  
Complete three courses in three different areas. One of these courses and the one under IV.A. below must be taken in the same department.
- III. American Institutions:** Three units of the six units of coursework which meet the American Institutions graduation requirement may be used in General Education, excluding courses numbered 500 and above.
- IV. Explorations: Courses in this area must not be taken sooner than the semester in which you achieve upper division standing (60 units passed). Upper division courses in the major department may not be used to satisfy General Education.**  
Total: 9 units; must include one course of cultural diversity.
- A. Upper division Humanities (3 units)  
Three units must be taken from the same department as one of the Humanities courses selected in Foundations.
- B. Upper division Humanities (3 units from a department not selected in A above.)
- C. Upper division Social and Behavioral Sciences (3 units)

### The Major

Civil engineering is the application of engineering principles to the improvement of the human environment. The civil engineering major prepares students to design and supervise the construction of buildings, dams, roads, harbors, airports, tunnels, and bridges. It also provides training in the planning and construction of the complex systems that supply clean water to cities, remove sewage, control floods, and perform other functions which ensure continued health and safety.

Civil engineers are needed in both the private and public sectors. They are employed in the aerospace industry, usually as structural engineers; design and construction of roads, buildings, bridges, airports, dams and other structures; research and teaching at colleges and universities (with an advanced degree); public utilities and transportation; manufacturing; and offshore drilling, environmental pollution, and energy self-sufficiency. New job opportunities in civil engineering will result from growing demands in housing, industrial buildings, power generating plants, and transportation systems.

### Civil Engineering Major

**With the B.S. Degree (Major Code: 09081)**

**NOTE:** See chart on the previous page for the recommended sequence of courses for the major in civil engineering.

The program below describes 137 units required for the degree. Each course specifically listed in the program is required. In addition, the total number of units specified in each elective category represents the minimum requirement, and there is a minimum requirement of nine units for the combination of the Engineering Science Elective and the Professional Electives.

**Preparation for the Major.** Civil Engineering 100, 120, 121, 160, 218, 220; Chemistry 200; Physics 195, 196; Mathematics 150, 151, 252; Engineering 280; Engineering Mechanics 200, 220.

**Engineering Science Elective.** At least one of the following courses: Electrical Engineering 204; Mechanical Engineering 240, 352.

**General Education.** Engineering students must follow the specific General Education program outlined on the first page of this section. Other general education requirements and limitations, as well as listings of specific General Education course electives are presented in the General Education section of Graduation Requirements for the Bachelor's Degree.

**Graduation Writing Assessment Requirement.** Completing one of the approved upper division writing courses (W) with a grade of C (2.0) or better or passing the Writing Proficiency Assessment with a score of 10 or above. See page 73 in "Graduation Requirements" section for a complete listing of requirements.

**Major.** A minimum of 48 upper division units to include the following required and elective courses. Required upper division courses in the major: Engineering Mechanics 340, 341; Environmental Engineering 355; Civil Engineering 301, 302, 321, 395, 401, 444, 462, 463, 481, 495.

**Civil and Environmental Engineering Option Courses.** Course choices must consist of either (1) at least one course from at least four of the first five areas (Water through Geotechnical), or (2) at least two courses from the last area (Construction) and at least one course each from two of the first five areas (Water through Geotechnical).

**Water** – Civil Engineering 445, 530.

**Transportation** – Civil Engineering 482, 580.

**Environmental** – Environmental Engineering 553, 554, 555, 556, 558.

**Structural** – Civil Engineering 421, 423, 479, 521, 525, 528.

**Geotechnical** – Civil Engineering 465.

**Construction** – Civil Engineering 479, 491, 492.

**Professional Electives.** At least six units selected from Engineering 430 and any 400- or 500-level Civil or Environmental Engineering courses not used to satisfy other requirements. *The student's choice of elective courses must be made in consultation with the adviser and documented by filing an approved master plan as soon as the civil engineering major is declared. Students are required to see their adviser prior to preregistration each semester.*

## Courses (CIV E)

Refer to Courses and Curricula and University Policies sections of this catalog for explanation of the course numbering system, unit or credit hour, prerequisites, and related information.

**Note:** Proof of completion of prerequisites (copy of transcript) is required for all courses which list prerequisites.

### LOWER DIVISION COURSES

#### CIV E 100. Introduction to Civil Engineering (1) I

Introduction to diverse field of civil and environmental engineering to include structural, geotechnical, water resources, transportation, construction engineering and management, and environmental engineering. Legal, ethical, and international dimensions of the profession.

#### CIV E 120. Civil and Environmental Engineering Computer Applications I (3) I

Prerequisite: Credit or concurrent registration in Mathematics 150.

Computing tools for civil engineering. Use of spreadsheets, programming, mathematical analysis programs, presentation, and graphics programs.

#### CIV E 121. Civil and Environmental Engineering Computer Applications II (2) II

Prerequisite: Civil Engineering 120.

Computer aided design for civil engineering applications (AutoCAD).

#### CIV E 160. Statistical Methods for Civil and Environmental Engineers (2) I, II

Prerequisite: Mathematics 141.

Application of statistical methods to civil and environmental engineering problems in construction, hydrology, water quality, air pollution, and other related areas. Students with credit or concurrent registration in the following lower division statistics courses will be awarded a total of four units for the two (or more) courses: Civil Engineering 160; Biology 215; Economics 201; Political Science 201; Psychology 270; Sociology 201; Statistics 119, 250.

#### CIV E 218. Surveying for Civil Engineers (3) I, II

Two lectures and three hours of laboratory.

Prerequisites: Civil Engineering 160 and Mathematics 151.

Principles of plane surveying. Measurement of horizontal distance, difference in elevation, and angles. Traverse surveys and computations. Horizontal and vertical curves. Principles of stadia. Topographic surveys. Earthwork.

#### CIV E 220. Civil and Environmental Engineering Computer Applications III (3) I

Prerequisite: Civil Engineering 121.

Graphical information systems (GIS), specialized civil engineering software, advanced problem solving.

#### CIV E 296. Experimental Topics (1-4)

Selected topics. May be repeated with new content. See *Class Schedule* for specific content. Limit of nine units of any combination of 296, 496, 596 courses applicable to a bachelor's degree.

### UPPER DIVISION COURSES (Intended for Undergraduates)

#### CIV E 301. Introduction to Solid Mechanics (3) I, II

Prerequisites: Engineering Mechanics 200 and concurrent registration in Engineering 280 or Mathematics 342A.

Mechanics of solid deformable bodies involving analytical methods for determining strength, stiffness, and stability of load-carrying members.

#### CIV E 302. Solid Mechanics Laboratory (1) I, II

Three hours of laboratory.

Prerequisite: Credit or concurrent registration in Civil Engineering 301.

Laboratory studies in solid mechanics. Experimental stress analysis. Experimental confirmation of theory.

#### CIV E 321. Structural Analysis I (3) I, II

Prerequisites: Civil Engineering 301 and 302.

Analysis of beams, frames, trusses, and three-dimensional frameworks. Influence lines; deflections; introduction to statically indeterminate structures and moment distribution.

#### CIV E 395. Introduction to Civil Engineering Design (2)

One lecture and three hours of laboratory.

Prerequisite: Credit or concurrent registration in Civil Engineering 301.

Civil engineering design process; identification and formulation of design problems; professional responsibilities of designers; documentation and presentation of designs.

#### CIV E 401. Civil Engineering and Society (1) I

Prerequisite: Senior standing in civil engineering.

Role of civil engineers in society. Historical, political, esthetic, and philosophical perspectives on civil engineering. Contemporary issues involving civil engineering.

#### CIV E 421. Reinforced Concrete Design (3) I, II

Prerequisite: Civil Engineering 321.

Properties and characteristics of reinforced concrete; design of structural components. Introduction to plastic theory and limit design.

#### CIV E 423. Timber Design (2) I, II

Prerequisites: Civil Engineering 321.

Physical and mechanical properties of wood. Sawn lumber, glulam, plywood. Design of various types of wood structures. Connection design.

#### CIV E 444. Applied Hydraulics (3) I, II

Prerequisite: Engineering Mechanics 340.

Open channel and pressure conduit flow, pumps and turbines, hydroelectric power, flood control, and water law.

#### CIV E 445. Applied Hydrology (3) II

Prerequisite: Civil Engineering 444.

Basic hydrologic principles, hydrologic measurements, small and midsize catchment hydrology, frequency analysis, regional analysis, reservoir, stream channel and catchment routing, hydrologic design.

#### CIV E 462. Geotechnical Engineering (3) I, II

Prerequisites: Civil Engineering 301, credit or concurrent registration in Engineering Mechanics 340, and concurrent registration in Civil Engineering 463.

Mechanics of soils as they apply to engineering problems, soil classification, compaction, swelling, consolidation, strength and permeability. Applications to geotechnical and environmental engineering problems.

#### CIV E 463. Geotechnical Engineering Laboratory (1) I, II

Three hours of laboratory.

Prerequisite: Concurrent registration in Civil Engineering 462.

Laboratory procedures of soil testing for geotechnical and environmental engineering problems.

#### CIV E 465. Foundation Engineering and Earth Retaining Structures (3) II

Prerequisites: Civil Engineering 462 and 463.

Soil mechanics theories applied to design of shallow and deep foundations; lateral pressure of soils, design of retaining walls.

### **CIV E 479. Construction Materials (3) II**

Two lectures and three hours of laboratory.

Prerequisites: Civil Engineering 462 and 481.

Selection, design and control of mixes of portland cement and asphalt concrete. Properties of these and other materials used in construction.

### **CIV E 481. Transportation Engineering (3) I, II**

Prerequisites: Civil Engineering 218.

Physical design of transportation facilities, traffic analysis and control for different modes, planning and demand analysis, introduction to environmental impacts of transportation systems and intelligent transportation systems.

### **CIV E 482. Highway Engineering (3) I, II**

Two lectures and three hours of laboratory.

Prerequisite: Civil Engineering 481.

Highway design, facility sizing, geometric design, drainage, earthwork, pavement design, traffic control devices, safety and environmental considerations.

### **CIV E 491. Construction Methods (3) I**

Prerequisite: Civil Engineering 321.

Components and methods of construction including earthwork; foundations; wood, steel, and concrete construction; roofing and cladding; interior construction.

### **CIV E 492. Construction Engineering (3) II**

Prerequisites: Civil Engineering 491 and Engineering 430.

Project oriented. Cost estimating; alternative cost-saving changes; critical path scheduling.

### **CIV E 495. Civil and Environmental Engineering Design (3) I, II**

One lecture and six hours of laboratory.

Prerequisites: Credit or concurrent registration in Civil Engineering 321, 421, 444, 462, 481, and Environmental Engineering 355. At least three of these courses must be completed prior to enrolling in this course.

Application of engineering principles and design techniques to the design of civil engineering projects.

### **CIV E 496. Advanced Civil Engineering Topics (1-3) I, II**

Prerequisites: Minimum grade point average of 3.0 and consent of instructor.

Modern developments in civil engineering. See *Class Schedule* for specific content. Maximum credit six units for any combination of Civil Engineering 496, 499 and 596.

### **CIV E 499. Special Study (1-3) Cr/NC I, II**

Prerequisites: Minimum grade point average of 3.0 and consent of instructor.

Individual study in the area of civil engineering. Maximum credit six units for any combination of Civil Engineering 496, 499 and 596.

## **UPPER DIVISION COURSES (Also Acceptable for Advanced Degrees)**

### **CIV E 521. Structural Analysis II (3) I**

Prerequisite: Civil Engineering 321.

Analysis of statically indeterminate structures by virtual work. Advanced treatment of slope deflection, moment distribution. Arch analysis, secondary stresses in trusses. Advanced treatment of influence lines. Introduction to matrix analysis of structures.

### **CIV E 525. Design of Steel Structures (3) I, II**

Prerequisite: Civil Engineering 321.

Mechanical behavior of structural steel. Design of steel beams, girders, columns and members subjected to combined stresses. Design of various types of connections of steel structures; plate girders, continuous beams and rigid frames.

### **CIV E 528. Masonry Structures Design (3) I**

Prerequisites: Civil Engineering 301 and 321.

Analysis and design of masonry beams, retaining walls, shear walls, bearing walls, and columns. Use of allowable stress and strength design methods. Design project, including structural system analysis and lateral design of masonry buildings.

### **CIV E 530. Open Channel Hydraulics (3) I, II**

Prerequisite: Civil Engineering 444.

Principles of open channel flow; analysis and problems of critical, uniform, gradually-varied, and rapidly-varied flows, design and environmental problems; computer simulations and applications; and culvert hydraulics.

### **CIV E 580. Traffic Engineering Design (3) II**

Prerequisite: Civil Engineering 481.

Sizing and configuration of highway facilities based on capacity analysis. Traffic signal design, impact and mitigation studies, parking, safety design.

### **CIV E 596. Advanced Civil Engineering Topics (1-3) I, II**

Prerequisites: Minimum grade point average of 3.0 and consent of instructor.

Modern developments in civil engineering. See *Class Schedule* for specific content. Maximum credit of six units for any combination of Civil Engineering 496, 499 and 596 applicable to a bachelor's degree. Maximum combined credit of six units of Civil Engineering 596 and 696 applicable to a 30-unit master's degree.

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## **GRADUATE COURSES Refer to *Bulletin of the Graduate Division*.**

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**For additional courses which are electives in the civil engineering program, refer to "Environmental Engineering" in this section of the catalog.**