

CIVIL AND ENVIRONMENTAL ENGINEERING

Department Website (https://sc.edu/study/colleges_schools/engineering_and_computing/study/civil_and_environmental_engineering/)

Juan M. Caicedo, *Chair*

The Department of Civil and Environmental Engineering offers a Bachelor of Science in Engineering degree with a major in civil engineering. Civil engineering is the planning, design, and construction of projects that define a civilization. Civil engineers have built landmarks that now stand as tributes to the profession's creative spirit and ingenuity. Civil engineering is everywhere: the buildings in which we live and work, the roads on which we travel, the water we drink, the bridges we cross. Civil engineers design industrial and commercial buildings, bridges, towers, dams, tunnels, and mass transportation facilities. They manage urban planning and public works projects, perform air quality monitoring, and plan and design waste collection and handling systems.

Program Educational Objectives¹

1. Graduates of the Civil engineering program should demonstrate their continuing successful practice as civil engineers and/or their pursuit of post baccalaureate education and/or their engagement in other professional careers that involve the application of engineering concepts.
2. Graduates of the civil engineering program should demonstrate a commitment for continuing professional development and life-long learning.
3. Graduates of the civil engineering program should demonstrate the ability to advance within their profession to positions of greater responsibility and leadership.

The first two years of the undergraduate curriculum form the necessary foundation in mathematics, computer programming, the physical sciences, and basic engineering sciences, together with courses in the liberal arts, to provide the student with a well-balanced educational experience. The upper-division civil engineering program includes the study of construction materials, structural analysis and design, soil behavior, systems analysis, water supply, and pollution control. The department offers elective courses in such areas of engineering as environmental, geotechnical, structural, transportation, and water resources.

The civil engineering graduate is prepared to enter the job market with federal, state, and municipal agencies and with private consulting firms involved with aspects of planning, design, construction, or environmental control. Students may, following graduate study, also pursue careers in teaching and in research and development.

¹ The Civil and Environmental Engineering Department at the University of South Carolina uses the term "program educational objective" to describe the expected accomplishments of our students in a few years (three to five years) following graduation. The term "student learning outcome" is used to describe the knowledge and skills at the time of graduation.

Bachelor's/Master's Accelerated Program

A combined B.S.E./M.S. or M.E. degree program is available to undergraduate civil and environmental engineering students with GPAs of 3.50 or above and 90 or more hours earned toward their baccalaureate degrees. Up to 6 credit hours of 500-level or above courses may be applied toward both the B.S.E. and M.S. or M.E. in Civil Engineering degree requirements. The approval of the student's advisor and the Department of Civil and Environmental Engineering graduate director are required. Questions about this program may be directed to the civil and environmental engineering graduate director.

Programs

- Civil Engineering, B.S.E. (<https://academicbulletins.sc.edu/undergraduate/engineering-computing/civil-environmental-engineering/civil-engineering-bse/>)
- Environmental and Sustainable Engineering, Minor (<https://academicbulletins.sc.edu/undergraduate/engineering-computing/civil-environmental-engineering/environmental-sustainable-engineering-minor/>)

Courses

ECIV 101 - Introduction to Civil Engineering (3 Credits)

Fundamental concepts in each of the disciplines of civil engineering are discussed. Critical thinking skills are formally fostered by hands-on experiences and group discussions.

ECIV 111 - Introduction to Engineering Graphics and Visualization (3 Credits)

Principles and practice of visualization and graphical representation using modern computer-aided design tools.

ECIV 200 - Statics (3 Credits)

Fundamentals of engineering mechanics. Equilibrium of particles and rigid bodies. Free-body diagrams, analysis trusses and frames. Distributed forces, centroids, centers of gravity, and friction.

Prerequisites: C or better in MATH 141.

ECIV 201 - Computational Methods for Civil Engineering (3 Credits)

The use of computational tools and techniques for solving civil and environmental engineering problems. Overview of numerical methods including roots of equations, systems of linear equations, interpolation, and integration. Analysis of civil and environmental systems.

Prerequisites: C or better in MATH 142 and ECIV 200 or ENCP 200.

ECIV 210 - Dynamics (3 Credits)

Kinematics of particles and rigid bodies. Vector representation of force and motion. Free-body diagrams, application of energy and momentum methods to solve problems. Rigid body and central force motion.

Prerequisites: C or better in ECIV 200 or ENCP 200; C or better in MATH 142.

ECIV 220 - Mechanics of Solids (3 Credits)

Concepts of stress and strain; stress analysis of basic structural members. Vectors, free bodies, equilibrium and elastic behavior. Combined stress, Mohr's circle. Beams, columns, torsion, and rotation.

Prerequisites: C or better in ECIV 200 or ENCP 200 and in MATH 142.

ECIV 300 - Civil Engineering Measurements (3 Credits)

Theory and application of plane surveying and mapping techniques. Lecture plus laboratory.

Prerequisites: D or better in MATH 241.

ECIV 303 - Civil Engineering Materials (3 Credits)

Mechanical and thermal properties of mineral aggregates, cements, concrete, timber, asphalt, metals, and plastics.

Prerequisites: C or better in ECIV 220 or ENCP 260.

ECIV 303L - Civil Engineering Materials Laboratory (1 Credit)

Experiments, exercises, and demonstrations to accompany ECIV 303.

Prerequisites: D or better in STAT 509 or STAT 511.

Prerequisite or Corequisite: D or better in ECIV 201 or ENCP 201; D or better in ECIV 303.

ECIV 307 - Professional Development for Civil Engineers (3 Credits)

Regulatory permits and scheduling of construction projects. Engineering responsibility and liabilities. Reporting of engineering designs and analysis. Cost estimation of engineering projects including present or future net value.

Prerequisite or Corequisite: D or better in ECIV 320, ECIV 330, ECIV 340, ECIV 350, or ECIV 362.

ECIV 320 - Structural Analysis I (3 Credits)

Equilibrium, shear and moment diagrams, and influence lines for statically determinate trusses, beams, and frames. Energy principles and other methods for displacement calculations. Introduction to indeterminate structural analysis.

Prerequisites: D or better in ECIV 201 or ENCP 201; D or better in MATH 242; C or better in ECIV 220 or ENCP 260.

ECIV 325 - Structural Steel Design (3 Credits)

Behavior and design of steel beams, columns, and tension members; strength and stability; design of connections using welded, bolted and riveted construction.

Prerequisites: C or better in ECIV 320.

ECIV 327 - Reinforced Concrete Design (3 Credits)

Behavior and design of reinforced concrete beams, columns, continuous beams and one way slabs, and footings.

Prerequisites: C or better in ECIV 320.

ECIV 330 - Introduction to Geotechnical Engineering (3 Credits)

Engineering properties of soil and rock; hydraulic conductivity, flow nets, drainage design; consolidation theory, shearing strength of soil.

Prerequisites: C or better in either ECIV 220 or ENCP 260.

ECIV 330L - Geotechnical Laboratory (1 Credit)

Laboratory associated with ECIV 330. Soil mechanics experiments, exercises, and demonstrations. Three contact hours per week.

Prerequisites: D or better in STAT 509 or STAT 511.

Prerequisite or Corequisite: D or better in ECIV 201 or ENCP 201; D or better in ECIV 330.

ECIV 340 - Introduction to Transportation Engineering (3 Credits)

Transportation design, planning, and operational analysis, including roadway, airway, and railway systems; transportation elements, including traveled way, vehicle, control, terminals, and advanced technology; traffic data collection, interpretation, and analysis.

Prerequisites: D or better in ECIV 201 or D or better in ENCP 201 and D or better in STAT 509 or D or better in STAT 511.

ECIV 340L - Transportation Engineering Laboratory (1 Credit)

This course covers the principles of distances, elevations and angles that pertain to roadways, basic theories in engineering measurements and surveying calculations, and an introduction to mapping, for transportation engineering applications. Three contact hours per week.

Prerequisites: D or better in STAT 509 or 511.

Prerequisite or Corequisite: D or better in ECIV 201 or ENCP 201; D or better in ECIV 340.

ECIV 350 - Introduction to Environmental Engineering (3 Credits)

Concepts of environmental engineering, including air and water pollution, solid and hazardous waste disposal, and noise pollution. Qualitative and quantitative development of engineering techniques for pollution control.

Prerequisites: D or better in CHEM 111 or CHEM 141; C or better in Math 142

ECIV 350L - Introduction to Environmental Engineering Laboratory (1 Credit)

Physical, chemical, and biological analysis of water and wastewater. Three laboratory hours per week.

Prerequisites: D or better in STAT 509 or STAT 511.

Prerequisite or Corequisite: D or better in ECIV 201 or ENCP 201; D or better in ECIV 350.

ECIV 360 - Fluid Mechanics (3 Credits)

Principles of fluid statics and dynamics. Conservation of mass, momentum, and energy. Similitude and dimensional analysis, open channel flow, lift and drag forces, and introduction to turbulent flow.

Prerequisite or Corequisite: C or better in ECIV 200 or ENCP 200; C or better in MATH 142.

ECIV 362 - Introduction to Water Resources Engineering (3 Credits)

Application of fluid mechanic principles to water resources engineering problems; pipe systems, pumps, open channel flow, peak runoff, seepage, hydraulic structures.

Prerequisites: C or better in either ECIV 360 or ENCP 360.

ECIV 362L - Introduction to Water Resources Engineering Laboratory (1 Credit)

Experiments, exercises, and demonstrations on flow in pipes and open channels, pumps, flow measurement, seepage, and infiltration. Three contact hours per week.

Prerequisites: D or better in STAT 509 or 511.

Prerequisite or Corequisite: D or better in ECIV 201 or ENCP 201; D or better in ECIV 362.

ECIV 405 - System Applications in Civil Engineering (3 Credits)

Systems approach to analysis and design; application of engineering economic principles to the evaluation of design alternatives; deterministic modeling and optimization emphasizing civil engineering applications.

Prerequisites: D or better in ECIV 201 or ENCP 201.

ECIV 426 - Structural Design (3 Credits)

Design of steel structures including elastic and plastic design concepts. Design of concrete structures including continuous members and long columns.

Prerequisites: D or better in ECIV 325 or ECIV 327.

ECIV 470 - Civil Engineering Design (4 Credits)

Application of hydraulic, geotechnical, and structural principles in design; project scheduling; cost estimation; ethics; environmental and social impact; design drawings; report documents.

Prerequisites: D or better in ECIV 307 and D or better in two ECIV Distribution Courses.

Prerequisite or Corequisite: D or better in ECIV 111 or ENCP 102.

Graduation with Leadership Distinction: GLD: Professional and Civic Engagement Internships, GLD: Research

ECIV 490 - Special Topics (0-3 Credits)

Course content varies and will be announced in the schedule of classes by course title. May be repeated as topic varies. A maximum of twelve credits may be applied towards a degree.

Graduation with Leadership Distinction: GLD: Research

ECIV 497 - Fundamentals of Engineering Preparation (1 Credit)

Preparation for the Fundamentals of Engineering Exam. Will cover general engineering and civil engineering specific areas. Restricted to Civil Engineering Seniors. Pass/ Fail Grading.

ECIV 499 - Independent Study in Civil and Environmental Engineering (1-3 Credits)

Individual investigation or studies of special topics. A maximum of six credits may be applied toward a degree.

Prerequisites: approval of project proposal by instructor; USC/GPA 2.8.

Graduation with Leadership Distinction: GLD: Research

ECIV 502 - Life Cycle Assessment of Engineered Systems (3 Credits)

The steps of conducting and interpreting an environmental life cycle assessment of engineered systems. Fundamentals associated with conducting a life cycle assessment, including goal and scope, inventory analysis, impact assessment and interpretation.

Prerequisites: D or better in ECIV 350.

ECIV 503 - Structural Modeling and Experimental Methods (3 Credits)

Introduction of structural modeling; strain gauge instrumentation; force, displacement, acceleration, pressure, temperature measurements; concrete and steel modeling; size effects; analysis of experimental data.

Prerequisites: ECIV 327.

ECIV 520 - Structural Analysis II (3 Credits)

Advanced methods of structural analysis with emphasis on matrix methods. Development of the generalized matrix force and matrix displacement methods of static analysis, with applications to trusses and frames.

Prerequisites: D or better in ECIV 320.

ECIV 521 - Numerical Methods in Mechanics (3 Credits)

Numerical modeling of typical engineering problems. Numerical solution of linear and nonlinear, boundary and initial value problems. Introduction to optimization.

Prerequisites: D or better in ECIV 201 or ENCP 201.

ECIV 524 - Structural Vibrations (3 Credits)

Response of single- and multiple-degree of freedom structurally dynamic systems to impact, harmonic, wind, and seismic excitations.

Prerequisites: D or better in ECIV 320.

ECIV 526 - Timber and Masonry Design (3 Credits)

Basic engineering properties of timber and masonry materials, design methods and philosophies for timber and masonry structures. Particular attention is paid to current codes, specifications and analysis.

Prerequisites: C or better in ECIV 320.

ECIV 530 - Foundation Analysis and Design (3 Credits)

Subsurface investigation procedures. Theoretical and practical aspects of the design of earth retaining structures, spread footings, and pile foundations.

Prerequisites: D or better in ECIV 330.

ECIV 531 - Design of Earth Structures (3 Credits)

Geotechnical engineering problems associated with the behavior of earth masses. Soil shear strength, lateral earth pressure, design of retaining structures, slope stability, water flow through soils.

Prerequisites: ECIV 330.

ECIV 533 - Geosynthetics and Geotechnical Design of Landfills (3 Credits)

Principles for the design, construction, and performance of waste containment systems. Characterization of barrier materials; geosynthetics; design of liner and leachate collection systems; stability and deformation analyses of landfills.

Prerequisites: D or better in ECIV 330.

ECIV 535 - Geotechnical Engineering in Transportation (3 Credits)

Remote sensing and engineering geology. Field and laboratory testing. Design and maintenance methods for flexible and rigid pavements. Topics in tunnel design and buried conduit.

Prerequisites: D or better in ECIV 330.

ECIV 539 - Experimental Methods in Geotechnical Engineering (3 Credits)

Overview of transducers, signal conditioning and data acquisition; test control methods, data analysis and measurement errors; testing systems to measure soil strength, stiffness, and hydraulic conductivity; laboratory projects and examinations.

Prerequisites: ECIV 330, ECIV 330L.

ECIV 540 - Transportation Systems Planning (3 Credits)

Fundamental interactions between supply and demand in transportation systems. Modeling transportation demand and trip-making behavior. Evaluation of alternatives for decision making.

Prerequisites: D or better in ECIV 340.

ECIV 541 - Highway Design (3 Credits)

Design of transportation facilities using relevant tools and guidelines with emphasis on physical and operational aspects of arterials, freeways, intersections, and interchanges, including geometry, capacity, control, and safety.

Prerequisites: D or better in ECIV 111 or ENCP 102 and D or better in ECIV 340.

ECIV 542 - Traffic Engineering (3 Credits)

Capacity analysis of freeways and arterials. Traffic flow characteristics and basic relationships among traffic flow parameters. Signalized and unsignalized intersection control and signal timing design.

Prerequisites: D or better in ECIV 340.

ECIV 543 - Traffic Safety Analysis (3 Credits)

Research concepts and methodologies to enable students to identify the underlying reasons and factors that contribute to traffic crashes and determine appropriate countermeasures.

Prerequisites: D or better in ECIV 340.

ECIV 551 - Elements of Water and Wastewater Treatment (3 Credits)

Unit operations and processes employed in the physical, chemical, and biological treatment of water and wastewater. Design of water and wastewater treatment systems.

Prerequisites: ECIV 350.

ECIV 555 - Principles of Municipal Solid Waste Engineering (3 Credits)

Fundamentals and engineering principles of solid waste generation, characterization, collection and transport, source reduction and recycling, and physical, chemical, and biological treatment strategies.

Prerequisites: D or better in ECIV 350.

ECIV 556 - Air Pollution Control Engineering (3 Credits)

Introduction to the sources of air pollution and the engineering principles used for control and prevention.

Prerequisites: D or better in ECIV 350.

ECIV 557 - Sustainable Construction for Engineers (3 Credits)

Instruction to sustainable engineering design alternatives and principles for construction and site development from preconstruction through design and the construction phase.

Prerequisites: D or better in ECIV 350 and ECIV 570.

ECIV 558 - Environmental Engineering Process Modeling (3 Credits)

Modeling fate and transport phenomena in environmental processes with applications in engineered unit operators and natural systems.

Prerequisites: D or better ECIV 350 and MATH 242.

ECIV 560 - Open Channel Hydraulics (3 Credits)

Steady and unsteady flows in single or multiple-channel systems.

Prerequisites: D or better in ECIV 360 or ENCP 360.

ECIV 562 - Engineering Hydrology (3 Credits)

Applications of hydrologic techniques to design problems; stormwater simulation models; urban stormwater.

Prerequisite or Corequisite: D or better in ECIV 362.

ECIV 563 - Subsurface Hydrology (3 Credits)

Hydrologic cycle, subsurface physical properties, equations of groundwater flow, well flow, well design, groundwater resource development, design of dewatering systems, groundwater contamination.

Prerequisites: D or better in ECIV 201 or ENCP 201; D or better in ECIV 362.

ECIV 570 - Land Development for Engineers (3 Credits)

Fundamentals of designing and permitting the conversion of land to new or altered states, including environmental issues, traffic and parking, utility resources, site engineering, ADA, safety, planning, and zoning requirements.

Prerequisites: Three from ECIV 320, ECIV 330, ECIV 340, ECIV 350, and ECIV 362.

ECIV 580 - Railway Engineering I (3 Credits)

Introduction to the analysis and design of the railway infrastructure for freight and passenger systems to include track and track support systems, grade crossings, special trackwork, construction, inspection, assessment and compliance.

Prerequisites: D or better in ECIV 320, ECIV 330, and ECIV 340.

Prerequisite or Corequisite: D or better in ECIV 303.

ECIV 582 - Operation and Logistics of Railway Systems (3 Credits)

Principles of rail operations; Network management; Best practices for train planning, performance management and delivery of service; technical elements of a railway from an operations perspective (train controls, signaling, communications, yards, tractive power etc).

Prerequisites: D or better in ECIV 340.

ECIV 588 - Design of Railway Bridges and Structures (3 Credits)

Introduction to railway infrastructure; Structural design considerations and criteria of railway structures; Bridge types and components; Planning and preliminary design of modern railway bridges; Loads and forces; Structural analysis and design of steel railway bridges and components.

Prerequisite or Corequisite: D or better in ECIV 330; D or better in ECIV 325 or ECIV 327.

ECIV 590 - Intermediate Special Topics (3 Credits)

The content of this course varies, and the topics are selected by the faculty. The aim of this course is to expose upper-level undergraduate students and graduate students to a contemporary issue, not covered in any Civil and Environmental Engineering course. Possible topics include intelligent infrastructure, sustainable construction, and monitoring and improvement of poor and degrading infrastructure.