

CIVIL ENGINEERING

The Department of Civil Engineering (<https://www.uakron.edu/engineering/CE/>) offers an undergraduate program leading to the Bachelor of Science in Civil Engineering. The department also offers graduate programs leading to a Master of Science in Civil Engineering, and an interdisciplinary Doctor of Philosophy in Engineering, along with graduate-level certificate programs for practicing professionals.

4300: Civil Engineering

Civil Engineers plan, design, build, and operate the infrastructure of modern society. This includes highways, bridges, buildings, power plants, industrial facilities, tunnels, seaports, airports, offshore structures and almost anything else needed as the basis of modern life. Civil engineers are also vigorously engaged in environmental activities, particularly creating safe water supplies and transporting it to where it is needed, collecting and treating wastewaters, cleanup of environmental problems, and insuring the safe disposal of solid wastes.

To achieve the high level of professional competence needed, an extensive study of mathematics, mechanics (both solids and fluids), engineering materials, structural design and environmental reactions is required. The civil engineering sub-topics that utilize these fundamentals are environmental, geotechnical, hydraulic, structural, and transportation engineering. The civil engineering curriculum at The University of Akron insures a firm grounding in all these sub-topic areas, while allowing a specialization, if desired, in the environmental, geotechnical, transportation, and structural areas. Engineering design problems are incorporated into courses in each area. The senior capstone design course presents a problem involving one, or possibly all, of these areas in the design of complex systems.

Most civil engineering graduates work for design consultants, construction companies, or governmental agencies. Others work for industrial firms and utilities. Many civil engineers own their own businesses.

The Civil Engineering program is accredited by the Engineering Accreditation Commission of ABET, www.abet.org (<http://www.abet.org/>). The program educational objectives (PEOs) for the Civil Engineering program are that, within a few years after graduation, our Civil Engineering graduates:

- successfully and accurately complete Civil Engineering projects as part of a team, on time and within budget, in an ethical and professional manner, and using modern engineering tools-software
- an ability to communicate effectively with written, oral, and visual means in both technical and non-technical settings
- professional service as evidenced by participation in a professional society and/or educational outreach activities
- engage in lifelong learning as evidenced by participation in continuing education courses, workshops, graduate courses, and by pursuing professional licensure
- a basic knowledge of the business of engineering including how the private and public sector operate separately and collectively

The curriculum is designed to emphasize the fundamentals which place the graduate in a strong position to pursue further education, formally or informally, and to begin a career in any of the above areas. To meet the curriculum requirements specified by the American Society of Civil

Engineers (ASCE), the civil engineering program will prepare students to meet the following student outcomes at the time of graduation:

- (1) an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics
- (2) an ability to 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) an ability to communicate effectively with a range of audiences
- (4) an ability to 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) an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives
- (6) an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions
- (7) an ability to acquire and apply new knowledge as needed, using appropriate learning strategies

Information specific to the available program options in civil engineering is available:

- Civil Engineering, BS (<https://bulletin.uakron.edu/undergraduate/colleges-programs/engineering-polymer-science/civil-engineering/civil-engineering-bs/>)
- Civil Engineering, Co-op Option, BS (<https://bulletin.uakron.edu/undergraduate/colleges-programs/engineering-polymer-science/civil-engineering/civil-engineering-co-op-bs/>)

Civil Engineering (4300)

4300:101 Introduction to Civil Engineering Fundamentals (3 Credits)

Corequisite: 3450:149 or higher math or appropriate AP test score.

Introduction to Civil Engineering. Basic concepts of civil engineering practice including communication skills, problem solving skills, professional ethics/goals, and teamwork. Introduction to professional level software including spreadsheets, database, and mathematical computation.

4300:102 Tools for Civil Engineering (3 Credits)

Prerequisite: 4300:101. Building on concepts of engineering practices learned in Tools I further developing communication skills, problem solving skills, professional ethics/goals, statistics and model-building, and teamwork. Advanced use of professional level software including CAD, MATLAB and Excel.

4300:201 Statics (3 Credits)

Corequisites: 3450:222 and 3650:291. Forces, resultants, couples; equilibrium of force systems; distributed forces; centers of gravity, analysis of simple structures; moments of inertia; kinematics.

4300:202 Introduction to Mechanics of Solids (3 Credits)

Prerequisite: 4300:201. Axial force, bending moment diagrams, axial stress and deformation; stress-strain diagrams; torsion; flexural stress; flexural shearing stress; compound stresses; indeterminate beams; columns.

4300:306 Theory of Structures (3 Credits)

Prerequisite: 4300:202. Stability and determinacy; statically determinate trusses and frames; approximate frame analysis influence lines; moving loads; virtual work analysis; moment area theorem; theorem of three moments; moment distribution for continuous beams and frames.

4300:313 Soil Mechanics (3 Credits)

Prerequisites: 4300:202 and admission to an engineering major within the College of Engineering and Polymer Science or permission. Physical properties of soils. Soil water and groundwater flow. Stresses, displacements, volume changes, consolidation within a soil mass. Soil strength. Compaction.

4300:314 Geotechnical Engineering (3 Credits)

Prerequisites: 4300:313 and admission to an engineering major within the College of Engineering and Polymer Science. Limiting equilibrium within a soil mass. Design of retaining walls, bulkheads, shallow, deep foundation systems. Slope stability.

4300:321 Introduction to Environmental Engineering (3 Credits)

Prerequisites: 3150:153 and 3450:222. Basic principles of ecosystems, microbiology, chemical reactions, and material flow that environmental engineers use to protect our water, air and soil.

4300:323 Water Supply & Pollution Control (3 Credits)

Prerequisite: 4300:321 and admission to an engineering major within the College of Engineering and Polymer Science. Pre/Corequisite: 3450:335. Water and wastewater characteristics, criteria, quantities and distribution. Water and wastewater treatment process flowsheets, design and operation. Wastewater and residue disposal.

4300:341 Hydraulic Engineering (3 Credits)

Prerequisites: 4600:310 and admission to an engineering major within the College of Engineering and Polymer Science. This course will focus on presentation and application of fundamental hydraulic principles in both the classroom and laboratory. Examination of flow in pipelines and pipe networks, pumps and pumping stations, hydrology, flow in open channels, groundwater hydraulics, and design of hydraulic structures will be studied. Emphasis will be placed on proper application of principles, data interpretation and analysis, problem solving, and report writing.

4300:361 Transportation Engineering (3 Credits)

Prerequisites: junior standing and admission to an engineering major within the College of Engineering and Polymer Science. Introductory survey of transportation topics including transportation planning requirements and techniques, introduction to design of highways, airports and railroads and introduction to traffic engineering.

4300:380 Engineering Materials Laboratory (3 Credits)

Prerequisites: 4300:202 and admission to an engineering major within the College of Engineering and Polymer Science. Fundamentals and applications of materials science, mechanics of solids and study of laboratory instrumentation and standard techniques in testing of engineering materials.

4300:401 Steel Design (3 Credits)

Prerequisites: 4300:306 and admission to an engineering major within the College of Engineering and Polymer Science. Tension, compression members; open web joists; beams; bearing plates; beam-columns; bolted, welded connections.

4300:403 Reinforced Concrete Design (3 Credits)

Prerequisites: 4300:306 and admission to an engineering major within the College of Engineering and Polymer Science. Ultimate strength analysis and design; compression steel; diagonal tension; stirrups; development length; one-way slab; T-beams; two-way slabs; columns; isolated and combined footings.

4300:404 Advanced Structural Design (3 Credits)

Prerequisites: 4300:401 and 4300:403. Composite design; plate girders; plastic design; cantilever retaining walls; torsion in R/C members; deflection of R/C members; continuous girder bridge design.

4300:407 Advanced Structural Analysis (3 Credits)

Prerequisite: 4300:306. Energy methods for beams and frames. Stiffness and flexibility formulations for framed structures using classical and matrix methods. Introduction to stability and plastic analysis. Warping-Torsion behavior of beams. Analysis of axisymmetric circular plates and membrane shells.

4300:414 Design of Earth Structures (3 Credits)

Prerequisite: 4300:314 or permission. Design of earth structures: dams, highway fills, cofferdams, etc. Embankment construction techniques, quality control, embankment analysis, instrumentation, foundation soil stabilization, seepage analysis and control. Design problem. Graduate students will perform more advanced analysis and design.

4300:418 Soil & Rock Exploration (3 Credits)

Prerequisite: 4300:314 or permission. Site exploration criteria and planning. Conventional boring, sampling and in situ testing methods. Theory and application of geophysics and geophysical methods including seismic, electrical resistivity, gravity, magnetic and radioactive measurements. Air photo interpretation.

4300:423 Chemistry for Environmental Engineers (3 Credits)

Prerequisite: One year of college chemistry. General, physical, organic biochemistry, equilibrium, and colloid chemistry concepts applied to Environmental Engineering. Concepts are used in water and wastewater laboratory.

4300:424 Water-Wastewater Laboratory (1 Credit)

Corequisite: 4300:323 or permission. Analysis of water and wastewater.

4300:426 Environmental Engineering Design (3 Credits)

Prerequisite: 4300:323. An introduction to the physical, chemical and biological processes utilized in the treatment of water and wastewater, with design parameters emphasized.

4300:427 Water Quality Modeling & Management (3 Credits)

Prerequisite: 4300:323. Analysis and simulation of the physical, chemical and biochemical processes affecting stream quality. Development of management strategies based upon the application of water quality modeling techniques to environmental systems.

4300:428 Hazardous & Solid Wastes (3 Credits)

Prerequisite: senior standing or permission of instructor. Hazardous and solid waste quantities, properties and sources are presented. Handling, processing, storage and disposal methods are discussed with non-technical constraints outlined.

4300:441 Hydraulic Design (3 Credits)

Prerequisite: 4300:341. Collection and critical evaluation of hydraulic data related to actual design problem selected by instructor. Development and analysis of design alternatives. Preparation of reports.

4300:443 Applied Hydraulics (3 Credits)

Prerequisites: 4300:341 and admission to an engineering major within the College of Engineering and Polymer Science. Review of design principles: urban hydraulics, stream channel mechanics, sedimentation, coastal engineering.

4300:445 Hydrology (3 Credits)

Prerequisite: 4300:341. Surface water hydrology, water cycle, precipitation, evaporation, stream flow. Principles of hydrologic systems and their analysis. Hydrologic simulation, reservoir planning and water supply studies. Analysis of rainfall and floods.

4300:448 Hydraulics Laboratory (1 Credit)

Prerequisite: 4300:341. Introduction to laboratory and field devices for hydraulic measurements. Reduction and presentation of hydraulic data. Individual assignments of model studies of hydraulic structures.

4300:450 Urban Planning (2 Credits)

Historical developments in urban planning; urban planning techniques and patterns; comprehensive master planning studies; planning regulations; design problems; class projects; class project presentation.

4300:451 Computer Methods of Structural Analysis (3 Credits)

Prerequisite: 4300:306. Computer methods of structural analysis. Finite element software and interactive graphics. Stiffness concepts and matrix formulation of beams; modeling of simple and complex structural systems; vibration analysis using microcomputers.

4300:452 Structural Vibrations & Earthquakes (3 Credits)

Prerequisite: 4300:306. Vibration and dynamic analysis of structural systems with one, two, or more degrees of freedom; beams, frames, buildings and bridges. Numerical methods of analysis. Elastic-plastic systems. Earthquake analysis of design. Earthquake codes.

4300:453 Optimum Structural Design (3 Credits)

Prerequisite: 4300:306. Basic concepts in structural optimization. Mathematical programming methods including unconstrained minimization, multidimensional minimization and constrained minimization.

4300:454 Advanced Mechanics of Materials (3 Credits)

Prerequisite: 4300:202 or equivalent. Three-dimensional state of stress and strain analysis. Unsymmetric bending of straight and curved members with shear deformation. Beams on elastic foundations. Saint Venant's torsional problems. Inelastic analysis of bending and torsional members. Introduction to energy method. Instability behavior of prismatic members.

4300:463 Transportation Planning (3 Credits)

Prerequisite: 4300:361. Theory and techniques for development, analysis and evaluation of transportation system plans. Emphasis on understanding and using tools and professional methods available to solve transportation planning problems, especially in urban areas.

4300:464 Highway Design (3 Credits)

Prerequisite: 4300:361. Study of modern design of geometrical and pavement features of highways. Design problem and computer use. Graduate students will produce a more complete design.

4300:465 Pavement Engineering (3 Credits)

Prerequisite: 4300:361. Theories of elasticity, of viscoelasticity and of layered systems as applied to pavements. Pavement materials characterization; pavement design, pavement restoration for rigid and flexible pavements.

4300:466 Traffic Engineering (3 Credits)

Prerequisite: 4300:361. Vehicle and urban travel characteristics, traffic flow theory, traffic studies, accidents and safety, traffic signs and marking, traffic signal planning, traffic control and transportation administration.

4300:467 Advanced Highway Design (3 Credits)

Prerequisites: 4300:464, autoCAD capability, or permission. Computer-aided geometrical design of highways including survey data input, digital terrain modeling, cross-section templates, horizontal and vertical roadway design, earthwork computations, and advanced topics.

4300:468 Highway Materials (3 Credits)

Prerequisites: 4300:361 and 4300:380 or permission. Properties of aggregates, manufacture and properties of portland cement concrete, properties of asphaltic materials, design and testing of hot mix asphalt pavement mixes and of surface treatments. Laboratory preparation of specimens and determination of properties. Graduate student requirement: Graduate students will be required to perform an additional eight-hour asphalt laboratory (Absorption recovery of asphalt from solution) and to prepare a paper on a highway materials topic.

4300:471 Construction Administration (3 Credits)

Prerequisites: senior standing and admission to an engineering major within the College of Engineering and Polymer Science or permission. Organization for construction, construction contracts, estimating, bidding, bonds and insurance. Construction financial management and supervision of construction, scheduling using critical path method.

4300:472 Construction Engineering (3 Credits)

Prerequisite: senior standing or permission. Construction equipment selection and management. Techniques of various engineering construction operations including blasting, tunneling, concrete framework and dewatering.

4300:473 Construction Materials (2 Credits)

Prerequisites: 4300:380, 4200:305. Composition, structure and mechanical behavior of structural materials such as concrete, wood, masonry, plastics and composite materials. Discussion of applications and principles of evaluating material properties.

4300:474 Underground Construction (2 Credits)

Prerequisite: 4300:314. Description of practices and techniques of underground construction. Selection of proper method for individual job. Design of underground openings, support systems and linings.

4300:480 Reliability-Based Design (4 Credits)

Prerequisite: 3470:261 and senior standing. Probability concepts in civil engineering. Risk analysis and reliability based design.

4300:482 Special Projects: Civil Engineering (1-3 Credits)

Prerequisites: senior standing and permission. Directed individual or group research or study in student's field of interest. Topic subject to approval by adviser.

4300:489 Fundamental of Engineering Exam Review (0 Credits)

Prerequisite: Senior standing. This course is intended to prepare civil engineering students for the Fundamentals of Engineering Exam, which is to be taken prior to graduation.

4300:490 Senior Design in Civil Engineering (3 Credits)

Prerequisites: senior standing and admission to an engineering major within the College of Engineering and Polymer Science. A civil engineering design project that emphasizes interdisciplinary teamwork to solve a substantial, currently relevant problem.

Gen Ed: Tier 3 - Complex Systems

4300:497 Honors Project (1-3 Credits)

(May be repeated for a total of six credits) Prerequisite: senior standing in Honors Program. Individual creative project or design relevant to civil engineering, supervised by faculty member of the department.