

CIVIL ENGINEERING

The graduate program in the Department of Civil Engineering provides students with opportunities to gain advanced knowledge, skills, and training to design, build, and maintain the foundation for our modern society. This includes our buildings, roads and bridges, drinking or wastewater and the environment, transportation and other civil engineering systems. Faculty and students conduct research projects that take on society's most pressing challenges. Students enhance their technical skills in civil engineering and create possibilities for future career advancement, and engineers currently working in the field will be able to apply what they learn in class to their work.

Visit the Department of Civil Engineering website (<https://uakron.edu/engineering/ce/>) to learn more about its faculty and facilities.

- Civil Engineering, MS (<https://bulletin.uakron.edu/graduate/colleges-programs/engineering/civil-engineering/civil-engineering-ms/>)
- Environmental Engineering, Certificate (<https://bulletin.uakron.edu/graduate/colleges-programs/engineering/civil-engineering/environmental-engineering-certificate/>)
- Geotechnical Engineering, Certificate (<https://bulletin.uakron.edu/graduate/colleges-programs/engineering/civil-engineering/geotechnical-engineering-certificate/>)
- Structural Engineering, Certificate (<https://bulletin.uakron.edu/graduate/colleges-programs/engineering/civil-engineering/structural-engineering-certificate/>)
- Transportation Engineering, Certificate (<https://bulletin.uakron.edu/graduate/colleges-programs/engineering/civil-engineering/transportation-engineering-certificate/>)

Civil Engineering (CIVE)

CIVE 514 Design of Earth Structures (3 Units)

Prerequisite: CIVE 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. (Formerly 4300:514)

CIVE 518 Soil & Rock Exploration (3 Units)

Prerequisite: CIVE 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. (Formerly 4300:518)

CIVE 523 Chemistry for Environmental Engineers (3 Units)

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. (Formerly 4300:523)

CIVE 526 Environmental Engineering Design (3 Units)

Prerequisite: CIVE 323. An introduction to the physical, chemical and biological processes utilized in the treatment of water and wastewater, with design parameters emphasized. (Formerly 4300:526)

CIVE 527 Water Quality Modeling & Management (3 Units)

Prerequisite: CIVE 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. (Formerly 4300:527)

CIVE 528 Hazardous & Solid Wastes (3 Units)

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. (Formerly 4300:528)

CIVE 543 Applied Hydraulics (3 Units)

Prerequisite: CIVE 341. Review of design principles; urban hydraulics, steam channel mechanics, sedimentation, coastal engineering. (Formerly 4300:543)

CIVE 551 Computer Methods of Structural Analysis (3 Units)

Structural analysis using microcomputers; finite element software, interactive graphics; beam stiffness concepts and matrix formulation; simple and complex structural systems modeling; vibration analysis. (Formerly 4300:551)

CIVE 553 Optimum Structural Design (3 Units)

Prerequisite: CIVE 306. Basic concepts in structural optimization. Mathematical programming methods including unconstrained minimization, multidimensional minimization and constrained minimization. (Formerly 4300:553)

CIVE 554 Advanced Mechanics of Materials (3 Units)

Prerequisite: CIVE 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. (Formerly 4300:554)

CIVE 563 Transportation Planning (3 Units)

Prerequisite: CIVE 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. (Formerly 4300:563)

CIVE 564 Highway Design (3 Units)

Prerequisite: CIVE 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. (Formerly 4300:564)

CIVE 565 Pavement Engineering (3 Units)

Prerequisite: CIVE 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. (Formerly 4300:565)

CIVE 566 Traffic Engineering (3 Units)

Prerequisite: CIVE 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. (Formerly 4300:566)

CIVE 567 Advanced Highway Design (3 Units)

Prerequisite: CIVE 564, Autocad, or permission. Computer-aided geometric design of highways including survey data input, digital terrain modeling, cross-section templates, horizontal and vertical roadway design, earthwork computations, and advanced topics. (Formerly 4300:567)

CIVE 568 Highway Materials (3 Units)

Prerequisites: CIVE 361, CIVE 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 (Abson recovery of asphalt from solution) and to prepare a paper on a highway materials topic. (Formerly 4300:568)

CIVE 574 Underground Construction (2 Units)

Prerequisite: CIVE 314. Description of practices and techniques of underground construction. Selection of proper method for individual job. Design of underground openings, support systems and linings. (Formerly 4300:574)

CIVE 604 Dynamics of Structures (3 Units)

Prerequisite: CIVE 306. Approximate, rigorous dynamic analysis of one, two, multiple and infinite degrees of freedom structural systems. Elastoplastic, plastic analysis. Equivalent systems, dynamic hinge concept. Modal analysis. Transfer matrices. Fourier, Laplace transforms. (Formerly 4300:604)

CIVE 605 Structural Stability (3 Units)

Prerequisite: CIVE 554 or equivalent. Buckling of bars, beam-columns and frames. Lateral buckling of beams. Double and tangent modulus theories. Energy methods. Compressed rings and curved bars. Torsional buckling. Buckling of plates and shells. Inelastic buckling. (Formerly 4300:605)

CIVE 606 Energy Methods & Elasticity (3 Units)

Prerequisite: CIVE 202. Work and complementary work. Strain energy and complementary strain energy. Virtual work and Castigliano's theorems. Variational methods. Applications. Formulation of boundary value problems in elasticity. Selected topics in energy methods and elasticity. (Formerly 4300:606)

CIVE 607 Prestressed Concrete (3 Units)

Prerequisite: CIVE 404. Basic concepts. Design of double-tee roof girder; shear; development length; column; piles; design of highway bridge girder; pretensioned, post-tensioned; continuous girders; corbels; volume-change forces; connections. (Formerly 4300:607)

CIVE 608 Multistory Building Design (3 Units)

Prerequisite: CIVE 401. Floor systems; staggered truss system; braced frame design; unbraced frame design; drift indices; monocoque (tube and partial tube) systems; earthquake design; fire protection. Analysis by STRUDL. (Formerly 4300:608)

CIVE 609 Finite Element Analysis I (3 Units)

Prerequisite: CIVE 554 or equivalent. Introductory development of finite element method as applied to various topics from continuum mechanics. Such areas as plane, axisymmetric and 3-D stress analysis; conduction, fluid mechanics; transient problems and geometric and material non-linearity. (Formerly 4300:609)

CIVE 610 Composite Materials in Civil Infrastructure (3 Units)

Prerequisite: CIVE 554 or equivalent. Constituent materials; manufacturing processes; panel properties by micro/macromechanics; simplified analysis of composite beams, columns, and applications to highway bridges; composites in concrete and wood structures. (Formerly 4300:610)

CIVE 611 Fundamentals of Soil Behavior (2 Units)

Prerequisite: CIVE 314. In-depth examination of structure and fundamental physico-chemical and mechanical properties of engineering soils viewed as particulate matter. (Formerly 4300:611)

CIVE 612 Advanced Soil Mechanics (3 Units)

Prerequisite: CIVE 314. Study of mechanics of behavior of soil as continuum. Principles of stress, strain, deformation, shear strength and pore water pressure as applied to mechanical behavior of soil masses. (Formerly 4300:612)

CIVE 613 Advanced Geotechnical Testing (3 Units)

Prerequisites: CIVE 518 and CIVE 612. Theory and practice of static and dynamic in situ and laboratory soil testing. Testing procedures, applicability, limitations. General evaluation of geotechnical parameters for routine and special site conditions. One lecture, two laboratories per week. (Formerly 4300:613)

CIVE 614 Foundation Engineering I (3 Units)

Prerequisite: CIVE 313 or permission. Foundation bearing capacity and settlement analysis. Design of shallow and deep foundation systems. Pile driving and load test procedures and analysis. Theory and design of earth-retaining structures including retaining walls, tiebacks and bulkheads. (Formerly 4300:614)

CIVE 615 Foundation Engineering II (3 Units)

Prerequisite: CIVE 614 or permission. Soil-structure interaction theory and applications to underground structures including conduits, tunnels and shafts. Advanced foundation construction methods and problems including dewatering, soil stabilization, underpinning and cofferdams. Slope stability analysis. (Formerly 4300:615)

CIVE 616 Soil Improvement (3 Units)

Prerequisites: CIVE 313 and CIVE 314. Admixture stabilization, precompression with vertical drains, blasting, vibrocompaction, injection and grouting, thermal methods, electro-osmosis, soil reinforcement, case studies. (Formerly 4300:616)

CIVE 617 Numerical Methods in Geotechnical Engineering (3 Units)

Prerequisites: CIVE 313 and CIVE 314. Steady-state and transient flow through soils, consolidation, soil-structure interaction, piling, stress-deformation analysis of earth structures. (Formerly 4300:617)

CIVE 618 Rock Mechanics (3 Units)

Prerequisite: CIVE 554 or permission. Mechanical nature of rocks; linear elasticity and application to rock problems; inelastic behavior of rocks, time dependence and effects of pore pressure, experimental characterization of rock properties; failure theory and crack propagation. (Formerly 4300:618)

CIVE 620 Sanitary Engineering Problems (2 Units)

Prerequisite: CIVE 323. Application of both laboratory methods and theory to solution of sanitary engineering problems involving water pollution, stream regeneration, special industrial wastes, detergents and others. (Formerly 4300:620)

CIVE 621 Environmental Engineering Principles (4 Units)

Corequisite: CIVE 523. Provide the basic principles of chemical reaction engineering, microbiology, environmental regulations, and contaminant migration required for the understanding and solving environmental problems. (Formerly 4300:621)

CIVE 622 Aquatic Chemistry (3 Units)

Prerequisites: CHEM 151 and CHEM 153 or permission. Quantitative treatment of variables that govern the chemistry of aquatic systems. Emphasis on carbonate in open-closed systems, metal complexation and solubility, and oxidation-reduction reactions. (Formerly 4300:622)

CIVE 623 Physical/Chemical Treatment Processes (3 Units)

Pre/Corequisite: CIVE 621. Theory, current research associated with physical/chemical processes, the impact on design-coagulation/flocculation, sedimentation, filtration, absorption processes emphasized. (Formerly 4300:623)

CIVE 624 Biological Treatment Processes (3 Units)

Pre/Corequisite: CIVE 621. Theory, current research associated with biological processes, related physical/chemical processes, the impact on design-activated sludge, fixed film processes, gas transfer, sludge stabilization, sludge dewatering processes emphasized. (Formerly 4300:624)

CIVE 625 Water Treatment Plant Design (3 Units)

Prerequisite: CIVE 623. Design of water treatment plants for potable, industrial and commercial uses. Development of water sources, treatment methods and financing used to design best practical methods in terms of cost-benefits. (Formerly 4300:625)

CIVE 626 Wastewater Treatment Plant Design (3 Units)

Prerequisite: CIVE 624. Application of theory and fundamentals to design of wastewater treatment plants. System design methods used for biological and chemical stabilization of wastewater to meet water quality criteria. Economic analyses made to determine best practical designs to be utilized. (Formerly 4300:626)

CIVE 627 Environmental Operations Laboratory (2 Units)

Prerequisite: CIVE 426 or permission of instructor. Conduction of laboratory experiments related to the design and operation of water and wastewater treatment processes. Experimental design, data collection, analysis and report preparation. (Formerly 4300:627)

CIVE 628 Advanced Chemical Oxidation Process (3 Units)

Prerequisites: CHEM 151 and CHEM 153 or permission. Qualitative and quantitative treatment of variables that govern process chemistry and kinetics in water. Emphasis on ozone, hydrogen peroxide, and ultra-violet light (UV). (Formerly 4300:628)

CIVE 631 Soil Remediation (3 Units)

Prerequisite: CIVE 621 or permission. Provide a thorough understanding of site characterization, traditional soil remediation technologies, as well as present new and emerging remediation technologies. (Formerly 4300:631)

CIVE 635 Air Pollution Control (3 Units)

Prerequisite: CIVE 621 or permission. Introduction to air pollution control philosophies, approaches, regulations, and modeling. Also contains an in-depth evaluation/design approach for the control of particular matter, SO_x, and NO_x. (Formerly 4300:635)

CIVE 640 Advanced Fluid Mechanics (3 Units)

Prerequisite: MECE 310 or permission. Basic equations, Navier-Stokes equations. Analysis of potential flow, turbulence, hydraulic transients. Solution of typical fluid mechanics problems. Analysis of water hammer in pipe networks by method of characteristics. (Formerly 4300:640)

CIVE 644 Open Channel Hydraulics (3 Units)

Application of basic principles of fluid mechanics to flow in open channels. Criteria for analysis of uniform, gradually varied and rapidly varied flows. Study of movement and transportation of sediments. Design problems utilizing numerical techniques. (Formerly 4300:644)

CIVE 645 Applied Hydrology (3 Units)

Discussion of water cycle such as precipitation, evaporation, stream flows, floods, infiltration. Methods of analysis and their application to studies of water demand, storage, transportation including mathematical modeling of urban runoff and statistical hydrology. (Formerly 4300:645)

CIVE 646 Coastal Engineering (3 Units)

Characteristics of linear and nonlinear wave theories. Interaction of structures, waves; design analysis of shore, offshore structures. Movement, transportation of sediments in lake shore areas. (Formerly 4300:646)

CIVE 663 Advanced Transportation Engineering I (3 Units)

Prerequisites: CIVE 361 and CIVE 466 or permission. Highway and parking facility design, transportation planning, highway capacity estimates, signal systems and optimization, incident detection and management, freeway ramp metering, and highway traffic safety. (Formerly 4300:663)

CIVE 664 Advanced Transportation Engineering II (3 Units)

Prerequisites: CIVE 361 and CIVE 466 or permission. Highway and parking facility design, transportation planning, highway capacity estimates, signal systems and optimization, incident detection and management, freeway ramp metering, and highway traffic safety. (Formerly 4300:664)

CIVE 665 Traffic Detection and Data Analysis (3 Units)

Prerequisite: CIVE 361 or consent of instructor. Theory and application of pressure tubes, loop detectors, and imaging sensing, microwave, infrared, ultrasonic, laser detectors. Parameter estimation, reliability, and data mining and fusion. (Formerly 4300:665)

CIVE 681 Advanced Engineering Materials (3 Units)

Selected topics on principles governing mechanical behavior of materials with respect to elastic, plastic and creep responses, stress rupture, low and high cycle and thermal fatigue. Failure theories and fracture phenomena in brittle and ductile materials. Crack propagation and life prediction of engineering materials. (Formerly 4300:681)

CIVE 682 Elasticity (3 Units)

Prerequisite: CIVE 202. Plane stress, plane strain. Two-dimensional problems in rectangular, polar coordinates. Strain-energy methods. Stress, strain in three dimensions. Torsion. Bending. Thermal stresses. (Formerly 4300:682)

CIVE 683 Plasticity (3 Units)

Prerequisite: CIVE 682 and MECE 622 or equivalent. Mathematical formulation of constitutive equations with focus on their use in structural analysis. Internal variables. Isotropic, kinematic hardening. Nonisothermal plasticity. Finite deformations. Anisotropy. (Formerly 4300:683)

CIVE 684 Advanced Reinforced Concrete Design (3 Units)

Prerequisite: CIVE 403. Slab systems. Equivalent frame properties. Limit analysis. Yield line theory. Lateral load systems. Shear walls. Footings. Biaxial column action. (Formerly 4300:684)

CIVE 685 Advanced Steel Design (3 Units)

Prerequisite: CIVE 401. Properties of steel, fasteners, bearing, friction joints, Gusset plates, bolts in tension, end plates, weld joints, cyclic loads, fatigue analysis, types of detail, torsion, stability design. (Formerly 4300:685)

CIVE 686 Experimental Methods in Structural Mechanics (3 Units)

Prerequisite: CIVE 682. Electrohydraulic closed-loop test systems. Methods for specimen heating. Strain measurement techniques for room and elevated temperatures. Design of computer controlled experiments investigating deformation and failure under complex stress states. (Formerly 4300:686)

CIVE 687 Limit Analysis in Structural Engineering (3 Units)

Prerequisites: [CIVE 454 or CIVE 554] and CIVE 682. Fundamental theorems of limit analysis. The lower-bound and upper-bound solutions. Applications to frames, plates and plane stress and plane strain problems. Design considerations. Mathematical programming and computer implementation. (Formerly 4300:687)

CIVE 694 Advanced Seminar in Civil Engineering (1-3 Units)

Prerequisite: Permission. Advanced projects, reading, studies, or experimental in various areas of civil engineering. (Formerly 4300:694)

CIVE 697 Engineering Report (2 Units)

Prerequisite: Permission of advisor. A relevant problem in civil engineering for students electing the non-thesis option. The final engineering report must be approved by the advisor and the advisory committee. (Formerly 4300:697)

CIVE 698 Master's Research (1-6 Units)

Prerequisite: Permission of advisor. (May be repeated.) Research on a suitable topic in civil engineering culminating in a master's thesis. (Formerly 4300:698)

CIVE 699 Master's Thesis (1-6 Units)

Prerequisite: Permission. Research and thesis on some suitable topic in civil engineering as approved by department. Defense of thesis is by final examination. (Formerly 4300:699)

CIVE 701 Earthquake Engineering (3 Units)

Prerequisite: CIVE 604. Earthquake fundamentals. Earthquake response of single-story and multi-story buildings, as well as structural components. Modal analysis for earthquake response. Inelastic response of multistory structures. Earthquake codes. Stochastic approach. (Formerly 4300:701)

CIVE 702 Plates & Shells (3 Units)

Prerequisite: CIVE 682. Navier and Levy solutions for rectangular plates. Approximate methods, including finite difference. Forces in middle plate. Large deflections. Differential geometry of a surface. Shells of revolution. (Formerly 4300:702)

CIVE 703 Viscoelasticity & Viscoplasticity (3 Units)

Prerequisite: CIVE 683. Formulation of constitutive relations for time dependent materials. Classical linear viscoelasticity. Internal variable representation of nonlinear, hereditary behavior. Creep and rate dependent plasticity. Continuum thermodynamics. Anisotropy. (Formerly 4300:703)

CIVE 704 Finite Element Analysis II (3 Units)

Prerequisite: CIVE 609 and CIVE 702 or permission. Curved, plate, shell brick elements. Quasi-analytical elements. Quadrature formulas. Substructuring for static and dynamic analyses. Solution algorithms for linear and nonlinear static and dynamic analysis. Computer program formulation. Review of large-scale production programs. (Formerly 4300:704)

CIVE 710 Advanced Composite Mechanics (3 Units)

Prerequisite: CIVE 610. Analysis of short-fiber composites and statistical behavior, bending, buckling and vibration of laminated plates and shells. Advanced topics involving stress concentration, residue stress, fatigue, fracture toughness, nonlinear and viscoelastic stress-strain formulations, solutions of nonlinear problems. (Formerly 4300:710)

CIVE 712 Dynamic Plasticity (3 Units)

Prerequisite: CIVE 683 or CIVE 703. Impulsive and transient loading of structural elements (beams, plates, shells, etc.) in which inelastic deformation occurs. Topics include: longitudinal and transverse plastic wave propagation in thin rods, propagation of plastic hinges, rate-dependent viscoplastic waves, transverse impact on beams and plates, high-rate forming, blast loading, plate perforation, shock waves in solids. (Formerly 4300:712)

CIVE 717 Soil Dynamics (3 Units)

Prerequisite: CIVE 614 or permission. Vibration and wave propagation theory relating to soils, soil structures and foundations. Dynamic behavior of soils. Design of foundations for dynamic loading impact, pulsating and blast loads. (Formerly 4300:717)

CIVE 731 Bioremediation (3 Units)

Prerequisite: CIVE 621 or permission. Provide the fundamentals required for understanding and successfully implementing the biodegradation of hazardous compounds coupled with the design and operational techniques of bioremediation systems. (Formerly 4300:731)

CIVE 745 Seepage (2 Units)

Discussion of parameters determining permeability of various soils. Analytical, numerical and experimental methods to determine two- or three-dimensional movement of groundwater. Unsteady flows. (Formerly 4300:745)

CIVE 898 Preliminary Research (1-15 Units)

(May be repeated for a total of 15 credits.) Prerequisite: Approval of dissertation director. Preliminary investigations prior to the submission of a dissertation proposal to the interdisciplinary Doctoral Committee. (Formerly 4300:898)

CIVE 899 Doctoral Dissertation (1-15 Units)

(May be taken more than once.) Prerequisite: Acceptance of research proposal by the Interdisciplinary Doctoral Committee and approval of the dissertation director. Original research by the doctoral student. (Formerly 4300:899)