Civil Engineering

College of Science, Engineering and Technology
Department of Mechanical and Civil Engineering
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Accreditation. The Civil Engineering program is accredited by the Engineering Accreditation Commission of ABET, www.ABET.org.

Civil Engineering, as defined by the American Society of Civil Engineers, is a profession in which a knowledge of the mathematical and physical sciences gained by study, experience, and practice is applied with judgment to develop ways to utilize, economically, the materials and forces of nature for the progressive well-being of humanity in creating, improving and protecting the environment, in providing facilities for community living, industry and transportation, and in providing structures for the use of humanity.

Civil engineers design and supervise the construction of roads, buildings, airports, tunnels, dams, bridges, water supply, water and wastewater treatment, and many other systems. Major specialties within civil engineering include: structural, geotechnical, water resources, transportation, environmental, and construction engineering.

Program Objectives. The Mission of the Civil Engineering Program at Minnesota State Mankato is to provide a broad-based education that will enable graduates to enter practice in the civil engineering profession, serving the needs of the State of Minnesota and the Nation.

Within 3-6 years of graduation, graduates of the civil engineering program at Minnesota State University, Mankato are expected to contribute to the profession and to society as a whole by achieving a combination of the following milestones.

1. Based on their strong technical foundation in civil engineering, they have advanced professionally to increased levels of responsibility have successfully transitioned into business or management, or have successfully completed an advanced degree.
2. They have become a registered professional engineer.
3. They have demonstrated an ability to communicate technical information through technical reports and/or proposals, development of plans and specifications, presentations to the public, published papers and articles, and/or conference presentations.
4. They have participated in continuing education or pursued additional industry certification.
5. They have participated in, or served as an officer of, a local, regional, or national professional engineering society, standards committee, or state/local board.

Program objectives are monitored by the constituencies (civil engineering profession through the program's Industrial Advisory Board and employers, alumni, and students of the program).

Other important features of a civil engineering education at Minnesota State Mankato include:

- Senior students work together as a design team in a full academic year course incorporating multiple civil engineering disciplines in a comprehensive design project.
- Students work closely with engineers from design firms and government agencies, and with faculty and students from other engineering courses in the senior design project.
- Students take the Fundamentals of Engineering exam in their senior year – the first step towards professional registration.
- The faculty maintains ties to industry, thereby keeping current with new technologies, design methodologies, and the world of civil engineering practice – a valuable resource for students.

Preparation. Recommended high school preparation is one year each of precalculus, physics and chemistry. Computer skills such as word processing, spreadsheets, and presentations are also recommended. Without this background it may take longer than four years to earn the degree.

Academic Map/Degree Plan at www.mnsu.edu/programs/#All

POLICIES/INFORMATION

Program Admission. Admission to the Civil Engineering Program is granted by the department, and is necessary before enrolling in 300- and 400-level courses. Near the end of the sophomore year, students submit an application for admission to the civil engineering program. Applications to the program may be obtained from the Department of Mechanical and Civil Engineering or downloaded from the department website.

Before being admitted to upper-division civil engineering courses, a student must complete a minimum of 43 credits, for grade, including the following core courses, applicable to the degree: calculus-based physics (mechanics), 4 credits; calculus and differential equations, 16 credits; introduction to problem solving and civil engineering design, 2 credits; engineering analysis (numerical methods and statistics), 3 credits; engineering mechanics (statics, dynamics, and mechanics of materials), 9 credits; chemistry with lab, 5 credits; and English composition, 4 credits.

To be admitted to the civil engineering program, a student must earn a grade of "C" (2.00) or better and a cumulative GPA of 2.50 in the courses listed above. All core course grades (including those for repeated courses) will be considered in the computation of the GPA for admission to the program. Provisional admission to the program for one semester may be granted in limited cases.

All admitted students are required to take a department-administered diagnostic test early in their junior year.

Transfer Students. The department makes a special effort to accommodate transfer students. Transfer students are encouraged to contact the department as soon as possible to facilitate a smooth transition. Generally, no transfer credits are allowed for upper division civil engineering courses. Transfer students must complete a minimum of 12 credits at Minnesota State Mankato prior to being considered for admission to the program.

Satisfactory Progress. Once admitted to the civil engineering program, a student must demonstrate satisfactory progress by maintaining a cumulative GPA of at least 2.30 in all upper-division engineering courses.

P/N Grading. P/N credit is not allowed for any course used to meet civil engineering degree requirements.

Probation. An admitted student who does not maintain satisfactory progress as defined above will be placed on program probationary status for a maximum of one semester. During the probationary period, the student must complete at least 8 credits, approved by the department, of upper division engineering courses for grade from the prescribed Civil Engineering curriculum. Students may not receive a degree without first conforming to the satisfactory progress criteria. A student who fails to meet satisfactory progress for a second semester (consecutive or non-consecutive) will not be allowed to continue in the program.

Appeals. A student may appeal any departmental decision in writing.

CIVIL ENGINEERING BSCE
Degree completion = 128 credits

Required General Education

Required Special General Education (23 credits)
The Bachelor of Science in Civil Engineering degree does not adhere to the standard general education program required by other majors. Rather, it requires a special distribution of communication, humanities, and social science courses. Courses may be chosen to satisfy the university cultural diversity requirement concurrently.

Required Humanities and Social Science Courses (minimum of 15 credits) To satisfy this requirement, the courses selected must provide both breadth and depth and should not be limited to a selection of unrelated introductory courses. Each student should discuss

with his/her academic advisor on the selection of courses to meet this requirement early in their academic career. A current list of acceptable courses is posted in the department office and on the department web site. Specifically, the minimum requirements consist of at least 6 credits in the humanities area, and at least 6 credits in the social sciences area in addition to the Required General Education courses.

To provide the measure of depth to the course of study, at least 3 credits at the 300-level or above must be included in either the humanities of the social sciences requirement. At least one upper division course must follow a course in the same subject area as a course at the 100 or 200 level.

ENG 101 Composition (4)
ENG 271W Technical Communication (4)
(choose 3 credits)
ECON 201 Principles of Macroeconomics (3)
ECON 202 Principles of Microeconomics (3)

Prerequisites to the Major

CHEM 201 General Chemistry I (5)
CIVE 201 Introduction to Problem Solving and Civil Engineering Design (2)
MATH 121 Calculus I (4)
MATH 122 Calculus II (4)
MATH 223 Calculus III (4)
MATH 321 Ordinary Differential Equations (4)
ME 212 Statics (3)
ME 214 Dynamics (3)
ME 223 Mechanics of Materials (3)
ME 291 Engineering Analysis (3)
PHYS 221 General Physics I (4)

Major Common Core

CIVE 101 Introduction to Engineering - Civil (2)
CIVE 145 CAD for Civil Engineering (2)
CIVE 235 Properties of Civil Engineering Materials (3)
CIVE 271 Civil Engineering Measurements (2)
CIVE 321 Fluid Mechanics (3)
CIVE 340 Structural Analysis (3)
CIVE 350 Hydraulics and Hydrology (4)
CIVE 360 Geotechnical Engineering (4)
CIVE 370W Transportation Engineering (4)
CIVE 380 Environmental Engineering (3)
CIVE 401W Civil Engineering Design I (2)
CIVE 402W Civil Engineering Design II (3)
CIVE 435 Civil Engineering Experimentation I (2)
CIVE 436 Civil Engineering Experimentation II (2)
GEOL 121 Physical Geology (4)
(choose 2 - 3 credits)
ME 241 Thermodynamics (3)
ME 299 Thermal Analysis (2)
(choose 3 credits)
CIVE 446 Reinforced Concrete Design (3)
CIVE 448 Steel Design (3)

Major Restricted Electives

Physics II or III

Choose one group
College Physics II
PHYS 222 General Physics II (3)
PHYS 232 General Physics II Laboratory (1)
College Physics III
PHYS 223 General Physics III (3)
PHYS 233 General Physics III Laboratory (1)

Civil and Technical Electives

Choose a minimum of 14 credits in civil (minimum 9) and technical (minimum 2) electives. Elective courses are selected from the list below, and are recommended to be taken after identifying an area of interest and in consultation with an academic advisor.

Civil Engineering Electives (choose 9 - 12 credits)

CIVE 432 Properties of Concrete (3)
CIVE 446 Reinforced Concrete Design (3)
CIVE 447 Prestressed Concrete Design (3)
CIVE 448 Steel Design (3)
CIVE 450 Finite Element Method (3)
CIVE 452 Open Channel Flow (3)
CIVE 454 Hydraulic Structures (3)
CIVE 458 Stormwater Management (3)
CIVE 461 Fundamentals of Pavement Design (3)
CIVE 465 Foundation Design (3)
CIVE 467 Earth Structures (3)
CIVE 470 Traffic Engineering (3)
CIVE 471 Highway Planning and Design (3)
CIVE 476 Planning and Design of Airports (3)
CIVE 481 Water & Wastewater Treatment, Collection & Distribution (3)
CIVE 482 Utility Pipeline Inspection, Repair and Rehabilitation (3)
CIVE 484 Landfill and Hazardous Waste Engineering (3)

Technical Electives (choose 2 - 5 credits)

BIOL 270 Microbiology (4)
BLAW 450 Contracts,Sales,and Professional Responsibility (3)
BLAW 453 International Legal Environment of Business (3)
BLAW 474 Environmental Regulation and Land Use (3)
BLAW 476 Construction and Design Law (3)
CHEM 202 General Chemistry II (5)
CHEM 305 Analytical Chemistry (4)
CHEM 407 Environmental Chemistry (3)
CIVE 300 - 489 Except Required Courses
CM 310 Estimating I (3)
CM 330 Planning and Scheduling (3)
CM 340 Construction Project Management (3)
EE 300 - 489
EE 230 Circuit Analysis I (3)
ENVR 440 Environmental Regulations (3)
ENVR 450 Environmental Pollution & Control (3)
ENVR 460 Analysis of Pollutants (4)
GEOG 315 Geomorphology (3)
GEOG 373 Introduction to Geography Information Systems (4)
GEOG 439 Transportation Modeling & GIS (4)
GEOL 330 Structural Geology (4)
GEOL 350 Environmental Geology (4)
GEOL 351 Engineering Geology (2)
GEOL 450 Hydrogeology (3)
ME 300 - 489

Required Minor: None.

COURSE DESCRIPTIONS

CIVE 100 (1) Explorations in Engineering
This course offers an introduction to the various disciplines of engineering and their relationship to the principles of physics and mathematics. Students are prepared for academic success and the transition into an engineering program.
Fall
GE-12

CIVE 101 (2) Introduction to Engineering - Civil
To prepare the students for a career in engineering with some emphasis in civil; introduce the engineering fundamentals and the skills necessary to have a successful learning experience; and to prepare students for engineering education and profession through interactions with upper-class engineering students and practicing engineers.
Prerequisite: MATH 113 or MATH 115 or MATH 121
Fall

CIVE 145 (2) CAD for Civil Engineering
Basic computer applications for drafting and designing civil engineering projects. Structure and use of standard CAD software. Basic orthographic construction and projections, and development of different types of drawings - sections, plan and profile, and construction details.
Fall, Spring

CIVE 201 (2) Introduction to Problem Solving and Civil Engineering Design
Introduction to the design concepts of civil engineering projects including presentations, codes and standards, construction drawings, and public hearing; problem solving skills for civil engineering analysis and design including the use of appropriate computational tools and programming logic. Includes laboratory component.
Prerequisite: CIVE 101
Fall, Spring

CIVE 212 (3) Statics
Resultants of force systems, equilibrium, analysis of forces acting on structural elements, friction, second moments, virtual work.
Prerequisite: PHYS 221
Fall, Spring

CIVE 214 (3) Dynamics
Kinematics and kinetics of particles, systems of particles and rigid bodies, work energy, linear and angular impulse momentum, vibrations.
Prerequisite: CIVE 212 or ME 212
Fall, Spring

CIVE 223 (3) Mechanics of Materials
Load, deformation, stress, strain, stress-strain relationship, buckling, energy concepts, stress analysis of structural elements.
Prerequisite: CIVE 212 or ME 212
Fall, Spring

CIVE 235 (3) Properties of Civil Engineering Materials
Mechanical behavior and properties of civil engineering materials. Microstructure, response to stress, creep, fatigue, fracture and failure. Composition, application and construction of steel, concrete, asphalt, aggregates, steel, timber, composites and other materials. Includes laboratory component.
Co-requisite: ME 223
Spring

CIVE 271 (2) Civil Engineering Measurements
Basic civil engineering measurements as relates to construction layout, including distances, angles, bearings, elevations, mapping, and positioning. Includes laboratory component.
Co-requisite: MATH 121
Fall

CIVE 293 (1) MAX Scholar Seminar
This class provides MAX scholars with an opportunity to explore a set of topics related to achieving success in academic, professional and personal realms. Speakers will include faculty, graduate students, visiting researchers and industry members as well as student participants. Students will be required to participate in mentoring of lower division MAX scholarship recipients and provide written and oral presentations of various topics during the semester. This course may be repeated and will not count towards graduation requirements.
Prerequisite: Recipient of a MAX scholarship or instructor consent.
Fall, Spring

CIVE 321 (3) Fluid Mechanics
Introduction to fluid properties, fluid statics, fluid flow, buoyancy, Bernoulli's equation, the integral and differential approach to basic flow equations, similitude and dimensional analysis, viscous internal and external flows, and pumps.
Prerequisite: CIVE 214 or ME 214
Co-requisite: ME 241 or ME299
Fall

CIVE 340 (3) Structural Analysis
Minimum design loads for buildings using ASCE 7 guidelines and load distribution. Analysis of determinate structural systems including the case of moving loads. Analysis of indeterminate structures using the flexibility and moment distribution methods. Use of software to enhance the analysis.
Prerequisite: CIVE 223 or ME 223
Fall

CIVE 350 (4) Hydraulics and Hydrology
Concept of hydraulics such as pipe flow and open channel flow. Hydrologic principles such as weather patterns; precipitation measurement and distribution, abstractions, and runoff; storm hydrograph and peak flow analysis. Design includes flood design, reservoir and channel routing. Includes significant design component.
Prerequisite: CIVE 321 or ME 321, ME 291
Spring

CIVE 360 (4) Geotechnical Engineering
Study of soil behaviors and their classifications; index properties. Applications of mechanics principles to soils as an engineering material, consolidation theory, compaction theory, effective stresses, shear strength; earth pressure and slope stability. Elements of foundation designs. Includes significant design component.
Prerequisite: CIVE 223 or ME 223
Co-requisite: CIVE 321 or ME 321
Spring

CIVE 370 (4) Transportation Engineering
Introduction to Transportation systems; land use and transportation interaction, planning, and traffic operations; transportation decision making using economic analysis. Introduction to design, construction, maintenance, and operation of various transportation modes. Includes significant design component.
Co-requisite: CIVE 271, ME 291

CIVE 370W (4) Transportation Engineering
Introduction to Transportation systems; land use and transportation interaction, planning, and traffic operations; transportation decision making using economic analysis. Introduction to design, construction, maintenance, and operation of various transportation modes. Includes significant design component.
Prerequisites: CIVE 145
Co-requisite: CIVE 271, ME 291
Fall
WI

CIVE 380 (3) Environmental Engineering
Introduction of the fundamental chemical, biological and physical principles of environmental engineering for water and wastewater treatment and distribution systems, solid waste management, air pollution control, and the analysis of air quality, surface water, and ground water. Includes significant design component.
Prerequisite: CHEM 201, MATH 321
Fall

CIVE 398 (0) CPT: Co-Operative Experience
Curricular Practical Training: Co-Operative Experience is a zero-credit full-time practical training experience for one summer and on adjacent fall or spring term. Special rules apply to preserve full-time student status. Please contact an advisor in your program for complete information.
Prerequisite: CIVE 201. At least 60 credits earned; in good standing; instructor permission; co-op contract; other prerequisites may also apply.
Fall, Spring, Summer

CIVE 401W (2) Civil Engineering Design I
Practical civil engineering design project with real world constraints. This course focuses on the planning and formulation of a project, and the presentation of preliminary findings to the public. Includes significant design component.
Prerequisite: CIVE 340, CIVE 350, CIVE 360, CIVE 370
Co-requisite: CIVE 380
Fall

CIVE 402W (3) Civil Engineering Design II
Practical civil engineering design project with real world constraints. Focuses on the engineering analysis, design, and economic analysis of the project. Includes significant design component.
Prerequisite: CIVE 401
Spring

CIVE 432 (3) Properties of Concrete
Selected studies in the properties and design of concrete mixtures, cement chemistry, concrete durability, specialty concrete, construction, admixtures, and quality control. Includes laboratory and significant design components.
Prerequisite: ME 223
Variable

CIVE 435 (2) Civil Engineering Experimentation I
Provides students with hands-on experience in the testing of civil engineering materials including concrete, metals and structural systems. Includes laboratory component.
Prerequisite: CIVE 340 & CIVE 370
Fall

CIVE 436 (2) Civil Engineering Experimentation II
Provides students with hands-on experience in the testing of civil engineering materials including soil and asphalt, fluid mechanics, hydraulics, and hydrology. Includes laboratory component.
Prerequisite: CIVE 350, CIVE 360
Spring

CIVE 446 (3) Reinforced Concrete Design
Design of reinforced concrete beams, columns, slabs, and structural foundations according to ACI 318 Building Code requirements. Includes significant design component.
Prerequisite: CIVE 340
Alt-Spring

CIVE 447 (3) Prestressed Concrete Design
Design of prestressed concrete structures. Basic materials and prestress loss mechanisms. Flexure, shear, and deflections of prestressed concrete beams. Load-moment interaction curves for columns. Prestressed concrete bridge girders. The use of software is expected. Includes significant design component.
Prerequisite: CIVE 340
Spring

CIVE 448 (3) Steel Design
Behavior and properties of structural steel. Design of tension members, compression members, beams, and connections using the LRFD method. Use of the AISC Steel Construction Manual is required. Includes significant design component.
Prerequisite: CIVE 340
Alt-Spring

CIVE 450 (3) Finite Element Method
Same as ME 450

CIVE 452 (3) Open Channel Flow
Analysis of open channel flow systems. Includes natural channels, designed channels, flow transitions, steady flow, unsteady flow, uniform flow, and non-uniform flow. Includes significant design component.
Prerequisite: CIVE 350
Variable

CIVE 454 (3) Hydraulic Structures
Analysis and design of water regulating structures. Includes dams, spillways, gates, dikes, levees, stilling basins, water distribution systems, and various simpler structures. Environmental impacts of hydraulic structures are discussed throughout the course. Includes significant design component.
Prerequisite: CIVE 350
Variable

CIVE 458 (3) Stormwater Management
Application of fluid mechanics and hydrology to the design of stormwater management facilities. Environmental impacts of stormwater management are discussed throughout the course. Includes significant design component.
Prerequisite: CIVE 350
Variable

CIVE 461 (3) Fundamentals of Pavement Design
Performance and design of rigid, flexible, and composite pavement structures with emphasis on modern pavement design procedures. Principles of pavement maintenance, rehabilitation, and pavement management systems. Materials characterization, tests, quality control, and life cycle cost analysis. Includes significant design component.
Prerequisite: CIVE 370, CIVE 223 or ME 223
Co-requisite: CIVE 360
Variable

CIVE 465 (3) Foundation Design
Classification of foundations; applications of fundamental soil mechanics to design and analysis of soil-structure systems; design and computer application of shallow and deep foundations, piles and caissons, retaining structures. Introduction to rock mechanics. Includes significant design component.
Prerequisite: CIVE 360
Variable

CIVE 467 (3) Earth Structures
Design and construction of traditional embankments, including slope stability analysis; earth and rockfill dams, introduction to seepage analysis; excavations, earth retaining structures, and other geotechnical structures. Geotechnical software application in analysis and design. Includes significant design component.
Prerequisite: CIVE 360
Variable

CIVE 470 (3) Traffic Engineering
Elements of traffic engineering including road use, vehicle and roadway systems; traffic flow theory; traffic studies and data collections; traffic control devices; principles of intersecting signalization; capacity and level of service; analysis of freeways, rural highways and intersections using computer software for traffic operations and management. Includes significant design component.
Prerequisite: CIVE 370
Variable

CIVE 471 (3) Highway Planning and Design
Classification and design process of highways; development and use of design controls, criteria, and highway design elements; design of vertical and horizontal alignment, and establishment of sight distances; design of cross sections, intersections, and interchanges. Extensive use of CAD software. Includes significant design component.
Prerequisite: CIVE 145 and CIVE 370
Variable

CIVE 476 (3) Planning and Design of Airports
Development and design of airport facilities and the integration of multiple disciplines including runway orientation and capacity, terminal facilities, forecasting, planning, noise, airspace utilization, parking, lighting, and construction. Includes significant design component.
Prerequisite: CIVE 370
Variable

CIVE 481 (3) Water & Wastewater Treatment, Collection & Distribution
Overview of municipal water and wastewater treatment and distribution practices. Application of chemical, biological and physical principles to design and the operation of water and wastewater treatment and distribution systems. Includes significant design component.
Prerequisite: CIVE 380
Variable

CIVE 482 (3) Utility Pipeline Inspection, Repair and Rehabilitation
Design and implementation of inspection plans, repairs and rehabilitation of sewer, storm drainage and drinking water supply pipelines. Consideration of performance, logistics and cost implications of all available methods. Includes significant design component.
Prerequisite: CIVE 380
Variable

CIVE 484 (3) Landfill and Hazardous Waste Engineering
This course will be taught as a classroom based course with a combination of lecture, individual and group projects, reading, homework, discussion, review, and examinations. The goal of the course is to develop competency in the design and implementation of landfill design and hazardous waste remediation, with understanding of both performance and cost implications to all choices.
Prerequisite: CIVE 380
Variable

CIVE 491 (1-4) In-Service
May be repeated for credit on each different topic.
Variable

CIVE 493 (1) MAX Scholar Seminar
This class provides MAX scholars with an opportunity to explore a set of topics related to achieving success in academic, professional and personal realms. Speakers will include faculty, graduate students, visiting researchers and industry members as well as student participants. Students will be required to participate in mentoring of lower division MAX scholarship recipients and provide written and oral presentations of various topics during the semester. This course may be repeated and will not count towards graduation requirements.
Prerequisite: Recipient of a MAX scholarship or instructor consent.
Fall, Spring

CIVE 494 (1) Global Experience in Engineering and Technology
This class provides students pursuing a minor in "Global Solutions in Engineering and Technology" with an opportunity to explore a set of topics related to achieving success in advance of and following an international experience (internship, study abroad, etc.). Speakers will include faculty, graduate students, visiting researchers and industry members as well as student participants. Returning students will be required to participate in mentoring of students preparing for their international experience and provide written and/or oral presentations of various topics during the semester. This course is required both before and after participation in the international experience (min. 2 cr.)
Variable

CIVE 497 (1-6) Internship
Variable

CIVE 499 (1-6) Individual Study