

## Civil Engineering

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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.

Accreditation. The Civil Engineering program is accredited by the Engineering Accreditation Commission of ABET, <http://www.abet.org>.

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, successfully transitioned into business or management, or have successfully fully 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.

The program mission and educational objectives are fully compatible with the mission of Minnesota State Mankato and the College of Science, Engineering, and Technology. 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 an education in civil engineering 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 flexible curriculum allows the students to have either a diverse or focused civil engineering study.
- 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 pre-calculus (or equivalent), 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.

**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 must 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 homepage.

Before being admitted to upper-division civil engineering courses, a student must complete a minimum of 48 credits, for grade, including the following core courses: calculus-based physics, 8 credits; calculus and differential equations, 16 credits; introduction to engineering, 2 credits; computer graphics, 2 credits; introduction to problem solving and civil engineering design, 2 credits; engineering mechanics (statics, dynamics, and mechanics of materials), 9 credits; chemistry, 5 credits; and English composition, 4 credits. Provisional admission to the program for one semester may be granted in limited cases.

To be considered for admission a grade of "C" (2.00) or better must be achieved in each course listed above, and a student must have a cumulative GPA of 2.50 in the core courses. All core course grades (including those for repeated courses) will be considered in the computation of the GPA for admission to the program.

**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. Please feel free to write, call, or visit the department. Generally, no transfer credits are allowed for upper division civil engineering courses. For exceptions to this policy, special written permission must be obtained from the department. Transfer students must take a minimum of 12 credits at Minnesota State Mankato prior to being considered for full admission to the program. For transfer students the distribution of credits specified for the core courses may vary, but the total credits must satisfy departmental transfer requirements. Transfer credits are not normally used in the computation of the GPA for admission to the program. Transfer students should refer to the Supplemental Information in the Undergraduate Bulletin for information about procedures to be followed when applying for admission to the University.

### POLICIES/INFORMATION

**Satisfactory Progress.** Once admitted to the civil engineering program, a student must maintain satisfactory progress by: (1) maintaining a cumulative GPA of at least 2.30 for all upper-division engineering courses (including repeated courses); and (2) achieving a GPA of at least 2.00 each semester for all major courses. Students are also required to take a department-administered diagnostic test in their junior year. The purpose of this test is to provide feedback which will be used to strengthen the curriculum and to improve the preparation of students.

## CIVIL ENGINEERING

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

**Probation Policy.** Once admitted to the program, a 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 (a) must complete at least 8 credits, approved by the department, of upper division engineering courses for grade from the prescribed Civil Engineering curriculum; and (b) shall 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. The student may later reapply for admission to the program. If readmitted, only probationary status will be granted, and continuation in the program will be based on performance in courses specified in a contract with the department.

**Appeals.** A student may appeal any departmental decision in writing. The department will consider such appeals individually.

### CIVIL ENGINEERING BSCE

#### **Required Special General Education (23 credits)**

The Bachelor of Science in Civil Engineering degree does not adhere to the standard general education program. 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 16 credits)*

To satisfy this requirement, the courses selected must provide both breadth and depth and not be limited to a selection of unrelated introductory courses. Each student should discuss with his/her civil engineering 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 website.

Specifically, the minimum requirements consist of (a) at least 6 credits in the humanities area, and (b) at least 9 credits in the social science area, of which 3 credits must be either microeconomics or macroeconomics; (a) and (b) must total at least 16 credits.

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 the 16-credit 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.

#### **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 16 credits):** To satisfy this requirement, the courses selected must provide both breadth and depth and not be limited to a selection of unrelated introductory courses. Each student should discuss with his/her civil engineering 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 (a) at least 6 credits in the humanities area, and (b) at least 9 credits in the social science area, of which 3 credits must be either microeconomics or macroeconomics; (a) and (b) must total at least 16 credits. 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 the 16 credit 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)  
(Choose 3-4 credits)  
CMST 102 Public Speaking (3)  
ENG 271W Technical Communication (4)

#### **Prerequisite to the Major**

CHEM 201 General Chemistry I (5)  
MATH 121 Calculus I (4)  
MATH 122 Calculus II (4)  
MATH 223 Calculus III (4)  
MATH 321 Ordinary Differential Equations (4)  
PHYS 221 General Physics I (4)  
PHYS 222 General Physics II (3)  
PHYS 232 General Physics II Lab (1)

#### **Major Common Core**

CIVE 101 Introduction to Engineering-Civil (2)  
CIVE 145 CAD for Civil Engineering (2)  
CIVE 201 Introd. to Problem Solving and Civil Engineering Design (2)  
CIVE 271 Civil Engineering Measurements (2)  
CIVE 340 Structural Analysis (3)  
CIVE 350 Hydraulics and Hydrology (4)  
CIVE 360 Geotechnical Engineering (4)  
CIVE 370 Transportation Engineering (4)  
CIVE 380 Environmental Engineering (3)  
CIVE 401 Civil Engineering Design I (2)  
CIVE 402 Civil Engineering Design II (3)  
CIVE 435 Civil Engineering Experimentation I (2)  
CIVE 436 Civil Engineering Experimentation II (2)  
ME 206 Materials Science (3)  
ME 291 Engineering Analysis (3)  
(Choose 3 credits)  
CIVE 212 Statics (3)  
ME 212 Statics (3)  
(Choose 3 credits)  
CIVE 214 Dynamics (3)  
ME 214 Dynamics (3)  
(Choose 3 credits)  
CIVE 223 Mechanics of Materials (3)  
ME 223 Mechanics of Materials (3)  
(Choose 2-3 credits)  
ME 241 Thermodynamics (3)  
ME 299 Thermal Analysis (2)  
(Choose 3 credits)  
CIVE 321 Fluid Mechanics (3)  
ME 321 Fluid Mechanics (3)  
(Choose 3 credits)  
CIVE 446 Reinforced Concrete Design (3)  
CIVE 448 Steel Design (3)

#### **Major Restricted Electives**

Students are required to choose a minimum of 18 credits in civil, science and technical electives: science elective (4 credits), technical electives (minimum 2 credits), and CIVE electives (minimum 9 credits). The science and technical electives are recommended to be taken after the student has identified his/her area of interest and in consultation with his/her academic advisor. Science and technical electives must be selected from the approved list.

## CIVIL ENGINEERING

### Civil Engineering Electives

(Choose 9-12 credits)

CIVE	432	Properties of Concrete (3)
CIVE	446	Reinforced 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 Design and Hazardous Waste (2)

### Science Electives

(Choose 4-12 credits)

BIOL	105	General Biology I (4)
BIOL	105W	General Biology I (4)
ENVR	101	Perspectives in Environmental Science (4)
GEOL	121	Physical Geology (4)

### Technical Electives

(Choose 2-12 credits)

BIOL	270	Microbiology (4)
BLAW	450	Contracts, Sales, and Professional Liability (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	300-499	Except Required Courses
CM	300	Construction Safety (3)
CM	330	Planning and Scheduling (3)
CM	440	Construction Project Management (3)
EE	300-499	
ENVR	440	Environmental Regulations (3)
ENVR	450	Environmental Pollution & Control (3)
ENVR	460	Analysis of Pollutants (4)
GEOL	330	Structural Geology (4)
GEOL	350	Environmental Geology (4)
GEOL	351	Engineering Geology (2)
GEOL	450	Hydrogeology (3)
ME	300-499	
PHYS	223	General Physics III (3)
PHYS	233	General Physics III Laboratory (1)

**Required Minor: None.**

### *Civil, Science and Technical Electives*

A civil engineering student is required to choose a minimum of 18 credits in civil, science and technical electives: science elective (4 credits), technical electives (minimum 2 credits), and CIVE electives (minimum 9 credits). The science and technical electives are recommended to be taken after the student has identified his/her area of interest and in consultation with his/her academic advisor. Science and technical electives must be selected from the approved list below.

### *Approved Science Electives*

BIOL	105	General Biology I (5)
CHEM	202	General Chemistry II (5)
ENVR	101	Perspectives in Environmental Science (4)
GEOL	121	Physical Geology (4)

### *Approved Technical Electives*

All CIVE courses except required courses

All EE courses 300-level and above and EE 230 (Circuit Analysis I)

All ME courses 300-level and above except required courses

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	305	Analytical Chemistry (4)
CHEM	407	Water Chemistry (3)
ENVR	440	Environmental Regulations (3)
ENVR	450	Environmental Pollution & Control (3)
ENVR	460	Analysis of Pollutants (4)
GEOL	330	Structural Geology (4)
GEOL	351	Engineering Geology (2)
GEOL	450	Hydrogeology (3)

## COURSE DESCRIPTIONS

### **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.

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.

Pre: CIVE 101

Co-Req: CIVE 145, MATH 121

Fall, Spring

### **CIVE 212 (3) Statics**

Resultants of force systems, equilibrium, analysis of forces acting on structural elements, friction, second moments, virtual work.

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.

Pre: 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.

Pre: CIVE 212 or ME 212

Fall, 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.

Fall

Pre: MATH 115

Coreq: MATH 121

### **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.

Pre: 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.

Pre: CIVE 214 or ME 214

Co-Req: 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.

Pre: 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.

Pre: CIVE 321 or ME 321, ME 291

### **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.

Pre: CIVE 223 or ME 223

Coreq: CIVE 321 or ME 321

### **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.

Coreq: CIVE 271, ME 291

### **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.

Pre: CHEM 201, MATH 321

Coreq: CIVE 321 or ME 321

### **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.

Pre: CIVE 201. At least 60 credits earned; in good standing; instructor permission; co-op contract; other prerequisites may also apply.

Fall, Spring, Summer

### **CIVE 401 (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.

Pre: CIVE 340, CIVE 350, CIVE 360, CIVE 370

Coreq: CIVE 380

### **CIVE 402 (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.

Pre: 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.

Pre: CIVE 435 or consent of instructor

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.

Pre: 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.

Pre: 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.

Pre: CIVE 340

Alt-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.

Pre: 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.

Pre: 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.

Pre: 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.

Pre: 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.

Pre: CIVE 370, CIVE 223 or ME 223

Coreq: 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.

Pre: 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.

Pre: 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.

Pre: 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.

Pre: 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.

Pre: 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.

Pre: 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.

Pre: CIVE 380

Variable

**CIVE 484 (2) Landfill Design and Hazardous Waste**

This course will 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.

Prereq: CIVE 380

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.

Pre: Recipient of a MAX scholarship or instructor consent.

Fall, Spring

**CIVE 497 (1-6) Internship**

Variable

**CIVE 499 (1-6) Individual Study**