Department of Civil, Construction and Environmental Engineering

Chairperson: Daniel H. Zitomer, PhD, PE, BCEE, FWEF
Department of Civil, Construction and Environmental Engineering website (http://www.marquette.edu/engineering/civil_environmental)

The department of civil, construction and environmental engineering offers curricula that lead to a bachelor of science degree in civil engineering or a bachelor of science degree in construction engineering. Students that pursue a bachelor of science degree in civil engineering may select from civil engineering or environmental engineering majors. Students who pursue a bachelor of science degree in construction engineering select the construction engineering major.

Civil, construction and environmental engineering is the art and science used in the creation of the infrastructure critical to our everyday life: airports, buildings, bridges, dams, harbors, highways, irrigation systems, transportation systems, wastewater treatment systems, and water supply systems. Civil, construction and environmental engineers are also stewards of the land, its resources and environment. Modern society depends on this contribution from these engineers, whose education is systematically developed from a strong background in mathematics and the physical and engineering sciences. The civil, construction and environmental engineer must relate to society and be aware of how the engineering principles can be applied for the benefit of others through sustainable infrastructure solutions.

Mission

The mission of the department of civil, construction and environmental engineering is to educate students in the Catholic, Jesuit tradition. These students will be competent in their technical fields, appreciate the moral and ethical impact of their professional work and continue their professional development throughout their careers. The students and faculty of the department will advance the state of technical and scientific knowledge through research and provide service to civic and professional communities.

Areas of Study

Civil, construction and environmental engineering is a very broad profession. The breadth of courses offered in the department is well-suited to allow specialization in one of the major divisions of this branch of engineering: Construction Engineering (CNEN); Environmental and Water Resources Engineering (ENWR); Structural Engineering and Structural Mechanics (SESM); and Transportation Engineering and Materials (TEMA). However, it is not necessary to make a commitment to only one area of concentration while in the undergraduate college. The curriculum at Marquette permits students to prepare themselves in civil engineering and construction engineering by completing the courses which provide the necessary fundamentals and the opportunity to select elective courses to acquire additional depth in one or more of the areas of specialization. All of the electives which the department offers are open to students with the required prerequisites. Selection of the courses for a general program requires careful planning between the student and an academic adviser. Students in the civil engineering and construction engineering degree programs are able to complete elective courses in a chosen area or areas of specialization.

Non-Civil or Non-Construction Engineering Majors or Minors

Students in the civil engineering curriculum who are interested in obtaining a major or minor in any other area outside the civil or construction engineering degree programs should consult the Opus College of Engineering Office of Undergraduate Affairs and their faculty mentor (adviser) during their freshman or sophomore year to plan their schedules to meet their particular objectives. Students wishing to earn a non-engineering minor should follow the guidelines listed in the "Concentrations and Minors" section of the Opus College of Engineering bulletin.

Five-Year B.S./M.S. Program

The department offers a five-year combined B.S./M.S. program. This program enables students to earn both their bachelor of science degree in civil engineering or construction engineering, and a master of science degree in civil engineering in just five years (or six with completion of a co-op). Students currently enrolled in an undergraduate degree program in the department of civil, construction and environmental engineering at Marquette University (with a GPA of 3.500 or above) may apply for admission to this five-year program during their junior year. Students must submit an application to the Marquette University Graduate School, indicate their interest in the five-year BS/MS program, and meet all other admission criteria as stated in the Application Requirements section of the Graduate Bulletin.

In addition to completing their undergraduate degree requirements, students take master's level courses during their senior year. (**Note:** no course is permitted to satisfy both the undergraduate and graduate degree requirements in the five-year BS/MS degree program in the department of civil, construction and environmental engineering.) The remaining master's level course work is taken during the student's fifth year. Students are strongly encouraged to pursue Plan A (thesis option), in which work on the thesis research should begin during the summer between the junior and senior years. Students continue to gain research experience during the summer between senior and fifth years, continuing throughout the fifth year and culminating in preparation of a written thesis and defense. Combined BS/MS programs following Plan B (course work option) may also be designed. See the Graduate Bulletin for further details.

Program Educational Objectives - Civil engineering degree

To carry out the mission of the college of engineering and the mission of the department described previously, the department of civil, construction and environmental engineering has established the following educational objectives for its undergraduate civil engineering degree program. Students graduating with the Bachelor of Science degree in civil engineering will:

- continue to participate in the civil engineering profession or in other related and/or emerging fields
- engage in life-long learning through achievement of graduate degrees, advanced research and/or other continuous professional development opportunities including attending professional conferences and seminars
- achieve professional licensure and certification after attaining the required years of professional experiences
- become leaders in their professional societies and civic communities

Civil engineering is the art and science used in the construction of facilities which people need in their environment — land, water and air. Airports, buildings, bridges, dams, harbors, highways, irrigation systems, transportation systems, sewerage and water supply systems are examples of the types of facilities which are the responsibility of the civil engineer.

Since the beginning of civilization, people have been building with the use of engineering principles. Modern society depends on this contribution from the civil engineer, whose education is systematically developed from a strong background in mathematics and the physical and engineering sciences. The civil engineer must relate to society and fellow men and women and be aware of how the engineering principles can be applied for the benefit of others.

Civil engineers are also stewards of the land, its resources and environment. Many civil engineers are involved in activities such as watershed and environmental planning, sustainable resource development and environmental protection.

The civil engineering degree program develops the analysis and design capabilities of the student in the study of structures and systems. The application of computers and pertinent software is used throughout the major. A broad educational program can be selected or some specialization is possible through advised elective course selection. The environmental engineering major within the civil engineering degree provides the student with a fundamental background in civil engineering and specialization in the field of environmental engineering.

The construction engineering degree provides the student with general engineering skills and the management and finance background for entry into the field of construction engineering.

The curriculum provides the graduate with the necessary education to begin a professional career without further formal education, while also affording those students who enter graduate studies the preparation to further their education in a field of specialization.

Areas of Study

The breadth of courses offered is well-suited to allow specialization in one of the major divisions of this branch of engineering. However, it is not necessary to make a commitment to only one area of concentration while in the undergraduate college. The curriculum at Marquette permits students to prepare themselves in civil engineering and construction engineering by completing the courses which provide the necessary fundamentals and the opportunity to select elective courses to acquire additional educational depth in one or more of the areas of specialization. All of the electives which the department offers are open to students who satisfy the required prerequisites. Selection of the courses for a general program requires careful planning between the student and an academic adviser. Students in the civil engineering and construction engineering and management degree programs have the option to select technical elective courses in the following areas.

General Civil Engineering (CE)

The diverse needs of people and society for many types of constructed facilities give a broad range to civil engineering and construction engineering practice. The following listing of courses are considered general civil engineering technical electives that cross boundaries of the civil, construction and environmental engineering professions.

CEEN 4310	Geographical Information Systems in Engineering and Planning	3
CEEN 4320	Engineering Decisions Under Uncertainty	3
CEEN 4340	Urban Planning for Civil Engineers (Design)	3
CEEN 4350	Law for Engineers	3
CEEN 4715	Sustainable Engineering (Design)	3

Construction Engineering (CNEN)

Construction projects of all types require management as well as the traditional engineering skills. Those students who want to focus more on construction engineering and management may prefer to pursue a bachelor of science degree in construction engineering and management. Students interested in specializing in construction engineering and management while still earning a degree in civil engineering may select courses from the following list as their technical electives.

CNEN 3860	Construction Materials and Methods	3
CNEN 4815	Mechanical and Electrical Systems for Buildings	3
CNEN 4820	Construction Operations and Productivity	3
CNEN 4825	E-Business in the Construction Industry	3
CNEN 4830	Construction Planning, Scheduling, and Control (Design)	3
CNEN 4840	Construction Cost Analysis and Estimating	3
CNEN 4845	Construction Equipment and Methods (Design)	3

Environmental and water resources ENGINEERING (ENWR)

The environmental and water resources engineering area deals with the control and improvement of human surroundings using principles developed in civil engineering. The environmental/water resources engineer is responsible for conceiving and designing systems for water supply, waste water treatment and disposal, air pollution control, solid and hazardous waste management and design of water resources systems. Those students that wish to focus more on environmental and water resources engineering may prefer to pursue a major in environmental engineering within the civil engineering degree program. Students interested in specializing in environmental engineering while earning a degree in civil engineering may select courses from the following list as their technical electives.

CEEN 4230	Urban Hydrology and Stormwater Management (Design)	3
CEEN 4515	Environmental Chemistry	3
CEEN 4520	Industrial Wastewater Management (Design)	3
CEEN 4525	Treatment Plant Design and Operation (Design)	3
CEEN 4530	Hazardous and Industrial Waste Management (Design)	3
CEEN 4535	Environmental Engineering Microbiology	3
CEEN 4550	Water Resources Planning and Management (Design)	3
CEEN 4715	Sustainable Engineering (Design)	3
CEEN 4560	Environmental Fate and Transport (Design)	3
CEEN 4615	Highway Planning and Design	3

Structural Engineering and Structural Mechanics (SESM)

The structural engineering and structural mechanics area focuses on the planning, analysis, design and construction of various types of structures including buildings, bridges, miscellaneous structures (e.g. amusement park rides, sign supports, earth retaining structures) and foundations for these systems. Students will learn to analyze and design structures in structural steel and reinforced concrete. They will also learn to analyze and design foundations for structures. Students interested in specializing in structural engineering and structural mechanics may select courses from the following list as their technical electives.

CEEN 4145	Advanced Strength and Applied Stress Analysis	3
CEEN 4411	Matrix Structural Analysis	3
CEEN 4431	Advanced Structural Steel Design (Design)	3
CEEN 4441	Advanced Reinforced Concrete Design (Design)	3
CEEN 4450	Bridge Design (Design)	3
CEEN 4460	Foundation Engineering (Design)	3

Transportation Engineering and Materials (TEMA)

The transportation engineering and materials area focuses on engineering analysis and design of urban streets, highways, intersections, interchanges, interstate highways and airports. This area of study also focuses on pavement engineering and the materials used in the construction of roadways along with traffic engineering (e.g. design, operations and traffic management). Students interested in specializing in transportation engineering and materials may select courses from the following list as their technical electives.

CEEN 4615	Highway Planning and Design (Design)	3
CEEN 4630	Airport Planning and Design (Design)	3
CEEN 4640	Traffic Characteristics and Design (Design)	3
CEEN 4650	Pavement Design (Design)	3
CEEN 4660	Pavement Management	3

Civil Engineering Major

Freshman

First Term	Hours	Second Term	Hours
CEEN 1200	3	CEEN 1210	3
CHEM 1001	4	CHEM 1002	4
MATH 1450	4	MATH 1455	4
ENGL 1001 or ESSV1 (MCC)	3	ENGL 1001 or ESSV1 (MCC)	3
PHIL 1001 or THEO 1001 (MCC)	3	PHIL 1001 or THEO 1001 (MCC)	3
	17		17

Sophomore

First Term	Hours	Second Term	Hours
CEEN 2110	3	CEEN 2130	3
CEEN 2315 or 2320[1]	3	CEEN 3320	3
GEEN 2952	1	MEEN 2120	3
CORE 1929 (MCC)	3	Basic Science elective[2]	3
MATH 2455	3	PHYS 1004	4
PHYS 1003	4		
	17		16

Junior

First Term	Hours	Second Term	Hours
CEEN 3160	3	CEEN 3210	3
CEEN 3410	3	CEEN 3610	3
CEEN 3510	3	CNEN 3810	3
MEEN 3320	3	MATH 4720	3
Cross-disciplinary Engineering elective[3]	3	DSCV (MCC)[4, 5]	3
DSCV (MCC)[4,5]	3		
	18		15

Senior

First Term	Hours	Second Term	Hours
CEEN 3430	3	CEEN 4998	4
CEEN 3440	3	CEEN Technical elective	3
CEEN Technical elective	3	CEEN Technical elective (Design)	3
CEEN Technical elective (Design)	3	CORE 4929 (MCC)	3
DSCV (MCC)[4, 5]	3	DSCV (MCC)[4, 5]	3
	15		16

Total credit hours: 131

1 CEEN 2320 Introduction to Civil Infrastructure, Geo-Spatial and Environmental Modeling is highly recommended for students interested in Environmental Engineering.

2 A basic science elective in addition to the CHEM and PHYS courses outlined above must be selected in areas such as biology, geology and meteorology, subject to approval by the CCEE Department.

[3] Either EECE 2010 Electric Circuits 1, EECE 2030 Digital Electronics, or MEEN 3310 Thermodynamics 1.

[4] The four courses in the Discovery Tier (DSCV) of the MCC must be completed in the same theme and include the following content areas: Humanities (HUM), Social Science (SSC), Natural Science and Mathematics (NSM) and one elective (ELE), which is an additional course from any of the three content areas. A maximum of two courses in the Discovery Tier can apply towards a primary major.

[5] Students must also complete the Writing Intensive (WRIT) and Engaging Social System and Values 2 (ESSV2) requirements of the MCC. These requirements can be fulfilled through designated courses in the Discovery Tier or other degree requirements.

Technical Elective Requirements

All civil engineering majors must complete 12 credits of technical electives from the courses listed previously under the areas of study. A minimum of 6 credits of civil engineering design is required and must be selected from those courses designated as design (Design).

Program Educational Objectives - Construction Engineering degree

To carry out the mission of the college of engineering and the department described previously, the department of civil, construction and environmental Engineering has established the following educational objectives for the construction Engineering degree program. Students graduating with the Bachelor of Science in construction engineering will:

- develop an appreciation for religious, moral, ethical and human values.
- be able to apply the fundamentals of science and mathematics to engineering analysis and design.
- have a foundation for understanding the application of construction engineering obtained through opportunities to experience the construction engineering profession through the co-operative engineering program, service learning, summer internships and/or hands-on experience in laboratory courses.
- communicate effectively in written, graphical and oral form.
- be prepared to be leaders through opportunities to exhibit leadership and develop team-building skills.
- have a commitment to lifelong learning.

Construction Engineering Major

Within the Department of Civil, Construction and Environmental Engineering students may also choose the bachelor of science degree program in construction engineering.

Freshman

First Term	Hours	Second Term	Hours
CEEN 1200	3	CEEN 1210	3
CHEM 1001	4	CHEM 1002	4
ENGL 1001 or ESSV1 (MCC)	3	ENGL 1001 or ESSV1 (MCC)	3
MATH 1450	4	MATH 1455	4
PHIL 1001 or THEO 1001 (MCC)	3	PHIL 1001 or THEO 1001 (MCC)	3
	17		17

Sophomore

First Term	Hours	Second Term	Hours
CEEN 2110	3	CEEN 2130	3
CEEN 2315	3	CNEN 3810	3
GEEN 2952	1	Math/Science elective[1]	3
ECON 1001	3	CORE 1929 (MCC)	3
MATH 2455	3	PHYS 1004	4
PHYS 1003	4		
	17		16

Junior

First Term	Hours	Second Term	Hours
CEEN 3160	3	CEEN 3320	3
CEEN 3410	3	CEEN 4350	3
CNEN 3860	3	CNEN 4815	3
ACCO 1030	3	Technical elective[4]	3
MATH 4720	3	ACCO 1031	3
DSCV (MCC)[2, 3]	3	DSCV (MCC)[2, 3]	3
	18		18

Senior

First Term	Hours	Second Term	Hours
CNEN 4830	3	CEEN 4998	4
CNEN 4845	3	CNEN 4840	3
Technical elective[4]	3	Technical elective (Co-op Requirement)[4]	3
Technical elective (Design)[4]	3	CORE 4929 (MCC)	3
DSCV (MCC)[2, 3]	3	DSCV (MCC)[2, 3]	3
	15		16

Total credit hours: 134

1 A math elective and science elective in addition to the CHEM and PHYS courses outlined above in areas such as advanced mathematics, biology, geology and meteorology must be selected subject to approval by the adviser, department chair and academic advising center.

2 The four courses in the Discovery Tier (DSCV) of the MCC must be completed in the same theme and include the following content areas: Humanities (HUM), Social Science (SSC), Natural Science and Mathematics (NSM) and one elective (ELE), which is an additional course from any of the three content areas. A maximum of two courses in the Discovery Tier can apply towards a primary major.

3 Students must also complete the Writing Intensive (WRIT) and Engaging Social System and Values 2 (ESSV2) requirements of the MCC. These requirements can be fulfilled through designated courses in the Discovery Tier or other degree requirements.

4 Co-op is required for the BS in Construction Engineering program. One academic credit is awarded for each co-op work term completed, three of which can be used as a technical elective toward degree requirements.

Technical Electives:

All Construction Engineering majors must complete 12 credits of technical electives from the courses listed below. A minimum of 6 credits of design is required and must be selected from the courses designated as design (Design).

CEEN 3430	Structural Steel Design (Design)	3
CEEN 3440	Reinforced Concrete Design (Design)	3
CEEN 3510	Environmental Engineering	3
CEEN 3610	Transportation Engineering	3
CEEN 4310	Geographical Information Systems in Engineering and Planning	3
CEEN 4320	Engineering Decisions Under Uncertainty	3
CEEN 4340	Urban Planning for Civil Engineers (Design)	3
CEEN 4411	Matrix Structural Analysis	3
CEEN 4441	Advanced Reinforced Concrete Design (Design)	3
CEEN 4450	Bridge Design (Design)	3
CEEN 4460	Foundation Engineering (Design)	3
CEEN 4650	Pavement Design (Design)	3
CEEN 4715	Sustainable Engineering (Design)	3

Environmental Engineering Major

In addition to the Civil Engineering major described above, students may elect to specialize in environmental engineering and obtain a major in that discipline. The major in Environmental Engineering provides a solid foundation in civil engineering as well as more comprehensive study in the area related to the environment.

Freshman

First Term	Hours	Second Term	Hours
CEEN 1200	3	CEEN 1210	3
MATH 1450	4	CHEM 1002	4
CHEM 1001	4	MATH 1455	4
ENGL 1001 or ESSV 1 (MCC)	3	ENGL 1001 or ESSV 1 (MCC)	3
PHIL 1001 or THEO 1001 (MCC)	3	PHIL 1001 or THEO 1001 (MCC)	3
	17		17

Sophomore

First Term	Hours	Second Term	Hours
CEEN 2110	3	CEEN 2130	3
CEEN 2320	3	CEEN 3320	3
GEEN 2952	1	MEEN 2120	3
CORE 1929 (MCC)	3	PHYS 1004	4
MATH 2455	3	DSCV (MCC)[1,2]	3
PHYS 1003	4		
	17		16

Junior

First Term	Hours	Second Term	Hours
CEEN 3160	3	CEEN 3210	3
CEEN 3410	3	CEEN 3610	3
CEEN 3510	3	CEEN 4535	3
MEEN 3310	3	CNEN 3810	3
MEEN 3320	3	MATH 4720	3
DSCV (MCC)[1, 2]	3		
	18		15

Senior

First Term	Hours	Second Term	Hours
CEEN 4515	3	CEEN 4998	4
CEEN 4953[3]	0	Environmental Technical elective[4]	3
Environmental Technical elective[4]	3	Environmental Technical elective (Design)[4]	3
Environmental Technical elective (Design)[4]	3	CORE 4929 (MCC)	3
Structural Design elective[5]	3	DSCV (MCC)[1,2]	3

DSCV (MCC)[1, 2]	3	
	15	16

Total credit hours: 131

1 The four courses in the Discovery Tier (DSCV) of the MCC must be completed in the same theme and include the following content areas: Humanities (HUM), Social Science (SSC), Natural Science and Mathematics (NSM) and one elective (ELE), which is an additional course from any of the three content areas. A maximum of two courses in the Discovery Tier can apply towards a primary major.

2 Students must also complete the Writing Intensive (WRIT) and Engaging Social System and Values 2 (ESSV2) requirements of the MCC. These requirements can be fulfilled through designated courses in the Discovery Tier or other degree requirements.

3 Participation in CEEN 4953 Environmental Seminar is required during either the first or second term of the senior year.

4 Acceptable environmental technical electives are subject to approval by the CCEE Department.

5 Either CEEN 3430 Structural Steel Design or CEEN 3440 Reinforced Concrete Design.

Environmental Electives

All environmental engineering majors must complete 12 credits of technical electives from the environmental engineering (ENEN) area of study. A minimum of 6 credits of environmental engineering design is required and must be selected from those ENEN courses designated as having design content (Design).

Civil Engineering Minor

The Department of Civil and Environmental Engineering offers a minor in civil engineering to all undergraduate students in the university except those students in civil or environmental engineering. Completion of the minor will be noted on the student's transcript if the following requirements are met:

Twenty-seven hours including required courses:

Required Courses:		
CEEN 2110	Statics	3
CEEN 2130	Mechanics of Materials	3
CEEN 3320	Civil Engineering Materials	3
MEEN 3320	Fluid Mechanics	3
Twelve additional hours from the following:		12
CEEN 2315	Introduction to Building Information Modeling	
CEEN 3160	Geotechnical Engineering	
CEEN 3410	Structural Analysis	
CEEN 3510	Environmental Engineering	
CEEN 3610	Transportation Engineering	
CNEN 3810	Introduction to Construction Management	
Additional needed credits from any upper-division CEEN course.		3
Total Credit Hours		27

The program, as a whole, must have departmental approval and be completed with a C average. At least half of these credit hours must be taken at Marquette University.

Environmental Engineering Minor

The Department of Civil and Environmental Engineering offers a minor in environmental engineering to all undergraduate students in the university except those students in civil or environmental engineering. Completion of the minor will be noted on the student's transcript if the following requirements are met:

Twenty-four hours including required courses:

Required Courses		
BIOL 1001	General Biology 1	3
or CHEM 2111	Organic Chemistry 1	
CEEN 2110	Statics	3
CEEN 2120	Dynamics	3
CEEN 3510	Environmental Engineering	3
MEEN 3320	Fluid Mechanics	3

Nine additional hours from the following courses:		9
CEEN 3210	Hydraulic Engineering	
CEEN 4230	Urban Hydrology and Stormwater Management	
CEEN 4515	Environmental Chemistry	
CEEN 4520	Industrial Wastewater Management	
CEEN 4525	Treatment Plant Design and Operation	
CEEN 4530	Hazardous and Industrial Waste Management	
CEEN 4535	Environmental Engineering Microbiology	
Total Credit Hours		24

The program, as a whole, must have departmental approval and be completed with a C average. At least half of these credit hours must be taken at Marquette University.

Civil Environmental Engineer Courses

CEEN 1200. Introduction to Infrastructure. 3 cr. hrs.
Introduction to civil, construction and environmental engineering with emphasis on civilian infrastructure and the built environment. Introduction to the natural environment and environmental infrastructure, structural infrastructure and construction, transportation infrastructure, civil engineering history and heritage and civil infrastructure systems. Discussion of planning and energy, sustainability, environmental, economic, ethics and security considerations in relation to civilian infrastructure. Introduction to analysis and design as they pertain to infrastructure and the built environment. Prereq: Enrollment in the Opus College of Engineering.

CEEN 1210. Introduction to Computing, Analysis, Design and Communication. 3 cr. hrs.
Introduction to computational tools, graphical communication tools and economic analysis principles as they relate to civil, construction and environmental engineering. Introduction to sketching as a means with which to convey and communication of ideas and workflow. Algorithm development and graphical display of engineering ideas and information in commercially available programs and programming environments. Implementation of infrastructure engineering analysis and design concepts and procedures from CEEN 1200 using commercially available programs and programming environments. Prereq: CEEN 1200 or GEEN 1200; enrollment in the Opus College of Engineering.

CEEN 2110. Statics. 3 cr. hrs.
Fundamentals of forces and force systems. Internal and external forces. Support reactions. Definition of a free-body diagram (FBD). Emphasis on development of FBD-drawing skills. Moment of a force. Force system resultants. Vector methods in two and three dimensions. Equilibrium analysis of particles and rigid bodies. Truss analysis by methods of joints and sections. Analysis of simple frames and machines. Analysis of friction. Centroids of composite areas and volumes. Resultants of distributed loads. Prereq: MATH 1451 or MATH 1455; same as MEEN 2110; enrolled in the OPUS College of Engineering.

CEEN 2120. Dynamics. 3 cr. hrs.
Fundamentals of motion of particles and rigid bodies. Application of Newton's laws. Principles of position, velocity, and acceleration. Use of work-energy and impulse-momentum methods. Introduction to vibrations. Prereq: CEEN 2110 or MEEN 2110. Same as MEEN 2120.

CEEN 2130. Mechanics of Materials. 3 cr. hrs.
Concepts of stress, strain and deflection. Factor of safety. Mechanical properties of materials. Stress and deformation calculations for cases of axially loaded rods, torsion of circular shafts, beam bending and combined loading. Horizontal shear connectors in built-up beams. Area moment of inertia. Parallel-axis theorem. Introduction to beam design. Stress concentration. Stress transformation and principal stress calculation by Mohr's circle. Statically indeterminate analysis. Elastic buckling of columns. Prereq: CEEN 2110. Same as MEEN 2130.

CEEN 2315. Introduction to Building Information Modeling. 3 cr. hrs.
Introduces the student to parametric modeling of building infrastructure system and Building Information Modeling (BIM). Emphasis on building terminology and technology experienced through generation of models for building systems and using commercial software for BIM (e.g. Autodesk Revit products). Students learn fundamentals of construction sequencing, building terminology and building system modeling principles. Students learn the process of querying BIM databases of information for building plan generation, quantity take offs, and other engineering-related processes. Prereq: CEEN 1210.

CEEN 2320. Introduction to Civil Infrastructure, Geo-Spatial and Environmental Modeling. 3 cr. hrs.
Introduction of parametric and geo-spatial modeling and its uses in civil, construction and environmental engineering applications to civilian infrastructure. Activities will focus on Geospatial Information Systems (GIS), civil site modeling, road infrastructure modeling, bridge modeling, watershed modeling/mapping and the use of surveying data in the layout of civil infrastructure. Students learn construction sequencing, infrastructure systems terminology and modeling principles as they relate to civil infrastructure. Prereq: CEEN 1210.

CEEN 3160. Geotechnical Engineering. 3 cr. hrs.
Fundamental properties and engineering characteristics of soil as a particulate mass aggregate are studied. The formation and the development of soil deposits, the physical and hydraulic properties and the methods of predicting the stress-strain behavior of soils for engineering applications are examined. Laboratory experiments are conducted and reports are required. 2 hrs. lec., 1.25 hrs. lab. Prereq: Jr. stndg. and CIEN, ENEN or CNEN major.

CEEN 3210. Hydraulic Engineering. 3 cr. hrs.
Fundamentals and applications of hydrostatics and hydrodynamics including pressurized pipe flow and pipeline network design, open channel flow, and sewer design, pump selection and flow measurement. Laboratory assignments and demonstrations. 2 hrs. lec., 1.25 hrs. lab. Prereq: MEEN 3320 which, may be taken concurrently.

CEEN 3320. Civil Engineering Materials. 3 cr. hrs.
Introduction to the properties and fundamental behavior materials used by civil engineers with emphasis on concrete, asphalt and steel. Lab experiments are used to demonstrate the behavior or materials subjected to various load levels and orientations. Use of spreadsheets and statistical analysis of experimental data are required. 2 hrs. lec; 1.25 hrs. lab. Prereq: Soph. stndg. and CIEN, ENEN or CNEN major.

CEEN 3410. Structural Analysis. 3 cr. hrs.
Determining the loads that act on structures and load combinations. Basic concepts in structural analysis of determinate beams, trusses, and frames. Deflections of determinate beams by moment area and conjugate beam methods. Development of basic virtual work concept to obtain deformations in determinate trusses, beams, and frames. Introduction to the solution of indeterminate structures by using the method of superposition. Influence lines for determinate beams. Prereq: CEEN 2130 or MEEN 2130.

CEEN 3430. Structural Steel Design. 3 cr. hrs.
Introduction to building codes, design standards and design specifications as they relate to the physical behavior and design of steel structures. Design of structural steel members subjected to tensile loading; compression loading (columns); and bending (beams). Design of mechanical fasteners, welds and connecting elements. Analysis and design of members subjected to combined loading (beam-columns). Emphasis on AISC Specifications. Prereq: CEEN 3320 and CEEN 3410.

CEEN 3440. Reinforced Concrete Design. 3 cr. hrs.
Fundamental concepts of reinforced concrete theory and design. Use of current design code for the analysis and design of basic structural members; strength design for flexure, shear and development of reinforcement. Prereq: CEEN 3410 and CEEN 3320.

CEEN 3510. Environmental Engineering. 3 cr. hrs.
Introduction to environmental engineering with a focus on the water environment. Topics include water quality, water resources, water supply, municipal water and wastewater systems, air quality, and solid and hazardous waste management. Prereq: Jr. stndg. and CIEN, ENEN or CNEN major.

CEEN 3610. Transportation Engineering. 3 cr. hrs.
Airport airside systems based on FAA guidelines. Road user and vehicle characteristics, applications of equations of motion, geometric design of roadways including horizontal and vertical alignment and cross-sectional elements. Traffic calming. Signalized intersections. Parking lot design. Traffic flow models. Emphasis on explaining technical details in writing. Prereq: Jr. stndg. and CIEN, ENEN or CNEN major.

CEEN 4145. Advanced Strength and Applied Stress Analysis. 3 cr. hrs.
Basic concepts of mechanics of deformable bodies. Two- and three-dimensional stress-strain relationships and theories of failure. Unsymmetrical bending analyses. Shear flow and shear center. Torsion of thin-walled sections (tubular and non-tubular). Composite beams. Stress concentration. Energy principles: strain and complementary energy. Castigliano's theorem. Prereq: CEEN 2130 or MEEN 2130.

CEEN 4230. Urban Hydrology and Stormwater Management. 3 cr. hrs.
Distribution and properties of water on the earth. Concept of the hydrologic cycle and basic principles governing water movement in the environment: precipitation, evapotranspiration, infiltration, runoff generation, streamflow and groundwater flow. Engineering methods of design of flood protection, stormwater management and stormwater pollution abatement systems. Prereq: CEEN 3150 or MEEN 3320.

CEEN 4310. Geographical Information Systems in Engineering and Planning. 3 cr. hrs.
Fundamentals of GIS, databases, data management, map projections, representations of spatial attributes, GIS analysis and GIS software systems such as ARC Info, ARC View, Grass. GIS use and expanded capabilities are taught. Case studies including environmental, transportation and economic applications are discussed. Prereq: Sr. stndg. and CIEN, ENEN or CEMA major.

CEEN 4320. Engineering Decisions Under Uncertainty. 3 cr. hrs.
Application of probability and statistics to modeling, analysis and design of civil engineering systems. Topics include: probability theory, decision theory, utility theory and simulation. Prereq: Sr. stndg. and CIEN, ENEN or CNEN major.

CEEN 4340. Urban Planning for Civil Engineers. 3 cr. hrs.
Concepts and principles underlying urban planning and development. Land use, transportation, utility, community facility planning problems, procedures, and techniques. The master plan and implementation devices such as zoning, subdivision control, official mapping, capital budgeting, and urban renewal. Prereq: Sr. stndg. and CIEN, ENEN or CNEN major.

CEEN 4350. Law for Engineers. 3 cr. hrs.
Basic legal principles and awareness of typical legal questions that arise when engineers and law interact. Topics include: American judicial system, law of contracts, forms of association, construction contracts, professional liabilities of engineers and torts. Prereq: Sr standing and CIEN major or ENEN major; or Jr standing and CNEN major.

CEEN 4411. Matrix Structural Analysis. 3 cr. hrs.
Introduction to symbolic and numerical linear algebra computations using commercial software. Modeling axial, bending, and torsion deformations in structural members using polynomials. Application of the principle of virtual work to compute deflections for statically determinate and indeterminate problems. Formulation of the matrix stiffness method via the principle of virtual displacements and the matrix flexibility method via the principle of virtual forces. Application of the matrix stiffness method for solving statically indeterminate structural analysis problems. Use of approximate methods of structural analysis (cantilever and portal methods) for critical evaluation of software-generated solutions. Use of commercial software for structural analysis. Prereq: CEEN 3410.

CEEN 4431. Advanced Structural Steel Design. 3 cr. hrs.
Continuation of CEEN 3430. Design of plate girders, composite beam and slab systems, composite columns and composite beam-columns, simple connections, moment connections, hollow structural shape (HSS) connections, bracing systems and single and multi-story steel framed building systems. Emphasis on AISC Specifications Prereq: CEEN 3430.

CEEN 4441. Advanced Reinforced Concrete Design. 3 cr. hrs.
Continuation of CEEN 3440. Presenting advanced concrete design applications to reinforced concrete statically indeterminate systems, two-way slabs and columns. Introduction to the philosophy and concepts of prestressed concrete design. Basic principles and procedures for the design and analysis of prestressed members including calculation of pre-stress loss, flexural analysis and design, shear, bond and anchorage requirements, member deflections and cable layouts. Emphasis on ACI code requirements. Prereq: CEEN 3440.

CEEN 4450. Bridge Design. 3 cr. hrs.
Introduction to bridge engineering and construction including: an abbreviated history of bridge construction; bridge types; bridge nomenclature; lessons from failures; design philosophies; and the construction process. Analysis of single-and multi-span bridge superstructures using classical techniques and commercial software. Design of single-span reinforced concrete slab bridges; reinforced concrete bridge decks; and single-span slab-bridges in prestressed concrete. Prereq: CEEN 3430 and CEEN 3440.

CEEN 4460. Foundation Engineering. 3 cr. hrs.
Design of earth retention systems, earthen dams, shallow and deep foundation members subjected to vertical and eccentric loadings. The effects of solid origin and deposition are analyzed in relation to bearing and capacity and settlement of structures. Prereq: CEEN 3160.

CEEN 4515. Environmental Chemistry. 3 cr. hrs.
Chemical stoichiometry, equilibrium, and kinetics relating to natural and engineered environmental systems. Basic concepts from organic and inorganic chemistry including oxidation-reduction reactions, acid-base chemistry, the carbonate system, alkalinity and acidity. Equilibrium and kinetic theories of chemical partitioning among gas, liquid and solid phases governing chemical fate and transport in the environment. Coordination chemistry describing metal-ligand interactions, precipitation and bioavailability of materials. Prereq: CEEN 3510 and CHEM 1002.

CEEN 4520. Industrial Wastewater Management. 3 cr. hrs.
Review of federal legislation and state regulations with regard to industrial wastewater management practices. Consideration of industrial process modifications and wastewater treatment options with respect to their effect on industrial user fees. Pretreatment standards and discharge permit requirements. Case studies of specific industrial applications. Prereq: CEEN 3510.

CEEN 4525. Treatment Plant Design and Operation. 3 cr. hrs.
Review of water and wastewater characteristics, drinking water, receiving water and effluent standards. Basic design methodology and operational features of common physical, chemical and biological processes for the treatment of waters and wastewaters. Introduction to the processing and disposal of sludges and other treatment plant residuals. Prereq: CEEN 3510.

CEEN 4530. Hazardous and Industrial Waste Management. 3 cr. hrs.
Overview of hazardous waste management, disposal and soil and ground water remediation. Review of RCRA, CERCLA-SARA, TSCA and Wisconsin's NR 700 and other regulations. Definition of hazardous wastes and characterization of industrial waste stream. Chemical, physical and biological properties of hazardous wastes. Introduction to hazardous waste remediation/treatment methods and technologies. Landfills and the RCRA Land Ban regulations. Site assessments, field investigations and laboratory analytical techniques. Environmental risk assessments, cleanup objectives and waste minimization. Prereq: Sr. stndg.; CIEN or ENEN major.

CEEN 4535. Environmental Engineering Microbiology. 3 cr. hrs.
Includes microbiological and biochemical properties of microorganisms important in environmental engineering practice. General fundamentals of environmental microbiology and their application to drinking water treatment and distribution, water pollution control and natural systems. Prereq: CEEN 3510.

CEEN 4550. Water Resources Planning and Management. 3 cr. hrs.
Planning and management of water resources. Institutional frameworks for water resources engineering. Comprehensive integration of the engineering economic, social and legal aspects of water resources planning and management. Case studies of water use and environmental resources are studied.

CEEN 4560. Environmental Fate and Transport. 3 cr. hrs.
Introduction to the movement and fate of chemicals in surface and subsurface waters, including physical transport and chemical and biological sources and sinks. Development and solution of continuity equations for coupled water and chemical transport relevant to environmental remediation, storm water control and wastewater treatment.

CEEN 4615. Highway Planning and Design. 3 cr. hrs.
Emphasis on highway planning, alternate highway alignments and alternate evaluation. Geometric design of highways including horizontal and vertical alignment, cross-section design. Projects on detailed design of reverse curves (plan and profile views); intersection design; cross-section and earthwork quantities. Legal aspects of engineering. Use of American Association of State Highway and Transportation Officials design guidelines. Prereq: CEEN 3610.

CEEN 4630. Airport Planning and Design. 3 cr. hrs.
Introduction to airport planning and design parameters, aircraft characteristics, payload versus range, runway length requirements, air traffic control, wind analysis, airside capacity and delay, airside separation criteria, terminal analysis and delay, airport access flow and capacity, ramp charts. Economic analysis of facility improvements. Prereq: CEEN 3610.

CEEN 4640. Traffic Characteristics and Design. 3 cr. hrs.
Components of the traffic system: vehicle and road user characteristics, geometric design and traffic controls. Intersection types, cross-section design elements and typical dimensions. Basic variables of traffic flow, observed traffic flow values. Freeway operations. Signalized intersections: flow, capacity, level of service. Projects addressing: intersection existing conditions (traffic, geometry, signalization); approach delay; safety performance; capacity; suggestions for improvements. Use of the Highway Capacity Manual and the Highway Capacity Software. Emphasis on technical report-writing and presentation. Prereq: CEEN 3610.

CEEN 4650. Pavement Design. 3 cr. hrs.
Study of the behavior and properties of highway pavements with emphasis on hot mix asphalt and jointed Portland cement concrete pavement. Pavement thickness designs are developed using current design methods and incorporating subgrade soil properties, traffic forecasts and pavement performance expectations. Use of spreadsheets and computer programs are required. Prereq: CEEN 3160 and CEEN 3610.

CEEN 4660. Pavement Management. 3 cr. hrs.
Study of the performance of pavement systems based on design, traffic and maintenance activities. Methods for evaluating in-service pavements including distress surveys and nondestructive testing are examined. Maintenance strategies are developed and life-cycle cost analysis of these strategies are studied. Prereq: CEEN 3610.

CEEN 4670. Advanced Transportation Materials. 3 cr. hrs.
Advanced study of materials used for constructing transportation facilities, with particular emphasis on subgrade soils, bound and unbound aggregates, hot mix asphalt and Portland cement concrete. Laboratory tests are conducted and analytical models used for characterizing transportation materials are examined. Prereq: CEEN 3320 and CEEN 3160.

CEEN 4710. Engineering Fundamentals Review. 1 cr. hr.
Review of basic science, mathematics, engineering science and economics. S/U grade assessment. Prereq: Sr. stndg. and CIEN or ENEN major.

CEEN 4715. Sustainable Engineering. 3 cr. hrs.
Provides a framework for the theory and practice of sustainable engineering. Introduces the importance and role of technological, social and sustainable systems in the modern world, which is increasingly characterized by integrated human/natural/built complex adaptive systems at local, regional and global scales. Develops critical problem solving approaches, including life-cycle assessment, global awareness, consciousness of patterns in technological evolution, and strategies for addressing environmental, economic and social equity issues in engineering design. Prereq: Sr. stndg. in College of Engineering.

CEEN 4850. FRP in Civil Engineering Infrastructure. 3 cr. hrs.
Introduces Fiber Reinforced Polymer (FRP) material properties, FRP reinforced concrete, FRP prestressed concrete, FRP repaired and retrofitted structures and pure FRP structures. Prereq: CEEN 3440.

CEEN 4931. Topics in Civil Engineering. 1-3 cr. hrs.
Course content announced each term. Prereq: Cons. of instr.

CEEN 4953. Environmental Seminar. 0 cr. hrs.
Topics related to environmental engineering, including subjects such as air pollution, urban hydrology and stormwater management, wastewater treatment and hazardous waste management. SNC/UNC grade assessment.

CEEN 4995. Independent Study in Civil and Environmental Engineering. 1-3 cr. hrs.
Undergraduate independent study project of either a theoretical or experimental nature. Prereq: Jr. stndg., 3.000 GPA, cons. of instr., and cons. of dept. ch.

CEEN 4998. Senior Design Project. 4 cr. hrs.
Design of selected civil engineering projects including planning, preliminary analysis and final design. Different projects are selected each year. Students are assigned to project teams with specific tasks under the direction of a faculty course coordinator. Professional engineers from local firms propose projects and act as consultants to each design team. Emphasis is placed on student initiative, responsibility and resourcefulness in an open-ended project. A final written design report and oral presentation are required for each design team. Emphasis on technical communications, professional ethics and engineering practices. 1 hr. lec., 3 hrs. disc. Prereq: CEEN 3430 or CEEN 3440; CEEN 3510, CEEN 3610, and CNEN 3810 for CIEN and ENEN majors. CNEN 3810, CNEN 4830 and CNEN 4845 for CNEN majors.

Construction Engineering Courses

CNEN 3810. Introduction to Construction Management. 3 cr. hrs.
Construction contracts, contract bonds, construction funding, cash flow analysis, labor productivity and cost. Analytical techniques for project planning and scheduling. Construction safety. Prereq: Soph. stndg for CNEN, CIEN, and ENEN majors. Sr. stndg. for all other majors.

CNEN 3860. Construction Materials and Methods. 3 cr. hrs.
Introduction to materials and methods of building construction and to construction drawings. Foundation, structural framing, floor, room and wall systems. Blueprint reading and quantity takeoff techniques. An introduction to building information modeling. Prereq: CNEN 3810.

CNEN 4815. Mechanical and Electrical Systems for Buildings. 3 cr. hrs.
Provides basic knowledge of electrical, plumbing and HVAC systems used in residential, commercial and industrial buildings. Studies the advantages and disadvantages of various systems, and how their design and installation integrates into the management of the building process. Particular attention is given to soliciting and managing mechanical and electrical subcontractors. Prereq: CNEN 3810.

CNEN 4820. Construction Operations and Productivity. 3 cr. hrs.
Study of construction operations with emphasis on productivity measurement and enhancement. Application of an integrated approach to planning, analysis and design of construction operations. Application of simulation models and other analytical tools for modeling construction operations. Study of productivity improvement strategies, including lean construction principles. Prereq: Senior standing.

CNEN 4825. E-Business in the Construction Industry. 3 cr. hrs.
Explores the ways in which information technology and its Internet components help to provide competitive advantage for construction companies. Selection/implementation of Web-based project management tools. An investigation of digital technologies in construction industry. Wire/wireless communication, online plan/bid rooms, mobile computing, and video conferencing. Prereq: Senior standing.

CNEN 4830. Construction Planning, Scheduling, and Control. 3 cr. hrs.
A study of principles and techniques used to plan, schedule and control costs on building construction projects. Network and linear scheduling models, resource allocation and time-cost analysis. Develops an appreciation of the resources required in a project and their limitations and introduces the techniques for analyzing and improving their use. Develops an understanding of the correlation between project planning and control and cost estimating and scheduling. Prereq: CNEN 3860.

CNEN 4840. Construction Cost Analysis and Estimating. 3 cr. hrs.
Study of various cost estimating methods and their applications. Topics include: labor, material, equipment and indirect costs; quantity takeoff; analysis of historical cost data; forecasting and computerized estimating methods. Prereq: CNEN 4845 or cons. of instr.

CNEN 4845. Construction Equipment and Methods. 3 cr. hrs.
Construction equipment and productivity analysis. Design of equipment fleet operations. Design of temporary structures used during construction such as earth retaining structures and concrete formwork systems. Construction equipment safety and safety standards related to earthwork and concrete forming operations. Prereq: CNEN 3810 and Sr. stndg.

CNEN 4931. Topics in Construction Engineering and Management. 1-3 cr. hrs.
Course content announced each term. Prereq: Cons. of instr.

CNEN 4995. Independent Study in Construction Engineering. 1-3 cr. hrs.
Undergraduate independent study project of either a theoretical or experimental nature. Prereq: Jr. stndg., 3.000 GPA, cons. of instr., and cons. of dept. ch.