# Construction Management

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In any given construction project the disciplines of architecture, engineering and management converge. Recognizing this fact is a student's first step towards becoming a real-world leader in the fields of project and construction management. The second step is taken by enrolling in Norwich University's Construction Management degree program, where students learn the foundational skills necessary to take projects from the conceptual stage straight through to the grand opening ceremony.

## Mission:

- Prepare students to excel in construction management and related fields.
- Make clear to students that above all else, the Construction Management profession is committed to bettering the world.
- Provide fundamental, hands-on education in the construction management field.
- Foster creativity, critical thinking, and problem solving abilities and motivate students to consider the impact of their work on society
- Enable students to be leaders in their profession, community, nation, and the world.

## Goals:

Construction Management students are taught to assess, strategize and execute projects from an interdisciplinary approach in which facets of architecture, engineering and management are taken into account. Along with business, engineering and architecture courses, students are required to take Construction Management courses specifically designed to prepare students for situations they may encounter while on the job site and in the office. Additionally, core studies include courses in the humanities, social sciences, mathematics and sciences.

The Goals [Program Educational Objectives (PEOs)] for graduates of the Construction Management Program are to:

- Lead project teams in their chosen field progressively rising to positions of technical or managerial leadership.
- Be respected and recognized for technical and managerial competence in the creation of solutions that balance sustainability, societal and economic issues.
- Become active citizens in their profession, community, the nation and the world.
- Communicate to both technical and non-technical audience.
- Actively engage in continuing education throughout life.

## Outcomes:

Students who are awarded the Bachelor of Science in Construction Management, may sit for the Associated Constructors (AC) and/or the Construction Management in Training Exams (CMIT) exams, and have a foundational understanding of:

- Construction project management from pre-design through commissioning;
- project life-cycle and sustainability;
- health and safety, accident prevention, and regulatory compliance;
- law, contract documents administration, and dispute prevention and resolution;
- materials, labor, and methods of construction;
- finance and accounting principles;
- planning and scheduling;
- cost management, plan reading, quantity takeoff and estimating;
- project delivery methods;
- leadership and people managment; and
- business and communication skills

Student Outcomes for graduates of the Construction Management Program are an ability to:

- Apply knowledge of science, mathematics, and applied sciences.
- Design and conduct experiments, as well as analyze and interpret data.
- Formulate and design a system, process or program to meet desired needs.
- Function on a multidisciplinary team, and be able to assume leadership roles on the team.
- Identify and solve applied science problems.
- Understand professional and ethical responsibility.
- Communicate effectively.
- Utilize the broad education necessary to understand the impact of solutions in a societal and global context.
- Recognize the need for and demonstrate an ability to engage in lifelong learning.
- Be knowledgeable of contemporary issues.
- Utilize the techniques, skills and modern scientific, and technical tools necessary for professional practice.
- Recognize that with the knowledge that construction changes society, construction managers must understand that they are leaders.

## Careers for this Major:

Graduates from this program manage varying job demands and requirements and are capable of adapting to rapidly changing technology. Whether working for a private construction firm, engineering firm, government agency, real estate developer, or Industry, there are many areas in which construction managers can focus. A few of the major specialties include:

- Construction management
- Construction supervision
- Construction inspection

- Safety inspection
- Project estimation
- Project development

To learn more about employment opportunities in Construction Management, please visit: http://careers.asce.org .

## Accreditation:

In the Fall of 2015, Norwich University applied to the Applied Science Accreditation Commission (ASAC) of ABET for review of the Construction Management Program. That application was approved and the formal review will occur in the Fall of 2016. ABET, http://www.abet.org , 415 N. Charles Street, Baltimore, MD 21201, (410) 347-7700.

**B.S. in Construction Management - Curriculum Map 2016-2017 Catalog**

Print PDF Curriculum Map (http://catalog.norwich.edu/residentialprogramscatalog/collegeofprofessionalschools/thedavidcrawfordschoolofengineering/eleccomp/enginmgmt/const_1460743003117.pdf)

| **Freshman** | | | |
|---|---|---|---|
| **Fall** | **Cr.** | **Spring** | **Cr.** |
| CH 103 General Chemistry I or GL 110 Introduction to Geology (General Education Lab Science) | 4 | AP 111 Fundamentals of Architecture | 4 |
| EG 109 Introduction to Engineering I | 3 | EM 101 Introduction to Construction Project Management or EG 110 Introduction to Engineering II | 3 |
| EN 101 Composition and Literature I | 3 | EN 102 Composition and Literature II | 3 |
| MA 107 Precalculus Mathematics (General Education Math) | 4 | MA 121 Calculus I or 108 Applied Calculus (General Education Math) | 4 |
| | | General Education: History/Literature/Arts & Humanities/Ethics* | 3 |
| Semester Total Credits | 14 | Semester Total Credits | 17 |
| **Sophomore** | | | |
| **Fall** | **Cr.** | **Spring** | **Cr.** |
| AP 225 Introduction to Passive Environmental Systems | 3 | AC 205 Principles of Accounting-Financial | 4 |
| CE 211 Surveying | 3 | AP 325 Materials, Construction, and Design | 3 |
| CE 264 Specifications and Estimating | 1 | CE 214 Site Development and Engineering | 4 |
| EC 202 Principles of Economics (Micro) (General Education Social Science) | 3 | EM 302 Supply Chain Management | 3 |
| EN 204 Professional and Technical Writing | 3 | QM 213 Business and Economic Statistics I or MA 232 Elementary Statistics | 3 |
| PS 201 General Physics I (General Education Lab Science) | 4 | | |
| Semester Total Credits | 17 | Semester Total Credits | 17 |
| **Junior** | | | |
| **Fall** | **Cr.** | **Spring** | **Cr.** |
| AP 327 Active Building Systems I | 3 | AP 328 Active Building Systems II | 3 |
| CE 336 Introduction to Transportation Engineering | 3 | CE 457 Wood, Steel, and Concrete Structures | 4 |
| CE 351 Statics and Mechanics of Materials | 4 | EM 320 Construction Productivity | 3 |
| CE 460 Construction Management | 3 | EM 322 Construction Safety | 3 |
| EG 350 Engineering Economics and Decision Analysis | 3 | General Education: History/Literature/Arts & Humanities/Ethics* | 3 |
| Semester Total Credits | 16 | Semester Total Credits | 16 |
| **Senior** | | | |
| **Fall** | **Cr.** | **Spring** | **Cr.** |
| CE 321 Materials Laboratory | 1 | EM 402 Construction Management Practices (Capstone) | 3 |
| CE 458 Structural Issues for Construction | 3 | CE 446 Soils in Construction | 4 |
| EM 301 Project Management | 3 | MG 310 Production/Operations Management | 3 |
| EM 401 Pre-Construction Management | 3 | MG 351 Organizational Behavior | 3 |
| MG 341 Business Law I | 3 | General Education: History/Literature/Arts & Humanities/Ethics* | 3 |
| MG 309 Management of Organizations | 3 | | |
| Semester Total Credits | 16 | Semester Total Credits | 16 |
| Total Credits For This Major: 129 | | | |

* Students MUST satisfy the General Education Ethics requirement by selecting an Arts & Humanities course that also meets the Ethics requirement, such as PH 303, PH 322, EG 450, etc.

**Construction Management Minor Curriculum Map 2016-2017 Catalog**

Engineering majors may elect this minor.

All of the following courses must be completed with a grade of C or higher.

| | | |
|---|---|---|
| **Two courses from:** | | 6-8 |
| AP 225 & AP 325 | Introduction to Passive Environmental Systems and Materials, Construction, and Design | 6 |
| CE 211 & CE 214 | Surveying and Site Development and Engineering | 7 |
| Two 300 and/or 400 level Civil Engineering courses | | 6-8 |
| Two 300 and/or 400 level Electrical Engineering courses | | 6-8 |
| Two 300 and/or 400 level Mechanical Engineering courses | | 6-8 |
| Two 300 and/or 400 level Computer Science courses | | 6-8 |
| Two 300 and/or 400 level Science courses | | 6-8 |
| **Two Architectural Design courses from:** | | 6-10 |
| AP 111 | Fundamentals of Architecture | 4 |
| AP 118 | Fundamentals of Architecture II | 4 |
| AP 211 | Architectural Design I | 5 |

| | | |
|---|---|---|
| AP 212 | Architectural Design II | 5 |
| AP 311 | Architectural Design III | 5 |
| AP 312 | Architectural Design IV | 5 |
| AP 411 | Architectural Design V | 5 |
| AP 412 | Architectural Design VI | 5 |
| **Four courses from:** | | 12-13 |
| EG 350 | Engineering Economics and Decision Analysis | 3 |
| or AC 205 | Principles of Accounting-Financial | |
| CE 460 | Construction Management | 3 |
| EM 301 | Project Management | 3 |
| MG 310 | Production/Operations Management | 3 |
| EM 302 | Supply Chain Management | 3 |
| Total Cr. | | 18 |

## Architecture Courses

**AP 106 Architectural Drafting 3 Cr.**
Techniques of architectural drafting are introduced as basic skills used to describe architectural form. The various graphic tools, techniques, and conventions are presented and the rationale behind their use is explained. In addition to the basic graphic constructions and multi-view projections, the methods of developing architectural plans, elevations, and sections are addressed. This course is primarily intended for students who have had little or no prior introduction to mechanical and architectural drafting. One hour of lecture and three 3-hours of studio per week. 1 lecture hour and 3 studio hours.

**AP 111 Fundamentals of Architecture 4 Cr.**
An introduction to the basic principles and skills that constitute the discipline of architecture. A series of two and three dimensional graphic exercises is used to cultivate an understanding of architectonics, the intentional arrangement of space and enclosure to communicate human values while also introducing graphic techniques for communicating concepts and solutions. One hour of lecture and three 9-hour studios per week.

**AP 118 Fundamentals of Architecture II 4 Cr.**
A continuation of the introduction to the fundamental processes and technologies that constitute the discipline of architecture. This course investigates the design process, explores interactive computer graphics (CAD) as a design tool, and culminates with the application of these principles, processes, and skills to an architectural design problem. One hour of lecture and 9 hours of studio per week. Prerequisite: AP 111.

**AP 211 Architectural Design I 5 Cr.**
The first in a sequence of design studio courses introducing the processes, judgment, and communications involved in the synthesis of architectural form. Through a focused series of individual and group projects, the influences of the human and physical contexts on form are explored. One hour of lecture and three 4-hour studios per week. Prerequisite: AP 118. 1 lecture hour and 12 studio hours.

**AP 212 Architectural Design II 5 Cr.**
Second in a sequence of design studio courses emphasizing the processes, judgment, and communications involved in the synthesis of architectural form. Through a focused series of individual and/or group projects, the influences of functional requirements on form are explored. One hour of lecture and three 4-hour studios per week. Prerequisite: AP 211. 1 lecture hour and 0 to 12 studio hours.

**AP 221 Site Development and Design 3 Cr.**
A course that deals with engineering principles and design considerations involved with site design. Earth shaping, drainage, roadway alignment, parking lot layouts, code requirements and environmental factors are studied prior to and after design changes. Two hours of lecture and one 2-hour studio per week. 2 lecture hours and 2 studio hours.

**AP 222 Human Issues in Design 3 Cr.**
An introduction to the psychological, sociological, and physical factors that influence the design of architectural space. The fields of anthropometrics, ergonomics, and proxemics are addressed, as well as considerations for barrier-free environments. Three hours of lecture/discussion per week. 3 lecture hours.

**AP 225 Introduction to Passive Environmental Systems 3 Cr.**
Through coordinated lectures and demonstrations, the impacts of environmental energies on architectural form are introduced and explored. Emphasis is given to the processes by which the architect orders light, climate, gravity, and sound responses to achieve building geometry. The course also addresses concepts and strategies for responding to environmental hazards, and designing healthy buildings and green architecture. Three hours of lecture. Prerequisite: AP 118, EG 110 or instructor's permission. 3 lecture hours.

**AP 241 Architectural Delineation 3 Cr.**
A studio course in advanced graphic methods. Various rendering techniques, definitive design development, and the principles of construction drawings and architectural detailing are presented and explored through individual projects. One hour of lecture and two 2-hour studios per week. 1 lecture hour and 4 studio hours.

**AP 311 Architectural Design III 5 Cr.**
The development of the comprehensive building process as a synthesis of spatial, functional, and contextual concerns with emphases on building systems and materials. Individual and group problems are of a limited and defined scope. One hour of lecture and three 4-hour studios per week. Prerequisites: AP 212 and AP 325. Corequisites: AP 327.

**AP 312 Architectural Design IV 5 Cr.**
This fourth course in the design studio sequence continues the development of a comprehensive building design process with problems of complex but limited scope. The synthesis of spatial, functional, and contextual concerns, as directly linked to the understanding and employment of building systems, continues to provide a framework. One 1-hour lecture and three 4-hour studios per week. Prerequisite: AP 311. 1 lecture hour and 12 studio hours.

**AP 325 Materials, Construction, and Design 3 Cr.**
An introduction to the processes by which construction materials and systems are evaluated, selected, incorporated, and detailed in building design. Both measurable and immeasurable design responses to environmental energies are explored in soils, concrete, masonry, wood, and metals. Three hours of lecture per week. Prerequisite: AP 225. 3 lecture hours.

**AP 327 Active Building Systems I 3 Cr.**
A survey of contemporary mechanical building equipment and systems, including heating, ventilation and air conditioning. Emphasis is placed on comparisons of design parameters, interfaces, and impacts on overall building form. Energy efficiency is addressed. Prerequisites: AP 225 and MA 107. 3 lecture hours.

**AP 328 Active Building Systems II 3 Cr.**
A continuation of AP 327, surveying contemporary electrical, lighting, and plumbing equipment and systems. Emphasis is placed on comparisons of design parameters, interfaces, and impacts on overall building form. Energy efficiency and building codes are addressed. Prerequisite: AP 327. 3 lecture hours.

**AP 403 Architectural Seminar in History and Theory 3 Cr.**
As both an art and a science, the profession of architecture is continually undergoing change and reassessment. This elective seminar focuses on one or more specific issues and topics regarding the historic and philosophical contexts that influence architecture today. Typically these topics range from the study of specific historic periods or schools of thought regarding design to the diverse trends in current architectural thinking. AP 504 shall require a graduate-level paper or project. This course may be repeated for credit. Three hours of lecture/discussion per week. 3 lecture hours.

**AP 406 Architectural Theory 3 Cr.**

**AP 411 Architectural Design V 5 Cr.**
Comprehensive problem-oriented design studio offered to fourth year students by various faculty members. The extension of the comprehensive design proves to include problems of an expanded scope and large scale, including building complexes and urban design. Individual and group problems emphasize the complex relationships of environmental factors, human concerns, and architectural form. This studio is considered the undergraduate capstone course in the undergraduate portion of the Architecture Program. A design portfolio, covering all seven semesters of studio work and including a written paper, is required to be submitted at the completion of this course. Prerequisite: AP 312. 1 lecture hour and 12 studio hours.

**AP 412 Architectural Design VI 5 Cr.**
Elective problem-oriented studios offered to fourth year students by various faculty members. The extension of the comprehensive design process to include problems of expanded scope and large scale, including building complexes and urban design. Individual and group problems emphasize the complex interrelationships of environmental factors, human concerns, and architectural form. One hour of lecture and three 4-hour studios per week. Prerequisite: AP 312. 1 lecture hour and 12 studio hours.

**AP 414 Architectural Seminar In Design 3 Cr.**
This elective seminar investigates in a non-studio setting one or more specific concepts, issues, or topics related to architectural design and its associated disciplines, such as urban, landscape, interior, and visual design. AP 514 shall require a graduate level paper or project. This course may be repeated for credit. Three hours of lecture/discussion per week. Prerequisite: approval of instructor. Cross listed with AP 520.

**AP 424 Architectural Seminar in Technology 3 Cr.**
As both an art and science, the profession of architecture is continually undergoing change and reassessment. This elective seminar focuses on one or more of the specific issues, topics, or skills related to technologies in architecture today. Typically, these specific semester topics range from advanced materials and construction systems to energy-conserving design; from environmental issues to hands-on building experiences. AP520 shall require a graduate-level paper or project. This course may be repeated for credit. Three hours of lecture/discussion per week. Prerequisites: AP 114, AP 325, or approval of instructor. Cross listed with AP 520.

**AP 431 Design Thinking and Innovation 3 Cr.**
This course explores the experience and practice of innovation by examining creativity as the ability to turn ideas into action. It examines the development, management, evolution, and broad context of emerging technologies and associated ventures. Students will complete innovation challenges from start to finish and leave with an understanding of the key tenets of design thinking and a sense for ways they can incorporate them into their work. This ‘hands-on’, project-based course involves students in the design and development of ‘visual brand languages’ for emerging technologies, foundation exercises in creativity, and case studies based on pivotal products from the past 50 years. Prerequisite: Not open to freshmen students.

**AP 434 Architectural Seminar in Process 3 Cr.**
As both an art and science, the profession of architecture is continually undergoing change and reassessment. This elective seminar focuses on one or more specific topics regarding the current and future practice of architecture: what architects do, and how they do it. Typically, these topics range from design techniques to office management and from specialties within the practice, to the legal environmental, and social forces that influence it. AP 534 seminar shall require a graduate-level paper or project. This course may be repeated for credit. Three hours of lecture/discussion per week. Prerequisite: instructor's approval. Cross listed with AP 534.

**AP 436 Project Delivery and Documentation 4 Cr.**
Relationships between the formal methods of project delivery and the architectural office form the basic investigation of this course. The project delivery process and the methods of communication and the documentation involved provide a detail study of typical office procedures. The studio component of this course provides practical experience of the typical project delivery process. Documentation is approached as the fundamental means of architectural communication. This communication is multi-layered acting as a foundation for the means of production of contemporary architecture. Various tools will be utilized ranging from computer aided design to conceptual organization schema in both the practice of typical architectural project delivery and the development of new means of communication and production. Two hours of lecture and four hours of studio per week. 2 lecture and 4 studio hours.

**AP 455 Special Projects in Architecture 1-3 Cr.**
An execution of a singular project related to architectural design, history/theory, process, or technology selected by the individual student. The course focuses on in-depth independent research, development, and a formal written and/or graphic presentation of an architecturally-related topic not otherwise covered in course offerings. The student must secure a faculty member who will agree to serve as advisor/evaluator for the project. Limited to Architecture majors who have completed at least the first two years of the curriculum. Hours and credits to be arranged. 1 to 3 lecture hours.

**AP 456 Senior Project 4 Cr.**

**AP 499 Sketching School 3 Cr.**

**AP 499L Advanced Seminar: Sketching 0 Cr.**

## Civil Engineering Courses

**CE 211 Surveying 3 Cr.**
A course in the theory and practice of plane surveying. Horizontal and vertical control, design of circular and parabolic curves, tachometry, construction surveys and earthwork quantities are covered in lecture. Fieldwork presents the practical applications of lecture material with the use of transits, tapes, levels, electronic distance measuring devices and theodolites. Classroom 2 hours, laboratory 3 hours. Prerequisite: MA 107.

**CE 214 Site Development and Engineering 4 Cr.**
A course that teaches the tasks and considerations involved in environmentally sound land development. Road design and it's interaction with development sites will be presented. Other topics covered include contours, drainage utilities, cut and fill, and aesthetic considerations. Codes and legal requirements will also be covered. CADD (Computer Aided Drawing and Design) software specific to Civil Engieering work will be introduced and employed extensively on student projects. Classroom 3 hours, laboratory 3 hours. Prerequisite: CE 211.

**CE 220 Introduction to Environmental Technology 4 Cr.**
A study of the fundamentals of environmental control technology. The course covers the topics of air pollution, water pollution, solid and hazardous wastes, and radioactive wastes. Noise pollution and control are also covered. The generation and treatment of wastes along with their effects on the environment are included in the course. The laboratory includes the basic methods of measuring pollution. Three Credits: Classroom 3 hours. Four Credits Classroom 3 hours, laboratory 2 hours. Prerequisite: CH 103. Not open to engineering students.

**CE 264 Specifications and Estimating 1 Cr.**
A laboratory in plan reading, quantity analysis and cost estimating of Civil Engineering projects. Students will be exposed to standard formats for specifications and estimating. Students will write sample specifications and will gain experience in construction estimation. Laboratory 3 hours. Co-requisites: CE 211.

**CE 318 Soil Mechanics 3 Cr.**
An introduction to the engineering properties of soil: soil classification; soil structure and mineralogy; water flow through soils; compressibility and consolidation; shear strength. Laboratory testing of soils and soil exploration. Offered to allow students from other institutions to transfer 3 credit equivalent courses.

**CE 321 Materials Laboratory 1 Cr.**
A laboratory course in the application of basic mechanics of materials principles to cement, aggregate, concrete, steel and wood. Operation of various types of testing machines and gauges. Tests of tension, compression, flexure, torsion, impact, shear, hardness and fatigue. Laboratory observations, analysis, interpretation and reports. Classroom 1 hour, laboratory 2 hours. Corequisite: EG 301 or CE 351.

**CE 322 Fluid Mechanics Laboratory 1 Cr.**
A laboratory course in which the principles of fluid mechanics are applied to civil engineering problems. The design and implementation of a laboratory research study, the analysis of data, the presentation of results, and the development of engineering conclusions are integral parts of this course. Lab topics include hydrostatics, pipeflow, open channel flow, flow measurement, and resistance to flow. Classroom 1 hour, laboratory 2 hours. Prerequisite or concurrent enrollment: EG 303.

**CE 328 Soil Mechanics 4 Cr.**
An introduction to the engineering properties of soil: soil classification; soil structure and mineralogy; water flow through soils; compressibility and consolidation; shear strength. Laboratory testing of soils and soil exploration. Classroom 3 hours, laboratory 2 hours. Prerequisite: EG 301 or permission of the instructor.

**CE 332 Engineering Hydrology 3 Cr.**
A study of the location, movement, and distribution of the waters of the earth for practical applications to society. This course includes the study of the engineering aspects of precipitation, evaporation, infiltration, steamflow and flood and drought prediction. The application of hydrological statistics and computer applications are stressed. Classroom 3 hours. Prerequisite: EG 303 or permission of the instructor.

**CE 336 Introduction to Transportation Engineering 3 Cr.**
An introduction to different modes of transportation with emphasis on roadway and traffic engineering. Topics include transportation planning, highway geometric and pavement design, drainage, construction, traffic-control devices, traffic operations and management, and highway capacity analysis. Classroom 3 hours. Prerequisites: CE 211: Surveying.

**CE 348 Structural Analysis 3 Cr.**
A course on the analysis of statically determinate and indeterminate beams, frames and trusses. Topics include loads to buildings, shear and moment diagrams, influence lines and classical methods of analysis. Computer applications are introduced using a general frame analysis program. The use of analysis in the overall design process is stressed using a semester-long project. Classroom 3 hours. Prerequisite: EG 301.

**CE 351 Statics and Mechanics of Materials 4 Cr.**
A study of elementary, primarily two-dimensional engineering mechanics. Fundamental concepts and basic laws of statics, force systems, structures, and support reactions for loading patterns. Stress-strain relationships to forces: concepts and applications. Consideration of engineering materials and their suitability in various structures and mechanisms. Classroom 4 hours. Prerequisites: MA 107 and PS 201. Not open to engineering students.

**CE 399 Introduction to Transportation Engineering 3,4 Cr.**

**CE 419 Foundation Engineering 3 Cr.**
A course on the use of soil properties to determine bearing capacity and settlement of shallow and deep foundations. Design of earth and earth supporting structures. Classroom 3 hours. Prerequisite: CE 328 or permission of the instructor.

**CE 421 Environmental Engineering 4 Cr.**
Sources, quantities and constituents of water and wastewater are examined and their interaction with the environment is developed. Design of chemical, physical and biological treatment facilities according to current practice is stressed. The laboratory develops standard methods of chemical, physical and biological examination and analysis. Classroom 3 hours, laboratory 3 hours. Co-requisite: CE 211.

**CE 422 Waste and Water Treatment 3 Cr.**
A study of physical, chemical and biological processes for water and wastewater treatment. The course emphasizes the evaluation of unit processes and the design of water and wastewater treatment facilities. Classroom 3 hours. Prerequisite: CE 421.

**CE 432 Solid and Hazardous Waste Engineering 3 Cr.**
A course on the state-of-the-art techniques for disposal of solid and hazardous waste material. Aspects covered will be system design, public health protection, and environmental protection. Classroom 3 hours. Prerequisites: CH 104 and junior or senior status in engineering or science.

**CE 441 Transportation Engineering 3 Cr.**
The planning, design, and construction of transportation systems to meet the mobility requirements of society while considering economic, environmental, and societal constraints. System maintenance and administration are also included. Classroom 3 hours. Prerequisite: CE 211 or permission of the instructor.

**CE 442 Design of Steel Structures 3 Cr.**
An introduction to the design of metal structures using the LRFD-AISC code as the basis. Topics include design of tension, compression and bending members; bolted and welded connections. Classroom 3 hours. Prerequisite: CE 348.

**CE 444 Reinforced Concrete Design 3 Cr.**
An introduction to the design of reinforced concrete members under bending, shear and axial loadings according to ACI 318R code requirements. Topics also include one-way slabs, footings and retaining walls and an introduction to pre-stressed concrete. Use of the computer as a design tool is introduced. Classroom 3 hours. Prerequisite: CE 348.

**CE 446 Soils in Construction 4 Cr.**
This is the first course in geotechnical engineering, one of the sub-disciplines of Civil Engineering. Its purpose is to impart knowledge of the engineering properties and behavior of soils that are used for construction of foundations and earth structures. Classroom 3 hours, laboratory 2 hours. Prerequisite: Junior standing or higher.

**CE 450 Air Pollution Control 3,4 Cr.**
A course presenting sources of air pollution and the effect on the environment, the measurement of air pollutants, modeling of air pollutant dispersion, and design of control measures. Use of manual monitoring techniques and physical and chemical fundamentals to measure air quality. Course may be taken for three credits without the lab. Classroom 3 hours, laboratory 3 hours. Prerequisite: EG 206.

**CE 451 Air Pollution Control Equipment Design 3 Cr.**
This course builds on and amplifies material studied in CE 450. Properties of air pollutant emissions and thermodynamics, fluid mechanics and heat transfer principles are utilized to design air pollution control equipment. Several major design projects are undertaken by student teams; interim and final design reports are required. In addition, a module on air quality modeling is included. Classroom 3 hours. Prerequisite: CE 450.

**CE 452 Introduction to Air Pollution Control 3 Cr.**
A course presenting sources of air pollution and the effect on the environment, the measurement of air pollutants, modeling of air pollutant dispersion, and design of control measures. Classroom 3 hours, laboratory 3 hours. Prerequisite: EG 206.

**CE 455 Structures I 3 Cr.**
This course builds directly on the material learned in CE 351 and is specifically directed to the study of the response of structural systems to various loadings. Gravity and lateral loads as well as load combinations on a structure are developed using appropriate building codes. The response of the structural system to imposed loading is studied by classical and computer analysis techniques. Finally, this course introduces the students to the design of simple steel structures that meet the appropriate building code. Classroom 3 hours. Prerequisite: CE 351. Not open to engineering majors.

**CE 456 Structures II 3 Cr.**
This course is intended to introduce the students to and develop an understanding of, structural design of wood, concrete and masonry. Particular attention will be given to failure modes of the member types and materials. Each of the principal member types, beam and column as well as connections, will be studied and members designed to meet the appropriate code. Classroom 3 hours. Prerequisite: CE 455. Not open to engineering majors.

**CE 457 Wood, Steel, and Concrete Structures 4 Cr.**
This course builds directly on the material learned in CE 351 and is specifically directed to the study of the response of structural systems to various loadings. Gravity and lateral loads as well as load combinations on a structure are developed using approriate building codes. The response of the structural system to imposed loading is studied by classical and computer analysis techniques. This course introduces the students to applicaitons - the design of simple structures of wood, steel, concrete and other materials that meet the appropriate building code. Classroom 4 hours. Prerequisite CE 351. Not open to engineering majors.

**CE 458 Structural Issues for Construction 3 Cr.**
This course is intended to introduce the students to structural building applications, and to develop knowledge and comprehension of structural design of steel, wood, concrete, and masonry. Particular attention will be given to concrete members, concrete form design requirements, steel connections, failure modes of the member types and materials. Detailed construction issues with each material will be emphasized. Each of the principal member types, beam and column as well as connections, will be studied and members designed to meet the appropriate code. Lecture 3 hours. Prerequisites: CE 455 or CE 457. Not open to engineering majors.

**CE 460 Construction Management 3 Cr.**
A course on the organization, scheduling and management of the construction project utilizing CPM and PERT. Survey of management functions by which construction is authorized, purchased, supervised, accomplished, inspected and accepted, including labor management relations and site design. Classroom 3 hours. Prerequisite: MA 107.

**CE 475 Senior Project Planning 1 Cr.**
Each student will work with a mentor and together will define and analyze a project so that an efficient design can be completed. The project scope will be developed, tasks will be laid out, and a schedule to complete the project will be created. All of this will be presented orally and in written form in a project proposal. Prerequisite: Senior status. Corequisite: CE 460.

**CE 480 Senior Design 3 Cr.**
A capstone course in civil engineering. This course builds on and integrates the engineering concepts developed in prior course work into the complete design of a major civil engineering project. The course will require a written and an oral presentation of the completed design to include, where appropriate, plans and specifications. Prerequisites: CE 328, CE 348, and CE 421, or departmental approval.

**CE 490 Advanced Topics 4 Cr.**
A course that provides instruction in an area of the instructor's special competence and student interests. Advanced topics would be presented in such areas as air pollution control, water and wastewater treatment, bioremediation, and nuclear radiation. Offered as the occasion demands. Prerequisite: senior standing.

## Construction Engr. Management Courses

**EM 101 Introduction to Construction Project Management 3 Cr.**
This course provides a broad overview of the managerial, technological and physical processes that are involved in the creation of the built environment. It specifically focuses on understanding the issues in the management of a construction project. (Prerequisites: none. 3 credit-hours - 2 hours lecture and 3 hours lab).

**EM 299 Test Course 4 Cr.**

**EM 301 Project Management 3 Cr.**
The course covers the principles and practices of project management with particular emphasis on issues related to engineering and construction projects. Students will learn the principles of project management within the firm and in an environment characterized by inter firm relationships. 3 hours of class time per week.

**EM 302 Supply Chain Management 3 Cr.**
The course covers the principles and practices of supply chain management with particular emphasis on issues related to engineering and construction projects. Students will learn the principles of supply chain management and purchasing in an environment characterized by inter firm relationships. 3 hours of class time per week.

**EM 320 Construction Productivity 3 Cr.**
This course focuses on the planning and execution of the construction of vertical and horizontal construction projects. The course emphasizes the means and methods associated with heavy civil projects, earthwork, and the construction of the project’s structural elements. Equipment selection and methods will be a major focus. Prerequisites: Junior standing. 3 credit-hours lecture.

**EM 322 Construction Safety 3 Cr.**
Administration and application of the OSHA Act in the construction industry; includes standards, hazard identification and the development of a safety plan. Fulfills the requirements for the 30-hour OSHA safety training certifications. Classroom 3 hours. Prerequisite: junior or senior status.

**EM 399 Special Construction Systems 3 Cr.**

**EM 401 Pre-Construction Management 3 Cr.**
This course addresses the initial phases of the building creation process. It focuses on addressing the owner's design and construction needs and the delivery of value to the owner. Business development, estimating, planning and presentation skills are emphasized. A Design/ Build model is employed to encompass the full spectrum of architecture, engineering and construction (AEC) requirements. Classroom 3 hours. Prerequisites: EM 302.

**EM 402 Construction Management Practices 3 Cr.**
A capstone and practicum course in construction management engineering that explores the processes of management as applied to actual construction projects. Topics will be reviewed in the seminar and students will work in teams to review how these topics were applied in an actual construction project and to design a construction management plan for a proposed project during laboratory. Two 1.5 hours seminar periods and a 3 hour laboratory per week. Prerequisite: EM 301 and EM 302.

**EM 499 Topics: 3 Cr.**