

MASTER OF ENGINEERING IN CONSTRUCTION ENGINEERING AND MANAGEMENT

The Master of Engineering (MEng) degree in Construction Engineering and Management (CEM) is a one-year program for individuals who generally intend to pursue a professional career in the construction industry upon completion of their MEng program. The degree particularly targets students and professionals who hold a B.S degree in civil engineering or its equivalent (e.g., B.S in Construction). Students from other disciplines may need to take background undergraduate courses in addition to the MEng course requirements to build the necessary foundation for this program. Students will be informed of any such requirements when they are admitted into the MEng program.

Justification

The construction industry's demand for highly skilled professionals has been consistently high in recent years. Particularly, considering the rapidly growing need for infrastructure development and renewal both in the U.S. and abroad, that demand is growing and will only increase in the coming years. Along with this high demand, the American Society of Civil Engineers (ASCE) recognizes the need for a Master's degree as a requisite for obtaining a Professional License, which further necessitates the need for industry-oriented higher education in construction. Thus, the MEng in CEM has been designed for students and professionals who want to meet such a societal and professional need while building on their strong background in construction engineering and management.

Program Description

A minimum of 26 credit hours are required to complete the MEng in CEM degree. MEng students will meet their CEM faculty advisor who will provide necessary consultation to ensure that the program meets their expectations and needs. Overall, the MEng in CEM is composed of: 1) core CEM courses that will cover fundamental knowledge in CEM; 2) a CEM elective that can deepen students' competence based on their own need; 3) minor electives in a related area within or outside the CEE department; 4) a CEM practicum course; and 5) two seminar courses, each of which will be one-credit hour. MEng students must take a minimum of 26 credit hours as follows:

a) Core CEM courses (≥12 hours)

Students should complete four core CEM courses (min 12 hours) that will build their fundamental knowledge on CEM. They are: CEE 431* (Construction Contracting), CEE531 (Construction Cost Engineering), CEE532 (Construction Project Engineering), and CEE536 (Critical Path Methods)

- Note*: Students who have already taken CEE 431 or its equivalent before enrolling in the MEng need to take one more construction elective instead.

b) CEM Elective (≥3 hours)

At least one course designated below as "C" should be taken as a CEM elective.

c) Minor Electives (≥6 hours)

At least two courses shall be selected for the minor. Any of the other concentration areas in the CEE department or a related technical or management area from outside the CEE department is recommended. The MEng students must consult with their faculty advisor before selecting these minor courses.

For example, two courses in same area (e.g., structural engineering, geotechnical engineering, systems engineering, transportation engineering, environmental engineering, business, architecture, real estate, etc.) can be taken, which should not be exclusively “C” in the course list below.

d) Practicum course

Students should take CEE530 (Construction Professional Practice; 3 hours) as a practicum course in which they have an opportunity to work on real-world projects working with industry professionals and CEM faculty members.

e) Seminar courses

MEng students should enroll in one seminar course per semester. One will be the CEM seminar course and the other seminar can be from either a concentration area in the CEE department (e.g., structural engineering, geotechnical engineering and environmental engineering) or a technical or management area outside the CEE department (e.g., real estate and business school)

We also recommend that MEng students elect one seminar course in the chosen area for minor electives outside CEM specific courses, which can deepen their knowledge within the chosen minor.

Appendix A lists all CEM courses. Appendix B shows an example of course election.

f) General Program Requirements and Policies

Credit hours and normal progress: Twelve regular course credits plus a one credit seminar is the usual full-time course load per semester. It is recommended that students plan to complete all of the courses required for the MEng degree in two regular semesters (8 months).

Grades: The grade point average for the 26 hours of courses used to fulfill the requirements for the MEng degree program must be equivalent to at least a straight B (3.00). Grades below C (2.00) are not acceptable for graduate credit, but are considered in computation of a student’s grade point average.

Time limit: A student must complete all work within a period of three consecutive years after his/her initial enrollment in the MEng degree program.

Graduate transfer credit: A maximum of six hours of graduate course credit may be transferred from another institution. These must be from graduate level courses taken either in residence or on-line with a grade of B or better from an accredited institution approved by the Rackham School of Graduate Studies. Students may request the transfer of such credits through the CEE Department after completion of one semester in the MEng program.

Undergraduate transfer credit: A maximum of six hours of graduate course credit, earned as an undergraduate student at the University of Michigan, with a grade of B or better may be included in the student's graduate study program subject to the following restrictions: (1) credit was not used to meet the bachelor's degree requirement, either required courses or required credit hours; (2) credit was earned no more than two years before formal admission to the MEng degree program; (3) credit was earned in courses approved for graduate credit by the Rackham Graduate School; and 4) credit was earned in courses approved for the MEng courses listed below. Students may request the transfer of such credits through the CEE Department any time after admission to the MEng program.

Appendix A: CEM Courses

- **R** = required course for MEng
- **C** = graduate credit as construction elective
- **M** = graduate credit as minor elective for MEng; many courses not listed are also acceptable, which should be consulted with CEM faculty designated in the beginning of the semester.
- **S** = one credit-hour seminar course
- All courses below exist as of October, 2016, except CEE 501 (Section 020) (will be offered from Winter, 2017) and CEE 830 (will be offered from Fall, 2017). They are offered on a regular basis.

CEE 431 - Construction Contracting

R

Construction contracting for contractors, architects, and owners. (1) Organization and administration; industry structure; construction contracts, bonds, insurance. (2) Planning, estimating, and control; quantity takeoff and pricing; labor and equipment estimates; estimating excavation and concrete; proposal preparation; scheduling; accounting and cost control. Students use contract documents to prepare detailed estimate. CEE 431 is prerequisite to CEE 531 and CEE 532. We recommend it be taken in the first term towards the M Eng and MSE degrees.

Offered Every Fall and Winter Terms (Menassa and Stino)

CEE 501 (Section 020) – Building Information Modeling

C

Fundamentals of Building Information Modeling (BIM) methods and their significance in project management and collaboration; Application of BIM in primary construction management functions such as coordination, design clash detection, sequencing, safety, logistics, and communication; BIM-based Integrated Project Delivery (IPD) approach and the project lifecycle; Reality capture methods for as-built documentation in BIM; BIM in facility and asset management; BIM standards and interoperability.

Offered Winter Term Only (Kamat)

CEE 530 - Construction Professional Practice

R

Industry speakers, field trips, team projects. Teams work with contractor or owner client addressing industry problem as volunteer consultants, prepare/present written and oral reports to class and client. Prerequisite: permission of instructor, mandatory satisfactory/ unsatisfactory.

Offered Winter Term Only (Menassa)

CEE 531 - Construction Cost Engineering

R

Cost engineering for construction organizations, projects, and operations. Construction financing; break even, profit, and cash flow analyses; capital budgeting. Equipment cost and procurement decisions. Construction financial accounting, cost accounting, cost control systems, data bases. Cost indices, parametric estimates, unit price proposals, measuring work and settling claims.

Prerequisite: graduate standing and preceded or accompanied by CEE 431.

Offered Fall Term Only (Kamat)

CEE 532 - Construction Project Engineering

R

The course covers the fundamentals of project-based organization, project delivery systems, resource management focusing primarily on human aspects, organizational behavior and culture, change and interface management, productivity measurement and analysis, and construction safety and ergonomics. Examples and case studies from construction are used to help students' learning.

Prerequisite: graduate standing and preceded or accompanied by CEE 431
Offered Winter Term Only (Lee)

CEE 534 - Construction Engineering, Equipment, and Methods **C**

Engineering principles and economics of conventional earthmoving equipment and its use in site development, earthwork, and excavation; Mobile and tower construction cranes, and their selection to perform services based on lifting capacity and working range; Concrete construction including concrete production, formwork and shoring systems, transportation and placement, and reinforcement systems; Aggregate production, including drilling and blasting, and crushing for use in concrete and asphalt production; Concrete and steel bridge construction, paving of asphalt and concrete highways, and piled foundations.

Offered Winter Term Only (Kamat)

CEE 536 - Critical Path Methods **R**

Construction project planning, scheduling, control using activity-on-arrow, activity-on-node, and overlapping network models. Start, finish, float, critical path calculations. Probabilistic activity durations, PERT concepts, merge event bias. Time-cost tradeoff, resource allocation and leveling algorithms, cost-schedule integration, computerized control systems. Case studies, term project.

Prerequisite: senior or graduate standing

Offered Fall Term Only (Ioannou)

CEE 537 - Construction of Buildings **C**

Material selection, construction details, manufacture, fabrication, and erection of building structures using steel, light wood, timber, cast-in-place concrete, precast concrete, and masonry; and of building materials for roof, floor, and wall surfaces. Field trips to fabrication plants and construction sites.

Offered Winter Term Only (Everett or Staff)

CEE 545 - Foundation Engineering **C, M**

Application of principles of soil mechanics to: determination of bearing capacity and settlement of spread footings, mats, single piles and pile groups; site investigation, evaluation of data from field and laboratory tests; estimation of stresses in soil masses; and lateral resistance of piles and pile groups.

Offered Fall Term Only (Hryciw)

CEE 547 - Soils Engineering and Pavement Systems **C, M**

Soils engineering as applied to the design, construction, and rehabilitation of pavement systems. The design, evaluation, and rehabilitation of rigid, flexible, and composite pavements.

Offered Fall Term Only (Hansen)

CEE 555 – Sustainability of Civil Infrastructure Systems **C**

Life Cycle Cost Analysis and Life Cycle Analysis - Methods and Applications in Buildings; Building Energy Modeling and Simulation; Energy Management in Buildings; Impact of Building Occupants and Behavioral Challenges; Renewable Energy and Efficiency in Buildings; Existing Buildings and Technical/Social Challenges of Energy Retrofits; and Building Certifications (e.g., LEED).

Offered Some Winter Terms Only (Menassa)

- CEE 631 - Construction Decisions Under Uncertainty** **C**
 Construction project and organization decisions for the uncertain future. Selection of construction method, equipment, contract, markup, and financing alternatives having the highest expected values. Uses decision theory, competitive bid analysis, probabilistic modeling and simulation, and multiple regression analysis in managing construction.
 Prerequisite: A course in probability or statistics such as Stat 310 or Stat 311 or SMS 301.
- CEE 812 – Seminar in Structural Engineering** **S**
- CEE 830 – CEM Seminar** **S**
- CEE 840 – Seminar in Geotechnical Engineering** **S**
- CEE 930 (Section 020) - Construction Industry Institute (CII) Best Practices** **C**
 Introduction to the Construction Industry Institute (CII) Best Practices defined and developed by CII over the last 25 years. Current professional and practice issues in the construction industry. The course covers the majority of CII Best Practices, such as Front End Planning, Zero Accident Techniques, Constructability and Materials Management. Lectures focus on Best Practices or practice, and critical issues facing the construction industry.
 Offered Fall Term Only (Lee)
- CEE 930 (Section 028) - Engineering Process Modeling and Risk Analysis** **C**
 Engineering complex systems, models and simulation. Probabilistic aspects of simulations. Data collection and selection of input distributions. Design of experiments, input and output analysis and interpretation. Random number generators, variate and process generation. Monte Carlo simulation models. Activity cycle diagrams. Cyclone-EZStrobe-Stroboscope networks. In-depth examination of discrete-event simulation systems. Variance reduction techniques, antithetic sampling, common random numbers. Simulation and optimization. Parametric analysis. Single system output analysis and multiple system comparison. Hands-on model development using Stroboscope, EZStrobe, ProbSched, Risk-Solver-Platform, Simtools, and YASAI. Animations using Proof-Animation, Vita2D and Vitascope++. Applications from on-site construction, off-site manufacturing, tunneling, earthmoving, mining, land, air, and marine transportation systems.
 Prerequisites: senior or graduate standing.
 Offered Fall Term Only (Ioannou)

Appendix B: Sample of Course Election Form

MEng Degree (Construction Engineering & Management) Student: Sample schedule w/ Geotech. Engr minor	Term:	
	F-16	W-17
Core CEM Courses, ≥ 12 credits		
CEE 431	X	
CEE 531	X	
CEE 532		X
CEE 536	X	
CEM Elective, ≥ 3 credits		
CEE 501 (020)		
CEE 534		
CEE 537		
CEE 555		X
CEE 930 (020)		
CEE 930 (028)		
Minor Area of Emphasis (e.g., Geotech. Engr.), ≥ 6 credits		
CEE 545 (Foundation Engineering)	X	
CEE 540 (Advanced Soil Mechanics)		X
Practicum, ≥ 3 credits		
CEE 530		X
Seminar Courses, 2 credits (maximum)		
CEE 830 (CEM)	X	
CEE 840 (Geotech. Engr.)		X