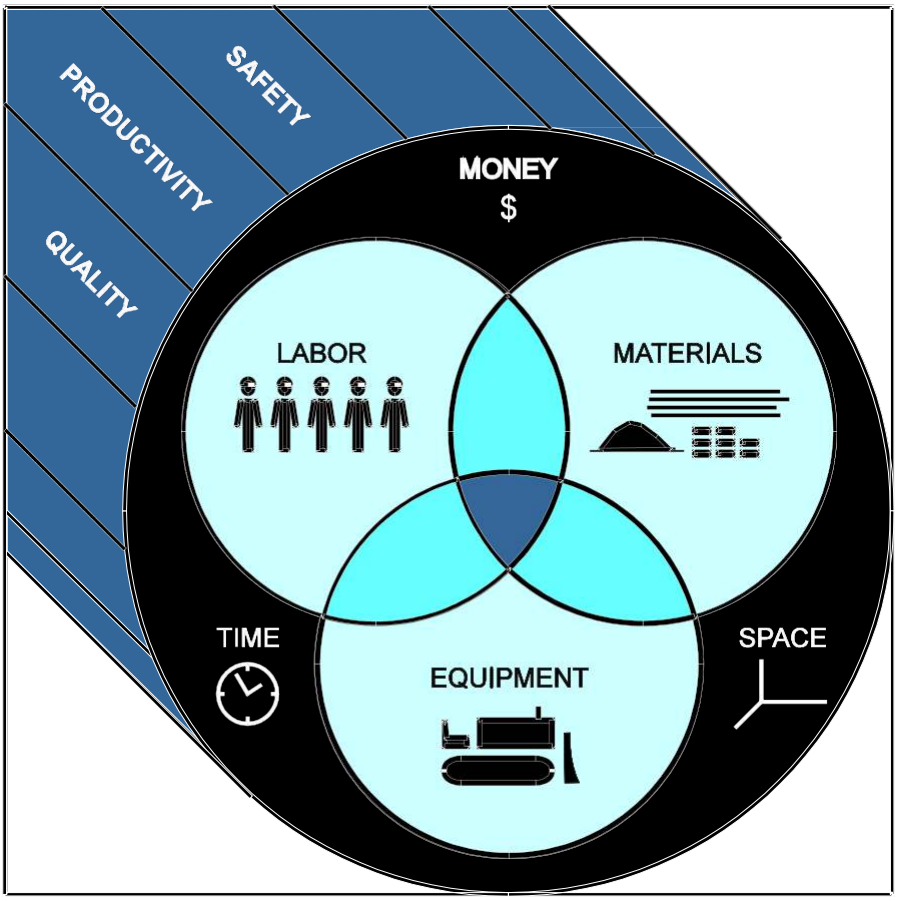
THE UNIVERSITY OF MICHIGAN

GRADUATE DEGREE PROGRAMS

Tishman Construction Management Program

DEPARTMENT OF CIVIL AND ENVIRONMENTAL ENGINEERING



The **Master of Science in Engineering (MSE)** program in Construction Engineering and Management, established in 1954, pioneered construction graduate education. Graduates lead construction engineering and management organizations throughout the world. The **Master of Engineering (MEng)** program in Construction Engineering and Management, established in 1994, continues this tradition with its strong emphasis on the highest level of professional practice. The integration of theory and practice in construction engineering and management attracts practicing engineers as well as recent engineering graduates. The **PhD** program focuses on the doctoral students' dissertation research. Graduates have made significant contributions to knowledge in construction engineering and management and occupy academic and research positions at leading institutions worldwide.

The Michigan Engineer is taught to perform at the three functional levels of construction engineering and management:

Construction Organization — Form a construction company or department and organize and direct its marketing, financing, estimating, personnel, purchasing, quality assurance, accounting, and control functions.

Construction Project — Estimate, bid, plan, schedule, control and manage a project at a profit, including contract negotiations, material selection, purchasing, financing, personnel, labor relations, subcontract procurement and coordination, safety, quality assurance, accounting, and schedule and cost control functions.

Construction Operations — Plan and supervise construction operations, select and train crews, select and maintain equipment, select, fabricate, erect, install, and test materials, measure and analyze operations for improved safety and productivity.

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MASTER'S DEGREE PROGRAMS

The **Master of Science in Engineering** in Construction Engineering and Management, abbreviated MSE (CE&M), is for students interested in combining research with construction professional practice, and who either wish to work in the construction industry or pursue a PhD following their Master's degree program. The MSE (CE&M) requires 30 hours of coursework that follows the program below.

CEE 531–Construction Cost Engineering	3 hr
CEE 532–Construction Project Engineering	3 hr
CEE 536–Critical Path Methods	3 hr
CEE 530-Construction Professional Practice OR	3 hr
CEE 630–Directed Studies in Construction	3 hr
Graduate CE&M Elective Courses	9 hr
Business, Industrial and Operations Engineering, or other management elective	3 hr
Mathematics, Probability, Statistics, Or Computer Science Elective	3 hr
Program Elective	3 hr
	30 hr

In addition to the above requirements, MSE (CE&M) students are strongly recommended to take the 1 hr CEE 830 CE&M Seminar.

The MSE (CE&M) program elective may be selected from graduate CE&M courses listed below, or from other areas such as those listed below as business or mathematics electives.

Most MSE (CE&M) students take a total of 24-27 hours in the Fall and Winter terms, and 3-6 hours in the Spring term or the following Fall term, completing their MSE (CE&M) program in 10-15 months of study.

The **Master of Engineering** in Construction Engineering and Management, abbreviated MEng (CE&M), is for students who are concentrating on state-of-the-art construction professional practice and plan to work in the construction industry. It requires 26 hours of coursework that follows the program below.

CEE 435-Construction Contracting	3 hr
CEE 531–Construction Cost Engineering	3 hr
CEE 532–Construction Project Engineering	3 hr
CEE 536–Critical Path Methods	3 hr
CEE 530–Construction Professional Practice	3 hr
CEE 830-CE&M Seminar	1 hr
Graduate-Level Seminar	1 hr
Graduate CE&M Elective	3 hr
Secondary Concentration Electives	6 hr
	26 hr

MEng (CE&M) students select a secondary concentration in an appropriate area outside Construction Engineering and Management, such as another area of Civil and Environmental Engineering, another department in the College of Engineering, the Graduate School of Business Administration, the Graduate Program in Architecture, or others. The MEng (CE&M) graduate-level seminar may be selected from other civil and environmental engineering areas such as structural or geotechnical engineering.

The MEng (CE&M) program can be completed by all students in 8 months of study (Fall and Winter terms).

The **Master of Science in Engineering (Civil Engineering)** is for students who want to specialize in Construction Engineering and Management, but specifically require their MSE degree to be in civil engineering for reasons such as scholarship sponsor compliance or active-duty military student rules. This degree requires the same coursework as the MSE (CE&M), except that 6 hours of program electives must be outside the construction engineering and management area and 2 hours of graduate-level seminars, one of which should be the CEE 830 CE&M Seminar.

The academic year for all Master's programs consists of the Fall Term (September- December) and the Winter Term (January-April). A limited number of courses may be taught in the Spring Term (May-June). All course selections for all programs must be approved by the student's academic advisor and the TCMP Program Advisor at the beginning of each term of study.

The grading system used for graduate studies follows the following 4-point scale: [A+ = 4.3; A = 4; A- = 3.7; B+ = 3.3; B = 3.0; B- = 2.7; C+ = 2.3; C = 2; C- = 1.7]. A minimum cumulative graduate grade point average (GPA) of 3 on this 4-point scale is required for all graduate courses taken for credit and applied toward a Master's Degree.

ADMISSION REQUIREMENTS

Regular admission to the MSE (CE&M) and MEng (CE&M) programs may be granted to graduates in any recognized branch of engineering. Students with undergraduate degrees in fields related to Civil Engineering, such as Construction Management and Architecture are also eligible for admission but may be required to complete specific background courses in civil engineering without graduate credit. Admission to the MSE (Civil Engineering) program is open to applicants with a Bachelor's degree in Civil Engineering or its substantial equivalent. The Graduate Record Exam (GRE) is recommended for admission to the MEng (CE&M) program and is required for admission to the MSE (CE&M) program.

Applicants with Bachelor's degrees in Architecture or other non-engineering programs may be admitted to the graduate program if they have completed adequate coursework in college-level mathematics (e.g., MATH215 - Multivariable Calculus, MATH 216 - Differential Equations, CEE 373 - Probability and Statistical Methods) and physics (e.g., PHY140 – Mechanics, PHY240 - Electricity and Magnetism) and if they have at least a B average in their mathematics and physics courses. In addition, such applicants, if admitted, will be required to take (without graduate credit, and with a B average) certain basic undergraduate civil engineering courses that are found missing in their background. The courses will include some or all of the following four: CEE 312 Structural Engineering; CEE 351 Civil Engineering Materials; CEE 345 Geotechnical Engineering; and CEE 331 Construction Management.

Most students who have an undergraduate degree in Construction Management will have taken the equivalent of CEE 312, CEE 351, CEE 345, and CEE 331. Most students who have an undergraduate degree in Architecture will have taken the equivalent of CEE 312 and CEE 351. With proper planning, CEE 331 and CEE 345 can be included in University of Michigan B Arch and M Arch programs. Students should work with their academic advisor to ensure that they have taken all classes to satisfy the degree requirements.

DUAL MASTER'S DEGREE PROGRAMS

The Tishman Construction Management Program has formal dual degree programs with the College of Architecture and Urban Planning and the Graduate School of Business Administration through which a student can earn the MEng (CE&M) and the Master of Architecture or the Master of Business Administration. Dual degree programs can also combine the MEng (CE&M) or MSE (CE&M) with Master's in structures, materials, geotechnical, industrial and operations engineering, and naval architecture and marine engineering. Students complete course requirements for both degrees; however, dual counting of some courses reduces the total hours to below that required when pursuing the degrees separately.

For each dual degree program, prospective students must apply to, meet all admission requirements for, and be accepted independently into both programs. Students enrolled in any of the individual programs may apply for admission to a dual program, but they can save time and unnecessary coursework by planning both programs in advance. These dual programs provide unique opportunities to gain the knowledge and credentials of two related programs, each of which is recognized to be among the strongest in the United States.

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Master of Architecture. The dual degree program combines the two-year 60-hour M Arch program with the one-year, 26-hour MEng (CE&M) program, resulting in a two and one-half year, approximately 75-hour program.

Master of Business Administration. The dual degree program combines the two-year, 60-hour MBA program with the one-year, 26-hour MEng (CE&M) program, resulting in a two-year (including Spring and/or Summer terms) approximately 69-hour program. The dual degree program can be completed in two years if the first year is devoted to core MBA courses.

Master of Science in Engineering. Dual MEng and MSE degree programs combine a 26-hour MEng (CE&M) or a 30-hour MSE (CE&M) program with another 30-hour Master's program resulting in a 51- hour program, 9 hours of which satisfy requirements for both programs. Usually, these 9 hours are core courses from the other Master's program, used as electives in the Construction Engineering and Management program. An applicant who has recently received or is working toward a Master's degree in another area of engineering can complete the MEng (CE&M) or MSE (CE&M) with an additional 21 hours of coursework.

PhD DEGREE PROGRAM

The Ph.D. program in Civil Engineering (specializing in Construction Engineering and Management) is open to outstanding applicants who have demonstrated excellence in their coursework and a capability for independent research. The focus of the doctoral work is on the student's dissertation research, which must make a significant contribution to knowledge. All admitted Ph.D. students are offered full financial support for the entire duration of their program. Direct admission to the Ph.D. program without a Master's degree is highly competitive and rare. Many applicants who are admissible to a Master's program will be declined for the Ph.D. program if they apply directly.

Ongoing and recent research by TCMP faculty and students has included the following topics:

Dynamic Project Management

The Dynamic Project Management (DPM) group aims at understanding and managing the construction dynamics in large-scale construction projects. Particularly, DPM strives to support diverse decision-making processes in order to manage schedule, cost, and quality as well as sustainability and safety using emerging technologies. DPM also has a great interest in how the decisions made can affect people's behavior and ultimately, would like to incorporate it to support the decision-making processes. To this end, DPM uses computer simulation (System Dynamics, Discrete Event Simulation, and Agent-based Modeling), automatic data capture and tracking technologies (computer vision, wireless sensor network, RFID equivalent technologies, and emission sensor), and visualization techniques. For more information, please visit http://dpm.engin.umich.edu/ or contact Professor SangHyun Lee at shdpm@umich.edu.

Sustainable and Intelligent Civil Infrastructure Systems

Current research in the Sustainable and Intelligent Civil Infrastructure Systems Laboratory (SICIS) is broadly focused on developing simulation models and quantitative tools to understand human impacts, evaluate risks, and assess environmental and social impacts during various life cycle phases of buildings and civil infrastructure systems. The research team uses analytics, simulation (high level architecture, agent-based modeling, system dynamics), financial engineering principles and theories from social sciences to achieve the research objectives. For more information, please visit https://sites.google.com/a/umich.edu/sicislab/ or contact Professor Carol Menassa at menassa@umich.edu.

Laboratory for Interactive Visualization in Engineering

The Laboratory for Interactive Visualization in Engineering (LIVE) conducts research focused on Automation and Robotics, and its applications in the construction, operation, and maintenance of civil infrastructure systems. LIVE is also conducting research in Real-Time Visualization and its applications in construction process monitoring and control. The LIVE also has significant expertise and experience in visual simulation, virtual and augmented reality, indoor and outdoor positioning systems, mobile computing, and its applications in construction and other engineering domains. The LIVE conducts research with full-size Kuka robotic arms and mobile platforms, and other pieces of computing, positioning, and reality-capture hardware. For more information, please visit http://live.engin.umich.edu or contact Professor Vineet Kamat at vkamat@umich.edu.

CIVIL ENGINEERING (CE&M) COURSES

CEE 331 is 4 credit hours. CEE 538 is 2 credit hours. CEE830 is 1 credit hour. All other courses are 3 credit hours. All courses except CEE 331 may be used for graduate credit by graduate students.

CEE 331–Construction Management
Construction contracting for contractors, architects, 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 control. Students use contract documents to prepare detailed estimate.

CEE 435– Building Information Modeling
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.

CEE 501-930-Construction Industry Institute Best Practices
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.

CEE 530–Construction Professional Practice
Capstone project in construction professional practice. Student teams investigate construction technologies and work with construction industry clients as volunteer consultants to address industry, organization, and project problems. Teams prepare and present written and oral reports weekly. A professional report and video is compiled by the end of the class for presentation to clients. Faculty and industry speakers discuss current technologies and elements for professional success and leadership.

CEE 531–Construction Cost Engineering
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.

CEE 532–Construction Project Engineering
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.

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CEE 533-Engineering Process Modeling and Risk Analysis
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. Variance reduction techniques, antithetic sampling, common random numbers. Parametric analysis. Single system output analysis and multiple system comparison. Applications from on-site construction, off-site manufacturing, tunneling, earthmoving, mining, land, air, and marine transportation systems.

CEE 534–Construction Engineering, Equipment, and Methods
This course focuses on the construction means, methods, and equipment used to transform a particular design concept into a completed usable structure or facility, with particular focus on the heavy civil engineering construction industry. Emphasis is placed on the selection and optimization of individual items of equipment as well as the systems needed to produce completed work to the required quality on time and on budget.

CEE 536–Critical Path Methods
Construction project planning, scheduling, and 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.

CEE 538– Computer-aided Project Management
Introduction to the application of modern project management computer systems, including Primavera P6 Professional and Microsoft Project, for construction project planning, scheduling and control. This course must be accompanied or preceded by CEE 536 (or MFG 536).

CEE 555–Sustainability of Civil Infrastructure Systems
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).

CEE 630–Directed Studies in Construction Engineering
Independent research under the direction of TCMP faculty leading to a written report (3 hr credit) or a Master's Thesis (6 hr credit), and an oral presentation.

CEE 631–Construction Decisions Under Uncertainty
Construction project and organization decisions for the uncertain future. Selection of construction methods, 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.

CEE 830-Construction Engineering and Management Seminar
Weekly guest speakers discuss CE&M careers and current topics on CE&M professional practice and research.

CEE 990–Dissertation/Pre-Candidate
Election for dissertation work by a doctoral student not yet admitted to status as Candidate.

CEE 995–Dissertation/Candidate
Election for dissertation work by a doctoral student who has been admitted to status as Candidate.

GRADUATE CE&M FACULTY

Photios G. Ioannou (Professor, PhD 1984, Massachusetts Institute of Technology), computerized decision support systems, project and process simulation, project scheduling and control, building construction, design-construction integration, financial management, tunneling.

Vineet R. Kamat (Professor, PhD 2003, Virginia Polytechnic Institute and State University), Automation and robotics, and its applications in the construction, operation, and maintenance of civil infrastructure systems; Real-time visualization and its applications in construction process monitoring and control; 3D visualization of construction processes and products.

SangHyun Lee (Professor, PhD 2006, Massachusetts Institute of Technology), Understanding and management of construction dynamics through the design and development of mechanisms, models, and systems that integrate automatic data acquisition, computer simulation, and visualization, particularly in mega construction projects.

Carol C. Menassa (Associate Professor, PhD 2009, University of Illinois at Urbana Champaign), Sustainable civil infrastructure systems; understanding and modeling the impact of occupants on energy use in buildings and developing decision frameworks to assist in building operations and management as well as, sustainable retrofit decisions.

ADDITIONAL INFORMATION

Send inquiries to Ms. Anne Speigle (Graduate Admissions Coordinator) at aspeigle@umich.edu or to Professor Vineet R. Kamat (Program Advisor) at vkamat@umich.edu. Mailing Address: Department of Civil and Environmental Engineering, 2105 G.G. Brown Building, University of Michigan, Ann Arbor, MI 48109-2125. Phone: (734) 764-4325. Fax: (734) 764-4292. Access additional information at http://tcmp.engin.umich.edu.

[Last updated by Professor Vineet R. Kamat on 09/13/2021]