



Western Michigan University

Department of Civil & Construction Engineering
College of Engineering & Applied Sciences

Master of Science in Civil Engineering

Program Focus

The primary areas of focus at the graduate level are: Construction Engineering and Management, Structural Engineering and Transportation Engineering. Students can earn the degree on a full-time or part-time basis and can have a design or research orientation.

Program Options

Research: Intended primarily for students who wish to conduct research and expand their civil engineering knowledge. Students must successfully complete: at least 24 credit hours of graduate coursework, including at least three courses in a primary area of study within civil engineering, and two courses in a secondary area of study within civil engineering; successfully complete at least six credit hours of graduate thesis research; prepare a research thesis; and successfully complete a final oral examination focused primarily on the research thesis but can also address coursework. The final examination will be administered by the student's graduate academic committee. (**This is the only degree option for which graduate assistantships are available.**)

Professional Practice: Intended primarily for students who plans to practice civil engineering at the professional level. Students must successfully complete a minimum of 27 credit hours of graduate coursework, including a minimum of three courses in each of two areas of civil engineering, and a minimum of three credit hours of graduate capstone design that culminates in the preparation of a project report. Depending upon the student's previous background, a course in management may be required, as the focus of this degree option is professional practice. Further, each student must successfully complete the Fundamentals of Engineering examination and a final oral examination that is focused on the graduate design project. The final examination will be administered by the student's graduate academic committee.

Technical & Management Development: Intended primarily for students in practice who want to enhance their technical skills and develop management skills. Students must successfully complete a minimum of 36 credit hours of graduate coursework, including a minimum of three courses in each of two areas of civil engineering and three courses developing business management and engineering management skills. a minimum of two civil engineering courses used for the program must be graduate design courses. Further, students must successfully complete a final comprehensive written and/or oral examination that addresses the student's undergraduate and graduate educa-



tion. The final examination will be coordinated by the student's graduate academic advisor.

Academic Advising

Students will be assigned an advisor at the time of first enrollment in the program. During their first semester, students are expected to select an advisor in their primary area of study (construction engineering, structural engineering, or transportation engineering). During each semester of enrollment the students must review their academic progress and selection of courses with their academic advisor.

Students pursuing either the **Research or Professional Practice** options are expected to form a graduate academic committee composed of their academic advisor and at least two other members of the graduate faculty from within the department. Additional faculty from within the department and other departments can be included on the committee as is deemed appropriate and necessary. Working

with this advisor, and in consultation with the graduate academic committee, the students will develop a plan of study for the degree and submit that plan to the Graduate College.

Students pursuing the **Technical and Management Development option** (3) will develop a plan of study with their academic advisor in consultation with the graduate coordinator in their secondary area of study. This plan of study will be submitted to the Graduate College during the first semester of study.

Program Requirements

To graduate from the master's degree program, all students must complete a course in advanced mathematics and must satisfy the requirements of one of three program options. Normally the course in advanced mathematics would be selected from one of the following:

The ASCE chapter students test the Concrete Canoe at the Parkview campus.





Numeric Analysis I - The analysis and use of numerical algorithms for the solution of nonlinear equations, systems of linear equations, interpolation, numerical differentiation and integration.

Applied Matrix Algebra - An introduction to the study of methods to solve linear systems of equations, least squares approximation problems, and eigen value problems. Applications from multivariate calculus will be discussed.

Vector Calculus and Complex Variables - Functions of several variables, implicit and inverse functions, Jacobians, multiple integrals, Green's Theorem, divergence, curl, the Laplacian, Stokes Theorem, analytic functions, Laurent expansions, residues, argument principle, and conformal mapping.

Advanced Differential Equations - Series solutions at ordinary and singular points of linear ordinary differential equations, Bessel and Legendre functions, self-adjoint boundary value problems, Fourier series, solution of partial differential equations by separation of variables.

Optimization - This course will cover topics from the area of optimization, such as: nonlinear or dynamic programming, optimal control,



Design of Timber Structures - Structural behavior of wood under loads; application of current timber design codes; design of structural components and systems in wood; mechanical properties of wood fasteners and connections.

Foundation Design - Foundation analysis and design for different civil engineering facilities. High-rise building, bridges and other complex structures such as piles, drilled piers, and caissons. Theoretical aspects of engineered foundations as well as practical applications are discussed.

Adv. Structural Analysis - Development and application of nonlinear matrix analysis techniques; analysis of civil structures using plastic analysis theory, stability of frames, analysis of thin-shell structures, shear wall, and introduction to finite element method.

Dynamic Analysis of Structures - Development and application of nonlinear matrix analysis techniques; analysis of civil structures using plastic analysis theory, stability of frames, analysis of thin-shell structures, shear wall, and introduction to finite element method.

Civil Systems Analysis - An introduction to the systems approach to analyze and design civil systems. Topics include the identification and formulation of civil engineering systems; modeling problems and their solution techniques; linear programming; simplex method, network analysis, simulation, and decision theory.

Traffic Operations & Management - This course deals with the application of traffic engineering and control concepts, including data collection, analysis, and traffic control systems design to traffic operations and management. Traffic engineering studies, traffic flow theory, traffic control devices, traffic signal control and ramp metering systems, and intelligent transportation systems will also be addressed.

Design & Analysis of Construction Operations - The course is designed to provide a thorough understanding of the fundamentals of discrete event simulation methodologies. The CYCLic Operations Network (CYCLONE) modeling methodology will be used as the basis for design and analysis of construction operations.

Construction Project Control - The major focus of the course will be topics such as financial and cost control, schedule update and monitoring, integrated project management systems, and computer integrated construction. Cost/Schedule Control Systems Criteria (C/SCSC) will be used to demonstrate the importance of monitoring, updating, and control functions on a construction project.

Design of Construction Systems - This course will focus on construction practices, equipment, construction, and productivity. It will provide an overview of issues related to construction site logistics such as temporary, shoring, and supporting structures. Knowledge of structural analysis, design and construction practices will form the basis of this course.

Course Offerings

Construction Project Delivery - The course provides a comprehensive coverage of the standard contracts between various agencies involved in construction as well as analysis of traditional and current project delivery methodologies. Issues related to insurance and bonding in the construction industry and topics such as alternate dispute resolution will also be covered.

Advanced Construction Project Management - The focus of this course will be to provide students with a knowledge of quantitative tools used in planning and controlling construction projects. Topics will include cash flow forecasting, site planning and administration, risk analysis, and contract documents administration.

Transportation Planning - Topics include: theoretical foundations of transportation planning, analysis, and evaluation methods.; Theory and application of aggregate and disaggregate models for land use, trip generation, and destination, mode, and route choice; Travel demand modeling and transportation network analysis for evaluation of system alternatives.





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Construction Quality Control - This course addresses the people and process aspects of quality in enhancing construction performance in detail. All quality applications in construction, including : Total Quality and lean construction, construction supply chain and quality assurance are also discussed.

Civil Engineering Seminar - This course will allow graduate students to explore recent advancements in the areas of structures, transportation, and construction engineering and management. A series of presentations will provide a broad information base.

Advanced Structural Systems Design - Principles of design of steel and reinforced concrete structural building systems, as well as the behavior of steel, reinforced concrete, and composite members will be studied. Projects involving analysis and design concepts for both steel and reinforced concrete structures will be assigned.

Pre-stressed Concrete Design - Principles of design of steel and reinforced concrete structural building systems, as well as the behavior of steel, reinforced concrete, and composite members will be studied. Projects involving analysis and design concepts for both steel and reinforced concrete structures will be assigned.

Advanced Design Project - Students pursuing the design option for the graduate degree in civil engineering will enroll in this course when conducting the design project. Students enrolled in this course will work under the direction of their graduate program advisor.

Advanced Topics in Civil Engineering - New or special topics on advanced developments in different aspects of civil engineering will be provided. Specific topics and prerequisites are identified by the instructor and will vary from semester to semester.



Additional courses offered by other departments in the College that are frequently elected by students to complete program requirements.

Industrial and Manufacturing Engineering

- Continuous Improvement in Operations
- Design of Experiments & Regression Analysis
- Capital Budgeting and Cost Analysis
- Linear Programming for Engineers
- Project Management



Mechanical Engineering

- Finite Element Method
- Principles of Fatigue and Fracture
- Theory of Plates and Shells
- Elastic & Inelastic Buckling of Bars & Frames
- Similarities in Structural Dynamics
- Advanced Finite Elements
- Engineering Fracture Mechanics

Student Profiles

Lavanya Sankaran - During my tenure at Western Michigan University, I have learned a great deal about the Civil & Construction industry through contact with learned Professors and fellow students. I also had an opportunity to interact with Senior Professionals who are currently practicing the industry and got to know more about techniques and best practices prevalent in the construction industry.



Coming from country where there are very few women in the construction industry urged me to pursue a career in Civil Engineering. I always had a keen interest in getting to learn more about the managerial aspects of civil engineering, which inspired me to pursue my Masters in Construction Management. In future I intend pursue my career in the construction industry and provide my contribution in all possible ways for the betterment of the industry.



Joseph Barbera - After earning a Bachelor's degree in Civil Engineering from Western Michigan University, all of the excellent opportunities and experiences available here lead me to the decision to pursue a Master's degree. As both an undergraduate and graduate student I have had abundant opportunities to work with professors who are experts in their field

which has greatly enhanced my educational experience. With the growing demand for Civil Engineers, having a Master's degree from Western will expand my potential for future success.



Faculty

Osama Abudayyeh, Ph.D., P.E., Assoc. Dean for Research & Graduate Programs, Professor of Civil and Construction Engineering. Research interests: non-destructive evaluation of civil infrastructure; bridge maintenance and health monitoring; safety management in construction, project controls concepts and systems.

Haluk Aktan, Ph.D., PE, Professor and Chair. Research interests: Condition assessment and health monitoring of structures; non-destructive testing; structural durability; data mining; knowledge discovery; and global education.

Upul Attanayake, Ph.D., EIT, Research Associate. Research interests: Condition assessment and health monitoring of structures; non-destructive testing; structural system behavior and durability; rapid bridge construction; and cast-in-place concrete quality control using sensor and communication technology.

Hubo Cai, Ph.D., P.E., Assistant Professor. Research interests and expertise in spatial modeling, GIS applications in Civil Engineering and Transportation, information technology and database applications, linear referencing systems, data mining, etc.

Ahmad Jrade, Ph.D., Assistant Professor. Research interests: integrated construction, 3D-CAD Modeling and simulations, sustainability; life cycle costing analysis and green construction and LEEV certification.

Jun-Seok Oh, Ph.D., Assistant Professor. Research Interests: network optimization theory and techniques in transportation systems analysis; technologies for Advanced Transportation Management/Information Systems (ATMIS); dynamic traffic simulation models; traffic safety; dynamic route guidance systems.

Sherif Yehia, Ph.D., P.E., Associate Professor. Research interests: construction materials and methods; behavior of steel, reinforced concrete, and pre-stressed structures; behavior of composite structures, material testing, non destructive testing and evaluation; and expert systems in civil engineering.



Facilities

The College of Engineering and Applied Sciences is located at the heart of the University's Parkview Campus. The 343,000-square-foot facility was completed in the fall of 2003. The high-tech academic building is the University's largest. The new facility includes seven computer teaching labs, 75 research and teaching laboratories, and a number of flexible classroom and lecture spaces. Many features are



aimed specifically at student study and research needs, including study lounges and breakout rooms where small groups can work together on engineering projects. The facility is a wireless computing environment, but also includes extensive hard wiring for high-end computing needs and interactive instruction. Additionally, a civil engineering construction materials lab shared with the Michigan Department of transportation provides students with a real world lab experience.

Admissions Requirements

Students entering the proposed master's degree program are expected to have a background equivalent to that of students graduating from the department's undergraduate civil and construction engineering degree programs, or to obtain such background through specified prerequisite coursework. Further, students are expected to have earned a grade-point average of at least 3.0/4.0 on the last four semesters of academic study (at least 60 semester credit hours). Applicants with a GPA less than 3.0/4.0 can be considered under special circumstances, such as significant related work experience.

All applicants to the program must submit the following:

- A completed graduate admissions application which can be found online at <http://www.wmich.edu/admissions/>.
- Two sets of official transcripts from **every** institution attended. (one copy sent to the admissions office and one copy sent to the department.)
- Three Letters of Reference.
- A Statement of Purpose.
- English Proficiency (TOEFL) Test Scores (international applications only).

Contact Information

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