The University Senate of Michigan Technological University
Proposal 9-21

(Voting Units: Academic)

Establishment of a New Graduate Certificate in Structural Engineering: Hazard Analysis

Submitted by: Department of Civil and Environmental Engineering

1. Proposal Date:
May 15, 2020

2. Proposing Contacts and Department:

- Dr. Theresa M. Ahlborn, Department of Civil and Environmental Engineering, tess@mtu.edu
- Dr. William M. Bulleit, Department of Civil and Environmental Engineering, wmbullei@mtu.edu
- Dr. Qingli Dai, Department of Civil and Environmental Engineering, qingdai@mtu.edu
- Dr. Daniel M. Dowden, Department of Civil and Environmental Engineering, dmdowden@mtu.edu
- Dr. Stephen M. Morse, Department of Civil and Environmental Engineering, smmorse@mtu.edu
- Dr. R. Andrew Swartz, Department of Civil and Environmental Engineering, raswartz@mtu.edu

3. Sponsor Department Approvals: May 29, 2020

4. General Description and Characteristics of Program:

4.1 General Description of Certificate

The structures faculty in the department of Civil and Environmental Engineering within the College of Engineering at Michigan Tech proposes a nine credit Certificate named Structural Engineering: Hazard Analysis. In addition to practicing structural engineers, individuals with an engineering background with an interest in structural analysis, will find the skills covered in this Certificate to be of use.

The proposed certificate provides individuals with the ability to determine the risks associated with environmental loads to structures under static and dynamic loadings including large deformation effects, post-yield behavior, and non-standard and unusual geometries. Analysis methods taught as part of this certificate go significantly beyond those at the undergraduate level.

4.2 Catalog Description

This certificate covers the advanced techniques to evaluate structures to determine the risk of environmental load effects applied to structures. Upon completion of this certificate students will be able to determine the loads applied to structures, including wind and earthquake ground motion and the likelihood of structural failure.

5. **Rationale for Certificate:**

The skills gained here will be to utilize advanced techniques to evaluate structures to determine the risk of environmental load effects applied to structures. The determination of loads applied to structures, including wind and earthquake ground motion and the likelihood of structural failure are addressed. Analysis skills learned as part of this certificate are very useful and necessary for career advancement of structural engineers in the technical track at larger engineering firms and other companies and agencies that focus on design and analysis of large and complex structures for risks associated with environmental load effects.

This certificate will be offered primarily online. Graduate students who want this stackable certificate that would count towards a full MS degree would benefit from this certificate. Also benefiting from this certificate would be working professionals, particularly those already holding undergraduate engineering degrees, who want to expand their skills to evaluate the hazard risks due to environmental load effects on structures. The online versions of these courses are already components of an existing online MSCE degree offering, thus they are currently online, or are planned to be online within the next two years. This program draws a significant number of MTU alumni and other students. Offering these courses as part of a certificate will increase these numbers to include students seeking only certificates as well. In addition, the certificate can attract full-time working professionals who do not find an MS degree necessary to achieve their goals.

6. **Related Programs:**

University of Central Florida
Structural engineering graduate certificate
12 credit hours
https://catalog.ucf.edu/preview_program.php?catoid=4&poid=1334&returnto=239

University of Kentucky
Structural engineering graduate certificate
9 credit hours
https://www.engr.uky.edu/research-faculty/departments/civil-engineering/students/graduate-program/graduate-certificate

The George Washington University
Structural engineering graduate certificates (4 options)
12 credit hours

https://www.cee.seas.gwu.edu/structural-engineering-graduate-certificate-program

The Citadel
Graduate certificate in structural engineering
12 credit hours
https://www.citadel.edu/root/cee-graduate-programs/structural-engineering

University of Louisville
Online graduate certificate in structural engineering
12 credit hours
http://louisville.edu/online/programs/certificate-programs/structural-engineering

University of Alabama at Birmingham
Structural engineering, graduate certificate
15 credit hours
https://www.uab.edu/degrees/graduate/structural-engineering-gc

The University of Kansas
Graduate certificate in structural design
12 credit hours
https://catalog.ku.edu/engineering/civil-environmental-architectural-engineering/certificate-structural-design/

7. Projected Enrollments:

The primary market for this certificate is expected to be online students who are currently working as engineers and are looking to enhance their career prospects. Also, students who are currently enrolled in the Civil Engineering online professional M.S. program are expected to enroll in this certificate program in order to add value to their work as they progress. Additional students are expected to enroll as certificate-seeking students, perhaps converting to degree-seeking roles after completion of one (or more) certificate(s).

The courses that are part of this certificate already exist and are taught on ground. Some of these courses have also been developed for online, asynchronous learning with the remaining courses to be developed for online by the Spring of 2022.

Semester	On-campus Enrollment	On-line Enrollment
Fall 2021	12	20

Fall 2022	14	24
Fall 2023	16	28
Fall 2024	20	32

8. Scheduling Plans:

No change in the regular scheduling of the existing courses is anticipated. The Departments delivering the online courses have agreed to fit them into their regular scheduling plans. Courses will be available online throughout the academic year.

9. Curriculum Design: The certificate is designed to be completed in 3 semesters. Online students that have other, full-time employment obligations tend to want to take a single graduate-level course at a time. **Only 3 credits at the 4000-level may be applied to this 9-credit certificate.**

Required Coursework: 3 credits

CEE5730: Probabilistic Analysis and Reliability (3 cr., Fall)

Elective Coursework: choose 6 credits from the following (maximum 3 cr. at the 4000 level)

CEE4244: Loads for Civil Structures (3 cr., Spring)
CEE5242: Advanced Structural Dynamics (3 cr., Fall)
CEE5201: Advanced Structural Analysis (3 cr., Spring)

10. Course Descriptions:

CEE 5730: Probabilistic Analysis and Reliability (3 cr.)

Examines probabilistic analysis of engineering systems including first-order methods, Monte Carlo simulation, and time-to-failure analysis. Reliability analysis will include capacity/demand reliability and system reliability. Emphasis will be on civil and environmental engineering systems.

CEE 4244: Loads for Civil Structures (3 cr.)

The course focuses on the theory and building code requirements for civil structural loadings that are used in design. The loads and load combinations will include dead loads, occupancy live loads, snow loads, wind loads, and seismic loads.

CEE 5242: Advanced Structural Dynamics (3 cr.)

Earthquake engineering and advanced dynamic analysis. Includes modal analysis, time history response of multiple degree-of-freedom systems, and base isolation.

CEE 5201: Advanced Structural Analysis (3 cr.)

The study of nonlinear structural analysis techniques, especially energy methods, applied to elastic buckling analysis, large deflections of beams, second-order effects in frames, plastic analysis of steel structures, and yield analysis of concrete beams and slabs.

11. Model Schedule Demonstrating Completion Time

The certificate is designed to be completed in 3 semesters, 2 Fall semesters and a Spring, or 2 Spring semesters and a Fall. The scheduling also allows the certificate to be earned in two semesters.

Fall Semester 1 or 2

CEE5242: Advanced Structural Dynamics

-or-

CEE5730: Probabilistic Analysis and Reliability

Spring Semester 1 or 2

CEE4244: Loads for Civil Structures

-or-

CEE5201: Advanced Structural Analysis

12. Library and other Learning Resources

No library or other learning resources are required at this time.

13. Faculty Resumes

The following faculty will be supporting the program.

- Dr. Theresa M. Ahlborn, Department of Civil and Environmental Engineering,
  - https://www.mtu.edu/cee/people/faculty-staff/faculty/ahlborn/
- Dr. William M. Bulleit, Department of Civil and Environmental Engineering,
  - https://www.mtu.edu/cee/people/faculty-staff/faculty/bulleit/
- Dr. Qingli Dai, Department of Civil and Environmental Engineering,
  - https://www.mtu.edu/cee/people/faculty-staff/faculty/dai/
- Dr. Daniel M. Dowden, Department of Civil and Environmental Engineering,
  - https://www.mtu.edu/cee/people/faculty-staff/faculty/dowden/
- Dr. Stephen M. Morse, Department of Civil and Environmental Engineering,
  - https://www.mtu.edu/cee/people/faculty-staff/faculty/morse-s/
- Dr. R. Andrew Swartz, Department of Civil and Environmental Engineering,
  - https://www.mtu.edu/cee/people/faculty-staff/faculty/swartz/

14. Equipment

No additional equipment will be required.

15. Program Costs

Initial costs for offering the certificate will not incur additional costs, but as enrollment grows additional instructional resources will be needed.

16. Space

There are no new space requirements.

17. Policies, Regulations, and Rules

Not applicable

18. Accreditation Requirements

The proposed certificate will not seek additional accreditation.

19. Planned Implementation Date

Spring 2021

20. Assessment

The learning objectives of the Certificate are:

1. Evaluate hazard and risk for various structures subjected to natural events, including earthquake, wind, and snow loads, and to improve the design and better communicate risk to owners and the general public.

21. Approval Process

Departmental Graduate Committee: May 15, 2020
Department: May 29, 2020
College of Engineering: June 2, 2020
Provost's Office and Deans' Council: June 10, 2020
Graduate School: June 23, 2020
Approved by the Senate:
Approved by the President: