The University Senate of Michigan Technological University
Proposal 10-21

(Voting Units: Academic)

Establishment of a New Graduate Certificate in Structural Engineering: Timber Building Design

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: Timber Building Design. 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 design timber structures, with an emphasis on timber buildings. The proposed certificate is comprehensive, including considering how timber buildings are different from buildings constructed using other common civil structural materials. The certificate requires that students take both timber design courses offered at Michigan Tech. It then provides options for the final course in

topics related to modeling and hazard analysis that are particularly relevant to timber designers.

4.2 Catalog Description

certificate covers the design of timber structures including dimension lumber and mass timber. Design is covered at the component and system level including axially and flexurally loaded members, shear, bearing, and combined loading on members, connection design, shear walls and diaphragms, arches and tapered beams, modeling, and loading.

5. Rationale for Certificate:

The skills gained here will be the use of advanced knowledge and techniques to design timber structures. In addition, students completing this certificate will take an optional course in modeling or hazard analysis that is especially relevant to timber design. The advent of mass timber and tall wood buildings has brought timber design back into the forefront of structural engineering and architecture. Furthermore, timber design is a historical strength of the CEE Department at Michigan Tech and MTU is unique as one of a very small number of universities that offers a second timber design course at the graduate level. This uniqueness is seen as a strategic advantage for recruitment of non-traditional graduate students from the ranks of full-time employed engineering professionals. Those students would be able to build a very useful and marketable skill through the proposed coursework, and the certificate would give them a way to receive recognition for those skills.

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 design timber 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 and during summer semester.

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: 6 credits

CEE4233: Structural Timber Design (3 cr., Spring)
CEE5233: Advanced Structural Timber Design (3 cr., Fall)

Elective Coursework: choose 3 credits from the following

CEE5202: Finite Element Analysis (3 cr., Spring)
CEE5241: Structural Dynamics (3 cr., Fall Summer)
CEE5730: Probabilistic Analysis and Reliability (3 cr., Fall)

10. Course Descriptions:

CEE 4233: Structural Timber Design (3 cr.)

Introduction to the use of wood as a structural engineering material. Includes design of beams, columns, nailed and bolted connection, glulam members, including tapered beams, tapered and curved beam, and design of wood shear walls and diaphragms.

CEE 5202: Finite Element Analysis (3 cr.)

Introduction to the use of finite element methods in structural analysis. Covers the finite element formulation, 1- and 2-D elements, including isoparametric elements, axisymmetric analysis, plate and shell elements, dynamics, buckling, and nonlinear analysis.

CEE 5233: Advanced Structural Timber Design (3 cr.)

Advanced design of timber structures, including arches and traditional timber frames, advanced shear wall design, advanced connection design, including timber connectors, and advanced analysis and behavior of wood, including cumulative damage modeling.

CEE 5241: Structural Dynamics (3 cr.)

Free and forced vibration of undamped and damped single degree of freedom systems. Seismic design using the equivalent lateral force method. Introduction to multi-degree of freedom systems and transmissibility.

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.

11. Model Schedule Demonstrating Completion Time

The certificate is designed to be completed in 3 semesters. Spring starts are most convenient, depending on the electives selected by the student. One example of a spring-start completion is shown. A fall or summer start would require that students already have CEE4233 (or equivalent) completed, or that their time to completion be non-contiguous.

Spring Start

Spring Semester
CEE4233: Structural Timber Design

Summer Semester
CEE5241: Structural Dynamics

Fall Semester
CEE5233: Advanced Structural Timber Design

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. Design a range of wood structures subjected to gravity and lateral loads, including glulam and light-frame wood structures.

21. Approval Process

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: