

Final Assessment Report

Civil Engineering (MAsc, MEng, PhD)

October 2024

Executive Summary

External reviewers found that the Civil Engineering (MAsc, MEng, PhD) programs delivered by the Department of Civil and Environmental Engineering were in good standing.

“Major strengths of the Department include its collegial and collaborative environment, a prevailing culture of pursuing excellence, the interdisciplinary potential resulting from the large number of faculty members with a wide spectrum of expertise, the tremendous research potential offered by its exceptional lab facilities, and the strong reputation of the undergraduate programs of the University of Waterloo, which attracts a strong pool of students.”

A total of nine recommendations were provided by the reviewers, regarding program requirements and courses, funding for students, faculty workloads, student support and completion times, fees for international students; and communication around TA opportunities, financial incentives and faculty-student conflict resolution processes. In response, the program created a plan outlining the specific actions proposed to address each recommendation as well as a timeline for implementation. The next cyclical review for this program is scheduled for 2028-2029.

Enrollment over the past three years

	MAsc in CE	MEng in CE	PhD in CE
2024-2025 (CURRENT YR)	67	26	94
2023-2024 (LAST YR)	61	29	90
2022-2023 (THREE YRS)	56	23	99

*Based on Active Student extract from Quest on October 29, 2024.

Background

In accordance with the University of Waterloo’s Institutional Quality Assurance Process (IQAP), this final assessment report provides a synthesis of the external evaluation and the internal response of the Civil Engineering (MAsc, MEng, PhD) programs delivered by the Department of Civil and Environmental Engineering. A self-study (Volume I, II, III) was submitted to the Associate Vice-President, Graduate Studies and Postdoctoral Affairs on July 26, 2023. The self-study (Volume I) presented the program descriptions and learning outcomes, an analytical assessment of the programs, including the data collected from a student survey, along with the standard data

package prepared by the Office of Institutional Analysis & Planning (IAP). The CVs for each faculty member with a key role in the delivery of the programs were included in Volume II of the self-study.

From Volume III, two arm's-length external reviewers were selected by the Associate Vice-President, Graduate Studies and Postdoctoral Affairs: Professor Samer Adeeb, Department of Civil and Environmental Engineering, University of Calgary; and Professor Moncef Nehdi, Department of Civil and Environmental Engineering, University of Western Ontario.

Reviewers appraised the self-study documentation and conducted a site visit to the University on Nov.21-22, 2023. An internal reviewer from the University of Waterloo, Associate Professor Johanna Wandel, Department of Geography and Environmental Management, was selected to accompany the external reviewers. The visit included interviews with the Vice-President, Academic & Provost; Associate Vice-President, Graduate Studies and Postdoctoral Affairs; Dean of the Faculty of Engineering; Faculty Associate Dean of Graduate Studies; Chair of the Department, as well as faculty members, staff and current graduate students. The Review Team also had an opportunity to have a tour of the laboratories and meet with representatives from the library.

Following the site visit, the external reviewers submitted a report on their findings, with recommendations. Subsequently, the program responded to each recommendation and outlined a plan for implementation of the recommendations. Finally, the Dean responded to the external reviewers' recommendations, and endorsed the plans outlined by the program.

This final assessment report is based on information extracted, in many cases verbatim, from the self-study, the external reviewers' report, the program response and the Dean's response.

Program Characteristics

CEE offers three main civil engineering graduate programs (MEng, MASc, PhD) and three civil engineering collaborative programs (MASc-Water, PhD-Water, MEng-Nuclear) as detailed below:

MEng in Civil Engineering: The objective of the MEng in Civil Engineering is to provide graduate students with the opportunity to enhance their engineering education by taking advanced courses and being exposed to the ideas of leaders in various fields. Students will advance their credentials and increase their ability to function effectively in industry through a program of course work, which includes the completion of a technical writing course.

MASc in Civil Engineering: The objective of the MASc program is to provide graduate students with the background that will lead to individual accomplishments of a high professional and academic standard. A MASc student who graduates from CEE will have a strong theoretical

background in their area of specialization and related field: Structures, Mechanics, and Construction, Water Resources and Environment, Transportation, and Geotechnical Engineering. This preparation is appropriate both for the analysis and design of systems that are needed by industry and government, or for entry to a PhD program. This objective is achieved through a combination of formal course work and the completion of a research thesis to be evaluated in an oral defence. The MASc thesis is expected to define a substantial research problem, provide a comprehensive review of the literature in the research problem area, describe the theoretical, analytical, and experimental solution, and provide a comprehensive set of conclusions and recommendations.

PhD in Civil Engineering: The PhD program provides graduate students with the required theoretical background and research methodology to demonstrate the accomplishment of independent and original research work. It is expected that this independent research work will result in oral conference presentations and the preparation of scholarly publications. Following graduation, a PhD student is expected to make significant research contributions in industrial, government or university environments. These objectives are achieved through a combination of minimal formal course work and a comprehensive research program. The program of research and the resulting thesis must demonstrate a critical awareness and understanding of the literature in the research field, exhibit a capability of defining original and useful research problems and a capability of independent thought in solving a research problem.

In 2014, UW began offering a unique research-based MASc and PhD Collaborative Water Program of which CEE students can take advantage. This program, jointly offered by eleven departments across the Faculties of Arts, Engineering, Environment, Mathematics, and Science, is intended to promote multi- and inter-disciplinary perspectives related to water. The goal of the program is to supplement disciplinary (specialist) training offered in individual departments with perspectives from a variety of water-related disciplines. Students graduating from the collaborative program will be better equipped to work in inter-disciplinary teams to solve increasingly complex water issues. The Collaborative Water Program represents tremendous opportunity for graduate students to train within their chosen disciplines while being exposed to perspectives of water research, innovation, and management from other fields.

Summary of Strengths, Challenges and Weaknesses based on Self-Study

- **Strengths**

- Attract strong international students.
- Retain a large number of excellent undergraduate students from our own very strong undergraduate programs in Civil, Environmental, Geological, Architectural Engineering.
- Faculty members have strong research programs, substantial connections to government and industry, and extensive practical knowledge and experiences.
- Graduate courses offered are demanding and of high caliber.
- Breadth of graduate courses is high.
- High faculty-student ratio.
- Good balance between fundamental vs. applied research.
- Collegial work environment within the department.

- **Challenges:**

- Large number of Civil Engineering and related departments at Universities in Ontario are creating and/or expanding MEng programs thus there will be more and increasing competition for domestic and international MEng students.
- The majority of provincial and federal research grants (e.g., from NSERC) are much shorter (e.g., 2 years) than the length of a typical PhD (4 years). Thus, research and student success are threatened as activities must be constantly realigned (and often significantly so) with ever changing funding sources.
- Restricted access to research accounts at the end of the project terms. To reclaim these accounts, faculty members spend time and efforts that exceeds what is required by industry and government partners. These funds could be directed towards graduate student training and to manage unexpected graduate thesis project events and costs much more efficiently, if these administrative barriers were lessened or eliminated.
- Bureaucracy of internal reporting, justification, and approval of grant expenditures.
- Increasing number of students in graduate classes, driven in part, by economical forces external to the department
- UW does not offer a guaranteed award for international master's students, unlike the PhD where we can offer the International Doctoral Student Award (IDSA). As a result, the cost to faculty of supporting international MASc students is much higher than the cost of supporting domestic MASc students.

- UW is not located in an urban center and we often struggle to attract and maintain students, who are more attracted to urban centers such as Toronto and Vancouver.
- **Weakness**
 - Low representation of women (<10%) and Indigenous (% unknown) faculty and researchers in CEE.
 - Level of awareness of indigenization is very low.
 - Most faculty members do not have dedicated office space for their students and thus research group cohesion and collaboration are often limited.
 - Year-over-year uncertainty about which courses will be offered in the future.
 - Increasing number of students in graduate classes, driven in part, by economical forces external to the department.
 - Perception by faculty and students that we do not offer enough graduate courses. Relatedly, too few “Level 2” graduate courses. Most courses are entry level and do not need advanced or prerequisite knowledge.
 - We have a challenge of recruiting non-UW domestic students.
 - Number of internationally educated MEng students who are not sufficiently prepared for success at UW. For many the problem lies in communication skills and for others it is technical background.
 - Low level sense of community among MEng students.
 - Low level of mentorship/academic advising (e.g., to help with course selection) of MEng students, as they do not have a specific supervisor.
 - Low level of social events to bring together undergraduate students and graduate students, to create a sense of community.

Summary of Key Findings from the External Reviewers

“The Department provides excellent support and a vibrant experience for the research students. The research is supported by around 8 highly qualified technicians, 2 graduate program administrators, and 3 department administrative and technical managers. The leadership within the department is forward thinking, fully engaged, energetic, and student focused. Graduate student research is empowered via impressive laboratories with ample space and state-of-the-art equipment to conduct cutting-edge research in the different subdisciplines within the Department. Students report excellent support and advice provided by the Department and external units within the University...

We estimate that revamping of the MEng program, reimagining teaching for the undergraduate program to allow faculty members to provide advanced graduate courses within their area of expertise, and increasing the minimum level of funding for graduate students would enhance the overall quality of the graduate program in civil and environmental engineering.”

Program Response to External Reviewers’ Recommendations

1. Revamp the MEng program considering the following items:
 - a) Provide adequate learning outcomes reflecting the purpose of the program with a focus on specialization and/or employability.
 - b) Provide a structure for the MEng program with clear specializations.
 - c) Provide a capstone project course for the MEng program.
 - d) Create an administrative position of ‘MEng Advisor’ that coordinates with the Associate Chair of graduate studies.
 - e) Consider providing a technical communications and leadership course for the MEng students that covers aspects of technical and persuasive writing.
 - f) Consider organizing industry mixers for the MEng (and possibly all graduate) students on a yearly basis.

Program Response

a) and b) The Civil and Environmental Engineering (CEE) Department has been working on a proposal to create five MEng specializations. These are being discussed by the different research groups within the department. A department vote has approved the following list of specializations:

- Architectural Engineering
- Environmental and Water Resources Engineering
- Structures, Mechanics and Construction Engineering
- Transportation Engineering

Also, several other MEng programs and specialization initiatives have been proposed. However, more discussion is still needed to finalize their criteria and outcomes. These include:

- Future Cities
- Health Technologies (specialization/collaborative program with ENG/ARTS/HLTH is already approved and underway)

c) An applied research-based project is currently offered by the CEE department in a form of a course CIVE 790R (Master of Engineering Project) under the direct supervision of a faculty member for 4 months. The MEng student works closely with a faculty member towards the solution of a defined applied research problem. The student must complete a final project report discussing the project, the current state of practice, and the lessons

learned in relation to published literature. This course is only open to MEng students; course credit may not be used to satisfy MAsc or PhD program requirements. Currently, this course is optional. In the future, we will consider if it makes sense to make it core (required).

d) This recommendation is currently being considered by the CEE Department Chair. We see a lot of potential benefits and are anticipating that such a role will likely be created. The optimal timing would coincide with the roll out of the new MEng programs and specializations discussed under items a) and b), as there will be sufficient work and new revenue to support such a position at this time.

e) As per degree requirement, MEng students who are not English Language Proficiency (ELP) exempt at the time of admission must take an English for Multilingual Speakers (EMLS) technical/professional writing course for Engineers. That said, we feel the reviewers are proposing something much bigger here than a language course. We appreciate this recommendation and see the value of the idea, which aligns very well with discussion that has been happening at the Faculty level surrounding the development of leadership skills in our graduate students. Our intention is to bring this recommendation forward to our CEE Graduate Studies Committee, to initiate work on developing such a course. There is a “chicken and egg” problem with this course in that it would surely attract students to our MEng program but would be difficult to implement in our current budget-constrained reality without increased enrollment to support it. We see it as an initiative we should work on and bring in thoughtfully as our new MEng specializations attract students and create the necessary resources to proceed.

f) This is an excellent point. Several initiatives are being considered to address the broader question of creating links between our graduate programs and industry. First, a coop version of our MEng program has been approved just recently. The first cohort started in Fall 2024. Second, there has recently been an expression of interest from industry to sponsor a seminar series to create stronger links between all of our students (graduate and undergraduate) with industry and to expose students to topics that are of relevance in the professional practice, which we typically don’t have the bandwidth to cover in our course offerings (such as emerging software solutions, general professionalism, case studies, etc.). We believe these initiatives will go a long way to addressing this recommendation.

Dean’s Response

I am very supportive of the plan CEE has put together to revamp their MEng programs and at the Faculty level we have created a new role “Director of Course based Masters programs” which will provide additional resources to these students in terms of career preparation and academic life. Professor Stan Dimitrov started in this role September 1st, 2024.

2. Increase the number of graduate courses available within the Department and provide a long-term plan and structure for the graduate courses to be offered over the next years.

Program Response

The department has recently implemented a 2-year plan for the graduate courses that have increased since the starting of Architectural Engineering (AE) program in 2018, which has been posted in [our website](#). The courses are distributed between research groups and offering terms. Achieving this plan is significant in our view, as in the past it was often only announced a month or two before the start of a term which grad courses would be available. This spring term we have started working on the 2026 grad course plan to maintain this 2-year forward looking window in perpetuity. We expect this will address issues including student satisfaction and recruiting and signal that grad course planning need not take a back seat to the delivery of the undergraduate curriculum. As unexpected events arise, such as faculty going on unplanned leave, steps will be taken to ensure that the course plan is delivered.

Dean's Response

I fully support the department's plan to address this recommendation.

3. Increase the minimum level of funding for graduate students, especially MASc students.

Program Response

This minimum funding level is established at the University level. We will bring this recommendation forward to the university to advocate that it be given consideration. Given the flexibility available for Faculties, some efforts have recently occurred at the Faculty level to effectively increase the minimum funding for PhD students, through additional financial support provided jointly by the Department and Faculty. The long-term viability of this initiative will require that PhD numbers increase to offset the cost. If this is achieved, then similar initiatives could be considered at the MASc level in the future.

Dean's Response

Starting September 1st, 2024, all new PhD students who are within time limits across the Faculty will receive a minimum stipend of \$30,000/year. To help realize this, the Dean of Engineering and Department chairs will contribute \$10,000/year towards this. All in-course PhD students who are within term limits will receive a top-up from the Dean of Engineering to ensure they also receive a minimum of \$30,000/year.

4. Attempt to decrease the undergraduate teaching load for faculty members by:
 - a) Promptly filling vacant faculty positions

- b) Hiring high quality lecturers that can teach general engineering courses such as statistics and engineering economics.
- c) Exploring streamlining of the courses offered to different streams.

Program Response

We agree with the thinking behind this recommendation. Two open positions are being filled this year. Our ability to fill other openings as they come up will be limited by our financial health. While we can impact our financial picture by increasing graduate student enrollment, many of the other levers that have traditionally been at our disposal have been impacted by recent federal and provincial government policies, which leave us limited options. The increased use of teaching stream faculty is one solution that has benefits aside from increased teaching capacity, such as the possibility to hire individuals with meaningful industry experience. The balance between teaching and research faculty is always a delicate one, as research is also a primary mandate of a university. However, under the current circumstances, it is easy to envision a mix with greater use of lecturers (teaching faculty) being supported to address this recommendation.

Dean's Response

I agree with the department's response to this recommendation.

5. Provide adequate support and supervisor training to ensure MASc and PhD students finish within 2 years and 4 years, respectively.

Program Response

Our newly hired faculty members normally need to work with other senior faculty members or get specific training before they get their Sole-Supervisory Privilege Status (SSPS) status, which is required for sole supervision of PhD students. Also, our newly hired faculty members can benefit from the mentorship program in our department where the junior members consult with a specific senior member of their choice. We suspect that some of the current cases of students needing significant extra time to complete their thesis projects are pandemic related, as students doing experimental work in many cases encountered significant research delays during the 2020-2021 period. In many instances, supervisors adjusted their expectations accordingly. However, this is not universally the case, which has likely resulted in a perception in our student population that overly long project durations are more common than they should be. A policy of increased enforcement is another tool that can and likely should be brought to bear in addressing the issue of program term limits being exceeded.

Dean's Response

I agree with the department's response to this recommendation.

6. Remove or alleviate the high differential fees associated with International MSc students.

Program Response

These differential fees are established at the Faculty level. We would generally be supportive of such an initiative, as the current funding model creates considerable financial challenges for international MASc students. We generally deal with this by discouraging faculty from accepting international MASc students or encouraging them to pay more than the minimum Graduate Research Studentship.

Dean's Response

The differential fees for international and domestic MASc students are established at the University level and there are some scholarships that are available for international masters students to offset these differences in tuition.

7. Provide better communication regarding TA opportunities and allow all eligible students with good standing to take advantage of the available opportunities.

Program Response

A new online system has recently been created to advertise open Teaching Assistant (TA) positions to all graduate students within the MASc and PhD programs. The system allows the graduate students to rank the top five positions they are interested in. Students also upload their resumes and any related experience. The instructors of the courses get to see the students that applied to TA their courses and rank them as well. The system then automatically matches these rankings. After the first round is complete and the first set of students accepted their offers, a second round is open with the courses that were not successful in matching with a TA position. This second round is now open to all students who were not able to find a position in the first round. The same process is followed in the second round. We tried this system for the first time in Spring 2024 and we found that it attracted a lot more graduate students to apply for TA positions. We received feedback from graduate students and instructors and the system has been currently implemented since the Fall 2024 academic term.

Dean's Response

I support the department's response regarding this recommendation.

8. Properly advertise the availability of the financial incentive intended for students who publish journal papers.

Program Response

The following statement will be added to the email sent to the students each academic term advising them to submit their activity reports: "An award may be granted to students who

publish a journal paper during the term. The value of the award granted last term was \$750. However, the future value may fluctuate depending on available budget.”

All our students who published a journal paper are rewarded. However, with the current budget restriction, a change is expected in the upcoming terms.

Dean’s Response

I support the department's response regarding this recommendation.

9. Provide a well-documented and carefully thought process for faculty-student conflict resolution, along with mechanisms of support for students in situations of power imbalance, including establishing an elected graduate student society (if it does not exist already).

Program Response

The department has a graduate student society (CEEGA). Currently, conflict resolution starts with the Associate Chair (AC) with the graduate studies and hear both sides of the story. Often, the conflict is resolved by the AC without further intervention. In all cases, the Chair of the department is kept informed about the situation. Further consultation with the Associate Dean of Graduate Studies is sometimes needed to resolve the conflict. In extreme cases, consultation at the University level may be needed.

Dean’s Response

I support the department's response regarding this recommendation.

Recommendations Not Selected for Implementation

Recommendation 6 is controlled at the university level as already mentioned.

Implementation Plan

	Recommendations	Proposed Actions	Responsibility for Leading and Resourcing (if applicable) the Actions	Timeline for addressing Recommendations
1.	Revamping MEng program considering several ideas specified by the reviewers.	MEng specializations plan is underway. Further thoughts will be considered on making 790R course mandatory.	Associate Chair-Grad & Chair	Dec 2024-Apr 2026
2.	Increase the number of graduate courses available within the Department and provide a long term plan and structure for the graduate courses to be offered over the next years.	A 2-year plan for graduate courses has now been created and will be maintained going forward.	Chair and Associate Chair	Done
3.	Increase the minimum level of funding for graduate students, especially MASc students.	This minimum funding level is established at the University level.	University policy	NA
4.	Attempt to decrease the undergraduate teaching load for faculty members employing ideas about hiring and streamlining of curriculum suggested by reviewers.	Two positions have been filled this year. Filling more openings will occur as financial health of the department permits.	Chair	Ongoing
5.	Provide adequate support and supervisor training to ensure MASc and PhD students finish within 2 years and 4 years, respectively.	Training is available for junior members. Most of the current cases of students delayed graduation are pandemic related, as students doing experimental work in many cases encountered significant research delays during the 2020-2021 period. We will continue to monitor this issue never-the-less and increase enforcement.	Chair and Associate Chair	Ongoing

	Recommendations	Proposed Actions	Responsibility for Leading and Resourcing (if applicable) the Actions	Timeline for addressing Recommendations
6.	Remove or alleviate the high differential fees associated with International MSc students.	These differential fees are established at the University level.	University policy	NA
7.	Provide better communication regarding TA opportunities and allow all eligible students with good standing to take advantage of the available opportunities.	A new online system has recently been created to advertise open Teaching Assistant (TA) positions to all graduate students within the MASc and PhD programs.	Associate Chair Undergrad Studies and Chair	Done
8.	Properly advertise the availability of the financial incentive intended for students who publish journal papers.	The following statement will be added to the email sent to student every term: <i>"An award may be granted to students who publish a journal paper during the term. The value of the award granted last term was \$750. However, the future value may fluctuate depending on available budget."</i>	Associate Chair Grad Studies	Completed in Fall 2024
9.	Provide a well-documented and carefully thought process for faculty-student conflict resolution, along with mechanisms of support for students in situations of power imbalance.	The department has a graduate student society (CEEGA). Current conflict resolution is proved to be effective. However, further discussion will take place to optimize the process.	Associate Chair in consultation with the Chair	Winter 2025

The Department Chair/Director, in consultation with the Dean of the Faculty shall be responsible for the Implementation Plan.



Date of next program review

2028-2029

Date

Signatures of Approval



Please keep this document in Word version. We do require you to sign it or demonstrate your approval. If you have issues with signing a Word document, please confirm your approval by adding the following wording when you send back the document by email "I hereby approve the attached document." We will collect formal signatures at a later stage on a pdf version.

January 28, 2025

Chair/Director

Date

January 30, 2025

AFIW Administrative Dean/Head (For AFIW programs only)

Date

Faculty Dean

Date

Note: AFIW programs fall under the Faculty of ARTS; however, the Dean does not have fiscal control nor authority over staffing and administration of the program.

Dec. 1, 2024

Associate Vice-President, Graduate Studies and Postdoctoral Affairs
(For graduate and augmented programs)

Date