FINAL ASSESSMENT REPORT

Institutional Quality Assurance Program (IQAP) Review

CIVIL ENGINEERING (UG) PROGRAM

Date of Review: March 28 – 29, 2023

In accordance with the University Institutional Quality Assurance Process (IQAP), this final assessment report provides a synthesis of the external evaluation and the internal response, and assessments of the undergraduate program delivered by the Civil Engineering program. This report identifies the significant strengths of the program, together with opportunities for program improvement and enhancement, and it sets out and prioritizes the recommendations that have been selected for implementation.

The report includes an Implementation Plan that identifies who will be responsible for approving the recommendations set out in the Final Assessment Report; who will be responsible for providing any resources entailed by those recommendations; any changes in organization, policy or governance that will be necessary to meet the recommendations and who will be responsible for acting on those recommendations; and timelines for acting on and monitoring the implementation of those recommendations.

Executive Summary of the Review

In accordance with the Institutional Quality Assurance Process (IQAP), the Faculty of Engineering submitted a self-study in February 2023 to the Vice-Provost (Teaching and Learning) to initiate the cyclical program review of the Civil Engineering undergraduate program. The approved self-study presented program descriptions, learning outcomes, and analyses of data provided by the Office of Institutional Research and Analysis.

Two arm's length external reviewers and one internal reviewer were endorsed by the Dean, Faculty of Engineering and selected by the Vice-Provost (Teaching and Learning). The review team reviewed the self-study documentation and then conducted a virtual site visit on March 28 – 29, 2023. The visit included interviews with the Vice-Provost (Teaching and Learning), Deputy Provost, Dean of the Faculty of Engineering, Chair of the Department of Civil Engineering, Acting Associate Dean (Academic), Associate Chair (Undergraduate), and meetings with groups of current students, full-time faculty, and support staff.

The Dean of the Faculty of Engineering, Chair of the Department of Civil Engineering, Associate Chair (Undergraduate), and the Academic Department Manager submitted responses to the Reviewers' Report. The initial response was prepared by the program in September 2023, and finalized by the Dean in March 2024. Specific recommendations were discussed, and clarifications and corrections were presented. Follow-up actions and timelines were included.

Strengths

- Integration of the City of Hamilton as a "live lab" in transportation courses. (p3)
- Improvements in the quality of instruction in the structural analysis program SAP2000. (p3)
- Improvements to the design spine, including Integrated Cornerstone Design Projects in Engineering (ENGINEER 1P13). (p3)
- High quality program is meeting its objectives and equipping students with program-level learning outcomes, with a good plan in place for monitoring these outcomes. (p4)
- "Laboratory staff seems a very strong team." (p6)
- Distinguished senior faculty and keen junior faculty who place a priority on teaching and interaction with students. (p7)
- Engaged with local industry and municipality. (p8, p10)
- Popular co-op program. (p8)
- Options in Society, Management, and Biomedical Engineering. (p8)

Opportunities for Improvement and Enhancement, Including Appropriateness of Resources

- Improve organization of courses leading to capstone design in order to have the required knowledge before undertaking the design. This could involve vetting projects to ensure knowledge is already required and/or providing students with support to "learn on the go." (p3, p10)
- Implement class participation marks using modern tools. (p3, p7)
- Increase proportion of students selecting Civil as their first choice by increasing visibility in first year and extending the use of advanced engineering software. (p4)
- Provide mentors to all junior faculty members, including regular checkpoints with senior colleagues or the chair. (p5, p10)
- Another faculty member is needed in the Geotechnical Engineering area. (p5, p7)
- Mentor and evaluate sessional instructors. (p5, p10)
- Refocus capstone to more narrow areas. (p5)
- Improve TA quality through mentoring, continuity, and performance criteria in assigning TAs. (p5, p9, p10)
- Update laboratories to better support experiential learning and increase space available for student clubs. (p6, p7)
- Embed software earlier in the program, with a more permanent solution for software licenses and more frequent use of digital tools throughout the program. (p6, p9, p10, p11)
- Provide space for transportation group. (p7, p9)
- Increase breadth of available electives outside of structural engineering. (p10)

- Have fundamental courses taught by regular instructors. (p11)

Summary of the Reviewers' Recommendations with the Program's and Dean's Responses

Recommendation #1: Consider changing the way the capstone design projects are identified (involving industry more directly and making the projects more focussed within subdisciplines), and by ensuring students have the required skills before tackling specific design tasks (coordinating delivery of the fourth-year electives).
Department's Response and Actions to be Taken: The capstone design project course has undergone significant improvements over the last few years, and there is still opportunity to improve. The immediate next step will be to meet with the 2023-2024 capstone instructors, most of whom have been teaching this course for several years, to discuss the IQAP Review Team's recommendations and opportunities for implementation.
Dean's Response: I am pleased with the ongoing enhancements to the capstone project within the department. As these improvements progress, I strongly suggest reaching out to other departments at McMaster and civil engineering programs across Canadian institutions to explore additional avenues for enhancement that may not have been considered yet. For instance, some departments have integrated the capstone project into the teaching load for all instructors. This ensures supervisors have adequate time to meet with the groups they oversee regularly, such as on a biweekly basis.

Recommendation #2: Integrate software in a more systematic way through the program – introducing some software earlier in the program and maintaining use of software skills (e.g. programming) through the later years.
Department's Response and Actions to be Taken: We plan to continue building on improvements made over the last few years to enhance our students' education in digital literacy for civil engineering. This recommendation could affect several courses and will be referred to the Undergraduate Affairs Committee for development. In particular, we are currently exploring the possibility of launching a new Level II Course "Introduction to Civil Engineering," which is envisaged to include an introduction to several software packages.

Dean's Response:

Digital literacy is a fundamental component of any engineering curriculum, requiring continuous evolution due to the swift pace of technological progress and its impact on problem-solving. I'm pleased to note that the proposed new Level II course has received approval from the Undergraduate Council and Senate, and I look forward to seeing how it develops.
Furthermore, it's worth mentioning that the Department of Computing and Software now offers a minor in Computer Science, open to all engineering students.

Recommendation #3: Improve performance of teaching assistants by strengthening mentoring by faculty or senior TAs, by assessing competence (not just financial need) when making TA assignments, and by using rubrics more consistently. Aim for increased engagement of the students in tutorials and lectures by giving partial marks for class engagement.

Department's Response and Actions to be Taken:

The recommendations regarding TAs will be referred to the Associate Dean, Academic, to advise on best practices for TA training and mentoring that can then be promoted to all instructors.

Suggestions regarding the assessment of TAs need to comply with the collective agreement between the TA Union and the University and cannot be initiated at the Department level.

We note that financial need is not the current basis for TA assignments in the department of civil engineering. There is a guaranteed minimum amount of funding for all MASc and PhD students, which includes a TAship. Assignment of additional TAships is via a competitive application process and is geared towards unfunded Year 5 PhD students as per their collective agreement.

Regarding participation grades, in addition to the fluids course identified by the reviewers (CIVENG 2O04), a pilot project is underway in CIVENG 4N04 (Steel Structures) in Fall 2023 where students will receive partial credit for lecture participation. This will be discussed at Department Meetings in 2023- 2024 in order to share best practices.

Dean's Response:

The Department is correct that the collective agreements between the TA union and McMaster University must be honoured when hiring TAs. TA training is offered each semester through the MacPherson Institute, which is McMaster's centre for leadership in teaching and learning. Training hours are counted in the TA hours of work as per the collective agreement. As the Department recruits higher quality graduate students, the quality of its TAs will also improve.

The literature shows that there are several effective ways of increasing student engagement in addition to assigning attendance grades. These include active learning and integrating principles of Universal Design for Learning (UDL) in course delivery. The Associate Dean Undergraduate is running a pilot project during the

summer 2024 and is asking for instructors to join. The project will support the integration of UDL principles into an existing course through one-on-one meetings with an educational developer, as well as creating a community of practice among a group of faculty members who are integrating UDL principles into their courses. I strongly encourage Civil Engineering to participate in this project to increase student engagement.

Recommendation #4: Improve the laboratory facilities and the access of the undergraduate students to laboratory tests and embedment of lab experiments in more classes. Secure lab spaces for the Transportation group.

Department's Response and Actions to be Taken:

Our current laboratory facilities include the Applied Dynamics Laboratory (labs related to structures, materials, and surveying), the Water Laboratory, the Geotechnical Laboratory, and a Design Studio. The Water Laboratory has been renovated since the previous IQAP review in order to expand its capacity, providing to a much-enhanced experience in the associated undergraduate courses. We see a need for similar enhancements to our other laboratory spaces, particularly if our enrollment is to grow, but still believe that we are providing quality experiential learning opportunities to our students within the constraints of our current facilities.
Space has been a considerable issue in the Faculty of Engineering, but the department will explore with the Faculty any possibilities to improve on the status-quo, including more effective use of the existing space and the planned new engineering building.

Embedding laboratory experiments in more classes will be referred to the Undergraduate Affairs Committee for discussion.

Dedicated laboratory space for our Transportation Group would help tremendously with enhancing the digital content of our curriculum, which is central to many of the activities in transportation- related curriculum. The department already has ongoing discussion on this aspect with the leadership of the Faculty of Engineering.

Dean's Response:
All Civil Engineering lab spaces have been renovated since the last IQAP review, including the Geotechnical, Water, and Applied Dynamics Lab, as well as the Design Studio. Space is limited within the Faculty of Engineering. To enhance digital labs, I suggest the department explore the implementation of virtual desktops. This would allow students to utilize licensed software from their personal computers while seated in a standard classroom or design studio. Technological advancements such as this must be embraced as we seek ways to adapt to our space challenges.

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Implementation Plan

In the chart below, please outline the recommendations made by reviewers, briefly outline the actions you plan to take, who will be responsible for leading the action, and a timeline for completion.

Recommendation	Action(s) to be Taken	Responsibility for Leading Action (specify the role(s) that will be responsible for each action item e.g. Program Chair.)	Timeline for Completing Action (indicate specific timelines (e.g. not 'ongoing') for action)
Consider changing the way the capstone design projects are identified (involving industry more directly and making the projects more focussed within subdisciplines), and by ensuring students have the required skills before tackling specific design tasks (coordinating delivery of the fourth-year electives).	Associate Chair, Undergraduate to meet with capstone instructors to discuss opportunities for improvement	Associate Chair, Undergraduate	Discussion over next 8 months, with potential changes to follow.
Integrate software in a more systematic way through the program – introducing some software earlier in the program, and maintaining use of software skills (e.g. programming) through the later years.	Undergraduate Affairs Committee to discuss and develop recommendations.	Undergraduate Affairs Committee (chaired by Associate Chair, Undergraduate)	Recommendations over next 8 months, with potential changes to follow.

Improve performance of teaching assistants by strengthening mentoring by faculty or senior TAs, by assessing competence (not just financial need) when making TA assignments, and by using rubrics more consistently. Aim for increased engagement of the students in tutorials and lectures by giving partial marks for class engagement.	1. Memo to be sent to Associate Dean, Academic, to request guidance from the Faculty of Engineering. 2. Pilot project related to participation marks to be discussed at a department meeting.	1. Department Chair 2. Associate Chair, Undergraduate	Discussions initiated over next 8 months, with potential follow-up as needed.
Improve the laboratory facilities and the access of the undergraduate students to laboratory tests and embedment of lab experiments in more classes. Secure lab spaces for the Transportation group.	1. Discussions to continue between the Chair, Dean, and Director (Finance and Administration). 2. Undergraduate Affairs Committee to discuss courses that could benefit from additional labs.	1. Department Chair 2. Undergraduate Affairs Committee (chaired by Associate Chair, Undergraduate)	Discussions initiated over next 8 months, with potential follow-up as needed.

Provide mentors to all junior faculty members, including regular checkpoints with senior colleagues or the chair.	1. The Department chair will assign a mentor to all newly hired faculty members. (This began in 2022.) 2. The Departmental Tenure and Promotion Committee mill meet annually with all junior faculty members and formal written feedback will be provided by the Department Chair. 3. Ongoing informal mentoring of junior faculty members by their senior colleagues will be further encouraged in department meetings.	Department Chair	This process has already been initiated and will be ongoing.
Another faculty member is needed in the Geotechnical Engineering area.	A faculty search in this area was initiated in early 2023 and is currently underway.	Department Chair	New faculty member to start within 12 months.
Mentor and evaluate sessional instructors.	Connect with all new sessional instructors to offer advice and support.	Associate Chair, Undergraduate	One month before the start of every academic term.

Quality Assurance Committee Recommendation:

McMaster's Quality Assurance Committee (QAC) reviewed the above documentation at the June 2024, meeting. The committee recommends that the **Civil Engineering** program should follow the regular course of action with an 18-month progress report and subsequent full external cyclical review to be conducted no later than eight years after the start of the last review.