



**Internal Academic Review 2007-2008  
Department of Civil Engineering  
Internal Academic Review Committee Report to Senate**

The Internal Academic Review (IAR) of the Department of Civil Engineering is now complete. The Internal Academic Review Committee (IARC) has taken into consideration all of the submissions related to the IAR of the Department of Civil Engineering and respectfully submits the following report. The IARC Report to Senate is intended to supplement the findings of the attached Review Team Report and to provide a mechanism for the Head of the Department and the Dean of the Faculty of Applied Science to jointly report on the progress in addressing the Review Team recommendations (please see the “Outcomes” section of this report).

**Summary of the Internal Academic Review of the Department of Civil Engineering**

The Department of Civil Engineering is to be applauded for providing a stimulating learning environment with a focused curriculum in the context of constrained resources. Quality instruction is offered by a dynamic faculty complement. The IARC recognizes the Department of Civil Engineering for its continued efforts to attract and increase major research funding, and its ability to build collaborative partnerships with national and international agencies and universities.

The IARC agrees with the Review Team and the External Consultants in their recommendation to continue a strategic planning process, in collaboration with the Faculty of Applied Science and the School of Graduate Studies and Research, to address sustainable enrolment growth while determining ways to address space and technical equipment requirements. The IARC recognizes that the dramatic increase in enrolment, at both the undergraduate and graduate levels, needs to be matched with improved resources and space in order to preserve academic excellence in the Department.

The IARC recognizes the Department’s efforts to address the Canadian Engineering Accreditation Board (CEAB) decision to grant a three-year accreditation instead of a six-year accreditation by implementing a curriculum revision with a focus on two areas of study: infrastructure and environment. To achieve continued success, the IARC agrees with suggestions in the IAR Team Report and the External Consultants’ recommendation that the Department undertake a strategic evaluation of recruitment and retention of faculty members, modify teaching and supervision loads, research and teaching demands, and help new faculty fully integrate into the Department.

The IARC recognizes the Department of Civil Engineering as a strong, vibrant department despite the current constraints of space and resources. The IARC fully supports the Department in its efforts to balance exceptional teaching and innovative

research while addressing the recommendations of the IAR Reports in a concerted effort to maintain a high level of performance and success.

### **Outcomes of the Internal Academic Review for the Department of Civil Engineering**

*submitted jointly by the  
Dean of the Faculty of Applied Science  
and the  
Head of the Department of Civil Engineering*

The Dean of the Faculty of Applied Science and the Head of the Department of Civil Engineering welcome the positive assessment by the IARC of the department's programs of engineering education and research. We are pleased to provide the following response to the specific recommendations made by the committee.

#### **1. Strategic Planning**

The Faculty of Applied Science undertook the development of a strategic plan in 2007/08 at the same time as the internal academic review of the department was being conducted. Our plan, which was approved by the Applied Science Faculty Board in January 2009, will guide the development of the Faculty in the coming years and serve as an overarching roadmap within which departments can align their distinctive program requirements. Although the Department of Civil Engineering has a strategic plan, a major revision to the plan is in progress as an outcome of a department retreat last year. The Department strategic planning committee is preparing its final report which is expected in October 2009. The revised strategic plan will provide a path with specific goals to chart the department's future evolution recognizing the extraordinary demands that have been placed upon it.

#### **2. Faculty Recruitment and Retention**

In recent years, one of the key challenges for the department has been the recruitment and retention of faculty members. Two key faculty members, the department head and the chair of undergraduate studies, left the Department in the last year. Unfortunately, these departures placed additional workload upon a faculty already below complement. The departures precipitated a reorganization of these two key leadership portfolios. The department received permission to fill both vacant positions as well as a third position, funded entirely from a Faculty endowment, which was transferred to the Department to recognize its critical shortage of academic staff.

The Department is in a strong position to move forward with the implementation of the recommendations of the Review Team. One new faculty member has been hired in the area of structural engineering, and a second offer of appointment to another potential faculty member is currently in the final stages of negotiation. A third faculty position at the Associate Professor level in Hydrotechnical Engineering has been advertised with

interviews scheduled for September. When these positions are filled the approved faculty complement will stand at 17, one higher than when the Internal Academic Reviews were conducted. Considering the Department's burgeoning enrollment at both the undergraduate and graduate levels, further faculty renewal is anticipated.

### 3. Undergraduate Curriculum:

At the undergraduate level, the Department is finalizing the implementation of a revised curriculum. This new curriculum addresses the concerns of the Canadian Engineering Accreditation Board visiting team in their last review. Based on a report submitted in June 2008, the CEAB extended accreditation of the Civil Engineering program until 2012. The new curriculum provides several innovations such as integrated design experiences, and "Civil Weeks" focused on professional skills and design challenges. To address workload issues, the new curriculum optimizes course offerings with the aim of providing a common program without options or streams. To provide some specialization, students focus on a particular area through their choice of technical electives in fourth year. The popularity of the Department with undergraduate students continues unabated. A record number from first year (over 140) chose Civil Engineering this year. As the Faculty of Applied Science remains committed to the common first year and flexibility in students' choice of program, the growth in enrollment means the Department now has the lowest faculty to student ratio of any Civil Engineering Department in the country, by a considerable margin. This has put strains on the faculty and staff beyond what was experienced at the time the IAR report was completed, and leaves great concern about the ramifications of the impending University budget reductions.

### 4. Graduate Studies

At the graduate level, the Department acknowledges concerns that limited resources have impacted the graduate experience. As a result, the Department has not increased graduate numbers, and has implemented improved procedures for PhD supervisory committees. The Department and Dean agree that increased support for technical staff would help facilitate progress of graduate research projects and alleviate some of the strain. The department hopes that recent success in attracting research funding coupled with anticipated future success with fundraising will provide the funding necessary to increase the complement of technical staff. The Faculty recently provided one-time funding for technical support and training of technical personnel in the department.

### 5. Space and Equipment

The Faculty provided a significant infusion of funding for equipment and infrastructure to the Civil Engineering Department in 2008/09. The annual allocation for equipment in the Faculty has increased fourfold over the past two budget cycles.

**Attachment:**  
Review Team Report

# Report of the Internal Academic Review Team on Civil Engineering

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## Summary

The Department of Civil Engineering has a modern undergraduate program with emphasis on infrastructure and the environment and a vibrant graduate program. Both programs have experienced significant enrolment increases, which have almost doubled the size of the department in the last seven years. The Department has also seen renewal of faculty over the last seven years with the hiring of several new faculty, who replaced retired professors, as well as with the addition of Canada Research Chairs.

Research funding in the Department is excellent and the dollar value per faculty member is one of the highest, if not the highest, in the country. Research output in terms of publications is among the highest in the country. Research is of high quality and researchers collaborate with international organizations, public utilities and governments. The number of graduate students per faculty member is very high compared to other departments in Applied Science and among the highest in the country, compared to similar departments in Canada.

Undergraduate curriculum has been reviewed during the last few years to introduce more choice for technical specialization and reduce teaching loads. Its current version is modern and well focused around the areas of expertise of the faculty. The quality of instruction is very good, evidenced from the high evaluation scores of individual courses. Teaching loads appear to be within University expectations. However they are high, compared to other research based institutions.

The quality of students appears to be excellent; the undergraduates enter the program after their common first year in Applied Science, which has high entrance requirements, while many of the graduate students are recipients of scholarships.

The significant increase in size has demanded an increase to the resources available to the Department, something that has not happened. Concerns have been expressed over the lack of technical support and delays in graduate work due to the lack of resources as well as the low availability of graduate courses within the graduate students' specialty. It appears that the Department has to manage growth within the constraints of the University and the University has to support and guide the department. It is imperative that a new strategic plan involving the department of Civil Engineering and Applied Science be prepared so that the Department can plan its path over the next decade.

## **Introduction**

The Civil Engineering Department at Queen's has a modern undergraduate program with emphasis on the infrastructure and the natural environment and a large graduate program. The number of undergraduate students makes it one of the largest departments in Applied Science, while the research budget for the Department makes it one of the most research intensive Civil Engineering Departments in the country. The Department interacts with other departments at the undergraduate, graduate and research levels. These departments include the other engineering departments within the Faculty of Applied Science, as well as the Departments of Mathematics and Statistics, Geography, Biology, Geological Sciences and Chemistry, and School of Urban and Regional Planning, Business and Environmental Studies. In addition, the Department has close links with the Department of Civil Engineering at the Royal Military College (RMC) also located in Kingston.

## **Undergraduate Program**

The current enrollment of the program is 285 students and has increased steadily and sometimes substantially over the last five years.

The undergraduate program is reviewed every six years by the Canadian Accreditation Board. In 2005 CEAB approved the Department's program for another three years making several suggestions on course content, title and marking. The Department has responded to the requested suggestions, revising its curriculum. Other changes were also undertaken in a curriculum review in 2006, prompted by the relatively low enrollment in the Environmental option. It is worth noting that this enrollment is around the 20% mark of the total enrollment in the last four years. As a result of this review, the two options (Infrastructure and Environmental) are replaced by a common program, offering more technical electives, providing more choice for technical specialization and reducing teaching loads for the faculty, who are burdened by a significant research effort. It is worth noting that the course load per faculty member is 3.8, which is acceptable and within the University range. However it seems to be on the high end of the scale, compared to other research intensive Civil Engineering Departments in the country. Currently, there does not seem to be a problem and faculty cope with the demands of teaching and research. However the combination of such teaching loads, increased enrollments in the undergraduate stream, high rate of research grants and the resulting high supervisory loads and research productivity have the possibility of eroding the undergraduate experience.

The quality of students is high, as expected. Students enroll in the second year of the program after a common first year in Applied Science. Entrance requirements in Applied Science are high, resulting in a high quality student population.

Undergraduate students, who were interviewed, expressed their enthusiasm for their learning experience and the faculty support. Students noted that their professors were accessible, they were present in tutorials and labs and found time for them to discuss academic and professional matters. Lab equipment may be aging but in working condition while professor seemed to be enthusiastic about their research, discussing it with undergraduate students.

The quality of undergraduate instruction is high, evidenced by high student evaluations and teaching awards won by Civil Engineering professors. The Department also encourages the synergy between research and teaching to keep course content current, enhance interaction between graduate and undergraduate students, foster a research environment and inspire future graduate enrollments and enable undergraduates to participate in established research partnerships, to create interaction between professionals in the industry and students.

Students in general were happy with their undergraduate experience. However some expressed concerns regarding the lack of surveying courses as well as the lack of visibility of courses offered by RMC, which are available to them. They do not seem to like the system where technical electives are offered in alternate years. Concerns were also expressed with the limited resources in the labs, where they find waiting lines for the use of apparatus, making the task of correcting an error tedious or impossible.

### **Graduate Program**

The graduate program is also reviewed every 6 years by the Ontario Council of Graduate Studies (OCGS). This review involves a detailed examination of a wide range of topics covering research funding, library resources, laboratory and computing facilities, intellectual development and educational experience of the student and program regulations. The Department is currently undergoing an OCGS review.

The number of graduate students has increased steadily over the last eight years. Currently the Department reports an enrolment of approximately 110 graduate students, more than double of the enrolment six years ago. Significant increase of graduate students occurred in 2002, 2003 and 2005 coinciding with the hiring of new faculty and the increase of the number and value of research grants. Since the full time faculty is 16, the average number of supervisions per faculty member is 6.7. This is substantially higher than the average in Applied Science and amongst the highest in other similar Departments of the country. According to the Department's projected enrolments the increasing trend of the number of graduate students will continue and in 2013 the Department is expected to have 121 graduate students. Such growth, at the present level of resource availability, is unsustainable as it will place additional burdens on faculty and staff of the Department.

The quality of the students is high as evidenced from the high percentage of NSERC, OGS and similar scholarship holders, which is close to 40%. Graduates appear to find meaningful jobs, related to their areas of expertise.

Students, during interviews, generally praised the department's efforts. However there were significant concerns, most of them related to the size of the program, compared to its infrastructure.

Students complained about the lack of technical support for research programs, which result in significant delays to their programs. This may not be only due to the number of technicians available but also to priority settings between graduate and undergraduate projects as well as to priority settings per job. It seems that as the number of students to both programs grows, the current infrastructure is increasingly unable to support both.

Progress monitoring is better defined for Ph.D. students (thesis proposal, supervisory committees etc.) while M.Sc. students are not always aware of expectations regarding their projects and expected completion time.

Because of the rather large size of the various research groups, there is limited communication between them and work of certain groups may not be appreciated. For example it is not certain that the majority of students in the program appreciate the work of the "humanitarian engineering" group. The department must find a method, possibly through seminars, to improve the cohesion of its research groups.

Other concerns were not directly related to the expansion of the graduate program.

Students complained about the lack of availability in the graduate course offerings, especially for those students who completed their undergraduate degrees at Queen's.

Another complaint was related to the regulations regarding student operation of machinery in laboratories. Currently, departmental regulations preclude such use; however through training and certification it may be possible to decrease the burden placed on technicians. The graduate students seemed to support this; however it is imperative that safety cannot be compromised in the name of productivity.

The above affect graduate student experience in ways such that some students had regretted their choice of place for graduate studies. It is clear that beyond research and academic output, the Department should address graduate students concerns, especially when numbers grow. Alternatively, it should decrease graduate student enrolment, if it cannot secure additional technical help and resources.

## **Research**

The Department has become a significant centre of research activity in Canada. The Department's research efforts are focused and related to areas of infrastructure and environment. All faculty hold NSERC grants and most faculty hold other grants. The 2006-07 research operating grants were \$4.85 million, placing the Department among the top research departments in Canada. Research output in terms of journal papers, books and chapters in books has been very high during the last 7 years. The numbers provided by the department suggest that in the last 7 years the average number of journal papers per professor and year was 6, 30% of professors had published books and 75% had authored chapters in books, indicating high research output.

The Department collaborates with RMC as well as other departments at Queen's (Geological Sciences and Geological Engineering and Mathematics and Statistics). It also has a number of collaborative projects involving outside agencies and Universities worldwide (Fudan University in China, University of Waterloo, Colorado State University, Oregon Graduate Institute, ISIS Canada Network of Centres of Excellence, Delft Hydraulics, Delft Technical University, EU laboratories)

Two new centers affiliated with the Department of Civil Engineering, have been established in recent years. These are the Centre for Water and the Environment (CWE), and the Geoengineering Centre at Queen's-RMC. These have created diverse networks of researchers from universities, hospitals, municipalities, conservation authorities and the private sector.

It appears that the Department has been involved in a variety of research areas that generate a significant amount of interest from funding agents and graduate students and enable the department's graduate students to follow meaningful careers. Such intense research effort is propelling the growth of Graduate studies, but at the same time, it places demands on people and resources.

## **Faculty**

The Department has recruited a large number of new faculty over the last seven years. Since 2000, 8 faculty members have retired, 3 have been tenured, 4 have been promoted and 11 have been hired. The net result has been an increase in faculty complement from 12 in 2000 to 16. The changes have resulted in a group with a relatively young age profile which the majority of professors in the 30-50 year age group.

There are two female faculty and one visible minority faculty member.

Two of the appointments are Canada Research chairs.

The faculty is young and enthusiastic, well liked by both graduate and undergraduate students. However they are overworked, trying to accommodate research and teaching demands from increasing populations of undergraduate and graduate students. Service to the University and to the Profession, which are typically expected from faculty members, also demand precious time from the faculty. It is worth noting that one Full Professor is the current Vice Principal, Research at the University while other faculty members serve in a variety of capacities in professional organizations, editors in scientific journals, grant selection committees, reviewers and members of conference organizing committees.

The Department is fortunate to have such dedicated faculty. However, considering the heavy demands on faculty's time, the Department may find it hard to retain its hard working staff, especially if additional help is not in sight. Faculty departures, if they occur, will have a significant impact on many aspects of the program.

## **Physical Facilities, Equipment and Space**

The department is based in a rather old building and traditionally it had adequate space to carry out its activities. Significant improvements have been made to the classrooms of Ellis Hall and significant new facilities and equipment have been built or purchased since 2000. In addition, research work is being carried out at several field sites. The laboratories at the university are supported by wood, metal, welding and electronic workshops and a technical services staff of seven.



Currently space at Ellis Hall is not considered to be adequate. The laboratories are used heavily and as described in the previous sections students have complained about delays, aging equipment and lack of technical support.

Another complaint is related to the lack of air condition in Ellis Hall during the summer months. Productivity has suffered during summer time, when it is imperative that research proceeds at maximum pace.

## **Equity**

During the past seven years the female percentage in the undergraduate program has decreased from 43.6% to 26.5%. The percentage of female students in the masters program has stayed between 25-35% while the percentage of Ph.D. candidates is between 9-21% and most commonly around 17%. In terms of absolute numbers, the number of women in the undergraduate program has stayed the same in spite of significant enrolment increases while the number of women in the graduate program is increasing, although not as fast as the number of males.

The percentages are similar to other disciplines in applied science with the exception of Chemical Engineering, which has a higher percentage of female students, and not different from other engineering schools in the country, where initial increases of women enrolled in engineering programs in the 90s were followed by a decline.

Two of the new faculty members are female, resulting in a proportion similar to other schools. It has been difficult to find female faculty members in engineering departments and the Department of Civil Engineering is not an exception to the rule. It is however necessary for the department to be innovative in attracting more female students, faculty and technical staff.

## **Strengths and weaknesses**

The strengths of the department are the following:

- It has a young and energetic faculty
- It has developed an excellent research program with the highest level of average funding level per faculty member
- It has created a very good research network with connections in universities, research organizations and other stakeholders worldwide
- The impact of its research is high, as evidenced from collaborative research grants
- The research output in terms of publications has been one of the highest in the country
- The research group has a large number of students
- The support staff is dedicated
- Undergraduate and graduate students are of high quality
- The Curriculum is focused on the strengths of the faculty without sacrificing students' needs.

The weaknesses are as follows:

- Significant growth to both graduate and undergraduate streams has resulted in considerable strain of resources
- Undergraduate enrolment cannot be controlled and can fluctuate over the years
- Growth has created a lack of technical support and space
- The faculty carry an unusually high work load combining high teaching loads and heavy supervisory duties
- Although common in engineering, there are not enough female professors and technicians to possibly attract more female undergraduates
- The loss of productivity in the summer due to lack of air conditioning poses additional burdens on staff and technical personnel.

## **Recommendations**

It is clear that, without increasing availability of resources, the current situation of increased enrollments cannot be considered healthy or sustainable. The complaints of graduate students about their experience and the remarks of CEAB, that the high level of research grants and the increased research effort they demand make teaching loads excessive, should be considered seriously. The Department cannot be asked to grow, as further growth without support will have a detrimental effect on the quality of the program. It is also interesting to examine whether growth is sustainable to commit University and other resources. It is imperative that a new strategic plan, involving the department of Civil Engineering and Applied Science be prepared so that the Department can plan its path over the next decade or so. The strategic plan should answer questions about the optimum number of undergraduate and graduate students and suggest practical ways of achieving the Department's targets, considering the constraints imposed by Applied Science, employment opportunities of the graduates, trends in the profession and the industry, ability to attract research funding and sustain a stable level of it, space and equipment requirements as well as requirements in technical and support staff.