# Rediscovering the Renaissance Architect: The Role of Cooperative Education in the Architectural Curriculum

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## THE DIVORCE OF THEORY AND PRAXIS

The ways and means to educating a person to become an Architect have changed multiple times throughout history. Where the Renaissance Architect, in revisiting the doctrines of Vitruvius, sought to be adept at both the humanities and the sciences, a distinct split happened towards the end of the 18th century with the division of roles into Architect and Engineer. It may have been felt that the issues surrounding the design and construction of buildings had become too complex for one person to lead. It may have happened as the "left brain" and "right brain" types found more pleasure in concentrating on the piece of the pie that suited their personality type. Regardless the cause, the split occurred, and continues to rule both the profession and many architectural institutions to the present day. The divorce of Theory and Praxis hinders the progression of many architectural curricula from answering the complexity of the requirements of architecture in the 21st century.

If we look back to Vitruvius the goals were quite clear.

> "CHAPTER I THE EDUCATION OF THE ARCHITECT
>
> 1. The architect should be equipped with knowledge of many branches of study and varied kinds of learning, for it is by his judgment that all work done by the other arts is put to test. This knowledge is the child of practice and theory. Practice is the continuous and regular exercise of employment where manual work is done with any necessary material according to the design of a drawing. Theory, on the other hand, is the ability to demonstrate and explain the productions of dexterity on the principles of proportion.
>
> 2. It follows, therefore, that architects who have aimed at acquiring manual skill without scholarship have never been able to reach a position of authority to correspond to their pains, while those who relied only upon theories and scholarship were obviously hunting the shadow, not the substance. But those who have a thorough knowledge of both, like men armed at all points, have the sooner attained their object and carried authority with them."[1]

More recent global awareness of the relationship between energy inefficient buildings and greenhouse gas emissions, combined with a global economic recession, has put significant pressure on the practice and hence the education of the architectural profession. Continuing Education requirements have Architects scrambling to keep current. Architects that specialize in "Design" that cannot answer to environmental, economic and technical issues are finding themselves under employed. Students graduating into the Architectural Profession who cannot engage in an Integrated Practice Model, and whose technological skills (structures, construction, sustainable design and computing) are not getting jobs. Firms are tending to hire students that come into the work force that can handle comprehensively designed buildings that simultaneously answer the goals of aesthetics in combination with a suitable layering of technical and environmental knowledge. Students with previous job experience are also at a distinct advantage. To get a job in a competitive (recessionary) environment normally requires that you have work experience.

## THE RENAISSANCE MODEL + COOPERATIVE EDUCATION

The curriculum at the School of Architecture at the University of Waterloo was founded on the basic pedagogies of a holistic, well rounded Renaissance education. Four streams of study were created: Design, Culture, Technology and Environment. Throughout the degree students typically engage in all four areas of study in each academic term. That is not to claim that there is extraordinary cooperation amongst the streams that results in a high level of cross-fertilization and integration. But the technology and environmental courses are placed alongside the Design Studio courses to hopefully provide "just in time" delivery of components that can feed into and better the results in Design Studio. (see Table 1)

Knitting the program together is a *mandatory* cooperative education system that provides students with real life work experience on an ongoing basis throughout their undergraduate degree. Students have the opportunity to engage in either Domestic or International work placement for six four-month sessions. These are distributed throughout the program starting from the end of their third term of study in our 4-year Bachelor of Architectural Studies Pre-Professional degree. So by the end of 4 academic years (32 months of study), each student will have acquired 24 months of architectural work experience. Students *must* complete 5 of the 6 work terms and submit four Work Reports in addition to successfully completing their academic requirements in order to graduate with their pre professional degree. This arrangement allows student to opt for a travel term or to accommodate economic slowdowns.

The nominal 2 year Professional Master of Architecture that follows our Honors Cooperative BAS degree is devoted to the creation of a significant thesis and does not have a coop work requirement. The integrative nature of the undergraduate degree serves as an excellent preparation for this professional part of the program.

The cooperative education system is fully supported by the University of Waterloo, and has become the core distinguishing mark for graduates in most areas of study. When the university was founded in 1957, only the Engineering and eventually Computer Science and Professional Schools participated in cooperative education. The success of these units led other more general programs to adopt the coop model. The Coop Education and Career Services department is dedicated to finding placements, arranging interviews, visiting the students during their work terms, and providing follow up. Jobs are not guaranteed, but even in the current recession more than 90% of our architectural students are employed. In recent pre recession years we have not been able to supply all the firms requesting students with placements.

In the early years of the program, students were limited to working in Canada due to Visa issues. This also meant that we could not accept International students into our School as they would be unable to participate in the coop program. Following NAFTA (the North American Free Trade Agreement) new agreements were reached and the borders were opened up. Varying kinds of work visas became possible in both the United States and abroad. During the early part of this decade student employment shifted from a Canada-centered set of offices to an International one. During the past 5 years, more than 50% of our students have worked outside of Canada. Even students going out on their first work term after their 2A academic term – at approximately 19 to 20 years of age – are seeking International experience. In spite of the current global recession, close to 50% of the placements remain outside of Canada. Where we might have once had 25 third year students employed in London, England, and have lost many of these positions to a depressed job market, there has been a shift to employment in other countries throughout the European Union as well as Asia.

## LOTS OF STUDENTS WORK...WHAT MAKES THE COOP REQUIREMENT DIFFERENT?

Many students work during the summer to support their schooling. Some schools offer one or two terms of coop placement. What differentiates and makes significant the coop education experience at the University of Waterloo is the frequency, rigor and cyclic nature of the placements. For the majority of the undergraduate degree students are on a 4-month school/work cycle.

Two exceptions exist within the system. Students are not offered work placement at the end of their first year of studies. It was felt that they were not well enough prepared for employment at this time, and

the summer timing would put them in competition with students from other Architecture programs also seeking summer employment. Students have an 8-month long work term following their third year of studies. This allows them to become more engaged in office projects as well as prepare financially for our study abroad term that occurs in their 4A term.

| TERM | Design | Culture | Technology | Environment | Other |
|---|---|---|---|---|---|
| 1A<br>Fall | Arch 192:<br>Design Studio<br>1.5 units | Arch 142:<br>Cultural<br>History 1<br>1.0 units | Arch 172:<br>Building<br>Construction 1 | | Arch 100: Intro to<br>Architecture<br>Arch 110: Drawing |
| 1B<br>Winter | Arch 193:<br>Design Studio<br>1.5 units | Arch 143:<br>Cultural<br>History 2<br>1.0 units | Arch 173:<br>Building<br>Construction 2 | Arch 125: Intro to<br>Environment | Arch 113: Digital Design |
| Off Term – Spring - (students can elect to take a Digital Portfolio credit class and non credit Intro to AutoCAD crash course) | | | | | |
| 2A<br>Fall | Arch 292:<br>Design Studio<br>1.5 units | Arch 246:<br>Cultural<br>History 3<br>1.0 units | Arch 260:<br>Principles of<br>Structures | Arch 226:<br>Environmental<br>Building Design<br>Arch 272:<br>Acoustics and<br>Lighting | |
| WORK TERM 1 - Winter | | | | | |
| 2B<br>Spring | Arch 293:<br>Design Studio<br>1.5 units | Arch 247:<br>Cultural<br>History 4<br>1.0 units | Arch 276:<br>Timber Design | Arch 273:<br>Mechanical<br>Systems | elective |
| WORK TERM 2 - Fall | | | | | |
| 3A<br>Winter | Arch 392:<br>Design Studio<br>1.5 units | Arch 343:<br>Cultural<br>History 5 | Arch 362: Steel<br>and Concrete<br>Design | Arch 364: Building<br>Science | elective |
| WORK TERM 3 - Spring | | | | | |
| 3A<br>Winter | Arch 393:<br>Design Studio<br>1.5 units | Arch 342:<br>Cultural<br>History 6 | Arch 365:<br>Structural<br>Design Build | Arch 327:<br>Architecture<br>of the Urban<br>Environment | elective |
| WORK TERM 4 - Winter | | | | | |
| WORK TERM 5 - Spring | | | | | |
| 4A<br>Fall | Arch 492:<br>Design Studio<br>(study abroad<br>Rome)<br>1.5 units | Arch 449:<br>Modern Italian<br>Architecture<br>Arch 448:<br>Ancient<br>Roman<br>Architecture | | Arch 446: Italian<br>Urban History | |
| WORK TERM 6 - Winter | | | | | |
| 4B<br>Spring | Arch 493:<br>Comprehensive<br>Building Design<br>1.5 units | Arch 442:<br>Modernisms | Arch 473:<br>Technical Report | Arch 425: Modern<br>Landscape | |

**Table 1:** The distribution of courses in the 4-year Honors Pre Professional Coop Bachelor of Architectural Studies degree showing the 4 theme areas of study and placement of coop work terms. All courses are 0.5 units (36 hours) unless otherwise stated.

| 1A | 1B | Off Sring | 2A | WT1 Winter | 2B | WT2 Fall | 3A | WT3 Spring | 3B | WT4 Winter | WT5 Spring | 4A | WT6 Winter | 4B |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|

**Table 2:** The Work Study Sequence for the 4 Year Honors BAS Degree (all 4 month terms) showing the high proportion of work experience

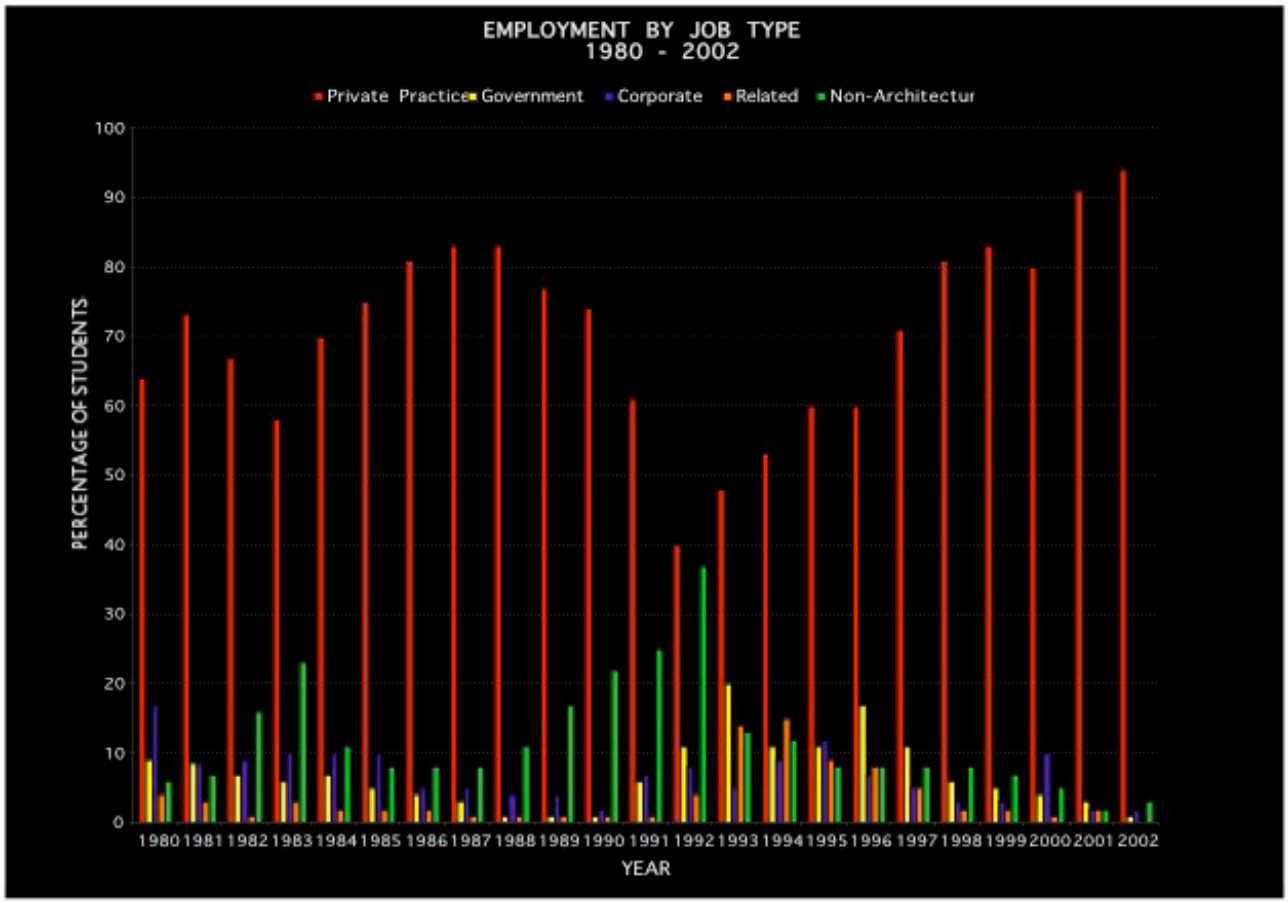


Figure 1. Employment by Job Type showing the deference to Private Practice (red)

The timing of the work terms is also significant. Students going out on their first two work terms are looking for employment in the Fall and Winter months, when other schools are in session. They do not have to compete in the summer job market until they have completed their 3A term, and will have at that time significant schooling as well as 8 months of work experience in their Resume. Likewise, summer employment only occurs again during the second half of the 8-month work term, meaning that employment was initiated during the non-competitive winter term.

The cyclic nature of the work/study cycle means that students are constantly being exposed to alternating points of view when it comes to the Design and Practice of architecture. School may be allowed to assume a more theoretical position at times, but this becomes balanced through engagement in the work place. Students begin to be able to differentiate "what is done at school" from "what is done in the real world". As the profession shifts towards the adoption of BIM, an Integrated Practice Model, Sustainable Design or any other motivating factor, the students are also exposed to these shifting paradigms, regardless the entrenched position of any faculty or courses within the curriculum. We have somewhat limited facility to teach a large variety of software platforms. The students gain proficiency in many of these in the work place and the improvement in their digital skills after several work terms is quite noticeable in their Design Studio and other project based work.

This is not to say that all work experience is equal. Students, by being limited to taking two placements in one office, are encouraged to work in a variety of offices of varying sizes and practice models. Some employment is more beneficial/interesting than others, but even the less attractive offices do educate

students about life at "the bottom end of the profession". The job opportunities as relates to the opportunity to work in private practices versus government type offices changes with the health of the economy. During recessionary times there is greater dependence on larger and government offices.

Where the current preoccupations of the profession may be carried back into the conversations at School, conversely, School can also be seen to influence the professional practice. In the early days of LEED™, students completing core courses in Environmental Design and studying the LEED™ system became the "point person" in offices just beginning to struggle with the system. This was very empowering to the students. Many students have gone to take their LEED™ exams with the intention of becoming LEED AP and bettering their employment opportunities and pay in subsequent coop terms.

## AN INCLUSIVE SYSTEM

At the University of Waterloo, many departments offer both Coop and Regular streams of study. Typically Cooperative education is reserved for the "best students". Students must maintain in the range of 70% cumulative averages. If they should fall below that point, they must drop down into a General program (with a 60% passive average) and lose the right to engage in the Coop work placement system. Some Architectural institutions with reduced coop programs also only offer placement to their best students. Pragmatically it is easy to see that this both reduces the number of placements to be found as well as ensures that employers will be happy with the quality of the students.

All students must maintain a minimum 70% cumulative average to remain in good standing in the school. Our program *requires* coop employment from all of our students, regardless of their standing in the class. It was the desire of the School to avoid creating a two-tier class type system. This would divide rather than unite the student body. It was also felt that students with lower academic standing would truly benefit from the work experience and indeed some of the weak junior students have gone on to become extremely strong graduates and practitioners. When active learning continues in the "between" academic terms, it proves to be of great benefit to weaker students. In many cases weak students gain in academic strength throughout their studies, which in most cases can be attributed to a combination of maturity and coop employment experience.

## TAILORING THE CURRICULUM TO PREPARE STUDENTS FOR COOP

Although the academic portion of our program has maintained its consistency in terms of our four theme areas of Design, Culture, Technology and Environment, it has undergone changes since the School opened its doors in 1968. In the early years of the program, "Technology" (known at that time as "Systems and Measures") consisted of (somewhat simplified versions of) typical engineering structures courses. There was a course in each of Calculus, Statistics, Statics, Strength of Materials, Analysis, Indeterminate Structures, Steel, Concrete and Timber. No "Materials and Methods" type courses were taught as it was assumed that students would gain some expertise in building construction for our climate during their work term placements. By the beginning of the 1980s, a little more than 10 years into the program, it was found that work term placements varied substantially, and many students were typically employed inking presentation drawings. Contract documents were reserved for the experienced detailers at the firm. The decision to offload the acquisition of technical construction knowledge to the workplace was deemed to have failed. The decision to overhaul the Technology Theme course area to correct this deficiency was taken.

*This narrative must take on a personal tone at this point. I was a student in the program from 1975 to 1982, when I graduated with my Bachelor of Architecture Degree. I had been a straight "A" student in Structures, employed as a Teaching Assistant for all courses, and was called back after graduation to assume courses while the two Engineers who taught our slate of Structures courses were on simultaneous sabbaticals. I had the experience of the academic program, cooperative employment experience, as well as a thorough understanding of the content of the technical stream of courses. I was asked to be part of a committee that was struck to overhaul the Technology curriculum.*

Our "Technology Stream" was radically redesigned in 1985. On my recommendation two core courses in Building Construction were added, a Theory of

Technology course (technology and materials as influence on design) and a greatly revised Mathematics were also introduced, in response to the need as a result of the uneven nature of technical experience during coop work terms. The Structures stream was compressed to make room. Indeterminate Structures was dropped and Statics and Analysis were combined into one course. The Building Construction courses were inserted at the 1B and 2A levels and were made core components of the program.

In the mid 1990s the Environmental Theme Area was also overhauled. This portion of the curriculum had never been very strong, lacking in a faculty champion, and had increasingly been compressed due to accreditation pressures that required the expansion of other areas of the curriculum as well as increased teaching of topics in the Cultural History Theme Area – one of the signatures of our School curriculum. Again the significant revision of one core introductory landscape course and addition of a second environmental design course followed as we were becoming increasingly aware of the importance of environmental issues to the study of responsible design and such courses did not exist in our curriculum. Initially these courses were placed at the 1B and 3A levels. The Sustainable Design movement allowed course material to be developed that had a clear focus, defined relationship to Design, as well as relationship to educating students for practice.

Over the years the curricular revisions in the program have responded to global issues outside of the School, the rigorous demands to prepare the academic program for accreditation, as well as to support and prepare students for the coop work requirement.

In order to both better prepare our students to be successful during their first work term, as well as to give them an excellent technical skill set to buoy their work in Design studio, the Building Construction courses were shifted down to the 1A and 1B terms. Additionally the Environmental Design courses were modified in content and arrangement. Developing an environmental ethic, passive design, and site/solar/material issues being located in the 1B term and active systems, daylighting, an introduction to energy software and LEED™/assessment systems being moved from the 3A into the 2A term. The latter was in response to student feedback that the material was being delivered "too late" and that they had already been required to be familiar with assessment systems like LEED™ during their work terms. With the present curriculum, before students embark on their first work term job they have also taken their initial structures course, digital modeling, and acoustics/lighting. Our program of study is as a result very heavily front-loaded in Technical core courses. Conversely, when the students take their 2-year Professional Master of Architecture degree, save for their Professional courses, it is quite unencumbered by core course/technical requirements – even for the thesis itself.

The focus of the first computing course in 1B is the acquisition of 3D modeling skills (transitioning now from FormZ to Rhino and VRay in response to external/coop demands) as well as good working knowledge of Adobe Photoshop and Adobe InDesign. As there is no room in the curriculum for another core digital course, we have developed several optional courses to give the students the opportunity to improve these skills prior to entering the competitive coop employment job market. The majority of students will not have any experience in digital drafting and they will need to develop a digital portfolio in preparation for the job interviews that happen 2/3 of the way through the term. They are offered a not for credit "crash" course in AutoCAD immediately prior to the start of the fall term. At this point we presently also offer an optional Digital Portfolio building course for credit that can be taken online during the off term between 1B and 2A. It has been found that the students who take the online Portfolio course have better results competing for job placements than their peers who have decided to postpone the creation of the portfolio concurrent with the workload of their fall term of studies.

Conversely experience gained during the coop work experience sequence is deemed essential for the successful completion of their 3A Design Studio. This studio typically requires the detailed design of a large urban building. The students take parallel courses in Steel and Concrete Design as well as Building Envelope Science during this term. The maturity and exposure to office work is quite evident in their ability to handle the integration of the many technical issues into this project and a high level of computing skill. This project serves in essence as the "trial run" preparation for the Com-

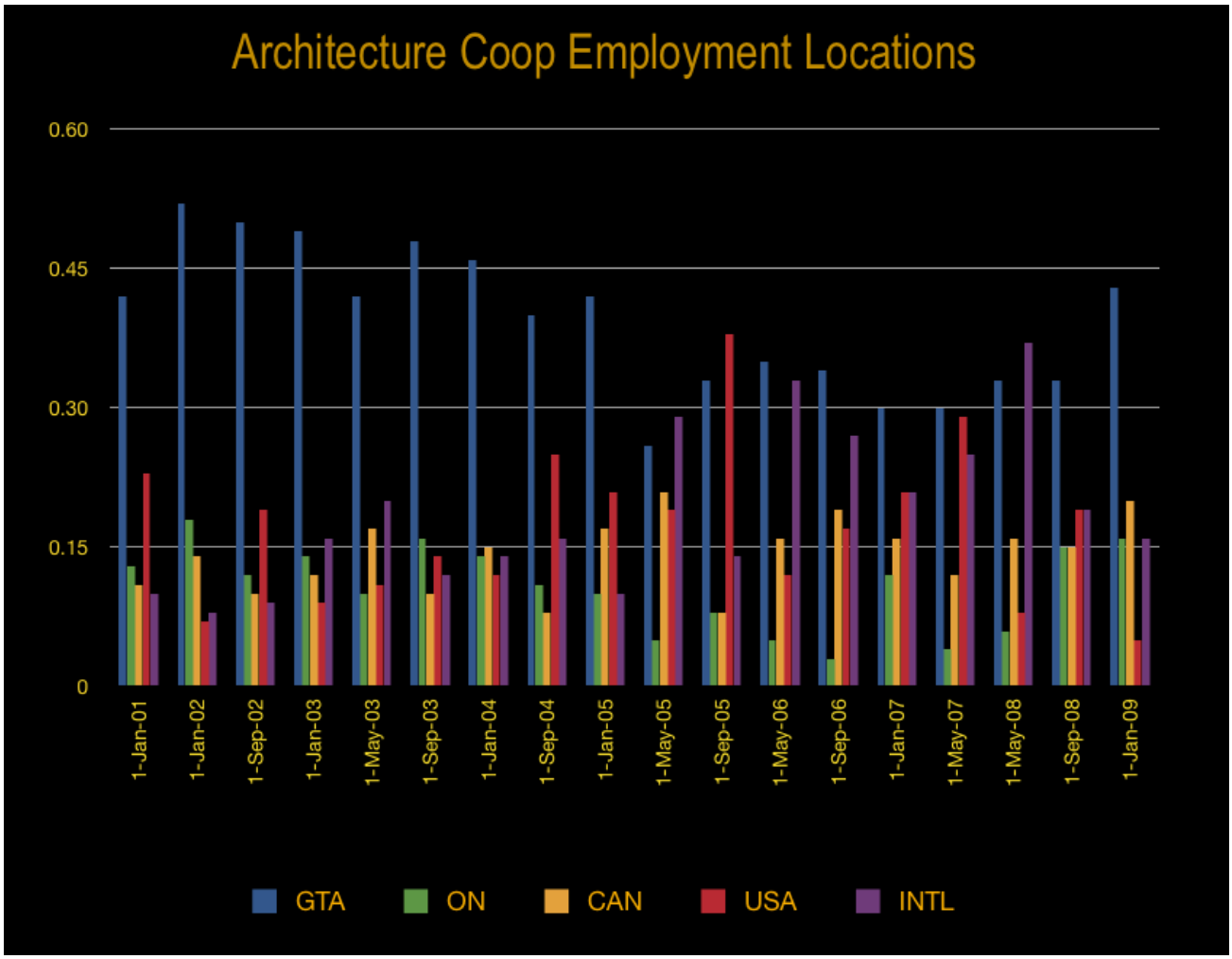


Figure 2: Percentage of Coop Employment by Term and by Location (GTA = Greater Toronto Area, ON = Ontario)

prehensive Design project that is located in their 4B term – the terminal term of the Undergraduate 4 year Pre Professional degree.

The Comprehensive Design Studio has purposefully been located in the terminal term of our undergraduate degree as it is intended to serve as "the final exam" that assesses the student's ability to thoroughly integrate everything they have learned in all four sectors of the curriculum – in addition to skills developed on their coop work terms. Students will have had 24 months of architectural office experience in addition to 28 months of school prior to undertaking their Comprehensive Design Project. The Comprehensive Studio is supported by a Technical Report Course, the purpose of which was to ensure the absolute requirement of the technical content of the studio and the ability to assign it a separate weighted grade.

The Comprehensive Design Project, as it is positioned in the terminal term of the pre professional degree, allows students who pursue their Professional Master of Architecture Degree at our School complete freedom of topic selection for their thesis. So where the undergraduate degree is technically and professionally driven by virtue of course content and the coop experience, the graduate portion of the degree is highly academic and full of freedom.

**BENEFITS OF THE SYSTEM: Applicant Incentive**

The coop program and the typical 4 month cycle allow the students to work throughout their degree

and helps them to afford their education without incurring extreme levels of debt. It is not unheard of for third year students to be earning in the range of $16 to $17 per hour – which is significantly higher than typical minimum wage position for non-coop students engaged in unskilled jobs.

Both the promise of experience and the financial bonus serve as significant attractors for potential applicants to our pre-professional program of study. Over the past 5 years we have routinely received between 1,100 to 1,200 applications for the 72 openings in the first year of our program. We are able to interview with a team of faculty and senior students[2] and hand select from a pool of 400 of the top applicants (selected on the basis of GPA greater than 84%). In addition to a portfolio and interview screening process, students also must write an English précis test. This helps to ensure a very high caliber of student – one that is better equipped to successfully proceed through the coop employment program. The coop program is the most frequently cited reason that applicants state when they asked their reasons for applying to our School.

The ability of the selection process to screen for literacy and critical thinking skills also radically diminishes the attrition rate. This may be as low as 5% or as high as 10% as a function of the make-up of the class.

**BENEFITS OF THE SYSTEM:**
**Encouraging Maturity**

The target audience for our 4+2 program is the high school graduate. The normal age of the incoming student is 18 years of age. Mature students (those that do not come directly from high school or who might have another degree or part thereof) make up less than 25% of the student body. The average age of the student when they commence their first work term is 19 years of age. The cooperative education system assists in the maturation of these young students. It is quite normal for students entering their first work term to select work in Europe, far away from the influences and security of family. Unlike the classic "study abroad" opportunity, which occurs infrequently and which normally has the security of a Faculty advisor making most of the arrangements and a peer group with which to travel, the students seeking distant coop opportunities are very much "on their own". These experiences not only assist in the general maturation of a very young student body, but also expose them to the global scene of architecture. This in turn allows them to bring new ideas about Design, building and practice back to the School environment.

The work term experience assists in preparing students for our study abroad term that happens in their 4A term. There is little nervousness in embarking on an extended academic stay in Rome. Students are on their own to find accommodation, prepare food and make their way to and from the Eternal City. This serves to relieve the Faculty members in charge from many onerous tasks normally associated with arranging a study abroad term.

**ADMINISTRATION: Logistics, Positive and Negative**

There are many issues, both positive and negative, when it comes to administering the coop system. Students are levied additional fees each term to support the Co-operative Education and Career Services department[3] and its operations. CECS assists students in finding jobs but does not guarantee a job for every student. Many students will look for jobs on their own in places that CECS does not routinely include in their repertoire. Those students must also (begrudgingly) pay coop fees. These work placements are subject to evaluation in the same way as University assisted placements.

Students are graded on their work term placement. It is unusual for a student to fail their work term, but if they do, they would be required to complete another to replace it. Success in work term placements is very important to ensure that the employers are happy and that the placement can be handed from student to student as they cycle through the school. The students understand that it is also in their best interest to perform well on the work term. As future employers can "see" the student's work term performance in addition to being able to view their academic score and portfolio, an unsatisfactory work term can easily make a student less attractive to other employers.

The submission of Work Reports is part of the coop system at the University of Waterloo. Each Faculty is permitted to tailor the nature of the report to suit their program. The Work Report requirement for Ar-

chitecture was customized so that the nature of the report would be useful to the student, rather than simply reflecting the type of work done on the work term. For example, one term's requirement is a digital portfolio that is to include samples of some of the work done on the work term. The terminal Work Report asks students to find a mentor and commence their work experience logbook through the Provincial Architecture Association. The Work Term and Work Report grades do not calculate in to their academic average, but are a requirement for graduation.

The interview process for the job placements occurs at the beginning of the third month of the academic term. If students do not have a digital portfolio ready for their interviews, creating or editing one can be very disruptive to their academic work. Job interviews run for approximately two weeks. Students must be able to pop in and out of classes for this period to attend interviews.

Students become "addicted" to the 4-month cycle. Many find it difficult to commence their 2-year Master of Architecture degree as they have become so accustomed to moving, as well as fond of the excitement of the International experience.

Our Master of Architecture graduates are in high demand. One of the added advantages of the cooperative education program is set of the contacts made by the students throughout their career. This makes finding full time employment after graduation much simpler and also allows students to make an educated choice about the type of office in which they would like to work. Our Provincial Association allows them to log 6 months of work experience (of the total 3 required), prior to graduation, thereby shortening the time requirement if they wish to obtain their License to Practice.

## OUTCOMES AND OTHER DEVELOPMENTS

There is work ongoing to make the system more responsive to student needs and changes in the work place.

We have added a special fall term event called "Paths to Practice". This is the second year that it has been offered and it was highly successful. The full day event consists of a keynote presentation from a high quality practitioner (normally a graduate from our School); a panel session on traditional


**Figure 3:** Students chatting with potential employers at Paths to Practice.

practice with 5 or 6 practitioners from diverse practice backgrounds; a panel discussion with graduates that went into non-traditional practices (film, graphic design, gaming); a job market where a number of potential employers are invited to set up tables and chat with the students; and, a portfolio feedback session, where the second year students embarking on their first coop work term can have their digital portfolios evaluated by masters students.

Interest in the "formula" of our program has resulted in a current set of efforts, championed by the Director of our School, to launch two new schools of Architecture in Canada; one in Sudbury, Ontario and another in Saskatoon, Saskatchewan. Both would be modeled very closely on our curriculum. This would increase the number of professional Architecture degree programs in Canada from 11 to 13. This is a significant increase when viewed as a percentage of the whole and more so if one considers that only 4 English speaking schools in Canada take students directly from high school (Carleton, Waterloo, Ryerson, McGill). It is felt that this expansion would better serve the students of the nation that are keenly interested in pursuing an architectural education, and also well qualified, but who simply cannot find a place in the current, highly competitive fray.

Cooperative education would naturally be included in this model as in the short 40 year history of our School it has proven to be one of the key factors in the success of students in our program.

We are highly pleased with the success of the structure of our holistic, Renaissance curriculum as it is

complemented by the *praxis* associated with the cooperative education experience.

## ENDNOTES

1. Vitruvius. The Ten Books of Architecture.
2. Each applicant interview lasts for 25 minutes and is attended by 2 faculty members and 2 senior students. Where applicants cannot visit the School due to distance, they must send in a 7 minute DVD in which they speak about three significant pieces of work. In this way we can get a better understanding of their literacy skills as well as some inkling of their ability to speak and think critically about their pieces.
3. The website for Co-operative Education and Career Services.http://www.cecs.uwaterloo.ca/