MASONRY EDUCATION IN CANADIAN POST-SECONDARY INSTITUTIONS

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ABSTRACT

Masonry Canada and the Canadian Portland Cement Association commissioned a survey of current post-secondary education on five structural and construction materials (Concrete, Steel, Wood, Masonry, Asphalt). They wanted to know what was taught in Faculties of Architecture, Departments of Civil Engineering in Universities and in technology programmes at Colleges/Institutes of Technology. The survey was conducted in two parts. First, Institutional web pages were searched for current course offerings. Where none were found, the Institution's academic calendar was examined. Descriptions of relevant courses were copied and entered into a Table for each Institution. Secondly, these Tables were sent to the respective Institutions with a request for someone to complete the Table as per the accompanying, completed Table for Civil Engineering at the University of Calgary. Academic programmes for which no course information could be obtained from public documents, or for which the course descriptions were too broad for interpretation in the required context, were asked to supply course information as well as lecture-hour and student data.

The response rates were sufficient (55-70%) for a realistic assessment of what is currently taught. Information supplied to responding institutions was over 90% correct, allowing analysis of course contents of non-responding units to be undertaken with confidence. The overall result is that concrete receives the most attention of the five materials considered, in all categories - architecture, engineering, technology; compulsory and optional; undergraduate and graduate. Except for a few minor occasions, masonry is solidly last, doing best in architecture programmes and worst in compulsory undergraduate structural design courses where it receives less than 3% the attention that concrete does. Steel is typically a close second to concrete; there is a gap to wood, then asphalt, and finally another gap to masonry.

If the masonry industry does nothing to garner the support of the relevant components of the higher education system, the use of masonry in Canada will decline further over the next few years.

Key words: Masonry education, Concrete education, Post-secondary institutions

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INTRODUCTION

Masonry Canada and the Canadian Portland Cement Association commissioned a survey of post-secondary education at Canadian universities, colleges and technical schools with respect to masonry, steel, concrete, timber and asphalt. They wanted to know what was taught in Faculties of Architecture, Departments of Civil Engineering in Universities and technology programmes at Institutes of Technology. With the knowledge obtained, the industries would be able to develop strategies to improve the situation if that was deemed necessary.

METHODOLOGY

There are ten Canadian universities which offer accredited Architecture programmes and one (Ryerson) which offers an architectural programme which, on its own, is insufficient for graduates to become architects. Twenty-five universities offer accredited Civil Engineering (or Genie Civil) degrees. Additionally, the Ecole de Technologie Superiore in Montreal offers a civil engineering/construction programme at the bachelor level. Twenty-four colleges/technical institutes were found offering various architecture, civil engineering technology and construction diplomas.

Information on course offerings from these sixty-one institutions was first sought on the internet. Courses deemed relevant were copied and tables established for each programme, containing information relevant to the survey objectives. Information on the majority of the twenty-six civil engineering bachelor degree programmes was thus obtained, and a number of the Colleges/Institutes of Technology. Where no detailed information was available from institutional home pages, academic calendars were found and assessed. On completion of this process, information on all twenty-six civil engineering degree programmes was obtained and eighteen of the twenty-four Colleges/Institutes of Technology. Architecture programmes tend not to have courses on specific materials, so data suitable for the study were difficult to obtain from web pages.

Where tables were established, the tables were sent to the Department Head with a request to complete the table in a similar fashion to the completed University of Calgary Civil Engineering Table, which was also enclosed for reference. To complete a table, a respondent was asked to provide information on the number of lecture hours on various subjects, the typical number of students in the course, the frequency of offering of the course, and the source of funding of other than the Institution's normal operating budget. Respondents were also asked to reply to various questions on staffing, reasons for changing course contents, reasons for not offering specific subjects and the long-term directions of the programme. Corrections to any information provided to the respondent about their programme were also requested.

For those Institutions where no detailed information could be obtained, a request to provide relevant information was made. Faculties of Architecture fell into this latter category. The lack of supplied data may be one reason for the lower response rate from architecture programmes compared to Civil Engineering Departments and with the Colleges/Institutes of Technology.
The Methodology described above was adopted so that respondents were being asked to

do the minimum amount of work. It was thought that a response was more likely if the recipient could see that information freely available had already been sifted, rather than asking them to provide that as well as the information not readily available from public sources.

RESPONSE RATES

Six of the eleven Faculties of Architecture (55%); eighteen of the twenty-six civil engineering bachelor programmes (69%); and seventeen of the twenty-four Colleges/Institutes of Technology responded. In this latter group, four indicated that civil engineering technology was no longer taught at their institution, thus the response rate became thirteen out of twenty (65%). These response rates were very similar to that obtained in the U.K. by Roberts and Simm (2000). The corrections to courses listed in the tables were generally small, indicating that information obtained from the internet and up-to-date calendars was over 90% accurate. Deductions from course offerings by those institutions which did not respond can therefore be deemed to be valid.

RESULTS

Faculties of Architecture

The total numbers of lecture hours spent on each subject are shown in Figure 1. Each subject material is divided into hours spent on the material properties and manufacture, compared to hours spent on structural design procedures for that material. In Architecture programmes, professors do not differentiate between brick and block; plain, reinforced or prestressed masonry, or standard vs. cold-formed steel. Architecture courses tend to be based on systems. Thus a course on the properties of building materials will typically cover introductory information on the four structural materials of interest to architects (concrete, steel, wood and masonry). On the construction side there is typically more emphasis on the design of concrete, steel and wood structures than on the design of structural masonry.

Masonry appears to be considered more a choice for building envelope rather than structural material. This, in itself, is not bad since architecture students are shown the aesthetic value of masonry in architectural history and culture based courses. The frequency of use of masonry as a veneer indicates that architects are aware of some but not all of the advantages of masonry.

The results (Fig. 1) are probably typical across all architecture programmes. Hence one may conclude that of all three groups surveyed, architecture students get exposed

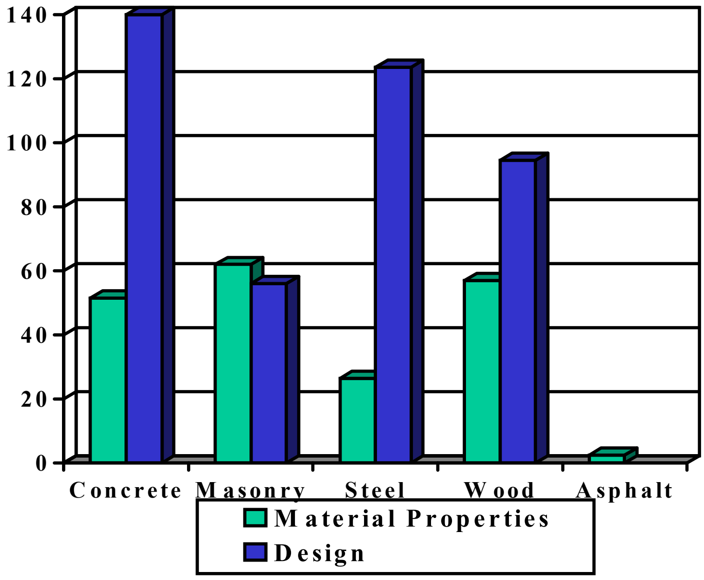


Figure 1. Total Lecture Hours in Responding Architecture Programmes per Year

proportionally to far more masonry than students in the engineering streams of universities or colleges. Architecture students learn about the aesthetics and material properties of masonry and undoubtedly could learn more. However, what is perhaps not taught so well is that masonry can still be used as a load bearing material as in the past.

Departments of Civil Engineering

Results for the total number of lecture hours presented to civil engineering undergraduates on the topics of interest are presented in Figure 2. Courses were divided into compulsory within the programme and optional. Multiplying the numbers of students by the number of hours to obtain the number of student hours on each subject accentuates the differences between the subjects as shown in Figure 3. The equivalent information at the graduate level is provided in Figures 4 and 5. The data have been pro-rated to allow for the frequency of course offering (once every year, once every two years, etc.).

The immediate and obvious observation which can be made is that concrete and steel are well covered at the undergraduate level in Canadian Civil Engineering degree programmes. This may be stated for both the physical properties and manufacturing of these materials, as well as structural design. Masonry is taught the least (less than a third as much as wood or asphalt). In compulsory course hours, concrete material properties are given over eighteen (18) times the hours that masonry is. In structural design, concrete receives thirty-six times more attention than the design of masonry. In optional courses, masonry may be thought to be doing better. However, some courses included are unlikely to be offered again (staff changes), so the numbers for masonry are generous.

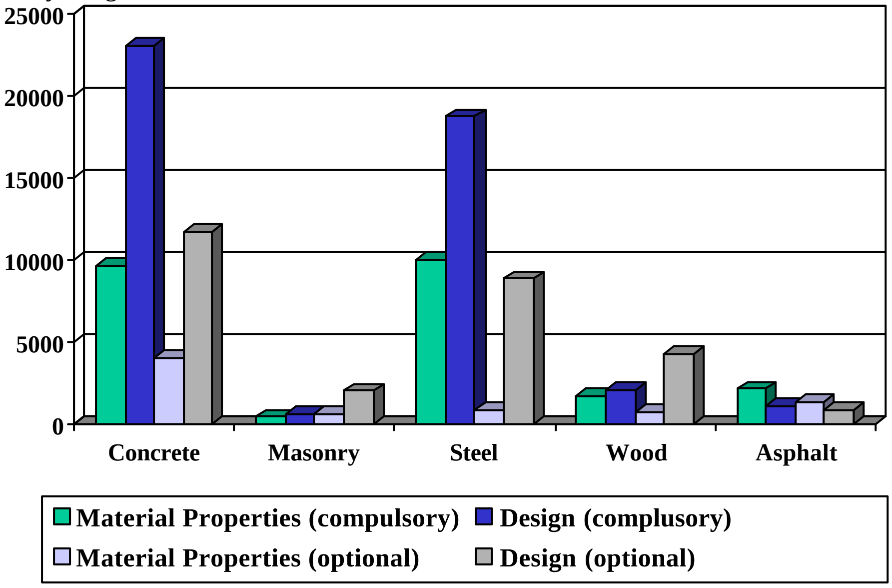


Figure 2. Departments of Civil Engineering Undergraduate Lecture Hours per Year

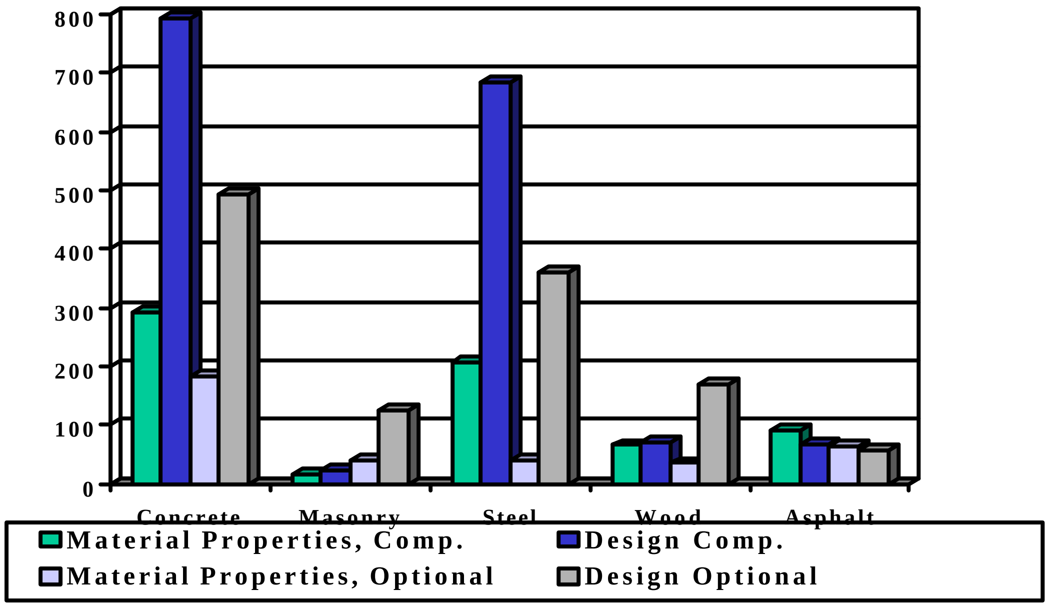


Figure 3. Departments of Civil Engineering Undergraduate Student Hours per Year

When the number of students taking the courses is taken into account (Figure 3), the results are more dismal for masonry and better for concrete than straight lecture hours. In terms of student hours, masonry material properties are taught for only 4% of the time devoted to concrete material properties. Structural concrete design (reinforced (prestressed)) is taught over thirty-seven (37.5) times more than structural masonry. Concrete is seen as the dominant construction material that must be taught in all undergraduate civil engineering programmes. With the current balance, concrete structures will continue to be a dominant structural material, along with steel.

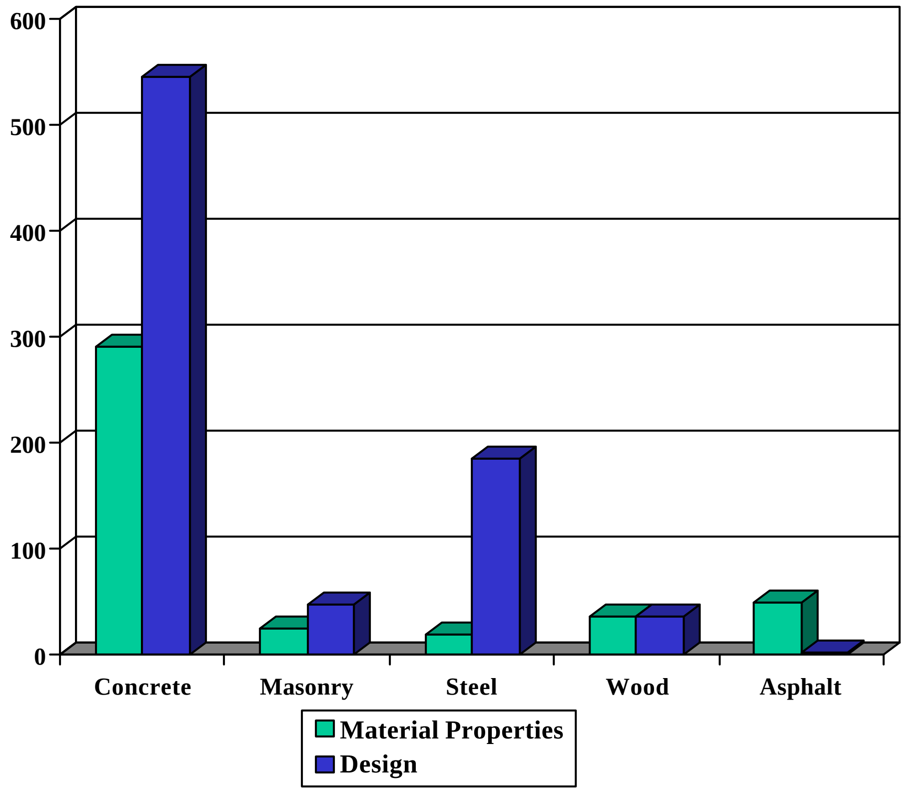


Figure 4. Departments of Civil Engineering Graduate Lecture Hours per Year

The situation is repeated at the post-graduate level. Graduate student hours spent on concrete are fifteen times those spent on masonry (Figure 4). Pavement design receives little attention, but many hours are spent on asphalt material properties. When student numbers are taken into account (Figure 5), asphalt receives three times the attention of masonry, while concrete has twenty-one times the attention. One disturbing feature of the results is that only half of the responding Departments of Civil Engineering offer graduate courses. Lack of funding is cited repeatedly as the cause for the lack of graduate course offerings.

The data can be viewed in a different way: a total of 69,431 compulsory undergraduate student hours are spent on concrete, steel, wood, asphalt and masonry. Of these 1,008 are spent on masonry; a market penetration of 1.45%. Concrete receives 32,705 student hours; 47.1% of the total. If optional hours are added, the grand total of student hours is

104,479, of which masonry has 3,618 (3.5%) and concrete 48,493 (46.3%). These shares are shown in the pie-charts of Figure 6. The numbers of straight lecture hours are: compulsory; total 2,300.5, of which masonry has 37.5 (1.6%) and concrete 1,083 (47.1%): compulsory plus optional; total 3,864.5, of which 203 (5.3%) are devoted to masonry and 1,758.5 (45.5%) to concrete. as shown in Figure 7.

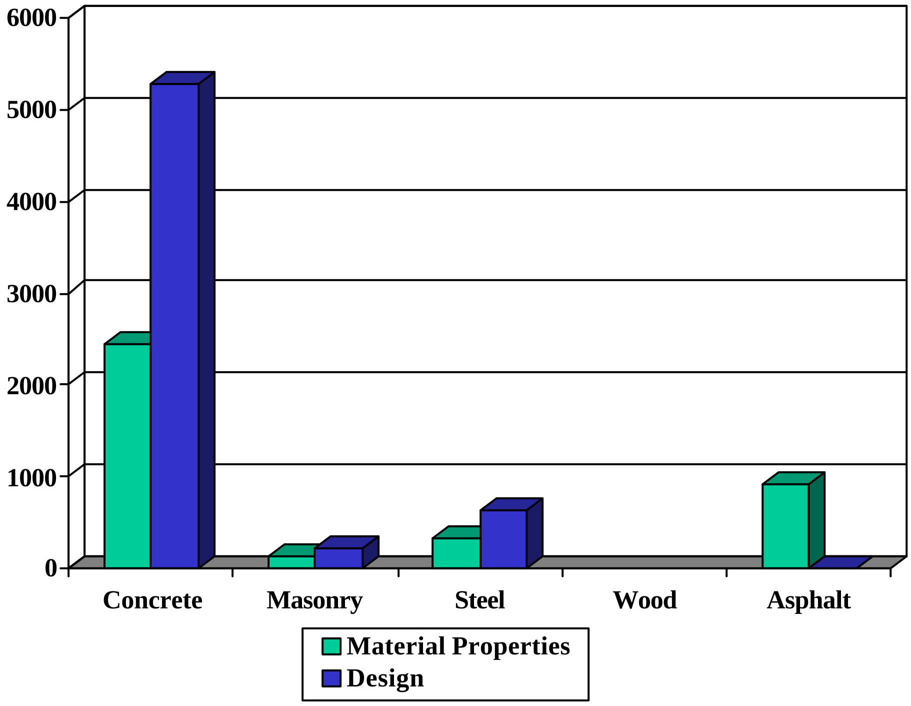
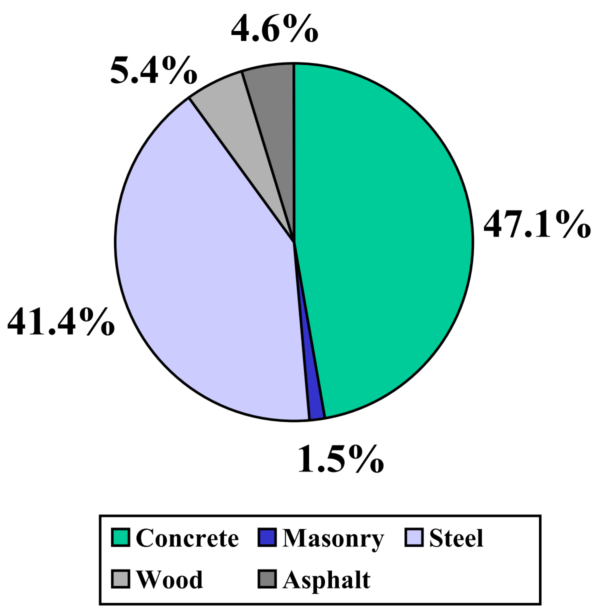


Figure 5. Departments of Civil Engineering Graduate Student Hours per Year

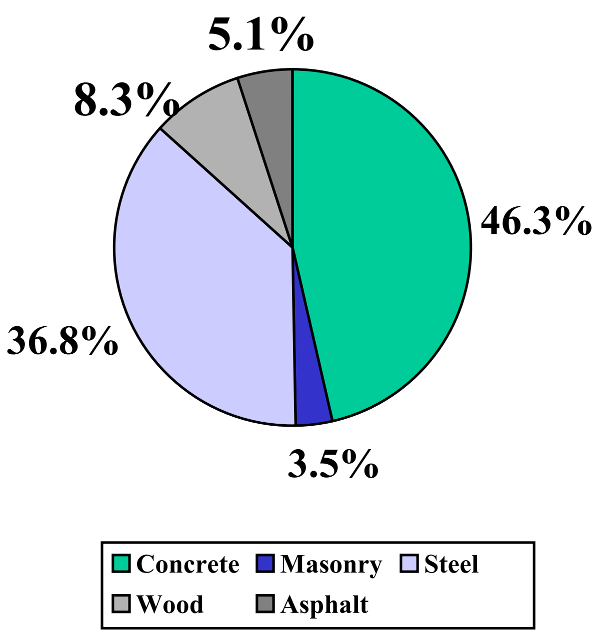
Colleges/Institutes of Technology

Distilling useful information from Colleges and Institutes of Technology was quite difficult. Course data from the programmes that responded are presented in Figure 8. Despite the difficulties, most colleges teach civil engineering technician/technology diploma programmes in which most courses are compulsory. There are very few options throughout the country. Using student numbers to examine student hours on each subject was therefore pointless, since there would be little change from the ratios for straight course hours.

The message is no different to that from the civil engineering departments. Concrete dominates; steel follows fairly close behind; wood this time is solidly third while masonry and asphalt fight it out for last spot, well back of the leader. Using the



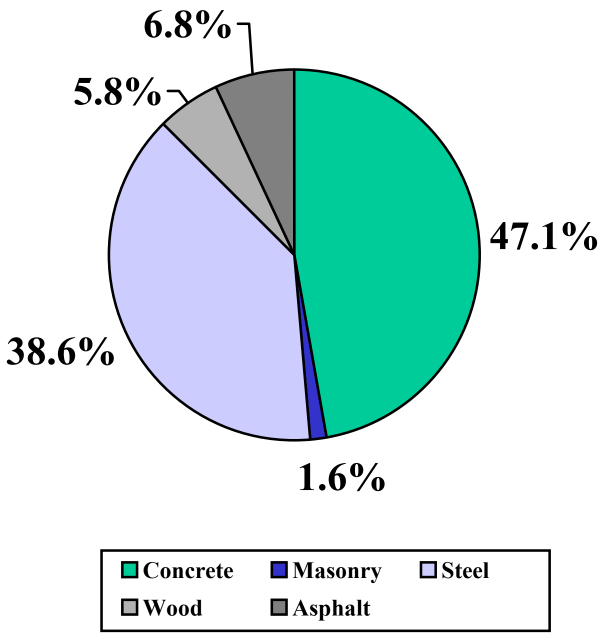
Compulsory student hours



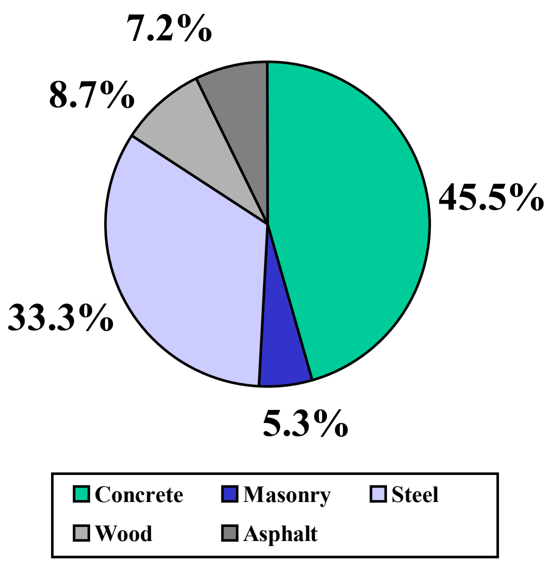
Total student hours (optional and compulsory)

Figure 6. Share of Undergraduate Student Hours

(Departments of Civil Engineering)



Compulsory lecture hours



Total lecture hours (optional and compulsory)
Figure 7. Share of Undergraduate Lecture Hours
(Departments of Civil Engineering)

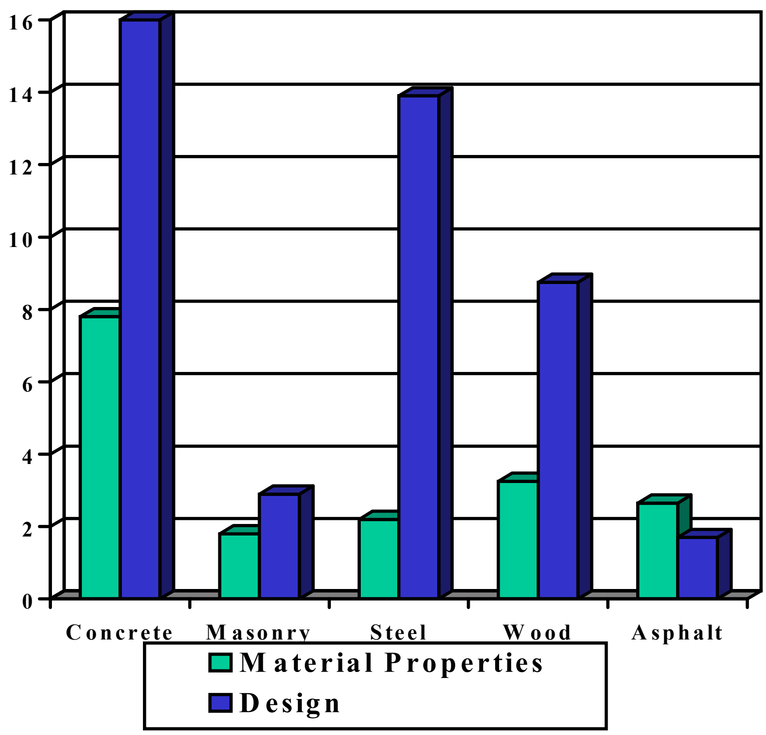


Figure 8. Courses Offered Per Annum, Responding Colleges/Institutes of Technology

concept of market penetration again, 5.2 courses out of 101.05 gives masonry a market penetration of 5.1%. Concrete has 39.7 courses for penetration of 39.3% (over twice what might be expected if all materials were treated equally).

ASSESSMENT

The message is consistent and clear throughout the post-secondary education system. Portland Cement Concrete is important and taught the most among structural materials: masonry is unimportant and taught the least. Less masonry courses are taught in Canadian universities than in British ones (Roberts and Simm 2000).

The situation will only deteriorate for masonry unless some action is taken to break the present cycle. Very simply, universities and colleges are very short of funds. Governments have reduced funding considerably in real terms to the post-secondary sector over the last decade. In some Provinces, this trend will continue until balanced budgets are achieved. Faculties and Departments short of funds must direct the meagre resources at their disposal to provide the best programme they can to their students. Thus, academic units direct resources to those subjects they see as most important to the success of their students in the workplace. Concrete and steel are perceived to be the materials of choice in construction, certainly in structural engineering (despite the volumes of wood (and masonry) used). Thus emphasis is placed on these materials. Students learn about these subjects: in industry they design them and in graduate school they perform research on them. Those that continue into the academic stream as professors or instructors in colleges/institutes of technology continue to research on these two (major) materials. Being conversant with the materials and design procedures, naturally they teach those subjects: their perception that these subjects are the important ones to teach remains. Students who do not proceed to academic careers, but move into structural design in consulting and EPC companies, are also fully cognizant of concrete and steel. Wherever a structural problem is presented, they think of a solution in concrete or steel. Possibilities in masonry are usually not considered unless an architect or owner demands one. More and more structures are built in concrete and steel, reinforcing the perception of those that stayed in academia that these are the structural materials of prime importance, which therefore must be taught before others when resources are limited. Masonry is thus relegated to a subject which only "rich" institutions can afford to offer as an option: masonry is relegated to the role of veneer and infill: an expensive wall decoration sometimes specified by architects. The structural capabilities of masonry, its durability and life-cycle economies are neither understood nor expounded upon.

The masonry industry's share of the construction marketplace will continue to decline in this scenario. As advanced composites are introduced, matters will only get worse. To change the current pattern, there are four target groups for the industry:

1) owners
2) Professors in Faculties of Architecture
3) Professors in Civil Engineering Departments
4) Instructors in Colleges/Institutes of Technology.

Owners need to be educated as to the life-cycle costs and durability of masonry. The industry must however, deliver on its promise. Quality construction with appropriate details to keep masonry walls dry must be built. If the industry does not serve up what it claims for its material, then all reputation and advancement will be lost.

Architecture Professors need to be provided with information on details that work, life-cycle costs and examples of structural masonry. The objective of providing information must be to demonstrate the versatility and aesthetic value of masonry as a structural material. Masonry must be seen as an integral part and excellent option when considering building envelope.

For Departments of Civil Engineering, the industry has to break into the concrete/steel cycle. One way to do this is to provide seed research dollars to structures and materials professors across the country. Examination of the data reveals that masonry is taught at Alberta, Calgary, McMaster and New Brunswick which contain staff, all funded in the late 70's, early 80's by what was then the Canadian Masonry Research Council. The funds were not extensive, but attracted the attention of these and other researchers (now retired). The only other Departments with meaningful masonry offerings are Lakehead and Memorial. The former began after a Professor's workshop but the individual teaching masonry does not research the subject. Similarly at Memorial, the professor does not research masonry. With the current trend, masonry will not be taught at all in Departments of Civil Engineering in the next 10-15 years: all will have retired.

The third group needing nurturing with respect to increasing exposure of students to masonry is the instructors in colleges and institutes of technology. As this group teaches the technology side of the industry, a primary boost to increasing masonry education would be a text similar to that published by the CPCA on concrete technology. A text with good notes and illustrations covering the practical hows and whys of good masonry construction would be an invaluable aid to technology educators. This document should also demonstrate what not to do - poor construction. (Note: such a text would also be helpful to engineers.) Offers from local representatives to help with classes and supply materials and masons for laboratory demonstrations would also be distinctly helpful. Industry should realize that these staff are under pressure from lack of resources. Hence offers to provide resources are seen as helpful. Offers of help have to be couched in constructive, positive terms, such that there is no perception of lobbying the staff member or institution to include masonry in the curriculum.

CONCLUSION

The survey reveals quite distinctly that masonry is taught very little in post-secondary education. In Civil Engineering Departments and Colleges/Institutions of Technology, less time is devoted to masonry than any other construction/structural material. Market penetration in the total number of student hours taught on masonry in Civil Engineering Departments is 3.9%. The same occurs in Faculties of Architecture but not to the same dramatic degree. The masonry industry has to reverse the situation or otherwise continue to lose market share to other forms of construction.

ACKNOWLEDGEMENTS

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REFERENCE

Roberts, J. and Simm, D. “What is Learnt About Masonry by Students of Civil and Structural Engineering?” Masonry International, Vol. 14 No. 1, pp. 5-8 (2000).