HOW SPECIFIERS LEARN ABOUT STRUCTURAL MATERIALS

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ABSTRACT

Many wood products are underutilized in the construction of nonresidential buildings. To understand better why this is so, a mail survey was conducted in both Canada and the United States to determine how specifiers (architects and structural engineers) learn about building materials.

Results indicate that, while architectural schools spend an adequate amount of time teaching students about timber design, engineering schools devote little time to teaching wood use as compared to time spent teaching students about steel and concrete. This is despite the fact that over 60% of the specifiers who work on buildings less than five stories in height have designed with wood. However, much of the learning about materials occurs on the job, where the most effective means of education include reading materials, data files, manuals, corporate promotion, and word of mouth. Specifiers who do not currently use wood are likely to be most influenced to do so through the use of physical examples such as demonstration buildings and case studies.

Long-term cooperative programs, including lobbying efforts and promotional campaigns, are needed to ensure that material specifiers have the knowledge and training required to be able to use traditional and new wood products that are ideally suited for nonresidential construction in North America.

Keywords: Nonresidential, construction, specifiers, architects, structural engineers, structural materials, education, promotion, timber design.

INTRODUCTION

There is no doubt that the process of learning has a tremendous bearing on the actions that professionals take and the attitudes that they have throughout their careers. This is no different in the field of design, where, among other subjects, architects and structural engineers are constantly acquiring knowledge about the use of various structural materials, products, and systems. It is this information that forms the basis of most decisions pertaining to the specification of materials for use in structural building applications.

As part of a larger study assessing the market situation for wood products in the nonresidential construction sector, this analysis undertook to determine how architects and structural engineers learn about structural materials, both at school and at work. In so doing, it is hoped that this information, coupled with market data describing the characteristics of the nonresidential sector (Kozak and Cohen 1996), will assist in industry efforts aimed at promoting and ultimately expanding wood use in this and other relatively unfamiliar markets.

BACKGROUND

The North American nonresidential construction market, unlike the residential sector, remains relatively untapped by the forest products industry. This large market incorporates a multitude of small to medium-sized structures used for commercial, industrial, educational, and public purposes, to name but a few. However, steel and concrete still dominate this market despite the vast array of wood products, both commodity-based and specialty-engineered, that exist and could be viably used in this context.

This lack of wood usage in the North American nonresidential construction market has been well documented. Most estimates put the size of this market at over \$100 billion, and while wood can be viably used as the main structural component in approximately half of these buildings (representing 90% of the floor area), it is used less than 15% of the time (Anderson 1987; Crowley 1993; Howatson 1987; Kozak and Cohen 1996; Reid 1977; Spelter and Anderson 1985; Spelter et al. 1987). What is not fully understood are the reasons why wood products have not been able to make more substantive inroads into this market. Given the market opportunities that exist for the forest products industry in the nonresidential sector, there is a strong need for scientifically valid market research in this area.

Clearly, to understand why a building material is or is not used in certain structural applications, one must query those responsible for their specification: namely, architects and structural engineers (collectively known as "specifiers"). This can be accomplished by conducting market research to obtain quantitative evidence pertaining to specifiers' attitudes and perceptions of structural materials. With some notable exceptions (Anderson 1987; Reid 1977; Spelter et al. 1987), scientifically valid studies of this nature (whereby representative samples of specifiers are surveyed) are sporadic, at best. Instead, the literature that exists is rife with commentary, speculation, and results from numerous qualitative studies—most relying on available census data, construction data, and the work of a few key researchers to support their claims (Crowley 1993; Howatson 1987; Jacques 1988).

While much of this research is commendable, it does nothing to add to the scientific body of knowledge surrounding the problem at hand: *Why are wood products so infrequently specified by architects and structural engineers in the nonresidential sector?* It does, however, serve to set directions for research in this field by offering some potential explanations.

One such theory purports that architects and structural engineers do not commonly specify wood products because of a lack of understanding—many of them are not formally trained in timber design concepts. This conjecture seems to operate on two levels. The first is simple: specifiers will have a tendency to utilize structural materials that they are most familiar with—probably ones that they learned about in school. The second level is more subtle: although specifiers may be open to the use of new products, they may have certain fears, misconceptions, and negative perceptions towards wood products, arising either from actual material deficiencies or from a lack of knowledge and experience. In both instances, attitudes among specifiers would have to be changed in order for wood use to increase. This can probably be best achieved through education, both at school and on the job.

Gill (1987) attributes the lack of wooden nonresidential structures in the United Kingdom, in part, to the lack of timber design education for architects and structural engineers. Moody and Freas (1987) elaborate on this point by discussing the issue of educating structural engineers on the use of wood. They state that there exist only a few designers and design firms with a high degree of competence in the area of timber engineering—a particularly surprising fact given that markets for wood exist in the nonresidential sector and any number of wood products are competitive and viable alternatives to steel and concrete. They support this claim with a survey of engineering schools (universities and technical schools) across the United States. They found that, while 75% of the engineering curricula required courses in steel and concrete design, only 13% required a timber engineering course. Knight (1987) concurs with this sentiment, adding that a tremendous volume of potential business for the forest products industry is lost because specifiers are not familiar with design concepts as they pertain to wood (framing). This problem, he concludes, stems from a lack of formal training from teaching institutions.

This dialectic is not restricted to the realm of forest products researchers, analysts, and managers. To comprehend better why there seems to be an appreciable lack of interest in teaching nonresidential wood design and construction techniques at the postsecondary level, one can also look to the history of the modern architecture movement in North America for elucidation. A case in point can be seen in Tom Wolfe's (1981) cutting critique of American architecture, "From Bauhaus to Our House," in which a lack of wood usage in nonresidential buildings is accounted for by putting the blame squarely on the university academy. Though his thesis does not explicitly center around issues of wood use, he is concerned with the state of architecture in America—namely, the repetitious and unattractive glass, concrete, and steel "boxes" that he sees as prevalent. This type of design stems from the German Bauhaus school of the 1920s and 1930s, where utopian, nonbourgeois ideals, coupled with the use of simple lines and materials, produced one of the most influential design aesthetics ever. The Bauhaus movement came to America in the late 1930s, and with it, a complete lack of understanding of the social constructs inherent in its manifesto. This left the issues of simple lines and materials to be taught in design institutions across the United States. Unfortunately, while glass, steel, concrete, and occasionally masonry were upheld as the materials of choice for this movement, wood was generally excluded to the point where "the principle of 'the integrally jointed wooden frame' seemed exhilaratingly rebellious" (Wolfe 1981). Throughout the twentieth century, architecture evolved in a variety of directions. However, material use and the notion of the repetitious "box" did not change. Today, steel and concrete remain the dominant structural materials for larger buildings, both in terms of what is taught at design school and what is used in practice.

OBJECTIVES

As part of a larger study assessing the market situation for wood products as a structural material in the nonresidential construction sector, the objective of this undertaking is threefold:

1) to determine how specifiers learn about structural materials, both at school and on the job;
2) to determine if and how knowledge acquisition varies between structural materials (wood, steel, concrete, and masonry); and
3) to determine how common and effective various promotional methods are in conveying information about structural products, systems, and services to specifiers on the job.

The rationale behind looking at educational issues both at school and at work is simply based on the notion that pedagogical opportunities missed at the scholastic level may be offset by various promotional means when specifiers become part of the work force. Ultimately, it is hoped that this research will broaden the understanding of how specifiers learn about structural materials and, in so doing, assist industry efforts to increase the use of wood products in the nonresidential sector.

METHODS

Sample and sampling procedure

The population under investigation consists of all North American architects and structural engineers involved in the nonresidential construction sector. The sample frame, from which the design professionals in this study were selected, came from three mailing lists: the Canadian Wood Council, the American Institute of Architects, and the American Society of Civil Engineers. These lists were chosen not only on the basis of size, but also on which ones best represented the population in question. In other words, while comprehensive lists were desirable, it was more important to obtain ones that closely approximated the population, both geographically and demographically.

In all, 90,000 names were represented. In order to bring this number down to a workable level and to ensure that the sample approximated the geographical makeup of architects and structural engineers across North America, each list was first stratified by region, and samples from each region were systematically chosen using an n^{th} name random selection scheme. In the end, sample sizes for architects and structural engineers were 3,986 and 1,822, respectively. These figures were based on differences in the population sizes of the two professional groups, recommendations from preliminary qualitative studies, and budgetary constraints. Sample size calculations were subsequently carried out to see whether or not the scientific validity of the experiment would be hindered at these levels. Results showed that statistical validity and precision levels would be upheld, assuming that response rates exceeded 4.6% for architects and 10.1% for structural engineers. Since response rates were expected to surpass these proportions, both professional groups would be oversampled at these levels. However, this course was followed to offset the possibility of very low returns and to increase the statistical precision even further.

The systematic selection of architects and structural engineers effectively created a proportional allocation sampling scheme (stratified sample) that was weighted geographically. Originally based on the twenty-one census regions in the United States and Canada, the strata were later collapsed together to form seven broader geographical groupings (see Fig. 1): three in Canada (West/North, Central, and East/Maritimes) and four in the United States (West, Midwest, South, and Northeast). The rationale behind collapsing the geographical groupings was to allow for more precise

FIG. 1. Collapsed Geographical Strata in Canada and the United States.

and meaningful results to emerge in each stratum.

Data collection and analysis

The mail survey method of primary data collection was used in this study as it is acknowledged to be the most efficient and cost-effective way of securing data from geographically diverse populations (Dillman 1978). The questionnaire used in this research was relatively lengthy, consisting of seven exhaustive sections with an estimated completion time of sixty minutes. The fourth section was dedicated to issues of learning about structural materials. In it, architects and structural engineers were asked identical questions pertaining to knowledge acquisition at school and at work. They were also asked to describe their educational backgrounds and the amounts of time devoted to learning about wood, steel, concrete, and masonry. Finally, specifiers were asked to rate various methods of obtaining product information on the job in terms of their use, prevalence, and influence. Questions in this section took on many forms and measurement scales including simple dichotomous questions, determinant choice questions, checklist questions, numerical rating scales, and constant sum scales.

Due to time constraints, full-scale, formal pretesting of the survey did not take place. However, peers, colleagues, and related professionals were asked to fill out the questionnaire, comment on its clarity, and note the time that it took to complete it. Based on this feedback, the survey was revised and reworded in an attempt to make it more accurate, lucid, and readable. The final version of the survey was professionally printed in booklet form, numbered, and mailed out (on 28 February 1994) in packages that included cover letters and business reply envelopes. In order to maximize response rates, a three-point contact system was adapted from Dillman (1978). That is, packages were followed up two weeks later with reminder/thank-you letters (to all sample units), and one month later with replacement questionnaires, business reply envelopes, and cover letters (to those sample units who had not yet responded). It should be noted that surveys were addressed to individual specifiers rather than entire design firms because it is believed that the personalization that comes with individual sampling ensures a higher response rate (Dillman 1978).

Upon completion of data entry, tallies, means, and standard deviations were computed throughout the questionnaire to summarize the results. Generally, aggregate values were obtained for all designers. However, in some instances, statistics were calculated separately for architects and structural engineers (accounting for obvious differences in the education of these two professional groups allowed for more specified information to emerge). Wherever applicable, one- and two-way Analyses of Variance (ANOVAs) at $\alpha = 0.05$ were performed to test differences in means. These were generally used in conjunction with Bonferroni's test of differences to determine which of the means significantly differed (Devore 1987).

RESULTS

Results pertaining to how specifiers learn about structural materials are discussed in four sections. First, the educational backgrounds of the respondents are examined. This is followed by an analysis of the extent to which knowledge of various structural materials (wood, steel, concrete, and masonry) is acquired, both at school and at work. The use, effectiveness, and prevalence of various promotional methods are also explored. Finally, specifiers' willingness to learn about and/or use alternative structural materials is investigated. After a brief discussion of the respondent breakdown and response rates, each is discussed in turn.

TABLE 1. *Breakdown of responses by country and professinal group.*

	Architects	Structural engineers
Canada	152	146
United States	442	238

Respondents

Lengthy questionnaires have the tendency to decrease response rates. For this seventeen-page survey, this was mitigated through the use of the Total Design Method (Dillman 1978). This system minimizes nonsampling error and maximizes response rates by offering prescriptive guidelines for mail survey design and implementation.

Of the 5,808 surveys that were sent out, 978 were returned before the cut-off date. The breakdown of total responses is seen by country and professional group in Table 1. Of the surveys sent out, 1,022 were not reachable while 44 were received after the cut-off date, for a total response rate of 21.4% (20.4%, if late responses are excluded). Of the 978 surveys returned, 553 respondents (56.5%) felt qualified to answer the survey in its entirety since respondents that did not work with buildings less than five stories (i.e., those suitable for the use of wood as a structural material) were asked to return the survey with only the Personal Section completed. By applying the proportion of designers qualified to answer the survey in its entirety to the initial sample, a revised sample size of 2,706 was obtained. The response rate was then recalculated to include only those specifiers qualified to answer the questionnaire, for a revised response rate of 22.1% (20.4%, if late responses are excluded). In other words, 22.1% of the qualified North American designers (12.5% of the North American designers that could be reached) responded to the survey. However, only 20.4% of the qualified designers (553 in total) were included in this analysis as a result of the late responses being discarded. In either case, these levels surpass those required to ensure statistical validity and are considered acceptable given the length and complexity of the survey (Bruvold and Comer 1988; Kanuk and Berenson 1975).

To detect for nonresponse bias, two commonly recommended methods were employed (Zikmund 1989). The first compared demographic characteristics of the sample with available demographic information for the population. In this case, geographical breakdowns (proportions) were compared by means of a series of two-tailed z-tests ($\alpha = 0.05$). In each instance, no significant differences between the population and the sample were observed. The presence of nonresponse error was also tested by observing bias patterns between respondents and underrepresented segments of the population. This was easily accomplished by comparing results of those who responded to the first mailout (assumed to be "respondents") to those who required more encouragement and responded only to the second mailout (assumed to be "nonrespondents"). Several key results were utilized to test for differences between these two mailout groups. Depending on the nature of the result, either a two-tailed z-test, a two-tailed t-test, or a two-tailed t-test with arcsin transformation (all at $\alpha = 0.05$) was incorporated. Again, no significant differences were observed on any of the variables tested. This result, coupled with the above demographic analysis, indicates that nonresponse error could not be detected in this study.

Educational background

In the *Personal Information* section of the survey, specifiers were asked where they received their formal design education. Results were fairly consistent with the actual regional breakdown of sample units. The majority of American specifiers received their formal design education in West or Northeast regions, while most Canadian designers went to school in the Central region, with the remainder being split between the West/North and East/Maritimes regions.[1] Still others received their formal training in different parts of the world, like Europe and Asia, both of which were mentioned more often than some Canadian provinces.

Respondents were also asked about their educational backgrounds in the field of design. By far, the most popular response, at 54.9%, was university training—33.5% at the undergraduate level and 21.4% at the postgraduate level. Continuing education and on-the-job/apprenticeship training accounted for 17.6% and 15.3% of the responses, respectively. Colleges and technical/trade schools made up only 6.7% and 3.3%. The remaining responses (2.3%) were split between no formal program or another form of training like art school, construction experience, or peers.

Specifiers were then asked to describe the orientation of their design education. Because of obvious differences between architectural and engineering training, these two professional groups were segmented in order to produce more meaningful results. The majority of structural engineers, 60.9%, claimed that the orientation of their schooling was technical. Practical and scientific orientations were cited 19.9% and 17.9% of the time, respectively, while a business orientation was referred to

[1] Broken down into official census regions, the majority of American designers received their formal education in the West North Central, East North Central, and Middle Atlantic regions (with the most popular region being East North Central), while the majority of Canadian designers received their formal education in Ontario, Quebec, Alberta, British Columbia, and Manitoba (with the most popular province being Ontario).

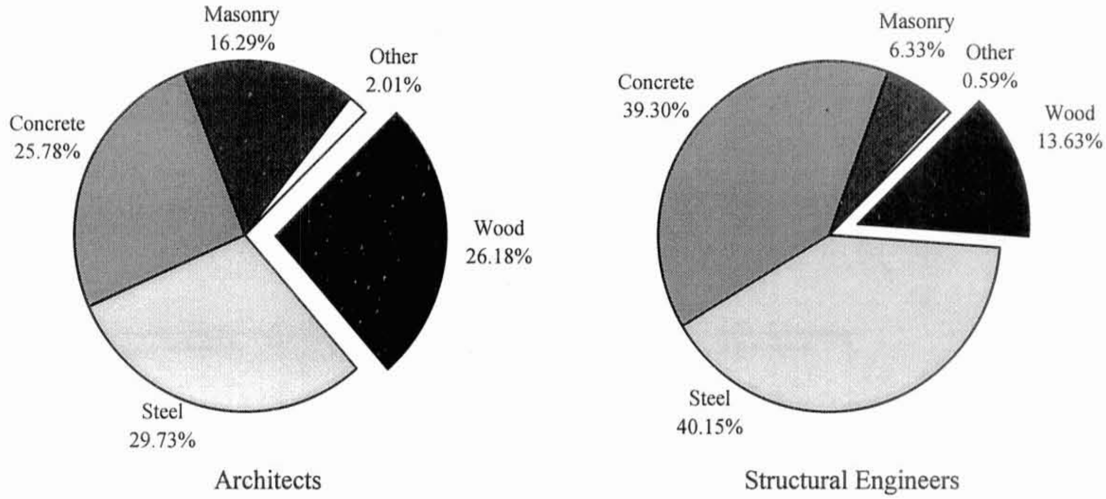

FIG. 2. Proportion of Time Spent Learning About Structural Materials at School for Architects and Structural Engineers.

only 1.3% of the time, and an artistic orientation was not mentioned at all. Conversely, architects cited artistic and practical orientations each 34.5% of the time and a technical orientation 26.3% of the time. Scientific and business orientations accounted for the remaining 2.7% and 1.9%, respectively. Thus, it can be said that structural engineers think of education as technical, for the most part. Conversely, architectural schooling is thought of in more artistic and practical terms.

Learning about structural materials

Next, specifiers were asked to comment on the process of learning about structural materials, both at school and on the job. Not surprisingly, 61.4% of the respondents stated that their design education has had an impact on the structural materials that they specify in their work today. However, just 15.8% claimed that they exclusively specify those materials that they learned about at school. This is substantiated by the fact that 75.5% of the respondents stated that most of what they have learned with regards to design concepts has been on the job, while only 24.5% said that it was at school. Almost all respondents (98.4%) indicated that most of what they have learned about product information has been on the job rather than at school. All of these results seem to indicate that while the role of education should not be diminished (this is where structural material use and the design process is first taught, after all), designers tend to learn more during the course of their professional careers.

That said, education is still a fundamental part of how a designer learns to use structural materials. With that in mind, specifiers were asked to estimate the proportion of time spent learning about structural materials that is devoted specifically to wood, steel, concrete, masonry, and other materials. Mean proportions were computed for both architects and structural engineers and results are seen in Fig. 2 One-way analyses of variance ($\alpha = 0.05$) and Bonferroni's test of differences were also performed on each professional group. For architects, no significant differences were observed in the times spent learning about steel, wood, and concrete. Significantly less time was devoted to learning about masonry, with other materials (plastic, aluminum, composites, tensiles/canvases) making up the remaining architectural teaching load. For structural engineers, the situation for wood is not nearly as favorable. Almost 80% of the time spent learning about structural materials at school is

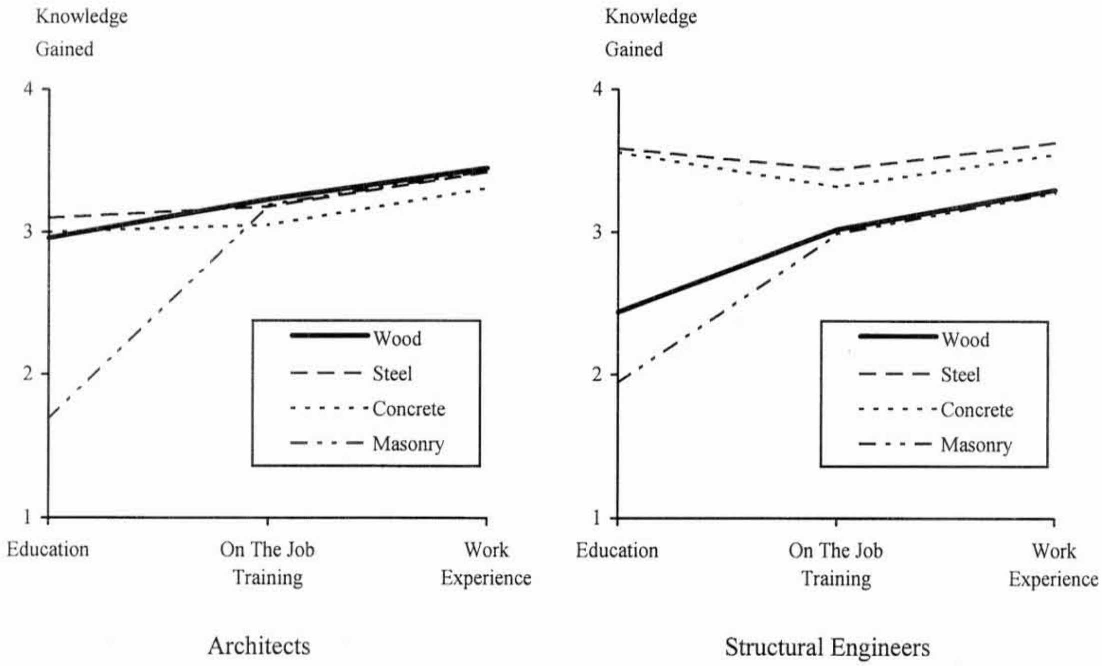

FIG. 3. Effectiveness of Various Methods in Gaining Knowledge about Structural Materials for Architects and Structural Engineers *(1—no knowledge of material gained; 2—little knowledge of material gained; 3—some knowledge of material gained; 4—much knowledge of material gained).*

devoted either to steel or to concrete (no significant differences were observed between these two materials). At one third of the levels of either steel or concrete, wood makes up a significantly lesser proportion of the engineering curricula (13.6%, which seems to validate Moody and Freas' 1987 findings), while the masonry teaching load is, once again, comparatively sparse. Finally, very little time is devoted to learning about other materials in engineering schools.

These results are in agreement with those seen in Fig. 3. Here, respondents were asked to rate three methods of acquiring knowledge about wood, steel, concrete, and masonry: their education, their on-the-job training, and their work experience. A four-point underlying metric scale was used to measure effectiveness of learning, as follows: *1. no knowledge of material gained; 2. little knowledge of material gained; 3. some knowledge of material gained; and 4. much knowledge of material gained.* Means of *knowledge gained* were computed for architects and structural engineers and are plotted in Fig. 3 by structural material. Here, a two-factor analysis of variance ($\alpha = 0.05$) was performed on each professional group. In each case, initial results indicated that highly significant interactions were taking place between the two factors: structural materials and methods of gaining knowledge. Upon further examination of Fig. 3, it was thought that the interactions were occurring in the education category (lines were not parallel for this factor). As a result, the education category was removed for both architects and structural engineers and the analyses re-run. As expected, there were no interactions in either of these models. This indicates that, for both design groups, the rate of acquiring knowledge does not vary by structural material between on-the-job training and work experience. In other words, while levels of knowledge may differ for each material at the workplace, the amount of new information that specifiers obtain about wood, steel, concrete, and masonry is consistent. Each industry seems to be promoting its structural products equally well.

The fact that interactions were taking place in the two-way analyses of variance meant that no other valid conclusions could be drawn pertaining to the two interacting factors: structural materials and methods of gaining knowledge. As a result, a separate one-way analysis of variance ($\alpha = 0.05$) was performed on each method of gaining knowledge for both professional groups. Bonferroni's test was employed wherever significant differences occurred.

For architects, average values for knowledge gained are all statistically similar for wood, steel, and concrete in all three categories. At school, *some knowledge* of each material is gained, increasing to a moderately higher level with work experience. Only masonry does poorly, with scores somewhat below *little knowledge of material gained.* However, masonry soon catches up to the rest of the materials with on-the-job training and work experience.

The picture is entirely different for structural engineers, where it can be seen that they primarily learn about steel and concrete throughout the entire span of their design careers. At school, the average scores for steel and concrete are statistically similar, lying between *some* and *much knowledge gained.* Conversely, the average scores for wood and masonry are statistically dissimilar, both from each other and from steel and concrete. Wood's score lies between *little* and *some knowledge gained*, while masonry's score falls slightly below *little knowledge gained.* Scores for steel and concrete decrease slightly with on-the-job training, but come back up to the same level with work experience. In the case of masonry and wood, scores simultaneously increase to *some knowledge of material gained* with on-the-job training, increasing to a slightly higher level with work experience. In both of these latter categories, steel and concrete cluster together at a significantly higher level than wood and masonry, which are again statistically similar.

The major difference between structural engineers and architects is that knowledge levels for steel and concrete are consistently very much higher in the engineering group. Conversely, levels for wood are somewhat higher for architects, while masonry levels remain approximately the same in both groups. For architects, knowledge of materials converges at work, while there is a distinct gap between steel/concrete and wood/masonry for structural engineers. Finally, architectural training at school puts far less emphasis on masonry, while engineers receive less formal training in both masonry and wood design.

The upward trend for most of the structural materials should also be noted (concrete and steel being the exception for structural engineers). In general, knowledge gained is lowest at school, increasing with on-the-job training, and maximizing with work experience. This validates the previously stated point that, with respect to structural materials, most learning is done on the job.

Promotional methods

Given the importance of learning about products, systems, and services on the job, respondents were queried about various methods of obtaining information at work. Specifically, they were asked to identify the promotional methods that were: 1) most common at their places of work; 2) typically used; and 3) most influential in impacting on their selection of structural materials. Selections were made based on the following list of promotional methods:

- **reading materials** (e.g., trade magazines, trade journals, trade books, text books, technical research, etc.);
- **manuals/data files** (e.g., design manuals, codes manuals, service manuals, fire protection manuals, span books, construction data files, etc.);
- **corporate (company-specific) promotion** (e.g., product manuals, company information packages/updates, product brochures/

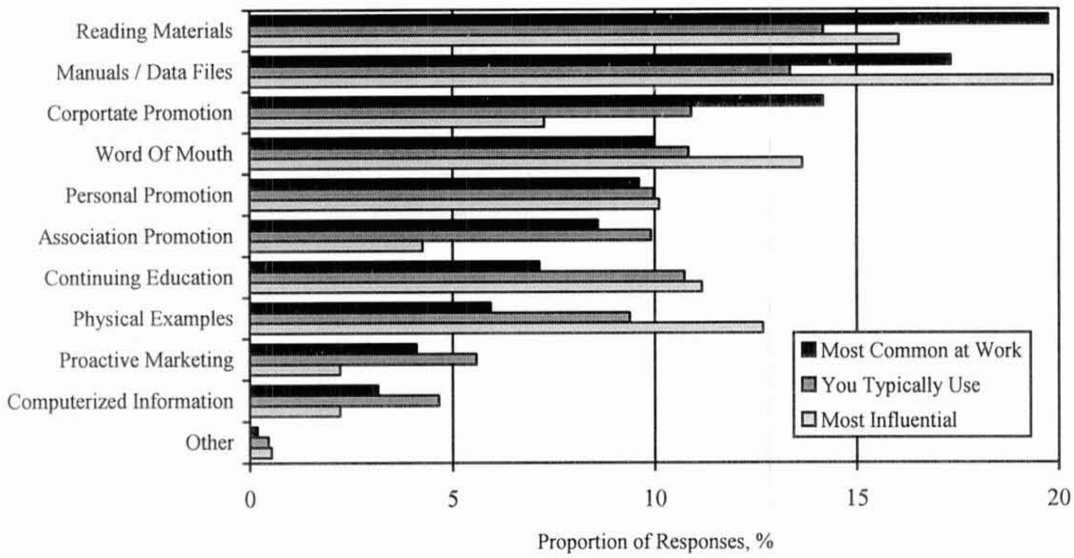

FIG. 4. Methods of Obtaining Product Information on the Job.

mailouts, third-party testimonials, advertisements, etc.);

- **association (industry-wide) promotion** (e.g., newsletters, updates, mailouts, etc.);
- **personal promotion** (e.g., personal sales calls and visits, customer service representatives, company/association representatives handling technical inquiries, company consultations, etc.);
- **continuing education** (e.g., information seminars, product seminars, short courses, lecture series, guest speakers, etc.);
- **word of mouth** (e.g., friends, peers, coworkers, clients, contractors, tradespeople, etc.);
- **proactive marketing tactics** (e.g., associations/companies costing projects, associations/companies submitting designs and drawings, etc.);
- **physical examples** (e.g., demonstration buildings, new buildings, exhibits, trade shows, case studies, etc.);
- **computerized information** (e.g., on-line data bases, internet, bulletin boards, design software, etc.)
- **other** (respondent to specify)

Proportions of responses were computed and are plotted in Fig. 4. From this figure, it can be seen that the most common forms of obtaining product information on the job are by reading materials, manuals/data files, and corporate promotion. These are followed by word of mouth, personal promotion, association promotion, and continuing education. Physical examples, proactive marketing, computerized information, and other miscellaneous methods (e.g., consultants and travel) are seen to be relatively uncommon methods of learning about new products, systems, and services.

The methods that specifiers typically use to obtain product information on the job correspond closely to how common they are. For example, the most prevalent methods, reading materials and manuals/data files, are also the most utilized. Two notable exceptions are continuing education and physical examples, both of which are used relatively frequently despite the fact that they do not commonly occur. These results were verified by asking designers which of the methods of obtaining product information were most influential. Here, manuals/data files are thought of as being the most influential, followed by reading materials. Word of mouth and physical examples are also seen as relatively effective means of educating specifiers about structural materials. These are

TABLE 2. *Methods of obtaining product information on the job by professional group.*

	Architects			Structural engineers		
	Most common	You use	Most influential	Most common	You use	Most influential
Reading materials	18.66%	13.83%	15.25%	20.12%	14.29%	16.33%
Manuals/data files	20.57%	13.36%	26.44%	16.17%	13.37%	17.53%
Corporate promotion	13.64%	11.11%	6.78%	14.36%	10.83%	7.44%
Word of mouth	10.77%	10.40%	10.17%	9.72%	11.02%	14.89%
Personal promotion	7.89%	9.57%	7.80%	10.23%	10.15%	10.92%
Association promotion	8.85%	11.47%	5.08%	8.51%	9.27%	3.96%
Continuing education	8.61%	11.11%	13.90%	6.62%	10.59%	10.20%
Physical examples	4.78%	6.97%	8.14%	6.36%	10.39%	14.29%
Proactive marketing	2.87%	6.38%	2.03%	4.56%	5.27%	2.28%
Computerized information	3.35%	5.67%	4.41%	3.10%	4.24%	1.44%
Other	0.00%	0.12%	0.00%	0.26%	0.59%	0.72%

followed by continuing education, personal promotion, and, to a lesser extent, corporate promotion. In comparison, association promotion, proactive marketing, computerized information, and other methods are seen as not being very influential. Two paradoxical trends should be noted here. First, corporate and association promotions, while relatively common, do not appear to be very influential to many specifiers. Conversely, relatively uncommon methods of obtaining product information, like word of mouth, continuing education, and physical examples, are seen as being influential.

In an attempt to determine how to most efficiently promote wood products to two very different groups of specifiers, the above analysis was segmented by profession. The results are seen in Table 2 for both architects and structural engineers. The methods of learning are ordered from most to least common (according to the combined ranking of architects and structural engineers).

On the whole, structural engineers and architects appear to be similar with respect to their methods of learning about new products/systems on the job. However, a few notable differences can be observed. For instance, the most popular methods of learning for architects are by reading materials, followed by manuals/data files. Each of these methods is approximately equally influential. For structural engineers, the inverse seems to be true. Manuals/data files are a little more common and far more influential than reading materials. Personal promotion seems to be somewhat more common and effective among architects, while the same is true for continuing education among structural engineers. Word of mouth is approximately equally common in both groups, although much more influential to architects. Computerized information, although relatively uncommon, seems to be more widely accepted in the engineering profession. Conversely, architects cite physical examples as being a more common, and much more influential, approach to learning about new products/systems. Proactive marketing is comparatively uncommon in both groups, although more so for structural engineers. Both professions find corporate promotion to be relatively common, although fairly ineffectual. The same is true for association promotion, which is even less common and influential.

Next, respondents were also asked to list the methods of obtaining product information which resulted in their exploring and actually using a new structural material. Proportions were again computed and are plotted in Fig. 5. The results obtained here verify those seen in Fig. 4. As above, reading materials, followed by manuals/data files and word of mouth, are the methods most commonly used in exploring and using new structural materials. Physical examples, corporate/personal promotion, and continuing education are seen

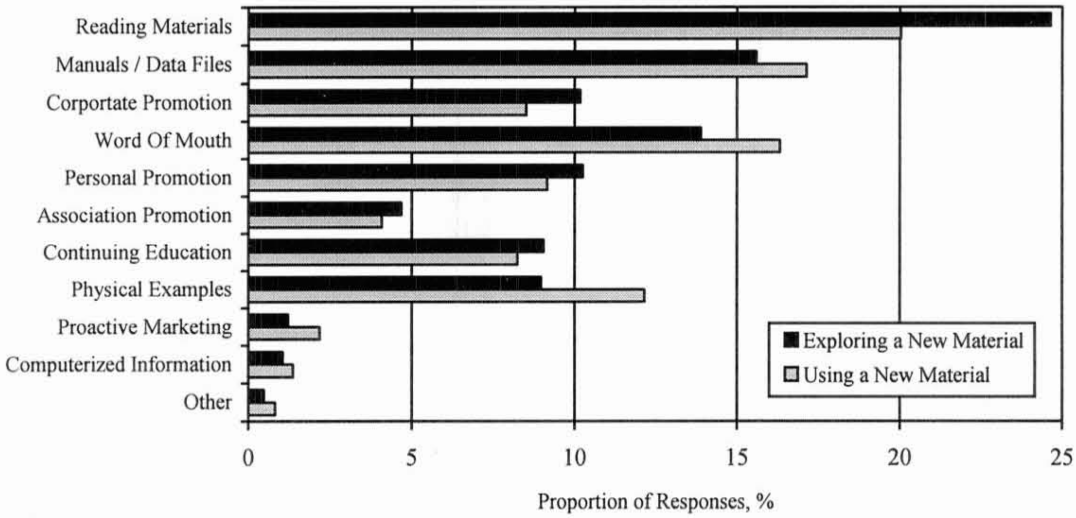

FIG. 5. Methods of Obtaining Product Information on the Job which Resulted in Exploring/Using a New Material.

as being relatively successful in terms of serving as a catalyst to the exploration and use of new materials. Finally, association promotion, proactive marketing, computerized information, and other methods are seen as being relatively unsuccessful in encouraging specifiers to explore and/or use new structural materials. It should be noted that, while most methods of obtaining product information result in more exploration than use, the inverse is true for manuals/data files, word of mouth, and physical examples (implying perhaps that these latter methods are more influential).

TABLE 3. *Willingness to use other structural materials in buildings four stories or less and key influences for material change.*

	Wood users (61.91%)	Non-wood users (38.09%)
Would not have used another structural material	24.03%	37.93%
A magazine/journal article	4.16%	2.13%
Simpler codes	5.39%	4.96%
Better text books	2.47%	2.48%
More technical research	5.86%	3.90%
A product seminar	5.08%	4.61%
A product mailout/brochure	3.39%	3.55%
An advertisement	1.54%	0.00%
Better design tools (manuals, software, etc.)	4.93%	6.74%
An association newsletter	0.92%	0.35%
A submitted design/drawing	4.01%	2.48%
A personal sales call/visit	3.85%	3.90%
A lecture/seminar	5.55%	3.55%
A peer/co-worker	5.24%	4.26%
An example/demonstration building	7.55%	6.03%
A trade show/exhibit	3.08%	1.77%
A case study	6.63%	6.74%
Other	6.32%	4.26%

Willingness to explore other structural materials

Specifiers were asked whether or not they had designed a building four stories or less in height using wood as the major structural component in 1993. The majority, 61.9%, said that they had and were subsequently asked to state which of the items listed in Table 3 would have encouraged them to change their minds and use another structural material. Conversely, the remaining 38.1% were asked to state which of the items listed would have encouraged them to change their minds and use wood. The majority of the respondents stated that they would not have used another structural material. It is interesting to note that 37.9% of the respondents would not have used wood, while somewhat fewer, 24.0%, said they would not have used another structural material. In other words, while wood users are somewhat amenable to the use of alternative structural materials, nonwood users feel more strongly about not using wood.

For those specifiers willing to use other structural materials (both the wood and nonwood users), the remainder of the responses were apportioned approximately equally (between 0% and 8% of the responses), with no items clearly offering the greatest inducement to change. However, several interesting trends did emerge; some of which verify the results seen above. For example, physical examples, like case studies and demonstration buildings, scored highly in both groups. Other items that scored reasonably highly include simpler codes, more technical research (especially with other materials), product seminars, lectures, and peers. Furthermore, a relatively large portion of the nonwood users state that better design tools, like manuals and software, might have encouraged them to use wood (this was true of wood users, as well, though not to the same extent). Association newsletters and advertisements, on the other hand, score very poorly in both groups. Trade shows, textbooks, and magazine articles (in the case of wood users) do not seem to fare very well either. Apart from the other category (which included cost considerations, lack of opportunities, and specification by other parties), the remaining responses were fairly evenly split at between 3% and 5%.

Finally, respondents were asked whether or not they would want to learn more about using wood in buildings of four stories or less. The majority of respondents, 66.9%, stated that they would, while 33.1% said that they would not. Respondents who said they did not want to learn more about wood use in buildings four stories or less were asked why. Nearly half of the respondents claimed that they already use wood. Over 15% stated that wood is not used in their area. An equal split, totaling slightly less than 20%, stated either that wood is not used in their firm, wood design is not part of their job, or that they are too busy. Less than 5% simply stated that they are not interested. Finally, a variety of other reasons were also stated, including environmental impact, wood not being suitable/adequate for the buildings that they design, and a general dislike of wood.

DISCUSSION

Two general approaches to overcoming the barriers to wood use in nonresidential construction are suggested. The first is in the form of an appeal to design schools to increase the amount of timber design taught at the postsecondary level. The second is a series of promotional campaigns aimed at increasing wood use among specifiers. The motivation here is to expand wood use by increasing product awareness among specifiers at their places of work—i.e., where the majority of knowledge regarding structural materials is acquired.

Of primary concern is the fact that many specifiers, especially structural engineers, learn little about wood design at the postsecondary level. It is essential that the forest products industry lobby structural engineering schools across North America to offer more courses in timber design. The results here clearly indicate that, compared to steel and concrete, the use of wood is not commonly taught in most engineering curricula. Furthermore, little is learned about the newly developed method of limit states design, as it pertains to wood (Kozak and Cohen 1996). Obviously, in terms of capturing market share in the nonresidential sector, this is a major problem. Wood cannot possibly be specified by structural engineers who possess little or no knowledge of its use. While this problem is not nearly as prevalent in the architectural schools of North America, efforts aimed at that discipline would likely prove beneficial as well.

Promotional marketing programs can also be implemented by the wood products industry as a means of capturing market share from steel and concrete in the North American nonresidential construction sector. As part of a larger study on specifiers' attitudes towards building materials in the nonresidential market, several target marketing strategies have been identified, but are not explicitly reported here (Kozak and Cohen 1996).

That said, promotional campaigns aimed at specifiers can take several forms. Furthermore, they can be directed at segments of the design population with varying product use levels (from non-users all the way to exclusive users). To promote the use of wood among specifiers in the nonresidential sector, specifically tailored target marketing programs should not only stress the advantages of wood use, but also alleviate the fears and negative perceptions that designers have toward wood products. In some instances, abating the fears of specifiers may prove challenging because some of their negative perceptions are, in fact, warranted. Here, the forest products industry must initiate and deliver research, coupled with concentrated promotional campaigns, to overcome these barriers to wood use. In cases where the negative perceptions are simply invalid, the marketing problem may prove simpler. Here, marketing plans designed to dispel these misconceptions must be implemented.

For example, marketing programs aimed at increasing wood use in low use segments should incorporate a series of individually tailored promotional campaigns which address some of the fears and perceptions (warranted or not) that specifiers have towards the use of wood products in nonresidential buildings (e.g., wood is combustible, not fire-resistant, unsafe, not strong, not long-lasting/durable, susceptible to deterioration/rot, inconsistently priced/delivered). Promotional strategies aimed at moderate use segments should be less intense in tone. Here, while the negative perceptions that specifiers have towards the use of wood products should not be ignored, the emphasis should be on the advantages to wood use in larger-scale, nonresidential buildings (e.g., wood is warm, inviting, comfortable, attractive, functional, inexpensive, adaptable, simple to install). Finally, promotional campaigns might also be aimed at appealing to high use segments in hopes that this would result in the successful implementation of a "pull" or "user-demand" strategy. Here, the benefits of wood use need not be sold to designers, although they may still be reminded. Rather, they should somehow be upheld as unconventional and avant-garde; designers whose buildings can be used as an example to the rest of the design community. Furthermore, if these experienced proponents of wood use are willing to be made available, they could serve as invaluable sources of information to less experienced designers. This, in turn, could effectively create "word of mouth" channels pertaining to the use of wood in a nonresidential context. Although this may be overstating the case somewhat, this might just be the kind of approach required to increase the share of wood products in both the moderate and low use segments (Kozak and Cohen 1996).

As a cautionary note, it should be stated that the above marketing programs should serve as general guidelines and not strategic recommendations. Promotional campaigns need not be limited to addressing a few attributes to a limited audience. For example, an obvious product trait, like wood's aesthetic appeal, could easily still be at the forefront of any marketing program aimed at overcoming specifiers' negative perceptions. Furthermore, marketers may wish to include some of the drawbacks to using alternative structural materials, like steel, concrete, and masonry.

This analysis clearly shows that the implementation of marketing plans aimed at designers should take their respective professions into account. While architects and structural engineers have similar objectives in terms of building design, their professions are very different. It is the job of an architect to conceptualize a building, while the structural engineer helps to realize this design by ensuring the structural integrity of the building. As such, both professions have different sets of wants and needs in terms of structural material use. However, for the most part, both groups play integral roles in the material specification process and as such, should both be targeted (Kozak and Cohen 1996). In other words, promotional campaigns aimed at architects and structural engineers should be coordinated, yet vary accordingly.

For both professions, efforts to increase the use of wood in the nonresidential sector should include some form of reading material, manual, and/or data file (architects and structural engineers rate these methods similarly in terms of effectiveness). However, the results of this analysis clearly indicate that specifiers prefer not to have these materials put out and/or sponsored by industry associations (although not included in the study, an alternative source for these materials might be nonaligned institutes and/or academia). With an emphasis on *material* considerations, strategies aimed specifically at structural engineers should also incorporate continuing education programs and demonstration buildings. Likewise for architects—but with an emphasis on *building* considerations—the use of physical examples, coupled with continuing education, is recommended. However, it is also important that companies embody some program of personal promotion by employing staffs of sales people and technical representatives who are readily available to support and assist architects in their design decisions. Finally, it is noteworthy that that both design professions place a great deal of importance on word of mouth. Unfortunately, it is very difficult to exploit this as a means to educate specifiers (with the possible exception of lecture series by noted professionals favorable to wood use). Nonetheless, a climate that places a high value on the opinions of peers is more conducive to new and well-regarded products being rapidly accepted in the marketplace.

CONCLUSIONS

Wood can and should be used more frequently in a nonresidential context. Understanding how architects and structural engineers learn about building materials is key to increasing the use of wood products in this market. For companies wishing to make inroads into this sector, the inclusion of any or all of these recommendations in their strategic plans would likely prove fruitful in capturing market share from steel and concrete. This is especially true in the case of the promotional campaigns that are being advocated (lobbying postsecondary design schools may require more of a cooperative, industry-initiated effort). However, these results should be treated as general guidelines. Marketing programs may vary by geography, media, niche, or product attribute, to name but a few examples. It is up to individual companies to develop and implement specifically tailored marketing strategies that serve to penetrate the lucrative nonresidential sector and increase the share of wood use.

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