

2006-2576: DEVELOPMENT OF A CONSTRUCTION MANAGEMENT SPECIALIZATION IN DEMOLITION AND RECONSTRUCTION

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Development of a Construction Management Specialization in Demolition and Reconstruction

Abstract

This paper details the development of a curriculum for a specialization in demolition and reconstruction within a construction management program in a college of technology. At present, an assistant professor faculty position has been funded, and an introductory three-credit course has been developed and offered. The introductory course is being taught for a second semester to an audience of approximately two dozen students. There will be three additional courses developed to provide interested students with a twelve-credit specialization in demolition and reconstruction management. Demolition industry contractors and equipment manufacturers are supporting the development of the curriculum. Opportunities exist for industry professionals to help shape the course offerings by reviewing proposed course descriptions and syllabi, by providing access to information and data for case studies and by presenting occasional guest lectures. In the area of scholarship, faculty will be able to study practical problems faced by the demolition and reconstruction segments of the construction industry. These research projects will help the industry overcome challenges, will provide faculty with field experience that can be shared in the classroom and, through publication, will help to build a body of knowledge for the demolition and reconstruction segments of the construction industry.

This paper will be of significance to those interested in demolition and reconstruction education in addition to those seeking to develop new curricula, particularly specializations. Specifically, this paper will detail the process from engaging an industry segment or segments to developing the actual courses in the newly developed specialization.

Background

Construction is central to the basic human needs of “food, shelter and clothing.” From the moment that people stopped living in caves, they became constructors by necessity. Therefore, construction is arguably one of the oldest “industrial” activities carried on by human beings. It was not until the last half of the twentieth century that post-secondary programs in construction management, construction technology and construction engineering began to develop in the United States. Many of these programs were started with the active involvement of the Associated General Contractors of America (AGC). The Accreditation Board for Engineering and Technology (ABET) accredited its first bachelor’s degree construction engineering program in 1958 and its first associate’s degree in construction technology program in 1963.¹ It was not until 1974 that the American Council for Construction Education (ACCE) was formed, and it began accrediting construction management programs shortly thereafter.²

At first, most programs were dedicated to building construction with an emphasis on commercial, institutional and light industrial projects. Graduates of these programs had a positive impact on the industry, and more general contractors sought college-educated constructors. As industry demand and support grew, degree specializations were developed in building construction (in both residential and commercial versions), heavy-highway construction,

mechanical construction and electrical construction. These segments of the industry are large enough to encourage a following at many institutions offering a construction degree. However, these specializations have addressed rather broad segments of the construction industry while providing limited content in industry segments such as demolition.

The next level of degree specialization in construction will need to be more focused. A narrowed focus, by definition, considerably reduces the amount of support that can be expected from industry in terms of both financial donations and demand for graduates of the specialization. Purdue University's Department of Building Construction Management has determined that it will lead the way into the next tier of construction degree specialization by adding specializations in Demolition and Reconstruction Management and Healthcare Construction Management. The Demolition and Reconstruction Management specialization is believed to be the first of its kind, and it will be the focus of this paper. The techniques used to develop this specialization can be applied to any number of construction management curricula.

Demolition and reconstruction are materially different from new construction in that the degree of uncertainty is much higher. In new construction, the design professionals dictate (or least attempt to dictate) all aspects of the project other than soil conditions and weather. In many demolition projects, there may not be any "design" other than a decree to remove a certain structure from the site. Even when drawings for the structure are available, it is possible that "as-built" conditions were not accurately recorded. On a reconstruction project, the design professionals often attempt to uncover the secrets that the structure holds, but it is not physically possible without great expense to look inside walls and floor and roof structures. Therefore, constructors on the demolition and/or reconstruction project are more likely to encounter the unknown than their counterparts on new construction projects.

Preliminary Exploration

In 2002, the department reached out to the National Association of Demolition Contractors (NADC) (the organization has recently changed its name to the National Demolition Association (NDA)) to ascertain how construction management programs could help prepare students for employment in the demolition industry. After the department head attended four quarterly board meetings and three annual national conventions, a relationship between Purdue University and the NDA was formed. The NDA's Board of Directors committed to supporting the development of a degree specialization in Demolition and Reconstruction Management. In addition to reaching out to the NDA, several meetings were held with the board of directors of the National Association of the Remodeling Industry (NARI) to discuss possible educational and research partnerships.

The NDA appears to have two motives for getting a specialization developed. The first motive is a desire to improve the professional image of its discipline. The second motive is a need to attract college graduates that can be groomed to become the next generation of industry managers, leaders and perhaps owners. The desire of industrial groups to expand the professionalism of their industry is a trend that has the potential to impact post-secondary construction education. The basis for professionalism can be observed by examining disciplines that, through self-regulation or government regulation, have evolved to become "professions" as

commonly viewed by the general public (doctors, lawyers, architects, and professional engineers). Some of the criteria typically cited include³:

- A systematic body of theory, which affects professional skills and training
- Sanctions of the professional community through licensing accreditation, and privileged communication
- A professional culture
- A professional authority
- A regulative code of ethics

The demolition and reconstruction industry segments are a significant employer of skilled and semi-skilled labor. However, the industry is populated by thousands of small organizations employing relatively few people within each company. To overcome the organizational shortcomings of the industry, small employers have joined together into professional associations such as NDA and NARI. These associations provide training and professional development programs that are widespread and diverse, but are difficult to administer uniformly. University-level education has the potential to meet some of the needs of the demolition and reconstruction community in its quest to standardize the primary criteria of professional development. By codifying and teaching a systematic body of theory, educators can provide the basis for professional certification. This body of knowledge, supplemented by ethical training throughout the university curriculum, has the potential to support the industry's criteria for professional status.

Industry Participation

Support from the NDA and its membership has been instrumental in the startup of the specialization at Purdue University. There are many areas of support that are necessary to ensure the success of the specialization. Financial support is the first component. The NDA has committed to direct financial support and fundraising to underwrite the first two years of the specialization. This "seed" money provides an assistant professor position to develop and teach courses as well as to encourage interest in the specialization within the student body through presentations and activities. The Dean of the College of Purdue has agreed to continue the position beyond the first two years as a strategic hire. A secondary responsibility of the demolition and reconstruction professor is to build interest within the academic community through papers and presentations such as this narrative. Salary support is also central to providing the professor some release time to become fully educated in the subject matter and to outline a research agenda that is responsive to the needs of the industry segment. The second component of industry involvement is advisory in nature. Construction is a practical and applied field, and the input of practitioners is particularly valuable in reviewing syllabi and course content. The NDA's education committee has been very helpful in its advice to the instructor of the introductory course. The department's industry advisory council also provided comment on the reconstruction aspects of the course.

Another area of support has been the willingness by member companies to share case studies and methodologies for tasks such as cost estimating, safety and risk management. Historically, the construction industry has tended to be secretive when it comes to sharing cost data and management techniques. Contractors often behave as if they have a better mousetrap that must

be shielded from outside eyes since a significant portion of construction work is contracted via competitive bidding. Anecdotal evidence suggests that companies submitting bids without adequate margin or below direct cost tend to be ones that do not have a high level of sophistication. Therefore, it may be argued that when the more sophisticated employers share information with instructors who can help educate the future employees of competitor firms, the contributing firms are helping to professionalize the industry. The challenge that must be overcome in developing instructional material for the demolition and reconstruction specialization is to convince industry participants that, in the long run, sharing information with educators will create a better business environment by reducing the prevalence of unsophisticated firms which tend to drive margins downward.

Guest speakers from industry, when carefully coordinated with the syllabus, are another way to support the development of the specialization. The NDA has provided several enthusiastic, knowledgeable guest speakers from the ranks of its membership for the introductory course offering. This help is particularly appreciated since there are not any domestic textbooks regarding demolition that could be used for a college-level curriculum. Therefore, the body of knowledge that would ordinarily be captured in book form is nonexistent. The donation of time and expertise by members of industry is invaluable in providing a context for the content of the course. Funding scholarships with the intention of encouraging students to complete the specialization is another means of support that will heighten awareness of the specialization among students. The downside of allocating scarce resources to scholarships is that a limited number of students benefit. Thus far, scholarships targeting the demolition and reconstruction specialization have not been explored at Purdue University.

The ultimate show of support for the specialization will be for demolition and reconstruction contractors to hire graduates of the degree specialization on a continuing basis. The department's placement coordinator will be working toward coop experiences and internships with demolition contractors both before degree specialization graduates are available and on an ongoing basis. These fixed-term employment relationships are a great method for prospective employees and contractors to try each other out. They also allow the student to sample an industry segment that they might not have otherwise pursued. At the same time, the employing firm has an opportunity to determine what a college-trained professional can bring to the firm without paying the salary a graduate would command. One student was employed by a demolition contractor in the summer of 2005 and at present, at least one student has a job with a demolition contractor for this coming summer. However, the finished product of a curriculum is a graduate, and a market must exist for graduates in order for the specialization to succeed. In the final analysis, the graduate must meet the requirements of industry in order to satisfy the market. The ultimate goal of this new specialization is to provide valuable employees to the demolition and reconstruction industry segments.

Initial Course Offering

The Introduction to Demolition and Reconstruction Management course mirrors many of the general requirements of a traditional construction management curriculum, including coverage of construction science, planning, regulation, estimating, safety, project management, and business management. Special emphasis was placed on contrasting demolition and reconstruction

activities with new construction. The limitations of a single three-credit semester course prevent an in-depth treatment of any major topic. Consequently this course concentrates on processes and activities that are required by demolition or reconstruction that might not be encountered in new construction. Since these activities require coordination with existing project conditions rather than execution of construction plans and specifications that start with a blank sheet of paper, the intricacies in management of unknown or unexpected conditions were emphasized.

Course Outline – BCM499C Introduction to Demolition and Reconstruction Management

Week #	Major Topic	Instructional Activities
1	Demolition & Reconstruction Vs. New Construction	Lecture, Introductory Video & Discussion
2	Demo & Reconstruction Regulations	Lecture & Discussion Student Research & Presentations
3 - 5	Techniques & Technologies	Lecture & Discussion Group Case Study Research & Presentations
6	Labor & Equipment Utilization	Guest Speaker Student Research & Presentation
7 - 8	Estimating & Cost Control	Lecture & Discussion Guest Speaker In-class Estimate
9	Dealing with Historic Properties	Lecture & Discussion
10	Project Management/Operations	Guest Speaker
11	Material Reuse & Recycling	Lecture & Discussion Group Research & Presentations
12 - 13	Safety/Risk Management	Guest Speakers NDA Safety Videos
14 - 15	Group Project Presentations	Report & Formal Presentations
16	Business Management & Wrap-up	Lecture & Discussion

It was anticipated that this introductory course would be utilized by many students as an elective regardless of their prospective career direction; however, 19 students of the approximately fifty enrolled to date expressed an interest in working in the demolition industry. The support of guest speakers from the demolition industry was employed to take full advantage of this opportunity to inform future construction managers of circumstances where general contractors frequently mismanage or misunderstand the demolition process. The guest speakers, as experienced practitioners, presented credible instances of demolition work that had been handled inappropriately and how similar situations could be avoided. Examples of successfully executed projects were also related to students. Close coordination of the subject matter presented by each guest speaker provided the opportunity for specific demolition topic coverage using actual project examples.

Many educators utilize a model developed by Kolb to describe the way in which student move through a cycle as they learn. Kolb describes the steps in the cycle as concrete experience, abstract conceptualization, reflective observation, and active experimentation.^{4,5} Through the use of instructional activities that support different aspects of the Kolb cycle, instructors can help

students move through the four stages.⁶ The activities chosen to support concrete experience in Introduction to Demolition and Reconstruction Management were group work and project specific examples. Discussion and reflective papers supported reflective observation. Lectures and written reports were used to advance abstract conceptualization, and case studies and projects were assigned for active experimentation. Where possible, multiple instructional activities were utilized for each major topic covered in the course. The final educational activity in the course consisted of a small group research project culminating in a written report and formal presentation. Students selected a topic with approval from the instructor. Project case studies were encouraged and chosen by more than 25% of the groups. Students were expected to utilize a variety of source materials that could include personal interviews and project field visits.

This introductory course was offered to all students without prerequisites. As expected the registered students tended to be predominantly juniors and seniors. The introductory nature of the material allowed the sophomores taking the course to participate fully. Introduction to Demolition and Reconstruction Management is being offered again in the spring semester of 2006 without prerequisites. The spring enrollment for the course is 23 and 25 students attended the first offering.

Future Curriculum Development

The demolition and reconstruction management specialization represents the fifth specialization developed at Purdue University. Other specializations consist of three existing specializations (residential, electrical and mechanical construction management) and one developing specialization (healthcare construction management). A sixth area being contemplated for the future is heavy-highway construction management. The “default” specialization in the degree program is commercial building construction. A degree specialization typically entails a total of twelve semester hours (four three-credit courses). In two of the three existing specializations, students take one required course and three electives related to the specialization. It is unclear at this time whether or not one of the four courses related to Demolition and Reconstruction Management will be required of all students.

In order to leverage resources effectively and to ensure adequate course enrollment, the concept of multi-disciplinary specialization courses is being explored. For example, a course focusing on heavy equipment utilization that includes concrete recycling could serve double duty for students in demolition and reconstruction as well as a heavy-highway specialization. The latter would be served directly through the addition of paving equipment to the course. The similarities between rock crushing and concrete recycling would suffice for both specializations. The basic technology and terminology related to explosives for demolition by implosion also would apply to blasting for quarrying operations. While it is often advantageous for students to have a specialization on their resume, it is likely that most students seeking a specialization will be employed in another industry segment at some point in their careers. Another advantage of multi-disciplinary specialization electives is that the student has the opportunity to learn not only what they seek within their chosen specialization but also something useful from another industry segment.

Another example for crossover content would be in the area of selective demolition and remodeling with the healthcare construction management specialization. Hospital facilities are under almost constant renovation as medical treatment technologies, patient age demographics and patient demand for comfort amenities evolve. Infectious control represents one of the more challenging aspects of selective demolition and remodeling to hospital constructors. Hospitals (as well as other structures) pre-dating the 1970's may be home to hazardous materials such as asbestos, PCB's and lead paints. Demolition contractors are often the first to encounter these hazards which represent a challenge whether they are to be encapsulated or abated and landfilled. It is hypothesized that a course focusing on selective demolition and remodeling could serve both specializations equally well.

In addition to a heavy equipment course, a selective demolition and remodeling course, and a "capstone"-style course in demolition and reconstruction management are planned to round out the specialization. These three courses provide an opportunity to further address areas that cannot be adequately covered in an introductory course. The addition of more case studies and field trips will be beneficial and could be incorporated into the capstone course which likely will include a formal laboratory session. The inclusion of detailed case studies in the capstone course will allow students to gain insight into the information and challenges an owner or developer must sift through and overcome while generating a pro forma for a project. A significant portion of the capstone course would be devoted to upper-level company management topics related to demolition and reconstruction. Issues related to sustainability and design for deconstruction will likely be left to a future graduate-level course.

Future Discipline Development

As mentioned previously, there is not a college-level textbook on the subject of demolition. Writing a comprehensive textbook would be a challenge from the faculty member's viewpoint, but at least one industry expert has agreed in principle to participate as co-author in the creation of a textbook. Availability of a text will lower a barrier to other institutions exploring demolition and reconstruction courses. While it is not practical for every institution offering a construction degree to get involved in this specialization, it is hoped that a few colleges and universities will address demolition in their curricula. It is the understanding of the authors that at least one university in the southwest is exploring demolition education. In order to expand the body of knowledge for demolition and reconstruction, it is important that the other institutions take up the specialization at least on a regional basis. Development of a set of academic peers will benefit the specialization through better reviews of papers and critiques of research results. A set of peer institutions for demolition and reconstruction is important to ensure that faculty will have adequate opportunities to share ideas and to build upon each other's work. There will be limits to how many institutions any one industry segment can underwrite. Nevertheless it will be necessary to offer similar support to a few other institutions in order to accelerate the maturation of the discipline in the academic environment.

Potential Research Directions

Activity in demolition and reconstruction appears to garner little attention from academics. For example, a search of the American Society of Civil Engineer's (ASCE) search engine for the

Journal of Construction Engineering and Management yields zero entries containing either the word “demolition” or the word “reconstruction” in the abstract, title or keywords. Furthermore, a search for “demolition” in the full ASCE online research library returns only 51 hits out of over 29,000 documents available, and a cursory review of these items reveals that perhaps as few as eight of these 51 documents would be of interest to a demolition contractor. A similar search for “reconstruction” yields 151 documents with only 19 of these related to building reconstruction. Eight of these 19 documents may be of interest to building reconstruction practitioners. Research in demolition and reconstruction segments of the construction industry has historically been minimal. As land resources become more guarded and transportation costs encourage redevelopment of central cities, demolition and reconstruction will become an important component of the construction industry and deserving of more research attention.

A few potential areas of research have become apparent in the limited time that the authors have been studying and interacting with demolition contractors. Specifically, there is still some uncertainty about the best approach to demolishing post-tensioned structures. Projects incorporating unbonded tendons have the potential to be particularly hazardous during demolition and reconstruction activities. Post-tensioning is a relatively modern construction technique, and subsequently not many of these structures have reached the end of their useful lives. Demolition contractors will encounter facilities that have incorporated this structural technique with increased frequency as we move into the future. A best practices manual should be developed to assist contractors in safely mitigating the inherent hazards associated with demolition and reconstruction of post-tensioned structures.

Another area where research could benefit the industry is scientifically determining how the wear and tear on construction equipment is accelerated by involvement in demolition activities. Many of the same types of equipment that are routinely used in earthmoving work are also used in demolition work. As an example, an excavator can be fitted with any number of crusher, grapple or shear attachments in lieu of a bucket. Some of these attachments can rival the excavator itself in terms of cost. Most industry cost data sources for equipment are based upon earthmoving activities which use a simple bucket instead of complex, expensive attachments. These earthmoving activities are inherently less stressful on the equipment. If a project owner insists on using the “standard rental rate” for the excavator that is based upon earthwork activity, the demolition contractor is under-compensated for the wear and tear on the excavator. In addition they may not be compensated at all for the use of the attachments. Anonymous accurate sharing of operating cost data by contractors will be required to scientifically approach the rental rate problem. The entire demolition industry can benefit when adequate data to establish industry segment-specific rental rates is made available.

A third topic that is apparent is the area of workforce development and training research in demolition and reconstruction. The construction industry as a whole is facing a shortage of young people entering the industry’s workforce. Demolition work certainly is perceived to be more hazardous and dirty than many other segments of the construction industry. It could be beneficial to demolition contractors to know what the perceptions of prospective workers are toward their segment of construction. Many demolition laborers are of Hispanic origin and may have challenges with English; however, safety is very important in the demolition industry and

this language barrier may be an impediment to safety performance for Hispanic workers.⁷ Workforce development and training represents a significant area of potential research.

As LEED certification becomes more and more popular, the opportunity to obtain additional “points” through careful salvage and recycling (in lieu of landfilling) becomes important in projects that require demolition effort. The authors recently attended a Building Materials Reuse Association annual conference. It is obvious that there are a multitude of opinions on what is deemed “reuse.” For some attendees, it is as simple as recycling as much of the waste stream as possible. For others it means some salvage work is incorporated into the project. For others, it means salvaging every single 2x4 stud and pulling the nails out of it for reuse. It is obvious that research into the impacts of liability (e.g., insurance), regulation (e.g., EPA, OSHA), labor (e.g., union work rules) and economic markets (e.g., raw material and second-hand retail markets) could be of value in helping owners and industry practitioners to decide how to approach a demolition and reconstruction project.

Applications to Other Specializations

The curriculum development techniques presented in this paper are not unique to demolition and reconstruction. In fact, it is suggested that this approach, with minor modifications, can be applied to virtually any segment of the construction industry. For example, future academic specializations in construction could include concrete, masonry, steel, tenant improvement (build-out), utility, railroad and other segments of the construction industry. However, the threshold, and most crucial activity, is to engage an industry association and to determine its level of interest in and ability to support a degree specialization. Without industry financial support and employer demand, there is little reason to develop a new degree specialization.

Conclusions

Over the last sixty years, many associate of science and bachelor of science degree programs in construction education have been developed across the United States. Graduate-level programs have also been developed. The vast majority of these programs have been directed at broad divisions of the construction industry with three areas receiving the most attention: non-residential (commercial, institutional and industrial) building, residential building and heavy-highway construction. Several programs have further specialized in mechanical or electrical construction. It is only logical that further specialization into other expanding industry segments may be necessary as construction management, general contractor, mechanical contractor and electrical contractor firms raise the bar in terms of the professionalism that is derived from a formal college education. Demolition, concrete, steel, carpentry, roofing and other specialties are industry segments that are potential areas of specialization in undergraduate construction management education.

The Demolition and Reconstruction Management specialization at Purdue University is the first of its kind and may be one of the first construction specializations to focus on a relatively narrow industry segment. It is hoped that some other institutions will begin to address this segment of the industry either with a specialization or course electives. By expanding the number of courses taught for and the research projects directed at this industry segment, a body of knowledge can

be developed to further professionalize demolition and reconstruction. While it is not likely that every construction program will be able to address the segment, it is a reasonable goal that some of the larger construction management, technology and engineering programs will begin to do so. As barriers to unrestricted land development grow, transportation costs increase and a desire to preserve our architectural heritage continues to thrive, the need to redevelop our urban areas will drive the demand for constructors with a working knowledge of demolition and reconstruction.

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