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Safety and Health Education for Demolition and Reconstruction

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Safety and Health Education for Demolition and Reconstruction

Abstract

In the fall semester of 2005, the Department of Building Construction Management (BCM) at Purdue University, located in West Lafayette, Indiana, USA, offered their first course in Demolition and Reconstruction Management. This first college level course developed with input from the demolition industry, offered in the newly created demolition and reconstruction management area of concentration, mirrors many of the general requirements of a traditional construction management curriculum. These include coverage of construction science, planning, regulation, estimating, safety, project management, and business management as they apply to projects that do not begin with a vacant site and a blank sheet of paper. During course development it became apparent that demolition and reconstruction activities present specialised safety considerations due to the high risk of accidents, injury, and potentially deleterious health effects presented by these activities. As contractors participate with increasing frequency in projects that involve existing built environments, there is a growing need for expansion of the safety training provided. This paper examines areas of demolition and reconstruction related safety that are frequently overlooked in construction management safety and health training.

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Abstract

In the fall semester of 2005, the Department of Building Construction Management (BCM) at Purdue University, located in West Lafayette, Indiana, USA, offered their first course in Demolition and Reconstruction Management. This first college level course developed with input from the demolition industry, offered in the newly created demolition and reconstruction management area of concentration, mirrors many of the general requirements of a traditional construction management curriculum. These include coverage of construction science, planning, regulation, estimating, safety, project management, and business management as they apply to projects that do not begin with a vacant site and a blank sheet of paper. During course development it became apparent that demolition and reconstruction activities present specialised safety considerations due to the high risk of accidents, injury, and potentially deleterious health effects presented by these activities. As contractors participate with increasing frequency in projects that involve existing built environments, there is a growing need for expansion of the safety training provided. This paper examines areas of demolition and reconstruction related safety that are frequently overlooked in construction management safety and health training.

1. Introduction

Construction management (CM) education in the United States during the twentieth century was fundamentally concerned with new construction. This concentration was a logical response to the needs of the industry since the majority of work involved vacant sites and all new construction.

In recent years, the construction organizations serving on Purdue University's Department of

Building Construction Management's Construction Advisory Council have reported increasing activity that involves work on existing structures or infrastructure.

As the built environment within the United States ages, it is anticipated that opportunities in demolition and reconstruction will continue to expand. In a recent survey of owners responsible for facility construction and maintenance, FMI, a management consulting and investment banking firm to the building and construction industry, and the Construction Management Association of America (CMAA) outlined a set of seven challenges they believe will cause construction markets to change direction in the near future. The first challenge outlined indicated that "Aging infrastructure in nearly every market segment is at or beyond its current useful life...represent(ing) trillions of dollars in necessary spending over the next 10 to 20 years to upgrade and replace these assets" (D'Agostino et al., 2007).

Identification of a need for college level education in demolition is not unique to the United States. In the spring 2008 issue of *Demolition Engineer*, a publication of the British Institute of Demolition Engineers, it was noted that demolition industry changes in the last 20 years have introduced stringent legislation, greater levels of administration, and increases in the complexity of demolition. These changes have moved the industry toward a greater level of professionalism with a need for demolition specific college courses. Construction education was suggested as a possible entry to demolition, yet specific challenges encountered in demolition, most notably the complexity of waste management, were not a topic of study in construction programs in the United Kingdom.

Many misconceptions are held about the activities of demolition contractors by the general public, general contractors, and young construction management professionals. The most frequently cited misconceptions include the belief that demolition contractors primarily “blow-up” buildings, recycle very little, operate unsophisticated businesses, and can successfully complete demolition activities with little knowledge or experience (National Demolition Association, 2009). As a result, the National Demolition Association (NDA), which represents more than 1000 demolition contractors in the United States and Canada, perceived a need for university construction management programs that include demolition in their undergraduate curriculum. The board of directors of the NDA has expressed a need for courses that will help the general contractors and construction managers of the future better manage the demolition process in addition to providing students with a background appropriate for employment in the demolition industry.

Through the encouragement of the National Demolition Association and the perceived need for an educational offering that includes the special requirements of demolition and reconstruction activities of all types, Purdue University’s Department of Building Construction Management (BCM) has developed an area of concentration in demolition and reconstruction management. During the development of the first course offerings it became apparent that many safety and health issues in demolition and reconstruction should be presented. Some of the most prevalent of these safety and health concerns are described in this paper for consideration as important topics for inclusion in all construction management safety training programs.

2. Demolition and Reconstruction Curriculum Development

Demolition and Reconstruction Management (DERM) is one of 6 BCM areas of concentration that offer elective coursework leading to a transcript designation denoting completion of specialised study. The two DERM courses currently offered mirror many of the general requirements of a traditional construction management curriculum. Special emphasis is placed on contrasting demolition and reconstruction activities with new construction. Courses concentrate on processes and activities that are required by demolition or reconstruction that might not be encountered in new construction. Since these activities frequently 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 are emphasized.

Because the DERM concentration was the first college-level attempt to offer a series of demolition specific courses in the United States that the author is aware of, there were several challenges to overcome in developing the curriculum. The primary impediment was the lack of a textbook or professional handbook. A secondary, but nonetheless significant issue was the limited demolition-related experience of the instructor. The National Demolition Association (NDA) offered the expertise of its board of directors through syllabus critiques, guest speaker appearances, job-site photography visits and virtual field trips. One immediate benefit that accrued to the author through the use of industry practitioners as guest speakers was an expanded knowledge of demolition operations. Interaction with practitioners through the curriculum planning process inculcated a curiosity to delve deeper into the subject matter. These planning interactions provided further opportunity to question and probe for understanding (Behling and Shaurette, 2007).

Hiring faculty to develop the curriculum and teach the courses in this specialised area was hindered by the combined requirements of extensive experience in the content area of demolition that the new faculty member was to teach and the preference for a candidate with a Ph.D. in a related field. The author, possessing both a Ph.D. and extensive construction experience was selected, even though his demolition specific experience was limited. This limitation required a rigorous exposure to demolition activity in a manner that allowed a thorough introduction to the work requirements of the demolition industry in a short period of time. A faculty internship was chosen as a means to obtain the new knowledge and experience. The author's faculty internship experience was not simply one of faculty development or keeping up with change. Instead, the need was to identify and define subject areas that demolition practitioners require to be competent in their field that are not currently included in the CM curriculum. As noted by Baha and Glon (1988), this internship was to help make the author an expert in the field. Because employment with a single company during summer breaks would have been inadequate to provide the breadth of experience necessary, twenty project visits in eight states were arranged with nine separate demolition contractors (Shaurette, 2010).

During the development of the first few years of course offerings in this specialisation it became apparent that more needed to be done to ascertain the specific knowledge and skills that demolition contractors would require of future demolition project managers. To gain a better understanding of these industry needs, guidance was obtained from members of an education committee of the National Demolition Association Board of Directors. This NDA advisory committee is made up of demolition company owners and senior managers from small, medium,

and large firms operating in geographically diverse areas of the United States (Pacific Northwest, South, Midwest, and National). The data collection process was a form of group needs assessment specifically designed to identify the course topics that the demolition industry identified as necessary for students who would be hired in entry level management positions by demolition contractors. The group members' knowledge and experience enabled them to identify and rank educational needs. To avoid an unstructured collection of data that could be dominated by high ranking, outspoken, strong willed or better prepared individuals, the nominal group technique was used to promote active participation by all group members (Bickman, & Rog, 1998).

Table 1 includes the results of the nominal group process to identify demolition topics that should be included in the demolition and reconstruction plan of study. Many of the topics are covered in depth in the core CM curriculum at Purdue University. Some of the topics are covered in the CM curriculum, but have specific demolition related content that must be augmented to fully prepare students for work in the demolition industry. There are also topics that are unique to the demolition industry and must be covered in their entirety by the concentration. The list is arranged in the rank order that resulted from the nominal group process with demolition topics that must be covered in their entirety in **bold underlined text** and topic content that needs to be augmented by the demolition and reconstruction concentration shown in **bold text** (Shaurette, 2009).

Table 1
Demolition Topics Identified by Advisory Committee

Importance Rank	Topic Description	Construction Mgmt. Topic	Mixed Topic	Demolition Topic
1	Blueprint Reading and Take off	X		
2	Safety		X	
3	Measures/Weights/Volumes, etc.	X		
4	<u>Project Management</u>			X
5	Basic Equipment Knowledge		X	
6	Estimating			X
7	Contract and Business Law	X		
8	<u>Environmental Regulations</u>			X
9	Negotiation	X		
10	Truck Haul Complexity		X	
11	Proposal Writing		X	
12	CAD/Computer Skills	X		
13	<u>Material Disposal</u>			X
14	Risk Management and Insurance		X	
15	<u>Recycle and Salvage Sales</u>			X
16	Chemistry and Physics as they apply	X		
17	Document Management	X		
18	Building Types	X		
19	Schedules		X	
20	<u>Methods</u>			X
21	<u>Hazardous Materials</u>			X
22	<u>Permits and Disconnects</u>			X
23	Office Technology and Office Management	X		
24	Spanish language	Future?		
25	Labour: Union vs. Non-Union		X	
26	Dealing with non-English speaking persons	Future?		
27	<u>Writing Engineering Survey</u>			X
28	Marketing		X	
29	Revenue Sources		X	

The two courses in the DERM concentration are technical electives which must be taken in sequence. No prerequisites are required for the first course, so students early in their college studies can obtain an introduction to the industry. The second course requires students to have completed a course in construction site planning. As a result, these students are generally in their third or fourth year of study and already possess a significant background in construction

management. Students who complete both courses receive an acknowledgement of completion of the DERM area of specialization on their college transcript.

The course content is updated regularly as the instructor is able to obtain a greater range of presentation material through demolition project visits and demolition industry interactions. Student performance assessment in the two courses includes tests, student presentation of research on relevant topic areas, and group projects dealing with various aspects of demolition project management. The specific learning objectives of the two courses currently offered in the DERM area of concentration are as follows.

Introduction to Demolition and Reconstruction Management

At the completion of the course, the students should be able to:

- Identify and describe management and organizational challenges unique to demolition and reconstruction.
- Locate and identify relevant regulations and the related issues that impact demolition and reconstruction activities.
- Identify, classify, and describe techniques and technologies that are utilized in demolition and reconstruction.
- Apply problem solving and decision making for labour and equipment utilization in demolition and reconstruction.
- Apply basic estimating procedures common in demolition and reconstruction.
- Identify, classify, and describe reuse and recycling potential in demolition and reconstruction.
- List key safety and risk management issues encountered in demolition and reconstruction.

- Identify the ways in which special knowledge and professional demolition and reconstruction activities bring about ethical obligations.

Advanced Demolition and Reconstruction Management

Upon completion of the course, students should be able to:

- Describe categories of equipment and how the equipment is used on demolition projects.
- Analyze demolition job site conditions.
- Select demolition equipment for specific tasks.
- Prepare a demolition plan and manage equipment utilization.
- Describe how explosives are effectively used in demolition.
- Price basic work involving demolition equipment.
- Analyze equipment ownership and operational costs.
- Think through the rent vs. buy decision from competitive and strategic viewpoints.
- Combine acquired skills to plan and manage a comprehensive and safe demolition or reconstruction project.
- Prepare and present a comprehensive demolition or reconstruction project proposal.

To date over 200 students have taken one of the DERM courses with approximately one third choosing to complete both courses. A number of these students have contacted the author since graduation to indicate that they have encountered demolition activity in their construction management careers. At least two students have been employed by demolition contractors, and several more work for earthwork or heavy construction firms that perform demolition as part of their construction service expertise. An early graduate of the program employed as a manager in the demolition industry recently sought to become a governing board member of the National Demolition Association.

3. Demolition and Reconstruction Safety

Safety was the highest ranked topic identified by the NDA education committee that does not have adequate demolition and reconstruction coverage in most construction management programs. A brief description of many of the demolition and reconstruction safety and health practices not commonly presented in collegiate CM programs follows (Shaurette, 2008).

Pre-job Planning and Hazard Identification

An engineering survey conducted by a qualified person is required by U.S. Occupational Safety and Health Administration (OSHA) regulation (Occupational Safety and Health Administration, 2009). This survey allows the demolition contractor to fully evaluate the project, become aware of potential hazards, examine public and employee safety issues, and collect data for planning the methods and materials to complete the job. Issues such as bracing and shoring, the need for temporary protective structures, dealing with environmental hazards and disposal, utility disconnects, fire protection, first aid services, and project site access are examined in detail during this survey. To appropriately manage the health and safety of their projects, construction managers charged with oversight of demolition activity as part of an overall construction project would be advised to obtain a copy of the demolition contractor's engineering survey and have a working knowledge of checklists used to perform similar surveys.

Handling of Hazardous Material

One of the most expansive sections of the OSHA safety and health standards deals with the handling of hazardous materials. The U.S. Environmental Protection Agency (EPA) also has comprehensive regulatory oversight of potentially hazardous materials encountered in demolition

and reconstruction activities. Some of the most commonly encountered hazards are asbestos, lead, and Polychlorinated Biphenyls (PCB).

Asbestos Safety. Asbestos was used extensively in construction materials until the 1970s when its use was gradually phased out. Although new building materials do not pose a risk of exposure, asbestos is likely to be encountered during demolition and reconstruction activity. Because of the high potential for damage to the health of employees and the general public when asbestos becomes airborne, handling of this material is broadly regulated (Environmental Protection Agency, 1990). Construction managers should be knowledgeable of the regulations, planning requirements, protective practices, and required disposal procedures for asbestos.

Lead Safety. Lead is well known for use in plumbing and paint materials, but is also present in a wide variety of metal alloys encountered in the built environment. Lead is a material that is toxic to the human body and has significant impacts on the nervous system. Lead accumulates in the body, so exposure to even small quantities of lead through inhalation or ingestion will present acute effects through the cumulative effect of constant exposure. Employees should be monitored to assure that their exposure is below OSHA limits. Construction managers should be aware of appropriate work practices to minimize lead exposure, and have sufficient knowledge to monitor the use of personal protective equipment and hygiene practices to prevent lead poisoning.

Polychlorinated Biphenyls Safety. PCBs, used in the manufacture of many transformers and capacitors, have been determined to be a potent carcinogen. Although production of PCBs has

been banned since 1979, the material is still in service in transformers and capacitors throughout the United States. The material is a potential health hazard to employees involved in demolition and reconstruction. In addition, it is a significant environmental hazard in that spills of PCB-based materials do not break down into harmless materials in the environment. Construction managers should be aware of these hazards and should have knowledge of proper handling and disposal of items containing PCBs.

Hazard Communication. Construction managers need to be aware of the unique material hazards present in demolition. In addition to assuring that the firms engaged in demolition activity on their projects have an appropriate hazard communication program, construction managers need to include these hazards in their own hazard communication program to inform all workers in the vicinity of demolition work of the potential for contact with hazardous material.

Personal Protective Equipment

Although personal protective equipment is not unique to demolition and reconstruction, the nature of the work requires some specialized knowledge to assure proper equipment selection and use. The extensive use of torch cutting requires both proper eye protection and respiratory protection. The release of lead fumes when torch cutting painted steel requires proper respirator selection, medical evaluation of workers who use the respirators, and a respirator maintenance program. Fall protection equipment selection, use, and maintenance are also important components for construction manager knowledge since demolition and reconstruction activity frequently exposes workers to unique height risks. Safety nets, retractable lanyards, full body

harnesses, and specialized anchoring systems may be required in addition to provisions for guard rails or other barrier type fall protection.

Safe Use of Hand Tools

Demolition and reconstruction frequently involves a form of material reuse called soft-stripping or non-structural deconstruction. Soft-stripping refers to the removal of specific building components that are determined to have a significant resale value. These components are removed prior to the demolition of the structure (Dept. of Housing and Urban Development, 2000). Common hand tools and manual labour are required for the removal and refurbishment of these materials. These tools are frequently used in a “forceful” manner, have sharp or abrasive surfaces, and are capable of significant human harm. Care must be taken to avoid the assumption that everyone knows how to use these tools. Construction managers should be able to select appropriate tools for the job, know how to use the tools in a safe manner, and assure that the tools are stored and maintained properly.

Safe Blasting Procedures

Although blasting is actually used in a rather small percentage of demolitions (National Demolition Association, 2009), explosives when used require careful planning, preparation, transportation, storage, and disposal. Safe blasting procedures are covered by a relatively large group of OSHA standards.

Safety When Working in Confined Spaces

Confined spaces in demolition and reconstruction include storage tanks, vaults, silos, utility tunnels, and vessels where natural movement is restricted, access is limited, and fresh air supply may be limited. In addition, these confined spaces may present flammable, toxic, corrosive, or irritating work environments. Construction managers must be aware of these hazards as well as

appropriate communications, ventilation, monitoring, and rescue planning procedures for work in confined spaces.

Safe Demolition of Pre-Stressed and Post-Tensioned Concrete

Many modern reinforced concrete structures utilize steel reinforcement placed under tension either during the placement of concrete or immediately after concrete placement. These pre-stressed or post-tensioned structures are now reaching an age where demolition may be required. Since the steel reinforcement is in tension at all times, the demolition process presents the potential for the release of violent or explosive forces. Construction managers should be aware of the potential for this forceful release of tension and must assure that appropriate engineering advice and planning is obtained prior to demolition of pre-stressed or post-tensioned concrete.

Debris Removal and Falling Debris

Removal of debris is a major component of demolition. The large quantity of material that must be moved from upper floors to the ground level presents the potential for impact damage to structures from falling debris, generation of potentially hazardous dust, danger to workers below debris removal activity from falling items, potentially unsafe cutting of floor openings for debris drop locations, and the improper use of debris chutes. OSHA regulations for demolition provide some guidance for construction managers in oversight of demolition debris removal operations.

Competent Person

OSHA regulation requires that a competent person continuously inspect the progress of a demolition project to detect potential hazards from weakened structures, inadequate shoring, lack of bracing, or other hazards from unexpected conditions. Since no employee should be allowed to work while an unsafe condition exists, construction managers should be aware of the competent person designated by the demolition contractor. Construction managers must

recognize that the competent person can and will stop work in the event they judge an unsafe condition to exist.

4. Demolition and Reconstruction Public Health Hazards

Demolition and reconstruction activities have a high potential for impact on the health of the general public. These activities are commonly conducted in close proximity to occupied spaces, often in high-density urban settings. Consequently, the public is likely to be exposed to an assortment of dust and debris that results from the dismantling processes. Both airborne and waterborne contaminants released by demolition or reconstruction dismantling have the potential to expose large populations to significant health hazard.

Demolition and reconstruction also produces a significant quantity of debris. Handling and disposal of this debris have the potential to impose both short-term public health exposure and long-term environmental pollution. The following discussion presents a brief description of some of the public health hazards of demolition and reconstruction that construction managers should be aware of.

Dust Exposure. Dust is generated in large quantities during demolition activities. In most cases, dust control is provided by wetting down affected areas with a fire hose to minimize dust generation. This is an effective method for minimizing the nuisance of dust exposure for surrounding properties in many situations. Unfortunately the use of fire hoses for dust control increases the weight of demolition debris and may require containment of excess water. An alternate form of dust control (Figure 1) uses an atomized mist of water to capture dust particles.

Atomized spray techniques rely on the principle of creating very small water droplets. The water droplets are launched from a powerful fan at moderate to high velocity, facilitating a collision with airborne dust particles to drive them to the ground. This method has proven very effective in demolition applications, providing dust control by surface wetting as well as airborne particle capture (Peterson, Shaurette, and Clarke, 2009).



Figure 1 – Atomized Spray Dust Control

Some demolition and reconstruction projects can expose special populations, such as the elderly and individuals with compromised immune systems, to health hazards that require greater care. Histoplasmosis is an infectious disease related to dust control. The disease is caused by spores of a fungus and can create a chronic lung disease that resembles tuberculosis. Although the disease is not contagious and cannot be transmitted from person to person, the spores are frequently

found in areas frequented by birds and bats in buildings (Heymann, 2004). Inhaled dust generated by demolition or reconstruction activity can become a vehicle for the transmission of the spores. Demolition workers should exercise care when working around bird or bat droppings.

Individuals (especially children) with compromised immune systems are more susceptible to infection, making dust control activity in and around healthcare and childcare facilities of critical importance (Lenhart, et al., 2004). The use of atomized spray dust control equipment on the project adjacent to a paediatric hospital shown in Figure 1 was able to capture dust particles and bring them safely to the surface of the ground under most conditions. Nevertheless, on windy days the competent person assigned to site safety monitoring needed to discontinue operations until the wind subsided and the dust control measures could be effective.



Figure 2 – Negative Air Pressure HEPA Filter

Inadvertent exposures to environmental pathogens such as aspergillus and legionella or airborne pathogens including mycobacterium tuberculosis and varicella-zoster virus can result from dust transfer during demolition and reconstruction activities in occupied health care facilities.

Environmental infection-control strategies and airflow controls can effectively prevent these infections. After performing an infection control risk assessment (ICRA), the multi-disciplinary team formed to manage infection control during healthcare construction activity creates a proactive plan of action. Infection-control measures typically include creating a negative air pressure condition within the spaces undergoing demolition or construction activities (Figure 2) to prevent contaminated air from leaving these spaces through uncontrolled ventilation. Air removal from the construction areas is through HEPA filtration, preferably exhausted to the exterior (Schulster & Chinn, 2003).

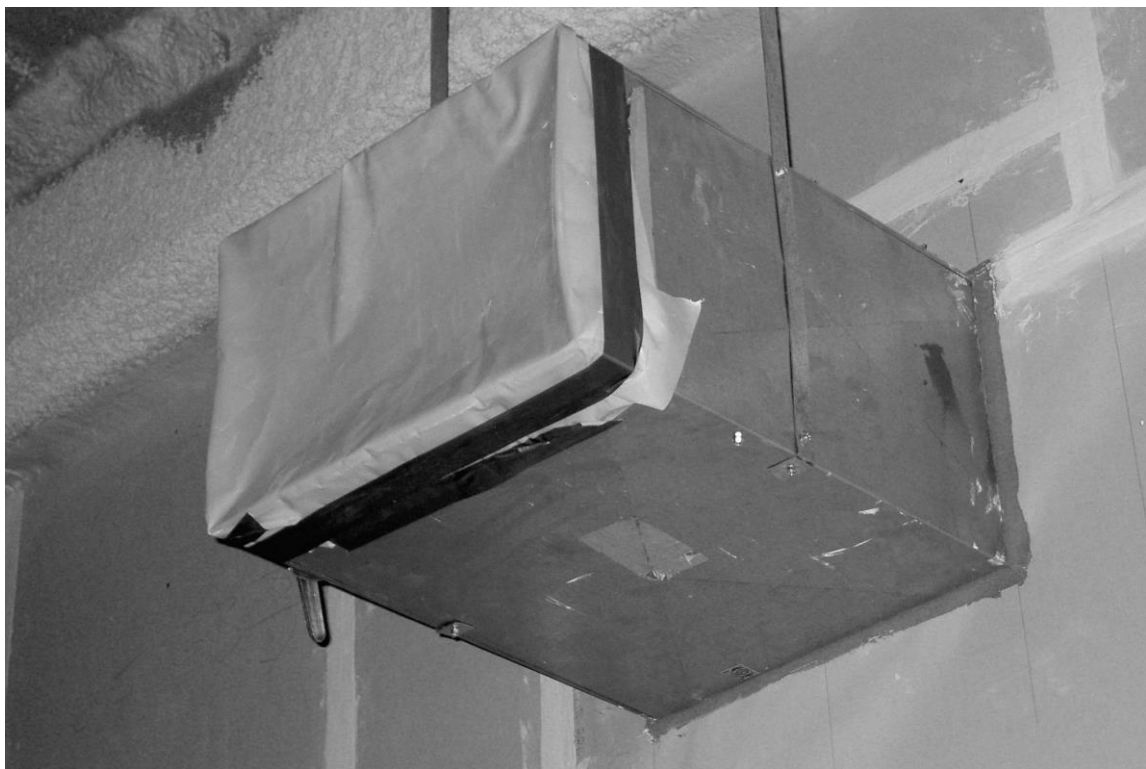


Figure 3 – Sealed Ductwork

In addition to creating and monitoring negative air pressure in the construction zone, the infection-control plan will require extensive containment procedures. Containment procedures include sealing all connections with the ventilation system (Figure 3), installation of dust control partitions of either hard walls or plastic film barriers (Figure 4), controlled access to and from the construction area, and limitations on construction traffic through unaffected portions of the building.



Figure 4 – Dust Barrier at Door

Construction activities within a healthcare facility that are limited to a small area may not be confined by partitions that allow large zones of negative air pressure to be created. In these situations it is necessary to enclose a limited space utilizing a containment cart (Figure 5) or plastic film barriers and a HEPA vacuum to create a limited area of negative pressure. The containment cart provides a sealed enclosure with an open top. By extending the flexible walls of

the containment cart to the ceiling using built-in corner supports and exhausting the air within the cart through a HEPA vacuum, worker can perform tasks above a suspended ceiling without exposing the surrounding area to potential contamination. These temporary containment areas can be installed for work requiring as little as an hour or two of construction or repair.



Figure 5 – Containment Cart

The examples given here demonstrate ways of meeting the need for dust control for infection-control purposes in conditions where severe public health conditions exist and enforcement is common within the facility. It is strongly suggested that similar dust control measures be considered for any demolition or reconstruction activity within or adjacent to an occupied space.

Not only would adoption of these measures prevent the spread of dust borne contaminants, it would minimize the nuisance and disruption created for the occupants.

Debris Disposal. A 1996 estimate concluded that the waste generated by demolition and renovation activities make up 92% of all construction and demolition waste generated in the United States. This represented 124,700,000 tons of debris generated (excluding waste resulting from roadway, bridge, and land clearing operations) or about 2.6 pounds per capita per day in 1998 (Environmental Protection Agency, 1998). On the assumption that these materials are benign and present little in the way of hazardous material that can be leached into surrounding groundwater, a large quantity of construction and demolition (C&D) waste is disposed of in landfills with minimal protection for the surrounding groundwater. Unfortunately products do exist in the demolition waste stream that contain small quantities of material which are hazardous to public health. These materials, when concentrated in a landfill, create a potential for environmental contamination through leaching of the hazards into the groundwater.

Listed below are some of the common products, along with the related hazardous material found in these products, which should be removed from the C&D waste stream through diversion to appropriate recycling programs or proper disposal in a hazardous waste facility:

- Fluorescent Light Bulbs – Mercury
- High Intensity Discharge Lamps – Mercury
- Thermostats - Mercury
- Silent Switches – Mercury
- Lighting Ballasts – PCBs, DHP, & DEHP

- Batteries – Lead, Mercury, & Cadmium
- Flashing & Pipes – Lead
- Treated Wood – Arsenic
- Refrigerants – CFCs
- Smoke Detectors – Radioactive Materials

Although the quantity of debris resulting from demolition activity that is diverted from landfills through recycling has been increasing, a recent survey of demolition contractors (Figure 6) shows that a large percentage of wood debris continues to be disposed of in a manner that has the potential to contaminate groundwater surrounding C&D landfills (Shaurette, 2006). Although raw wood products do not contain hazardous material, contaminated wood (exposed to industrial contaminants or oils) and treated wood need greater scrutiny before disposal in a C&D landfill. A recent study of unlined C&D landfills in Florida confirmed that groundwater sampled from the soil surrounding 21 C&D landfills containing CCA-treated wood and CCA-treated wood ash exceeded the 5 mg/L regulatory level for total arsenic leaching. The authors concluded that CCA-treated wood and CCA-treated wood ash should be classified as a hazardous waste (Solo-Gabriele, et al., 2004).

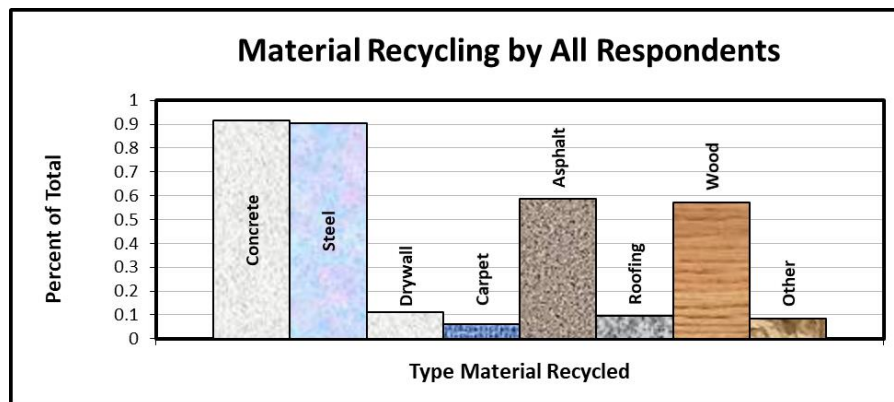


Figure 6 – Demolition Recycling Survey Results

5. Industry Participation in Demolition Safety Standards and Practice

Through the work of the membership and board of directors of NDA, the demolition industry in the United States has been proactive in the development and dissemination of health and safety training material. In May of 2005, NDA established an alliance with the U.S. Occupational Safety and Health Administration (OSHA) to jointly develop health and safety curricula. In October of 2009 NDA held its 15th Annual Safety/Management Training Summit, featuring a Demolition-Specific OSHA 10-Hour Training Certification (Clements, 2009).

International recognition of the need for health and safety training for demolition is born out in a publication promoting safety training for young workers by the European Agency for Safety and Health at Work, a tripartite organization of European Union governments, employers, and worker's representatives organized to promote occupational health and safety. One of the 25 practical examples selected from entries in the 7th annual Good Practice competition to support the dissemination of good practice information in workplaces in the twenty-seven Member States dealt with demolition safety (Kotzabasi, M., 2006).

6. Conclusion

As the built environment in the United States continues to age, a greater percentage of construction professionals will include demolition and reconstruction activities as services they provide. Because demolition and reconstruction activities have unique safety and public health impacts, it is important that university construction management educational programs provide some exposure to safe practices and appropriate planning procedures required to protect both

employees and the general public during demolition and reconstruction. The temptation exists to assume that new construction and reconstruction share sufficient materials and methods to treat them as synonymous in the educational environment. Nevertheless, the existence of hazardous materials, selective demolition work, frequent close proximity of other structures, and need to work in partially occupied spaces all demand implementation of additional safety and health considerations when dealing with demolition and reconstruction.

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