POST-NATURAL DISASTER HAZARDS ENCOUNTERED BY REMEDIATION WORKERS

By

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To all of the underpaid, under trained, and overworked skilled laborers who have suffered through injuries, for without their pain and suffering this thesis would be unnecessary.
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The purpose of this research was to identify hazards in the built environment that may be encountered by construction workers in the aftermath of a natural disaster. Currently in the construction industry regulations are lacking that address hazardous situations arising from the occurrence of natural disasters. The objective of this research was to bring attention to those hazards that are common in disaster stricken areas. In addition, this research was to identify recommendations that could be made to protect workers from the hazards they might encounter. This was achieved by analyzing previous occurrences of injuries, to make knowledgeable recommendations to future remediation workers in order to allow them to be better prepared to safely perform their work. The identified safety hazards discovered in this research will comprise a database listing the activities for which hazards might occur, the equipment involved in those activities, possible injuries associated with the activities and the steps to be taken to minimize the chance of injury.
CHAPTER 1
INTRODUCTION

Post-Natural Disaster Hazards

Workers tasked to perform remediation construction work in an area that has been stricken by a natural disaster are subjected to hazards that are not encountered on conventional construction projects. The destructive force that a natural disaster imposes on the built environment creates the added hazards or facilitates the development of those hazards. Buildings that have been affected by the various forces of a natural disaster present dangerous situations to workers because of the reduced structural integrity of buildings, piles of debris in and around structures, the growth of mold, and exposed hazardous materials and chemicals. In addition to the effects of a natural disaster on buildings, areas that have been affected by a natural disaster often have experienced a reduction in basic necessities such as electricity, water, and medical services.

Statement of the Problem

There has been a minimal amount of research or literature written on the topic of identifying post-natural disaster hazards encountered by remediation workers. It is understandable that there is an increased risk of injury presented to construction workers in an environment that has been affected by the chaos of a disaster. Considering the plethora of manuals discussing construction safety, it seems problematic that there is such a deficit in research on construction safety regarding remediation work in the aftermath of a natural disaster.

Objective

Construction workers are subjected to a dangerous work environment on a routine basis. In the aftermath of a natural disaster, such as a hurricane, workers tasked to restore or demolish buildings are often subjected to a broad variety of hazards. The objective of this research is to
identify those hazards that remediation workers might encounter. This research also analyzed previous injuries so that knowledgeable recommendations could be made for future remediation workers that might allow them to be better prepared to safely perform their work. As a final objective of this research, the hazards that are associated with natural disaster remediation work will be examined to devise preventative measures to avoid worker injuries. The preventative measures will be used to create a database on which safety-training modules could be developed.
CHAPTER 2
LITERATURE REVIEW

Introduction

The characteristics of common activities performed in construction generally present a broad variety of safety hazards to personnel working in the built environment. When performing construction work in the aftermath of a natural disaster, the common safety hazards that are present during normal operations may be accompanied by other hazards that may be less identifiable to an unprepared worker. Currently, there is a minimal amount of literature on worker preparation for construction personnel entering an area that has been affected by a natural disaster. Jacob Kovel (1996) noted in his research entitled Planning Construction for Disaster Preparedness, “While nearly every emergency management agency has a plan, very few of these plans have the detail necessary for effective response activities, particularly in the area of construction”. Although there is a deficit of research on construction worker preparation for entering a post-natural disaster area, there is a plethora of literature on the basic safety guidelines of building construction. In combining the basic standards of construction safety with an overview of the possible conditions that may exist in the aftermath of a disaster, it is possible to create guidelines to improve worker safety through proper preparedness.

Illnesses and Injuries

The Centers for Disease Control and Prevention (CDC) has accumulated data on illnesses and injuries occurring after disasters such as hurricane Katrina, and has published various findings in issues of Morbidity and Mortality Weekly Report (MMWR). According to one issue representing injury and illness surveillances from September 8\textsuperscript{th} to the 25\textsuperscript{th}, 2005 in New Orleans, Louisiana “a total of 7,508 events were recorded; 4,169 (55.6\%) were illnesses, and 2,018 (26.9\%) were injuries. Another 1,321 (17.5\%) were nonacute health-related events, not
classified as either illnesses or injuries” (“Surveillance for Illness and Injury after Hurricane Katrina-New Orleans, Louisiana.” 2005). Although these findings are delivered with a sense of accuracy, the results lose relevance to the subject of this research due to the inclusion of military forces, volunteer workers, and residents. Fortunately, the results were further divided to illustrate the injury differences between relief workers and residents. Of the relief workers’ injuries, a total of 338 events occurred; the largest percentage (34.6) of injuries was attributed to cuts, blunt trauma, burns, and environmental exposures. Injuries of undetermined causes (21.3%), bites and stings (19.9%), and falls (13.6%) also represented a significant portion of injuries to relief workers. Of the relief workers’ illnesses, a total of 528 events were recorded, the largest percentage (22.5) of those illnesses was attributed to acute respiratory infection, and another significant portion (19.1%) of illnesses were caused by skin or wound infection (“Surveillance for Illness and Injury after Hurricane Katrina-New Orleans, Louisiana.” 2005). The results of these surveillances provide a good overall view on the type of hazards that are present in the aftermath of a natural disaster. Although these particular findings were associated with the aftermath of a massive hurricane, it should be noted that the effects of a hurricane such as flooding, destruction of infrastructure, and wind damage, could be mirrored by other natural disasters such as a tsunami, earthquake, tornado, or major storm.

From August 31, 2005 to March 10, 2006 the Occupational Safety and Health Administration (OSHA) observed the activities of workers performing post-natural disaster remediation construction work. The OSHA representatives documented their findings in 129 Situation Reports (SitReps) gathered from locations including Florida, Alabama, and Mississippi following hurricanes Katrina, Rita, and Wilma. The information included in the SitReps described over 9,500 interventions of hazardous situations made by OSHA personnel. The
interventions consisted of the OSHA representatives handing out written materials on the proper procedures to safely complete a task, verbal assistance directed toward workers or their employers, and in some instances OSHA representatives directed the removal of employees from jobsites (“Part I: Summary of Safety and Health Intervention Information from OSHA Situation Reports.” 2006). The activities that were most frequently referenced in the reports along with the percentage in which they were identified in the SitReps are as follows:

- Roof Inspection, Tarping, and Repair (26%)
- Debris Collection and Removal (26%)
- Tree Trimming (8%)
- Restoring Electrical Utilities (7%)
- Debris Reduction, Recycling, and Disposal (6%)
- Assessment, Cleanup, and Repair of Structures (2%)
- Restoring Communication Systems (2%)
- Restoring Water and Sewer Systems (1%)
- (Part I: Summary, 2006)

It is important to note that the intervention of these activities and their inclusion in the SitReps does not specify occurrences of injuries; the intervention of these activities only represents instances where an injury had the possibility of occurring. Figure 2-1 displays the percentages in a pie chart in order to highlight that site work, including debris collection and tree trimming, makes up 34% of the interventions.

Figure 2-1. Hazard interventions
Preventing Injuries

Essentially all injuries have the possibility of being prevented. The most advantageous time to take appropriate actions that may reduce hazardous job site conditions is before the construction begins, during the preconstruction stage of a project. According to one of the nation’s leading construction safety experts “Before any work is performed on site, the work activities should be planned. The planned activities should then be examined to identify those that warrant special attention to ensure that they will be performed in a safe manner” (Hinze 2006). It is imperative that planning of activities should occur before the work proceeds. This is especially important when performing remedial construction work in unusual conditions, such as in a post-natural disaster setting. An assessment of the techniques used to complete the various activities, as well as the general conditions of the site, should be completed with the intention of identifying potential safety hazards that remediation workers may encounter (Hinze 2006). In most cases it is necessary to visit the site in order to identify all of the potential safety hazards such as proximity of power lines, soil stability, and various other site conditions. Having an OSHA consultant visit the site is another viable option that may increase the possibility of identifying hazards in circumstances that are somewhat unfamiliar to an activities planner (Hinze 2006). Although it is preferable to identify the operations that pose the greatest potential for injury before remediation work begins, it is understandable that some hazardous situations arise during construction. In instances where the construction has already commenced the identification of jobsite hazards is essentially everyone’s responsibility.

Medical Screenings

Workers entering disaster areas can moderately reduce their risk of injury, or at least be better prepared to deal with illnesses or injuries by taking general medical precautions before entering a location that has been devastated by a natural disaster. The National Institute for
Occupational Safety and Health (NIOSH) has established that there are unique needs associated with natural disaster remediation work, and has developed an “Interim Guidance for Pre-exposure Medical Screening of Workers Deployed for Hurricane Disaster Work” (“Interim Guidance for Pre-exposure Medical Screening of Workers Deployed for Hurricane Disaster Work.” 2005). According to the guidance provided, the reason for the pre-exposure medical screening is to assess a worker’s ability to carry out potentially dangerous or stressful activities. An additional motive for conducting pre-exposure medical screenings is to identify any existing health concerns that may increase the likelihood of becoming ill during an extended stay in a post-natural disaster area. The article discusses the rationale for pre-screening personnel entering a disaster area, such as establishing a baseline of the workers health before entering the area. The guidance also states that pre-screening workers would identify immunization needs, and workers with pre-existing health conditions whose activities might need to be restricted. In addition, the article specifies the individuals to be screened, the types of screening that needs to take place, and when the workers should be screened in relation to entering a post-natural disaster area. As part of the medical screening process, individual remediation workers’ medical records should be updated to ensure that notations have been made regarding the administered inoculations and any previous medical conditions that may be amplified by harsh conditions.

**Immunizations**

The administration of immunizations for workers entering a post-natural disaster area is a subject area that has accumulated increased attention during recent years. The CDC has developed some recommendations about the immunizations that should be required. According to an article depicting the need for inoculations, tetanus and hepatitis B comprise the recommended immunizations for emergency responders. The article also states that there is not a high need for vaccines such as hepatitis A, typhoid, cholera, meningococcal, and rabies
vaccines. Although the article is particularly vague on which individuals are included under the title “Emergency Responders” (“Interim immunization recommendations for emergency responders: Hurricane Katrina.” 2005), it is presumed that the title includes workers entering the disaster area during an unspecified time period following the disaster when basic infrastructure is rendered ineffective.

**General Safety Concerns**

**Weather**

In the aftermath of a natural disaster, working in extremely hot or cold conditions can present a hazardous situation to remediation workers, especially when electricity is unavailable to provide heating or cooling relief from the elements. As noted in one of the many construction manuals on safety “Exposure of employees to excessive heat at the worksite can bring about medical emergencies in a number of ways” (Heberle 1998). A few of the medical conditions associated with excessive heat include heat cramps, heat exhaustion, heat stroke, and sunburn. Cold weather can also introduce working hazards such as hypothermia, frostbite, as well as sunburn. “Much construction work is scheduled so that outdoor tasks can be done during mild to warm temperatures, but when work must be accomplished in cold and subfreezing conditions, employees should dress properly to avoid hypothermia and frostbite” (Heberle 1998). Although this literature on weather precautions is relevant to the topic of research, it should be acknowledged that natural disasters occur at random and therefore remove the option of scheduling remediation work around seasonal temperatures.

**Sanitation**

In the aftermath of a natural disaster, the infrastructure of a city can be rendered ineffective. In the case of electricity or communications, these issues can be a hindrance but not necessarily a hazard. When drinking water becomes contaminated, severe diseases become a
serious hazard (Black 2007). Water designated for drinking “should be obtained from a source approved by local health authorities. If a source of safe, untreated drinking water is not available, water should be treated as directed by local authorities” (Smith 1992). It is also noted that pails and reusable cups should not be used for distributing drinking water due to the resulting increased possibility of spreading germs and/or diseases. It is also recommended that “Water dispensers and portable fountains require regular sterilization” (Smith 1992). The frequent sterilization of dispensers and water fountains will assist in preventing the buildup of mold and accumulation of germs. The issue of safe drinking water is of particular concern for construction work in disaster areas that may not have running water and ensuring that only safe drinking water is consumed is the responsibility of all personnel on the jobsite.
CHAPTER 3
METHODOLOGY

Introduction

The research for this thesis was performed to identify potential safety hazards that workers may be exposed to in the aftermath of a disaster. In conjunction with the identification of these hazards, procedures were developed as possible methods of reducing the risk of injury. The process through which these safety hazards were identified was completed by gathering information collected by the Centers for Disease Control and Prevention (CDC) and the Occupational Safety and Health Administration (OSHA) related to post-natural disaster hazards and injuries, by interviewing workers that have performed remediation work in such areas, and by compiling information gathered from students in the Rinker School of Building Construction (BCN) at the University of Florida. The hazards identified through this research were carefully considered when developing a training program for workers performing work in a post-natural disaster area. The training program was envisioned as being delivered in approximately four hours with the use of power point slides. The objective of the training session is to increase worker awareness of the dangers that may exist in buildings and in their surroundings that have been damaged by wind or water.

Motivation for the Research

The justification for conducting this research was based on the need for identifying and minimizing the risk of injury in post-natural disaster locations. It was believed that if injuries and hazards from previous locations affected by a natural disaster could be analyzed, a collection of precautionary measures could be developed in order to reduce future injuries during remediation work. The overall objective was to reduce remediation worker injuries through careful preparation and training.
Data Collection

The initial set of data was gathered from students in the BCN program. The students were asked to develop a job hazard assessment (JHA) for selected work categories. Within each category of work, subcategories were to be listed along with their respective potential hazards, corrective actions, and equipment/tools/materials required to complete the task. The categories of remediation work that were analyzed included General preparations, Site Work, Structural, Walls and Ceilings, Roofs, Floors, Indoor Utilities, Special Features, Other Interior Items, Furnishings, and Garage/Mechanical Rooms. A total of 45 job hazard assessments were completed by 129 students and the results were analyzed and combined into a master JHA file. To ensure thorough coverage of possible hazards within the master JHA file, reports that the CDC and OSHA produced after natural disasters, such as Hurricane Katrina, were examined and used to add potential hazards to their respective categories within the JHA file.

As a second source of data, eight semi-structured phone interviews were conducted in an attempt to discover additional information about specific issues related to remediation work in post-natural disaster areas. The injuries identified through the interviews were then categorized by assigning them to the particular aspect of the building or site where the threat was created. The interviews were also used to identify aspects of remediation work that most commonly pose a possibility of inflicting harm to a person’s body or health. In addition to identifying hazards the interviews were used as a means to identify procedures that may reduce the possibility of inflicting harm to the workers. The interviews were conducted with both subcontractors and general contractors that have had experience in remediation work in the southeastern United States. The intent of the interviews was to focus on the respondents’ individual encounters with hazardous operations during remediation work. In order to direct the interviews towards the respondent’s own experiences, a series of open-ended and closed-ended questions were devised.
For the purpose of keeping some sort of structure to the interview, an interview guide was developed specifying topics to be covered and also to lead the conversation in the appropriate direction depending on the respondent’s familiarity with the area of work. The interview guide consisted of seven open-ended questions. The intent of the interview guide was to induce more specific answers from the respondent as the interview proceeded.

**Data Analysis**

The information obtained through the JHA, OSHA and CDC websites, and the semi-structured interviews were utilized in the analysis of the data. The data were combined to assemble a unique piece of literature based on the information obtained from all three sources. The information was separated into categories including general preparations, site work, structural, building exterior, building interior, special features, and special considerations. The general preparations section included information that would help prepare a construction firm for entering a disaster area by advising them on medical screenings for workers, obtaining or bringing food and water along with advice on how to prepare and preserve rations, and preparations to make when using portable generators as a means of power. The site work section included data on identifying hazards when removing debris, and wildlife that may be encountered in the area. The structural section included information on identifying hazards associated with structural components such as foundations, steel, load bearing walls, and trusses. A section on exterior components of buildings identified hazards associated with roofs and façade types. The segment on building interior included data on identifying hazards associated with non-load bearing walls, ceilings, floors, and indoor utilities. A special features section covered building components that are not common to all buildings such as elevators, stairs, decks, and garage/mechanical rooms. The final section on special considerations included hazards associated with mold and asbestos.
CHAPTER 4
RESULTS ANALYSIS

Introduction

The data gathered from the JHA’s, interviews, and from the CDC and OSHA websites were used to create a comprehensive database listing all of the conceived potential hazards that might be encountered in a post-natural disaster location. The database was separated into 11 main categories distinguishing different areas of remediation work. The resulting outcome of the compilation of data is presented in four sections. A general preparations section introduces topics that need to be preplanned before a remediation crew enters a disaster site. The second section, site work, presents information on identified hazards in the surrounding area of a building that may need to be cleared in order to gain access to the building. A third section identifies injuries that may result from the structural and outer shell aspects of a building. The final section presents information on identified hazards that may be present in the interior of a structure.

General Preparations

Medical Screening

Considering the limited resources that may be available in the aftermath of a natural disaster, specific information was sought about ways of preparing employers and their respective employees before entering a disaster area. It was noted that performing medical screenings on personnel before commencing work may identify any preexisting medical conditions that could possibly cause a worker to be more susceptible to injury, disease, or heat related illnesses. The research also suggested that personnel with preexisting health problems might spread illnesses or disease to coworkers. Updating remediation workers’ vaccinations was also found to be a recommended preparation due to workers being subjected to disease infested or contaminated
areas. The research also concluded that workers with open wounds (discovered during the medical screening) should be kept from entering disaster areas due to the increased susceptibility of the wound becoming infected from unsanitary conditions in locations affected by natural disasters.

**Food and Water**

Data were sought about potential hazards related to the absence or lack of a substantial amount of food and water. Aside from the obvious hazardous situations such as starvation and dehydration, the issues of contamination and sanitation were discovered to be a potential hazard regarding the health of workers. It was noted, through an interview, that water pipes could have ruptured during natural disasters or after a natural disaster due to large equipment traveling on structurally compromised roads built over vulnerable water pipes. Preparations should be made to keep perishable food sources on ice to prevent spoilage. Due to the ease of preparation and conservation, employers should consider bringing canned foods and Meals Ready to Eat (MRE’s) during the preparation stage of deploying to an area suspected to have a shortage of food availability.

**Portable Power**

Because of the possibility of limited sources of power, data were collected on the different methods of providing power to jobsites. The information gathered on sources of portable power expressed a significant risk of injury to remediation workers as well as residents. Sources of power such as generators produce toxic levels of carbon monoxide, and should only be operated in well-ventilated outdoor areas. The fuel used for generators, as well as other equipment, should be kept in safe locations to reduce the potential of explosion. Extension cords connected to generators pose a potential for shocking workers and should be kept dry and in proper working order.
Site Work

Debris Removal

Identifying injuries associated with debris removal was of interest, specifically debris that blocks access to building sites. An assortment of potential injuries was found to be associated with clearing debris such as trees, vegetation, hazardous waste, as well as various types of furnishings, and junk material. Trees that have been uprooted and fallen over pose a risk of branches falling on workers as the limbs are being cut for removal. Additionally, the equipment used to cut off the branches poses a risk of striking workers if the equipment is used improperly or if one or more of the safety features has been removed or has broken. Equipment used to trim trees also has the possibility of coming into contact with live power lines or extension cords which can shock workers operating the equipment. Various types of vegetation, aside from trees, such as poison ivy have the potential of causing skin irritation to remediation workers who did not wear proper working clothes. Hazardous waste was also found as a possible cause of injury to workers that have not been properly trained to handle and dispose of such waste.

Wildlife

Wildlife and displaced domestic pets that may have gotten lost or that have been abandoned by their owners in a post-natural disaster location were identified as a source of potential hazards to remediation workers. In the Southeastern United States, where natural disasters such as hurricanes have recently occurred, alligators were found to have encroached into neighborhoods affected by rising floodwaters. Research also has indicated that snakes, mosquitoes, spiders, and various other biting/stinging insects and animals have contributed to the vulnerability of remediation workers. Remediation workers should be aware of possible locations where animals may be seeking shelter such as beneath decks and underneath frame floor houses.
Structural Foundation

Data were collected on injuries that might result from remediation workers performing activities on buildings with compromised structural foundation integrity. The potential for building collapse due to remedial construction work is increased if the foundation has been damaged or moved due to high winds or erosion. An injury that may result from damaged building foundations in a post-natural disaster area include the possibility of workers being crushed by building materials that have become dislodged. In circumstances where supporting soil has eroded away from a foundation, a hazard is created in which workers may become caught-in-between portions of the foundation and the remaining soil. Erosion of soil from around building foundations also presents a hazard of building settlement while workers are inside due to a decrease in structural support and an increased load on the structure.

Structural Steel

In instances where steel has been utilized as the main structural component in a building that has possibly been damaged by a natural disaster, the integrity of the steel members and their connections should be assessed prior to commencing remediation work. The resulting injuries that may occur from damaged or shifted steel members include workers being struck by the members themselves, by the equipment being used, or by the material supported by the steel members. In circumstances where structural steel members could be adjusted or fixed in place, such as tightening bolts or welding connections, hazards such as falling from lifts, scaffolding, or the structure itself are presented to workers. When utilizing cranes in the adjustment of steel members, safety concerns such as proximity to power lines and working over other workers warrant precautionary measures such as keeping the boom of cranes ten feet away from power lines.
Load-Bearing Walls

When performing remedial construction work on structures with potentially damaged load bearing walls, severe hazards such as collapse of the wall, falling debris, or collapse of the structure exist. Hazards associated with wood frame load bearing walls may also originate from the materials located within the wall such as utility components and insulation. Structures utilizing tilt-up walls have the potential for collapsing if the welds connecting steel joists to embeds have been compromised.

Trusses

Information was gathered on hazards associated with roof trusses in a post-natural disaster setting. The research suggests that the main risks related to roof trusses include the potential of collapse and workers falling during repair. Instances where roof assemblies have shifted or have become disconnected from the supporting walls may present the greatest potential risk of falling debris or collapse. In the event that workers are required to repair roof trusses in place, identifiable hazards include falling, shock from electrical connections, and minor injuries related to the type of equipment being used.

Building Exterior

Roofs

Roofs, depending on type (sloped or flat) pose differing levels of risk relative to falling hazards. Roof coverings, equipment located on the roofs, and the methods by which roof are supported by the structure may all present different hazards to remediation workers. The most common type of damage to a building following a natural disaster involving high winds is the loss of, or damage to, roofing shingles, tiles, etc. Workers repairing roofs with major damage are subjected to hazards such as falling from the roof, being electrocuted or severely shocked from connection points to power lines, falling through openings such as skylights or perhaps holes.
created by trees, or other injuries related to the type of equipment the workers are using. Common types of equipment used by roofers include nail guns, hammers, ladders, scaffolding, and various tools utilized to remove existing shingles. Workers involved in roofing activities are also subjected to extreme weather conditions such as exposure to the sun, extreme heat, strong winds, and lightning.

**Façade**

Identifying hazards attributable to the exterior façade was of interest, specifically a façade that has been damaged by a natural disaster and needs to be replaced or repaired. A variety of potential hazards were found to be associated with façades such as brick, stucco, and vinyl as well as various types of accessories. A brick façade has the potential for falling off the structure in pieces or tumbling over essentially in one piece, presenting a struck by or crushing hazard to workers. Stucco, on the other hand, presents less of a hazard to remediation workers due to its resilience and tendency to remain attached to the structure and to its relatively lightweight. Vinyl, although less resilient than stucco and relatively light in weight, poses a hazard to workers in the form of falling debris.

Regardless of the type of siding on a structure, if the siding needs to be repaired or removed, workers will need to access the material by means of a ladder, scaffolding, or a lifting mechanism of some kind. Remediation workers faced with completing a task at height will inherently be confronted with a potential vulnerability to falling. Workers utilizing scaffolding, ladders, or a lift to access siding at an elevated level in order to remove damaged pieces of façade create a hazard for those workers completing activities on the ground level due to the possibility of falling portions of removed siding. Damaged façade should not be used as a support for ladders due to the possibility that the façade may move or shift, increasing the possibility for the worker to fall.
Building Interior

Non-Load-Bearing Walls

Data were gathered which suggested a potential vulnerability to workers while working on or near non-load-bearing walls, such as partitions. In the event that a structure has been damaged by a natural disaster, the possibility exists that portions of the building have shifted, essentially turning a non-load-bearing wall into a load-bearing wall. In situations where non-load bearing walls have accumulated a substantial load, there is an increased risk of falling materials or debris. In a structure that has undergone extensive damage resulting from a natural disaster, some items may have become exposed within the interior partitions such as electrical conduit or insulation. In circumstances where electrical conduit is exposed, personnel should be notified if the power is on in order to prevent accidental shock.

Ceilings

Information was gathered on hazards associated with ceiling components and fixtures attached to ceilings in a post-natural disaster setting. Dropped ceilings consisting of acoustical tiles and hangers create a hazard of falling debris if the tiles have been damaged or broken. In wet conditions the hangers can rust, break and fall creating sharp rusty edges creating a hazard for workers. Ceiling insulation can create an inhalation hazard or act as an irritant to skin if proper respirators or clothing are not worn. Ceiling attachments were identified as being hazards that may fall on personnel. Fixtures attached to ceilings may become loose due to wet conditions, vibrations, or from being struck by equipment. Items that may have been stored above the ceiling tiles could fall on remediation workers if the ceiling tiles are removed without a heightened level of debris awareness. The electrical connections running power to ceiling fixtures may create a hazard to workers if the wiring has become exposed or comes into contact with water.
Floors

Flooring systems and coverings may present various hazards to remediation work personnel. In structures where frame floors are part of the floor system, special care should be taken due to the possibility of workers falling through floors that have been damaged or weakened from exposure to water or shifting of the foundation. Structures with more than one floor or storey introduce hazards associated with falling as well. Floor coverings in a building affected by a natural disaster may present hazards to workers such as a tripping hazard, as well as injuries that may result from installing or removing damaged floor coverings. Hazards created by installing or removing floor coverings include being cut by equipment, accidentally cutting through power cords, and running extension cords through wet areas.

Indoor Utilities

Information regarding hazards created by indoor utilities was of interest. The water supply to a building may be contaminated presenting a harmful situation if personnel attempt to drink the water without treating it, such as boiling it first. The electrical breaker box is potentially a source where workers may be shocked, and is also the appropriate place to employ lock-out/tag-out procedures. Utilities, such as plumbing pipes and fixtures, have been identified as possible sources where workers can become caught in between fixtures in tight spaces. Ductwork systems pose potential hazardous situations to workers if the supports become damaged and the ductwork becomes more susceptible to falling. Ductwork may also accumulate hazardous waste in situations where flooding has occurred. Water heaters, washers, dryers, and air handlers should all be disconnected from their power source before performing maintenance work or removing them to prevent workers from being shocked. It is also advisable to drain the water from the units before removing or repairing them due to the possibility of the water being contaminated.
Special Features

Elevators

Information was gathered on hazards associated with elevators and their shafts in a post-natural disaster setting. The potential hazards for workers around elevators include personnel falling into shafts, being shocked by electrical components, or being struck by hydraulic fluid due to a weakened or overexerted system.

Stairs

Stairs within a structure that has been damaged by a natural disaster may create a source of hazards due either to weakened supports, damaged treads or missing handrails. Temporary guardrails should be installed prior to commencing remediation work.

Decks

Decks, usually being outdoors and made of wood are vulnerable to the harsh conditions encountered during natural disasters. Hazards associated with decks include falling from or through planks that have been weakened due to over exposure to water. Displaced domestic animals, rodents, and reptiles may also seek refuge beneath decks, presenting a dangerous situation to unsuspecting remediation workers.

Garage/Mechanical Room

Information was sought to identify hazards that may be encountered by remediation workers when working in garages or in mechanical rooms. Depending on what items are stored within garages or storage areas, various hazards could be encountered. If chemicals are found in a storage area, possible hazards include toxic fumes from spilled containers, chemical reaction, or fire. Chemicals should not be mixed when disposing or removing them from the site in order to prevent chemical reactions. Do not allow unknown or known unsafe chemicals to come into contact with the skin to prevent burning or skin irritation.
Special Considerations

Mold

Mold is a ubiquitous concern when water and warm temperature conditions exist. Until this point mold has intentionally been excluded from the discussion for the simple reason that mold could have been mentioned in nearly every topic about a structure affected by a natural disaster. In many instances in the Southeastern United States, natural disasters involve a substantial amount of water damage to buildings. The result of this intrusion of water into buildings leads to mold spreading throughout the structure. Although most types of mold are not harmful, there are a few types that are unsafe for people to inhale. In circumstances where the type of mold is suspected to be harmful workers should wear proper respirators.

Asbestos

Although asbestos is rarely used in construction practices today, there is a possibility that an older building that has recently been affected by a natural disaster would contain asbestos. Asbestos can cause mesothelioma if extremely small fibers are inhaled. Asbestos was commonly utilized in fire retardant materials, floor tiles, insulation, siding, and other components throughout a structure. If a component within a structure in a post-natural disaster area is suspected of containing asbestos personnel should not touch or otherwise disrupt the material as disrupting the material can send the asbestos particles into the air. Proper respirators should be worn to protect against the airborne fibers if personnel are going to remove the asbestos containing components. If asbestos-containing materials located on the outside of a building are going to be removed, all openings to the interior of the structure should be closed. If debris suspected of containing asbestos is located on the jobsite, workers should remove the debris to an area where the debris will not be crushed, scraped, or broken from the operations taking place on the jobsite.
Conclusion

After compiling the data gathered from the JHA’s, interviews, and from the CDC/OSHA websites it became clear that the most valuable information was gathered from the CDC and OSHA websites. The data gathered from the JHA assignment was useful for identifying hazards, developing preventative actions, and itemizing the necessary tools and equipment. Considering that the students providing the data had limited experience with performing remediation work, most could readily identify with the damages that could result from a natural disaster. The information gathered through discussions with eight general contractors and subcontractors provided credibility to the data previously gathered, but did not identify any hazards that were previously unknown. The presence of mold was identified by each of the contractors/subcontractors as being a potential hazard to remediation workers. Outdoor construction activities involved with clearing the site and gaining access to buildings were major tasks recognized by most respondents. Other notable remediation activities identified through the interviews include roofing hazards, repairing water utilities, restoring electrical utilities, and flooring installation. All of the interviewees identified minor cuts and scrapes as being the most prevalent type of injury.

Table 4-1 matches cleanup and reconstruction activities with their respective hazards as identified through all facets of the research. The table identifies which hazards can be encountered during the process of each activity. As the table illustrates, and as discovered through the research process, debris removal could be associated with every hazard listed in the table. Although every activity or possible hazard is not covered in the table due to the magnitude of possible activities and hazards in a post natural disaster setting, Table 4-1 represents common identifiable hazards that may be encountered.
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<th>Electrical hazard</th>
<th>Struck by material</th>
<th>Struck by equip.</th>
<th>Minor cuts</th>
<th>Falling debris</th>
<th>Fall hazard</th>
<th>Caught between</th>
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Table 4-1. Summary matrix
CHAPTER 5
RECOMMENDATIONS

The problem of identifying the various types of hazards related to remediation work in post-natural disaster areas has been completed. In the event of a future researcher continuing the study, it should be noted that the research could have more accurate if the researcher was able to actually visit an area that has been affected by a natural disaster. The advantage of visiting a post-natural disaster area would be that the researcher could witness the practices taking place during the remediation work. In order to get a perspective on the frequency of different types of injuries sustained by remediation workers it would be optimal to observe all injuries that occurred in the aftermath of a natural disaster. Identifying the most frequent types of injuries and how they occurred would give the construction industry a perspective on how to better train the personnel.

Simply identifying hazards is not sufficient in preventing hazards from occurring. Extensive research needs to be accomplished in identifying preventative measures. Upon completion of identifying the preventative measures, it would be advisable to create a training seminar used to inform remediation workers entering a post-natural disaster area on the potential hazards that may exist as well as the best preventative measures to take in avoiding the hazards.
APPENDIX A
INTERVIEW GUIDE

Name:

Phone #: Company:

1. What area(s) of construction were you involved with in the remediation work following a disaster?

2. What types of hazards were observed during the remediation work?

3. Was there any type of injury that was more prevalent than others? Explain?

4. What do you feel is possibly the most dangerous aspect of _____________ work in a post-natural disaster setting? (Answer to 1.)

5. Have you discovered/implemented any successful ways of reducing the risk of any specific injury?

6. What types of safety equipment have you utilized?

7. If presented with the situation again, what kind of preparations would you make prior to entering the disaster area?
APPENDIX B
JHA ASSIGNMENT

For this assignment, you are to assume that you are employed by a medium-sized Florida-based construction firm. The company does about $90 million worth of in-place construction work each year. This work is evenly split between custom homebuilding and small commercial buildings. Unlike most of its competitors, this company performs most of the work on its projects with its own employees.

In the past few years the company has been involved extensively with work necessitated by hurricanes that have struck Florida. This work was lucrative for the firm, but it has been determined that these projects cannot be undertaken in the same manner as new construction projects. This realization came as a result of the large number of worker injuries that have been sustained by company workers when performing hurricane remediation work on homes and commercial buildings. A new approach is needed.

The company has decided that its workers must be aware of the potential hazards that they might encounter when they are sent to a residence or commercial site to perform hurricane remediation work. While all conceivable hazards may not be envisioned before actually visiting a site, it has been determined that some of the more likely or possible hazards need to be identified prior to visiting a site. To assist in this effort you are asked to prepare a job hazard assessment for a selected work category. That is, site unseen, you are to identify the major hazards that would be expected to be encountered when performing work on a facility that has been hit by high winds, heavy rainfall, or both. You will work with one or two other company employees in preparing this JHA.

The subject areas have been broken down into eleven different categories. You are to select one category and prepare a job hazard analysis for this selection. There can be as many as three individuals per group. Each group is encouraged to brainstorm about other possible areas within the category selected (the areas listed in the table have been included to assist in thinking about the scope of the effort, but the list could easily grow). There are 11 categories and each is to be selected by only one group in the class. The first group to make a selection will be assigned that category. Each group is to select a category by no later than October 29 (Monday).

The group is to use the JHA format shown at the bottom of this message. The column headed with “code” is to designate whether the identified possible hazard is likely to occur on a residential (r) or a commercial (c) project. If a hazard might occur on both types of projects, simply enter “rc”.

Before actually beginning to put together your ideas for a JHA, first look on the Internet to see what information you can find on the devastation related to hurricanes, high winds or extensive rainfall. Be sure to think about both safety and health.
1. General:
- Preparations prior to visiting the site
- Travel services
- Accommodations
- Food
- Water
- Power
- Inoculations
- Work conditions: rain, wind, dust, heat

2. Site Work
- Site Utilities
- Site Drainage
- Asphalt pavement
- Concrete pavement
- Sidewalks
- Roads
- Parking lot
- Retention ponds
- Irrigation
- Trees
- Landscaping & Vegetation
- Lawns

3. Structural
- Steel
- Frame Lumber
- Masonry
- Concrete Block
- Tilt-Up Panels
- Concrete (precast & cast-in-place)
- Reinforcing steel
- Bar joists
-Lintels

4. Walls and Ceilings
- Wall insulation
- Drywall (sheetrock)
- Exterior wall insulation
- Access doors
- Windows
- Doors
- Dropped ceilings
- Fixtures on walls
- Fixtures on ceilings
- Lath and plaster
- Siding
- Masonry
- Load bearing walls
- Non-load bearing walls

5. Roofs
- Flat
- Sloped
- Equipment on roofs
- Antennas
- Flashing
- Fascia
- Supports for roof-mounted eqpt
- Roof insulation
- Vents
- Access doors
- Skylights
- Metal decking

6. Floors
- Tile flooring
- Wood flooring
- Carpeting
- Concrete flooring
- Split levels
- Second floors
7. **Indoor Utilities**
- Water supply
- Faucets
- Tubs
- Lavatories
- Electrical
- Plumbing
- Ductwork
- Mechanical anchors & hangers
- Appliances

8. **Special Features**
- Elevators
- Stairs
- Dumbwaiters
- Pools
- Garage doors and openers
- Decks
- Sheds
- Fences
- Laundry chutes
- Trash compactors
- Trash chutes
- Overhead cranes

9. **Other Interior Items**
- Acoustical treatment
- Window treatments
- Counters
- Fans
- Kitchen Hoods
- Finish carpentry
- Automatic doors
- Louvers and registers

10. **Furnishings**
- Beds
- Tables
- Chairs
- Wardrobes
- Sofas
- Television sets
- Cabinets
- Stereos

11. **Garage/Storage/Mechanical Room (all surfaces and contents)**
- Possible chemical storage
- Garage door and opener
- Shop tools
- Machinery
- Vehicles
- Water Heaters

Selected Subject Area (1 to 11): _____

<table>
<thead>
<tr>
<th>Code</th>
<th>Work Area</th>
<th>Eqpt/Tools/Mat’ls</th>
<th>Potential Hazard</th>
<th>Corrective Action</th>
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</thead>
</table>

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LIST OF REFERENCES


BIOGRAPHICAL SKETCH

Upon completion of high school, Josh Casart enlisted in the United States Air Force where he proudly served 5 years of active duty service in nine different countries. During his enlistment, Josh received numerous medals including The Air Force Achievement Medal and The Armed Forces Expeditionary Medal for his meritorious services in support of Operations Enduring Freedom, Phoenix Duke, and Southern Watch. After fulfilling his military commitment, Josh Casart attended Pensacola Junior college where he received an Associate in Arts degree with honors. Josh continued his education at the University of Florida where he first received a Bachelor of Science in business administration along with a Master of Science in Building Construction. Josh Casart is currently assuming a position with McIntyre Elwell & Strammer General Contractors as an assistant estimator/project manager.