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PUBLIC HEALTH SERVICE/CDC/NIOSH/DSR
FACE 98-18

TO: **Director, National Institute for Occupational Safety and Health**

FROM: **Division of Safety Research, NIOSH**

SUBJECT: **Equipment Operator Crushed When Chimney Falls on Hydraulic Excavator -- Virginia**

SUMMARY:

On July 2, 1998, a 37-year-old male equipment operator (the victim) was crushed in the cab of a track-mounted hydraulic excavator (backhoe) when a brick chimney toppled over and struck the machine during demolition operations. The victim and a co-worker, a truck driver, were in the final stages of demolishing a 2½-story stone and stone veneer house. They had demolished about 75 percent of the structure, leaving a large brick chimney between 26 and 30 feet high and part of a stone wall. As the victim proceeded to knock down the rest of the wall, the co-worker seated inside the truck saw the chimney sway and topple en masse, falling directly across the operator's cab of the machine. The weight of the chimney crushed the cab with the victim inside. The co-worker went down the driveway and flagged a passing truck, requesting the driver to radio 911. Three local emergency medical units responded within 10 to 12 minutes. Because of the condition of the victim, no first aid procedures were initiated. The victim was pronounced dead at the scene of massive head trauma and brain stem separation.

NIOSH investigators concluded that to prevent similar incidents in the future, employers should:

- ***ensure that before demolishing any structure, an engineering survey is performed by a competent person to determine the condition of the structure, evaluate the possibility of unplanned collapse, and plan for potential hazards and injuries***

- ***ensure that machine operators are provided with the safest work environment possible by complying with the boom height standards of ANSI A10.6 - 1990 Safety Requirements for Demolition Operations***

- ***carefully evaluate the methods used for demolition of masonry structures such as chimneys to prevent exposure of workers to the hazards of premature collapse.***

INTRODUCTION

On July 2, 1998, a 37-year-old equipment operator (the victim) working for a site-clearing and excavating company was killed when a brick chimney toppled over and crushed the cab of the track-mounted hydraulic excavator which he was operating. On August 14, 1998, officials of the Virginia Occupational Safety and Health Administration, (VOSH), notified the Division of Safety Research (DSR) of the incident and requested technical assistance. On August 31, 1998, a DSR Safety Engineer reviewed the case with the VOSH compliance officer assigned to investigate. Photographs and videos of the incident site taken immediately following the incident were examined. On September 1, 1998, the safety engineer interviewed the company vice-president and discussed company safety programs and employee training.

The company employed 35 people and had been engaged in the business of excavation and site development for 10 years. This was their first fatality. The vice-president managed safety and health programs, including training, and visited each job site on a weekly basis. Additionally, the company president made daily visits to each job site. The company had a written general safety policy. Training was conducted both formally and on the job. Before beginning work at a new job site, each crew participated in a pre-job tailgate training session specific to the job environment.

The victim had worked for the employer since 1989. He was the employer's most experienced operator and knew the most about demolition. The employer did not specialize in demolition work, such work being ancillary to the company's primary work of site development. However, the company's workers had demolition experience relative to large residential dwellings, including the demolition of a four-story building during a site-preparation job. The victim was considered the employer's expert (competent person[1]) in such matters and decisions relating to demolition were deferred to him.

At the time of the incident, the company had been subcontracted to

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[1]Competent person: One who is capable of identifying existing and predictable hazards in the surroundings or working conditions which are unsanitary, hazardous, or dangerous to employees, and who has the authority to take prompt corrective measures to eliminate them.

provide site development for a recreation center for terminally-ill children. This included demolishing the 2½-story stone and stone veneer house, separating the masonry materials from the wood, performing controlled fill of the old excavation, burning the wood, and completing site clearing.

INVESTIGATION

The victim and truck driver had been assigned the task of demolishing the house and disposing of the debris and rubble. On the day of the incident, the victim and the truck driver arrived at the site shortly before 7 a.m. They began knocking down the structure with the victim using the excavator to pull over walls and load the debris into the dump truck. They had demolished about 75 percent of the structure by about 2 p.m. when the company president arrived on site. At that time, only the 26-to-30 foot high, three-flue brick chimney and the southwest corner of the house were standing. The three men discussed demolition of the remainder of the structure. Since the victim was the most experienced person relative to demolition and operation of the excavator, his expertise was relied upon for planning the procedures for demolishing the chimney. The president and victim inspected the chimney for defects from ground level. Neither of them noted any cracks in the bricks or mortar joints. They continued to discuss demolition of the chimney, and the victim indicated that he intended to use the excavator to push the chimney over to the south so that he could more easily segregate the brick and masonry from the wooden debris. The president left the site at about 2:30 p.m., and the victim positioned the excavator north of and facing the chimney. The truck driver returned to the cab of the truck to wait. The victim began to knock over a small portion of wall which was close to or may have been in contact with the west face of the chimney. As he did so, the truck driver noticed the chimney start to sway. He started to get out of the cab to warn the victim but the chimney toppled over onto the excavator before he could do so. He went to the machine and saw that the cab had been collapsed, crushing the victim inside. He then went back to the truck and attempted to radio for assistance. He was unable to establish radio contact, and leaving the site via the driveway, flagged down a passing truck on the highway. The truck driver notified 911. Three EMS units responded to the call, arriving on site within 10 to 12 minutes of notification. Due to the extensive damage to the machine's cab and the nature of the victim's injuries, no first aid or CPR procedures were initiated.

CAUSE OF DEATH

The medical examiner attributed death to massive head trauma and brain-stem separation.

RECOMMENDATIONS

Recommendation #1: Employers should ensure that before demolishing any structure, a comprehensive engineering survey is performed by a competent person to determine the condition of the structure, evaluate the possibility of unplanned collapse, and plan for potential hazards and injuries.

Discussion: On the day of the incident, the victim and the company president examined the chimney for defects and discussed the procedures which the victim intended to use to demolish it. However, the extent to which the evaluation considered the condition of the chimney before demolition began is not clear since no record of an engineering survey was maintained. The OSHA Technical Manual, Section IV-Chapter 1, Demolition, Preparatory Operations provides guidance in conducting a comprehensive engineering survey. A complete survey would have evaluated the condition of the entire structure, including the framing, floors, walls, and chimney before any demolition activity took place so that necessary measures could be taken to prevent premature collapse. An examination of the chimney conducted while the house was still standing may have afforded a much better opportunity to detect structural defects than examination from the ground after the house had been torn down. The pre-demolition survey should also plan for potential hazards such as fires, cave-ins, and injuries, and would include ensuring that communications are available for contacting emergency rescue providers. After the incident, the victim's co-worker had to leave the site and flag down a passing motorist to request communications assistance because the worker's radios were experiencing interference.

Additional discussion of standards and requirements for demolition operations is contained in the American National Standard ANSI A10.6 - 1990 and Safety Requirements for Demolition Operations; and the OSHA Safety and Health Standards, 29CFR Part 1926.850 through 1926.860.

Recommendation #2: Employers should ensure that machine operators are provided with the safest work environment possible by complying with the boom height standards of ANSI A10.6 - 1990 Safety Requirements for Demolition Operations.

Discussion: Consideration should also be given to the choice of

equipment which will be used for the demolition. The machine in this incident was a Caterpillar EL 240 having a maximum reach of 34 feet, nine inches. The exact height of the chimney is not known, but is estimated to have been between 26 and 30 feet. The American National Standard for Construction and Demolition Operations — Safety Requirements for Demolition Operations ANSI A10.6 - 1990, contains standards for machine demolition. ANSI A10.6 - 1990, 14.4 specifies that no structure shall be demolished by a crane or backhoe when the boom is less than 5 feet above the height of the building. While the exact height of the chimney is not known, estimates indicate that the machine may not have possessed adequate reach to allow for safe clearance between the machine and the chimney.

Recommendation #3: Employers should carefully evaluate the methods used for demolition of masonry structures such as chimneys to prevent exposure of workers to the hazards of premature collapse.

Discussion: When evaluating methods for demolishing buildings containing masonry chimneys, the order of procedure should be carefully considered to minimize the hazards of premature collapse of the chimney. In this incident, it may have been possible to demolish part of the chimney before any of the house was demolished. Using suitable fall protection equipment, workers could have removed the top of the chimney above the roof by manually knocking down a few brick courses at a time. The chimney below the roof could have then been accessed from inside the house to continue manual demolition until the chimney had been reduced to a height of 15 to 20 feet. The house could have then been demolished and the rest of the chimney pulled down. This would have consumed more time, but would have provided more clearance for the machine when knocking down the remainder of the chimney.

REFERENCE

American National Standards for Construction and Demolition Operations - Safety Requirements for Demolition Operations, ANSI A10.6 - 1990. American National Standards Institute, Inc., New York, New York.

Occupational Safety and Health Administration, OSHA Safety and Health Standards, Construction, 29 CFR 1926, 1981. U.S. Government Printing Office: Washington D.C.

OSHA Technical Manual Directive TED 1.15, Section IV, Construction Operations, U.S. Department of Labor, Occupational Safety and Health Administration ,Washington, D.C. 1995.

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Fatality Assessment and Control Evaluation (FACE) Project

The National Institute for Occupational Safety and Health (NIOSH), Division of Safety Research (DSR), performs Fatality Assessment and Control Evaluation (FACE) investigations when a participating State reports an occupational fatality and requests technical assistance. The goal of these evaluations is to prevent fatal work injuries in the future by studying the working environment, the worker, the task the worker was performing, the tools the worker was using, the energy exchange resulting in fatal injury, and the role of management in controlling how these factors interact.

States participating in this study: North Carolina, Pennsylvania, South Carolina, Tennessee, and Virginia.

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