TO: Director, National Institute for Occupational Safety and Health

FROM: Iowa FACE Program

SUBJECT: Construction worker killed by hydraulic excavator while working in trench.

SUMMARY:

A 26-year-old construction worker was killed while working in an 8-foot deep trench, trying to remove a concrete sewer casing. He was part of a crew constructing new sanitary sewer lines along a residential street. The victim was standing inside an iron trench box, while a hydraulic excavator was being used to remove the concrete casing around a sewer pipe in the trench box. The victim was giving hand signals to a co-worker operating the excavator above him because it was impossible for the operator to see the bottom of the trench where the casing was located. While pulling off the encasement, the bucket teeth slipped off the edge of the concrete and the excavator arm and bucket swung toward the victim, crushing him against the metal side of the trench box (see diagram). The excavator operator immediately moved the bucket away from the wall and went to aid his co-worker, who was still conscious. The man soon became unresponsive and was pronounced dead approximately one hour later in a local hospital from severe internal chest injuries.

RECOMMENDATIONS based on our investigation were as follows:

1. *Machine operators should keep machine attachments at a safe distance from workers at all times.*
2. *Employers should train workers regarding safety when working in close proximity to heavy machinery.*
3. *Alternative working methods should be considered to eliminate the need to work close to a hydraulic bucket while in a trench box.*

INTRODUCTION

In the spring of 1996, a 26-year-old construction worker was killed while laying new storm sewer lines in Iowa. The Iowa FACE program became aware of the incident from a newspaper article and began an investigation. Information was gathered from OSHA, newspapers, and employee statements. One investigator from the Iowa FACE program made a site visit to the company office several weeks after the accident. No visit was made to the construction site for the work had already been completed.

The employer was a general contractor who had been in business for over 30 years. They had several work crews: for concrete, iron erection, tiling, building construction, etc. The company had 40 employees, with six employees on the storm sewer crew. The victim had worked for this company for seven years, spending most of his time on this water/sewer crew.

Safety training for new employees included routine safety talks conducted on site for specific

construction hazards, and an annual full-day safety training program. No written safety procedures were in place that were specific for excavator safety while working in a trench. The company had a good safety record with no overnight hospitalizations due to work injuries. Company representatives state that employees have been disciplined for unsafe working behaviors in the past. This was the company's first work-related fatality.

INVESTIGATION

The victim and the excavator operator (site supervisor) were working together preparing a residential area for insertion of new sewer pipes. In the bottom of an 8-foot hole was a concrete encasement around an existing pipe that the men were trying to remove. An iron trench box was in the hole measuring approximately 20' long, 8' tall, and 8' wide. The victim was standing in the hole giving hand signals to the excavator operator above him. He was positioned between the excavator bucket and the inside wall of the trench box (see diagram). The men were trying to carefully remove the piece of concrete without damaging the pipe. In the process of prying off the encasement, the bucket teeth slipped off the edge of the concrete, and the rebound pressure caused the bucket to swing toward the victim, crushing him against the wall of the trench box, causing chest and abdominal injuries. An ambulance was immediately called but when it arrived the man was unresponsive. He was pronounced dead about an hour later in a local hospital.

There was water in the bottom of the hole, which obscured the view of the concrete encasement. The operator was not able to see the edge of the bucket, and it is likely that the victim did not see it either due to the water. When the bucket slipped, it immediately swung to the side toward the victim. The combination of water in the trench and the need for hand signals contributed to this hazardous situation. After this incident, the concrete encasement was eventually removed using an air-powered jack hammer.

The victim was in a dangerous position, between the bucket and the trench box wall, in line with the force being applied by the bucket. The workers appeared to be accustomed to this arrangement, not aware of this hazard working between the bucket and the trench box wall. When prying and lifting a heavy concrete object with any hydraulic machine component, significant movements of the machine may occur if the bucket slips. Working close to a hydraulic bucket is inherently dangerous in the best of conditions. There was nothing mechanically wrong with the excavator, nor did the operator appear to make an error or misunderstand a hand signal. Hazardous conditions were created by working too close to the operating range of the excavator bucket.

There are no guidelines which prohibit a worker from being in a trench box while a hydraulic excavator is being used in the same trench box. According to the company's General Safety Rules, employees are to "stay out of the swing line of buckets or drags." It is common sense to advise staying clear, if possible, from the working reach of a machine attachment, however many times this is impractical, as in this case, when visual sight of the bucket is obstructed. The company now recommends that employees make sure they are out of the immediate range of the attachment. This is a decision that each employee must make on-the-job, and experience and common sense are key factors.

Normally one would anticipate forward and backward movement when considering a hydraulic excavator, but in this case, due to the prying nature of the procedure, considerable sideways

force was being applied to the bucket teeth at the same time. Both the victim and the operator seemed unaware of the danger created by using the bucket in this fashion. According to photographs of the scene, there was significant room in the trench box for the victim to stand clear of the bucket, out of the swing line for the procedure they were attempting. The company was cited by OSHA for failure to instruct their employees in the recognition and avoidance of unsafe conditions.

CAUSE OF DEATH

The cause of death as taken from the death certificate was, *"closed thoracic and abdominal trauma*" An autopsy was performed which confirmed the above.

RECOMMENDATIONS / DISCUSSION

Recommendation #1 *Machine operators should keep machine attachments at a safe distance from workers at all times.*

Discussion: This operator and worker were accustomed to working in close quarters, ignoring the hazard of standing between the bucket and the trench box wall. Hydraulic excavators may cause jerky movements from rebound pressure if the bucket slips. In addition, there may be significant play in the mechanical linkages which allows greater rebound movement of the bucket. The operator was not able to recognize the hazard since he could not see the exact position of the bucket and the concrete encasement, relying on hand signals from the victim. The operator must know the location of all workers around his machine and not allow them to work in close proximity to the bucket. Employers, site managers, and owner/operators using hydraulic equipment need to be reminded of the potential for rebound movement, and must specify safe distances and follow safe operating procedures at all times.

Recommendation #2 *Employers should train workers regarding safety when working in close proximity to heavy machinery.*

Discussion: Employers and machine owners/operators should ensure that workers are aware of the possibility of rebound movements of machine attachments and keep safe distances from heavy machinery. In this case the worker placed himself between the bucket and the trench box wall. Workers should be trained to stay clear from machinery components, especially in the direction where they may rebound.

Recommendation #3 *Alternative working methods should be considered to eliminate the need to work close to a hydraulic bucket while in a trench box.*

Discussion: This concrete encasement was eventually removed using an air-powered jack hammer, eliminating the need to work in close proximity to the excavator bucket, which is clearly hazardous. It might be preferable to use jack hammers to remove similar encasements in the future. This would avoid using the hydraulic bucket to pry off the concrete, eliminating the sideways force which caused the bucket to swing.

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Fatality Assessment
&
Control Evaluation Program
(FACE)

The University of Iowa, in conjunction with the National Institute for Occupational Safety and Health (NIOSH), is investigating the causes of work-related fatalities in the State of Iowa. FACE is a surveillance program that identifies all occupational fatalities, conducts in-depth, on-site investigations on specific types of fatalities, and makes recommendations for employers and farmers to help prevent similar fatal accidents in the future.

Iowa is a major farming state, and therefore the Iowa FACE Program deals with many occupational deaths on the farm. It is a very hazardous profession that claims hundreds of lives nationally every year. We publish detailed reports that are disseminated to key agricultural leaders in Iowa who share our concern for the safety of farmers. To reach and effectively communicate with this independent and vulnerable group is a worthy challenge here in Iowa.

NIOSH funded state-based FACE Programs include: Alaska, California, Iowa, Kentucky, Maryland, Massachusetts, Minnesota, Missouri, Nebraska, New Jersey, Ohio, Oklahoma, Texas, Wisconsin, Washington, and Wyoming.

Additional information regarding this report or the Iowa Face Program is available from:

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