Fertilizer Company Worker Crushed to Death by Falling Concrete Ecology Block

FACE
Washington
Fatality Assessment
& Control Evaluation

Investigation: #12WA00701

Release Date: August 29, 2016

SHARP Report: 52-36-2016

Washington State Department of
Labor & Industries

SHARP
Safety & Health Assessment &
Research for Prevention

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SUMMARY

In February 2012, a 56-year-old heavy equipment operator working for a fertilizer distribution company died when a concrete “ecology block” weighing approximately 4000 pounds fell from a retaining wall, crushing him.

On the day of the incident, the victim and other employees had been unloading bulk fertilizer from rail cars and moving it into a large steel storage tank. The interior of the tank was partitioned into containment bays using stacked concrete ecology blocks to separate the different materials. Semi-truck trailers filled with bulk fertilizer were driven into the storage tank and backed into a containment bay, which was bordered on three sides by ecology block walls. Using a mobile conveyor belt system, or piler, connected to the rear of the trailer, fertilizer was unloaded into a pile on the floor. As the pile grew larger, an employee operating a front end loader would push the material to the back of the bay.

In the early evening, the victim and one other employee were working to unload the last truck of the day. The victim was operating the front end loader, pushing fertilizer further into the bay after it dropped from the conveyor. At one point, the victim stopped the front end loader and went to investigate whether material was leaking through the rear wall of the bay. He climbed onto and walked along the ecology block wall to the back wall of the bay, which blocked a large opening in the tank. The second worker in the tank shut off the piler and heard several loud booms. He yelled for the victim, but there was no answer. He ran up the pile and saw that the blocks had collapsed, so he ran outside and around the storage tank and found the victim pinned by a fallen block against the wall of the tank. He yelled to another employee to call 911.

Investigators suspect that the victim saw that material was leaking between the blocks of the wall and climbed down a ladder on the back of the tank to take a closer look. The victim was apparently trying to brace the unstable block wall with some long pieces of lumber when it collapsed. The top block of the wall fell directly onto the victim’s head and neck, crushing him against the wall of the storage tank. First responders arrived within five minutes, but the victim was declared dead at the scene.

RECOMMENDATIONS

To prevent similar incidents, Washington State Fatality and Control Evaluation (FACE) recommends that employers should:

- Plan bulk material storage facilities for safety and stability by choosing structures designed specifically for bulk material containment, whether they are permanent or modular.

- Consult a registered professional engineer prior to constructing bulk material containment walls or other structures using ecology blocks.

- Provide employees with training on the hazards of working around ecology block walls, and safe practices, including to:
  - Inspect ecology block wall storage areas before and after loading in material.
  - Immediately stop work around ecology block walls showing signs of material leakage, leaning, moving, or other damage.
  - Never attempt to brace or stabilize a leaning ecology block wall on your own.
  - Avoid walking on top of ecology block walls.
  - Avoid contacting ecology block walls with heavy or other equipment.
  - Notify the proper person if structural integrity issues in an ecology block wall are found.

- Regularly assess and audit the structural stability of ecology block walls. If integrity appears compromised, work around the wall must cease and the wall must be repaired or rebuilt.

INTRODUCTION

In February of 2012, the Washington State Division of Occupational Safety and Health (DOSH) notified the Washington State Fatality Assessment and Control Evaluation (FACE) program of the death of a 56-year-old heavy equipment operator.

WA FACE investigators interviewed the Safety Director and an owner of the company where the victim had been employed. Documents reviewed during the course of this FACE investigation include the DOSH investigation file and death certificate.

Employer

The victim's employer is an agricultural products and fertilizer formulation and distribution company with multiple sites in Washington and Oregon. At the time of the incident, the company had been in business for approximately 8 years. The site where the incident occurred is the company's main wholesale facility which, at the time, had been operational for approximately 6 years. The facility primarily receives and

distributes dry fertilizer, but also formulates mixed products and supplies liquid fertilizer as well.

Employer Safety Training Program

The employer conducted new-hire training, formal forklift training and other on-the-job training. Hazardous materials training and other safety training was provided by outside vendors. The employer reported that they conducted employee safety meetings monthly and sent a weekly “safety message” email, and a safety committee of employees and managers attempted to meet quarterly. None of the training specifically addressed hazards associated with working with bulk materials or ecology blocks.

Victim

The victim was a 56-year-old laborer at a fertilizer distribution company. He had been employed full-time with the company for approximately four months at the time of the incident. He had various duties at the site, including operating heavy equipment, primarily the front end loader. According to the employer, the victim came to the job with approximately 30 years of experience in heavy equipment operation.

Ecology Blocks

Ecology blocks are stackable concrete blocks designed with an interlocking tongue and groove system on the top and bottom, and sometimes sides, for stability (photo 1). Other names include Eco-blocks, bin blocks, and bunker blocks. They are manufactured from unused concrete left over from other construction processes. Common ecology block dimensions are 2’ x 2’ x 3’, 2’ x 2’ x 4’, and 2’ x 2’ x 6’. They typically weigh between 2000 and 4000 pounds. They are usually equipped with a rebar loop, or picking eye, on the top of the block for loading, unloading, and placement. Ecology blocks are marketed for use in retaining walls, storage of bulk materials, and other applications. Their modular nature makes them convenient to use when permanent structures would not meet the needs of the user.

Photo 1: Concrete ecology block

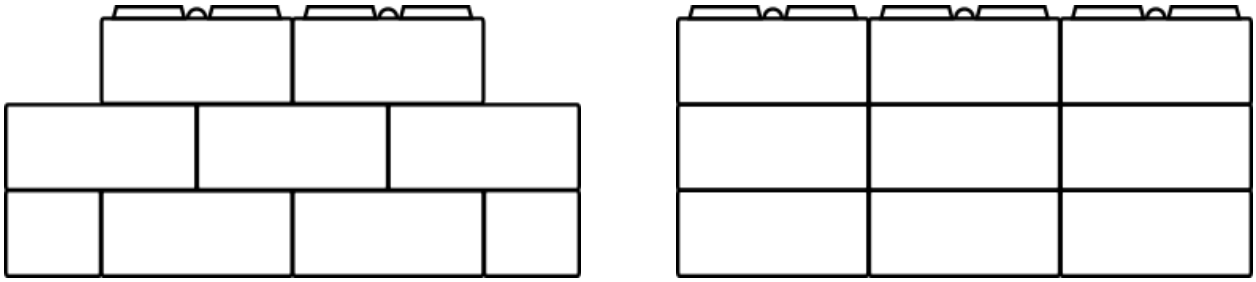
Incident Scene

The incident took place in a large tank used for storing dry bulk fertilizer material (photo 2). The six-million-gallon steel tank had originally been used to store sugar beet

Photo 2: Steel tank used for bulk fertilizer storage

syrup, but had been converted for dry fertilizer material storage. The tank's original steel floor remained. The interior of the tank was partitioned into containment bays using stacked, concrete ecology blocks to create retaining walls approximately six to eight feet high. The ecology blocks used interlocked on the top, bottom, and sides. Two large doors had been cut on either end of the tank to create a corridor to allow semi-trucks and equipment to move in and out. At the time of the incident, extra space had been needed in the storage tank and one of the doors had been blocked off with a retaining wall to create another area for material storage. Most of the ecology block walls within the storage tank had been constructed by stacking the blocks in an offset manner: however, the rear wall of the section where the incident occurred was stacked without offsetting the blocks, with higher blocks directly on top of the lower blocks (figure 1).

Figure 1: Offset vs. vertical wall assembly



Offset **Vertical**

INVESTIGATION

Photo 3: Semi-trailer and "piler" positioned to unload product in the storage tank containment bay

At approximately 5:00 p.m. on the day of the incident, the victim and another worker were in a large steel storage tank unloading a semi-truck trailer of granular bulk fertilizer into a containment bay partitioned by retaining walls assembled using concrete ecology blocks stacked four high. Each trailer contained approximately 25 tons of fertilizer. It was the last truck of the day; two trailers had already been unloaded into the containment area. The trailer had been backed into the containment area (photo 3) and connected to a mobile conveyer belt, or piler, operated by the victim's coworker. Fertilizer was offloaded from the trailer onto the piler, which would drop the fertilizer into the containment bay. The victim was operating a front end loader. As the fertilizer dropped from the conveyer into a pile, the victim would periodically use the front end loader to push the material further into the

bay, against the rear retaining wall. According to the employer and other workers, it was common for the bucket of the front end loader to run into the block walls during this process. The storage tank wall served as the back wall in most other containment bays, and other walls in the center of the storage tank had material on either side. The bay they were working in had previously been part of a corridor that consisted of two large open doorways on either side of the storage tank. When more area for material storage had been needed approximately two years prior, the bay had been created by blocking the large opening with an ecology block retaining wall. No inspection of the block wall had occurred before workers began unloading fertilizer on the day of the incident.

When the trailer had been approximately one-third of the way unloaded, the victim stopped the front end loader and left the machine. He climbed onto one of the sidewalls (photo 4) and walked on top of it toward the rear of the bay, presumably to check to see if material was leaking through the back wall. Shortly after, the victim's coworker heard several loud noises and yelled for the victim, but there was no answer. He ran to the top of the fertilizer pile and saw that blocks had fallen from the back wall. He ran to the outside of the tank. After pulling some of the fertilizer out of the way, he saw the victim pinned to the side of the storage tank wall by a fallen ecology block (photo 5). Another worker immediately called 911 and emergency responders arrived within five minutes. The victim was declared dead at the scene.

Photo 4: Ecology block wall that victim walked on top of to get to the rear of the containment bay

Photo 5: Arrow points to area where victim was pinned to tank wall by falling ecology block

Investigators and the employers believe that the victim saw that material was, in fact, leaking through the retaining wall and climbed down a ladder on the back wall of the storage tank to take a closer look. It appeared that he had been attempting to brace the wall with some long 2" x 6" pieces of lumber when it collapsed.

CONTRIBUTING FACTORS

- Lack of proper design, construction, and maintenance of material storage areas
- Lack of training regarding the dangers of working around bulk material and ecology blocks
- Possible destabilization of block wall due to granular material leaking between the blocks
- Possible destabilization of block wall through contact with the front end loader bucket

CAUSE OF DEATH

The death certificate listed the cause of death as “crush force injury of head and neck.”

POST-INCIDENT CORRECTIVE ACTIONS BY EMPLOYER

Following the incident, the employer created an ecology block training program, which includes training employees not to walk on top of block walls and to minimize work, such as sweeping, near block walls. The employer now requires ecology block walls to be stacked no more than three blocks high.

RECOMMENDATIONS AND DISCUSSION

Recommendation 1: Plan bulk material storage facilities for safety and stability by choosing structures designed specifically for bulk material containment, whether they are permanent or modular.

Discussion: Loose bulk material stored in piles, such as soil, sand, grain, or fertilizer, exerts pressure on the structures that contain it. The specifics of the forces exerted vary depending on the properties of the material being stored, and change as bulk material is moved in and out of storage areas. Containment areas should be planned to accommodate both the quantity and the specific properties associated with the bulk material to be stored. Structures and building materials are available that have been specifically designed for the storage of bulk goods. Plan bulk material storage systems using structures that have been designed for the material to be contained and install them according to the manufacturer’s instructions.

Recommendation 2: Consult a registered professional engineer prior to constructing bulk material containment walls or other structures using ecology blocks.

Discussion: Ecology blocks are marketed and sold to consumers in numerous industries for a variety of purposes, including bulk material storage. Blocks interlock using a tongue and groove system, but are not bound with mortar. Retaining walls or storage bunkers can be assembled or disassembled relatively easily using standard

equipment, such as a backhoe. While ecology blocks are versatile, cost effective, and widely used, standards or best practices for their safe use are not readily available. In this incident, the ecology block retaining wall became unstable and collapsed. The precise reason this occurred remains unknown.

Before assembling either temporary or permanent retaining walls from ecology blocks, employers should consult a registered professional engineer (RPE) for approval of the design. A registered professional engineer has the knowledge to ensure that the design takes into account any issues that may affect the structural integrity or safe use of the wall.

Recommendation 3: Provide employees with training on the hazards of working around ecology block walls, and safe practices, including to:

- Inspect ecology block wall storage areas before and after loading in material.
- Immediately stop work around ecology block walls showing signs of material leakage, leaning, moving, or other damage.
- Never attempt to brace or stabilize a leaning ecology block wall on your own.
- Avoid walking on top of ecology block walls.
- Avoid contacting ecology block walls with heavy or other equipment.
- Notify the proper person if structural integrity issues in an ecology block wall are found.

Discussion: In this incident, workers did not receive training specifically regarding the hazards of working around stacked ecology block walls. The victim apparently was attempting to brace the unstable wall himself when it collapsed, fatally crushing him. To ensure the safety of workers, employers must train employees about the possibility of ecology block wall collapse, give frequent reminders at safety meetings, and make sure workers are following best practices through spot checks.

Recommendation 4: Regularly assess and audit the structural stability of ecology block walls. If integrity appears compromised, work around the wall must cease and the wall must be repaired or rebuilt.

Discussion: At this worksite, ecology block retaining walls were often assembled and left in place for years, but inspections were not conducted to assess continuing structural integrity. In this case, it is possible that the wall that collapsed was compromised before workers began unloading material into the containment bay and pushing it back against the wall with the front end loader. Employers should develop a written plan that includes detailed inspection procedures and a thorough checklist. This should be done in cooperation with a professional engineer. The plan and checklist should be shared with employees as part of their training. The plan should also include how walls will be repaired or replaced if issues are found.

ACKNOWLEDGEMENTS

This report was reviewed by stakeholders from labor and business communities and various Washington State and Federal worker safety agencies. Though we are unable to acknowledge specific individuals for their contributions to this report, we would like to recognize the following for their help and support of the FACE mission and objectives:

- The Employer involved in the incident
- Safety & Health Assessment & Research for Prevention (SHARP)
- Division of Occupation Safety and Health (DOSH)
- Federal FACE Program Management (NIOSH)

INVESTIGATOR INFORMATION

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WASHINGTON STATE FACE PROGRAM INFORMATION

The Washington State Fatality Assessment and Control (WA FACE) program is one of many workplace health and safety programs administered by the Washington State Department of Labor & Industries' Safety & Health & Research for Prevention (SHARP) program. Under a cooperative agreement with the National Institute for Occupational Safety and Health (NIOSH grant# 2U60OH008487-11), WA FACE collects information on occupational fatalities in WA State and targets specific types of fatalities for evaluation. WA FACE investigators evaluate information from multiple sources. Findings are summarized in narrative reports that include recommendations for preventing similar events in the future. These recommendations are distributed to employers, workers, and other organizations interested in promoting workplace safety. NIOSH-funded, state-based FACE programs include: California, Kentucky, Massachusetts, Michigan, New York, Oregon, and Washington. WA FACE does not determine fault or legal liability associated with a fatal incident. Names of employers, victims and/or witnesses are not included in written investigative reports or other databases to protect the confidentiality of those who voluntarily participate in the program.

Additional information regarding the WA FACE program can be obtained from:

Washington State FACE Program
www.lni.wa.gov/safety/research/face/
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