MIFACE INVESTIGATION REPORT #09MI075

SUBJECT: Semi-Truck Driver Died When Struck by Precast Concrete Panel That Fell From Semi Trailer

Summary

In fall 2009, a male semi-truck driver in his 60s died when he was struck by a 3,770-pound precast concrete panel that fell from a semi-truck trailer. The semi-trailer had two A-frames carrying precast concrete panels. One A-frame was located toward the rear of the trailer and one to the front of the trailer. The sides of the A-frame, against which the panels rested, were faced outward on both sides of the trailer. After arriving at the site, the decedent removed the load securement straps from all of the concrete panels. The unsecured precast concrete panel that struck the decedent was located on the A-frame toward the front of the trailer facing the passenger side. A crane operator was lifting a precast panel from an A-frame located at the rear of the trailer facing the driver's side. A single looped tag line approximately 45 feet in length was in use. The following sequence of events is postulated: As the precast panel from the rear of the trailer was lifted up and over toward the truck cab, the looped tag line caught the edge of the unsecured panel at the front passenger side A-frame. The decedent was standing near the passenger door and noticed the looped tag line catch on the corner of the incident panel. As he was approaching to move the tag line away from the panel, the tag line ran out of slack, tightened, and exerted enough force to cause the panel to fall from the A-frame, strike his right shoulder and head, and then pin him to the ground (See Figure 1). After the panel fell, the crane operator lowered the precast panel he was lifting. Coworkers unhooked this panel and then hooked the crane to the panel pinning the decedent. The panel was lifted from the decedent and emergency response was called. The decedent was transported to a local hospital and declared dead.

Figure 1. A-frames on trailer and locations of concrete panels involved in incident

MIFACE identified the following factors to be contributory to this incident:

- Unsecured concrete panel
- Looped tag line
- Unloading sequence of trailer
- Truck driver entered swing radius of crane and load

RECOMMENDATIONS

- Transport devices, such as shoulder bolts, should be utilized to secure individual concrete sound panels to the A-frames during transport and unloading unstrapped loads.
- Standard Operating Procedures (SOPs) should include work practices that address load securement during the unloading process. When load configuration permits, truck drivers should wait to release the load securement tie down assemblies until after the material to be unloaded is secured with the unloading line or other unloading device.
- Truck driver training, in addition to training regarding SOPs, should emphasize safe driver positioning during unloading and to never enter the unloading zone without confirmation from the individual unloading the trailer.
- Additionally, crane operators and their employers should ensure employees follow appropriate crane operation procedures.

BACKGROUND

In fall 2009, a male semi-truck driver in his 60s died when he was struck by a 3,770-pound precast concrete sound wall panel that fell from a semi-truck trailer. MIFACE learned of this incident from the MIOSHA 24-hour hotline. MIFACE contacted the safety director at the firm who agreed to participate with the MIFACE program at a future date. In 2013, the firm agreed to participate with MIFACE. MIFACE personnel received written documents and scene re-enactment pictures from the safety director. During the writing of this report, MIFACE reviewed the MIOSHA compliance investigation file, the death certificate and the police report and pictures.

The employer is a trucking company employing 16 individuals, 12 of whom had the same occupation as the decedent (semi-truck driver). He had been employed with the firm for 17 years, both as a mechanic and a truck driver. The transportation firm had been in business for 80 years. The firm had been on the site for 7 days. The decedent's job titles were truck mechanic and semi-truck driver. He was paid hourly, and worked full-time, 8-hour days with overtime. His shift began at 5:50 a.m. He had arrived at the site to make a delivery. He was wearing foot protection, a hard hat and a high visibility vest.

The employer had a written health and safety program in both English and Spanish. There were written safety rules and procedures in place for the delivery task. The company used both a private consultant and a consultant provided by their insurance company to develop their safety program. The program's safety director had attended safety classes and had on-the job experience. The safety director reported to the company owner.

The firm had a health and safety committee comprised of hourly employees and management representation. The committee met monthly. Weekly safety meeting were held with all company personnel. Both the employer and the consultant provided safety training. All employees

received approximately 40 hours of safety training per year. The firm provided training in both English and Spanish. The types of training provided included classroom, on-the-job, videos, manuals, tool box talks and OSHA 10- and 30- hour training. Training records were maintained. Safety training topics included:

Accident Reporting & Investigation	Electrical Safety	Hearing Conservation Program
Back Safety/Lifting	Emergency Action Plan	Housekeeping Policy
Bloodborne Pathogens	Environmental Program	Lockout/Tagout Program
Confined Space Entry	Excavations	Personal Protective Program
Contractor Safety	Fall Protection	Respiratory Protection Program
Corporate Safety Policy	Fire Prevention	Return-to-Work Program
Crane Safety	Forklift Safety	Smoking Policy
Disaster Response Plan	Hazard Communication Program	Substance Abuse Policy

The firm had a written disciplinary procedure. Safety issues concerning this site were discussed with the drivers. The decedent was following the employer's standard operating procedure at the time of the incident.

MIOSHA Construction Safety and Health Division issued the following alleged Serious citations to the employer at the conclusion of its investigation:

Serious: General Rules, Part 1

- Rule 114(2)(c): Inspections of the construction site, tools, materials and equipment to assure that unsafe conditions which could create a hazard are eliminated were not conducted. (Employee exposed to unsecured precast concrete panel during the unloading process of other panels.). *NOTE:* Construction Safety Standard, General Rules Part 1 was changed in 2013. Old Rule 114(2)(c) is now Rule 114(2)(a) in the new 2013 version.
- Rule 114(2)(d): Instructions were not provided to each employee in the recognition and avoidance of hazards and the regulations applicable to his or her work environment to control or eliminate any hazards or other exposure to illness or injury. (Employer not providing adequate training for hazards associated with overhead hoisting. Employee unable to recognize and avoid overhead hoisting and associated hazards.) NOTE: Construction Safety Standard, General Rules Part 1 was changed in 2013. Old Rule 114(2)(d) is now Rule 114(2)(c) in the 2013 version

Serious: Handling and Storage of Materials, Part 8, Rule 818(1):

> All material shall be stacked, racked, blocked, interlocked, or otherwise secured to prevent sliding, falling or collapse during storage or transit. (Precast concrete panels not properly secured to prevent falling. Precast concrete panel 2 feet by 19 feet by 16 inches rolled off of a trailer while another panel was being unloaded. Falling precast concrete panel struck driver of truck causing a fatality.)

MIFACE did not interview employees of the company who was contracted to unload the panels and construct the sound wall.

INVESTIGATION

Construction Area

The construction activity involved the erection of a sound barrier wall. The east-west, 2-lane highway had the right lane closed and separated from the active travel lane by construction barrels. On the south side of the closed lane was a concrete barrier wall separating the construction work area from the unloading site. The north-south road grade was 3.2-degree (1.5%).

An early model 1990s crane (RT760) operated by another construction contractor (Contractor A) was located on the south side of the concrete barrier wall. The operator had placed the crane outriggers straight down and was operating with a short boom length.

A man lift was positioned east of the crane on the south side of the concrete barrier with its platform positioned at the sound barrier wall (Figure 2).

The site supervisor was not present at the time of the incident.

Figure 2. Overview of construction site including example of position of decedent's truck and location of additional company trucks

Semi-Trailer Description

The semi-trailer was equipped with two A-frames that carried the precast concrete sound panels (Figure 3). One A-frame was located toward the rear of the trailer and one to the front of the trailer. The A-frames were appropriately secured to the trailer bed. The sides of the A-frames, against which the panels rested, were facing outward; the driver (northern direction) and passenger side (southern direction) of the trailer. The foot of the A-frame supporting the panel involved in the incident was narrower than the bottom of the slab. Additionally, the wood attached to the A-frame stopped short of the bottom of the steel. The keyway on the bottom of the barrier panel that fell caused the bearing surface to become smaller. The A-frames were measured at 12 degrees south to north. The concrete sound panels were located approximately 65 inches above the roadway. An example of panel securement for transportation is shown in Figure 4.

Figure 3. Example of concrete sound panel orientation on A-frames on trailer

Figure 4. Example of securement method for concrete panel transportation

Incident

The decedent transported the concrete sound barrier panels, which were loaded at a plant in a nearby state, to the construction site. The decedent parked the truck in the closed lane next to the barrier wall and the crane. His truck was the first truck to be unloaded that day. Other company trucks were in line to his west (Figure 2). He removed all the load securement straps from the concrete sound panels. While the panels were being unloaded the decedent stood next to the concrete roadway barrier near the passenger door.

Company A's crane operator began to unload the panels, from the rear of the trailer. Company A provided a rigger to secure the load. When the crane operator lifted the panels, the rigger indicated the truck "shook". When unloading the panels resting against the A-frames facing the driver's side of the truck, the crane operator lifted the panels up toward the cab and over (north to south) the trailer. The crane operator had unloaded 5 sound barrier panels (unloading sequence unknown) and they had been set into position into the sound barrier wall by a single laborer in the man lift. A single looped tag line approximately 45 feet in length was used. The use of the looped tag line was for the elimination of a second man lift to set the precast panels in place at their final distination.The foreman for the erecting employer stood on the ground while a employee in an elevated manlift made the connection to the wall. (See Figure 2). The looped tag line also assisted the employee located in the elevated man lift to set the panels if the foreman was absent.

Figure 5. Path of panel being unloaded and position of panel that fell from truck striking decedent

The unsecured 2-foot high by 19-foot long by 16-inch wide precast concrete panel weighing approximately 3,500 pounds that struck the decedent was located on the A-frame toward the front of the trailer facing the passenger side. The incident occurred when the crane operator lifted a 4-foot, 7,000-pound precast panel that was resting against the A-frame located on the driver's side at the rear of the trailer (See Figure 5).

No one saw the precast panel fall nor did they see anything that would have caused the panel to come off the truck.

The rigger indicated he felt the trailer shake and looked over and saw the concrete block lying on top of the decedent. The crane operator indicated he heard a loud "bang" and saw that the panel had fallen from the trailer. The incomplete wood upon the A-frame (See Figure 1) allowed the unsecured panel to pivot in its transported position; scuff marks were present on the lower portion of the A-frame. After the panel fell, the crane operator lowered the precast panel he was lifting to the ground. Contractor A employees unhooked this panel and then hooked the crane to

the panel pinning the decedent. The panel was lifted from the decedent and emergency response was called. The decedent was transported to a local hospital and declared dead.

There were no impact points on any of the equipment, product or A-frames which ruled out the possibility of sudden movement of the truck causing the panel to fall.

The MIOSHA compliance officer investigating this incident made a recommendation to the decedent's employer that they should conduct a re-creation of the incident. Several weeks after the incident, the decedent's employer used a third party in an attempt to recreate the sequence of events leading to the concrete sound panel falling from the A-frame. The firm provided the same semi-tractor trailer driven by the decedent and loaded it with concrete panels placed in the same configuration as they were on the day of the incident. The semi was positioned at a location that was identically graded to that of the roadway location. A single looped 40-foot tagline was used to simulate conditions at the time.

The sound barrier panel that was positioned in the same location as the panel falling from the truck and crushing the decedent was loosely secured by restraining straps so it would not become dislodged during the several lift attempts performed to ascertain if the tag line could dislodge this panel from the A-frame.

The crane lifted the 4-foot, 7,000-pound precast panel that was resting against the A-frame located on the driver's side at the rear of the trailer. The 45-foot (approximate length) tag line hung in a large loop when this panel was raised. The left rear panel was raised from the left rear A-frame and moved several times in the same manner as the crane operator did at the time of the incident to determine the location of the looped tag line as the panel moved toward the right front of the trailer. When the concrete panel was lifted off the rear of the truck, the truck moved slightly, but not nearly enough to cause the panel to tip and fall from the trailer. On several occasions, the single piece looped tag line encircled (looped around) the upper corner of the loosely restrained sound barrier panel causing it to tip and fall against the restraining straps.

The restraining straps were removed from the concrete sound barrier panel. The rear 4-foot, 7,000- pound panel was raised and brought forward, again in the same manner that the crane operator had consistently utilized to unload the panels from the trailer. The single piece, looped tag line caught on the 2-foot concrete panel and dislodged it from the front A-frame causing it to fall off of the A-frame, flipping 360 degrees and landing flat on the bottom edge. The damage to the panel involved in the re-creation occurred in the same locations and was very similar to the damaged panel at the incident scene. The impressions on the ground were similar to those made on the roadway at the time of the fatal incident.

Based on the re-creation, the following sequence of events was postulated: Based on the decedent's position at the cab of the truck he was the only individual that would have been able to see the tag line encircle the bottom edge of the concrete sound panel. The decedent noticed that the tag line was getting caught on the panel and approached the trailer to move the tag line

away from the panel. While he was approaching, the tag line ran out of slack, tightened, and exerted enough force to cause the panel to fall from the A-frame and strike his right shoulder and head, and pin him to the ground.

CAUSE OF DEATH

The cause of death as listed on the death certificate was blunt force injuries of torso. Toxicology was negative for alcohol, prescription and non-prescription drugs.

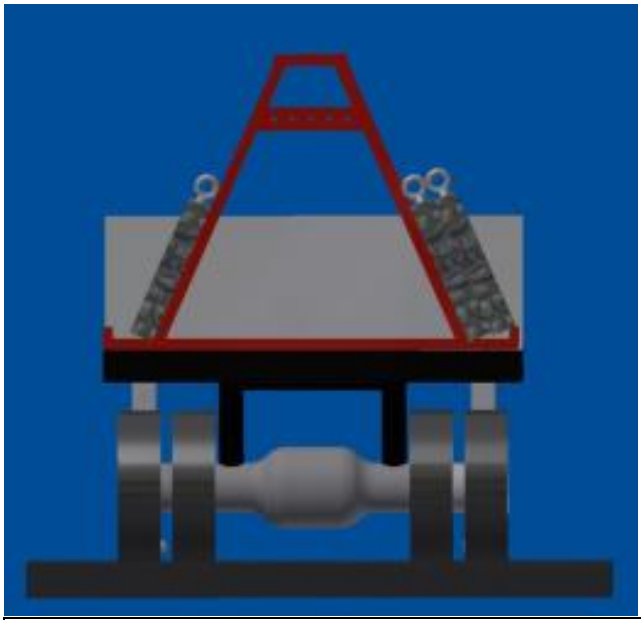
RECOMMENDATIONS/DISCUSSION

- Transport devices, such as shoulder bolts, should be utilized to secure individual concrete sound panels to the A-frames during transport and unloading unstrapped loads.

The only securement of the concrete sound panels were the securement straps. When the securement straps were removed, all panels were unsecured. To re-secure the unsecured panels not being unloaded, the driver would have to enter the unloading zone, re-secure the tie down assemblies, exit the unloading zone, and then the crane operator could unload the desired panel. The firm modified the securement of the panels during transport and unloading by attaching woodworking C-clamps to both the concrete panel and the A-frame (Figure 6). C-clamps are not rated for this application. The clamps could vibrate, loosen or come off during transport and may provide a false sense of security regarding the stability of the panel against the A-frame.

MIFACE recommends that during the initial load securement process, transport devices such as shoulder bolts be installed in the panels and rated straps and come-a-longs used to secure each individual panel to the A-frame, either onto welded rings on the A-frame or around the frame itself (Drawing 1).

Figure 6. Concrete panel securement with C-clamps, after the incident



Drawing 1. Transport and unloading securement devices, such as shoulder bolts, to be removed prior to lift

Additional securement straps should be placed over all panels. When the load arrives at its destination, the truck driver can remove the securement straps placed over all the panels. These short-term/temporary holding devices and associated tie down straps would secore the the concrete panels while the truck driver removes the load securement straps. As each concrete panel is unloaded, the rigger could remove tie down assemblies from the panel, remove the shoulder bolts, and install the appropriate lifting devices into each panel prior to it being unloaded.

- Standard Operating Procedures (SOPs) should include work practices that address load securement during the unloading process. When load configuration permits, truck drivers should wait to release the load securement tie down assemblies until after the material to be unloaded is secured with the unloading line or other unloading device.

The concrete blocks were not individually secured to the A-frame. The decedent removed all of the load securement straps prior to the unloading process MIFACE recommends that when the load configuration permits, that truck drivers communicate with the individual unloading the truck regarding the unloading sequence. Understanding how the truck will be unloaded will provide the driver with the knowledge of how best to maintain securement of the unloaded material and thus enhance product and human safety.

- Truck driver training, in addition to training regarding SOPs, should emphasize safe driver positioning during unloading and to never enter the unloading zone without confirmation from the individual unloading the trailer.

In this incident, the decedent was very close to the path of travel of the raised concrete panel as it was being lifted up and over the truck which could have posed a hazard if there had been a failure of the lifting device. Additionally, under the proposed scenario, when the driver attempted to free the looped tag line from the unsecured panel, he placed himself not only within the travel path but under the raised load. Employers should emphasize the safety hazards posed by drivers Employers should train drivers that standing too close to the travel path and under raised loads puts them at risk of injury. Drivers should not enter these exclusion zones unless the forklift or crane operator has signaled that it is safe to enter and the forklift or crane operation has ceased all movement. Additionally, employers should emphasize to drivers that if they see something about to happen with their load that they communicate the issue with the person unloading the material, not try to “fix” the problem without the knowledge of the person performing the unloading activity.

- Additionally, crane operators and their employers should ensure employees follow requirements outlined in MIOSHA Construction Safety Standard, Part 10, Lifting and Digging Equipment.

MIOSHA Construction Safety Standard Part 10, Lifting and Digging Equipment sets forth the requirements of safe crane operation. The configuration of the RT760 crane at time of the fatality

was not approved by the manufacturer. The crane did not have a 0% extension outrigger chart, therefore no applicable load chart was present and no capacity available for the crane. Due to structural limitations at the time of manufacture, a 0% extension outrigger chart was not possible.

Key Words: Struck by, concrete sound panel, truck driver, hazard zone, crane safety, trailer unloading, Transportation

ACKOWLEDGMENT

Technical assistance was provided by Tony McKenzie, Ph.D., P.E., Research Safety Engineer, NIOSH, Division of Safety Research, Protective Technology Branch.

REFERENCES

MIOSHA standards cited in this report may be found at and downloaded from the MIOSHA, Michigan Department of Licensing and Regulatory Affairs (LARA) website at: www.michigan.gov/mioshastandards. MIOSHA standards are available for a fee by writing to: Michigan Department of Licensing and Regulatory Affairs (LARA), MIOSHA Standards Section, P.O. Box 30643, Lansing, Michigan 48909-8143 or calling (517) 322-1845.

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