

MIFACE INVESTIGATION REPORT: #09MI049

Subject: Commercial Roofer Died When Struck By a Falling Load of Palletized Roofing Material

Summary

In the summer of 2009, a 48-year-old male commercial roofer, working on a roof, died when a load of shrink-wrapped roofing material, weighing approximately 1,900 pounds fell 20-30 feet from a 40-inch by 50-inch wooden pallet being transported overhead by a tower crane. The decedent's supervisor, who was the roof man (signal person) for the lift, was working in another area of the roof clearing space for the pallet of rolled roofing material to be placed. The rigger placed a ratchet strap around the roofing bundle, and then "basket-rigged" the wooden pallet with two slings, both of which were 28-foot long, 2-inch wide polyester slings. The slings were connected to a ½-inch by 19-foot 2-inch leg spreader equipped with 10-inch hooks and a master ring that was connected to the crane's hook. The slings were placed through the fork lift sleeves of the pallet. The rolls of roofing material were not secured to the pallet. The rigger indicated the load was ready to be hoisted to the roof. As the rigger observed the load being raised, he did not note any load instability or imbalance. The crane operator lifted the load approximately 20-30 feet above roof level, and then began to transport the load to the placement area. This involved swinging the load over the area where the decedent and his coworkers had been assigned to work by the supervisor. The crane operator noticed the roofing rolls were beginning to fall from the pallet. The crane operator yelled out a warning to the workers. The rolls of roofing material fell from the pallet and struck the decedent. The coworkers called for emergency response, unhooked the ratchet strap, and removed the roofing materials from the decedent. Emergency response provided care, and the decedent was transported to a local hospital where he was declared dead.



Figure 1. Configuration of the roof area. X indicates location of decedent.

RECOMMENDATIONS

Decedent's employer

- Employers should ensure riggers are appropriately trained in safe and proper rigging techniques, including assessing the scope of the activity being performed, planning the activity, selecting and inspecting rigging components, and execution of the rigging and lift.
- Employers should ensure roof signal persons are appropriately trained.
- Employers working on a multiple-employer construction site should institutionalize a communication system to ensure safety warnings are communicated to affected employees.
- Employers should discuss with appropriate personnel (e.g. crane operator, rigger, signal person, other safety personnel, etc.) upcoming material lifts, including selecting the load path and landing location, worker warning systems, and any additional safety concerns.
- Employers should develop as required, a job safety analysis (JSA) for worker tasks.

Crane operator

- Crane operators should conduct a visual survey of the transport path prior to the lift to identify worker locations. If workers are in the transport path, the crane operator should provide an audible warning that a load will be transported overhead and/or contact the signal person to warn these workers.
- Crane operators should visually inspect the load after lifting to the desired height and prior to transport to the landing site to ensure load stability.

General Contractors

- General contractors should develop a detailed outline to follow during subcontractor orientation to ensure training consistency.
- General contractors should develop a method for auditing both the development and submission of subcontractor job safety analysis plans.
- Contractual arrangements between general contractors and site owners should be adhered to and enforced.

Tower Crane Manufacturers

- Tower crane manufacturers should consider including a wireless camera as part of the standard equipment package for a tower crane purchase/rental.

Employers Utilizing Tower Cranes

- Employers utilizing tower cranes without cameras should, in consultation with the crane operator, consider renting and/or mounting a wireless camera directly on the hook block or crane jib to assist the crane operator in monitoring the load.

INTRODUCTION

MIFACE investigators were informed of this work-related fatality by the Michigan Occupational Safety and Health Administration (MIOSHA) personnel, who had received a report on their 24-hour-a-day hotline. Several weeks after the incident, the MIFACE researcher interviewed the general contractor's site safety manager, who also escorted the MIFACE researcher to the incident scene. The company for whom the decedent worked declined to participate with the MIFACE research project. MIFACE interviewed the MIOSHA Construction Safety officer assigned to the fatality, reviewed the responding police report and pictures, death certificate, medical examiner report, and the MIOSHA file and citations. All pictures used in this report are courtesy of the responding police department.

Roofing Company Background Information

The company for whom the decedent worked conducted commercial roofing activities. Safety training was provided to all employees. The decedent's employer had developed a written safety plan that was specific to the construction site. The foreman had held tool box talks as required.

The rigger who prepared the pallet of roofing material for hoisting worked for the same company as the decedent. This rigger had completed formal Management and Unions Serving Together (MUST) safety modules, including the rigging module. The MUST training was not expired. MUST modules are safety awareness modules only; MUST modules are not intended to be skill or task training. MUST training does not qualify an individual to be a "competent person" nor does it provide all training that may be necessary by state and federal regulations. The contractor provided hands-on training to supplement the MUST training. The hands-on rigging training was conducted by a coworker who operated another type of crane used at the company; the rigger had to demonstrate to the roofing company that he was familiar with rigging techniques. The rigger had also assisted another rigger from the company while at the construction site. He had been performing rigging duties at the company for one year and also operated other machinery for the company (front end loader). He did not have a National Commission for the Certification of Crane Operators (NCCCO) certification in rigging. The rigger had been trained to rig pallets using either the choke method (cross the two ends of the straps by putting one through the end of the other before fastening it to the crane) or the basket hitch (continuous sling forming a cradle under the load) method. The rigger indicated he did not like the "choke" method and he didn't use it. The rigger had been rigging loads with a coworker (another rigger) at the site for approximately a week and a half. The rigger he had previously been assisting at the site was not at the site the day of the incident.

The foreman on the jobsite had been employed by the roofing firm for more than 30 years. The foreman had completed the MUST safety modules. The MUST training was not expired.

Normally, the foreman was not the signal person on the roof (operating the 2-way radio). This was the first time he was the signal person at this construction site.

The crane operator had been employed for one year with the general contractor and operated this particular tower crane for the past year. The operator had been operating a tower crane for 11 years and was NCCCO certified in tower crane operation. His training certification was not expired. The operator had received a safety orientation by the general contractor that included the requirement to not hoist loads over workers. The operator was a member of the operator's union. The crane operator had demonstrated his load handling skills to the general contractor's site safety manager prior to the beginning of his employment with the firm. The crane operator was determined to be a competent crane operator.

General Contractor Background Information

Per contractual arrangement, the general contractor provided only the tower crane, operator and crane oiler. The subcontractors were responsible for safely moving their material, providing appropriate barricades, and designating and identifying to the crane operator the ground (rigger) and roof (signal) personnel. Per the general contractor's site safety manager, subcontractor signal persons were responsible for advising/clearing the load path prior to calling for the load to be hoisted and placed on the roof.

The general contractor's safety manager for the site had been employed by the firm for more than 10 years. He had been working at the site as the safety manager for 2½ years. He reports to the firm's corporate safety manager. Safety responsibilities are delegated to the subcontractors, who are responsible for ensuring their employees follow both their in-house safety program and the general contractor's safety program. A weekly progress meeting is held; safety issues can be raised at this meeting. The site safety manager conducts site walkthroughs on a daily basis. When a safety issue is observed, the site safety manager indicated the issue is corrected and disciplinary action is taken.

All subcontractors were contractually required to prepare a daily pre-task analysis (job safety analysis or JSA) one day prior to the actual work activity and submit the JSA to the site safety manager. The daily JSA requirement was intended to encourage the subcontractor to assess the tasks of next day's activity, identify the potential safety hazards, and develop prevention strategies. The decedent's employer had previously submitted a JSA for "working with roof materials" and a "lift plan" when lifting material to the roof. The lift plan included steps to control hazards: use proper straps and rig properly and don't lift over workers in area. The decedent's employer had not developed (and thus had not submitted) a rigging/hoisting JSA to the site safety manager, nor the daily task/JSA for lifting the rolled roofing materials.

The site safety manager provided all subcontractor personnel, prior to beginning work at the site, a safety orientation (which was documented by the general contractor) and a safety guide (brochure). This training lasts approximately one hour and followed a checklist format. As an item is covered, the box associated with the item is checked off. The safety orientation included general safety items, such as hazard communication, emergency phone numbers, and the general contractor's disciplinary policy, as well as specific safety instructions for the project, such as eye protection, hard hat requirements, fall protection, site specific/trade specific hazards, accident reporting, etc. It did not cover a prohibition of workers working in the swing radius areas of the tower cranes. Additionally, the brochure listed general site safety policies and levels of discipline for safety infractions. The site safety manager was not at the site for the safety orientation of the decedent's employer's employees. Another person from the general contractor's staff conducted this orientation.

One week prior to the incident, the site safety manager held a meeting with the decedent's employer regarding roofing material delivery times and areas, and the location of roofing material load placement on the roof. The roofing material delivery area was determined to be at the south east corner of the building.

The general contractor's job site superintendents were responsible to coordinate scheduling construction work activities that required tower crane use with the subcontractor's foreman. A board in the general contractor's trailer contained the schedule of the tower crane activity. The schedule board was checked each day by the subcontractor foreman and the site's gate attendant. When a material load was delivered, it was the responsibility of the subcontractor to coordinate the lift with the crane operator. The general contractor had not developed a JSA for hoisting a load.

The site safety manager indicated that the general contractor required crane operators to sound the horn before the load moves horizontally. The crane operator indicated that there was no mandatory requirement for sounding the horn to alert workers on an incoming overhead lift.

At the conclusion of the MIOSHA Construction Safety and Health Division investigation, the following citations were issued.

To the decedent's employer:

SERIOUS: GENERAL RULES, PART 1, 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 exposures to illness or injury:

Employees were not trained on procedures when materials are being hoisted overhead. The employer was contracted to perform roofing related work for a facility under construction.

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:

An employer did not ensure that Hydro-Flex roofing materials were properly stacked, racked, blocked, interlocked, or otherwise secured during transit. Rigging became disengaged while being hoisted by a Tower Crane.

- RULE 832(1):
Rigging equipment for material handling was not inspected at the time of installation, before each job, and at the beginning of each shift if in use. Defective rigging equipment was not removed from service:

Roofing material on a pallet in a vertical position secured in place by a ratchet strap became disengaged while engaged in roofing activities for a facility under construction.

SERIOUS: LIFTING AND DIGGING EQUIPMENT, PART 10

- RULE 1025a(12):
An employee shall not be permitted under a suspended load:

Load of Hydro-Flex roofing material weighing in excess of 1400 pounds, was transported over an employee while engaged in roofing activities for a facility under construction.

- RULE 1025a(16):
A load shall be secured and balanced before the load is lifted more than 6 inches:

A load of Hydro-Flex material was not secured and balanced while engaged in roofing activities for a facility under construction.

SERIOUS: SIGNALS, SIGNS, TAGS, AND BARRICADES, PART 22, RULE 2233(L):

A danger sign to alert employees was not used where an immediate hazard existed. The sign was not removed when the hazard no longer existed:

No danger sign posted in work area under a hoisted load of roofing material while engaged in roofing activities for a facility under construction.

To the General Contractor:

SERIOUS: GENERAL RULES, PART 1, RULE 114(2)(b)

No instructions were provided to each employee regarding the operation procedures, hazards, and safeguards of tools and equipment when necessary to perform the job.

No instructions provided by employer to an employee regarding the safe procedures of a piece of equipment. The employer allowed an employee to operate a Liebherr tower crane. Employees were engaged in hoisting materials over workers performing roofing work below without a pre-lift meeting, job analysis, a procedure or guidance in place to alert the employees of potential overhead hazards while engaged in roofing activities.

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.

SERIOUS: LIFTING AND DIGGING EQUIPMENT, PART 10

- **RULE 1005a(5):**

All portal, tower and pillar cranes shall be in compliance with the requirements of ASME standard B30.4 "Portal, Tower and Pillar Cranes," 1996 edition

- **RULE 1025a(12):**

An employee shall not be permitted under a suspended load

Instance A: Load of Hydro-Flex roofing material weighing in excess of 1400 pounds was transported over an employee while engaged in roofing activities.

Instance B: No signal device use to signal movement of materials being lifted and moved by a Liebherr tower crane while engaged in roofing activities.

- **Rule 1025a(16):**

A load shall be secured and balanced before the load is lifted more than 6 inches

INVESTIGATION

The roofing company began work on the construction project approximately three months prior to the day of the incident. On the day of the incident, the six-person work crew began work at 6:30 a.m. They were assigned to work in the southeast corner of the building as it was the last area where work was to be performed. The decedent and another coworker were chalking lines

for the roofing material. The tower crane operator, rigger and foreman on the roof all had radios for communication. The tower crane operator indicated that he was to coordinate the lift with the foreman on the roof.

The crane operator had performed the required daily crane inspection and found all crane components to be operating correctly. The crane operator involved in the incident had, in the past, sounded the crane horn when lifting precast concrete panels to place on the building wall. The operator indicated that when he lifted a “really heavy or awkward size” load, he would use the horn to warn workers of the lift. The crane operator stated that it was usually the person on the roof who alerted workers that a load was coming so they could move out of the way. The crane operator and a representative of the decedent’s employer did not have a pre-lift meeting concerning the route to use for delivering the rolled roofing material to the roof.



Figure 2. Position of tower crane in relation to roof area

The crane operator had performed at least eight lifts on the morning of the incident, six of which were for the decedent’s employer (sand and gravel). During one of these lifts, he indicated to the police that as he was lifting dirt to the roof in a 5-yard concrete bucket, he observed an unstable load: a hook shackle that was not sitting correctly (cocked). After setting the bucket on the roof, he informed the rigger, asking him to ensure rigging provided a stable load. Figure 2 shows the location of tower crane in relation to the work area of the six-person crew.



Figure 3. Shrink-wrapped roofing materials, with ratchet strap, on pallet on truck trailer

The site safety manager meeting with the decedent’s employer regarding load delivery occurred the same week that a load of Hydro-Flex rolled roofing material was scheduled to be delivered. The load was delivered on a semi-flatbed trailer three days after the scheduled delivery time while the morning’s sand/gravel lifts were taking place. The foreman was notified of the delivery, and he instructed the rigger to continue lifting the sand/gravel until break, and then, after the break, lift the roofing materials.

Due to the size and space limitations of the project, the

general contractor asked subcontractors to ensure that incoming loads of materials were unloaded as soon as possible. After taking the morning break, the foreman radioed the rigger and crane operator to hoist the Hydro-Flex roofing material to the roof.

The Hydro-Flex roofing material was positioned upright (standing on end) on a 40-inch by 50-inch stringer-class wood pallet (Figure 3). Longitudinal stringers ran the length of the pallet on the outside and two stringers were equally spaced to further support the deck boards, which were flush to the outside stringers. The pallet load of 20 Hydro-Flex rolls weighed approximately 1,900 pounds. The rolls were individually bound with tape to keep their roll shape intact and stretch-wrapped to unitize (bundle) the rolls for shipping. The Hydro-Flex bundle was not centrally positioned on the pallet; the rolls were positioned toward both one side and the top of the pallet. The bundle was not secured to the pallet. Police pictures taken at the scene show a number of pallets/bundles with this shipping configuration.

After break the decedent and his coworkers returned to the southeast corner of the roof. The foreman instructed the crane operator to look for him (he was wearing a green shirt) to identify the location to land (lay down) the Hydro-Flex on the roof. He radioed the rigger to begin to unload the trailer.

The incident occurred during the lift of the first pallet load of Hydro-Flex. The rigger stated he had performed an inspection of his rigging equipment prior to the load being hoisted. He was familiar with using the single crane hook and was not as familiar using a spreader configuration for the palletized material. The rigger indicated he was concerned about how the Hydro-Flex was positioned on the pallet: the plastic shrink wrap was only around the Hydro-Flex rolls and not the Hydro-Flex rolls and pallet.



Figure 4. Police re-enactment of lift showing pallet bowing

The rigger asked for Lift-All Load Hugger ratchet straps located on the roof. One of the workers on the roof placed the ratchet straps into a dirt bucket and the crane operator lowered the bucket. The foreman left the southeast area where the crew was working to clear a landing location for the Hydro-Flex on the northwest section of the roof. He could not see the decedent or his coworkers from his location. The foreman indicated in his interview statements he assumed the crew knew that a load was coming up because he informed the decedent, rigger and the “look out” worker. He identified these individuals as the “key people”. It was customary for the “look out” individual or the foreman to “take charge” of the load when it came to the roof. He did not inform each employee that a load

was coming up and over their heads nor did he walk the roofing load after it was hoisted to the lay down area.

Upon receiving the ratchet strap, the rigger placed it around the middle of the shrink-wrapped rolls. After strapping the rolls, the rigger placed the two 28-foot-long 2-inch-wide polyester slings in a double basket hitch configuration. He placed one sling each under the pallet through the lift fork sleeves and connected the slings ends to two 19-foot spreader hooks. The rigger indicated that he placed the slings through “the strongest part of the pallet.” The slings were outside of the ratchet strap.

The rigger radioed the crane operator to begin the lift. The rigger observed the rigging/load by signaling the crane operator to raise the load very slowly and visually inspected the slings to ensure they were seated correctly and that the load was level. The rigger could not see a problem, although the pallet was most likely bowing due to the weight of the load. He signaled to crane operator to continue the lift. The rigger watched the load as it was raised. The rigger indicated the load continued to appear level and it did not rotate at any time. He observed the load until it was out of his sight over the roof.

The crane operator was facing south. The load’s swing path was south to northwest (to the operator’s left). Wind speed was 10-15 mph. When the load was approximately 20-30 feet above the roof, the crane operator began to swing the load to the northwest landing area. The operator indicated he was watching the load. As the load was crossing the roof, he noted the load “did not look right”. The load became unbalanced, started to tip, and the shrink-wrapped, strapped rolls came off the pallet. The operator yelled out the crane’s window to warn the workers below.

The decedent was kneeling and chalking the roof lines when he struck on his back by the falling bundle. The ratchet strap and the shrink wrap held the rolls together after the roll bundle struck the decedent. The decedent’s coworkers removed the ratchet strap and shrink wrap from the roll bundle, and then removed the rolls from the decedent. His coworkers called for help and emergency response. The decedent’s coworkers did not start CPR because the decedent was breathing and had a pulse. When emergency response arrived, his pulse had stopped. The decedent was transported to a local hospital where he was declared dead.



Figure 5. Pallet involved in incident

After the incident, another crane operator saw the empty pallet still in the slings and the ends of the slings still in the hooks of the spreaders. The tower crane operator involved in the incident set the empty pallet on the ground. Responding police found a piece of the wooden pallet and the ratchet strap near the decedent's location.

The responding police department requested the rigger and crane operator to re-enact the rigging and lifting sequence followed for the previous load. The rigger placed the ratchet strap and slings in the same positions as the first load. The police department requested the crane operator to lift the palletized load from the trailer. This re-enactment load, once clear of the trailer, was found to be leaning and not centered with slings. The pallet was also bowing under the weight of the rolled roofing. The rigger stated that the previous load was not situated like this and if it was, he would not have allowed it to be lifted. One of the police officers returned to the roof near the incident site and instructed the crane operator to sound the horn and to shout out from the window. The horn sounded and was clearly heard as was the crane operator's voice as he shouted from the window

CAUSE OF DEATH

The cause of death as stated on the death certificate was multiple trauma. Toxicology was negative for alcohol or illegal drugs.

RECOMMENDATIONS AND DISCUSSION

Decedent's employer

- Employers should ensure riggers are appropriately trained in safe and proper rigging techniques, including assessing the scope of the activity being performed, planning the activity, selecting and inspecting rigging components, and execution of the rigging and lift.

Although the rigger had received rigging training, he did not appropriately rig and secure the palletized load. The "strongest part of a pallet" when rigging a pallet for a crane lift is not the forklift runner, which is perpendicular to the deck board; it is the longitudinal direction of the stringer. Figure 4 shows the flexing of the pallet due to placing the rigging straps in the pallet runners. The horizontal forces acting on the pallet caused the pallet to flex. If using slings to lift the roofing rolls on a pallet, the ratchet straps should be placed on the outside of the sling, and should secure the rolls to the pallet after the crane operator placed tension on the slings. Another suggestion made by his colleagues was that if the rigger wanted to use the spreader, then one hook should have been used.

Additionally, the roofing material was not centered on the pallet thus the center of gravity of the load was not in the center of the pallet. When suspended, a load being raised tends to move so that the center of gravity is directly below the hoisting hook. This “shifting” of the load may have placed extra stress on the pallet deck boards, causing the pallet to tip and the outermost deck board to break, causing the roofing material to fall (Figure 5).

Other methods to rig and raise this load could include using a crane pallet fork to lift the palletized roofing materials. The pallet fork tongs, which can be adjusted, slide into the fork runners. As the material is raised, the center of gravity is automatically adjusted to be located under the hoisting hook. Another method would be to use a forklift to lift and place the palletized material into a wire basket to raise the material to the roof.

This incident occurred prior to the promulgation of the OSHA Cranes and Derricks in Construction, 29 CFR 1926.1400 rule. The rule requires that materials be rigged by a *qualified* rigger (1926.1400(c)(3)). The proposed rule defines a “qualified rigger” as one who meets the criteria for a qualified person – a person who, by possession of a recognized degree, certificate, or professional standing, or who by extensive knowledge, training and experience, successfully demonstrated the ability to solve/resolve problems relating to the subject matter, the work, or the project. Qualified riggers are required whenever workers are within the fall zone and hooking, unhooking, or guiding a load, or doing the initial connection of a load to a component or structure (1926.1425(c)). A person who is designated as a qualified rigger must have the ability to properly rig the load *for a particular job (emphasis added)*. The rigger does not have to be qualified to perform every type of rigging job.

Employers must ensure that whoever is designated as a qualified rigger can perform the rigging work needed for the exact type of load and lifts required for a particular job with the equipment and rigging that will be used for that job.

- Employers should ensure roof signal persons are appropriately trained.

The foreman, who was acting as signalman, indicated that this was the first time he had acted as the signal man for this job. Interview statements indicated that no one instructed him to have signal duty on the day of the incident. The timing of the delayed arrival of the roofing rolls and the absence of the experienced rigger caused him to perform this task. The foreman indicated that he was not aware of a company JSA for signaling or hoisting loads where workers were present.

The NCCCO Signalperson Task Force has grouped the knowledge that signalpersons need to have into five areas: know and understand both hand signals and voice communications, have a basic knowledge of crane operations, understand specific considerations concerning the

construction site (“situational awareness”), and know applicable safety standards and regulations.

At the time of the incident, MIOSHA did not require either riggers or signalpersons to be certified but did require that construction personnel must be qualified.

The recently promulgated OSHA Cranes and Derricks in Construction, 29 CFR 1926.1400 rule requires a signal person when:

1. The point of operation is not in full view of the operator
2. The operator’s view is obstructed in the direction the equipment is traveling
3. Either the operator or the person handing the load determines that a signal person is needed because of site-specific safety concerns.

The OSHA Cranes and Derricks in Construction rule also requires signal persons meet specific qualifications prior to giving any signal. The signal person’s qualifications must be assessed by either a third party evaluator or by the individual’s employer, who has its own qualified evaluator. The signal person is considered qualified if he/she:

1. Knows and understands the type of signals used at the worksite
 2. Is competent in using these signals
 3. Understands the operations and limitations of the equipment, including the crane dynamics involved in swinging, raising, lowering and stopping loads and in boom deflection from hoisting loads,
 4. Knows and understands the relevant signal person qualification requirements specified in subpart CC,
 5. Passes an oral or written test and a practical test
- Employers working on a multiple-employer construction site should institutionalize a communication system to ensure safety warnings are communicated to affected employees.

On worksites, especially those with multiple employers/cranes, it is imperative that communication occurs between interacting construction employers. In this incident, a breakdown in communication occurred. The decedent’s foreman at the landing zone did not ensure that workers were adequately apprised of and removed from the path of the overhead load. Coworker interviews indicated that the responsibility to alert workers of an incoming load was the responsibility of the worker on the roof with the two-way radio. The crane operator may not have been informed that there were workers in the transport path of travel and did not ensure a clear travel path prior to hoisting and transporting the load to the landing point. The crane operator did not sound the horn to warn workers of the overhead load; only upon seeing the workers under the load did he stop transporting the load.

Communication breakdown also occurred between the decedent's employer and the general contractor: The decedent's employer did not submit a JSA for lifting roofing material as specified by contract and this omission was not detected by the general contractor.

- Employers should discuss with appropriate personnel (eg crane operator, rigger, signal person, other safety personnel, etc.) upcoming material lifts, including selecting the load path and landing location, worker warning systems, and any additional safety concerns.

Although not a critical lift, a discussion about the delayed arrival of the roofing and its subsequent lift would have identified that workers were now deployed in the load transport zone; workers would not have been working in under the load path if the load had arrived on time. A discussion would have identified the workers in the transport zone and the necessity of either a different travel zone or clearing a different landing location. Although the general contractor strongly urged contractors to promptly clear the delivery area, the discussion could have developed a different transport route (after hoisting, trolleying the load closer to the crane operator cab, swinging the boom toward the landing location and then extending the load out to and landing the load at the new location). A discussion may also have identified a different option to hoist the palleted load, such as a forklift to lift the pallets from the truck and placing them into an appropriate container, and then hoisting the container to the roof or lifting forks. The discussion might have shown the need to have an individual identified on the roof at the location of the workers to alert them of an incoming load while the foreman was at the landing area to receive the load. The crane operator knew he was looking for a roof person in a particular color shirt – identifying this person by shirt color only instead of by shirt color and location – may make it more difficult for the crane operator to take the appropriate load precautions.

- Employers should develop as required, a job safety analysis (JSA) for worker tasks.

OSHA defines a job hazard analysis as “a technique that focuses on job tasks as a way to identify hazards before they occur. It focuses on the relationship between the worker, the task, the tools, and the work environment.” A Job Safety Analysis (JSA) is a method that can be used to identify, analyze and record: 1) the steps involved in performing a specific job, 2) the existing or potential safety and health hazards associated with each step, and 3) the recommended action(s)/procedure(s) that will eliminate or reduce these hazards and the risk of exposure to a workplace injury or illness.

The general contractor required a JSA for job tasks. Although a JSA for lifting loads had been developed by the decedent's employer, a job specific JSA for lifting roofing materials had not been developed. The rigger was unfamiliar with rigging this type of load. The signalperson (with the radio on the roof) was not the usual signalperson and did not adequately alert the workers on the roof. A JSA may have identified another rigging method or the appropriate safety measures

required for lifting with the straps used in the incident and the need for additional signalpersons on the roof as the drop zone was an extended distance from the rigging location.

Crane operator

- Crane operators should conduct a visual survey of the transport path prior to the lift to identify worker locations. If workers are in the transport path, the crane operator should provide an audible warning that a load will be transported overhead and/or contact the signal person to warn these workers.

One of the many safety actions a crane operator must take is to ensure safe load travel is to verify that workers are not in the path of overhead travel. In this incident, the crane operator did not make this critical safety observation prior to hoisting the roofing material.

- Crane operators should visually inspect the load after lifting to the desired height and prior to transport to the landing site to ensure load stability.

Figure 4 demonstrates that the rigged pallet was flexing under the weight of the roofing material, indicating stress on the pallet and potential load instability. Another safety action a crane operator must undertake is to ensure load stability. Although the crane operator may not have recognized the extent of flexing of the pallet due to his position in the cab when the load was rigged on the ground, after the load was hoisted, the flexing may have become more apparent as it was closer to his position. The crane operator however, now having the load hoisted, looking for the decedent's coworker at the landing spot and noting the workers in the travel path, may not have been observing the stability of the load once it was hoisted.

General Contractors

- General contractors should develop a detailed outline to follow during subcontractor orientation to ensure training consistency.

Although the general contractor had a safety orientation program for all contractors, the consistency of safety information that was given was subject to change based upon the trainer. An outline of all subtopics that should be covered under a general topic heading would enable trainers to be consistent in information presented.

- General contractors should develop a method for auditing both the development and submission of subcontractor job safety analysis plans.

The general contractor's audit system for subcontractor JSA submission did not identify the non-submitted JSA for rigging/hoisting the pallet loads. Additionally, as the employer of the crane operator, a JSA for rigging and warnings were not developed. The general contractor should

develop an audit system to identify subcontractor tasks that are required to have a JSA submitted and to ensure the required JSA is submitted prior to the performance of said task.

- Contractual arrangements between general contractors and site owners should be adhered to and enforced.

The general contractor/site owner contract indicated that the general contractor was not to perform “construction work” on the construction site. The general contractor was the employer for the crane operator, who provided hoisting services to all subcontractors who needed such services. The site owner did not address this contract violation with the general contractor prior to the incident.

Tower Crane Manufacturers

- Tower crane manufacturers should consider including a wireless camera as part of the standard equipment package for a tower crane purchase/rental.

Few tower crane manufacturers mount wireless camera systems to the tower crane as a part of the standard tower crane safety equipment. The American Society of Civil Engineers, in their Policy Statement 424 – Crane Safety on Construction Sites, states in part “Encourage the development and implementation of technology to improve hoisting and lifting operations.”

Employers Utilizing Tower Cranes

- Employers utilizing tower cranes without cameras should, in consultation with the crane operator, consider renting and/or mounting a wireless camera directly on the hook block or crane jib to assist the crane operator in monitoring the load.

To improve safety and productivity, wireless camera installation should be considered by employers whose employees operate tower cranes. Employers should consider contacting a tower crane wireless camera manufacturer to identify an appropriate camera system for the configuration and site characteristics in which the crane is being used.

Although some crane operators do not embrace nor like camera technology, improvements in job performance by tower crane operators has been demonstrated in a number of studies including Shapira (2008) and Leung (1999). Among the additional safety benefits provided by wireless camera systems, tower crane operators can more easily verify the load rigging, the location of the block, navigate obstacles and minimize lifting blind, identify nearby ground workers, and improve communication with the rigger.

REFERENCES

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

- MIOSHA Construction Safety Division, Lifting and Digging Equipment, Part 10
- MIOSHA Construction Safety Division, General Rules, Part 1
- MIOSHA Construction Safety Division, Handling and Storage of Materials, Part 8
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