Assembler / Fabricator Dies When Struck by “L” Rack Loaded with Glass Mirrors in Washington State

Fatality Investigation

Washington State Fatality Assessment and Control Evaluation (FACE)

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Developed by the Washington State Fatality Assessment and Control Evaluation (FACE) Program and the Division of Occupational Safety and Health (DOSH), WA State Dept. of Labor & Industries. The FACE Program is supported in part by a grant from the National Institute for Occupational Safety and Health (NIOSH). For more information, contact the Safety and Health Assessment and Research for Prevention (SHARP) Program, 1-888-667-4277.

SUMMARY

In September 2008, a 35-year-old male died when he was struck by a metal shipping framework known as an “L” rack (see Figure 1). The victim was a skilled assembler and fabricator who worked in the model room at a custom glass and mirror manufacturing facility in Washington State. The rack was loaded with a crate of mirrors that tipped over while being moved by three employees using two pallet jacks. Prior to the event the victim was engaged in moving a large “L” rack loaded with an estimated 3,000 lb crate of plate mirrors. The victim and two co-workers were in the process of moving the large “L” rack of mirrors closer to a glass cutting table area inside the business. The rack was previously offloaded by other employees using a forklift from a truck and then moved again by the victim, a co-worker, and the night supervisor using two manual pallet jacks. The “L” rack was designed with forklift pockets at the bottom with the intention that it be moved using a forklift only. As the loaded rack was being moved and repositioned by the employees using the two pallet jacks, it fell rearward and struck the victim. Several employees attempted to move the rack and mirror crate while 911 responded. The victim was pronounced dead at the hospital due to blunt force head trauma caused by being struck by the rack loaded with the crate of mirrors.

To prevent similar occurrences, Washington State Fatality Assessment and Control Evaluation (FACE) recommends that businesses engaged in handling, shipping, or receiving plate glass or similar products should follow these recommendations:

1. Develop a safer method of glass transportation and handling that eliminates the currently used glass rack.
2. Modify glass racks permanently or temporarily while at the business location to prohibit the use of pallet jacks.
3. Design and organize the work environment to eliminate hazard potential.
4. Institute and enforce strict material handling policies that prohibit unsafe and improper materials handling.
5. Require written hazard assessments and plans specific to materials handling tasks.
6. Provide safety training materials in an appropriate language for employees.

INTRODUCTION

In September 2008, a 35-year-old male working as a skilled assembler and fabricator of custom glass mirror products was struck by a crate of mirrors being transported on a large “L” rack and died. The mirror transport rack commonly referred to as an “L” rack fell over as the victim and coworkers were moving it with pallet jacks. The rack loaded with glass mirrors weighed an estimated 3,000 lb. The Washington FACE program was notified of the incident by the Washington Division of Occupational Safety and Health (DOSH). DOSH investigators visited the company soon after the incident. During this visit, DOSH investigators interviewed the Plant Manager, a supervisor, and several employees involved in assembly. The FACE field investigator conducted preliminary interviews and a site visit with the DOSH compliance investigator and with the manufacturing facility manager where the incident occurred. Representatives of the FACE program conducted a follow-up site investigation and interview. FACE personnel interviewed the Plant Manager who is also in charge of plant safety. The investigation included an extensive interview and tour of the facility (see Figure 2) and incident site (see Appendix B for photographs). In addition to the site investigation, Washington FACE utilized a variety of sources to augment the investigation.

Company

The company designs, fabricates, and assembles custom glass mirror products predominantly marketed for use in the hotel industry. They did not manufacture mirrors, but ordered them from suppliers. The company had been in operation since 2000 and had been at the current location for three years. At the time of the incident, the business had 90 employees working two shifts. The majority of the employees worked day shift and six employees, including the supervisor, were working the night shift when this incident occurred. Typically, there were four supervisors during the dayshift and one on the nightshift.

Safety Program

At the time of the incident, the Plant Manager acted as informal Safety Director and the company did not have a comprehensive written safety program or specific written protocols for materials handling. Specifically, the company did not have written protocols for the use of pallet jacks or their use for the movement of “L” racks. In addition, the company had no organized safety committee and no regular multi-level safety meetings. They did conduct weekly toolbox safety talks in English for each shift.

Training Program

The company had no organized written training program for new hires and no regular refresher trainings. The company did provide training for forklift and pallet jack operation and all of the employees involved in this incident had documented pallet jack training. Other training was conducted informally while on the job and machine specific training was provided by supervisors, other employees, or machine operators. The company also employed skilled trade workers like welders and machine operators who had completed specialized training prior to being hired.

The Victim

The victim was one of the first employees hired and had nearly four years of experience with the company. According to the Plant Manger:

> The victim was one of the most skilled workers and assemblers in the company.
> The victim was familiar with and highly skilled at almost every task.
> The victim had previously performed the incident task over 100 times and was familiar with the work area.
> The victim had been trained as a forklift and pallet jack operator.

The victim was a native of Ukraine and a non-native English speaker. His level of communication in English was described as “beginner” by the Plant manager. The victim was offered English lessons at the expense of the company but had refused. One of the other employees involved in the fatal incident spoke the same language as the victim.

INVESTIGATION

At the time of the incident, the company was assembling custom glass mirror products from sheets of plate glass mirrors. The victim and co-workers were at work approximately four hours prior to the incident and were involved in similar tasks. One of the victim’s tasks was to move racks of glass mirrors and position the racks near the glass cutting area where the incident occurred. The glass cutting area is located in close proximity to the overhead door. Also in the area adjacent to the incident site was a glass edging machine and a large metal receptacle for broken and scrap glass. This receptacle was only movable using a forklift or pallet jack thus making it semi-stationary.

Earlier in the day, employees offloaded the “L” rack of glass using a forklift and placed it between the overhead door and the six foot safety fence that separates the cutting area from the general work area (see Figure 2, position 1). It was reported that the rack was initially placed in an awkward position making it difficult to unload plates of glass onto the cutting table. The victim and two co-workers were attempting to reposition the offloaded “L” rack of glass mirrors so the plate glass mirrors could be more easily moved to the cutting table. The three employees attempted to reposition the rack of glass mirrors using two manual pallet jacks so the rack was at the end of the fence and the plates of glass mirror were accessible to the cutting table area (see Figure 2, position 2).

The Glass or “L” Rack

The metal racks are designed in an “L” shape with a 90° angle at the bottom and are available in different sizes (see Figure 1 and Photos 3-6). In this industry, “L” racks are used to store and transport large glass plates. Similar racks are used in other industries to handle and transport slabs of stone and other flat heavy materials. The large “L” shaped metal racks like the one in this incident are designed to accommodate up to 5000 pounds during shipment. The Plant Manager estimated that this particular rack loaded with glass mirrors weighed 3000 pounds. The rack in this incident was 8 feet 1 inch long by 6 feet 10 inches high by 2 feet 6 inches in width. The rack was designed with pockets at the bottom to allow for access and movement with forklifts. However, the remainder of the bottom area of this specific rack was not otherwise blocked or designed to prevent the use of manual pallet jacks (see Figure 1 and Photo 3). Glass mirrors in wood crates are loaded on the racks and positioned at a slight rearward angle on rack braces in order to stabilize the sheets of glass and prevent them from toppling forward off the rack (see Figure 1).

The incident company now uses straps and braces to stabilize crates of glass on racks and uses straps to fasten racks to the backstop of forklifts (Photo 4). When positioned on the floor or on a forklift with a backstop and strapped for support, the loaded racks are stable and generally not susceptible to toppling. However, when a loaded rack is lifted with a manual pallet jack at each end, the center of gravity of the rack and the load dynamics change dramatically making racks more unstable and thus susceptible to toppling. The rack instability is greatly increased when using two pallet jacks at maximum height. This creates unbalanced load centers and an uncontrolled rack, as was the case in this incident. Assembly employees reported to DOSH investigators that one short “L” rack had fallen over while being moved with pallet jacks and employees considered moving the tall “L” racks with pallet jacks to be “hazardous” and “unstable”. Another employee commented that, “The most hazardous part of my job is moving glass”.

There are several companies that manufacture “L” and similar racks and there is variation in rack design depending on the rack manufacturer. Racks are specified for flat glass and stone handling and transportation. The incident company reported to the DOSH investigator that the manufacturers and suppliers who provide the “L” racks do not furnish any handling instructions for the racks nor are there any instructions or warning labels on the “L” racks. One version of the rack is manufactured with “L” racks welded back to back and referred to as an “A-Frame” rack that allows for loading on both sides of the rack and provides a more stable base (see Photo 7). However, depictions of this rack from manufacturers show that they also have open bottom areas that allow for the use of pallet jacks.

Two related materials handling products in use for plate glass handling may also pose significant hazards. One is a wheeled cart and the other is a wheeled dolly (see Photo 8). The cart is designed to handle sheets of glass or stone stacked in an angled upright position and is equipped with two pneumatic tires, two rotating castors, a 24 inch wide wheel base, and rated at 2000lb. capacity. The cart has no physical barrier to limit the vertical size of the glass or stone transported on it thus compromising the stability of the cart and creating a significant toppling hazard. The wheeled dolly is available with two pneumatic tires centered on a channel with casters at either one end or both ends of the channel. The channel height is approximately 6.5 inches from the ground. The dolly is designed to carry sheets of glass or stone in the channel, available in three lengths (36, 48, and 72 inches), and rated at 1000lb. capacity. The dolly has no vertical support structure or ability to limit the dimensions of the load making the stability of the load completely dependent upon the skill of the user. This dolly design allows loads to fall over and is a significant hazard.

The Incident

It is unclear why the victim, co-workers, and shift supervisor attempted to reposition the rack loaded with a crate of glass mirrors using manual pallet jacks instead of the available forklift. The employees had been verbally instructed several times not to use

the pallet jacks to move the racks. This was the first known incident of the shift supervisor participating in the use of manual pallet jacks to move large “L’ racks. The plant manger noted that the large metal scrap bin was located in a position that prevented the forklift from swinging around and setting the rack and crate in the appropriate place. The plant manager hypothesized that the employees may not have wanted to spend the time to maneuver the rack with the forklift or did not fully understand the risk associated with using manual pallet jacks to lift and attempt to move the rack. The DOSH investigator also noted there was insufficient room to maneuver the “L” rack with a forklift in the current work area configuration. An employee reported to DOSH investigators that, “The large ‘L’ rack was moved by pallet jacks this time because the three-man team decided that movement of the rack with pallet jacks was OK for a short distance”.

The victim and the supervisor inserted the pallet jacks into the lower backside of the “L” rack and raised the jacks to their highest position. It was reported that the “L” rack loaded with the crate of plate glass angled rearward and was leaning towards the employees operating the pallet jacks. The crate of glass mirrors was not secured to the rack. As the two workers maneuvered the rack by pushing from behind on the pallet jacks, another worker remained on the side of the rack pushing and stabilizing the crate. The workers were in the process of rotating the rack ~180° to be perpendicular to and at the end of the safety fence. The loaded rack reportedly got caught up on the safety fence post multiple times causing the employees to reposition the rack by moving it back and forth.

The three employees were close to having the “L” rack in the desired destination when the victim gave the pallet jack one more shove causing the rack to topple backward striking and trapping him between the safety fence and the rack (see Figure 3 and Photo 6). The other worker using the pallet jack was able to escape from behind the rack, as was the worker pushing from the side of the rack. The victim’s co-workers described the incident as occurring very quickly with no time for the victim to escape. The remaining workers attempted to move the rack using a forklift and manual lifting

while 911 responded. Emergency response was on the scene in five minutes and transported the victim to the hospital where he was pronounced dead from his injuries.

CAUSE OF DEATH

The medical examiner states that the cause of death was due to craniocerebral trauma due to blunt force injury of the head.

RECOMMENDATIONS AND DISCUSION

RECOMMENDATION #1: Develop a safer method of glass transportation and handling that eliminates the currently used "L" racks.

DISCUSSION: The FACE program recommends that this company and other companies that use similar "L" racks investigate options for safer transportation and handling of large plate glass, mirrors, granite or concrete slabs, and similar size and weight materials. Alternate methods to the "L" rack are stacking materials horizontally or vertically in a crate with spacers between each piece for protection and access for handling. A vacuum handling system with crane ways and forklift mounted vacuum units for the handling and movement of individual pieces would complement the transportation by crate method (see Photo 9). Vacuum systems are used effectively in many other industries including window, door, and glass manufacturing and have been used effectively in the newspaper business to move and handle paper rolls weighing 8000 pounds. Handlers of glass mirrors and similar flat heavy materials should refrain from using wheeled carts and wheeled dollies which also pose significant hazards.

RECOMMENDATION #2: Modify "L" racks permanently or temporarily while at the business location to prohibit the use of pallet jacks.

DISCUSSION: The design of the rack involved in this incident made it possible for employees to use pallet jacks to move the rack and mirror crates. The bottoms of the racks should be modified to prevent the use of pallet jacks. Evaluation of the "L" rack involved in this incident, revealed that a pallet jack will not physically fit into the pockets

used by the forklift but can fit into the spaces outside of the forklift pockets. The company should develop a method to permanently block the spaces on any racks that will remain at the facility and a method that will not allow access by pallet jack while racks are at the facility. A method to permanently prevent the use of pallet jacks could be to weld plates over the lower front and back spaces (see Figure 4.A). The device to temporarily prohibit access could be plates that cover the bottom open spaces connected front to back and tightened using a threaded rod and nut or clamping system. Other options would be to fabricate a solid object to fill the spaces under the rack with clamps that connect it to the base of the rack (see Figure 4.B) or fasten a temporary belt around the bottom perimeter of the rack (see Figure 4.C).

RECOMMENDATION #3: Design and organize the work environment to eliminate hazards.

DISCUSSION: This company and others should design and organize work areas so there is sufficient space to move and manipulate large racks of materials. The Plant Manager suggested that the employees were moving this tall "L" rack with pallet jacks because a scrap bin was in the path where the forklift would move. During the investigation, FACE personnel along with the company safety manager noted there was insufficient space between the safety fence and the scrap bin to use a forklift to maneuver the "L" rack. As a hazard prevention practice, companies should organize the workspace to provide sufficient space for handling and movement of large and heavy materials. The scrap bin could have been easily moved and placed out of the way by a forklift. Moving the scrap bin may have allowed space for the forklift to maneuver. Another option is to segregate the workspace into zones where specific activities or equipment are either allowed or prohibited. In this case, it may have been beneficial to prohibit the use of pallet jacks in the area where or when large "L" racks were regularly moved. The company and employees identified the hazard of moving "L" racks with pallet jacks and could have eliminated the hazard by segregating the components by physical or administrative means.

RECOMMENDATION #4: Institute and enforce strict material handling policies that prohibit unsafe and improper materials handling.

DISCUSSION: This company did not have a strict written and verbal policy against moving "L" racks with pallet jacks. According to employee reports, moving small materials and racks with pallet jacks was considered appropriate practice for their stock and assembly processes. Three workers, 50% of the nightshift workforce including the supervisor, were involved in this incident of extremely hazardous materials handling. If the company had a strictly enforced policy prohibiting it, one of the three employees may have objected or cautioned the other two against the maneuver. Several companies have instituted strict safety and hazard prevention rules with a "three strikes and out" or stepped disciplinary action for offenders.

RECOMMENDATION #5: Require written hazard assessments and plans specific to materials handling tasks.

DISCUSSION: This task and similar hazardous materials moving tasks should require a specific written hazard assessment and step by step plan for the task. This is especially important for non-routine tasks. The hazard assessment should include a specific listing of the individual tasks, who will be involved, and how the hazards associated with each component will be managed. The assessment and the plan should be developed jointly by all involved in the task, reviewed by the company safety manager, and strictly followed. The preparation of such a plan and review by the safety manager in this incident may have prompted a revision in the methods used to move the large "L" rack.

RECOMMENDATION #6: Provide safety training and materials in appropriate language for employees.

DISCUSSION: The victim in this case may have benefitted from a better understanding of the hazards associated with the task. It is possible that due to the "beginner" level of English proficiency, the victim did not fully comprehend the severity of the hazard associated with the task. This company and others should provide safety training and materials in languages appropriate to all employees. This extends to verbal training and

written materials. A possible option is to designate an employee as safety representative and liaison for each language. These language specific safety trainings and materials may have helped the victim understand the toppling hazard associated with the “L” rack and the severe consequences of the hazard, death.

ACKNOWLEDGEMENTS

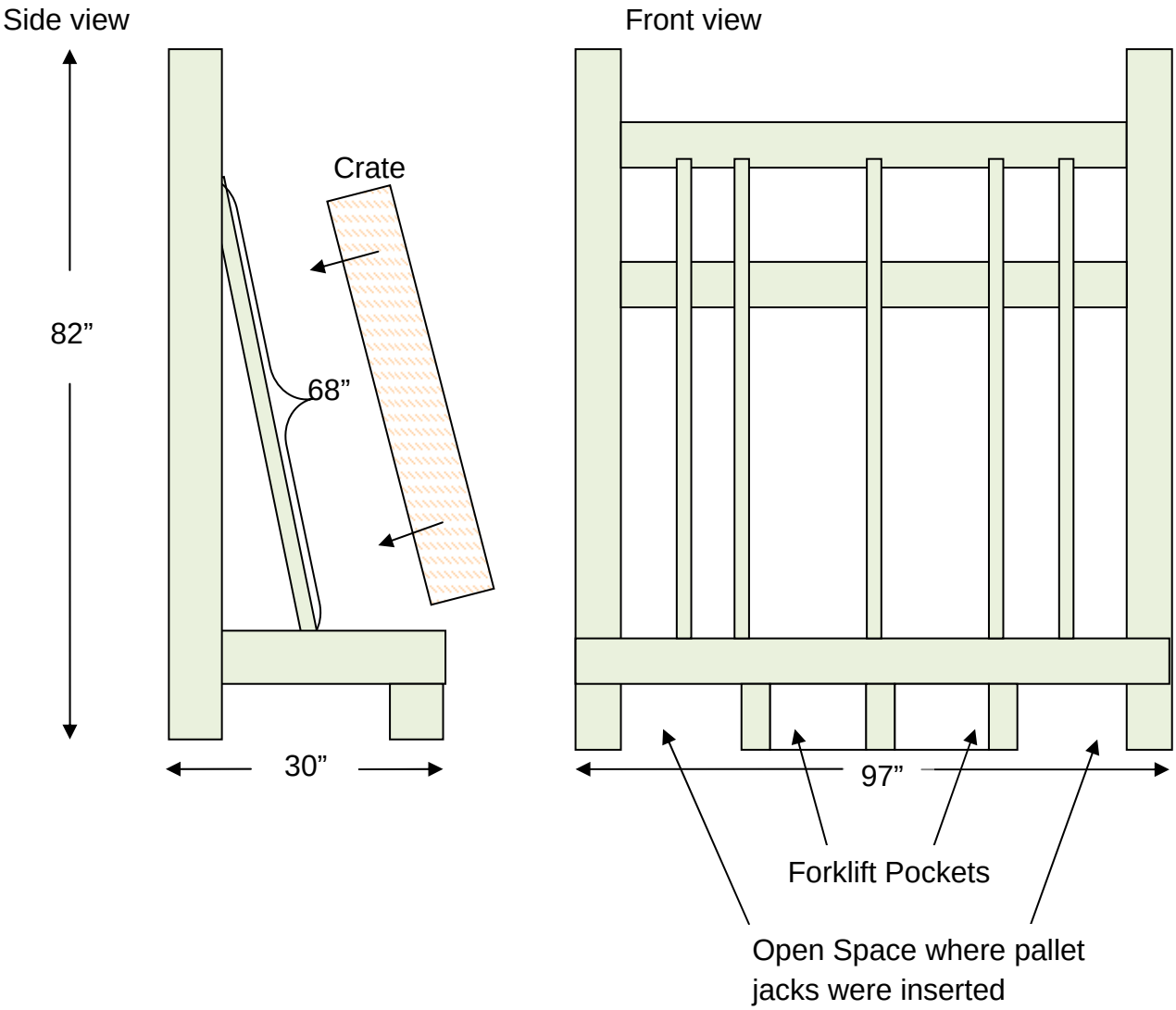
This report was reviewed by stakeholders from labor and business communities and various Washington State and Federal worker safety agencies.

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’s representative involved in the incident.
- DOSH Compliance Operations.
- DOSH Enforcement.
- Federal FACE Program Management (NIOSH).
- Safety & Health Assessment & Research for Prevention (SHARP).
- Washington State Attorney General’s Office.

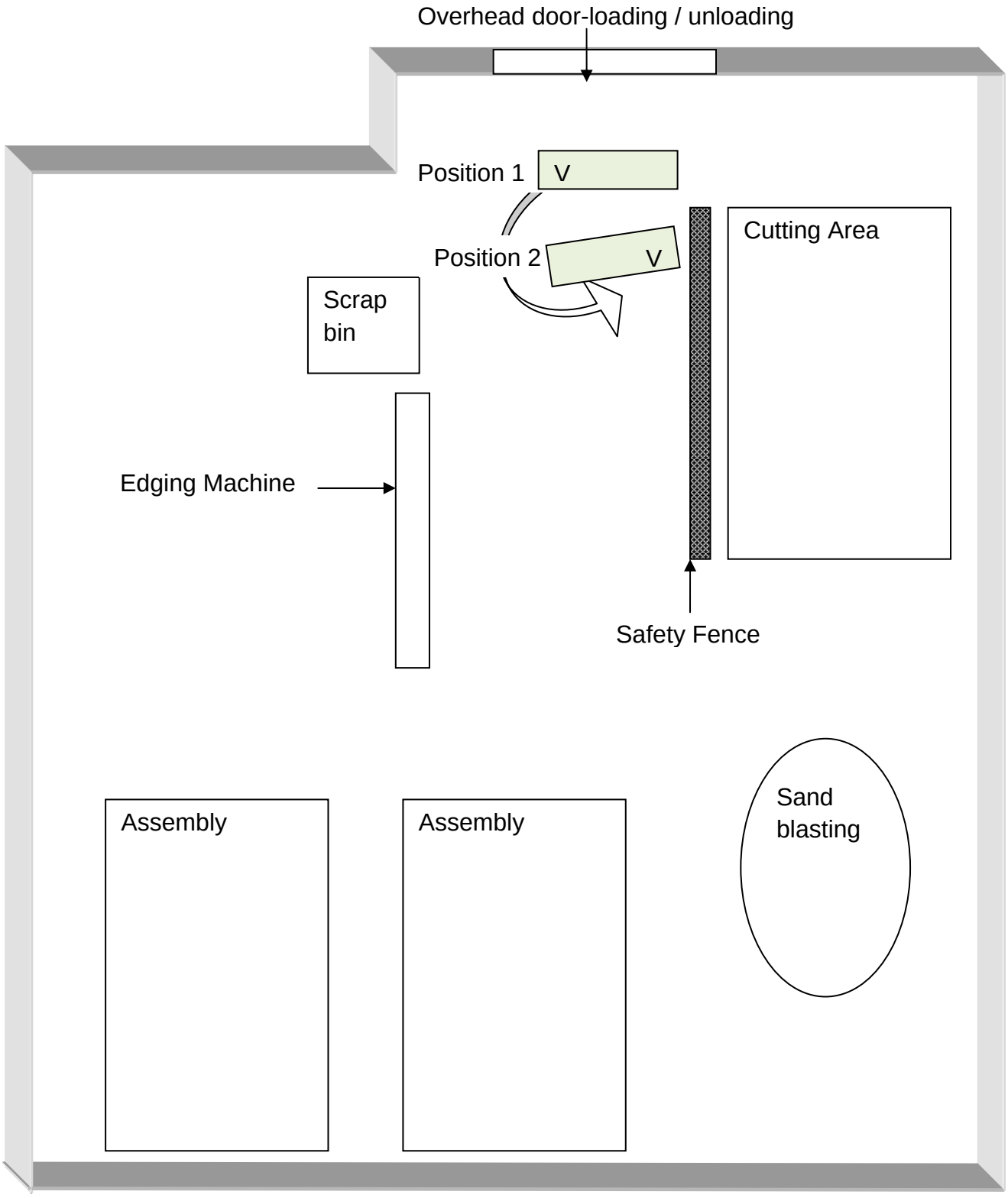
Appendix A. Figures

Figure 1. Illustration of “L” Rack for Transportation and Storage of Glass Mirrors



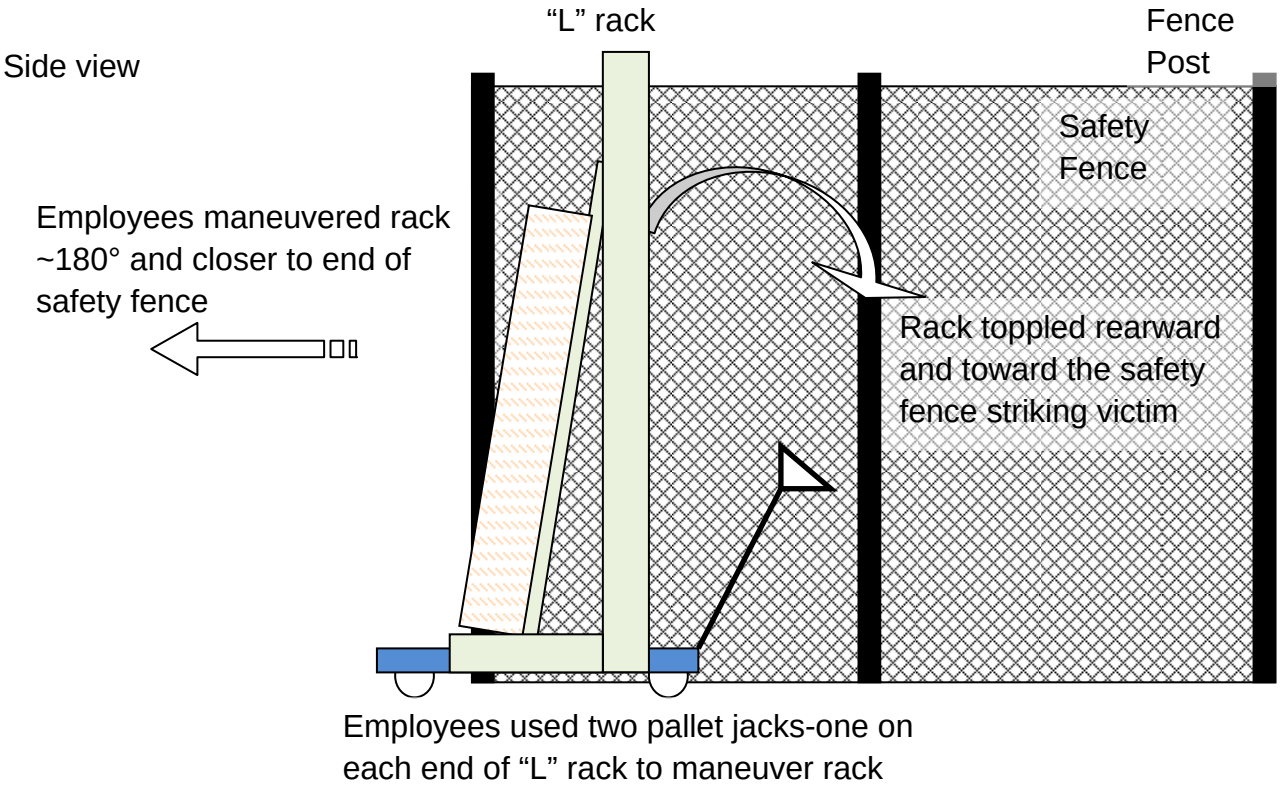
Note: Not to scale

Figure 2. Illustration of Facility Floor Plan



V = Victim location
Note: Not to scale

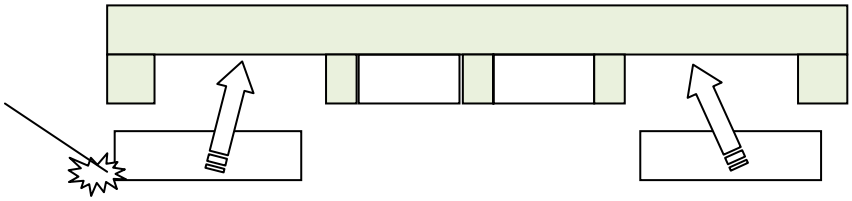
Figure 3. Illustration of Reported Incident Scene



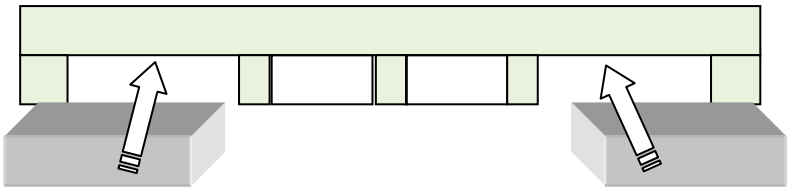
Note: Not to scale

Figure 4. Illustration of Suggested Remediation Methods

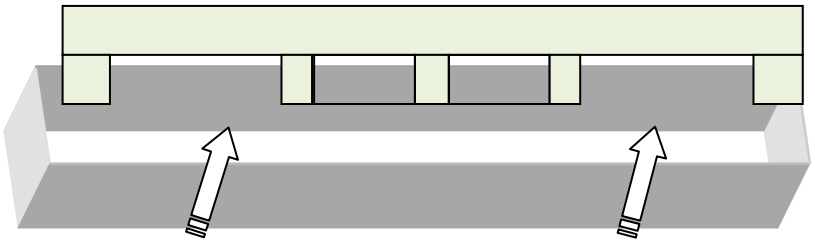
A. Weld plates to permanently cover openings to prohibit use of pallet jacks



B. Fabricate physical blockers that can be secured to rack to temporarily fill spaces



C. Fasten a tight fitting semi-rigid belt to prohibit unplanned and unauthorized movement of “L” racks. Belt can be removed to allow movement with forklift.



Appendix B. Photos

Photo1. Forklift used to transport “L” rack from truck in delivery area into work area.

Photo 2. Manual pallet jack similar to the one used in incident.

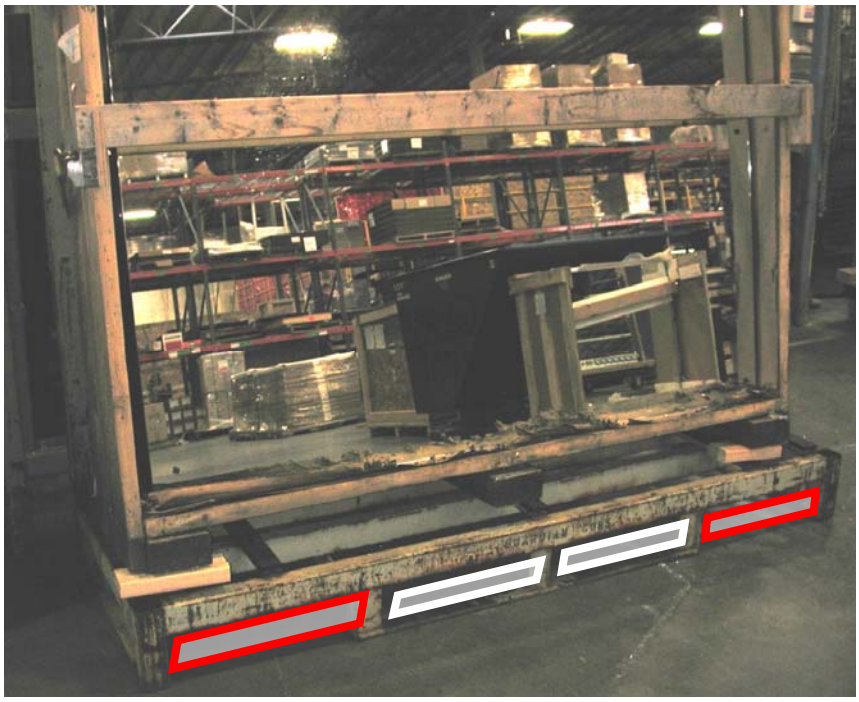


Photo 3. “L” rack similar to the one involved in incident. Racks were designed with pockets (outlined in white) to facilitate movement with forklift. Outermost pockets (outlined in red) are large enough to accommodate pallet jacks.

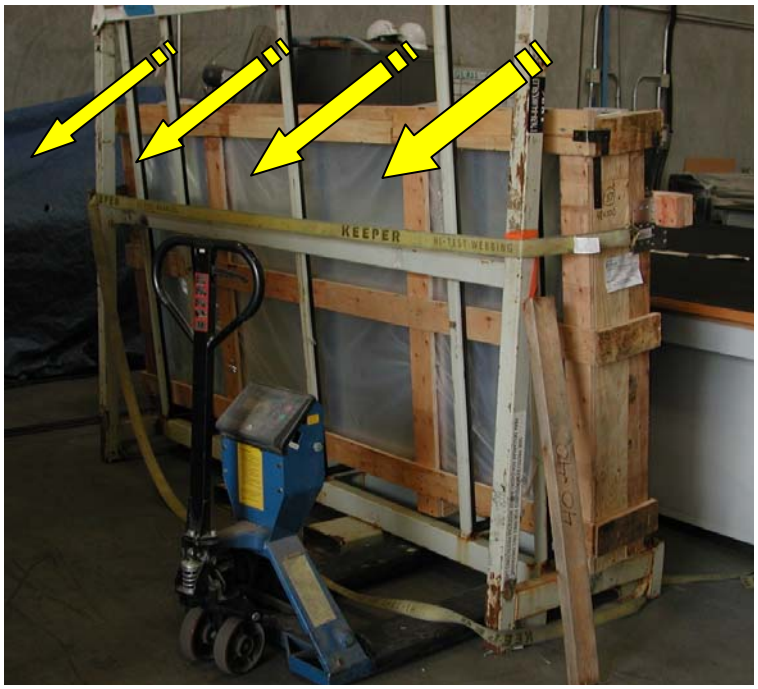


Photo 4. “L” rack with manual pallet jack positioned in open space beside forklift pocket (two pallet jacks-one on each side were used in this incident). Arrows indicate direction of that “L” rack toppled.

Photo 5. "L" rack in position near incident site outside safety fence surrounding cutting table area.

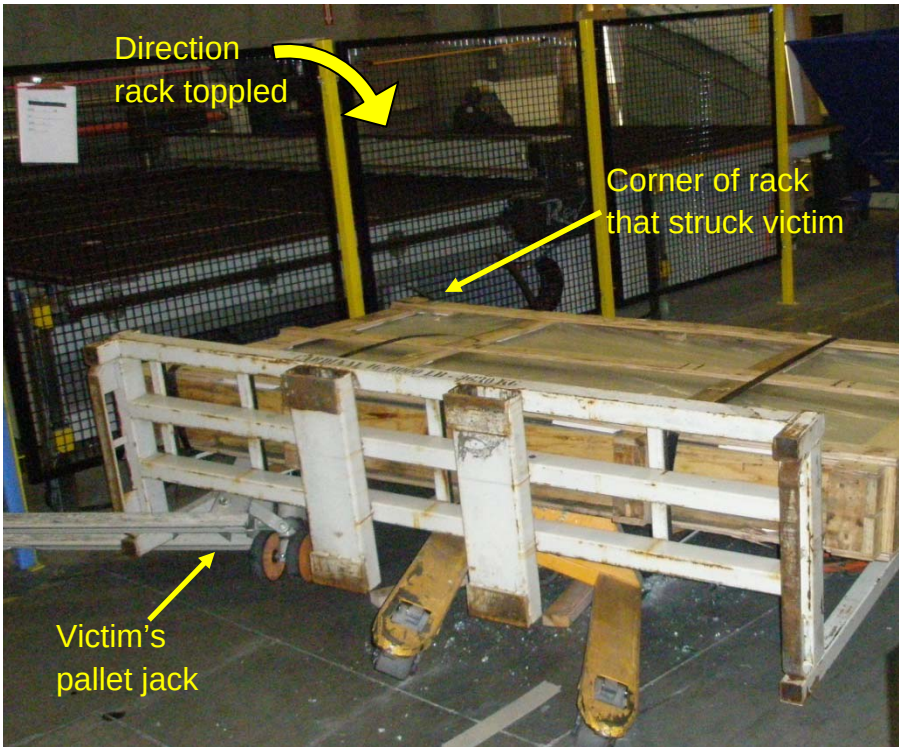


Photo 6. Incident site with "L" rack in final position and manual pallet jacks still in place.

Photo 7. Example of "A" rack used to store and transport glass. Photos courtesy of http://www.barkow.com/

Photo 8. Examples of wheeled cart (left) and dollies (right) used to transport glass. Photos courtesy of http://www.barkow.com/

Photo 9. Examples of vacuum manipulators and crane used to handle and transport glass. Several models are available with safe working loads up to 1600kg (3520lb) with tilting and turning capabilities. Photos courtesy of http://www.bystronic-glass.com/global/