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AKE File 18-032X
Fire Station Door Incident

May 9, 2018

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Mr. Hulsman:

I have a Bachelor of Science in Mechanical Engineering, a Masters in Advanced Safety Engineering and Management, and am also a registered professional engineer with over thirty-nine years' experience. I consult with and perform forensic examinations for various parties including the Arizona Division of Occupational Safety and Health (ADOSH).

On April 12, 2018, I participated in a multi-party examination of a fire station door designed by Door Engineering that was involved in the death of a minor, Joseph Reiss. The door is located at the fire station in Scottsdale, Arizona on Miller Road.

The first fundamental canon in the code of ethics for professional engineers states: "Engineers, in the fulfillment of their professional duties, shall hold paramount the safety, health and welfare of the public." Because the design and operation of the fire station doors present an ongoing hazard, I am required by the code to submit this letter.

After inspecting, documenting and observing the operation of the door, I have the following comments and concerns about the design and operation of the door.

The fire station door is a four-panel, bi-fold door that is operated via a motor, gearbox and articulating arms. There were three of these types of doors made by Door Engineering at the Scottsdale fire station.

The doors open with a remote control in the fire truck or with a wall-mounted button. Prior to the door opening, there is no audible warning. When the door is in the fully opened position, there is a gap of approximately 9 inches at the door hinge points: right and left sides.

All in attendance at the examination observed that after the door opens and the fire truck departs, the door remains open for approximately 3 minutes and 45 seconds, then suddenly closes without warning. My understanding is that Joseph Reiss was in the 9-inch gap at a hinge point at the time the doors closed, causing his fatal injury. It is not uncommon to occasionally host children at fire stations, but the large gap at the door hinges and the manner of operation of the doors presents an ongoing hazard to workers at the station as well.

The regulations promulgated by OSHA are intended to protect workers from exposure to workplace hazards. As an example, OSHA publishes "Safeguarding Equipment and Protecting Employees from Amputations" (OSHA 3170-02R 2007), which is available online. The

publication covers machinery used in industry. The common characteristics of the machines cited by OSHA is that they are powered and have hazards occurring at the point of operation and/or contain pinch points, which can cause injury to worker's upper body, limbs or fingers. The publication also notes: "Amputation hazards are not limited to mechanical equipment... Doors also have the potential to amputate fingers. These injuries typically result when a door closes while a person's hands are in the doorjamb." Similarly, injuries occurring from the public's exposure (particularly children) to door hinges in various settings are well documented.[1, 2, 3] Fingers and hands have been injured by closing doors at schools and restaurants because the danger zone in the door hinges is relatively small. Unfortunately, the danger zone in the door hinges at the fire station is large enough to fit a child's head and presents an ongoing hazard.

Companies that intend to design and introduce products into the stream of commerce best serve the consumers and themselves if they perform hazard and risk assessments of their products, including, for example, within the context of what OSHA has already identified as hazards. My observation and assessment of the doors at the Scottsdale fire station is that they contain hazards that are foreseeable and must be mitigated.

Similar principles of hazard and risk assessment apply to property owners. For example, I noted during the inspection that a Retract-A-Belt had been installed in front of the right, side door to ostensibly guard the area and manage the risk where the injury occurred. However, when the door opened and created the hazardous area at the hinge, the belt retracted in and obviated what appeared to be the intent behind installing the belt. Instead, it would be appropriate for the risk management department or others at the City of Scottsdale to install an efficacious and perhaps removable guard, add warnings, and provide training to the personnel until the Reiss matter is resolved. Then the guards on the door hinges could be permanently attached. Risk management is meant to avoid bringing hazards and risks into the workplace.[4] However, because the hazard of the doors already exists, the City of Scottsdale's risk management department should mitigate the hazard at the fire station.

Mitigation of hazards is addressed through the hierarchy of controls as follows:

- Eliminate the hazard.
- Substitute with something less hazardous, e.g. lower speed, force or pressure.
- Engineering controls such as guarding and enclosures.
- Warnings via signs, labels, and audible and visual warnings.
- Administrative controls such as procedures, training and inspections.
- Personal protective equipment such as hardhats, safety glasses and gloves.

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[1] Closing the Door on Finger Injuries. Geoff Moseley. Doors & Hardware. July 2008. Print.

[2] Dangers Related to Doors – Hand and Finger Injuries. McDonald's Insurance Program – Safety Bulletin. July 2012. Print.

[3] Hand/finger injuries caused by doors: 1992-1995. National Electronic Injury Surveillance System. U.S. Consumer Product Safety Commission. Print.

[4] Manuele, Fred A., "Advanced Safety Engineering Management," John Wiley & Sons, Inc., 2008. Print.

In regards to the design and operation of the fire station door, I submit the following actions:

Elimination

Eliminating the pinch point at the door hinges does not appear practicable to mitigate hazards already in place because information from Door Engineering indicates other existing fire stations have similar door configurations.

Substitution

Reducing the speed or force of the door is not practical and does not eliminate the gap. However, I recommend that the manual release handles that are hanging on each side of the doors be painted red and spaced further away from the wall so they can be pulled and release the doors from the drive system in case of an emergency. Garage door openers in homes have a similar red-colored emergency release handle.

Engineering Controls

Guarding the pinch point with a flexible and tough barrier appears to be the most effective solution which can be applied to existing doors. Schools use carpet scraps to guard hinge gaps on classroom doors to keep small fingers from being crushed. Examples of current hinge guards are available online.

I do have a concern about the safety edges on the doors. The edges contain contacts that are wired to battery-powered transmitters on the doors. When a safety edge contacts an obstacle, the contacts close and the transmitter sends a signal to the motor control center to stop the door. The transmitters have a low-battery warning, but at this point, I do not know if the transmitters will fail safe. In other words, if the transmitters are not operating, say, from a dead battery, the doors should not operate because the safety edges would not be active.

Warnings

Online research found that a Gilbert, Arizona, fire station with bi-fold doors, similar to the subject door, has caution labels on its doors. These types of labels are available online through various suppliers (http://www.safetysign.com/door-safety-signs) and should be added to the doors. Additionally, an audible warning and flashing light should precede the opening and closing of the doors. A similar application can be found on airport conveyor belts that alert passengers and baggage handlers that the belts are about to start moving.

Administrative Controls

The personnel at the fire station should be trained on the operation of the doors, including the safety features, e.g., open, close, stop buttons and the emergency release handle. Additionally, the safety features of the doors should be tested and documented on a periodic basis.

Personal Protective Equipment

Worn safety apparel does not appear applicable.

Of note is that although OSHA and machine manufacturers require training, nowhere have I found references to worker safety being related to them having precognitive abilities to predict a machine about to start or having cat-like reflexes to move themselves or someone else out of the way of an advancing mechanism or the closing of a pinch point on a machine. This is particularly relevant to any specious and ineffective suggestion whatsoever that Ms. Reiss is

somehow responsible for her son's death. Such an argument detracts from the issue at hand and does not solve the existing hazard associated with fire station doors of the type at the Scottsdale station.

Historically, unguarded door hinges and childrens' fingers are a bad mix. It's even worse when it involves an automatic door. Now, we have the situation that concerns Joseph Reiss and developing a safer path forward. To paraphrase James Reason in his book "Managing the Risks of Organizational Accidents," neither investigators nor responsible organizations should end their search for the cause of an accident with the mere identification of human failure. This is seen more as a consequence of a latent condition, such as poor design, that lays undetected for many years before it combines with local circumstances to finally be manifested in an injury or fatality. Joseph Reiss' death was preventable. I believe that the City of Scottsdale, Door Engineering and others are responsible organizations and will take the opportunity learned from Joseph Reiss to enact changes in existing doors and future designs to prevent a similar occurrence.

The findings contained herein are based on information currently available and the author reserves the right to revise and/or supplement this letter as additional information is acquired, clarified or becomes available and is reviewed.

Regards,

Augspurger Komm Engineering, Inc.

Mark R. Cannon, P.E.
Consulting Engineer