An IH View of Falls

Daniel Felperin

Many of the construction activities performed today involve elevated work that can seriously threaten an individual's personal safety. Falls to lower levels made up 10.5 percent of total worker fatalities in 1997.[1] Of the 652 deaths, almost 57 percent occurred in the construction industry. Fall protection is required if a fall of 6 feet or more is possible before striking the next working level or surface.[2] In addition to the general fall protection requirements of Subpart M, OSHA also addresses situation-specific fall hazards. Examples include scaffolds, cranes, derricks, steel erection, electric transmission/distribution, stairways and ladders.[3]

Fall Protection Systems

Types of fall prevention devices, equipment and methods include warning lines, guardrails, perimeter cables, safety nets, fences, scaffolds with complete decking and guardrails and personal fall protection equipment. The conventional hierarchy of controls generally applies to fall hazards. First, eliminate the hazard by engineering it out (e.g., equipment redesign or temporary platforms). Preventative controls such as guardrails, warning lines or restraining devices, especially for leading-edge work, are routinely used. A leading edge may be described as the working edge of a floor, roof or other walking/working surface, such as a deck, which changes location as additional sections are placed, formed or constructed.

If engineering controls do not eliminate the hazard, employers must provide workers with the appropriate personal fall protection systems. The categories of personal fall protection include restraint, positioning and arrest systems. Restraint systems are used to prevent a fall by limiting how far workers can travel so they cannot fall off of or into an unguarded edge or opening (e.g., while performing leading-edge work activities). It consists of an anchorage, connector (such as a snap hook and lanyard) and full-body harness. A restraint system does not stop the fall; it constrains the worker from physically moving into an area where he or she could fall.

Positioning systems may only be used for securing the worker in place and are designed to enable a worker to use both hands while performing tasks. Analogous to restraint systems, these devices are not personal fall arrest equipment and shall be configured in such a manner as to limit the free fall distance to just 2 feet. Positioning devices must be secured to an anchorage capable of supporting at least twice the arresting force resulting from a fall or 3,000 pounds, whichever is greater.

Arrest systems are the third category of fall protection systems. Personal fall arrest systems commonly consist of an anchorage point, lanyard and full-body harness. (Effective Jan. 1, 1998, body belts and nonlocking snap hooks were prohibited from use in fall arrest systems.[4]) Specific arrest configurations may also include a decelerating device (e.g., shock-absorbing lanyard), lifeline or combination of these. Fall-arrest systems must limit the arresting force on the worker to 1,800 pounds.

Deceleration equipment must bring the worker to a complete stop within 3.5 feet of the device engaging. The free-fall distance must be as short as possible to reduce the probability of serious injury. Anchorage attachment points should be at D-ring level. The total stopping distance required, including free-fall and deceleration distances, must be calculated and must be less than the distance to the next working level or other structures (swing arc).

The full-body harness, when fit properly, is designed to distribute the arresting force evenly over the body to alleviate the stress loading to internal organs when the deceleration device engages. All harnesses and lanyards placed in service after Feb. 1, 1997, must be labeled to meet the requirements found in ANSI A10.14-1991, American National Standard for Construction and Demolition Use, or ANSI Z359.1-1992, American National Safety Requirements for Personal Fall Arrest Systems, Subsystems and Components.

Workers must inspect equipment prior to use. A competent person must inspect it after it has been subjected to an impact and before it is returned to service. Equipment must be carefully inspected for any defective components and damage, including frayed stitching, cuts, tears, abrasions, chemical attack and the like.[5] Snap hooks and D-rings must be checked for alignment, corrosion and cracking. If any defect is found, the equipment must be immediately removed from service and either repaired or replaced.

Equipment should be stored in a cool, dry place out of direct sunlight when it is not being used. The equipment can generally be cleaned with warm water and mild detergent and air dried.

Anchorage Points

Ideally, anchorage points should be directly above the worker to minimize free fall and swing hazard. Anchorage points must be capable of supporting at least 5,000 pounds per worker/equipment or twice the expected impact load, as determined by a qualified person. All anchorage points, such as structural beams and eyebolts, should be carefully identified to meet the above requirements and workers instructed as to their location and proper use.

Anchorage-connecting hardware and accessories include a wide array of choices, such as carabiners (coupling devices), horizontal and vertical lifelines, cross-arm straps and assorted hardware for attaching to pipes, rings, I-beams and holes. Both the anchoring point and any accessory anchoring devices must be properly rated for the total anticipated load.

Horizontal lifelines usually consist of a steel cable attached to two anchorage points. They must be designed, installed and used under the supervision of a qualified person. Multiple workers can "tie off" to this horizontal cable as long as engineered load limits are not exceeded. Beam-trolleys are another type of device that can move freely on existing I-beams overhead to maintain a direct connection to the worker.

Fall Hazard Analysis

Proactive analysis of fall hazards is essential to ensuring worker safety at heights. It is necessary to record information that is relevant to each observed hazard, such as:

- Proximity to the edge;
- Type of working/walking surface;
- Environmental factors (temperature, wind, visibility);
- Physical obstacles; and
- Tripping hazards.

Once the technical information is collected, the next step is prioritizing. The hazard analysis should also yield information that will identify the necessary

(Continued on p. 23)

(Continued from p. 22)

resources and costs to minimize, if not eliminate, the potential for a fall. These resource requirements will influence the final decision on which method to choose.

In comparing and evaluating protective measures, it is often useful to construct a hazard control model and substitute in the cost/benefit parameters of each option.[6] Checklists are helpful reminders to ensure that general categories of equipment, such as ladders, scaffolds and personal fall protection systems, are covered during the job hazard analysis.

Training

Training is an essential element of any effective fall prevention program. It must address every reasonable physical hazard anticipated and the controls necessary to abate them. It must be sufficient in length, content and quality to enable employees to recognize and minimize fall hazards.[7] A hands-on familiarity with procedures, equipment and other hardware is necessary to develop satisfactory skills and user comfort. Training must be provided and documented by a competent person(s) qualified in:

- The nature of the hazards;
- The correct equipment assembly, maintenance and inspection procedures;
- The role of each employee in the safety monitoring system and fall protection plan;
- The proper use and operation of guardrail systems, personal fall arrest systems, safety net systems, warning lines, safety monitoring, controlled access zones and any other technology or procedures used;
- Limitations of the mechanical equipment used for restraining devices;
- Set-up of overhead protection systems and devices;
- Correct procedures for storage and handling of materials and equipment; and
- Any standards referenced in the regulation.

Fall Protection Plans

Fall protection plans are an administrative form of worker protection only to be used under specified circumstances. A fall protection plan is difficult to implement and even harder for OSHA to accept, due to the many new technology options.

The FPP is a written document describing the ways to reduce and/or eliminate the risk of recognized hazards. FPPs must also document and rationalize why conventional systems may be infeasible or pose an even greater hazard. Infeasible is defined as "impossible to perform (construction) work using a conventional fall protection system or … technologically impossible to use any system to provide protection."[8]

Plans must be written or revised by a qualified person—an individual who by reason of extensive experience, recognized certification or training has demonstrated the ability to identify and resolve problems and issues related to the specific types of hazards likely to be encountered. These plans must also identify the exact locations where conventional systems cannot be used and describe the supplemental control measures to be implemented, such as a safety monitoring system and controlled access zones.

Safety monitoring systems require that a competent person anticipate hazards and maintain visual and verbal contact with designated workers at all times. Competent persons are those individuals who are capable of identifying existing and predictable hazards in the work environment that may be hazardous or become dangerous to employees. The competent person also has the direct-line authority (and responsibility) to take prompt corrective action such as stopping work.

Controlled access zones are areas such as leading-edge work, overhead bricklaying or precast concrete erection. Certain work may take place in a CAZ where the use of guardrail systems, personal fall arrest, safety nets, etc., cannot be used alone for worker protection. Access to this zone is tightly controlled and prohibited to unauthorized persons.

Rescue Plans

In the event someone does fall, the predetermined rescue plan must be initiated. The extent of the injuries a worker suffers after a fall is related to the time it takes to rescue that individual. Therefore, it is desirable if at all possible for the workers to rescue themselves. This may be simplified by limiting the total fall distance so that the worker stops within reach of a structure or making sure portable ladders are available. Relevant factors such as the availability of rescue personnel, equipment, medical treatment facilities, access to the victim and the estimated time to carry out the operation must all be evaluated and addressed. Employers must also contact the local fire department to determine its ability to perform a high-angle rescue, including estimated response time to the work site.

Fall hazards are found in most industrial settings, especially those activities involving construction or demolition. As noted above, deaths from falls to lower levels made up 10.5 percent of 1997 worker fatalities. Industrial hygiene and safety professionals alike have an ongoing responsibility to mandate and oversee the active use of fall protection on the job whenever the elevated work calls for it.

Acknowledgments

The author would like to thank Mark Monson and Don Garvey for their technical review of the original manuscript for this article.

Felperin is founder and director of operations of FRESH Training Concepts, Cobb, Calif.

References

1. National Safety Council, *Injury Facts* (formerly *Accident Facts*). 1999 edition, p. 52.
2. Federal OSHA, 29 CFR 1926.501(b).
3. Federal OSHA, 29 CFR 1926 Subparts L, N, R,V, X.
4. Federal OSHA, 29 CFR 1926.502(d).
5. California OSHA Electrical Safety Orders, Group 2, High Voltage Electrical Safety Orders.
6. Persons, J., *Competent Person Fall Protection Seminar Training Manual.*
7. Federal OSHA, 29 CFR 1926.503(a).
8. Federal OSHA. 29 CFR 1926.500(b).

Technical Exchange is a feature offering a forum to discuss real-life experiences in technical areas. These experiences are informational and are not peer reviewed. However, submissions are reviewed for technical accuracy. They are intended to help IHs share information for the benefit of all industrial hygiene professionals.

Readers are encouraged to submit summaries of case studies, new technology, problem solving and other experiences they may encounter through the course of their work. Send submissions to David Rapoport, **The Synergist**, *2700 Prosperity Ave., #250, Fairfax, Va. 22031; fax (703) 207-3561; drapoport@aiha.org. Submissions will be edited for space and clarity.*