Construction is among the most dangerous industries in the country. In 2010, data from the Bureau of Labor Statistics (BLS) indicated that 774 fatal on-the-job injuries occurred to construction workers, more than in any other single industry sector and nearly one out of every five work-related deaths in the U.S. that year.

According to OSHA and BLS, overall in the U.S., workplace fatalities and injuries have actually decreased. “Last August, BLS released final updates to the 2010 Census of Fatal Occupational Injuries, and within the private construction sector, the final fatal work injury total was down 7% from 2009 and 2010, the fourth consecutive year that fatal work injury totals declined in construction. Not only are fatalities declining, but they are declining at a rate greater than the rate at which construction activity has slowed over the past several years” (July/August 2012, Constructor).

These reductions are outstanding and are in part due to the hard work and dedication of safety and health professionals throughout the country. However, construction workers are still dying on the job every day. This is unacceptable.

The leading causes of worker deaths on construction sites are referred to as OSHA’s Focus Four. They are falls, electrocution, struck by object and caught in/between.

These “Fatal Four” were responsible for nearly three out of five (56%) construction worker deaths in 2010, BLS reports.

The actual breakdown of these causes of fatalities on construction sites in 2010 is as follows (numbers are a percentage of the 774 total construction-related fatalities that occurred in 2010):

- Falls: 264 (34%);
- Electrocutions: 76 (10%);
- Struck by object: 64 (8%);
- Caught in/between: 33 (4%).

To mitigate these fatality statistics, OSHA and other professional safety and health organizations, both in the private and public sectors, are targeting the contributing factors. This article summarizes essentials of OSHA’s Focus Four. Resources used to combat Focus Four incidents include outreach and training to help inform and enable employees and employers to better recognize, evaluate and control falls, electrocutions, struck by objects and caught in/between hazards on construction sites and related activities.

**Fall Hazards**

On most construction sites, working at height presents the greatest chance of death or serious injury. Fall hazards are present at most worksites, and many workers are exposed to these hazards on a daily basis. A fall hazard is any exposure condition at the worksite that could cause a worker to lose his/her balance or to lose bodily support and fall. Any walking or working surface can be a potential fall hazard.

Workers are at risk any time they are working at a height of 4 ft. or more. OSHA generally requires that fall protection be provided for an employee working at a height of 4 ft. in general industry, 5 ft. in maritime and 6 ft. in construction. However, regardless of the fall distance, fall protection must be provided when working over dangerous equipment and machinery. This includes...
impalement hazards (e.g., rebar). The importance of fall protection cannot be stressed enough.

Nearly half (48%) of all fatal falls in private industry involve construction workers. Between 1992 and 2005, about one third of fatal falls in construction were from roofs, 18% were from scaffolding or staging, 16% were from ladders and 8% were from girders or structural steel. The other 25% of fatal falls include falls through existing floor openings, from nonmoving vehicles, from aerial lifts, etc.

Each year, on average, between 150 and 200 workers are killed and more than 100,000 are injured as a result of falls at construction sites. OSHA recognizes that incidents involving falls are generally complex events frequently involving a variety of factors. Consequently, the standard for fall protection addresses both the human- and equipment-related issues in protecting workers from fall hazards.

Three generally accepted methods of protecting construction workers who are exposed to vertical drops of 6 ft. or more are guardrails, safety net systems and personal fall arrest systems.

- Guardrails are considered prevention systems, as they stop the employee from falling in the first place.
- Safety net systems are designed to catch the employee and break the fall. They must be placed as close as attainable under the working surface but never more than 30 ft. below.

- A personal fall arrest system consists of an anchorage, connectors and a full-body harness that work together to break the employee’s fall.

Additionally, employers have certain responsibilities specific to fall protection that include:
- providing fall protection;
- ensuring proper scaffold construction;
- ensuring safe ladder use and condition;
- conducting daily worksite equipment maintenance and PPE inspections by an authorized competent person;
- providing training.

**Electrical Hazards**

The numbers of deaths by electrocution clearly show that exposure to electricity is a major hazard to construction workers. Electrocution results when a person is exposed to a lethal amount of electrical energy.

An electrical hazard can be defined as a serious workplace hazard that exposes workers to the following (BESAFE):

- **Burns**
- **Electrocution**
- **Shock**
- **Arc flash/arc blast**
- **Fire**
- **Explosions**

An average of 143 construction workers are killed each year by contact with electricity (based on government data for 12 years, 1992 through 2003). Electrical workers had the most electrocutions per year with the most serious concern being working “live” or near live wires. Proper protocol is deenergizing and using lockout/tagout procedures. Among nonelectricians (e.g., construction laborers, carpenters, supervisors of nonelectrical workers and roofers), failure to avoid live overhead power lines and a lack of basic electrical safety knowledge are the major concerns.

Major types of electrocution incidents come from:
- contact with overhead power lines;
- contact with energized sources (e.g., live parts, damaged or bare wires, defective equipment or tools);
- improper use of extension and flexible cords.

To better protect against electrocution hazards:
- Locate and identify utilities before starting work.
- Look for overhead power lines when operating any equipment.
- Maintain a safe distance away from power lines; learn the safe distance requirements.
- Do not operate portable electric tools unless they are grounded or double-insulated.
- Use ground-fault circuit interrupters for protection.
- Be alert to electrical hazards when working with ladders, scaffolds or other platforms.
**Struck-by Hazards**

Struck-by injuries are produced by forcible contact or impact between the injured person and an object or piece of equipment.

Struck-by hazards are categorized as follows:
- struck by flying object;
- struck by falling object;
- struck by swinging object;
- struck by rolling object.

One real-life event illustrates the struck-by hazard.

Four workers were installing signs on a highway when a pickup truck changed several lanes and entered the work area. The truck struck one worker, knocking him off the road and over a bridge rail. He fell approximately 18 ft. and died from his injuries. Another example would be when an employee was struck by a nail from a nail gun fired by another employee through a wall made of wallboard.

In 2010, 402 occupational fatalities were caused by struck-by hazards. To better prevent struck-by incidents:
- Never position yourself between moving and fixed objects.
- Stay alert of heavy equipment and stay clear of lifted or suspended loads.
- Check vehicles before each shift to ensure that all parts and accessories are in safe operating condition.
- Do not drive a vehicle in reverse gear with an obstructed rear view, unless it has an audible reverse alarm or another worker signals that it is safe.
- Wear appropriate PPE to include eyes, face, head and high-visibility clothing.

**Caught-in/Between Hazards**

Events that should be classified as caught-in include:
- cave-Ins (trenching);
- being pulled into or caught in machinery and equipment (this includes strangulation as the result of clothing caught in running machinery and equipment);
- being compressed or crushed between rolling, sliding or shifting objects, such as semitrailers and a dock wall, or between a truck frame and a hydraulic bed that is lowering.

The number of fatalities involving caught-in or between hazards in the private construction industry has decreased by about 20% since 2003. The largest decrease in caught-in or between fatalities in the private construction industry has been in excavation or trench cave-ins. However, in 2008, 92 construction fatalities still occurred as a result of caught-in or between hazards.

To prevent caught-in/between hazards:
- Use machinery that is properly guarded.
- Use other methods to ensure that machinery is sufficiently supported, secured or otherwise made safe (e.g.,

Each year, on average, between 150 and 200 workers are killed and more than 100,000 are injured as a result of falls at construction sites.
•Deenergize equipment and use lockout/tagout and block-out procedures.

•Use protection to prevent being pinned between equipment, materials or other objects.

•Avoid entry and working in unsafe excavations and only after inspection of a competent person.

•Seek and take advantage of safety training opportunities.

•Take extra precautions and considerations before entering into confined or enclosed spaces.

Being sure not to lose sight of other workplace hazards, we must focus attention on the Focus Four to further reduce the trend in workplace fatalities.

To help in that effort, OSHA has developed training presentations, handouts and tailgate and toolbox topics. Learn more at www.osha.gov or contact occupational safety and health resources available to you, such as your employer’s safety department, insurance broker, loss control representative, industry association(s) and/or accredited safety and industrial hygiene professionals.

References

•OSHA
•Bureau of Labor Statistics
•Center for Construction Research & Training
•ClickSafety, 2012 Focus Four Modules

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Tips

•In general, it is better to use fall prevention systems (e.g., guardrails) than fall protection systems, such as safety nets/fall arrest devices, because prevention systems provide more positive safety means.

•Reference OSHA 1926 Construction Regulations, Subpart M (or state equivalent), as well as applicable letters of interpretation for regulatory specific information.

•Working on or around live electrical circuits should be avoided whenever possible. Employers should reference 2012 NFPA 70E standards for additional information.

•According to OSHA, “struck” is defined as injuries produced by forcible contact or impact between the injured person and an object or piece of equipment.

•According to OSHA, caught-in or between hazards are defined as injuries resulting from a person being squeezed, caught, crushed, pinched or compressed between two or more objects or between parts of an object. This includes individuals who get caught or crushed in operating equipment, between other mashing objects, between a moving object and a stationary object or between two or more moving objects.

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Industrial Hygiene

The Industrial Hygiene Practice Specialty (IHPS) began in 1998. IHPS seeks to strengthen ASSE through an extensive IH knowledge base, expand relationships with other IH associations, such as AIHA, and work to advance occupational health and safety in the workplace. IHPS diligently addresses hot topics related to industrial hygiene and is an invaluable resource for technical content related to this discipline.

IHPS is led by a volunteer advisory committee with experience and expertise in this area of safety. IHPS contributes technical content to ASSE and the SH&E profession through its publication, The Monitor, research, virtual events and conference sessions. IHPS is open to all ASSE members.

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