Struck-By Hazards

OSHA 10 Hour Construction
Identifying struck-by hazards & preventative measures
Understanding the OSHA
“Focus Four”
workplace hazards
Struck-By Hazards

Struck-by hazards
• One of OSHA’s construction Focus Four designed for
  – Foremen
  – Crew leaders
  – Employers
  – Construction trades
  – Construction support staff
  – Anyone wanting general construction safety knowledge
• Engage in all interactive exercises to advance
• 45 minutes in duration
Struck-By Hazards

Additional online resources
- OSHA eTools
- OSHA publications
- OSHA Quick Cards
- OSHA Safety & Health topic page
- NIOSH Safety & Health topic page
- NIOSH Fatality Assessment and Control Evaluation (FACE) program
- Electronic library of construction Occupational Safety & Health Administration materials

LINK: link to Construction Focus Four: Struck-By Hazards
Introduction

Overview

• The purpose of this lesson is to provide workers with practical information that will enable them to recognize common struck-by hazards at construction worksites.
  – The lesson will cover each of the following four areas
    1. What is a struck-by hazard?
    2. What are the common types of struck-by hazards in construction?
    3. How can I protect myself from struck-by hazards?
    4. What is my employer required to do to protect workers from struck-by hazards?
Introduction

- Use all student handouts by clicking on links provided.
- Material includes Fatal Facts Accident Summary worksheets and links to other resources.
- Print handouts for review and reference.
- Your participation is required.
Introduction

Learning Objectives

• After completing this training module you should be able to
  – Identify common struck-by hazards
  – Describe types of struck-by hazards
  – Protect yourself and employees from struck-by hazards
  – Recognize employer requirements to protect employees from struck-by hazards
What is a hazard?

- A hazard is a situation or condition that has the potential to cause harm to
  - Life
  - Health
  - Property
  - Environment

- Engineered controls protect us from known hazards.
- Dormant hazards can become active hazards when conditions change.
- Theoretical hazards are the hardest to recognize.
What is a struck-by hazard?

- Struck-by hazards cause injuries by forcible contact or impact between a person and an object or piece of equipment.
- Struck-by hazards can resemble caught-in or -between hazards.
Struck-by, or caught-in or -between incident?

- A struck-by incident is when the impact alone creates an injury.
- A caught-in or -between incident is when an injury is a result of the crushing force between two objects.
Definitions

What is a struck-by hazard?

• Example
  – A worker was struck by the counterweight and revolving superstructure of an excavator when he walked between the excavator and a hillside.
Definitions

What is a struck-by hazard?

- Links to more examples
  - More examples and accident summaries can be found on OSHA’s website. [LINK](http://www.osha.gov/pls/iimis/accidentsearch.html)
  - Within the keyword field, enter a keyword to search.
  - For example, to obtain accident investigations involving struck-by hazards, enter the keyword “struck.”
  - To view a list of keywords, use the keyword list at the bottom of the Accident Investigation Search page.
  - You also can check OSHA’s Weekly Fatality Reports at: [LINK](http://www.osha.gov/dep/gatcat/dep_fatcat.html)
This worker is standing in a very dangerous position and is at risk of both a struck-by and caught-between injury. The cement mixer is backing up near an excavation that could give way, causing the truck to fall into the trench, along with the worker.

This worker has placed himself at high risk of a serious struck-by injury because the crane boom easily can obstruct the operator’s vision of the approaching worker.
Definition of theoretical (or “what if?”) hazards

- A theoretical hazard is one that is not obvious and may take an event or series of events to occur.
- Example
  - A worker is walking and looking down at his phone and doesn’t see or hear the concrete truck backing and is almost struck by the concrete truck.
  - A backing truck with a spotter and a back-up alarm is a controlled hazard that should not cause any harm. However, when you add the “what if” factors
    - No spotter for the truck
    - Broken back-up alarm
    - Noisy worksite
    - Worker not paying attention
  - This would be a theoretical hazard and one that you must constantly pay attention not to fall prey to.
Struck-By Hazards

Primary types of struck-by hazards

• Struck-by hazards are categorized as follows
  – Struck by flying object
  – Struck by falling object
  – Struck by swinging object
  – Struck by rolling object

• We will discuss examples and preventative measures for each.
Struck-By Hazards

- Struck-by hazards account for
  - More than 300 deaths in construction (2007)
  - 26% of all construction fatalities
  - 10% of all workplace deaths
  - Thousands of recordable and disabling injuries

- All are preventable.

- Don’t let yourself become one of these statistics.
### Struck-by Hazards

<table>
<thead>
<tr>
<th>Struck-By Fatalities By Category, 2008</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>108 workplace fatalities due to struck-by incidents</td>
<td></td>
</tr>
<tr>
<td>1. Struck by object or equipment</td>
<td>86</td>
</tr>
<tr>
<td>2. Struck by swinging or slipping object</td>
<td>14</td>
</tr>
<tr>
<td>3. Struck by flying object</td>
<td>4</td>
</tr>
<tr>
<td>4. Uncategorized</td>
<td>4</td>
</tr>
</tbody>
</table>

Source: Census of Fatal Occupational Injuries - Bureau of Labor Statistics
Struck-by Hazards

Construction struck-by statistics

- 90 construction workers died because of struck-by hazards in 2006.
- Construction laborers
  - 46 deaths in 2006
  - Most at risk and account for more than half of all struck-by fatalities
  - Leading cause is struck by parts and materials
  - Contributing factor is inadequate or lack of safety training
- Equipment operators
  - 16 deaths in 2006
  - Leading cause was struck by machinery
Struck-by Hazards

What is a struck-by hazard?

• Review exercise
  – What are the four categories of struck-by hazards discussed earlier?
  – Answers
    • Struck by flying object
    • Struck by falling object
    • Struck by swinging object
    • Struck by rolling object
Struck-By Hazard #1

Struck by object or equipment

- Census of Fatal Occupational Injuries (CFOI)
  - Compiles data on all fatal work-related injuries
  - Struck by object or equipment continues to be a leading cause of death

- Struck-by incidents typically result in serious
  - Head injury
  - Torso injury
  - Internal injuries
  - Death
Struck-By Hazard #1

Recognize any hazards?

Source: Construction Safety Council
Struck-By Hazard #1

A worker could be struck by the wrecking ball, hit, or run over by the excavator.

The wrecking ball is loosely attached to arm; could come loose and strike operator’s cab.

Source: Construction Safety Council
Struck-By Hazard #1

Struck by object or equipment

- Construction has the highest rate of struck-by incidents of any industry.
  - Struck by equipment
    - Highest fatality rate
    - Most severe and disabling injuries
  - Struck by objects
    - Most overall injuries
    - Thousands of eye injuries every year
Struck-By Hazard #1

Struck by equipment

• Vehicle safety practices must be observed at construction sites.
  – Segregate construction equipment operations from normal motor vehicle traffic.
  – Use traffic flaggers where construction traffic and/or vehicle traffic must intersect.
  – Use parabolic mirrors for blind corners or severe elevation changes.

Safety Tip:
For additional information check out the regulations at:
• 29 CFR 1926 Subpart G, Signs, signals, and barricades
• 1926.201, Signaling
• 29 CFR 1926 Subpart O, Motor vehicles, mechanized equipment, and marine operations
• 1926.601, Motor vehicles
Struck-By Hazard #1

Struck by equipment

• Safe work practices
  – Do not drive a vehicle in reverse with an obstructed rear view unless it has an audible reverse alarm, a back-up camera or a spotter to ensure it is safe.
  – Set parking brakes when vehicles and equipment are parked, and chock the wheels if they are on an incline.
  – All vehicles must have adequate emergency braking systems and have all other safety devices in working order.
Struck-By Hazard #1

Struck by equipment

• Safe work practices
  – Use traffic signs, barricades or flaggers when construction takes place near public roadways.
  – Protect the public from struck-by hazards.
    • Control site access.
    • Visitors should have safety orientation and be escorted.
• All workers and visitors should wear highly visible clothing or vests.
• Reflective Type 3 clothing must be worn after dusk and at night.
Struck-By Hazard #1

Struck by equipment

• Working safely around equipment
  – Biggest mistake is thinking you are “seen” because of your vest.
  – Make eye contact and communicate with each operator.
  – Be aware of your surroundings at all times.

• Wear high-visibility reflective clothing.

• Do not put yourself at risk of being struck by a vehicle, and do not get caught in a situation in which there is no escape route.

• Do not direct traffic unless you are the flagger.

Safety Tip: Flaggers and other workers on foot are at greater risk of exposure to being struck; therefore, they must be visible by both motorists and equipment operators.
Struck-By Hazard #1

Struck by equipment

• When working on or near any construction zone
  – Check that necessary warning signs are posted.
  – Never cross the path of a backing vehicle.
  – Follow the exit and entry worksite traffic plan.

Safety Tip: If the equipment doesn’t have a reverse signal alarm loud enough to be heard above the surrounding noise level, the employer will designate a worker to signal when it’s safe to back up when the operator has an obstructed rear view.
Struck-By Hazard #1

Example

• Four workers were installing signs on a highway when a pickup truck changed several lanes and entered the work area. The truck struck one of the workers, knocking him off the road and over a bridge rail. He fell about 18 feet and died. *Cones are a warning system, not protective barriers. Always leave yourself an out.*
Struck by equipment

- Main causes of death
  - Workers on foot hit by moving equipment
    - Especially when equipment is backing up or changing directions
  - Equipment rollovers
    - Operating on slopes or loading/unloading equipment
  - Equipment not secured
    - Brakes not set, left in gear, wheels not chocked
  - Too close to operating equipment
    - Too close to backhoe buckets, crane booms and counterweights
Preventative measures

• Moving equipment struck-by hazards
  – Stay away from moving equipment when it’s operating.
  – Remain alert to the location of all operating equipment whether in use or not.
  – Stay clear of lifted loads, and never work under a suspended load.
  – Beware of unbalanced loads.
Preventative measures

• Avoiding moving equipment hazards
  – Maintain eye contact with equipment operators.
    • Stay out of operator “blind spots.”
    • Communicate (hand/eye/radio) to ensure you are seen.
  – Wear highly reflective clothing and personal protective equipment.
  – Maintain a safe distance from hazards.
  – Maintain 360-degree awareness at all times.
  – Use spotters or traffic control to limit exposures.
Struck-By Hazard #1 (Cont.)

Know your equipment’s limitations
Preventative measures

- Avoid moving equipment hazards
  - Lower or block bulldozer and scraper blades, end-loader buckets, and dump bodies when not in use.
  - Leave all controls in the neutral position.
  - Do not exceed a vehicle’s rated load or lift capacity.
  - Do not carry personnel unless there is a safe place to ride.
  - Drive equipment (or vehicles) on grades or roadways that are safely constructed and maintained.
  - Make sure that all workers and other personnel are in the clear before using dumping or lifting devices.
Struck-By Hazard #1 (Cont.)

Preventative measures

- Equipment rollover hazards
  - Know your equipment and its limitations, and read the operator’s manual.
  - Never remove a rollover protective structure (ROPS).
  - Ensure equipment is in good condition before each use.
  - Be familiar with the terrain; pre-walk the working area.
  - Always wear seatbelts.
  - Shut off equipment before leaving the seat.
This operator survived because the Roll Over Protective Structure prevented this roller from crushing him to death. Never try to jump from the seat during a rollover because the safest place to be is in the seat with the seat belt on.

*Source: U.S. Department of Energy*
Employer responsibilities

• Determine whether the ground is sufficiently level and firm to support the anticipated weight of hoisting equipment and associated loads

• Assess hazards within the work zone, such as power lines, objects, or personnel, within the swing radius of the hoisting equipment

• Erect barriers around the rotating superstructure to warn workers of the danger zone

Link: http://www.osha.gov/SLTC/cranehoistsafety/index.html
Employer requirements

- Ensure that the equipment is in safe operating condition via required inspections
- Comply with all manufacturer procedures
- Ensure safe attachment of rigging devices, such as shackles, hooks, eyebolts, spreader beams and slings, wedge sockets, and wire rope clips

Link to OSHA’s Qualified Rigger fact sheet:

Link to OSHA’s Crane and Derricks Signal Person Qualification:
Employer requirements
• Additionally in reference to heavy equipment, employers must
  – Provide seat belts when required.
  – Ensure roadways and grades are maintained to accommodate the safe movement of equipment and vehicles.
  – Ensure all earthmoving/compacting equipment with an obstructed view does not operate in reverse gear unless the equipment has a reverse signal alarm or a worker has been designated to signal when it is safe.

Safety Tip: If a worker must enter a marked area, the crane operator must be notified of the entry and must not rotate the superstructure until the area is clear.
Preventative measures

• Securing equipment
  – Follow manufacturer’s requirements for securing equipment with wheels, rollers, or tracks – set brakes, chock wheels, turn wheels.
  – Transported cargo must be secured to prevent shifting, slipping, rolling, or falling – use tie downs, straps, chains, webbing, or wire rope
Struck-By Hazard #1 (Cont.)

Recognize any hazards?

Source: National Photo Archive ID #1470
Unsecured gas cylinders are being transported, exposing workers to struck-by hazard from flying projectiles.
Preventative measures

• Don’t stand too close to operating equipment
  – Never stand next to or within the swing radius of operating equipment.
  – Observers should stand a minimum of six feet away from operating equipment's swing radius.
  – Place safety delineators around the swing radius.
  – Never park or place other equipment within 20 feet of operating equipment such as backhoes or excavators.
  – Do not let your safety depend on avoiding operator error or equipment malfunctions.
Struck-By Hazard #2

Struck by objects

- Main causes
  - Falling objects
  - Projectiles from cutting, grinding, chopping, striking
  - Fasteners (nails, brads, staples) ejected under power
  - Rigging failures
  - Working on pressurized systems
  - Loose or shifting materials

- Never allow yourself to be under a suspended load
Struck-By Hazard #2

Struck by falling objects

• Example:
  – A construction worker was hoisting bricks in a bucket to the top of a building. The bucket tilted, and the bricks spilled out of the bucket, striking the worker in the head. The worker suffered blunt force trauma to his head, and he died at the hospital eight days later.

• Use secured and approved methods for hauling tools and materials
Struck-By Hazard #2

Recognize any hazards?

Source: OTI Course #2080
Stay clear of loads that are suspended or about to be suspended which create struck-by hazards from falling or swinging objects. If control of the load by a worker is necessary then a tag line should be used.

This worker is exposed in the same way to a possible struck by hazard should the load suddenly swing toward him.
Falling object hazards

• Struck by falling objects
  – Many of these injuries are severe and include
    • Falling from an elevation to a lower level
    • Being crushed, pinned, or caught under a falling object
    • Crushed by collapsing material or structures

• Never allow yourself or anyone else to place themselves in harm’s way, like the worker in the photo.
Falling object hazard

• Example: A worker was cutting an 8,000-pound boiler in sections with a cutting torch. The section being cut fell off, causing the remaining 5,000-pound section to flip over and land on the worker.

• Lesson: Always ensure that the material you are working on is adequately supported and that you are protected from struck-by hazards.
Struck-By Hazard #2

Falling object hazard

- Example: A worker was assisting a rigger who had attached a load to a crane. The crane operator was positioned in the cab waiting for the hand signal to make the lift. During this process, the jib of the crane fell from its stowed position on the boom and struck the worker.
  - The worker died at the scene.
  - It was discovered that the pin used to secure the jib to the boom was missing, thus allowing the jib to be displaced.
  - The crane was not inspected prior to use.

- Lesson: Unexpected mechanical failures or human error can occur at any time. Never assume that you are safe standing under any suspended load or crane boom. Keep a safe distance, and be the witness of a near miss, not the victim.
Falling object hazards

• Virtual classroom exercise
  – Ball and socket connectors are used to attach conductor stringing blocks to insulators on the arms of 90-foot metal towers.
  – Normally, stainless steel cotter keys secure the ball and socket connector in place. However, black electrical tape was wrapped around the socket to keep the ball in place rather than a cotter key.
  – The tape failed, and the ball came loose, dropping the stringing block 90 feet onto the head of an employee below, killing him.

• Ensuring equipment repairs meet the manufacturer’s specifications can save your life.
Falling object hazards

- OSHA accident prevention recommendations
  - Rigging and equipment must be inspected regularly and maintained in safe operating condition as required by general provisions of OSHA's construction safety standards (29 CFR 1926.995).
  - Employees must be instructed to recognize and avoid unsafe conditions and be made aware of regulations that apply to the work and the work area to eliminate safety and health hazards as required in the safety training and education section of OSHA's construction safety standards (29 CFR 1926.21(b)(2)).
Recognize any hazards?
Avoid working below suspended overhead materials. Worker is exposed to falling and swinging struck-by hazards. It appears that the worker guiding the suspended load is not wearing hand protection.

Notice the debris on the ground, such as the 2-by-4 piece of lumber that presents a tripping hazard.

The two employees on the right are not watching what could be a hazard approaching. There are at least two employees without high-visibility apparel, which may make it difficult for the crane operator and other equipment operators to see them.
Hard hats

- Required and protect from
  - Overhead hazards
  - Falling objects
  - Flying objects
  - Many other construction hazards
- Rated for intended use
- Designed to absorb shock and resist penetration of falling/flying objects
- Date coded
  - Shell must be replaced every five years
  - Lining replaced every year

Safety Tip: All personal protective equipment (PPE) should be of safe design and construction, and should be maintained in a clean and reliable fashion. Employers should take the fit and comfort of PPE into consideration when selecting appropriate items for their workplace. PPE that fits well and is comfortable will encourage employee use.
Struck-By Hazard #3

Struck by swinging or slipping objects

• Main causes
  – Cranes, boom trucks, hoists
    • Operator error
    • Improper rigging, defective slings, no tag line
    • Excessive loads, wind, speed
    • Inexperience
  – Trucks, forklifts, all-terrain forklifts
    • Improper rigging, excessive load and speed
    • Worker too close to load on rough terrain
Struck-By Hazard #3

This is a definite hazard
How about the safety catch?

Did you happen to notice the “custom-made” safety catch that someone fabricated from a piece of rebar? This modification is illegal but appeared to be an effective safety catch from a distance. Close examination shows that it in no way would prevent the sling loops from sliding off of the hook. Never modify any safety system or device unless you are qualified and authorized by the manufacturer.
Struck-By Hazard #3

Struck by swinging or slipping objects

- Mechanically lifted materials
  - Have the potential to swing and strike workers
  - Can swing, twist, or turn as the load is lifted
  - This movement can catch workers by surprise, and they could be hit by the swinging load.
  - Windy conditions are especially hazardous because the load will swing more.
Struck-By Hazard #3

Struck by swinging or slipping objects

• Example: Two workers were landing and placing reinforcing steel using a crane.
  – A truck crane was used at street level, 30 feet higher in elevation than the ground slab and about 162 feet from the landing area.
  – The landing area was about 40 feet beyond the radius limit for the crane.
  – The load of #9 rebar was picked up and loaded onto the crane's hoist line at street elevation, 50 feet in front of the crane.
  – The operator made the pick up and was swinging around and lowering when the right pennant line broke at the yoke/bridle.
  – The boom collapsed, striking a worker on the head, killing him.

• Lesson: Ensure your equipment is in good condition before each use
Struck-By Hazard #4

Struck by flying objects

• Most common hazards
  – Projectiles from cutting, grinding, chopping, striking
  – Fasteners (nails, brads, staples) ejected under power, such as
    • Electrical
    • Powder-actuated
    • Pneumatic
Struck-By Hazard #4

• Flying object hazards from residual energy
  – A worker was removing a frozen bolt from the track of a caterpillar front-end loader and was struck by a bolt that entered his forehead.
  – A worker was freeing a pump component under pressure and was impaled by the pump component.

• Always ensure a zero-energy state exists before starting work, or develop a work plan to complete the work safely.
Struck-By Hazard #4

Flying object hazard

- Powder-actuated and compressed air tools
  - Powder-actuated tools are particularly hazardous because of the force behind the fastener – designed to go through wood, concrete, and steel, and certainly can go through a worker.

- Using compressed air also can cause flying object hazards.
  - Compressed air is commonly used to power tools and clean surfaces.

- Take a moment to click on the link and review OSHA’s “Hazard Alert: Nail Guns” handout.
Personal protective equipment (PPE)

- Eye and face protection
  - Safety glasses or goggles should be worn any time work operations present an eye hazard – during welding, cutting, grinding, nailing, or when working with concrete and/or harmful chemicals or when exposed to flying particles.

Safety Tip: Face shields are intended to protect the entire face or portions of it from impact hazards, such as flying fragments, objects, large chips, and particles. When worn alone, face shields do not protect employees from impact hazards. Workers should use face shields in combination with safety spectacles or goggles, even in the absence of dust or potential splashes, for additional protection beyond that offered by spectacles or goggles alone.
Struck-By Hazard #4

Powder-actuated tools can create flying object struck-by hazards. Never drive into easily penetrated materials when workers are on the other side.

Source: Susan Harwood Grant Number SH-17792-08-60-F-48 by Compacion Foundation
Employer Responsibilities

Training

- Employers must
  - Train workers in the work zone to recognize hazards associated with the use of the equipment and any related duties that they are assigned
  - Ensure crane operators are qualified or certified according to OSHA standards
  - Ensure signal person meets qualification requirement according to OSHA standards.

**Link:** to view OSHA Cranes and Derricks in Construction Final Rule, Compliance Assistance Fact Sheets at [http://www.osha.gov/cranes-derricks/index.html](http://www.osha.gov/cranes-derricks/index.html)

**Tip:** For further information regarding operator, signaler, and rigger qualification and certification requirements, see OSHA 29 CFR 1926 Subpart CC Section 1926.1428 Signal person qualifications, 1926.1430 –Training requirements, 1926.21(b)(2)
Employer Responsibilities

Training

• Additionally, employers must
  – Instruct workers in the recognition and avoidance of unsafe conditions and the regulations applicable to the work environment to control or eliminate any hazards or other exposure to illness or injury
  – Ensure that qualified operators and riggers have been trained on rigging safety

Tip: The basic rules of rigging that all qualified operators and riggers must know are:
• Know the weight of the load the rigging is expected to support
• Know the capacity of the strength of the rigging (type and method of use)
• Retain the load – know which hitches work best for certain types of loads
• Control the load – know which hitches provide good load control and where the center of gravity of the load is. (Source: Construction Safety Council)
Summing Up Struck-by Hazards

Summary

• Overview of common struck-by hazards
• Ways to protect yourself and others on a jobsite from struck-by hazards
• What employers must do to protect workers from struck-by hazards.
• Should you have any questions, contact your supervisor, safety coordinator, or employer.
Summing Up Struck-by Hazards

References / Sources
• Bureau of Labor Statistics (BLS)
• Centers for Disease Control and Prevention (CDC)/National Institute for Occupational Safety and Health (NIOSH)
• Construction Hazard Awareness, by the University of Alabama Continuing Studies Environmental and Industrial Programs
• Construction Safety Council
• Electronic Library of Construction Occupational Safety and Health (eLCOSH),
• Center for Construction Research and Training
• Occupational Safety and Health Administration (OSHA)
• Susan Harwood Grant from OSHA materials
• The Construction Chart Book