



Highway Worker Safety Program



Instructor Guide



Introduction

Introduction

Streets, roads, and highways have been around a relatively short time. The first recognized road across the USA was the Lincoln Highway, formally dedicated October 31, 1913, as America's first memorial to President Abraham Lincoln. It ran from Times Square in New York City to Lincoln Park in San Francisco, California. The officially recorded mileage in 1913 was 3,389 miles. By 1924, the mileage was down to 3,142 miles – thanks to highway workers!¹

Irish scientist Mary Ward fell from her cousins' steam-powered automobile and died August 31, 1869 – believed to be the first highway fatality.² The team of safety professionals dedicated to development of this product could find no record of the first highway worker killed in a work zone. We do know that there have been too many. National Institute of Occupational Safety and Health (NIOSH) information indicates that every year nearly 100 workers are killed and more than 20,000 injured in highway and street construction. As this team worked to complete this safety product, there were a number of mornings we woke to news of another highway worker killed in a work zone or while working beside the roadways in this country.

Highway and street construction work is some of the most dangerous work in the construction industry. On any road construction site, you risk potential injury, even death. Your safety, and that of the people you are training, will depend on their knowledge of the hazards and use of safe work practices. It is your job to help them learn how to recognize hazards and how to control the hazard to prevent accident and injury. We can do better.

This is not information taught in the public high school systems. The hazards have been identified through thousands of accident investigations. The controls have been identified through many trial and error methods to lower the risk of those accidents happening. We have analyzed the deaths and injuries of many workers to develop the understanding we now have of how to work highways more safely yet maintain traffic flow.

This package focuses on the most common hazards found on highway construction sites, as well as proven strategies for hazard control. This tool, the Instructor Manual, is designed to help you, the instructor, prepare for and present a good educational class.

In the Participant Guide we say, "With this information, and your own commitment to safety, you will have many of the tools you need to keep yourself and your co-workers safe while on the job." The commitment piece is vitally important.

The federal law creating the Occupational Safety and health Administration (OSHA) established at the very core what has come to be known as the "General Duty Clause". We hear a lot about 5(a)(1) and 5(a)(2). That is where enforcement activity focuses. Take a minute to read 5(b).

"SEC. 5. Duties

(a) Each employer --

(1) shall furnish to each of his employees employment and a place of employment which are free from recognized hazards that are causing or are likely to cause death or serious physical harm to his employees;

(2) shall comply with occupational safety and health standards promulgated under this Act.

(b) Each employee shall comply with occupational safety and health standards and all rules, regulations, and orders issued pursuant to this Act which are applicable to his own actions and conduct."

29 USC 654

In construction work, the tasks performed, hazards encountered, and controls required change frequently due to the changing nature of the project and work environment, a factor that distinguishes construction work. For highway work, the changes may occur minute to minute. As an industry, we must educate our workforce to recognize and control the minute-to-minute hazards they face in highway work. They must understand they are just as legally bound to follow these safe work rules and practices as the companies for which they work. As you teach your class, remember the importance of individual responsibility. One shortcut can, and often does, lead to accidents with very serious outcomes.

In this program, we had to make some decisions as to where to focus attention. Statistics indicate that the majority of injuries and fatalities in construction are caused by four basic hazards:

- falls
- struck-by
- caught-in-betweens
- electrocutions

We call these the Focus Four Hazards, because they account for approximately 80 percent of fatalities in the construction industry. We believe highway work is no different. We chose to focus on the top four killers of highway construction workers. Looking a little closer, we find:

The primary causes of fall-related fatalities are:

- unprotected sides, edges, and holes
- improperly constructed walking/working surfaces
- improper use of access equipment
- failure to properly use personal fall arrest systems
- slips and trips due to poor housekeeping

The primary causes of struck-by accidents are:

- vehicle and equipment strikes
- falling or flying objects

Vehicle and equipment strikes often occur when drivers back up without adequate care or warning. Workers on foot are especially at risk on highway construction sites. Surprisingly, the largest number of these vehicle strikes do not come from the traveling public but from contractor vehicles striking their own workers.

Falling object hazards can result from:

- rigging failure
- loose or shifting materials
- equipment tip-over or malfunction
- lack of overhead protection

The primary causes of caught-in-between accidents are:

- trench or excavation collapse
- rotating equipment
- unguarded parts
- equipment rollovers
- poor equipment maintenance

The primary causes of electrocution are:

- contact with overhead or underground utility lines
- contact with live circuits
- poorly maintained cords and tools
- lightning strikes

In addition to the Focus Four Hazards, highway construction workers are exposed to yet another serious hazard that we do not hear as much about – the risk of soft tissue injuries (STIs).

Although most of these soft tissue injuries are not fatal, they can create years of pain and suffering for workers and their families. Soft tissue injuries are injuries to the musculoskeletal structure – the joint tissues, ligaments, tendons and muscles, better known as strains and sprains.

Types of soft tissue injuries include, but are not limited to, these:

- sore muscles
- back pain
- strains
- sprains
- bruises
- inflammation
- pinched nerves
- numbness and tingling

Many activities – even normal activities – can lead to soft tissue injuries. Soft tissue injuries are a main contributor to the many disabling injuries suffered by highway workers annually. By adding the risk of soft tissue injuries to our list of basic hazards, we now have the Focus Four Plus One Hazards.

Your job is to teach your students more about the Focus Four plus One Hazards. They will be learning about how to protect themselves and their co-workers from these hazards, to do their part to help reduce accidents, to perform their legally required duty to follow existing safety standards, rules, regulations and orders – and most important, to save lives.

The protection they must know and be able to implement against hazards has traditionally been performed following a hierarchy of controls, starting with the most effective methods and ending with the least effective.

The best controls are Engineering Controls. Engineering controls physically remove a hazard or place a barrier between the worker and the hazard.

Engineering controls may include:

- setting up traffic control barriers to separate workers from traffic
- using a forklift to move materials rather than carrying by hand
- using wet methods for concrete and asphalt cutting operations to minimize dust

The next method of control – Administrative Controls – involves changes in work procedures to reduce the duration, frequency, and severity of exposure to workplace hazards. Administrative controls are often implemented by field supervision.

Administrative controls may include:

- developing and implementing housekeeping programs to reduce slips or trip hazards
- rotating workers through various job assignments to reduce exposures such as repetitive motion hazards
- education/training programs
- enforcement/reward programs

A third and final method of hazard control is the use of personal protective equipment, or PPE.

PPE controls may include:

- hard hats and safety glasses
- work boots
- hearing protection
- fall arrest systems
- full face shields
- respirators
- work gloves
- high-visibility gear

PPE may be used to supplement engineering or administrative controls, or used alone where other controls are not feasible. PPE is the last means of defense between the worker and an injury-producing event. That is an important concept for workers to learn. Often all three types of controls are employed to control a hazard and prevent accidents.

Safety in highway work zones begins with identifying the Focus Four Plus One Hazards, and then selecting the most effective methods for hazard control.

This approach must be used to improve safety in specific areas of highway construction, including:

- traffic control
- asphalt paving and patching work
- concrete paving and patching work
- bridge construction work
- utility operations
- demolition operations
- grading operations
- short-term and mobile operations

This educational package addresses these main types of work activity performed on highway work. The topic of street, road, and highway worker safety is so broad that any attempt to address every possible exposure would render the package to burdensome to utilize. In this package, we concentrate on the “Focus Four + One.” We focus on the main activity types only. We encourage not just training but a thorough education of the workers in the importance of being able to identifying exposures and controlling the hazards.

This program is just an additional tool in your company’s safety program to help keep employees safe on your company’s highway construction projects. Use this tool with and to supplement your existing company safety controls already in place. There is an editable PowerPoint program to be used with this instructor guide that we encourage you to personalize with your company’s pictures and work activities to key in to the Focus Four + One exposures most common to your company’s work activities.

You will find the information in the public use sections such as the Video and Participants’ Guides arranged to support this retention goal. This Instructor Manual is laid out in similar fashion with the exception of having controls arranged in the hierarchy manner. As an instructor, you should be able to recognize which are Engineering, Administrative, or PPE and set up your comments accordingly.

As you approach this program, remember this program is not designed to address more specific or comprehensive training needs, such as (but not limited to):

- Scaffolding
- Fall Protection
- Ladders
- Cranes & Rigging
- Fire Prevention
- Confined Space
- Aerial Work Platforms
- Forklifts
- Hand & Power Tools

Specific training by topic is available through AGC and other sources. Please see the AGC Resource section in the materials for further information.

This introduction section addresses some issues that are common across all types of highway work. Please review the introduction and the necessary construction areas in the manual before reviewing with your class. It contains many comments to help you present a strong educational program. There are many tools in this package; take time to review them before deciding on the best manner of presenting your class. We start with the foundation of all successful projects – PLANNING.

Right now, you, the instructor, have a very important responsibility. You have to do your best to send this class of workers out the door as a team that is fully knowledgeable of their workplace, ready and able to work in such a manner that they not only do not expose themselves to injury but also are able to protect themselves when others provide the exposure.

Common Street, Road, Highway

Planning

Keep in mind that in the other parts of this program the controls are presented in the order of Engineering, Administrative, and PPE. As this is the global standard for personnel responsible for safety programs, we did not do so in this instructor manual. As you arrange your talk, think in terms the Hierarchy of Controls. A goal of the program is to help educate street, road, and highway workers of that concept. Point out to the class that controls are never effective if not implemented correctly. Ensuring that happens is part of their job.

Planning must include a diagram showing traffic patterns, both vehicle and workers on foot (WOF). The plan must identify the type of flag stations, need for escort vehicle, etc. The plan must identify the type of intrusion alarm the flag person or others will use to warn of problems. If necessary, plan the use of law enforcement to supplement maintenance of traffic (MOT) and follow up when workers take license numbers of vehicles that do not follow direction or are abusive. Plan inspections – what (checklists), when (frequency of completion), who (superintendent, safety committee, other), etc. Include plans for illumination, including the flag stations for work during night time hours. Make sure to address glare for oncoming traffic.

Specific Exposure Types for Street, Road, Highway Work	Measures to Control Exposures	Instructor Notes
<ul style="list-style-type: none"> • High accident frequency • Struck-by accidents • Productivity losses 	<p>Pre-Planning</p> <ul style="list-style-type: none"> • At estimation phase <ul style="list-style-type: none"> – Identify known hazards – Identify needed skills – Identify special risks <p>Pre-job</p> <ul style="list-style-type: none"> • Written • Comprehensive • Forms foundation of project • State Standard DOT Plans <p>Pre-task</p> <ul style="list-style-type: none"> • Start of shift • Start of new group task <p>Personal</p> <ul style="list-style-type: none"> • Before each action Σ – 2 second look ahead 	<p>Planning is always the basis for success.</p> <p>Pre-planning begins when the bid is assembled. At that point major risk control issues should be identified. This should include the need for MOT and any special skills the workers might need that require specialized training, such as Flag Person.</p> <p>The estimate should be reviewed, safety issues identified and controls placed on paper – like doing a material take-off.</p> <p>Every worker's education should include the idea that they ask themselves "How can I do this without injury or accident?" before starting any task. Learning to trust their own answers will help prevent accidents and injuries.</p> <p>ALL workers, subcontractors, and haulage employees who will enter the work zone should receive, at a minimum, a basic orientation to that site, to include at least internal construction traffic flow, external traffic control features, means of entering and exiting the work area, emergency escape path designations, required PPE, and emergency signals for vehicle intrusions into the work area.</p> <p>Planning is an on-going activity. While it starts with the estimate, it does not stop until each task is complete.</p>
<ul style="list-style-type: none"> • Confusion in work flow • Poor efficiency 	<p>Communicating the Plan</p> <ul style="list-style-type: none"> • Unified Incident Plan • Start of assignment to project orientation • Crew morning meetings • Pre-task meetings 	<p>Take every opportunity to inform workers of the safety planned in to the project. For a successful project to occur, they must believe they can provide suggestions to improve safety without fear of being belittled or worse. Minute-by-minute safety is everyone's responsibility on every job.</p>

Specific Exposure Types for Street, Road, Highway Work	Measures to Control Exposures	Instructor Notes
<ul style="list-style-type: none"> • Worker confusion • Lack of understanding requirements for safety and productivity 	<p>Educating</p> <ul style="list-style-type: none"> • Explain the why's as well as the what and how • Constant vigilance • Specific task • Job skills • Safety • HazMat 	<p>Educate workers to recognize the hazards; understand the potential impact on themselves, their co-workers, families and friends; know the proper control methods; and feel empowered to raise questions and make suggestions.</p> <p>Workers must be trained to at least a minimum required by nationally recognized standard. Many states have specific requirements – check your state DOT. Even counties and municipalities may have specific requirements. For state by state requirements for traffic control training visit: http://www.workzonesafety.org/training/flagger_training.</p> <p>Discussions must include a prohibition against stepping/standing in front of traffic that has not yet come to a complete Stop, selection of personal emergency escape path, and procedure for dealing with uncooperative drivers.</p>
<p>Environmental Exposures</p> <ul style="list-style-type: none"> • Temperature extremes <ul style="list-style-type: none"> – Standing on hot asphalt • Precipitation • Lightning 	<ul style="list-style-type: none"> • Provision for worker sanitation and hydration • Dress in layers • Provide large umbrella on stand • Good protective footwear • Worker rotation and relief planned • Protection from inclement weather <ul style="list-style-type: none"> – Shelter – Rain slicker • Warning system and plan for worker protection when lightning in area. 	<p>Environmental factors influence every job every day. Discuss common controls.</p> <p>If you have time, near the end of the class develop an exercise that fits the work your class usually faces. Lay out a scenario for them – give the road type, expected environmental conditions, controls already in place if part of an ongoing job, etc. Make certain there are two or three actions they should take to control risks. Let them work on it individually, in groups, or lead them through as a class.</p> <p>Taking it further, you can give class members a specific task and ask them to think of controls. This is good practice in developing plans at a personal, two-second think-ahead level.</p> <p>Throughout the program, you should come back to the central point – the path to success lies through good planning.</p>
<ul style="list-style-type: none"> • Struck by vehicle or equipment 	<ul style="list-style-type: none"> • High-visibility clothing 	<p>“See and Be Seen” starts here. It is very important that flag person training very strongly emphasize one of the most valuable characteristics of effective flag persons: that of acquiring mutual visual eye contact with approaching drivers and BOLDLY commanding/communicating the desired travel path or action for drivers.</p> <p>High-visibility clothing is appropriate for all work zone environments. Increases visibility of WOF to public drivers who drive past, equipment operators, and vehicles within the construction areas.</p> <ul style="list-style-type: none"> • Classifications of high-visibility clothing: <ul style="list-style-type: none"> – Class 1: <ul style="list-style-type: none"> • Not for street, road, highway work. – Class 2: <ul style="list-style-type: none"> • For workers who need visibility in inclement weather conditions • Traffic speeds between 25 and 50 mph • Targeted at law enforcement conducting traffic control, tollgate personnel, airport ground crews, etc. – Class 3: <ul style="list-style-type: none"> • Highest level of visibility • Wide range of weather conditions

Specific Exposure Types for Street, Road, Highway Work	Measures to Control Exposures	Instructor Notes
<ul style="list-style-type: none"> Struck by vehicle or equipment (cont.) 		<ul style="list-style-type: none"> Traffic speed exceeds 50 mph Targeted at road construction, utility workers, survey crews, etc. <p>http://www.cdc.gov/niosh/topics/highwayworkzones/ This web site offers a possible alternative to having live flag persons performing this work activity. www.noflag persons.com</p>
<ul style="list-style-type: none"> Dirt, debris in eyes 	<ul style="list-style-type: none"> Safety glasses or goggles 	<p>Discuss means by which dust can enter the eyes. Discuss availability of safety glasses and company policy.</p>
<ul style="list-style-type: none"> Slips and falls 	<ul style="list-style-type: none"> Sturdy work boots 	<p>Discuss the reasons work boots are required. Boots should have good soles to help prevent slips and puncture wounds, leather uppers to provide foot protection.</p>
<ul style="list-style-type: none"> Lacerations, scrapes to hands 	<ul style="list-style-type: none"> Work gloves 	<p>Discuss availability and company policy regarding glove use.</p>

Maintenance of Traffic (MOT)

Introduction

What safety professionals and supervisory personnel know as MOT is generally referred to as Traffic Control by workers. In this Trainer manual it may be referred to either way and the terms are interchangeable. In the video, it is referred to as Traffic Control. You should use the term that is most easily understood by the work force in your company.

Approximately 90% of construction worker fatalities involve a fall, being struck by something, being caught in or between things, or electrical shock. In addition, soft tissue injury, usually seen as strains or sprains, is one of the most severe injury types in this work. These types of injuries are rarely fatal but can, and do, have a serious impact on the injured worker and his or her family's quality of life. Injuries range from scratches to fatalities.

In traffic control work we frequently find workers within feet, even inches, of vehicles weighing tons traveling at a high rate of speed. The responsible crew must have an emergency plan to address challenges resulting from accidents and the resultant injuries. The resultant physical and emotional stresses are often much more frustrating and tiring than employees and managers would realize. Proper selection of personnel, with attention to physical and mental abilities, is critical to success.

A good traffic control plan is always the foundation for successful highway work. Always start with a good plan.

Address abbreviations with the class. Examples might be MOT (maintenance of traffic), WZ (work zone); TCD (traffic control devices), WOF (worker(s) on foot), etc.

Flag work is of great concern. It is where we often put the new person who does not yet know much about the work. Sometimes it is the injured person who is on work restrictions. Flag work involves direct interface with the public and therefore can be both physically and mentally challenging. Formal flag person training is an essential element to increase the safety of the flag person, driving public, and all other work zone participants' safety.

Flagger are not the only workers exposed to injury. Workers placing signs, setting or taking in cones, barrels, etc., are also exposed.

As you prepare and present the Maintenance of Traffic section, consider how similar the controls are for various exposures. This feature can help you point out that doing a few things right every time will reduce the chances of injury. The tasks "Setting up MOT," "Taking down MOT," and "Flagging" all contain the following controls:

- See and Be Seen
- Constant vigilance
- Planned movements
- Education

Traffic Control Work

FALLS Introduction

Falls from vehicles setting out or collecting cones may result in severe contusions and broken bone injuries and fatalities. Workers' being run over by their own company's vehicles is a significant part of the annual fatalities. Slips and trips may result in abrasions, contusions, fractures, and even fatalities.

Specific Exposure Types for Street, Road, Highway Work	Measures to Control Exposures	Instructor Notes
<ul style="list-style-type: none"> • Elevated Falls <ul style="list-style-type: none"> – From vehicle (ex. collecting cones) – From elevated work site (ex. flag person working on an existing bridge) 	<ul style="list-style-type: none"> • Use mechanical device to avoid employee exposure • Seat with seat belt bolted to tailgate, or better yet a manufactured traffic truck with worker seat compartments on the sides • Always walk to side of truck • Back-up camera mounted on pick up truck (this technology is becoming more standardized on all vehicles) • Personal fall protection if elevated stationing required 	<p>Workers may ride the cargo area or tailgate of trucks that are not equipped with side rails. Prohibit the practice of riding tailgates unprotected, even with slow-moving vehicles.</p> <p>A good exercise is to ask attendees what they do and involve everyone in discussion.</p> <p>Plan to station flag persons on either side of the bridge to provide them with an escape route. If the work encompasses a long bridge with only part being repaired, the flag person could be provided a harness, lanyard, and anchorage as legally required in the event they must jump to avoid being struck by an intruding vehicle.</p>
<ul style="list-style-type: none"> • Same-level falls <ul style="list-style-type: none"> – Slip/trip on existing materials, etc. – Slip/trip while avoiding incoming vehicle 	<ul style="list-style-type: none"> • Housekeeping • Mud/slick surface control • Use of boots with slip-resistant soles • Constant vigilance • Constantly refreshed escape plan 	<p>Workers must maintain constant awareness of their surroundings and always know where they are going to run or jump to get out of the way.</p> <p>Proper work boots and a level area for flag persons to stand are important. Flag persons might need to work from a small shoulder that has a fall exposure in mountainous areas, but this can be controlled in most instances by slightly increasing the work zone to accommodate a safe area for the flag person to stand.</p>

Traffic Control Work

Struck by

Approximately 22% of all construction worker fatalities involve being struck by something.¹

For 1992 – 2,000 worker deaths in work zones, 91% of the 910 worker deaths in work zones involved vehicles, most being dump trucks.^{5, 6-2}

NIOSH records indicate that in 2005, 390 workers were killed in struck-by incidents, accounting for 7% of all occupational fatalities.⁷

Injuries range from contusions and lacerations to fractures, crushing, and fatalities.

Current estimations are that approximately half the workers killed in highway work zones are killed by construction vehicles. These accidents usually involve crushing injuries and fatalities.

Injuries experienced in this area can range from lacerations and contusions from being struck by debris to being struck by vehicles, resulting in fatal accidents.

Specific Exposure Types for Street, Road, Highway Work	Measures to Control Exposures	Instructor Notes
<ul style="list-style-type: none"> • Debris <ul style="list-style-type: none"> – Thrown – Blown by wind – Falling off passing vehicle 	<ul style="list-style-type: none"> • Adequate PPE for eyes, face, and head protection • Watch for approaching vehicles with visible motion inside – arm moving, etc. • Worker visibility may be reduced due to ambient lighting • Keep debris away from flag station. • Observe approaching vehicles, especially pickups, for loose articles. • Adequate lighting at flag person work stations to insure visibility of flag person • Personal flashing lights to workers setting out or taking up cones, barrels, signs, etc. 	<p>Flag persons are positioned at the critical point where oncoming traffic is supposed to stop.</p> <p>Passersby, especially those young and/or drunk, may throw cans, bottles, etc., at workers, mostly flag persons. Always face moving traffic! Avoid retaliation when incidents occur. Getting license numbers to provide the sheriff's department is worth a try.</p> <p>Sometimes approaching vehicles do not stop for the flag person. Flag persons and other workers near the edge of work zones should never turn their back to oncoming traffic. Ask if anyone has worked a job where the flag person was struck by a vehicle.</p>
<ul style="list-style-type: none"> • Vehicle <ul style="list-style-type: none"> – Public owned vehicle – Construction vehicle 	<ul style="list-style-type: none"> • Place warning signage on vehicles that enter and leave the work zone. • Layout of work area <ul style="list-style-type: none"> – Planned traffic flow – Planned foot traffic flow – Adequate back-up alarms • Proximity Warning Devices 	<p>Hard hats and vests with personal flashing lighting are now available to help make workers at the edges of the work zone more visible.</p> <p>Place signs that warn drivers behind not to follow on the rear of vehicles that enter and leave the work zone. This is to prevent non-construction vehicles from entering the work zone inadvertently. Vehicles such as Superintendents' pickups, maintenance trucks, etc., are good candidates for such signage.</p> <p>Caterpillar, Inc. has developed blind area diagrams for all of their vehicles and equipment to help the operators and WOF determine areas to avoid when working around this equipment.</p>

Specific Exposure Types for Street, Road, Highway Work	Measures to Control Exposures	Instructor Notes
<ul style="list-style-type: none"> • Vehicle (cont.) 		<p>Proximity Warning Devices are being designed that notify the drivers of company vehicles such as dump trucks the location of not only flag persons but also other WOF who are used in the unloading and material placement process.</p> <p>Workers must be educated to recognize the hazard of being behind a moving vehicle and taught methods they can employ to avoid being injured.</p> <p>Backing is less than 1% of fleet mileage but accounts for approximately 30% of all accidents. Workers must be aware of their position in relation to driver blind spots.⁶⁻³</p>
<ul style="list-style-type: none"> • Traffic control may fail due to: <ul style="list-style-type: none"> – Driver inattention – Impairment <ul style="list-style-type: none"> • Mental • Physical – Environmental conditions – Lack of coordination of workers from multiple companies 	<ul style="list-style-type: none"> • Cell phones • Crying kids • Working while driving • People drink, smoke pot, do other drugs, then drive • Handicapped • Aged • Infirm • Geographical <ul style="list-style-type: none"> – Curves – Hills • Exposure to injury from traffic, both internal and external 	<p>Wherever possible, traffic control measures should include means to positively prevent unplanned intrusions into the work area. Means and methods that include impact attenuators or barriers (Jersey Barriers, K-Rail, etc.) are preferred beyond simple channelizing methods (cones, barrels, etc.). Ongoing documented inspections of emplaced traffic control should be implemented, and needed corrections made in a timely manner.</p> <p>Station MOT so it will be visible. Signs placed near trees in the winter may be hidden by spring growth of leaves.</p> <p>Curves and hills can hide what is just ahead – if that is a short-term job with a few cones or a flagger station, a serious accident could occur.</p> <p>ALL workers, subcontractors, and haulage employees who will enter the work zone should receive, at a minimum, a basic orientation to that site, to include at least internal construction traffic flow, means of entering and exiting the work area, emergency escape path designations, required PPE, and emergency signals for vehicle intrusions into the work area.</p>
<ul style="list-style-type: none"> • Public vehicle accidents within the work zone increase worker exposure to traffic 	<ul style="list-style-type: none"> • Unified Incident Command • Safety plan inclusion • Education 	<p>Preplanning and training of workers should address Unified Incident Command at accident sites (who is in charge) as well as measures to protect workers during an incident. Topics should address the increased hazards of traffic, fire, and HAZMAT resulting from an accident (fuel, cargo, debris, and biohazards) that may result.</p>

Traffic Control Work

Caught in / between

Approximately 18% of construction worker fatalities involve being caught in or between objects.¹

Such injuries often involve a section of the body being crushed to the point the pinned person may be alert but will die in a short period of time.

There have been documented cases where pinned workers, loved ones were rushed to the site to say good-bye before the worker died.

Amputations are also a frequent result of such accidents. Fingers are most frequent, but workers lose arms and legs as well at times.

Caught in/between injuries are rarely minor. Even inadvertently falling into a trench may create a cave-in, suffocating the worker.

Specific Exposure Types for Street, Road, Highway Work	Measures to Control Exposures	Instructor Notes
<ul style="list-style-type: none"> Maintenance work 	<ul style="list-style-type: none"> Lock out/tag out equipment Block if raised 	<p>All mechanical work must be performed so the mechanic has positive assurance the vehicle or equipment will not start or move unexpectedly. Frequently this includes keeping the key in the mechanic's pocket. Mechanics are killed every year because they were crushed by parts that were raised but not well secured falling on them, crushing them between parts.</p>
<ul style="list-style-type: none"> Backing vehicle 	<ul style="list-style-type: none"> Rear view cameras Back-up alarms "No see" chart training 	<p>Far too often, backing vehicles pin workers between the rear bumper of the vehicle and another object such as a pole, piece of equipment, etc. Back-up alarms help and are required by law but are not the only answer. Unfortunately, construction workers become accustomed to hearing them and mentally block the sound. Workers may have impaired hearing. Companies that make equipment that is frequently found in work zones are beginning to develop and make available charts for equipment that show the "blind spots" the operator has. Employee education in blind spot recognition makes good weekly safety meetings and helps prevent accidents.</p>
<ul style="list-style-type: none"> Vehicle intrusion 	<ul style="list-style-type: none"> "See and Be Seen" 	<p>Previously mentioned MOT barriers, properly rated high-visibility clothing, etc., are all important in avoiding such accidents.</p> <p>A pre-planned escape route is a very important element in setting up traffic control work. Ask attendees how many locate escape routes.</p> <p>Traffic control workers in a work zone have to watch oncoming traffic, what they are doing, where the moving equipment is, and where their co-workers are all at the same time. It is no wonder that occasionally they walk into a trench.</p>
<ul style="list-style-type: none"> Trench cave-in 	<ul style="list-style-type: none"> Avoid walking along the edge of open trenches 	<p>Rare with traffic control work but possible.</p>

Traffic Control Work

Electrical

Approximately 17% of construction worker fatalities involve an electrical current.¹

Injuries resulting from electrical contact include severe burns, unconsciousness, loss of mental and/or physical ability for the remainder of the worker's life, and frequently a prolonged period of suffering then death. Death may be immediate.

Electrical current passes from point of contact with a live circuit through the body to an exit point where the body is grounded. An example is a worker holding a metal signpost that is touching the ground who touches a short-circuited generator that is not grounded. The current would pass from one hand, through the lungs and heart, and out the other hand.

A severe shock or lightning strike can literally incinerate a worker as other workers look on.

Specific Exposure Types for Street, Road, Highway Work	Measures to Control Exposures	Instructor Notes
<ul style="list-style-type: none"> • Portable generators 	<ul style="list-style-type: none"> • Proper grounding 	Traffic control workers are mostly at risk from electrical shock by touching a piece of electrical equipment or wiring that is not grounded and has a wiring problem, resulting in a short circuit.
<ul style="list-style-type: none"> • Lighting circuits 	<ul style="list-style-type: none"> • Ground fault circuit interrupters (GFCIs) • Properly wired and adequately illuminated flag person stations. 	Rare, but possible.
<ul style="list-style-type: none"> • Light plants 	<ul style="list-style-type: none"> • Avoid contact with frame/body • Proper grounding 	Grounding all portable electrical equipment and using GFCIs for all portable electrical tools is essential to electrical safety. Use care when raising these elevated lights to avoid overhead powerlines.
<ul style="list-style-type: none"> • Overhead power line 	<ul style="list-style-type: none"> • Identify by placing signs or other visible markings on the ground below. • Be aware – identify and remind frequently in safety briefings, tool-box talks, etc. 	Far too frequently in highway work, a raised piece of equipment will contact a live overhead power line. Such contact can energize the ground with the potential lessening as the distance from the point of contact increases. A traffic control worker walking nearby can receive a severe shock from stepping across invisible differences in potential in the ground. Explain how to shuffle feet so they always are in contact with the ground and explain how this can prevent shock when crossing electrified ground.
<ul style="list-style-type: none"> • Lightning 	<ul style="list-style-type: none"> • Electronic tracking • Minimize exposure 	Lightning is another issue. Lightning can strike miles in front of a storm. Handheld electronic devices that measure the distance to the closest lightning strike can provide ample warning to allow workers to seek safety. Every project plan should have a section on lightning. Standardizing the process for protecting workers helps eliminate inconsistencies from job to job, even day to day. Lightning proximity meters are available and prices are fairly inexpensive.

Traffic Control Work

Soft tissue

Soft tissue injuries – strains and sprains primarily, are the number one injury type in highway/street/road work.

Strains and sprains can have a greater negative impact on workers, their families and the company than any injury short of a fatality. A person who severely injures his or her back may never be able to pick up children or grandchildren.

Specific Exposure Types for Street, Road, Highway Work	Measures to Control Exposures	Instructor Notes
<ul style="list-style-type: none"> Moving/maintaining traffic control devices (TCDs) 	<ul style="list-style-type: none"> Seek help 	Worker rotation and relief planned
<ul style="list-style-type: none"> Material handling 	<ul style="list-style-type: none"> “NO MORE ON THE FLOOR” - Store materials approximately waist high Lift and carry close to the body Stretch before performing task 	<p>NO MORE ON THE FLOOR means that storing materials waist high will prevent bending to lift materials – lowering the risk of back injuries. As an industry, we need to learn to store materials so workers do not have to bend to lift them.</p> <p>Adequate PPE when carrying can include shoulder pads and gloves – even good work boots.</p> <p>Discuss proper lifting and carrying techniques for MOT equipment. You can ask class members to tell what they have found effective.</p> <p>Understanding that the field management team supports stretching helps construction workers understand the importance and acceptance. Knowing stretching exercises is an important aspect in getting workers to help protect them, just like stretching helps athletes.</p>
<ul style="list-style-type: none"> Overexertion 	<ul style="list-style-type: none"> Rotate workers Change positions frequently 	The weight of TCDs should be considered, along with lifting and twisting required when handling TCDs.



Asphalt Paving and Patching Operations

Introduction

Approximately 90% of construction worker fatalities and serious injuries involve a fall, struck by, caught in or between, or electrical shock.

In addition, soft tissue injuries (STIs), usually seen as strains or sprains, are one of the most frequent injury types in this work. STIs are rarely fatal but can, and do, have a serious impact on the injured worker and family's quality of life. Asphalt paving operations involves heavy lifting at times, so strains and sprains can be frequent.

In 2005, the National Highway Transportation Safety Administration reported:

- 4,315 motorcyclists died
- Alcohol-related fatalities rose to 16,972
- Pedestrian deaths increased to 4,674
- Large truck crash fatalities rose to 5,226
- Motor vehicle transportation remains the number one killer of people on the job¹²

All of these things can, and do, happen in work zones. Accident rates are the highest for the fastest and slowest 5% of traffic.¹² In work zones where some slow their speed as required and some don't, the difference in speed may be more pronounced. 88% of large truck crashes¹⁴ and 80% of automobile crashes¹⁵ are caused by driver behavior:

- Human error
- Inattention
- At-risk behavior

Asphalt Paving Operations can be hazardous work. In addition to vehicle crashes, the hazards may be a broken gas line, downed power line, or some completely unexpected accident in the work zone. Many times there will be a crusher plant set up adjacent to the asphalt paving process, which creates additional exposures to belts, crushing equipment, trucks, and loaders.

In Asphalt Paving Operations we frequently find workers within feet, even inches, of moving vehicles that are sometimes traveling at a high rate of speed. Such work may begin before good traffic control is in place. The responsible

workers must have an emergency plan to address challenges presented by the various types of accidents that can happen in a work zone.

Fractures, contusions, foreign objects in the eye, inhalation of toxic fumes, strains, and sprains are common. Fatalities, often from being struck by vehicles and especially dump trucks in the work area, occur far too often. Backing dump trucks and working in the operator blind spot of equipment may be the biggest hazards.

Health concerns also must be accounted for in planning. Asphalt fumes, noise, exposure to the sun and the elements are part of asphalt work. Workers, especially field management, should be educated in first aid. Ensure local medical providers understand the proper treatment of hot asphalt burns or bitumen when stuck to the skin. Workers should know how to deal with initial care prior to arrival of emergency care.

Plans must be made for access and egress to the work area. Use of "Do NOT Follow" signs on trucks that enter and leave the work zone can help prevent unwanted intrusions by public motorists. Once in the work area, an Internal Traffic Control Plan (see NIOSH Guide) is critical to success.

The company safety manual should include items such as:

- Properly certified/authorized employees for MOT, competent persons, equipment and dump truck operators, etc.
- Write "asphalt" into the HazCom section and, as an example, attach a weekly safety meeting topic dealing with asphalt safety.
- In the Fall Protection section, address working on equipment – things like nonskid pads where people likely to stand, maintenance of steps and hand-holds, good housekeeping, etc.
- Insert a traffic control section for MOT basics
- Insert a "Working in an MOT Protected Work zone" section.

Wherever possible, traffic control measures for short-term work should include means to positively prevent unplanned intrusions into the work area. Means and methods that include impact attenuators or barriers (Jersey Barriers, K-Rail, etc.) are preferred beyond simple channelizing methods

(cones, barrels, etc.). Ongoing documented inspections of emplaced traffic control should be implemented, and needed corrections made in a timely manner.

Station traffic control personnel, signage, and devices where they will be the most visible. Signs placed near trees in the winter may be hidden by spring growth of leaves.

Curves and hills can hide what is just ahead – if that is a short-term job with a few cones or a flagger station, a serious accident could occur.

ALL workers, subcontractors, and haulage employees who will enter the work zone should, at a minimum, receive a basic orientation to that site, to include at least internal construction traffic flow, means of entering and exiting the work area, emergency escape path designations, required PPE, and emergency signals/sounds for vehicle intrusions into the work area.

Preplanning and training of workers should address Unified Incident Command at accident sites (who is in charge) as well as measures to protect workers during an incident. Topics should address the increased hazards of traffic, fire, and HAZMAT resulting from an accident (fuel, cargo, debris, and biohazards) that may result.

Specific Exposure Types for Asphalt Paving Operations	Measures to Control Exposures	Instructor Notes
<p>Asphalt paving operations share some hazards with other forms of street/road/highway work. These include exposure to moving traffic, exposure to environmental conditions, and heavy work involving lifting, pushing, and pulling. Falls from equipment, working in close proximity to backing equipment, and slips, trips, and falls are common injury causes.</p> <p>Asphalt paving has one hazard that is specific to this type of work – heated asphalt workers must work with.</p> <p>This work frequently requires traffic control. Remember a high percentage of highway worker deaths in work zones are from being struck by a vehicle or equipment. A great many of those involve dump trucks, mostly while backing.</p>	<p>Control methods are rarely 100% effective, but history has proven that workers can follow procedures and significantly reduce the chance they, or co-workers, will be involved in an accident or sustain an injury.</p> <p>In this column we will identify control measures that will help reduce the risk of accident or injury if implemented.</p>	<p>Welcome your class and try to put them at ease. Tell them how you are going to discuss the work they do and how to do it without injury.</p> <p>One good method to put crews at ease is to ask each one how long they have been doing this type of work. Keep track of the years of experience for each and when everyone has provided their input, total the years. This is usually a high number, and showing the individuals how much experience they share in total helps them approach the training with some confidence.</p> <p>As the educator, make sure you know the scope of the work they usually perform and tailor your discussion to meet those needs. For instance, do they perform tasks that occur within an existing work zone or are they outside any structured work zone? Do they work primarily during daylight hours or at night? Have they ever had to respond to an emergency in a work zone?</p> <p>A good exercise is to involve everyone in discussion by asking if anyone has ever been involved in an asphalt paving operation. A discussion of events and experiences may lead to covering the most important points.</p> <p>Adult Learning Basics:</p> <ul style="list-style-type: none"> • Adult learners do best when addressing real-world problems they face in their life. • Set the stage so attendees understand why this training is important to them in terms of their lifestyle and families as well as employment. • Set parameters up front – breaks, question/answer, etc. • Adults learn best from experience, not note taking. If you can't get them in the field, discuss operations they perform, use pictures. • Adult learners do best when involved – ask questions, try to get everyone to say something. • Ask the question, give the group a few seconds to think about it, and then call on someone to say what they think.

Specific Exposure Types for Asphalt Paving Operations	Measures to Control Exposures	Instructor Notes
<p>In Asphalt Paving Operations of bridges and on road projects there is usually a time factor to allow the highway or road to re-open after an accident/incident, which causes everyone to hurry – thus creating a greater hazard.</p> <p>You also have flying, falling debris and concrete both in solid and dust form.</p> <p>Traffic lanes are often compressed in highway work. There is a high exposure to truck traffic entering and exiting the work zone as well as public motorists in close proximity to the paving operation.</p> <p>Control methods are means employed to lessen the risk of accident or injury.</p>		<ul style="list-style-type: none"> • Ask several to answer, then play off the answers. • Ask questions before (to discover what they already know), during (for involvement and repetition to improve learning), and then after (to see what they learned) the session. • Structure the session loosely to allow for spontaneity – a good learning tool. • You, the educator, have to believe in the material before you can make others believe in it. • Always remember you, the educator, are in charge of the group. Maintain looseness but control, don't let discussions wander aimlessly, keep on topic, meet your promised goals.

Asphalt Paving and Patching Operations

Falls

Falls in Asphalt Paving Operations are most likely as a slip, trip/fall working on uneven ground around the scene, occasionally from equipment or vehicles.

Numerous elevated work areas are present in plant operations and all present fall hazards to unprotected workers. An example is a worker clearing a blocked hopper opening. Some hoppers have no grate protection or the openings in the grate are large enough for someone to fall through.

Asphalt truckers are required to spray a release agent on the beds of their trucks. Asphalt plants need to have a hand-railed platform or other means for this process to safely take place.

Falls from equipment may result in severe contusions and broken bone injuries, even fatalities.

Slips and trips may result in abrasions, contusions, fractures, and even fatal burns if the fall is into very hot asphalt.

Once a person is falling they are out of control and the extent of their injuries resulting from the fall depends on the distance of the fall, the angle of the body when they land, and anything they may strike during the fall or landing. A “same-level trip or slip” fall can result in a fatality if the person strikes their head wrong.

Specific Exposure Types for Street, Road, Highway Work	Measures to Control Exposures	Instructor Notes
<ul style="list-style-type: none"> • General contributing factors <ul style="list-style-type: none"> – Attitude – Faulty equipment – Shortcuts – not following procedure 	<ul style="list-style-type: none"> • Safety First Attitude • Ongoing Employee Education Teamwork • Equipment inspection and maintenance procedures, including access steps and hand holds • Enforced access/egress procedures 	<p>Although falls from heights during Asphalt Paving Operations are not the most common injuries, they can be fairly serious. These falls frequently happen to workers getting on and off equipment or on wrecked vehicles.</p> <p>Know the company policy on equipment access/egress (use of steps/holds vs. jumping) and address them to ensure knowledge and understanding.</p>
<ul style="list-style-type: none"> • Asphalt Plant Operations 	<ul style="list-style-type: none"> • Proper Lighting • Proper railing at all elevated work areas • Use of Personal Fall Prevention/Protection systems if work in unguarded areas is required • Controlled access to hoppers, bins, drums, etc. 	<p>Many companies perform the roadbed preparation and manufacture/truck the asphalt. Asphalt plant operations present the most serious fall hazards present in asphalt paving operations.</p> <p>Ensure stands for truck inspection/tarping are in good condition with railing around the platform and along the stairs.</p> <p>Ask plant workers to identify all the places where workers might be exposed to falls, then follow up by discussing controls.</p>
<ul style="list-style-type: none"> • Into hot asphalt pavement 	<ul style="list-style-type: none"> • Maintain Awareness • Extreme care around hoppers and shuttles • Planned worker positioning • Control trip hazards • Excellent housekeeping 	<p>Workers must maintain constant awareness of their surroundings and always know where they can run or jump to get out of the way. This is especially important in active Asphalt Paving Operations.</p> <p>Documented cases exist where workers are struck by backing dump trucks, pushed into shuttles of hot asphalt, then have a load dumped on them.</p> <p>Even falling on a “just placed” asphalt road bed can cause serious, life – threatening burns.</p>

Specific Exposure Types for Street, Road, Highway Work	Measures to Control Exposures	Instructor Notes
<ul style="list-style-type: none"> • Elevated Work <ul style="list-style-type: none"> – From equipment – Unguarded Elevated Surfaces – From vehicles (ex. Collecting cones) 	<ul style="list-style-type: none"> • Ensure truck steps in place and in good condition • Steps are non-skid • Proper PPE • Positive Protective Device • Personal fall protection if elevated stationing required • Ensure handrails on trucks are adequately maintained 	<p>The practice of riding pickup beds unprotected should be controlled, even with slow-moving vehicles.</p> <p>Workers must not be allowed to ride on the sides of the bed or tailgates of pickups or the bucket of loaders.</p> <p>Ask attendees to develop a list of elevated exposures or provide examples of any falls they know about in asphalt operations.</p> <p>Working on equipment – things like nonskid pads where people likely to stand, maintenance of steps and hand holds, good housekeeping, etc.</p>
<ul style="list-style-type: none"> • Same Level <ul style="list-style-type: none"> – Slips/Trips – Sawing – Shoveling – Slip/trip while working near vehicles – Wet/Slick Environment 	<ul style="list-style-type: none"> • Proper foot protection • Exceptional housekeeping • Worker awareness/positioning • Inspect jobsite during the day • Special care during Asphalt Paving Operations 	<p>As Asphalt Paving Operations is often on uneven or partially removed surfaces, slips, trips, and falls are likely. In an accident scene, either vehicle- or utility-related, the walking surface may be slick with oil or water, covered with debris, dark, and unknown.</p> <p>WOF must be educated to recognize the hazard of being around and behind moving vehicles and taught methods they can employ to avoid being injured. In these type of operations, vehicle/equipment movement is much more frequent and therefore is a bigger hazard to workers.</p> <p>Proper work boots with a sturdy sole.</p> <p>Work areas free of material, debris, etc.</p>

Asphalt Paving and Patching Operations

Struck by

Approximately 22% of all construction worker fatalities involve being struck by something.¹

For 1992 – 2,000 worker deaths in work zones, 91% of 910 worker deaths involved vehicles, most being dump trucks.^{5, 6-2}

NIOSH records indicate that in 2005, 390 workers were killed in struck-by incidents, accounting for 7% of all occupational fatalities.⁷

Many struck-by accidents involve workers standing or walking in areas the driver cannot see. Working in “blind spots” is a topic being researched by NIOSH.

Injuries range from contusions, lacerations, and STIs to fractures, crushing, and fatalities.

Current estimations are that approximately one-half the workers killed in highway work zones are killed by construction vehicles. These accidents usually involve crushing injuries and fatalities.

Specific Exposure Types for Street, Road, Highway Work	Measures to Control Exposures	Instructor Notes
<ul style="list-style-type: none"> Falling/flying debris from the Asphalt Paving process. <ul style="list-style-type: none"> Blown by wind Falling off passing vehicles Vehicles – Public owned or construction 	<ul style="list-style-type: none"> Worker awareness/positioning Housekeeping Constant vigilance – watch approaching vehicles for visible motion inside – arm moving etc. Keep debris away from work area Adequate PPE – eyes, face, and head Observe approaching vehicles, especially pickups, for loose articles 	<p>Although heavy equipment is used in much of this process, workers sometimes need to be in close proximity to the operations to help the equipment which can cause a struck by exposure.</p> <p>Passersby, especially those young and/or drunk, may throw cans, bottles, etc. at workers, mostly flag persons. Always face moving traffic and be aware of the potential for flying debris. Flying debris can also come from a vehicle accident in the work zone.</p>
<ul style="list-style-type: none"> Work Zone Intrusions 	<ul style="list-style-type: none"> Practice “See & Be Seen” Personal flashing lights Mud/slick surface control Work behind positive barriers (concrete, etc.) Position arrow-board truck properly Constantly refreshed escape plan Stage vehicles so if hit, vehicle will turn into barrier wall 	<p>Workers positioned at the critical point where oncoming traffic is approaching the work zone should be aware of the hazards of vehicle intrusion and worker abuse. A warning sounded by them can provide the few seconds critical to avoiding fatalities.</p> <p>Workers near the edge of work zones should never turn their backs to oncoming traffic. Ask if anyone has worked a job where a worker was struck by a vehicle, and if so, discuss events immediately before, during, and after the incident.</p> <p>Ask students to list factors that might lead to a work zone intrusion. They should list:</p> <ul style="list-style-type: none"> Reduced visibility or glare Impaired drivers Young and elderly drivers Inattention Watching construction activities, not road Fatigued drivers Lighting Rain Limited physical barriers

Specific Exposure Types for Street, Road, Highway Work	Measures to Control Exposures	Instructor Notes
<ul style="list-style-type: none"> • Work Zone Intrusions (cont.) 		<ul style="list-style-type: none"> • Lack of knowledge/experience • Working behind non positive barriers • Congestion • Two-lane road work • Cell phones • Crying kids • Working while driving • People drink, smoke pot, or do other drugs, then drive • Geographical <ul style="list-style-type: none"> – Curves – Hills <p>Hardhats and vests with personal flashing lighting are now available to help make workers at the edges of the work zone more visible.</p>
<ul style="list-style-type: none"> • Equipment and construction vehicle traffic within work zone <ul style="list-style-type: none"> – Lack of coordination of workers from multiple companies 	<ul style="list-style-type: none"> • Pre-established and known vehicle traffic flow plan • Pre-established and known foot traffic plan • Maintain Awareness by all • Safety First Attitude • Proper Worker Position • Back-up Alarms/Spotters • Back-up Cameras • Proper Lighting <ul style="list-style-type: none"> – Visibility of workers – Visibility for workers • Vehicle-Equipment Inspection • Teamwork • Ongoing worker education • Proximity Warning Devices 	<p>Make certain your class understands that most work zone fatal accidents involve WOF and construction equipment (not intruding vehicles).</p> <p>An unfortunate, but classic, highway worker fatality that happens far too often occurs when a worker stands in a (not “the,” as there are several for every piece of equipment) blind spot where the operator cannot see them. The equipment moves, usually backing; the worker is looking away and does not see; and it is noisy so they do not hear but they certainly feel it as it runs them down.</p> <p>Backing is less than 1% of fleet mileage but accounts for approximately 30% of all accidents. Workers must be aware of their position in relation to driver blind spots.⁶⁻³</p> <p>Third-party truckers – Daily orientation with the truck foreman as to the traffic control plans</p> <p>Caterpillar, Inc. has developed blind area diagrams for all of their vehicles and equipment to help the operators and WOF determine areas to avoid when working around this equipment.</p> <p>Point out that WOF may become desensitized to the sound of back-up alarms over time. Even though the back-up alarm may operate, it may not register with the WOF because they hear it so often.</p>
<ul style="list-style-type: none"> • Working near rotating/moving equipment. <ul style="list-style-type: none"> – Loading and unloading of equipment 	<ul style="list-style-type: none"> • Boots with slip-resistant soles • Constant vigilance • Layout of work area • Avoid working under booms and suspended loads • Planned foot traffic flow 	<p>Clearance between equipment and WOF is frequently measured in inches, not feet. Constant awareness of personal location in relation to equipment is critical.</p> <p>When working around moving equipment such as backhoes, ensure workers’ position is such that they cannot be struck by the equipment.</p> <p>Proximity Warning Devices are being designed that notify the drivers of company vehicles, such as dump trucks, the location of not only flag persons but also other WOF who are involved in the unloading and material placement process.</p>

Specific Exposure Types for Street, Road, Highway Work	Measures to Control Exposures	Instructor Notes
<ul style="list-style-type: none"> • Equipment/employee moves into oncoming traffic 	<ul style="list-style-type: none"> • Access and egress clearly marked • Unified Incident Command • Safety plan inclusion • Education 	<p>Issues to discuss include speed differential, mud/rocks coming off tires, limited visibility, inattentive drivers, both public and construction vehicles. Ask about others.</p> <p>Usage of law enforcement – how do you train them to understand what is going on around them?</p> <p>Discuss company requirements for placing “DO NOT FOLLOW” signs on the rear of vehicles that move in and out of the work zone – such as Superintendents’ pickups.</p> <p>Discuss designated employee parking – transportation to jobsite – off the immediate roadway. Documented examples exist where workers were struck by public vehicles and killed walking to their vehicles parked along the roadside at the end of the shift.</p>
<ul style="list-style-type: none"> • Equipment contact with power lines 	<ul style="list-style-type: none"> • Proximity Warning Devices • General Contractor establish overhead clear zone 	<p>Powerline contact can create falling parts, loads, and debris in addition to the electrical hazard. Avoiding the contact is the best control. Avoiding the area near and under suspended loads is also important.</p> <p>Bilingual – use of symbols – can non-English-speaking/reading people understand the hazard?</p>
<ul style="list-style-type: none"> • Close proximity of public traffic 	<ul style="list-style-type: none"> • All workers maintain constant awareness of their position in relation to moving traffic • See and Be Seen • Look before moving • Look twice – move once 	<p>Injuries and fatalities occur when workers forget where they are or forget to look before moving. When that first move exposes them to public motorists passing by, the “struck by” could be fatal.</p> <p>This is a good area for a slogan campaign such as “Look twice – Move once” to help workers remember to make sure before they move.</p>

Asphalt Paving and Patching Operations

Caught in / between

Approximately 18% of construction worker fatalities involve being caught in or between objects.¹

Such injuries often involve a section of the body being crushed. Fatalities can be instantaneous, or occasionally the pinned person may be alert but will die in a short period of time. There have been documented cases where pinned workers, loved ones were rushed to the site to say good-bye before the worker died.

Amputations are also a frequent result of such accidents. Fingers are most frequently affected, but workers lose arms and legs as well at times.

Truck drivers have been caught in the vehicle driveshaft or in turning gears, workers have been caught between the backing truck and the paver hopper, and mechanics have been trapped between the bed and truck frame when a bed fell. Intrusion of public vehicles into the work zone may result in workers being caught between that vehicle and stationary objects.

Caught in/between injuries are rarely minor. Injury types frequently seen include:

- Lacerations
- Amputations
- Crushing
- Fractures
- Burns
- Contusions
- Fatality

Specific Exposure Types for Street, Road, Highway Work	Measures to Control Exposures	Instructor Notes
<ul style="list-style-type: none">• Plant Operations<ul style="list-style-type: none">– Loading/unloading– Plant belts/conveyors– Equipment operation	<ul style="list-style-type: none">• Proper equipment labeling• Ongoing worker education• Compliance audits/correction• Proper PPE• Proper guarding of rotating equipment	<p>Workers may be crushed between backing equipment or vehicles and other equipment.</p> <p>Ask class to develop a list of places where hands/fingers may be caught in or between – some possibilities include:</p> <ul style="list-style-type: none">• Augers• Belt/chain drives• Loading/unloading

Specific Exposure Types for Street, Road, Highway Work	Measures to Control Exposures	Instructor Notes
<ul style="list-style-type: none"> • Vehicular traffic within work zone <ul style="list-style-type: none"> – Backing vehicle – dump trucks – Asphalt spreading/ applying machinery 	<ul style="list-style-type: none"> • Electronic – (radio) • Train to expect/cooperate • Employee positioning clear of pinch points • Operator awareness and due care • Internal Traffic Control Plan • Worker positioning • Minimize backing • Rear-view Cameras • Back-up alarms • “No see” chart training • “See and Be Seen” 	<p>Have class list types of equipment usually seen in asphalt work zones. Examples may be:</p> <ul style="list-style-type: none"> • Rollers • Milling machines • Front end loaders • Graders • Scrapers • Tack trucks • Water trucks <p>In asphalt work, backing dump trucks are thought to be responsible for a high percentage of highway worker deaths – perhaps more than any other single hazard. Make certain your class understands this important point. Discuss the company policy related to worker positioning between backing dump trucks and the hopper.</p> <p>Companies that make equipment frequently found in work zones are beginning to develop and make available charts for equipment that shows the “blind spots” the operator has. Employee education in blind spot recognition makes good weekly safety meetings and helps prevent accidents. Check with your equipment manufacturer of to see if they offer a blind-spot chart.</p> <p>An “Internal Traffic Control Plan” is critical to the safety of WOF. Ensure that whenever possible, trucks and equipment do as little backing up as possible with the work areas.</p> <p>Backing vehicles pinning workers between the rear bumper of the vehicle they are driving and another object such as a pole or a piece of equipment happens far too often. Sometimes the equipment is moving and traps the WOF between the equipment and a stationary object. Back-up alarms help and are required by law but are not the only answer. Unfortunately, construction workers become accustomed to hearing them and mentally block the sound. Workers may have impaired hearing.</p>
<ul style="list-style-type: none"> • Equipment maintenance <ul style="list-style-type: none"> – Moving/rotating equipment parts 	<ul style="list-style-type: none"> • Hands clear of pinch points • Block raised items, such as a truck beds or wrecked vehicle • Caution in hand/finger placement during sawing/impact work 	<p>During Asphalt Paving Operations, avoid pinch points. All work must be performed so the worker has positive assurance that the vehicle or equipment will not move unexpectedly. Frequently, this includes blocking or supporting the equipment. Asphalt Paving employees are killed every year because they were crushed by parts that were raised, but not well secured, falling on them.</p>
<ul style="list-style-type: none"> • Hand spreading <ul style="list-style-type: none"> – Complacency, inattention – Improper communication – Asphalt crews work 	<ul style="list-style-type: none"> • PPE Guarding • Arrow-board truck • Position to stay clear • Constant vigilance 	<p>MOT barriers, properly rated high-visibility clothing, etc. are all important in avoiding accidents.</p> <p>A pre-planned escape route is a very important element in asphalt paving work.</p> <p>Working adjacent to concrete barriers and around live traffic creates opportunities for pinch points.</p>

Specific Exposure Types for Street, Road, Highway Work	Measures to Control Exposures	Instructor Notes
<ul style="list-style-type: none"> • Vehicular traffic <ul style="list-style-type: none"> – Intruding vehicle 	<ul style="list-style-type: none"> • Education • Teamwork • Position to stay clear 	Being pinned between an incoming vehicle and stationary equipment is a constant danger in asphalt work. Ask the class if anyone has observed a vehicle straying into the work zone. This is a good point to involve students in a discussion around the topic “What do you do to make sure you don’t get pinned by an outside vehicle driving into the work zone?”
<ul style="list-style-type: none"> • Noise 	<ul style="list-style-type: none"> • PPE 	<p>Vendors/subcontractors/inspectors should be included in hearing protection.</p> <p>A general guideline is that if you have to raise your voice to be heard when speaking, then hearing protection is probably in order.</p>

Asphalt Paving and Patching Operations

Electrical

Approximately 17% of construction worker fatalities involve an electrical current.¹

Injuries resulting from electrical contact include severe burns, unconsciousness, loss of mental and/or physical ability for the remainder of the worker’s life, and frequently a prolonged period of suffering, then death. Death may be immediate.

Electrical current passes from point of contact with a live circuit through the body to an exit point where the body is grounded. An example is a worker who is holding a metal signpost and then touches a short-circuited generator that is not grounded. The current would pass from one hand, through the lungs and heart, and out the other hand.

If an electrical arc is involved, burns from molten metal and severe respiratory distress from breathing superheated air are likely.

A severe shock or lightning strike can burn a worker to death as other workers look on. This can create a post-traumatic stress-type injury to survivors.

Electronic devices that warn of approaching or nearby lightning strikes are available for very reasonable prices.

Highway, street, and road workers are at risk from electrical shock when a truck or backhoe boom comes in contact with overhead power lines. Lightning strikes also pose a significant hazard. Accidents in the work zone may create electrical hazards by knocking down power poles.

Specific Exposure Types for Street, Road, Highway Work	Measures to Control Exposures	Instructor Notes
<ul style="list-style-type: none"> • Electrical equipment <ul style="list-style-type: none"> – Portable crushing operations and equipment – Improper grounding – Poorly maintained equipment 	<ul style="list-style-type: none"> • GFCI use 100% of time • Inspect/maintain equipment • GFCI • Maintain Awareness • Proper PPE • Use non conductive tools • Perform lockout tagout • Proper grounding 	<p>Ask the class to identify some equipment found on work zone sites that might pose the hazard of electrical shock, such as:</p> <ul style="list-style-type: none"> • Portable generators • Lighting plants <p>Grounding all portable electrical equipment and using GFCIs for all portable electrical tools is essential to electrical safety. Discuss what electrical grounding means. If possible, have someone with an electrical background explain what proper grounding is and how to accomplish it.</p> <p>Explain the danger of internal wiring vibrating loose and energizing the external frame and casing of equipment. Electrical dangers are usually unseen.</p>

Specific Exposure Types for Street, Road, Highway Work	Measures to Control Exposures	Instructor Notes
<ul style="list-style-type: none"> Cutting underground utilities 	<ul style="list-style-type: none"> Identify <ul style="list-style-type: none"> One Call (811) Potholing 	<p>Ask the class to tell about examples where underground utilities were struck while digging because they were not actually where they were marked.</p> <p>Discuss the importance of potholing – hand digging to physically find and observe the underground utilities and plot an actual position before digging.</p> <p>Ask if crews have probe rods, T-handle steel rods with a pointed end, to use to help locate underground structures and utilities (except gas and electrical).</p>
<ul style="list-style-type: none"> Overhead power line 	<ul style="list-style-type: none"> Maintain Awareness Mark locations on ground Minimize exposure – maintain distance 	<p>Far too frequently, equipment will contact a live overhead power line. An electrical charge can jump a gap, creating an arc that energizes the equipment so contact is not even necessary. Such contact can energize the ground with the potential lessening as the distance from the point of contact increases. A concrete worker walking nearby can receive a severe shock from stepping across invisible differences in potential in the ground as well as from being in physical contact with the energized truck.</p>
<ul style="list-style-type: none"> Equipment operations <ul style="list-style-type: none"> Taking short cuts Using improper equipment for the job 	<ul style="list-style-type: none"> Electronic tracking Electrical wiring meets code Ground prong for extension cords Ongoing employee education Avoid contact Use correct tool for the job 	<p>When assigning equipment to locations consider clearance issues with overhead power lines (or other overhead structures).</p> <p>Operators must stay the proper distance away from overhead power lines. Explain “spotters” and what they are responsible for. Discuss the challenges perspective brings and how to make sure spotters have the right angle to the work.</p>
<ul style="list-style-type: none"> Weather related lightning 	<ul style="list-style-type: none"> 30-30 Rule: <ul style="list-style-type: none"> 30 seconds between flash and thunder – take cover 30 minutes after seeing the last flash – resume work Do NOT: <ul style="list-style-type: none"> Be the tallest object Stand in the open Stand under a tree Stand in a gazebo or open shelter Stand next to or touch metal objects Stay next to water Use electrically powered tools Use a plug-in phone or computer with modem Do: <ul style="list-style-type: none"> Get into an enclosed building Get into a car, truck, or van 	<p>Lightning is another issue. Lightning can strike 10 miles in front of a storm. 30% of those struck by lightning die, most within an hour. Approximately 74% sustain some sort of permanent disability.¹¹</p> <p>Handheld electronic devices that measure the distance to the closest lightning strike can provide ample warning to allow workers to seek safety.</p> <p>Tuning a radio to the AM band allows the static blast of lightning strikes to be heard.</p> <p>Every company with outside work should have a standard lightning policy that superintendents/foremen know and enforce. That policy should address when to send workers to cover; that the cover does not include trees, metal objects, high, clear ground, etc.; and when to return to work.</p> <p>Every project plan should have a section on lightning. Standardizing the process for protecting workers helps eliminate inconsistencies from job to job, even day to day.</p>

Asphalt Paving and Patching Operations

Soft tissue

Soft tissue injuries (STIs) – strains and sprains primarily, are the number-one injury type in highway/street/road work. Asphalt Paving Operations requires moving heavy parts; pick and shovel work where equipment can't reach; walking on uneven ground; and many other ways to strain or sprain shoulders, elbows, knees, and ankles. Many operators jumping off equipment and landing in uneven Asphalt Paving Operations damage, and even destroy, knees and ankles every year.

What sort of work activities are we talking about here? Some examples include:

- Work activities
 - Reaching
 - Carrying
 - Pushing – wheelbarrows over uneven ground
 - Pulling
 - Digging
 - Sawing
- Other issues of concern
 - Repetitive motion
 - Overexertion
 - Poor posture

A good education program will ensure that employees know the ergonomic hazards and can recognize when they or co-workers are at risk. They also have to know how to control the exposure to minimize their risk of injury.

Strains and sprains can have a greater negative impact on workers, their families, and the company than any injury short of a fatality. A person who severely injures his or her back may never be able to pick up children or grandchildren.

Strains and sprains to ankles and knees occur frequently from walking or stepping on debris or uneven ground. Even jumping off damaged vehicles can create problems. Shoulder and elbow strains/sprains are also likely in hand work, pulling people or things out of danger. Back injuries also are associated with Asphalt Paving Operations work. Reaching out to rake or shovel can result in slipped or bulging discs in the back. Shoulder strains may occur from improper posture when shoveling or raking.

Specific Exposure Types for Street, Road, Highway Work	Measures to Control Exposures	Instructor Notes
<ul style="list-style-type: none"> • Repetitive motion <ul style="list-style-type: none"> – Raking/Placement – Shoveling 	<ul style="list-style-type: none"> • Workers changed out periodically • Acclimation of employees <ul style="list-style-type: none"> – Heat/cold adjustment • Stretch program • Use of powered equipment • Get help • Rotate workers • Change positions frequently • Educate workers on proper techniques 	<p>Worker rotation and relief should be planned ahead so no one has to perform the hottest, heaviest jobs for too long a period.</p> <p>Knowing that stretching exercises and other ergonomic controls are supported by the field management team and upper management are important aspects to getting workers to help protect themselves.</p>
<ul style="list-style-type: none"> • Placement of MOT <ul style="list-style-type: none"> – Lifting/carrying – large bulky items 	<ul style="list-style-type: none"> • Employee rotation • Break into smaller loads • Get help • Ongoing employee education • Using proper lifting techniques • Three-point mount/dismount of trailers, equipment, and pickups • Good housekeeping • Taking breaks • Follow written procedures 	<p>Understanding how stretching helps construction workers, just like it does athletes. Discuss stretching, how athletes make it a natural part of their performance. Even dogs and cats stretch naturally when rising from a nap.</p> <p>Ask workers what they have to move/lift/carry routinely that they consider very heavy. Follow-through to see if mechanical assistance can be arranged, the materials be purchased in smaller containers, the job be made a two-person task, etc.</p> <p>Getting help for heavy loads requires asking someone, and construction workers do not do that well. Make sure the class understands it is OK to ask for help and provide help when asked.</p>
<ul style="list-style-type: none"> • Material handling <ul style="list-style-type: none"> – Lifting/moving heavy equipment – Using improper lifting techniques – Failure to ask for help – Forced repetition / Posture 	<ul style="list-style-type: none"> • Motorized equipment when possible • Get help • “NO MORE ON THE FLOOR” – Store materials approximately waist high • Utilize product bags with minimal weight • Lift and carry close to the body • PPE 	<p>Heat and cold extremes can make soft tissue more susceptible to injury so stretching is more important.</p> <p>Adequate PPE when carrying can include shoulder pads and gloves – even good work boots. Good gloves and boots are especially important to working hot concrete.</p> <p>The weight of the tools should be considered, along with lifting and twisting required when handling.</p>
<ul style="list-style-type: none"> • Improper mount/dismount trailers, pickups, equipment • Poor housekeeping 	<ul style="list-style-type: none"> • Acclimatization of employees <ul style="list-style-type: none"> – Layer clothing – Provide water and shade – Educate for heat- and cold-related medical issues • Stretching is more important • OSWPS – Operators Stand When Possible and Stretch 	<p>Asphalt Paving moving operations are physically demanding. Operators face hours of sitting in one seat, often with whole body vibrations that shake them constantly. Jumping off equipment onto uneven ground frequently results in sprained ankles and knees, even backs.</p>



Concrete Paving Work and Paving Operations

Introduction:

Approximately 90% of construction worker fatalities and serious injuries involve a fall, being struck by something, being caught in or between things, or electrical shock.

In addition, soft tissue injuries (STIs), usually seen as strains or sprains, are one of the most frequent injury types in this work. STIs are rarely fatal, but can and do have a serious impact on the injured worker and families' quality of life. Concrete is heavy, so strains and sprains are frequent.

In concrete paving work, we often find workers within feet, even inches, of vehicles weighing tons traveling at high speeds. The responsible crew must have an emergency plan to address challenges resulting from injuries.

NIOSH lists these hazards faced by concrete workers:

- Ergonomics – addressed in this program's focus on soft tissue injury prevention
- Noise – companies need to have a hearing protection program for all employees. This should include testing for noise levels, engineering controls (use of low noise equipment), administrative controls (employee rotation, audiometric testing), and PPE
- Silica – airborne, respirable dust from activities such as dry saw cutting of concrete
- Cement Dermatitis – the pH factor of concrete can cause burns or immediate irritation of eyes and skin, over time, dermatitis can develop
- Concrete additive irritants – MSDS sheets should be reviewed with all employees who could be affected by these admixtures

Specific Exposure Types to Concrete Paving Work	Measures to Control Exposures	Instructor Notes
In this column, we will identify hazards that may lead to accidents and injuries.	In this column, we will identify control measures that will help reduce the risk of accident or injury if implemented.	In this column, we will provide tips and suggestions to help the instructor present the material in a meaningful way. Comments are geared toward instructors that may be supervisors first, instructors only as needed.
Concrete paving shares some hazards with other forms of street/road/highway work. These include exposure to moving traffic, exposure to environmental conditions, and heavy work involving lifting, pushing, and pulling. Other hazards include falls from equipment, working in close proximity to backing equipment, and slips, trips and falls.	Control methods are rarely 100%, but history has proven that workers can follow procedures and significantly reduce the chance that they, or coworkers will be involved in an accident or sustain an injury. Recommended PPE to avoid concrete splashes to the eyes and skin is safety glasses, rubber gloves, and rubber boots for all workers with concrete where they need to step into or handle the concrete. Best practice precautions include taping up rubber boots to ensure none of the concrete gets down into the rubber boots and burns the feet.	Welcome your class and try to put them at ease. Tell them how you are going to discuss the work they do and how to do it without injury. One good method to put crews at ease is to ask each one how long they have been doing this type of work. Keep track of the years of experience for each, and when everyone has provided input, total the years. This is usually a high number, and showing the individuals how much experience they share in total helps them approach the training with some confidence. Adult Learning Basics: <ul style="list-style-type: none"> • Adult learners do best when addressing real-world problems they face in their lives. • Set the stage so attendees understand why this training is important to them in terms of their lifestyle and families, as well as employment. • Set parameters upfront – breaks, question/answer, etc. • Adults learn best from experience, not note taking. If you can't get them in the field, discuss operations they perform, use pictures. • Adult learners do best when involved – ask questions, try to get everyone to say something. • Ask the question, give the group a few seconds to think about it, and then call on someone to say what they think. • Ask several to answer, then play off the answers.

Specific Exposure Types to Concrete Paving Work	Measures to Control Exposures	Instructor Notes
In this column, we will identify hazards that may lead to accidents and injuries.	In this column, we will identify control measures that will help reduce the risk of accident or injury if implemented.	In this column, we will provide tips and suggestions to help the instructor present the material in a meaningful way. Comments are geared toward instructors that may be supervisors first, instructors only as needed.
Concrete paving has one hazard that is specific to this type of work – that of the pH factor of the concrete. Concrete hardens through a chemical reaction that occurs in the cement. The cement in the concrete is a strong oxidizer and therefore can cause serious burns to exposed skin and through clothing that soaks up moisture from the concrete.	Workers who do not take precautions to protect themselves can find their skin has become sensitized to cement/concrete burns, which can cause a much quicker and more severe reaction.	<ul style="list-style-type: none"> • Ask questions before (to discover what they already know), during (for involvement and repetition to improve learning) and then after (to see what they learned) the session. • Structure the session loosely to allow for spontaneity – a good learning tool. • You, the educator, have to believe in the material before you can make others believe in it. • Always remember you, the educator, are in charge of the group. Maintain looseness but control, don't let discussions wander aimlessly, keep on topic, meet your promised goals. <p>eLCOSH Ready Mixed Concrete Truck Drivers: Work-Related Hazards and Recommendations for Controls http://www.cdc.gov/eLCOSH/docs/d0400/d000493/d000493.html#10</p>

Concrete Paving Work and Paving Operations

Falls

Although falls from heights during concrete operations are not the most common injuries, many times they can be fairly serious. These falls frequently happen to truckers getting in and out of trucks or spraying truck beds to assist in the removal of concrete products. These operations happen mostly at the plant.

Falls from equipment may result in severe contusions and broken bone injuries, even fatalities.

The National Safety Council (1986) indicated that falls account for 50% of injuries to concrete truck drivers.

Slips and trips may result in abrasions, contusions, fractures, and even fatalities.

A person who is falling is out of control, and the extent of the injuries resulting from the fall depend on the distance of the fall, the angle of the body when it lands and anything it may strike during the fall or landing. A same-level trip or slip fall can result in a fatality if the person strikes their head wrong.

A good exercise is to ask attendees what they do and involve everyone in discussion.

Specific Exposure Types to Concrete Paving Work	Measures to Control Exposures	Instructor Notes
<ul style="list-style-type: none"> • Concrete plant operations 	<ul style="list-style-type: none"> • Maintain handrails at all plant platforms • Maintain proper footwear for workers • Keep ladders and steps clean and free of debris 	Another common area of concern is the plant itself. Making sure you have good catwalks is an adequate way to guard the workers performing maintenance operations at heights.

Specific Exposure Types to Concrete Paving Work	Measures to Control Exposures	Instructor Notes
<ul style="list-style-type: none"> • Cleaning truck and drum – external 	<ul style="list-style-type: none"> • Provide a hand-rail protected, elevated work platform at the plant site • Clean from ground in field 	<p>If concrete delivery truck drivers are in the class, ask them the best methods of cleaning the truck without falling off. Make sure maintenance of steps and hand holds, clean boots, etc. are mentioned.</p>
<ul style="list-style-type: none"> • Same-level slip and trip <ul style="list-style-type: none"> – Slip/trip on existing materials, etc. – Slip/trip while avoiding incoming vehicle – Walking in slab form – Into wet concrete 	<ul style="list-style-type: none"> • Worker awareness/positioning • Housekeeping • Watch where you are walking • Walk flat footed so toe does not trip on wire reinforcement 	<p>Workers must be educated to recognize the hazard of being around and behind a moving vehicle and taught methods they can employ to avoid being injured. The practice of riding in pickup beds should be controlled, even with slow moving vehicles.</p> <p>Proper work boots and work areas free of material, debris, etc., for workers are important.</p> <p>Workers are exposed to trip hazards when walking in forms prior to pouring the concrete slab. It is easy to catch a toe on the wire, leading to a face-first fall. Discuss the importance of avoiding this action whenever possible, then learning to walk flat-footed to avoid tripping for times exposure is required.</p> <p>Falling into a fresh concrete pour is not unheard of. Discuss positioning, maintaining clear walkways around pour area, and adequate attention by workers.</p>
<ul style="list-style-type: none"> • Elevated Falls <ul style="list-style-type: none"> – From vehicle – Concrete paving machines – Mixing trucks – Batch plant operations – From elevated work site (ex. Pour on a bridge) – From moving equipment 	<ul style="list-style-type: none"> • Non-skid steps on trucks • Ensure handrails on trucks are adequately maintained • Personal fall protection if elevated stationing required • Never anchor a fall protection lanyard to an outside rebar – always use interior rebar adequate to hold 5,000 pounds • Three-point contact climbing on/off of equipment and ladders. • Worker awareness/positioning • Housekeeping • Mud/slick surface control • Boots with slip resistant soles • Constant vigilance • Constantly refreshed escape plan • Never hitch a ride on a concrete truck or on a piece of equipment • Use positioning devices and fall protection on vertical form work • Never tie-off to an outside wrap of rebar in a vertical column 	<p>Elevated falls during concrete paving are often from equipment.</p> <p>Discuss best practice regarding:</p> <ul style="list-style-type: none"> • Maintaining boots free of mud and other slippery materials • Maintaining good housekeeping in all walkways, especially along the pour • Working near open sides such as on bridges • Need for preplanning escape route • Identifying anchor points with the foreman before mounting vertical rebar cages or form work

Concrete Paving Work and Paving Operations

Struck by

Approximately 22% of all construction worker fatalities involve being struck by something.

For 1992 – 2000 worker deaths in work zones, 91% of 910 worker deaths involved vehicles, most being dump trucks.

NIOSH records indicate that in 2005, 390 workers were killed in struck by incidents, accounting for 7% of all occupational fatalities.

Injuries range from contusions and lacerations to fractures, crushing and fatalities.

Current estimations are that approximately half the workers killed in highway work zones are killed by construction vehicles. These accidents usually involve crushing injuries and fatalities.

Injuries experienced in this area can range from lacerations and contusions being struck by debris to being struck by vehicles resulting in fatal accidents.

Backing is less than 1% of fleet mileage but accounts for approximately 30% of all accidents.

Caterpillar, Inc. has developed blind area diagrams for all of their vehicles and equipment to help the operators and WOF determine areas to avoid when working around this equipment.

Specific Exposure Types to Concrete Paving Work	Measures to Control Exposures	Instructor Notes
<ul style="list-style-type: none"> • Debris <ul style="list-style-type: none"> – Thrown – Blown by wind – Falling off passing vehicle – Material falling off bridge operations located overhead. • Splashed by concrete 	<ul style="list-style-type: none"> • Adequate PPE –eyes, face, and head • Watch approaching vehicles for visible motion inside – arm moving, etc. • Keep debris away from work zone. Secure trash being hauled in pickups. • Observe approaching vehicles, especially pickups, for loose articles. • Use safety glasses and goggles or face shields to prevent concrete splash in the eyes • Wear long sleeves and gloves to prevent skin contact 	<p>Workers must maintain constant awareness of their surroundings and always know where they are going to run or jump to get out of the way. Workers positioned at the critical point where oncoming traffic is approaching the work zone should be aware of the hazards of vehicle intrusion and worker abuse. A warning sounded by them can provide the few seconds critical to avoiding fatalities.</p> <p>Be observant of passing vehicles that look suspicious (see arms out of windows, loose material on truck, etc.). Passersby, especially those young and/or drunk, may throw cans, bottles, etc. at workers, mostly flag persons. Watch moving traffic!</p> <p>Workers near the edge of work zones should never turn their back to oncoming traffic. Ask if anyone has worked a job where a worker was struck by a vehicle and if so, discuss events immediately before, during and after the incident.</p> <p>Tie down materials that might blow about in high winds from passing trucks, storms, etc.</p> <p>Maintain areas below bridge work as No-Access Zones. Do not allow ground workers under elevated work.</p> <p>Use an MSDS sheet to discuss the chemical hazards, controls, and first aid for preventing injury from concrete splashes. Doing this may also count as HazCom training.</p>

Specific Exposure Types to Concrete Paving Work	Measures to Control Exposures	Instructor Notes
<ul style="list-style-type: none"> • Vehicle <ul style="list-style-type: none"> – Public owned vehicle – Construction vehicle – Paving Equipment • Worker visibility reduced due to poor ambient lighting 	<ul style="list-style-type: none"> • Chock wheels of equipment when parked • Park equipment as far off the edge of roadway as possible. • Adequate lighting to insure visibility of workers • Constant vigilance • Layout of work area <ul style="list-style-type: none"> – Internal and External Planned traffic flow – Planned foot traffic flow – Adequate back-up alarms • Proximity Warning Devices • Personal flashing lights on workers' PPE • Spotters for backing vehicles, especially dump trucks 	<p>Ask if anyone in the class has ever seen a worker struck by a vehicle in the work zone. If so, discuss what happened and preventative methods.</p> <p>Ask which the class thinks most likely to happen – “worker struck by public vehicle intruding in work zone” or “worker struck by construction vehicle in the work zone”? Ensure they understand the hazard of being struck by their own equipment or trucks is greater than a public vehicle.</p> <p>Discuss high-visibility clothing requirements, especially when night work is involved. Go over your company policy on use of high-visibility clothing.</p> <p>Some new PPE is available with flashing lights on the hardhat, vest, etc. to increase worker visibility. The hardhats and vests with personal flashing lighting help make workers at the edges of the work zone more visible.</p> <p>Proximity warning devices that let the operator/driver know if something (or someone) is behind them when backing are new to dump trucks but are starting to be seen in the workplace.</p> <p>Front discharge concrete trucks allow drivers to reach their pour location with limited or no backing; however they have to back out when empty. Discuss use of spotters for backing equipment.</p>
<ul style="list-style-type: none"> • Moving parts 	<ul style="list-style-type: none"> • Maintain distance from moving parts 	<p>Concrete work involves moving parts, especially chutes and elephant trunks – ensure workers stay clear of these.</p>

Concrete Paving Work and Paving Operations

Caught in / between

Approximately 18% of construction worker fatalities involve being caught in or between objects.

Such injuries often involve a section of the body being crushed. Fatalities can be instantaneous, or occasionally the pinned person may be alert but will die in a short period of time.

There have been documented cases where pinned workers, loved ones were rushed to the site to say good-bye before the worker died.

Amputations are also a frequent result of such accidents. Fingers are most frequently affected, but workers lose arms and legs as well at times.

Truck drivers have been caught in the vehicle driveshaft, in joints of the chute, and turning gears; workers between the backing truck and the paver hopper; and mechanics between the bed and truck frame when a bed fell. Intrusion of public vehicles into the work zone may result in workers being caught between that vehicle and stationary objects.

Caught in/between injuries are rarely minor.

Working adjacent to concrete barriers and around live traffic creates opportunities for pinch points. An Internal Traffic Control Plan is critical to the safety of WOF. Ensure that, whenever possible, trucks and equipment minimize backing up within the work areas.

Occasionally, concrete work associated with paving operations takes place in trenches or excavations. Remember such work is subject to extensive regulatory standards. To perform work safely in trenches and excavations educate your workers to meet those requirements.

Specific Exposure Types to Concrete Paving Work	Measures to Control Exposures	Instructor Notes
<ul style="list-style-type: none"> Plant operations <ul style="list-style-type: none"> – Loading/unloading – Plant belts/conveyors 	<ul style="list-style-type: none"> Worker positioning Guarding 	Discuss key issues at the plant, including: <ul style="list-style-type: none"> Maintenance of stairs, ladders, and handrails, as well as the walking surfaces. Good housekeeping to remove trip hazards Maintaining all guards in the proper position Positioning workers to avoid moving equipment such as loaders
<ul style="list-style-type: none"> Concrete spreading machinery <ul style="list-style-type: none"> – Auger – Belt/chain drives – Loading/unloading 	<ul style="list-style-type: none"> Guarding Position to stay clear Hands clear of pinch points 	Concrete truck drivers have to place the chute, involving moving parts and several pinch points. Ask the class to name all the possible pinch points they can think of when doing a concrete pour, then discuss the best means of avoiding them.
<ul style="list-style-type: none"> Backhoe/loader work 	<ul style="list-style-type: none"> Position to stay clear Proper shovel 	Workers struck by loaders and backhoes during concrete operations may happen when workers are distracted or not paying attention to their repetitive tasks. Discuss positioning to stay clear of equipment.

Specific Exposure Types to Concrete Paving Work	Measures to Control Exposures	Instructor Notes
<ul style="list-style-type: none"> Maintenance work 	<ul style="list-style-type: none"> Lockout/tagout equipment Block if raised Use a buddy system if working at night – keep in touch with another mechanic Employee positioning clear of pinch points Guarding – always replace, repair if missing 	<p>Mechanics should stay in touch with each other when servicing equipment at night. Contact each other a minimum of every half hour or work within sight distance if possible to ensure safety.</p> <p>During maintenance of truck mechanisms, avoid pinch points. All mechanical work must be performed so the mechanic has positive assurance that the vehicle or equipment will not start or move unexpectedly. Frequently this includes keeping the key in their pocket. Mechanics are killed every year because they were crushed by parts that were raised, but not well secured, falling on them.</p> <p>Guards are there for a reason – make the class realize that. Develop a list of guards on tools and equipment that need to be checked to make sure they are in place and functioning properly.</p>
<ul style="list-style-type: none"> Backing vehicle 	<ul style="list-style-type: none"> Operator awareness and due care Minimize backing Rear view Cameras Back-up alarms “No see” chart training “See and Be Seen” 	<p>Backing vehicles pinning workers between the rear bumper of the vehicle they are driving and another object such as a pole, piece of equipment, etc. happens far too often. Back-up alarms help and are required by law but are not the only answer. Unfortunately, construction workers become accustomed to hearing them and mentally block the sound. Workers may have impaired hearing.</p> <p>Companies that make equipment frequently found in work zones are beginning to develop and make available charts for equipment that shows the blind spots the operator has. Employee education in blind spot recognition makes good weekly safety meetings and helps prevent accidents.</p>
<ul style="list-style-type: none"> Intruding vehicle – Possible with Concrete work 	<ul style="list-style-type: none"> Constant vigilance Know and use audible warning MOT 	<p>Previously mentioned MOT barriers, properly rated high-visibility clothing, etc. are all important in avoiding such accidents.</p> <p>A pre-planned escape route is a very important element in setting up traffic control work.</p>
<ul style="list-style-type: none"> Trench/Excavation 	<ul style="list-style-type: none"> Know requirements Have competent person Test soil and classify Conduct required training Plan ahead Have ladder access within 25 feet Maintain inspection log 	<p>Regulatory agencies list many requirements that help reduce the risk of working in trenches and excavations. Workers that will be in and around those work sites must have the proper training and put the proper controls in place to protect themselves.</p> <p>Those not associated with trench work need to be aware of where it is and their responsibility to avoid that area.</p> <p>There are many available resources to help develop and present trench/excavation training.</p>

Concrete Paving Work and Paving Operations

Electrical

Approximately 17% of construction worker fatalities involve an electrical current.

Injuries resulting from electrical contact include severe burns, unconsciousness, loss of mental and/or physical ability for the remainder of the worker's life and frequently a prolonged period of suffering, then death. Death may be immediate.

Electrical current passes from point of contact with a live circuit through the body to an exit point where the body is grounded. An example is a worker who is holding a metal signpost that is touching the ground, and then touches a short-circuited generator that is not grounded. The current would pass from one hand, through the lungs and heart, and out the other hand.

If an electrical arc is involved, burns from molten metal and severe respiratory distress from breathing superheated air are likely.

A severe shock or lightning strike can literally incinerate a worker as others look on.

Specific Exposure Types to Concrete Paving Work	Measures to Control Exposures	Instructor Notes
<ul style="list-style-type: none"> • Portable generators • Light plants • Cords 	<ul style="list-style-type: none"> • Proper grounding • Competent persons – qualified electricians setting up equipment and necessary wiring. • Avoid contact • Grounded and guarded 	<p>Grounding all portable electrical equipment and using GFCIs for all portable electrical tools is essential to electrical safety.</p> <p>Grounding includes a ground rod – make sure your workers know how to perform the task of grounding equipment properly.</p>
<ul style="list-style-type: none"> • Overhead power line 	<ul style="list-style-type: none"> • Identify and mark on ground and on overhead line if possible • De-energize if possible • Use spotter • Educate workers about hazards and response if problem develops 	<p>Concrete workers are at risk from electrical shock when a truck or backhoe boom comes in contact with overhead power lines. Lightning strikes also pose a significant hazard.</p> <p>Far too frequently, equipment will contact a live overhead power line. An electrical charge can jump a gap, creating an arc that energizes the equipment so contact is not even necessary. Such contact can energize the ground with the potential lessening as the distance from the point of contact increases. A concrete worker walking nearby can receive a severe shock from stepping across invisible differences in potential in the ground as well as from being in physical contact with the energized truck.</p>
<ul style="list-style-type: none"> • Plant operations – 480 volt electrical systems on batch plants, etc. 	<ul style="list-style-type: none"> • Electrical wiring meets code • Ground prong for extension cords • GFCI use 100% of time • Lockout/tagout • Continuity testing • Identify • Be aware • NFPE 70E • Gloves, etc 	<p>Workers that do not perform electrical work as a normal part of their daily activities rarely understand the nature and extent of the hazard. Explain how grounding works and what grounding portable electrical equipment does to protect them.</p> <p>Explain GFCI units to workers. Address how they monitor current across the potential dangerous to workers and trip faster than a person can blink an eye to open the circuit – preventing a dangerous electrical shock.</p> <p>Normal plant operations, including portable crushing and sorting equipment, must utilize Lockout/tagout to protect workers. Educate workers to look for obvious electrical issues such as wires pulled loose, exposed conductors, sparking, etc. and report problems immediately. Lock out the equipment until a qualified electrician can check it out and repair.</p>

Specific Exposure Types to Concrete Paving Work	Measures to Control Exposures	Instructor Notes
<ul style="list-style-type: none"> • Weather related lightning 	<ul style="list-style-type: none"> • Electronic tracking • Minimize exposure • 30-30 Rule: <ul style="list-style-type: none"> – 30 seconds between flash and thunder – take cover – 30 minutes after seeing the last flash – resume work • Do NOT: <ul style="list-style-type: none"> – Be the tallest object – Stand in the open – Stand under a tree – Stand in a gazebo or open shelter – Stand next to or touch metal objects – Stay next to water – Use electrically powered tools – Use a plug-in phone or computer with modem • Do: <ul style="list-style-type: none"> – Get into an enclosed building – Get into a car, truck, or van 	<p>Lightning is another issue. Lightning can strike 10 miles in front of a storm. 30% of those struck by lightning die, most within an hour. Approximately 74% sustain some sort of permanent disability.</p> <p>Handheld electronic devices that measure the distance to the closest lightning strike can provide ample warning to allow workers to seek safety.</p> <p>Tuning a radio to the AM band allows the static blast of lightning strikes to be heard.</p> <p>Every company with outside work should have a standard lightning policy that superintendents/foremen must know and enforce. That policy should address when to send workers to cover, that the cover does not include trees, metal objects, high, clear ground, etc. and when to return to work.</p> <p>Every project plan should have a section on lightning. Standardizing the process for protecting workers helps eliminate inconsistencies from job to job, even day to day.</p>

Concrete Paving Work and Paving Operations

Soft tissue

Soft tissue injuries – strains and sprains primarily, are the number-one injury type in highway/street/road work.

Strains and sprains can have a greater negative impact on workers, their family, and the company than any injury short of a fatality. A person who severely injures his or her back may never be able to pick up children or grandchildren.

Reaching out to rake concrete can result in slipped or bulging discs in the back. Shoulder strains may occur from improper postures when shoveling or raking.

Understanding how stretching helps construction workers, just like it does athletes, is important to getting workers to accept the stretching process.

A good education program will ensure that employees know the ergonomic hazards and can recognize when they or co-workers are at risk. They also have to know how to control the exposure to minimize their risk of injury.

Knowing stretching exercises and other ergonomic controls are supported by the field management team and upper management are important aspects to getting workers to help protect themselves.

Specific Exposure Types to Concrete Paving Work	Measures to Control Exposures	Instructor Notes
<ul style="list-style-type: none"> • Placement <ul style="list-style-type: none"> – Repetitive motion – Awkward positions 	<ul style="list-style-type: none"> • Employee rotation • Motorized equipment when possible • Get help • Stretch/flex programs • Design work to avoid stressful positions 	<p>Repetitive motion is not considered doing the same things a couple of times in a shift. It is frequent repetition, probably over some extended period of multiple shifts.</p> <p>Finishing concrete may be repetitive but rest breaks give muscles time to recover.</p> <p>Awkward positions such as stooping, bending, kneeling require muscles and other soft tissue to function in ways that put the body in a position not considered normal posture. The longer or more frequent those episodes occur, the greater the hazard of injury.</p>
<ul style="list-style-type: none"> • Acclimation of employees <ul style="list-style-type: none"> – Heat/cold adjustment 	<ul style="list-style-type: none"> • Layer clothing • Water • Educate for heat- and cold-related medical issues • Stretching is more important 	<p>The hot work environment may compound exposure to soft tissue injuries. The ambient temperature is frequently hot, as many locations do this work in the summer only.</p> <p>Worker rotation and relief should be planned ahead so no one has to perform the hottest jobs for too long a period. Heat and cold extremes can make soft tissue more susceptible to injury, so stretching is more important.</p>
<ul style="list-style-type: none"> • Material handling 	<ul style="list-style-type: none"> • “NO MORE ON THE FLOOR” – Store materials approximately waist high • Utilize product bags with minimal weight • Mechanical means of material handling • Lift and carry close to the body • PPE 	<p>Adequate PPE when carrying can include shoulder pads and gloves – even good work boots. Good gloves and boots are especially important to working concrete.</p> <p>Use mechanical assistance whenever possible.</p> <p>Design the project so materials that are used frequently, such as rebar, can be stored approximately waist high. Supporting stands must be adequate to support the weight. Bending to pick up materials from ground level may lead to an increased risk of soft tissue injury, especially back injury. Teach workers the “No More on the Floor” way.</p>

Specific Exposure Types to Concrete Paving Work	Measures to Control Exposures	Instructor Notes
<ul style="list-style-type: none"> • Truck and equipment cleaning <ul style="list-style-type: none"> – Overreaching – Equipment access 	<ul style="list-style-type: none"> • Use automated systems • Use properly built stands 	<p>Cleaning the truck, other equipment, and tools involves reaching and lifting. Sometimes gaining access to hard-to-reach places presents awkward position issues. If automated systems are available, use them.</p> <p>Stretching is important in preventing strains and sprains.</p>
<ul style="list-style-type: none"> • Screeding <ul style="list-style-type: none"> – Repetitive motion – Overexertion – Awkward posture 	<ul style="list-style-type: none"> • Hand troweling • Use of powered screed • Rotate workers • Change positions frequently • Provide water and shade • Educate workers on proper techniques • Use of powered trowel • Use of two trowels, one for support • Knee pads 	<p>The weight of concrete and the tools required to work with it should be considered, along with lifting and twisting required when handling.</p>



Bridge Construction Work

Introduction

Approximately 90% of construction worker fatalities and serious injuries involve a fall, being struck by something, being caught in or between things or electrical shock.

In addition, soft tissue injuries (STIs), usually seen as strains or sprains, are one of the most frequent injury types that employees incur during bridgework.

In bridgework, we often find workers within feet, even inches, of vehicles weighing tons traveling at a high rate of speed. The responsible crew must have an emergency plan to address challenges resulting from injuries.

Bridgework shares some hazards with other forms of street/road/highway work. These include exposure to moving traffic, exposure to environmental conditions and heavy work involving work at height, lifting, pushing and pulling, stooping and bending, slips, trips, and falls.

Concrete bridgework may include work with the exposure of the pH factor of the concrete. Proper work practices and PPE is vital for safe performance of concrete work.

For bridgework involving active traffic lanes, workers must be trained to at least a minimum nationally recognized standard for work near moving traffic. States may have specific requirements – check your state DOT.

Training must include a prohibition against turning your back to oncoming traffic that has not yet come to a complete stop, selection of a personal emergency escape path, and a procedure for dealing with unexpected events.

Moving bridge beams is just the most visible of the materials flying around a bridge site. Installing pans, railings, wood form work, and other items present the opportunity for numerous exposures to dropped items, wrenches, etc., which frequently strike workers. Forming the superstructure of bridges that are cast in place also offers a large exposure to struck-by injuries.

Bridge Construction Work

Bridge work is the demolition, repair, or new construction of structures that span lower-lying features. Bridges help speed the flow of traffic and are essential to community life. Bridges vary from simple to extremely involved. Some of our best-loved architectural structures are bridges, perhaps the best-known example being the Golden Gate Bridge in San Francisco, CA.

Bridge work may be the most labor-intensive area of the actual road building process. Injuries can include:

- Fractures
- Severe trauma
- Eye – foreign object
- Contusions
- Lacerations
- Muscle strain/sprain
- Heat exhaustion
- Frostbite

Preplanning and education of workers must address Unified Incident Command at accident sites (who is in charge) as well as measures to protect workers during an accident. Topics should include the increased hazards from:

- Fire
- Emergency traffic – equipment and vehicle
- HazMat (fuel, cargo, etc.)
- Biohazards (injured persons)
- Temporary traffic control
- Emergency evacuation procedures

Specific Exposure Types for Bridgework	Measures to Control Exposures	Instructor Notes
<p>This column will contain information about specific hazards or exposures that can help create the chain of events leading to accident and injury.</p>	<p>This column will contain information about specific means to help reduce the risk of accident or injury if implemented.</p>	<p>This column will contain notes to help provide ideas to the instructor.</p>
<ul style="list-style-type: none"> • Height • Weather extremes • Manual material movement • Rotating equipment • Use of hand tools • Pinch points • Rebar/form work • Excessive noise • Crane operations • Work over water • Exposure to live traffic • Work at or near railroads 	<ul style="list-style-type: none"> • Hazard assessment • Pre-work planning <ul style="list-style-type: none"> – Over water • Skiff • Lifeline • PFD <ul style="list-style-type: none"> – Railroad – Internal traffic flow • Fall protection <ul style="list-style-type: none"> – Railings – Nets • Personal fall protection systems • Use of electrical grounding • STI prevention program • Daily equipment, rigging, and tool inspections • LOTO program • Dress for weather extremes • Adequate drinking water • Good housekeeping • Dust control • Eye, hearing, and other PPE • Education/training of workforce 	<p>Useful training ideas:</p> <ul style="list-style-type: none"> • Bridgework presents many hazards to control. We are focusing on bridgework in general. Please custom tailor your training to address the type of bridges you build. • Evaluate your class – have attendees introduce themselves, state job and years of experience. Point out how much experience is in the room and talk about the knowledge all that experience brings. Sharing knowledge with others in the class is a key benefit of being there and a great way to learn. • Following your presentation, go around the room asking attendees to identify injuries they think could occur on bridgework. Note items on a flip chart, board, or piece of paper. Once you have a list you think is reasonably complete, ask the attendees to develop a list of things that might lead to the injury and what can be done to prevent it. Workers drawing on their experience may come up with ideas worthy of implementing into the company control program.

Bridge Construction Work

Falls

Because bridges are elevated above ground level, often very high, falls from the structure are usually the first hazard we think of. Falls in bridgework can also be at the same level.

Falls from elevation kill workers and are a major contributor to injuries on a bridgework project. These injuries also include fractures, sprains and strains, and contusions. Fall exposures can occur at almost every stage of the bridge work.

Work that can result in falls can include abutment form and stripping work, girder installation, decking placement, forming barrier rail, and paving. Falls from equipment may result in severe contusions and broken bone injuries, even fatalities. Slips and trips may result in abrasions, contusions, fractures, and even fatalities.

Teaching the importance of selecting and using a good anchorage point for personal fall protection is a key issue.

The National Safety Council (1986) indicated falls account for 50% of injuries to concrete truck drivers. Concrete work is often part of bridgework.

A person who is falling is out of control, and the extent of the injuries resulting from the fall depend on the distance of the fall, the angle of the body when it lands, and anything it may strike during the fall or landing. A same-level trip or slip fall can result in a fatality if the person strikes their head wrong.

A good exercise is to ask attendees what they do and involve everyone in discussion.

Specific Exposure Types for Bridgework	Measures to Control Exposures	Instructor Notes
<ul style="list-style-type: none"> • Elevated Falls <ul style="list-style-type: none"> – From vehicle – Deck operations – Stems walls and soffit pours on monolithic bridge structures – Pier operations – Beam placement 	<ul style="list-style-type: none"> • Ensure steps/ladders on trucks and equipment are in place and good repair • Control riding in pickup beds • Seat belts required/used • Maintain handrails at all elevated work areas • Personal fall protection if elevated stationing required • Proper PFP anchorage to forms and rebar. • Educate workers on forms about tie-off points – use inside rebar, etc. • Use of sliders 	<p>Advance planning must include fall exposure controls. The only constant forces in bridgework are gravity and the unexpected.</p> <p>Although falls from heights during bridge operations may not be the most common injuries but many times they are serious. These falls frequently happen to workers on bridge piers, setting beams, and decking.</p> <p>Many advances in beam gripping anchorages with more comfortable harnesses have been made. Ask the class what features they like in fall protection.</p> <p>Stem walls on larger structures that are not pre-cast concrete in nature may top out at 10 – 12 feet and require workers to be elevated to place concrete. Planning walk boards and other fall protection systems are critical to safe placement of concrete during these operations.</p> <p>Use of retractable lifelines may be considered. Positioning devices might be useful for formwork. Handrails and/or safety nets may become an option after the proper point in construction is reached.</p>
<ul style="list-style-type: none"> • From elevated work site (ex. Pour on an existing bridge) <ul style="list-style-type: none"> – Ladders – Platforms 	<ul style="list-style-type: none"> • PFP systems • Slider anchorage • Retractable lifelines 	<p>Same level falls are often the result of tripping on materials left in pathways. Good housekeeping is a key to preventing same level falls in bridgework.</p> <p>Workers must be educated to recognize the hazard of being around and behind a vehicle or equipment that may move and taught methods they can employ to avoid being injured. The practice of riding in pickup beds should be controlled, even with slow moving vehicles.</p>

Specific Exposure Types for Bridgework	Measures to Control Exposures	Instructor Notes
<ul style="list-style-type: none"> • Same-level slip and trip <ul style="list-style-type: none"> – Slip/trip on existing materials, etc. – Slip/trip while avoiding incoming vehicle – Uneven surfaces including dirt 	<ul style="list-style-type: none"> • Worker awareness/positioning • Housekeeping • Mud/slick surface control • Use of boots with slip resistant soles • Constant vigilance • Constantly refreshed escape plan • Steps are non-skid 	<p>Proper work boots and work areas free of material, debris, etc. for workers are important.</p> <p>Workers must maintain constant awareness of their surroundings and always know where they are going to run or jump to get out of the way.</p> <p>Housekeeping and adequate lighting are two key control methods for preventing slips, trips, and falls.</p>
<ul style="list-style-type: none"> • Special exposures <ul style="list-style-type: none"> – Railroad – at or near – Over water work 	<ul style="list-style-type: none"> • Coordination with railroad company • They will identify special requirements • Develop specific plan • Determine if rescue or recovery • Over water <ul style="list-style-type: none"> – Skiff – Lifeline – PFD 	<p>Special exposures entail specific requirements.</p> <p>If working with a railroad, such as at a crossing, your company must coordinate with the railroad that owns the line. They will provide the specific requirements.</p> <p>Work over water varies in height above and depth of water. At some point, surviving a fall is highly unlikely. It is important that people not be put at undue risk performing rescue operations when it is almost certainly body recovery.</p> <p>Federal OSHA has specific requirements for work over water. Controls include those noted.</p> <p>Discussing the variables in work over water can make an interesting learning experience.</p>

Bridge Construction Work

Struck by

Approximately 22% of all construction worker fatalities involve being struck by something.

For 1992 – 2000 worker deaths in work zones, 91% of 910 worker deaths involved vehicles, most being dump trucks.

NIOSH records indicate that in 2005, 390 workers were killed in struck-by incidents, accounting for 7% of all occupational fatalities.

Struck-by injuries on bridges can occur from vehicles/equipment, falling objects and crane operations, and use of impact-type tools such as grinders, choppers, jackhammers, etc. Forming the superstructure of bridges that are cast in place also offers a large exposure to struck by injuries.

These injuries are frequently foreign body in eye, lacerations, fractured ribs, arms, and especially hands and fingers.

Injuries range from contusions and lacerations to fractures, crushing and fatalities.

Current estimations are that approximately one-half the workers killed in highway work zones are killed by construction vehicles. These accidents usually involve crushing injuries and fatalities.

Specific Exposure Types for Bridgework	Measures to Control Exposures	Instructor Notes
<ul style="list-style-type: none"> • Suspended and/or moving loads • Wood and steel form construction • Form loading during concrete placement • Concrete placement using pumps and buckets 	<ul style="list-style-type: none"> • Inspection of rigging equipment is important • Always plan material and equipment movement in advance of actual performance • Ensure that all forms are properly secured with bracing and tiebacks before the placement of concrete. Proper engineering for placement of snap ties and bracing is critical to avoid form collapse during concrete pouring operations. • Engineered concrete pour rates should be strictly followed to ensure structural integrity of forms in place • Warn workers to move when loads will pass overhead 	<p>Bridgework involves moving equipment and materials as well as vehicles. Moving bridge beams is just the most visible of the materials moving around a bridge site. Installing pans, railings, and other items present the opportunity for dropped items striking workers.</p> <p>All bridges require some amount of wood or steel form construction before the placement of concrete. These might include column forms or forms constructed for footers, expansion joints, column caps, coffer dams, etc. This work is very labor intensive and all of these materials are typically flown and placed by crane. Emphasize proper worker placement on the superstructure to avoid being struck by these materials. Workers may be required to monitor concrete forms for structural failure during concrete pours; this should be done from a safe position and engineer-required pour rates should be closely monitored to ensure stability of forming systems.</p> <p>Employee positioning is a key to avoiding the struck-by moving equipment or materials injuries.</p> <p>Discuss with class the need to:</p> <ul style="list-style-type: none"> • See the site through the eyes of the people they work with, and realize that <ul style="list-style-type: none"> – Others can not always see them – They can not always see others – Unexpected things happen to materials being moved

Specific Exposure Types for Bridgework	Measures to Control Exposures	Instructor Notes
<ul style="list-style-type: none"> • Debris/tools/materials <ul style="list-style-type: none"> – Thrown – Blown by wind – Falling off passing vehicle – Falling from overhead structure 	<ul style="list-style-type: none"> • Be observant • Adequate PPE – eyes, face, and head • Keep debris away from work zone • Observe approaching vehicles, especially pickups, for loose articles • Tie off tools and materials subject to falling • Use toe boards on scaffolding and platforms • Store materials in safe manner 	<p>Work around the base of piers presents exposures to falling tools and materials.</p> <p>Ask if anyone knows of an incident where someone was struck by debris, tools, or materials.</p> <p>Discuss wind blown hazards – what items are likely to move in wind, how strong wind has to be, etc.? What are company requirements for securing tools and materials during elevated work? What methods are employed to secure tools and materials?</p>
<ul style="list-style-type: none"> • Vehicle <ul style="list-style-type: none"> – Intrusion of public owned vehicle – Construction vehicle – Worker visibility reduced due to poor ambient lighting 	<ul style="list-style-type: none"> • MOT barriers • Watch approaching vehicles for visible motion inside – arm moving, etc. • Adequate lighting to insure visibility of workers • Constant vigilance • Layout of work area <ul style="list-style-type: none"> – Planned traffic flow – Planned foot traffic flow – Adequate back-up alarms • Proximity Warning Devices • Personal flashing lights on workers' PPE 	<p>Workers positioned at the critical point where oncoming traffic is approaching the work zone during pier work should be aware of the hazards of vehicle intrusion and worker abuse. A warning sounded by them can provide the few seconds critical to avoiding fatalities.</p> <p>Passersby, especially those young and/or drunk, may throw cans, bottles, etc. at workers, mostly flag persons. Always face moving traffic!</p> <p>Workers near the edge of work zones should never turn their back to oncoming traffic. Ask if anyone has worked a job where a worker was struck by a vehicle and, if so, discuss events immediately before, during, and after the incident.</p> <p>Hardhats and vests with personal flashing lighting are now available to help make workers at the edges of the work zone more visible, especially at night.</p> <p>Backing is less than 1% of fleet mileage but accounts for approximately 30% of all accidents. Workers must be aware of their position in relation to driver blind spots.</p> <p>Caterpillar, Inc. has developed blind area diagrams for all of their vehicles and equipment to help the operators and WOF determine areas to avoid when working around this equipment.</p> <p>Proximity Warning Devices are being designed that notify the drivers of company vehicles such as dump trucks the location of not only flag persons but also other WOF who are used in the unloading and material placement process.</p> <p>Ask trainees to say what they do to help prevent struck by injuries.</p>

Bridge Construction Work

Caught in / between

Fractures and lacerations as well as contusions and bruising are common. Crushing injuries, especially those involving the upper torso, can result in death.

Approximately 18% of construction worker fatalities involve being caught in or between objects.

Such injuries often involve a section of the body being crushed. Fatalities can be instantaneous, or occasionally the pinned person may be alert but will die in a short time. There have been documented cases where pinned workers, loved ones were rushed to the site to say good-bye before the worker died.

Amputations are also a frequent result of such accidents. Fingers are most frequently affected, but workers lose arms and legs as well at times.

Truck drivers and mechanics have been caught in the vehicle driveshaft. Workers have been caught in/between joints of the chute, between the elephant trunk and a solid, stationary object, within turning gears, or between a backing truck and the stationary object; and mechanics have been caught between the bed and truck frame when a bed fell. Intrusion of public vehicles into the work zone may result in workers being caught between that vehicle and stationary objects.

Caught in/between injuries are rarely minor.

Specific Exposure Types for Bridgework	Measures to Control Exposures	Instructor Notes
<ul style="list-style-type: none"> • Backing vehicle/equipment • Intruding vehicle • Flying formwork 	<ul style="list-style-type: none"> • Worker positioning • Operator awareness and due care • Minimize backing • Rear view cameras • Back-up alarms • "No see" chart training • "See and Be Seen" • Constant vigilance • Taglines, proper hand signals or use of radio communications 	<p>An Internal Traffic Control Plan is critical to the safety of WOFs. Ensure that whenever possible, trucks and equipment minimize backing up within the work areas.</p> <p>Teaching workers about blind spots is very important. Moving equipment is a primary contributing factor. Backing equipment, a worker crossing behind, and a tree or another piece of equipment is the recipe for disaster. Backing vehicles pinning workers between the rear bumper of the vehicle they are driving and another object such as a pole, piece of equipment, etc. happens far too often. Back-up alarms help and are required by law but are not the only answer. Unfortunately, construction workers become accustomed to hearing them and mentally block the sound. Workers may have impaired hearing and not be able to hear back-up alarms.</p> <p>Companies that make equipment frequently found in work zones are beginning to develop and make available charts for equipment that shows the blind spots the operator has. Employee education in blind spot recognition makes good weekly safety meetings and helps prevent accidents.</p> <p>Previously mentioned MOT barriers, properly rated high-visibility clothing, etc. are all important in avoiding such accidents.</p> <p>A pre-planned escape route is a very important element in setting up bridgework.</p> <p>Use taglines when flying all large pre-assembled forms and rebar for placement. Follow proper signaling for crane operators. Use radios for controlling two crane picks.</p>

Specific Exposure Types for Bridgework	Measures to Control Exposures	Instructor Notes
<ul style="list-style-type: none"> • Pier work <ul style="list-style-type: none"> – Moving material – Excavation cave-in 	<ul style="list-style-type: none"> • Controlled access areas • Guarding • Position to stay clear • Slope/Shore/Trench Box use • Position to stay clear 	<p>Bridgework usually involves cranes and other rotating heavy equipment. Being pinned and crushed between a rotating piece of equipment and a stationary object such as a parked truck or bridge pier is, unfortunately, too common in highway work.</p> <p>Working adjacent to concrete barriers and around live traffic creates many opportunities for pinch points.</p>
<ul style="list-style-type: none"> • Deck work <ul style="list-style-type: none"> – Pan installation – Dropped materials/tools – Loading/unloading 	<ul style="list-style-type: none"> • Maintain materials in tied down position • Employee education to recognize hazards • Employee positioning clear of pinch points 	<p>Plan material movement considering the positioning of workers to ensure loads are not swung into someone.</p> <p>Shifting loads when loading, unloading or storing materials injures many workers each year. Discuss what workers should look for and how to stack (height, tie-in, etc.) materials – including consideration for later pick-up (store on properly configured sawhorses, etc.</p>
<ul style="list-style-type: none"> • Stem walls and soffit construction <ul style="list-style-type: none"> – Placement of rebar – Formwork – Concrete pours 	<ul style="list-style-type: none"> • Stay clear of all rebar and formwork during crane operations. Use taglines. • Use positive means to control concrete pump hose and buckets during pouring operations 	<p>Discuss preplanning for concrete pump placement during pours, about having pump operator set up with remote pump control in elevated spot to see signals from concrete finishers.</p> <p>Taglines on all rebar and proper rigging to ensure bundles don't break. Don't rig using nine wire supplied with rebar.</p>
<ul style="list-style-type: none"> • Maintenance work 	<ul style="list-style-type: none"> • Lockout/tagout equipment • Block if raised • Hands clear of pinch points 	<p>During maintenance of bridges avoid pinch points. Lockout/tagout of equipment under maintenance or repair helps prevent workers getting their hands/fingers in pinch points.</p> <p>Perform all mechanical work so the mechanic has positive assurance the vehicle or equipment will not move unexpectedly. Frequently, this includes keeping the key in their pocket. Mechanics are killed every year because they were crushed by parts that were raised but not well secured, falling on them.</p> <p>Ask the class to name all the possible pinch points they can think of when doing a concrete pour, then discuss the best means of avoiding them.</p>

Bridge Construction Work

Electrical

There are three main sources for electrical incidents – overhead/underground power lines, lightning, and portable equipment. Electrical impulses in the body can also be interrupted, causing heart/lung and brain function problems. Electrical injuries typically involve burns, often severe. If an electrical arc is involved, burns from molten metal and severe respiratory distress from breathing superheated air are likely. A severe shock or lightning strike can literally incinerate a worker as others look on.

Approximately 17% of construction worker fatalities involve an electrical current.

Injuries resulting from electrical contact include severe burns, unconsciousness, loss of mental and/or physical ability for the remainder of the worker’s life, and frequently a prolonged period of suffering, then death. Death may be immediate.

Electrical current passes from point of contact with a live circuit through the body to an exit point where the body is grounded. An example is a worker who is holding a metal signpost that is touching the ground, and then touches a short-circuited generator that is not grounded. The current would pass from one hand, through the lungs and heart, and out the other hand.

Lightning is an electrical hazard.

<ul style="list-style-type: none"> • 30-30 Rule: <ul style="list-style-type: none"> – 30 seconds between flash and thunder – take cover – 30 minutes after seeing the last flash – resume work 	<ul style="list-style-type: none"> • Do NOT: <ul style="list-style-type: none"> – Be the tallest object – Stand in the open – Stand under a tree – Stand in a gazebo or open shelter – Stand next to or touch metal objects – Stay next to water – Use electrically powered tools – Use a plug-in phone or computer with modem 	<ul style="list-style-type: none"> • Do: <ul style="list-style-type: none"> – Get into an enclosed building – Get into a car, truck, or van
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Specific Exposure Types for Bridgework	Measures to Control Exposures	Instructor Notes
<ul style="list-style-type: none"> • Equipment commonly in use <ul style="list-style-type: none"> – Portable generators – Lightning plants 	<ul style="list-style-type: none"> • Proper grounding • Regular documented inspections • Proper maintenance 	Grounding portable generators, use of GFCIs help prevent electrocution.

Specific Exposure Types for Bridgework	Measures to Control Exposures	Instructor Notes
<ul style="list-style-type: none"> • Overhead power line 	<ul style="list-style-type: none"> • Identify prior to start of work <ul style="list-style-type: none"> – De-energize – Insulate – Flag – Draw warnings on ground • Avoid contact <ul style="list-style-type: none"> – Use spotters – Know adequate distance for conditions • Ground equipment • Constant awareness 	<p>Workers are at risk from electrical shock when a truck or backhoe boom comes in contact with overhead power lines.</p> <p>Mark overhead and underground utilities and remind workers they are there.</p> <p>Far too frequently, equipment will contact a live overhead power line. An electrical charge can jump a gap, creating an arc that energizes the equipment so contact is not even necessary. Such contact can energize the ground with the potential lessening as the distance from the point of contact increases. A bridge worker walking nearby can receive a severe shock from stepping across invisible differences in potential in the ground, as well as from being in physical contact with the energized truck.</p>
<ul style="list-style-type: none"> • Weather-related lightning 	<ul style="list-style-type: none"> • Electronic tracking • Written plan <ul style="list-style-type: none"> – ID circumstance for moving to shelter • Educate workers to minimize exposure 	<p>Lightning is another issue. Lightning can strike 10 miles in front of a storm. 30% of those struck by lightning die, most within an hour. Approximately 74% sustain some sort of permanent disability.</p> <p>Handheld electronic devices that measure the distance to the closest lightning strike can provide ample warning to allow workers to seek safety. Tuning a radio to the AM band allows the static blast of lightning strikes to be heard.</p> <p>Every company with outside work should have a standard lightning policy that superintendents/foremen must know and enforce. That policy should address when to send workers to cover, that the cover does not include trees, metal objects, high, clear ground, etc. and when to return to work. Every project plan should have a section on lightning. Standardizing the process for protecting workers helps eliminate inconsistencies from job to job, even day to day.</p>
<ul style="list-style-type: none"> • Plant/shop operations 	<ul style="list-style-type: none"> • Wiring meets code • Ground prong for extension cords • GFCI use 100% of time • Plug and cord inspections • Employee education 	<p>Grounding all portable electrical equipment and using GFCIs for all portable electrical tools are essential to electrical safety.</p> <p>Discuss ground prongs and how they are important to keeping workers safe.</p> <p>Discuss what to look for in a plug/cord inspection.</p>

Bridge Construction Work

Soft tissue

Bridgework is often heavy and may result in back problems.

Soft tissue injuries – strains and sprains primarily, are the number one injury type in highway/street/road work.

Strains and sprains can have a greater negative impact on workers, their families and the company than any injury short of a fatality. A person who severely injures his or her back may never be able to pick up children or grandchildren.

Reaching out to rake concrete can result in slipped or bulging discs in the back. Shoulder strains may occur from improper posture when shoveling or raking.

A good education program will ensure employees know the ergonomic hazards and can recognize when they or co-workers are at risk. They also have to know how to control the exposure to minimize their risk of injury.

Knowing stretching exercises and other ergonomic controls are supported by the field management team and upper management are important aspects to getting workers to help protect themselves

Specific Exposure Types for Bridgework	Measures to Control Exposures	Instructor Notes
<ul style="list-style-type: none"> • Manual material handling • Placement <ul style="list-style-type: none"> – Overreaching – Equipment access 	<ul style="list-style-type: none"> • Mechanical assistance • Utilize product containers with minimal weight • “NO MORE ON THE FLOOR” – Store materials approximately waist high • Set manual lifting limits • Get help • Change positions frequently • Employee rotation • Stretching <ul style="list-style-type: none"> – Daily – morning – Pre-task • Lift and carry close to the body • PPE <ul style="list-style-type: none"> – Knee pads – Shoulder pads 	<p>Bridgework requires plenty of climbing, lifting, carrying, bending, pushing, and pulling. Setting forms and tool use including shovel, hammer, wrenches, wire tools, etc, all can lead to sore, irritated, or damaged soft tissues.</p> <p>Store rebar and other materials off the ground, preferably approximately waist high. This helps prevent excessive bending by workers. Use mechanical assistance to move heavy loads.</p> <p>Adequate PPE when carrying can include shoulder pads and gloves – even good work boots. Good gloves and boots are especially important when working with hot material.</p> <p>The weight of material and the tools required to work should be considered, along with lifting and twisting required when handling.</p> <p>Placement in bridge work can include bracing, pans, rebar – many items. Understanding how stretching helps construction workers, just like it does athletes. Placement involves a lot of manual material handling.</p>
<ul style="list-style-type: none"> • Acclimatization of employees <ul style="list-style-type: none"> – Heat/cold adjustment 	<ul style="list-style-type: none"> • Layer clothing • Water • Educate for heat- and cold-related medical issues • Stretching is more important • Provide water and shade • Educate workers on proper techniques. 	<p>The hot work environment may compound exposure to soft tissue injuries. Not only is the concrete hot when worked, the ambient temperature is frequently hot as many locations do this work in the summer only.</p> <p>Worker rotation and relief should be planned ahead so no one has to perform the hottest jobs for too long a period. Heat and cold extremes can make soft tissue more susceptible to injury so stretching is more important.</p>



Utility and Drainage Work

Introduction

Approximately 90% of construction worker fatalities and serious injuries involve a fall, being struck by something, being caught in or between things, or electrical hazards.

In addition, soft tissue injuries (STIs), usually seen as strains or sprains, are frequent types of injuries in such work, and are rarely fatal but potentially create a serious impact upon workers and their families. Utility work involves heavy lifting at times and walking on uneven terrain, so strains and sprains are frequent.

Utility work is very hazardous work. Workers on foot (WOF) in close proximity to heavy equipment that is moving or rotating presents definite hazards. Many construction workers are maimed or even killed each year in this process.

Locating existing underground utilities is especially important as this work frequently involves digging. Always use the available locating services. Remember to leave markings in place as long as possible (when dug up). The use of hand digging (potholing) to positively find and observe existing utilities is very important – know the direction and depth before beginning digging with mechanized equipment. Make sure all utilities in the area are positively found.

In utility work, we frequently find workers within feet of vehicles and equipment weighing tons, sometimes traveling at high speed. Virtually all highway work zone activities experience traffic exposures, both public and internal site vehicles, which mandate advance planning to identify and implement the appropriate routing, signage, and hazard control implementation and maintenance programs.

Fractures, contusions, foreign objects in the eye, strains, and sprains are common. Fatalities, usually from being struck by equipment, occur far too often. The responsible crew must have an emergency plan to address challenges resulting from injuries.

As an instructor, you will be educating adults. Adults learn differently than they did when children. If you try to teach based on how you remember your favorite school teacher performing, you are likely to be less effective than you could be. In the interest of improving your ability to train and educate adults, please review the following hints:

Adult Learning Basics:

- Adult learners do best when addressing real-world problems they face in their life.
- Set the stage so attendees understand why this training is important to them in terms of their lifestyle, and their families, as well as their employment.
- Set parameters up front – breaks, question/answer, etc.
- Adults learn best from experience, not note taking. If you cannot get them in the field, discuss operations they perform – use pictures whenever possible.
- Adult learners do best when involved – ask questions, try to get everyone to say something.
- Ask the question, give the group a few seconds to think about it, and then call on someone to say what they think.
- Ask several to answer, then play off their answers in addressing the topic.
- Ask questions before (to discover what they already know), during (for involvement and repetition to improve learning), and then after (to see what they learned) the session.
- Structure the session loosely to allow for spontaneity – a good learning tool.
- You, the educator, have to believe in the material before you can make others believe in it.
- Always remember you, the educator, are in charge of the group. Maintain looseness but control, don't let discussions wander aimlessly, keep on topic, meet your promised goals.

Recommended support materials:

- <http://www.workzonesafety.org/>
- <http://www.cdc.gov/niosh/topics/highwayworkzones/>
- AGC # Soft Tissue Injury Prevention package
Fall Protection training package

Specific Exposure Types for Utility Work	Measures to Control Exposures	Instructor Notes
<p>This column will contain information about specific hazards or exposures that can help create the chain of events leading to accident and injury.</p>	<p>This column will contain information about specific means to help reduce the risk of accident or injury if implemented.</p>	<p>This column will contain notes to help provide ideas to the instructor.</p>
<p>Utility work shares some hazards with other forms of street/road/highway work. These include exposure to moving traffic, exposure to environmental conditions, and heavy work involving lifting, pushing, and pulling. Falls from equipment, working in close proximity to backing equipment and slips, trips, and falls are common injury causes.</p> <p>This work frequently requires traffic control. Remember, some 91% of highway worker deaths in work zones are from being struck by a vehicle or equipment. A great many of those involve dump trucks, mostly while backing.</p>	<p>Control methods are means employed to lessen the risk of accident or injury. Control methods are rarely 100% effective but history has proven that workers can follow procedures and significantly reduce the chance they, or coworkers, will be involved in an accident or sustain an injury.</p> <p>Controls should be implemented in this order:</p> <ol style="list-style-type: none"> 1. Engineering 2. Administrative 3. Personal Protective Equipment (PPE) 	<p>Welcome your class and try to put them at ease. Tell them how you are going to discuss the work they do and how to do it without injury.</p> <p>One good method to put crews at ease is to ask each one how long they have been doing this type of work. Keep track of the years experience for each and when everyone has provided their input, total the years. This is usually a high number and showing the individuals how much experience they share in total helps them approach the training with some confidence.</p> <p>As the educator, make sure you know the scope of the work they usually perform and tailor your discussion to meet those needs. For instance, do they perform tasks that occur within an existing work zone or are they outside any structured work zone? Do they work primarily during daylight hours or at night? Do they perform dump truck or pan scraper work primarily?</p>

Utility and Drainage Work Basics – Apply to all Utility Work

Planning

Planning and communicating the plan is perhaps the single most critical item. Well-planned projects tend to work accident and injury free. These projects have the right mix of workforce, tools, equipment, and materials on hand at all times. They follow a critical path process and all personnel/companies associated with the critical path understand the relevance of what they do. The plan is communicated to all workers on a daily basis so each knows and understands his or her part – what they need to accomplish safely that will aid in the overall success of the project. Well planned and executed projects tend to finish on budget and within schedule because actions are accomplished at the right time, by the right people, in the right manner. There are few if any accidents to slow progress.

Poorly planned projects tend to have accidents and injuries because workers do not have the right tools, equipment, and materials, so they try to “adapt.” These adaptations and the resulting engineering problems, accidents, and injuries tend to put the project behind schedule and beyond budget.

Specific Exposure Types for Utility Work	Measures to Control Exposures	Instructor Notes
<ul style="list-style-type: none"> • Pre-Planning <ul style="list-style-type: none"> – At estimation phase – Pre-job – Pre-task <ul style="list-style-type: none"> • Personal 	<ul style="list-style-type: none"> • Identify known hazards • Identify needed skills • Identify special risks • Written • Comprehensive • Forms foundation of project • State Standard DOT Plans • Verbal • Start of shift • Start of new group task • Before each action <ul style="list-style-type: none"> – Two-second look ahead 	<p>Planning is always the basis for success.</p> <p>Pre-planning begins when the bid is assembled. At that point, major risk control issues should be identified. This should include the need for MOT, or any special skills the workers might need that require specialized training, such as Work Zone Awareness or Confined Space Entrant. Identify what pieces of equipment will be required and how many operators are needed for each. Do your workers have the proper certifications and authorizations for the equipment?</p> <p>Like doing a material take-off, the estimate should be reviewed and identified safety issues placed on paper.</p> <p>Every worker’s education should include the idea that they ask themselves, “How can I do this without injury or accident?” before starting any task. Learning to trust their own answers will help prevent accidents and injuries to themselves.</p> <p>This program does not address NFPA 70E requirements in full. If workers are exposed to electrical arcs, those requirements must be reviewed and implemented, including the training requirements.</p>
<ul style="list-style-type: none"> • Communicating the Plan 	<ul style="list-style-type: none"> • Unified Incident Plan • Start of assignment to project orientation • Crew morning meetings • Pre-task meetings 	<p>Take every opportunity to inform workers of the safety planned into the project. For a successful project to occur, they must believe they can provide suggestions to improve safety without fear of being belittled or worse. Minute-by-minute safety is everyone’s responsibility on every job.</p> <p>The “Hats of Highway Incident Management” video is available from the TRAA – Towing and Recovery Association of America. It provides some good footage to show how many different people and organizations can lay claim to being in charge in an emergency response.</p>

Educating

Education of our workforce provides them the understanding necessary to accomplish their work in the safest, most efficient, productive manner possible. Training, the art of teaching performance of specific work processes, plays a very important part in educating our workforce. Training is the “who and how to” portion of education but is not the sole need. Basic education, the understanding of “what, when, and why,” serves an important place in developing a top-performing team. Education regarding the project should begin at the orientation and continue through daily briefings where the plan is communicated.

Specific Exposure Types for Utility Work	Measures to Control Exposures	Instructor Notes
Lack of knowledge regarding how to perform tasks safely and efficiently	<ul style="list-style-type: none"> • Constant vigilance • Specific task • Job skills • Safety • HAZMAT 	<p>Educating workers to recognize the hazards; understand the potential impact on themselves, their co-workers, families, and friends; know the proper control methods and empowerment to raise questions and make suggestions.</p> <p>Workers must be trained to at least a minimum nationally recognized standard for work near moving traffic. States may have specific requirements – check your state DOT and other regulatory agencies.</p> <p>Training must include a prohibition against turning your back to oncoming traffic and walking in blind spots. Also address selection of personal emergency escape paths, and procedures for dealing with unexpected events.</p>

Environmental Exposures

Specific Exposure Types for Utility Work	Measures to Control Exposures	Instructor Notes
<ul style="list-style-type: none"> • Temperature extremes <ul style="list-style-type: none"> – Standing on hot concrete – Standing on hot asphalt – Work stationary in summer sun – Work in winter cold 	<ul style="list-style-type: none"> • Good protective footwear • Worker rotation and relief planned • Provide large umbrella on stand • Dress in layers • Provision for worker sanitation and hydration 	<p>Ask “What are the worst weather conditions you have ever worked in?”</p> <p>This is a good question because it is usually pretty easy to play off the answers. You can follow up by asking “How did you dress?” and similar questions to bring out the controls.</p>
<ul style="list-style-type: none"> • Precipitation 	<ul style="list-style-type: none"> • Protection from inclement weather <ul style="list-style-type: none"> – Shelter – Rain slicker 	<p>One thing that probably everyone working this type of work has in common is they have worked in the rain. You can ask anyone who has to hold up their hand – this helps provide a sense of commonality and a “we are all in this together” feeling.</p>
<ul style="list-style-type: none"> • Lightning 	<ul style="list-style-type: none"> • Maintain a lightning detector in the superintendent’s care. • Monitor and move workers to shelter when lightning reaches a predefined distance. 	<p>Examples of people struck by lightning are easy to find to support this topic.</p> <p>Note that many children’s ball parks now have detectors and games are stopped when lightning is nearby.</p> <p>Having a plan for accomplishing worker protection when lightning is in the area removes the indecision and inconsistency of individual calls.</p>

Specific Exposure Types for Utility Work	Measures to Control Exposures	Instructor Notes
<ul style="list-style-type: none"> • High-visibility clothing 	<ul style="list-style-type: none"> • Increases visibility of WOF <ul style="list-style-type: none"> – To public drivers who drive past – Equipment operators – Vehicles within the construction areas 	<p>“See and Be Seen” starts here. It is very important that highway worker training very strongly emphasize one of the most valuable characteristics of effective flag persons: that of acquiring mutual visual eye contact with approaching drivers and BOLDLY commanding/communicating the desired travel path or action for drivers.</p> <p>High-visibility clothing appropriate for all work zone environments</p> <p>Classifications of High-visibility clothing:</p> <ul style="list-style-type: none"> • Class 1: <ul style="list-style-type: none"> – For workers who have ample separation from traffic – Traffic speeds not to exceed 25 mph – Delivery vehicle drivers, parking lot attendants, warehouse workers • Class 2: <ul style="list-style-type: none"> – For workers who need visibility in inclement weather conditions – Traffic speeds between 25–50 mph – Targeted at law enforcement conducting traffic control, tollgate personnel, airport ground crews, etc. • Class 3: <ul style="list-style-type: none"> – Highest level of visibility – Wide range of weather conditions – Traffic speed exceeds 50 mph – Targeted at road construction, utility workers, survey crews, etc.

Utility and Drainage Work

Falls

Falls in utility work are likely from equipment or a slip, trip, or fall working on level ground around the equipment. Workers can fall into excavations as well.

Falls from equipment may result in severe contusions and broken bone injuries, even fatalities.

Slips and trips may result in abrasions, contusions, fractures, and even fatalities.

A person who is falling is control and the extent of the injuries resulting from the fall depend on the distance of the fall, the angle of the body when they it lands, and anything it may strike during the fall or landing. A same-level trip or slip fall can result in a fatality if the person strikes their head wrong.

Utility workers can fall from elevated bucket trucks, poles, and/or tower structures.

Specific Exposure Types for Utility Work	Measures to Control Exposures	Instructor Notes
<ul style="list-style-type: none"> • General <ul style="list-style-type: none"> – Uneven terrain, sharp changes in elevations, open excavations, slick and muddy surfaces, and heavy equipment mounting/dismounting all contribute to fall injury exposures, warranting constant employee awareness 	<ul style="list-style-type: none"> • Safety First Attitude • Ongoing Employee Education • Teamwork 	<p>Advance planning, incorporating careful analysis of not only the anticipated physical hazards but also personnel orientation and training.</p> <p>WOF must be educated to recognize the hazard of being around and behind moving vehicles and taught methods they can employ to avoid being injured. In these type of operations, vehicle/equipment movement is much more frequent and therefore a bigger hazard to workers.</p> <p>A good exercise is to ask attendees what they do and involve everyone in discussion.</p>
<ul style="list-style-type: none"> • Elevated Work <ul style="list-style-type: none"> – Ramps – Buckets – Poles or Towers – From equipment – Pick-up Trucks – Unguarded Elevated Surfaces – Wet/Slick Environment 	<ul style="list-style-type: none"> • Maintain Awareness • Proper Lighting • Ensure truck steps in place and in good condition • Ensure handrails on trucks are adequately maintained • Steps are non-skid • Proper PPE • Positive Protective Device • Personal fall protection if elevated stationing required 	<p>Point out that a fall from a pickup bed is a fall from elevation. The practice of riding pickup beds unprotected should be controlled, even with slow moving vehicles.</p>
<ul style="list-style-type: none"> • Same Level <ul style="list-style-type: none"> – Slips/Trips – Sawing – Shoveling – Slip/trip while avoiding incoming vehicle 	<ul style="list-style-type: none"> • Exceptional housekeeping • Worker awareness/positioning • Inspect jobsite during the day 	<p>Proper work boots and work areas free of material, debris, etc. for workers are important.</p> <p>Workers must maintain constant awareness of their surroundings and always know where they can run or jump to get out of the way.</p>

Specific Exposure Types for Utility Work	Measures to Control Exposures	Instructor Notes
<ul style="list-style-type: none"> Falls into Open Excavations 	<ul style="list-style-type: none"> Warning/Barricades by open excavation 	Equipment operators and vehicle drivers may not be able to see an excavation until it is too late to stop. Everyone on the job associated with trenching, excavation, equipment operation, or driving should know and understand the project rules on ensuring such openings are marked or barricaded.

Utility and Drainage Work

Struck by

Struck-by injuries, especially when struck by backing equipment and specifically dump trucks, is one of if not the leading cause of highway worker fatalities. As utility work may involve a large number of dump trucks, it is critical that as an instructor you put special emphasis on this topic.

Approximately 22% of all construction worker fatalities involve being struck by something.

For 1992 – 2000 worker deaths in work zones, 91% of 910 worker deaths involved vehicles, most being dump trucks.

NIOSH records indicate that in 2005, 390 workers were killed in struck-by incidents, accounting for 7% of all occupational fatalities.

Injuries range from contusions, lacerations, and STIs to fractures, crushing, and fatalities.

Backing is less than 1% of fleet mileage but accounts for approximately 30% of all accidents.

Current estimations are that approximately one half of the workers killed in highway work zones are killed by construction vehicles. These accidents usually involve crushing injuries and fatalities.

Specific Exposure Types for Utility Work	Measures to Control Exposures	Instructor Notes
<ul style="list-style-type: none"> Work zone Intrusions <ul style="list-style-type: none"> Reduced visibility Impaired Drivers Inattention Limited Physical Barriers Lack of knowledge/experience Working behind non positive barriers 	<ul style="list-style-type: none"> Practice "See & Be Seen" Personal flashing lights Worker awareness/positioning Housekeeping Mud/slick surface control Use of boots with slip-resistant soles Constant vigilance Constantly refreshed escape plan Position arrow-board truck properly 	<p>Workers positioned at the critical point where oncoming traffic is approaching the work zone should be aware of the hazards of vehicle intrusion and worker abuse. A warning sounded by them can provide the few seconds critical to avoiding fatalities.</p> <p>Workers near the edge of work zones should never turn their back to oncoming traffic. Ask if anyone has worked a job where a worker was struck by a vehicle and if so, discuss events immediately before, during and after the incident.</p> <p>Clearance between equipment and moving traffic is frequently measured in inches, not feet. Constant awareness of personal location in relation to work zone boundaries is critical.</p>

Specific Exposure Types for Utility Work	Measures to Control Exposures	Instructor Notes
<ul style="list-style-type: none"> • Equipment and construction vehicle traffic within work zone <ul style="list-style-type: none"> – Equipment/employee moves into oncoming traffic – Loading and unloading of equipment – Blind Spots – Glare – Complacency – Worker visibility reduced due to poor ambient lighting 	<ul style="list-style-type: none"> • Pre-established and known traffic flow plan • Maintain Awareness by all • Safety First Attitude • Proper Worker Position • Back-up Alarms/Spotters/Back-up Cameras • Ongoing worker education • Proper Lighting • Vehicle/Equipment Inspection • Teamwork • Stage vehicles so if hit, vehicle will turn into barrier wall 	<p>An unfortunate but classic highway worker fatality that happens far too often occurs when a worker stands in a (not “the,” as there are several for every piece of equipment) blind spot where the operator can not see them. The equipment moves, usually backing, the worker is looking away and does not see and it is noisy so they do not hear but they certainly feel it as it runs them down.</p> <p>Hardhats and vests with personal flashing lighting are now available to help make workers at the edges of the work zone more visible.</p> <p>Caterpillar, Inc. has developed blind area diagrams for all of their vehicles and equipment to help the operators and WOF determine areas to avoid when working around this equipment.</p> <p>Proximity Warning Devices are being designed that notify the drivers of company vehicles such as dump trucks the location of not only flag persons but also other WOFs who are used in the unloading and material placement process.</p> <p>Point out that WOFs may become desensitized to the sound of back-up alarms over time. Even though the back up alarm may operate, it may not register with the WOF because they hear it so often.</p>
<ul style="list-style-type: none"> • Working near rotating/ moving equipment <ul style="list-style-type: none"> – Falling poles or structures – Buckets and/or arms of excavation equipment – Steel road plates being swung overhead. – Falling chains. – Outrigger pads. 	<ul style="list-style-type: none"> • Adequate lighting to insure visibility of workers • Constant vigilance • Layout of work area • Planned foot traffic flow • Adequate back-up alarms • Proximity Warning Devices • Personal flashing lights on workers’ PPE • Safety latches on chain clasps 	<p>“SEE and BE SEEN” a responsibility of each and every individual on a highway work zone site! Sufficiently important as to be continuously emphasized by supervision to ensure the vital importance in the minds of all workers and visitors on such locations.</p> <p>A common incident is for a backhoe to rotate and strike a worker who has just walked into the swing radius unknowingly.</p> <p>When working around moving equipment such as backhoes, ensure workers’ position is such that they can not be struck by the equipment.</p>
<ul style="list-style-type: none"> • Debris <ul style="list-style-type: none"> – Thrown – Blown by wind – Falling off passing vehicle – Equipment contact with power lines 	<ul style="list-style-type: none"> • Adequate PPE – eyes, face, and head • Watch approaching vehicles for visible motion inside – arm moving, etc. • Keep debris away from work zone • Observe approaching vehicles, especially pickups, for loose articles • Strong, enforced crane program • Controlled access zones • ID and mark overhead power lines • Use of spotters 	<p>Passersby, especially those young and/or drunk, may throw cans, bottles, etc. at workers, mostly flag persons. Always face moving traffic and be aware of the potential for flying debris.</p> <p>Powerline contact can create falling parts, loads and debris in addition to the electrical hazard. Avoiding the contact is the best control. Avoiding the area near and under suspended loads is also important.</p>

Specific Exposure Types for Utility Work	Measures to Control Exposures	Instructor Notes
<ul style="list-style-type: none"> • Traffic control may fail due to: <ul style="list-style-type: none"> – Driver inattention – Impairment <ul style="list-style-type: none"> • Mental • Physical – Environmental conditions – Lack of coordination of workers from multiple companies – Public vehicle accidents within the work zone 	<ul style="list-style-type: none"> • Cell phones • Crying kids • Working while driving • People drink, smoke pot, do other drugs, then drive • Handicapped • Aged • Infirm • Geographical <ul style="list-style-type: none"> – Curves – Hills • Exposure to injury from traffic, both internal and external • Unified Incident Command • Safety plan inclusion • Education 	<p>Wherever possible, traffic control measures for short-term work should include means to positively prevent unplanned intrusions into the work area. Means and methods that include impact attenuators or barriers (Jersey Barriers, K-Rail, etc) are preferred beyond simple channelizing methods (cones, barrels, etc). Ongoing documented inspections of emplaced traffic control should be implemented, and needed corrections made in a timely manner.</p> <p>Station MOT so it will be visible. Signs placed near trees in the winter may be hidden by spring growth of leaves.</p> <p>Curves and hills can hide what is just ahead – if that is a short-term job with a few cones or a flagger station, a serious accident could occur.</p> <p>ALL workers, subcontractors, and haulage employees that will enter the work zone at a minimum, should receive a basic orientation to that site, to include at least internal construction traffic flow, means of entering and exiting the work area, emergency escape path designations, required PPE, and emergency signals for vehicle intrusions into the work area.</p> <p>Preplanning and training of workers should address Unified Incident Command at accident sites (who is in charge) as well as measures to protect workers during an incident. Topics should address the increased hazards of traffic, fire, and HAZMAT resulting from an accident (fuel, cargo, debris, and biohazards) that may result.</p> <p>Clearance between equipment and moving traffic is frequently measured in inches, not feet. Constant awareness of personal location in relation to work zone boundaries is critical.</p>
<ul style="list-style-type: none"> • Falling materials <ul style="list-style-type: none"> – Unsecured tools and materials – Falling loads 	<ul style="list-style-type: none"> • General contractor establish overhead clear zone • Avoid working under booms and suspended loads • Awareness of large sections chipping off 	<p>This type work frequently involves elevated work – from slopes on the side of cuts to bridges. Workers below are exposed to anything that falls from above – from a hammer to a bulldozer.</p> <p>Ask the class about the most unusual falling object they have experienced.</p>
<ul style="list-style-type: none"> • Airborne particles from chipping, grinding, etc. 	<ul style="list-style-type: none"> • Employee positioning • Goggles, gloves, and protective clothing to prevent unexpected contact 	<p>Rock breaking with jack hammers, grinding, chopping concrete – many work activities can generate airborne particles. Nearby workers are at risk of contusions and penetrating injuries. Eyes seem to be a magnet for airborne debris.</p>

Utility and Drainage Work

Caught in / between

Approximately 18% of construction worker fatalities involve being caught in or between objects.

Such injuries often involve a section of the body being crushed. Fatalities can be instantaneous, or occasionally the pinned person may be alert but will die in a short period of time.

There have been documented cases where pinned workers, loved ones were rushed to the site to say good-bye before the worker died.

Amputations are also a frequent result of such accidents. Fingers are most frequently affected, but workers lose arms and legs as well at times.

Truck drivers have been caught in the vehicle driveshaft or in turning gears, workers have been caught between the backing truck and the paver hopper, and mechanics have been caught between the bed and truck frame when a bed fell. Intrusion of public vehicles into the work zone may result in workers being caught between that vehicle and stationary objects.

Caught in/between injuries are rarely minor. Injury types frequently seen include:

- Lacerations
- Amputations
- Crushing
- Fractures
- Burns
- Contusions
- Fatality

Ask the class to name all the possible pinch points they can think of when doing a job then discuss the best means of avoiding them.

Specific Exposure Types for Utility Work	Measures to Control Exposures	Instructor Notes
<ul style="list-style-type: none"> • Equipment operation 	<ul style="list-style-type: none"> • Ongoing worker education 	<p>Workers may be crushed between backing equipment or vehicles and other equipment.</p> <p>Working adjacent to concrete barriers and around live traffic creates opportunities for pinch points. An Internal Traffic Control Plan is critical to the safety of WOF. Ensure that whenever possible trucks and equipment does as little as possible backing up within the work areas.</p>
<ul style="list-style-type: none"> • Unloading materials <ul style="list-style-type: none"> – Shifting loads – Suspended loads and fixed surfaces (example: suspended pile penning worker in trench) – Outrigger poles landing on workers feet • Loading/unloading of equipment to trailers 	<ul style="list-style-type: none"> • Compliance audits/correction • Train to expect/cooperate • Hands clear of pinch points 	<p>Material and equipment used in this work is heavy. Injuries occur when workers are pinned by moving loads.</p> <p>Ask the group if they have worked a job where someone was pinned between objects while moving equipment or material. Someone likely has – use the answers to address the hazards and controls.</p>

Specific Exposure Types for Utility Work	Measures to Control Exposures	Instructor Notes
<ul style="list-style-type: none"> • Equipment maintenance 	<ul style="list-style-type: none"> • Proper guarding of rotating equipment • Lockout/tagout equipment • Block if raised • Proper equipment labeling • PPE for sawing/impact work 	<p>During maintenance of truck mechanisms, avoid pinch points.</p> <p>All mechanical work must be performed so the mechanic has positive assurance the vehicle or equipment will not move unexpectedly. Frequently this includes keeping the key in their pocket. Mechanics are killed every year because they were crushed by parts that were raised, but not well secured, falling on them.</p>
<ul style="list-style-type: none"> • Moving/rotating equipment parts <ul style="list-style-type: none"> – Backhoe work 	<ul style="list-style-type: none"> • Proper guarding • Employee positioning clear of pinch points • Operator awareness and due care • Position to stay clear • PPE 	<p>Provide examples – for example, a backhoe operator set the bucket down on a worker’s foot, crushing it between the bucket and asphalt road surface. Try to use something that has happened within the company that they will associate with. Ask the class what could be done to prevent such accidents – let them develop a list of controls. This could be a good class exercise if time permits.</p> <p>Make the point that hardhats and steel-toed boots are no match for a backhoe bucket, loader bucket, etc. The equipment always wins.</p>
<ul style="list-style-type: none"> • Complacency, Inattention <ul style="list-style-type: none"> – Electronic (cell phone, radio) – Improper communication 	<ul style="list-style-type: none"> • Education • Teamwork 	<p>Ask the class what they find takes their mind off the job at hand. Discuss how dangerous this type of work area is. Point out that accidents frequently happen when workers let their guard down.</p>
<ul style="list-style-type: none"> • Vehicular traffic in work zone <ul style="list-style-type: none"> – Backing vehicle 	<ul style="list-style-type: none"> • Internal Traffic Control Plan • Worker positioning • Minimize backing • Rear-view cameras • Back-up alarms • “No see” chart training • “See and Be Seen” 	<p>An Internal Traffic Control Plan is critical to the safety of WOF.</p> <p>Back-up alarms and/or signalmen to aid backing trucks or equipment are also essential safety elements.</p> <p>Backing vehicles pinning workers between the rear bumper of the vehicle they are driving and another object such as a pole, piece of equipment, etc. happens far too often. Sometimes the equipment is moving and traps the WOF between the equipment and a stationary object. Back-up alarms help and are required by law but are not the only answer. Unfortunately, construction workers become accustomed to hearing them and mentally block the sound. Workers may have impaired hearing.</p> <p>Companies that make equipment frequently found in work zones are beginning to develop and make available charts for equipment that shows the blind spots the operator has. Employee education in blind-spot recognition makes good weekly safety meetings and helps prevent accidents. Check with your equipment manufacturer of to see if they offer a blind-spot chart.</p>
<ul style="list-style-type: none"> • Vehicular traffic <ul style="list-style-type: none"> – Intruding vehicle 	<ul style="list-style-type: none"> • Guarding <ul style="list-style-type: none"> – Arrow-board truck • Position to stay clear • Constant vigilance 	<p>“SEE and BE SEEN”</p> <p>MOT barriers, properly rated high-visibility clothing, etc. are all important in avoiding accidents.</p> <p>A pre-planned escape route is a very important element in setting up traffic control work.</p>

Specific Exposure Types for Utility Work	Measures to Control Exposures	Instructor Notes
<ul style="list-style-type: none"> • Trench Collapse <ul style="list-style-type: none"> – Vibration of heavy equipment – Improper sloping – Spoils pile 	<ul style="list-style-type: none"> • Written trench/excavation program • Use of sloping, shoring, or trench boxes • Competent person identified • Competent person inspections • Education and training • Spoil pile minimum of two feet away from edge 	Excavations, commonly encountered utility work exposures, warrant careful planning to ensure adherence to proper soil determinations and sloping or shoring necessary to ensure collapse avoidance and attention to all aspects of worker protection prior to entry into excavations.

Utility and Drainage Work

Electrical

Approximately 17% of construction worker fatalities involve an electrical current.

Injuries resulting from electrical contact include severe burns, unconsciousness, loss of mental and/or physical ability for the remainder of the worker's life, and frequently a prolonged period of suffering, then death. Death may be immediate.

Electrical current passes from point of contact with a live circuit through the body to an exit point where the body is grounded. An example is a worker who is holding a metal signpost, and who then touches a short-circuited generator that is not grounded. The current would pass from one hand, through the lungs and heart, and out the other hand.

If an electrical arc is involved, burns from molten metal and severe respiratory distress from breathing superheated air are likely. Remember the requirements of NFPA 70E must be implemented, including the training portion, if electrical arc exposure is part of the task being performed.

A severe shock or lightning strike can burn a worker to death as other workers look on. This can create a post-traumatic stress type injury to survivors.

Specific Exposure Types for Utility Work	Measures to Control Exposures	Instructor Notes
<ul style="list-style-type: none"> • Electrical equipment <ul style="list-style-type: none"> – Portable generators – Lighting plants <ul style="list-style-type: none"> • Improper grounding • Poorly maintained equipment 	<ul style="list-style-type: none"> • Inspect/maintain equipment • GFCI • Maintain Awareness • Proper PPE • Use nonconductive tools • Perform lockout/tagout • Proper grounding • Electronic tracking • Electrical wiring meets code • Ground prong for extension cords 	Grounding all portable electrical equipment and using GFCIs is essential to electrical safety.

Specific Exposure Types for Utility Work	Measures to Control Exposures	Instructor Notes
<ul style="list-style-type: none"> • Electrical utility strike • Unmarked • Cutting underground • Contacting overhead power line 	<ul style="list-style-type: none"> • Avoid contact • Identify <ul style="list-style-type: none"> – One Call – Potholing • Maintain Awareness • Mark locations on ground • Maintain 20 foot clearance between conductive equipment/ materials and overhead powerlines. 	<p>Workers are at risk from electrical shock when a truck or backhoe boom comes in contact with overhead power lines.</p> <p>Preoperational determination regarding overhead power lines, their possible challenges to maintenance of a minimum ten-foot clearance by all personnel, equipment and materials stored.</p> <p>Far too frequently, equipment will contact a live overhead power line. An electrical charge can jump a gap, creating an arc that energizes the equipment so contact is not even necessary. Such contact can energize the ground with the potential lessening as the distance from the point of contact increases. A ground worker walking nearby can receive a severe shock from stepping across invisible differences in potential in the ground as well as from being in physical contact with the energized equipment.</p> <p>Pending regulatory programs anticipate making the clearance between equipment and power lines 20 feet rather than the current 10 feet. Implementing that practice now will help put your workers and company ahead of the curve.</p>
<ul style="list-style-type: none"> • Equipment/tool operations <ul style="list-style-type: none"> – Taking short cuts – Using improper equipment for the job 	<ul style="list-style-type: none"> • Minimize exposure – maintain distance • Identify surface encumbrance. • GFCI use 100% of time • Ongoing employee education • Use correct tool for the job 	<p>Using GFCIs for all portable electrical tools is essential to electrical safety. Be prepared to discuss how a GFCI works and what it does. You will probably find many workers do not understand GFCIs.</p>
<ul style="list-style-type: none"> • Weather related lightning 	<ul style="list-style-type: none"> • 30-30 Rule: <ul style="list-style-type: none"> – 30 seconds between flash and thunder – take cover – 30 minutes after seeing the last flash – resume work • Do NOT: <ul style="list-style-type: none"> – Be the tallest object – Stand in the open – Stand under a tree – Stand in a gazebo or open shelter – Stand next to or touch metal objects – Stay next to water – Use electrically powered tools – Use a plug-in phone or computer with modem • Do: <ul style="list-style-type: none"> – Get into an enclosed building – Get into a car, truck, or van 	<p>Lightning strikes also pose a significant hazard.</p> <p>Be alert to approaching lightning storms and be prepared to alert all personnel when avoidance measures must be undertaken.</p> <p>Lightning is another issue. Lightning can strike 10 miles in front of a storm. 30% of those struck by lightning die, most within an hour. Approximately 74% sustain some sort of permanent disability.</p> <p>Handheld electronic devices that measure the distance to the closest lightning strike can provide ample warning to allow workers to seek safety.</p> <p>Tuning a radio to the AM band allows the static blast of lightning strikes to be heard.</p> <p>Every company with outside work should have a standard lightning policy that superintendents/foremen know and enforce. That policy should address when to send workers to cover, that the cover does not include trees, metal objects, high, clear ground, etc. and when to return to work.</p> <p>Every project plan should have a section on lightning. Standardizing the process for protecting workers helps eliminate inconsistencies from job to job, even day to day.</p>

Specific Exposure Types for Utility Work	Measures to Control Exposures	Instructor Notes
<ul style="list-style-type: none"> • Lighting Circuits <ul style="list-style-type: none"> – Temporary – Existing 	<ul style="list-style-type: none"> • Understand hot work and lockout/tagout requirements 	<p>Temporary lighting circuits are occasionally used in this work but the most frequent source is light plants. Follow manufacturer instructions for grounding and maintenance.</p> <p>Bridges and related structures may have existing lighting circuits in unexpected places. Ask the class about any unusual electrical exposures they have seen.</p>

Utility and Drainage Work

Soft tissue

Utility work requires moving heavy parts, pick and shovel work where equipment cannot reach, walking on uneven ground, and many other ways to strain or sprain shoulders, elbows, knees and ankles. Jumping off equipment and landing in uneven dirt damages, even destroys many operators' knees and ankles every year

Soft tissue injuries – strains and sprains primarily – are the number-one injury type in highway/street/road work.

Strains and sprains can have a greater negative impact on workers, their families, and the company than any injury short of a fatality. A person who severely injures his or her back may never be able to pick up children or grandchildren.

Utility workers are at high risk because the focus of such work is speed – the necessity to achieve an established goal within a specified time frame. This can cause rushing and shortcuts. Those invariably lead to sprain and strain injuries.

Strains and sprains to ankles and knees occur frequently from walking on uneven ground and operators jumping off equipment. Shoulder and elbow strains/sprains are also likely in hand work. Back injuries also are associated with Utility work.

Specific Exposure Types for Utility Work	Measures to Control Exposures	Instructor Notes
<ul style="list-style-type: none"> • Moving heavy pipe and valves • Pick and shovel work 	<ul style="list-style-type: none"> • Employee rotation • Motorized equipment when possible • Get help 	<p>Emphasize with students planning mechanical means to transport pieces of pipe and heavy valves into excavations.</p> <p>Discuss alternative methods of potholing for existing utilities rather than pick and shovel, such as vacuum and water jet systems.</p>
<ul style="list-style-type: none"> • Acclimatization of employees <ul style="list-style-type: none"> – Heat/cold adjustment 	<ul style="list-style-type: none"> • Layer clothing • Provide water and shade • Educate for heat- and cold- related medical issues • Stretch more important 	<p>Discuss drinking water before getting thirsty to stay hydrated.</p>
<ul style="list-style-type: none"> • Material handling <ul style="list-style-type: none"> – Lifting/moving heavy equipment – Using improper lifting techniques – Failure to ask for help – Improper dismount of trailers, pickups, equipment 	<ul style="list-style-type: none"> • “NO MORE ON THE FLOOR” – Store materials approximately waist high • Utilize product bags with minimal weight • Lift and carry close to the body • PPE 	

Specific Exposure Types for Utility Work	Measures to Control Exposures	Instructor Notes
<ul style="list-style-type: none"> • Work activities <ul style="list-style-type: none"> – Reaching – Carrying – Pushing – Pulling – Digging – Sawing – Repetitive motion – Overexertion – Poor posture <ul style="list-style-type: none"> • Forced repetition/posture • Poor housekeeping • Placement of MOT <ul style="list-style-type: none"> – Repetitive motion – Lifting/carrying 	<ul style="list-style-type: none"> • Stretch program • Use of powered equipment • Get help • Rotate workers • Change positions frequently • Educate workers on proper techniques • Use of powered trowel • Use of two trowels, one for support • Knee pads • Ongoing employee education • Using proper lifting techniques • Three-point mount/dismount of trailers, equipment and pickups • Consistently good housekeeping • Taking breaks • Follow written procedures • OSWPS – Operators Stand When Possible and Stretch 	<p>Maintain access ladders and footwear as clear of mud and similar slippery surfaces as possible, resisting the urge to jump off equipment</p> <p>Get help when heavy or awkward lifting is encountered</p> <p>Adhere to proper lifting techniques, back straight, avoid twisting</p> <p>Use gloves to minimize hand and finger injury potential</p> <p>Dirt moving operations are physically demanding. Operators face hours of sitting in one seat, often with whole body vibrations that shake them constantly</p> <p>Worker rotation and relief should be planned ahead so no one has to perform the hottest jobs for too long a period. Heat and cold extremes can make soft tissue more susceptible to injury so stretching is more important</p> <p>Adequate PPE when carrying can include shoulder pads and gloves – even good work boots. Good gloves and boots are especially important to working concrete and asphalt, handling wood, etc.</p> <p>The weight of the tools should be considered, along with lifting and twisting required when handling.</p> <p>Understanding how stretching helps construction workers, just like it does athletes.</p> <p>A good education program will ensure employees know the ergonomic hazards and can recognize when they or co-workers are at risk. They also have to know how to control the exposure to minimize their risk of injury.</p> <p>Knowing stretching exercises and other ergonomic controls are supported by the field management team and upper management are important aspects to getting workers to help protect themselves.</p>



Demolition Operations

Introduction

Demolition – From Wikipedia, the free encyclopedia

“Demolition is the opposite of construction: the tearing-down of buildings and other structures. It contrasts with deconstruction, which is the taking down of a building while carefully preserving valuable elements for re-use.”

For the purpose of this program, demolition and deconstruction are considered interchangeable. The exposures and controls for both are very similar.

Approximately 90% of construction worker fatalities and serious injuries involve a fall, struck by, caught in or between or electrical shock.

In addition soft tissue injuries (STIs), usually seen as strains or sprains, are one of the most frequent injury types in this work. STIs are rarely fatal but can and do have a serious impact on the workers’ and families’ quality of life. Demolition Operations work involves heavy lifting at times and walking on uneven terrain, so strains and sprains are frequent.

In 2005, the National Highway Transportation Safety Administration reported:

- 4,315 motorcyclists died
- Alcohol related fatalities rose to 16,972
- Pedestrian deaths increased to 4,674
- Large truck crash fatalities rose to 5,226
- Motor vehicle transportation remains the number-one killer of people on the job¹²

All of these things can and do happen in work zones. Accident rates are the highest for the fastest and slowest 5% of traffic.¹³ In work zones where some slow as required and some do not, the difference in speed may be more pronounced. 88% of large truck crashes¹⁴ and nearly 80% of automobile crashes¹⁵ are considered related to driver behavior:

- Human error
- Inattention
- At-risk behavior

Demolition Operations may be hazardous work. In addition to vehicle crashes, the situation may be a broken gas line, downed power line or some completely unexpected accident in the work zone. This work frequently requires traffic control. Some 91% of highway worker deaths in work zones are from being struck by a vehicle or equipment. A great many of those involve dump trucks, mostly while backing. Traffic lanes may be compressed and there is a high exposure from construction traffic entering and exiting the work zone.

In Demolition Operations work, we frequently find workers within feet of moving vehicles sometimes traveling at high speed. There is usually a time factor to allow the highway or road to re-open which causes everyone to hurry – thus creating a greater hazard. You may also have flying or falling debris, asphalt, or concrete both in both solid and dust form.

The responsible workers must have a demolition plan to address challenges presented by the various types of accidents that can happen in a work zone.

Fractures, contusions, foreign objects in the eye, inhalation of toxic fumes, strains, and sprains are common. Fatalities, usually from being struck by vehicles, occur far too often.

Demolition Operations work shares some hazards with other forms of street/road/highway work. These include exposure to moving traffic, exposure to environmental conditions and heavy work involving lifting, pushing, and pulling. Falls from equipment, working in close proximity to backing equipment, and slips, trips, and falls are common injury causes.

Specific Exposure Types for Demolitions Operations	Measures to Control Exposures	Instructor Notes
<p>This column will contain information about specific hazards or exposures that can help create the chain of events leading to accident and injury.</p>	<p>This column will contain information about specific means to help reduce the risk of accident or injury if implemented.</p>	<p>This column will contain notes to help provide ideas to the instructor.</p> <p>Control methods are rarely 100% effective, but history has proven that workers can follow procedures and significantly reduce the chance they, or co-workers, will be involved in an accident or sustain an injury.</p>
<ul style="list-style-type: none"> • Poorly planned operations • Heavy lifting • Sudden shock loads • Unstable work areas • Damaged rigging • Airborne debris • Falling objects • Moving equipment • Live traffic 	<ul style="list-style-type: none"> • Worker education • Worker training • Equipment inspections • Advance planning • Constant evaluation of structure • Back-up alarms • Traffic plan 	<p>Welcome your class and try to put them at ease. Tell them how you are going to discuss the work they do and how to do it without injury.</p> <p>One good method to put crews at ease is to ask each one how long they have been doing this type of work. Keep track of the years of experience for each, and when everyone has provided his or her input, total the years. This is usually a high number and showing the individuals how much experience they share in total helps them approach the training with some confidence.</p> <p>As the educator, make sure you know the scope of the work they usually perform and tailor your discussion to meet those needs. For instance, do they perform tasks that occur within and existing work zone or are they outside any structured work zone? Do they work primarily during daylight hours or at night? Have they ever had to perform demolition in a work zone?</p> <p>A good exercise is to involve everyone in the discussion by asking if anyone has ever been involved in demolition in the work zone. A discussion of events and experiences may lead to covering the most important points.</p>

Demolition Operations

Falls

Falls in Demolition Operations work are most likely as a slip, trip, or fall working on uneven ground around the scene, occasionally from equipment. Falls from equipment may result in severe contusions and broken bone injuries, even fatalities. Slips and trips may result in abrasions, contusions, fractures, and even fatalities.

A person who is falling is out of control and the extent of the injuries resulting from the fall depend on the distance of the fall, the angle of the body when it lands, and anything it may strike during the fall or landing. A same-level trip or slip fall can result in a fatality if the person strikes his or her head wrong.

Cutting out the supporting structure over you or that you are standing on is a hazard almost specifically found in demolition work.

Finding adequate fall-protection anchorage points may be more of a challenge.

Workers must also remember the hazards may come from their own work or tasks being performed nearby by others.

Specific Exposure Types for Demolitions Operations	Measures to Control Exposures	Instructor Notes
<ul style="list-style-type: none"> • Inattention • Lack of understanding of the work process • Fragmented approach to accomplishing the work 	<ul style="list-style-type: none"> • Planning • Safety First Attitude • Ongoing Employee Education • Teamwork • Control cell phone use 	<p>Ask if anyone has ever suffered or observed a fall during demolition work. If such an event has happened within your company in the past, learn the circumstances and root causes. Also, learn the particulars behind one or two such accidents that have occurred in other companies. These can be found in OSHA Fatal Facts or NIOSH FACE Facts. Discuss with the class how these accidents happened, what the outcome was, and what the root causes were. Ask them to provide ideas about how such accidents could be prevented.</p> <p>Discuss how attitude affects workplace accidents.</p> <p>Point out that cell phones are just as distracting for workers as they are for drivers. Demolition work requires every worker's full attention.</p>
<ul style="list-style-type: none"> • Elevated Work <ul style="list-style-type: none"> – From equipment – Unguarded Elevated Surfaces 	<ul style="list-style-type: none"> • Maintain Awareness • Proper Lighting • Ensure truck steps in place and in good condition • Ensure handrails on trucks are adequately maintained • Steps are non-skid • Proper PPE • Personal fall protection if elevated stationing required 	<p>Although falls from heights during demolition operations are not the most common injuries, they can be serious. These falls frequently happen to workers getting on and off equipment or on unstable surfaces.</p> <p>Not infrequently, workers performing demolition work saw, or otherwise tear down, the very place they are standing on. Discuss the cartoon "saw the limb off behind you" type accident and how important planning and education is to safe performance of this work.</p> <p>The practice of riding pickup beds unprotected should be controlled, even with slow moving vehicles.</p>
<ul style="list-style-type: none"> • Same Level <ul style="list-style-type: none"> – Slips/Trips – Sawing – Shoveling – Wet/Slick Environment 	<ul style="list-style-type: none"> • Exceptional housekeeping • Worker awareness/positioning • Inspect jobsite during the day • Special care during demolition situations 	<p>Demolition work may be on uneven or partially removed surfaces, making slips, trips, and falls more likely.</p> <p>Proper work boots and work areas free of material, debris, etc. for workers are important.</p> <p>Workers must maintain constant awareness of their surroundings and always know where they can run or jump to get out of the way. This is especially important in a demolition situation.</p>

Demolition Operations

Struck by

Approximately 22% of all construction worker fatalities involve being struck by something.

For 1992 – 2000 worker deaths in work zones, 91% of 910 worker deaths involved vehicles, most being dump trucks.

NIOSH records indicate that in 2005, 390 workers were killed in struck-by incidents, accounting for approximately 7% of all occupational fatalities.

Injuries range from contusions, lacerations, and STIs to fractures, crushing, and fatalities.

Current estimations are that approximately one-half the workers killed in highway work zones are killed by construction vehicles. These accidents usually involve crushing injuries and fatalities.

ALL workers, subcontractors, and haulage employees that will enter the work zone should, at a minimum, receive a basic orientation to that site, to include at least internal construction traffic flow, means of entering and exiting the work area, Demolition escape path designations, required PPE, and signals for vehicle intrusions into the work area.

Preplanning and training of workers should address Unified Incident Command at accident sites (who is in charge) as well as measures to protect workers during an incident. Topics should address the increased hazards of traffic, fire, and HAZMAT resulting from an accident (fuel, cargo, debris, and biohazards) that may result.

Although heavy equipment is used in much of this process, workers sometimes need to be in close proximity to the operations to help the equipment which can cause a struck by exposure.

Specific Exposure Types for Demolitions Operations	Measures to Control Exposures	Instructor Notes
<ul style="list-style-type: none">Falling/flying debris from the demolition process.	<ul style="list-style-type: none">Debris NettingPractice "See & Be Seen"Personal flashing lightsWorker awareness/positioningHousekeepingPPE, especially hard hats and safety glasses	<p>Even when we plan, events may happen unexpectedly. For example, demolition workers dumped scrap into a construction dumpster using a Lull. The debris struck a steel bar which acted as a lever, propelling a 35 pound piece of metal lying on the other end out of the dumpster and 15 feet through the air, striking a worker in the right front of his head – thankfully, on his hard hat. The worker was dazed and sustained a small laceration on his forehead from the force of the blow. He walked away, visited a doctor to be checked out, and was home with his family that night.</p> <p>Discuss similar accidents that may have occurred within your company.</p>

Specific Exposure Types for Demolitions Operations	Measures to Control Exposures	Instructor Notes
<ul style="list-style-type: none"> • Work zone Intrusions <ul style="list-style-type: none"> – Reduced visibility – Impaired Drivers – Inattention – Limited Physical Barriers – Lack of knowledge/ experience – Working behind nonpositive barriers – Cell Phones 	<ul style="list-style-type: none"> • Constant vigilance • Constantly refreshed escape plan • Position arrow-board truck properly • High-visibility Vest 	<p>Clearance between equipment and moving traffic is frequently measured in inches, not feet. Constant awareness of personal location in relation to work zone boundaries is critical.</p> <p>Workers near the edge of work zones should never turn their back to oncoming traffic. Ask if anyone has worked a job where a worker was struck by a vehicle and if so, discuss events immediately before, during and after the incident.</p> <p>Wherever possible, traffic control measures for short-term work should include means to physically prevent unplanned intrusions into the work area. Means and methods that include impact attenuators or barriers (Jersey Barriers, K-Rail, etc) are preferred beyond simple channelizing methods (cones, barrels, etc). Ongoing documented inspections of emplaced traffic control should be implemented and needed corrections made in a timely manner.</p> <p>Place all MOT so it will be visible through all seasons. Signs placed near trees in the winter may be hidden by spring growth of leaves. Curves and hills can hide what is just ahead – if that is a short-term job with a few cones or a flagger station, a serious accident could occur.</p>
<ul style="list-style-type: none"> • Equipment and construction vehicle traffic within work zone <ul style="list-style-type: none"> – Equipment/employee moves into oncoming traffic – Loading and unloading of equipment – Blind Spots – Glare – Complacency – Worker visibility reduced due to poor ambient lighting 	<ul style="list-style-type: none"> • Pre-established and known traffic flow plan • Maintain Awareness by all • Safety 1st Attitude • Proper Worker Position • Back-up Alarms/Spotters/Back-up Cameras • Ongoing worker education • Proper Lighting • Vehicle/Equipment Inspection • Teamwork • Stage Vehicles so if hit, vehicle will turn into barrier wall 	<p>An unfortunate but classic highway worker fatality that happens far too often occurs when a worker stands in a (not “the,” as there are several for every piece of equipment) blind spot where the operator cannot see them. The equipment moves, usually backing, the worker is looking away and does not see and it is noisy so they do not hear but they certainly feel it as they are struck.</p> <p>Hardhats and vests with personal flashing lighting are now available to help make workers at the edges of the work zone more visible.</p> <p>Backing is less than 1% of fleet mileage but accounts for approximately 30% of all accidents.</p> <p>Caterpillar, Inc. has developed blind area diagrams for all of their vehicles and equipment to help the operators and WOF determine areas to avoid when working around this equipment.</p> <p>Proximity Warning Devices are being designed that notify the drivers of company vehicles such as dump trucks the location of not only flag persons but also other WOFs who are used in the unloading and material placement process.</p> <p>Point out that WOFs may become desensitized to the sound of back-up alarms over time. Even though the back up alarm may operate, it may not register with the WOF because they hear it so often.</p>

Specific Exposure Types for Demolitions Operations	Measures to Control Exposures	Instructor Notes
<ul style="list-style-type: none"> Working near rotating/moving equipment. Many times, there will be a crusher plant set up adjacent to the demolition process that creates additional exposures to belts, crushing equipment, trucks, and loaders. 	<ul style="list-style-type: none"> Adequate lighting to insure visibility of workers Constant vigilance Layout of work area Planned foot traffic flow Adequate back-up alarms Proximity Warning Devices Personal flashing lights on workers' PPE Mud/slick surface control Use of boots with slip resistant soles 	<p>WOF must be educated to recognize the hazard of being around and behind moving vehicles and taught methods they can employ to avoid being injured. In these types of operations, vehicle/equipment movement is much more frequent and therefore a bigger hazard to workers.</p> <p>Do a boot check to demonstrate boot soles that provide good traction and those that do not.</p> <p>Discuss how workers naturally tend to stand near ongoing work. When the backhoe is digging and they are waiting to return in the trench for example, workers tend to stand near where the bucket is working. Remind them that standing clear can prevent a serious injury.</p>
<ul style="list-style-type: none"> Debris <ul style="list-style-type: none"> – Thrown – Blown by wind – Falling off passing vehicle 	<ul style="list-style-type: none"> Clearance distance Adequate PPE – eyes, face, head, and feet Watch approaching vehicles for visible motion inside – arm moving, etc. Keep debris away from work zone. Observe approaching vehicles, especially pickups, for loose articles. Maintain adequate clearance between falling walls, roofs, beams, etc. and construction equipment and workers. 	<p>Workers positioned at the critical point where oncoming traffic is approaching the work zone should be aware of the hazards of vehicle intrusion and worker abuse. A warning sounded by them can provide the few seconds critical to avoiding fatalities.</p> <p>Passersby, especially those young and/or drunk, may throw cans, bottles, etc. at workers, mostly flag persons. Always face moving traffic and be aware of the potential for flying debris. Flying debris can also come from a vehicle accident in the work zone.</p> <p>When working around moving equipment such as backhoes, ensure workers' position is such that the equipment cannot strike them.</p> <p>Powerline contact can create falling parts, loads, and debris in addition to the electrical hazard. Avoiding the contact is the best control. Avoiding the area near and under suspended loads is also important.</p> <p>Discuss how falling portions of the structure being demolished can travel further than expected – plan for adequate clearance for people and equipment.</p>
<ul style="list-style-type: none"> Equipment contact with power lines 	<ul style="list-style-type: none"> Have power turned off nearby lines Identify and mark overhead hazards before the project starts Identify and mark location of underground hazards before starting Manually locate of underground hazards before using power equipment Properly designed set-up location Avoid working under booms and suspended loads 	<p>Contact with overhead and underground utilities remains one of the more common preventable accidents in construction.</p> <p>Discuss the actions every crewmember should know when working around potential energized sources, electric, gas, or water. Point out that it is everyone's responsibility to look up and down to identify hazards.</p> <p>Discuss company requirements regarding powerline location and marking. What kinds of signs are placed on the ground to warn workers and operators?</p> <p>Consider implementing a 20 feet powerline clearance rule for all equipment. At the time of this writing, that appears to be the direction regulations are going.</p>

Demolition Operations

Caught in / between

Approximately 18% of construction worker fatalities involve being caught in or between objects.

Such injuries often involve a section of the body being crushed. Fatalities can be instantaneous, or occasionally the pinned person may be alert but will die in a short time.

There have been documented cases where pinned workers loved ones were rushed to the site to say good-bye before the worker died.

Amputations are also a frequent result of such accidents. Fingers are most frequently affected, but workers lose arms and legs as well at times.

Truck drivers have been caught in the vehicle driveshaft or in turning gears, workers have been caught between the backing truck and the paver hopper, and mechanics have been caught between the bed and truck frame when a bed fell. Intrusion of public vehicles into the work zone may result in workers being caught between that vehicle and stationary objects.

Caught in/between injuries are rarely minor. Injury types frequently seen include:

- Lacerations
- Amputations
- Crushing
- Fractures
- Burns
- Contusions
- Fatality

Specific Exposure Types for Demolitions Operations	Measures to Control Exposures	Instructor Notes
<ul style="list-style-type: none"> • Vehicular traffic in the work zone • Backing vehicle • Vehicular traffic – Intruding vehicle 	<ul style="list-style-type: none"> • Internal Traffic Control Plan • Worker positioning • Minimize backing • Rear-view Cameras • Back-up alarms • “No see” chart training • “See and Be Seen” • Guarding – Arrow-board truck • Position to stay clear • Constant vigilance 	<p>Workers may be crushed between backing equipment or vehicles and other equipment.</p> <p>Never lose sight of the fact that the hazard that kills most highway workers is being struck by dump trucks and other equipment in the work area. While it may not seem very important in demolition operations, it is in fact one of the most important issues to stress.</p> <p>Backing vehicles pinning workers between the rear bumper of the vehicle they are driving and another object such as a pole, piece of equipment, etc. happens far too often. Sometimes the equipment is moving and traps the WOF between the equipment and a stationary object. Back-up alarms help and are required by law but are not the only answer. Unfortunately, construction workers become accustomed to hearing them and mentally block the sound. Workers may have impaired hearing.</p>

Specific Exposure Types for Demolitions Operations	Measures to Control Exposures	Instructor Notes
<ul style="list-style-type: none"> • Vehicular traffic (cont.) 		<p>Working adjacent to concrete barriers and around live traffic creates opportunities for pinch points. An Internal Traffic Control Plan is critical to the safety of WOF. Ensure that whenever possible trucks and equipment does as little backing up as possible with the work areas.</p> <p>MOT barriers, properly rated high-visibility clothing, etc. are all important in avoiding accidents.</p>
<ul style="list-style-type: none"> • Moving/rotating equipment parts 	<ul style="list-style-type: none"> • Proper guarding of rotating equipment • Worker positioning 	<p>Companies that make equipment frequently found in work zones are beginning to develop and make available charts for equipment that shows the blind spots the operator has. Employee education in blind spot recognition makes good weekly safety meetings and helps prevent accidents. Check with your equipment manufacturer of to see if they offer a blind-spot chart.</p> <p>Ensure workers understand the importance of lock-out and in replacing all guards if removed during maintenance.</p>
<ul style="list-style-type: none"> • Equipment operation 	<ul style="list-style-type: none"> • Proper equipment labeling • Ongoing worker education • Compliance audits/correction 	<p>During demolition operations, avoid pinch points. All work must be performed so the worker has positive physical assurance the vehicle or equipment will not move unexpectedly.</p>
<ul style="list-style-type: none"> • Equipment maintenance 	<ul style="list-style-type: none"> • Lockout equipment/vehicle • Block all raised parts • Plan for pinch points • Proper PPE for sawing/impact 	<p>Frequently this includes blocking or supporting the equipment. Demolition employees are killed every year because they were crushed by parts that were raised, but not well secured, falling on them.</p>
<ul style="list-style-type: none"> • Complacency, Inattention <ul style="list-style-type: none"> – Improper communication – Electronic (radio, cell) 	<ul style="list-style-type: none"> • Education • Teamwork • Position to stay clear • Employee education • Restrict use of electronic equipment while actively working 	<p>Especially important in demolition work as rapidly changing conditions dictate constant vigilance.</p> <p>Discuss how fast things can change. A tactic to try is, while discussing that, slam your hand or a book on a table unexpectedly making a loud noise. This gets everyone's attention. Then explain that is how fast an accident happens. There may be no time to run. Thinking ahead, asking "What could happen to me in the next minute?" or "How can I do this without hurting myself or others?" are critical.</p>
<ul style="list-style-type: none"> • Loading/unloading 	<ul style="list-style-type: none"> • Ensure stabilization of moveable items • Hands and bodies clear of pinch points • Educate to recognize hazards and control 	<p>Materials can move in unexpected ways.</p> <p>Ask the class if they have seen items fall off a truck, etc.</p> <p>Discuss how to preplan to use equipment as bracing to prevent roll-off accidents.</p> <p>A preplanned escape route is a very important element in demolition work.</p>
<ul style="list-style-type: none"> • Backhoe work 	<ul style="list-style-type: none"> • Employee positioning clear of pinch points/swing radius • Operator awareness and due care 	<p>Workers injured or killed when struck by a backhoe is a very preventable accident.</p> <p>Show photos of backhoes at work; discuss where a spotter should stand and where no one should stand.</p>
<ul style="list-style-type: none"> • Unstable structures 	<ul style="list-style-type: none"> • Block raised items, such as a wrecked vehicle • Evaluate before starting work • Plan ahead 	<p>Discuss that workers should never work, walk, or stand under or near an unstable structure.</p> <p>Discuss types of injuries possible when heavy items fall on a worker.</p>

Demolition Operations

Electrical

Approximately 17% of construction worker fatalities involve an electrical current.

Injuries resulting from electrical contact include severe burns, unconsciousness, loss of mental and/or physical ability for the remainder of the workers' life, and frequently a prolonged period of suffering, then death. Death may be immediate.

Electrical current passes from point of contact with a live circuit through the body to an exit point where the body is grounded. An example is a worker who is holding a metal signpost, and who then touches a short-circuited generator that is not grounded. The current would pass from one hand, through the lungs and heart, and out the other hand.

If an electrical arc is involved, burns from molten metal and severe respiratory distress from breathing superheated air are likely.

A severe shock or lightning strike can burn a worker to death as other workers look on. This can create a post-traumatic stress type injury to survivors.

Remember all workers exposed to electrical arc need to have NFPA 70E required training.

Specific Exposure Types for Demolitions Operations	Measures to Control Exposures	Instructor Notes
<ul style="list-style-type: none"> • Electrical equipment <ul style="list-style-type: none"> – Portable crushing operations and equipment – Portable generators – Lighting plants <ul style="list-style-type: none"> • Improper grounding • Poorly maintained equipment 	<ul style="list-style-type: none"> • Electrical wiring meets code • Inspect/maintain equipment • Ground prong for extension cords • Proper grounding • Use non-conductive tools • GFCI • Maintain Awareness • Perform lockout/tagout • Electronic tracking • Proper PPE 	<p>Grounding all portable electrical equipment and using GFCIs for all portable electrical tools is essential to electrical safety.</p> <p>Workers have been electrocuted when they touched an improperly wired piece of equipment. Good maintenance and careful handling of electrical equipment is important.</p> <p>Discuss company policy regarding grounding of portable electrical equipment and methods to best accomplish grounding.</p>
<ul style="list-style-type: none"> • Utility strikes <ul style="list-style-type: none"> – Unmarked utilities – Cutting underground utilities – Overhead power line 	<ul style="list-style-type: none"> • Isolate source • Insulate source • Avoid contact • Identify <ul style="list-style-type: none"> – One Call – Potholing • Maintain Awareness • Mark locations on ground and in air • Minimize exposure – maintain distance 	<p>Highway, street, and road workers are at risk from electrical shock when a truck or backhoe boom contact or arcs to an overhead power line. Lightning strikes also pose a significant hazard. Accidents in the work zone may create electrical hazards by knocking down power poles.</p> <p>During demolition situations, workers must be vigilant for electrical hazards. Look for damaged poles. Sudden grass fires can be an indicator of downed power lines. Remember, downed lines may be hidden in vegetation, smoke, debris, or darkness.</p> <p>Far too frequently, equipment will contact a live overhead power line. An electrical charge can jump a gap, creating an arc that energizes the equipment so contact is not even necessary. Such contact can energize the ground with the potential lessening as the distance from the point of contact increases. A worker walking nearby can receive a severe shock from stepping across invisible differences in potential in the ground as well as from being in physical contact with the energized truck.</p>

Specific Exposure Types for Demolitions Operations	Measures to Control Exposures	Instructor Notes
<ul style="list-style-type: none"> Weather related lightning 	<ul style="list-style-type: none"> 30-30 Rule: <ul style="list-style-type: none"> 30 seconds between flash and thunder – take cover 30 minutes after seeing the last flash – resume work Do NOT: <ul style="list-style-type: none"> Be the tallest object Stand in the open Stand under a tree Stand in a gazebo or open shelter Stand next to or touch metal objects Stay next to water Use electrically powered tools Use a plug-in phone or computer with modem Do: <ul style="list-style-type: none"> Get into an enclosed building Get into a car, truck, or van 	<p>Lightning is another issue. Lightning can strike 10 miles in front of a storm. 30% of those struck by lightning die, most within an hour. Approximately 74% sustain some sort of permanent disability.</p> <p>Handheld electronic devices that measure the distance to the closest lightning strike can provide ample warning to allow workers to seek safety.</p> <p>Tuning a radio to the AM band allows the static blast of lightning to be heard.</p> <p>Every company with outside work should have a standard lightning policy that superintendents/foremen know and enforce. That policy should address when to send workers to cover, that the cover does not include trees, metal objects or high, clear ground, etc. and when to return to work.</p> <p>Every project plan should have a section on lightning. Standardizing the process for protecting workers helps eliminate inconsistencies from job to job, even day to day.</p> <p>If you do not have a lightning policy – develop one before teaching this class. Communicate it down the line as Superintendent acceptance is critical for success.</p>

Demolition Operations

Soft tissue

Soft tissue injuries (STIs) – strains and sprains primarily, are the number-one injury type in highway/street/road work. Consider the impact on a family when a parent can no longer work at home or on a job. Strains and sprains can have a greater negative impact on workers, their families, and the company than any injury short of a fatality. A person who severely injures his or her back may never be able to pick up children or grandchildren. Make certain your workforce understands that this is not about carpal tunnel from computer work – this is about the physical demands on their muscular system, how they prepare and perform to minimize injury to themselves.

Demolition Operations workers are at high risk because the focus of such work is speed – the desire to save lives often overweighs thinking things through. This can cause rushing and shortcuts. Those invariably lead to sprain and strain injuries. Strains and sprains to ankles and knees occur frequently from walking or stepping on debris or uneven ground. Even jumping off vehicles can create problems. Shoulder and elbow strains/sprains are also likely in handwork, pulling on materials. Back injuries also are associated with Demolition Operations work. Demolition Operations work requires moving heavy parts, pick and shovel work where equipment cannot reach, walking on uneven ground, and many other ways to strain or sprain shoulders, elbows, knees, and ankles.

Demolition Operations moving operations are physically demanding. Operators face hours of sitting in one seat, often with whole body vibrations that shake them constantly, working on uneven surfaces, and carrying heavy loads. Worker rotation and relief should be planned so no one has to perform the hottest jobs for too long a period. Heat and cold extremes can make soft tissue more susceptible to injury so stretching is more important.

Understand how stretching helps construction workers, just as it does athletes. Discuss some favorite sports teams, talk about how their players stretch before practice, games, etc., why they do it and how much like their work sports are.

A good education program will ensure employees know the ergonomic hazards and can recognize when they or co-workers are at risk. They also have to know how to control the exposure to minimize their risk of injury.

Knowing stretching exercises and other ergonomic controls are supported by the field management team and upper management are important aspects to getting workers to help protect themselves

Specific Exposure Types for Demolitions Operations	Measures to Control Exposures	Instructor Notes
<ul style="list-style-type: none"> • Placement of MOT <ul style="list-style-type: none"> – Repetitive motion – Lifting/carrying – large bulky pieces of debris – Shoveling debris 	<ul style="list-style-type: none"> • Employee rotation • Motorized equipment when possible • Get help 	<p>MOT placement requires pushing and pulling, lifting and carrying.</p> <p>Ask someone who performs this work to explain what they do and what muscles ache.</p>
<ul style="list-style-type: none"> • Acclimation of employees <ul style="list-style-type: none"> – Heat/cold adjustment 	<ul style="list-style-type: none"> • Layer clothing • Provide water and shade • Educate for heat- and cold-related medical issues • Stretch more important 	<p>Temperature extremes have an impact on bodily functions, even the muscular system.</p> <p>Discuss how cold makes stretching more difficult and hot weather may lead to muscle cramps.</p>
<ul style="list-style-type: none"> • Material handling <ul style="list-style-type: none"> – Lifting/moving heavy equipment – Using improper lifting techniques – Failure to ask for help – Improper dismount trailers, pickups, equipment 	<ul style="list-style-type: none"> • “NO MORE ON THE FLOOR” – Store materials approximately waist high • Lift with legs and carry close to the body • PPE – shoulder pads, etc. 	<p>Adequate PPE when carrying can include shoulder pads and gloves – even good work boots. Good gloves and boots are especially important to working demolition as sharp edges may be present.</p> <p>Explain the “Power Zone” – the area a person can work with their hands when their upper arms are at their sides and the arms are bent at the elbow. Explain that, like a crane, the further we move our arms from our body, the weaker we are and the more likely we are to strain something.</p> <p>Bending knees when lifting and lifting with the legs and never twisting the back when holding or carrying a load are two more issues that are important.</p>
<ul style="list-style-type: none"> • Work activities <ul style="list-style-type: none"> – Reaching – Carrying – Pushing – wheelbarrows over uneven ground – Pulling – Digging – Sawing – Repetitive motion – Overexertion – Vibration – Awkward posture – Forced repetition/Posture – Poor housekeeping 	<ul style="list-style-type: none"> • Stretch/Flex program • Use of powered equipment • Get help • Rotate workers • Change positions frequently • Educate workers on proper techniques • Knee pads • Anti-vibration gloves • Limit exposure • Ongoing employee education • Using proper lifting techniques • Three-point mount/dismount of trailers, equipment and pickups • Good housekeeping • Taking breaks • Follow written procedures • OSWPS – Operators Stand When Possible and Stretch 	<p>The weight of the tools should be considered, along with lifting and twisting required when handling.</p>



Grading and Earthmoving Operations

Introduction

Approximately 90% of construction worker fatalities and serious injuries involve a fall, being struck by something, being caught in or between things, or electrical hazards. In addition, soft tissue injuries (STIs), usually seen as strains or sprains, are frequent types of injuries in such work and are rarely fatal but potentially create a serious impact upon workers and their families. Grading work involves heavy lifting at times and walking on uneven terrain, so strains and sprains are frequent.

Moving dirt is very hazardous work. Workers on foot (WOF) in close proximity to moving heavy equipment present definite hazards. Many construction workers are maimed or even killed each year in this process. We frequently find workers within feet of public vehicles, sometimes traveling at high speed. The responsible crew must have an emergency plan to address challenges resulting from injuries.

Keep in mind one injury can have multiple contributing factors. An example is the pan scraper operator who drove through a deep rut. The resulting bounce threw him out of the seat, into the frame, knocked him unconscious, he fell into the floor. He was caught between the fuel feed and the structure, which kept the pan scraper moving toward a public interstate with heavy traffic. He had fall, struck by, and caught between in the space of seconds. He was lucky – a supervisor saw the equipment veer off-path, ran it down

in his truck, jumped onto the cab, and stopped it a short distance before it went onto an interstate highway. Maintaining the haul road free of deep ruts and requiring seat belt use may have prevented this incident.

Fractures, contusions, foreign objects in the eye, strains, and sprains are common. Fatalities, usually from being struck by equipment, occur far too often.

Virtually all activities in a highway work zone experience traffic exposures, both public and internal site vehicles. This exposure mandates advance planning to identify all associated exposures, the appropriate controls such as routing, Maintenance of Traffic (MOT) equipment and layout, emergency response, etc. Ensure ongoing protection by planning for implementation and maintenance programs. Educate everyone on the site so they know the plan and expectations.

ALL workers, subcontractors, and haulage employees that will enter the work zone should receive, at a minimum, a basic orientation to that site, to include at least internal construction traffic flow, external traffic control features, means of entering and exiting the work area, emergency escape path designations, required PPE, and emergency signals for vehicle intrusions into the work area.

Specific Exposure Types for Grading Work	Measures to Control Exposures	Instructor Notes
<p>In this column, we will identify hazards that may lead to accidents and injuries.</p>	<p>In this column, we will identify control measures that will help reduce the risk of accident or injury if implemented.</p>	<p>In this column, we will provide tips and suggestions to help the instructor present the material in a meaningful way. Comments are geared toward instructors that may be supervisors first, instructors only as needed.</p>
<p>Pushing dirt from here to there – how can anyone get hurt – right? It sounds so simple until we consider the size, speed, and weight of the equipment. Add to that the human tendency to take risks, and grading work kills workers each year</p> <p>Grading work includes operations that involve pan scrapers, backhoes, track hoes, loaders, dump trucks, graders, rollers, and other heavy equipment. Vehicles include water, maintenance and supervisor trucks, vendors, delivery trucks, fuel trucks, etc</p> <p>Grading work shares some hazards with other forms of street/road/highway work. These include exposure to moving traffic, exposure to environmental conditions, and heavy work involving lifting, pushing, and pulling. Falls from equipment, working in close proximity to backing equipment, and slips, trips, and falls are common injury causes.</p> <p>This work frequently requires traffic control. Remember some 91% of highway worker deaths in work zones are from being struck by a vehicle or equipment. A great many of those involve dump trucks, mostly while backing.</p>	<ul style="list-style-type: none"> • Stretch/Flex program • Use of powered equipment • Get help • Rotate workers • Change positions frequently • Educate workers on proper techniques • Knee pads • Anti-vibration gloves • Limit exposure • Ongoing employee education • Using proper lifting techniques • Three-point mount/dismount of trailers, equipment and pickups • Good housekeeping • Taking breaks • Follow written procedures • OSWPS – Operators Stand When Possible and Stretch 	<p>Welcome your class and try to put them at ease. Tell them how you are going to discuss the work they do and how to do it without injury. One good method to put crews at ease is to ask each one how long they have been doing this type of work. Keep track of the years of experience for each, and when everyone has provided their input, total the years. This is usually a high number and showing the individuals how much experience they share in total helps them approach the training with some confidence.</p> <p>As the educator, make sure you know the scope of the work they usually perform and tailor your discussion to meet those needs. For instance, do they perform tasks that occur within and existing work zone or are they outside any structured work zone? Do they work primarily during daylight hours or at night? Do they perform dump truck or pan scraper work primarily?</p> <p>Adult Learning Basics:</p> <ul style="list-style-type: none"> • Adult learners do best when addressing real-world problems they face in their life. • Set the stage so attendees understand why this training is important to them in terms of their lifestyles and families, as well as employment. • Set parameters up front – breaks, question/answer, etc. • Adults learn best from experience, not note taking. If you can't get them in the field, discuss operations they perform, use pictures. • Adult learners do best when involved – ask questions, try to get everyone to say something. • Ask the question, give the group a few seconds to think about it, and then call on someone to say what they think. • Ask several to answer then play off the answers. • Ask questions before (to discover what they already know), during (for involvement and repetition to improve learning) and then after (to see what they learned) the session. • Structure the session loosely to allow for spontaneity – a good learning tool. • You, the educator, have to believe in the material before you can make others believe in it. • Always remember you, the educator, are in charge of the group. Maintain looseness but control, don't let discussions wander aimlessly, keep on topic, meet your promised goals.

Grading and Earthmoving Operations

Falls

Falls in grading work are likely from equipment or a slip, trip, or fall working on level ground around the equipment. Workers may slip into excavations, possibly bring the wall down with them.

Falls from equipment may result in severe contusions and broken bone injuries, even fatalities.

Slips and trips may result in abrasions, contusions, fractures, and even fatalities.

A person who is falling is out of control, and the extent of the injuries resulting from the fall depend on the distance of the fall, the angle of the body when its, land and anything it may strike during the fall or landing. A same-level trip or slip fall can result in a fatality if the person strikes his or her head wrong.

Specific Exposure Types for Grading Work	Measures to Control Exposures	Instructor Notes
<ul style="list-style-type: none"> • General 	<ul style="list-style-type: none"> • Safety First Attitude • Ongoing Employee Education • Teamwork 	<p>Advance planning, incorporating careful analysis of not only the anticipated physical hazards but also personnel orientation and training.</p> <p>A good exercise is to ask attendees what they do and involve everyone in discussion.</p> <p>Stress the team concept. This approach appears very effective in highway work.</p>
<ul style="list-style-type: none"> • Elevated Work <ul style="list-style-type: none"> – Ramps – From equipment – Unguarded Elevated Surfaces – Wet/Slick Environment – heavy equipment mounting/dismounting – open excavations 	<ul style="list-style-type: none"> • Maintain Awareness • Proper Lighting • Ensure truck steps in place and in good condition • Ensure handrails on trucks are adequately maintained • Steps are non-skid • Proper PPE • Positive Protective Device • Personal fall protection if elevated stationing required 	<p>Although falls from heights during grading work are not the most common injuries, they can be fairly serious when they occur. These falls frequently happen to operators getting in and out of equipment.</p> <p>WOF must be educated to recognize the hazard of being around and behind moving vehicles and taught methods they can employ to avoid being injured. In these type of operations, vehicle/equipment movement is much more frequent and therefore a bigger hazard to workers.</p> <p>The practice of riding pickup beds unprotected should be controlled, even with slow moving vehicles. Discuss your company policy.</p>
<ul style="list-style-type: none"> • Same Level <ul style="list-style-type: none"> – Slips/Trips – Sawing – Shoveling – Slip/trip while avoiding incoming vehicle – Uneven terrain – Sharp changes in elevations – Slick and muddy surfaces 	<ul style="list-style-type: none"> • Exceptional housekeeping • Worker awareness/positioning • Inspect jobsite daily • Maintain walking surfaces that are free of trip hazards and as level as possible 	<p>As grading work is often on almost flat ground falls seem unlikely. Tell that to the workers who trip on the uneven ground or fall off equipment. Ask how many in the class have ever fallen while walking through a grading/earthmoving site</p> <p>Proper work boots and work areas free of material, debris, etc. for workers are important. Point out muddy boots lead to falls.</p> <p>Workers must maintain constant awareness of their surroundings and always know where they can run or jump to get out of the way.</p> <p>Discuss requirements, company practices for maintaining hazard free walkways.</p>

Grading and Earthmoving Operations

Struck by

Approximately 22% of all construction worker fatalities involve being struck by something.

For 1992 – 2000 worker deaths in work zones, 91% of 910 worker deaths involved vehicles, most being dump trucks.

NIOSH records indicate that in 2005, 390 workers were killed in struck-by incidents, accounting for 7% of all occupational fatalities.

Injuries range from contusions, lacerations, and STIs to fractures, crushing, and fatalities.

Current estimations are that approximately one-half the workers killed in highway work zones are killed by construction vehicles. These accidents usually involve crushing injuries and fatalities.

Specific Exposure Types for Grading Work	Measures to Control Exposures	Instructor Notes
<ul style="list-style-type: none"> • Work zone intrusions <ul style="list-style-type: none"> – Reduced visibility – Impaired drivers – Inattention – Limited physical barriers – Lack of knowledge/experience – Working behind nonpositive barriers 	<ul style="list-style-type: none"> • Practice “See & Be Seen” • Personal flashing lights • Worker awareness/positioning • Housekeeping • Mud/slick surface control • Use of boots with slip-resistant soles • Constant vigilance • Constantly refreshed escape plan • Position arrow-board truck properly 	<p>“SEE and BE SEEN” is a responsibility of each and every individual on a highway work zone site! Knowing where traffic is and making certain they see you is sufficiently important as to be continuously emphasized by supervision. Constant attention will help ensure the vital importance in the minds of all workers and visitors on such locations.</p> <p>Workers positioned at the critical point where oncoming traffic approaches the work zone must be aware of the hazards of vehicle intrusion and worker abuse. A warning sounded by them can provide the few seconds critical to avoiding fatalities.</p> <p>Hardhats and vests with personal flashing lighting are now available to help make workers at the edges of the work zone more visible.</p> <p>Workers near the edge of work zones should never turn their back to oncoming traffic. Ask if anyone has worked a job where a worker was struck by a vehicle and, if so, discuss events immediately before, during, and after the incident.</p>
<ul style="list-style-type: none"> • Equipment and construction vehicle traffic within work zone <ul style="list-style-type: none"> – Equipment/employee moves into oncoming traffic – Loading and unloading of equipment – Blind Spots – Glare – Complacency – Worker visibility reduced due to poor ambient lighting 	<ul style="list-style-type: none"> • Pre-established and known traffic flow plan • Maintain awareness by all • Safety First Attitude • Proper Worker Position • Back-up Alarms/Spotters/Back-up Cameras • Ongoing worker education • Proper Lighting • Vehicle/Equipment Inspection • Teamwork • Stage vehicles so if hit, vehicle will turn into barrier wall 	<p>An unfortunate but classic highway worker fatality that happens far too often occurs when a worker stands in a (not “the,” as there are several for every piece of equipment) blind spot where the operator cannot see them. The equipment moves, usually backing; the worker is looking away and does not see; and it is noisy so they do not hear but they certainly feel it as it runs them down.</p> <p>Backing is less than 1% of fleet mileage but accounts for approximately 30% of all accidents.</p> <p>Caterpillar, Inc. has developed blind area diagrams for all of their vehicles and equipment to help the operators and WOF determine areas to avoid when working around this equipment.</p> <p>An excellent demonstration for a field safety meeting is to have a workers walk around a dump truck or other piece of heavy equipment while it is shut down. Ask the operator to hold up his hand when he can see the worker, drop it when he cannot.</p>

Specific Exposure Types for Grading Work	Measures to Control Exposures	Instructor Notes
<ul style="list-style-type: none"> • Equipment and construction vehicle traffic within work zone (cont.) 		<p>Proximity Warning Devices are being designed that notify the drivers of company vehicles such as dump trucks the location of not only flag persons but also other WOF who are used in the unloading and material placement process.</p> <p>Point out that WOF may become desensitized to the sound of back-up alarms over time. Even though the back up alarm may operate, it may not register with the WOF because they hear it so often.</p>
<ul style="list-style-type: none"> • Working near rotating/ moving equipment 	<ul style="list-style-type: none"> • Adequate lighting to ensure visibility of workers • Constant vigilance • Layout of work area • Planned foot traffic flow • Adequate back-up alarms • Proximity Warning Devices • Personal flashing lights on workers' PPE 	<p>A common incident is for a backhoe to rotate and strike a worker that has just walked into the swing radius unknowingly.</p> <p>Clearance between equipment and moving traffic is frequently measured in inches, not feet. Constant awareness of personal location in relation to work zone boundaries is critical. Remember "See and Be Seen."</p> <p>When working around moving equipment such as backhoes, ensure workers' position is such that the equipment cannot strike them.</p>
<ul style="list-style-type: none"> • Debris <ul style="list-style-type: none"> – Thrown – Blown by wind – Falling off passing vehicle • Equipment contact with power lines 	<ul style="list-style-type: none"> • Adequate PPE – eyes, face, and head • Watch approaching vehicles for visible motion inside – arm moving, etc. • Keep debris away from work zone • Observe approaching vehicles, especially pickups, for loose articles • Avoid working under booms and suspended loads 	<p>Passersby, especially those young and/or drunk, may throw cans, bottles, etc. at workers, mostly flag persons. Always face moving traffic and be aware of the potential for flying debris.</p> <p>Powerline contact can create falling parts, loads and debris in addition to the electrical hazard. Avoiding the contact is the best control. Avoiding the area near and under suspended loads is also important.</p>
<ul style="list-style-type: none"> • Traffic control may fail due to: <ul style="list-style-type: none"> – Driver inattention – Impairment <ul style="list-style-type: none"> • Mental • Physical – Environmental conditions – Lack of coordination of workers from multiple companies 	<ul style="list-style-type: none"> • Cell phones • Crying kids • Working while driving • People drink, smoke pot, do other drugs, then drive • Handicapped • Aged • Infirm • Geographical <ul style="list-style-type: none"> – Curves – Hills • Exposure to injury from traffic, both internal and external 	<p>Wherever possible, traffic control measures should include means to positively prevent unplanned intrusions into the work area. Means and methods that include impact attenuators or barriers (Jersey Barriers, K-Rail, etc) are preferred beyond simple channelizing methods (cones, barrels, etc). Ongoing documented inspections of emplaced traffic control should be implemented, and needed corrections made in a timely manner.</p> <p>Station MOT so it will be visible. Signs placed near trees in the winter may be hidden by spring growth of leaves.</p> <p>Curves and hills can hide what is just ahead – if that is a short-term job with a few cones or a flagger station, a serious accident could occur. Discuss making certain drivers can see warning signs well in advance of the work zone.</p>

Specific Exposure Types for Grading Work	Measures to Control Exposures	Instructor Notes
<ul style="list-style-type: none"> Public vehicle accidents within the work zone <ul style="list-style-type: none"> Increase worker exposure to traffic 	<ul style="list-style-type: none"> Unified Incident Command Safety plan inclusion Employee training 	<p>Preplanning and training of workers should address Unified Incident Command at accident sites (who is in charge) as well as measures to protect workers during an incident. Topics should address the increased hazards of traffic, fire, and HAZMAT resulting from an accident (fuel, cargo, debris, and biohazards) that may result.</p> <p>Workers must know what their responsibility is in the event of an accident near their work location. Ensure they are knowledgeable of the idea that rescuers become victims when they do not think ahead and use adequate care.</p>
<ul style="list-style-type: none"> Maintenance – Moving parts 	<ul style="list-style-type: none"> Education Clear the swing radius of all equipment Lockout equipment Block raised parts Safe parking 	<p>Maintenance work is often overlooked but has dangers of its own. Discuss staying clear of maintenance operations unless personally involved. Talk with mechanics about blocking and lockout. Even parking their maintenance truck can be a key issue.</p>
<ul style="list-style-type: none"> Falling materials <ul style="list-style-type: none"> Pour locations close to structures Cleaning drum 	<ul style="list-style-type: none"> General contractor establish overhead clear zone Awareness of large sections chipping off Goggles, gloves, and protective clothing to prevent unexpected contact 	<p>Loads are frequently raised in the air, such as in pipe laying operations. Ask if anyone has ever seen a load fall unexpectedly.</p> <p>Discuss what happens to workers if something falls on them from above.</p> <p>Discuss ground work around bridge and pier work and the hazards of falling materials and tools.</p>

Grading and Earthmoving Operations

Caught in/between

Approximately 18% of construction worker fatalities involve being caught in or between objects.

Equipment rollover accidents may cause the operator to be thrown off or try to jump clear. When roll over protection cages are in place, they often land on the operator, pinning the operator to the ground and crushing whatever part of the body they strike. Such injuries often involve the trunk of the body being crushed. Fatalities can be instantaneous, or occasionally the pinned person may be alert but will die in a short time. There have been documented cases where loved ones of pinned workers were rushed to the site to say good-bye before the worker died.

Amputations are also a frequent result of such accidents. Fingers are most frequently affected, but workers lose arms and legs as well.

Workers in trenches may be crushed and suffocate by collapsing trench walls.

Truck drivers have been caught in the vehicle driveshaft and in turning gears, workers have been caught between the backing truck and the other equipment or structures, and mechanics have been caught between the bed and truck frame when a bed fell. Intrusion of public vehicles into the work zone may result in workers being caught between that vehicle and stationary objects.

Caught in/between injuries are rarely minor. Injury types frequently seen include:

- Lacerations
- Amputations
- Crushing
- Fractures
- Burns
- Contusions
- Fatality

Specific Exposure Types for Grading Work	Measures to Control Exposures	Instructor Notes
<ul style="list-style-type: none"> • Equipment operation 	<ul style="list-style-type: none"> • Proper equipment labeling • Ongoing worker education 	<p>Workers may be crushed between backing equipment or vehicles and other equipment.</p> <p>Working adjacent to concrete barriers and around live traffic creates opportunities for pinch points. An Internal Traffic Control Plan is critical to the safety of WOF. Ensure that whenever possible, trucks and equipment do as little backing up as possible with the work areas.</p> <p>“SEE and BE SEEN”</p>
<ul style="list-style-type: none"> • Equipment maintenance 	<ul style="list-style-type: none"> • Compliance audits/correction • Proper PPE • Lockout/tagout equipment • Block if raised • PPE for sawing/impact work 	<p>Avoid pinch points during maintenance of truck mechanisms.</p> <p>All mechanical work must be performed so the mechanic has positive assurance the vehicle or equipment will not move unexpectedly. Frequently, this includes keeping the key in their pocket.</p> <p>Mechanics are killed every year because they were crushed by parts that were raised, but not well secured, falling on them.</p>
<ul style="list-style-type: none"> • Moving/rotating equipment parts • Backhoe work 	<ul style="list-style-type: none"> • Proper guarding of rotating equipment • PPE 	<p>While the backhoe is the most obvious piece of equipment moving and rotating in the work zone, it is by far not the only one. Ask the class to develop a list of equipment moving or rotating in the work zones.</p> <p>Discuss company requirements for employee positioning around such equipment.</p>
<ul style="list-style-type: none"> • Excavation 	<ul style="list-style-type: none"> • Written procedure and plan • Use trench box or other protective device as required • Employee education • Proper access/egress 	<p>Excavations, commonly encountered site preparation work exposures, warrant careful planning to ensure adherence to proper soil determinations and sloping or shoring necessary to ensure collapse avoidance and attention to all aspects of worker protection prior to entry into excavations.</p>
<ul style="list-style-type: none"> • Complacency, Inattention 	<ul style="list-style-type: none"> • Education • Teamwork • Position to stay clear 	<p>Grading work can be repetitious, and it may be difficult to maintain focus.</p> <p>Educate workers to recognize this issue and discuss means of overcoming it. Teamwork is very important.</p>

Specific Exposure Types for Grading Work	Measures to Control Exposures	Instructor Notes
<ul style="list-style-type: none"> • Improper communication • Background noise 	<ul style="list-style-type: none"> • Electronic (radio) • Train to expect/cooperate • Noise-canceling head sets 	<p>Talking on the cell phone or listening to music on the headsets takes the workers' mind off the job at hand.</p> <p>Discuss company requirements for electronics use on the job.</p> <p>Noise-canceling headsets are easier to find and cheaper now. They do a good job blocking background noise and improving understanding of unusual noise and voice communication.</p>
<ul style="list-style-type: none"> • Loading/unloading 	<ul style="list-style-type: none"> • Hands clear of pinch points • Employee positioning clear of pinch points • Operator awareness and due care 	<p>Loading and unloading materials and equipment is a frequently performed task. Ask how many have ever done such work.</p> <p>Ask class to identify pinch points and what they do to avoid them.</p> <p>Discuss working around round items such as pipe that roll easily.</p> <p>Discuss maintaining position clear of the potential for trouble if they shift.</p>
<ul style="list-style-type: none"> • Vehicular traffic within work zone <ul style="list-style-type: none"> – Backing vehicle 	<ul style="list-style-type: none"> • Internal Traffic Control Plan • Worker positioning • Minimize backing • Rear-view Cameras • Back-up alarms • "No see" chart training • "See and Be Seen" 	<p>An Internal Traffic Control Plan is critical to the safety of WOF.</p> <p>Back-up alarms and/or signalmen to aid backing trucks or equipment are also essential safety elements. Back-up alarms help and are required by law but are not the only answer. Unfortunately, construction workers become accustomed to hearing them and mentally block the sound. Workers may have impaired hearing.</p> <p>Companies that make equipment frequently found in work zones are beginning to develop charts for equipment that show the blind spots the operator has. Employee education in blind-spot recognition makes good weekly safety meetings and helps prevent accidents. Check with your equipment manufacturer to see if they offer a blind-spot chart.</p> <p>If a manufacturer chart is not available – develop your own for each piece of equipment as tool-box talks. With operator in the seat, have someone move about the equipment (turned off) and mark on a drawing where the operator cannot see the WOF. Save those charts for future refresher training.</p>
<ul style="list-style-type: none"> • Vehicular traffic <ul style="list-style-type: none"> – Intruding vehicle 	<ul style="list-style-type: none"> • Guarding <ul style="list-style-type: none"> – Arrow-board truck • Position to stay clear • Constant vigilance • See and Be Seen 	<p>MOT barriers, properly rated high-visibility clothing, etc. are all important in avoiding accidents.</p> <p>A pre-planned escape route is a very important element in setting up traffic control work.</p>

Grading and Earthmoving Operations

Electrical

Approximately 17% of construction worker fatalities involve an electrical current.

Injuries resulting from electrical contact include severe burns, unconsciousness, loss of mental and/or physical ability for the remainder of the worker’s life, and frequently a prolonged period of suffering, then death. Death may be immediate.

Electrical current passes from point of contact with a live circuit through the body to an exit point where the body is grounded. An example is a worker who is holding a metal signpost, and who then touches a short-circuited generator that is not grounded. The current would pass from one hand, through the lungs and heart, and out the other hand.

If an electrical arc is involved, burns from molten metal and severe respiratory distress from breathing superheated air are likely. Workers that may be exposed to electrical arc must have NFPA 70E training.

A severe shock or lightning strike can burn a worker to death as other workers look on. This can create a post-traumatic stress type injury to survivors.

Specific Exposure Types for Grading Work	Measures to Control Exposures	Instructor Notes
<ul style="list-style-type: none"> • Electrical equipment <ul style="list-style-type: none"> – Portable generators – Lighting plants – Improper grounding – Poorly maintained equipment 	<ul style="list-style-type: none"> • Inspect/maintain equipment • GFCI use • Maintain Awareness • Proper PPE • Use non-conductive tools • Perform lockout/tagout • Proper grounding • Electrical wiring meets code • Ground prong on cords 	<p>Grounding all portable electrical equipment and using GFCIs for all portable electrical tools is essential to electrical safety.</p>
<ul style="list-style-type: none"> • Unmarked utilities <ul style="list-style-type: none"> – Cutting underground utilities – Overhead power line 	<ul style="list-style-type: none"> • Avoid contact • Identify <ul style="list-style-type: none"> – One Call – Potholing • Maintain Awareness • Mark locations on ground • Minimize exposure – maintain distance 	<p>Preoperational determination regarding overhead power lines, their possible challenges to maintenance of a minimum ten-foot clearance by all personnel, equipment, and materials storage.</p> <p>Workers are at risk from electrical shock when a truck or backhoe boom comes in contact with overhead power lines. Lightning strikes also pose a significant hazard.</p> <p>Discuss the “hand dig until you find” approach to locating underground utilities.</p>
<ul style="list-style-type: none"> • Equipment operations <ul style="list-style-type: none"> – Taking short cuts – Using improper equipment for the job – Striking overhead power lines 	<ul style="list-style-type: none"> • GFCI use 100% of time • Ongoing employee education • Use correct tool for the job • Closely control movement of equipment with raised bed or hydraulic arm, boom, etc. 	<p>Far too frequently, equipment will contact a live overhead power line. An electrical charge can jump a gap, creating an arc that energizes the equipment so contact is not even necessary. Such contact can energize the ground with the potential lessening as the distance from the point of contact increases. A concrete worker walking nearby can receive a severe shock from stepping across invisible differences in potential in the ground as well as from being in physical contact with the energized truck.</p> <p>Discuss methods of controlling when, where, and how equipment that is capable of striking an energized power line moves about the site.</p> <p>Discuss maintaining a minimum of 20 feet clearance from overhead power lines.</p>

Specific Exposure Types for Grading Work	Measures to Control Exposures	Instructor Notes
<ul style="list-style-type: none"> Weather related lightning 	<ul style="list-style-type: none"> 30-30 Rule: <ul style="list-style-type: none"> 30 seconds between flash and thunder – take cover 30 minutes after seeing the last flash – resume work Do NOT: <ul style="list-style-type: none"> Be the tallest object Stand in the open Stand under a tree Stand in a gazebo or open shelter Stand next to or touch metal objects Stay next to water Use electrically powered tools Use a plug-in phone or computer with modem Do: <ul style="list-style-type: none"> Get into an enclosed building Get into a car, truck, or van 	<p>Be alert to approaching lightning storms and be prepared to alert all personnel when avoidance measures must be undertaken.</p> <p>Grounding all portable electrical equipment and using GFCIs is essential to electrical safety.</p> <p>Lightning is another issue. Lightning can strike 10 miles in front of a storm. 30% of those struck by lightning die, most within an hour. Approximately 74% sustain some sort of permanent disability.</p> <p>Handheld electronic devices that measure the distance to the closest lightning strike can provide ample warning to allow workers to seek safety.</p> <p>Tuning a radio to the AM band allows the static blast of lightning strikes to be heard.</p> <p>Every company with outside work should have a standard lightning policy that superintendents/foremen know and enforce. That policy should address when to send workers to cover, that the cover does not include trees, metal objects, high, clear ground, etc. and when to return to work.</p> <p>Every project plan should have a section on lightning. Standardizing the process for protecting workers helps eliminate inconsistencies from job to job, even day to day.</p>

Grading and Earthmoving Operations

Soft tissue

Soft tissue injuries – strains and sprains primarily, are the number-one injury type in highway/street/road work.

Strains and sprains can have a greater negative impact on workers, their families, and the company than any injury short of a fatality. A person who severely injures his or her back may never be able to pick up children or grandchildren.

Site preparation/grading workers are at high risk because the focus of such work is speed – the necessity to achieve an established goal within a specified time frame. This can cause rushing and shortcuts. Those invariably lead to sprain and strain injuries.

Grading work requires moving heavy parts, pick and shovel work where equipment can't reach, walking on uneven ground, and many other ways to strain or sprain shoulders, elbows, knees, and ankles. Strains and sprains to ankles and knees occur frequently from walking on uneven ground. Jumping off equipment and landing in uneven dirt often damages, even destroys, operators' knees and ankles every year. Shoulder and elbow strains/sprains are also likely in hand work – digging, shoveling, etc. Back injuries also are associated with grading work.

Understanding how stretching helps construction workers, just like it does athletes. A good education program will ensure employees know the ergonomic hazards and can recognize when they or co-workers are at risk. They also have to know how to control the exposure to minimize their risk of injury.

Teach the method to lift, hold and carry tools and materials that puts the least strain on soft tissues – near waist, upper arms

pressed into sides. Storing materials and tools waist high rather than on the ground will prevent soft tissue injuries, especially back injuries.

Knowing stretching exercises and other ergonomic controls are supported by the field management team and upper management are important aspects to getting workers to help protect themselves

Specific Exposure Types for Grading Work	Measures to Control Exposures	Instructor Notes
<ul style="list-style-type: none"> • Placement of MOT <ul style="list-style-type: none"> – Repetitive motion – Lifting/carrying 	<ul style="list-style-type: none"> • Employee rotation/help • Motorized equipment when possible 	<p>Teach workers to push with the legs, not pull with the back.</p> <p>Discuss rotation – not having one person do the same job every minute of the day.</p>
<ul style="list-style-type: none"> • Acclimatization of employees <ul style="list-style-type: none"> – Heat/cold adjustment 	<ul style="list-style-type: none"> • Layer clothing • Provide water and shade • Educate for heat- and cold-related medical issues • Stretching is more important 	<p>The seasons of change – cold to hot or hot to cold – are especially dangerous. It takes the human body some time to grow accustomed to the change (acclimatize).</p> <p>Discuss warning signs:</p> <ul style="list-style-type: none"> • Cold <ul style="list-style-type: none"> – Numbness/tingling of extremities – White skin – Skin cold to touch – Extreme weakness, tiredness • Heat (Heat stroke treated as a medical emergency, call 911) <ul style="list-style-type: none"> – Red, dry skin – Sweating, then stop – Weakness – Nausea – Disorientation
<ul style="list-style-type: none"> • Material handling • Lifting/moving heavy equipment 	<ul style="list-style-type: none"> • “NO MORE ON THE FLOOR” • Utilize product bags with minimal weight • Lift and carry close to the body • PPE • Stretch program • Use of powered equipment • Get help • Rotate workers • Change positions frequently 	<p>Store materials at approximate hip height, ensuring they are secure and will not fall.</p> <p>Discuss use of padding for shoulders when carrying loads there. Nerve impingement is close to surface there.</p> <p>Discuss how our body loses strength as we hold a load further from our torso.</p> <p>Discuss the importance of stretching prior to handling materials. Go over the company’s stretching program. If you do not have one – develop one.</p> <p>Adequate PPE when carrying can include shoulder pads and gloves – even good work boots.</p>

Specific Exposure Types for Grading Work	Measures to Control Exposures	Instructor Notes
<ul style="list-style-type: none"> Using improper lifting techniques 	<ul style="list-style-type: none"> Educate workers on proper techniques Get help when heavy or awkward lifting is encountered Use good technique, even for light lifts. Position material with future need to lift in mind – “No more on the floor” 	<p>The weight of the tools should be considered, along with lifting and twisting required when handling.</p> <p>Ask class to develop a “how to lift properly” list. Adhere to proper lifting techniques such as:</p> <ul style="list-style-type: none"> Back straight Use legs to lift, not back Avoid twisting <p>Discuss the “No More On The Floor” concept of storing materials approximately hip height to help avoid bending to lift.</p>
<ul style="list-style-type: none"> Failure to ask for help 	<ul style="list-style-type: none"> Worker education Company lifting/carrying policy 	<p>Workers tend to try to do more than they should sometimes. Younger workers want to prove they have the “right stuff” to do the job. Older workers may want to prove they can keep up with the younger workers. Ask the class for examples of times when they should ask for help.</p>
<ul style="list-style-type: none"> Improper dismount trailers, pickups, equipment 	<ul style="list-style-type: none"> Worker education <ul style="list-style-type: none"> Don’t jump Look at ground before dismount 	<p>Jumping from a pickup bed has led to many sprained or strained ankles and knees as well as numerous fractures.</p> <p>Educate workers to resist the urge to jump off equipment.</p>
<ul style="list-style-type: none"> Work activities <ul style="list-style-type: none"> Reaching Carrying Pushing Pulling Digging Sawing Repetitive motion Overexertion Poor posture Poor housekeeping 	<ul style="list-style-type: none"> Knee pads Ongoing employee education Using proper lifting techniques Three-point mount/dismount of trailers, equipment, and pickups Good housekeeping Take breaks OSWPS – Operators Stand When Possible and Stretch 	<p>Maintain access ladders and footwear as clear of mud and similar slippery surfaces as possible.</p> <p>Use gloves to minimize hand and finger injury potential.</p> <p>Dirt moving operations are physically demanding. Operators face hours of sitting in one seat, often with whole body vibrations that shake them constantly.</p> <p>Worker rotation and relief should be planned ahead so no one has to perform the hottest jobs for too long a period. Heat and cold extremes can make soft tissue more susceptible to injury so stretching is more important.</p>



Short-Term and Mobile Operations

Introduction

Approximately 90% of construction worker fatalities and serious injuries involve a fall, being struck by something, being caught in or between things or electrical shock.

In addition soft tissue injuries (STIs), usually seen as strains or sprains, are one of the most frequent injury types in this work. STIs are rarely fatal but can, and do, have a serious impact on the injured worker and families' quality of life.

In mobile or short-term work, we frequently find workers within feet, even inches, of vehicles weighing tons traveling at a high rate of speed. The responsible crew must have an

emergency plan to address challenges resulting from injuries.

Fractures, contusions, crushing, foreign objects in the eye, strains, and sprains are common injury types.

Workers in short term/mobile work may be more "on their own," as actions and reactions are fast paced. The supervisor may not have time to respond. Thinking ahead, and developing a personal safe work plan for every activity is critical for every worker's personal success.

Specific Exposure Types for Mobile or Short-Term Work	Measures to Control Exposures	Instructor Notes
<p>Mobile or short-term work consists of work processes that complete within a shorter period of time. We have selected 24 hours as the maximum time through traffic may be diverted. In most operations, the work may flow in real-time with no follow-up traffic interruptions. Some examples considered are:</p> <ul style="list-style-type: none"> • Concrete sawing and lift-out • Shoulder work • Striping • Surface Treatments • Asphalt Patchwork • Storm water drain clearing <p>Mobile or short-term work shares some hazards with other forms of street/road/highway work. These include exposure to moving traffic, exposure to environmental conditions, and heavy work involving lifting, pushing, and pulling. Falls from equipment, working in close proximity to backing equipment, and slips, trips, and falls are also common.</p>	<p>Control methods are means employed to lessen the risk of accident or injury. Control methods are rarely 100% effective, but history has proven that workers can follow procedures and significantly reduce the chance they, or coworkers, will be involved in an accident or sustain an injury.</p> <p>In this column, we will identify control measures that will help reduce the risk of accident or injury if implemented.</p>	<p>Welcome your class and try to put them at ease. Tell them how you are going to discuss the work they do and how to do it without injury.</p> <p>One good method to put crews at ease is to ask each one how long they have been doing this type of work. Keep track of the years experience for each, and when everyone has provided their input, total the years. This is usually a high number and showing the individuals how much experience they share in total helps them approach the training with some confidence.</p> <p>As the educator, make sure you know the scope of the work they usually perform and tailor your discussion to meet those needs. For instance, do they perform tasks that occur within and existing work zone or are they outside any structured work zone? Do they work primarily during daylight hours or at night?</p> <p>Adult Learning Basics:</p> <ul style="list-style-type: none"> • Adult learners do best when addressing real-world problems they face in their life. • Set the stage so attendees understand why this training is important to them in terms of their lifestyles and families, as well as employment. • Set parameters up front – breaks, question/answer, etc. • Adults learn best from experience, not note taking. If you cannot get them in the field, discuss operations they perform, use pictures. • Adult learners do best when involved – ask questions, try to get everyone to say something. • Ask the question, give the group a few seconds to think about it, and then call on someone to say what they think. • Ask several to answer then play off the answers. • Ask questions before (to discover what they already know), during (for involvement and repetition to improve learning) and then after (to see what they learned) the session. • Structure the session loosely to allow for spontaneity – a good learning tool.

Specific Exposure Types for Mobile or Short-Term Work	Measures to Control Exposures	Instructor Notes
<p>Mobile or short-term has one hazard that is specific to this type of work – the lack of firm barriers for worker protection. Much of this work may be in front of a truck with an arrow-board.</p> <p>This work usually requires traffic control. Remember some 91% of highway worker deaths in work zones are from being struck by a vehicle or equipment. A great many of those involve dump trucks, mostly while backing.</p>		<ul style="list-style-type: none"> You, the educator, have to believe in the material before you can make others believe in it. Always remember you, the educator, are in charge of the group. Maintain looseness but control, do not let discussions wander aimlessly, keep on topic, and meet your promised goals.

Short-Term and Mobile Operations

Falls

Falls in resurfacing work are likely from equipment or slips, trips, or falls working on level ground around the equipment.

Falls from equipment may result in severe contusions and broken bone injuries, even fatalities. Slips and trips may result in abrasions, contusions, fractures, and even fatalities.

A person who is falling is out of control and the extent of the injuries resulting from the fall depend on the distance of the fall, the angle of the body when it lands, and anything it may strike during the fall or landing. A same-level trip or slip fall can result in a fatality if the person strikes his or her head wrong.

Specific Exposure Types for Mobile or Short-Term Work	Measures to Control Exposures	Instructor Notes
<ul style="list-style-type: none"> General 	<ul style="list-style-type: none"> Safety First Attitude Ongoing Employee Education Teamwork 	<p>Although falls from heights during mobile or short-term operations are not the most common injuries, many times they can be serious. These falls frequently happen to truckers getting in and out of trucks.</p> <p>Workers must be educated to recognize the hazard of being around and behind moving vehicles and taught methods they can employ to avoid being injured. In these types of operations, vehicle/equipment movement is much more frequent and therefore a bigger hazard to workers.</p> <p>A good exercise is to ask attendees what they do and involve everyone in discussion.</p>

Specific Exposure Types for Mobile or Short-Term Work	Measures to Control Exposures	Instructor Notes
<ul style="list-style-type: none"> • Elevated Work <ul style="list-style-type: none"> – Bridge – Ramps – From vehicle – Unguarded Elevated Surfaces – Wet/Slick Environment 	<ul style="list-style-type: none"> • Maintain Awareness • Proper Lighting • Ensure truck steps in place and in good condition • Ensure handrails on trucks are adequately maintained • Steps are non-skid • Proper PPE • Personal fall protection if elevated stationing required 	<p>The practice of riding pickup beds unprotected should be controlled, even with slow moving vehicles.</p> <p>Discuss the importance of good housekeeping on equipment. Operators or workers moving about the deck usually have their mind on something else, not watching what they might trip over.</p> <p>Discuss the company policy for reporting/repairing damaged or defective steps, ladders, handholds, etc. on equipment.</p>
<ul style="list-style-type: none"> • Same Level <ul style="list-style-type: none"> – Slips/Trips – Sawing – Shoveling – Slip/trip while avoiding incoming vehicle 	<ul style="list-style-type: none"> • Exceptional housekeeping • Worker awareness/positioning • Inspect jobsite during the day 	<p>Proper work boots and work areas free of material, debris, etc. for workers are important.</p> <p>Workers must maintain constant awareness of their surroundings and always know where they are going to run or jump to get out of the way.</p> <p>Good housekeeping on the ground is also critically important.</p>

Short-Term and Mobile Operations

Struck by

Approximately 22% of all construction worker fatalities involve being struck by something.

For 1992 – 2000 worker deaths in work zones, 91% of 910 worker deaths involved vehicles, most being dump trucks.

NIOSH records indicate that in 2005, 390 workers were killed in struck-by incidents, accounting for 7% of all occupational fatalities.

Injuries range from contusions, lacerations, and STIs to fractures, crushing, and fatalities.

Current estimations are that more than one-half of the workers killed in highway work zones are killed by construction vehicles. These accidents usually involve crushing injuries and fatalities.

ALL workers, subcontractors, and haulage employees that will enter the work zone should, at a minimum, receive a basic orientation to that site, to include at least internal construction traffic flow, means of entering and exiting the work area, emergency escape path designations, required PPE, and emergency signals for vehicle intrusions into the work area. This includes law enforcement vehicles/personnel assisting with MOT.

Preplanning and training of workers should address Unified Incident Command at accident sites (who is in charge) as well as measures to protect workers during an incident. Topics should address the increased hazards of traffic, fire, and HAZMAT resulting from an accident (fuel, cargo, debris, and biohazards) that may result.

Wherever possible, traffic control measures for short-term work should include means prevent unplanned intrusions into the work area by use of sturdy barriers. Means and methods that include impact attenuators or barriers (Jersey Barriers, K-Rail, etc) are preferred beyond simple channelizing methods (cones, barrels, etc). Ongoing documented inspections of emplaced traffic control should be implemented, and needed corrections made in a timely manner.

Specific Exposure Types for Mobile or Short-Term Work	Measures to Control Exposures	Instructor Notes
<ul style="list-style-type: none"> • Work zone Intrusions <ul style="list-style-type: none"> – Reduced visibility – Impaired Drivers – Inattention – Limited Physical Barriers – Lack of knowledge/experience – Working behind nonpositive barriers 	<ul style="list-style-type: none"> • Practice “See & Be Seen” • Personal flashing lights • Worker awareness/positioning • Housekeeping • Mud/slick surface control • Use of boots with slip-resistant soles • Constant vigilance • Constantly refreshed escape plan • Position arrow-board truck properly 	<p>The sturdiest barrier available is often an arrow-board truck. Ensure understanding about positioning the truck properly.</p> <p>Clearance between equipment and moving traffic is frequently measured in inches, not feet. Constant awareness of personal location in relation to work zone boundaries is critical.</p> <p>Workers at the critical point where oncoming traffic is approaching the work zone should be aware of the hazards of vehicle intrusion and worker abuse. A warning sounded by them can provide the few seconds critical to avoiding fatalities. Workers near the edge of work zones should never turn their back to oncoming traffic. Ask if anyone has worked a job where a worker was struck by a vehicle and, if so, discuss events immediately before, during, and after the incident.</p> <p>Discuss what methods will be utilized to sound intrusion warnings. For example, do flag persons have an air horn immediately available? What method will other workers use?</p>
<ul style="list-style-type: none"> • Traffic control may fail due to: • Driver inattention <ul style="list-style-type: none"> – Cell phones – Crying kids – Working while driving • Driver Impairment (mental or physical) <ul style="list-style-type: none"> – People drink, smoke pot, do other drugs, then drive – Handicapped – Aged – Infirm – illness • Environmental conditions <ul style="list-style-type: none"> – Geographical <ul style="list-style-type: none"> • Curves • Hills • Lack of coordination of workers from multiple companies 	<ul style="list-style-type: none"> • See And Be Seen <ul style="list-style-type: none"> – Use proper PPE to ensure visibility to passing motorists – Use constant vigilance to be aware of your surroundings – Use eye contact to help determine motorists’ intent • Workers always have mental escape plan • Educate workers to recognize this hazard and know controls • Plan MOT placement so seasonal changes will not affect visibility • Hold frequent coordination meetings with subs, crews, and communication plans 	<p>Ask class to list reasons drivers may enter the work zone even if the MOT is placed properly. Make sure they understand that even the best efforts on their part cannot control a drunk or high driver.</p> <p>Curves and hills can hide what is just ahead – if that is a short-term job with a few cones or a flagger station, a serious accident could occur. Place all MOT so it will be visible to oncoming drivers. Signs placed near trees in the winter may be hidden by spring growth of leaves.</p> <p>Coordination between contractors working near each other is critical to avoiding accidents. Ask for examples of supervisors working with other companies to ensure everyone is protected. Discuss your company policy.</p> <p>Discuss historical incidents where traffic control has failed and vehicles have intruded into the work areas. Base discussion on knowledge of attendees or documentation from a source such as NIOSH FACE reports or OSHA Fatal Facts.</p>

Specific Exposure Types for Mobile or Short-Term Work	Measures to Control Exposures	Instructor Notes
<ul style="list-style-type: none"> • Equipment and construction vehicle traffic within work zone <ul style="list-style-type: none"> – Equipment/employee moves into oncoming traffic – Loading and unloading of equipment – Blind Spots – Glare – Complacency – Worker visibility reduced due to poor ambient lighting 	<ul style="list-style-type: none"> • Pre-established and known traffic flow plan • Maintain Awareness by all • Safety First Attitude • Proper Worker Position • Back-up Alarms/Spotters/Back-up Cameras • Ongoing worker education • Proper Lighting • Vehicle/Equipment Inspection • Teamwork • Stage vehicles so if hit, vehicle will turn into barrier 	<p>Ensure that workers understand this is the one hazard that kills more workers than any other. Understanding this hazard and the controls is critical to their future.</p> <p>Backing is less than 1% of fleet mileage but accounts for approximately 30% of all accidents.</p> <p>Caterpillar, Inc. has developed blind area diagrams for all of their vehicles and equipment to help the operators and WOF determine areas to avoid when working around this equipment.</p> <p>Proximity Warning Devices are being designed that notify the drivers of company vehicles, such as dump trucks, the location of not only flag persons but also other WOF who are used in the unloading and material placement process.</p> <p>Go over the internal traffic control plan, make certain all workers understand which paths are for equipment, which are for workers on foot.</p>
<ul style="list-style-type: none"> • Working near rotating/moving equipment 	<ul style="list-style-type: none"> • Adequate lighting to ensure visibility of workers • Constant vigilance • Layout of work area • Planned foot traffic flow • Adequate back-up alarms • Proximity Warning Devices • Personal flashing lights on workers' PPE 	<p>When working around moving equipment such as backhoes, ensure workers' position is such that the equipment cannot strike them.</p> <p>Ask if anyone has had a narrow escape or seen anyone else almost struck by equipment.</p> <p>Discuss potential accidents and serious injury to public if equipment is stationed so it rotates into the path of public traffic.</p>
<ul style="list-style-type: none"> • Debris <ul style="list-style-type: none"> – Thrown – Blown by wind – Falling <ul style="list-style-type: none"> • Off passing vehicle • Equipment contact with power lines 	<ul style="list-style-type: none"> • Adequate PPE – eyes, face, and head • Watch approaching vehicles for visible motion inside – arm moving, etc. • Keep debris away from work zone. • General Contractor establish overhead clear zone • Observe approaching vehicles, especially pickups, for loose articles. • Avoid working under booms and suspended loads 	<p>Passersby, especially those young and/or drunk, may throw cans, bottles, etc. at workers, mostly flag persons. Always face moving traffic and be aware of the potential for flying debris.</p> <p>Hardhats and vests with personal flashing lighting are now available to help make workers at the edges of the work zone more visible.</p> <p>Powerline contact can create falling parts, loads, and debris in addition to the electrical hazard. Avoiding the contact is the best control.</p> <p>Avoiding the area near and under suspended loads is also important.</p> <p>Discuss use of tag lines to control load while avoiding standing under the load.</p>
<ul style="list-style-type: none"> • Public vehicle accidents within the work zone 	<ul style="list-style-type: none"> • Increase worker exposure to traffic • Unified Incident Command • Safety plan inclusion • Education 	<p>Discuss with the group company requirements regarding responding to traffic accidents within or near the work zone. Stress the principle that rescuers must not place themselves in danger. Go over reporting plan.</p>

Short-Term and Mobile Operations

Caught in / between

Approximately 18% of construction worker fatalities involve being caught in or between objects.

Such injuries often involve a section of the body being crushed. Fatalities can be instantaneous or occasionally the pinned person may be alert but will die in a short time. There have been documented cases where the loved ones of workers caught in/between objects were rushed to the site to say good-bye before the worker died.

Amputations are also a frequent result of caught in/between accidents. Fingers may be most frequently affected, but workers also lose arms and legs at times.

Truck drivers and mechanics have been caught in the vehicle driveshaft, in joints of the chute, and in turning gears; workers have been caught between the backing truck and the paver hopper, and mechanics have been caught between the bed and truck frame when a bed fell. Intrusion of public vehicles into the work zone may result in workers being caught between that vehicle and stationary objects.

Caught in/between injuries are rarely minor. Injury types frequently seen include:

- Lacerations
- Amputations
- Crushing
- Fractures
- Burns
- Contusions
- Fatality

Workers may be crushed between backing equipment or vehicles and other equipment. This is a frequent cause of worker death in street/road/highway work.

Specific Exposure Types for Mobile or Short-Term Work	Measures to Control Exposures	Instructor Notes
<ul style="list-style-type: none"> • Equipment operation • Moving/rotating equipment parts 	<ul style="list-style-type: none"> • Proper equipment labeling • Ongoing worker education • Proper guarding of rotating equipment • PPE • Education • Teamwork • Position to stay clear 	<p>Short-term work often involves a get-in, get-it-done, get-out attitude. Workers may tend to take more chances by positioning themselves close to operating equipment to save time.</p> <p>Discuss this attitude and how trying to hurry often slows operations down when an accident happens.</p> <p>Discuss how workers must control their instinct to rush in and work fast. Thinking ahead and developing a personal plan for safe, productive work is critical in performing successful short-term work.</p>
<ul style="list-style-type: none"> • Equipment maintenance 	<ul style="list-style-type: none"> • Compliance audits/correction • Proper PPE • Lockout/tagout equipment • Block if raised 	<p>During maintenance of truck mechanisms, avoid pinch points.</p> <p>All mechanical work must be performed so the mechanic has positive assurance the vehicle or equipment will not start or move unexpectedly. Frequently, this includes keeping the key in their pocket. Mechanics are killed every year because they were crushed by parts that were raised, but not well secured, falling on them.</p>

Specific Exposure Types for Mobile or Short-Term Work	Measures to Control Exposures	Instructor Notes
<ul style="list-style-type: none"> Complacency, Inattention 	<ul style="list-style-type: none"> Electronic (radio) Train to expect/cooperate Discuss paying attention frequently, before work, after breaks, etc. 	<p>Even in short-term work, repetition can make workers complacent. Discuss company policy (which should be no personal listening devices while working) and the reason they are important.</p>
<ul style="list-style-type: none"> Improper communication 	<ul style="list-style-type: none"> Ensure everyone understands common warning words in English <ul style="list-style-type: none"> Develop informal class with best translator for common terms, work on daily Develop system of signals for use when understanding is difficult 	<p>There are many challenges to understanding each other. Differences in the primary language spoken, regional dialects, background noise, and workers with poor hearing ability – all play a part. Short-term work is usually fast paced and understanding verbal information is critical to success.</p> <p>Discuss difficulties workers have seen first-hand. Discuss what they did to overcome those difficulties and what they might do in the future.</p>
<ul style="list-style-type: none"> Loading/unloading 	<ul style="list-style-type: none"> Hands clear of pinch points 	<p>Unloading large pipe and preformed concrete structures are common in even short-term work.</p> <p>Ask if anyone has ever seen a load shift or an accident involving loading/unloading materials. Discuss what could have prevented it.</p> <p>Discuss company requirements, such as placing heavy equipment beside truck beds to prevent roll-off accidents, etc.</p>
<ul style="list-style-type: none"> Backhoe work 	<ul style="list-style-type: none"> Employee positioning clear of pinch points Operator awareness and due care Barricade truck bed sides to prevent roll-off accidents 	<p>It is human nature to want to be close to the action. Workers standing close to the working bucket of a backhoe are often seen in work zones. Couple improper positioning with inattention, blind spots, and background noise, and workers are sometimes struck by the moving bucket.</p> <p>Ask about narrow escapes, accidents, etc. Point out the benefit of staying clear of the swing radius of the bucket.</p>
<ul style="list-style-type: none"> Vehicular traffic within work zone <ul style="list-style-type: none"> Backing vehicle 	<ul style="list-style-type: none"> Internal Traffic Control Plan Worker positioning Minimize backing Rear-view Cameras Back-up alarms “No see” chart training “See and Be Seen” 	<p>Working adjacent to concrete barriers and around live traffic creates opportunities for pinch points. An Internal Traffic Control Plan is critical to the safety of WOF. Ensure that whenever possible, trucks and equipment do as little backing up as possible with the work areas.</p> <p>Backing vehicles pinning workers between the rear bumper of the vehicle they are driving and another object such as a pole, piece of equipment, etc. happens far too often. Back-up alarms help and are required by law but are not the only answer. Unfortunately, construction workers become accustomed to hearing them and mentally block the sound. Workers may have impaired hearing.</p> <p>Companies that make equipment frequently found in work zones are beginning to develop and make available charts for equipment that shows the blind spots the operator has. Employee education in blind spot recognition makes good weekly safety meetings and helps prevent accidents.</p>

Specific Exposure Types for Mobile or Short-Term Work	Measures to Control Exposures	Instructor Notes
<ul style="list-style-type: none"> • Vehicular traffic <ul style="list-style-type: none"> – Intruding vehicle 	<ul style="list-style-type: none"> • Guarding <ul style="list-style-type: none"> – Arrow-board truck • Position to stay clear • Constant vigilance 	<p>A pre-planned escape route is a very important element in setting up traffic control work. Ask class to describe what they do now and how they might improve to better prepare themselves for any future incident.</p> <p>Previously mentioned MOT barriers, properly rated high-visibility clothing, etc. are all important in avoiding such accidents.</p>
<ul style="list-style-type: none"> • Noise 	<ul style="list-style-type: none"> • PPE for sawing/impact work • Noise-canceling headphones 	<p>A work zone can be a noisy environment. Short-term work is usually positioned close to moving traffic with a great deal of background noise.</p> <p>Headphones that cancel out the background noise, leaving speech easier to understand, are becoming more easily available and cheaper. They allow unusual noises to be heard by the wearer.</p>

Short-Term and Mobile Operations

Electrical

Approximately 17% of construction worker fatalities involve an electrical current.

Injuries resulting from electrical contact include severe burns, unconsciousness, loss of mental and/or physical ability for the remainder of the worker's life, and frequently a prolonged period of suffering, then death. Death may be immediate.

Electrical current passes from point of contact with a live circuit through the body to an exit point where the body is grounded. An example is a worker who is holding a metal signpost, and who touches a short-circuited generator that is not grounded. The current would pass from one hand, through the lungs and heart, and out the other hand.

If an electrical arc is involved, burns from molten metal and severe respiratory distress from breathing superheated air are likely.

A severe shock or lightning strike can burn a worker to death as other workers look on. This can create a post-traumatic stress type injury to survivors.

Workers are at risk from electrical shock when a truck or backhoe boom comes in contact with overhead power lines. Lightning strikes also pose a significant hazard.

The greatest hazard may be when current travels a path through the body that goes through the chest, involving the heart and lungs.

Specific Exposure Types for Mobile or Short-Term Work	Measures to Control Exposures	Instructor Notes
<ul style="list-style-type: none"> • Electrical equipment <ul style="list-style-type: none"> – Portable generators – Lighting plants <ul style="list-style-type: none"> • Improper grounding • Poorly maintained equipment 	<ul style="list-style-type: none"> • Inspect/maintain equipment • Proper grounding • Use GFCI • Maintain Awareness • Proper PPE • Use insulated tools • Perform lockout/tagout • Electrical wiring meets code • Ground prong for extension cords 	<p>Grounding all portable electrical equipment and using GFCIs for all portable electrical tools is essential to electrical safety.</p> <p>Discuss company requirements and means of accomplishing 100% grounding of portable electrical equipment.</p>

Specific Exposure Types for Mobile or Short-Term Work	Measures to Control Exposures	Instructor Notes
<ul style="list-style-type: none"> • Unmarked utilities • Overhead power line • Cutting underground utilities 	<ul style="list-style-type: none"> • Avoid contact • Identify <ul style="list-style-type: none"> – One Call – Potholing • Maintain Awareness • Mark locations on ground • Minimize exposure – maintain distance 	<p>Far too frequently, equipment will contact a live overhead power line. An electrical charge can jump a gap, creating an arc that energizes the equipment so contact is not even necessary. Such contact can energize the ground with the potential lessening as the distance from the point of contact increases. A concrete worker walking nearby can receive a severe shock from stepping across invisible differences in potential in the ground as well as from being in physical contact with the energized truck.</p> <p>Discuss means and methods of marking overhead utilities on the ground to increase awareness of workers on foot and operators.</p>
<ul style="list-style-type: none"> • Equipment operations <ul style="list-style-type: none"> – Taking short cuts – Using improper equipment for the job 	<ul style="list-style-type: none"> • GFCI use 100% of time • Ongoing employee education • Use correct tool for the job 	<p>Even when mobile operations are performed an emergency basis, care should be taken to ensure all equipment is in good condition and safe to operate, and well-trained operators are utilized.</p> <p>Ask if anyone has observed defective equipment in use on a job and the company process for repair or replacement.</p>
<ul style="list-style-type: none"> • Weather related lightning 	<ul style="list-style-type: none"> • 30-30 Rule: <ul style="list-style-type: none"> – 30 seconds between flash and thunder – take cover – 30 minutes after seeing the last flash – resume work • Do NOT: <ul style="list-style-type: none"> – Be the tallest object – Stand in the open – Stand under a tree – Stand in a gazebo or open shelter – Stand next to or touch metal objects – Stay next to water – Use electrically powered tools – Use a plug-in phone or computer with modem • Do: <ul style="list-style-type: none"> – Get into an enclosed building – Get into a car, truck, or van 	<p>Lightning is another issue. Lightning can strike 10 miles in front of a storm. 30% of those struck by lightning die, most within an hour. Approximately 74% sustain some sort of permanent disability.</p> <p>Handheld electronic devices that measure the distance to the closest lightning strike can provide ample warning to allow workers to seek safety.</p> <p>Tuning a radio to the AM band allows the static blast of lightning strikes to be heard.</p> <p>Every company with outside work should have a standard lightning policy that superintendents/foremen must know and enforce. Discuss you company policy and ensure everyone understands it.</p> <p>That policy should address when to send workers to cover, that the cover does not include trees, metal objects, high, clear ground, etc. and when to return to work.</p> <p>Every project plan should have a section on lightning. Standardizing the process for protecting workers helps eliminate inconsistencies from job to job, even day to day.</p>

Short-Term and Mobile Operations

Soft tissue

Mobile operations are almost always physically demanding. Such operations may include sign placement, guardrail installation, asphalt patching, small concrete patching, landscaping, stripe work, shoulder maintenance, etc.

Soft tissue injuries – strains and sprains primarily – are the number-one injury type in highway/street/road work.

Strains and sprains can have a greater negative impact on a workers, their families, and the company than any injury short of a fatality. A person who severely injures his or her back may never be able to pick up children or grandchildren.

Mobile, short-term operations increase the risk because the focus of such work is speed – the necessity to achieve an established goal within a specified time frame. This can cause rushing and shortcuts. Those invariably lead to sprain and strain injuries.

Specific Exposure Types for Mobile or Short-Term Work	Measures to Control Exposures	Instructor Notes
<ul style="list-style-type: none"> • Placement of MOT <ul style="list-style-type: none"> – Repetitive motion – Lifting/carrying 	<ul style="list-style-type: none"> • Employee rotation • Motorized equipment when possible • Get help • Push – not pull 	<p>Pushing/pulling on concrete barriers as they are moved into place causes muscle strains.</p> <p>Educate workers to push using the legs, not pull using the back.</p>
<ul style="list-style-type: none"> • Acclimatization of employees <ul style="list-style-type: none"> – Heat/cold adjustment 	<ul style="list-style-type: none"> • Layer clothing • Provide water and shade • Educate for heat- and cold-related medical issues • Stretch more important • Watch each other 	<p>The critical periods are when the weather first changes from hot to cold or cold to hot.</p> <p>Educate workers to understand the hazards in becoming too hot or too cold. Teach them the warning signs:</p> <ul style="list-style-type: none"> • Heat <ul style="list-style-type: none"> – Stop sweating – Dry, red skin – Disorientation – Nausea • Cold <ul style="list-style-type: none"> – White, tingling skin – Tiredness – Shivering
<ul style="list-style-type: none"> • Material handling • Lifting/moving heavy equipment • Using improper lifting techniques • Failure to ask for help • Improper dismount of trailers, pickups, equipment 	<ul style="list-style-type: none"> • “NO MORE ON THE FLOOR” – Store materials approximately waist high • Utilize product bags with minimal weight • Lift and carry close to the body • PPE 	<p>Worker rotation and relief should be planned so no one has to perform the hottest jobs for too long a period. Heat and cold extremes can make soft tissue more susceptible to injury, so stretching is more important.</p> <p>Adequate PPE when carrying can include shoulder pads and gloves – even good work boots. Good gloves and boots are especially important.</p> <p>The weight of the tools should be considered, along with lifting and twisting required when handling.</p>

Specific Exposure Types for Mobile or Short-Term Work	Measures to Control Exposures	Instructor Notes
<ul style="list-style-type: none"> • Work activities <ul style="list-style-type: none"> – Reaching – Carrying – Pushing – Pulling – Digging – Sawing – Repetitive motion – Overexertion – Poor posture <ul style="list-style-type: none"> • Forced repetition/ Posture • Poor housekeeping 	<ul style="list-style-type: none"> • Stretch program • Use of powered equipment • Get help • Rotate workers • Change positions frequently • Educate workers on proper techniques • Use of powered trowel • Use of two trowels, one for support • Knee pads • Ongoing employee education • Using proper lifting techniques • Three-point mount/dismount of trailers, equipment, and pickups • Good housekeeping • Taking breaks • Follow written procedures 	<p>Understanding how stretching helps construction workers, just like it does athletes.</p> <p>A good education program will ensure employees know the ergonomic hazards and can recognize when they or co-workers are at risk. They also have to know how to control the exposure to minimize their risk of injury.</p> <p>Knowing the field management team and upper management support stretching exercises and other ergonomic controls are important aspects to getting workers to help protect themselves.</p>



Appendices

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AGC/Zurich Workzone Product Resource Guide

Name of Resource	Description	Organization	URL
MUTCD home page	Home page of the MUTCD web site	US DOT – FHA	http://mutcd.fhwa.dot.gov/index.htm
Report-Work Zone Safety Issues	Discussion report on workzone construction impact on fatalities	NHTSA	http://www.nhtsa.dot.gov/people/injury/aggressive/aggressive%20capital%20beltway/workzone_safety.html
Research Paper	Use of FARS to answer question: “Do older drivers have more crashes in construction work zones?”	Fatality Analysis Reporting System	http://filebox.vt.edu/users/eolsen/files/papers/olsen_2000_older_workzone.pdf
Asphalt workzone safety guide	Comprehensive WorkZoneSafetyGuide	The Colorado Asphalt Pavement Association – Work Zone Safety Committee	http://www.co-asphalt.com/documents/WorkZoneSafetyGuide.pdf
Article from “Government Engineering”	Informative article explaining “Intelligent Transportation System” in Work Zones	“Government Engineering”	http://www.govengr.com/ArticlesSep05/workzone.pdf
NC-DOT script of speech	Speech – 2005 Work Zone Safety Awareness Month Kick-off Event – general interest information, most state specific	NC-DOT	http://www.ncdot.org/doh/safety/workzone/Awareness/2006/DeVanesRemarks.pdf
Oregon DOT fact & tip sheet	Work Zone Safety Fact Sheet & Safety Tips – hits high points	Oregon DOT	http://www.oregon.gov/ODOT/TS/docs/Workzone/WZ_Facts_2007.pdf
Oregon DOT article	Article – A dangerous occupation – good safety meeting material	Oregon DOT	http://www.oregon.gov/ODOT/TS/docs/Workzone/WZjob2006.pdf
SafeRoads.org paper on work zone intersections safety	Brief – Intersection Safety	SafeRoads.org	http://www.saferoads.org/Intersection-RLR/ITE%20factsheets%20Intersection%20RLR/workzones.pdf
Iowa Workzone safety resource page	Information sources – work zone safety	Iowa DOT	http://www.iowadot.gov/workzone/index.htm
Laborers H & S Fund Comprehensive Workzone Safety resources	External resources page with links to workzone programs and other information.	Laborers H & S Fund of North America	http://www.lhsfna.org/index.cfm?objectID=98C69A27-D56F-E6FA-98B79A404AA09856
South Dakota State University – Video Recommendations	Listing of video resource recommendations with description	South Dakota State/Engineering	http://www.engineering.sdstate.edu/~sdltap/frames/LiabilityPage.htm
Safety & Work Zone Education/Training guidelines	Safety & Work Zone Competency Matrices	US DOT/FHA – NHI	http://www.nhi.fhwa.dot.gov/tccc/matrix05.htm
US DOT – FHA NIGHT Work Zone Safety	Improving Traffic Control for Night Work Zones	US DOT/FHA	http://safety.fhwa.dot.gov/wz/wzn2.htm

Name of Resource	Description	Organization	URL
US DOT – FHA Work Zone Safety	Worker Safety and Visibility	US DOT/FHA	http://safety.fhwa.dot.gov/wz/wzw5.htm
Workzonesafety.org home page	Home Page – links to more information than any other web site on this topic.	The National Work Zone Safety Information Clearing House	http://www.workzonesafety.org/
NIOSH Highway Workzone Safety book – downloadable	Booklet – Building Safer Highway Work Zones: Measures to Prevent Worker Injuries From Vehicles and Equipment	NIOSH	http://www.cdc.gov/niosh/docs/2001-128/
GHSA – State Highway Safety Laws	State laws, other useful information	Governors Highway Safety Association	http://www.ghsa.org/html/stateinfo/index.html
Maryland DOT – Work Zone Safety and Mobility	Work Zone safety information	Maryland DOT	http://marylandroads.com/safety/workzone.asp
workzonesafety.org	By state listing of Flagger training/certification requirements	The National Work Zone Safety Information Clearing House	http://www.workzonesafety.org/training/flagger_training
workzonesafety.org	Tool box talk information and links	The National Work Zone Safety Information Clearing House	http://www.workzonesafety.org/training/toolbox_talks
Florida DOT Safety	Worker safety information	Florida DOT	http://www.dot.state.fl.us/safety/
NIOSH Safety and Health Topic:	Highway Work Zone Safety information and resources	NIOSH	http://www.cdc.gov/niosh/topics/highwayworkzones/
Electronic Library of Construction Safety & Health	Use search feature to locate information on any construction topic, such as workzones.eLCOSH	eLCOSH	http://www.elcosh.org/
Zurich Services Corporation			www.zurichservices.com
AGC Online Bookstore			www.agc.org/bookstore

AGC Products Reference:

Supervisory Training Program: Unit 7 (Accident Prevent & Loss Control)

The AGC Supervisory Training Program (STP) is designed to meet the specific needs of the construction professional. There are 12 courses in the entire STP curriculum – information about all 12 can be found on the STP web site (www.agc.org/stp). Seventh Edition, 2008.

Sessions include:

- An introduction to site safety and health management
- Safety leadership, communication, and expectations
- Planning for site safety
- Site safety management
- Site security and projection
- Multi-employer jobsite safety
- Construction risk management
- Safety and human resources
- Regulatory procedures, record keeping, and documentation
- Safety reference material and other resources

Supervisory Training Program: Unit Heavy/Highway (Construction Supervisor Overview)

The AGC Supervisory Training Program (STP) is designed to meet the specific needs of the construction professional. Topics covered in this session include: Leadership, Motivation, Problem Solving, Cost Awareness, Planning and Organizing, Production Control, Accident Prevention and Loss Control, and Project Documents. Third Edition.

Construction Tool Box Safety Talks Manual Vol. III

This manual has been written to assist supervisors on training workers in the class and on the jobsite. It includes 10 chapters and 150 new safety talks. Topics include: Caught in Between, Electrical, Environmental, Excavations, Falls, Health Hazards, Highway Hazards, Scaffolds & Ladders, Steel, and Struck By. Includes the full version on CD-ROM. 2007

Soft Tissue Injury Prevention Program

This material, co-developed by AGC of America and Zurich, focuses on why soft tissue injuries occur and highlights effective methods to reduce the number of soft-tissue injuries, such as back injuries, sprains and strains and pinched nerves – and most important, how you can reduce them. (Includes PowerPoint presentation.) 2005.

Load Securement: Know Before You Go

This DVD video reviews applicable requirements for transporting equipment and materials over the road. Unsecured cargo can injure workers or worse. Make sure you have a plan for safety. 2009

MUTCD (Parts 1, 5 & 6)

This book is a must-have for contractors involved in highway construction. The Federal Highway Administration has totally revised the Manual of Uniform Traffic Control Devices (MUTCD) Parts 1, 5, and 6 Temporary Traffic Control, and you are required to know about these new specifications and meet them. This manual will help you meet those requirements. Perfect bound, 7" x 9", over 285 pages, 2003 Edition.

Work Zone Traffic Control Supervisors

This guide is designed to be used as part of a training session that gives participants state-of-the-art knowledge of the entire process of planning, designing, installing, maintaining, and monitoring traffic control for work zones. This short course is a basic requirement essential to all persons involved in street and/or highway work. Includes MUTCD Part VI. 2002.

www.agc.org/bookstore



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While certain practices appear to be desirable, none can guarantee that highway worker injuries will not occur. This program does not create any obligations, or establish any specific standards or guidelines, for managing the risk of such injuries. It is not an exhaustive or complete treatment of its subject matter.

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