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Preventing Runovers and Backovers

Instructor Background Information

This training program was developed under contract 212-2009-M-32109 from the Centers for Disease Control and Prevention/National Institute for Occupational Safety and Health. The views expressed in these materials and video presentations do not necessarily reflect the official policies of the Department of Health and Human Services; nor does mention of trade names, commercial practices, or organization imply endorsement by the U.S. Government.

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Preventing Runovers and Backovers

Instructor Background Information

Overview:

This training program provides information to minimize runover and backover incidents in roadway work zones. Course materials contain information needed to develop and implement Internal Traffic Control Plans (ITCPs) on roadway construction sites as the primary means to reduce runovers and backovers. The target audience includes site workers, safety professionals and company safety officers, senior project managers, site superintendents and lead persons. The training would also be valuable for roadway owners including resident engineers and construction managers.

The program is designed to be broken apart for specific audiences. For example, Modules 1 & 2 could be used as stand-alone modules to train non-management employees (laborers, operators, truck drivers, etc.) about ITCP concepts so they would understand the importance of compliance with the program and basic concepts needed to implement ITCPs. Modules 1 & 2 could be further supplemented with the video and introductory slides from Module 7 if the construction project will include technology such as cameras and other proximity warning devices for this same audience.

For equipment operators and truck drivers, Modules 1, 2 and Module 3 should be combined to provide instruction on safe operations within the work area and proper methods for entering and exiting the work space. For site superintendents and lead persons, Modules 1 – 6 are appropriate. Module 7 contains detailed information related to collision avoidance technology and would be used only if the participants needed detailed information on these resources. A brief explanation of such technologies is included at the end of Module 2 and should be sufficient for most audiences.

Objectives:

Upon completion of the full course, participants should be able to do the following:

- Explain the most common cause of death and injury for roadway construction workers;
- Explain the elements of an Internal Traffic Control Plan and the hazards ITCPs are designed to mitigate;
- Discuss the roles and responsibilities all members of the construction team have with regards to successful deployment of an ITCP;
- Explain their role in ensuring an ITCP functions properly on a job site;
- Develop an ITCP for any project on which they will work;
- Implement an ITCP on a construction site

Instruction Time:

<i>Module</i>	<i>Presentation Time</i>	<i>Running Time</i>
1 – Principles of “Internal Traffic Control”	30 minutes	30 minutes
2 – Workers on Foot	30 minutes	60 minutes
3 – Access and Egress	40 minutes	100 minutes
4 – Productivity	20 minutes	120 minutes
5 – Roles and Responsibilities	30 minutes	150 minutes
6 – Developing the Program	90 minutes	240 minutes

Total Course Time **4 hours**

7 – Technology (optional)	60 minutes	300 minutes
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Module 1 – Principles of “Internal Traffic Control” for Roadway Construction:

Construction contractors, contracting agencies, and others responsible for work zone safety face the challenge of providing a safe workplace while ensuring the safe movement of the public through the work zone. Highway and street construction presents a complex work situation in which workers face multiple injury risks under conditions that may change without warning. The concept of an *Internal Traffic Control Plan* (ITCP) involves coordination of *construction traffic inside* the activity area of a temporary traffic control zone. The purpose of ITCP is to separate—to the extent possible—construction vehicles and equipment from workers on foot.

Those involved in roadway construction are likely familiar with *temporary traffic control plans* (TTCP) which describe how a specific work zone is to be set up to ensure the safety of the motoring public. Construction workers, equipment and vehicles within the work space, however, are not addressed in the TTCP. The internal traffic control plan (ITCP) is a process that project managers and others who have production responsibility for roadway construction projects can use to coordinate and control the flow of construction vehicles, equipment, and workers operating in close proximity within the work space to ensure the safety of workers.

ITCPs align smoothly with regulations issued by both the Occupational Safety and Health Administration (OSHA) and the Federal Highway Administration (FHWA) requiring development and execution of safety programs for construction workers. For example, FHWA’s *Manual on Uniform Traffic Control Devices* (MUTCD) contains the following prescription in Section 6B.01–Fundamental Principles of Temporary Traffic Control: “Road user and worker safety and accessibility in TTC zones should be an integral and high-priority element of every project from planning through design and construction.”

MUTCD Section 6D.03 Worker Safety Considerations

Support: Equally as important as the safety of road users traveling through the TTC zone is the safety of workers. TTC zones present temporary and constantly changing conditions that are unexpected by the road user. This creates an even higher degree of vulnerability for workers on or near the roadway.

Maintaining TTC zones with road user flow inhibited as little as possible, and using TTC devices that get the road user’s attention and provide positive direction are of particular importance. Likewise, equipment and vehicles moving within the activity area create a risk to workers on foot. When possible, the separation of moving equipment and construction vehicles from workers on foot provides the operator of these vehicles with a greater separation clearance and improved sight lines to minimize exposure to the hazards of moving vehicles and equipment.

Guidance: *The following are the key elements of worker safety and TTC management that should be considered to improve worker safety:*

A. Training—all workers should be trained on how to work next to motor vehicle traffic in a way that minimizes their vulnerability. Workers having specific TTC responsibilities should be trained in TTC techniques, device usage, and placement.

B. Temporary Traffic Barriers—temporary traffic barriers should be placed along the work space depending on factors such as lateral clearance of workers from adjacent traffic, speed of traffic, duration and type of operations, time of day, and volume of traffic.

C. Speed Reduction—reducing the speed of vehicular traffic, mainly through regulatory speed zoning, funneling, lane reduction, or the use of uniformed law enforcement officers or flaggers, should be considered.

D. Activity Area—planning the internal work activity area to minimize backing-up maneuvers of construction vehicles should be considered to minimize the exposure to risk.

E. Worker Safety Planning—a trained person designated by the employer should conduct a basic hazard assessment for the worksite and job classifications required in the activity area. This safety professional should determine whether engineering, administrative, or personal protection measures should be implemented. This plan should be in accordance with the Occupational Safety and Health Act of 1970, as amended, “General Duty Clause” Section 5(a)(1) - Public Law 91-596, 84 Stat. 1590, December 29, 1970, as amended, and with the requirement to assess worker risk exposures for each job site and job classification, as per 29 CFR 1926.20 (b)(2) of “Occupational Safety and Health Administration Regulations, General Safety and Health Provisions” (see Section 1A.11).

OSHA construction industry regulations (29 CFR* 1926, Subpart O) address operation of vehicles and equipment within an off-highway job site not open to public traffic. However, Subpart O is not exhaustive in its coverage of machinery types or safety equipment, nor does it address work practices, traffic control plans, or shift work. Flagging and signaling practices are discussed in general terms in Subpart G, which

covers signs, signals, and barricades. Subpart G defers to the 1971 MUTCD on matters relating to hand signals, barricades, and traffic control devices.

Compliance with the MUTCD and OSHA regulations is a necessary first step in providing a safe work environment. However, these sources, taken together, do not provide comprehensive guidance to ensure worker safety in highway work zones. To identify gaps in standards and regulations and to compile additional prevention measures to enhance worker safety, NIOSH undertook a comprehensive review of scientific literature, fatality and injury data, and current safety research. Many of the findings from nearly a decade of research are contained in this training program.

Internal Traffic Control Plans: In simple terms, ITCPs are a protocol to inform all parties operating within the work space about the location of others. ITCPs create “zones” designed to minimize interaction between workers on foot and construction vehicles by designating routes and operating procedures for large trucks delivering materials.

The plan also creates a traffic pattern to minimize backing. This is one of the most important elements of the ITCP as backing is the greatest hazard for workers on foot. An effective plan enables communication among all work zone parties in advance of arrival to the construction site, making sure all parties know the location of access points and the proper path for truck and equipment movement, including pickup trucks and other work vehicles.

The movement of workers and equipment within the work space should be planned in a manner similar to the way the TTC plan guides road users through a work zone. Whereas Temporary Traffic Control Plans focus on moving traffic safely through a work zone, Internal Traffic Control Plans focus on keeping workers on foot from being struck by construction equipment and large trucks. *TTCPs and ITCPs contain common principles, including:*

- Providing clear direction to drivers
- Separating moving vehicles from workers on foot
- Using temporary traffic control devices to mark traffic paths, and
- Maintaining a smooth traffic flow

The need for ITCPs: During the 5 years from 2003 to 2007, 639 workers were killed at road construction sites, according to data from the Bureau of Labor Statistics Census of Fatal Occupational Injuries (CFOI) program. The majority of these fatal occupational injuries were incurred by workers in the highway, street, and bridge construction industry. ⁽²⁾

The most common event associated with fatal occupational injuries at a road construction site was *worker struck by vehicle, mobile equipment*. Of the 639 total fatal occupational injuries at road construction sites during the 2003–07 period, 305 were due to a worker being struck by a vehicle or mobile equipment.

More workers were killed by construction-related vehicles or equipment (38 percent) than by cars, tractor-trailer trucks, and vans (33 percent). A total of 100 fatally injured workers (33 percent) were employed as construction laborers. Another 37 (12 percent) were employed as highway maintenance workers. First-line construction supervisors and managers accounted for 28 (9 percent) of the fatalities, while crossing guards (including flaggers) accounted for 27 fatalities (9 percent). Almost 10 percent of the fatalities resulted from a worker being struck by a dump truck that was backing up. ⁽²⁾

Blind Spots: A blind spot (or blind area) is the area around a vehicle or piece of construction equipment that is not visible to the operator, either by direct line-of-sight or indirectly by use of internal and external mirrors. Each vehicle has its own, unique blind spots. Operators should be familiar with the blind spots surrounding each piece of equipment he or she operates and should be sensitive to the fact workers and other objects cannot be seen in certain areas.

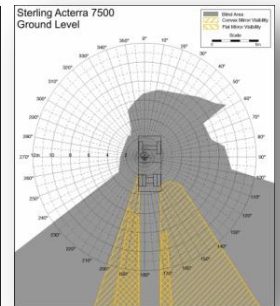
Blind spots are hazardous because workers on foot often perform tasks near moving equipment and vehicles, or walk by equipment en route to another destination. When they enter a blind spot, the worker is virtually invisible to the operator.⁽⁴⁾

Construction equipment is typically large and has an enclosed cab. These characteristics can make the blind areas very large and difficult for the operator to see. Also, the size of construction vehicles and equipment often place truck drivers and equipment operators high above the ground. They cannot see workers on foot crossing close in front of them. Items placed on the dash board or attached equipment can create even larger blind spots and reduce visibility. There are several basic actions workers must take to avoid hazardous blind spots:

- Do not cross directly in front of, immediately behind or in close proximity to large heavy equipment or trucks.
- Communicate with an operator (verbally and/or by confirming signal) before entering any area near heavy equipment or large trucks.
- If workers are required to be near parked equipment or trucks, stand in front or on operator side so if equipment comes into use, the operator can see them and they can see the operator.

Over the past decade, NIOSH has developed diagrams that depict the area around a vehicle that an operator cannot see. These maps have been developed for more than 40 pieces of heavy equipment using an International Organization for Standardization (ISO) test method. Along with the ISO standard ground-level map, NIOSH added diagrams at 900 mm, the height of most construction barrels, and 1500 mm, which is the shoulder level of the 95th percentile female.

See <http://www.cdc.gov/niosh/topics/highwayworkzones/BAD/imagelookup.html>
http://www.workzonesafety.org/runover_backover/know_the_blind_spots_poster



Since 1982 NIOSH has investigated hundreds of work-related deaths and produces FACE reports (Fatality Assessment and Control Evaluation) with recommendations to better protect workers. The following case study may be shared with the class when discussing worker behavior issues:

Roadway Construction Worker Dies From Crushing Injuries When Backed Over by a Dump Truck – Virginia

NIOSH 2002-06: <http://www.cdc.gov/niosh/face/In-house/full200206.html>

In this case, a 34-year old construction worker was killed when he was backed over by the dump truck shown in this photo. The death occurred in 2002 in Virginia. The worker who was killed was walking along the side of a grader near the center of the road. He was picking up centerline reflectors that had been pulled out by the grader when he was run over by the dump truck. The loaded dump truck was backing towards the paver at the time of the incident.

Module 2 - Workers on Foot:

Habits and Behavior: When developing an ITCP, it is important to consider human behavior. For example, where are workers likely to stand or congregate? On hot days, is there shade nearby? Where are the latrines? Where might workers stand when cold? If raining? If workers are likely to walk to a location, is there a safe route for them to get there? A good ITCP will include such considerations.

Radio and cell phone use occurs with increasing frequency. Can workers use phones on the job? How does the foreman communicate with all the other parties? When talking on the phone, people frequently plug the ear away from the phone and look to the ground so they can concentrate on the call in a busy, noisy environment. When they do so, they will not see dangers or hear alarms. How might the ITCP control for this behavior? Can a place(s) be designated to making and receiving calls? Human factors play an important role in ITCP development and should be considered carefully.

NIOSH FACE REPORT:

Laborer Run Over by Dump Truck at Roadway Resurfacing Operation—Virginia

NIOSH 1998-19: <http://www.cdc.gov/niosh/face/In-house/full9819.html>

In this case, the worker crossed in front of the paver, walking along the center line. We don't know exactly why he crossed the road – since it was a hot day, he may have decided to take a break under the trees on the opposite side. As he crossed the center line and walked into the unpaved lane, he stepped into the path of a tandem axle dump truck that was traveling about 5 mph. The driver had been looking into his rear view mirror to make sure he had cleared the paver. It is possible that this is when the right front wheel of the truck struck the victim.

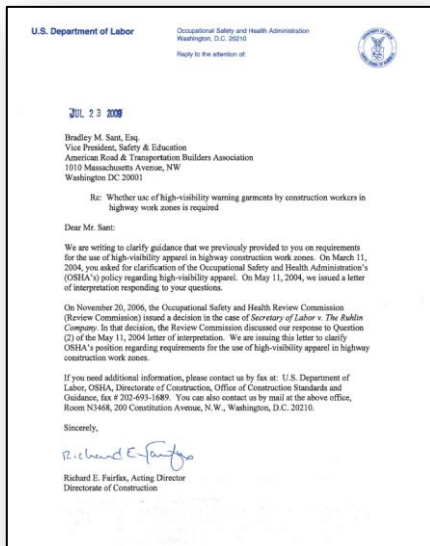
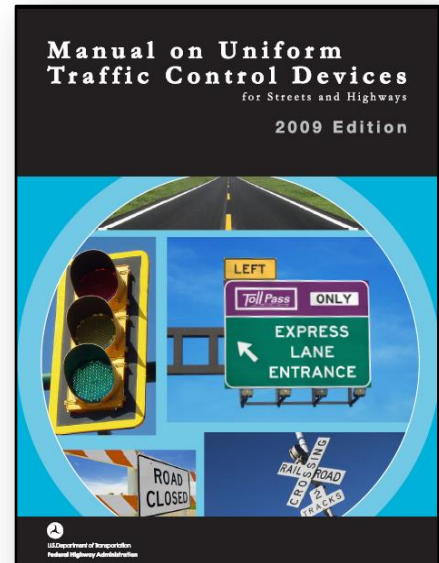
Worker Visibility: Workers must be clearly visible to drivers and operators. High visibility garments are now required by both FHWA and OSHA for all workers, not just those exposed to motorists/on-road traffic. These agencies require workers to be dressed in a minimum *ANSI Class II* vest. The make-up of these vests is explained in a standard known as the ANSI/ISEA 107 "American National Standard for High-Visibility Apparel." This standard describes three "classes" of vests. An ANSI Class I or "unrated" vest is not appropriate for roadway construction workers. The most common class of garment for road construction work is Class II. A Class II vest will not likely have sleeves, but is closed on the sides and must be fastened in front to provide coverage at 360 degrees. The background fabric must be fluorescent and it will have retroreflective tape on the front, back and sides.

A Class III garment is appropriate for night work and some daylight situations where workers need maximum visibility. Class III garments may be created by adding pants (Class E) to a Class II vest, or by using a vest or jacket that covers the full torso and has full or partial sleeves.

When choosing a vest, consider the appropriate fluorescent color. Some states have specific regulations as to the color of the vest. If your jurisdiction is not specific, follow the ANSI/ISEA standard that requires the worker to be distinguished from the background. In other words, if workers are around a lot of orange barrels and equipment, yellow-green might be the best color. If they are working around green foliage and trees, orange-red would be best.

FHWA: MUTCD 6D.03, December 2009 Edition

Standard: All workers, including emergency responders, within the right-of-way who are exposed either to traffic (vehicles using the highway for purposes of travel) or to work vehicles and construction equipment within the TTC zone shall wear high-visibility safety apparel that meets the Performance Class 2 or 3 requirements of the ANSI/ISEA 107–2004 publication entitled “American National Standard for High-Visibility Safety Apparel and Headwear” (see Section 1A.11), or equivalent revisions, and labeled as meeting the ANSI 107-2004 standard performance for Class 2 or 3 risk exposure, except as provided in Paragraph 5. A person designated by the employer to be responsible for worker safety shall make the selection of the appropriate class of garment.



OSHA: Letter of Interpretation to ARTBA, July 23, 2009

Letter of Interpretation: The FHWA's rationale underlying the rule well illustrates that the industry recognizes that construction workers in highway/ road construction work zones need protection against the hazard posed by moving traffic. The FHWA's recent mandatory standard for workers on federal-aid highways shows that struck-by hazards in highway/road construction work zones are well recognized by the construction industry. Accordingly, high-visibility apparel is required under the General Duty Clause to protect employees exposed to the danger of being struck by public and construction traffic while working in highway/road construction work zones. Typically, workers in a highway/road work zone are exposed to that hazard most of the time.

Additional information related to high visibility clothing can be found in the appendices to this document. Please see OSHA Guidance Letter to ARTBA and the Worker Visibility Guidance produced by the Work Zone Safety Alliance.

Backing Safety: “Backing” is one of the most dangerous situations in which workers on foot are vulnerable, especially if the equipment is a large dump truck. There are several key principles to safe backing in work zones:

1. The work area should be organized to minimize backing;
2. Backing should only take place in designated locations;
3. There should be clear communication between the operator and workers on foot before backing begins.

In addition to the safe backing principles, there are several good practices each type of worker in the construction zone should employ:

1. Operators should be certain of their surroundings and the location of workers, equipment and ground obstacles
2. Spotters should be identified and used when possible and practical, especially when backing or maneuvering near workers on foot or other hazardous conditions
3. All workers should be trained to avoid approaching or working near backing equipment
4. Operators and drivers should avoid backing up unless necessary
5. Operators and drivers must walk around their vehicle to check for hazards
6. Operators, drivers and workers on foot should be aware of blind areas

Given the known hazards involved in backing large construction vehicles, several states have enacted statutes to govern safe backing practices.

Washington State: WAC 296-155-610

Before backing a dump truck the driver must determine that no one is currently in the backing zone and it is reasonable to expect that no employee will enter the backing zone while operating the dump truck in reverse.

If employees are in the backing zone or it is reasonable to expect that an employee will enter the backing zone, you must make sure the truck is backed up only when:

- An observer signals that it is safe to back; or
- An operable mechanical device that provides the driver a full view behind the dump truck is used, such as a video camera.



Virginia State: 16 VAC 25-97

Do not back-up any covered vehicle unless it has a back-up alarm audible above the surrounding noise level, and it is backed-up only when a ground guide signals that it is safe to do so; or before backing-up, the driver looks to see that no employee is in the path of the vehicle.

- If the back-up alarm stops working properly & an immediate fix is not possible that day, the vehicle shall be backed-up using ground guide signals; or taken out of service until the alarm is repaired.
- Covered vehicles with operable video or similar technological capability can replace ground guide.



Vehicle Pathways: A critical step in developing an ITCP is plotting where workers on foot will normally be located, the types of equipment in the work area, and the path for each piece of equipment. The paths for truck and construction vehicle movement should be planned in conformance with the principles of safe construction traffic control. Long backing maneuvers for dump trucks should be avoided and points of access and egress of trucks moving within the work space should be controlled. Workers on foot should be located as far as possible from vehicle paths. Parking, toilet, and break areas should be staged away from the principal conflict points involved with the paving rollers and dump trucks.

In some situations, such as stationary/long-term worksites, the route may be marked with temporary traffic control devices. Serious consideration to marking pathways should be given when:

- Deliveries of materials are completed by a variety of subcontractors/ independent drivers who are not familiar with the site and procedures;
- Multiple operations occur in close proximity to each other;
- Workers on foot are in the vicinity.

When creating vehicle pathways, the primary concerns are ensuring the drivers/operators know where they should- and should not go and ensuring workers know the areas to avoid. Route planning occurs before vehicles arrive on site to separate operations, minimize backing, and provide clear guidance.

Module 3 – Access/Egress

The establishment and maintenance of safe access and egress points are key determinants of project safety. In order for roadway construction jobs to maintain safe operations, there must be procedures to allow for safe and efficient passage of work vehicles into and out of the work space and for motorists to travel through the work zone. Effectively addressing safe access and egress at the project level requires planning during the project development phase and implementing traffic control plans throughout the entire project. ⁽³⁾

In December 2007, the U.S. Federal Highway Administration issued a new rule, 23 CFR 630 Subpart K, to promote safety for workers and motorists in roadway construction zones. One section of the new rule states, “In addition to addressing risks to workers and road users from motorized traffic, the agency processes, procedures, and/or guidance . . . should also address safe means for work vehicles and equipment to enter and exit traffic lanes and for delivery of construction materials to the work space, based on individual project characteristics and factors.”

Access to and egress from highway construction and maintenance zones presents a significant challenge to both travelers and work crews when the work is taking place on or adjacent to a highway that is open to traffic. This is especially true if the highway carries high traffic volumes or traffic speeds are high. Safety challenges include:

- Motorists following construction vehicles into the work space;
- Acceleration and deceleration of construction vehicles as they exit and enter open traffic lanes;
- Proximity of pedestrians to access and egress locations; and
- Proximity of parked or staged equipment to passing motorists or to exit and entry points.

Motorists following construction vehicles and acceleration/deceleration require intervention and coordination between ITCPs and TTCPs. Access and egress issues are most effectively addressed in the temporary traffic control (TTC) planning and design phase before construction begins, and should be addressed in the ITCP in conjunction with other planning requirements. The designer should address how contractors will safely move personnel, materials, and equipment into and out of the work area with minimum disruption to traffic and exposure of workers to the traveling public. While proper planning is important, systematic reviews of changing conditions are also essential throughout construction to ensure that planned access and egress points meet safety and mobility performance needs.

Construction vehicles entering or exiting the work space can create significant speed differentials between themselves and normal traffic using the facility. Large speed differentials have significant adverse effects on both work zone capacity and work zone crashes and should be minimized as much as possible. Access and egress considerations are particularly challenging in large-scale projects or on high speed/limited access highways.

In addition, projects with significant roadside development and frequent driveway access points create construction vehicle acceleration and deceleration conflicts.

Project planners and work zone designers should strive to anticipate conditions requiring work vehicles to merge in/out of high-speed traffic or work activities that will generate frequent delivery of materials (i.e., paving operations, bridge work, and aggregate work). Planners must ensure adequate right-of-way is secured and obstacles are identified to allow for safe vehicle operations into and out of the activity area. Depending on the work operation, planners should also consider where vehicles waiting to deliver materials will be positioned so that they are not queued in active travel lanes.

On some projects, access/egress points may need to be relocated from time to time. On other projects, access/egress points may be used during some phases but not during others. In both cases, there are

likely periods when work activity is not occurring and thus access/egress points are not active. All warning signs noting work zone access and egress activities should be covered or removed when work is not active. Appropriate techniques and strategies need to be in place during the day-to-day construction activities to facilitate safe utilization of access and egress points.

Contractors should provide appropriate information to work vehicle drivers so that they know the safe locations to enter or exit the work zone. For most projects, contractors, subcontractors, supervisors, and agency/company officials need special, site specific training to ensure the movement of construction vehicles and motorist traffic operates in a smooth, coordinated fashion. In many situations, subcontractors and independent truck drivers are not included in these discussions. Work vehicle access/egress plans, including any changes to previously used plans, should be discussed with and communicated to contractor employees, truck drivers, owner/agencies, and others who are likely to visit the construction site. This discussion may take place during partnering or pre-shift meetings when subcontractors are present.

Activities that occur under the direction of construction contractors include maintaining a clear/open area around access/egress points where equipment or vehicles should not be parked. Contractors are also responsible for educating on-site employees about areas near access/egress points that are prone to heavy truck traffic and inspection of trucks entering the work area for proper safety functions (i.e., lights, beacons, backup alarms, and other safety features).

Code of Federal Regulations (CFR)



FHWA: 23 CFR part 630, Subpart K

(e) Work Vehicles and Equipment.

In addition to addressing risks to workers and road users from motorized traffic, the agency processes, procedures, and/or guidance established in accordance with 23 CFR 630.1006 should also address safe means for work vehicles and equipment to enter and exit traffic lanes and for delivery of construction materials to the work space, based on individual project characteristics and factors.

Module 4 – Productivity

When considered during the planning and design phases, an ITCP integrates easily into other planning processes such that it does not require significantly more time or resources to implement. Anticipating ITCP needs will improve delivery schedules and processes, minimize disruptions, improve safety, and create more efficiency.

An important part of an internal traffic control plan is how you will handle communications on site. In developing an ITCP, one must consider how you will communicate with drivers before they arrive. Planning for this communication will translate into overall better communication with all subcontractors with regards to other on-site scheduling and activities.

The ITCP should operate through the existing “Chain of Command” ensuring responsibilities for carrying out the plan is assigned and accounted. The most critical members of the construction team to ensure the ITCP enhances productivity will be site supervisors, equipment operators and truck drivers. To facilitate communication among the parties, basic contact information should be readily available, including company personnel, other on-site contractors, the contracting agency, and emergency response services.

An ITCP operations communication plan should include procedures for orienting independent truck drivers and subcontractors to the work space and the ITCP, methods of communication regarding changes in the ITCP; a means for workers on foot to talk with equipment operators, truck drivers, and the people in charge of controlling or coordinating the flow of vehicles and equipment entering and leaving the work space, and the movement of heavy equipment within the work space. Onsite communications also require a means for grader operators, dozer operators, truck drivers and scraper operators to communicate with each other and with the prime and sub-contractors.

The ability for all construction segments to communicate with each other will not only improve ITCP implementation, but will allow for improved communications regarding all construction processes. For example, in addition to protecting workers, there are other hazards that ITCP will protect against, including hidden dangers such as catch basins and open holes. ITCPs will guard against any excavation work in or around wall openings. The plan will also provide protection to site visitors, such as inspectors and DOT personnel. ITCP planning will ensure operators do not operate equipment around overhead power lines unless they are authorized and trained to do so.

ITCPs work in tandem with project scheduling processes. In addition to assigning dates to project activities, project scheduling is intended to match the resources of equipment, materials and labor with project work tasks over time. Good scheduling can eliminate problems due to production bottlenecks, facilitate the timely procurement of necessary materials, and otherwise insure the completion of a project as soon as possible. Inasmuch as ITCPs require timely communication with delivery vehicles (dump trucks), ITCP coordination and project scheduling fit together easily.

Module 5 – Roles and Responsibilities

There are many individuals who should be involved in implementing the ITCP. These may include:

- Safety Professional
- Inspectors/Quality Control
- Superintendent/ Project Manager
- Supervisor and Lead Person
- Workers on Foot
- Truck Drivers
- Equipment Operators
- Spotters
- Site “visitors”
 - Surveyors
 - OSHA
 - Senior Management

Some of the people with roles critical to the safety of workers on foot and execution of the ITCP are discussed below.

While many people are involved, the plan is developed—in most instances—by one or more members of the contractor’s staff and should be part of the project’s safety plan. The safety officer should be closely involved in developing the general ITCP. However, it is the foreman, in collaboration with the project manager/site superintendent, who will actually develop and implement the site-specific ITCP as he/she is the one always on site. Every time the operation changes, the ITCP must change. As such, the foreman must be intimately familiar with the principles of safe construction traffic control and be in charge of the daily set up and monitoring of the ITCP. In reality, the ITCP is part of the production process.

Though general ITCP concepts should be considered in the early design and planning phases, the site-specific plan should be prepared after the contract is awarded but prior to the start of construction. The primary candidate for creating the initial plan will likely be the company safety officer, but in some instances it may be developed by a paving foreman working with the site superintendent. For more complex operations, the developer should meet the OSHA requirements of a “competent person.”

The safety officer (or other designated competent person) should be intimately involved throughout the project's duration and should have a role in the development and monitoring of the ITCP. A competent person who can identify safety hazards and make changes to the ITCP, if needed, should be on-site during all critical operations. Again, this would typically be the site foreman. The person overseeing the ITCP should be aware of safe traffic control practices and meet the requirements of a “knowledgeable” person as stated in the MUTCD. These duties may be assigned to more than one person who will work together to develop, modify and execute the ITCP.

The project superintendent and/or project manager is a key person in ensuring an ITCP is implemented properly on the site. While the superintendent/manager may assign one or more foremen to directly implement the plan, he/she controls the various factors that must be coordinated to ensure cooperation in ITCP implementation. To properly implement the plan, workers, operators, dump truck drivers, inspectors – virtually all site visitors must be apprised of the plan and made aware of its basic operation. Such coordination and implementation is greatly facilitated with support of the person in charge of site operations and the project schedule.

With direct responsibility for on-site operations, compliance with the project schedule and coordinating personnel, the supervisor or lead person will play the most important role in developing and executing the ITCP. He/she should be involved in initial planning activities. The supervisor/lead person will implement the plan by directing onsite operations and ensuring workers on foot, operators, dump truck

drivers and other onsite workers are apprised of the ITCP and know where and how they should carry out their duties in compliance with the plan. The lead person/foreman will be responsible to ensure the plan is updated as work progress and site conditions change. He/she is also responsible for general work place safety.

The truck boss needs to be informed about the daily plan as well as the initial planning of the site. He will provide vital information affecting operation safety that should be considered in the planning process. In the training process those involved need to recognize the primary purpose of the truck drivers: to deliver material. They want to do this as efficiently as possible so they can return with another load. Their focus is aligned with the ticket taker on site, and the dump man once the truck is in the queue.

Dump truck drivers present the greatest risk to workers on foot. According to data from the Bureau of Labor Statistics, dump trucks are responsible for over ¼ of all runover or backover deaths in this industry. This is primarily because dump trucks have large blind areas into which the driver cannot see; they are “visitors” to the site (bringing asphalt, aggregate and other materials) and may not be aware of current site conditions and operations, and they are in constant movement on the site as they enter, back-up, empty materials, and then exit the work area. With regard to ITCPs, it is critical that drivers be informed of the plan and know where they should and should not go. Drivers should be provided with ITCP instructions and receive navigation assistance (spotters) when driving in the work space when appropriate. Simply, truck drivers on site need to understand the ITCP and operate under the guidelines of the ITCP. This means it needs to be reasonable, understandable, and communicated.

Module 6 – Developing the Program

For the purposes of developing an ITCP, the project should be considered in phases, with specific activities identified for each phase. These are:

- Design
- Owner/Agency Planning
- Contractor Planning, and
- Construction

Ideally the ITCP should be considered from the very beginning of a project because some important elements—such as the size of the work space—will be dictated by the amount of right-of-way, number of lane closures, etc. To facilitate proper separation between workers on foot and mobile equipment, adequate space is necessary. If such considerations are not anticipated from the beginning, it will be more difficult to organize a complete ITCP.

State and local agencies have significant influence upon decisions made during early planning of a project that impact the options available to the contractor when developing an ITCP. For example, planners can ensure the project has access and egress points that are not encumbered by roadway geometry or structures such as bridges. Forethought to ITCP needs will impact the amount of right-of-way obtained for acceleration/deceleration lanes, access/egress points, and parking and staging of vehicles. Some consideration may be allowed for contractor selection based on past safety performance.

The site-specific portion of the ITCP will generally begin after the contract is awarded, but before construction worker actually begins. The Contractor Planning Phase is an ideal time to negotiate responsibility for executing certain elements of the ITCP. Duties can be allocated to the roadway owner, project engineer, superintendent, foremen and other personnel. Risk can be properly allocated and process can be assigned such as participation in safety meetings, how and if law enforcement will be used, location of access and egress points, and the amount of lane encroachments.

The ITCP is implemented during the construction phase. The ITCP should be part of the project's safety plan. The site supervisor/foreman should oversee implementation and will likely develop the site plan. As noted, foremen, supervisors, lead persons and others are crucial for plan implementation and should be taught the principles of safe construction traffic control. They will be in charge of daily set-up and monitoring of the ITCP. Responsibilities for key personnel are assigned and any remaining training is conducted during this phase. Onsite workers are provided training in both overall ITCP concepts and specific implementation elements at their assigned work area. To function properly, the ITCP must be reviewed and modified each day before the beginning of each shift so employees can receive instruction on how it will be implemented that day. In addition, ITCPs may be modified more frequently as conditions change throughout the day.

ITCP Elements

TTC plans consist of three basic components: the traffic control layout or diagram, a legend explaining symbols used in the diagram, and notes explaining portions of the diagram. The components of an ITCP are the same as for a TTC plan, but the specifics of each part vary from those of TTC plans.

ITCP Diagrams

ITCP's covered the "hatched" area demonstrated in the traffic control plan. The heart of the ITCP is the diagram showing the layout of the work space and the movement of personnel and vehicles within the work space. Since the ITCP will include the access points to the work space, it will also show some parts of the overall work zone. However, there is no need to show all of the work zone and temporary traffic control devices because the TTC plan will cover the entire work zone.

An ITCP diagram may be the model plan, a modified model plan, or a separate site-specific plan showing the actual work space. While the diagram does not have to be to scale, it should be adequate to give those reviewing the plan a good concept of how the safety features will operate.

ITCP Notes

The ITCP notes contain 1) safety points, 2) injury reduction measures, 3) site-specific provisions, and 4) duties of various contractor personnel. **Safety points** include areas where pedestrians are not allowed and buffer areas for vehicles such as rollers. **Injury reduction measures** specify when project safety meetings should be held, use of the ITCP, communication needs, coordination of dump truck arrivals and departures, and reference to general safety requirements such as OSHA and FHWA regulations. **Site-Specific Provisions** take into consideration any features that are unique to the specific site, such as access and egress points and progression of work. **Duties** of the safety officer, site supervisor, workers on foot, and truck drivers in safety terms are specified. The ITCP notes should include provisions for communication between workers, spotters for backing trucks, and site speed limits.

Legend

The legend explains the symbols used on the ITCP diagram. Standard symbols are based on those used in the MUTCD. However, additional details on classes of personnel and vehicle types are needed in developing an ITCP for a paving operation.

ITCP Preparation

The ITCP is a working plan and will likely change frequently throughout the day. In most cases, it will be initially prepared by contractor personnel after the contract is awarded, but will be updated regularly as needed by onsite personnel. The ITCP is a map of how the contractor chooses to complete the construction project; therefore, it must be done after the contract is awarded. (A model plan for some of the tasks involved in the project may be included in the PS and E package). The ITCP is then utilized during the project to reduce worker injuries and fatalities.

The ITCP must build on the information in the TTC plan and other contract documents. Site-specific ITCPs are completed for the phases of construction with large numbers of workers on foot in close interaction with trucks and other equipment. For paving projects, this will generally be the paving phase, which requires a number of workers on foot to work near the dump trucks bringing asphalt to the paving machine. For example one may create a separate ITCP for paving each lane of highway, as well as a separate ITCP for each time the paver backs to begin the next lane. Bringing in a tack truck changes the ITCP to account for its movement, the actions of a spotter, and possibly the hand application of tack to the pavement edge.

Step 1: Review Contract Documents and Model Plans

The contract document most relevant to the ITCP preparation is the project plan, annotated with information such as access points and work sequencing plans. Also, a plan and cross section of the site and the sequence of construction is important to review. Model plans are consulted to determine the basic layout of the paving operation.

Step 2: Determine Construction Sequence

In this step, identify the operations and sub-operations for each phase of construction and list the personnel and equipment required for each operation. If certain sub-operations or tasks are identified as hazardous, a task-specific ITCP should be considered.

Step 3: Draw the Basic Work Area Layout

In this step, the configuration of the work area is drawn. The drawing does not need to be scaled, but it should be of sufficient size to allow the addition of personnel and equipment paths to the ITCP. Access and egress points for dump trucks will be shown on the ITCP; therefore, the existing traffic lanes will also be shown in most cases. In many circumstances, the basic layout can be taken from the TTC plan for the phase being shown.

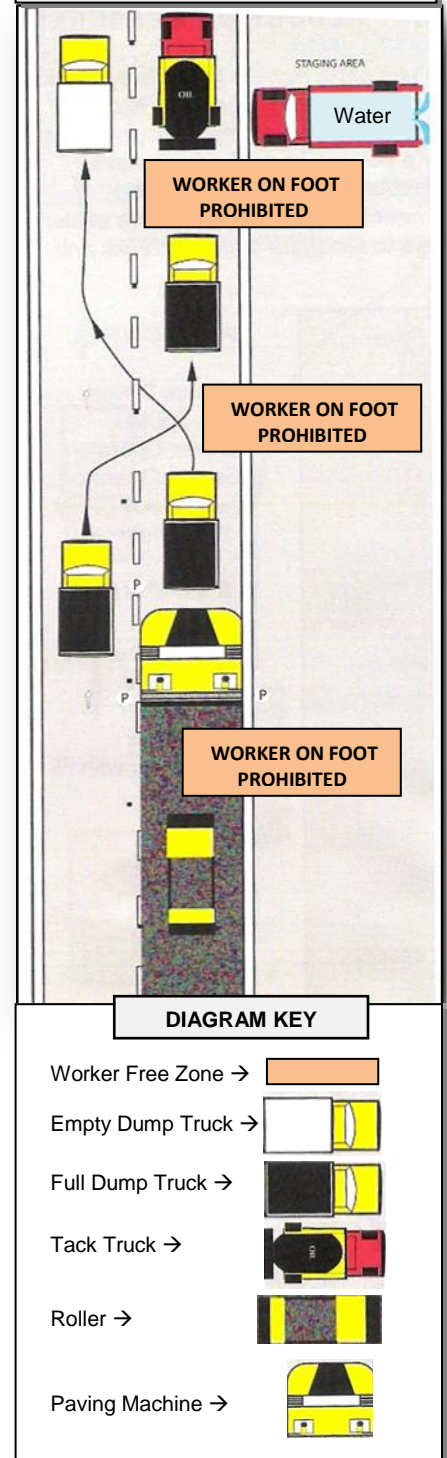
Step 4: Plot Pedestrian and Vehicle Paths

The pivotal step of the ITCP development is to plot where pedestrians will normally be located, the types of equipment in the work area, and the path for each piece of equipment in the work area. For a paving operation, the main activity will be around the paving machine. Dump trucks move into the work area to the front of the paver to deliver asphalt and then exit the work area. Workers on foot led by a foreman will be stationed near the paver; a spotter should be guiding trucks and directing the windrowing of asphalt in front of the paver. Other vehicles and workers on foot are stationed at various points relative to the paver. For example, rollers will work the new pavement mat behind the paver, and inspectors will move to the paver or mat behind the paver to sample the paving material.

The paths of vehicle movement should be planned in line with the principles of safe construction traffic control. Long backing maneuvers for dump trucks should be avoided and points of access and egress of trucks moving to the paver should be controlled. Pedestrians should be

SAMPLE ITCP DIAGRAM

This diagram shows a basic paving operation where workers are not allowed to walk behind trucks, in front of the paver or across the hot mat. ITCPs can be simple or complicated, depending on the operation. They may be hand-drawn or illustrated, depending on need.



located as far as possible from vehicle paths. Parking, toilet, and break areas should be staged away from the principal conflict points involved with the paving rollers and dump trucks.

Once you have established paths equipment will use and locations where ground workers will labor, plot “worker free zones” to keep workers from congregating near equipment or vehicles paths.

Step 5: Locate Utilities, Storage, and Staging Areas

To complete the ITCP diagram, the location of utilities, storage areas for equipment and materials, and staging areas within the work area are added to the diagram. Utilities that would impact the work area operations, such as power lines or catch basins, should be shown on the ITCP. Special warning devices, such as overhead power lines awareness markers, should also be added to the diagram. Equipment needed periodically should be stored in a safe area.

Step 6: Prepare ITCP Notes

The next step in the preparation of the ITCP is to write notes that explain the diagram and specify the duties of various personnel in the work area. The notes can contain general conditions that are common to most paving operations and specific conditions that are applicable for only that site and phase of construction. The notes of the ITCP should supplement other contract documents but should not conflict with or supersede other contract provisions. Safety points can include a description of pedestrian-free areas and required buffer areas for vehicles, such as the minimum distance between the paver and rollers. These notes become site audit tools that will assist supervisors in auditing the success of their safety program.

Step 7: Develop a Communications Plan

The final step is developing and implementing a communications plan to inform and update the affected parties about ITCP. The communications plan should include a listing of the individuals or groups of workers who require information and their contact information, a schedule and plan for on-site training, a means to communicate with truck drivers and other occasional visitors, and a plan for regular communications as work progresses and the plan is updated.

There are several studies and research papers that have been developed which look in-depth at the creation and viability of Internal Traffic Control Plans. For more information, please look to references at the end of this document.

Module 7 – Technology

Work-zone and ITCP safety efforts usually concentrate on “controls,” keeping workers and traffic separate. Traffic control, signage and barriers are integral parts of every roadway construction project. Nevertheless, other technologies are important to protect workers on foot for those activities which require them to work in close proximity to trucks and equipment.

Strategies to improve safe equipment operation within the work zone include the use of electronic signaling devices or sensors to warn equipment operators of workers on foot in the immediate work area. Workers are constantly exposed to the hazards produced by moving heavy equipment. By being exposed daily to the noise of warning devices of backing up equipment, they can become accustomed to it, reducing the effectiveness of these devices in preventing accidents. Therefore, other devices that emit a different noise should be considered in addition to the standard backing up alarms. Other practices to improve safe equipment operation within the work zone while preventing worker accidents and fatalities are also being developed. ⁽⁵⁾

Back-Up Alarms

The first line of defense is a working back-up alarm. However, back-up alarms are often not effective, due to excessive background noise or the unconscious adjustment of workers to the regularity of alarms throughout the worksite. A recent Department of Energy Safety Bulletin offered a solution: "Workers can become accustomed to the sound of backup alarms in construction sites, thereby reducing their effectiveness in controlling accidents. Concerns about continued hazards have led industry to develop supplementary control measures to warn of people or objects in the operator's obstructed view zone. Such measures include rear-viewing video cameras." Despite these concerns, traffic control managers should make sure all vehicles have working alarms when they come on the site. Also, new types of alarms have been developed that distinguish alarms from background noise and are easier to hear.

Application	Strength	Limitation
Required for use on all heavy construction equipment and dump trucks (and other commercial vehicles).	Provides audible warning every time the vehicle is geared into reverse/when backing.	The sound is ubiquitous on construction sites, especially where a number of vehicles are operation. Workers become accustomed to the warning sound.

New and Emerging Technologies: New technologies include more complex collision warning systems which continue to evolve. Currently there are different commercially available systems, such as cameras, radars, ultrasonic sensors, and radio frequency identification (RFID) systems.

Back-Up Camera and Radar Systems

Several large companies like UPS now use back-up cameras or radar systems on their delivery trucks. Similar equipment exists for construction trucks. After testing, NIOSH has concluded that back-up cameras are helpful in giving operators a view of what is behind them. They work best in combination with a radar system that beeps louder or faster when closing in on an obstacle behind the truck and alerts the driver to look at the display screen.

The Mine Safety & Health Administration (MSHA) uses camera systems in surface mining operations in lieu of spotter personnel. MSHA has shown that video cameras improve safety around large vehicles and has urged mining operations to employ this and other technology to reduce the chances of blind-spot accidents. Other federal agencies are conducting research on these additional safety devices for heavy equipment to warn drivers when someone is in their blind spot.

Application	Strength	Limitation
Cameras enable operators to see into blind spots which are not visible using mirrors on sight lines alone.	Operators and drivers can see workers and other objects normally out of their site enabling them to stop if someone is close.	Operators and drivers are often focused on their task. If they do not look in a monitor, they will not see the danger.

Application	Strength	Limitation
Coupling radar or sonar with a camera creates a more complete system to warn the driver/ operator. If an object enters into the field observed by the radar or sonar, an alarm is sounded prompting the operator to look in his monitor.	This combination system overcomes the weakness of cameras alone by prompting the driver/operator to look at the monitor when he/she might otherwise be focused on a task.	This system relies solely on the operator to respond. Workers on foot are not warned when they are in danger. Also, like the backup alarm, operators may become calloused to alarms which do not discriminate between real dangers (workers nearby) and other objects (dirt pile, other equipment).

As a technology, RFID show a lot of promise. Some systems have a two-way alarm warning feature, which enables both the equipment operator and the worker to receive individually a warning alarm. The driver receives an alarm from a device installed in the truck cab, and the worker receives an alarm from a device or tag that he uses on his belt. This means that each person to be protected by an RFID must wear a tag. The RFID technology has two components: (1) a reader, which is a device used to communicate with the (2) tag. The reader has at least one antenna that emits radio waves and receives signals back from the tag. The tag is a microchip attached to an antenna that can be incorporated into a product, animal, person, etc. It contains a unique serial number and can be either a passive or an active tag. Active tags have their own internal power source, which is used to generate the outgoing signal, while passive tags reflect the radio waves coming from the reader antenna. ⁽⁵⁾

The RFID systems used for collision avoidance in mining do not produce false alarms since they detect only objects or individuals using the tag. In theory, the applicability of this system can be extended to construction and maintenance work zones.

Application	Strength	Limitation
RFID systems can be used in any situation where a worker on foot (or another object) is likely to come into close proximity of a moving vehicle. The dual-warning system allows both parties to react when the alarm is triggered.	RFID systems offer the most comprehensive collision avoidance protection because they alert both the driver/operator and the worker on foot when they are in close proximity to one another. Because the tag communicates with the device observed by the driver/operator, it eliminates the false alarms when sonar or radar is used.	For RFID systems to work, each exposed worker must wear a tag. Application is therefore limited to sites with controlled access. As the technology is relatively new and its use is not fully commercial, these systems are still quite expensive making their use on roadway construction sites seem cost prohibitive.

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