Internal Traffic Control Plans and Worker Safety Planning Tool

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The safety of pedestrian workers and construction vehicle operators can be enhanced by a carefully prepared internal traffic control plan (ITCP) administered by a competent person. Time and effort spent in preparing and using an ITCP should lower the rate of occupational injuries and fatalities experienced by construction personnel. This paper describes the purpose and components of ITCPs and presents details of a number of highway worker accidents and discusses how an ITCP prepared by a competent person on the project could have prevented or lessened the severity of the accident. Results of observation of paving at four sites in Arizona and recommendations for preparation and use of ITCPs are also discussed. Accident details are taken from several investigations and from Fatality Assessment and Control Evaluations funded by the National Institute for Occupational Safety and Health. During the study of four paving sites, a guide for preparing and administering ITCP was prepared.

The pavement saw operator had the required personnel protection equipment. Damping of sound from the ear protectors was certainly necessary for the job he was performing: cutting out sections of squares in the pavement that would later be removed and excavated to make way for a new water supply pipe in a fast-growing California suburb. He was working alone, well away from the excavator and pipe-laying machines. In fact, he worked for a subcontractor and did not really interact with other workers on the job. He saw dump trucks accessing the site to remove excavated soil material, but he never viewed them as a hazard.

But one afternoon a backing dump truck swerved into the lane where the saw operator was working and pushed him into the saw he was operating. The backup alarm buzzer on the truck may or may not have been working, but its warning was of little use to the worker, protected as he was from the din of the pavement saw. The dump truck had to back up over 1/4 mi, and it swerved less than 15 ft to strike the saw operator working on the narrow two-lane street. That worker was quite fortunate that he did not become a worker fatality—though he did spend 6 weeks in a hospital recovering from his injuries.

Would an internal traffic control plan (ITCP) have prevented this accident? Was there an alternative to the long backing maneuver? Could the truck driver have been more aware of the saw operator? Should the saw operator have been aware of the hazard presented by the backing truck?

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Answers may hinge on effective plans. This paper discusses the purpose and preparation of ITCPs. Research conducted for the National Institute of Occupational Safety and Health (NIOSH) investigated fatal and serious injury accidents in work zones. A second NIOSH research project developed ITCPs for four paving projects in Arizona, whose sites were observed to determine how an ITCP would have improved the safety of the paving operations. The second project also developed a guide ITCP preparation.

PURPOSE OF AN INTERNAL TRAFFIC CONTROL PLAN

The *Manual on Uniform Traffic Control Devices* (MUTCD) defines a temporary traffic control (TTC) plan in Section 6C.01. According to the MUTCD, "A temporary traffic control plan describes temporary traffic control measures to be used for facilitating road users through a work zone or incident area."

In establishing TTC plans as a fundamental part of temporary traffic control, no provisions were made to control vehicle or pedestrian worker movements within the work space itself. The work space is shown only as a shaded area or black hole in most typical applications.

In Section 6B.01–Fundamental Principles of Temporary Traffic Control of the MUTCD, the following guidance is given: "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."

The 2003 *Manual on Uniform Traffic Control Devices* (*1*) has several new guidance statements relating to worker protection, and for the first time these statements are referenced to long-standing Occupational Safety and Health Administration (OSHA) Regulations for workplace safety. Specifically in Section 6D.03–Worker Safety Considerations, two recommendations are as follows:

> E. 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.
> F. Worker Safety Planning—A competent person designated by the employer should conduct a basic hazard assessment for the work site 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 91-569, 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."

The term "competent person" has been used in OSHA standards for many years. It evolved from the basic concept of employers'

duty to provide a safe work environment. Section 5(a) (*1*) of the OSH Act, often referred to as the General Duty Clause, requires employers to "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."

The MUTCD provides a much more recent use of that term (*1*). But even so, the competent person is designated as the one responsible for selection of worker safety apparel. Nevertheless, the requirement for a competent person on each project cannot be overstated; unfortunately, sometimes the term is misused and the concept is misunderstood.

Considerable research has addressed the problem of injuries to motorists traveling through work zones. Until recently, the problem of worker injuries has received relatively less attention. Studies by the Laborers' Health and Safety Fund of North America (LHSFNA) reported that highway construction workers had high rates of fatal injuries compared with rates for other construction workers and all other workers (J. Graham and J. Migletz, Internal Traffic Control Plans, unpublished report for LHSFNA, Report on Highway Workers, 1997; www.lhsfna.org).

Both the LHSFNA report and Pratt et al. (*2*) reported that only one-third of worker fatalities in work zones were attributable to workers being struck by road users entering the work space. The remaining two-thirds occurred when pedestrian workers were struck by construction vehicles or equipment, or when vehicle or equipment operators were killed in vehicle-related incidents. Pratt et al. (*2*) found that backing equipment, particularly dump trucks, accounted for half the fatalities of pedestrian workers in work zones.

Why shouldn't the movement of workers and equipment in the work space be planned in a manner similar to the TTC plan measures designed to facilitate road users through a work zone? Thus, the concept of the ITCP was proposed by Graham-Migletz Enterprises, Inc., as an intervention to prevent worker injuries and fatalities during the LHSFNA study.

The creation of ITCPs for paving operations was based on the principles of safe construction traffic control developed by Graham and Migletz in the LHSFNA report:

- Reduce the need to back up equipment.
- Limit access points to work zones.
- Establish pedestrian-free areas where possible.
- Establish work zone layouts commensurate with type of equipment.
- Provide signs within the work zone to give guidance to pedestrians, equipment, and trucks.
- Use FAA and Coast Guard principles on vehicle movement, marking, and right-of-way where applicable.
- Design buffer spaces to protect pedestrians from errant vehicles or work zone equipment.

A model plan for asphalt paving under traffic developed in this earlier research is shown in Figure 1 (*2*). This model plan included safety points for paving operations and listing of personnel and equipment involved in the operations. Model plans were also developed for trenching and dirt spread operations.

Who should be responsible for developing an ITCP? There are several ways to answer that question:

- The ITCP is developed by one or more members of the contractor's staff and should be part of the project's safety plan. It should be prepared after contract award but before the start of construction.
- The safety officer, if qualified, should be in charge of developing the ITCP.
- That officer should meet the OSHA requirements of a competent person.
- According to 29 CFR1926.32, pertaining to definitions, a "competent person" means one who is capable of identifying existing and predictable hazards in the surroundings or working conditions that are unsanitary, hazardous, or dangerous to employees, and who has authorization to take prompt corrective measures to eliminate them (www.access.gpo.gov/nara/cfr/cfr-retrieve.html). The competent person should have sufficient experience and training to recognize and eliminate safety violations and other hazardous situations, because failure to observe safety standards and other safe work practices could result in serious injury or death.

A competent person is needed throughout a project's duration and should have a role in developing and monitoring of the ITCP. A competent person who has the education, training, and experience to recognize potential safety hazards and make changes to the ITCP, if needed, should be on site during all work operations. The competent person should be certified by the American Board of Industrial Hygienists as a construction health and safety technician, which requires 1 to 3 years of field experience or a degree in civil engineering and 1 year of field experience. Students in programs leading to associate or higher degrees in occupational safety and health may sit for the exam in their last semester.

If the safety officer is not an engineer, he or she would need to work with an engineer or traffic control technician to develop the ITCP. The engineer should be aware of safe traffic control practices and meet the requirements of a knowledgeable person as stated in the MUTCD. The MUTCD recommends that any changes in the temporary traffic control plan should be approved by an official knowledgeable (e.g., trained or certified, or both) in proper temporary traffic control practices. The on-site person should be knowledgeable in traffic control, construction practices, and safety; if more than one person is involved, they should work together to develop and modify the ITCP.

COMPONENTS OF AN ITCP

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. Components of an ITCP are the same as for a TTC plan, but specifics of each part vary from those for TTC plans.

ITCP Diagrams

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. Because the ITCP includes 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.

A model plan (similar to typical applications) for a paving operation with traffic separated from the work space by a temporary

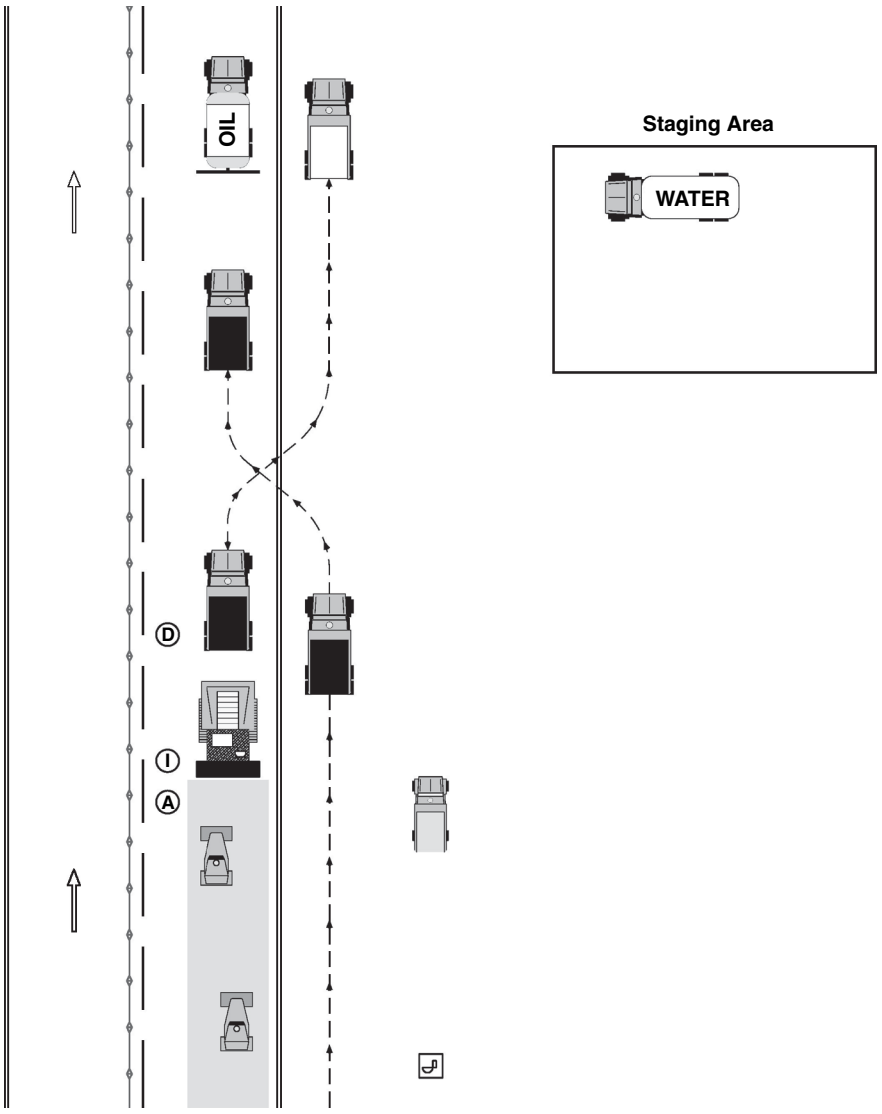

FIGURE 1 Paving model plan diagram.

barrier is shown in Figure 1. 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 show critical dimensions related to the injury reduction measures. For example, a 50-ft minimum distance required between the paver and the first roller is shown in the ITCP in Figure 2.

The ITCP diagram may be shown on 8½-in. × 11-in. or larger sheets of paper, up to plan-sized sheets, if required. In some cases, a site diagram may be required with the ITCP diagram covering a portion of the site; however, most plan sets will include the site diagram.

ITCP Legend

The legend explains the symbols used on the ITCP diagram. Figure 3 shows a legend for paving ITCP. 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. If worker or visitor parking is allowed on site, the legend should have a symbol for parking.

ITCP Notes

The ITCP notes contain safety points, injury reduction measures, site-specific provisions, and duties of various contractor personnel. Safety points include pedestrian-free zones and buffer areas for vehicles such as rollers. Duties of the safety officer, plant operator, pedestrian workers, and truck drivers, pertaining to safety, are specified. 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 29 CFR. The ITCP notes may include provisions for communication between workers, spotters for backing trucks, and site speed limits.

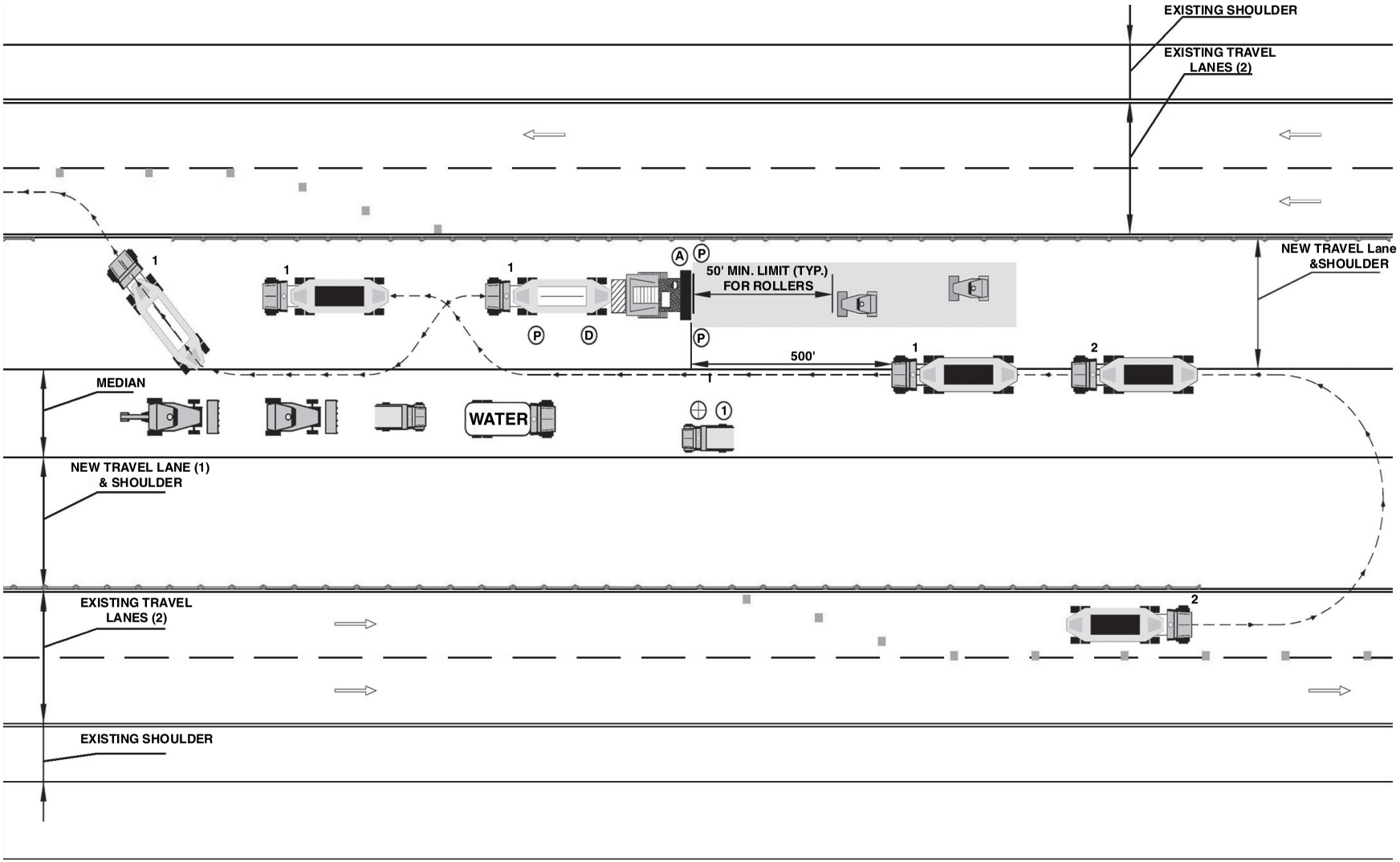

FIGURE 2 ITCP with all remaining features.

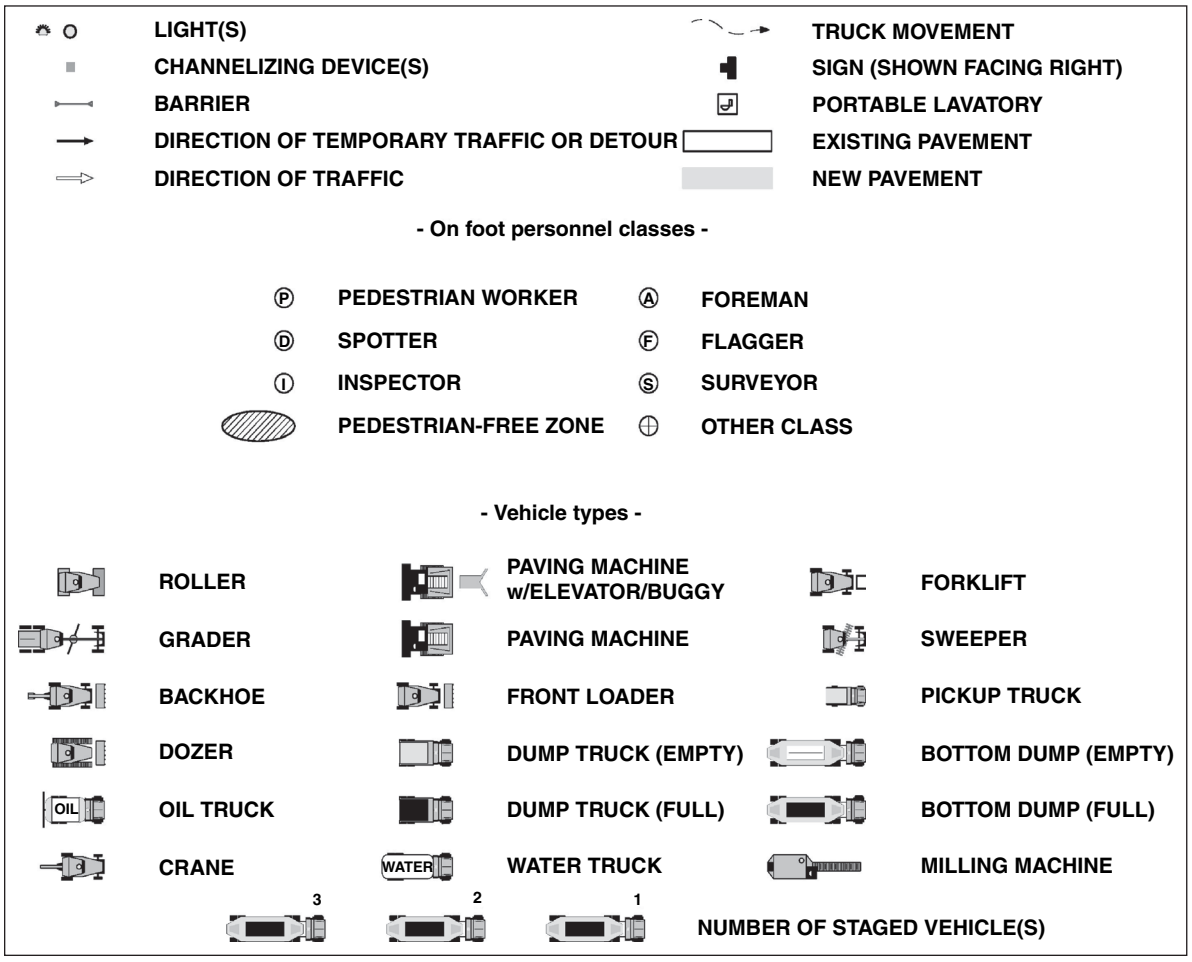

FIGURE 3 ITCP legend.

PREPARATION OF ITCP

The ITCP is part of the file documents for a construction project. In most cases, it will be prepared by contractor personnel after contract award. 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. (The model plan for some of the tasks involved in the project may be included in the plans, specifications, and equipment package.)

A process for developing an ITCP using principles of safe construction traffic control is detailed in the development guide (*3*) and summarized here. The ITCP is then used during the project to reduce worker injuries and fatalities. Application of the ITCP is discussed later in this paper.

The following outline shows six steps in the preparation of an ITCP. 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 expected to be the most hazardous, due to large numbers of pedestrian workers and their interaction with trucks and other equipment. For paving projects, this will generally be the paving phase, which requires a number of pedestrian workers to work near the dump trucks bringing asphalt to the paving machine. Full details of ITCP development are given in the development guide (*3*). Figure 2 provides an example of an ITCP at one of the paving projects studied. The figure shows portable concrete barrier used to protect both ends of the work space.

Step 1. Review contract documents and model plans.

Step 2. Determine the sequence of construction and choose which, if any, phases should have site-specific ITCPs.

Step 3. Draw the basic work area layout.

Step 4. Plot pedestrian and vehicle paths.

Step 5. Locate utilities, storage, and staging areas.

Step 6. Prepare ITCP notes.

APPLICATION OF ITCP

While preparation of an ITCP may benefit a contractor in planning for a safe project, the main benefit of the ITCP is conferred during preconstruction and project safety meetings. Use of the ITCP in daily safety meetings is necessary to make all project personnel aware of how to safely perform their jobs.

At preconstruction meetings, the ITCP can be used to illustrate the safety plan and the contractor's approach to worker safety. The plan is also useful to assure the contracting agency that worker safety is being considered and planned for in a manner similar to that for road users moving through the work zone.

During the project, the plans are useful for discussing construction strategy and daily changes that are part of any paving project. The plan should be distributed to all personnel working on the project, including inspectors and subcontractors such as independent truckers. The safety officer and competent person on the project should make changes in the ITCP as conditions warrant during the project.

ITCP Use at Preconstruction Meetings

The ITCP should be a discussion item at the preconstruction meeting, along with the overall safety plan. All stakeholders should be present, including inspectors, project engineers, superintendents, safety officers, competent person, utility owners, subcontractors, and other interested parties. Common worker injury and fatalities for work operations should be discussed along with injury reduction measures contained in the ITCP notes.

Critical parts of the ITCP such as truck access points and staging areas should be discussed and approved by the contracting agency. Protection of vehicle operators from hazards such as overhead power lines or steep slopes should be discussed. Also, a plan for communicating the provisions of the ITCP and the overall safety plan to each worker should be discussed. Communication methods should include daily safety meetings and required attendance of subcontractors at ITCP briefings. Training for inspectors and tare collectors in safely performing their jobs should be provided by using the ITCP. All personnel employed on the project need training specific to work activities and their duties.

ITCP Use During Construction

The safety officer and designated competent person for each shift should use the ITCP to illustrate the safety plan and ensure its relevant to the particular operation. If changes to the ITCP are necessary as the project progresses, then the competent person should be in charge of getting the changes approved and communicating the changed plan to all project personnel.

Furthermore, the competent person should be responsible for warning pedestrian workers or vehicle operators about violations of the ITCP. Such violations could include workers out of position or working in pedestrian-free zones, or truck drivers operating at speeds above the designated speed limit at the site. The safety officer or competent person should take photographs or video of the work operation to check compliance with the ITCP or to check areas where changes are necessary.

Truck drivers should be briefed on how to access the project site, the path to follow to deliver materials, where to stop for staging, and how the spotter will instruct them once they are near the work operation. The plant operator also should be briefed on holding trucks at the plant site to control the number of trucks on the site at any one time. In addition, truck drivers should be briefed on procedures for leaving the project area and reentering the traffic stream.

A method for handling visitors to the project should also be discussed. Visitors should park at an off-site staging area and then be briefed on the ITCP. If visitors drive to the site, they should access at a known point and should park and walk in approved areas.

At the conclusion of each construction phase, the ITCP should be critiqued, and critical points of upcoming phases should be discussed.

OBSERVATIONS OF PAVING

Two asphalt paving sites and two portland cement concrete (PCC) paving sites were observed. ITCPs were prepared for these sites by the researchers, but the plans were not implemented on the sites by the contractors, for their contract did not require an ITCP. Observations and recommendations of the research team are reported in a number of project reports.

The paving operations were videotaped with two cameras. One camera was stationary and filmed the overall operation of each site. The second camera was a handheld digital camera that was used to videotape from ground level. It was also used to videotape from inside construction vehicles and to record interviews with workers and vehicle operators. Sites were observed for approximately 40 h each, and Site 1 included night observation.

PAVING OBSERVATION RESULTS

The researchers observed the following situations.

1. At most sites, safety officers were on site only once a day for 15 to 30 min.
2. At one of the PCC paving sites, truck drivers were confused about where to go and where to start backing to the paver. At an asphalt, site truck drivers were not instructed about how to enter and exit the work space.
3. A loader was operated between the paver and backing trucks at one PCC paving site. The movement of the loader was seen as a potential conflict, and if the loader struck the paver, an unbelted rebar setter on the paver could have been thrown into the paver's auger.
4. At the first asphalt-paving site, truck drivers tried to complete the cycle from the plant to the paving site as quickly as possible. The speeds of the trucks were a hazard to both the traveling public and those working at the site. No desirable speeds were required or mentioned for either the public travel portion or the work space portion of the trip. Other vehicles were observed operating at relatively high speed in the work space.
5. At all sites, if paving operations were halted or stopped, several trucks backed up on site, creating additional unnecessary hazards.
6. While all operations had designated spotters, there was no method of communication between trucks and spotters other than hand signals, which were often inadequate to protect workers from backing trucks.
7. Trucks and pavers had blind spots where a person could not be seen, and workers were not always aware of where blind spots were in relation to equipment.
8. At one site, a backhoe placed paving material in paving gaps. The backhoe moved in and out of the area between trucks and the dump area. No one directed the backhoe's movements, and workers were not warned of the operator's movements.
9. For night paving operations, sufficient light was available near the paver. However, there was little light available in other areas, such as where inspectors were sampling the placed asphalt mat.
10. One of the most serious violations of safety procedures was observed when an employee entered the front of the paving machine while the concrete auger was still rotating. The auger should be deenergized as required in lock-out, tag-out procedures.

CONCLUSIONS FROM PAVING OBSERVATIONS

Several conclusions were drawn from paving observations:

1. The ITCP is a graphical method to inform vehicle operators and pedestrian workers of hazards inside the work area. Provision for an ITCP would have reduced hazards and observed conflicts at all four paving sites observed.
2. A competent person was not available during all paving operations. The safety officer was either absent or visited the site for a very brief time.

3. Safety plans were generic and not specific to any of the sites.
4. Truck drivers were often confused about how to access the site, and most could not communicate vocally with spotters, foremen, or plant operators.
5. At one site, material trucks and other service vehicles operated at relatively high speeds, even at night with little illumination.
6. There was no reliable method of controlling the rate of truck arrivals at the work site.
7. Lock-out, tag-out procedures were not always observed.

ACCIDENT INVESTIGATIONS

In a media release before the 2005 Memorial Day weekend, the American Society of Safety Engineers referred to several roadway work zone fatalities that reflect different risks involved in highway work zones. However, of the 18 incidents cited from NIOSH Fatality Assessment and Control Evaluations (FACE) investigations, 10 were incidents completely internal to the work zone or involving construction vehicles. The incidents referred to include the following:

- A construction worker died after a water truck and a scraper collided (South Carolina).
- An asphalt-milling superintendent was crushed under an asphalt-milling machine (Virginia).
- A construction worker died after being struck by a front-end loader (Pennsylvania).
- A construction worker died after being run over by an asphalt roller at a highway construction site (Virginia).
- A construction worker died after a compactor tipped over at a highway construction site (South Carolina).
- A 17-year-old part-time road construction worker died after being run over by a water truck (Indiana).
- A construction worker died after being run over and crushed by a grader at a road construction site (North Carolina).
- In incidences at various places, construction workers were killed after being backed over by dump trucks (California).
- A worker died after being crushed between a rock spreader and a large roller (Minnesota).

Furthermore, the following accident investigations were conducted under the FACE program; data are derived from a given state's FACE investigation report. Individual recommendations by the investigators have been edited for brevity and relevance to the ITCP concept.

Accident 1

A 46-year-old worker (victim) died of injuries he sustained after being run over by a bulldozer at a construction site (Minnesota, 2003). On the day of the incident, workers were preparing the base for new asphalt roadways in a residential housing development. The victim's job was to work near the bulldozer and advise the operator whether the material being added was level or not in preparation for laying the curbing. The bulldozer operator was aware that the victim was working behind him, but he did not realize how close to the Caterpillar the other worker was. The bulldozer operator was driving forward when he looked back and noticed that the victim had been run over.

Minnesota FACE investigators concluded that to reduce the likelihood of similar occurrences, the following guidelines should be followed: Mobile equipment should be equipped with an audible backup alarm as well as sensing units to detect pedestrian workers in the blind spots of the equipment operator. Also, employers should design, develop, and implement a comprehensive safety program.

Accident 2

A 60-year-old male police officer (victim) was fatally injured when he was crushed beneath an asphalt-loaded dump truck at a public roadway construction site (Massachusetts, 2000). The dump truck involved was backing inside the work zone while the victim was walking away from the dump truck, preparing to help the truck back. Two truck drivers who were parked within the construction site noticed the dump truck was backing in line with the walking officer. They attempted to warn the officer and the backing truck operator. The dump truck struck and knocked the victim to the ground and then backed over him with the left rear wheels. The Massachusetts FACE Program concluded that to prevent similar occurrences in the future, employers and roadway construction contractors should do the following:

- Carefully evaluate project scheduling by considering the type of work zone setup, time of day, and time of year the work will be performed.
- Develop, implement, and enforce an ITCP specific to each construction site to reduce backing of construction vehicles.
- Ensure backing procedures are in place and that designated individuals are assigned as signalers to direct backing construction vehicles on construction sites.

In addition, local and state government agencies should consider offering work zone safety training for all municipal officers who perform traffic details on roadway construction sites.

Furthermore, manufacturers of heavy construction equipment such as dump trucks should explore the possibility of incorporating new monitoring technology on their equipment to assist the operator while backing.

Accident 3

A 55-year-old male highway department supervisor (victim) died from multiple trauma after he was struck by a reversing dump truck at a multilane highway repair project (Missouri, 1996). The victim was the job-site superintendent on the project. He had just instructed the driver of the dump truck to back his truck, loaded with asphalt material, to the beginning of the road patch area. After delivering instructions to the workers, the supervisor proceeded to walk along the shoulder of the highway toward the incident site. The dump truck began reversing along the patch the workers had just completed. At some point, the supervisor crossed from the shoulder into the lane used by the reversing truck. The truck driver did not see the victim and backed over him. The Missouri FACE investigator concluded that to prevent similar occurrences, employers should do the following:

- Ensure that mobile equipment contains well-maintained audible backup alarms to warn pedestrians of impending equipment movement.
- Ensure that work procedures minimize or eliminate pedestrians' exposure to hazards from moving vehicles and mobile equipment.
- Consider providing personal audible alarms (similar to pagers) to pedestrian workers who are exposed to hazards of vehicle movement.

Accident 4

A 45-year-old female flagger died after being struck by a dump truck as it was backing up in a residential road construction site (Washington State, 1999). The flagger (victim) was working with a construction company hired by the county to pave the residential street. The construction crew had already completed paving the west side of the street and was in the process of paving the east side when the incident occurred. The victim had been assigned to control traffic at a side street feeding the two-lane road being paved. Full and empty dump trucks were traveling through the work zone. A pilot car was used to bring non–road construction traffic up and down the west side of the road. As the pilot car approached the victim's flagging position during one of its runs, the driver of that car noticed that the victim was in the roadway and in the path of an oncoming dump truck. The dump truck was in the process of backing down the west side of the road to drop its load of asphalt into a paver. Its backup alarm was activated at the time. Shortly after being seen by the pilot car driver, the flagger was struck and killed by the dump truck.

To prevent future similar occurrences, the Washington State FACE investigative team concluded that flaggers involved in highway construction work zones should follow these guidelines and requirements:

- Flaggers should not put themselves at risk attempting to stop vehicles intruding into work zones.
- Employers need to have a continuing process for site and program evaluation and for identification, correction, and communication of hazardous conditions for workers within a changing work zone.
- Flaggers should be equipped with two-way portable radio communication devices and other emergency signaling equipment.
- Consideration should be given to using a spotter to provide direction for trucks and heavy equipment backing up in work zones.
- Dump trucks should be equipped with additional mirrors or other devices to cover blind spot areas for drivers when they are backing up.
- Employers should develop methods to ensure that flaggers have adequate warning of equipment or vehicles approaching from behind.
- Employers should continually train all workers about specific hazards associated with moving construction vehicles and equipment within a work zone.
- Employers should develop and use an internal traffic safety plan for each highway and road work zone project.

Accident 5

A 20-year-old road construction worker died from multiple injuries received when a dump truck fully loaded with asphalt backed over him (Oklahoma, 2003). Five dump trucks loaded with asphalt were preparing to transfer their loads into the asphalt paver. As the first truck unloaded its asphalt, the victim was sent to repair a break in the string line used to guide the paver. The victim was kneeling down to nail the string to the road surface. He was about 10 ft behind the second dump truck, in the driver's blind spot and had his back to the truck. As the truck began backing up to the unloading position, at least one other worker in the area heard the backup warning signal. He and another worker saw the hazard, and although they tried to warn the victim, he was run over by the truck's dual rear tires.

Oklahoma FACE investigators concluded that to prevent similar occurrences, employers should do the following:

- Develop and implement a written program that includes policies and procedures pertaining to the positioning of employees during all phases of the asphalt-laying process.
- Consider the use of a spotter to direct vehicles that are backing up in a work zone.
- Implement the use of warning devices more effective than backup alarms in work zone areas.

Accident 6

A 43-year-old male public works employee died when he was struck and run over by a dump truck that was backing up along a city street that was under construction (Washington State, 2000). A construction superintendent was also struck and seriously injured in the incident. The city worker was working alongside the construction superintendent at the time of the incident. Both were standing in the street running a chalk line when a dump truck backed down the street and struck them.

To prevent similar occurrences in the future, the Washington State FACE investigative team concluded that employers engaged in roadway construction or maintenance should follow these guidelines:

- There should be development and use of an ITCP for each road construction project.
- All employees working in road construction work zones should wear high-visibility safety apparel such as high-visibility vests and hard hats.
- Construction work zones and construction vehicle and equipment traffic flow should be designed to avoid backing up vehicles and equipment as much as possible.
- A spotter should be used to provide direction for trucks and heavy equipment backing up in work zones.
- Dump trucks should be equipped with additional visual or sensing devices to cover blind spots.
- Construction vehicle drivers and key work zone personnel should be equipped with two-way portable radio communication devices to help coordinate activity of construction vehicles within the work zone.

CONCLUSIONS FROM ACCIDENT INVESTIGATIONS

Several conclusions were drawn from the accident investigations:

1. Even if they are operating, backup alarms alone are not sufficient to eliminate the hazard of backing vehicles.
2. Spotters should have direct communication with truck drivers.
3. Three types of information are needed by workers and can be illustrated by an ITCP. The first is information that is essential to the job they are performing. For example, truck drivers should know where they are going and how to access the work area (that is not always the case). Second, workers should be briefed on what other equipment and personnel are in the work area. Doing so is especially important where a number of companies are operating in the work area. Last, work areas are dynamic, and workers should be updated at least once per shift on changing conditions and as conditions change during their work shift.
4. The competent person, safety officer, or other designated qualified person should conduct accident and incident investigations to determine the root cause. The purpose is to prevent future accidents

and to determine if there is a basic flaw in the system that should be analyzed; analysis results should be incorporated into future projects.

5. It is important that the ITCP be clearly understood by all workers. The plan should define the work areas, hazards, potential emergency situations, and hazard prevention methods related to the work zone.

RECOMMENDATIONS

A number of measures are recommended to ensure safety of pedestrian workers and construction vehicle operators:

1. A detailed safety plan should be ensured—one that meets or exceeds 29 CFR requirements, with specific documented training for all employees. A competent person who meets 29 CFR standards should be required on site during the work. An ITCP should be required as part of the safety plan.
2. Daily safety meetings should be conducted with all personnel, including truck drivers, inspectors, and others. The ITCP should be discussed, along with updates in operations.
3. Spotters should have direct communication with truck drivers bringing materials to the work site; there should be use of radios or other communication devices to do so.
4. For paving operations, a crew member, most logically the screed operator, should be designated to communicate with the rest of the crew when the paving machine is backing up.
5. A crew member should be designated to communicate with the rest of the crew when other equipment is operating in the work area.
6. Truck drivers need instructions on how to enter and exit the work zone and how to maneuver within the work zone. Such instruction could be accomplished by having the designated safety officer go over the ITCP with them before the work begins.
7. All other equipment operators or passenger truck drivers on site should also be made familiar with the ITCP so that they can more safely and efficiently operate within the work area
8. For night work, light standards should be placed so that lighting is consistent along the work site
9. All safety apparel should be checked for retroreflectivity for night operations.
10. Desirable operating speeds should be established for vehicles on public roads and in the work space.
11. Seat belts should be required for all vehicles, and a seat belt or harness should be required for the rebar setter on PCC paving machines.
12. A specific lock-out, tag-out program should be established for use when there is servicing of machinery.

SUMMARY

Safety of pedestrian workers and construction vehicle operators can be enhanced by a carefully prepared ITCP administered by a competent person at the paving site. Time and effort spent in preparing and using an ITCP should lower the rate of occupational injuries and fatalities experienced by construction personnel at asphalt paving projects. The full development guide, while aimed specifically at asphalt-paving projects, can also be useful in preparation of ITCPs for other common types of construction. It is hoped that in the future, additional model plans will be prepared that can aid in development of ITCPs for other construction operations.

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