

Internal Traffic Control Plans

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ABSTRACT

While a temporary traffic control plan describes how a specific work zone is to be set up to ensure the safety of the motoring public, construction equipment and vehicles within the work space are not addressed. An internal traffic control plan (ITCP) is a tool that project managers can use to coordinate and control the flow of construction vehicles, equipment, and workers operating in close proximity within the activity area to ensure the safety of workers. Recent federal regulations require safety plans of all construction contractors prepared by competent persons.

The concept of ITCP was developed as a promising intervention in research conducted by the Laborers' Health and Safety Fund for the Federal Highway Administration. This study found that only one-third of highway worker injuries are traffic-related, and that approximately half of the fatal injuries of workers on foot in the work space involve a backing construction vehicle. Among interventions that were developed during this research was the provision of an internal traffic control plan to control traffic within the work space. Model ITCPs were developed for paving, dirt spread, and trenching operations.

Additional accident data on worker injuries was collected and analyzed by Pratt et al. of the National Institute for Occupational Safety and Health (NIOSH). In 2002, NIOSH sponsored research to prove the applicability of the ITCP concept to paving operations on freeway work zones. Two asphalt paving and two portland cement concrete sites were observed in this research, and ITCPs were developed for each site. An ITCP development guide to aid contractors in preparing ITCPs was also developed in this research. This paper will describe the preparation of ITCPs and discuss field observations of asphalt and concrete paving operations. While additional research is needed, this intervention shows promise to reduce worker injuries in highway construction zones.

Key words: internal traffic control plan—worker injury—work space safety

BACKGROUND

Purpose of an Internal Traffic Control Plan

The *Manual on Uniform Traffic Control Devices* (MUTCD) (2003) defines a temporary traffic control (TTC) plan in Section 6C.01: “A temporary traffic control plan describes temporary traffic control measures to be used for facilitating road users through a work zone or incident area.” The MUTCD also specifies that “TTC plans range in scope from being very detailed to simply referencing typical drawings contained in this Manual, standard approved highway agency drawings and manuals, or specific drawings contained in the contract documents.”

However, 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. 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 recently published MUTCD has several new guidance statements that relate to worker protection, and for the first time these statements are referenced to long standing 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.”

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 to other construction workers and to all workers. Both the LHSFNA report and Pratt et al. (2001) 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. (2001) found that backing equipment, particularly dump trucks, accounted for half the fatalities of pedestrian workers in work zones.

Principles of an Internal Traffic Control Plan

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. Thus, the ITCP was proposed by Graham-Migletz Enterprises, Inc., as a way to prevent worker injuries and fatalities during the LHSFNA study.

The purpose of this paper is to detail how an ITCP for paving operations is developed and used. The research described was completed under contract 200-2002-00596 “Pavement Operation Internal Traffic Control Plans” for the National Institute for Occupational Safety and Health (NIOSH). The ITCPs used as examples in this guide were developed for two paving operations observed in Tucson and Casa Grande, Arizona, in December 2002 and January 2003, respectively. The complete development guide and ITCP plans for two PCC paving projects were also prepared under this contract.

The development of ITCPs for paving operations was based on the following principles of safe construction traffic control, developed by Graham and Migletz (1997):

- 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/CG principles 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 earlier research is shown in Figure 1. This model plan also included safety points for paving operations and listing of personnel and equipment involved in the paving operation.

The NIOSH project specified that only freeway projects where traffic was separated from the paving operation either by a median or by temporary traffic barriers be observed. In this type of operation, the access and egress of trucks delivering asphalt to the job site is also included as part of the ITCP.

Responsibility for Developing the ITCP

The following criteria are necessary for those developing the ITCP:

1. 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 the contract is awarded but prior to the start of construction. A typical organizational chart of a paving contractor is shown in Figure 2.
2. The safety officer, if qualified, should be in charge of the development of the ITCP.
3. This officer should meet the OSHA requirements of a “competent person.”

Section 29 CFR 1926.32 defines a “competent person” as 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. The competent person should have sufficient experience and training to recognize and eliminate safety violations and other hazardous situations, as 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 the development and monitoring of the ITCP. A competent person who can spot safety hazards and make changes to the ITCP, if needed, should be on-site during all paving operations. If the safety officer is not an engineer, s/he will need to work with an engineer 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 (i.e., trained and/or certified) in proper temporary traffic control practices. The

The remainder of this paper will explain the components of the ITCP, the preparation of the ITCP for a specific site, and the use of the ITCP during paving operations.

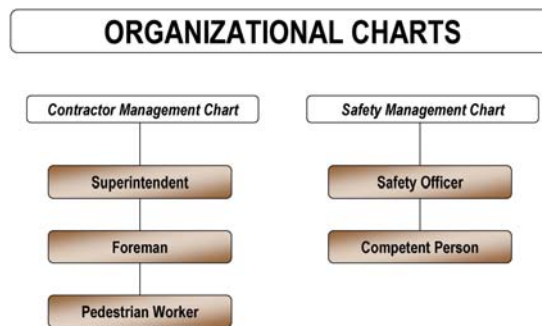


Figure 2. Typical organizational chart for a paving contractor

COMPONENTS OF AN INTERNAL TRAFFIC CONTROL PLAN

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

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.

A model plan (similar to typical applications) for a paving operation with traffic separated from the work space by a temporary 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-foot minimum distance required between the paver and the first roller is shown in the ITCP. The ITCP diagram may be shown on 8.5 x 11-inch sheets or larger, up to plan-size 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.

Legend

The legend explains the symbols used on the ITCP diagram. A legend used for a paving ITCP is shown in Figure 3. 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 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 in safety terms 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 for Site 1 included provisions for communication between workers, spotters for backing trucks, and site speed limits.

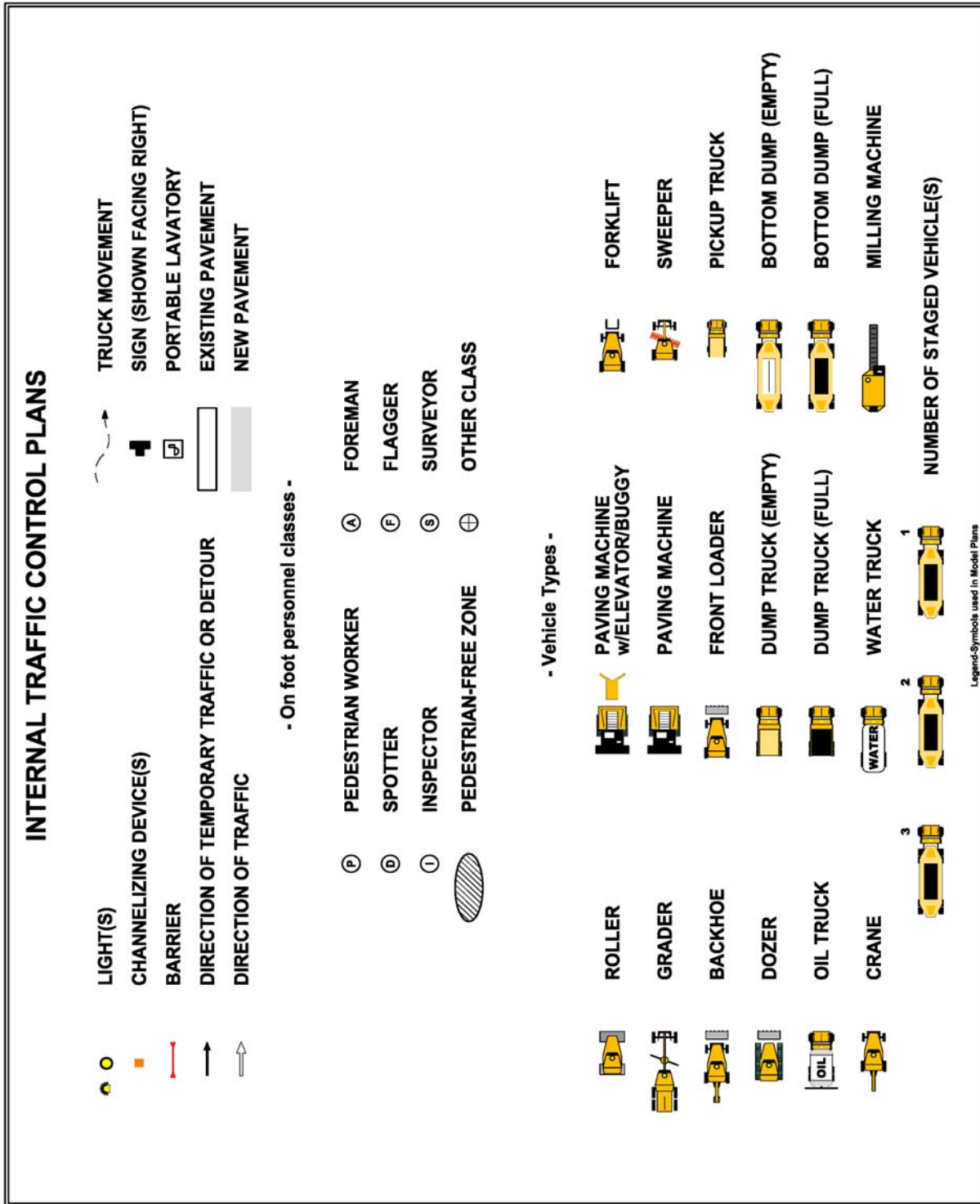


Figure 3. Internal traffic control plan legend

ITCP PREPARATION

The ITCP is part of the contract documents for a construction project. In most cases, it will be prepared by contractor personnel after the contract is awarded. 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 PS and E package).

A process for developing an ITCP using principles of safe construction traffic control is detailed in the development guide and summarized here. The ITCP is then utilized during the project to reduce worker injuries and fatalities. Application of the ITCP is also 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 that are 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.

Each of the steps in preparing an ITCP is discussed below. Examples of an ITCP are taken from the two asphalt paving projects studied.

Step 1: Review Contract Documents and Model Plans

The contract document most relevant to the ITCP preparation is the TTC plan. 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.

A work site plan and cross section of the first example site is shown in Figure 4. This site was an urban four-lane freeway between two interchanges. The median of the freeway was to be cleared and new paving would add a travel lane and shoulder to each direction of travel. Other work included milling and overlay of the existing paved section and interchange improvements at Ina Road. Because of heavy traffic volumes, it was expected that some of the work would have to be completed at night. The paving of existing lanes was similar to the traffic-adjacent paving model plan and the paving of the new lanes in the median was similar to the model plan for paving with traffic separate (see Figure 1).

Step 2: Determine Construction Sequence and Choose Phases Having Site-Specific ITCPs

In this step, the personnel and equipment required for each phase of construction are listed, and the phases considered potentially hazardous are chosen for site-specific ITCPs. The sequence of construction, for example, in Site 1 was the following:

- Phase 1: Clear median and set concrete barrier
- Phase 2: Mill existing lanes and repave
- Phase 3: Add fill to median for subbase for new traffic lanes
- Phase 4: Pave new lanes in median

The equipment and personnel required for Phase 4 are shown in Table 1. This phase involved the most equipment and personnel and would be expected to be the most hazardous phase of this project. A site-specific ITCP was drawn for Phase 4.

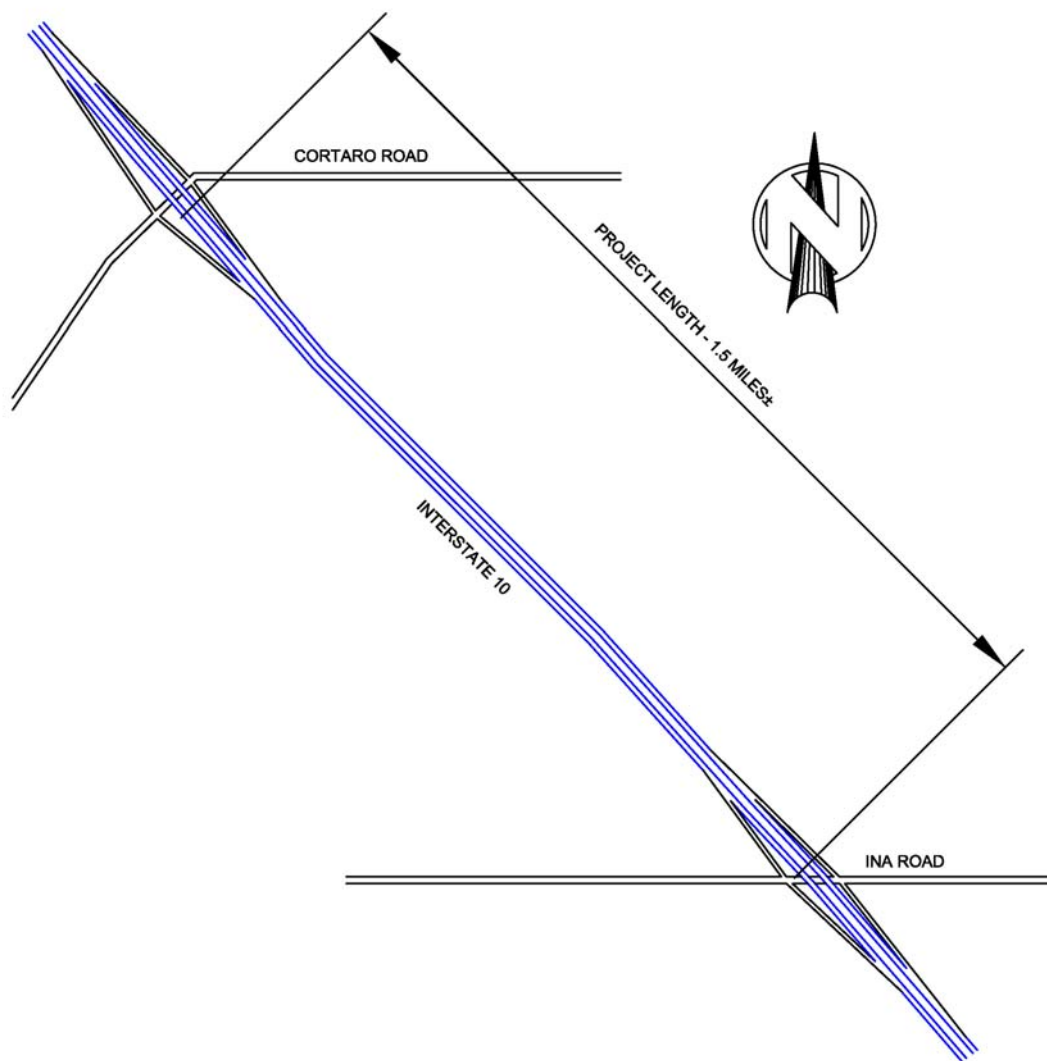
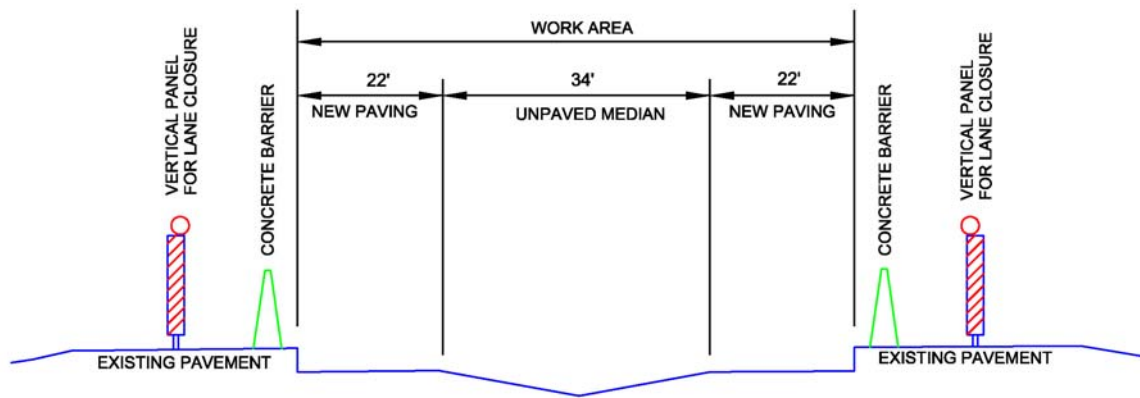


Figure 4. Site plan

Table 1. Equipment and personnel list for Site 2

Personnel	Equipment
Supervisor (1)	Oil (boot) truck (1)
Boot truck operator (1)	Paving machine (1)
Truck driver (8-10)	Bottom (belly) dumps (8-10)
Paving machine operator (1)	Backhoe (1)
Screed operator (1)	Loader (1)
Laborer/raker (2)	Vibratory roller (2)
Spotter/truck guide (2)	Water truck (1)
Roller operator (2)	Sweeper (1)
Mechanic (1)	Mechanic truck (2)
ADOT inspector (1-2)	Miscellaneous pickup truck (6)
Materials inspector (1)	

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.

The basic layout for example site 1 included the old median area where new lanes are to be added. As shown in Figure 4 the old median is divided into three areas, including a westbound travel lane and shoulder, a new median, and an eastbound travel lane and shoulder. The provision for concrete barriers was shown in the TTC plan and is therefore part of the basic layout of the ITCP.

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

Vehicles and pedestrian workers at site 1 paving of new lanes are shown in Figure 5. Note that truck access points are controlled by openings in the barrier along the new travel lanes. An existing travel lane is closed in each direction to allow the trucks to exit and reenter the traffic stream. The truck access points were chosen to minimize the length that trucks traveled in the work area and to minimize the length of round trip from the asphalt plant to the work area. An alternate scheme would be to have trucks exit at the same point as they entered, but this would increase the truck travel in the work area and could cause conflicts between entering and exiting trucks. At site 1, bottom dump trucks were utilized and an elevator was used on the paver. These pieces of equipment allowed material to be windrowed in front of the paver rather than trucks backing up to the paver hopper.

Since this phase of construction was done at night, Figure 5 shows the location of light stations needed to ensure acceptable light levels throughout the work area. Pedestrian free zones should be added when pedestrian workers are in great danger, such as behind backing trucks. Buffer spaces between pedestrians and equipment should be provided. For example, see the 50-foot minimum buffer between the paver and rollers at site 1 in Figure 5.

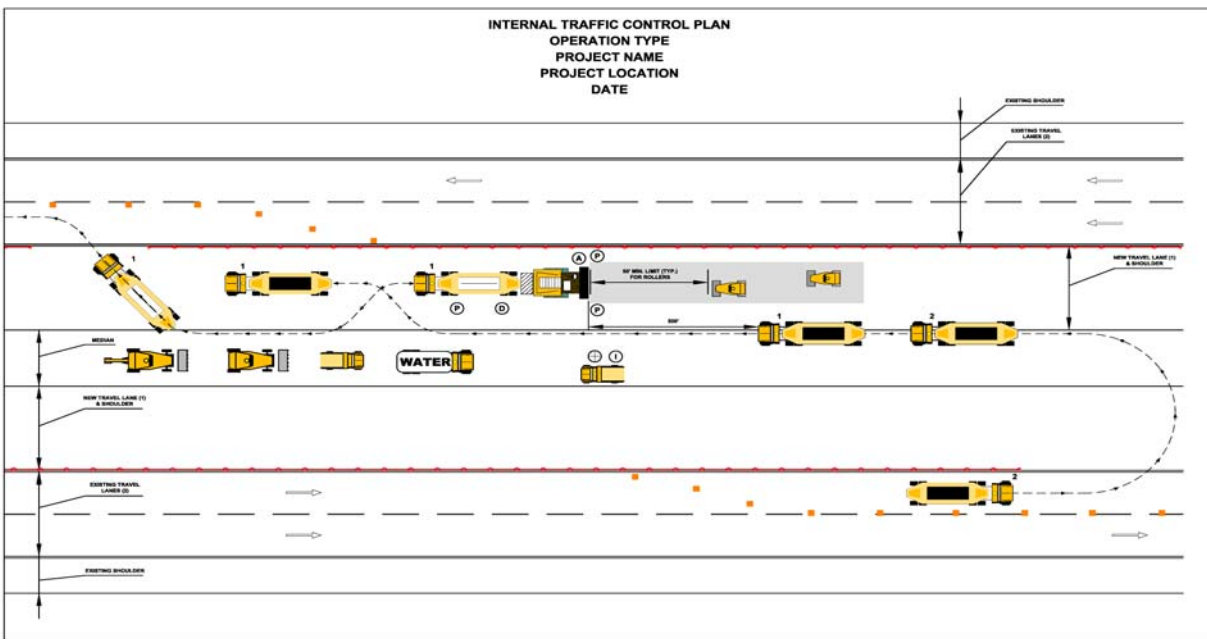


Figure 5. ITCP with all remaining features

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 traffic control, such as overhead power lines awareness markers, should also be added to the diagram.

Equipment needed periodically should be stored in a safe area. For example, at site 1 the water truck, backhoe, and front-end loader were stored in the median until needed (see Figure 5). At site 2, the equipment storage and restroom facility were stored near the right-of-way line of the interchange area being repaved (see Figure 6).

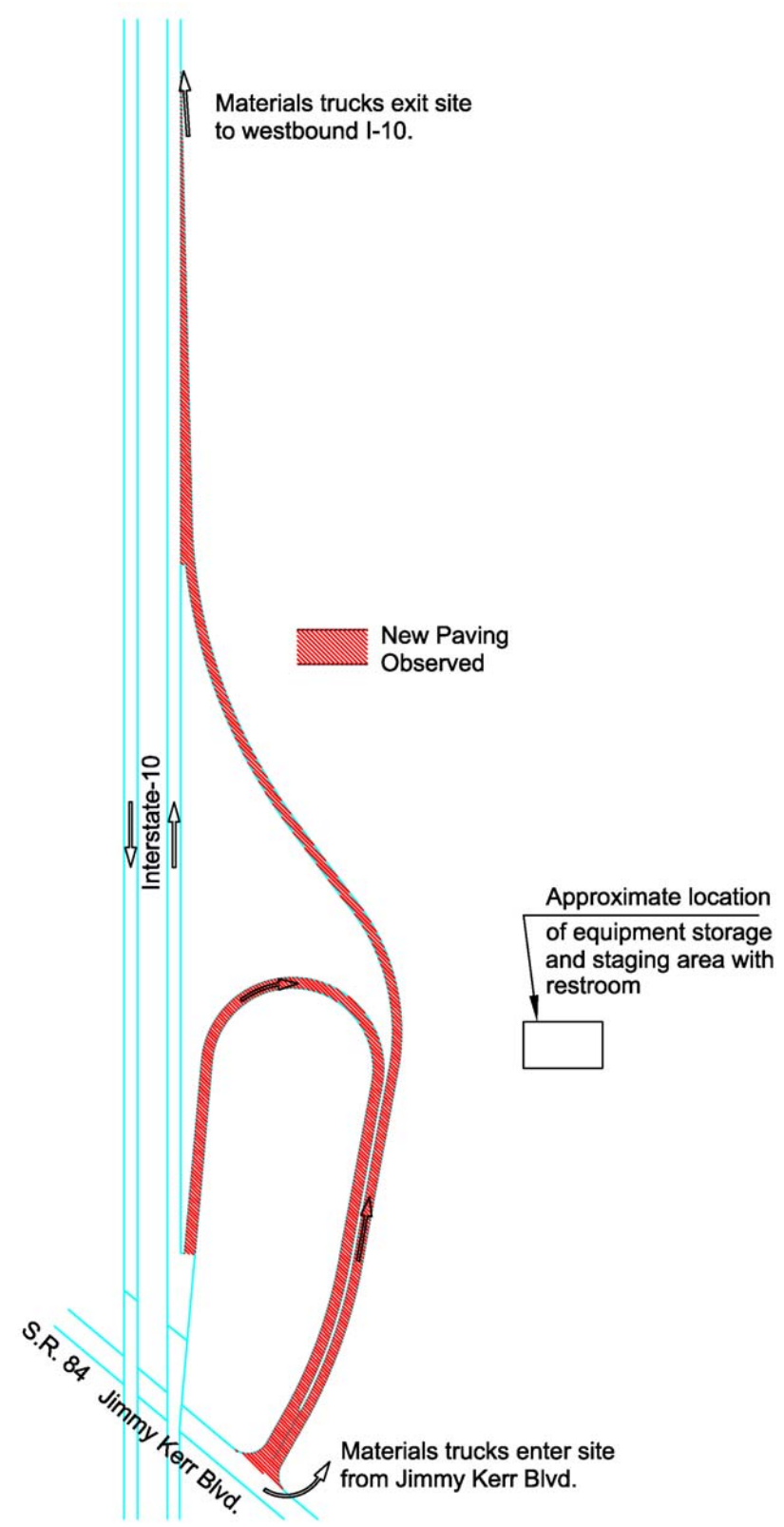


Figure 6. Internal traffic control plan with equipment storage and restroom facility

Step 6: Prepare ITCP Notes

The last 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 for site 1 included references to lighting requirements and use of fog lights for trucks, since this phase of work was done at night. The notes may also reference other safety requirements such as CFR29. The notes of the ITCP should supplement other contract documents but should not conflict with or supercede 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.

APPLICATION OF ITCPS

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

At pre-construction 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 of road users moving through the work zone.

During the project, the plans are useful to discuss 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.

Using ITCPS at Pre-Construction Meetings

The ITCP should be a discussion item at the pre-construction meeting along with the overall safety plan. Common worker injury and fatalities for paving 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. A plan for communicating the provisions of the ITCP and the overall safety plan to each worker should be discussed at the pre-construction meeting. 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 utilizing the ITCP.

Using ITCPS During Construction

The safety officer and designated competent person for each shift should use the ITCP to illustrate the safety plan for the paving 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.

The competent person should also be responsible for warning pedestrian workers or vehicle operators of violations of the ITCP. These violations could include workers out of position or working in pedestrian-

free zones, or truck drivers operating at speeds above the designated site speed limit. The safety officer or competent person should take photographs or video of the paving 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 the paver, where to stop for staging, and how the spotter will instruct them once they are near the paver. The plant operator will also be briefed on holding trucks at the plant site to control the number of trucks on the site at any time. Truck drivers should also be briefed on procedures for leaving the project area and re-entering 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 park and walk in approved areas.

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

OBSERVATION OF PAVING OPERATIONS

Two asphalt paving sites and two PCC paving sites were observed. ITCPs were prepared for these sites, but were not implemented. The results of the observations and recommendations of the research team are contained in a number of project reports.

The paving operations were videotaped with two cameras. One of the cameras was stationary and filmed the overall operation of each site. The second camera was a hand-held digital camera that was used to film from the ground level and also filmed from inside construction vehicles and filmed interviews with workers and vehicle operators. Sites were observed for approximately 40 hours at each and site 1 included night observation.

Observation Results

1. At most sites, safety officers were only on-site once per day for 15-30 minutes.
2. No accidents or near accidents were observed.
3. At one of the PCCP 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 on how to enter and exit the work space.
4. A loader was operated between the paver and backing trucks at one PCCP 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.
5. At the first asphalt paving site, truck drivers tried to complete the cycle from the plant to the paving site as quickly as possible. No desirable speeds were required or mentioned for the public travel portion nor the work space portion of the trip. Other vehicles were observed operating at relatively high speeds in the work space.
6. At all sites, if paving operations were halted or stopped, several trucks backed up on-site, creating additional unnecessary hazards.
7. While all of the operation had designated spotters, there was no method of communication between trucks and spotters other than hand signals.
8. Trucks and pavers had blind spots where a person could not be seen.
9. 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 his movements.

10. For night paving operations, sufficient light was available near the paver; however, there was little light available in other areas, such as where inspectors sampled the placed asphalt mat.
11. 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 de-energized as required in lock-out, tag-out procedures.

CONCLUSIONS

This research yielded the following conclusions:

1. The ITCP is a graphical method to inform vehicle operators and pedestrian workers of hazards inside the work area. The provision of 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 short 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 with spotters, forepersons, 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.

RECOMMENDATIONS

The following are the recommendations based on this research:

1. Ensure that there is a detailed safety plan that meets 29 CFR requirements with specific documented training for all employees. Require a competent person who meets 29 CFR standards to be on site during the work.
2. Daily safety meetings should be conducted with all personnel, including truck drivers, inspectors, etc. The ITCP should be discussed, along with updates in operations.
3. Spotters should have direct communication with the material truck drivers through the use of radios or other communication devices.
4. 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. This could be accomplished by the designated safety officer going over the ITCP with them prior to the work commencing.
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 need to be placed so that lighting is consistent along the work site.
9. All safety vests should be checked for reflectivity for night operations.
10. Establish desirable operating speeds 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. Establish a specific lock-out, tag-out program for use when servicing the machinery.

SUMMARY

Safety of pedestrian workers and construction vehicle operators can be enhanced by a carefully prepared internal traffic control plan 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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