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CHAPTER EIGHTY-THREE

Traffic Control Devices (In Construction Zones)

83-1.0 GENERAL

The proper use of traffic control devices is critical to both public and worker safety and has been proven to significantly reduce accidents in construction zones. This chapter provides supplemental information on these devices and presents specific Department policies and procedures. For additional information, the designer is encouraged to review the references listed in Section 83-1.01.

83-1.01 References

For additional information on the design, application and placement of traffic control devices in work areas, the designer is referred to the latest editions of the publications as follows:

1. *Manual on Uniform Traffic Control Devices* (*MUTCD*), FHWA;
2. INDOT *Standard Drawings*, INDOT;
3. INDOT *Standard Specifications*, INDOT;
4. *Indiana Design Manual,* Chapter Seventy-five – "Highway Signs," INDOT;
5. *Indiana Design Manual,* Chapter Seventy-six – "Pavement Markings," INDOT;
6. *Indiana Design Manual,* Chapter Seventy-seven – "Traffic Signals," INDOT;
7. *Indiana Design Manual,* Chapter Seventy-eight – "Highway Lighting," INDOT.

The INDOT publications can be obtained by contacting the Contracts and Construction Division. For other publications, the indicated source should be contacted.

83-1.02 MUTCD Context

Throughout the *MUTCD*, the words "shall," "should," and "may" are used to describe the appropriate application for various traffic control devices. The *MUTCD* defines three terms as follows:

1. Shall. A *mandatory* condition. Where certain requirements in the design or application of the device are described with the "shall" stipulation, it is mandatory when an installation is made that these requirements be met.

2. Should. An *advisory* condition. Where the word "should" is used, it is considered to be advisable usage, recommended but not mandatory.

3. May. A *permissive* condition. No requirement for design or application is intended.

83-1.03 Official Action

An "official action" is required whenever a proposed change is made to a facility's regulatory control. For example, an "official action" is required where proposed changes are made for parking restrictions, intersection control, no-passing zones, traffic signals and work zone speed limits. However, Indiana Statutes provide for the establishment of enforceable reduced speed limits in work sites without an "official action" (see Section 83-2.03). On State-controlled facilities, the designer must coordinate and obtain a copy of the approved "official action" from the appropriate INDOT district traffic engineer and include the copy in the contract documents. On locally controlled facilities, approval (i.e., local ordinance) must be obtained from the appropriate jurisdiction.

83-2.0 HIGHWAY SIGNS

In construction zones, regulatory signs are used to temporarily override an existing mandate or prohibition (e.g., reduced speed limit). Warning signs are used in advance of the construction area to indicate potentially hazardous conditions, and guide signs are used at varying locations to inform drivers of detour routes, destinations and points of interest.

In general, the INDOT *Standard Drawings*, the INDOT *Standard Specifications* and *MUTCD* Part VI provide the Department's criteria for the design, application and placement of these signs in construction zones. This section provides the designer with supplemental information on the application of these highway signs. In addition, the designer should review the applicable sections for permanent signs in Chapter Seventy-five and the *MUTCD*.

83-2.01 Metric Sign Legends

Regulatory and advisory speed limits, distance messages and other sign legends displayed in construction zones will remain in english units until notified otherwise. Figure 83-2A provides guidelines for converting english units to metric.

83-2.02 Placement

The uniform placement of construction signing, although desirable, is not always practical. Road geometrics and other factors often dictate a more advantageous placement. The designer should consider the following guidelines together with established criteria when determining the placement of construction signing.

1. Permanent Signs. Construction signs in close proximity to permanent signs should be reviewed after the theoretical temporary sign location has been determined. For example, the permanent sign should not block the view of the temporary sign nor convey conflicting information. The designer should also avoid creating an information overload by placing too many signs near each other.

2. Intersections. If construction signing is warranted near an intersection, the designer should consider placing the temporary signs beyond the intersection. On the intersection approach, permanent signs typically provide control and directional information to the driver. Locating the construction signing after the intersection will usually enhance a driver's comprehension of the sign.

3. Roadside Barriers. The designer should consider placing temporary construction signs behind an existing roadside barrier if practical. This will reduce the probability that it will be impacted.

83-2.03 Regulatory Signs

83-2.03(01) Work Zone and Work Site Speed Limit Signing

Different speed limits may apply based on whether the speed limit is within the work zone or if it is within a work site. The work zone speed limit generally applies throughout the project. Work site speed limits apply to a specific location within the work zone where work is actually occurring. The following provides guidance in the selection and implementation of work zone and work site speed limits.

1. Work Zone Speed Limit. The work zone speed limit will be determined based on the construction zone design speed, traffic volumes, construction work type, geometrics, project length, etc. The work zone speed limit should not exceed the construction zone design speed through the construction area. Section 82-3.01 provides guidance on the selection of construction zone design speeds. If the work zone speed limit is different than the existing

regulatory speeds prior to construction, an "official action" as discussed in Section 83-1.03 will be required.

2. Work Site Speed Limit. Indiana Statutes permit INDOT to establish work site speed limits without an "official action." They also stipulate that the work site speed limit will either be 45 mph or 10 mph below the original posted speed, whichever is less. The work site speed limit will only be applicable where and while work is actually in progress and workers are present.

3. Sign Size and Assembly. Work zone and work site speed limit sign assembles should be placed according to the *MUTCD* and should be of a size specified for the facility. All work site assemblies should have a "Worksite" plaque mounted above the regulatory sign.

4. Flashing Beacons. All work site speed limit sign assemblies should incorporate strobe-type flashing beacons with one mounted in each upper corner of the regulatory sign. A "When Flashing" plaque should be used below the sign. The beacons should only be activated when work is in progress and workers are present. This device provides for both worker and public safety without imposing unnecessary travel delays during non-working periods.

5. Selection. Figure 83-2B provides suggested work zone and work site speed limits for freeways based on the type of facility and the proposed construction application.

6. Location and Spacing. In determining the location and spacings of signs, the following will apply.

   a. Work Zone Signs. The designer should coordinate with the district traffic engineer to determine the appropriate beginning and ending locations for the work zone speed limit. Work zone Speed Limit signs should be placed prior to the construction zone and after each interchange entrance ramp within the construction zone. Reduced speed limits should begin prior to any expected queue backups due to lane closures, lane restrictions, etc.

   b. Work Site Signs. The INDOT *Standard Specifications* provide the guidelines for determining the appropriate locations of work site speed limit signage.

7. Rural Areas. In rural areas, use a "Reduced Speed Ahead" sign in advance of the first Speed Limit sign.

8. Multi-Lane Facilities. Place Speed Limit signs on both sides of a multilane facility (i.e., two or more lanes in each direction).

83-2.03(02) Stop/Yield Signs

Specific sites may warrant the use of other regulatory sign changes. For example, the installation of a "Stop" or "Yield" sign may be considered at a previously uncontrolled merge and acceleration area if the taper length is reduced during construction operations. An "official action," as described in Section 83-1.03, must be coordinated through the district traffic engineer in these cases. Based on *MUTCD* guidelines, the implementation of a "Stop Ahead" or "Yield Ahead" sign may also be considered.

83-2.03(03) Selective Exclusion Signs

Where a lane shift occurs through a construction zone and the lane shift requires the use of the shoulder as a travel lane, the designer may consider the use of selective exclusion signs to assign heavy truck traffic to lanes on the pavement proper (i.e., heavy trucks may not be permitted to use the shoulder as a travel lane). An "official action," as described in Section 83-1.03, must be coordinated through the district traffic engineer in these cases.

83-2.04 Advance Warning Signs

Warning signs are used to alert drivers of potentially hazardous conditions on or adjacent to the roadway. The unnecessary use of these signs may breed driver disrespect for signing in general. The designer should therefore only use the minimum number of warning signs necessary to adequately warn the driver. The following provides additional information on the sequence and placement of advance warning signs.

Warning signs are typically used in three areas of the construction zone (i.e., advance warning, transition and activity areas). The advance warning area deserves particular attention because it is the first opportunity to inform a driver on the safe negotiation of the upcoming construction activity. The designer should consider the following factors when determining the sequence and placement of advance warning signs.

1. road facility type and location,
2. traffic volume and mix,
3. posted speed limit,
4. construction activity type and location, and
5. actual or anticipated field conditions.

Based on these factors, the advance warning area may warrant either a single warning sign or a multiple sign sequence. Advance warning sign sequences may be classified into three general categories: "A," "A-B," and "A-B-C." Figure 83-2C, Advance Warning Signs, and the *MUTCD* present typical applications of these sequences. The following briefly describes each sign sequence category and typical application:

1. "A" Signing. The "A" signing category is a single sign placed upstream from the nearest point of transition or restriction. The designer should consider the "A" signing pattern for work beyond shoulders.

2. "A-B" Signing. "A-B" signing is a two-sign configuration within the advance warning area. The "B" sign is placed upstream from the "A" sign. The "A-B" signing pattern should be considered for the construction activities as follows:

    a. work on shoulders,
    b. interior lane closure on multi-lane streets, and
    c. lane closure on minor streets.

3. "A-B-C" Signing. "A-B-C" signing consists of three or more signs within the advance warning area. The "C" sign is placed upstream from the "B" sign. The designer should consider using the "A-B-C" signing pattern for the construction activities as follows.

    a. road closures with traffic diversion;
    b. lane closures for one-lane, two-way traffic control; and
    c. lane closures for multi-lane highways and freeways.

Generally, the use of multiple advance warning signs is required on limited access facilities with higher speeds and on those facilities with construction activities which present the driver with major decision points (e.g., lane closures, multiple lane shifts, queue backups). Advance warning signs tend to be spread out over greater distances on these facilities to provide the driver adequate time and distance to safely negotiate the downstream construction activity.

Figure 83-2C presents suggested sign placement distances for various facility types. The column headings "A," "B," and "C" in Figure 83-2C are the distances between signs and should be used to mark the theoretical sign locations. The designer should use these distances as a starting point and adjust the sign locations as necessary based on actual and anticipated field conditions (e.g., sign location relative to crest vertical curves, line of sight obstructions). Figure 83-2C should be used in conjunction with the construction activities discussed above and with the diagrams shown in the *MUTCD*. The designer should note that the warning sign placement distances in Figure 75-4A are not directly applicable to work zone applications.

83-2.05 Guide Signs

The references in Section 83-1.01 provide the Department's criteria for the placement, design and application of guide signs on Indiana highway facilities. The designer should also review applicable criteria for permanent guide signs in Section 75-5.0 and in the *MUTCD*. The following provides supplemental information on the use of guide signs in construction zones.

1. Panel Signs. Guide signs are typically warranted in construction zones and on alternate routes where temporary route changes are necessary. For example, the designer may consider using large panel signs for ramp and lane closures (e.g., "Ramp ___ Closed Use Ramp ___," "Ramp ___ Closed (date)"). See the INDOT *Standard Drawings* for information for determining the sizes of panel sign supports.

2. Other. Standard route markings, street name signs, special information signs, directional and detour signs may also be warranted based on the particular work on the facility.

83-2.06 Portable Changeable Message Signs

Portable changeable message signs (PCMS) are very effective in communicating the construction zone information to the general public. INDOT's practice is to use PCMS on all applicable freeway construction projects. The use of PCMS on other roadway facilities should be determined on a project-by-project basis based on road alignment, traffic routing or other situations requiring advance warning and information. For all facilities, some typical applications where the PCMS device may be effectively used in construction zones are as follows:

1. where speed is expected to drop substantially;
2. where significant traffic queuing and delays are expected;
3. where changes in road alignment or surface conditions are present;
4. to provide advance notice of ramp, lane or road closures;
5. to notify or direct motorists to alternate routing; and
6. to show work site speed limits as a supplemental to standard regulatory signs.

The *MUTCD* provides the design and application criteria relative to PCMS. The designer should also consider the following when specifying portable changeable message signs.

1. Display. The display should provide no more than the maximum amount of information that can be read and comprehended by the motorist at a quick glance (i.e., no rolling messages). The typical changeable message sign is capable of displaying three lines of eight characters each. There should be no than three messages phased in order to provide readability and

comprehension. All messages should be able to stand alone. For multiple messages, use two signs.

2. Location. The sign should be visible from 2500 ft under ideal day and night conditions, and the first message should be legible at a minimum distance of 650 ft from all lanes. PCMS should typically be placed in advance of any other advance warning sign. When two signs are needed to communicate a multiple message, they should be placed on the same side of the roadway and separated by at least 1000 ft. PCMS are normally placed on the shoulder of the road but, if practical, may be further from the traveled way. Overhead placement may also be considered.

3. Traffic Control Devices. The portable changeable message sign may be used as a supplement, but it should not be used as a substitute to the proper use of conventional traffic control devices.

4. Flashing Arrow Signs. Changeable message signs should not be used as an alternative to flashing arrow signs. However, a PCMS may be used to simulate an arrow display in the message.

83-2.07 Flashing Arrow Signs

In construction areas, flashing arrow signs are used to supplement conventional traffic control devices. They are typically used where additional warning and directional information is required to assist in merging and controlling traffic through or around the work activity. Flashing arrow signs should be used on all freeway construction projects requiring lane closures. For other sites, the designer will determine the need for flashing arrow signs on a project-by-project basis. The typical applications where flashing arrow signs may be considered are as follows:

1. Work in vicinity of entrance and exit ramps,
2. median crossovers on freeways,
3. interior and double lane closures on multi-lane streets and freeways,
4. right-lane closures on the far side of an intersection, and
5. mobile operations on shoulders and on multi-lane roads.

The INDOT *Standard Drawings*, the INDOT *Standard Specifications*, and the *MUTCD* provide the Department's criteria for the placement, design and application of flashing arrow signs. The *MUTCD* also illustrates typical application diagrams. The following provides the designer with supplemental information on the use of flashing arrow signs in construction areas.

1. Display. The application of the flashing arrow sign should use the appropriate display message. The following presents applicable display modes.

   a. Flashing Arrow or Sequential Arrow. Typically used for left- or right-lane shifts or diversions.

   b. Flashing Double Arrow. Typically used for interior lane closures where traffic is permitted to either travel left or right around the work activity.

2. Use and Location. The flashing arrow sign should be located at the beginning of each lane merge taper. For stationary activities, locate the sign on the shoulder or in the closed lane behind channeling or barricade devices. For mobile operations, locate the mounted flashing arrow sign at the rear of the activity upstream of maintenance vehicles. Where used in the vicinity of ramps, median crossovers and side road intersections, the flashing arrows sign placement should not confuse the driver. Figure 83-2D provides the recommended usages and the minimum legibility distances under ideal day and night conditions.

3. TLTWO. Flashing arrow signs should not be used to shift traffic in 2-lane, two-way operations (TLTWO).

4. Shoulder/Roadside Activities. Flashing arrow signs should only be used in the flashing caution mode for shoulder and roadside work activities.

5. Flaggers. Flashing arrow signs should not be used if flaggers are used for traffic control at the work site.

6. Multiple Lane Closures. The designer should consider using multiple flashing arrow signs for multiple lane closures. In this situation, a flashing arrow sign should be located at the beginning of each lane merge taper. The designer should not use flashing arrow signs to laterally shift multiple lanes of traffic.

7. Traffic Control Devices. The flashing arrow sign may be used as a supplemental traffic control device, but it should not be used as a substitute to the proper use of signs, pavement markings and lighting in construction zones. The flashing arrow sign should not replace any required conventional signing.

83-3.0 CHANNELIZATION DEVICES

The INDOT *Standard Drawings*, the INDOT *Standard Specifications*, and the *MUTCD* provide the Department's criteria for the selection, application and placement of channelization devices. The

MUTCD also illustrates several typical application diagrams for the use of these devices. The following provides additional information for channelization devices.

83-3.01 Types

There are numerous types of channelization devices available, each having its specific application in construction operations (e.g., crossovers, runarounds, lane closures, road closures and 2-lane, two-way operations). The following channelization devices are typically used by INDOT in construction zones.

1. Barricades: The following will apply.

    a. Type I and Type II Barricades. INDOT does not use Type I or Type II barricades.

    b. Type III Barricades. Types III barricades are used to close a roadway. Section 83-3.04 provides the guidelines for their application and placement.

2. Drums. Drums are most commonly used in a linear series to channelize and delineate the desired travel path. They may also be used individually or in groups to mark specific locations. They are generally used for channelization and can be easily shifted to accommodate changing conditions within the construction zone. However, for temporary lane closures during daylight hours, cones, tubular markers or vertical panels may be used in place of drums.

3. Cones. Traffic cones are channelization devices used to delineate a travel path, divide opposing traffic lanes, divide traffic lanes in the same direction and/or delineate short-duration construction, maintenance and utility activities.

4. Tubular Markers/Vertical Panels. These devices are typically used to channel traffic, divide opposing lanes of traffic, divide travel lanes or in place of drums where space is limited. Tubular markers and vertical panels have less visible area than other devices and should be used only where space restrictions do not allow for use of more visible devices (e.g., with temporary bituminous dividers). These devices are to be used on all multi-lane divided non-freeways.

5. Temporary Bituminous Divider. Temporary bituminous divider should not be used for separating traffic.

6. Temporary Concrete Barriers (TCB). The TCB should only be used where positive protection is desired and not based on channelization needs. This device should be used on

all freeways. The TCB should be located behind and in conjunction with supporting channelization devices, delineators and/or pavement markings. Section 82-4.03 provides information on the application and placement of the TCB. Delineators and steady-burning lamps should also be attached to the TCB. However, where used between lanes in 2-lane, two-way operations, experience has shown that opposing vehicular headlights generally wash out the lamp and cannot be safely maintained. Therefore, they should not be used in this situation.

7. Delineators. Delineators provide retroreflection from headlights and are supplemental devices commonly used to indicate the roadway alignment and the intended path through the construction zone. Delineators are used along pavement edges in runaround operations and are typically attached to the TCB.

8. Longitudinal Pavement Markings. The application of pavement markings in construction zones is presented in Section 83-4.0. Longitudinal pavement markings should only be used in combination with other primary channelization devices to delineate the desired travel path. Temporary double solid yellow lines should be used in conjunction with tubular markers/vertical panels or TCB. They should also be used on all urban and rural multi-lane undivided roadways. Revisions to existing pavement markings are not required for temporary daylight lane closures.

These channelization devices are used extensively in construction zones to warn drivers of work activities in or near the traveled way, to protect workers in the area and to guide drivers and pedestrians safely through and around the work site. Because each construction project differs, the selection, application and location of these devices should be determined on a project-by-project basis.

83-3.02 Taper Rates

One of the most important design elements in construction zones is the taper section delineated by the channelization devices. These taper rates are shown in Figure 83-3A. Figures 83-3B and 83-3C present and illustrate the minimum taper lengths for various taper applications in construction zones (e.g., lane closures, lane shifts).

83-3.03 Spacing

As with transition tapers, the longitudinal spacing of channelization devices is dependent on vehicular speeds. In 1-lane, two-way traffic operations, the spacing at taper sections should be 10 ft for 50-ft tapers and 20 ft for 100-ft tapers. A 20-ft spacing should be used for all taper sections on

Interstates. Tubular markings on bituminous dividers should be at 50-ft spacings. Figure 83-3D presents suggested spacing of channelization devices for other conditions in construction zones. Unless otherwise specified, the maximum spacing of drums, cones and vertical panels should be based on Figure 83-3D.

83-3.04 Type III Barricades

The Department uses two types of Type III barricades for road closures: Type III-A and Type III-B. The Type III-A barricade is used where traffic is not allowed behind the barricade. Reflectorized rails are used only on the side facing traffic. The Type III-B barricade is used where traffic is allowed behind the barricade. Reflectorized rails are required on both sides of the barricade. The designer should also consider the following:

1. Materials. Type III barricades are constructed with three 12-ft sections mounted on skid-type supports or on posts driven into the ground. Use skid-mounted barricades where the barricades are located on the traveled way or shoulder. Use post-driven barricades where the barricades are outside of the paved portion of the roadway.

2. Complete Closure. Type III-A barricades should extend completely across the roadway and across roadway side slopes, within the right-of-way, that are 3:1 or flatter. During non-working hours, no openings are allowed within the barrier assembly.

3. Divided Highways. Where one set of lanes of a divided facility is closed to traffic, the Type III-A barricade will be required across the pavement area and on any slopes which are 3:1 or flatter from the right-of-way line to the centerline of the median. Additional barricade assemblies will be required across the closed portion where the facility intersects with local roads (e.g., county roads, driveways). Additional barricades will be required where bridges or pipes are removed; see Item 6.

4. Crossovers. Specify Type III-B barricades where a permanent crossover on a divided facility is closed because one set of lanes is closed for construction and two-way traffic is being maintained on the other side.

5. Local Traffic. If local traffic is allowed to use the facility under construction, use Type III-B barricades at the beginning and end portions of the closed road. The barricades should extend onto the side slopes, within the highway right-of-way, that are 3:1 or flatter. Additional barricades will be required where bridges or pipes are removed, see Item 6.

6. Bridge and Pipe Removals. Where there is a possibility that a vehicle could be on a closed facility and where there is a bridge removal, pipe removal or other hazard location, provide an additional line of Type III barricades within 150 ft of the hazard.

7. Road Closure Sign Assemblies. Where a Type III barricade is used, the designer is required to include the road closure sign assembly in the plans. However, do not use these sign assemblies next to lane closures where adjacent lanes remain open to traffic, or where barricades are specified for closure of lanes on a multilane undivided facility and where the remaining lanes are being used to maintain traffic.

83-4.0 PAVEMENT MARKINGS

The INDOT *Standard Drawings* and the *MUTCD* provide the Department's criteria for the selection, application and placement of pavement marking in construction zones. The INDOT *Standard Specifications* provides additional information on pavement marking removal. Chapter Seventy-six should also be reviewed for applicable information. The following sections provide supplemental guidelines to these sources.

83-4.01 Types

The following types of pavement markings are typically used by INDOT in construction zones.

1. Temporary Paint. Quick-drying paint is a low-cost, temporary pavement marking that may be used on construction projects. To improve reflectivity, glass beads are required. The Department does not normally allow the use of temporary paint markings on final pavement surfaces.

2. Raised Temporary Pavement Markers. In high-volume locations, the designer may consider using raised temporary pavement markers as a supplemental device to improve delineation through the construction zone. Typical locations include lane lines, gore areas and other areas where there are changes in the alignment (e.g., lane closures, lane shifts). For lane lines, temporary raised pavement markers are placed mid-point in the gap (i.e., every 40 ft). For tapers, gore markings, etc., the raised markers should be spaced at 20 ft. Temporary raised pavement markers must be removed prior to placing of the next pavement course.

3. Temporary Pavement Marking Tape. Temporary pavement marking tape is an excellent material choice where there are changes to the traffic pattern during construction (e.g., crossover switches). Temporary tape can be easily and quickly installed and, if necessary, easily removed. One disadvantage is that this tape tends to move and/or breakup under

heavy traffic volumes. Therefore, routine inspections are required to check serviceability. The following describes the temporary pavement marking tapes used by the Department.

a. Type I. Type I tape may be used for lane lines, centerlines and no-passing lines that are placed parallel to the normal pavement marking pattern. It should also be used where pavement markings are placed at an angle to the normal pavement marking pattern (e.g., tapers for lane closures, lane shifts). Type I is made to be removable from the pavement.

b. Type II. Type II tape is used for pavement markings which are expected to be removed or covered by additional pavement courses. It may be used for edge lines, lane lines, centerlines that are parallel to the normal pavement markings. It also may be used for lane lines or centerlines on resurfacing overlay courses.

4. Thermoplastic Markings. Thermoplastic markings are generally used in construction zones only if the traffic volumes are high, and the traffic pattern will be in place for a long duration (e.g., over one year).

5. Buzz Strips. Buzz strips are used on high-speed, multilane facilities in advance of lane closures, alignment changes or stop conditions to warn motorists of the impending change. They are typically made with extruded material or repeated passes of pavement marking tape to reach a ¼-in. height. Figure 83-4A illustrates the typical layout for buzz strips with a lane closure. The spacing criteria are also applicable to the other conditions listed above.

83-4.02 Application

The application of pavement markings in construction zones depends on facility type, project duration, project length and anticipated traffic volume. The INDOT *Standard Specifications* provide the criteria for the use of pavement markings in construction zones.

83-5.0 TRAFFIC SIGNALS

83-5.01 Location

The use of temporary traffic signals in construction zones will be determined on a project-by-project basis. The warrant criteria for permanent installations in Section 77-2.0 should be used to help determine if a temporary traffic signal is warranted. However, the traffic volumes expected during construction should be used for the warrant analysis. An “official action,” as described in Section

83-1.03, must be coordinated through the district traffic engineer in these cases. Common locations where temporary signal installations may be used include the following:

1. Intersections where an existing signal must be maintained;

2. existing non-signalized intersections and driveways where construction patterns and volumes now warrant a signal;

3. at a temporary haul road or other temporary access points;

4. at long-term one-lane, two-way traffic operations (e.g., bridge lane closures); and

5. at crossroad/ramp intersections where there is an increase in traffic or there is a decrease in capacity due to the construction.

83-5.02 Application

The designer should consider the following:

1. Design. The designer should determine the impacts a construction activity has on existing signal operations and attempt to maximize the level-of-service. For example, the designer should consider the following:

    a. Recommend re-timing or re-phasing the signal to compensate for changes in traffic volume, mix or patterns and for changes in lane designations or intersection approach geometrics.

    b. Physically relocating poles or adjusting signal heads to maintain compliance with the MUTCD.

    Chapter Seventy-seven and the *MUTCD* provide the designer with design information on traffic signals.

2. Bridges. The INDOT *Standard Drawings* illustrate a temporary signal installation for a bridge lane closure. If a lane closure is expected to be closed overnight, a temporary signal should be considered.

3. Plan Sheets. Show all temporary signal installations in the Traffic Maintenance Detail Sheets.

83-6.0 HIGHWAY LIGHTING

83-6.01 Types

The lighting devices are commonly used in construction areas are as follows:

1. hazard identification beacons (flashing warning lights),
2. steady-burning warning lamps,
3. warning lights,
4. floodlights, and
5. conventional highway lighting.

83-6.02 Warrants

Hazard identification beacons, steady-burning electric lamps and warning lights are typically used to supplement signs, barriers and channelization devices and emphasize specific signs, hazard areas and the desired travel path. The warrants for these lighting devices should meet the criteria in the *MUTCD*. Floodlights are typically used to illuminate the work area during night operations (e.g., flagger stations, equipment crossings, areas requiring supplemental lighting).

For conventional highway lighting, the need for temporary lighting will be determined on a project-by-project basis. Existing highway illumination should be maintained on all projects unless discontinuance of the highway illumination is specifically permitted. The warrants presented in Section 78-2.0 for permanent highway lighting should be reviewed to assist in determining the need for temporary lighting. The designer should consider the use of temporary lighting at construction areas with the characteristics as follows: Advance Warning Signs

1. high traffic volumes;
2 high traffic speeds;
3. heavy queuing or congestion;
4. areas with complicated traffic maneuvers (e.g., freeway crossovers, intersections); and
5. other areas where hazardous locations may exist.

If existing light standards are removed or shut off during construction, the designer should consider providing temporary lighting until permanent light standards are reinstalled. In construction areas, the Department typically uses high-pressure sodium lamps mounted on temporary wood posts. However, the designer may wish to consider using portable lighting as an option. Chapter Seventy-eight provides additional information on the design of highway lighting.