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CHAPTER EIGHTY-THREE

TRAFFIC-CONTROL DEVICES IN A CONSTRUCTION ZONE

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 a construction zone. This Chapter provides supplemental information on these devices and provides 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 a work area, 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*;
3. INDOT *Standard Specifications*;
4. *Indiana Design Manual,* Chapter Seventy-five – Highway Signs;
5. *Indiana Design Manual,* Chapter Seventy-six – Pavement Markings;
6. *Indiana Design Manual,* Chapter Seventy-seven – Traffic Signals;
7. *Indiana Design Manual,* Chapter Seventy-eight – Highway Lighting.

The INDOT publications can be obtained by contacting the Contract Administration 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 each traffic-control device. The *MUTCD* defines the terms as follows:

1. Shall. A mandatory condition. Where certain requirements in the design or application of a device are described with stipulation *shall*, it is mandatory that if 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 if a proposed change is made to a facility's regulatory control. For example, an Official Action is required where a proposed change is made regarding a parking restriction, intersection control, no-passing zone, traffic signal, or work-zone speed limit. However, Indiana Statutes provide for the establishment of an enforceable reduced speed limit in a work site without an Official Action (see Section 83-2.03). For a State-controlled facility, the designer must contact the appropriate INDOT district traffic engineer and obtain a copy of the approved Official Action, and include it in the contract documents. For a locally-controlled facility, approval (i.e., local ordinance) must be obtained from the appropriate jurisdiction.

83-2.0 HIGHWAY SIGNS

In a construction zone, a regulatory sign is used to temporarily override an existing mandate or prohibition (e.g., reduced speed limit). A warning sign is used in advance of the construction area to indicate a potentially-hazardous condition. A guide sign is used to inform the motorist of a detour route, destination, or point of interest.

The INDOT *Standard Drawings*, the INDOT *Standard Specifications*, and *MUTCD* Part VI provide the Department's criteria for the design, application, and placement of signs in a construction zone. This Section provides the designer with supplemental information on the application of a highway sign. The designer should review Chapter Seventy-five and the *MUTCD* regarding permanent signs.

83-2.01 Sign-Legend Measurement Units

Regulatory or advisory speed limit, distance message, or other sign legend displayed in a construction zone 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 or other factors often dictate a more advantageous placement. The designer should

consider the following guidelines together with established criteria in determining the placement of construction signing.

1. Permanent Sign. A construction sign in close proximity to a permanent sign 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. Intersection. If construction signing is warranted near an intersection, the designer should consider placing the temporary sign beyond the intersection. On the intersection approach, a permanent sign provides control and directional information to the motorist. Locating a construction sign beyond the intersection will usually enhance a motorist's comprehension of the sign.

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

83-2.03 Regulatory Signing

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 applies throughout the project. A work-site speed limit applies to a specific location within the work zone where work is actually occurring. The following provides guidance in the selection and implementation of a work-zone or work-site speed limit.

1. Work-Zone Speed Limit. The work-zone speed limit will be determined based on the construction-zone design speed, traffic volume, 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 a construction-zone design speed. If the work-zone speed limit is different than the existing posted speed limit prior to the start of 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 a work-site speed limit 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 limit, whichever is lower. 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. A work-zone or work-site speed-limit-sign assembly should be placed according to the *MUTCD* and should be of a size specified for the facility. Each work-site assembly should include a "Worksite" plate mounted above the regulatory sign.

4. Flashing Beacon. Each work-site speed-limit-sign assembly should incorporate strobe-type flashing beacons with one mounted at each upper corner of the regulatory sign. A "When Flashing" plate should be placed below the sign. The beacons should be activated only while work is in progress and workers are present. The 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 a freeway based on the type of facility and the proposed construction application.

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

   a. Work-Zone Sign. The designer should coordinate with the district traffic engineer to determine the appropriate beginning and ending locations for the work-zone speed limit. A work-zone speed limit sign should be placed prior to the construction zone and after each interchange entrance ramp within the construction zone. The reduced-speed zone should begin prior to an expected queue backup due to a lane closure, lane restriction, etc.

   b. Work-Site Sign. The INDOT *Standard Specifications* provide the guidelines for determining the appropriate location for a work-site speed-limit-sign assembly.

7. Rural Area. A "Reduced Speed Ahead" sign should be placed in advance of the first speed-limit sign.

8. Divided Facility. An assembly should be placed on each side of each roadway.

83-2.03(02) "Stop" or "Yield" Sign

Each specific site 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. Based on

MUTCD guidelines, the implementation of a "Stop Ahead" or "Yield Ahead" sign may also be considered.

83-2.03(03) Selective-Exclusion Sign

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 a selective-exclusion sign to assign heavy-truck traffic to lanes on the pavement proper (i.e., a heavy truck is 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.

83-2.04 Advance-Warning Sign

A warning sign is used to alert the motorist of a potentially hazardous condition on or adjacent to the roadway. The unnecessary use of this type of sign may breed motorist disrespect for signing in general. The designer should therefore only use the minimum number of warning signs necessary to adequately warn the motorist. The following provides additional information on the sequence and placement of advance warning signs.

A warning sign is used in an advance warning, transition, or activity areas of a construction zone. The advance-warning area is the first opportunity to inform a motorist regarding the safe negotiation of the upcoming construction activity. The designer should consider the following in 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. An advance-warning sign sequence may be classified as A, A-B, or A-B-C. Figure 83-2C, Advance-Warning Signs, and the *MUTCD* provide applications for each sequence classification. The following describes each sign sequence category and its application.

1. A Sequence. This consists of a single sign placed upstream from the nearest point of transition or restriction. The designer should consider the sequence for work outside a shoulder.

2. A-B Sequence. This is a two-sign configuration within the advance-warning area. The B sign is placed upstream from the A sign. The sequence should be considered for a construction activity as follows:

   a. work on a shoulder;
   b. interior-lane closure on a roadway with 3 or more lanes; or
   c. lane closure on a minor street.

3. A-B-C Sequence. This consists of three or more signs within the advance-warning area. The C sign is placed upstream from the B sign. The sequence should be considered for a construction activity as follows.

   a. road closure with traffic diversion;
   b. lane closure for one-lane, two-way traffic control; or
   c. lane closure for a highway with 4 or more lanes or a freeway.

The use of a multiple advance-warning sign sequence is required on a limited access facility with a higher speed or a facility with construction activities which present the motorist with major decision points (e.g., lane closure, multiple-lane shift, queue backup). Advance warning signs tend to be spread out over a greater distance on such a facility to provide the motorist with adequate time and distance to safely negotiate the downstream construction activity.

Figure 83-2C provides the suggested sign-placement distance for each facility type. The columns headed A, B, and C represent the distance between signs and should be used to mark the theoretical sign location. The designer should use these distances as a starting point and adjust each sign location as necessary based on actual and anticipated field conditions (e.g., sign location relative to a crest vertical curve, line of sight obstruction). Figure 83-2C should be used in conjunction with each construction activity discussed above and with the diagrams shown in the *MUTCD*. The warning-sign placement distances shown in Figure 75-4A are not directly applicable to a work-zone application.

83-2.05 Guide Sign

The references in Section 83-1.01 provide the Department's criteria for the placement, design, and application of a guide sign. 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 a guide sign in a construction zone.

1. Panel Sign. A guide sign is warranted in a construction zone or alternate route where a temporary route change is necessary. For example, the designer may consider using a large panel sign for a ramp or lane closure, e.g., "Ramp ___ Closed Use Ramp ___," "Ramp ___

Closed (date)". See the INDOT *Standard Drawings* for information for determining the size of a panel-sign support.

2. Other. Route markers, street-name signs, special-information signs, directional, or detour signs may also be warranted based on the particular work on the facility.

3. Worksite Increased-Penalty Signs. Signs are required which inform the motorist of increased penalties for moving violations.

Sign messages and details are shown on the INDOT *Standard Drawings*.

The XG20-7 sign, 78 in. x 42 in. (2000 mm x 1050 mm), should be specified for a rural area with sufficient right of way to accommodate the sign. It should be specified for an urban area with a posted speed limit of 40 mph or higher, and sufficient right of way to accommodate the sign.

The XG20-7a sign, 60 in. x 36 in. (1500 mm x 900 mm), should be specified for an urban area with a posted speed limit of 35 mph or lower, under one of the conditions as follows:

a. the existing conditions outside the edge of pavement make installation of driven posts impractical, or

b. the width of the right of way outside of the edge of pavement is not sufficient to accommodate the XG20-7 sign.

The XG20-7b and XG20-7c signs, both 48 in. x 48 in. (1200 mm x 1200 mm), should be specified to be used in series with each other, and should be used under one of the conditions as follows:

a. the project is in a rural area where the right-of-way width outside of the edge of pavement is not sufficient to accommodate the XG20-7 sign; or

b. the project is a moving operation where construction signs are set and removed each day to accommodate the changing location of the work.

The following guidelines should also be used to determine the location and quantity of the signs.

a. Signs are required for each project in which traffic will travel through an active construction zone marked by "Road Construction Ahead" and "End Construction" signs.

b. An XG20-7 or XG20-7a sign, where warranted, should be placed in advance of the first "Road Construction Ahead" sign for each direction of travel on the project mainline. The advance distance should be 500 ft (150 m) in a rural area, or 100 ft (30 m) in an urban area.

c. XG20-7c and XG20-7b signs, where warranted, should be placed in advance of the first "Road Construction Ahead" sign for each direction of travel on the project mainline. The advance distance for the XG20-7c sign should be 1000 ft (300 m) in a rural area, or 200 ft (60 m) in an urban area. The advance distance for the XG20-7b sign should be 500 ft (150 m) in a rural area, or 100 ft (30 m) in an urban area.

d. Signs should not be placed on side roads or ramps leading into a construction zone.

e. Signs are not required if the active construction zone is completely isolated from live traffic, i.e., a full road closure with a detour, or construction along a new alignment.

The location of each sign should be indicated as for other construction signs shown on the traffic-maintenance plan.

83-2.06 Portable Changeable Message Sign

A portable changeable message sign (PCMS) is effective in communicating the construction-zone information to the general public. INDOT's practice is to use PCMS on each applicable freeway construction project. The use of a PCMS on another type of facility should be determined on a project-by-project basis based on road alignment, traffic routing, or other situation requiring advance warning and information. For each facility, the 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 a change in road alignment or surface conditions are present;
4. to provide advance notice of a ramp, lane, or road closure;
5. to notify or direct motorists to alternate routing; or
6. to show a work-site speed limit as supplemental to other regulatory signs.

The *MUTCD* provides the design and application criteria relative to a PCMS. The designer should also consider the following in specifying a PCMS.

1. Display. The display should provide not more than the maximum amount of information that can be read and comprehended by the motorist at a quick glance (i.e., no rolling message). A PCMS is capable of displaying three lines of eight characters each. There

should be not than three messages phased in order to provide readability and comprehension. Each message should be able to stand alone. For a multiple message, use two signs.

2. Location. The sign should be visible from 800 m under ideal day or night conditions. The first message should be legible at a minimum distance of 200 m from each lane. A PCMS should be placed in advance of other advance-warning signs. If 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 300 m. A PCMS is placed on the shoulder, but, if practical, may be farther from the traveled way. Overhead placement may also be considered.

3. Traffic-Control Devices. A PCMS may be used as a supplement, but it should not be used as a substitute to the proper use of other traffic-control devices.

4. Flashing-Arrow Sign. A PCMS should not be used as an alternative to a flashing-arrow sign. However, a PCMS may be used to simulate an arrow display in a message.

83-2.07 Flashing-Arrow Sign

A flashing-arrow sign is used to supplement other traffic-control devices. It is used where additional warning and directional information is required to assist in merging and controlling traffic through or around the work activity. A flashing-arrow sign should be used on each freeway construction project requiring a lane closure. For another site, the designer will determine the need for a flashing-arrow sign on a project-by-project basis. The applications where a flashing-arrow sign may be considered are as follows:

1. work in vicinity of an entrance or exit ramp;
2. median crossover on a freeway;
3. interior or double-lane closure on a freeway or other roadway of 4 or more lanes;
4. right-lane closure on the far side of an intersection; or
5. mobile operation on a shoulder or roadway of 4 or more lanes.

The INDOT *Standard Drawings*, the INDOT *Standard Specifications*, and the *MUTCD* provide the Department's criteria for the placement, design, and application of a flashing arrow sign. The *MUTCD* also includes application diagrams. The following provides the designer with supplemental information on the use of a flashing-arrow sign.

1. Display. The applicable display modes are as follows.

   a. Flashing Arrow or Sequential Arrow. This is used for a left- or right-lane shift or diversion.

b. Flashing Double Arrow. This is used for an interior-lane closure 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 a lane-merge taper. For a stationary activity, locate the sign on the shoulder or in the closed lane behind a channeling or barricade device. For a mobile operation, locate a mounted sign at the rear of the activity upstream of the maintenance vehicles. Where used in the vicinity of a ramp, median crossover, or side-road intersection, the flashing-arrows sign placement should not confuse the motorist. Figure 83-2D provides the recommended usages and the minimum legibility distances under ideal day or night conditions.

3. Two-Lane, Two-Way Operation (TLTWO). A flashing-arrow sign should not be used to shift traffic in a TLTWO.

4. Shoulder or Roadside Activity. A flashing-arrow sign should only be used in the flashing caution mode for a shoulder or roadside work activity.

5. Flagger. A flashing-arrow sign should not be used if a flagger is used for traffic control at the work site.

6. Multiple-Lane Closure. The designer should consider using multiple flashing-arrow signs for a multiple-lane closure. In this situation, a flashing-arrow sign should be located at the beginning of each lane-merge taper. The designer should not use a flashing-arrow sign 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, or lighting in a construction zone. The flashing-arrow sign should not replace other required 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 includes application diagrams for the use of these devices.

83-3.01 Types

There are a number of channelization devices available, each having its specific application in a construction operation (e.g., crossover, runaround, lane closure, road closure, or 2-lane, two-way operation). The following channelization devices are used in a construction zone.

1. Barricade.

   a. Type I or Type II Barricade. INDOT does not use this type of barricade.

   b. Type III Barricade. This is used to close a roadway. Section 83-3.04 provides the guidelines for its application and placement.

2. Drums. Drums are used in a linear series to channelize and delineate the desired travel path. They may also be used individually or a group to mark a specific location. They are used for channelization and can be easily shifted to accommodate changing conditions within the construction zone. However, for a temporary lane closure during daylight hours, cones, tubular markers, or vertical panels may be used in lieu 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, or delineate a short-duration construction, maintenance, or utility activity.

4. Tubular Markers or Vertical Panels. These devices are used to channel traffic, divide opposing lanes of traffic, or divide travel lanes 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. These devices are to be used a divided non-freeway.

5. Temporary Asphalt Divider. This device should not be used for separating traffic.

6. Temporary Concrete Barrier (TCB). TCB should only be used where positive protection is desired, and not based on channelization needs. This device should be used on a freeway. The TCB should be located behind and in conjunction with supporting channelization devices, delineators, 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 a 2-lane, two-way operation, experience has shown that opposing vehicular headlights wash out the lamp and cannot be safely maintained. Therefore, lamps should not be used in this situation.

7. Delineators. Delineators provide retro reflection from headlights and are supplemental devices used to indicate the roadway alignment and the intended path through the construction zone. Delineators are used along the pavement edge in a runaround operation and are attached to the TCB.

8. Longitudinal Pavement Markings. The application of pavement markings is provided 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. A temporary double solid yellow line should be used in conjunction with tubular markers or vertical panels or TCB. Markings should also be used on each undivided roadway of 4 or more lanes. Revisions to existing pavement markings are not required for a temporary daylight lane closure.

Channelization devices are used in a construction zone to warn the motorist of work activities in or near the traveled way, to protect workers in the area, and to guide the motorist or pedestrian 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 Length

The required length of tapered section delineated by channelization devices is shown on the INDOT *Standard Drawings*. Figures 83-3B and 83-3C provide the minimum taper requirement for each taper application in a construction zone (e.g., lane closure, lane shift).

83-3.03 Spacing

As with a transition taper, the longitudinal spacing of channelization devices is dependent on vehicular speed. In a 1-lane, two-way traffic operation, the spacing at a tapered section should be 3 m for a 15-m taper length, or 6 m for a 30-m taper length. A device spacing of 6 m should be used for an Interstate-route taper. Tubular markers should be at a 15-m spacing. Figure 83-3D provides suggested spacing of channelization devices for other conditions. Unless otherwise specified, the maximum spacing of drums, cones, or vertical panels should be based on Figure 83-3D.

83-3.04 Type III Barricade

The Department uses a type III-A or type III-B barricade for a road closure. 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. A type III barricade is constructed with three 3.6-m sections mounted on skid-type supports or on posts driven into the ground. Use a skid-mounted barricade where the

barricade is to be located on the traveled way or shoulder. Use a post-driven barricade where the barricade is to be outside of the paved portion of the roadway.

2. Complete Closure. A type III-A barricade should extend completely across the roadway and across a roadway side slope that is 3:1 or flatter within the right of way. During non-working hours, openings are not allowed within the barrier assembly.

3. Divided Highway. Where one set of lanes of a divided facility is closed to traffic, a type III-A barricade will be required across the pavement area and on slopes which are 3:1 or flatter from the right-of-way line to the centerline of the median. An additional barricade will be required across the closed portion where the facility intersects with a local road (e.g., county road, drive). An additional barricade will be required where a bridge or pipe is to be removed; see Item 6.

4. Crossover. Specify a type III-B barricade where a crossover on a divided facility is required because one set of lanes is closed for construction and two-way traffic is being maintained on the other set.

5. Local Traffic. If local traffic is allowed to use the facility under construction, use a type III-B barricade at the beginning and end portions of the closed road. Each barricade should extend onto side slopes of 3:1 or flatter, within the highway right-of-way. An additional barricade will be required where a bridge or pipe is to be removed, see Item 6.

6. Bridge or Pipe Removal. 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 type III barricade within 45 m of the hazard.

7. Road-Closure-Sign Assembly. Where a type III barricade is used, the designer is required to show a road-closure-sign assembly on the plans. However, do not use such a sign assembly next to a lane closure where adjacent lanes remain open to traffic, or where a barricade is specified for closure of a lane on an undivided facility of 4 or more lanes where the remaining lanes are being used to maintain traffic.

83-4.0 PAVEMENT MARKINGS [REV. APR. 2008]

The INDOT *Standard Drawings* and the *MUTCD* provide the Department's criteria for the selection, application, and placement of pavement markings in a construction zone. The INDOT *Standard Specifications* provides additional information on temporary-pavement-marking material usage. The following provides supplemental guidelines to these sources.

83-4.01 Types [Rev. Apr. 2008]

83-4.01(01) Paint [Rev. Apr. 2008]

Quick-drying traffic paint is a low-cost, temporary pavement marking. To improve reflectivity, glass beads are required. Temporary paint is a non-removable type of temporary pavement marking. The Department does not desire the use of temporary paint markings on a final pavement surface. However, temporary paint may be the most suitable choice under certain conditions, particularly if temporary markings are anticipated to be in place through the winter months.

83-4.01(02) Temporary Raised Pavement Markers [Rev. Apr. 2008]

In a high-traffic-volume location, raised temporary pavement markers should be considered as a supplemental device to improve delineation through the construction zone. Typical locations include canter line, lane line, gore area, or where there are changes in the alignment (e.g., lane closure, lane shift). For a center line or lane line, temporary raised pavement markers are placed at the midpoint in the each gap, i.e., every 12 m. For a taper, gore, etc., the raised markers should be spaced at 6 m. Temporary raised pavement markers must be removed prior to the placing of the next pavement course.

83-4.01(03) Temporary Pavement-Marking Tape [Rev. Apr. 2008]

Temporary pavement-marking tape is an excellent material choice where there is a change to the traffic pattern during construction (e.g., crossover switch). Temporary tape can be easily and quickly installed and, if necessary, easily removed. Disadvantages of temporary tape are that it tends to move or break up under heavy traffic volume, and that it is not suitable for usage during the winter months. Temporary pavement-marking tape requires significant maintenance in comparison to temporary paint. The following describes the temporary pavement-marking tapes used by the Department.

1. Type I. Type I tape may be used as a temporary center line, lane line, or no-passing-zone line that is placed parallel to the normal pavement marking pattern, or as a temporary transverse marking or pavement-message marking. It should also be used where pavement markings are placed at an angle to the normal pavement-marking pattern (e.g., taper for lane closure, lane shift). Type I tape is a removable type of temporary pavement marking.

2. Type II. Type II tape is used on a pavement which is expected to be removed or covered by additional pavement courses. It may be used as a center line, lane line, or edge line that is parallel to the normal pavement markings. It also may be used as a center line or lane line on a resurfacing overlay course. Type II tape is a non-removable type of temporary

pavement marking.

83-4.01(04) Thermoplastic or Epoxy Markings [Rev. Apr. 2008]

Thermoplastic or epoxy markings are used in a construction zone only if the traffic volume is high, and the temporary traffic pattern will be in place for over one year. Thermoplastic or epoxy markings are non-removable types of pavement markings.

83-4.01(05) Buzz Strips [Rev. Apr. 2008]

Buzz strips are used on a high-speed facility of 4 lanes or more in advance of a lane closure, alignment change, or stop condition to warn the motorist of the impending change. They are made with extruded material or repeated passes of pavement-marking tape to reach a 6-mm 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 [Rev. Apr. 2008]

The application of temporary pavement markings in a construction zone depends on facility type, project duration, project length, and anticipated traffic volume. The phasing of temporary traffic control during construction should be considered. The temporary pavement markings should be selected that are best suited to the anticipated conditions and are most economical for the project. The removal of a removable temporary pavement marking is included in the removable-temporary-pavement-marking quantity. If non-removable markings that must be removed are selected as part of the planned traffic-maintenance plan, a quantity for removal of the non-removable markings is required. If non-removable temporary pavement markings are necessary on a final surface, placement of the temporary markings should be indicated to be as near as possible to the location of the final permanent pavement markings.

83-5.0 TRAFFIC SIGNAL

83-5.01 Location

The use of a temporary traffic signal in a construction zone 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 volume 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. Locations where a temporary-signal installation may be used include the following:

1. intersection where an existing signal must be maintained;

2. existing non-signalized intersection or drive where construction patterns and traffic volume now warrant a signal;

3. temporary haul road or other temporary access point;

4. long-term one-lane, two-way traffic operation (e.g., bridge lane closure); or

5. crossroad or ramp intersection 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 that a construction activity has on existing signal operations and should 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 designation or intersection-approach geometrics; and

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

    Chapter Seventy-seven and the *MUTCD* provide design information for a traffic signal.

2. Bridge. If a lane is expected to be closed overnight, a temporary signal should be considered.

3. Plan Sheets. Show each temporary-signal installation in the traffic-maintenance plan.

83-6.0 HIGHWAY LIGHTING

83-6.01 Types

The lighting devices that are used in a construction zone 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 used to supplement signs, barriers, or channelization devices, and emphasize specific signs, hazard areas, and the desired travel path. The warrants for lighting devices should satisfy the *MUTCD*. Floodlights are used to illuminate the work area during a nighttime operation (e.g., flagger station, equipment crossing, area 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 unless discontinuance of the highway illumination is specifically permitted. The warrants provided 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 with the characteristics as follows:

1. high traffic volume;
2 high traffic speed;
3. heavy queuing or congestion;
4. area with complicated traffic maneuvers (e.g., freeway crossover, intersection); and
5. other area where a hazardous location may exist.

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

English-Units Value	Metric-Units Equivalent
SPEED LIMIT	
30	50
35 or 40	60
45	70
50	80
55	90
60 or 65	100
70	110
LONGITUDINAL DISTANCE	
500 ft	150 m
1000 ft	300 m
1500 ft	450 m
¼ mi	400 m
½ mi	800 m
1 mi	1.5 km
2 mi	3 km

ENGLISH-TO-METRIC UNITS CONVERSION

Figure 83-2A

Existing Facility and Construction Type	Existing Posted Speed		
	50 mph	55 mph	65 mph
4-lane Interstate with crossover to a 2-lane facility	n/a	WZ 45 mph with TCB WS 45 mph	WZ 55 mph with TCB WS 45 mph
4-lane Interstate with lane closure without a crossover	n/a	WS 45 mph	WZ 55 mph WS 45 mph
6-lane Interstate with crossover to a 4-lane facility with TCB	WS 40 mph	WS 45 mph	WZ 55 mph WS 45 mph
6-lane Interstate with lane closure without a crossover	WS 40 mph	WS 45 mph	WZ 55 mph WS 45 mph
Non-Interstate divided highway with crossover	Project-by-project	WZ 45 mph with TTM & TDSYL WS 45 mph	WZ 55 mph with TCB or TTM & TDSYL. WS 45 mph
Non-Interstate divided highway with lane closure without a crossover	Project-by-project	WS 45 mph	WZ 55 mph WS 45 mph

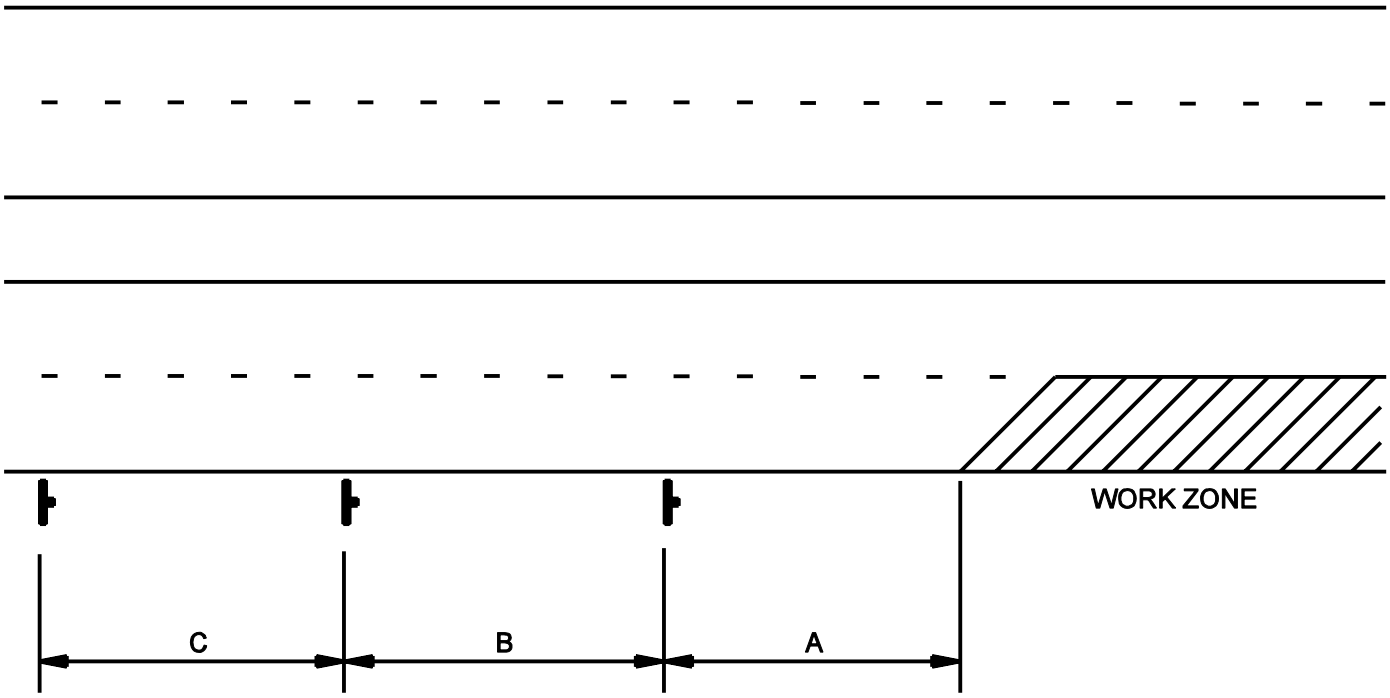
Where:

WS = Work-Site Speed Limit (Indiana Statutes)
WZ = Work-Zone Speed Limit (Official Action)
TCB = Temporary Concrete Barrier
n/a = Not Applicable
TTM = Temporary Tubular Markers
TDSYL = Temporary Double Solid Yellow Line

Note: Speed limit may vary based on circumstances and actual field conditions.

SUGGESTED DIVIDED-HIGHWAY SPEED LIMITS
(Work Zone or Work Sites)

Figure 83-2B



Road Type	Distance Between Signs (m)		
	A	B	C
Urban (45 mph or lower)*	60	60	60
Urban (50 mph or higher)*	105	105	105
Rural	150	150	150
Freeway/Expressway	300	480	780

* Posted Speed Limit of Facility

Notes:

1 *Distance "A" is for marking the locationof warning sign "A" up stream from the transition or point of restriction in the construction zone.*

2 *Distance "B" is the location of warning sign "B" upstream from the location of "A" in two and three sequence signing arrangements.*

3 *Distance "C" is the location of warning sign "C" upstream from sign "B" when three or more signs are used within the advanced warning area.*

4 *For for or more signs, the spacing will be determined on a case-by-case basis.*

ADVANCED WARNING SIGNS

Figure 83-2C

Panel Type[1]	Permitted Use	Minimum Legibility Distance[2]
A	Permitted on facility with speed lower than 60 km/h. Appropriate for use on low-speed urban facility.	800 m
B	Appropriate for intermediate-speed facility, or for maintenance or mobile operation on high-speed roadway. (Not used by INDOT.)	1200 m
C	Permitted on every facility. Appropriate for use on a high-speed, high-volume traffic-control project.	1600 m

Notes:

1. *For panel type, see the INDOT* Standard Specifications *and* Federal MUTCD *Part VI.*
2. *Minimum legibility distance under ideal day or night conditions.*

SUGGESTED USE AND LOCATION OF FLASHING-ARROW SIGN

Figure 83-2D

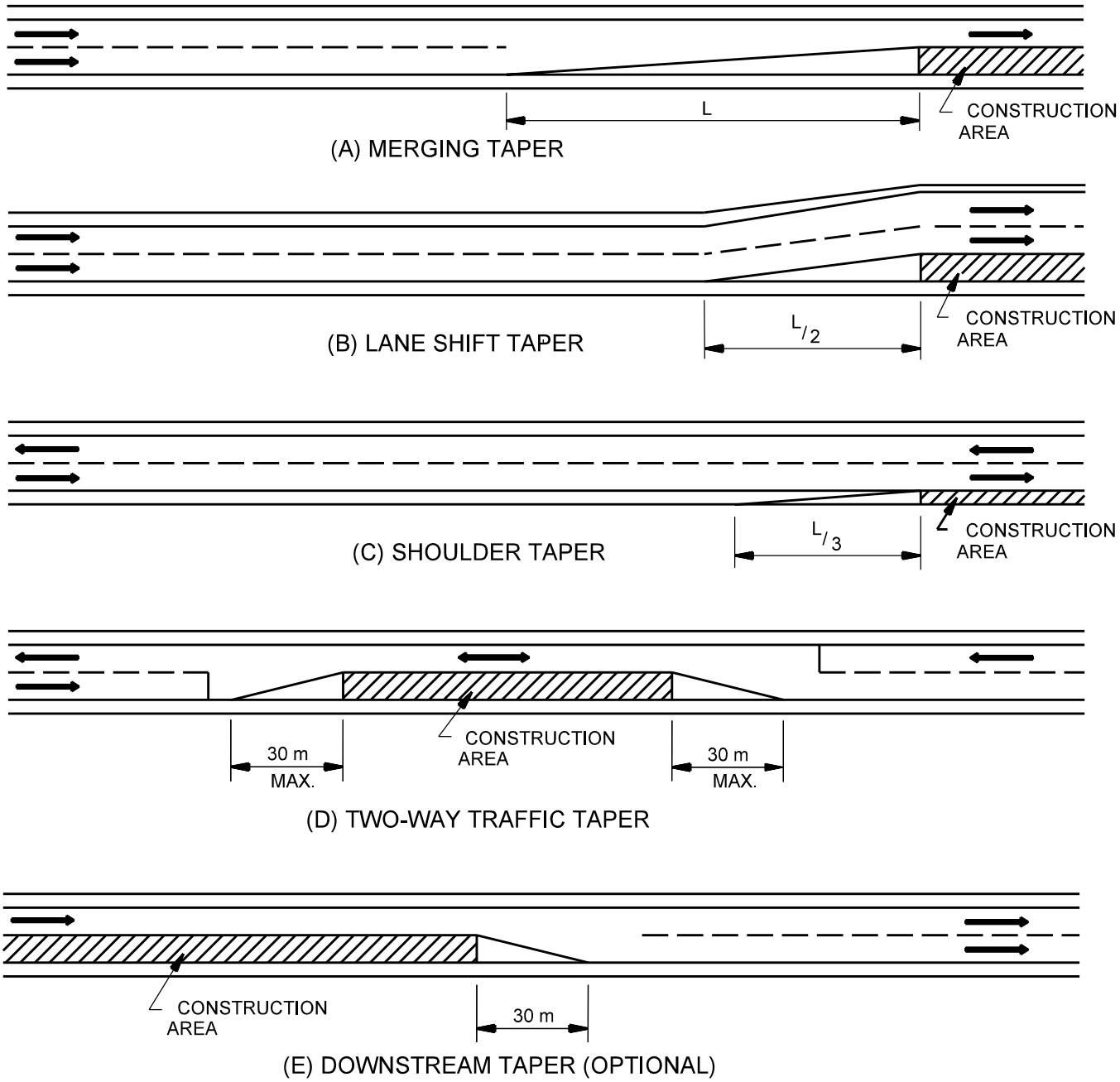
Taper Type		Minimum Length
Upstream	Merging	*L*
	Shifting [3]	½ *L*
	Shoulder	$^{1}/_{3}$ *L*
	Two-Way Traffic	30 m
Downstream (optional)		30 m per Lane

Notes:

1. *See the INDOT* Standard Drawings *for* L.
2. *Figure 83-3C illustrates the permissible taper types.*
3. *May be used for determining buffer-zone length.*

TAPER-LENGTH CRITERIA FOR CONSTRUCTION ZONE

Figure 83-3B



Note: See the INDOT Standard Drawing for "L".

TAPER LENGTH CRITERIA FOR CONSTRUCTION ZONES
(Application)

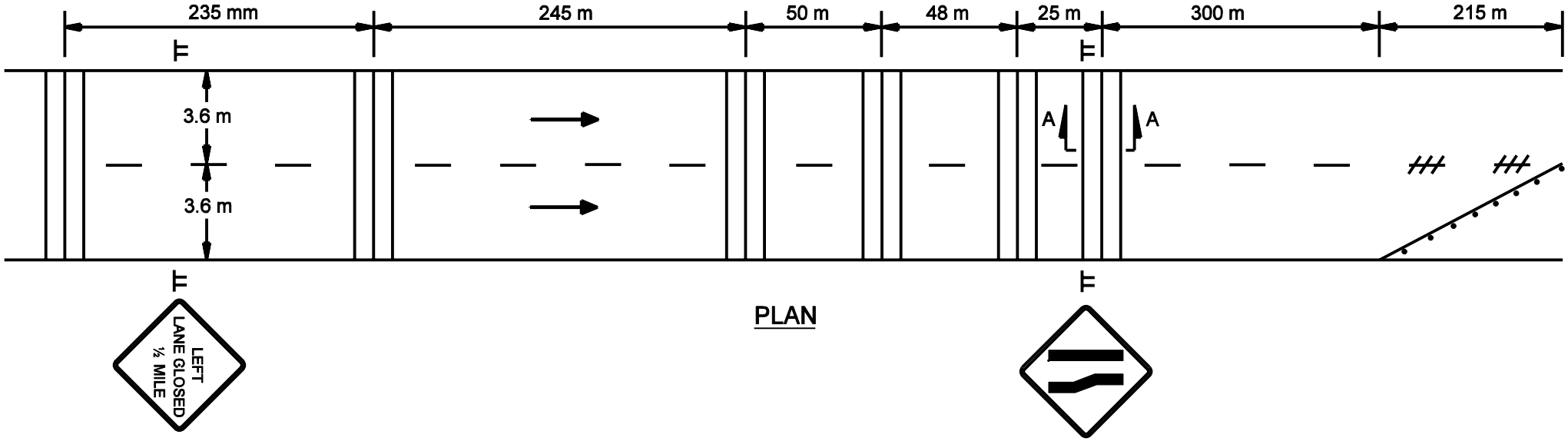
Figure 83-3C

Construction-Zone Design Speed (km/h)	Suggested Maximum Spacing (m)	
	Tapered Section	Tangent Section
40 *	7 *	14
50	9	18
60	11	22
70	13	26
80	15	30
90	17	34
100	19	38
110	21	42

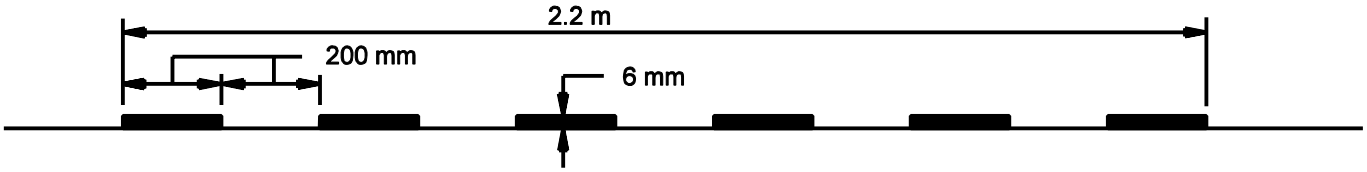
* *For a speed of 30 km/h or lower, spacing should not be less than 6 m.*

SUGGESTED MAXIMUM SPACING OF CHANNELIZATION DEVICES

Figure 83-3D



PLAN



SECTION A-A
(TYPICAL)

BUZZ STRIPS

Figure 83-4A