

# CHAPTER 2 – Flagging and Other Traffic Control Measures





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## 2.1 Flagging Operation Basics

### (MUTCD Section 6C.10 thru 6C.12 & 6E.01 thru 6E.03 & 6E.07 & 6E.08)

- Flaggers are required to be Qualified thru an NCDOT approved Flagger Training Course as of July 1, 2010.
- The Qualified Work Zone Supervisor has responsibility for a wide range of decisions affecting Flaggers such as when to use a 2 Flagger operation, when to use a 1 Flagger operation, when to use a Flagger with pilot car operation, how to handle flagging through intersections, when to use Automated Flagger Assistance Devices, when to use a haul crossing with Flaggers, and how and when to direct work trucks into a vehicle traffic stream.
- Always select a Lead Flagger to coordinate the Flagging operation.
- Location of the Flagger – Always start on grass side of white edge line.
- Hand Signals- Stop (palm out at 90 degrees perpendicular), Proceed (use hand fingers & arm to sweep across body toward open lane for travel), Slow (“Pat the Dog” with palm down and move palm up & down).
- Face Traffic. Never turn your back on moving traffic. Never stop traffic from in the roadway. Never release traffic from in the roadway.
- Radio Communication between Flaggers is recommended.
- Always have an escape route planned
- Never use cones or other devices as a “Flagger Station”. They get in the way of escape routes and they become “Stop & Slow” paddle holders which then get in the way of escape routes.
- At minimum, wear ANSI Class II safety vest. Recommend wearing orange hat or orange hat cover during flagging operation. Use 18 inch minimum “Stop & Slow” paddle on a rigid staff measuring 7 foot from the bottom of the sign to the ground.
- Prepare for emergencies by carrying “Stop & Slow” paddles with telescoping or sectioned staffs that reach 7 feet and lights to illuminate the flagger at night.
- When workers stop traffic to allow work vehicles to deliver materials or unload equipment they must use advance warning signs & “Stop & Slow” paddles.
- Rotate Flaggers every 2 to 3 hours to give them breaks to keep them fresh & alert.
- Alternate traffic flow every 2 to 3 minutes under heavy traffic conditions



## 2.1.1 Notes for Flagger & Flagger Devices

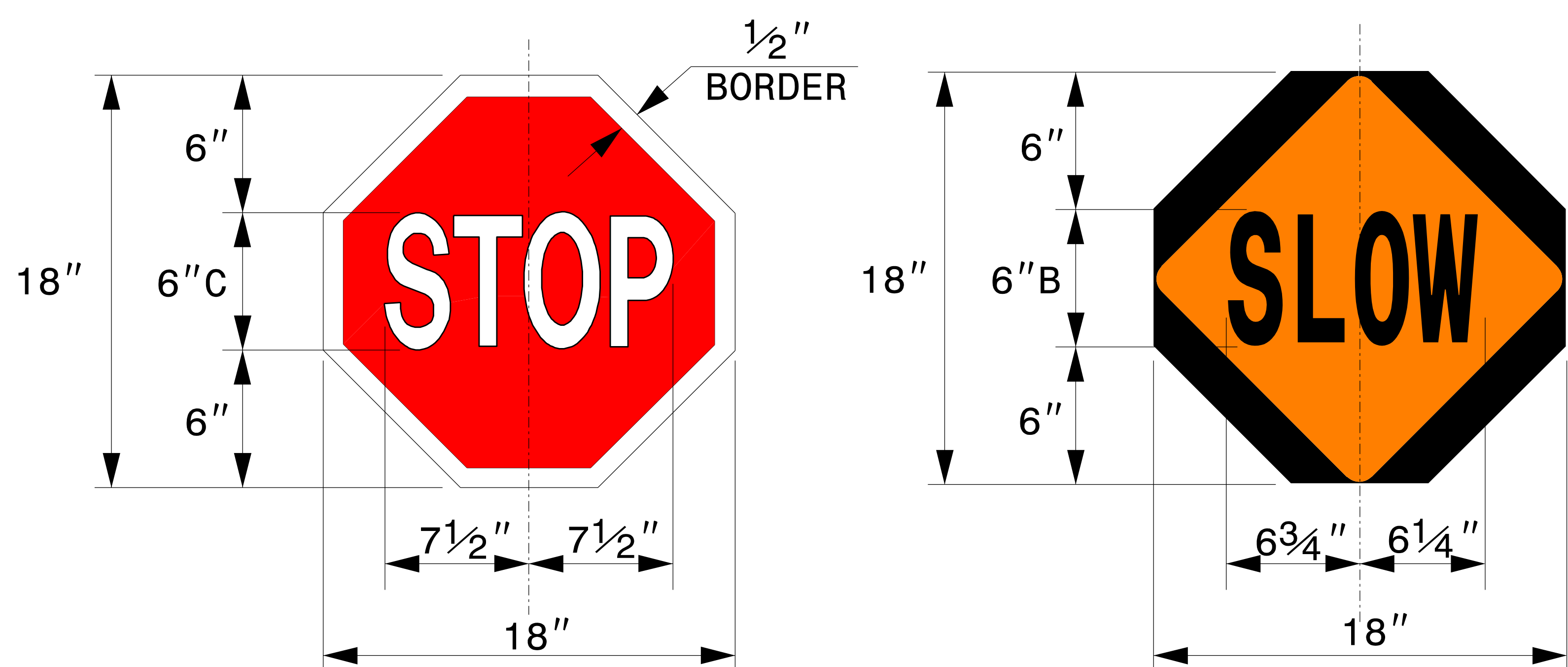
### (MUTCD Chapter 6E)

1. Fabricate Stop-Slow paddles from sheet metal or other light semi-rigid material. Provide a rigid handle of sufficient length so the paddle is held at least 7 feet above ground level.
2. Locate Flagger position to provide stopping sight distance as a minimum viewing distance from motorist to Flagger (**See Page 22**).
3. Illuminate Flagger stations during night operations. (See NCDOT Standard Specifications for Roads and Structures – Section 1413 – Portable Construction Lighting for guidance)



# Flaggers

## STOP / SLOW PADDLE



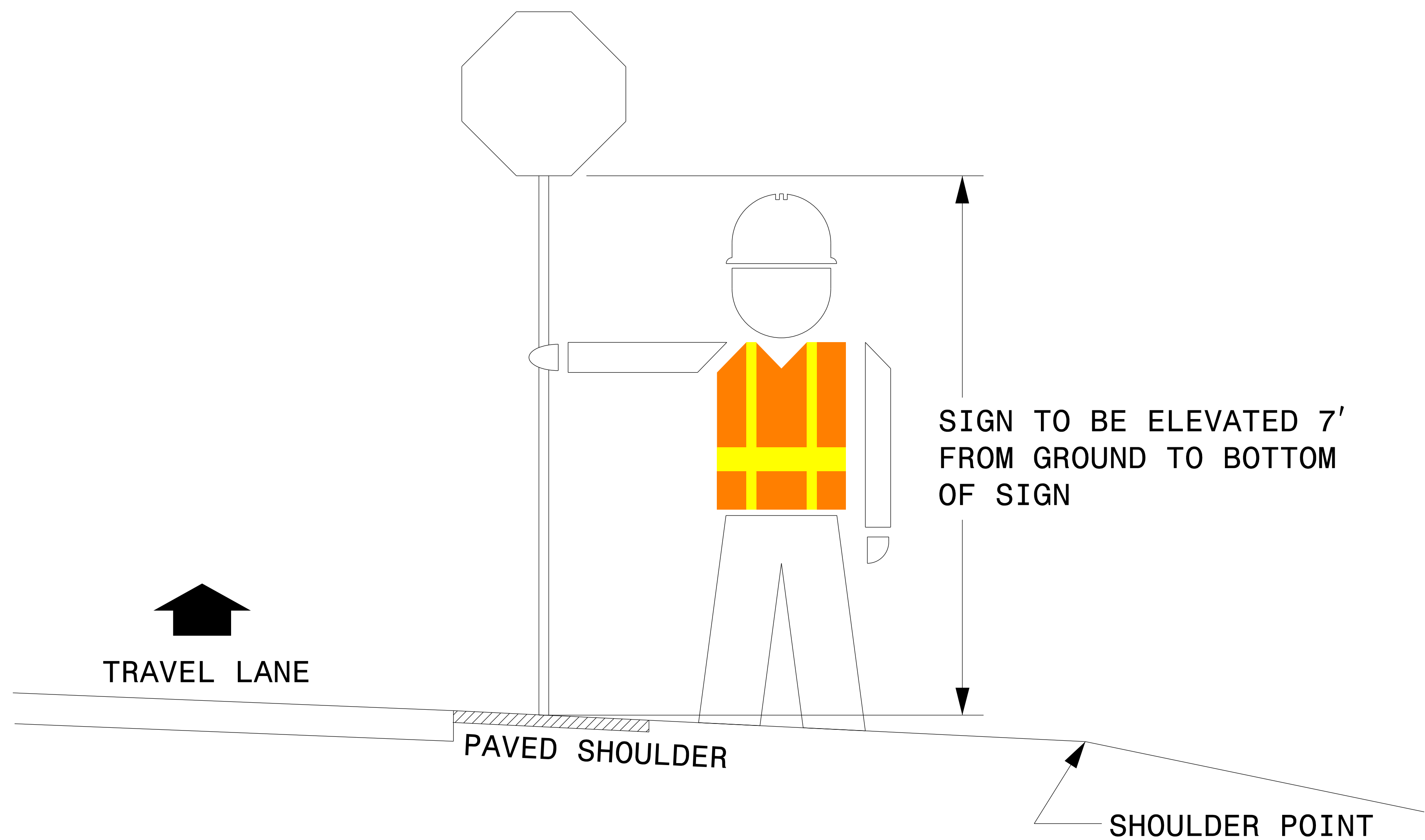
### STOP:

LEGEND-WHITE REFLECTORIZED  
BORDER-WHITE REFLECTORIZED  
BACKGROUND-RED REFLECTORIZED

### SLOW:

LEGEND-BLACK NON-REFLECTORIZED  
BORDER AREA-BLACK NON-REFLECTORIZED  
BACKGROUND-ORANGE REFLECTORIZED

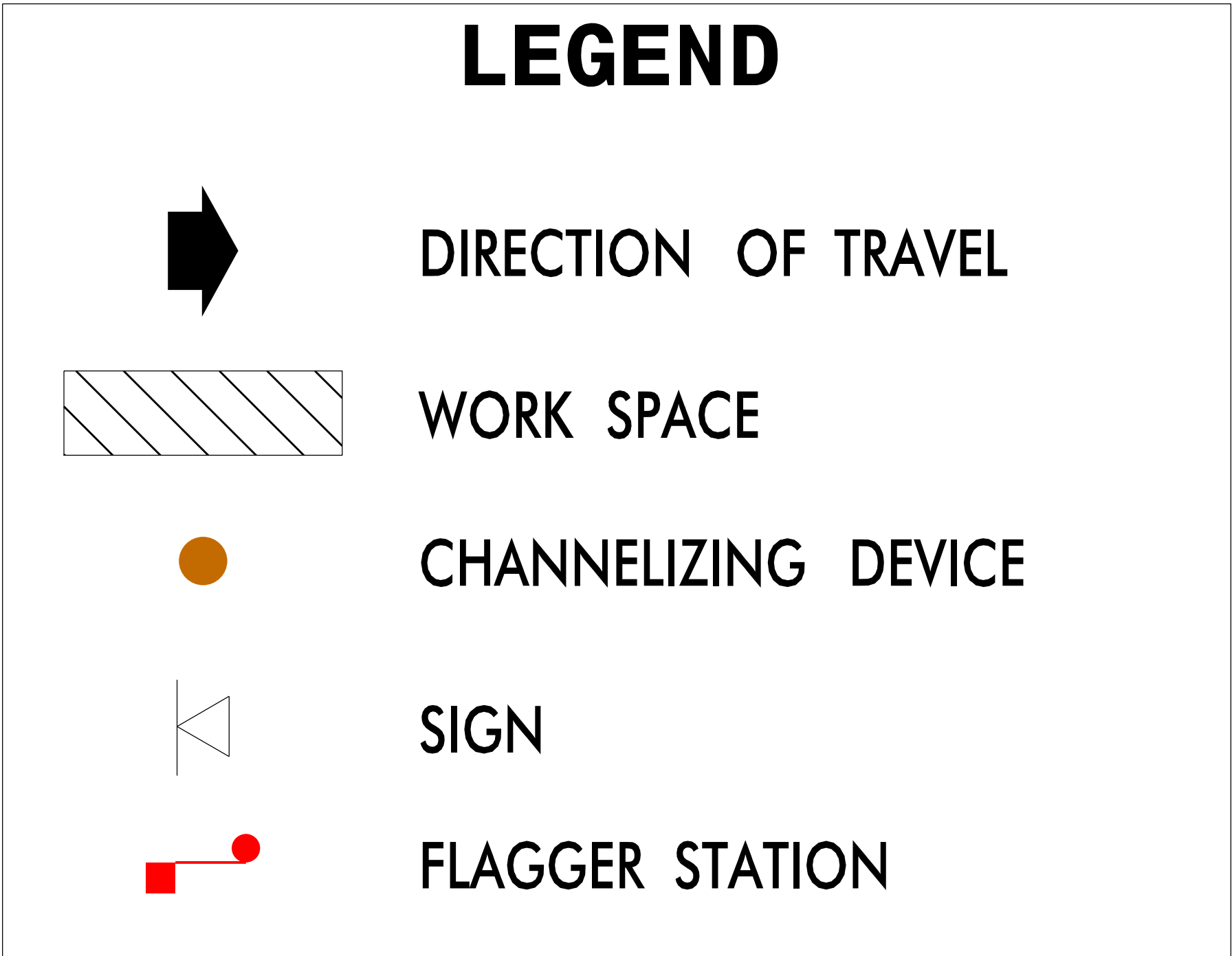
NOTE: FOR OPERATIONS THAT ARE RESTRICTED TO DAYLIGHT HOURS ONLY,  
USE NON-REFLECTORIZED LEGENDS, BORDERS AND BACKGROUNDS.





# 2.1.2 Notes for Lane Closure on a Two-Lane Road Using Two Flaggers

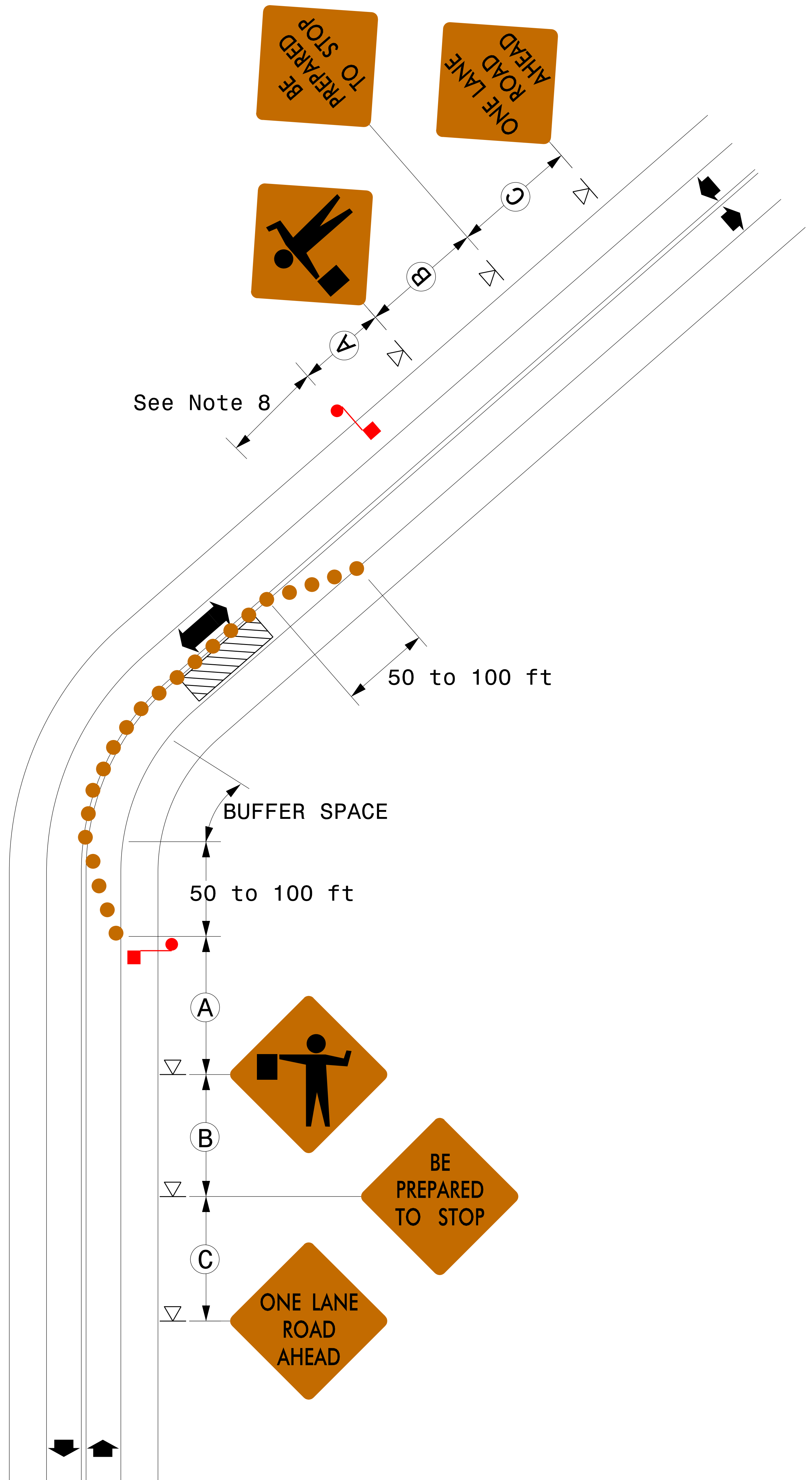
- 1. The buffer space should be extended so that the two-way traffic taper is placed before a horizontal or crest vertical curve to provide adequate sight distance for the flagger and a queue of stopped vehicles. (Refer to Roadway Standard Drawing 1101.11, Sheet 2)
- 2. At night, flagger stations shall be illuminated (truck lights are NOT approved for use).
- 3. When a grade crossing exists within or upstream of the transition area and it is anticipated that queues resulting from the lane closure might extend through the grade crossing, the Temporary Traffic Control zone should be extended so that the transition area precedes the grade crossing. Refer to page 17 for standard drawing.
- 4. When the grade crossing equipped with active warning devices exists within the activity area, provisions should be made for keeping Flaggers informed as to the activation status of these warning devices.
- 5. When a grade crossing exists within the activity area, drivers operating on the left-hand side of the normal center line should be provided with comparable warning devices as for drivers operating on the right-hand side of the normal center line.
- 6. Early coordination with the railroad company or light rail transit agency should occur before work starts.
- 7. Location of Flagger Station should allow adequate room for road users to return to their normal driving path.
- 8. If the queuing of vehicles across active rail tracks cannot be avoided, a uniformed law enforcement officer or flagger shall be provided at the grade crossing to prevent vehicles from stopping within the grade crossing (considered as being 15 feet on either side of the closest and farthest rail), even if automatic warning devices are in place.
- 9. The “DO NOT STOP ON TRACKS” sign should be used on all approaches to a grade crossing within the limits of a TTC zone.





# Lane Closure

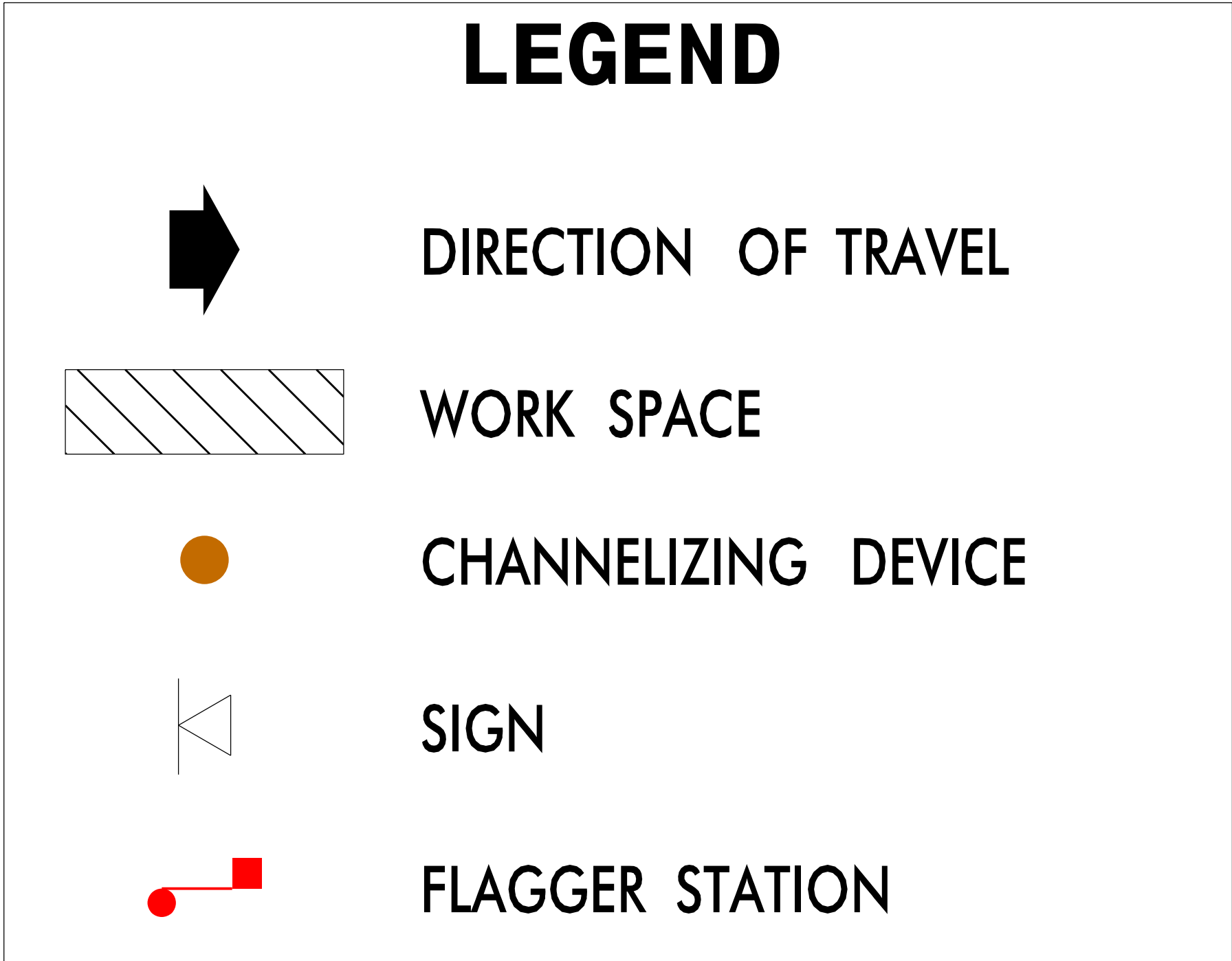
on a Two-Lane Road with Curve or Hill  
Using Two Flaggers





### 2.1.3 Notes for Lane Closure on a Two-Lane Road – Straight Road Using One Flagger 45 MPH or Less

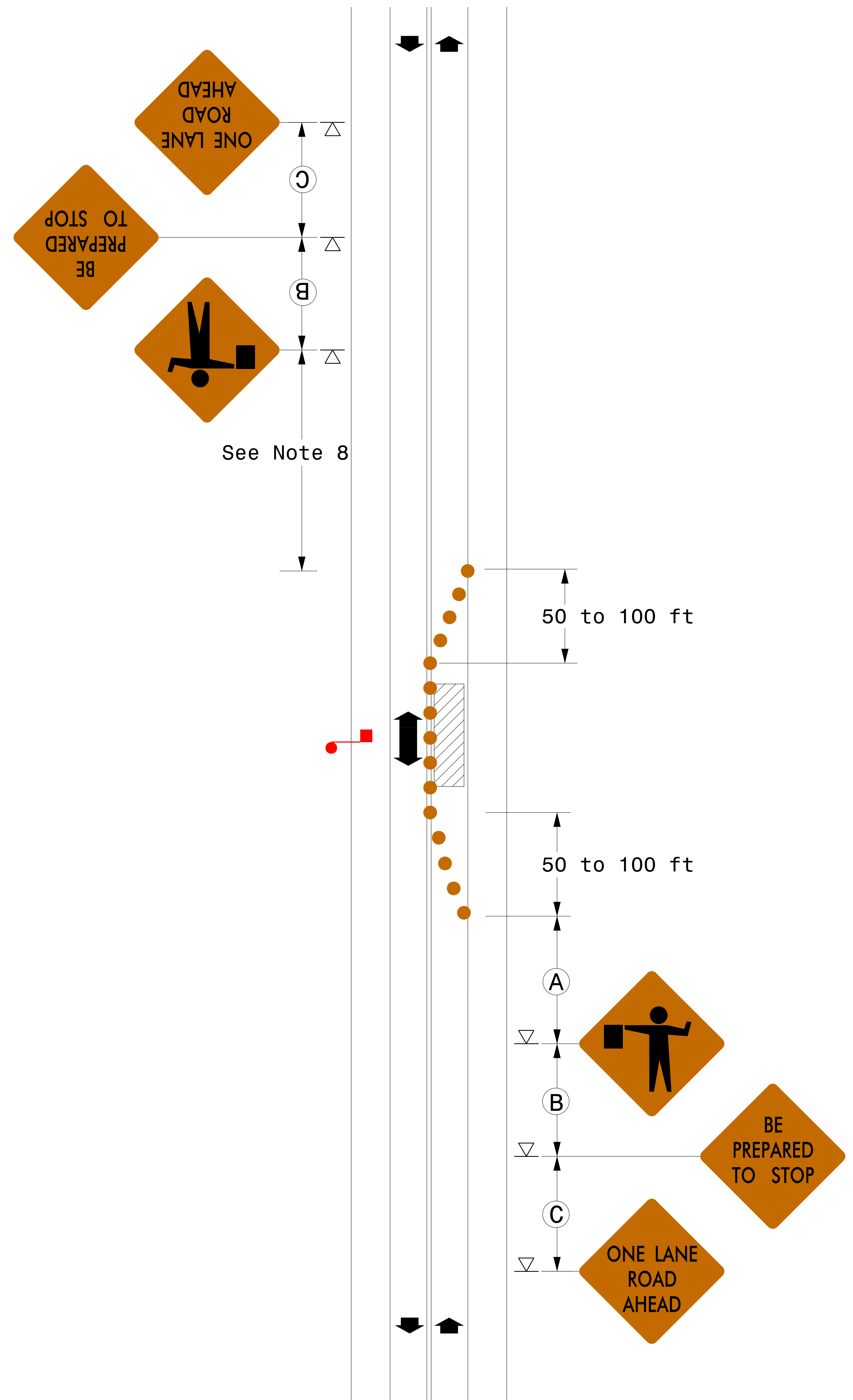
1. For low-volume situations with short work zones on straight roadways where the Flagger is visible to road users approaching from both directions, a single Flagger, positioned to be visible to road users approaching from both directions may be used.
2. At night, Flagger stations shall be illuminated (truck lights are NOT approved for use). (See note 3 on page 10)
3. When a grade crossing exists within or upstream of the transition area and it is anticipated that queues resulting from the lane closure might extend through the grade crossing, the Temporary Traffic Control zone should be extended so that the transition area precedes the grade crossing. Refer to page 15 for standard drawing.
4. When the grade crossing equipped with active warning devices exists within the activity area, provisions should be made for keeping Flaggers informed as to the activation status of these warning devices.
5. When a grade crossing exists within the activity area, drivers operating on the left-hand side of the normal center line should be provided with comparable warning devices as for drivers operating on the right-hand side of the normal center line.
6. Early coordination with the railroad company or light rail transit agency should occur before work starts.
7. Location of Flagger Station should allow adequate room for road users to return to their normal driving path.
8. If the queuing of vehicles across active rail tracks cannot be avoided, a uniformed law enforcement officer or flagger shall be provided at the grade crossing to prevent vehicles from stopping within the grade crossing (considered as being 15 feet on either side of the closest and farthest rail), even if automatic warning devices are in place.
9. The “DO NOT STOP ON TRACKS” sign should be used on all approaches to a grade crossing within the limits of a TTC zone.





# Lane Closure

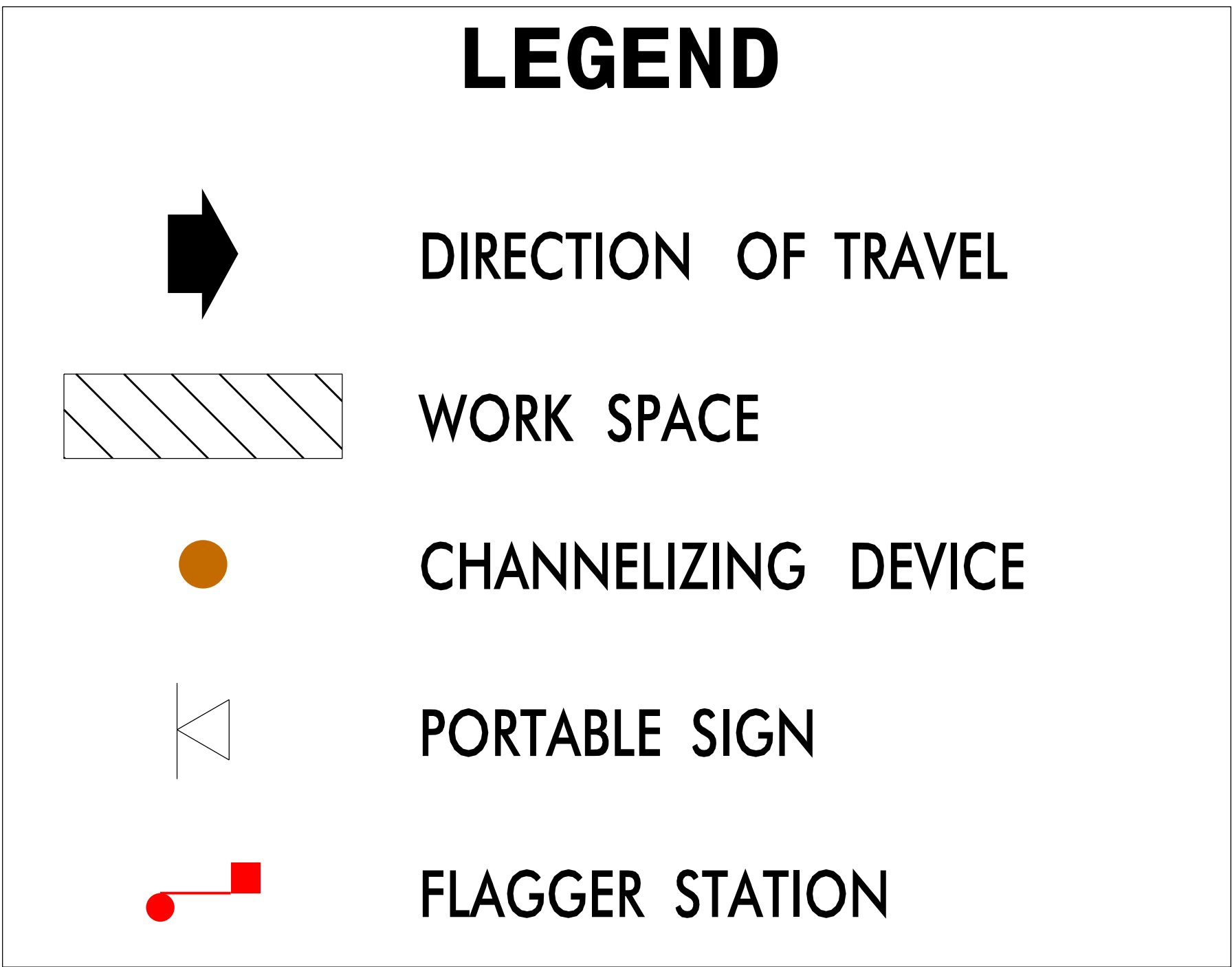
on a Two-Lane Road - Straight Road  
Using One Flagger 45 Miles Per Hour or Less





# 2.1.4 Notes for Lane Closure on a Two-Lane Road – In the Vicinity of a Railroad Grade Crossing

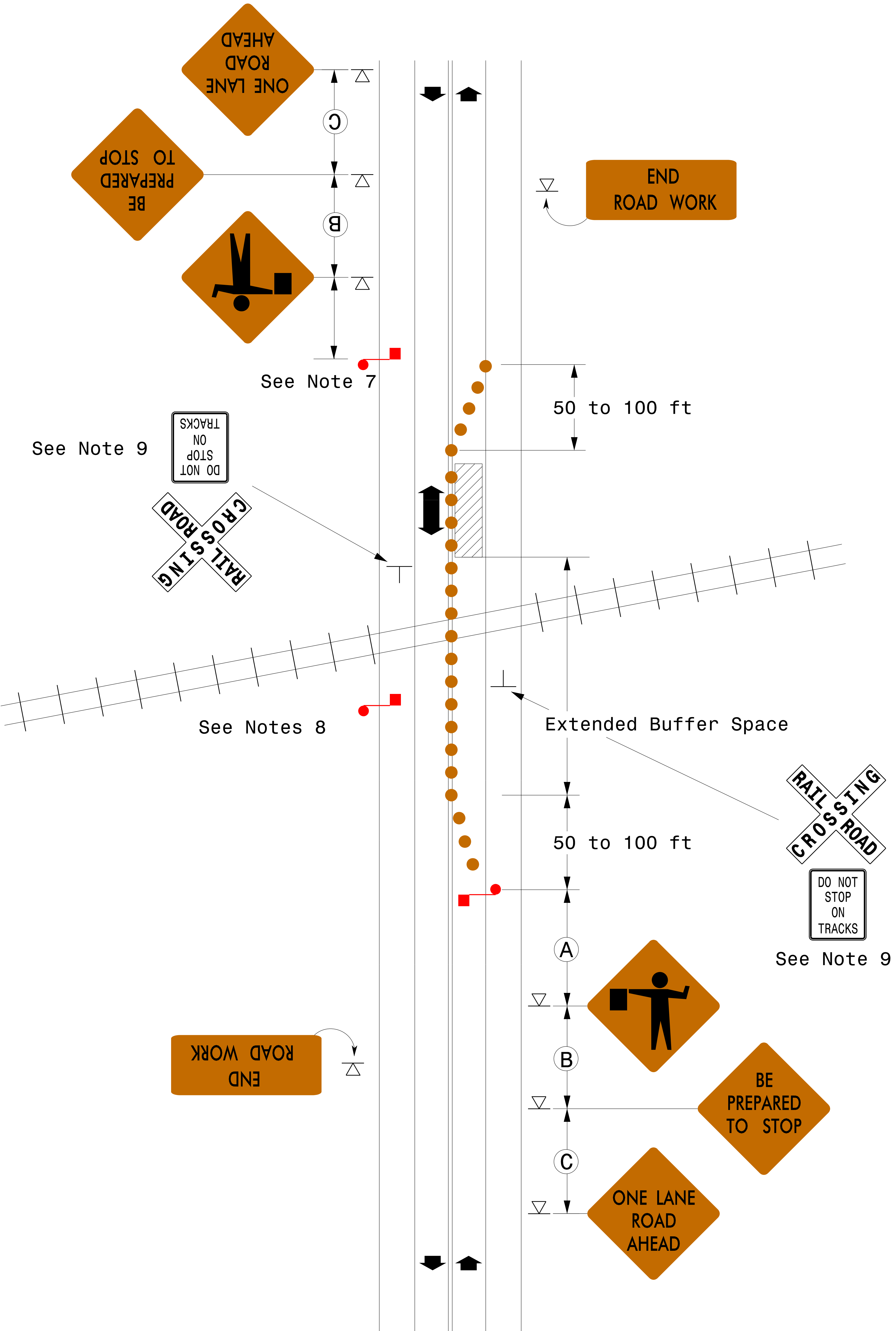
1. For low-volume situations with short work zones on straight roadways where the Flagger is visible to road users approaching from both directions, a single Flagger, positioned to be visible to road users approaching from both directions may be used.
2. At night, Flagger stations shall be illuminated (truck lights are NOT approved for use). (See note 3 on page 10)
3. When a grade crossing exists within or upstream of the transition area and it is anticipated that queues resulting from the lane closure might extend through the grade crossing, the Temporary Traffic Control buffer space should be extended so that the transition area precedes the grade crossing. (Do not allow stopped traffic to back up over a crossing.)
4. When the grade crossing equipped with active warning devices exists within the activity area, provisions should be made for keeping Flaggers informed as to the activation status of these warning devices.
5. When a grade crossing exists within the activity area, drivers operating on the left-hand side of the normal center line should be provided with comparable warning devices as for drivers operating on the right-hand side of the normal center line.
6. Early coordination with the railroad company or light rail transit agency should occur before work starts.
7. Location of Flagger Station should allow adequate room for road users to return to their normal driving path.
8. If the queuing of vehicles across active rail tracks cannot be avoided, a uniformed law enforcement officer or flagger shall be provided at the grade crossing to prevent vehicles from stopping within the grade crossing (considered as being 15 feet on either side of the closest and farthest rail), even if automatic warning devices are in place.
9. The “DO NOT STOP ON TRACKS” sign should be used on all approaches to a grade crossing within the limits of a TTC zone.





# Lane Closure

on a Two-Lane Road in the Vicinity  
of a Railroad Grade Crossing



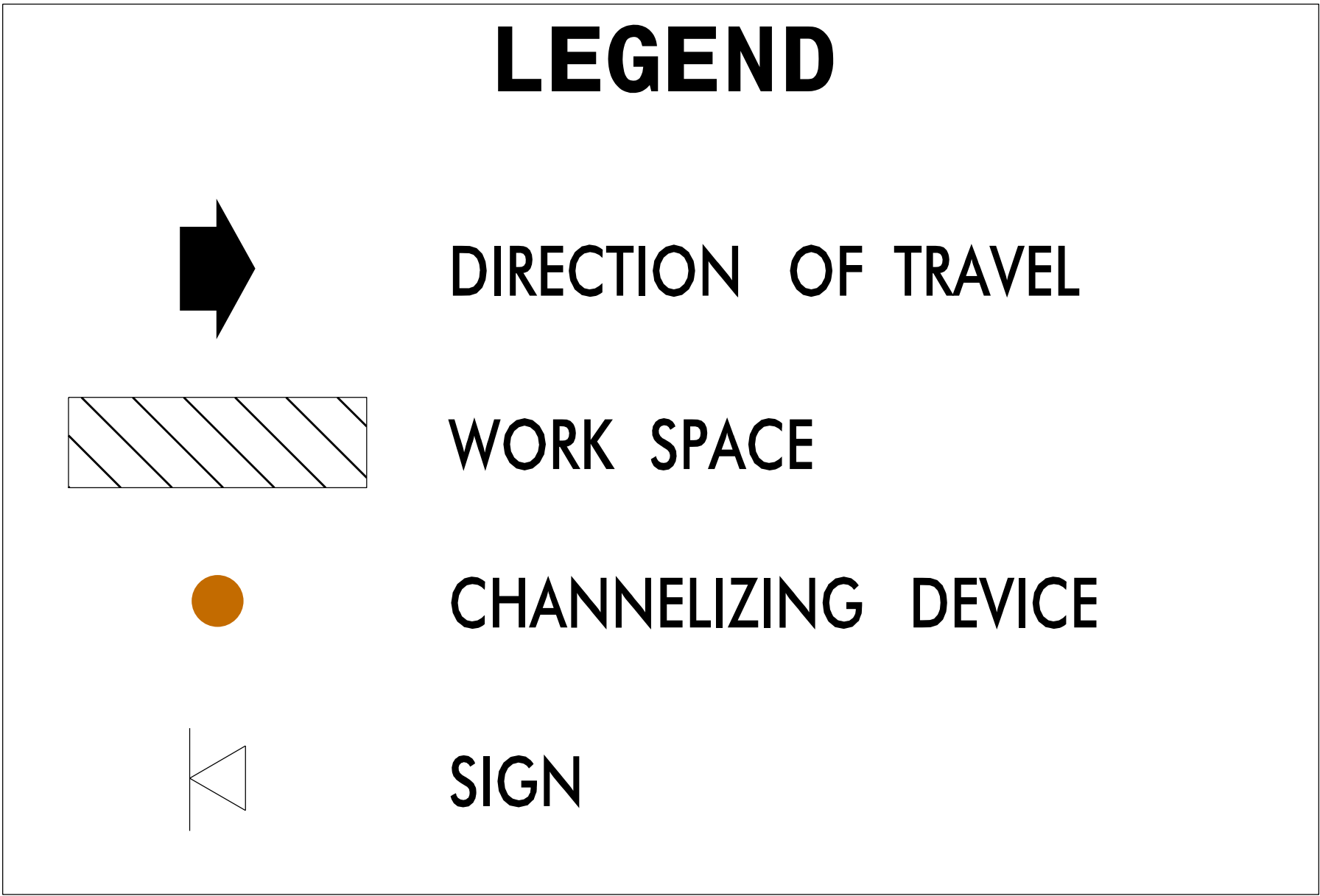


2.2 Components of Temporary Traffic Control Zone

(MUTCD Section 6C.03 thru 6C.07)

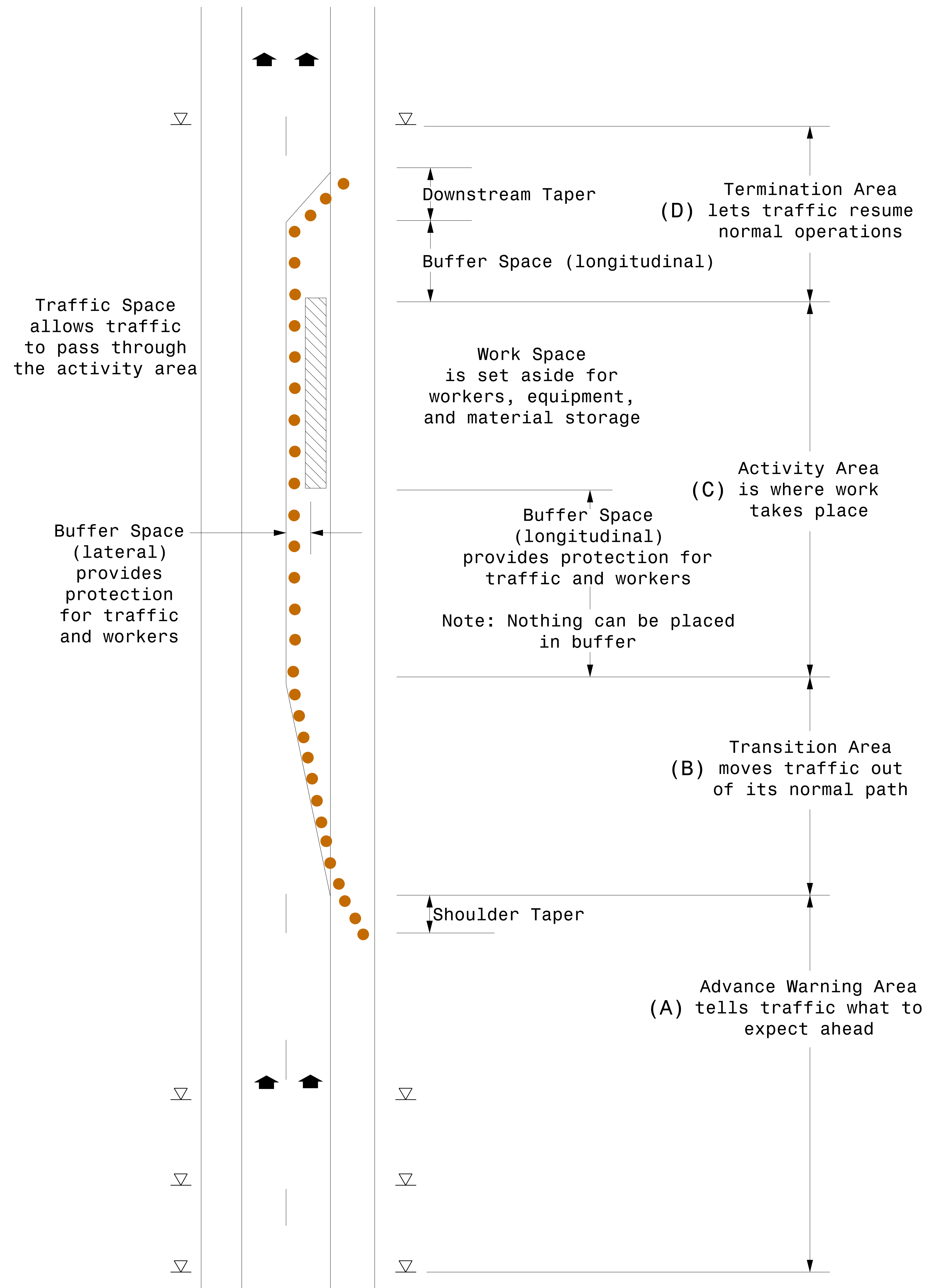
These components are discussed in order in which the motorist will encounter them along a highway. These components apply to stationary, mobile, or moving work zone operations.

- (A) **Advance Warning Area** – This is the section of highway at the beginning of the work zone where motorists are informed about the upcoming work zone or incident area. Vehicle warning lights (see page 3) and signs are part of the advance warning area (see pages 23 thru 28 for information on advance warning signs).
- (B) **Transition Area** – This is the section of highway after the Advance Warning Area where motorists are redirected out of their normal path to a different path using a taper of cones, skinny drums, drums, or barrier, or other means. Tapers are shown and discussed on pages 17 thru 20.
- (C) **Activity Area** – This is the section of highway after the Transition Area where motorists see the work on the closed side or lane of the highway. The Activity Area is broken in to two areas called the Buffer Space and the Work Space (See pages 17 thru 22).
  - a. **Buffer Spaces** can be both Longitudinal and Lateral. Longitudinal buffer spaces must be completely open to allow an errant motorist to come to a full stop before hitting an object
  - b. **Work Space** contains the workers, equipment (including the TMIA), and materials.
- (D) **Termination Area** – This is the section of highway after the Activity Area where motorists are returned to their normal driving path (See page 16).

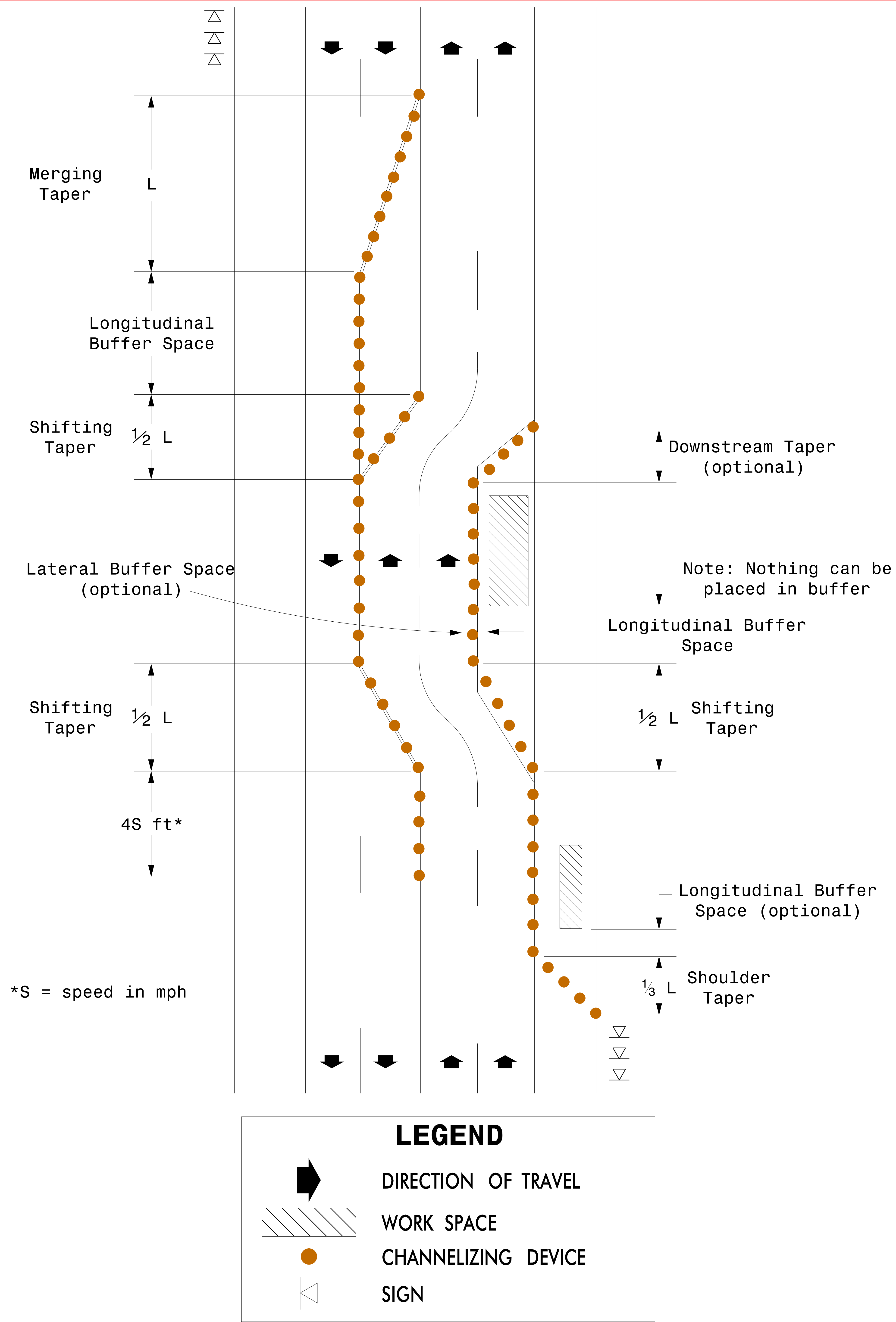




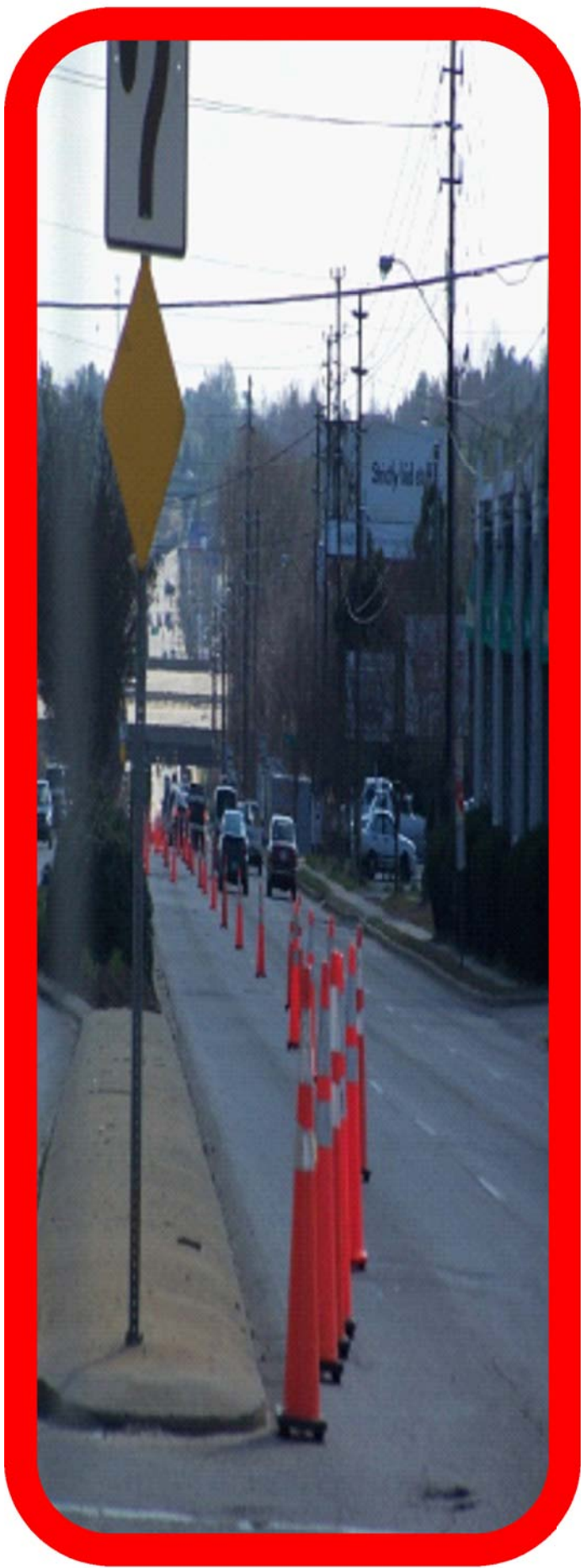
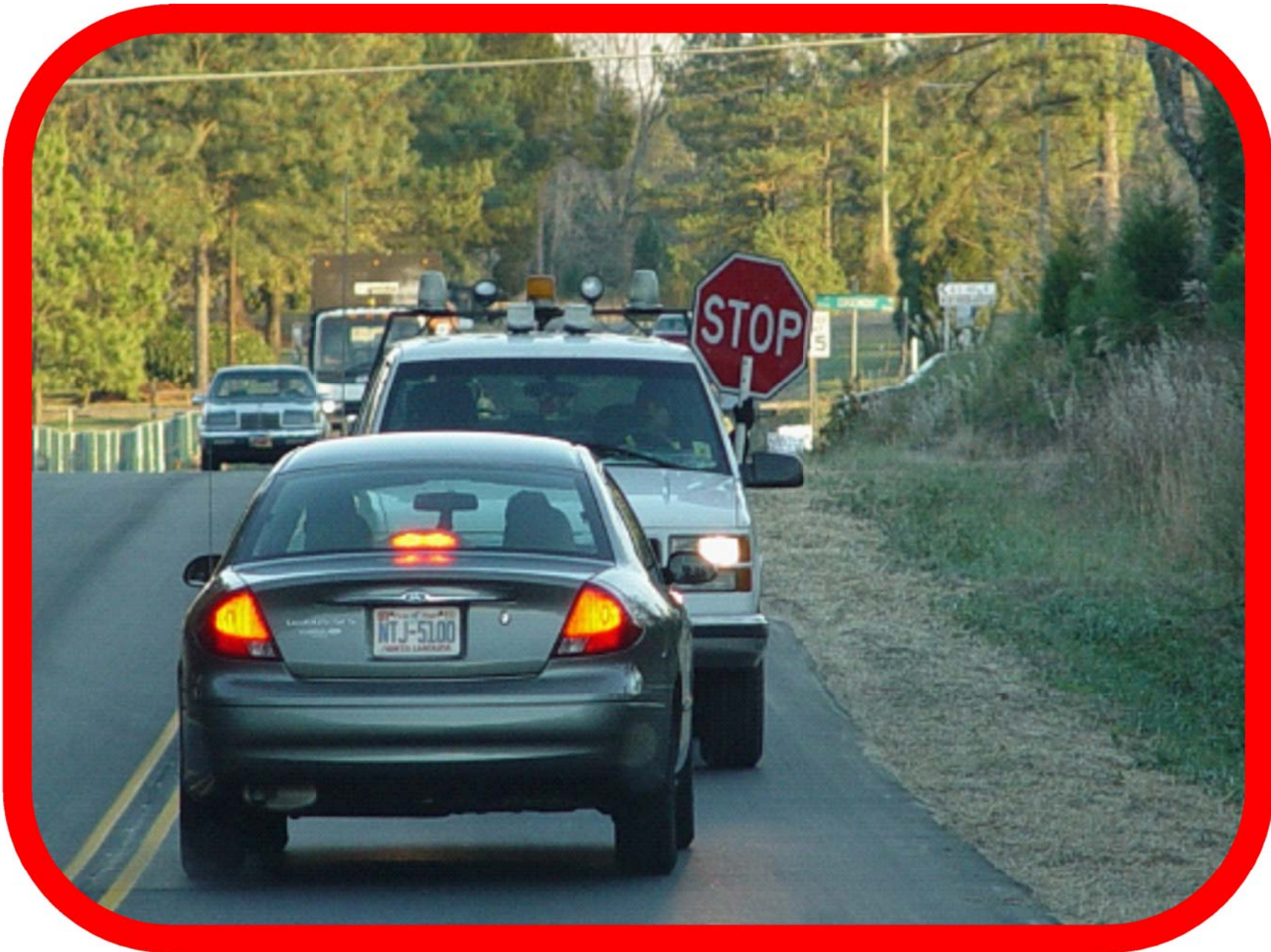
# Component Parts of a Temporary Traffic Control Zone



# Types of Tapers and Buffer Spaces









2.3 Notes for “L” Distance and Channelizing Device Taper

1. Table for “L” distance is based on channelization taper formula from the MUTCD where:

<u>Speed Limit</u>	<u>Formula</u>
40 MPH or Less	$L_{MIN} = \frac{W \times S^2}{60}$
45 MPH or Greater	$L_{MIN} = W \times S$

L = Minimum Taper Length in Feet (Longitudinal Distance)  
W = Width of Offset in Feet (Lateral Distance)  
S = Posted Speed Limit in MPH, or off-peak 85 percentile speed in MPH prior to work starting, or the anticipated operating speed in MPH.

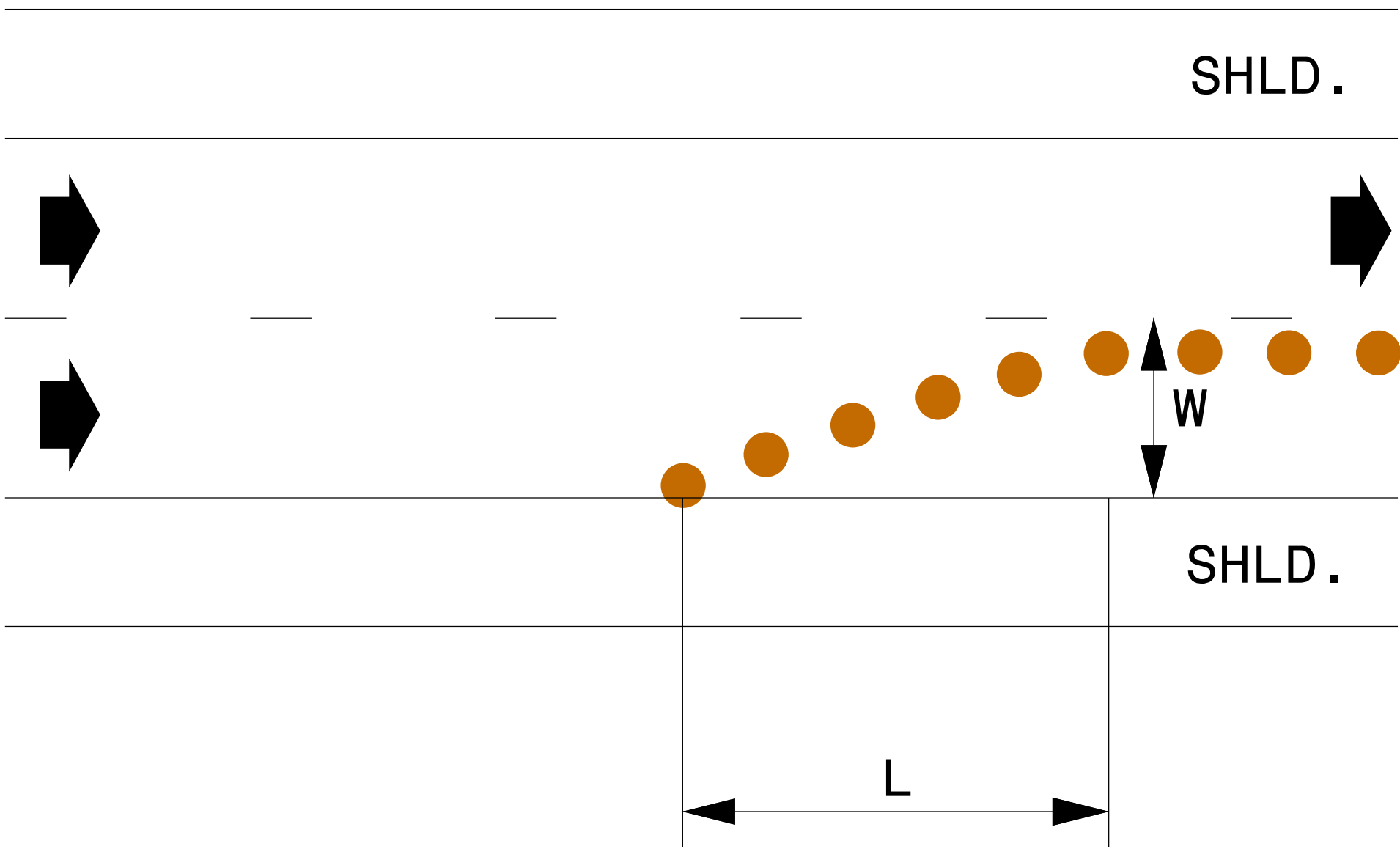
2. “L” distance is for application with channelizing device and pavement marking tapers and transitions. Channelizing devices include drums, cones, skinny drums, and barricades.



# "L" Distance and Channelizing Device Taper Criteria

QUICK REFERENCE - "L" DISTANCE TABLE												
MINIMUM LONGITUDINAL DISTANCE "L" (FEET) (ROUNDED VALUES)												
POSTED SPEED "S" (MPH)	LATERAL WIDTH "W" (FEET)											
	1	2	3	4	5	6	7	8	9	10	11	12
20	10	15	20	30	35	40	50	55	60	70	75	80
25	15	25	35	45	55	65	75	85	95	105	115	125
30	15	30	45	60	75	90	105	120	135	150	165	180
35	25	45	65	85	105	125	145	165	185	205	225	245
40	30	55	80	110	135	160	190	215	240	270	295	320
45	45	90	135	180	225	270	315	360	405	450	495	540
50	50	100	150	200	250	300	350	400	450	500	550	600
55	55	110	165	220	275	330	385	440	495	550	605	660
60	60	120	180	240	300	360	420	480	540	600	660	720
65	65	130	195	260	325	390	455	520	585	650	715	780
70	70	140	210	280	350	420	490	560	630	700	770	840

## EXAMPLE OF "L" & "W" DESIGNATIONS



## TAPER LENGTH CRITERIA FOR CHANNELIZING DEVICES IN WORK ZONES

### TYPES OF TAPERS

### TAPER LENGTH

#### UPSTREAM TAPER

MERGING TAPER.....	L MINIMUM
SHIFTING TAPER.....	1/2 L MINIMUM
SHOULDER TAPER.....	1/3 L MINIMUM
TWO-WAY TRAFFIC TAPER.....	50 - 100 FEET MAXIMUM

#### DOWNSTREAM TAPER.....100 FEET MAXIMUM

## 2.4 Notes for Stopping Sight Distance Table

1. Use of stopping sight distance in traffic control plan applications includes providing sight distance for traffic approaching a lane closure. For lane closures on 2-lane, 2-way roadways provide stopping sight distance to the Flagger. For lane closures on multi-lane roadways provide stopping sight distance to the beginning of the lane closure merge taper or flashing arrow panel. Extend lane closures from the buffer space such that stopping sight distance is provided.
2. The buffer space is a lateral and/or longitudinal area that separates traffic from the work space or an unsafe area and might provide some recovery space for an errant vehicle.
3. Neither work activity nor storage of equipment, vehicles or materials (including a TMA) shall occur within a buffer space.
4. Buffer spaces may be positioned either longitudinally or laterally with respect to the direction of traffic. The activity area may contain one or more lateral or longitudinal buffer spaces.
5. A longitudinal buffer space may be placed in advance of a work space
6. When a longitudinal buffer is used, the values shown in the Table on page 22 shall be used to determine the length of the longitudinal buffer space.
7. When a TMA, arrow board or changeable message sign is placed in a closed lane in advance of a work space, only the area upstream of the TMA, arrow board or changeable message sign constitutes the buffer space.
8. The lateral buffer space as shown on page 16 & 17 may be used to separate the traffic space from the work space and areas such as excavations or pavement-edge drop-offs. A lateral buffer space may also be used between two travel lanes, especially those carrying opposing flows.
9. The width of a lateral buffer space should be determined by engineering judgment. (Consult your Qualified Work Zone Designer or your Project Engineer



# Buffer Space & Sight Distance

DESIGN SPEED (MPH)	MINIMUM SIGHT DISTANCE		MINIMUM LONGITUDINAL BUFFER SPACE (FEET)
	STOPPING SIGHT DISTANCE (FEET)	PASSING SIGHT DISTANCE (FEET)	
30	200	1090	85
35	250	1280	120
40	305	1470	155
45	360	1625	195
50	425	1835	240
55	495	1985	290
60	570	2135	345
65	645	2285	405
70	730	2480	470
75	820	2580	540
80	910	2680	615

\*DESIGN SPEED IS 5 MPH GREATER THAN POSTED SPEED LIMIT

## General Notes

1. Tables are based on the AASHTO Green Book “A Policy on Geometric Design of Highways and Streets” and the “Manual on Uniform Traffic Control Devices”. Minimum sight distance values are for passenger car vehicles on wet and level roadways. Consult the AASHTO Green Book to make final determination of stopping sight distance requirements.
2. Buffer space table is based on the braking distance portion of stopping sight distance for wet and level pavements.
3. Use of stopping sight distance in traffic control plan applications includes providing sight distance for traffic approaching a lane closure. Provide 2-lane, 2-way roadways stopping sight distance to the flagger. For lane closures on multilane roadways provide stopping sight distance to the beginning of the lane closure merge taper, or flashing arrow board. Extend lane closures at the buffer space such that stopping sight distance is provided.
4. Use of minimum passing sight distance table in traffic control plan applications includes providing sight distance requirements for placement of pavement marking passing/no-passing zones for 2-lane, 2-way roadways.



## **2.5 Temporary Traffic Control Zone Sign Basics (MUTCD Section 6F.02 thru 6F.59)**

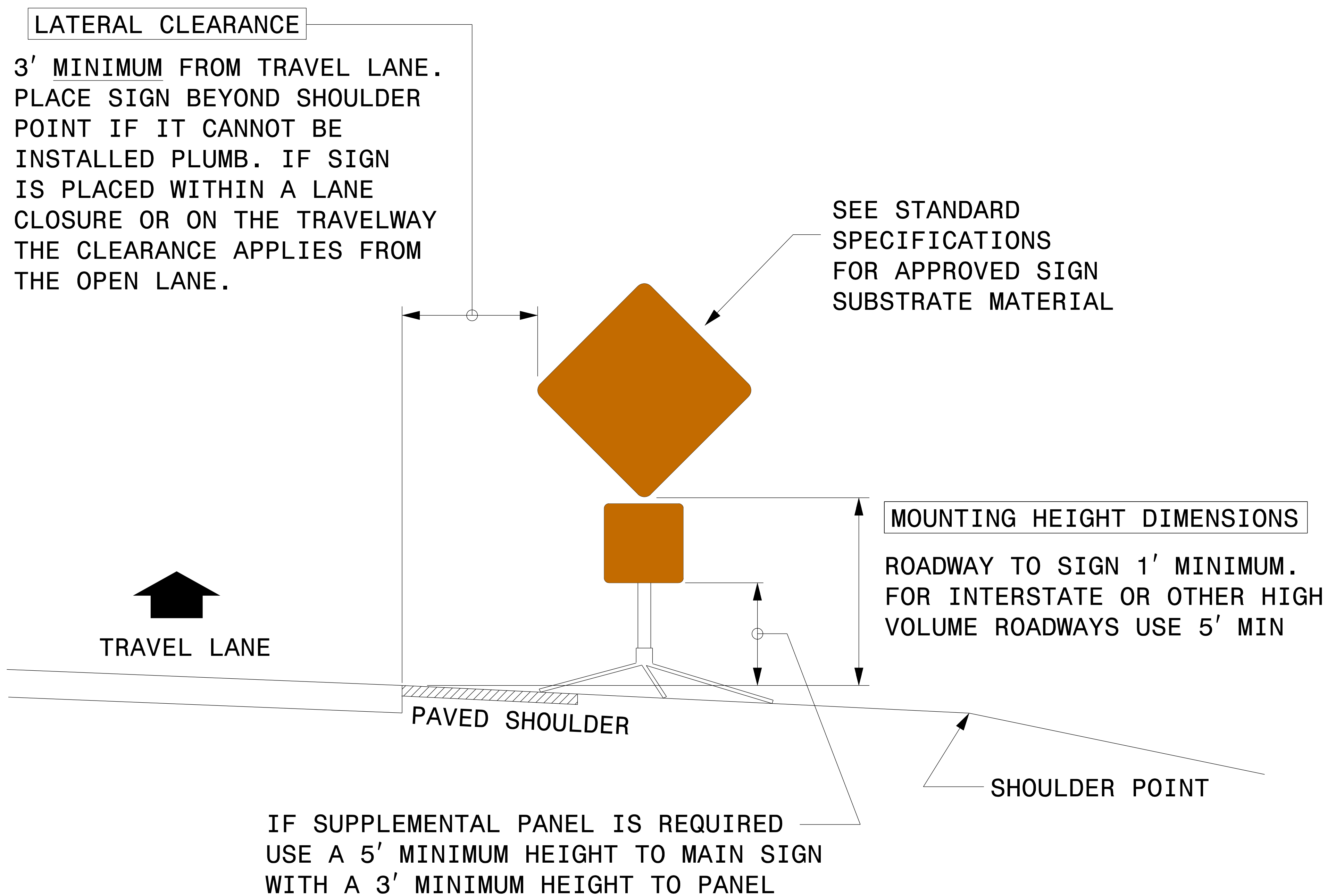
- Signs must be retroreflective and made from NCDOT approved materials. Mesh signs are NOT allowed.
- Portable and Stationary sign supports must meet NCDOT material requirements.
- Road Work Ahead or Begin Work Zone signs are required if the work area is not inside a larger long term stationary work zone that has these signs already in place, and that will remain in effect overnight.
- All Signs may be portable mounted. Consider Stationary mounting, especially the Road Work Ahead or Begin Work Zone signs if work activity lasts more than 1 week.
- Signs may be mounted on the front of work vehicles such as the “Keep Right” sign on the front of a lead vehicle in a moving or mobile operation like Pavement Marking. Signs must be standard sizes and clearly visible to on-coming traffic.
- Signs may be mounted on the rear of work vehicles such as the “Worker in Road” sign on the back of the last vehicle in a mobile crack sealing operation. Signs must be standard sizes and clearly visible to on-coming traffic.
- Signs should use messages that are clearly understandable by the motorist, clean, and legible from at least the distance required in the Stopping Sight Distance Table on Page 22.
- Signs should be positioned so the Sign Face is turned slightly away from the travel lane to reduce sun and headlight glare.
- Use proper ballast such as sand bags on portable sign stand legs to prevent overturning or use stationary mounted signs in high wind areas.
- Work with all other contractors in the work area to eliminate sign overlap
- During periods of construction inactivity (longer than 30 minutes such as lunch) signs should be removed, turned away from the motorist’s view, or laid down to remove the sign from the motorist’s view.

### **2.5.1 Notes for Portable Work Zone Signs**

1. Dimensions shown are minimum values. Mount signs so they are clearly visible to approaching traffic even when signs are mounted behind traffic control devices such as drums, barrier, or other objects.
2. All portable sign and stands must meet or exceed the crash-test requirements of NCHRP 350 for work zone category II devices. Use portable work zone signs and stands specifically designed for each other.
3. All portable work zone signs and stands must be listed on North Carolina approved products list by the Work Zone Traffic Control Unit.



# Portable Work Zone Signs Mounting Height & Lateral Clearance



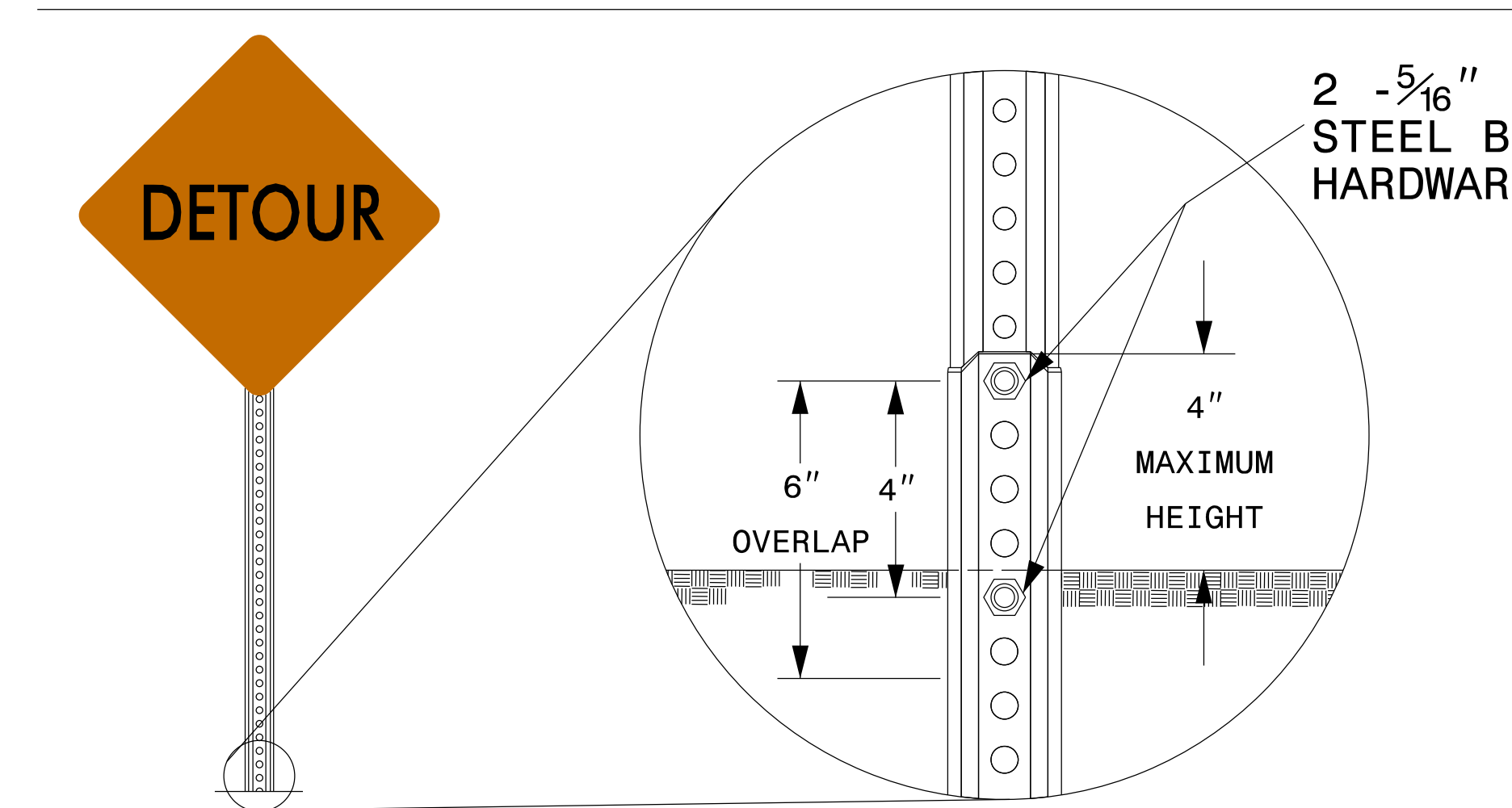
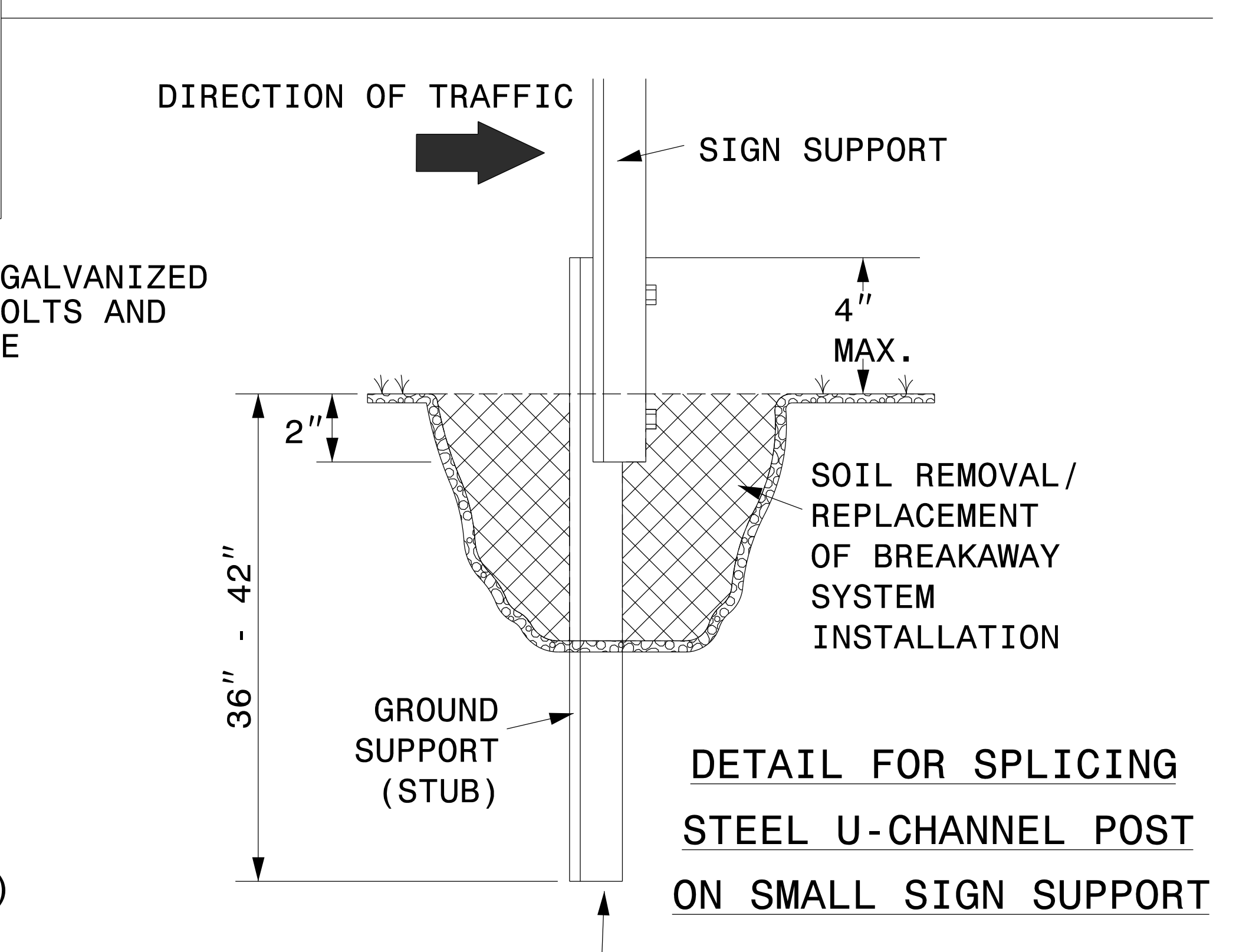
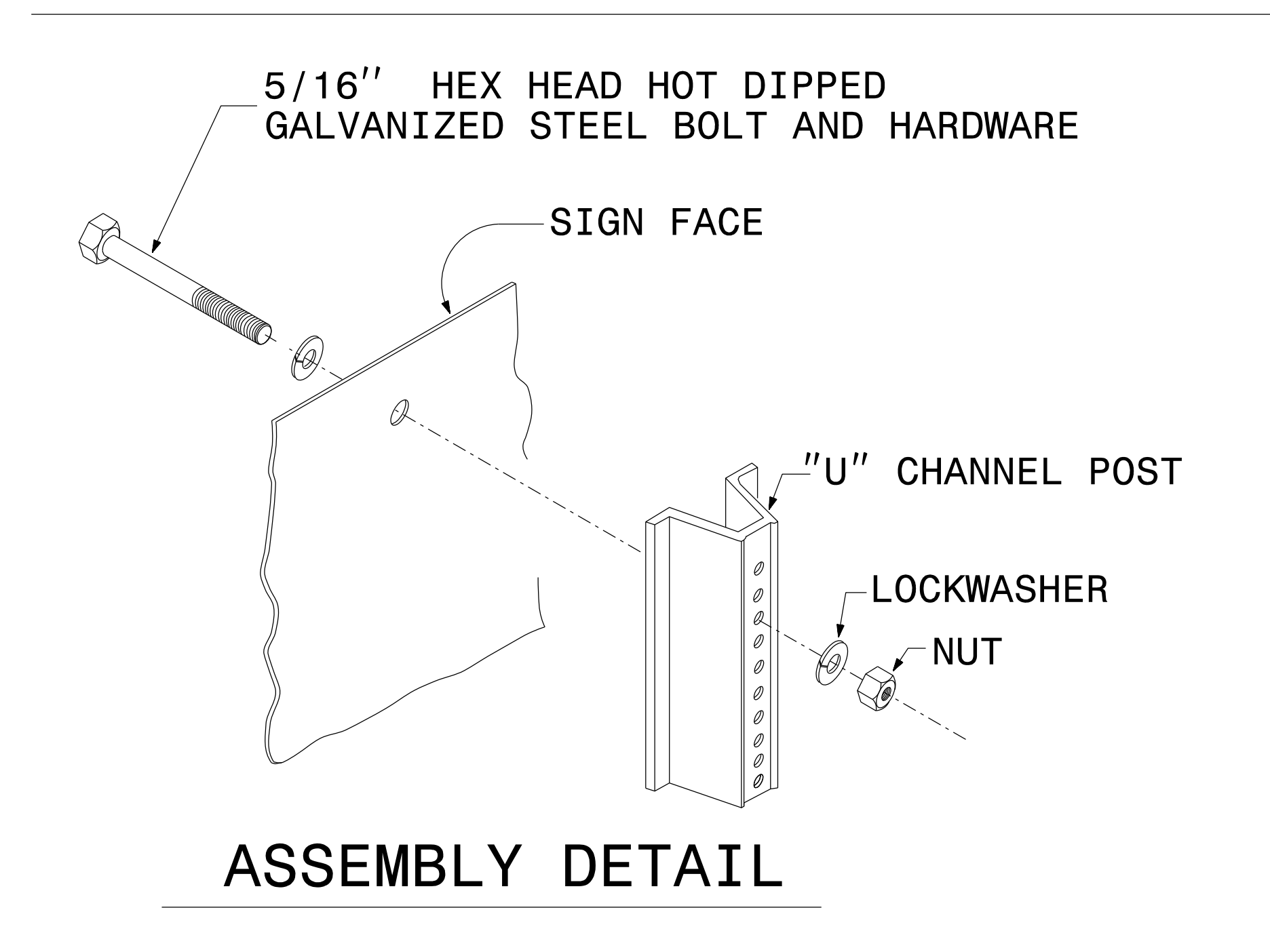
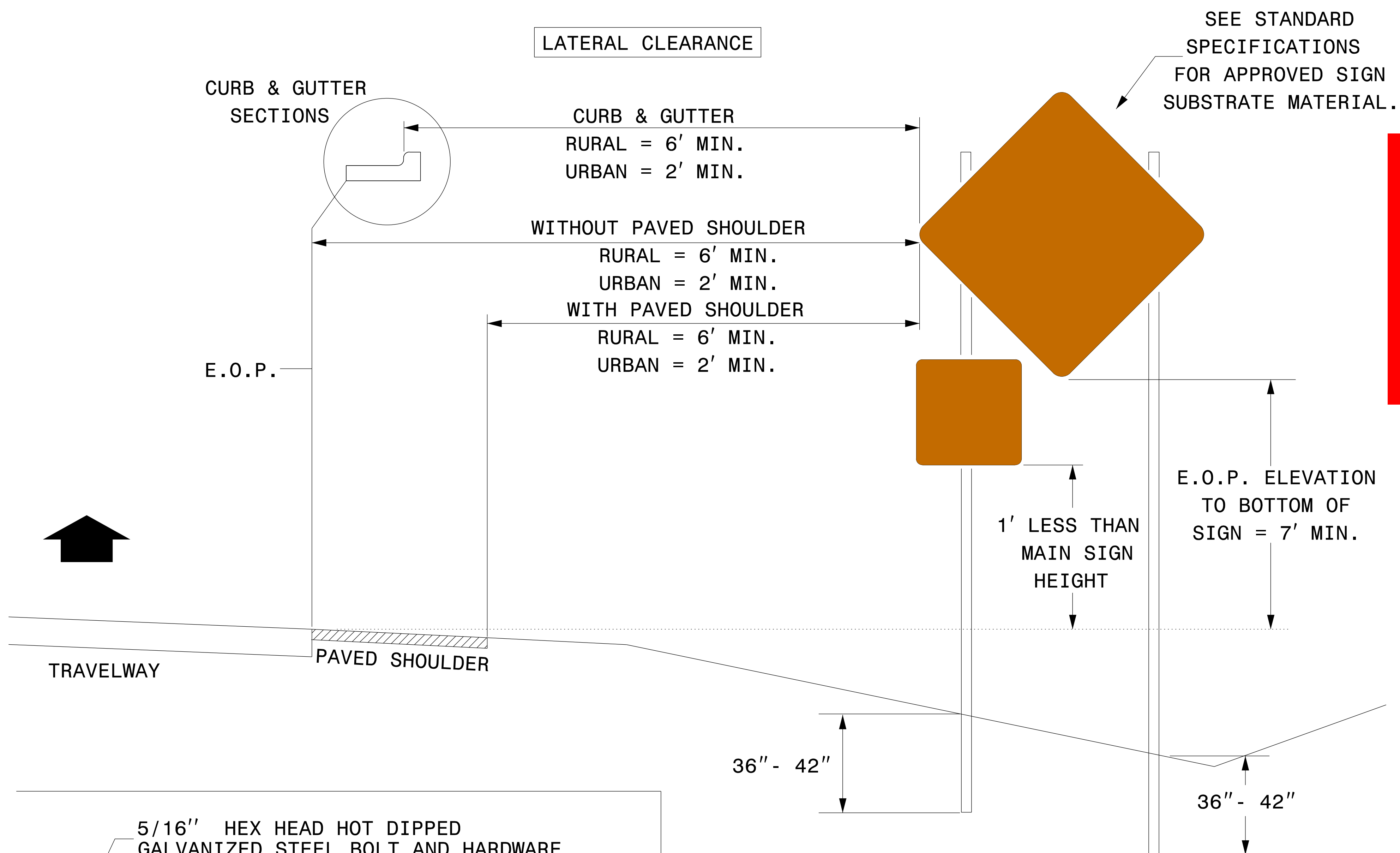
## 2.5.2 Notes for Stationary Work Zone Signs

1. Dimensions shown are minimum values. When signs are mounted behind traffic control devices such as drums, barrier, or other objects that detract from their visibility, mount the signs at an appropriate height such that they are clearly visible to approaching traffic.
2. Use 3-lb U-channel steel posts, 4"x 4" wood posts or perforated square steel tubing having the equivalent or greater strength of 3-lb U-channel posts for all stationary work zone signs. Dual mount signs with surface areas greater than 10 sf on either 3-lb U-channel steel posts, 4" x 4" wood posts or perforated square steel tubing posts having the equivalent or greater strength of 3-lb U-Channel Steel posts. Perforated square steel tubing breakaway posts certified by the manufacturer for single mounting purposes may be used for the single mounting of stationary work zone signs greater than 10 sf.
3. When using the splicing detail on page 26 all of the post driven into the ground must be removed when removing the sign from the work zone.



# Stationary Work Zone Signs

## Mounting Height & Lateral Clearance



BOLTS MUST BE 4" APART. THE GROUND SUPPORT (STUB) SHALL NOT EXTEND HIGHER THAN 4" ABOVE THE GROUND. ATTACH THE SIGN SUPPORT TO THE BACK OF THE GROUND SUPPORT (STUB) WITH THE APPROPRIATE HARDWARE PROVIDED BY THE MANUFACTURER OF THE BREAKAWAY SYSTEM. OVERALL LENGTH OF THE BREAKAWAY SYSTEM IS 6".

WHEN SIGN IS REMOVED AT THE END OF PROJECT, REMOVE THE GROUND SUPPORT (STUB).

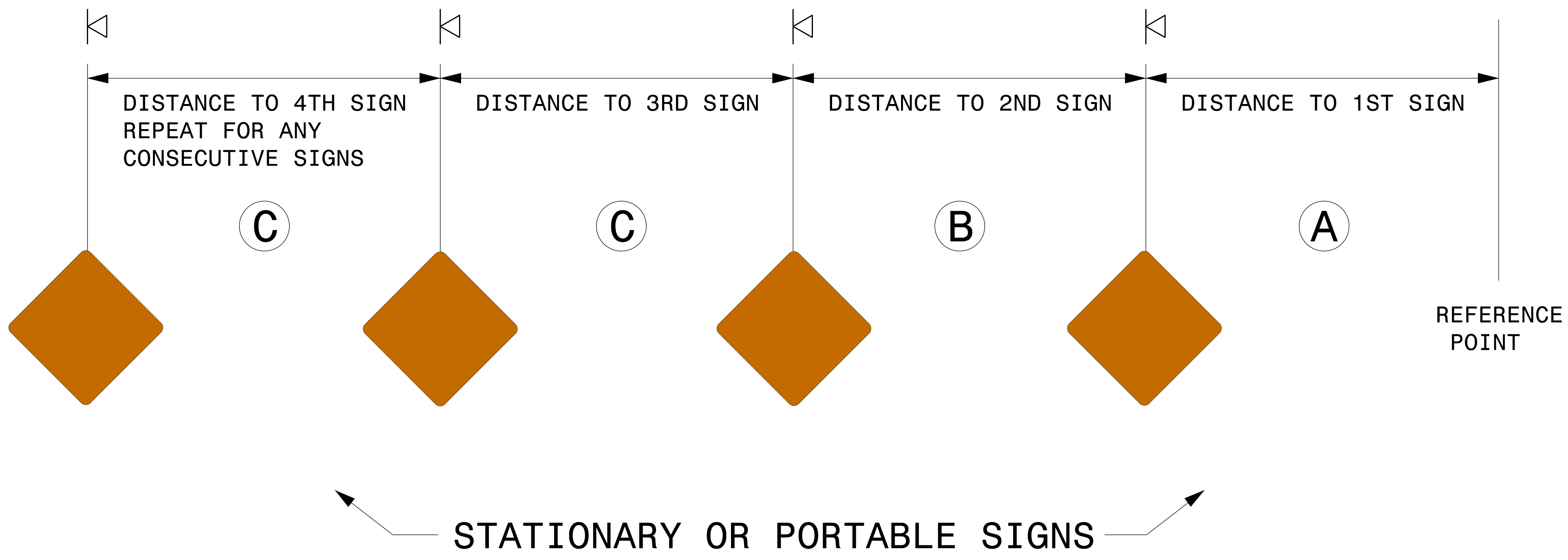
### 2.5.3 Notes for Spacing of Temporary Signs in Series

1. Use this drawing in conjunction with other traffic control drawings where sign spacing distances A, B, C, are specified.
2. Apply the advance warning sign spacing chart where a series of 2 or more signs are used. All sign spacing dimensions are approximate. Field adjust as various conditions occur, such as limited sight distance, obstruction interference, etc.



# Spacing of Temporary Signs in Series

ADVANCE WARNING SIGN SPACING CHART			
POSTED SPEED LIMIT (MPH)	RECOMMENDED DISTANCE BETWEEN SIGNS (FEET) ±		
	Ⓐ	Ⓑ	Ⓒ
≤ 35	200	200	200
40 - 50	350	350	350
55	500	500	500
CONTROLLED ACCESS ROADS ( ≥ 55 )	1000	1500	2700





## 2.6 Other Temporary Traffic Control Zone Devices

**(MUTCD Section 6F.61, 6F.63, 6F.64, 6F.67, 6F.68, 6F.77 thru 6F.79)  
Information for the devices listed below is for speeds of 55 MPH or below. When using these devices at Posted Speed Limits above 55 MPH consult with your Qualified Work Zone Supervisor.**

- A. Cones
- B. Skinny Drums
- C. Drums
- D. Type II & III Barricades
- E. Flashing Arrow Boards
- F. Automated Flagger Assistant Devices (AFAD's)
- G. Truck Mounted Attenuators (TMA's)
- H. Portable Concrete Barrier
- I. Temporary Barrier
- J. Temporary Steel Covers
- K. Pavement Markings

### A. Notes for Cones

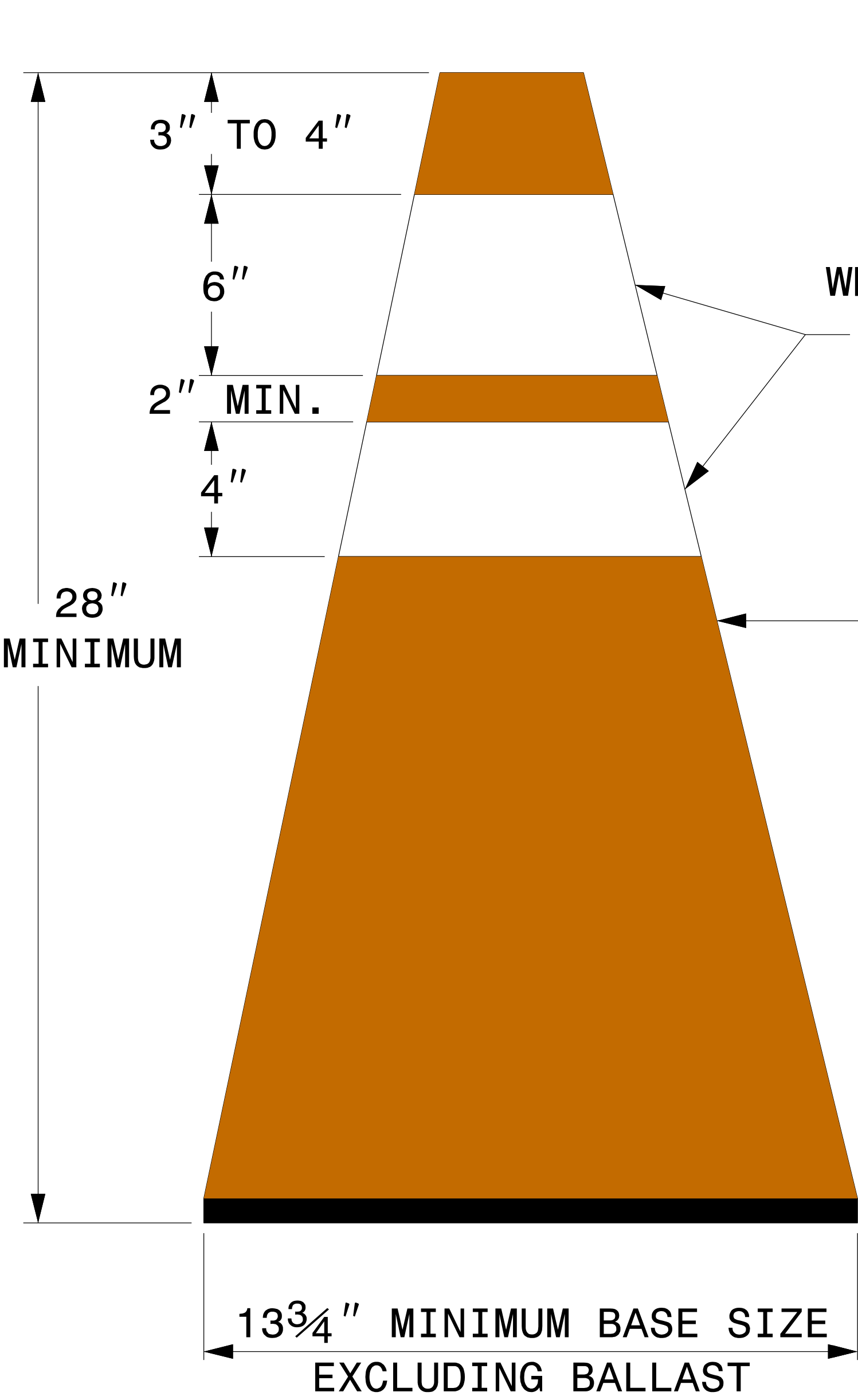
1. Achieve ballasting by using special weighted bases such as sand bag rings, doubling cones, or bases that can be filled with ballast. Seventy percent of the weight of the cone must be in the base. Use ballasts that do not present a hazard when struck.
2. If desired, the name of the agency, contractor, or supplier may be placed on non-retroreflective cone surfaces near the bottom of the device. The letters and numbers must be created using a non-retroreflective color and must not be over 2 inches in height.



# Cones

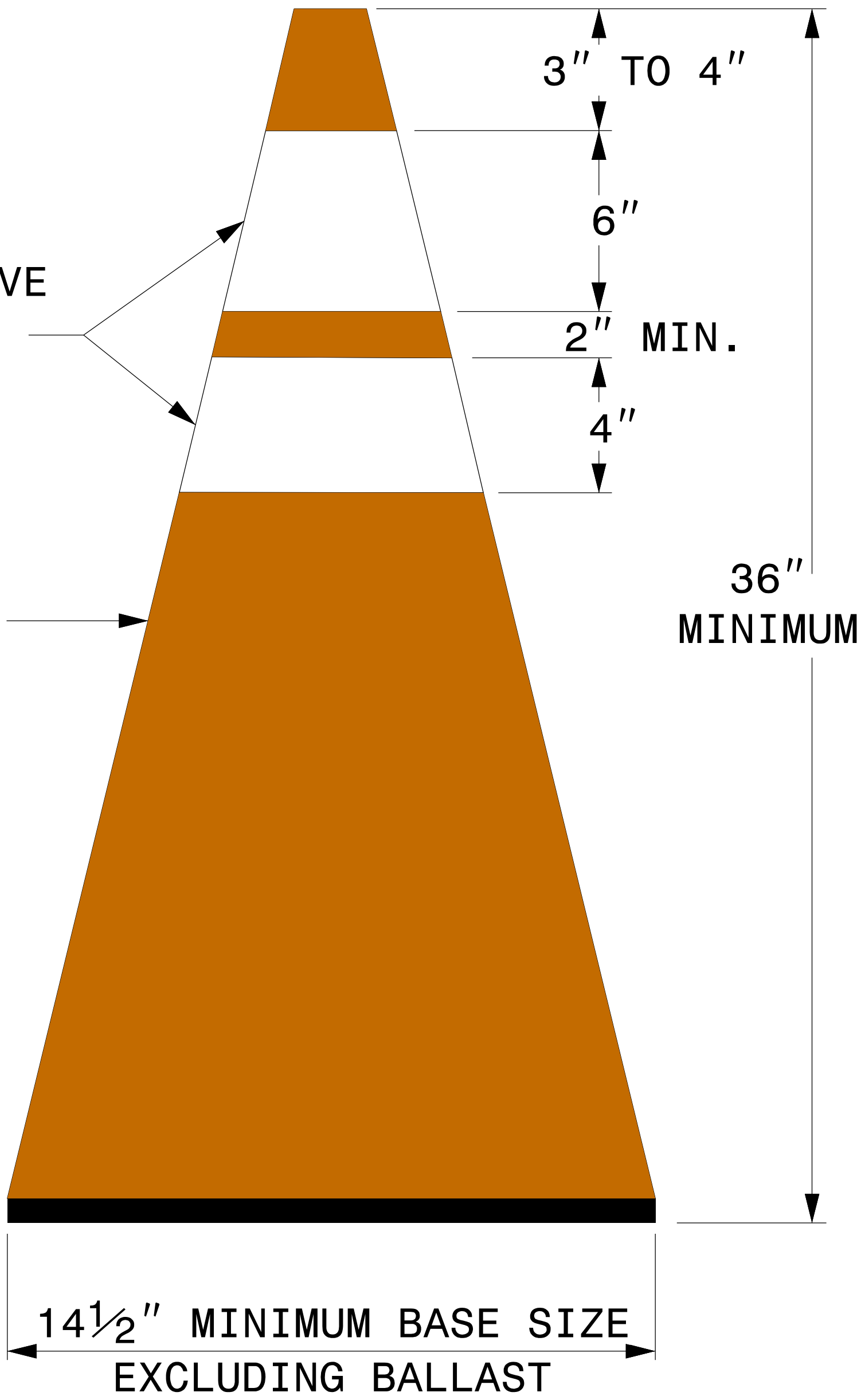
## 28 INCH CONE

(MINIMUM SIZE CONE FOR  
ALL CLASSES OF ROADS  
EXCEPT FREEWAYS AND EXPRESSWAYS)



## 36 INCH CONE

(REQUIRED FOR  
FREEWAYS AND EXPRESSWAYS)

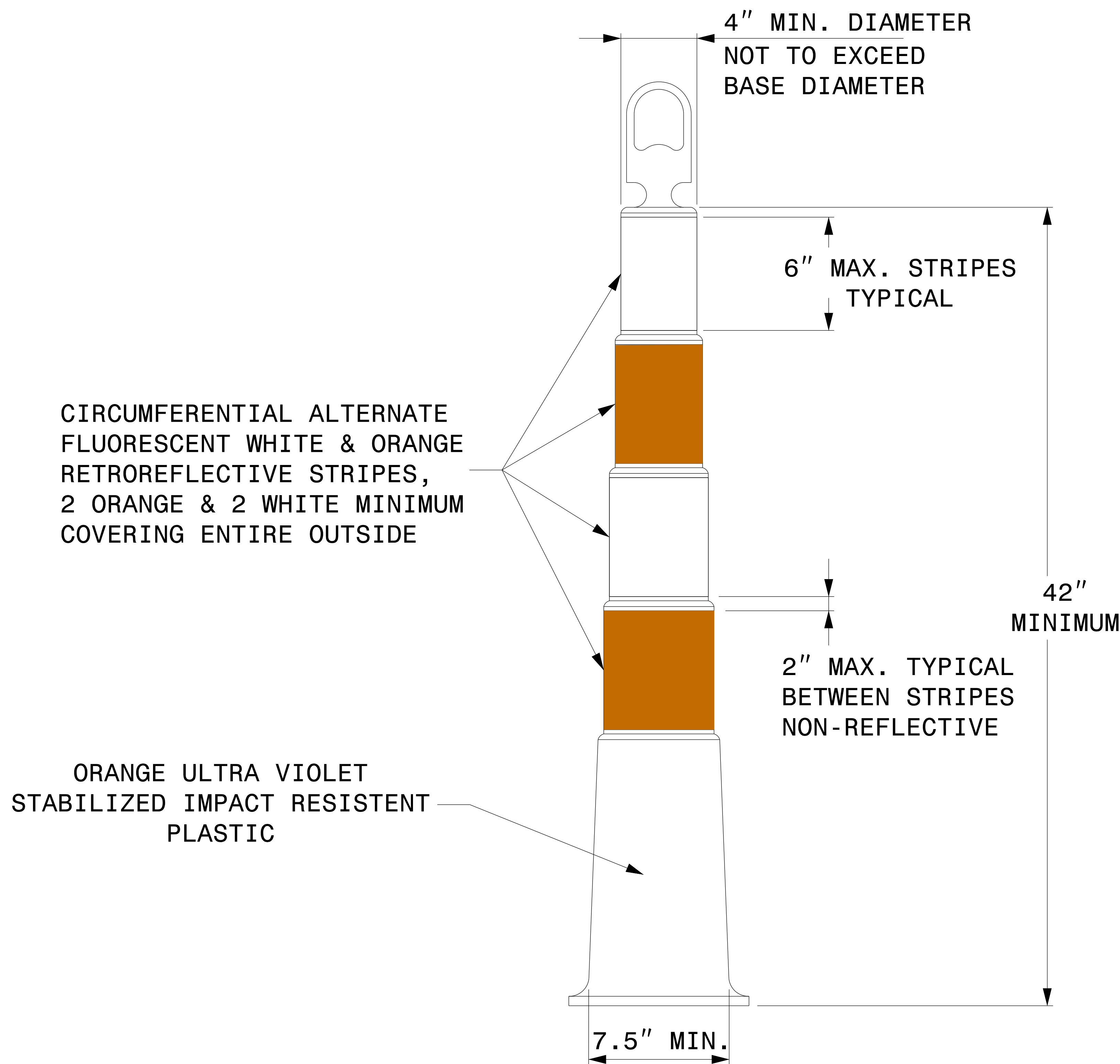


## **B. Notes for Skinny Drums**

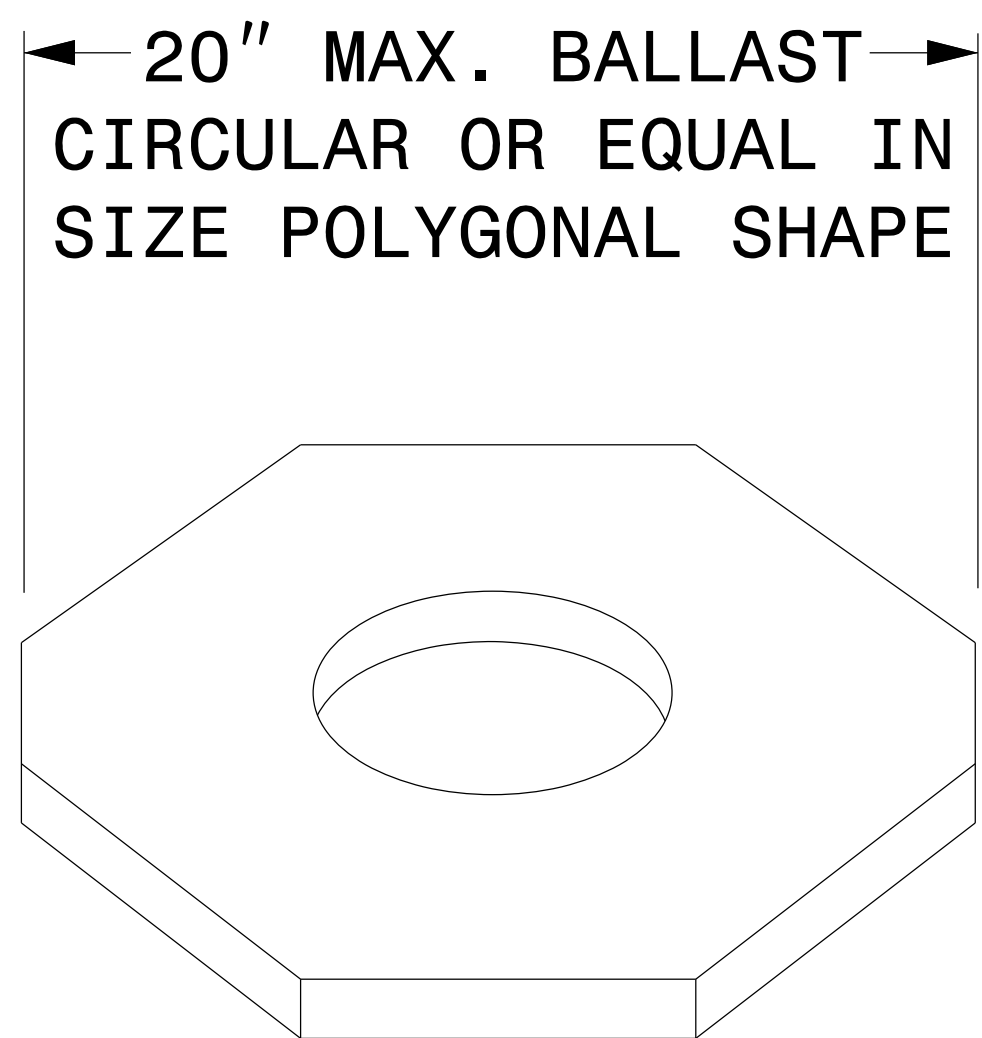
1. New Skinny Drums purchased after July 20, 2010 will use 4 – 6 inch bands of Type III or higher high intensity prismatic sheeting. Existing inventories of Skinny Drums may be used until the end of their useful life and the Skinny Drum types may be intermixed.
2. If desired, the name of the agency, contractor, or supplier may be placed on non-retroreflective skinny drum surfaces near the bottom of the device. The letters and numbers must be created using a non- retroreflective color and must not be over 2 inches in height.
3. Ballasting shall be achieved by the preformed weighted base specifically designed for the model skinny drum or as specified by the manufacturer. Do not place ballast on top of the skinny drum.



# Skinny-Drum



## TYPICAL BALLAST



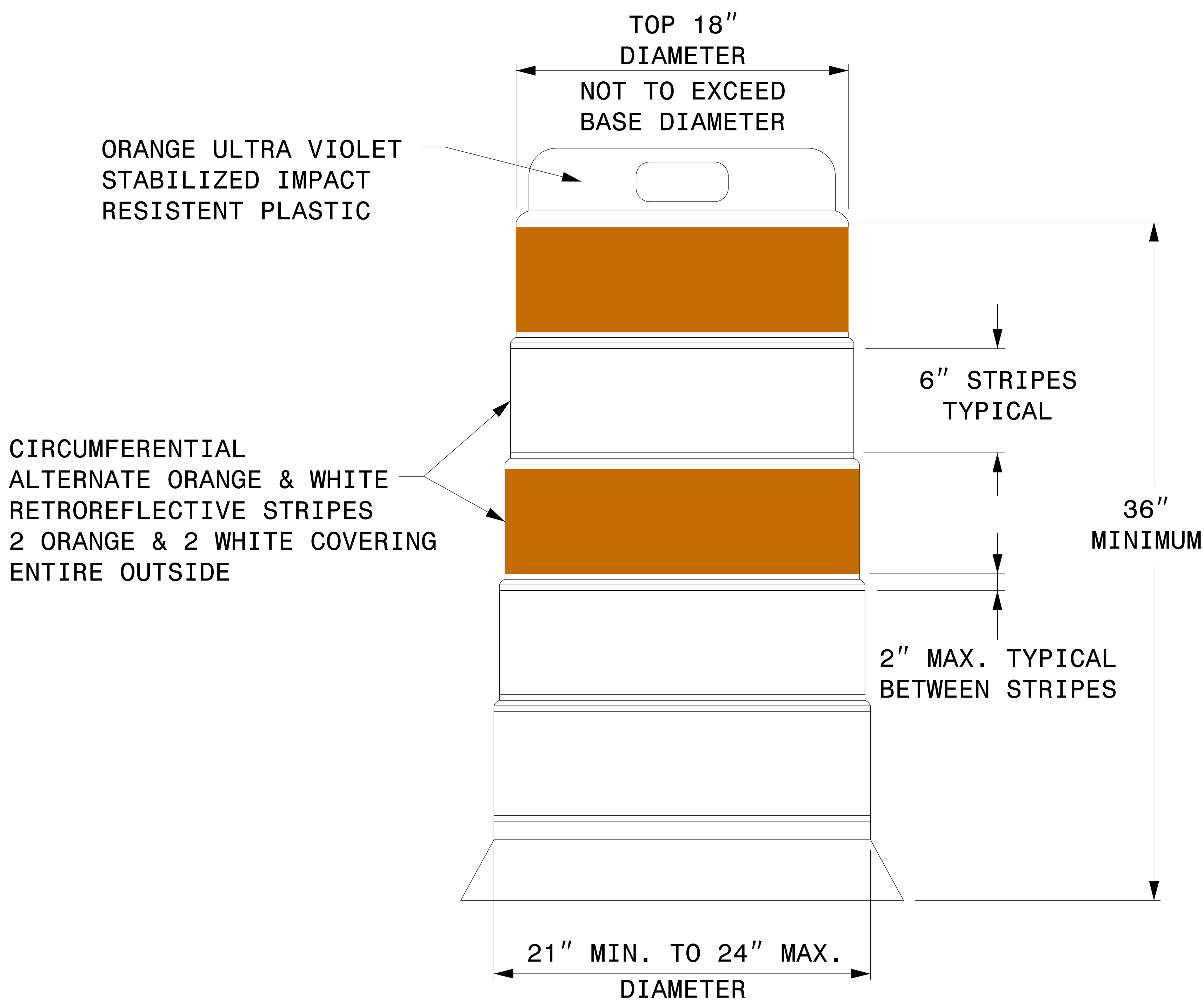
BALLAST WILL BE A MINIMUM OF 15 POUNDS

## C. Notes for Drums

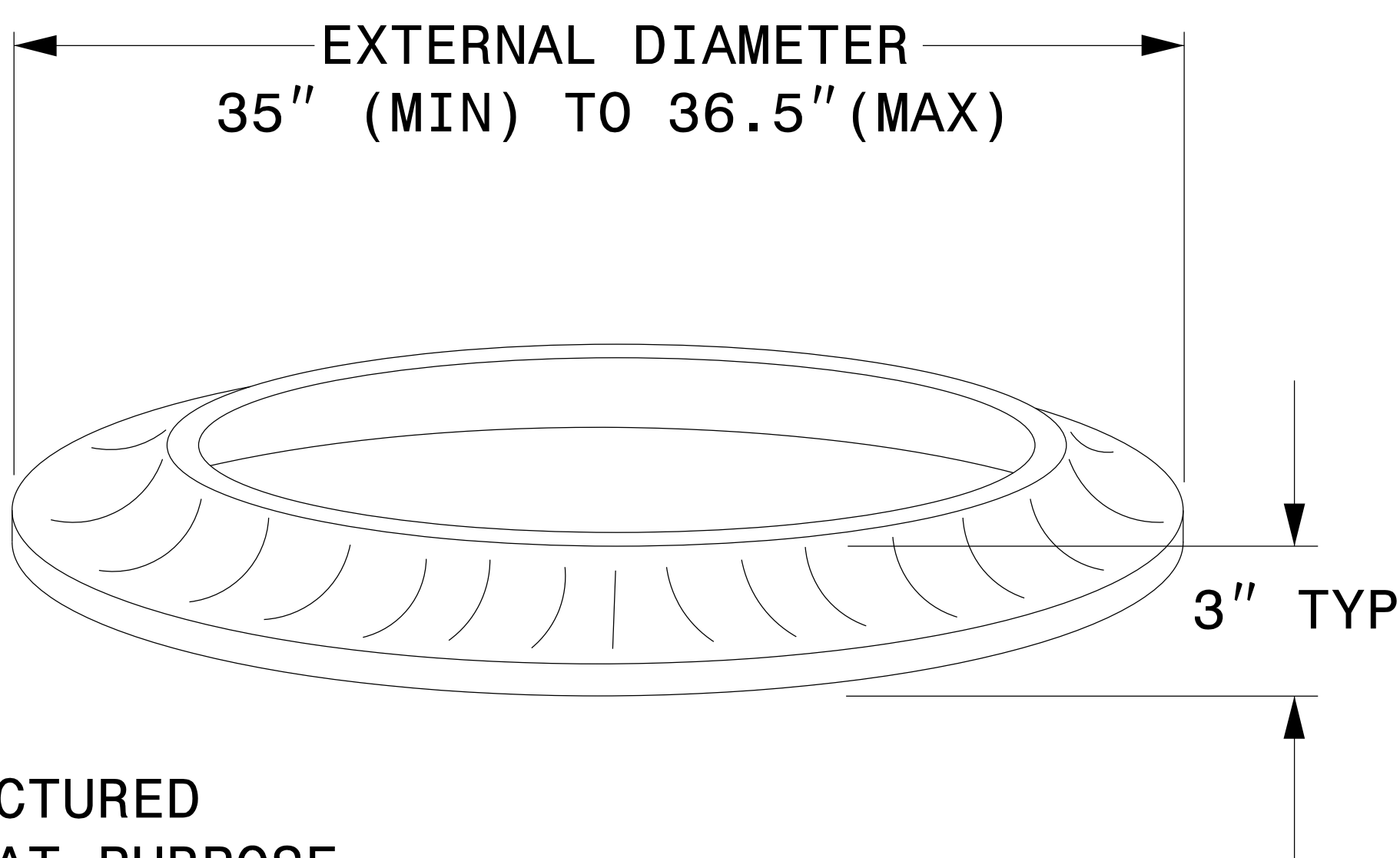
1. New Drums purchased after July 20, 2010 will use 4 - 6 inch bands of Type III or higher high intensity prismatic sheeting. Existing inventories of Drums with 5 bands of Engineers Grade sheeting (as shown on Page 33) may be used until the end of their useful life and the Drum types may be intermixed.
2. Ballasting shall be achieved by the sand bag, tire-sidewall, or preformed weighted base methods. Do not place ballast on top of the drum. Use the tire ballast as specified by the manufacturer. Tire Ballast is matched to a specific drum and has been crash tested as a pair.
3. If desired, the name of the agency, contractor, or supplier may be placed on non-retroreflective drum surfaces near the bottom of the device. The letters and numbers must be created using a non-retroreflective color and must not be over 2 inches in height.



# Drum



## TIRE BALLAST



NOTE: DRUMS THAT USE TIRE BALLASTS ARE MANUFACTURED SPECIFICALLY FOR THAT PURPOSE. DO NOT USE TIRE BALLASTS WITH OTHER DRUM DESIGNS.

ALL RUBBER COLLARS MUST BE BLACK IN COLOR AND FREE OF ANY COLORED PAINT.

BALLAST COLLAR SHOULD HAVE A GOOD CONTACT WITH THE BARREL FLANGE AND BALLAST OUTER EDGE MUST LAY FLAT WITH ROAD SURFACE.

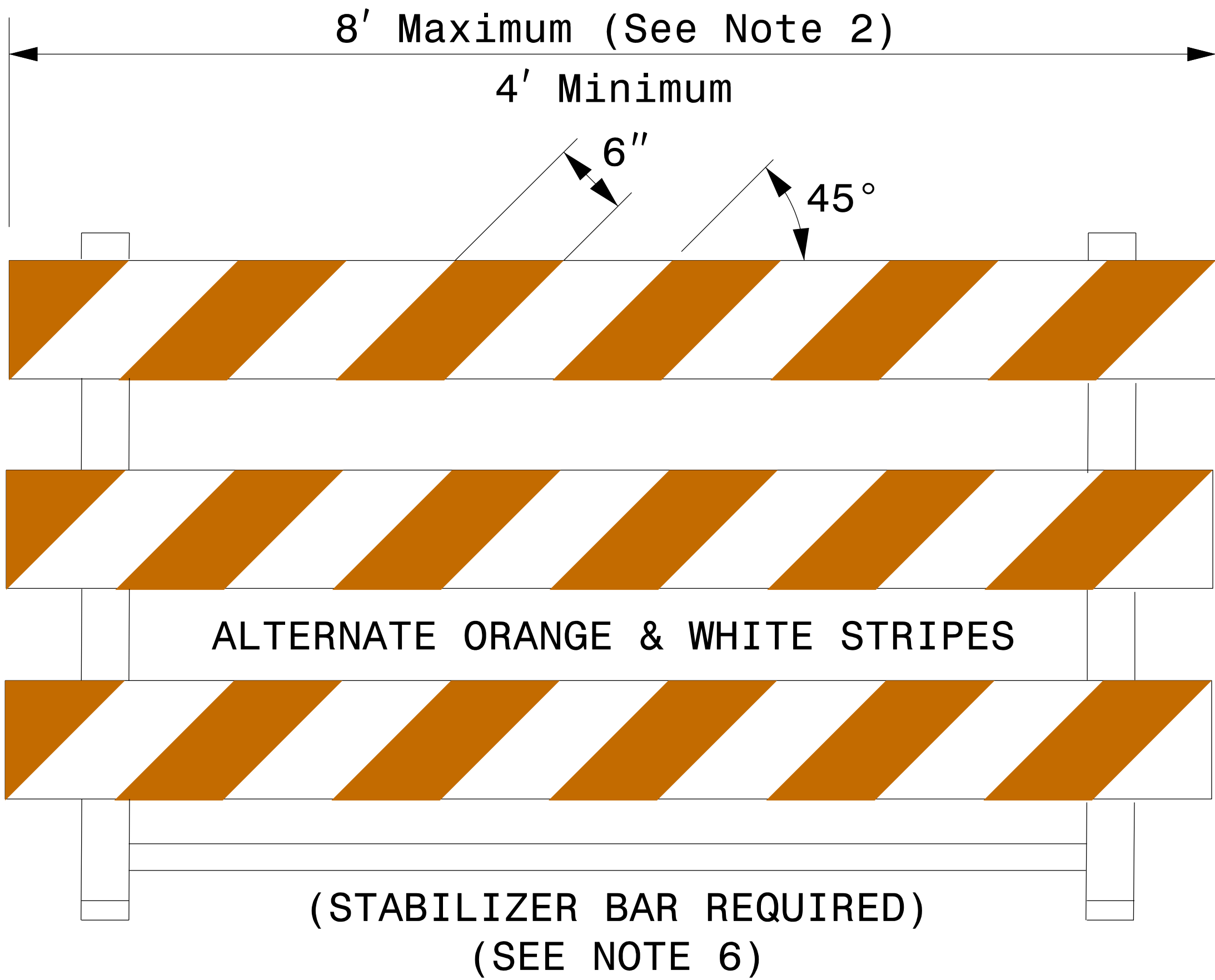
## D. Notes for Type III Barricades

1. Horizontal rails for barricades may be constructed of approved composite, hollow/corrugated extruded rigid polyolefin, high density polyethylene, or other NCDOT approved material.
2. Barricade shall be limited to a maximum length of 8 feet unless NCHRP 350 crash tested for category II devices and NCDOT approved.
3. Only NCDOT approved composite and roll-up signs may be mounted on the barricade rails. Mount signs to barricade rails to ensure sign will not become detached under normal wind and traffic conditions.
4. Signs shall be mounted a minimum of 1 foot from the ground to the bottom of the sign unless signs R11-3 or R11-4 are required by the plans or directed by the engineer.
5. Use type III or higher prismatic retroreflective sheeting on both sides of the barricade rails.
6. Barricade must be NCHRP 350 for category II devices and NCDOT approved with stabilizer bar or adequate lateral bracing.
7. Assembly of the generic barricades must be self-certified by the assembler.
8. Barricades used to close a roadway shall extend across the entire roadway. Where local traffic must be maintained, they may be placed in a staggered pattern.
9. Stripes on work zone barricade rails shall be alternate orange and white retroreflective stripes, sloped downward towards the side which traffic is to pass or turn in detouring. Where no turns are intended, the stripes should slope downward toward the center of the barricade or barricades.
10. Use red and white stripes for permanent barricades.
11. See the department's approved products list at <https://apps.dot.state.nc.us/vendor/approvedproducts>.
12. Place manufacturer's name and federal highway administration's NCHRP 350 approval letter number on barricade frame.
13. Place sandbags or other approved ballasting methods on the feet of the frame. Do not place sandbags on top of a striped rail or stabilizer bar. Do not ballast barricades by heavy objects such as rocks, chunks of concrete or other items that would cause damage if the barricade is struck by a vehicle.



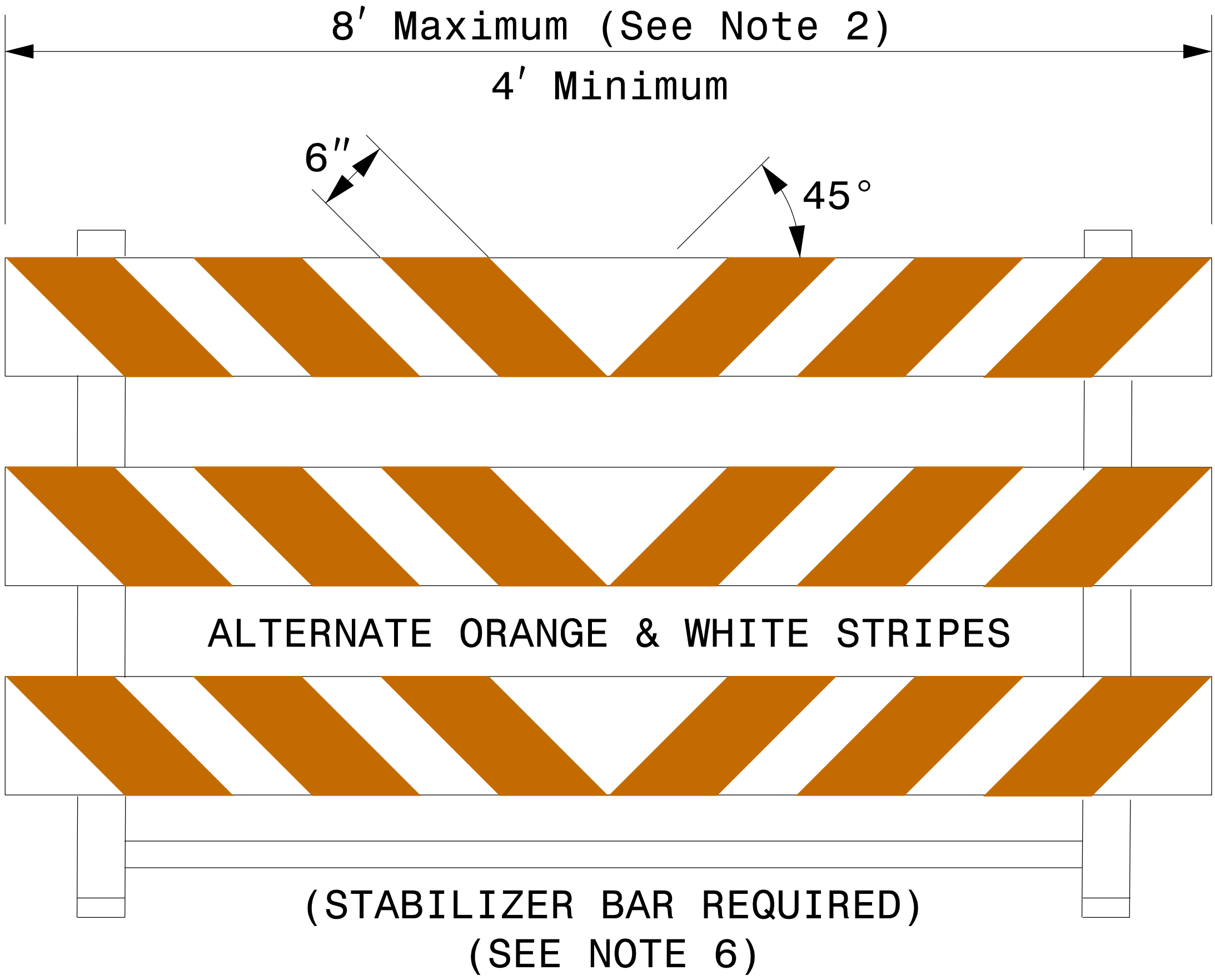
# Type-III Barricades

## TYPE III BARRICADE



## TYPE III BARRICADE

END-OF-ROADWAY APPLICATIONS



## E. Notes for Flashing Arrow Boards

### (MUTCD Section 6F.61)

1. Do not use straight-line, static (not moving) chevron or alternating diamond caution displays.
2. Use a minimum mounting height of 7 feet from ground level to the bottom of the panel for all arrow boards (trailer or vehicle mounted).
3. Use arrow board elements capable of a minimum 50 percent dimming from their full rated lamp voltage. Use full lamp voltage during the day, and use the dimmed mode at night.
4. Do not use arrow boards in flashing arrow mode on a two-lane, two-way roadway during a one lane operation, nor on multilane roadways when shifting all traffic lanes laterally.
5. See the department's approved products list at <https://apps.dot.state.nc.us/vendor/approvedproducts>.
6. See letter clarifying the sizes of Flashing Arrow Boards (REVISED)  
Dated: February 5, 2013 at [https://connect.ncdot.gov/projects/WZTC/Documents/FEB\\_2013\\_FAB\\_REVISION.pdf](https://connect.ncdot.gov/projects/WZTC/Documents/FEB_2013_FAB_REVISION.pdf)

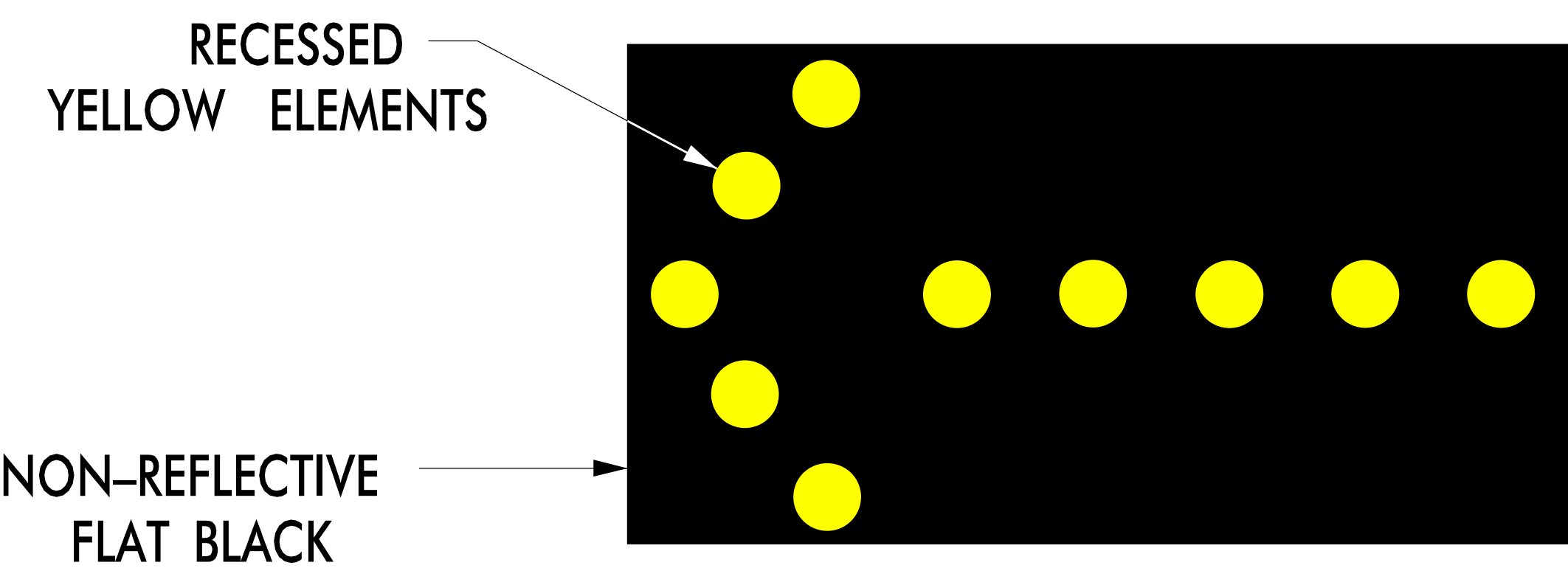


# Flashing Arrow Boards

## FLASHING ARROW BOARD TYPES

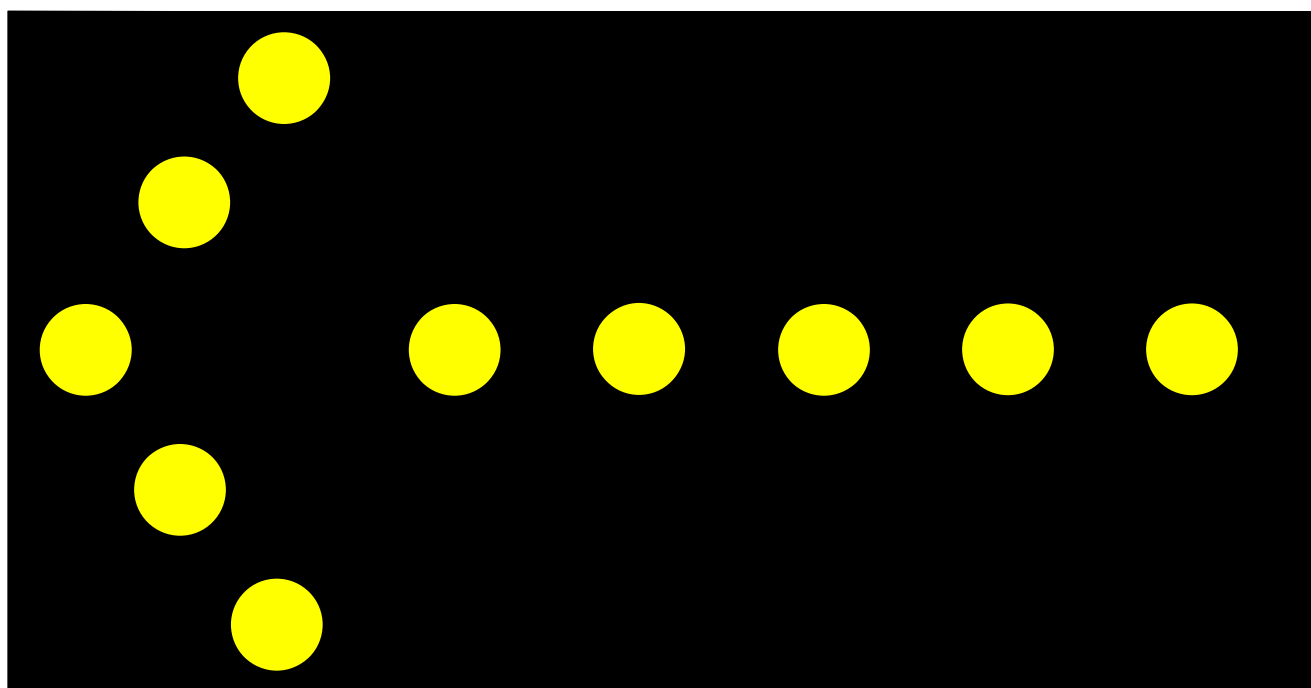
BOARD TYPE	MINIMUM SIZE (W x H INCHES)	MINIMUM LEGIBILITY DISTANCE (MILES)	MINIMUM NUMBER OF ELEMENTS
C	96 X 48 (SEE NOTE 6)	1	15

## TYPICAL FLASHING ARROW BOARD

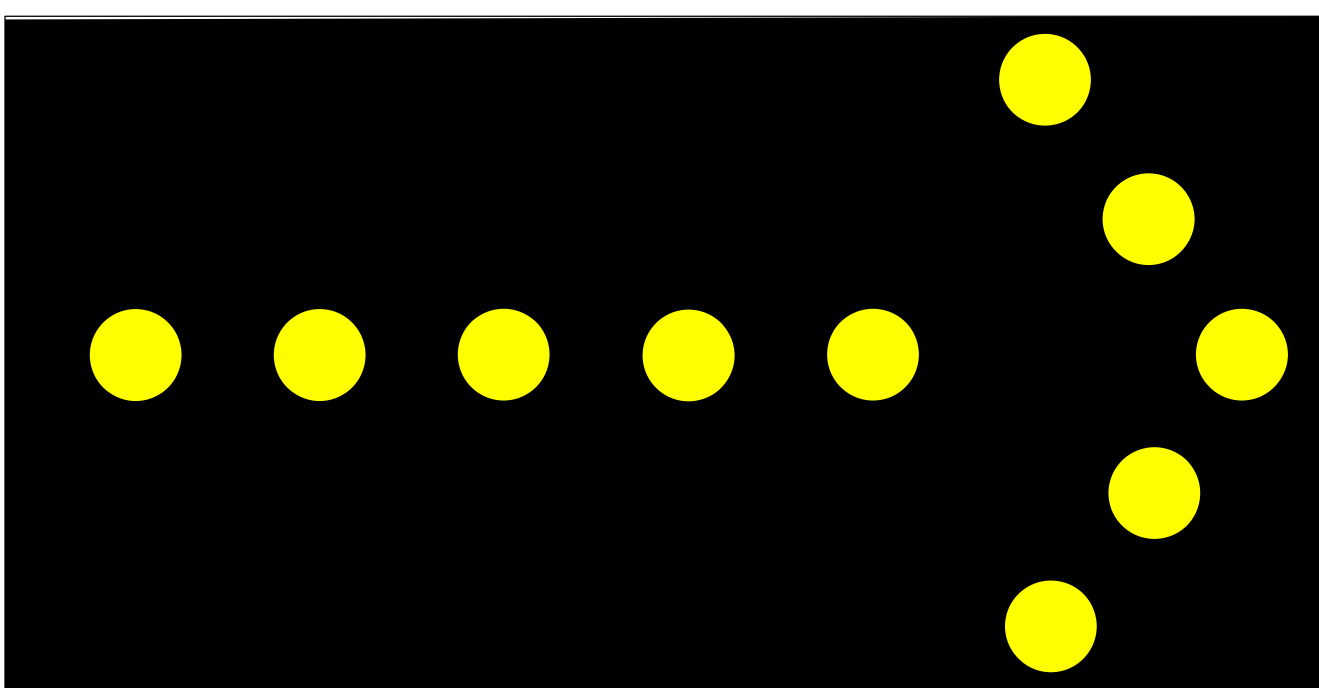


## FLASHING ARROW BOARD MODES

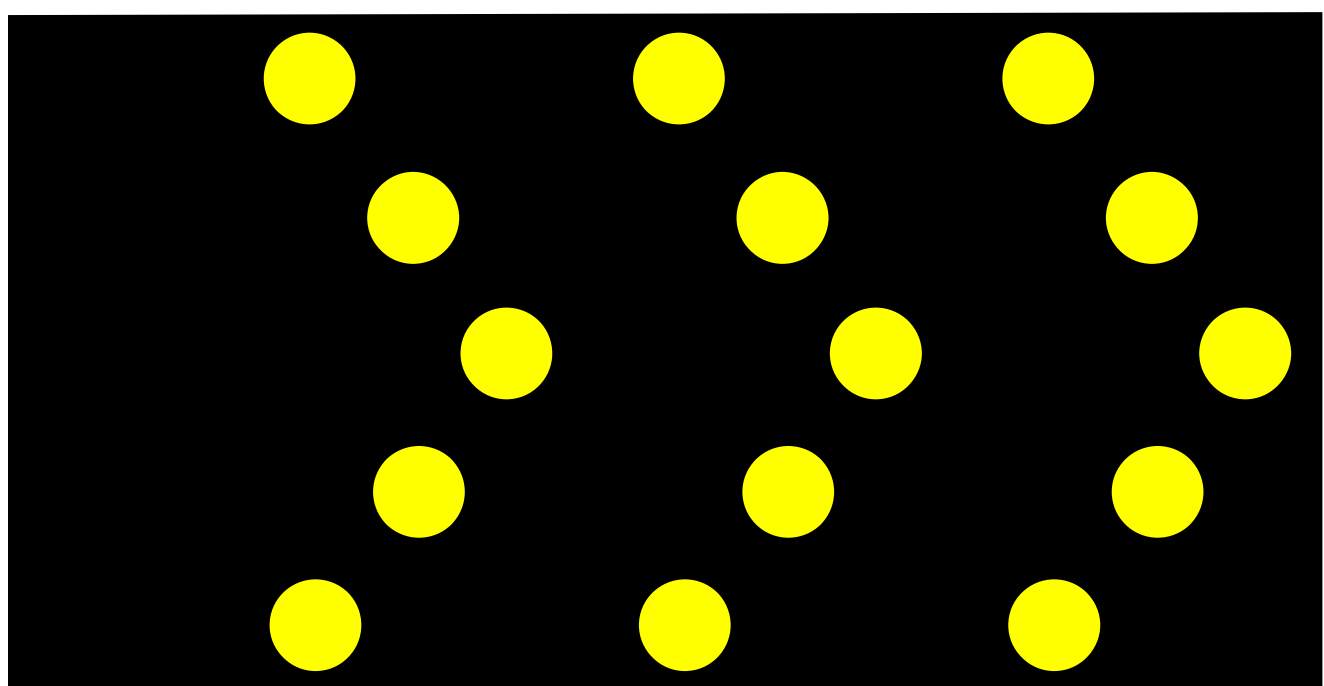
FLASHING ARROW  
RIGHT LANE CLOSURE



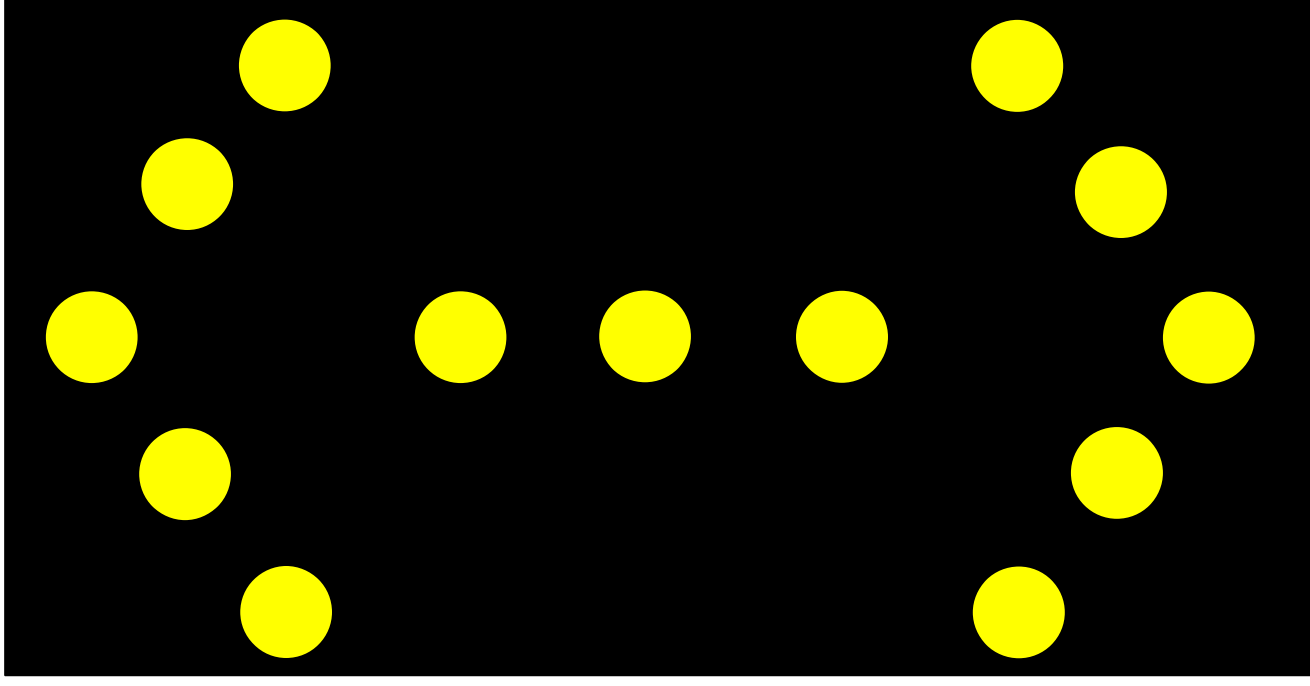
FLASHING ARROW  
LEFT LANE CLOSURE



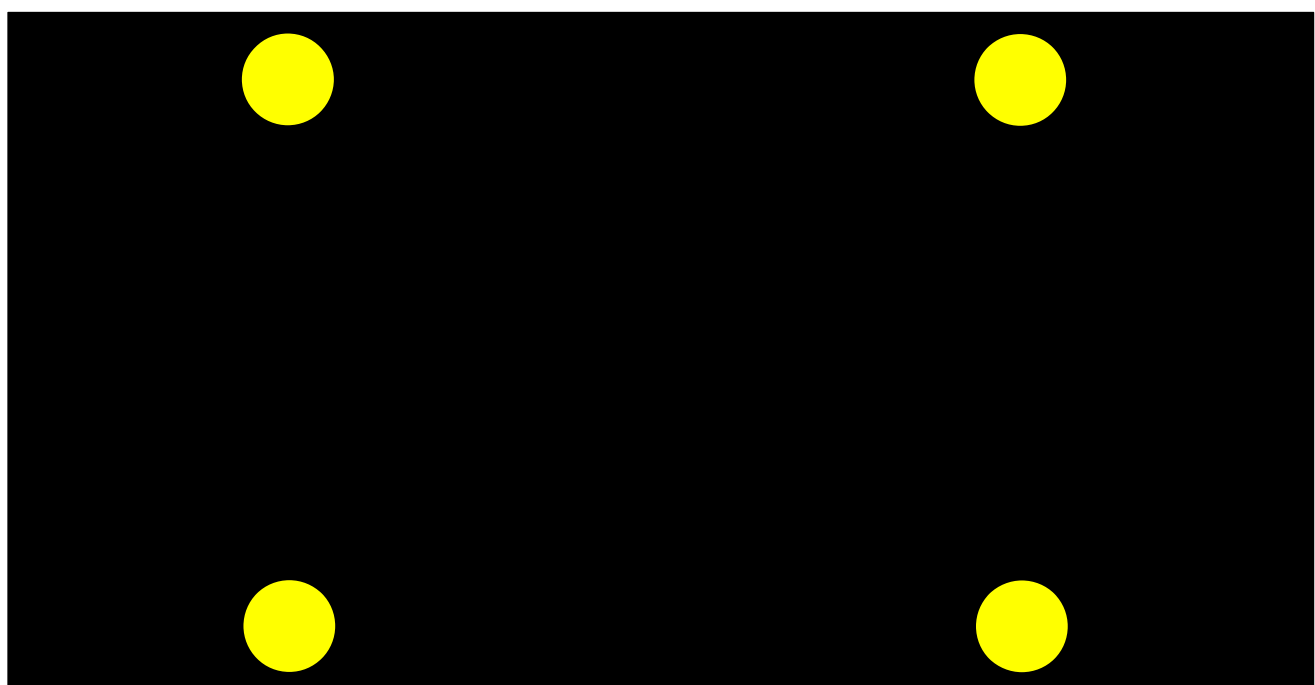
MOVING  
CHEVRON



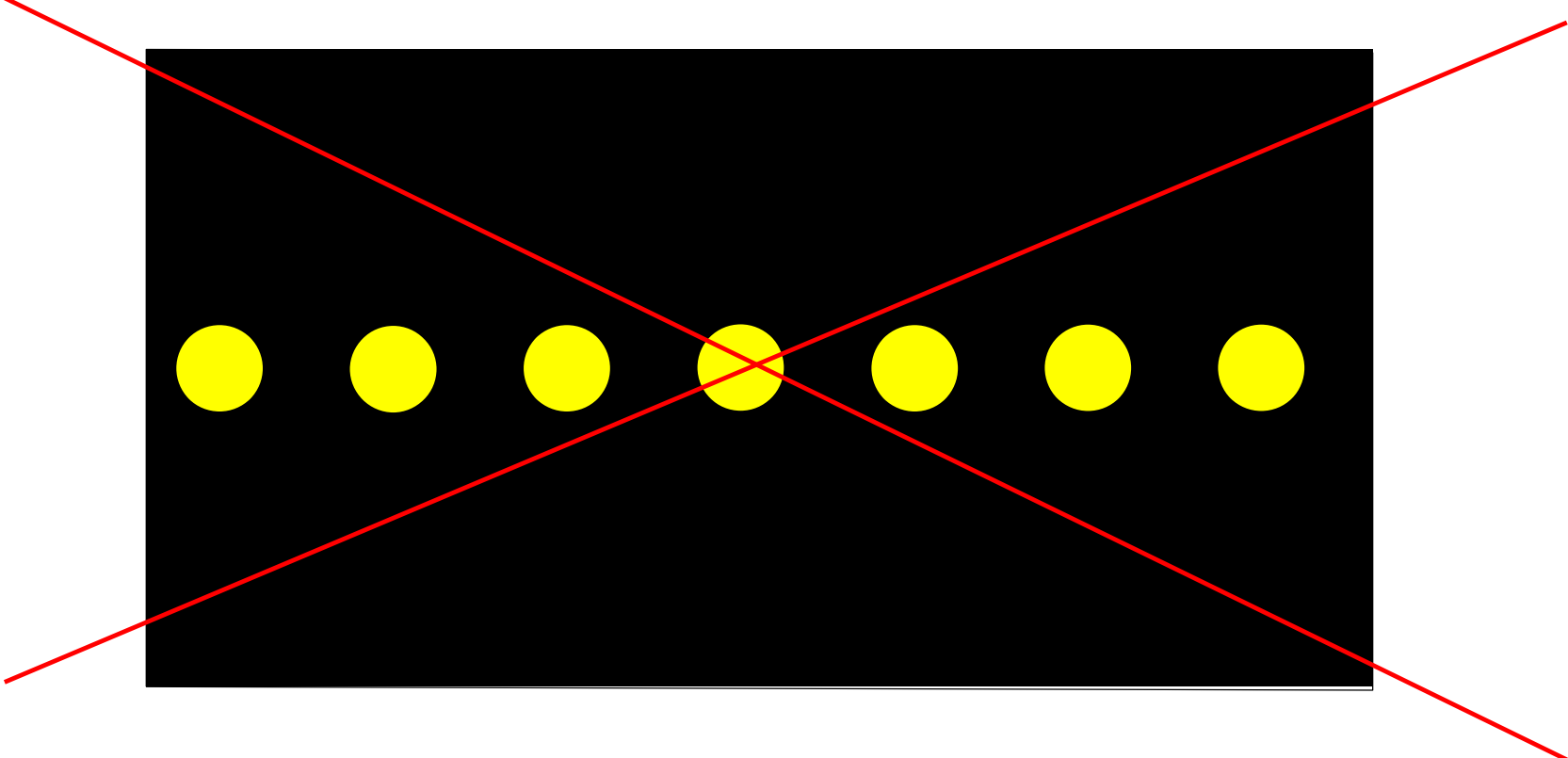
FLASHING DOUBLE ARROW  
CENTER LANE CLOSURE



FLASHING  
CAUTION MODE



THIS PATTERN IS  
NOT ALLOWED



## **F. Notes for Red/Yellow Lens Automated Flagger Assistance Devices (AFAD)**

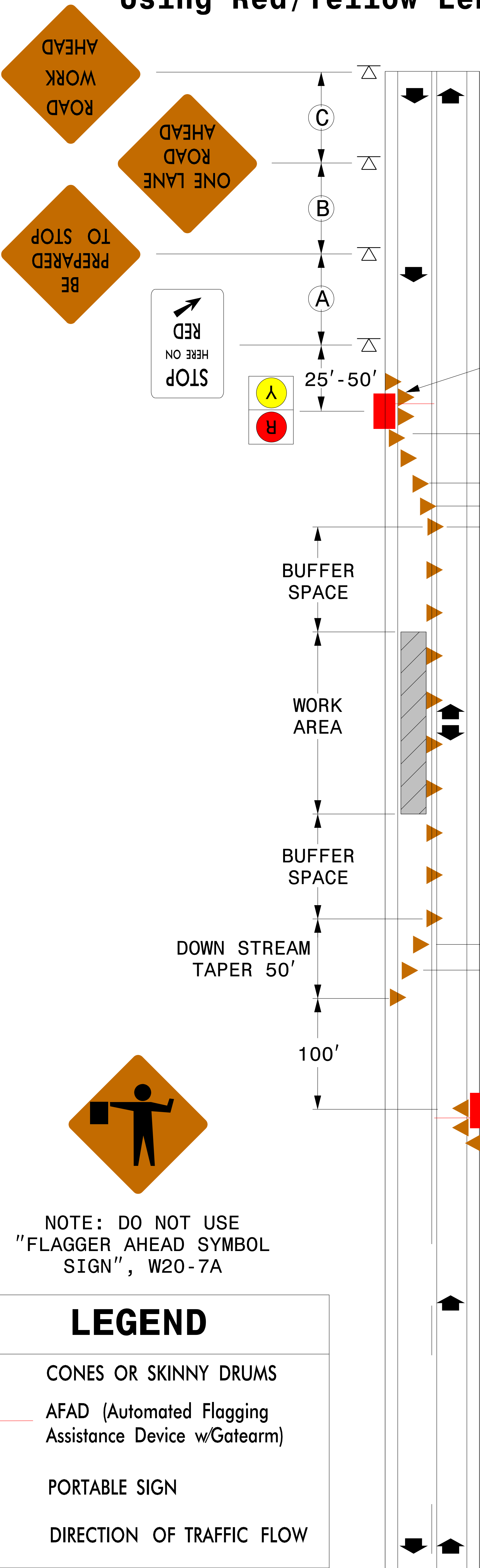
1. Installation and removal of the AFAD devices requires a normal flagging set up as shown on the detail. In order to safely install the taper and devices, place the system in the "all red"/"all stop" condition to stop both directions of traffic. Once the devices are installed and workers safely away from the lane, begin controlling traffic with the AFADS. Refer to sign spacing chart for sign spacing. All spacing dimensions are approximate. Field adjust as various conditions occur, such as limited sight distance, obstructions, etc.
2. Install lane closures with the direction of the traffic flow; remove lane closures against the direction of the traffic flow.
3. Place cones or skinny drums from the two way traffic taper to the downstream taper on equal spacing no greater than two times the posted speed limit. Use either all cones or all skinny drums around AFAD and for approach taper.
4. The bottom of the signal head housing or sign displays shall be a minimum of 7' above pavement.
5. An AFAD shall be operated by a qualified flagger who has received training on the operation for the specific AFAD device they are operating. Qualified flaggers must be certified by a NCDOT approved source. The flagger operating the AFAD(S) shall not leave the AFAD(S) unattended at any time while they are being used to assign the right-of-way.
6. The AFAD should be parked 2 feet outside of the lane being controlled unless there is not enough shoulder. If there is limited room outside the lane being controlled, the AFAD may be positioned partially within the lane as necessary with the gate arm reaching at least to the center of the lane but not exceeding the lane width.
7. When work is not pursued for 30 minutes or longer, all parts of the AFAD unit shall be removed from the travel lane a minimum of 2' from the edge line. The gate arms shall be in the upright position, remove all traffic control devices from road, place 2 cones by each AFAD unit and all signs associated with the AFAD system shall be laid down except the "road work ahead" signs. Each AFAD unit shall be placed in the "caution mode", either flashing yellow signal display or the "slow" sign indicated and yellow beacon flashing.
8. In the event that one or both AFAD units become inoperative, be prepared at all times to replace the unit or system with the same type and model of AFAD, or revert to normal flagging operations, or terminate all construction activities requiring the use of the AFAD until the AFAD is operative or qualified human flaggers are available.



9. A single operator may simultaneously operate two AFADS as long as the operator has an unobstructed view of both AFADS: The operator has an unobstructed view of approaching traffic in both directions; and the AFADS are spaced no greater than the manufacturer's recommendations.
10. If the AFADS are spaced greater than the manufacturer's recommendations, then an operator must be assigned to and control each individual AFAD.
11. AFAD operators may control traffic at side streets or driveways between the AFAD units while operating the AFAD system if approved by the engineer and or the Work Zone supervisor. AFAD units must continue to be within clear sight of the operator during this work activity.

# Temporary Lane Closures

## Using Red/Yellow Lens AFAD's (TYPE I)



ADVANCE WARNING SIGN SPACING CHART			
POSTED SPEED LIMIT (MPH)	RECOMMENDED DISTANCE BETWEEN SIGNS FEET (+/-) SEE NOTE #1		
	A	B	C
≤ 35	200	200	200
40 - 50	350	350	350
55	500	500	500

DESIGN SPEED (MPH)	BUFFER SPACE (FEET)
30	85
35	120
40	155
45	195
50	240
55	290
60	345
65	405
70	470
75	540
80	615

NOTE: DO NOT USE "FLAGGER AHEAD SYMBOL SIGN", W20-7A

LEGEND	
	CONES OR SKINNY DRUMS
	AFAD (Automated Flagging Assistance Device w/Gatearm)
	PORTABLE SIGN
	DIRECTION OF TRAFFIC FLOW

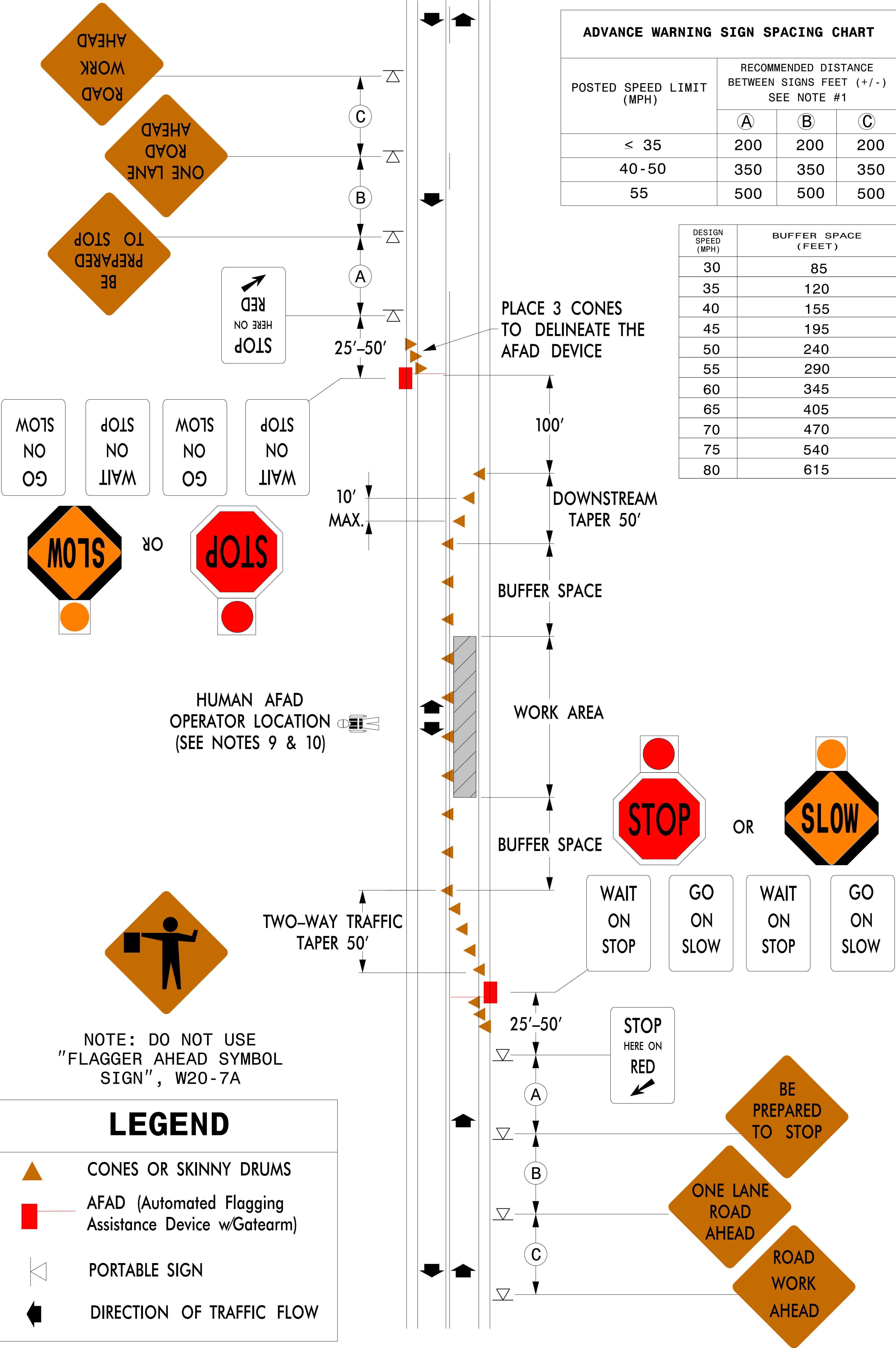


# Temporary Lane Closures

## Using Red/Yellow Lens AFAD's (TYPE II)

ADVANCE WARNING SIGN SPACING CHART			
POSTED SPEED LIMIT (MPH)	RECOMMENDED DISTANCE BETWEEN SIGNS FEET (+/-) SEE NOTE #1		
	(A)	(B)	(C)
≤ 35	200	200	200
40 - 50	350	350	350
55	500	500	500

DESIGN SPEED (MPH)	BUFFER SPACE (FEET)
30	85
35	120
40	155
45	195
50	240
55	290
60	345
65	405
70	470
75	540
80	615



## G. Notes for Truck Mounted Attenuators

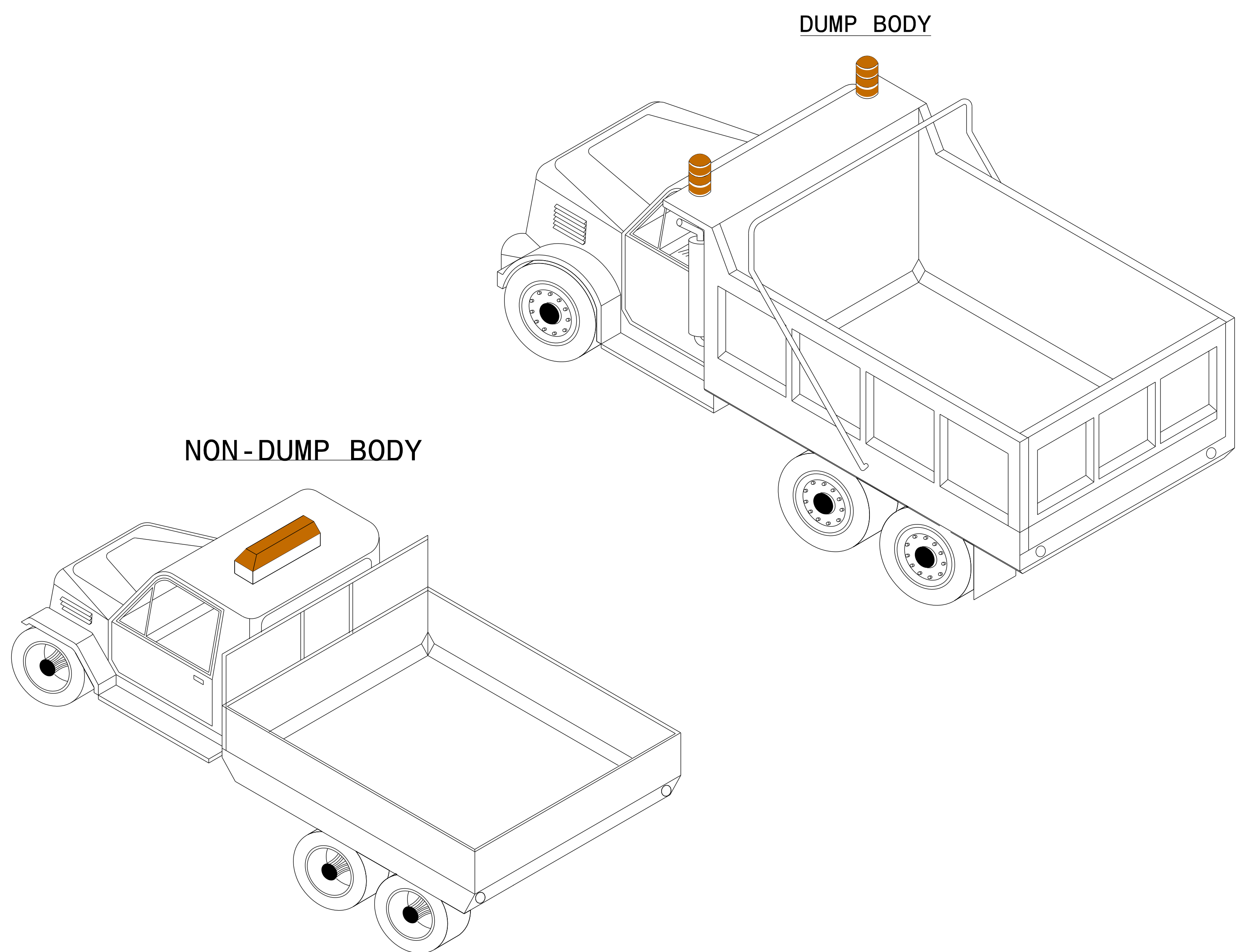
1. The weight of Truck and TMA in a moving and stationary operation varies from 10,000 lbs. to 20,000 lbs. The truck may be ballasted as needed to reach the required weight using NCDOT approved ballasting methods. The Qualified Work Zone Supervisor will determine if the truck is properly ballasted.
2. When TMA's used for shadow vehicles, contact the TMA manufacturer for specific truck requirements.
3. TMA must meet or exceed the requirements of NCHRP 350 test level II for work zones with posted speed limit of 45 mph or less; or test level III for work zones with posted speed limit of 50 mph or greater. TMA may either be truck mounted or trailer mounted.
4. Each Truck Mounted Attenuator has different roll-ahead distances for stationary use and moving and mobile operation use. Use the manufacturer's recommendations for these distances. Insure you have taken these distances into account when positioning the TMA in front of workers on foot. When using a TMA in a stationary work zone turn wheels away from the live traffic lane, engage the emergency brake, and place the truck in gear.
5. TMA's must be operated during moving and mobile work zones either COMPLETELY in the lane or COMPLETELY on the shoulder of the roadway.
6. Do not use 5-point harness for drivers unless is it fitted to their body size.
7. TMA drivers shall not leave vehicle while in a moving or mobile work operation.
8. See the department's approved product list at <https://apps.dot.state.nc.us/vendor/approvedproducts>



# Truck Mounted Attenuator

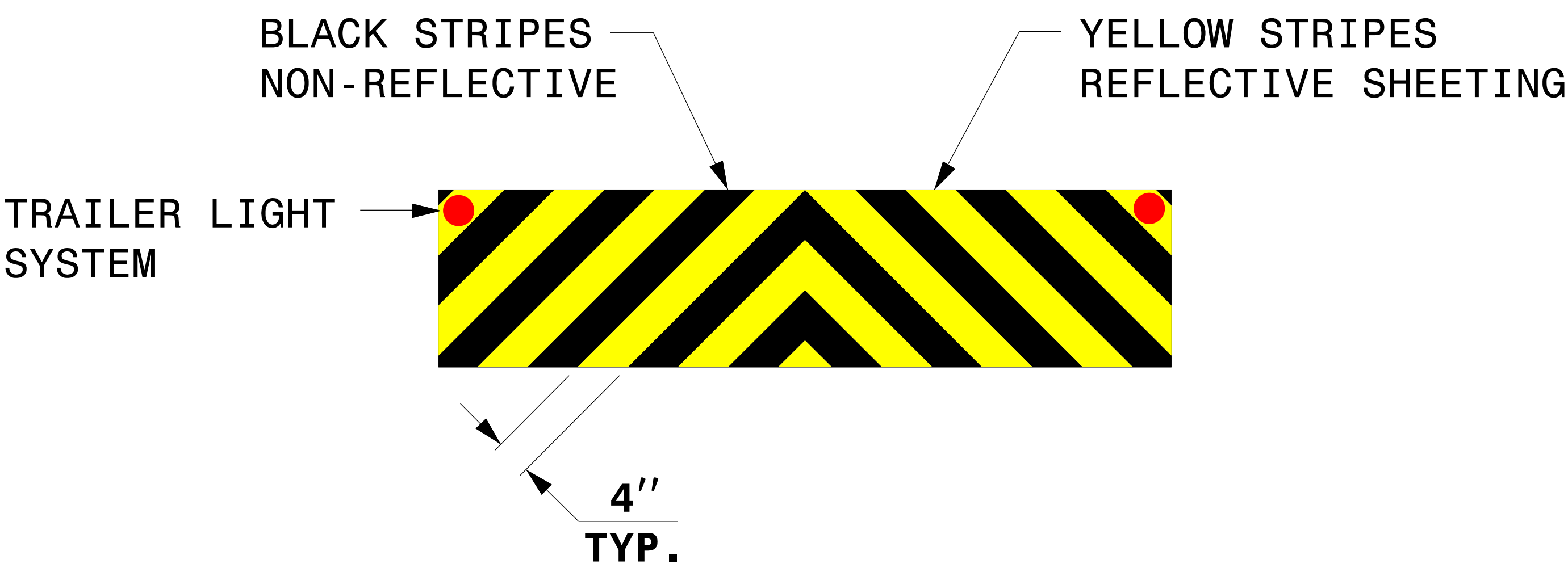
## LIGHT SYSTEM OPTIONS

- I. TRUCKS WITHOUT DUMP BODIES- CHOICE OF EITHER:
  - A. LIGHT BARS (15" MINIMUM)- EITHER LED OR ROTATING FLASH WITH FULL AMBER LIGHTS AND AMBER DOME OR LIGHT BARS MAY BE HALF AMBER/HALF WHITE WITH AMBER DOME. (ALL WHITE LIGHT SYSTEMS ARE PROHIBITED)
  - B. 2 HIGH INTENSITY STROBES (CLASS 2)- AMBER LED/AMBER FLASH AND AMBER DOME MOUNTED ON EACH SIDE OF THE HEADBOARD
- II. TRUCKS WITH DUMP BODIES- (NOT REQUIRED, BUT ENCOURAGED)
  - A. 2 HIGH INTENSITY STROBES (CLASS 2)- AMBER LED/AMBER FLASH AND AMBER DOME MOUNTED ON EACH SIDE OF THE CAB PROTECTOR



## DETAIL OF TMA DELINEATION

ENTIRE END OF ATTENUATOR SHALL BE DELINEATED

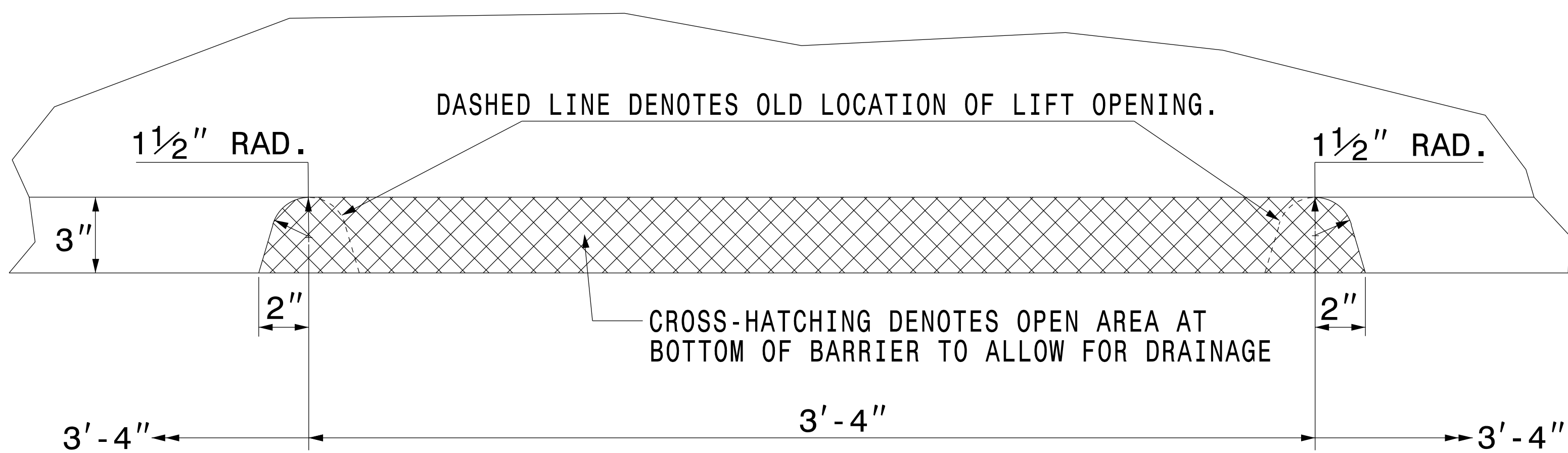
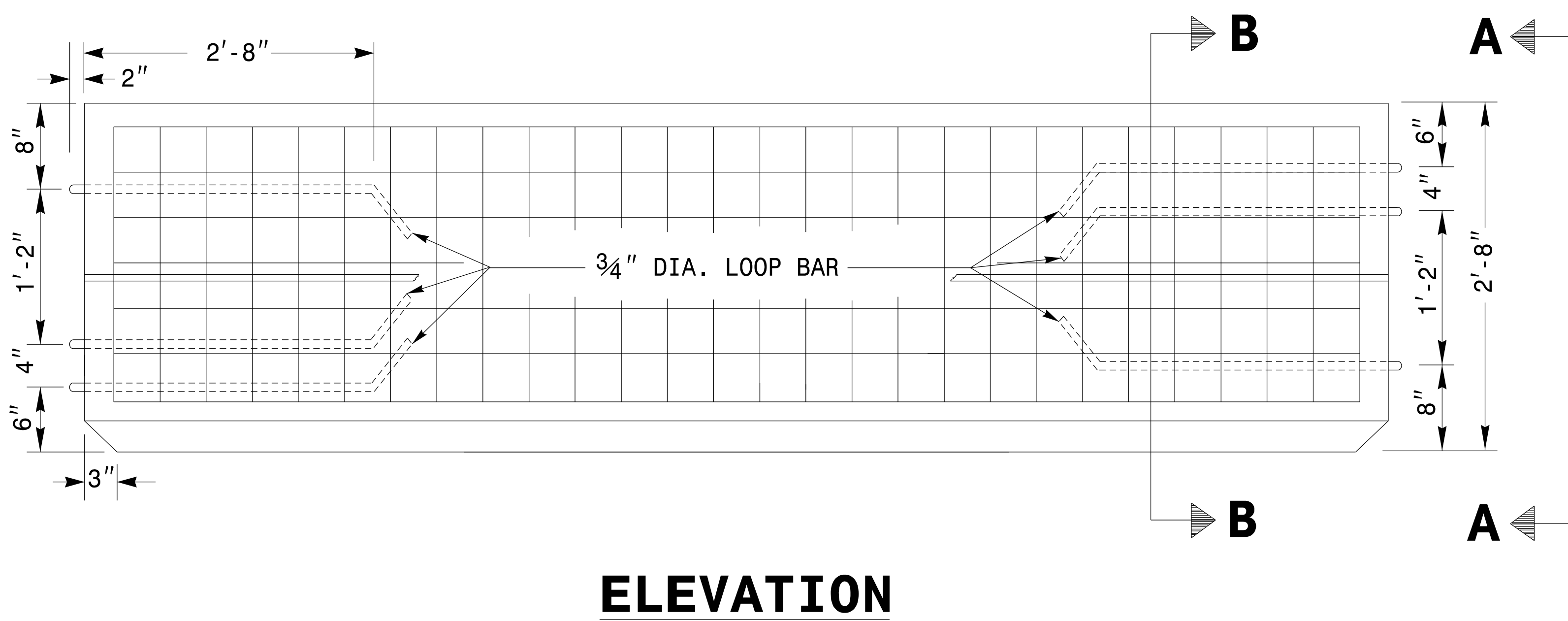
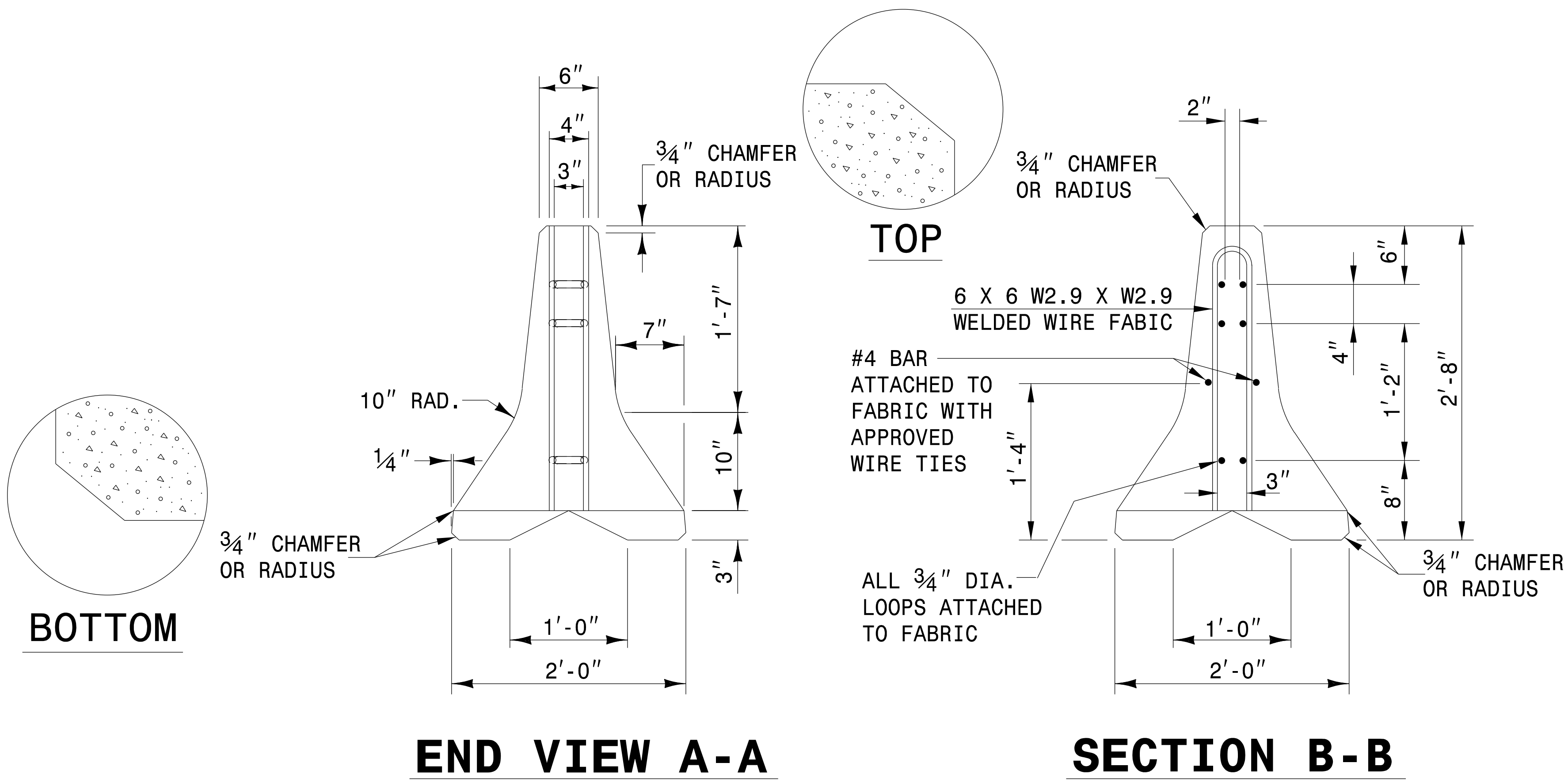
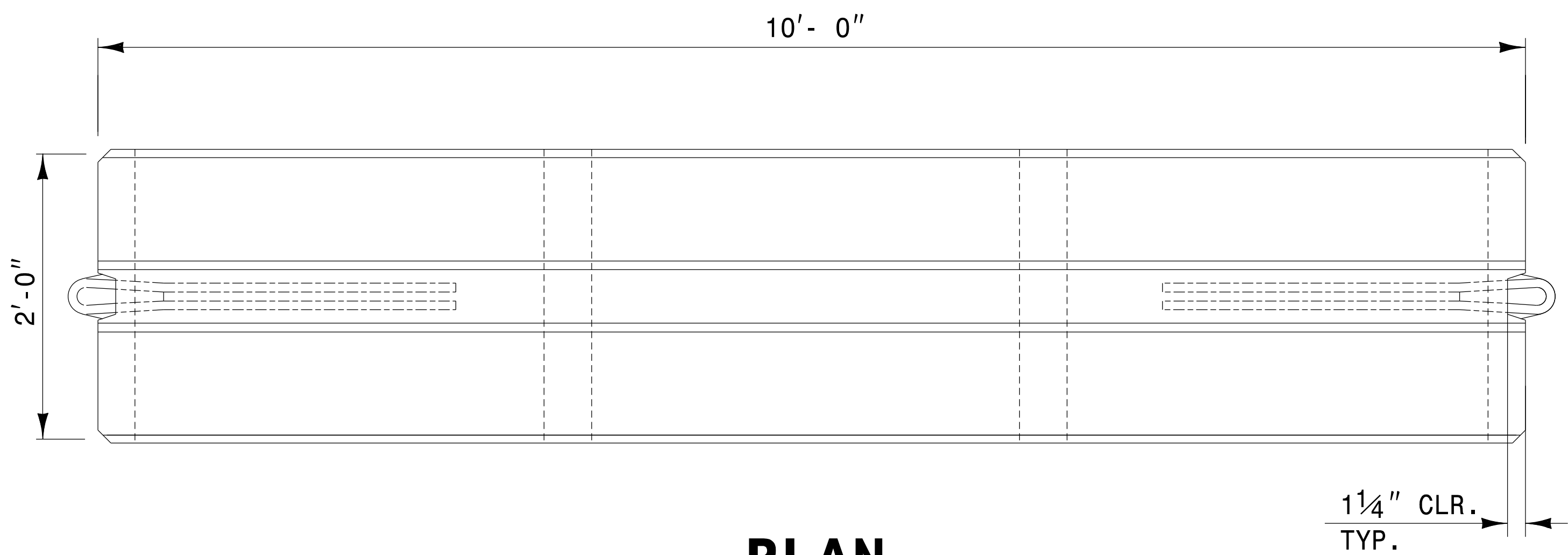


## H. Notes for Portable Concrete Barrier

1. The drainage/lift slot shown at the bottom of the drawing is a modification of the regular lift openings, all other design criteria such as reinforcement bars, etc. are the same as shown on drawing.
2. The barrier with drainage/lift slot is intended to be used in areas where roadway surface water runoff causes excess puddling adjacent to the temporary barrier. Install this barrier when directed by your Qualified Work Zone Supervisor.
3. The drainage/lift slot modification can also be used with anchored “Portable Concrete Barrier”. Your Qualified Work Zone Supervisor will determine when to anchor Portable Concrete Barrier into pavement.
4. On any particular “Run” of Portable Concrete Barrier all connection and barrier types as well as section lengths must be the same.
5. See ruling on the following web page regarding NC Requirements for Portable Concrete Barrier:  
<https://connect.ncdot.gov/projects/WZTC/Pages/Product%20Guidelines.aspx>  
Also, note: Beginning with the January 2012 Letting all portable concrete barrier used on NCDOT projects must be NC Approved NCHRP 350 barrier. See your Qualified Work Zone Supervisor for more information on this subject.
6. Portable Water-filled Barrier, Portable “Movable” Concrete Barrier and Portable Guardrail Barrier are all types of portable barrier that can be used to provide “positive” protection in the work zone. Your Qualified Work Zone Supervisor will determine when to use any of these types of Portable Barrier.
7. All decisions involving the “Length of Temporary Barrier Need” will be made by your Qualified Work Zone Supervisor or your Qualified Work Zone Designer based on NCDOT standards.



# Portable Concrete Barrier



## **I. Notes for Temporary Barrier Flare Rates**

1. A barrier is considered flared when it is not parallel to the edge of the travel way.
2. Normally, barriers are used for Work Area Protection. When serving the additional function of a channelizing device, such as when shifting traffic, barrier tapers shall meet standard channelizing taper lengths as shown on Page 20.

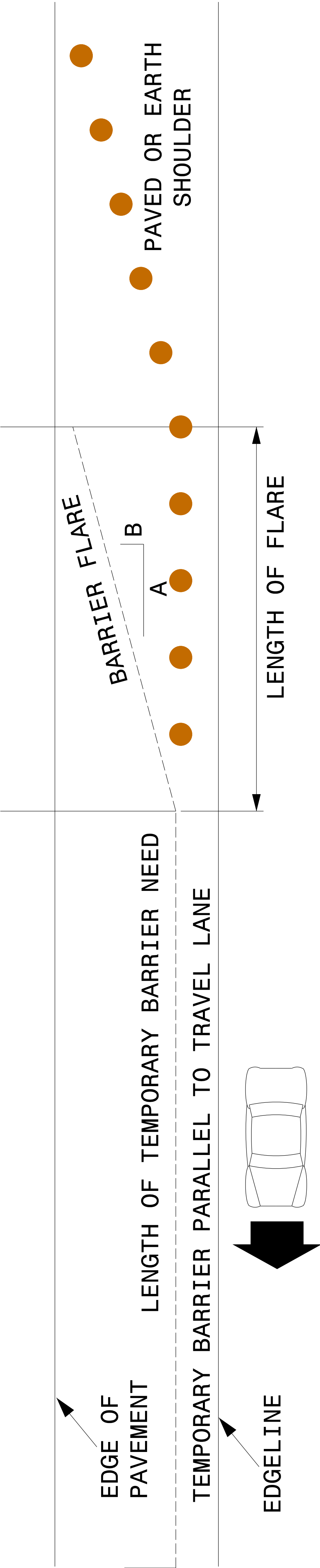


# Temporary Barrier Flare Rates

TEMPORARY BARRIER FLARE RATES		
POSTED SPEED (MPH)	ANCHORED (A : B)	UNANCHORED (A : B)
≤ 30	8 : 1	7 : 1
35	10 : 1	8 : 1
40	10 : 1	8 : 1
45	12 : 1	10 : 1
50	14 : 1	11 : 1
55	16 : 1	12 : 1
60	18 : 1	14 : 1
65	19 : 1	15 : 1
70	20 : 1	15 : 1

### GENERAL NOTES

- 1-DRUM TANGENT IS EQUAL TO BARRIER FLARE, DRUM TAPER SAME AS PAGE 17
- 2-USE DRUMS IN ADVANCE OF INTRODUCTION OF PORTABLE BARRIER
- 3-DRAWN AS SHOULDER CLOSURE SEE ROADWAY STANDARD FOR LANE CLOSURE

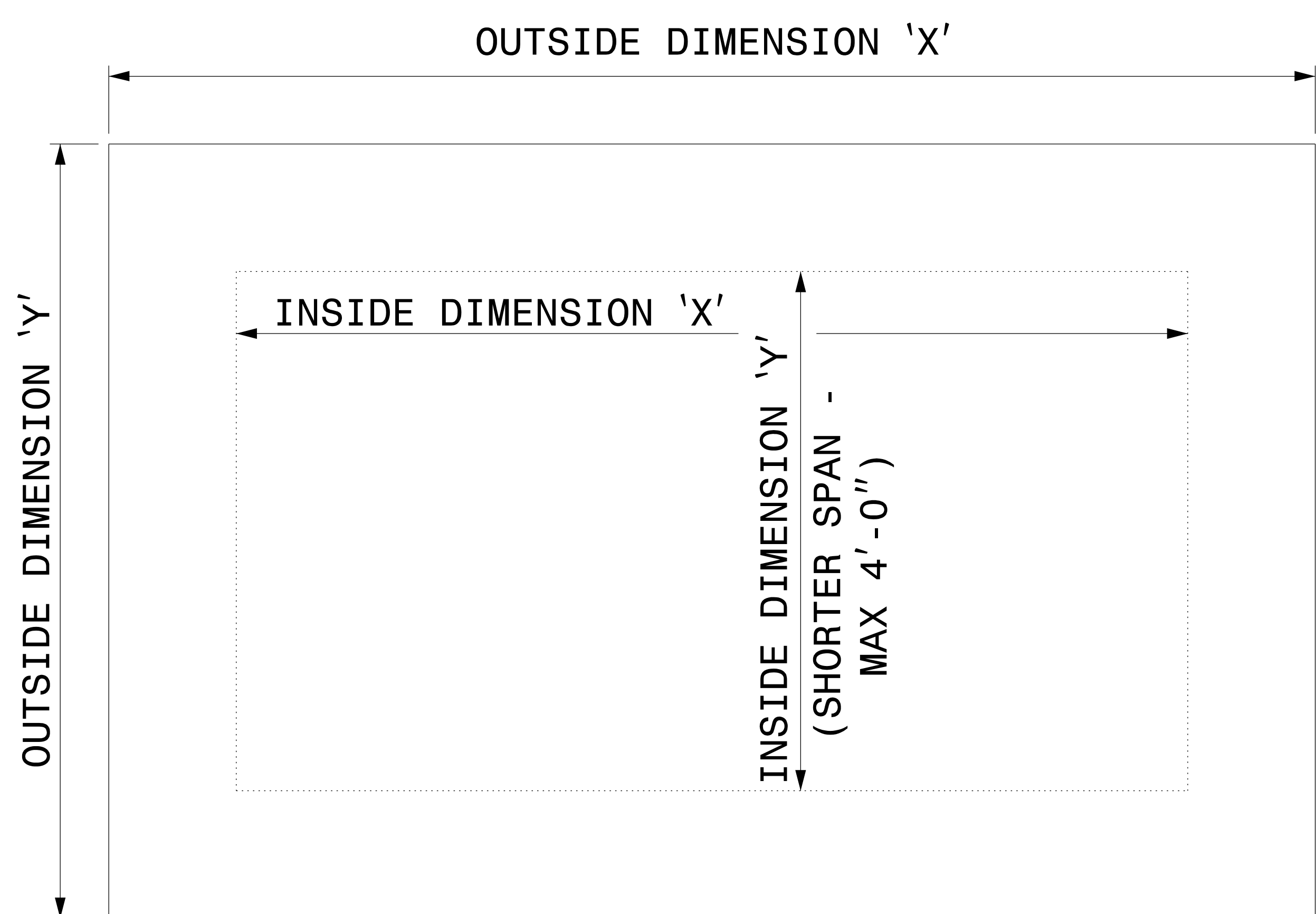


## **J. General Notes for Temporary 1” Steel Cover over Pits and Drainage Structures**

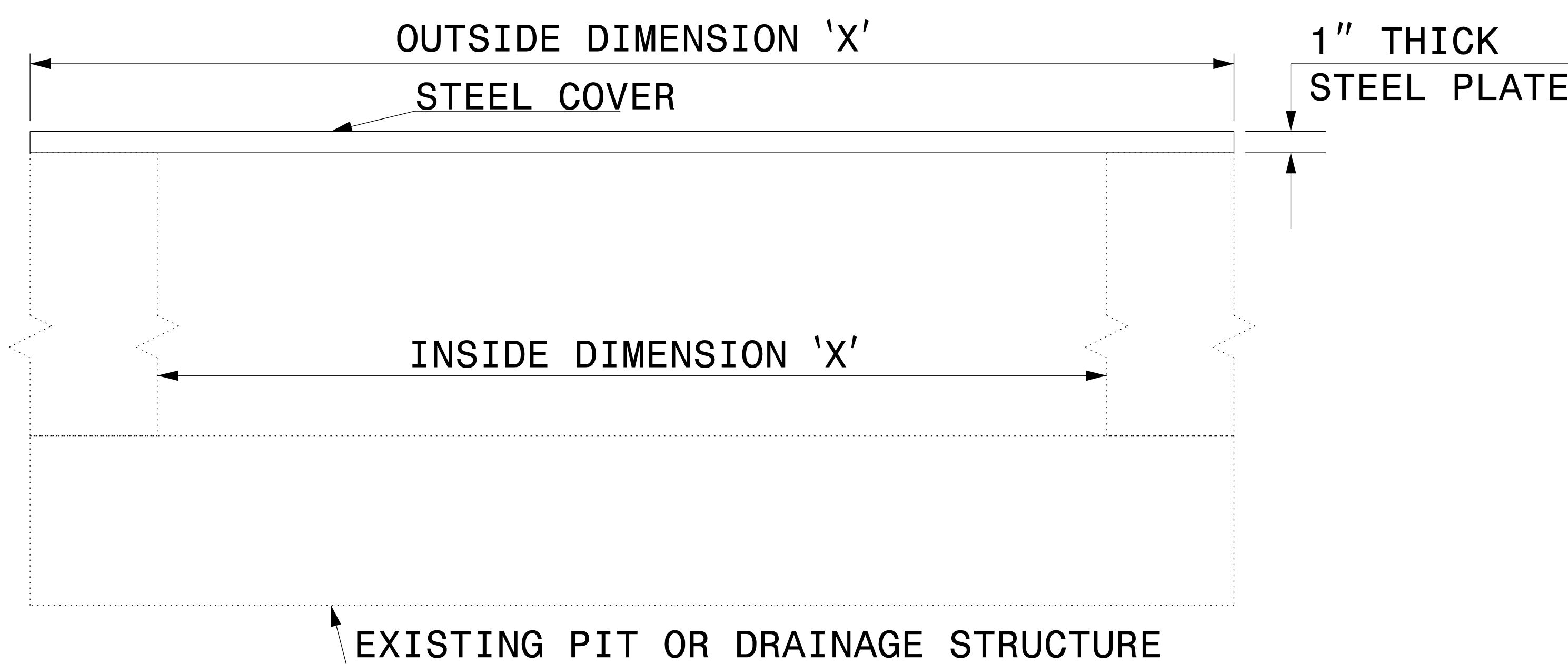
1. Use Grade A36 steel for covers.
2. Steel covers are for temporary use during construction.
3. Any required fill shall be placed directly over the steel covers.
4. Secure the steel covers with tapered pins or asphalt wedges if fill is not placed over steel covers.
5. Use “Bump” sign if steel covers are not even with the surrounding pavement surface.
6. Consider using “Slippery When Wet” signs when plate is large, not covered with fill, and placed where water may stand.
7. May be used up to 7 days before being required to backfill pit or cover drainage structure according to NCDOT specifications.



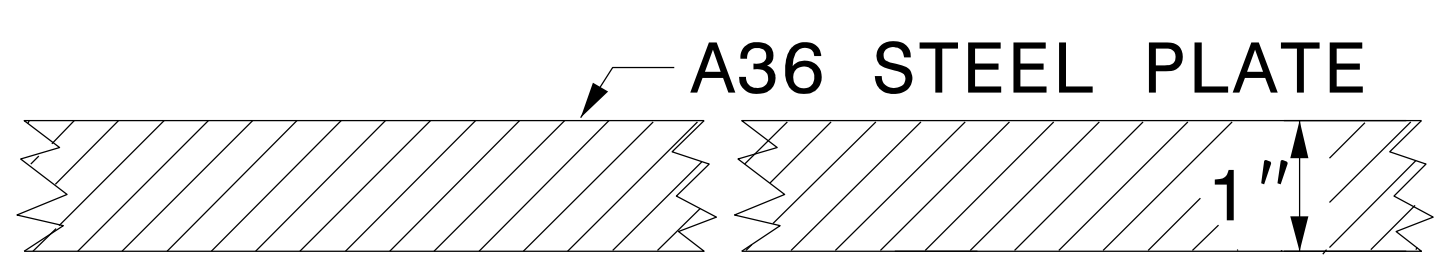
# Detail of Temporary 1" Steel Covers Over Pits or Drainage Structure



PLAN VIEWS



ELEVATION VIEWS



SECTION VIEW OF STEEL TOP PLATE

## **K. Paved Markings**

- Generally pavement markings that are removed or altered during construction are replaced with the same type material by a sub-contractor specializing in this work. Discuss this issue with your Qualified Work Zone Supervisor if your work in any way will damage or change the pavement marking in your area

**See the NCDOT Standard Specifications for Roads & Structures and the Contract or Encroachment document for further information on work zone traffic control device specifications. See the NCDOT Approved Products website for approved brands and models of these work zone traffic control devices.**

**<https://apps.dot.state.nc.us/vendor/approvedproducts/>**