C - BARRICADES, CONES, ETC.

C-1 Barricades

The only barricades permitted for use on all roads, streets, and highways is the type III.

NOTE: All Width Dimensions Are Standard Lumber Sizes. Number of Reflectorized, Rails 4-(two each direction)

C-2 Characteristics

Width of Rail	8"min.	12"max.
Length of Rail	4'min.(per MUTCD)	variable max.
Width of Stripes	6 in.	
Height	5'min.	8'max.
Minimum Height of Bottom Rail From Ground	18"	
Minimum Distance	N/C	
Between Rails	8"	
Type of Frame	Post or Skids	
Flexibility	Essentially Permanent	

C-3 Markings

Barricade Design and Application

Barricades with stripes that begin at the upper right side and slope downward to the lower left side are to be designated as "right" (R) barricades. Barricades with stripes that begin at the upper left side and slope downward to the lower right side are to be designed as "left" (L) barricades.

Markings for barricade rails shall be alternate orange and white stripes (sloping downward at an angle of 45 degrees in the direction traffic is to pass.)

Where a barricade extends entirely across a roadway, it is desirable that the strips slope downward in the direction toward which traffic must turn in detouring. Where both right and left turns are provided for, the chevron striping may slope downward in both directions from the center of the barricade.

Barricade rails should be supported in a manner that will allow them to be seen by the motorist and provide a stable support not easily blown over by the wind or traffic.

NOTE Type I and Type II barricades shall not be used on all roads, streets, and highways

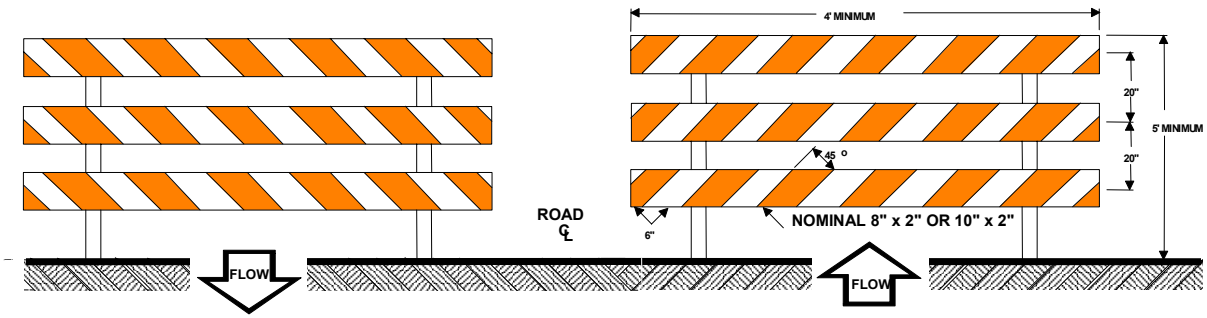
C-4 Barricade Construction

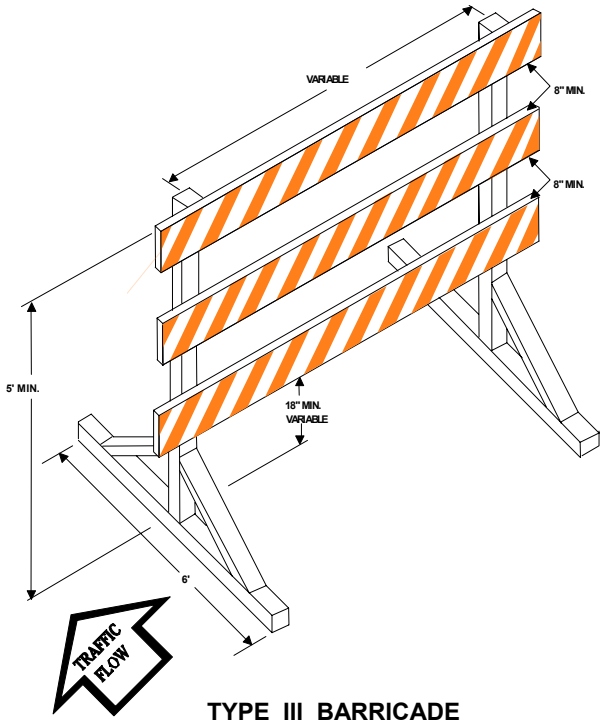
Since Type III barricades are somewhat permanent in nature and are required to function in one location for a relatively long time, they should be substantially constructed. When the barricades are constructed on bases instead of posts set into the ground, it may be desirable to ballast the bases with sandbags to provide added resistance to overturning during periods of high winds.

C-5 Barricades and Channelizing Devices

The function of barricades and channelizing devices are to warn and alert drivers of construction, maintenance, and utility activities in or near the traveled way, and to guide and direct drivers while providing maximum safety for the equipment and the workers on the job.

Barricades and channelizing devices are elements in a total system of traffic control devices for use in highway construction, maintenance and utility operations, and these elements shall be preceded by a system of warning devices that are adequate in size, number, and placement for the type of highway on which the work is to take place.





TYPE III BARRICADE

* The intent of this diagram is to show the correct position of approaching or passing traffic relative to the diagonal striping of the device. All Type III Barricades must meet the specifications of NCHRP 350.

C-6 Vertical Difference

A Vertical Difference is created whenever a difference in grade of more than one (1) inch exists:

1. Between the travelway and an adjacent area.
2. Across a travelway.
3. Along or between a travelway(s).

Examples of causes include, but are not limited to, milling or excavation for paving, repaving lifts, and utility operations.

A. Operations shall be sequenced so vertical differences of greater than three (3) inches do not exist across a travelway open to traffic or between adjacent travelways open to traffic.

B. Whenever a vertical difference of more than one (1) inch exists on or within 10 feet of a travelway, warning signs must be displayed.

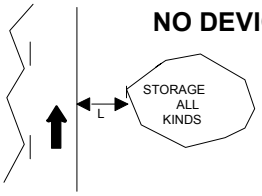
   1. For differences along or between travelways, the sign is "Uneven Pavement Joints" (Section B-43), or Symbol Sign.
   2. For differences between travelway and a shoulder or at edge of pavement less than 10' from travelway, the sign is "Low Shoulder" (Section B-42).
   3. For transverse differences within a travelway, the sign "Bump" (Section B-38) or "Dip" (Section B-39) shall be used.

C. Whenever a vertical difference of one (1) inch to six (6) inches exists on or within 10 feet of a travelway, the following requirements shall be met:

   1. In addition to the Warning signs required above, drums, cones, or vertical panels shall be used at the edge of the travelway.
   2. The work area is limited to distances of not more than 1,000 feet. Traffic shall be under flagger control or under portable traffic signal control.
   3. Transverse vertical differences across the travelway and shoulder shall be ramped with Bituminous TRM material at a slope of 20 to 1 or flatter.
   4. Vertical differences between travelways up to 2 inches require no Awedge@ provided the difference is eliminated no later than the following day.
   5. Adjacent to travelways, at the end of the work day, a fillet of material, a "wedge" of gravel, or other suitable material as directed by the Engineer shall be placed in a manner that will provide stability for errant vehicles. This material must be placed no steeper than a 4 to 1 slope. Drums and warning signs with lights are required. See Case in Manual for details.

STORAGE OF EQUIPMENT

NO DEVICES NEEDED AT EDGE OF TRAVELWAY



L is greater than 30'

SYMBOLS

D Drums

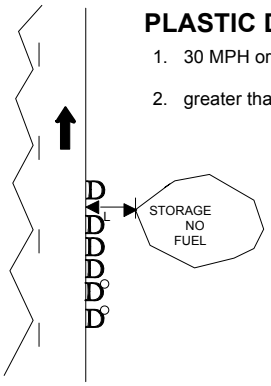
L Variable Distance in feet

LIGHT SYMBOLS

◯ Type "B" amber high-intensity light

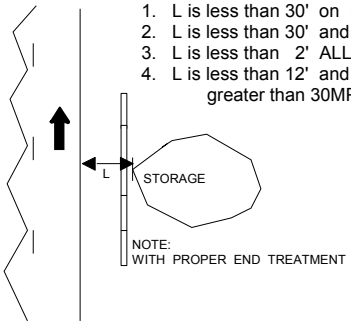
PLASTIC DRUMS NEEDED AT EDGE OF TRAVELWAY

1. 30 MPH or less and L is greater than 2'
   but L is less than or equal to 12'
2. greater than 30 MPH and L greater than 12'
   but L is less than or equal to 24'



BARRIER NEEDED

1. L is less than 30' on EXPRESSWAYS
2. L is less than 30' and FUEL IS STORED ALL ROADWAYS
3. L is less than 2' ALL ROADWAYS
4. L is less than 12' and the POSTED SPEED
   greater than 30MPH ALL ROADWAYS



D. Whenever the vertical difference is greater than six (6) inches and less than 10 feet from travelway, the following steps must be followed:

1. In addition to the Warning signs required above, drums, cones, or vertical panels shall be used at the edge of the travelway.
2. The work area is limited to distances of not more than 1,000 feet. Traffic shall be under flagger control or under portable traffic signal control.
3. If the vertical difference is in the travelway, it shall be plated or backfilled at the end of the work day.

E. If the vertical difference can not be properly reduced to less than six (6) inches during non-working periods, portable barriers are required. This applies to trenches, excavations, holes, or pavement lifts greater than 6" within 30' from the travelway unless directed by the Engineer. If the vertical difference is properly reduced to less than six (6) inches during non-working periods, Paragraph C. above applies during those periods.

F. Whenever a vertical difference of one (1) to three (3) inches exist on an obstacle (manhole, water valve, catch basin, junction well, etc.) in a travelway open to traffic, a "wedge" of Bituminous TRM shall be placed in a manner that provides a ramp with a slope no steeper than 20 to 1.

C-7 Storage of Equipment and Materials

Storage occurs whenever materials or equipment are placed less than thirty (30) feet from a travelway. Each Storage area shall be treated as a road side obstacle.

Examples of storage include, but are not limited to pipe, sand, gravel, fuel, propane, burning equipment, cranes, graders, and rollers.

The traffic control devices noted herein shall be provided to define and protect each Storage area.

A. Warning signs shall be placed for each Storage area as directed by the Engineer.
B. Portable barriers shall be placed for any Storage:
   1. On Expressway, Freeway, and limited access facilities.
   2. Within two feet of the edge of any travelway.
   3. Of fuel, propane, or other flammable materials within thirty (30) feet of the travelway.
   4. That is less than twelve (12) feet from the travelway where the posted speed is greater than 30 M.P.H.
C. If the posted speed is 30 M.P.H. or less and portable barriers are not required, plastic drums shall be placed at the edge of the travelway.
D. If the storage is twelve (12) feet but less than 24 feet from the travelway and the posted speed is greater than 30 M.P.H., plastic drums are required.

(see previous page for appropriate details)

C-8 Traffic Cones

Traffic cones shall be a minimum of 28 inches in height with a broadened base and made of materials which will withstand impact without damage to themselves or to vehicles.

18 inch cones may be used for pavement markings operations.

Orange shall be the predominant color on cones when viewed in either daytime or artificial light. They shall be kept clean and bright for maximum target value.

Cones must have reflective white collars for nighttime use. A 6 inch white reflective bands must be 3 to 4 inches below the top of the cone. An additional 4 inch white reflective band placed 2 inches below the 6 inch white band.

C-9 Flexible Guide Markers

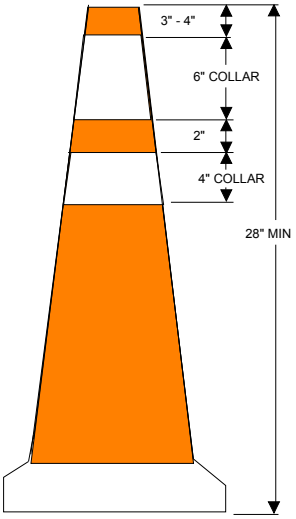
Flexible guide markers shall be constructed of not less than 2.125 inches outside diameter tubular material, and shall be designed to withstand impact without damage to themselves or to vehicles and to return to an upright position after impact. They shall be a minimum of 28 inches in height. The basic flexible guide markers shall be orange in color. Reflectorization shall be added to the uppermost twelve (12) to sixteen (16) inches of the flexible guide marker. There shall be minimum of two(2) bands with four(4) to six(6) inches of orange reflective material or other color as specified on the approved Traffic Control Plan. The standards for reflective material shall be not less than the standards prescribed for advance warning signs used for construction, maintenance and utility activities.

The spacing for flexible guide markers shall be not more than 25 feet on curves and not more than 50 feet on tangent sections of a travelway.

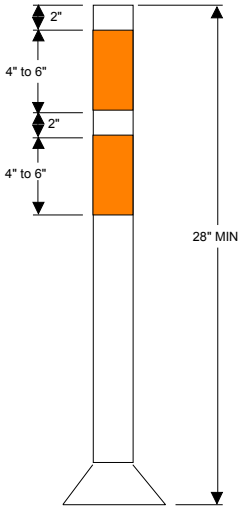
The supporting base of the flexible guide marker shall be firmly attached to the road surface per manufacturers specifications.

C-10 Vertical Panels

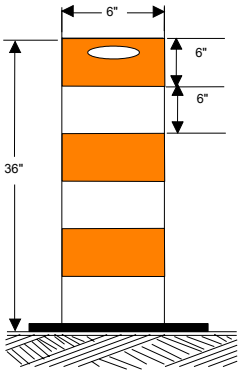
Vertical panels used as channelizing or warning devices shall be a minimum of 12 inches in width and a minimum of 36 inches in height. They shall be Orange and White Striped and Reflectorized (see diagram for details). If used for traffic in two directions, they shall be reflectorized on both front and back. These devices may be used for traffic separation or shoulder barricading where space is at a minimum, in lieu of a drum provided approval is obtained from the Engineer.



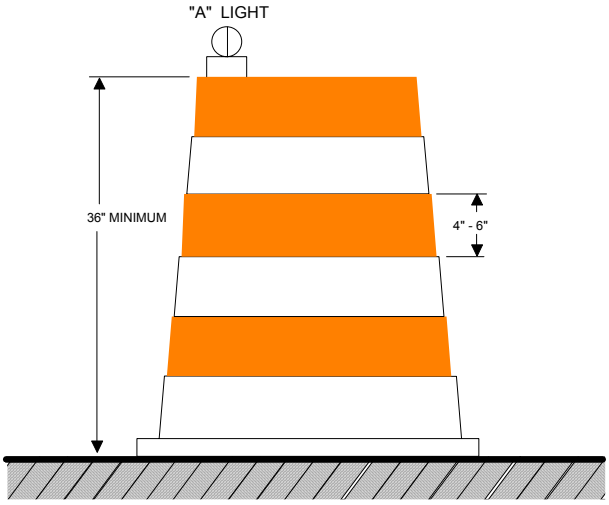
CONE



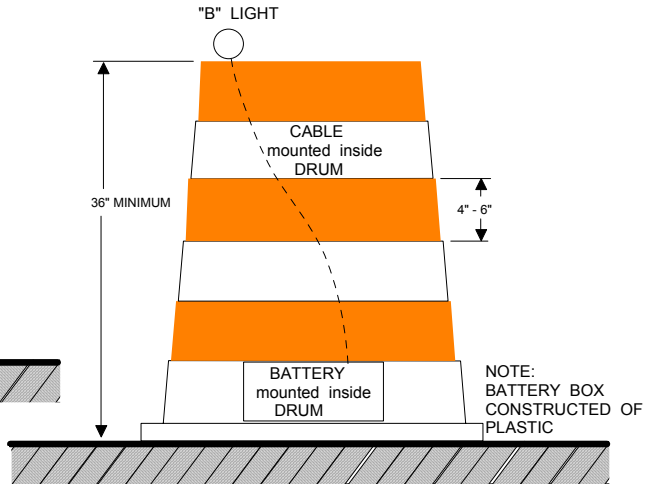
BASE VARIES
FLEXIBLE GUIDE



VERTICAL PANEL



DRUM with "A" light



NOTE:
BATTERY BOX
CONSTRUCTED OF
PLASTIC

DRUM with "B" light

C-11 Plastic Drums

Construction, Maintenance or Utility Projects.

Drums shall not be less than 3 feet high or not less than 18 inches in diameter perpendicular to the travel lane, and not less than 14 inches in any diameter. The predominant color of drums shall be orange with at least 2 orange and 2 white reflectorized stripes, 4 to 6 inches wide. The markings on drums shall be horizontal and circumferential. Narrow gaps between stripes are permitted.

The drum shall be 2 pieces. It must be capable of being securely fastened together in such a manner as to prevent accidental separation from air turbulence, created by passing trucks and normal winds.

The drum when impacted shall separate from its base section and ballast weight. The base shall be low enough to allow an automobile to pass over it without making contact with the vehicle undercarriage.

Type "A" warning light and mounting bracket shall be capable of withstanding an impact without becoming detached from drum.

Drums are an effective traffic control device for use in delineating an unusual vehicle path. Another effective application occurs on road widening projects where a row of drums is used at night to mark the edge of the pavement. During working hours the same drums are moved onto the pavement to provide working room for the construction activity and smoothly channelize traffic around the work area. Drums may also be used singly or in groups to mark specific hazards, with the appropriate lights. Drums are highly visible and have good target value. They give the appearance of being formidable obstacles and, therefore, command the respect of drivers, yet they do not inflict undue damage to a vehicle in the event of being struck. Drums shall not be weighted with sand, water, or any material to the extent that would make them hazardous to motorists. Weights shall never be placed on top of drums.

When using a Type "B" warning light, the battery shall not be mounted on top of the plastic drum.

Drums must be upright and attached to the weighted base when on a job site except for those contained within a defined storage area.

C-12 Portable Barrier

Portable Barrier's are usually made of concrete. They are designed to contain and redirect an errant vehicle. Portable barriers may be precast sections with built in connecting devices.

Channelization of traffic through a work area may be accomplished by the use of a portable barrier. This device may be used for traffic separation or shoulder barricading.

When the barrier is used in a lane or shoulder closing situation, the barrier should be preceded with channelizing devices placed along a standard lane or shoulder closing taper.

A. Installation should be designed so that expected contacts will occur at angles of approximately ten degrees or less. The maximum upper limit is fifteen degrees.

B. Offsets of three feet are desirable where possible. Offsets of one foot in ten foot lanes are a minimum.

C. The devices are to be linked together continuously for a minimum of one hundred (100) feet in any one installation.

D. Protection of the lead end of the barrier by attenuating devices is required at all times except under the following conditions:

(1) lead end is located 30 feet from travel lane.
(2) lead end turns into a bank or hill.
(3) lead end turns into guardrail and the guardrail is anchored to the face of the portable barrier in a manner that will minimize formation of a pocket when struck in an accident.

E. MAINTENANCE OF PORTABLE BARRIER

(1) To be painted white on traffic side before installation unless directed by the Engineer.
(2) To be painted white every March, July, and November unless directed by the Engineer
(3) White surface to be cleaned once a month while construction is active unless directed by the Engineer. Cleaning in winter months must be done so as not to create ice on the roadway.

F. If the lead end is protected by an attenuating device, there shall be two (2) Type "B" amber flashing lights mounted horizontally at least two (2) feet apart on the lead end of the actual barrier. Batteries for the Type "B" light shall be mounted on top of the barrier or shall be located on the work zone side of the barrier. The first reflective panel shall be mounted within ten (10) feet of the Type "B" lights.

G. Under conditions where attenuating devices are not required to protect the lead end, the first non-directional reflective panel shall be mounted on the first element of the barrier or on a taper when the taper reaches a point which is less than 15 feet from the travelway, reflective panels shall be used on curb barrier at fifty (50) feet intervals on non-tangent sections and at one hundred (100) foot intervals on tangent sections. At least six(6) reflective panels shall be used in every case.

H. The device shall be installed with traffic starting at the lead end of the taper. It shall be removed against traffic.

I. Lights and reflective devices shall be installed as the individual sections are installed.

J. Sections of the barrier stored within thirty feet of a moving lane of traffic shall be protected in accordance with the above requirements.

K. Portable barrier shall be used whenever:

(1) A vehicle entering, in, or leaving a work area would be subjected to extreme hazard.

(2) A vehicle out of control would hit any of the following:

a. Material or equipment stored within 12 feet of the near edge of an open travelway.

b. Fuel or chemical storage containers.

(3) Traffic on an otherwise divided highway is placed on an undivided travelway which has fewer travel lanes than the divided area.

a. On either end of the work area.

b. Prior to start of the work area.

L. The appropriate color edge line is always required when using Portable Barriers.

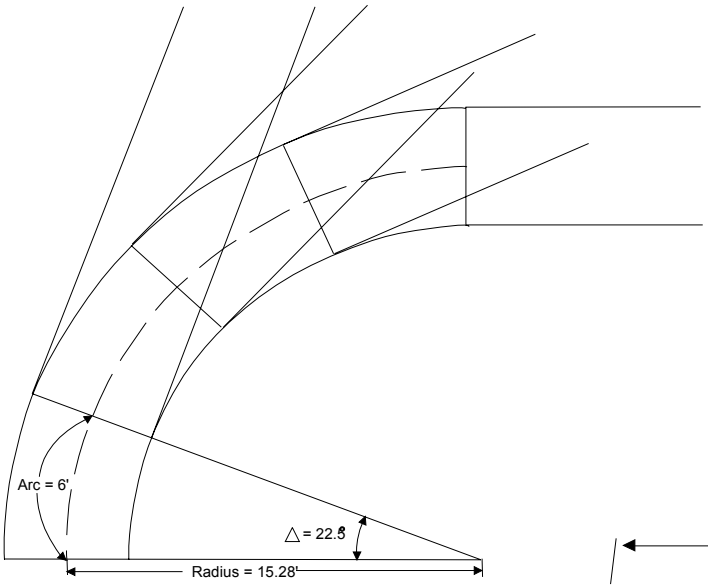
C-13 Portable Barrier 6' Curve Section

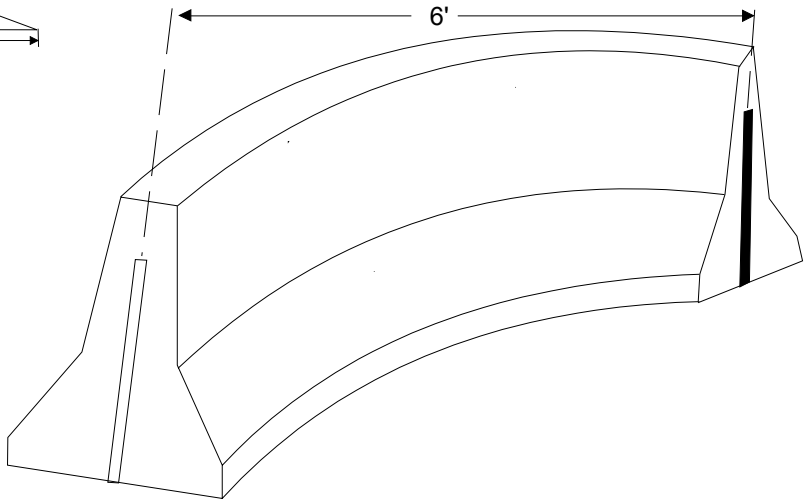
Placement;
The portable barrier 6' curve section is placed on curve sections of concrete barriers, to eliminate a pocket or pinch point were an auto could snag. Portable barrier 6' curve section shall be linked together with steel plate insert.

*Application;
Portable concrete curb radius barriers may be used where the posted speed is 35 MPH or less, to provide a positive and smooth connection between tangent and flared sections of portable concrete barrier into a shopping center or driveway.

If the portable concrete radius barrier is used at any intersection or where the posted speed is greater than 35 MPH, the design must be approved by the Traffic Engineer.

The device shall be painted white on the traffic side.





C-14 Portable Concrete Barrier End Protection

Traffic shall be protected from exposed portable concrete barrier. Crash cushion impact attenuators and tapered end sections are used to protect vehicles from impacting blunt ends of portable concrete barriers.

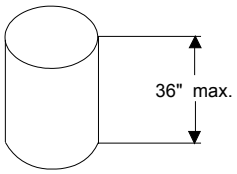
End protection is required if the blunt end is less then thirty (30) feet from the travelway with the posted speed greater than 35 m.p.h. An impact attenuator or crash cushion shall be installed.

If the blunt end is less than thirty (30) feet from the travelway with the posted speed of 35 m.p.h. or less, a tapered end section shall be installed.

NOTE C15 Sand-Filled Plastic Barrels

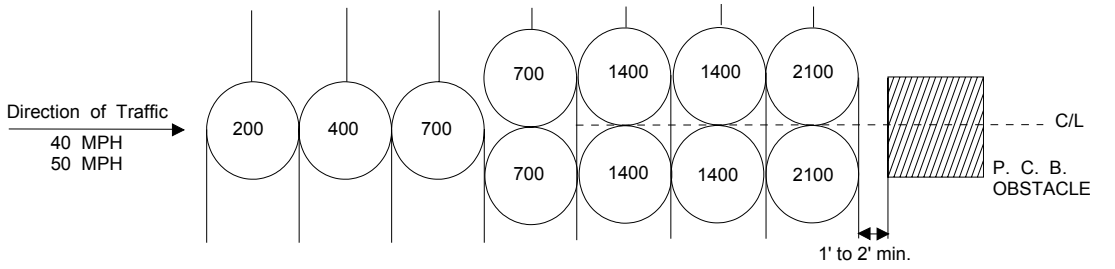
Placement;
A space should be left behind the last row of modules so sand and debris will not be confined to produce a ramping effect on the vehicle. One or two feet are the minimum space requirements.

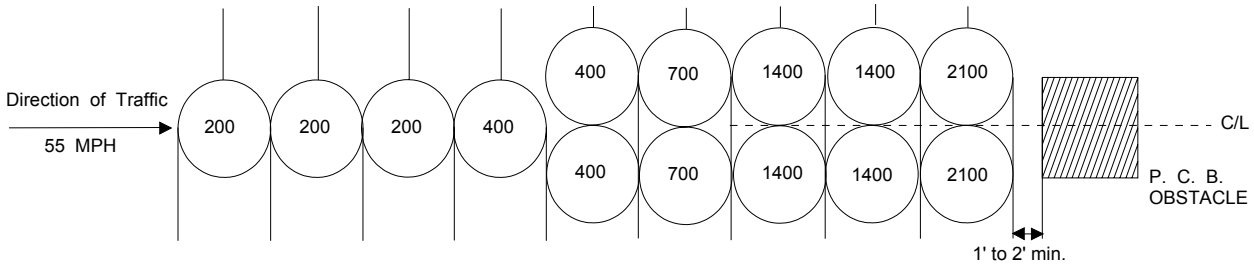
Sand
Moisture Content of the loose sand should be 3% percent or less and clean sand should be used to minimize caking. A significant variation in the density of the sand could have some effect on the performance of the crash cushion. If the sand contains a high enough moisture content and temperature remains below freezing for several days, the sand may freeze. Mixing a 5% percent (by volume) of rock salt with the sand will prevent wet sand from freezing under most conditions.



All Inertial Barrier should not exceed 36" inches in height.

Configurations shown shall be used unless a barrel manufacturer requires a different configuration for the design or posted speed.





C-16 Application of Drums, and Cones

Channelization (See Table II)

Within the system of traffic devices where a reduction in pavement width is involved, the single most important element is the taper that is provided for the channelization. An inadequate taper will almost always produce undesirable traffic operations with resulting congestion and potential accident hazard.

A minimum desirable taper length essential for smooth traffic operation is the posted speed limit times the width of the lane to be closed. For example, if a 12 foot lane is to be closed on a roadway with an existing 55 M.P.H. speed limit, the channelization to accomplish the transition shall be placed on a 55 x 12 or 660 ft. taper length.

For controlled access roadways, the minimum taper shall be 1,000 ft.

Adjustments may become necessary to provide adequate sight distance on the approach to the channelization. Similarly, the proximity of interchange ramps, crossroads, etc., to the work site may dictate the need for adjustments. In general, better traffic operations will result when the adjustments consist of increasing the length of the taper rather than reducing the length below the minimum desirable recommended above.

On construction, maintenance, or utility projects, channelization often remains in the same place for long periods of time. During such a long interval some of the elements, drums, cones etc., get out of their original alignment due to construction activities, etc. It is necessary, therefore to patrol the channelization at regular intervals to assure its proper functioning as a traffic control device. Replacement or shifting of the elements into the original alignment can best be done if the original positions of the elements are indicated on the pavement by paint marks. This technique assures good alignment and proper vehicle performance over a long period of time with minimum expenditure of men and materials in maintaining the channelization.

C-17 Placement of Drums and Cones

Drums, and cones used in tangent sections shall be placed at approximate right angles to the traffic flow and not more than 50 feet apart.

Drums, and cones used on tapers shall be placed at approximate right angles to the traffic flow and at not more than 25 feet intervals for the first four (4) devices in place.

Drums and cones shall be used in high speed and high volume areas to delineate non-normal travel paths.

C-18 Traffic Cones, Flexible Guide Markers Vertical Panels, or Drums

When cones, flexible guide markers, vertical panels, or drums are used, precautions are necessary to assure they will not blow over or become displaced. Added weights shall not be sufficient to present a hazard if the devices are inadvertently struck.

C-19 Type III Barricades

Construction, Maintenance or Utility

When a road section is closed to traffic, Type III barricades shall be erected at the points of closure. They may extend completely across a roadway and its shoulders as a fence, or from curb to curb, but where provisions must be made for access of equipment and authorized vehicles, the Type III barricades shall be provided with gates or movable sections that can be closed when work is not in progress, or with indirect openings that will discourage public entry. Where access is provided through the Type III barricades, responsibility shall be assigned to a person to assure proper closure at the end of each working day.

When a road or street is legally closed, but access must still be allowed for local traffic, the Type III barricade cannot be erected completely across a roadway. Instead, an arrangement should be devised that will permit local use but effectively discourage use by through traffic. A sign with the appropriate legend concerning permissible use by local traffic shall be installed. Applications of this principle are illustrated in the cases at the end of this Manual. (see page 50 for implementation)

C-20 Signs on Barricades

Barricades, particularly those of the fixed type, offer a most advantageous facility for the erection of signs. The Road Closed and Detour Arrow signs, and the large arrow warning signs, for example, can effectively be mounted above the barricade that close the roadway.

C-21 Maintenance or Utility Activities

A street or highway condition requiring maintenance is seldom of a character that will require a complete closing of the facility. When such a condition does occur, it is almost always an emergency situation, as would result from a broke water main or a washed out culvert, for example. Repair work is generally initiated on an emergency basis and the street or road closing generally uses plastic drums, flares, or cones.

C-22

TABLE II

NOTE: For controlled access roadways, the minimum taper shall be 1,000 ft. using 22 cones for the taper to close one lane.

	POSTED SPEED LIMIT: M.P.H.					
	30	35	40	45	50	55
Length of Taper	420'	490'	560'	630'	700'	770'
Lane Width 14 Ft. 15 cones						
Distance Between Cones	30'	35'	40'	45'	50'	50'
Length of Taper	360'	420'	480'	540'	600'	660'
Lane Width 12 Ft. 13 cones						
Distance Between Cones	30'	35'	40'	45'	50'	50'
Length of Taper	330'	385'	440'	495'	550'	605'
Lane Width 11 Ft. 12 cones						
Distance Between Cones	30'	35'	40'	45'	50'	50'