Section 9 - Crash Cushions

9.1 Introduction

Fixed objects within the clear zone distance should preferably be removed, relocated, or modified to be breakaway. Where this is not practical, the obstruction should be shielded to prevent an impact of the obstruction by an errant vehicle.

A detailed discussion on warranting obstructions and clear zone distance can be found in Section 8, "Guide Rail and Median Barriers".

A crash cushion is a type of traffic barrier that can be used to shield warranting obstructions such as overhead sign supports, bridge piers, bridge abutments, ends of retaining walls, bridge parapets, bridge railings, and longitudinal barriers. They can significantly reduce the severity of impacts with fixed objects by gradually decelerating a vehicle to a safe stop. The designer should, where practical, attempt to place obstructions beyond the clear zone or provide designs that will avoid the need to require shielding by a crash cushion.

To assess the crashworthiness of crash cushions, standards for conducting crash tests have been developed and are presented in NCHRP Report 350 (1993) and the Manual for Assessing Safety Hardware (MASH 2016). The MASH criteria supersede NCHRP 350 to reflect the current characteristics of each class of vehicle among other requirements. Manufacturers developing new designs of crash cushions must use MASH 2016 criteria for crash testing.

The most common use of a crash cushion is to shield a warranting obstruction in a gore and the end of barrier curb at intersections. However, other warranting obstructions in the median and along the roadside can also be shielded with a crash cushion. Figure 9-A shows typical crash cushion layout criteria.

9.2 Selection Guidelines

9.2.1 General

There are two types of crash cushions, inertial and compressive. MASH compliant inertial and compressive crash cushions are listed on the Department's Qualified Products List:

https://www.state.nj.us/transportation/eng/materials/qualified/QPLDB.shtm

Parameters that are evaluated to determine which crash cushions should be selected for each location are discussed in the following Sections:

- Dimensions of the Obstruction
- Space Requirements
- Geometrics of the Site
- Physical Conditions of the Site
- Redirection Characteristics
- Design Speed
- Foundation Requirements

A. Inertial Barriers

Inertial barriers consist of sand-filled plastic barrels containing varying amounts of sand. When inertial barriers are impacted, deceleration occurs due to the transfer of energy from the vehicle to the mass of the sand-filled modules. Inertial barriers are not designed to redirect vehicles for side impacts. Inertial barriers shall not be used at barrier curb openings in the median for permanent installations. Existing inertial barriers within the limits of a project that do not conform with MASH requirements described in Section 9.3.1 shall be replaced. MASH compliant inertial barriers for use on Department projects are listed on the Department's Qualified Products List.

B. Compressive Barriers

Each compressive barrier system uses a unique method of absorbing energy via the deformation of the system. When compressive barrier systems are impacted head-on, deceleration occurs due to the transfer of energy from the vehicle to the system's compressive components. When impacted on the side of the system, the vehicle is redirected away from the hazard.

A MASH compliant compressive system as listed on the Department's Qualified Products List shall be used for all permanent and temporary installations of compressive crash cushions where site conditions permit. Existing compressive barriers within the limits of a project that are not MASH compliant shall be replaced. Where site conditions do not permit the use of a MASH compliant compressive crash cushion, an NCHRP 350 compliant compressive crash cushion as listed on the Qualified Products List may be used. However, it is the responsibility of the designer to maintain a record justifying the use of an NCHRP 350 compliant crash cushion and to contact manufacturers of NCHRP 350 compliant compressive crash cushions to determine which systems remain available. Where an NCHRP 350 compliant compressive crash cushion is proposed, the designer shall submit a request to the Project Manager containing an explanation and all supporting documentation justifying the use of an NCHRP 350 compliant compressive crash cushion. For projects on the NHS with Federal-aid reimbursement, the Project Manager shall submit the request to the FHWA Division Office for the purpose of obtaining Federal-aid eligibility acceptance.

There are 4 classifications of compressive barriers:

- Permanent Compressive Barrier
- Permanent Low Maintenance Compressive Barrier
- Temporary Compressive Barrier
- Temporary Low Maintenance Compressive Barrier

These classifications are listed on the Department's Qualified Products List for compressive barriers.

A Permanent Low Maintenance Compressive Barrier shall be used in lieu of a Permanent Compressive Barrier when one of the following conditions exists:

- A through lane would need to be closed while repairs are being made
- In gore areas where the horizontal and/or vertical sight distance is substandard

- To replace an existing compressive barrier or inertial barrier that has been impacted two or more times within an eight-year period

A Temporary Low Maintenance Compressive Barrier should be used in lieu of a Temporary Compressive Barrier at locations where the temporary crash cushion will be in place for a year or more.

A Permanent Compressive Barrier or, where warranted, a Permanent Low Maintenance Compressive Barrier shall be used as a crash cushion treatment at barrier curb openings in the median.

9.2.2 Dimensions of the Obstruction

Inertial barriers can be designed to shield obstructions of various widths and design speeds. Compressive barriers are available to shield obstructions of various widths for both TL-2 and TL-3 applications. TL-2 compressive barriers are used for design speeds equal to or less than 45 MPH. TL-3 compressive barriers are used for design speeds greater than 45 MPH. The Department's Qualified Products List provides a list of MASH compliant compressive systems appropriate for the applicable design criteria including classification, system width, system length, and design speed (TL-2 or TL-3). The designer shall verify the system dimensions based on the current manufacturer's product manual. The designer shall indicate the location of the back of the crash cushion by Station on the plans.

Where there is enough area in advance of a wide obstruction, the designer should use a barrier curb or guide rail transition to reduce the required width of the crash cushion. For transitioning from guide rail to a crash cushion in a gore area, see Figure 8-S. The flare should not begin at the back of the crash cushion. A short section of tangent barrier curb or guide rail should be provided between the crash cushion and the beginning of the flare. The tangent length required for barrier curb downstream of a compressive barrier is typically 2.5 feet minimum to allow for the crash cushion side panels to retract upon impact. The tangent length required for guide rail downstream of a compressive barrier varies per crash cushion manufacturer and may differ for bidirectional and unidirectional applications. The designer should refer to manufacturer information for transitioning to guide rail to determine if site conditions will accommodate the length of the transition. Where a tall barrier or parapet (e.g., 42-inch F shape) is being shielded, a vertical transition to a lower height compatible with the requirements of the crash cushion system is required. Vertical transitions shall be 6:1 or flatter and shall not extend above the back of the crash cushion by more than 1 inch.

9.2.3 Space Requirements

A. Area Occupied by the Crash Cushion

MASH compliant inertial barriers have a typical width of 6.5 feet (two 3-foot-wide modules six inches apart).

For compressive barriers, the widths are separated into 4 categories for the purpose of measurement and payment:

- Narrow (24” to 30”)
- Medium (greater than 30” to 48”)
- Wide (greater than 48” to 72”)
- X-Wide (greater than 72”)

B. Compressive Crash Cushion Reserve Area

During the preliminary design stages for new construction and for rehabilitation or reconstruction of existing highways, making provisions for adequate space for compressive crash cushions to shield non-removable fixed objects should be considered. This will promote compatibility between the final design and the crash cushion requirements. Figure 9-B suggests the approximate area that should be made available for a compressive crash cushion installation. Although it depicts a gore location, the same recommendations may apply to other types of obstructions that require shielding by a crash cushion. Figure 9-B also shows a range of dimensions, the significance of which is as follows:

1. Minimum

    a. Restricted Conditions

    These dimensions approximately describe the minimum space required for installation of the current generation of MASH compliant crash cushion systems without encroaching onto shoulders. In extreme cases, where the crash cushion must encroach into the shoulder, a low maintenance compressive barrier system should be considered since a higher-than-normal frequency of impacts could reasonably be expected when the crash cushion is closer to the traveled way.

    b. Unrestricted Conditions

    These dimensions should be considered as the minimum for all projects where plan development is not far advanced except for those sites where it can be shown that the increased cost for accommodating these dimensions, as opposed to those for Restricted Conditions, will be unreasonable. For example, if the use of the greater dimensions would require the demolition of an expensive building or a considerable increase in construction costs, then the lesser dimensions might be considered.

2. Preferred

These dimensions, which are considerably greater than required for the current generation of MASH compliant crash cushions should be considered optimum. This does not imply that if space is provided in accordance with these dimensions that it will be fully occupied by a crash cushion. The reason for

proposing these dimensions is to make allowance for future design modifications. Also, the unoccupied reserved crash cushion space will provide additional recovery area for errant vehicles.

9.2.4 Geometrics of the Site

The vertical and horizontal alignment, especially curvature of the road and sight distance, are important factors to be considered. Adverse geometrics could contribute to a higher-than-normal frequency of impacts.

Crash cushions should be placed on a relatively flat surface. Longitudinal and transverse slopes should not exceed 8% for compressive barriers and 5% for inertial barriers. For compressive barriers, the cross slope should not vary more than 2 percent over the length of the unit.

9.2.5 Physical Conditions of the Site

All curbs and islands should be removed from 50 feet in front of a crash cushion to the back of the system. However, where curb is necessary for drainage purposes at new installations or replacements of crash cushions, the curb height shall be reduced from 50 feet in front of the crash cushion to the back of the system. For design speeds greater than 45 MPH, the maximum curb height shall be 2 inches. For design speeds 45 MPH or less, curb height of 2 inches is preferred, however, curb height shall not be more than 4 inches. Where curb height is transitioned before or after the system, a 10-foot transition length is typically used.

For roadside applications, a minimum clear area 4 feet wide should be provided for the length of the crash cushion on the non-traffic side, if feasible.

Expansion joints in the crash cushion area may require special design accommodations for compressive crash cushions. The designer shall contact the manufacturer before proceeding with a compressive crash cushion design that spans an expansion joint.

Where a crash cushion is to be installed on the end of a median barrier at an intersection, locate the end of the median barrier based upon the longest crash cushion that could be used at the intersection. The designer shall provide Stations for the beginning and end of median barrier curb at the intersection.

9.2.6 Redirection Characteristics

Compressive barriers have redirection capabilities when impacted on the side of the system, and for this reason, are preferred over inertial barriers where feasible. Since inertial barriers are non-redirective, placement details with respect to the obstruction shown in Figure 9-C are designed to minimize penetration for side impacts.

9.2.7 Design Speed

Compressive barrier systems are available for design speeds less than or equal to 45 MPH (TL-2) or for design speeds greater than 45 MPH (TL-3). Inertial barrier system layouts for design speeds of 30 MPH through 60 MPH are provided in Figure 9-D and Figure 9-E. A TL-3 compressive or a 60 MPH inertial crash cushion system is considered compliant for design speeds greater than 60 MPH.

9.2.8 Foundation Requirements

Inertial barriers shall be placed on concrete or asphalt pavement that is four inches or greater in thickness.

A reinforced or non-reinforced concrete pad foundation is required for a permanent compressive barrier. Concrete pads are typically 4 feet wide for narrow crash cushions. Pad thickness is 6 to 8 inches and steel reinforcing requirements vary among the manufacturers. Some compressive barriers require a concrete anchor block as part of the foundation requirements. If the construction of an anchor block would interfere with underground utilities, that system should be eliminated from consideration. The designer should refer to manufacturer information regarding foundation requirements. The designer shall specify an appropriate foundation on *Construction Detail CD-611-1* as described in Section 9.3.2.

The contractor is required to submit working drawings for compressive crash cushion concrete pad foundations for each location. The designer shall confirm that the drawings meet current manufacturer requirements for each location including the pad dimensions, reinforcement, and anchor block where applicable.

Temporary installations of compressive barriers can be placed on existing pavement. Typical minimum requirements are as follows:

- 6” reinforced concrete
- 8” non-reinforced concrete
- 3” Hot Mix Asphalt over 3” concrete
- 6” Hot Mix Asphalt over 6” Dense Graded Aggregate Base Course
- 8” Hot Mix Asphalt

The designer shall confirm the manufacturer’s requirements for each temporary system under consideration. Where existing pavement does not meet minimum requirements, the designer shall specify an appropriate foundation on *Construction Detail CD-159-10* as described in Section 9.3.2.

9.3 Design Procedure

9.3.1 Inertial Barriers

Figures 9-D and 9-E provide inertial barrier configurations for design speeds of 30 MPH through 60 MPH. The designer shall use these configurations for the applicable design speed for inertial barrier design. A layout of the modules, including the weight of each module, shall be included as a Construction Detail in the contract plans. The designer shall include the following note on the Construction Detail:

“THE MODULE TO MODULE SPACING AND THE SPACING BETWEEN MODULES AND THE OBSTRUCTION SHALL BE IN ACCORDANCE WITH THE MANUFACTURER’S RECOMMENDATIONS.”

The designer shall indicate the location of the back of the inertial barrier by Station on the plans.

Where the rear modules of an inertial barrier array may be exposed to reverse direction impacts, a series of modules is required in the reverse direction as shown in Figure 9-F. If space for the reverse direction modules is not available, a compressive crash cushion shall be used.

Inertial barriers consist of sand-filled plastic barrels containing varying amounts of sand ranging from 200 lbs. to 2,100 lbs. When inertial barriers are impacted, deceleration occurs due to the transfer of energy from the vehicle to the mass of the

sand-filled modules. The following information is provided detailing the procedure used for calculating inertial barrier forces encountered by an impacting vehicle.

The design of an inertial barrier is based on the law of conservation of momentum. It can be shown that:

Equation 1

$$V_f = \frac{W\ V_0}{W + W_s}$$

Where:

V_f = velocity of vehicle after impact with W_S (fps)

V_0 = velocity of vehicle prior to impact with W_S (fps)

W = weight of vehicle (lbs.)

W_S = weight of sand impacted by a vehicle (lbs.)

This equation is used to calculate the velocity of a vehicle as it penetrates each row of the inertial barrier. Theoretically, the vehicle cannot be stopped completely by this principle. Practically, it is usually adequate to design this type of crash cushion to reduce the vehicle velocity to about 10 mph (14.7 fps) after the last module has been impacted. The remaining energy is imparted to the sand as the vehicle bulldozes through the modules.

The deceleration force is calculated using Equation 2. The design deceleration force used by manufacturers varies with design speed, but the typical maximum is 8 G's. Note that velocity is in feet per second (fps).

Equation 2

$$G = \frac{V_0^{\,2} - V_f^{\,2}}{2\,D\,g}$$

Where:

G = deceleration force in G's

V_0 = velocity of vehicle prior to impact (fps)

V_f = velocity of vehicle after impact with one row of modules (fps)

D = distance traveled in decelerating from V_0 to V_f = width of a module = 3 feet

g = 32.2 ft/s^2

The standard weights of modules used are 200 lbs., 400 lbs., 700 lbs., 1,400 lbs., and 2,100 lbs. To calculate G forces, module configurations are analyzed for both a 5,000 lb. vehicle and a 2,420 lb. vehicle (MASH requirements). Multiple modules in a single row must be the same weight. Each row must have either the same weight or a greater weight than the previous upstream row. Using the module layout for a design speed of 50 mph (73.3 fps) shown in Figure 9-E and Equations 1 & 2, Table 9-1 and Table 9-2 provide an example of inertial barrier G force calculations for both MASH vehicle weights.

Table 9-1
Example of an Inertial Barrier Design
50 MPH 5,000 lb. vehicle

Row	W_S (lbs.)	V_0 (fps)	V_f (fps)	G
1	200	73.3	70.5	2.1
2	400	70.5	65.3	3.7
3	700	65.3	57.3	5.1
4	1,400	57.3	44.7	6.6
5	2,800	44.7	28.7	6.1
6	2,800	28.7	18.4	2.5
7	2,800	18.4	11.8	1.0
8	4,200	---	---	---

Table 9-2
Example of an Inertial Barrier Design
50 MPH 2,420 lb. vehicle

Row	W_S (lbs.)	V_0 (fps)	V_f (fps)	G
1	200	73.3	67.7	4.1
2	400	67.7	58.1	6.3
3	700	58.1	45.1	7.0
4	1,400	45.1	28.6	6.3
5	2,800	28.6	13.2	3.3
6	2,800	---	---	---
7	2,800	---	---	---
8	4,200	---	---	---

Where inertial barriers are proposed at a wide obstruction requiring more than two modules per row, the designer shall contact the manufacturer for module layout guidance. Approved MASH compliant inertial barriers are listed on the Department's Qualified Products List.

There are two standard pay items for inertial barriers contained in Section 159 and Section 611 of the 2019 Standard Specifications for Road and Bridge Construction:

- TEMPORARY CRASH CUSHION, INERTIAL BARRIER SYSTEM, ___ MODULES
- CRASH CUSHION, INERTIAL BARRIER SYSTEM, ___ MODULES

9.3.2 Compressive Barriers

There are two standard pay items for permanent compressive barriers contained in Section 611 of the 2019 Standard Specifications for Road and Bridge Construction:

- CRASH CUSHION, COMPRESSIVE BARRIER, TYPE __, WIDTH _____
- CRASH CUSHION, LOW MAINTENANCE COMPRESSIVE BARRIER, TYPE __, WIDTH _____

There are two standard pay items for temporary compressive barriers contained in Section 159 of the 2019 Standard Specifications for Road and Bridge Construction:

- TEMPORARY CRASH CUSHION, COMPRESSIVE BARRIER, TYPE __, WIDTH _____
- TEMPORARY CRASH CUSHION, LOW MAINTENANCE COMPRESSIVE BARRIER, TYPE __, WIDTH _____

Each standard item is divided by TYPE:

- TYPE 2 = Design Speed of 45 MPH or less
- TYPE 3 = Design Speed greater than 45 MPH

Each standard item is further divided by WIDTH:

- NARROW = 24” to 30”
- MEDIUM = >30” to 48”
- WIDE = >48” to 72”
- X-WIDE = >72” to 120”

The Designer should determine which standard item to use along with the type and width to fit each site. Examples of pay item names are as follows:

- CRASH CUSHION, COMPRESSIVE BARRIER, TYPE 3, WIDTH NARROW
- TEMPORARY CRASH CUSHION, COMPRESSIVE BARRIER, TYPE 2, WIDTH NARROW
- CRASH CUSHION, LOW MAINTENANCE COMPRESSIVE BARRIER, TYPE 3, WIDTH MEDIUM
- TEMPORARY CRASH CUSHION, LOW MAINTENANCE COMPRESSIVE BARRIER, TYPE 3, WIDTH WIDE

Since the item names are generic, the designer will need to determine which of the approved crash cushion systems to consider for each site and list them on the appropriate Crash Cushion Compressive Barrier Summary Table in the Standard Roadway Construction Details. The contractor will use the information provided by the designer in these summary tables as a basis for their bid. Follow the guidance below to properly fill in these tables.

The designer shall determine which of the approved MASH compliant compressive crash cushions are appropriate for each site based on the design criteria included in this Section and the information provided on the Department’s Qualified Products List. Multiple crash cushion systems are not required to be listed where site conditions indicate that one system is preferred.

The designer shall provide the Item Number, Pay Item, Design Speed, Baseline and Station, and Products and Foundation in the Standard Roadway Construction Details.

The designer shall enter the information for temporary compressive crash cushions and temporary low maintenance compressive crash cushions on the Temporary Crash Cushion Compressive Barrier Summary Table on *Construction Detail CD-159-10* for the crash cushion systems that the contractor may use for each site.

The designer shall enter the information for permanent compressive crash cushions and permanent low maintenance compressive crash cushions on the Crash Cushion Compressive Barrier Summary Table on *Construction Detail CD-611-1* for the crash cushion systems that the contractor may use for each site.

Figure 9-G and Figure 9-H are examples of the Temporary Crash Cushion Compressive Barrier Summary Table and the Crash Cushion Compressive Barrier Table. These Figures contain sample data.

The following are instructions for filling out the summary tables using Figure 9-H as a reference:

1. The first column on the left side of the table is labeled "ITEM NO." Enter the standard item number chosen for each site (e.g., 611312M). The list of Item Numbers is updated as needed and made available on the New Jersey Department of Transportation web page, Doing Business, AASHTOWare Project Software, Cost Estimation at:

   https://www.nj.gov/transportation/business/aashtoware/estimation.shtm

   The temporary compressive crash cushions are in the 159200 item number series and the permanent compressive crash cushions are in the 611300 item number series.

2. The second column from the left side of the table is labeled "PAY ITEM". Enter the pay item description for the item number chosen, (e.g., CRASH CUSHION, COMPRESSIVE BARRIER, TYPE 3, WIDTH NARROW).

3. The third column from the left side of the table is labeled "DESIGN SPEED". Enter the design speed for each site (e.g., 60 MPH).

4. The fourth column from the left side of the table is labeled "BASELINE AND STATION". Enter the Route or roadway name for each site. If it is on a ramp, name the ramp as it appears on the plans. Then identify which baseline you are using, the station location, and the side it is on (e.g., ROUTE 130 PROPOSED BASELINE STATION 1406+08 LT.).

5. The fifth column from the left side of the table is labeled "PRODUCTS AND FOUNDATION". This is the final list of systems that fit each site. The Product information shall include the product name, TL-2 or TL-3, width, length, and foundation type. Using Section 9 design criteria and the information provided on the Qualified Products List, list the products that may be used for each site. Note that the information provided on the Qualified Products List is subject to change as MASH compliant system availability is modified.

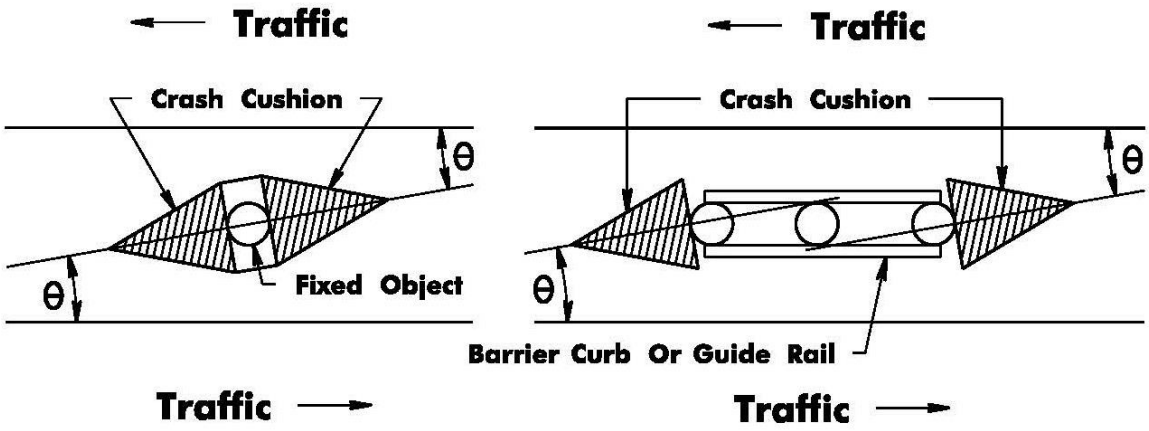
   For the Temporary Crash Cushion Compressive Barrier Summary Table, if the existing pavement meets the manufacturer's requirements as described in Section 9.2.8, enter "EXISTING PAVEMENT" under the product information, as

shown in Figure 9-G. If the existing pavement does not meet the requirements, enter an appropriate pavement foundation for that system.

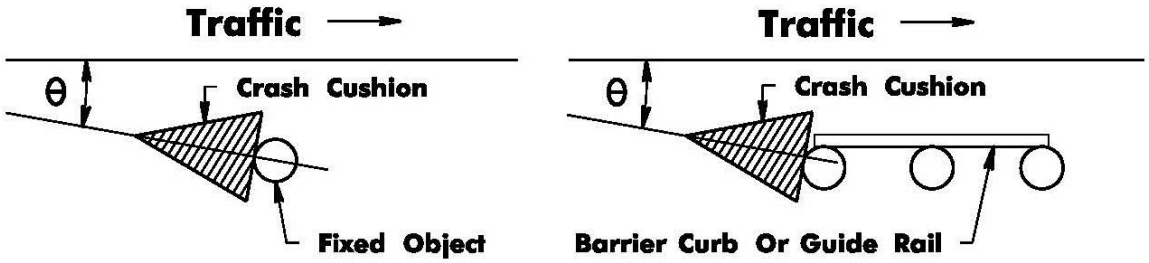
6. Continue to fill out the summary tables for all compressive barrier locations, following steps 1 through 5 above. Include the completed summary tables in the Construction Details of the project plans.

FIGURE 9–A:
CRASH CUSHION LAYOUT CRITERIA

FLAT* MEDIANS



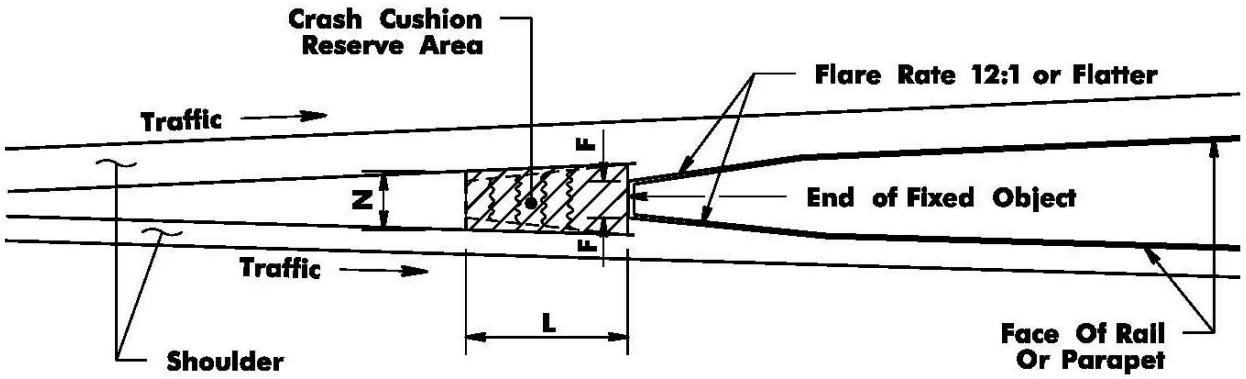
FLAT* ROADSIDE AREA



θ = 10 DEGREES MAX.

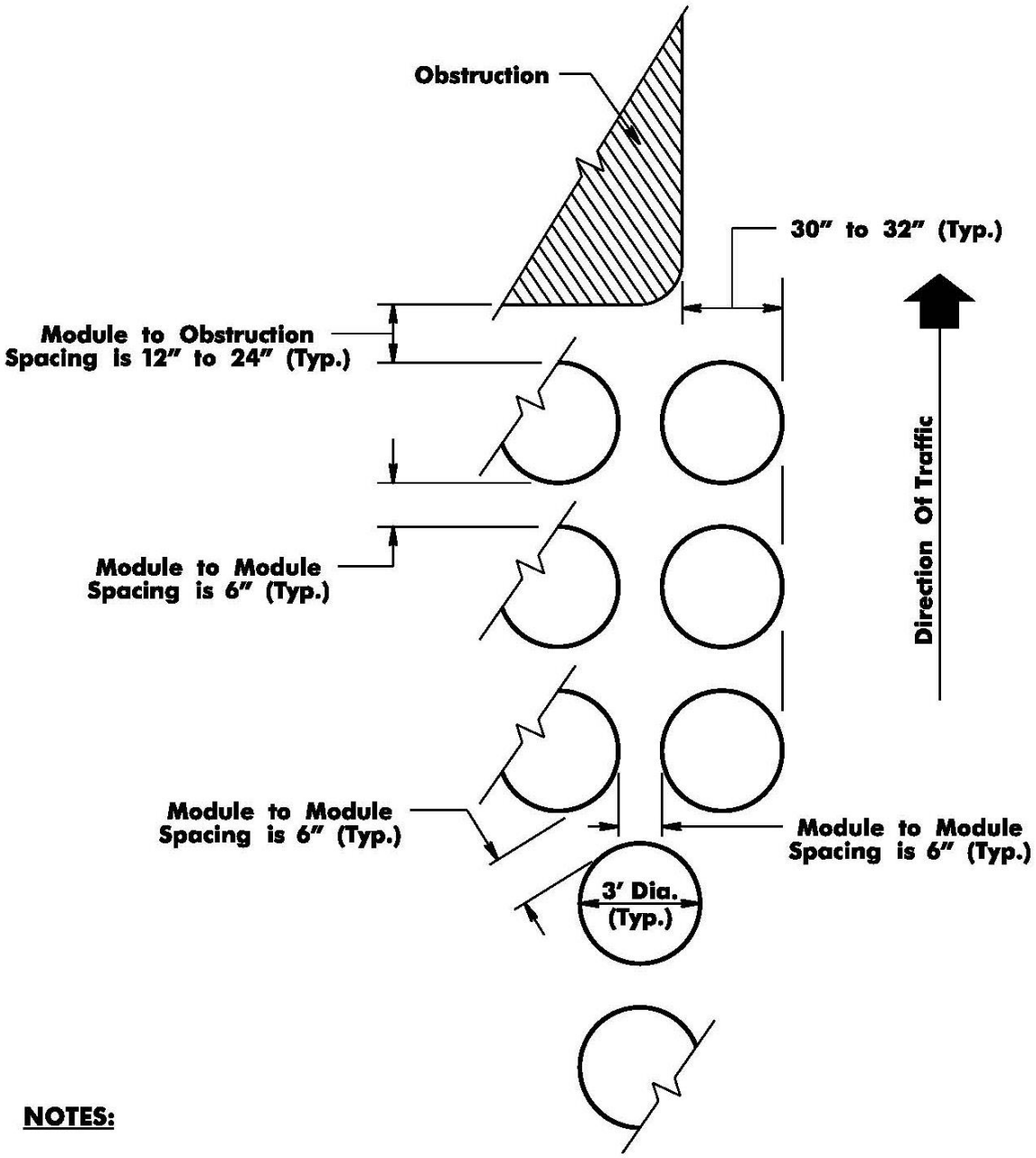
* = SLOPE 8% OR FLATTER FOR COMPRESSIVE BARRIERS
5% OR FLATTER FOR INERTIAL BARRIERS

FIGURE 9–B:
COMPRESSIVE CRASH CUSHION RESERVE AREA FOR PRELIMINARY DESIGN



DESIGN SPEED ON MAINLINE (MPH)	APPROXIMATE DIMENSIONS FOR CRASH CUSHION RESERVE AREA FOR PRELIMINARY DESIGN (FEET)								
	MINIMUM						PREFERRED		
	RESTRICTED CONDITIONS			UNRESTRICTED CONDITIONS					
	N	L	F	N	L	F	N	L	F
45 or less	6	14	2	8	18	3	12	24	4
greater than 45	6	22	2	8	26	3	12	32	4

FIGURE 9–C:
TYPICAL INERTIAL BARRIER LAYOUT
FOR THE LAST THREE MODULE ROWS

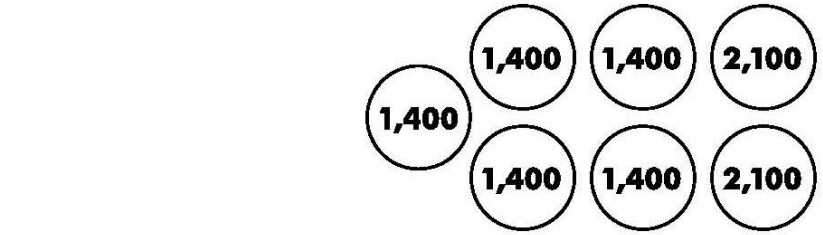


NOTES:

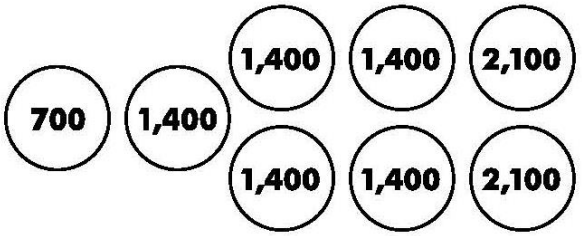
1. A minimum of two modules must be provided in the last three rows.
2. The designer shall include the following note on the construction detail for the module layout:

   "THE MODULE TO MODULE SPACING AND THE SPACING BETWEEN MODULES AND THE OBSTRUCTION SHALL BE IN ACCORDANCE WITH THE MANUFACTURER'S RECOMMENDATIONS."

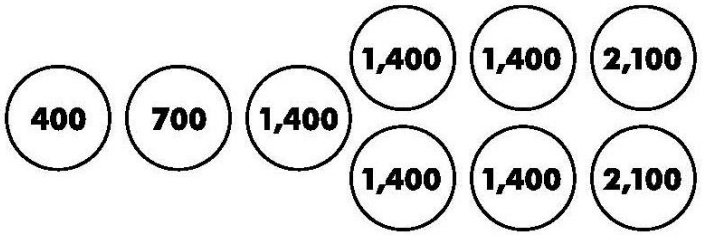
FIGURE 9–D:
INERTIAL BARRIER CONFIGURATIONS
30 TO 45 MPH DESIGN SPEEDS



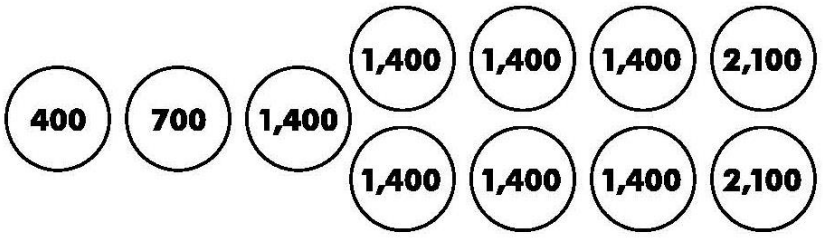
30 MPH DESIGN SPEED



35 MPH DESIGN SPEED

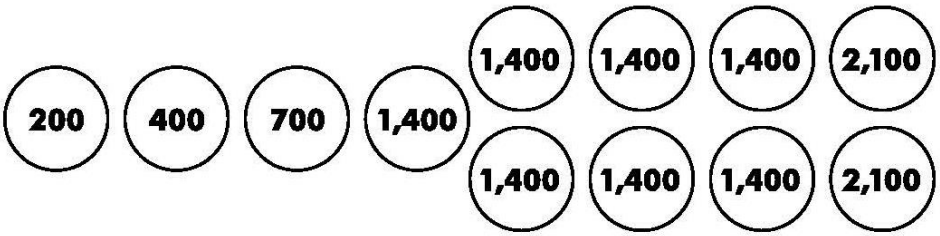


40 MPH DESIGN SPEED

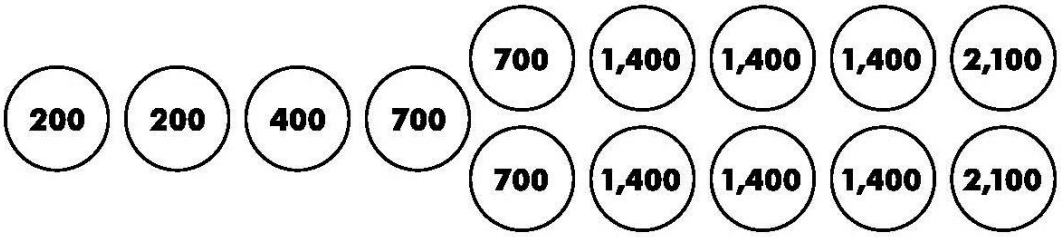


45 MPH DESIGN SPEED

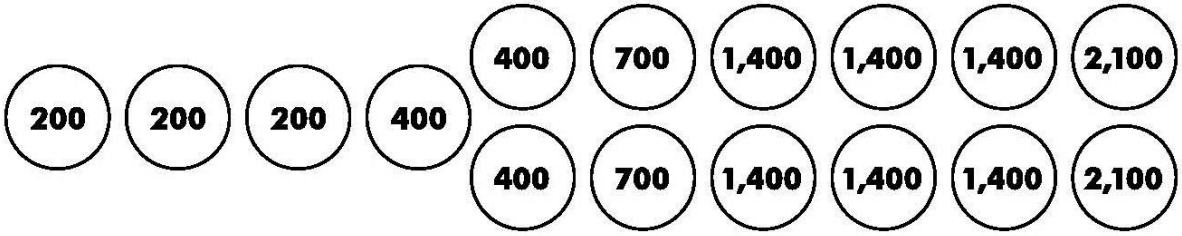
FIGURE 9–E:
INERTIAL BARRIER CONFIGURATIONS
50 TO 60 MPH DESIGN SPEEDS



50 MPH DESIGN SPEED

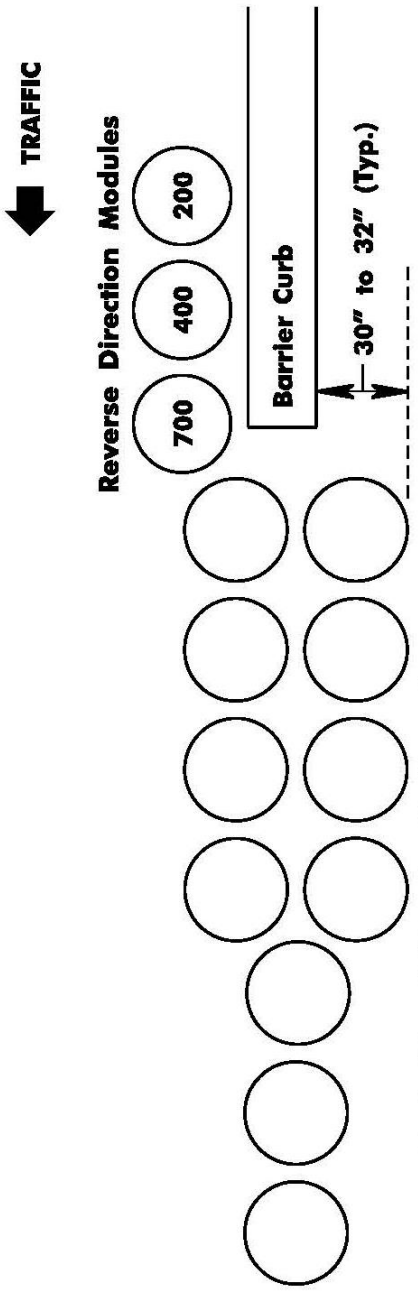


55 MPH DESIGN SPEED



60 MPH DESIGN SPEED

FIGURE 9–F:
INERTIAL BARRIER CONFIGURATION
FOR REVERSE DIRECTION IMPACTS



NOTE:

Where the rear modules of an inertial barrier array may be exposed to reverse direction impacts, a series of modules is required in the reverse direction. If space for the reverse direction modules is not available, a compressive crash cushion shall be used.

FIGURE 9-G: EXAMPLE OF TEMPORARY CRASH CUSHION COMPRESSIVE BARRIER SUMMARY TABLE

TEMPORARY CRASH CUSHION COMPRESSIVE BARRIER SUMMARY TABLE

ITEM NO.	PAY ITEM	DESIGN SPEED	BASELINE AND STATION	PRODUCTS AND FOUNDATION		
159212M	TEMPORARY CRASH CUSHION, COMPRESSIVE BARRIER, TYPE 3, WIDTH NARROW	60 MPH	ROUTE 130, PROPOSED BASELINE STATION 1422+61 RT.	SMART CUSHION TL-3 24" WIDTH 21'-6" LENGTH EXISTING PAVEMENT	TAU-M TL-3 30" WIDTH 23'-11" LENGTH EXISTING PAVEMENT	
159215M	TEMPORARY CRASH CUSHION, COMPRESSIVE BARRIER, TYPE 3, WIDTH MEDIUM	50 MPH	ROUTE 130, PROPOSED BASELINE STATION 1537+93 LT.	SMART CUSHION TL-3 36" WIDTH 25'-10" LENGTH EXISTING PAVEMENT		
159200M	TEMPORARY CRASH CUSHION, COMPRESSIVE BARRIER, TYPE 2, WIDTH NARROW	40 MPH	MAIN STREET BASELINE STATION 21+76 RT.	TAU-M TL-2 30" WIDTH 15'-5" LENGTH 8" HMA		

CD-159-10 NOTES

1. For each location shown in the Temporary Crash Cushion Compressive Barrier Summary Table, install one (1) of the products listed for that location.
2. The contractor is responsible for installing the crash cushion in accordance with the manufacturer's recommendations including transitions.
3. The Station shown is an approximate location. See plans for specific location information.

NOTES TO DESIGNER

1. This Figure contains sample Products data. For current crash cushion availability and dimensions, refer to the Qualified Products List.
2. The 30" wide Tau-M systems may be used for a 24" application.
3. Multiple crash cushion systems are not required to be listed where site conditions indicate that one system is preferred.

FIGURE 9–H: EXAMPLE OF CRASH CUSHION COMPRESSIVE BARRIER SUMMARY TABLE

CRASH CUSHION COMPRESSIVE BARRIER SUMMARY TABLE

ITEM NO.	PAY ITEM	DESIGN SPEED	BASELINE AND STATION	PRODUCTS AND FOUNDATION		
611312M	CRASH CUSHION, COMPRESSIVE BARRIER, TYPE 3, WIDTH NARROW	60 MPH	ROUTE 130, PROPOSED BASELINE STATION 1406+08 LT.	SMART CUSHION TL–3 24" WIDTH 21'–6" LENGTH 6" REINFORCED PCC	QUADGUARD M10 TL–3 24" WIDTH 22'–0" LENGTH 6" REINFORCED PCC WITH ANCHOR BLOCK	TAU–M TL–3 30" WIDTH 23'–11" LENGTH 6" REINFORCED PCC
611348M	CRASH CUSHION, LOW MAINTENANCE COMPRESSIVE BARRIER, TYPE 3, WIDTH NARROW	50 MPH	ROUTE 130, PROPOSED BASELINE STATION 1763+22 RT.	SMART CUSHION TL–3 24" WIDTH 21'–6" LENGTH 8" NONREINFORCED PCC		
611300M	CRASH CUSHION, COMPRESSIVE BARRIER, TYPE 2, WIDTH NARROW	40 MPH	MAIN STREET BASELINE STATION 22+38 RT.	TAU–M TL–2 30" WIDTH 15'–5" LENGTH 8" NONREINFORCED PCC		

CD–611–1 NOTES

1. For each location shown in the Crash Cushion Compressive Barrier Summary Table, install one (1) of the products listed for that location.
2. The contractor is responsible for installing the crash cushion in accordance with the manufacturer's recommendations including transitions.
3. A concrete pad foundation shall be constructed in accordance with the manufacturer's recommendations for all permanent compressive crash cushion installations, including an anchor block where applicable.
4. The Station shown is an approximate location. See plans for specific location information.

NOTES TO DESIGNER

1. This Figure contains sample Products data. For current crash cushion availability and dimensions, refer to the Qualified Products List.
2. The 30" wide Tau–M systems may be used for a 24" application.
3. Multiple crash cushion systems are not required to be listed where site conditions indicate that one system is preferred.