Section 9
Guidelines for the Selection and Design of Crash Cushions

9.1 Introduction

Fixed objects within the clear zone distance should be removed, relocated or modified so as to be breakaway. When this is not practical, the obstruction should be shielded so as 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, "Guidelines for Guide Rail Design 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, longitudinal barriers, etc. Due to the maintenance needs of crash cushions, the designer should, when practical, attempt to place obstructions beyond the clear zone, or provide designs that will avoid the need to require shielding by a crash cushion.

The most common use of a crash cushion is to shield a warranting obstruction in a gore. However, warranting obstructions in the median and along the roadside can also be shielded with a crash cushion (see Figure 9-A).

9.2 Selection Guidelines

9.2.1 General

Once it has been determined that a crash cushion is to be used to shield a warranting obstruction, a choice must be made as to which crash cushion is best for the particular location under consideration.

Several factors must be evaluated when determining which of the recommended crash cushions should be used. There is therefore no simple, systematic selection procedure.

The factors that normally should be considered are briefly discussed in the following later subsections:

- Dimensions of the Obstruction
- Space Requirement
- Geometrics of the Site
- Physical Conditions of the Site
- Redirection Characteristics
- Design Speed
- Foundations
- Backup Structure Requirements
- Anchorage Requirements
- Flying Debris Characteristics
- Initial Cost
- Maintenance

In many cases, evaluation of the first few items will establish the type of crash cushion to be used. When designing a crash cushion, review the design instructions and product limitations in the manufacturer's design manual thoroughly before performing the necessary work.

The following crash cushions are presently recommended for permanent and temporary installations (Subsections 9.2.1.A thru E) on Departmental projects. Existing crash cushions that are not of the type listed below shall be evaluated to

determine whether repairs or replacement are necessary.

A. Inertial Barriers

The following inertial barriers may be used in permanent and temporary installations. These barriers consist of sand filled plastic barrels containing varying amounts of sand ranging from 200 lbs to 1400 lbs. Sand filled plastic barrels when impacted at an angle near the front of the system allow an impacting vehicle to pass through (gating). When impacted on the side, the system will contain and capture the impacting vehicle (non-redirective).

1 Energite III Inertial Barrier

2. Universal Inertial Barrier

3. Big Sandy Inertial Barrier

B. Compressive Barriers

The following compressive barrier systems may be used in permanent installations. When impacted at an angle near the front of the system, the barrier will capture the errant vehicle (non-gating), and when impacted downstream from the front of the system, it will redirect the vehicle away from the hazard. These systems can be installed between opposing directions of traffic (bidirectional). However, a transition will be required on the reverse traffic side of the backup structure.

1. Quad Guard II
   - Shield narrow to x-wide obstructions
   - Design speeds 25 to 70 mph
   - See Table 9-1
2. SCI
   - Shield narrow to x-wide obstructions
   - Design speeds 25 to 70 mph
   - See Table 9-2
3. TRACC
   - Shield narrow to wide obstructions
   - Design speeds 25 to 70 mph
   - See Table 9-3
4. Universal TAU-II
   - Shield narrow to x-wide obstructions
   - Design speeds 25 to 70 mph
   - See Table 9-4

C. Low Maintenance Compressive Barriers

Low maintenance compressive barrier systems shall be used in permanent installations to shield obstructions when the posted speed is 45 mph or greater, the ADT is 25,000 or greater and the through lane would need to be closed while repairs are being made. In addition, a low maintenance compressive barrier should be used in gore areas when the horizontal and/or vertical sight distance approaching the gore area requires a design exception. A low maintenance compressive barrier should also be installed to replace an existing standard compressive barrier or inertial barrier that has been impacted two or more times within an eight-year period.

The following low maintenance compressive barrier systems are energy absorbing crash cushions that are bidirectional, non-gating, redirective and reuseable.

CRASH CUSHION

FIGURE: 9–A

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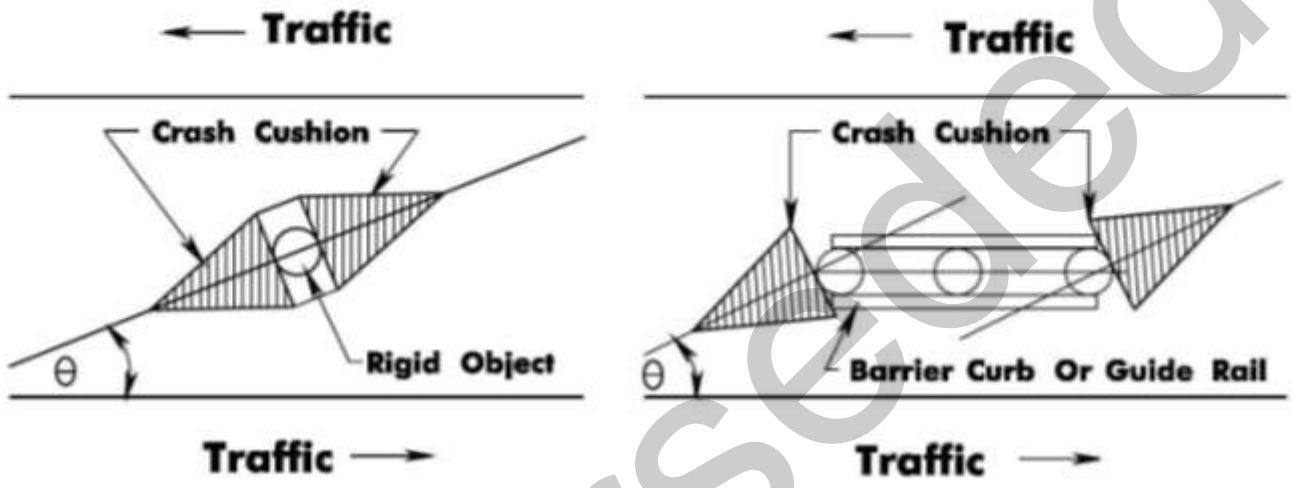
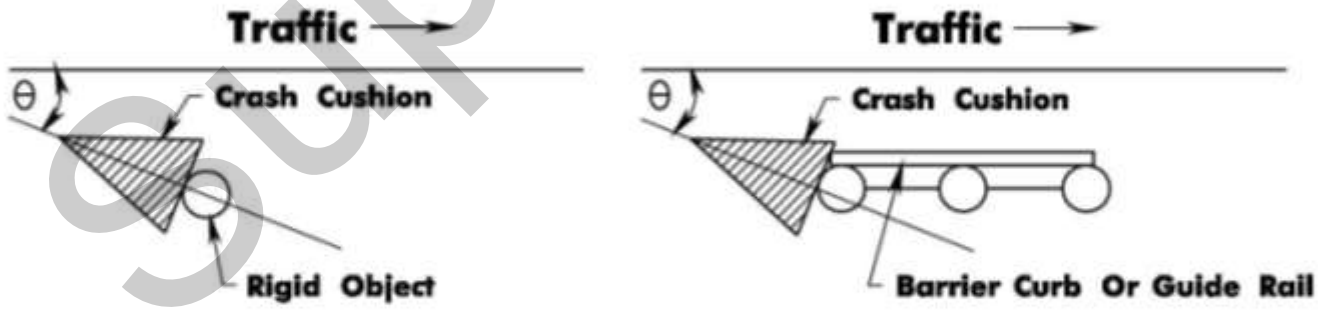
FLAT * MEDIANS



FLAT * ROADSIDE AREA



θ = 10 DEGREES MAX
* = SLOPE 8% OR LESS

1. Quad Guard Elite
    - Shield narrow to x-wide obstructions
    - Design speeds 25 to 70 mph
    - See Table 9-5
2. REACT 350 & REACT 350 II
    - Shield medium width obstructions
    - Design speeds 25 to 70 mph
    - See Table 9-6
3. SCI
    - Shield narrow to x-wide obstructions
    - Design speeds 25 to 70 mph
    - See Table 9-2

D. Temporary Compressive Barriers5

The following temporary compressive barriers are energy absorbing crash cushions that are bidirectional, non-gating and redirective.

1. QuadGuard II CZ
    - Shield narrow and medium obstructions
    - Design speeds 25 to 70 mph
    - See Table 9-7
2. SCI
    - Shield narrow to x-wide obstructions
    - Design speeds 25 to 70 mph
    - See Table 9-2
3. TRACC
    - Shield narrow to wide obstructions
    - Design speeds 25 to 70 mph
    - See Table 9-3
4. Universal TAU-II
    - Shield narrow to x-wide obstructions
    - Design speeds 25 to 70 mph
    - See Table 9-4

E. Temporary Low Maintenance Compressive Barriers

The criteria for when to use a temporary low maintenance compressive barrier are the same as that for low maintenance compressive barriers and should be used when the temporary barrier will be in place for a year or more. The following temporary low maintenance compressive barriers are energy absorbing crash cushions that are bidirectional, non-gating and redirective.

1. REACT 350WZ & REACT 350 II WZ
    - Shield medium width obstructions
    - Design Speeds 25 to 70 mph
    - See Table 9-8
2. SCI
    - Shield narrow to x-wide obstructions
    - Design Speeds 25 to 70 mph
    - See Table 9-2

9.2.2 Dimensions of the Obstruction

Inertial barriers can be designed to shield obstructions of practically any width. Compressive barrier systems (QuadGuard II, TAU-II, TRACC and SCI systems) are used to shield obstructions ranging in width from 2 feet to a maximum of 10.5 feet. Tables 9-1 through 9-8 provides design criteria (system width, system length and design speed) for approved compressive barrier systems. These tables are provided for informational purposes only. The designer should refer to the manufacturer's product manual for the most up to date information. When the distance in front of the obstruction that is available for the installation of a compressive crash cushion is very limited, the designer shall contact the supplier/manufacturer to determine the exact distance from the front of the crash cushion to the obstruction.

The maximum width of the obstruction for the standard QuadGuard II and TAU-II systems are 10.5 feet and 8.5 feet, respectively. The TRACC, ShorTRACC and FasTRACC have a maximum width of 2.5 feet. However, the WideTRACC has a standard width of 41 inches when flared on one side and 58 inches when flared on both sides and both are 21 feet long. The WideTRACC can also be customized to fit any width by adding 2.33 feet of length and 6 7/8 inches in width for each section when widening on both sides, and 3 7/16 inches in width for widening on one side. The standard SCI system is designed to shield obstructions 24 inches wide. However, wider obstructions can be shielded by using transition assemblies available from the manufacturer to shield obstructions up to 180 inches wide. The transition assemblies increase the overall length of the SCI system from approximately 28 feet to approximately 60 feet depending upon the width being shielded.

Use compressive barriers (QuadGuard II, SCI, Universal TAU II, or TRACC Systems) or, when warranted, a low maintenance compressive barrier (QuadGuard Elite, REACT 350, REACT 350 II, or SCI Systems)as a crash cushion treatment at barrier curb openings in the median.

When a low maintenance compressive barrier (QuadGuard Elite, REACT 350, REACT 350 II and SCI) is warranted the following apply:

A. QuadGuard Elite

   1. The QuadGuard Elite can be used to shield obstructions up to 7.5 feet wide and is available in five nominal widths (24", 30", 36", 69" and 90").

B. REACT 350 or REACT 350 II

   1. The REACT 350 is to be used for design speeds of 45 mph and less and the REACT 350 II is used when the design speed is 50 mph or greater.
   2. The REACT 350 and REACT 350 II are available in widths of 36", 60", 96" and 120". However, because of their cost, widths greater than 36" are not recommended on Department projects.
   3. When using a Self-Contained Backup, the width of the obstruction is limited to 8" in gore areas. Obstructions in non-gore area may be up to 24" wide. If used to shield the end of 24" wide median barrier curb, it is recommended that the shoulder be a minimum of 3' wide and the end of the barrier be tapered in accordance with the manufacturer's recommendation. Transition hardware is required to connect the Self-Contained Backup to the barrier. If the obstruction has a vertical shape, the system shall be offset from the obstruction toward traffic on the approach side. The offset is accomplished by aligning the vertical face of the cylinder with the rear or trailing face of the vertical barrier/obstruction.

4. If a concrete backup is used, the width of the obstruction that can be shielded may be up to 36" wide. However, when used in the median on bidirectional roadways, the shoulder width must be a minimum of 3' wide, and a 10' long tapered section must be provided. The minimum dimensions of the concrete backup must meet the manufacturer's recommendations.

C. SCI

1. The SCI system is designed to shield obstructions up to 24 inches wide. However, wider obstructions can be shielded by using transition assemblies to shield obstructions greater than 24 inches to 180 inches wide. The use of transition assemblies greater than 120 inches is not recommended. Transition assemblies will increase the system length of the SCI100GM from approximately 22 feet for an obstruction 24 inches wide to approximately 47 feet for an obstruction 120 inches wide.

   When there is sufficient area in advance of a wide obstruction, the designer should consider providing a barrier curb or guide rail transition to avoid using a compressive crash cushion wider than 30 inches or low maintenance compressive crash cushion wider than 36 inches. The transition to a wide obstruction should not begin at the back of the crash cushion. A short section of roadside barrier (concrete barrier curb or beam guide rail) shall be provided between the crash cushion and the beginning of the transition. The minimum length of concrete barrier curb or beam guide rail prior to the transition should be 10 feet and 12.5 feet, respectively.

   Crash cushions are not ordinarily used along the length of an obstruction. Usually guide rail or barrier curb is used. Figure 9-A shows typical installations where a crash cushion is used in conjunction with a barrier curb or guide rail.

9.2.3 Space Requirement

A. Area Occupied by the Crash Cushion

The compressive barrier systems generally require about 20 percent less length than an inertial barrier. To meet the requirement of Figure 9-B, inertial barriers will have a minimum width of approximately 6.5 feet (two barrels each at three feet wide plus a six inch space between them).

See Table 9-1 through 9-8 for design criteria (system width, system length and design speed) for the approved compressive barrier systems. The design criteria in Tables 9-2, 9-3 and 9-4 are also applicable to the Temporary crash cushions for the SCI, TRACC and Universal TAU-II, respectively. In addition, the design criteria in Table 9-2 apply to the SCI low maintenance attenuator. The widths are separated into 4 categories: narrow (24" to 30"), medium (greater than 30" to 48"), wide (greater than 48" to 72") and x-wide (greater than 72").

B. Reserve Area for Crash Cushion

Figure 9-C shows dimensions to be used in determining if adequate space is available for the installation of a crash cushion. Although it depicts a gore location, the same recommendations will apply to other types of obstructions that require shielding by a crash cushion. Also, Figure 9-C shows a range of dimensions, the significance of which is as follows:

1. Minimum

   Restricted Conditions These dimensions approximately describe the space required for installation of the current generation of crash cushion devices

without encroachment on shoulders and the nose of the device offsets slightly back of the parapet or shoulder line. However, there are designs already developed that would not fit in the space provided by these dimensions and quite often it will not be possible to provide the recommended reserve area, particularly on existing roadways. In either case, the crash cushion should be designed to not encroach into the shoulder. 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.

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 present generation of crash cushions should also 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 and device installation suitable for greater ranges of vehicle weights and/or for lower deceleration forces if experience determines that such may be necessary. In the meantime, the unoccupied reserved crash cushion space will provide valuable additional recovery area.

SUGGESTED LAYOUT FOR LAST THREE MODULE ROWS IN AN INERTIAL BARRIER

FIGURE: 9–B

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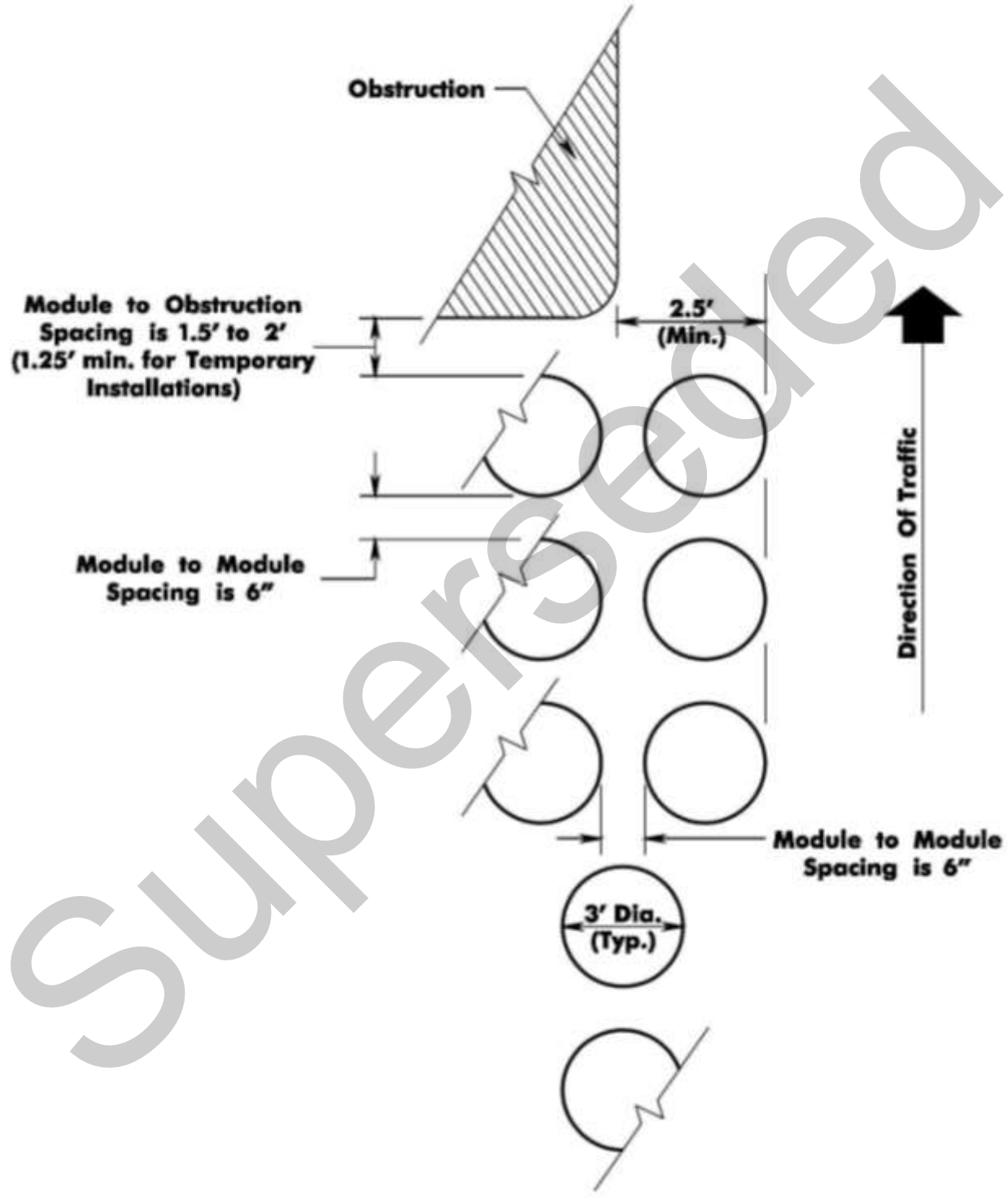

NOTE: A minimum of two modules must be provided in the last three rows.

CRASH CUSHION RESERVE AREA DETAILS

FIGURE: 9–C

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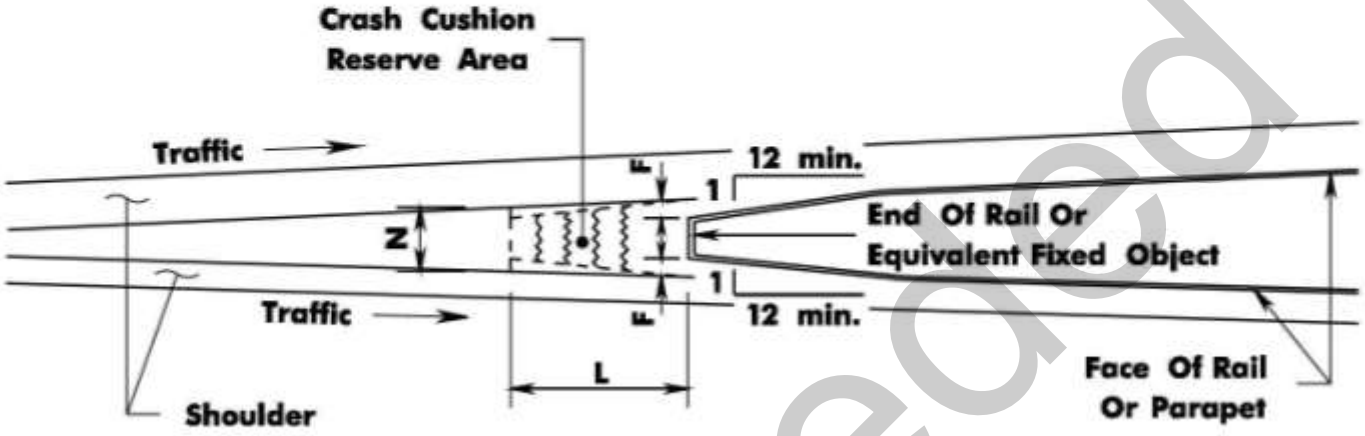


DESIGN SPEED ON MAINLINE (M.P.H.)	DIMENSIONS FOR CRASH CUSHION RESERVE AREA ON NEW CONSTRUCTION (FEET)								
	MINIMUM						PREFERRED		
	RESTRICTED CONDITIONS			UNRESTRICTED CONDITIONS					
	N	L	F	N	L	F	N	L	F
30	6	8	2	8	11	3	12	17	4
50	6	17	2	8	25	3	12	33	4
70	6	28	2	8	45	3	12	55	4

NOTE:

For intermediate design speeds, use the values for the higher design speed (i.e., for design speed of 40 M.P.H., use values for 50 M.P.H. design speed)

Table 9-1

QuadGuard II[1]

Width		Design Speed (mph), No. Bays, Length									
		Type 2					Type 3			Type 4	
		25	30	35	40	45	50	55	60	65	70
Narrow	24″[2]	1 Bay 6′-11″[3]	2 Bay 9′-11″[3]	2 Bay 9′-11″[3]	2 Bay 9′-11″[3]	3 Bay 12′-11″[3]	3 Bay 12′-11″[3]	4 Bay 16′-0″[3]	5 Bay 19′-0″[3]	6 Bay 22′-0″[3]	8 Bay 28′-1″[3]
	30″[2]	1 Bay 6′-11″[3]	2 Bay 9′-11″[3]	2 Bay 9′-11″[3]	2 Bay 9′-11″[3]	3 Bay 12′-11″[3]	3 Bay 12′-11″[3]	4 Bay 16′-0″[3]	5 Bay 19′-0″[3]	6 Bay 22′-0″[3]	8 Bay 28′-1″[3]
Medium	36″[2]	1 Bay 6′-11″[3]	2 Bay 9′-11″[3]	2 Bay 9′-11″[3]	2 Bay 9′-11″[3]	3 Bay 12′-11″[3]	3 Bay 12′-11″[3]	4 Bay 16′-0″[3]	5 Bay 19′-0″[3]	6 Bay 22′-0″[3]	8 Bay 28′-1″[3]
	48″[2]	1 Bay 6′-11″[3]	2 Bay 9′-11″[3]	2 Bay 9′-11″[3]	2 Bay 9′-11″[3]	3 Bay 12′-11″[3]	3 Bay 12′-11″[3]	4 Bay 16′-0″[3]	5 Bay 19′-0″[3]	6 Bay 22′-0″[3]	8 Bay 28′-1″[3]
Wide	69″[2]	3 Bay 13′-0″[4]	3 Bay 13′-0″[4]	3 Bay 13′-0″[4]	3 Bay 13′-0″[4]	4 Bay 16′-0″[4]	4 Bay 16′-0″[4]	5 Bay 19′-0″[4]	5 Bay 19′-0″[4]	6 Bay 22′-0″[4]	8 Bay 28′-0″[4]
X-Wide	90″[2]	3 Bay 13′-0″[4]	3 Bay 13′-0″[4]	3 Bay 13′-0″[4]	3 Bay 13′-0″[4]	4 Bay 16′-0″[4]	4 Bay 16′-0″[4]	5 Bay 19′-0″[4]	5 Bay 19′-0″[4]	6 Bay 22′-0″[4]	8 Bay 28′-0″[4]
	126″[2]						6 Bay 22′-0″[4]	6 Bay 22′-0″[4]	6 Bay 22′-0″[4]	6 Bay 22′-0″[4]	8 Bay 28′-0″[4]

Note: 1. Design table applicable to permanent installations of compressive barriers only
2. Width = distance between fender panels
3. Length = Approximate distance from nose of unit to back of unit. Includes tension strut backup. For 1 to 3 bays, add 1′-4″ for concrete backup; 4 to 7 bays add 1′-3″ for concrete backup; 8 bay add 1′-2″ for concrete backup.
4. Length = Approximate distance from nose of unit to back of unit. Includes tension strut backup. Add 2′ for concrete backup.

Table 9-2											
SCI[1]											
Width		Design Speed (mph), Model, Length									
		Type 2					Type 3			Type 4	
		25	30	35	40	45	50	55	60	65	70
Narrow	24″[2]	SCI70GM 13′-6″[3]	SCI70GM 13′-6″[3]	SCI70GM 13′-6″[3]	SCI70GM 13′-6″[3]	SCI70GM 13′-6″[3]	SCI100GM 21′-6″[3]	SCI100GM 21′-6″[3]	SCI100GM 21′-6″[3]	SCI100GM[4] 21′-6″[3]	SCI100GM[4] 21′-6″[3]
	30″[2]	SCI70GM 18′-0″[3]	SCI70GM 18′-0″[3]	SCI70GM 18′-0″[4]	SCI70GM 18′-0″[3]	SCI70GM 18′-0″[3]	SCI100GM 26′-0″[3]	SCI100GM 26′-0″[3]	SCI100GM 26′-0″[3]	SCI100GM[4] 26′-0″[3]	SCI100GM[4] 26′-0″[3]
Medium	36″[2]	SCI70GM 19′-5″[3]	SCI70GM 19′-5″[3]	SCI70GM 19′-5″[3]	SCI70GM 19′-5″[3]	SCI70GM 19′-5″[3]	SCI100GM 29′-7″[3]	SCI100GM 29′-7″[3]	SCI100GM 29′-7″[3]	SCI100GM[4] 29′-7″[3]	SCI100GM[4] 29′-7″[3]
	48″[2]	SCI70GM 21′-10[3]	SCI70GM 21′-10[3]	SCI70GM 21′-10[3]	SCI70GM 21′-10[3]	SCI70GM 21′-10[3]	SCI100GM 29′-10[3]″	SCI100GM 29′-10[3]″	SCI100GM 29′-10[3]″	SCI100GM[4] 29′-10[3]″	SCI100GM[4] 29′-103,″[3]
Wide	54″[2]	SCI70GM 23′-4″[3]	SCI70GM 23′-4″[3]	SCI70GM 23′-4″[3]	SCI70GM 23′-4″[3]	SCI70GM 23′-4″[3]	SCI100GM 31′-4″[3]	SCI100GM 31′-4″[3]	SCI100GM 31′-4″[3]	SCI100GM[4] 31′-4″[3]	SCI100GM[4] 31′-4″[3]
	72″[2]	SCI70GM 27′-6″[3]	SCI70GM 27′-6″[3]	SCI70GM 27′-6″[3]	SCI70GM 27′-6″[3]	SCI70GM 27′-6″[3]	SCI100GM 35′-6″[3]	SCI100GM 35′-6″[3]	SCI100GM 35′-6″[3]	SCI100GM[4] 35′-6″[3]	SCI100GM[4] 35′-6″[3]
X-Wide	84″[2]	SCI70GM 30′-4″[3]	SCI70GM 30′-4″[3]	SCI70GM 30′-4″[3]	SCI70GM 30′-4″[3]	SCI70GM 30′-4″[3]	SCI100GM 38′-4″[3]	SCI100GM 38′-4″[3]	SCI100GM 38′-4″[3]	SCI100GM[4] 38′-4″[3]	SCI100GM[4] 38′-4″[3]
	120 ″[2]	SCI70GM 38′-10″[3]	SCI70GM 38′-10″[3]	SCI70GM 38′-10″[3]	SCI70GM 38′-10″[3]	SCI70GM 38′-10″[3]	SCI100GM 46′-10″[3]	SCI100GM 46′-10″[3]	SCI100GM 46′-10″[3]	SCI100GM[4] 46′-10″[3]	SCI100GM[4] 46′-10″[3]

Note: 1. Design table applicable to permanent and temporary installations of compressive barriers and low maintenance compressive barriers. Temporary installations are only provided in narrow width.

2. Width = distance between side panels at rear of crash cushion. Obstructions wider than 24” require a transition assembly available from SCI Products, Inc.
3. Length = Approximate distance from front of crash cushion to rear of crash cushion. For widths greater than 24”, the length includes a transition assembly. Although SCI Products, Inc. provides transition assemblies for any width up to 180”, the use of transition assemblies greater than 120” is not recommended.
4. The SCI has been successfully crash tested to NCHRP Report 350 or MASH and is considered to be compliant and sufficient for design speeds greater than 60 mph.

Table 9-3

TRACC[1]

Width		Design Speed (mph), Model, Length									
		Type 2					Type 3			Type 4	
		25	30	35	40	45	50	55	60	65	70
Narrow	24″[2]	ShorTRACC 14′-3″[3]	ShorTRACC 14′-3″[3]	ShorTRACC 14′-3″[3]	ShorTRACC 14′-3″[3]	ShorTRACC 14′-3″[3]	TRACC 21′-3″[3]	TRACC 21′-3″[3]	TRACC 21′-3″[3]	FasTRACC 26′-0″[3]	FasTRACC 26′-0″[3]
	30″[2]	ShorTRACC 14′-3″[3]	ShorTRACC 14′-3″[3]	ShorTRACC 14′-3″[3]	ShorTRACC 14′-3″[3]	ShorTRACC 14′-3″[3]	TRACC 21′-3″[3]	TRACC 21′-3″[3]	TRACC 21′-3″[3]	FasTRACC 26′-0″[3]	FasTRACC 26′-0″[3]
Medium	41″[2]	NA	NA	NA	NA	NA	WideTRACC 21′-0″[3]	WideTRACC 21′-0″[3]	WideTRACC 21′-0″[3]	NA	NA
Wide	58″[2]	NA	NA	NA	NA	NA	WideTRACC 21′-0″[3]	WideTRACC 21′-0″[3]	WideTRACC 21′-0″[3]	NA	NA

Note: 1. Design table applicable to permanent and temporary installations of compressive barriers

2. Width = distance between side panels at rear of crash cushion

3. Length = Approximate distance from front of crash cushion to backup frame. WideTRACC-L (left side) and WideTRACC-R (right side) have a flare on one side only and are used to shield wide obstructions. By adding extensions, wider obstructions can be shielded. Each extension adds 28 inches of length and 3 7/16 inches of width. WideTRACC-B (both sides) is flared on each side and is also used to shield wide obstructions. By adding extensions, wider obstructions can be shielded. Each extension for the WideTRACC-B adds 28 inches of length and 6 7/16 inches of width.

Table 9-4

Universal TAU-II[1, 2]

Width		Design Speed (mph), No. Bays, Length									
		Type 2					Type 3			Type 4	
		25	30	35	40	45	50	55	60	65	70
Narrow	30″[3]	2 Bay 10′-0″[4]	2 Bay 10′-0″[4]	3 Bay 13′-0″[4]	4 Bay 15′-9″[4]	4 Bay 15′-9″[4]	5 Bay 18′-6″[4]	7 Bay 24′-3″[4]	8 Bay 27′-3″[4]	10 Bay 30′-0″[4]	10 Bay 32′-9″[4]
Medium	36″[3]	2 Bay 10′-0″[4]	2 Bay 10′-0″[4]	3 Bay 12′-9″[4]	4 Bay 15′-9″[4]	4 Bay 15′-9″[4]	5 Bay 18′-9″[4]	7 Bay 24′-3″[4]	8 Bay 27′-0″[4]	10 Bay 29′-9″[4]	10 Bay 32′-9″[4]
	42″[3]	2 Bay 10′-0″[4]	2 Bay 10′-0″[4]	3 Bay 12′-9″[4]	4 Bay 15′-9″[4]	4 Bay 15′-9″[4]	5 Bay 18′-9″[4]	7 Bay 24′-3″[4]	8 Bay 26′-3″[4]	10 Bay 29′-9″[4]	10 Bay 32′-9″[4]
	48″[3]	2 Bay 10′-0″[4]	2 Bay 10′-0″[4]	3 Bay 13′-0″[4]	4 Bay 15′-3″[4]	4 Bay 15′-3″[4]	5 Bay 18′-0″[4]	7 Bay 23′-6″[4]	8 Bay 23′-9″[4]	10 Bay 29′-0″[4]	10 Bay 31′-9″[4]
Wide	54″[3]	2 Bay 10′-9″[4]	2 Bay 10′-9″[4]	3 Bay 13′-0″[4]	4 Bay 15′-9″[4]	4 Bay 15′-9″[4]	5 Bay 18′-0″[4]	7 Bay 23′-9″[4]	8 Bay 26′-3″[4]	10 Bay 29′-0″[4]	10 Bay 31′-9″[4]
	60″[3]	2 Bay 10′-9″[4]	2 Bay 10′-0″[4]	3 Bay 12′-9″[4]	4 Bay 15′-9″[4]	4 Bay 15′-9″[4]	5 Bay 18′-3″[4]	7 Bay 23′-6″[4]	8 Bay 27′-0″[4]	10 Bay 29′-0″[4]	10 Bay 32′-9″[4]
	66″[3]			2 Bay 9′-9″[4]	3 Bay 12′-6″[4]	3 Bay 12′-6″[4]	4 Bay 15′-6″[4]	5 Bay 20′-9″[4]	7 Bay 23′-6″[4]	9 Bay 26′-3″[4]	9 Bay 29′-9″[4]
	72″[3]			2 Bay 10′-0″[4]	3 Bay 12′-6″[4]	3 Bay 12′-6″[4]	4 Bay 15′-6″[4]	5 Bay 18′-9″[4]	7 Bay 24′-0″[4]	8 Bay 27′-0″[4]	8 Bay 27′-0″[4]
X-wide	78″[3]			2 Bay 9′-9″[4]	3 Bay 12′-6″[4]	3 Bay 12′-6″[4]	4 Bay 15′-6″[4]	5 Bay 18′-6″[4]	7 Bay 24′-9″[4]	8 Bay 27′-0″[4]	8 Bay 27′-0″[4]
	84″[3]				3 Bay 13′-0″[4]	3 Bay 13′-0″[4]	4 Bay 15′-9″[4]	5 Bay 18′-6″[4]	7 Bay 24′-0″[4]	8 Bay 27′-3″[4]	8 Bay 27′-3″[4]
	90″[3]				3 Bay 13′-0″[4]	3 Bay 13′-0″[4]	4 Bay 15′-9″[4]	5 Bay 18′-9″[4]	7 Bay 24′-3″[4]	8 Bay 27′-0″[4]	8 Bay 27′-0″[4]
	96″[3]				3 Bay 12′-9″[4]	3 Bay 12′-9″[4]	4 Bay 16′-3″[4]	5 Bay 18′-9″[4]	7 Bay 24′-3″[4]	8 Bay 27′-0″[4]	8 Bay 27′-0″[4]
	102″									8 Bay 27′-0″[4]	8 Bay 27′-0″[4]

Note: 1. Design table applicable to permanent and temporary installations of compressive barriers
2. Can be used in construction zones to shield the end of construction barrier curb or other obstruction up to 36 inches wide.
3. Width = distance between end panels at backup.
4. Length = Approximate distance from nose to back of end panel. The lengths listed are for Compact and Wide Flange backstops. Overall system lengths for other backstops will vary slightly

Table 9-5											
QuadGuard Elite [1]											
Width		Design Speed (mph), No. Bays, Length									
		Type 2					Type 3			Type 4	
		25	30	35	40	45	50	55	60	65	70
Narrow	24″[2],	5 Bay 17′-11″[3]	5 Bay 17′-11″[3]	5 Bay 17′-11″[3]	7 Bay 23′-10″[3]	7 Bay 23′-10″[3]	8 Bay 26′-7″[3]	8 Bay 26′-7″[3]	11 Bay 35′-6″[3]	14 Bay 44′-9″[3]	14 Bay 44′-9″[3]
	30″[2]	5 Bay 17′-11″[3]	5 Bay 17′-11″[3]	5 Bay 17′-11″[3]	7 Bay 23′-10″[3]	7 Bay 23′-10″[3]	8 Bay 26′-7″[3]	8 Bay 26′-7″[3]	11 Bay 35′-6″[3]	14 Bay 44′-9″[3]	14 Bay 44′-9″[3]
Medium	36″[2]	5 Bay 17′-11″[3]	5 Bay 17′-11″[3]	5 Bay 17′-11″[3]	7 Bay 23′-10″[3]	7 Bay 23′-10″[3]	8 Bay 26′-7″[3]	8 Bay 26′-7″[3]	11 Bay 35′-6″[3]	14 Bay 44′-9″[3]	14 Bay 44′-9″[3]
Wide	69″[2]	5 Bay 17′-11″[3]	5 Bay 17′-11″[3]	5 Bay 17′-11″[3]	7 Bay 23′-10″[3]	7 Bay 23′-10″[3]	8 Bay 26′-7″[3]	8 Bay 26′-7″[3]	11 Bay 35′-6″[3]	See Note 4	See Note 4
X-Wide	90″[2]	5 Bay 17′-11″[3]	5 Bay 17′-11″[3]	5 Bay 17′-11″[3]	7 Bay 23′-10″[3]	7 Bay 23′-10″[3]	8 Bay 26′-7″[3]	8 Bay 26′-7″[3]	11 Bay 35′-6″[3]	See Note 4	See Note 4

Note:
1. Design table applicable to permanent installations of low maintenance compressive barriers only
2. Width = distance between fender panels at rear of crash cushion
3. Length = Approximate distance from front of crash cushion to back of unit, including tension strut backup.
4. Since a 14 bay unit is not available in either a 69″ or 90″ system width, an 11 bay unit may be used. The QuadGuard Elite has been successfully crash tested to NCHRP Report 350 or MASH and is considered to be compliant and sufficient for design speeds greater than 60 mph.

Table 9-6											
REACT 350 & REACT 350 II [1]											
Width		Design Speed (mph), No. Bays, Length									
		Type 2[2]					Type 3[3]			Type 4[3]	
		25	30	35	40	45	50	55	60	65	70
Medium[6]	36"[4]	4 Bay 14'-2"[5]	4 Bay 14'-2"[5]	4 Bay 14'-2"[5]	4 Bay 14'-2"[5]	4 Bay 14'-2"[5]	6 Bay 20'-2"[5]	6 Bay 20'-2"[5]	6 Bay 20'-2"[5]	6 Bay[7] 20'-2"[5]	6 Bay[7] 20'-2"[5]

Note:
1. Design table applicable to permanent installations of low maintenance compressive barriers
2. REACT 350
3. REACT 350 II
4. Width = outside diameter of cylinder
5. Length = Approximate distance from face of front cylinder to obstruction. Add 3" for concrete backup with unidirectional traffic, and 9" for concrete backup with bidirectional traffic.
6. Although wider REACT 350 units are available, due to the expense of these units, only the medium width is recommended for used on Department projects.
7. The REACT 350 and REACT 350 II have been successfully crash tested to NCHRP Report 350 or MASH and are considered to be compliant and sufficient for design speeds greater than 60 mph.

Table 9-7											
QuadGuard II CZ[1]											
Width		Design Speed (mph), No. Bays, Length									
		Type 2					Type 3			Type 4	
		25	30	35	40	45	50	55	60	65	70
Narrow	24″[2],	2 Bay 9′-11″[3]	2 Bay 9′-11″[3]	2 Bay 9′-11″[3]	2 Bay 9′-11″[3]	3 Bay 12′-11″[3]	3 Bay 12′-11″[3]	4 Bay 16′-0″[3]	5 Bay 19′-0″[3]	6 Bay 22′-0″[3]	8 Bay 29′-1″[3]
	30″[2]	2 Bay 9′-11″[3]	2 Bay 9′-11″[3]	2 Bay 9′-11″[3]	2 Bay 9′-11″[3]	3 Bay 12′-11″[3]	3 Bay 12′-11″[3]	4 Bay 16′-0″[3]	5 Bay 19′-0″[3]	6 Bay 22′-0″[3]	8 Bay 29′-1″[3]
Medium	36″[2],	2 Bay 9′-11″[3]	2 Bay 9′-11″[3]	2 Bay 9′-11″[3]	2 Bay 9′-11″[3]	3 Bay 12′-11″[3]	3 Bay 12′-11″[3]	4 Bay 16′-0″[3]	5 Bay 19′-0″[3]	6 Bay 22′-0″[3]	8 Bay 29′-1″[3]
	48″[2]	2 Bay 9′-11″[3]	2 Bay 9′-11″[3]	2 Bay 9′-11″[3]	2 Bay 9′-11″[3]	3 Bay 12′-11″[3]	3 Bay 12′-11″[3]	4 Bay 16′-0″[3]	5 Bay 19′-0″[3]	6 Bay 22′-0″[3]	8 Bay 29′-1″[3]

Note: 1. Design table applicable to temporary installations of compressive barriers only
2. Width = distance between fender panels
3. Length = Approximate distance from nose to rear of steel backup

Table 9-8											
REACT 350 WZ[1] & REACT 350 II WZ											
Width		Design Speed (mph), No. Bays, Length									
		Type 2[3]					Type 3[4]			Type 4[4]	
		25	30	35	40	45	50	55	60	65	70
Medium	36″[2]	4 Bay 13′-9″[5]	4 Bay 13′-9″[5]	4 Bay 13′-9″[5]	4 Bay 13′-9″[5]	4 Bay 13′-9″[5]	6 Bay 21′-3″[5]	6 Bay 21′-3″[5]	6 Bay 21′-3″[5]	6 Bay[6] 21′-3″[5]	6 Bay[6] 21′-3″[5]

Note: 1. Design table applicable to temporary installations of low maintenance compressive barriers only
2. Width = outside diameter of cylinder
3. REACT 350 WZ
4. REACT 350 II WZ
5. Length = Approximate distance from face of front cylinder to rear of steel self-contained backup.
6. The REACT 350 and REACT 350 II have been successfully crash tested to NCHRP Report 350 or MASH and are considered to be compliant and sufficient for design speeds greater than 60 mph.

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.

9.2.5 Physical Conditions of the Site

The presence of a curb can seriously reduce the effectiveness of a crash cushion. It is recommended that all curbs and islands be removed approximately 50 feet in front of a crash cushion and as far back as the unit's backup. While new curbs should not be built where crash cushions are to be installed, it is not essential to remove existing curbs less than four inches in height. Curbs from four inches to six inches in height should be removed unless consideration of the curb shape, site geometry, impending overlays that would reduce the curb height, and cost of removal justify leaving the curb in. Curbs over six inches high shall be removed before installing a crash cushion. When a curb is terminated behind a crash cushion, the curb should be gently flared and/or ramped. Flares of 15:1 and ramps of 20:1 are recommended on high speed facilities.

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.

Crash cushions should be placed on a relatively flat surface. Longitudinal and transverse slopes in excess of 8 percent could adversely affect the performance of a crash cushion and should be avoided. If the cross slope varies more than 2 percent over the length of the unit, a concrete leveling pad or other compensating alterations may have to be made at the site.

Joints, especially expansion joints, in the crash cushion area may require special design accommodations for those crash cushions that require anchorage. The designer should contact the manufacturer/supplier before proceeding with a crash cushion design that spans an expansion joint(s).

9.2.6 Redirection Characteristics

Compressive barriers have redirection capabilities. Since inertial barriers have no redirection capabilities, it is important that the recommended placement details shown in Figure 9-B be adhered to so as to minimize the danger of a vehicle penetrating the barrier from the side and hitting the obstructions.

9.2.7 Design Speed

Compressive barriers and inertial barrier systems can be designed for speeds up to 70 mph.

9.2.8 Foundations

Permanent inertial barriers shall be placed on concrete or asphalt pavement that is four inches or greater in thickness. Temporary inertial barriers may be placed on any smooth compacted surface. Permanent QuadGuard II, QuadGuard Elite, REACT 350 and REACT 350 II Systems must be installed on existing concrete pavement or a concrete pad. A concrete foundation is also required for permanent SCI, Universal TAU-II and TRACC systems. All temporary compressive barriers may be placed on HMA, HMA over concrete or HMA over DGA. Table 9-9 lists the minimum foundation requirements for the various compressive barrier systems.

In addition to the permanent foundation types indicated in Table 9-9 for the Universal TAU II, it may also be installed on a 4” minimum non-reinforced concrete

pad or 6” HMA over a 6” DGA base pad. However, this will require the construction of a reinforced anchor block 48” wide x 36” deep x 33.5” long at the front of the pad when using a portable concrete barrier backstop anchored directly to an existing or proposed concrete barrier curb or wall. If a compact backstop is used, a reinforced anchor block 48” wide x 36” deep x 33.5” long will be required at the front of the pad and an anchor block 48” wide x 36” deep x 47” long will be required at the back of the pad.

When the QuadGuard II or QuadGuard Elite with a tension strut backup is installed on a 6” reinforced concrete pad, an anchor block 48” long x 30” deep x 48” wide at the front of the pad is required. The anchor block is not required if these units are installed on an 8” reinforced concrete pad. For the QuadGuard II with a concrete backup, a footing 24” long x 36” deep x 48” wide is required and is to be poured monolithically with the backup.

For an independent installation, the REACT 350 and REACT 350 II with a self-contained backup requires an anchor block to be poured monolithically with the concrete pad. The anchor block is 54” wide x 28” deep x 24” long for unidirectional traffic and 30” long for bidirectional traffic at the rear of the concrete pad. However, if the system is to be placed against and supported by a rigid barrier or other structure, the anchor block may be omitted.

To avoid conflicts, the designer should avoid placing drainage systems or subsurface utilities within the foundation area of compressive barrier systems.

Table 9-9					
Compressive Barrier System	Minimum Foundation Requirements				
	Permanent and Temporary Installations		Temporary Installation		
	Existing Concrete[1]	Concrete Pad[2]	HMA Only	HMA over Concrete	HMA & DGA
QuadGuard II	6" reinforced, 8" nonreinforced	6" reinforced 8" reinforced[3]	NA	NA	NA
QuadGuard II CZ	6" reinforced, 8" non-reinforced	6" reinforced	8"	3" HMA 3" Concrete	6" HMA 6" DGA
QuadGuard Elite	6" reinforced, 8" non-reinforced	6" reinforced 8" reinforced[3]	NA	NA	NA
REACT 350 REACT 350 II	8" reinforced, 8" non-reinforced	8" reinforced	NA	NA	NA
REACT 350WZ REACT 350 II WZ	8" reinforced, 8" non-reinforced	8" Precast reinforced[4]	8"	3" HMA 3" Concrete	6" HMA 6" DGA
SCI	6" reinforced 8" non-reinforced	6" reinforced 8" non-reinforced	8"	3" HMA 3" non-reinforced	6" HMA 6" DGA
TRACC	6" reinforced, 8" non-reinforced	6" reinforced 8" non-reinforced	8"	3" HMA 3" Concrete	6" HMA 6" DGA
Universal TAU-II	6" reinforced, 8" non-reinforced	6" reinforced 8" non-reinforced	8"	3" HMA 3" Concrete	6" HMA 6" DGA

HMA = Hot Mix Asphalt
DGA = Dense Graded Aggregate Base Course

Note: 1. Minimum concrete pavement dimensions are 12 feet wide by 50 feet long.
2. The dimensions of the concrete pad are available from the manufacturers.
3. Optional concrete pad for tension strut backup. To prevent sliding during an impact, the concrete pad must be installed against or tied to an existing structure otherwise additional below grade supports must be added.
4. 36" wide, 4-bay system only

9.2.9 Backup Structure Requirements

Inertial Barriers do not require a backup structure.

Several compressive crash cushions have more than one type of backup structure that is capable of withstanding the forces of an impact. Backup systems and detailed drawings are available from the manufacturer/supplier (see Subsection 9.4 for contact information).

Table 9-10 lists the backup systems for various compressive crash cushions

Table 9-10	
BACKUP STRUCTURES	
Crash Cushion	Backup Structure[1]
QuadGuard II	Tension Strut Backup[2] Concrete Backup[2]
QuadGuard Elite	Tension Strut Backup[2]
QuadGuard II CZ	Steel Backup[2]
REACT 350	Steel Self-Contained Backup[4] Concrete Backup[5]
REACT 350WZ	Steel Self-Contained Backup[4]
Universal TAU-II	Compact Backstop[2],[3] Compact Backstop with Asphalt Adapter[2],[3] Portable Concrete Barrier Backstop[2],[3] Portable Concrete Barrier Backstop with Asphalt Adapter[2],[3] Flush Mount[2],[3] Wide Flange Backstop[6]
TRACC	W-beam median barrier, thrie beam median barrier, vertical concrete wall or concrete barrier curb[7]
SCI	Self supporting, does not require backup structure [2]

Note:
1. Where there is a choice of backstops, the designer shall contact the manufacturer/supplier to determine the appropriate backstop to use for each site.
2. Provision shall be made for rear side panels to move rearward beyond the back of the crash cushion a minimum of 2.5 ft. on impact.
3. Must be attached directly to the end of a concrete barrier
4. Where used to shield barrier curb, the base of the barrier curb must be tapered, see manufacturer's recommendations. Include the tapered requirements in GENERAL NOTES on the applicable construction detail (CD—611-1 or CD-159-11).
5. Where used to shield barrier curb, a 10' barrier curb transition shall be provided to avoid the backup from protruding beyond the barrier curb where traffic will be approaching from the rear of the system. Include the taper requirement in the GENERAL NOTES on the applicable construction detail (CD—611-1 or CD-159-11).
6. Required for systems 42" wide and greater
7. 5 ft. clear space required on both sides of the backup structure for the side panels to retract during an end-on impact

9.2.10 Anchorage Requirements

Compressive barrier systems require an anchorage that is capable of restraining the crash cushion during an impact. The manufacturers' standard designs of these crash cushions include the necessary anchorage.

9.2.11 Flying Debris Characteristics

Impact with an inertial barrier will produce some flying debris. However, this is not considered a serious drawback.

9.2.12 Initial Cost

The inertial barriers have the lowest initial cost. Compared to inertial barriers, the compressive barrier systems have the highest initial cost. Assuming the same site preparation requirements, the initial cost of a compressive barrier system will

usually be five to six times higher than an inertial barrier. The initial cost of the QuadGuard Elite, REACT 350 and REACT 350 II Systems is significantly higher than the standard compressive barrier systems. However, due to their reusability after a crash, the cost to maintain these systems is much less than the QuadGuard II, TRACC and the Universal TAU II.

9.2.13 Maintenance

Inertial barriers are particularly susceptible to damage during minor impacts. Because of their susceptibility to damage, permanent inertial barriers should not be used in gore areas unless the width of the obstruction cannot be shielded by a compressive barrier. In addition, at locations where nuisance hits may be common or there is a high probability of accidents, a compressive barrier should be considered in lieu of the inertial barrier as a means of reducing maintenance requirements.

Compressive barrier systems are generally reusable after a minor collision. After a severe impact, the QuadGuard II and Universal TAU-II Cartridges must be replaced after the units are repositioned and other damaged components replaced. The TRACC system may be permanently twisted after a severe impact. If one side of the system is raised more than 1 ½ inches when compared to the other side of the system, then the damaged base assembly should be replaced in addition to other damaged components. The SCI after most frontal impacts has only minor damage and generally no repairs are required after a side impact. Repairs can typically be made within one hour.

For most impacts with the QuadGuard Elite, REACT 350 and REACT 350 II Systems, the main structural elements and energy absorbing materials do not require replacement. The unit is reusable after most impacts and can generally be placed back into service in approximately one hour.

9.3 Design Procedure

9.3.1 Inertial Barriers

Inertial barriers on the Qualified Products List (QPL) are interchangeable in any array. The design of an inertial barrier is based on the law of conservation of momentum. It can be shown that:

Equation 1

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

V_f = velocity of vehicle after impact with Ws, in fps

V_o = velocity of vehicle prior to impact with Ws, in fps

W = weight of vehicle, in lbs

W_s = weight of sand actually impacted by a 6-foot wide vehicle, in lbs.

This equation is used to calculate the velocity of a vehicle as it penetrates each row of the inertial barrier. When a vehicle has been slowed to approximately 10 mph (14.7 fps) or less per Equation 1, it will actually have been stopped because of deceleration forces that have been neglected in Equation 1.

Slowing of the vehicle must take place gradually so that the desirable deceleration force is 6G's for unrestrained occupants, and 8G's with lap belt in place. Where space is limited, a maximum of 12G's should be used. The deceleration force is calculated using Equation 2. Note that velocity is in feet per second (fps).

Equation 2

$$G = \frac{V_0^2 - V_f^2}{2Dg}$$

G = deceleration force in G's

V_o = velocity of vehicle prior to impact, in fps

V_f = velocity of vehicle after impact with one row of modules, in fps

D = distance traveled in decelerating from Vo to Vf

(Usually D = width of a module = 3 feet)

g = 32.2 ft/s2

The standard weights of modules used are 200 lbs., 400 lbs., 700 lbs., 1400 lbs., and 2100 lbs. However, the use of a 2100 lbs. module is not recommended unless site conditions are restricted and the use of 1400 lbs. modules would not stop the vehicle from striking the obstruction.

A minimum of two modules are required in the last three rows of the barrier array to meet the 2.5 feet criteria shown in Figure 9-B. An additional last row of 1400 lbs. modules is provided after required reduction in speed is obtained.

When a wide obstruction is being shielded, the modules may be spaced up to 3 feet apart. However, module to module spacing greater than 6 inches must be accounted for in the design. Ws in Equation 1 is the weight of sand impacted by a 6-foot wide vehicle. Therefore, if 1400 lbs. modules (three feet diameter) were spaced 2 feet apart, Ws would equal 1867 lbs.

Sand barrel arrays can be designed for any speed up to 60 mph. On projects that have design speeds exceeding 60 mph, the sand barrel array shall be designed for 60 mph. The Energite III, Universal and Big Sandy Inertial Barriers have been successfully crash tested to NCHRP Report 350 or MASH and are considered to be compliant and sufficient for design speeds greater than 60 mph.

Figures 9-D, 9-E and 9-F illustrate typical sand barrel configurations for narrow barrier arrays.

The designer should first check the sand barrel configuration for an 1800 lb. vehicle and then make the same check for a 4400 lb. vehicle. Using Figure 9-F with a design speed of 60 mph (88 fps) as an example:

Example of Inertial Barrier Design
for 1800 lb. Vehicle:

ROW	W_s	V_o	V_f[1]	G[1, 2]
1	200	88	79.2	7.6
2	200	79.2	71.3	6.2
3	200	71.3	64.2	5.0
4	400	64.2	52.5	7.1
5	700	52.5	37.8	6.9
6	700	37.8	27.2	3.6
7	1400	27.2	15.3	2.6
8	2800	15.3	6.0	1.0
9	2800	---	---	---
10	2800	---	---	---

Note 1 V_f and G are calculated using Equations 1 & 2.
Note 2 It is desirable to limit G for each row to a maximum of 6. However, since 200 lbs. is the lightest module recommended for use, the 7.6 cannot be decreased.

Example of Inertial Barrier Design
for 4400 lb. Vehicle:

ROW	W_s	V_o	V_f[1]	G[1]
1	200	88	84.2	3.4
2	200	84.2	80.5	3.1
3	200	80.5	77.0	2.9
4	400	77.0	70.6	4.9
5	700	70.6	60.9	6.6
6	700	60.9	52.5	4.9
7	1400	52.5	39.9	6.1
8	2800	39.9	24.4	5.2
9	2800	24.4	14.9	1.9
10	2800	---	---	---

Note 1 V_f and G are calculated using Equations 1 & 2.

Since the assumed configuration (shown in Figure 9-F) meets all the requirements specified in the previous examples, no changes are necessary.

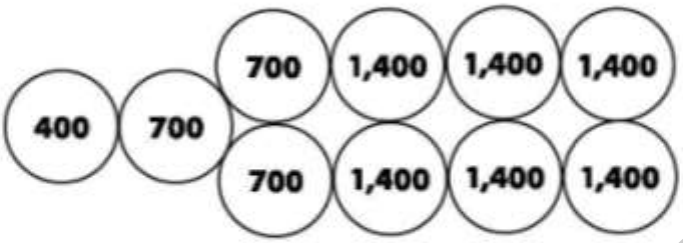
Although manufacturers of inertial barriers have developed designs for various speeds, designers shall develop barrier arrays based upon the previous examples.

A layout of the modules, including the weight of each module, must be included as a construction detail in the contract plans.

TYPICAL SAND BARREL CONFIGURATION

FIGURE: 9–D

BDC12MR–03



40 MPH DESIGN – 4,400# VEHICLE

ROW	Ws (LB)	V_o	V_f	G
1	400	58.7	53.8	2.8
2	700	53.8	46.4	3.8
3	1,400	46.4	35.2	4.7
4	2,800	35.2	21.5	4.0
5	2,800	21.5	13.1	1.5
6	2,800	—	—	—

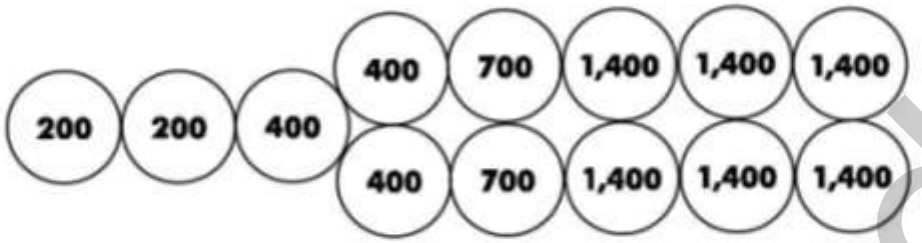
40 MPH DESIGN – 1,800# VEHICLE

ROW	Ws (LB)	V_o	V_f	G
1	400	58.7	48.0	5.9
2	700	48.0	34.6	5.7
3	1,400	34.6	19.5	4.2
4	2,800	19.5	7.6	1.7
5	2,800	—	—	—
6	2,800	—	—	—

TYPICAL SAND BARREL CONFIGURATION

FIGURE: 9–E

BDC12MR–03



50 MPH DESIGN – 4,400# VEHICLE

ROW	Ws (LB)	V_o	V_f	G
1	200	73.3	70.1	2.4
2	200	70.1	67.1	2.2
3	400	67.1	61.5	3.7
4	800	61.5	52.0	5.6
5	1,400	52.0	39.5	6.0
6	2,800	39.5	24.1	5.1
7	2,800	24.1	14.7	1.9
8	2,800	—	—	—

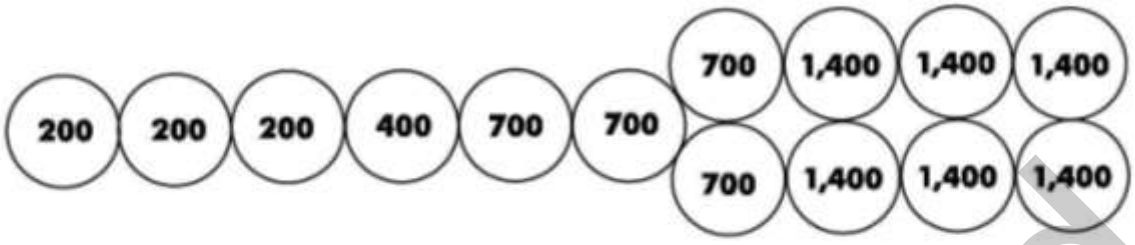
50 MPH DESIGN – 1,800# VEHICLE

ROW	Ws (LB)	V_o	V_f	G
1	200	73.3	66.0	5.3
2	200	66.0	59.4	4.3
3	400	59.4	48.6	6.0
4	800	48.6	33.6	6.4
5	1,400	33.6	18.9	4.0
6	2,800	18.9	7.4	1.6
7	2,800	—	—	—
8	2,800	—	—	—

TYPICAL SAND BARREL CONFIGURATION

FIGURE: 9–F

BDC12MR–03



60 MPH DESIGN – 4,400# VEHICLE

ROW	Ws (LB)	V_o	V_f	G
1	200	88.0	84.2	3.4
2	200	84.2	80.5	3.1
3	200	80.5	77.0	2.9
4	400	77.0	70.6	4.9
5	700	70.6	60.9	6.6
6	700	60.9	52.5	4.9
7	1,400	52.5	39.9	6.1
8	2,800	39.9	24.4	5.2
9	2,800	24.4	14.9	1.9
10	2,800	—	—	—

60 MPH DESIGN – 1,800# VEHICLE

ROW	Ws (LB)	V_o	V_f	G
1	200	88.0	79.2	7.6
2	200	79.2	71.3	6.2
3	200	71.3	64.2	5.0
4	400	64.2	52.5	7.1
5	700	52.5	37.8	6.9
6	700	37.8	27.2	3.6
7	1,400	27.2	15.3	2.6
8	2,800	15.3	6.0	1.0
9	2,800	—	—	—
10	2,800	—	—	—

9.3.2 Compressive Barriers

The standard items for compressive barriers are generic.

There are two different types of standard items for permanent compressive barriers contained in the current Section 611 of the 2007 Standard Specifications for Road and Bridge Construction (BDC10S-04):

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

There are also two different types of standard items for temporary compressive barriers contained in the current Section 159 of the 2007 Standard Specifications for Road and Bridge Construction (BDC10S-04):

- 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 of 50 to 60 MPH
- TYPE 4 = Design Speed of 65 to 70 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”

Determine which standard item to use along with the type and width to fit your site. Examples of item names would be:

- CRASH CUSHION, COMPRESSIVE BARRIER, TYPE 3, WIDTH NARROW
- CRASH CUSHION, LOW MAINTENANCE COMPRESSIVE BARRIER, TYPE 2, WIDTH MEDIUM
- TEMPORARY CRASH CUSHION, COMPRESSIVE BARRIER, TYPE 4, WIDTH NARROW
- TEMPORARY CRASH CUSHION, LOW MAINTENANCE COMPRESSIVE BARRIER, TYPE 3, WIDTH X-WIDE

Since the item names are generic, the designer will need to determine which of the approved crash cushion models and sizes will fit 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 should determine which of the approved crash cushion models will fit at each site, based on the dimensions of the obstruction being protected (see subsection 9.2.2) and the space requirements of the crash cushion (see subsection 9.2.3). Subsection 9.2.1 B, C, D and E list the approved models and Table 9-1 through 9-8 list the model sizes based on TYPE, WIDTH and design speed. Unless there is a space limitation at a site, any one of the approved crash cushions may be used. Therefore, the designer must determine which compressive crash cushion model(s)/size(s) will fit at each location.

After determining which models and sizes will physically fit each site, the designer should further narrow down the list of potential models/sizes by evaluating the remaining factors contained in subsection 9.2.4 through 9.2.13. There is therefore no simple, systematic selection procedure.

The final list of potential models/sizes should include all those deemed appropriate for the site. The designer then must provide the Item Number, Pay Item, Description, Design Speed, Product information, Route and Station, Foundation and Backup System information in the Standard Roadway Construction Details. In addition, information specific to the model(s) selected, such as required barrier transitions, system offsets, anchor blocks, etc shall be included in the GENERAL NOTES on the applicable construction detail (CD-159-11 or CD-611-1). The designer shall enter the information for temporary compressive crash cushions and temporary low maintenance crash cushions on the Temporary Crash Cushion Compressive Barrier Summary Table in Construction Detail CD-159-11 for all the crash cushion models/sizes that the contractor may use for that site. The designer shall enter the information for permanent compressive crash cushions and permanent low maintenance crash cushions on the Crash Cushion Compressive Barrier Summary Table in Construction Detail CD-611-1 for all the crash cushion models/sizes that the contractor may use for that site. Figure 9-G and Figure 9-H are examples of the Temporary Crash Cushion Compressive Barrier Summary Table and Crash Cushion Compressive Barrier Table respectively.

EXAMPLE TEMPORARY CRASH CUSHION COMPRESSIVE BARRIER SUMMARY TABLE

FIGURE: 9–G

BDC12MR–03

TEMPORARY CRASH CUSHION COMPRESSIVE BARRIER SUMMARY TABLE

ITEM NO.	DESCRIPTION	DESIGN SPEED	ROUTE AND STATION	PRODUCT	FOUNDATION	BACKUP SYSTEM
159200	TEMPORARY CRASH CUSHION, COMPRESSIVE BARRIER TYPE 2, WIDTH NARROW	40 MPH	ROUTE 130, PROPOSED BASELINE STATION 1500+00 RT.	QUADGUARD II CZ 2 BAY, 24" WIDE 9'–11" LENGTH	EXISTING PAVEMENT	TENSION STRUT
				TAU II, 4 BAY, 30" WIDE 15'–9" LENGTH	EXISTING PAVEMENT	CONCRETE BACKSTOP WITH ASPHALT ADAPTER
				SHORTRACC, 24" WIDE 14'–3" LENGTH	EXISTING PAVEMENT	NA
				SCI 70GM, 24" WIDE 13'–6" LENGTH	EXISTING PAVEMENT	NA

GENERAL NOTES:

1. FOR EACH LOCATION SHOWN IN THE TEMPORARY CRASH CUSHION, COMPRESSIVE BARRIER SUMMARY TABLE, INSTALL ONE (1) OF THE CRASH CUSHIONS LISTED FOR THAT LOCATION.
2. THE STATION LOCATION SHOWN IS APPROXIMATE AND MAY BE ADJUSTED IN THE FIELD.

EXAMPLE CRASH CUSHION COMPRESSIVE BARRIER SUMMARY TABLE

FIGURE: 9–H

BDC12MR–03

CRASH CUSHION COMPRESSIVE BARRIER SUMMARY TABLE

ITEM NO.	DESCRIPTION	DESIGN SPEED	ROUTE AND STATION	PRODUCT	FOUNDATION	BACKUP SYSTEM
611312	CRASH CUSHION, COMPRESSIVE BARRIER TYPE 3, WIDTH NARROW	50 MPH	ROUTE 130, PROPOSED BASELINE STATION 1450+50 LT.	QUADGUARD II 3 BAY, 24" WIDE 12'-11" LENGTH	8" REINFORCED CONCRETE PAD	TENSION STRUT
				TAU II, 5 BAY, 30" WIDE 18'-6" LENGTH	6" REINFORCED CONCRETE PAD	COMPACT BACKSTOP
				TRACC, 24" WIDE 21'-3" LENGTH	6" REINFORCED CONCRETE PAD	NA
				SCI 100 GM, 24" WIDE 21'-6" LENGTH	6" REINFORCED CONCRTE PAD	NA
611315	CRASH CUSHION, COMPRESSIVE BARRIER TYPE 3, WIDTH MEDIUM	60 MPH	ROUTE 130, PROPOSED BASELINE STATION 1600+00 RT.	QUADGUARD II 5 BAY, 36" WIDE 19'-0" LENGTH	6" REINFORCED CONCRETE PAD (SEE NOTE 2)	TENSION STRUT
				TAU II, 8 BAY, 36" WIDE 27'-0" LENGTH	6" REINFORCED CONCRETE PAD	COMPACT BACKSTOP
				WIDE TRACC, 41" WIDE 21' LENGTH	6" REINFORCED CONCRETE PAD	NA

GENERAL NOTES:

1. FOR EACH LOCATION SHOWN IN THE CRASH CUSHION, COMPRESSIVE BARRIER SUMMARY TABLE, INSTALL ONE (1) OF THE CRASH CUSHIONS LISTED FOR THAT LOCATION.
2. ANCHOR BLOCK REQUIRED UNDER FRONT OF CONCRETE PAD. CONTACT MANUFACTURER/SUPPLIER FOR DETAILS.

The following are instruction for filling out the summary tables:

1. The first column on the left side of the table is labeled "ITEM NO." Place the standard item number chosen for the first site (IE: 611312). The list of Item numbers are updated as needed and made available on the New Jersey Department of Transportation web page, Doing Business, Trns*port Software, Cost Estimation at http://www.nj.gov/transportation/business/trnsport/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 "DESCRIPTION". Place the description of the item number chosen (IE: CRASH CUSHION, COMPRESSIVE BARRIER, TYPE 3, WIDTH NARROW). Use the descriptions shown in the web site list referenced above.
3. The third column from the left side of the table is labeled "DESIGN SPEED". Place the design speed for the first site (IE: 50 MPH).
4. The fourth column from the left side of the table is labeled "ROUTE & STATION". Place the Route name that the first site is on. 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 (IE: ROUTE 130 PROPOSED BASELINE STATION 1450+50 LT.) For temporary crash cushions, the station is approximate:
5. The fifth column from the left side of the table is labeled "PRODUCT". This is the final list of models and sizes that fit this site. The Product information shall include the product name, number of bays (if applicable), width and length. For example:

   QUADGUARD II

   3 BAY

   24" WIDE

   12'-11" LONG

   UNIVERSAL TAU II

   5 BAY

   30" WIDE

   18'-6" LONG

   TRACC

   24" WIDE

   21'-3" LONG

   SCI 100 GM

   24" WIDE

   21'-6" LONG

   In the example above, the first site had an obstruction 2' wide and an available length of crash cushion reserve area of 25 feet. In this example, all 4 compressive crash cushion products fit the site. If the available length of crash cushion reserve area was only 19 feet long, only the top 2 products listed above would have fit the site.

6. The sixth column from the left side of the table is labeled "FOUNDATION". Place the foundation type for each of the models at the first site, see Section 9.2.9 and Table 9-9. For example, the QUADGUARD II and SCI 100 GM are using a "concrete pad."
7. The seventh and final column from the left side of the table is labeled "BACKUP SYSTEM". Place the backup system for each of the models at the first site, see Section 9.2.10 and Table 9-10. For example, the QUADGUARD II is using the "tension strut"; and SCI 100 GM does not require a backup system, therefore enter "NA". Standard designs for backup structures are available from the manufacturer.
8. Continue to fill out the summary tables for the rest of your project sites, follow steps 1 thru 7 above. Attach the completed summary table construction detail(s) to the project plans.
9. On federally funded projects, when a site requires either a permanent or temporary crash cushion and there are less than 3 products that are available to fit the site, the designer will need to fill out a *REQUEST FOR APPROVAL OF PATENTED/PROPRIETARY ITEMS ON FEDERALLY FUNDED PROJECTS* (Form DF-15). Prior to completing the said form, the designer must follow the instructions under subsection 106.09 of the Standard Input. A copy of the request form and Questions and Answers Regarding Public Interest Findings are included at the end of the section. The completed request shall be submitted to the Project Manager for his/her signature in Section F. The Project Manager shall submit the request to the appropriate FHWA Area Engineer at the following address:

   FHWA – NJ Division, Division Administrator,

   Attention: "Area Engineer"

   840 Bear Tavern Road, Suite 202,

   West Trenton, NJ 08628.

   To allow for sufficient lead time for FHWA review and approval, the designer should prepare and submit the request to the project manager as early as possible during the preparation of the Final Design.

   On non-federally funded projects, the procedure models the procedure for FHWA projects except that the form for *REQUEST FOR APPROVAL OF PATENTED/PROPRIETARY ITEMS ON NON-FHWA FUNDED CONTRACTS* (Form DF-16) must be completed in addition to following the instructions under subsection 106.09 of the Standard Input prior to completing the aforementioned form. The completed form will be submitted to the Project Manager for review and signature and his ultimate submittal to the Director of Capital Program Support for approval. A copy of the request form and Questions and Answers Regarding Waivers are included at the end of the section.

   Electronic versions of the request forms DF-15 and DF-16 are also available at: http://www.state.nj.us/transportation/eng/forms/index.shtml

   In addition, for both federally funded and non-federally funded projects, designers must include the following text preceding the list of manufactures/suppliers in the appropriate subsection of the Special Provisions.

   "The following manufactures/suppliers are capable of manufacturing/supplying the Item/material specified for this contract. This list is not intended to be a complete list of potential manufactures/suppliers."

9.4 Product Information

For additional information regarding the products contained in this section, the designer should contact the following manufacturers/suppliers:

Barrier Systems Inc. 1-888-800-3691

Universal TAU-II

SCI Products Inc. 1-800-327-4417

SCI

TrafFix Devices Inc. 1-949-361-5663

Big Sandy Inertial Barrier

Transpo Industries 1-914-636-1000

Energite III Inertial Barrier

QuadGuard II

QuadGuard CZ

QuadGuard Elite

REACT 350

REACT 350 WZ

Universal Inertial Barrier

Trinity Highway Products 1-800-321-2755

TRACC

FEDERAL HIGHWAY ADMINISTRATION
NEW JERSEY DIVISION

NEW JERSEY DEPARTMENT OF
TRANSPORTATION

REQUEST FOR APPROVAL OF PATENTED/PROPRIETARY ITEMS ON FHWA FUNDED CONTRACTS

Regulatory References: 23 CFR 635.411

Federal funds shall not participate, directly or indirectly, in payment for any patented and proprietary material, specification, or process set forth in the plans and specifications for a contract unless:

1. The patented or proprietary item is purchased or obtained through competitive bidding with 2 or more **equally** suitable unpatented items; or
2. The State certifies either the patented or proprietary item is essential for synchronization or no suitable alternative exists; or
3. The patented/proprietary item is used for research or for a distinctive type of construction on relatively short sections of road for experimental purposes.

Section A: STATE CERTIFIES AND/OR REQUESTS A PUBLIC INTEREST DETERMINATION FOR

	Synchronization with existing facilities (23 CFR 635.411 (a)(2))
	No suitable Alternative/Sole Source (23 CFR 635.411 (a)(2))
	Experimental or Research Purposes (23 CFR 635.411 (a)(3)); (NOTE: If item is for research and experimental purposes then NJDOT, New Technologies & Products Unit (NTP), must submit a workplan and follow procedures outlined within FHWA's policy and guidance for "Construction Projects Incorporating Experimental Features".) (http://www.fhwa.dot.gov/programadmin/contracts/expermnt.cfm)

Section B: STATEWIDE OR SPECIFIC CONTRACT DETERMINATION

Is the request to be used for 2 or more FHWA funded contracts (Statewide/multiple contracts)?	☐ Yes (If yes, then do not complete Section C. Proceed to Section D through Section F).	☐ No (If no, then proceed to Section C through Section F).

Section C: SPECIFIC CONTRACT INFORMATION

Proj. Delivery (Pipeline):	☐ I	☐ II	☐ III	☐ IV	☐ Other Proj. Delivery Types: _____
Federal Project Number:					Project Description:
UPC#:					
Route:					
Section:					
County:					

Section D: PRODUCT DESCRIPTION

(NOTE: Provide detailed information concerning the intended use of the product. Attach relevant product information as warranted.)

Section E: REASONS FOR REQUESTED APPROVAL

(NOTE: Justification should document engineering and economic considerations, product availability and compatibility, logistical concerns, and other unique considerations. The purpose is to document a finding of public interest. Attach supporting documentation as deemed appropriate by FHWA or State.)

Section F: SIGNATURE BLOCKS

REQUESTOR SIGNATURE:	REQUESTOR NAME & TITLE	DATE:

Section G: TO BE COMPLETED BY FEDERAL HIGHWAY AMDINISTRATION (FHWA) ONLY

REMARKS (FHWA):

SUNSET PROVISION REQUIRED:	☐ Yes, If so, expiration date is _____	☐ No

APPROVED BY FHWA'S REPRESENTATIVE	REPRESENTATIVE NAME & TITLE:	DATE:

NOTE: According to Stewardship Agreement FHWA's Signature is required for all FHWA funded contracts.

NEW JERSEY DEPARTMENT OF TRANSPORTATION

REQUEST FOR APPROVAL OF PATENTED/PROPRIETARY ITEMS ON NON-FHWA FUNDED CONTRACTS

State funds are not to be participate, directly or indirectly, in payment for any patented and proprietary material, specification, or process set forth in the Plans and specifications for a contract unless:

1. The patented or proprietary item is purchased or obtained through competitive bidding with 2 or more **equally** suitable unpatented items; or
2. The Designer certifies either the patented or proprietary item is essential for synchronization or no suitable alternative exists; or
3. The patented/proprietary item is used for research or for a distinctive type of construction on relatively short sections of road for experimental purposes.

Section A: STATE CERTIFIES AND/OR REQUESTS A PUBLIC INTEREST DETERMINATION FOR

☐	**Synchronization with existing facilities**
☐	**No suitable Alternative/Sole Source**
☐	**Experimental or Research Purposes**
☐	**Other (explain)**

Section B: SPECIFIC CONTRACT INFORMATION

DP#:		Project Description:
Route:		
Section:		
County:		

Section C: PRODUCT DESCRIPTION

(NOTE: Provide detailed information concerning the intended use of the product. Attach relevant product information as warranted.)

Section D: REASONS FOR REQUESTED APPROVAL
(NOTE: Justification should document engineering and economic considerations, product availability and compatibility, logistical concerns, and other unique considerations. The purpose is to document a finding of public interest. Attach supporting documentation as deemed appropriate by NJDOT.)

Section E: SIGNATURE BLOCKS		
REQUESTOR SIGNATURE:	REQUESTOR NAME & TITLE	DATE:

Section F: TO BE COMPLETED BY MANAGER OF QUALITY MANAGEMENT SERVICES		
REMARKS		
APPROVED BY:	NAME & TITLE	DATE:

Questions and Answers Regarding Public Interest Findings

Reference: FHWA Contract Administration Questions & Answers (http://www.fhwa.dot.gov/programadmin/contracts/011106qa.cfm)

"The FHWA regulation in 23 CFR 635.411, "Material or product selection," prohibits the expenditure of Federal-aid funds on a Federal-aid highway project "for any premium or royalty on any patented or proprietary material, specification, or process" (referred to hereafter as "proprietary product"), unless specific conditions are met. This regulation is intended to ensure competition in the selection of materials, products, and processes while also allowing the opportunity for innovation where there is a reasonable potential for improved performance."

1. **What is a proprietary product?**

   Generally, this is a product, specification, or process identified in the plans or specifications as a "brand" or trade name (e.g. 3M, Corten). However, it may also be a product so narrowly specified that only a single provider can meet the specification.

2. **Are patented products considered proprietary?**

   Yes, if the patented product is identified within the plans or specifications as a "brand" or trade name; or the specification is written so that only the patented product can meet the specification.

3. **If the patent of a product expires, does the State DOT still need to certify and/or request to utilize the product for the product to be considered a federally participating expense?**

   Depends upon the situation. If the patent expires but the product's name is identified within the plans and specifications without 2 or more equally suitable alternates then the product is considered proprietary and still subject to 23 CFR 635.411 (c).

4. **What is an example of a patented or proprietary item meeting the requirements of having 2 or more equally suitable alternates?**

   For examples of patented or proprietary items meeting the requirements of having 2 or more equally suitable alternates, review the NJDOT's Qualified Products List. In particular, for "reflective sheeting" there are several products under the material category of Reflective Sheeting, Type III that satisfy the 2 or more equally suitable alternates condition.

5. **If a patented or proprietary item meets the requirements of having 2 or more equally suitable alternates, is a public interest finding still required?**

   No as long as the plan, specification, or qualified products list identifies all 3 products (ie. patented or proprietary item and the 2 equally suitable alternates), a public interest finding is not required.

6. **What is the difference between a sole source waiver and public interest finding?**

   Federal Highway Administration, New Jersey Division utilizes the terms interchangeably. Therefore if the State DOT is requesting to use a single or sole source with federal dollars then a public interest finding request is still needed.

The "***Request for Approval of Patented or Proprietary Items on Federally Funded Projects***" form satisfies Division requests for a sole source waiver and public interest finding.

7. What should the State DOT consider during the material selection process?

If there are a limited number of products available that may meet the proposed specifications, a State DOT should undertake an engineering and economic analysis. The analysis should address the following questions:

- Are there other products on the market that meet the specifications?
- Are these products of satisfactory quality? and,
- Are the anticipated costs for the products are approximately the same?

The extent of the analysis should be appropriate for the value and complexity of the products involved, using life cycle cost analysis to develop cost comparisons based on comparable designs to meet product requirements using the anticipated service life for each product.

8. May contracting agencies set "above average" performance standards for a product?

Yes. A contracting agency may specify a higher or "above average" standard of performance on certain construction projects. However, if this "above average" standard reduces the pool of suitable products to a single proprietary product, the contracting agency must then prepare a public interest finding, which would document its minimum needs and support its contention that such a performance standard is necessary and reasonable to achieve these needs.

9. What factors should be considered when basing the use of a proprietary product on synchronization?

Synchronization may be based on function (the proprietary product is necessary for the satisfactory operation of the existing facility), aesthetics (the proprietary product is necessary to match the visual appearance of existing facilities), logistics (the proprietary product is interchangeable with products in with an agency's maintenance inventory) or a combination of the three. This may be best demonstrated by the following examples:

- A Federal aid construction project in City A includes the replacement of traffic signals and controllers in the downtown area. The City's existing signal control system is compatible with only Controller X. As part of its Downtown Beautification Plan, the City has specified Signal Pole Y for all intersections in the downtown area. To ensure FHWA participation, the contracting agency should provide sufficient documentation to support both functional and aesthetic synchronization, which could merely consist of a statement from the City justifying its decision to specify Controller X (functional synchronization with control system) and Signal Pole Y (aesthetic synchronization with signal poles).

- A Federal-aid construction project includes the replacement of existing substandard guardrail end terminals with those conforming to NCHRP 350 requirements. Upon project completion, the County will be responsible for the maintenance of the project. End Terminal T, which is NCHRP 350-compatible, has been constructed on other County-maintained routes in the vicinity. Due to scarce financial and labor resources, it desires to stock only one type of NCHRP 350-compatible end treatment, and has requested that

the contracting agency to specify Terminal T. To ensure FHWA participation, the contracting agency should address these logistical issues in its supporting documentation.

10. What should be included in a State DOT request to use a patented or proprietary product for research or experimental purposes?

If the State requests to use a patented or proprietary product for research or for a distinctive type of construction on a relatively short section of road for experimental purposes, it must submit an experimental product work plan for review and approval. The work plan should provide for the evaluation of the proprietary product, and where appropriate, a comparison with current technology. Go to http://www.fhwa.dot.gov/programadmin/contracts/expermnt.htm for additional information.

11. What is a "sunset provision"?

A sunset provision is the length of time that the Division has granted approval to use the patented/proprietary product on statewide or multiple projects. The sunset provision date is the date upon which the Division approval will expire. Typically, public interest findings for specific projects will not have a sunset provision.

12. Can the Division office extend approval for the use of the patented or proprietary product past the "sunset provision" date?

No. Once the sunset provision date has expired, the State DOT must certify and/or request a new determination that the use of the patented or proprietary product is still in the interest of the public.

Questions and Answers Regarding Waivers

1. What is a proprietary product

Generally, this is a product, specification, or process identified in the plans or specifications as a "brand" or trade name (e.g. 3M, Corten). However, it may also be a product so narrowly specified that only a single provider can meet the specification.

2. Are patented products considered proprietary?

Yes, if the patented product is identified within the Plans or specifications as a "brand" or trade name; or the specification is written so that only the patented product can meet the specification.

3. If the patent of a product expires, does the Designer still need to certify and/or request to utilize the product for the product to be considered for use?

Depends upon the situation. If the patent expires but the product's name is identified within the Plans and specifications without 2 or more equally suitable alternates then the product is considered proprietary.

4. What is an example of a patented or proprietary item meeting the requirements of having 2 or more equally suitable alternates?

For examples of patented or proprietary items meeting the requirements of having 2 or more equally suitable alternates, review the NJDOT's Qualified Products List. In particular, for "reflective sheeting" there are several products under the material category of Reflective Sheeting, Type III that satisfy the 2 or more equally suitable alternates condition.

5. If a patented or proprietary item meets the requirements of having 2 or more equally suitable alternates, is a waiver still required?

No as long as the Plans, specification, or qualified products list identifies all 3 products (ie. patented or proprietary item and the 2 equally suitable alternates), a waiver is not required.

6. What should the Designer consider during the material selection process?

If there are a limited number of products available that may meet the proposed specifications, the Designer should undertake an engineering and economic analysis. The analysis should address the following questions:

- Are there other products on the market that meet the specifications?
- Are these products of satisfactory quality? and,
- Are the anticipated costs for the products are approximately the same?

The extent of the analysis should be appropriate for the value and complexity of the products involved, using life cycle cost analysis to develop cost comparisons based on comparable designs to meet product requirements using the anticipated service life for each product.

7. May a Designer set "above average" performance standards for a product?

Yes. A Designer may specify a higher or "above average" standard of performance on certain construction projects. However, if this "above average" standard reduces the pool of suitable products to a single proprietary product, the Designer must then

prepare a waiver, which would document its minimum needs and support its contention that such a performance standard is necessary and reasonable to achieve these needs.

8. What factors should be considered when basing the use of a proprietary product on synchronization?

Synchronization may be based on function (the proprietary product is necessary for the satisfactory operation of the existing facility), aesthetics (the proprietary product is necessary to match the visual appearance of existing facilities), logistics (the proprietary product is interchangeable with products in with an agency's maintenance inventory) or a combination of the three.

9. What should be included in a Designer request to use a patented or proprietary product for research or experimental purposes?

If the Designer requests to use a patented or proprietary product for research or for a distinctive type of construction on a relatively short section of road for experimental purposes, it must submit an experimental product work plan for review and approval. The work plan should provide for the evaluation of the proprietary product, and where appropriate, a comparison with current technology.