To:		New York State Department of Transportation ENGINEERING INSTRUCTION	EI 01-003

SUPERSEDED BY EI 01-026 EFFECTIVE 7/11/02

Title: **TRACC - PERMANENT AND CONSTRUCTION ZONE - CRASH CUSHION**

Distribution:
- ☒ Manufacturers (18)
- ☒ Main Office (30)
- ☒ Local Govt. (31)
- ☒ Regions/Agencies (32)
- ☒ Surveyors (33)
- ☒ Consultants (34)
- ☒ Contractors (39)
- ☐ _____( )

Approved:

P. J. Clark, Deputy Chief Engineer, Design Division

01/23/01
Date

ADMINISTRATIVE INFORMATION. This Engineering Instruction is *effective with projects submitted for the letting of 07/05/2001.* The devices described and the transmitted specifications may be used sooner. No instructions or bulletins are superseded.

PURPOSE. To issue specifications and design information for permanent and temporary applications of the TRACC (Trinity Attenuating Crash Cushion), a redirective impact attenuator manufactured by Trinity Industries, Inc. Also, to issue a shelf note to modify section §619-5 General, to include impact attenuators and crash terminals in the list of articles for which the non-payment provisions of section §619 apply.

DESIGN INFORMATION. TRACC may be used to shield narrow objects, less than or equal to 610 mm width, and may also be used as end terminals for concrete barriers. In two-way traffic situations, transition pieces are needed for NJ shape or single slope concrete barriers. TRACC transitions to a NJ shape using w-beam pieces with wood or plastic block-outs that attach directly to the last concrete shape. The manufacturer will supply all the material required for the metal transition. In case of a run of single slope barriers - the last single slope barrier should be transitioned to a NJ shape using our standard transition (see EI 99-005), then a NJ shape barrier should be placed as the final piece and the metal transition pieces attached to that.

Curbs and islands higher than 100 mm should be removed. Mountable curbs and islands 100 mm or lower may be retained if they are needed to collect and control pavement runoff, but otherwise even they should be removed from the back of the unit to a point 15 m in advance of the nose of the unit. New curbs, of any height, are not to be installed within the above described limits when these devices are to be used.

It is very important to leave a minimum of 1.5 m of clear space behind both sides of the backup frame (that attaches to the end face of the shielded object) for the fender panels to retract during an end-on impact.

Cross slopes steeper than 6% under the unit are to be avoided. If encountered, they should be corrected by means of leveling or grading.

In a construction situation Item 15619.28 M, TRACC Bays Damaged and Repaired, should always be used in conjunction with either or both of 15619.26 M and 15619.27 M pay items. For Item 15619.28 M the designer will have to estimate the maximum number of bays that could be damaged. Until we have a better history, an estimate of fifty percent of the total number of bays exposed to traffic may be used.

Until a price history is developed, the cost of the nine bay unit may be estimated to be $10,000. The cost of any concrete pad and excavation would be another $1200. The cost of any metal transition would be another $175. These prices do not include any Contractor mark-up.

Also, the cost of the six bay unit may be estimated to be $6,500. The cost of any concrete pad and excavation would be another $750. The cost of any metal transition would be another $175. These prices do not include any Contractor mark-up either.

These units may be installed on existing concrete foundations free of cracking or deterioration that may impair anchorage or the integrity of the foundation. Working cracks or working joints should not be bridged by these units.

IMPLEMENTATION. Actions by DQAB: The main office Design Quality Assurance Bureau will insert the attached specifications into projects that call for their use.

The shelf note will be inserted by main office DQAB for all items with root 619 including special specifications.

Actions by Designers: Certain information should be shown on the plans. This information should include a plan view

showing the unit, its concrete pad or notes that the existing foundation at the site is to be used for foundation, the locations of any drainage structures, utility information, expansion joints, working cracks, edges of pavements, curbing or islands, and identifying any special transitions required between these units and the shielded object.

TRANSMITTED MATERIAL. Special Specifications for the TRACC, as indicated below:

15654.26 M	Six bay TRACC crash cushion on existing concrete foundation slab	Each
15654.27 M	Nine bay TRACC crash cushion on existing concrete foundation slab	Each
15654.28 M	Six bay TRACC crash cushion on new concrete foundation slab	Each
15654.29 M	Nine bay TRACC crash cushion on new concrete foundation slab	Each
15619.26 M	Six bay TRACC crash cushion for construction zone	Each
15619.27 M	Nine bay TRACC crash cushion for construction zone	Each
15619.28 M	TRACC bays damaged and repaired	Each

Shelf note titled "Construction Zone" that changes parts of §619-5 Basis of Payment.

No drawings are transmitted. Considerable design, maintenance, and installation information may be found in manuals available from the manufacturer/vendor.

BACKGROUND. The nine bay TRACC is rated as a NCHRP 350 "Test Level 3" device. This means the units can be used on all facilities. The six bay TRACC is rated as a NCHRP 350 "Test Level 2" device. TL2 devices are to be used on facilities with design speeds of 45 mph or less.

TRACC may be used to protect one way approaching traffic and, with the appropriate metal transition pieces, may also be used in two-way traffic situations. Transition is available for Concrete Jersey Barrier shapes. The metal transition pieces are included in the price of the unit.

The nine bay TRACC is 6.4 m long and 810 mm wide. The six bay TRACC is 4.33 m long and 810 mm wide. The maximum width of an object that can be shielded by a TRACC unit is 610 mm. The unit installs on both new and existing concrete or asphalt pad. Only concrete pads would be allowed for permanent installations.

The TRACC is reusable to a *limited extent*. During end-on impacts, if the stroke (movement of the front face of the sled assembly) is not more than 1.35 m then field repairs can be made; otherwise the entire system must be replaced. Similarly, during redirecting side impacts if the cross ties do not bend more than 19 mm (vertically) then field repairs can be made; otherwise the entire system must be replaced. In construction zone situations only, the Contractor may choose to replace the damaged unit with a refurbished unit. Details of repair procedures are spelled out in the system's manuals.

Details on the anchorage of the units and reinforcements of concrete pads and transitions will be provided in the shop drawings. For permanent installations TRACC can be installed on minimum 150 mm thick reinforced concrete pad (new or existing) using 190 mm anchor studs. Upon severe redirecting side impacts, the anchor studs may come loose from the concrete foundation. Then the damaged anchors would have to be reset before replacing the TRACC unit. For temporary (work zone) installations, in addition to the above type of foundation, TRACC can be installed on 1) minimum 150 mm thick asphalt over minimum 150 mm thick compacted subbase (minimum 95% of maximum theoretical density) using 450 mm anchor studs, or 2) minimum 200 mm thick asphalt using 450 mm anchor studs, or 3) minimum 150 mm thick reinforced portable concrete pad using 190 mm anchor studs. Upon moderate to severe impact, the anchor studs must be reset in place and the resulting voids in the pavement repaired.

Anchorage to asphalt concrete is not permitted in permanent applications because of concerns that the Department would not be able to repair a damaged asphalt foundation quickly enough following impact. Since, however, a Contractor will be at the site during construction, and an EIC will be watching over the work, asphalt anchorage can be a reasonable alternative in the maintenance and protection of traffic setting for moderate to moderately severe service conditions. If collisions at the site are expected to be more than moderate in number or severity, a concrete foundation may be warranted, even in the Maintenance and Protection of Traffic setting.

VENDOR INFORMATION. The TRACC is manufactured and vended by Trinity Industries, Inc. - (800) 321-2755.

CONTACT PERSON. All questions about this EI should be directed to Pratip Lahiri of DQAB at (518) 457-4090.

15654.26 M SIX BAY TRACC CRASH CUSHION ON EXISTING CONCRETE FOUNDATION SLAB

15654.27 M NINE BAY TRACC CRASH CUSHION ON EXISTING CONCRETE FOUNDATION SLAB

15654.28 M SIX BAY TRACC CRASH CUSHION ON NEW CONCRETE FOUNDATION SLAB

15654.29 M NINE BAY TRACC CRASH CUSHION ON NEW CONCRETE FOUNDATION SLAB

DESCRIPTION. The contractor shall furnish and install TRACC crash cushions, metal transitions and concrete foundations at the locations shown on the plans or directed by the Engineer in accordance with these specifications, the approved shop drawings, and the directions of the Engineer.

MATERIALS. TRACC crash cushions shall be manufactured by Trinity Industries, Inc. of Dallas, TX or shall be an alternative crash cushion determined by the Regional Director to be equal thereto and be approved by the Deputy Chief Engineer, Design Division.

Each TRACC crash cushion shall contain all external and internal parts necessary to give satisfactory service at the indicated site.

The major components of the TRACC are - 1 sled assembly, 7 (nine bay[1]) or 4 (six bay) intermediate frames, 1 backup frame, base assembly, cross ties and 20 (nine bay) or 12 (six bay) fender panels. One or more of the following components may also be required - concrete pad (if indicated), metal transition panels, wood or plastic block outs, backup frame adapter and W-beam end shoes.

A. **Fender Panels**. Fender panels shall be fabricated from 10 gage steel, double corrugated beam guide rail sections.

B. **Nose Cover**. The nose cover shall be made from a high density polyethylene plastic material of the color indicated in the plans or directed by the Engineer.

C. **Metal Work**. All metal work shall be fabricated from ASTM A36M steel. After fabrication, all metal work shall be galvanized in accordance with section §719-01, Galvanized Coatings and Repair Methods, Type I (ASTM A123). Welding shall be in accordance with the New York State Steel Construction Manual.

D. **Fasteners**. All bolts used within the TRACC crash cushion shall be American Standard Regular Bolts, unless indicated otherwise in the Plans. Anchor studs shall be ASTM A193 grade B7, grouted into the concrete or asphalt.

E. **Grout**. Anchors, not cast integrally into a new slab, shall be grouted with material approved under section 701-05 Concrete Grouting Material or section 701-07 Anchoring Materials - Chemically Curing.

F. **Concrete**. Concrete for pad shall meet the requirements for Class A concrete in section 501 - Portland Cement Concrete - General. If accelerators are needed, the Contractor must submit the concrete mix design to the Director, Materials Bureau for prior approval.

G. **Reinforcing Steel**. Reinforcing steel shall conform to §709-04 Epoxy Coated Bar Reinforcement, Grade 420.

H. **Transition Panels**. Transition panels shall be fabricated from 12 gage steel, double corrugated beam guide rail sections. They shall be terminated at the concrete barrier end with W-beam end shoes. Standard transition panels between TRACC and Jersey Barrier shall be available. Details of the transition shall be provided by Trinity Industries, Inc.

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[1] For the purposes of this specification a bay is defined as all the hardware and material that make up the space between two intermediate frames or the space between the last intermediate frame and the backup frame. The sled assembly is also considered a bay.

15654.26 M **SIX BAY TRACC CRASH CUSHION ON EXISTING CONCRETE FOUNDATION SLAB**

15654.27 M **NINE BAY TRACC CRASH CUSHION ON EXISTING CONCRETE FOUNDATION SLAB**

15654.28 M **SIX BAY TRACC CRASH CUSHION ON NEW CONCRETE FOUNDATION SLAB**

15654.29 M **NINE BAY TRACC CRASH CUSHION ON NEW CONCRETE FOUNDATION SLAB**

I. **Plastic Block Outs.** Plastic block outs shall conform to §710-26 Plastic and Synthetic Block Outs for Heavy Post Guiderail System, except the dimensions shall be as per the approved shop drawings.

J. **Wood Block Outs.** Wood block outs shall conform to §710-13 Wood and Timber Posts and Timber Blockouts, except the dimensions shall be as per the approved shop drawings. Pressure treatment shall be done after all cutting, sawing, trimming and drilling have been completed.

K. **Reflectorization.** Reflectorization, consisting of Class B (High Intensity) sheeting conforming to §730-05 directly applied to aluminum sheeting, shall be affixed to the front face of the sled assembly in a manner satisfactory to the engineer. Aluminum sheeting shall be 6061T6, 0.81mm thick. The pattern and color of the reflectorization shall be as indicated on the plans.

If no pattern is provided, the pattern shall be approximately square, minimum 625 mm on a side. Whenever approaching traffic is allowed to pass on both sides of the unit, the pattern shall be chevrons formed with alternating 100 mm reflectorized stripes and black opaque non-reflectorized stripes. When approaching traffic is permitted on only one side, the pattern shall be diagonal 100 mm stripes, downward pointing to the side traffic is to be permitted, formed as indicated above.

If no color is given, color shall be yellow.

Basis of Acceptance. TRACC crash cushion will be accepted on the basis of its conformance with the approved shop drawings and the manufacturer's certificate of compliance with these specifications.

CONSTRUCTION DETAILS. Prior to ordering any materials required under this item, the Contractor shall submit two copies of the shop drawings to the Engineer for approval. Shop drawings shall show supports, connections, miscellaneous parts, any backup frame adapter necessary, any concrete foundations indicated in the plans, any metal transitions and wood or plastic block outs necessary, any W-beam end shoes required, and anchorages not detailed in the plans but necessary to develop the full potential of the TRACC crash cushion. In addition to the above, the Contractor shall deliver to the Engineer two (2) copies of Design Manuals, Installation Manuals, and Maintenance Manuals prepared for the product and one copy of the same manuals to the Resident Engineer of the county where the TRACC is being installed. The Contractor shall install the TRACC only after approval of the above shop drawings and authorization from the Engineer to do so.

TRACC shall be installed on 150 mm reinforced concrete pad (new or existing) using 190 mm anchor studs. Any new concrete pad shall be built as per manufacturer's instructions.

The Contractor shall construct the concrete pad at the locations shown, or directed, to the dimensions indicated in the approved shop drawings. The appropriate standard metal transition shall be furnished and installed. If a special transition piece is required, prior approval shall be obtained from the Deputy Chief Engineer, Design Division before installation.

In a two-way traffic situation the ends of the metal transitions exposed to opposing traffic shall be terminated with a W-beam end shoe.

15654.26 M SIX BAY TRACC CRASH CUSHION ON EXISTING CONCRETE FOUNDATION SLAB

15654.27 M NINE BAY TRACC CRASH CUSHION ON EXISTING CONCRETE FOUNDATION SLAB

15654.28 M SIX BAY TRACC CRASH CUSHION ON NEW CONCRETE FOUNDATION SLAB

15654.29 M NINE BAY TRACC CRASH CUSHION ON NEW CONCRETE FOUNDATION SLAB

TRACC crash cushion shall bear upon prepared surfaces as shown in the plans. Necessary site preparation shall be performed in accordance with, and included under, their respective items.

To minimize exposure of vehicular traffic to the possibility of impact on the end of concrete barrier or the object being shielded, the Contractor shall complete the crash cushion installation within seven calendar days after completion of the concrete barrier or the object being shielded.

Traffic protection devices, such as cones, drums, lights, signs, barricades, or other articles directed by the Engineer, shall be provided and maintained under appropriate items. Those devices shall not be removed until the TRACC crash cushion is fully operational. In lighted areas or areas to be lighted, these articles shall also be maintained until the lighting system is operational.

METHOD OF MEASUREMENT. The work will be measured as the number of TRACC crash cushions satisfactorily furnished and installed in accordance with these specifications, the plans, approved shop drawings, and the directions of the Engineer.

BASIS OF PAYMENT. The unit price bid shall include the cost of all labor, materials, and equipment necessary to satisfactorily perform the work. The unit price bid shall include the back-up frame and adapter, if necessary, any metal transitions necessary, and necessary materials to fasten the TRACC crash cushion to the protected feature. Site preparation and maintenance and protection of traffic will be paid for separately under appropriate items.

Payment will be made under:

15654.26 M	Six bay TRACC crash cushion on existing concrete foundation slab	Each
15654.27 M	Nine bay TRACC crash cushion on existing concrete foundation slab	Each
15654.28 M	Six bay TRACC crash cushion on new concrete foundation slab	Each
15654.29 M	Nine bay TRACC crash cushion on new concrete foundation slab	Each

15619.26 M SIX BAY TRACC CRASH CUSHION FOR CONSTRUCTION ZONE
15619.27 M NINE BAY TRACC CRASH CUSHION FOR CONSTRUCTION ZONE
15619.28 M TRACC BAYS DAMAGED AND REPAIRED

DESCRIPTION. The contractor shall furnish, install, repair, maintain, move and remove TRACC crash cushions and metal transitions at the locations shown on the plans or directed by the Engineer in accordance with these specifications, the approved Shop Drawings, and the directions of the Engineer.

MATERIALS. TRACC crash cushions shall be manufactured by Trinity Industries, Inc. of Dallas, TX or shall be an alternative crash cushion determined by the Regional Director to be equal thereto and be approved by the Deputy Chief Engineer, Design Division.

Each TRACC crash cushion shall contain all external and internal parts necessary to give satisfactory service at the indicated site.

The major components of the TRACC are - 1 sled assembly, 7 (nine bay[1]) or 4 (six bay) intermediate frames, 1 backup frame, base assembly, cross ties and 20 (nine bay) or 12 (six bay) fender panels. One or more of the following components may also be required - concrete pad, metal transition panels, wood or plastic block outs, backup frame adapter and W-beam end shoes.

A. **Fender Panels**. Fender panels shall be fabricated from 10 gage steel, double corrugated beam guide rail sections.

B. **Nose Cover**. The nose cover shall be made from a high density polyethylene plastic material of the color indicated in the plans or directed by the Engineer.

C. **Metal Work**. All metal work shall be fabricated from ASTM A36M steel. After fabrication, all metal work shall be galvanized in accordance with section §719-01, Galvanized Coatings and Repair Methods, Type I (ASTM A123). Welding shall be in accordance with the New York State Steel Construction Manual.

D. **Fasteners**. All bolts used within the TRACC crash cushion shall be American Standard Regular Bolts, unless indicated otherwise in the Plans. Anchor studs shall be ASTM A193 grade B7, grouted into the concrete or asphalt.

E. **Grout**. Anchors, not cast integrally into a new slab, shall be grouted with material approved under section 701-05 Concrete Grouting Material or section 701-07 Anchoring Materials - Chemically Curing.

F. **Concrete**. Concrete for pad shall meet the requirements for Class A concrete in section 501 - Portland Cement Concrete - General. If accelerators are needed, the Contractor must submit the concrete mix design to the Director, Materials Bureau for prior approval.

G. **Reinforcing Steel**. Reinforcing steel shall conform to §709-04 Epoxy Coated Bar Reinforcement, Grade 420.

H. **Transition Panels**. Transition panels shall be fabricated from 12 gage steel, double corrugated beam guide rail sections. They shall be terminated at the concrete barrier end with W-beam end shoes. Standard transition panels between TRACC and Jersey Barrier shall be available. Details of the transitions shall be provided by Trinity Industries, Inc.

I. **Plastic Block Outs.** Plastic block outs shall conform to §710-26 Plastic and Synthetic Block Outs for Heavy Post Guiderail System, except the dimensions shall be as per the approved shop drawings.

J. **Wood Block Outs.** Wood block outs shall conform to §710-13 Wood and Timber Posts and

[1] For the purposes of this specification a bay is defined as all the hardware and material that make up the space between two intermediate frames or the space between the last intermediate frame and the backup frame. The sled assembly is also considered a bay.

Timber Blockouts, except the dimensions shall be as per the approved shop drawings. Pressure treatment shall be done after all cutting, sawing, trimming and drilling have been completed.

K. **Reflectorization.** Reflectorization, consisting of Class B (High Intensity) sheeting conforming to §730-05 directly applied to aluminum sheeting, shall be affixed to the front face of the sled assembly in a manner satisfactory to the engineer. Aluminum sheeting shall be 6061T6, 0.81mm thick. The pattern and color of the reflectorization shall be as indicated on the plans.

If no pattern is provided, the pattern shall be approximately square, minimum 625 mm on a side. Whenever approaching traffic is allowed to pass on both sides of the unit, the pattern shall be chevrons formed with alternating 100 mm reflectorized stripes and black opaque non-reflectorized stripes. When approaching traffic is permitted on only one side, the pattern shall be diagonal 100 mm stripes, downward pointing to the side traffic is to be permitted, formed as indicated above.

If no color is given, color shall be yellow.

Basis of Acceptance. TRACC crash cushion will be accepted on the basis of its conformance with the approved shop drawings and the manufacturer's certificate of compliance with these specifications.

CONSTRUCTION DETAILS. Prior to ordering any materials required under this item, the Contractor shall submit two copies of the shop drawings to the Engineer for approval. Shop drawings shall show supports, connections, miscellaneous parts, any backup frame adapter necessary, any metal transitions and wood or plastic block outs necessary, any W-beam end shoes required, and anchorages not detailed in the plans but necessary to develop the full potential of the TRACC crash cushion. In addition to the above, the Contractor shall deliver to the Engineer two (2) copies of Design Manuals, Installation Manuals, and Maintenance Manuals prepared for the product. The Contractor shall install the TRACC only after approval of the above shop drawings and authorization from the Engineer to do so.

TRACC shall be installed on 1) 150 mm reinforced concrete pad (new or existing) using 190 mm anchor studs, or 2) 75 mm asphalt over 75 mm unreinforced concrete using 450 mm anchor studs, or 3) 150 mm asphalt over 150 mm of compacted subbase (minimum 95% of maximum theoretical density) using 450 mm anchor studs, or 4) 200 mm asphalt using 450 mm anchor studs, or 5) 150 mm reinforced portable concrete pad using 190 mm anchor studs. Any new concrete pad shall be built as per manufacturer's instructions.

The standard metal transition shall be furnished and installed. If a special transition piece is required, prior approval shall be obtained from the Deputy Chief Engineer, Design Division before installation.

In a two-way traffic situation the ends of the fender panels or metal transitions exposed to opposing traffic shall be terminated with a W-beam end shoe.

To minimize exposure of vehicular traffic to the possibility of impact on the end of concrete barrier or the object being shielded, the Contractor shall complete the crash cushion installation within seven calendar days after completion of the concrete barrier or the object being shielded.

Traffic protection devices, such as cones, drums, lights, signs, barricades, or other articles directed by the Engineer, shall be provided and maintained under their respective items. Those devices shall not be removed until the TRACC crash cushion is fully operational. In lighted areas or areas to be lighted, these articles shall also be maintained until the lighting system is operational.

The Contractor shall be required to maintain the TRACC crash cushion and shall be responsible

for continuous 24 hour operation. If for any reason a crash cushion is out of operation the Contractor shall provide delineation, as described above, acceptable to the Engineer until repairs are made or a new or refurbished crash cushion installed.

TRACC shall be moved to another location or removed from the project site as shown in the plans or as directed by the Engineer. When the TRACC is removed from a location and the concrete/asphalt foundation is left in place, the anchors shall be removed from the foundation and the damaged areas repaired with concrete/asphalt as directed by the Engineer. If a portable concrete pad was placed at the location or a new concrete pad was built, then the foundation shall be removed along with the TRACC and the area restored to match the surrounding area as directed by the Engineer.

METHOD OF MEASUREMENT. The work for crash cushions will be measured as the number of TRACC crash cushions satisfactorily furnished, installed and removed in accordance with these specifications, the plans, approved shop drawings, and the directions of the Engineer.

The work for repair of damaged bays will be measured as the number of bays damaged by public traffic and then repaired by the Contractor in accordance with the manufacturers directions and the directions of the Engineer.

BASIS OF PAYMENT. The unit price bid for crash cushions shall include the cost of all labor, materials, and equipment necessary to satisfactorily erect, maintain and remove a crash cushion. The unit price bid shall include the back-up frame and adapter, if necessary, any metal transitions necessary, and necessary materials to fasten the TRACC crash cushion to the protected feature. Maintenance and protection of traffic will be paid for separately under its respective item(s). After a crash cushion is placed and is operational, payment will be made for ninety (90) percent of the unit bid price, the remaining ten (10) percent will be paid upon final removal.

The unit price bid for repair of each bay damaged by public traffic shall include the cost of all labor, materials, and equipment necessary to make the crash cushion fully functional in accordance with the manufacturer's instructions. The gap between the plastic nose and the front face of the sled assembly shall <u>not</u> be considered a bay. No payment will be made to the Contractor for repair or replacement of any crash cushion damaged by the Contractor's operations. If a TRACC is severely damaged such that it has to be replaced with a new or refurbished unit, payment will be made under the repair item as if all six or nine bays were damaged.

Whenever the Engineer directs that the crash cushion be moved to a new location, payment will be made in the same manner as if it were a new crash cushion. Minor movements within a single site, such as movements to realign, adjust, maintain, etc., will not be considered as a movement to a new location and will not entitle the Contractor to additional payment.

Payment will be made under:

15619.26 M	Six bay TRACC crash cushion for construction zone	Each
15619.27 M	Nine bay TRACC crash cushion for construction zone	Each
15619.28 M	TRACC bays damaged and repaired	Each

CONSTRUCTION ZONE

Make the *following* changes to the Standard Specifications of January 2, 1995:

Page 6-100 line 5 and line 17:

Insert the following after "Barriers,":

"Impact Attenuators, Crash Cushions, Crash Terminals,".