Section 648—Traffic Impact Attenuator

648.1 General Description

This work includes furnishing and installing impact attenuation devices that conform to the details. Install where shown on the Plans.

648.1.01 Definitions

General Provisions 101 through 150.

648.1.02 Related References

A. Standard Specifications

General Provisions 101 through 150.

B. Referenced Documents

ASTM A 709 Grade 36 (ASTM A 709 M Grade 250)

Merchant Quality-M-1020

648.1.03 Submittals

General Provisions 101 through 150.

648.2 Materials

Use attenuators that have been approved by FHWA as meeting NCHRP 350 for the test level required.

Ensure that materials used in the attenuator meet the requirements of the following:

Type 1	Cell sandwich	High speed (45 mph [70 kph] and over)*
Type 1-A	Cell cluster	Low speed (up to 45 mph [70 kph])*
* mph (kph) shown are for general information and may change due to actual design conditions.		

A. Cells

1. Flexible Cell Cartridges for Cell Sandwich Type Attenuator

   Provide material for a cell sandwich type attenuator as follows:

   a. Use flexible cell cartridges with an outside diameter of approximately 5 1/2 in (140 mm) and standard lengths of 24 in (600 mm), 30 in (750 mm), and 36 in (900 mm). Use cartridges made of vinyl-coated nylon fabric (shelter-lite style 3022-RG-0) or equal with these features:
      - Consists of 6.1 oz/yd² (207 g/m²) of nylon and 16 oz/yd² (543 g/m²) of vinyl to produce a total weight of 22.1 oz/yd² (750 g/m²).
      - Remains flexible and watertight in extreme heat and cold.
      - Has a hydrostatic resistance of 300 psi (2070 kPpa) or better.

      Permanently glue an insert containing orifices to regulate the release of water into the open end.

   b. In the nose of the cell sandwich type attenuator, use vinyl wall cells as described in this subsection, except equip each unit with a flexible cell cartridge assembly suspended in the open end.

2. Vinyl Wall Cells for Cluster Type Attenuator

   Provide material for a cluster type attenuator as follows:

   a. Use cells that are hollow, vinyl plastic cylinders with ¼ in (6 mm) thick walls, and a nominal outside diameter of 6 in (150 mm). The cells shall be 39 in (1 m) long unless otherwise indicated on the Plans.

   b. Permanently glue an insert with orifices to regulate the release of water into the open end of the cells.

   c. Use cells made of high-quality plastic specially formulated from high molecular weight homopolymer vinyl resins combined with the appropriate plasticizers. Ensure that the plasticizers can produce a high-strength and flexible vinyl in high and low temperatures.

   d. Use ultra-violet stabilizers, heat stabilizers, antibacteriological agents, and other additives to give maximum protection and long life in outdoor environments.

B. Fasteners for Cluster Type Attenuator

Ensure that the fasteners are the proper length. Use self-drilling, heat-treated, sheet-metal screws (No. 14 hexagonal head) and speed nut-washer combinations that are cadmium plated or hot-dip galvanized.

Join the cells at the top and bottom to adjacent or adjoining cells as required by the design. Attach to the structural backing system with straps and fasteners specified above, as shown on the drawings or as recommended by the manufacturer.

Ensure that other fastener types such as nuts and bolts are commercial grade, galvanized, or zinc-plated steel.

C. Orifice Inserts and Evaporation—Control Caps

Use insert-cap combination units made of the same quality vinyl plastic as the cells. Permanently attach the caps to the inserts with an adhesive that can bond the parts together. Determine the orifice sizes from the design requirements and permanently bond the orifice insert to the cell with a vinyl adhesive as recommended by the manufacturer.

D. Miscellaneous Metal Work

Use metal parts that are ASTM A709 Grade 36 (A 709 M Grade 250) or merchant-quality M-1020 unless otherwise specified and are hot-dip galvanized, painted, or both, to protect against corrosion.

E. Wire Rope

For the two 7/8 in (22 mm) wire ropes, use preformed galvanized 6 by 19 wire ropes with independent wire cores. Have the manufacturer furnish the 4 pullout wire ropes. Ensure that they are flexible, 3/8 in (10 mm) galvanized, 7 in by 12 in (175 mm by 300 mm) wire ropes, or an approved equal. Use wire rope that meets the requirements of ASTM A 741, Type 2.

F. Diaphragms, Fender Panels, and Interior Panels

Use diaphragms with a nominal thickness of 1-1/2 in (38 mm) and a fiberglass coating on both sides.

Use diaphragms and fender panels designed by the manufacturer to meet the strength requirements of the unit.

Fender panels may vary in thickness from 3/4 in to 1-1/4 in (19 mm to 32 mm). Coat both sides with fiberglass.

Overlay the interior panels with plywood. Seal and paint the edges for further protection.

G. Color

Use a yellow attenuator painted by the manufacturer with yellow fender panels with a 6 in (150 mm) reflectorized vertical white stripe along the outer edge of each panel, according to the Plan details.

H. Safety Flex Belt

Have a safety flex belt wrapped around the cell clusters and nose section of cell sandwich units. The belt is 30 in (750 mm) high.

Ensure that the belt is made of polypropylene cloth and resins combined to distribute loads vertically yet allow longitudinal or transverse deflections.

Use ½ in (13 mm) diameter carriage bolts to fasten the belt to the backup or other sections of the belt or to fender panels.

I. Concrete Work, Anchors, and Back-Up Assemblies

Perform concrete work with anchors and construct back-up assemblies according to the Plan details and the manufacturer's recommendations.

J. Type 2 Sand Loaded Modules—Cylindrical Drums

1. Cylinder Walls

   Use cylinder walls that are made of high-density polypropylene structural foam or equal material. Each cylinder shall have a nominal diameter of 36 in (900 mm) and a height as shown on the Plans.

   Join the cylinders together according to the manufacturer's instructions. Use pop-rivets if needed.

2. Lids

   Use polyethylene lids with a thinner wall thickness than cylinder walls. Ensure that lids press tightly and snap fit into the module.

3. Core

   Use a polystyrene or equal material core of the appropriate height. Install the core according to the manufacturer's instructions.

4. Rivets

   Use rivets that are AD 612 BSLF with ½ in (13 mm) diameter washers and an approximate weight of 10 lbs (4.5 kg) per 1,000 rivets.

5. Sand

   For Type 2 attenuators, use a high-grade washed and dried silica sand that conforms to the following gradation:

Material passing No. 10 (2.00 mm) sieve	90 to 100% by weight
Material passing No. 50 (300 µm) sieve	0 to 5% by weight
Add 5% salt to the sand to prevent freezing.	

6. Color

   Use the color yellow unless otherwise specified.

K. Type 2-A Sand Loaded Modules—Stabilizer Drums with Wine Glass-Shaped Inner Containers

1. Stabilizer and Inner Container Walls

   Use stabilizer and inner container walls made of high-density expanded polyethylene structural foam or equal material.

   Mold each stabilizer and inner container into one piece.

   - The stabilizer shall be 35-3/4 in (900 mm), ± 1/4 in (6 mm) high with an outside diameter of 36 in (900 mm), ± 1/4 in (6 mm) at the top and 2 ft -8 1/2 in (825 mm), ± 1/4 (6 mm) in at the bottom.
   - The wine glass-shaped inner container shall be 36 in (900 mm), ± 1/4 in (6 mm) high and in sizes designed to contain 200, 400, and 700 lb (90, 180, and 320 kg) sand masses or other amounts as determined by the Engineer.

   The stem heights place the center of gravity of each module at the proper elevation to control the attitude of impacting vehicles. Place the inner containers inside the stabilizers in an array, and like the stabilizer, to shatter upon impact.

   - The wall thickness for both stabilizer and inner container shall be 1/4 in (6 mm), ± 1/16 in (2 mm).

2. Lids

   Use black lids made of the same material and thickness as the walls. Ensure that the lid has a tight fit and clamps securely over the horizontal lid on the top of the container.

   Use stabilizers, inner containers, and lids made of durable and weatherproof material formulated to resist deterioration from ultra-violet rays.

3. Sand

   Use the same sand for Type 2-A attenuators as specified for Type 2.

4. Color

   Use the color yellow unless otherwise specified.

NOTE: Hex foam sandwich crash cushion may be substituted for the water or solid filled cylinders.

648.2.01 Delivery, Storage, and Handling

General Provisions 101 through 150.

648.3 Construction Requirements

648.3.01 Personnel

Have the attenuator assembly installed by experienced workers. Have experienced workers attach a cable, strap, or other device to existing pavement, bridge, or other structure.

648.3.02 Equipment

General Provisions 101 through 150.

648.3.03 Preparation

Before installing the attenuator unit, prepare the site, including removing and replacing concrete and other items.

648.3.04 Fabrication

Ensure that traffic impact attenuators of the type shown are installed according to the manufacturer's recommendations and conform with the Plans.

648.3.05 Construction

A. Type 1 And Type 1-A Cell Sandwich and Cell Cluster

Use vinyl wall cells in the nose portion of Type 1 and Type 1-A. Use flexible cell cartridges in the cell sandwich portions of the Type 1 attenuator and place according to the Plan details.

1. Install according to the manufacturer's recommendations and the Plan details. Installation includes filling the cells with water and enough antifreeze consisting of calcium chloride 78 percent flake or ethylene glycol at the rate of 3.7 lb/gal (443 g/L) to prevent freezing to –38 °F (–39 °C).

   Do not use calcium chloride in attenuators mounted on structures.
2. Fasten the cells together at the top and bottom according to the manufacturer's recommendations. Ensure that the concrete portions of the attenuator are according to the Plan details.
3. Have the manufacturer provide the standard anchors, clips, straps, or other incidentals to mount the attenuator.

B. Type 2 and Type 2-A Sand-Loaded Modules

Assemble the parts of the completed module, including filling it with sand, in sequence and according to the recommendations of the manufacturer.

1. Ensure that the weight, height, and location of each module and overall arrangement of each installation is as shown on the Plans.
2. Use the bottom disc when placing Type 2 modules on soft ground or when directed by the Engineer.
3. Place the modules so that they will remain in their final position after being filled with sand. Mark the location and weight of each module on the bearing surface for easy replacement.
4. After the modules are set and filled with sand, drill each lid for Type 2 attenuators at 4 equidistant points. Pop-rivet the lids in place to prevent loss or theft.
5. When placing Type 2 modules on sloping areas subject to extreme vibration, use steel half-ring locators to prevent serious displacement.

   These cases will be noted on the Plans. Install half-ring locators on the side of the downward slope according to the manufacturer's recommendations.
6. When placing Type 2-A modules on surfaces subject to vibration (i.e., bridge decks) or on slopes, fasten to the surface an ¼ in (6 mm) by ± 1/16 in (2 mm) thick stem block with a 6 in (150 mm) diameter hole in the center. The block holds the stem of the inner container in place and prevents the module from moving.

648.3.06 Quality Acceptance

General Provisions 101 through 150.

648.3.07 Contractor Warranty and Maintenance

General Provisions 101 through 150.

648.4 Measurement

Each traffic impact attenuator (array) of the type specified, complete, in place, and accepted at its location (No.___), is measured by the Unit, including components, hardware, anchors, incidentals, freeze treated water or sand, and labor for each installation shown on the Plans.

Site preparation work, as described under Subsection 648.3.05, "Construction Requirements," is measured and paid for separately under the respective items involved unless otherwise specified.

648.4.01 Limits

General Provisions 101 through 150.

648.5 Payment

Traffic impact attenuator, as measured above, is paid for per each unit. Payment is full compensation for materials, labor, and incidentals to complete the Item.

Payment will be made under:

Item No. 648	Traffic impact attenuator array, type 1, no.___	Per each
Item No. 648	Traffic impact attenuator array, type 1-A, no.___	Per each
Item No. 648	Traffic impact attenuator array, type 2, no.___	Per each
Item No. 648	Traffic impact attenuator array, type 2-A, no.___	Per each

648.5.01 Adjustments

General Provisions 101 through 150.

Section 649—Concrete Glare Screen

649.1 General Description

This work includes erecting a Portland cement concrete glare screen according to Plan dimensions on top of a concrete median barrier.

649.1.01 Definitions

General Provisions 101 through 150.

649.1.02 Related References

A. Standard Specifications

Section 621—Concrete Barrier

B. Referenced Documents

General Provisions 101 through 150.

649.1.03 Submittals

General Provisions 101 through 150.

649.2 Materials

Use materials that comply with Section 621 and the Plan details.

649.2.01 Delivery, Storage, and Handling

General Provisions 101 through 150.

649.3 Construction Requirements

649.3.01 Personnel

General Provisions 101 through 150.

649.3.02 Equipment

General Provisions 101 through 150.

649.3.03 Preparation

General Provisions 101 through 150.

649.3.04 Fabrication

General Provisions 101 through 150.