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| <p style="text-align: center;">SUPERSEDED ^{BY} <i>EB 02-019</i> EFFECTIVE 9/12/02</p> |  | <p><i>New York State Department of Transportation</i> ENGINEERING INSTRUCTION</p> | <p>EI 01-009</p> |
| <p>Title: CRASH-CUSHION ATTENUATING TERMINAL 350 (CAT 350)</p> | | | |
| <p>Distribution:</p> <p><input checked="" type="checkbox"/> Manufacturers (18) <input checked="" type="checkbox"/> Surveyors (33) <input checked="" type="checkbox"/> Main Office (30) <input checked="" type="checkbox"/> Consultants (34) <input checked="" type="checkbox"/> Local Govt. (31) <input checked="" type="checkbox"/> Contractors (39) <input checked="" type="checkbox"/> Regions/Agencies (32) <input type="checkbox"/> _____ ()</p> | | <p>Approved:</p> <p style="text-align: center;"> P. J. Clark, Deputy Chief Engineer, Design Division</p> <p style="text-align: right;"><u>04/24/01</u> Date</p> | |

ADMINISTRATIVE INFORMATION. This Engineering Instruction does not modify or supersede any existing EI. It will become effective with projects submitted for the letting of 09/06/01. The guidance contained in this EI ultimately will be incorporated into Chapter 10 of the HDM. The specifications will be main office inserts, and will be inserted into projects calling for their use.

PURPOSE. The purpose of this EI is to issue guidelines and specifications for use of a safety device, the Crash-Cushion Attenuating Terminal 350¹ (hereafter referred to as CAT 350) to shield median hazards. The hazards that can be shielded include, but are not limited to: ends of concrete barriers (via a transition), HPBO corrugated beam median barrier, and narrow bridge piers. CAT 350 is a device approved to NCHRP Report 350, Test Level 3.

APPLICABILITY. This EI is applicable to new installations on new construction projects, reconstruction projects, and on 3R projects.

DESIGN INFORMATION. The overall length of the CAT 350, from the first wooden post to the last steel post in the tail-end section, is 13.34 m (43'-9"). CAT 350 has six short breakaway wood posts installed in steel foundation tubes and a tail-end portion that has two driven steel posts. All posts are spaced at 1.905 m. The CAT 350 is installed in a straight line, and requires no concrete footings or foundations. The area under the unit needs to be reasonably flat, and cross slopes steeper than 8% are to be avoided. If encountered, they should be corrected by means of leveling or grading.

The downstream end of CAT 350 can be connected only to HPBO corrugated beam median barrier using the 3.8 m long tail-end section provided with the CAT 350. If a concrete median barrier needs to be shielded by CAT, then the tail end portion is to be connected to the appropriate transition established under pay items 606.8705 M, 606.8755 M, 606.8706 M, and 606.8756 M. These were issued by EI 00-002 Transition Between HPBO Corrugated Median Barrier and Concrete Median Barrier. The transition design and layout shall conform to the appropriate Standard Sheets M606-42, M606-43, M606-44 and M606-45 issued by EB 00-005, Transition Between HPBO Corrugated Median Barrier and Concrete Median Barrier.

The CAT 350, when impacted head on, is designed to telescope on itself from Stage 1 to Stage 3 without "fanning" of the beam element or significant increase in width. Therefore, CAT 350 can be installed on narrower medians than the Brakemaster 350.

Generally, the presence of expansion joints does not present a problem, but you should contact the manufacturer, Syro Steel Company / Trinity Industries Inc., Girard, Ohio (800-321-2755), with any questions on the subject.

Curbs and islands higher than 100 mm (4") should be removed. Mountable curbs and islands 100 mm (4") 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 tail end unit to a point 15 m (50') 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.

POINT-OF-NEED INFORMATION. The CAT 350 gates up to the fourth post, and redirects after that. Guidance

¹ Safety articles like QuadGuard, React 350, Brakemaster 350 can also be used as alternatives to protect median barriers.

on Point-of-Need determination can be obtained in §10.2.4. Median Barriers.

TRANSMITTED MATERIALS. This EI transmits information and specifications for CAT 350. The specifications are proprietary, but if they are used in accordance with this EI, no justification need be made for their use. The transmitted specifications are:

ITEM 15606.46 M CRASH-CUSHION ATTENUATING TERMINAL 350, CAT 350
ITEM 15606.4650 M CRASH-CUSHION ATTENUATING TERMINAL 350, CAT 350 (RUSTIC)

FUNCTIONAL DESCRIPTION OF THE SYSTEM. CAT 350 is designed to provide adequate anchorage and to be a crashworthy energy absorbing crash-cushion. The CAT 350 is a four-stage crash-cushion. The first three are made up of energy absorbing beam elements, breakaway timber posts, steel foundation tubes, and a cable anchorage system. The first three stages are designed to absorb end-on impacts sequentially. These are attached to the fourth stage, the "tail end portion," which is composed of standard corrugated guiderail beams, 152 mm steel posts, and steel blockouts.

The first stage is approximately 1.9 m long, and consists of a nose piece attached to the first post and a pair of flat 10 gauge sheets stretching between the first and second posts. The sheets buckle at very low force levels. The two posts are both weakened timber posts, and the above ground portion of the first post has been additionally weakened by reduction to 64 x 203 mm cross section. The second through sixth posts are also weakened posts, 152 X 203 mm in cross section. The first stage is intended to anchor the crash-cushion, and to provide a cushion between the vehicle and the second stage. The second and third stages absorb most of the energy. The tail-end portion consists of HPBO median barrier steel posts, a pair of W-beam panels (one on each side) and two steel block-outs provided by the supplier, Trinity Industries, Inc.

The second and third stages are each 3.8 m long, and are made up of standard length, specially slotted W-beam elements, 12 and 10 gauge, respectively.

The three crushable stages of the CAT 350 crash-cushion function as follows when impacted end-on at high speeds by a 2000 kg vehicle. The tail-end is not a crushable stage.

Stage 1. The vehicle readily collapses the nose and the two 10 gauge flat beam elements, and fractures the weak post 1, releasing the anchor cable.

Stage 2. After collapsing the first stage, special splice bolts are forced through the slotted strips in the 12-gauge W-beam at a predetermined force level, and posts 2 and 3 are fractured.

Stage 3. After all the slotted strips in the 12-gauge beams (spans between posts 2 and 4) are stripped, stripping of the 10-gauge beam (spans between posts 4 and 6) begins, and posts 4 and 5 fracture in this stage as the vehicle continues into the crash-cushion.

The CAT 350 is designed so that a small car, weighing 820 kg and traveling at 100 km/h, is able to collapse only the first and second stages of the crash-cushion. More severe impacts with heavier vehicles or faster speeds, or both, would activate the third stage.

IMPLEMENTATION. DQAB will insert the specifications into the proposals that call for their use.

ESTIMATED COST. Each CAT 350 installed in the upstate regions is expected to cost \$4200 and perhaps somewhat more in the downstate regions. This estimate is based on \$2700 parts cost and an installation cost of \$1500 per CAT 350 crash-cushion. Grading costs are not included in these estimates and would vary based on location and region. Rustic versions are expected to be around \$500 more expensive than their regular versions.

VENDOR INFORMATION. Syro Steel Company / Trinity Industries Inc., Girard, Ohio. Phone - (800) 321-2755.

CONTACT PERSON. Arvind Salgam, Design Quality Assurance Bureau, M.O. Bldg 5, Room 410, (518) 457-5855.

SCHEMATIC ILLUSTRATION OF CAJ 350

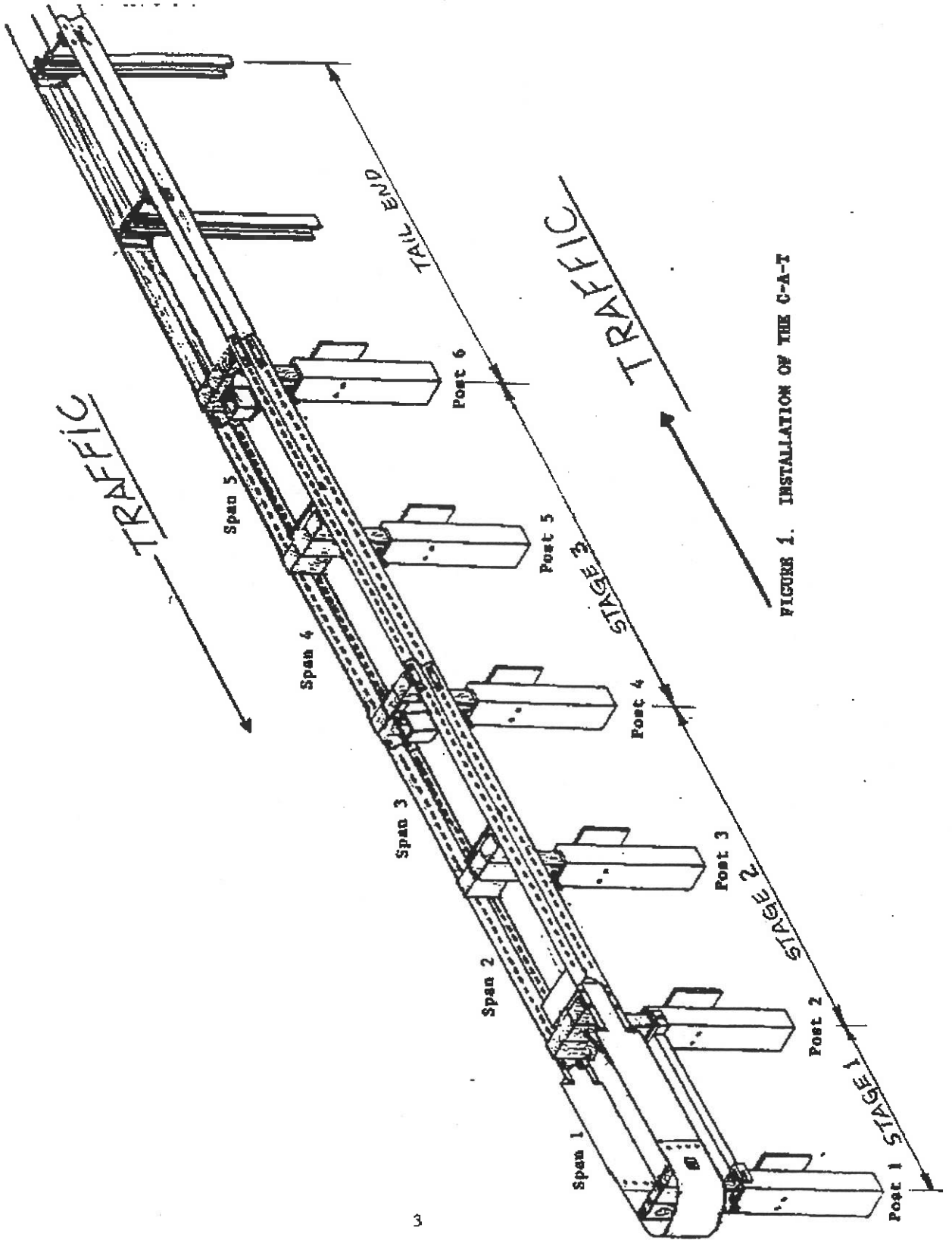


FIGURE 1. INSTALLATION OF THE C-A-T

ITEM 15606.46 M CRASH-CUSHION ATTENUATING TERMINAL 350, CAT 350
ITEM 15606.4650 M CRASH-CUSHION ATTENUATING TERMINAL 350, CAT 350 (RUSTIC)

DESCRIPTION

Under this work, the Contractor shall furnish and install the Crash-Cushion Attenuating Terminal 350 (hereafter referred to as CAT 350) of the type indicated and at the locations indicated in the Contract Documents, or where directed by the Engineer, in accordance with these specifications and the manufacturer's directions and drawings.

MATERIALS

Crash-Cushion. The crash-cushion shall be the CAT 350, as fabricated by the Syro Steel Company / Trinity Industries Inc., Girard, Ohio. Phone - (800) 321-2755. All parts shall be new, and the configuration of the CAT 350 crash-cushion shall be as indicated in these specifications and on the manufacturer's drawings.

Steel foundation tubes shall meet the requirements of §710-21, Box Beam Guide Railing and Median Barrier. The breakaway wood posts shall be of the dimensions indicated on the manufacturer's drawings, and shall be pressure treated as per §708-31, Wood Preservative - Water Borne. The timber posts and the timber blockouts shall meet the requirements of §710-13, Wood and Timber Posts and Timber Blockouts. Corrugated beam guide rail elements, and the flat beam side plate shall meet the requirements of §710-20, Corrugated Beam Guide Railing and Median Barrier. Steel block-outs, steel posts, soil plates, struts, bearing plates shall meet the requirements of ASTM A36 or ASTM A36 M. The dimensions of steel block-outs shall conform to those given in the manufacturer's drawings. All metal parts and components shall be hot dipped galvanized in accordance with §719-01, Galvanized Coatings and Repair Methods.

The rustic version of CAT 350 crash-cushion shall comply with the above requirements except metal parts exposed to view shall meet the requirements of §710.25, Guide Rail and Median Barrier Systems (Rustic).

Reflectorization, consisting of Class B (High Intensity) sheeting directly applied to aluminum sheeting, shall be affixed to the nose of the CAT 350 crash-cushion. The Class B (High Intensity) sheeting shall conform to §730-05, Reflective Sheeting.

If traffic passing either side of the unit is going in the same direction, the pattern shall be upward pointing chevrons formed with alternating 100 mm reflectorized stripes and black opaque non-reflectorized stripes. If no color is given, then the color shall be yellow. If traffic passing on either side of the CAT 350 is going in opposite directions, the pattern shall be a 45° hatch pattern, with the stripes sloping so that the lower end of them is on the side the approaching traffic is to pass.

Silicone sealant shall be commercially available silicone sealant which will adhere to wood and galvanized steel.

BASIS OF ACCEPTANCE

CAT 350 crash-cushion will be accepted on the basis of its conformance with the approved manufacturer's drawings and the manufacturer's certificate of compliance with these specifications.

CONSTRUCTION DETAILS

A minimum of one week prior to installing any materials required under this item, the Contractor shall submit to the Engineer two (2) copies of the Manufacturer's Drawings, Design Manuals, Installation Manuals, and Maintenance Manuals prepared for the product and one (1) copy of the same manuals intended for the Resident Engineer of the county where the unit is being installed. The

ITEM 15606.46 M CRASH-CUSHION ATTENUATING TERMINAL 350, CAT 350
 ITEM 15606.4650 M CRASH-CUSHION ATTENUATING TERMINAL 350, CAT 350 (RUSTIC)

contractor shall install the crash-cushion only after receiving authorization from the Engineer to do so.

§606-3.01, General of the Standard Specifications shall apply. Foundation tubes shall be driven unless otherwise approved by the Engineer. CAT 350 and CAT 350 (Rustic) shall be installed after grading is completed, at the locations indicated on the Plans, or where directed by the Engineer. They shall be installed in accordance with the manufacturer's instructions and the directions of the Engineer.

The work, including the necessary grading work, shall be coordinated with the installation of the median barrier or transition or removal of existing anchorage units in order to minimize the time the traveling public is exposed to unanchored runs of rail. During periods when the traveling public is exposed to unanchored rail, plastic drums or other devices approved by the Engineer, shall be placed in advance of the unanchored run and beyond the ends of the rail. In addition, the ends of the rail shall be brought to the ground level, twisted over to lay flat, and be pinned to the ground.

Unless a different period is indicated or directed, the Contractor shall be required to complete the crash-cushion installation within five working days after installation of the HPBO median barrier or removal of the anchor or turned down end or installation of the transition, so as to limit the exposure of vehicular traffic to impact with the exposed end of the barrier.

To limit water and dirt infiltration, the space between the wooden posts and the top of the foundation tube shall be sealed with a commercially available silicone sealant. The sealant shall be compatible with both wood and galvanized steel to the satisfaction of the Engineer.

In the event CAT 350 or CAT 350 (Rustic) is damaged, the units shall be promptly repaired. Unless another period is indicated in the contract documents, promptly shall mean fourteen (14) calendar days from the date the original damage occurs.

METHOD OF MEASUREMENT

The work will be measured as the number of CAT 350 crash-cushions or CAT 350 (Rustic) crash-cushions satisfactorily furnished and installed in accordance with the plans, specifications and directions of the Engineer. The pay limits for these units shall extend from the reflectorized sheeting in the front to the center of the eighth post (second steel post) in the tail-end portion of the crash-cushion.

BASIS OF PAYMENT

The unit price bid per CAT 350 or CAT 350 (Rustic) shall include the cost of all labor, materials, and equipment necessary to satisfactorily furnish and install the units between the above described pay limits.

Payment will be made under:

| Item No. | Item | Pay Unit |
|--------------|--|----------|
| 15606.46 M | Crash-Cushion Attenuating Terminal 350, CAT 350 | Each |
| 15606.4650 M | Crash-Cushion Attenuating Terminal 350, CAT 350 (Rustic) | Each |