

April 9, 2002

HSA-10/CC-77

Keith R. Lane, P.E.
Director of Research and Materials
Bureau of Engineering and Highway Operations
Connecticut Department of transportation
280 West Street
Rocky Hill, Connecticut 06067-3502

Dear Mr. Lane:

With your October 10, 2001 letter to Mr. Frederick Wright, former Federal Highway Administration Program Manager for the Safety Core Business Unit, you sent the final test report in a series of tests conducted over the past six years to certify the Connecticut Impact Attenuation System (CIAS) as a National Cooperative Highway Research Program (NCHRP) Report 350 test level 3 (TL-3) crash cushion.

The CIAS is a unique attenuator that “captures” vehicles impacting at or near the nose and along its front sides, while redirecting vehicles impacting near the back of the unit. As shown in greater detail in Enclosure 1, the CIAS consists of twelve steel cylinders 1.22 m in diameter and two cylinders 0.91 m in diameter. Each cylinder is 1.22-m high. Wall thickness varies from 6.35 mm for the three cylinders attached to the backup structure to 7.94 mm for the next two cylinders to 4.76 mm for the remaining large-diameter cylinders. The two 0.91 m diameter cylinders are made from 8-gauge plate steel. The CIAS array is set on two steel skid rails bolted to a concrete pad and connected to a 1980-mm wide backup wall with L-brackets on each side of the wall. These L-brackets are the only significant modification from the original design. They serve to offset the rear-most cylinders 610 mm from the edge of the wall to minimize vehicular snagging at this point.

NCHRP Report 350 tests 3-32, 3-33, 3-34 and 3-35 (note: test 3-35 was originally run as test 3-38) were successfully conducted. I consider tests 3-35 and 3-38 to be essentially the same tests for the CIAS design and note that test 3-35 demonstrated an acceptable redirection capability of the CIAS in a side impact near the back of the array after the design was modified as noted above. Test 3-30 is similar to the head-on small car test run under NCHRP Report 230 guidelines and was waived as previously agreed by our respective staff members. Test 3-31 was considered unnecessary based on the results of test 3-33. Consequently, the CIAS, as tested, may be considered an NCHRP Report 350 TL-3 crash cushion and may be used on the National Highway System in gore areas and other locations where traffic can pass on either side of the array and opposite-direction impacts are not a concern.

I understand that the CIAS, while patented, is not proprietary and that plans, specifications, and additional information on its cost and performance can be

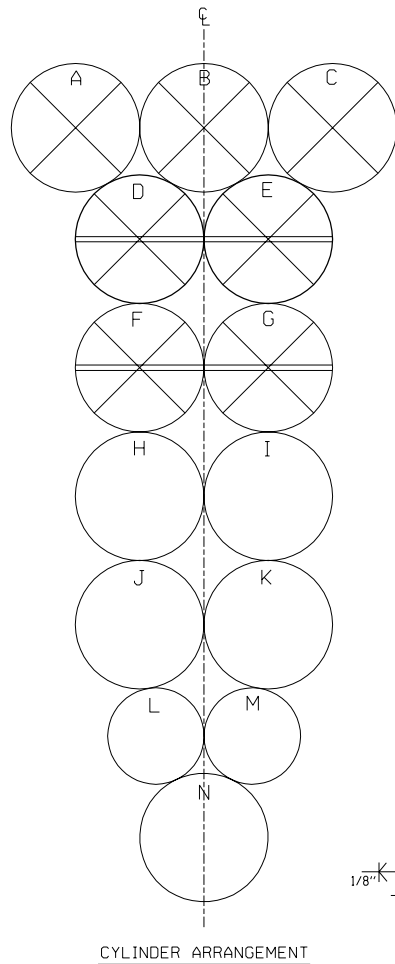
obtained through Mr. James Sime, Manager of Research, at (860) 258-0309 or via e-mail at james.sime@po.state.ct.us.

Sincerely yours,

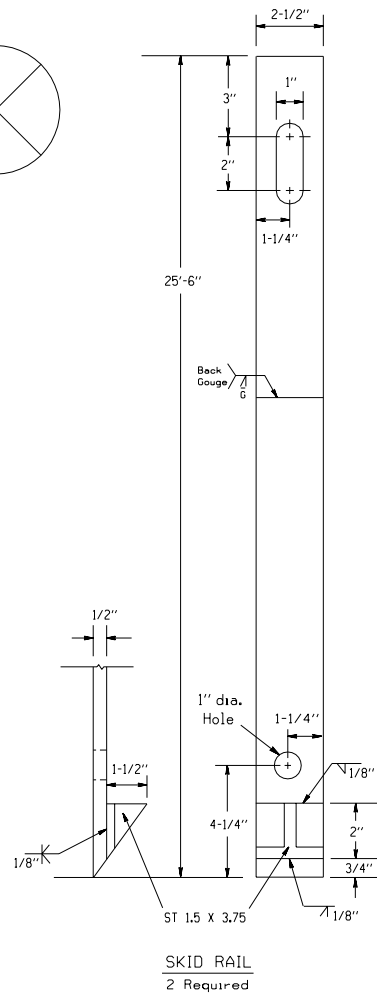
(original signed by A. George Ostensen)

A. George Ostensen
Program Manager, Safety

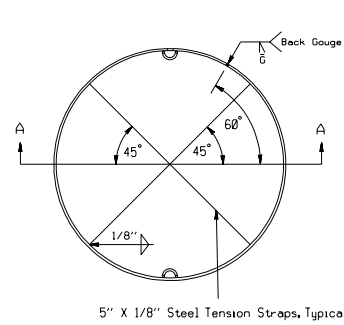
Enclosure



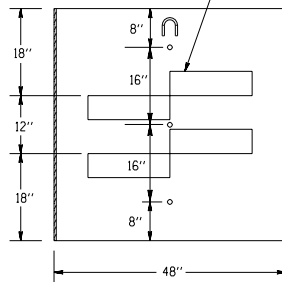
CYLINDER ARRANGEMENT



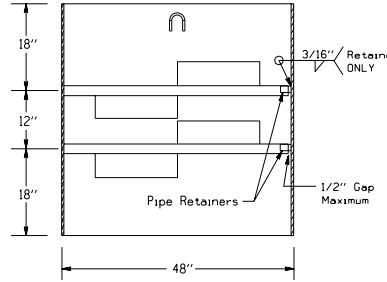
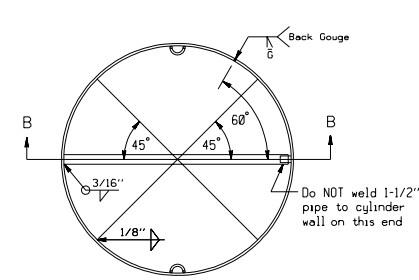
SKID RAIL
2 Required



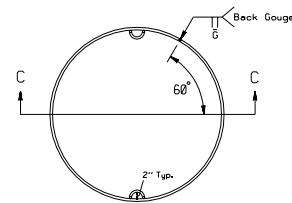
5" X 1/8" Steel Tension Straps, Typical



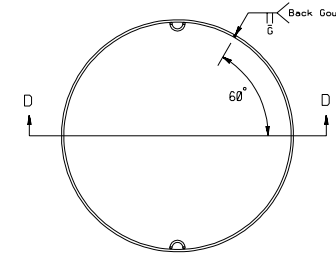
SECTION A - A
CYLINDERS A, B, C



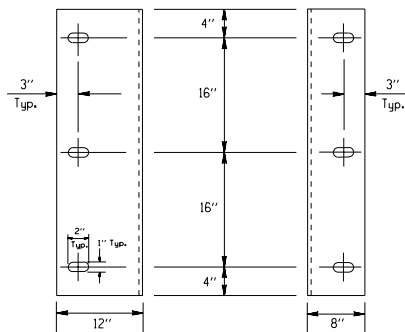
SECTION B - B
CYLINDERS D, E, F, G



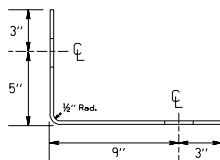
SECTION C - C
CYLINDERS L, M



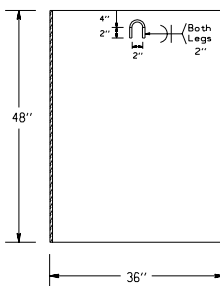
SECTION D - D
CYLINDERS H, I, J, K, N



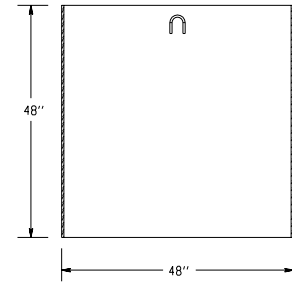
L - BRACKET
(1/4" Thick)
2 Required



L - BRACKET
(1/4" Thick)
2 Required



SECTION C - C
CYLINDERS L, M



SECTION D - D
CYLINDERS H, I, J, K, N

GENERAL SPECIFICATIONS

- All steel used in the fabrication of the CIAS shall be produced in the United States.
- Steel Specifications:
 - All steel plates, bars, and structural shapes shall conform to the requirements of ASTM A36.
 - All steel sheets and strips shall conform to the requirements of ASTM A569.
 - All steel pipe shall conform to the requirements of ASTM A53, Grade B.
- All welding shall be performed by ConnDOT certified welders, and shall conform to the requirements of the most recent edition of the State of Connecticut, Department of Transportation, Standard Specifications. Welding electrodes shall be approved by the Engineer before work begins.
- All edges shall be machined in a workmanlike manner and shall be free of burrs and sharp edges. All holes shall be drilled or machine cut.
- All complete CIAS units shall be assembled in their entirety, inspected and approved by ConnDOT prior to shipping.
- Each steel cylinder shall:
 - have the following wall thickness. No substitutions in wall thickness sizes will be accepted:
A, B, C = 1/4" D, E = 3/8" F, G, H, I, J, K, N = 3/8" L, M = 8 gage
 - have a single electrically welded seam, cut square;
 - be ± 1/2" of the specified diameter, measured across any diameter of the cylinder;
 - have 1"-diameter holes drilled 8" from the top and 8" from the bottom at all locations where the cylinders touch each other in the arrangement shown. Cylinders A, B, C shall have 1"-diameter holes drilled at the rear of the system as shown in Section A-A;
 - have two rings welded to the inner face for lifting purposes as shown. The lifting rings shall be made from 1/2" round bar stock, and;
 - be permanently labeled on the inside wall with its individual letter designation shown.
- Stiffeners:
 - Cylinders D, E, F, G shall each have two compression pipe stiffeners installed as shown. The pipes shall be fabricated from 1-1/2" ID, Schedule 40 steel pipe. Each of these internal stiffening pipes shall be welded to the cylinder wall on ONE END ONLY. The free end shall rest on a pipe retainer as shown. The retainers shall be 3" in length, and fabricated from 1" ID, Schedule 40 steel pipe. The retainers shall be welded to the cylinder wall as shown, but NOT welded to the 1-1/2" ID stiffening pipe.
 - Cylinders A, B, C, D, E, F, G shall each have four tension straps installed as shown. Tension straps shall be 5" X 1/8", and shall be cut to the proper length and welded to the cylinder wall at the orientation and height shown.
 - When the CIAS is assembled, the stiffeners (compression pipes and tension straps) shall be oriented to the Systems' centerline as shown on the Cylinder Arrangement detail. All cylinder sections (A-A thru D-D) are taken perpendicular to the Systems' centerline.
- Connections:
 - Each complete CIAS unit shall be supplied with fifty (50) 2"-long X 3/8"-diameter bolts conforming to ASTM A307. Each bolt shall be provided with two (2) washers and one (1) nut. All bolts, nuts, and washers shall be galvanized in accordance with ASTM A153.
- Skid Rails and L-Brackets:
 - Each complete CIAS unit shall be provided with two (2) skid rails fabricated from 2-1/2" X 1/2" bar stock, 25'-6" long. The rear end of each rail shall have a slot as shown, and the front end of each rail shall be beveled, have a wedge shaped ST 1.5 X 3.75 section welded to it, and have a 1" diameter hole as shown.
 - Each complete CIAS unit shall be provided with two (2) 12" X 8" X 1/4" L-Brackets, 40" long with six (6) 1" X 2" bolt slots as shown.
- Protective Coating:
 - Surface Preparation - All steel parts, with the exception of the connectors, shall be prepared for painting by sandblasting in conformance with Steel Structures Painting Council, SP-6, "Commercial Blast Cleaning." All blasted surfaces shall be approved prior to coating.
 - Prime Coat - All prepared surfaces shall be shop coated with an approved zinc-rich urethane primer. The prime coat shall be free of sags and runs and have a uniform dry film thickness of 3 - 5 mils. All primed surfaces shall be approved before the final coat is applied.
 - Final Color Coat - All primed surfaces shall be shop coated with an approved high-build aliphatic urethane, Federal Color No. 13538. The final coat shall be free of sags and runs with a uniform dry film thickness of 3 - 5 mils.

1	5/97	L-Brackets Center Hole added to rear of Cylinders A, B, & C.	
REV.	DATE	DESCRIPTION	SHEET NO.

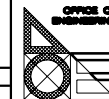
NOT TO SCALE

DESIGNER: John F. Carney III	6/83
DRAWN BY: Michael M. Kasznik	11/98
CHECKED BY: L. A. Storon	11/86
DATE CHECKED:	

STATE OF CONNECTICUT
DEPARTMENT OF TRANSPORTATION

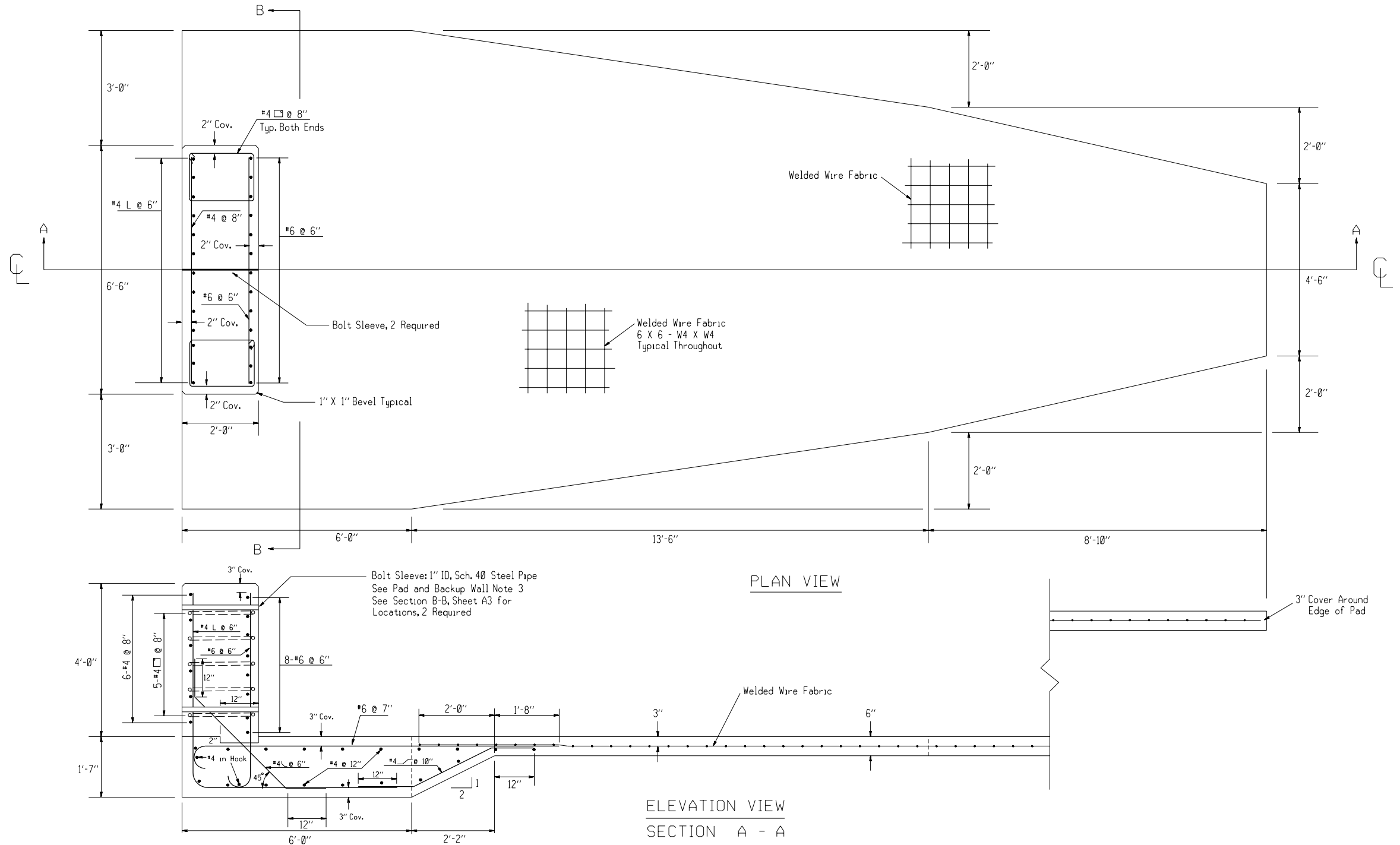
OFFICE OF ENGINEERING

APPROVED BY: _____ DATE: _____



PROJECT TITLE:	TOWN:
CADD	PLOTTED

DRAWING TITLE: CONNECTICUT IMPACT ATTENUATION SYSTEM (CIAS) SHOP FABRICATED DETAILS	PROJECT NO.:
	DRAWING NO.:
	SHEET NO.:

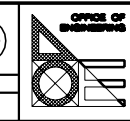


1	5/97	Width of Backup Wall; Spacing of various reinforcing bars.	
REV.	DATE	DESCRIPTION REVISIONS	SHEET NO.

NOT TO SCALE

DESIGNER: A. A. M. 7/84
 DRAFTER: Eric C. Lohrey 12/98
 CHECKED BY: Michael M. Kosinski 12/98
 DATE CHECKED:

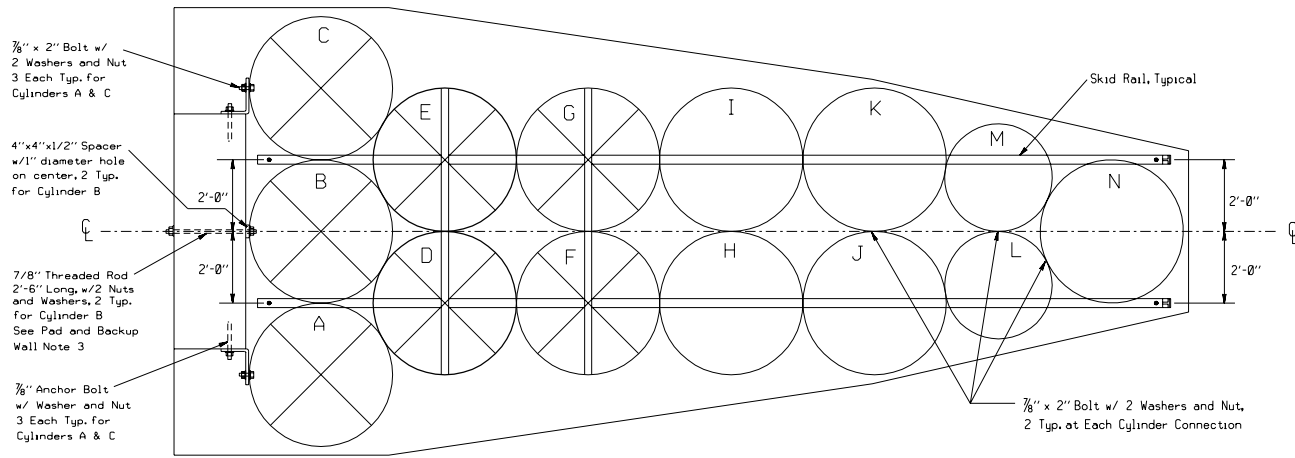
STATE OF CONNECTICUT
 DEPARTMENT OF TRANSPORTATION
 ENGINEER: OFFICE OF ENGINEERING
 APPROVED BY: DATE:



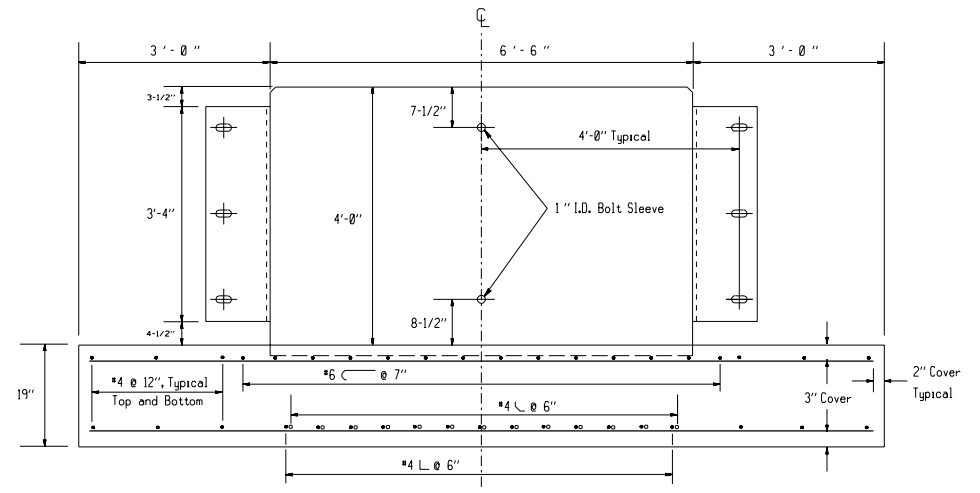
PROJECT TITLE:
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TOWN:
 DRAWING TITLE:
 CONNECTICUT IMPACT ATTENUATION
 SYSTEM (CIAS)
 PAD AND BACKUP WALL DETAILS

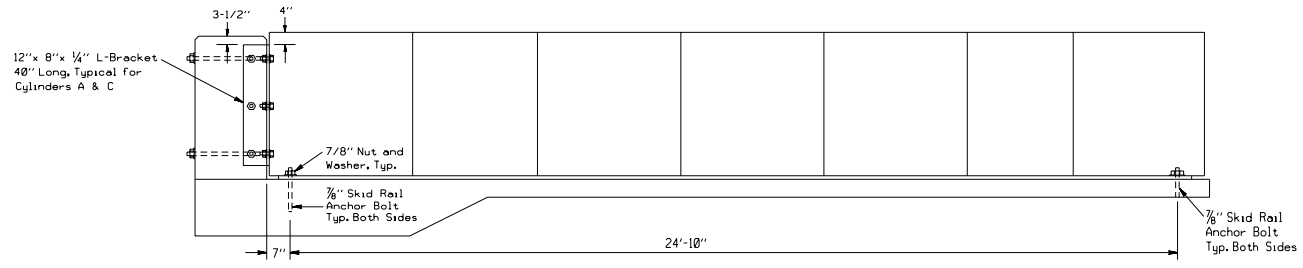
PROJECT NO.:
 DRAWING NO.: MDS-
 SHEET NO.:



ANCHORAGE and ASSEMBLY DETAILS



BACKUP WALL
SECTION B - B



ASSEMBLY NOTES

- Skid Rails and L-Brackets shall be placed in position over the corresponding Anchor Bolts, and secured in place with washers and nuts. All anchor bolt nuts shall be tightened to a minimum final torque of 75 ft-lb.
- Cylinder B shall be connected to the Backup Wall with two (2) 7/8" x 2'-6" threaded rods and nuts conforming to ASTM A325, and washers conforming to ASTM F436. 4" x 4" x 1/2" ASTM A36 steel spacers with 1" diameter holes on center shall be placed between the Backup Wall and Cylinder B as shown above. All threaded rods, nuts, washers, and spacers shall be galvanized after fabrication in conformance with ASTM A153.
- All Cylinders (A thru N) shall be placed on the Skid Rails in the configuration shown above. It is extremely important that the individual Cylinders be placed in their proper position in the array. All Cylinders shall be connected to each other at all points of tangency with two (2) 7/8" x 2" bolts, nuts and washers. Cylinders A and C shall be secured to the corresponding L-Bracket with three (3) 7/8" x 2" bolts, nuts and washers. All bolts shall be tightened to a minimum final torque of 75 ft-lb.
- Cylinder connection hardware (bolts, nuts, and washers) shall be supplied by the CIAS manufacturer. Anchoring hardware (threaded rods, spacers, chemical anchor bolts, and related nuts and washers) shall be supplied by the CIAS installation contractor as part of the Pad and Backup Wall construction.

PAD and BACKUP WALL NOTES

- Construction of the CIAS shall conform to the requirements of the Connecticut Department of Transportation, Standard Specifications for Roads, Bridges and Incidental Construction (most recent edition) and the Special Provisions.
- The CIAS Pad and Backup Wall shall be constructed with concrete having a minimum compressive strength (f'c) of 4000 psi.
- All reinforcing steel shall be new deformed bars conforming to ASTM A615, Grade 60 unless otherwise noted. Welded Wire Fabric shall be size designation 6x6 - W4xW4 and Grade 60. The Bolt Sleeves shall be 1" diameter, Schedule 40 steel pipe conforming to the requirements of ASTM A53, Grade B. They shall be tied to the reinforcing cage in the exact locations shown above prior to the placement of the Backup Wall concrete. When securing CIAS to an existing Backup Wall, use two (2) 7/8" chemical anchor bolts in place of Bolt Sleeves and Threaded Rods for Cylinder B.
- Top of Pad elevations shall be within the range 0" to 1/4" above the top elevations of the surrounding pavement. The Pad shall NOT be constructed such that water will collect and be retained on its surface at any time.
- The Pad and Backup Wall details shown are for construction on a gravel base. Backup Walls and Pads constructed on existing concrete or bridge decks shall be designed to meet site requirements.
- Anchor bolts and nuts shall conform to ASTM A325. Washers for the anchor studs shall conform to ASTM F436. Anchor studs, nuts and washers shall be galvanized after fabrication in accordance with ASTM A153. Each anchor bolt shall be chemically imbedded in a prepared hole in strict conformance with the manufacturer's recommendations. The chemical anchors and methods of hole preparation shall be approved by the Engineer before work begins. Each anchor bolt shall have 2" of threads exposed above the concrete surface.

REV.	DATE	DESCRIPTION	SHEET NO.
1	5/97	Width of Backup Wall; L-Brackets.	

NOT TO SCALE

DESIGNER: A. A. M. 7/84

DRAFTER: Eric C. Lohrey 1/91

CHECKED BY: Michael M. Kosinskis 1/91

DATE CHECKED:

STATE OF CONNECTICUT
DEPARTMENT OF TRANSPORTATION

ENGINEER: OFFICE OF ENGINEERING

APPROVED BY: _____ DATE: _____

PROJECT TITLE:

CADD _____ PLOTTED _____

TOWN:

DRAWING TITLE:
CONNECTICUT IMPACT ATTENUATION
SYSTEM (CIAS)
BACKUP WALL AND ASSEMBLY DETAILS

PROJECT NO.:

DRAWING NO.: MDS-

SHEET NO.: