ADIEM II END TERMINAL FOR CONCRETE BARRIER

OR-EF-98-11

Construction Report
Experimental Features
Project #96-01

by

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Research Specialist

Prepared for

Oregon Department of Transportation
Research Unit
Salem, OR 97310

and

Federal Highway Administration
Washington, D.C. 20590

March 1998

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16. Abstract

An ADIEM II (Advanced Dynamic Impact Extension Module) was installed on Interstate 5 near Salem, Oregon. This device was used for an end treatment because of space limitations imposed by the steep fill. A three-person crew completed installation in about two hours.

Because the installer did not have the proper lifting equipment, the installation was delayed while a heavy-duty forklift was transported to the job site. No other major problems developed.

The bases of the crushable concrete modules were not sealed with paint as effectively as the rest of the module. Moisture could penetrate the porous concrete from the bottom up. This area will be watched closely during the next three-year evaluation period. The blocks are easy to move if additional sealing is necessary.

17. Key Words	18. Distribution Statement
ADIEM, BARRIER, CRASH CUSHION, END TREATMENT	Available through the ODOT Research Unit.

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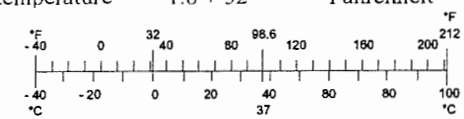
SI* (MODERN METRIC) CONVERSION FACTORS

APPROXIMATE CONVERSIONS TO SI UNITS

Symbol	When You Know	Multiply By	To Find	Symbol
		LENGTH		
in	inches	25.4	millimeters	mm
ft	feet	0.305	meters	m
yd	yards	0.914	meters	m
mi	miles	1.61	kilometers	km
		AREA		
in^2	square inches	645.2	millimeters squared	mm^2
ft^2	square feet	0.093	meters squared	m^2
yd^2	square yards	0.836	meters squared	m^2
ac	acres	0.405	hectares	ha
mi^2	square miles	2.59	kilometers squared	km^2
		VOLUME		
fl oz	fluid ounces	29.57	milliliters	mL
gal	gallons	3.785	liters	L
ft^3	cubic feet	0.028	meters cubed	m^3
yd^3	cubic yards	0.765	meters cubed	m^3
NOTE: Volumes greater than 1000 L shall be shown in m^3.				
		MASS		
oz	ounces	28.35	grams	g
lb	pounds	0.454	kilograms	kg
T	short tons (2000 lb)	0.907	megagrams	Mg
		TEMPERATURE (exact)		
°F	Fahrenheit temperature	5(F-32)/9	Celsius temperature	°C

APPROXIMATE CONVERSIONS FROM SI UNITS

Symbol	When You Know	Multiply By	To Find	Symbol
		LENGTH		
mm	millimeters	0.039	inches	in
m	meters	3.28	feet	ft
m	meters	1.09	yards	yd
km	kilometers	0.621	miles	mi
		AREA		
mm^2	millimeters squared	0.0016	square inches	in^2
m^2	meters squared	10.764	square feet	ft^2
ha	hectares	2.47	acres	ac
km^2	kilometers squared	0.386	square miles	mi^2
		VOLUME		
mL	milliliters	0.034	fluid ounces	fl oz
L	liters	0.264	gallons	gal
m^3	meters cubed	35.315	cubic feet	ft^3
m^3	meters cubed	1.308	cubic yards	yd^3
		MASS		
g	grams	0.035	ounces	oz
kg	kilograms	2.205	pounds	lb
Mg	megagrams	1.102	short tons (2000 lb)	T
		TEMPERATURE (exact)		
°C	Celsius temperature	1.8 + 32	Fahrenheit	°F



* SI is the symbol for the International System of Measurement

(4-7-94 jbp)

ACKNOWLEDGMENTS

The author would like to thank the following Oregon Department of Transportation (ODOT) personnel for their contributions and help gathering information for this report: Mike Dunning, Otto Heider and Sam Johnston. In addition, the author thanks Steven D. Easton of Syro, Inc. for supplying technical data on the ADIEM II.

DISCLAIMER

ADIEM II END TERMINAL FOR CONCRETE BARRIER

TABLE OF CONTENTS

LIST OF FIGURES

1.0 INTRODUCTION

The Advanced Dynamic Impact Extension Model II (ADIEM II) is an end terminal system that has met all FHWA design standards as well as passing NCHRP 230 crash tests. The system has been used by other states with mixed results. Utah describes some of the crushable concrete blocks as "falling apart". Pennsylvania has concerns about the coatings but finds the system acceptable. Washington also has concerns about the coating, appearance, weight, and replacement for permanent installations. Washington, however, did find it easier and less expensive to install than other attenuators.

The Oregon Department of Transportation (ODOT) installed its first ADIEM II system on I-5 near Salem, Oregon. Although the system has worked well in crash tests and has saved lives at temporary installations in other states, there are concerns about the waterproof coating durability. The system will be monitored for three years with particular attention given to the coating. This report documents the installation of the temporary ADIEM II system and the first month's performance. Product reviews are included in Appendix A.

The ADIEM II design has recently been replaced by the ADIEM 350 that meets NCHRP 350 crash test procedures. If additional systems are installed, they will be the ADIEM 350 design.

1.1 BACKGROUND

The ends of concrete barriers and portable concrete barriers present a troublesome safety problem. Some solutions, such as the sloping concrete wedge, are low cost, but their effectiveness in reducing injuries is questionable. Sand-filled barrels and steel barrel cushions are fairly low cost, but maintenance is difficult. They also require a wide median or roadside (see Figure 1.1), which is often not available, especially in constrained construction areas. Further, they do not have side redirection characteristics. Finally, there are narrow cushions for end treatments in narrow zones that perform well in collisions. An example is the GREAT CZ, shown in Figure 1.2. The cushions, however, are costly. A successful test of the ADIEM II terminal would give ODOT the option of a low-cost and easily repairable end terminal for design applications.

Figure 1.1: Buried end-terminals require wider shoulder space.

Figure 1.2: The GREAT CZ installed on the southbound off-ramp near Delany Road.

2.0 PROJECT DESCRIPTION

2.1 PROJECT LOCATION AND ENVIRONMENT

The project is located on Interstate 5 at milepost 248.31 about 9.7 km south of Salem, Oregon (see Figures 2.1 and 2.2). The ADEIM II was installed at the south end of a run of concrete barrier, which protects traffic from a bridge end, and has a 4:1 fill slope. Level space to build a conventional buried-end terminal was not available because of the fill slope.

The system is located in a lane-changing area of a freeway with an ADT of more than 40,000. Traffic engineers find that such sections have higher accident rates. Also, according to Syro documents, some of the survivors of collisions with the ADIEM II report that their accidents resulted from trying to avoid other vehicles making sudden lane changes. Within three months of the ADIEM II installation, a truck hit another temporary crash system in the vicinity.

The average annual rainfall for this area is 1.1 m. The last two years have been above average at nearly 1.4 m. This large amount of moisture could degrade the crushable concrete if the moisture penetrates the blocks' coating.

Several freeze thaw cycles are typical during the months of December and January. This process could weaken the crushable concrete. Thus, weather data will also be collected during the three-year monitoring period.

2.2 DESIGN

The ADIEM II system is composed of a wedge-shaped base and eight crushable concrete modules. The base is held in-place by twelve 25 mm x 60 mm steel pins. These pins are driven though the base into the asphalt or gravel upon which the base rests. The crushable concrete modules are 610 mm high, 901 mm wide, and 280 mm deep. The blocks are held in place by cast-in brackets, which slide into a steel slot on the base (see Figures 2.3 and 2.4). A side pipe rail is cast on the base at auto-hub height to help redirect side impacts. Note that Figure 2.3 is for the ADIEM II system. See manufacturer's details for current ADIEM 350 dimensions.

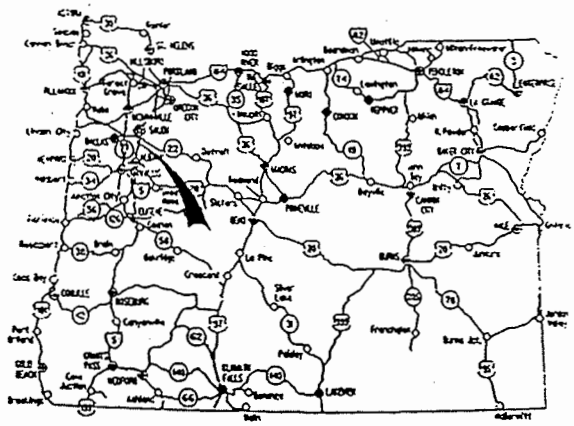


Figure 2.1: Project location map.

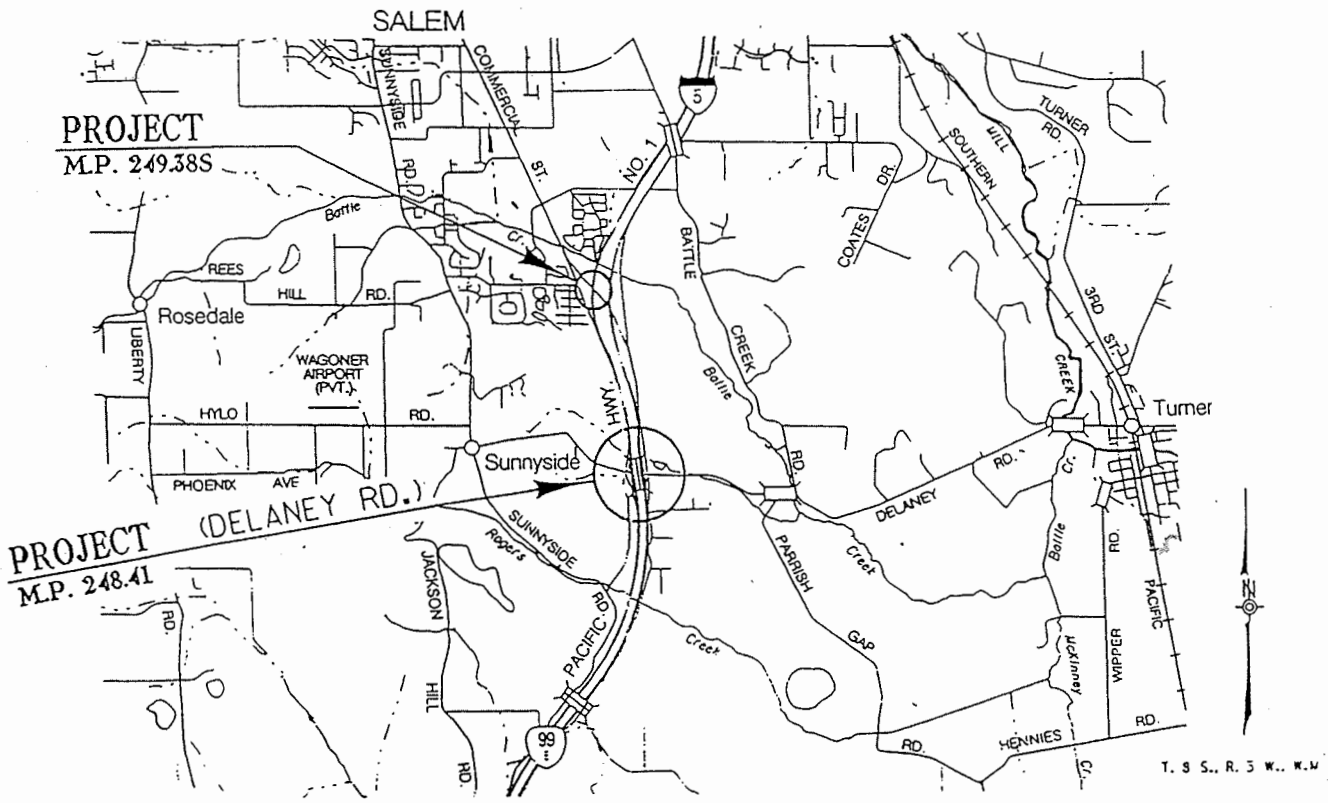


Figure 2.2: Project vicinity map.

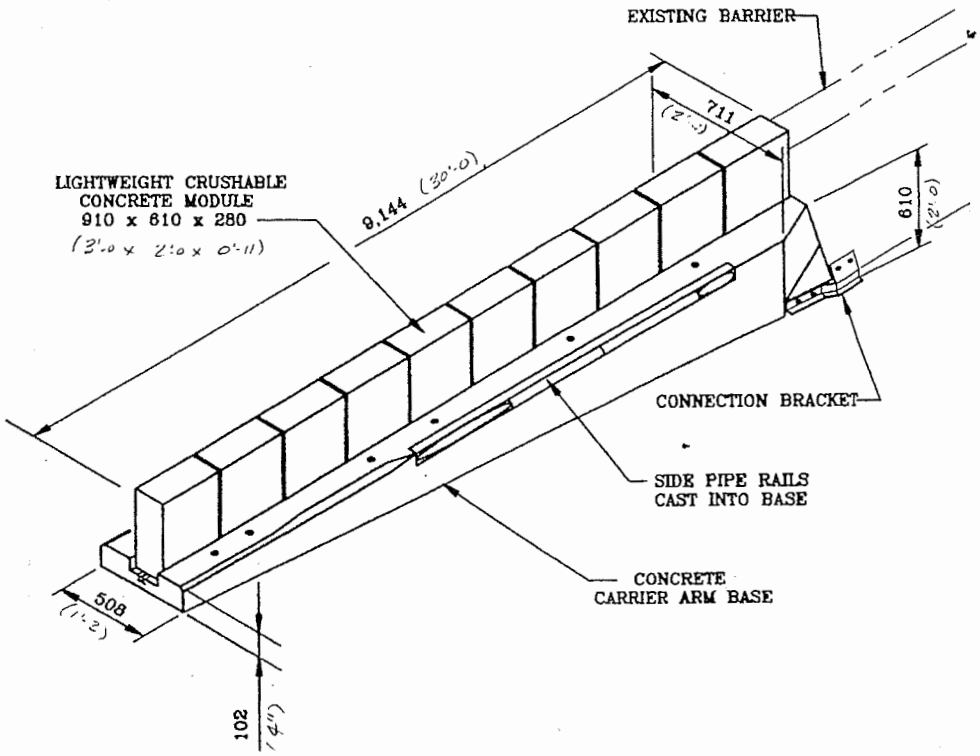


Figure 2.3: ADIEM II design.

Figure 2.4: Crushable blocks have a cast-in mounting bracket on the base.

3.0 CONSTRUCTION

3.1 INSTALLATION OF ADIEM II

On September 9, 1997, an ADIEM II terminal end for concrete barrier was installed near the Delany Road over-crossing on I-5. A three-person crew used an 8.2 metric ton forklift to complete the installation in about two hours. The crew leader from Dirt and Aggregates Interchange, Inc. had been certified by SYRO to install the ADIEM II and other crash attenuation systems.

All of the materials and mounting hardware were delivered to the job site in satisfactory condition. The blocks had been covered on all sides except the bottoms with an acrylic latex. The bottoms were covered with a coating material which flaked off quite easily. This should be watched closely over the next three years of evaluation (see Figure 3.4).

3.2 UNLOADING THE ADIEM II

The work was delayed because of problems unloading the base of the system from the flat bed delivery truck. A Pettibone general-purpose crane at the job site was not able to move the base. The contractor had to rent a large forklift to do the lifting. The rental was a Hyster 190 with a lifting capacity of 8.2 metric tons. The base had been loaded in Troutdale using two forklifts.

The manufacturer stated that the bases are moved at the plant using the recessed grooves. Although the base was made with transverse grooves for handling by a forklift, the contractor felt that the base did not balance well. The forks of the Hyster were placed on the bottom of the base, not in the grooves (see Figure 3.1). This increased the handling problems because the base had to be placed on wood posts near the installation location. The base was then wrapped with a chain and lifted with the Hyster. Another contractor in the region uses lifting straps of different lengths and a crane to set the bases in place.

3.3 BASE PLACEMENT

The contractor set the base in position and marked the holes for the twelve steel pins, which hold the base in place. After the holes were marked, the base location was marked and the base was moved about one meter to the left. The holes were drilled through the asphalt and base rock to a total depth of 0.60 m. The base was then moved on the wood posts to its final location and the steel pins were lined up with the drilled holes. A chain was wrapped around the base and the wood posts were removed in order to lower the base to its final position (see Figure 3.2). At that time, a slight adjustment was needed for alignment of all the pins. This forklift was able to use the ADIEM II's built-in grooves for this final maneuver. The steel pins were then driven firmly into the pavement.

Figure 3.1: The base was set in place using a 190 Hyster forklift.

Figure 3.2: A chain was wrapped around the base to place it in its final position.

3.4 MODULE PLACEMENT

The lightweight crushable concrete (LWCC) modules were moved from the loading pallet and slid up the steel slot on the base. Two workers easily moved the blocks and said that the blocks did not seem to weigh 90 kilograms. Crushable concrete specific weight should be checked according to manufacturer's tolerances. Variances could occur due to improper proportions of Perlite.[1] Although the blocks slid easily for most of the length of the track, the edges of the metal slot were rough and the blocks had to be lifted and pushed simultaneously to overcome friction at a few spots (see Figure 3.3). The producer recommends oiling the track before installing the blocks (see Appendix B).

3.5 BARRIER CONNECTION

The base of the ADIEM II was connected to the concrete barrier with a steel splice plate. Two large through-bolts were placed in pre-drilled holes in the base of the ADIEM II, while three holes on each side of the barrier were drilled about 250 mm deep (see Figure 3.5). The holes were filled with a two-part epoxy and then the threaded shafts were inserted into the holes. A nut and washer were placed tightly on the shaft finger. The final tightening was made about two hours later after the epoxy cured.

3.6 FINAL DRESSING

The final step of the installation was to touch up any scratches or scars made in the LWCC modules during installation. The manufacturer supplied a container of the same acrylic latex paint used for the initial coating. The bottoms of the LWCCs were not accessible for this step. The yellow and black warning chevron was attached to the south end of the ADIEM II with epoxy (see Figure 3.6). No special pre-cast or pre-drilled holes are provided for this mounting. The project inspector stated that some time could be saved if a mount was cast in the base.

Because the mounting procedure is not critical to the operation of the ADIEM II, it is left to the discretion of the engineer.

[1] D. L. Ivey and M. A. Marek. Transportation Research Record No. 1367.

Figure 3.3: Two workers easily install LWCC modular blocks.

Figure 3.4: The coating on the bottom of the blocks flaked off easily.

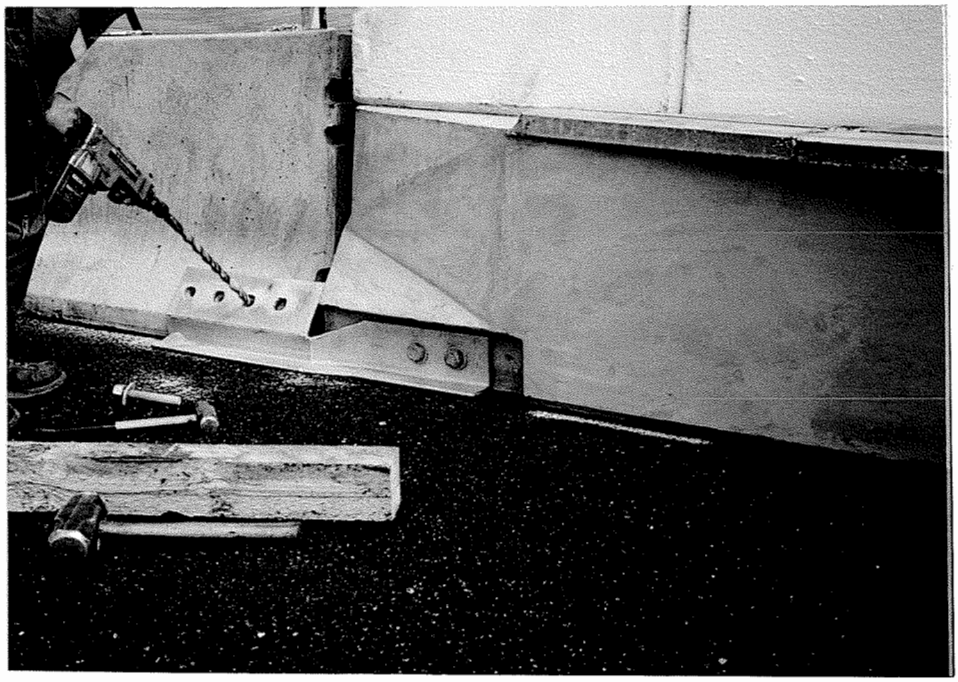


Figure 3.5: Holes are drilled in the existing barrier for the connection plate.

Figure 3.6: Completed ADEIM II installation.

4.0 COSTS

The ADIEM II is a relatively low-cost barrier end terminal. The buried end may seem to be lower cost because it only requires dirt. Dirt however, can be expensive when right-of-way has to be bought. Also, there are cases where the extra shoulder space is not available, as in the Delany Road installation.

Another narrow space end terminal, the GREAT CZ, costs about 30% more than the ADIEM II, or about $15,100 per unit. Producing a lower cost end terminal was one of the motivating factors for the Texas Transportation Institutes ADIEM II development.

ADIEM II prices can be negotiated with the manufacturer. Single units are available for $11,000. An order of 20 units was sold at a unit cost of about $8,000. Because they are manufactured in Centerville, Utah, they can be shipped to any of the western states within a few days.

Contract cost for temporary installations of the ADIEM II or GREAT CZ may not reflect true unit costs. On the Delany road project, the GREAT CZ was bid at $3,500 while the ADEIM II was bid at $6,500. Contractors can bid below new unit cost on a temporary installation because the unit is returned to the contractor and can be used on other projects. Also, guardrail and other traffic protection devices were under the same sub-contract, so the true cost for the ADIEM II was masked (unbalanced bid).

5.0 POST-CONSTRUCTION INSPECTION

On October 17, 1997, about six weeks after the ADEIM II was installed, the ODOT Research Unit performed a visual end terminal inspection. The installation had not been hit and in general was in excellent condition. Three minor defects were found: discoloration, a soft spot, and a crack.

The crushable blocks were no longer bright white but were somewhat dirty with yellow splotches.

A 30-mm diameter soft-spot had developed on the crushable block adjacent to the barrier. The spot was located near the center of the block on the east facing side (see Figure 5.1).

A small hairline crack was found in the base. This crack, also on the east facing side, was not observed at the time of installation.

These three defects will be monitored during the coming winter months. The ADIEM II's current condition may be related to above average rainfall for the period prior to the inspection (120 mm with average at 50 mm). Further deterioration of the system could eventually compromise the system performance, however, the manufacturer has not expressed concern over the defects.

Figure 5.1: Small soft spot on block is circled.

6.0 CONCLUSIONS AND RECOMMENDATIONS

The ADIEM II installation is quick. A trained but inexperienced contractor completed the work on this project in less than one day. The actual work time after the large forklift arrived at the job site was about two and a half hours. The most time consuming task was pre-drilling the holes for the pins. Driving the pins also required a great deal of time and effort.

The contractor had difficulty moving the base using the built-in recessed grooves. Both the manufacturer and an experienced barrier installer state that a forklift operator placing the forks in the grooves can move the bases. The preferred method is to use a crane with a lifting capacity of at least 9 metric tons. Lifting straps are placed in the grooves, allowing the installer to move the base from the delivery truck to its resting place at the end of the barrier.

Extra time was used to place the base at the end of the barrier, mark the holes, and then move the base to one side in order to pre-drill the holes in asphalt for the pins. After the holes were drilled, the base was reset in the final position. Lining up all of the pins with the holes was quite a challenge. Installation instructions recommend against this practice (see Appendix B).

We recommend contractors follow the manufacturer's installation instructions. Two time savers for installation are: (1) a crane or fork lift with 9 metric tons or greater lifting capacity (the base weighs about 6,800 kgs) and (2) a 23 kg airhammer/drill with a 91 cm drill bit.

APPENDIX A

PRODUCT REVIEWS

Oregon

DEPARTMENT OF
TRANSPORTATION

Operations Support Section

FILE CODE:

September 12, 1994

DAVID R LEWIS
SYRO INC
1170 N STATE ST
GIRARD OH 44420

SUBJECT: **Product:** **Adiem II** MAT 3-4
Category: **Impact Attenuator, Temporary, 00225.12** ODOT No. 1224

Your product was submitted for review to the Product Evaluation Committee of the Oregon Department of Transportation (ODOT). In reviewing your product, we have determined that it appears to be suitable for the intended use.

We are adding your product to our Qualified Products List for the category listed above.

The information you have provided is on file at the Operations Support Section. Please keep us advised on any changes with regards to this product so that we may keep our files current.

If you have further questions please contact me at (503) 986-3059.

Sincerely,

Mike Dunning

Mike Dunning
New Products Coordinator

MD:mkm
newprod\qualprod.ltr

Post-It™ brand fax transmittal memo 7671 | # of pages ▸ 2

To Don Gupney	From Mike Dunning
Co.	Co. ODOT
Dept.	Phone # 503/986-3059
Fax # 206/943-9559	Fax #

Airport Road SE
m, OR 97310
) 986-3000/986-3100
FAX (503) 986-3032
FAX (503) 986-3096/LAB

4-2255 (2-94)

Oregon

DEPARTMENT OF
TRANSPORTATION

Operations Support Section

November 27, 1995

COPY

DAVID LEWIS
SYRO A DIVISION OF TRINITY
1170 N STATE ST
GIRARD OH 44420

FILE CODE:
MAT 3-4

Product: **ADIEM II**
Category: **Impact Attenuator, Permanent, NCHRP 230** ODOT No. 1224

Your product was submitted for review to the Product Evaluation Committee of the Oregon Department of Transportation (ODOT). In reviewing your product, it appears to be suitable for the intended use. We are adding your product to our Experimental Use List, subject to a trial installation.

This experimental use will permit the product to be used and evaluated on the approved project only. If the trial installation and evaluation is successful, the product will be included on our Qualified Products List. Further testing and qualification on a job-by-job basis may be necessary.

The information you have provided is on file at the Operations Support Section Materials Laboratory. Please keep us advised on any changes with regard to this product so that we may keep our files current.

If you have further questions please contact me at the Materials Lab (503) 986-3059.

Mike Dunning
New Products Coordinator

DMD:nj
newprod/conditio.fin

c: Don Gripne
5216 Brassfield Dr
Olympia WA 98501

800 Airport Road SE
Salem, OR 97310
(503) 986-3000/986-3100
FAX (503) 986-3032
FAX (503) 986-3096/LAB

U.S. Department
of Transportation

**Federal Highway
Administration**

400 Seventh St., S.W.
Washington, D.C. 20590

March 3, 1997

Refer to: HNG-14

Mr. Don L. Ivey
Research Engineer
Safety Division
Texas Transportation Institute
Texas A&M University System
College Station, Texas 77843-3135

Dear Dr. Ivey:

Your November 22, 1996, letter to Mr. James H. Hatton and Mr. Richard Powers transmitted copies of a November 1996 Texas Transportation Institute (TTI) report, "NCHRP Report 350 Test 3-32 on the ADIEM," and requested the Federal Highway Administration's (FHWA) acceptance of the ADIEM as a TL-3 terminal-crash cushion. Test 32 was the final test in the series of tests considered necessary for acceptance of the ADIEM under the National Cooperative Highway Research Program (NCHRP) Report 350 guidelines. The other tests run and the corresponding TTI test reports submitted earlier for the FHWA review included the following:

3-30 "Development of a Low Cost High Performance Terminal for Concrete Median Barriers and Portable Concrete Barriers," August 1991;

3-31 "NCHRP Report 350 Compliance Tests of the ADIEM," December 1995;

3-35 "NCHRP Report 350 Compliance Tests of the ADIEM," December 1995;

3-39 "NCHRP Report 350 Compliance Tests of the ADIEM," December 1995;

3-34 "NCHRP Report 350 Test 3-34 on the ADIEM," August 1996.

Summary results of each of these tests (including test 3-32) are shown in Enclosure 1. We concur that test 3-33 (a 15-degree nose impact with a 2000-kg pickup truck at 100 km/h) can be waived, based on computer simulation with this vehicle and on the passing results of test 3-32.

We have noted that there were three significant changes in the ADIEM design from the NCHRP Report 230 version. These are:

1. The 76-mm diameter steel pipe rails on the outside upper rear edges of the carrier arm have been replaced with 102-mm X 51-mm X 4.8-mm steel tubes with tapered ends;

2. The two S3 X 7.5 beams forming the center channel in the carrier arm in which the "feet" of the individual expendable modules slide have been replaced by a C-shaped, 76-mm X 76-mm X 6.35-mm, cold formed channel;

3. The nose of the carrier arm has been tapered over the first 3350 mm from an initial width of 305 mm at the ground line to a final width of 610 mm. The original design maintained a constant width of 610 mm throughout its entire length at the ground line.

Enclosure 2 shows the final NCHRP Report 350 design, including anchorage and barrier attachment details. We note that the plans require different length anchor pins depending on site foundation conditions (i.e., concrete, asphalt, or compacted base or soil). We have noted also that the ADIEM is not recommended for use on loose soil. These details, plus its attachment to a standard height (810 mm) concrete safety barrier to allow controlled crushing of the ADIEM modules at both ends, must be followed in field installations to maintain crash worthiness.

When the ADIEM is used to shield the end of temporary concrete barrier, the anchorage needs of the temporary barrier must be independently met. You will need to provide appropriate guidance to users of the ADIEM for temporary installations. We understand that you have developed custom splice connections to be used with different barrier configurations and will recommend different ADIEM positioning in such cases to ensure that the transition between the ADIEM and the shielded barrier will not cause vehicle snagging for traffic on the approach side of the device or on the back side of the device in a reverse-direction hit.

We have noted that the occupant impact velocity in test 3-32 was 12.12 m/s, slightly higher than the 12 m/s limit recommended in NCHRP Report 350. We believe, as did the researchers, that this is a marginally acceptable result and we are willing to accept it as "passing." We must, however, point out that we gave considerable thought to how much beyond the imprecisely-expressed 12 m/s in Report 350 we will consider acceptable. We concluded that nothing above 12.20 m/s will be considered acceptable.

Of greater concern is the apparent sensitivity of the ADIEM to the proper fabrication of the Perlite concrete modules. One of your earlier tests revealed unacceptable performance when the depth of the top layer of low-density concrete exceeded the specified depth of 178 mm. Your January 10 letter to Messrs. Hatton and Powers described the specifications and quality control measures that you have established to ensure the actual thicknesses and strengths of the production modules will conform to the tested-design. Briefly, you indicated that a thickness tolerance of ½-inch (13 mm) and a 28 day compressive strength range of 90 to 120 psi (620 to 827 kPa) would be allowed in the top layer of concrete. You also indicated that the middle layer of concrete must have a 28-day compressive strength between 20 and 40 psi (138 to 276 kPa). You have not indicated the tolerances for the bottom 3-inch (76-mm), 500-psi (3448-kPa) layer of concrete in the modules. We assume these will be established at a level at least as demanding as was established for the other portions of the modules and that these requirements will be added to your specifications and quality control procedures. Please send us copies of revised specifications and quality control procedures that reflect these additions.

In summary, we find the modified ADIEM design, including tolerances, described above satisfies the evaluation criteria contained in the NCHRP Report 350 and is acceptable for use on the National Highway System (NHS) as a TL-3 terminal-crash cushion when requested by a highway agency. We consider it to be a gating terminal with the beginning of its length of need at its midpoint, as evidenced by vehicle redirection in test 3-35. Since the ADIEM remains a proprietary device, its use on Federal-aid projects, except exempt, non-NHS projects, is subject to the conditions stated in Title 23, Code of Federal Regulations, Section 635.411.

Sincerely yours,

Dwight A. Horne

Dwight A. Horne, Chief
Federal-Aid and Design Division

2 Enclosures

SYRO, INC.
A SUBSIDIARY OF **TRINITY INDUSTRIES, INC.**

Don J. Gripne
5216 Brassfield Dr.
Olympia, WA 98501
360-943-9559
Fax No. 360-943-9559

April 14, 1997

Mr. Mike Dunning
Oregon Department of Transportation
Materials Section
800 Airport Road S.E.
Salem, Or 97310

Dear Mike:

Enclosed per you letter of April 9, 1997 is a completed "Preliminary Information for Product Evaluation" form for the ADIEM 350 for your use in evaluating the ADIEM 350.

This product, having passed the crash testing requirements of NCHRP 350, replaces the ADIEM II. The ADIEM II should still be left on your "Qualified Products" list for use as a temporary device.

I talked to Sam Johnston about the use of the ADIEM 350 as a permanent device. The issue in Oregon on using the ADIEM has been its durability of the coating on the modules. Sam asked me about its use in Utah, which had put a hold on it due to the durability. Today Utah has approved its use, but approval by their headquarters is required before it can be installed in a permanent location. The approval has to do with their desire to control the places the ADIEMs are installed. It has nothing to do with it durability.

I would ask that the ADIEM 350 be placed on the "Qualified Products" list for use as both a permanent and a temporary attenuator.

If you have any questions, please give me a call.

Very truly yours,

Don J. Gripne

Don J. Gripne
SYRO, Inc.

Enclosure:

cc: Sam Johnston w/enclosure

Oregon
John A. Kitzhaber, M.D., Governor

Department of Transportation
Operations Support Section
800 Airport Road SE
Salem, OR 97310
(503) 986-3000
FAX (503) 986-3096

August 21, 1997

COPY

FILE CODE:

CHARLES NORTON
SYRO A DIVISION OF TRINITY
950 W 400 S
CENTERVILLE VT 84014

MAT 3-4

Product: **ADIEM 350**
Category: **Impact Attenuator, Temporary** ODOT No. 1663

Your product was submitted for review to the Product Evaluation Committee of the Oregon Department of Transportation (ODOT). In reviewing your product, it appears to be suitable for the intended use. We are adding your product to our Conditional Use List subject to a trial installation.

It is your responsibility to find a district manager or a contractor willing to use the product on an active State highway project. The contractor must submit the product through the project manager for consideration prior to use. Be sure to indicate that the product is on the"Conditional List" and that they should contact the Materials Laboratory for confirmation. A contract change order may be necessary.

This status will be effective for two years. At that time, if there are no indications the product has or will be used in Oregon, conditional status will be revoked.

This conditional use will permit the product to be used and evaluated on the approved project only. If the trial installation and evaluation is successful, the product will be included on our Qualified Products List. Further testing and qualification on a job-by-job basis may be necessary.

The information you have provided is on file at the Operations Support Section Materials Laboratory. Please keep us advised on any changes with regard to this product so that we may keep our files current.

If you have further questions please contact me at the Materials Lab (503) 986-3059.

Mike Dunning
New Products Coordinator

DMD:nj
newprod/conditio.fin

c: Don Gripne
5216 Brassfield Dr
Olympia WA 98501

Oregon
John A. Kitzhaber, M.D., Governor

Department of Transportation
Operations Support Section
800 Airport Road SE
Salem, OR 97310
(503) 986-3000
FAX (503) 986-3096

August 21, 1997

COPY

FILE CODE:

CHARLES NORTON
SYRO A DIVISION OF TRINITY
950 W 400 S
CENTERVILLE VT 84014

MAT 3-4

Product: **ADIEM 350**
Category: **Impact Attenuator, Permanent** ODOT No. 1663

Your product was submitted for review to the Product Evaluation Committee of the Oregon Department of Transportation (ODOT). In reviewing your product, it appears to be suitable for the intended use. We are adding your product to our Experimental Use List subject to a trial installation.

It is your responsibility to find a district manager or a contractor willing to use the product on an active State highway project. The contractor must submit the product through the project manager for consideration prior to use. Be sure to indicate that the product is on the"Conditional List" and that they should contact the Materials Laboratory for confirmation. A contract change order may be necessary.

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Mike Dunning
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c: Don Gripne
5216 Brassfield Dr
Olympia WA 98501

Form 734-2255 (5/97)

Washington State Department of Transportation
Sid Morrison
Secretary of Transportation

Transportation Building
P.O. Box 47300
Olympia, WA 98504-7300

October 1, 1997

Don Gripne
SYRO, Inc
5216 Brassfield Dr.
Olympia, WA 98501

RE: ADIEM Impact Attenuators

Dear Mr. Gripne:

In your April 7, 1997 letter to Dick Albin, you requested that the ADIEM II-350 be approved as an NCHRP 350, TL-3 system for use in the State of Washington. It was assumed from your request that you were also asking us to reconsider our current policy that allows the use of the ADIEM in temporary locations but not in permanent locations.

In permanent locations we were concerned about the durability and maintainability of the lightweight concrete modules. Therefore, we allowed approximately 15 of these devices to be installed in permanent locations and then stopped specifying them so that we could evaluate them over several years. In response to your request, we conducted a field review of all of the permanent ADIEM locations and spoke with the maintenance people that are responsible for them.

The following is a summary of the concerns that need to be addressed by SYRO before we will allow the ADIEM to be used again in permanent locations:

The major concern we have is the quality of the modules. With only 2 exceptions, there was deterioration and cracking, in some cases severe, of the module coating. We believe that some of the defects were present when the ADIEM was first installed and they probably should have been rejected and not allowed to be installed. These modules had major coating damage or soft spots under the coating. Attempts were made to repair these defects with the Acrylink that was supplied with the units. In a couple cases where the modules had slight damage the patching appears to have repaired the module adequately. However, in most cases, the patching did not provide a product that we feel is acceptable.

Light vehicle impacts can cause major damage to the modules. It is also believed that some of the damage that we have observed was caused by flying road debris and vandalism.

The durability of the modules also creates some aesthetic concerns as the appearance of the modules is poor once they begin to deteriorate.

The weight of the modules is another issue that needs to be addressed. Our maintenance people are not allowed to lift more than 50 pounds. Therefore, lifting equipment is needed to move and replace a module. Also, the modules are bulky and do not have lifting appuratuses which makes handling difficult. This problem is compounded because the modules are easily damaged.

Replacement of the rear module requires removal of all of the modules. In many frontal impacts, the modules in the middle were not damaged and in a median application impact, the rear module was the only one damaged. In both cases all of the modules had to be removed. This increases the work and exposure of our maintenance people to traffic.

When hit, debris is scattered into other lanes and into catch basins and ditches. In one instance, a large section of one of the modules landed on the shoulder down stream from the ADIEM.

Mounting a delineator on the front of the attenuator is very difficult. We have used straps, wires, bungee cords, rope and adhesives to attach the delineator. In many cases this has caused damage to the module.

In considering the use of this attenuator we also identified some positives. It is more simplistic and it is cheaper initially than other comparable attenuators. However, in weighing these benefits against the concerns listed above, we do not feel that the ADIEM is a good choice for use as a permanent impact attenuator on our highways. We will continue to specify the ADIEM for temporary use and the ADIEM-350 is approved for this use.

If you have any questions, please contact Dick Albin at (360) 705-7269.

Sincerely,

Donald K. Nelson
State Design Engineer

DKN:jce/97-247
RBA (DPP)

cc: Dave Bowers, 47358

APPENDIX B

PRODUCT INFORMATION
(INCLUDES INSTALLATION INSTRUCTIONS AND DRAWING)

INSTALLATION INSTRUCTIONS
FOR ADIEM-II

1. The ADIEM base is to placed on a smooth surface (the same horizontal plane as the concrete barrier) and parallel to the mainline or ramp traveled lane(s).

2. Install anchor rods for ADIEM base by driving in soil or soft asphalt or driving in pre-drilled holes for hard asphalt or concrete (no epoxy required). The base should not be moved after the holes are drilled. The holes should be drilled using at a minimum, a 35# hammer and minimum 36 inch long drill bit. (A 50# hammer is recommended.)

3. Attach connection brackets to base with two (2) 1 1/8" x 24" threaded rods provided. Then field drill holes into the existing barrier and attach the other end of the connection bracket to it with expansion anchor hardware provided.

4. Oil the ADIEM base track. Slide the modules onto the base. Be careful not to damage edges of the modules while sliding onto the base.

5. If the modules are scuffed or nicked, apply ACRYLINK coating to the affected area.

6. Recommended tools and equipment:
   - 35/50# air hammer/drill
   - 1 3/8" dia. x 36" rock drill
   - 1 1/4" dia. x 12" rock drill
   - Sledge hammer
   - Oil
   - Wrenches

Note:
1. Anchor pins are 1" diameter, hex head, pointed rods, galvanized.

ALTERNATE INSTALLATION INSTRUCTIONS
FOR ADIEM-II

1. At a holding site, the modules are slid into the ADIEM base after oiling the base track. Be careful not to damage the edges of the modules while sliding them onto the base.

2. If the modules are scuffed or nicked, apply ACRYLINK coating to the affected area.

3. The unit is then delivered to the job site. The unit is to be placed on a smooth surface (the same horizontal slope as the concrete barrier) and parallel to the mainline or ramp traveled lane (s).

4. The front module should be removed so the remaining modules can be shifted for easy access for drilling the anchor rod holes.

5. Install anchor rods for ADIEM base by driving in soil or soft asphalt or driving in pre-drilled holes for hard asphalt or concrete (no epoxy required). The base should not be moved after the holes are drilled. The holes should be drilled using at a minimum, a 35# hammer and minimum 36 inch long drill bit. (A 50# hammer is recommended.)

6. Attach connection brackets to base with two (2) 1 1/8" x 24" threaded rods provided. Then field drill holes into the existing barrier and attach the other end of the connection bracket to it with expansion anchor hardware provided.

7. Recommended tools and equipment:
   35/50# air hammer/drill
   1 3/8" dia. x 36" rock drill
   1 1/4" dia. x 12" rock drill
   Sledge hammer
   Oil
   Wrenches

Note:
1. Anchor pins are 1" diameter, hex head, pointed rods, galvanized.

SPECIFIC ADIEM II FEATURES

1. Two-thirds the cost of comparable systems.
2. Used in both temporary and permanent locations.
3. Easily portable.
4. Side impact - redirects with little or no damage to the unit.
5. Low maintenance cost.
6. Quick installation (less exposure to traffic hazards).
7. Quick refurbishment.
8. No jobsite forming or pouring of concrete.
9. No epoxy required.
10. ADIEM is both a terminal and a crash cushion.
11. ADIEM is both a bi-directional and a uni-directional end treatment.
12. The modules are all identical and are not placed in any specific order on the base.
13. Can be placed on soil, asphalt, or concrete surface.

INTENDED USE

ADIEM (Advanced Dynamic Impact Extension Module) is a high-performance, redirecting, energy-absorbing crash cushion and end treatment for portable and permanent protection of concrete barriers, bridge parapet rail, bridge piers and other hazards. It is simply installed with pins on a smooth surface in the same plane as the barrier on soil, asphalt or concrete (ADIEM does not require any jobsite forming or pouring of a concrete pad).

For temporary or construction zone applications, the system may be easily relocated as the work zone changes, and from project to project.

The energy absorption elements of the ADIEM are lightly reinforced, ultra low strength perlite concrete modules. The ADIEM dissipates the energy of an impact as the light-weight modules are crushed. Clean up and restoration of the system into full service are quick and easy. Simply replace the damaged modules and minor sweep up of debris.

The redirection element of the system is a heavily reinforced concrete, variable height curb with automobile hub-height tube rails.

	TL-3	TL-2
Length -	9145 mm	5485 mm
Maximum width -	710 mm	710 mm
Height -	varies (sloped base)	
Design speed -	ALL NHS	75 km/h

CONTACT INFORMATION

TRINITY/SYRO
Highway Safety Systems Division

Dallas, TX
(800)644-7976

Girard, OH
(800)321-2755

SPECIAL PROVISIONS: ADIEM-II ENERGY ABSORBING CRASH CUSHION

1. DESCRIPTION. This item shall govern the furnishing and installation of the ADIEM-II Crash Cushion System, or equal (based on equivalent crash-tests results, equivalent site/space requirements, and acceptance to NCHRP Report 350, Test Level 3, by the Federal Highway Administration) at locations shown on the plans. After installation, the crash cushion system shall remain intact and redirect traffic face vehicular impacts within specified limits. End-on vehicular impacts shall crush the energy absorbing material to attenuate the force of errant vehicles ranging from the light truck (3/4 ton pickup) class (4500# truck) to the subcompact class (1800# cars). The ADIEM-II crash cushion system is a patented product and may be obtained from Trinity Industries, Inc., Dallas, TX (800)644-7976.

2. MATERIALS. All materials shall be new. The ADIEM-II energy absorbing modules shall be made of lightly reinforced, ultra low strength perlite concrete as detailed by the original design engineers. The base of the ADIEM-II shall be made of concrete with a minimum of 3000# compressive strength at 30 days. Attachment brackets to concrete barrier shall be made of steel meeting ASTM A36 and galvanized to ASTM A123.

3. CONSTRUCTION. ADIEM-II Crash Cushion System shall be fabricated and installed in accordance with the details shown in the plans so as to provide an crash cushion that performs to the safety standards of NCHRP Report 350, Test Level 3.

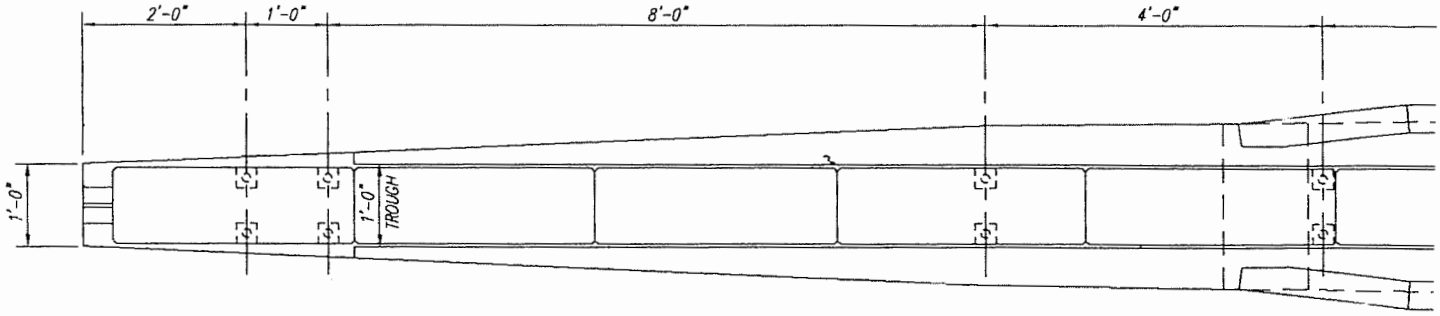
   Further information regarding assembly and installation of the ADIEM-II Crash Cushion System may be obtained from Trinity Industries, Inc. The manufacturer shall provide in-field assistance for first time contractors for this item.

   Damaged crash cushions shall be repaired or replaced immediately.

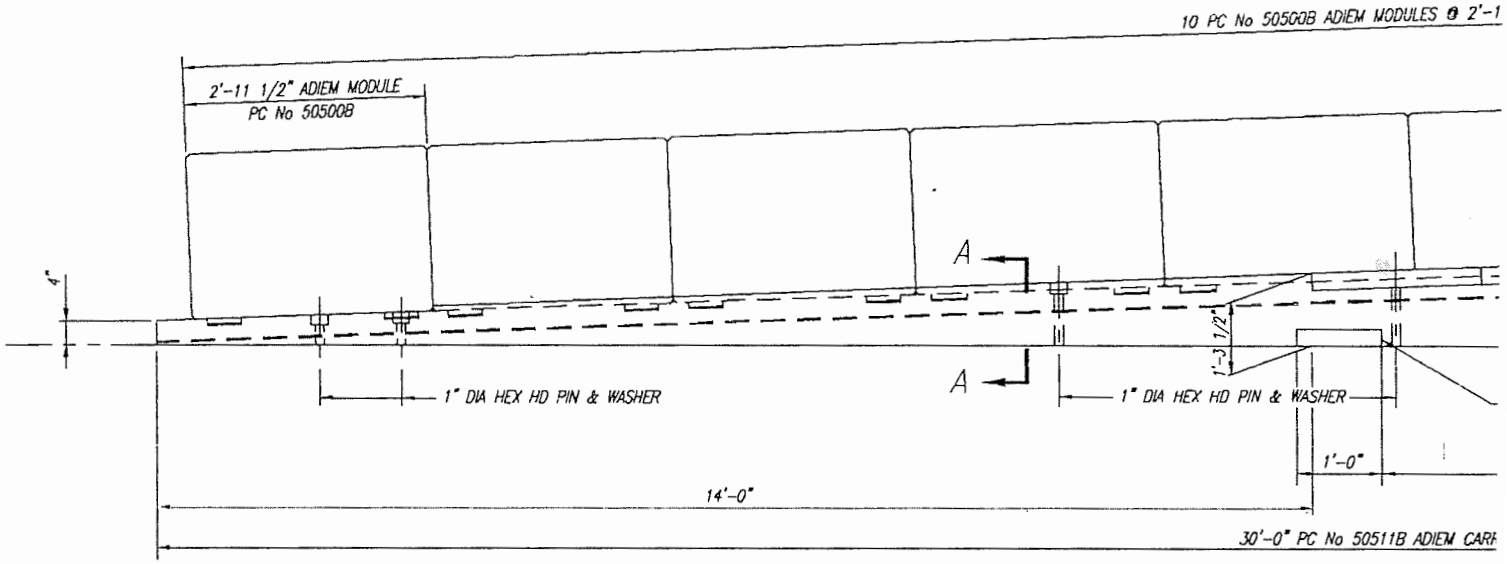
4. MEASUREMENT. This item will be measured as each ADIEM-II installation in place as shown on the plans.

5. PAYMENT. Work performed and materials furnished under this item will be paid per the unit price for ADIEM-II, which shall be full compensation for all labor, equipment, tools, incidentals and services, and for furnishing all materials necessary to complete the work described in this item, including the base, modules, pin anchors, hardware, brackets and incidentals.

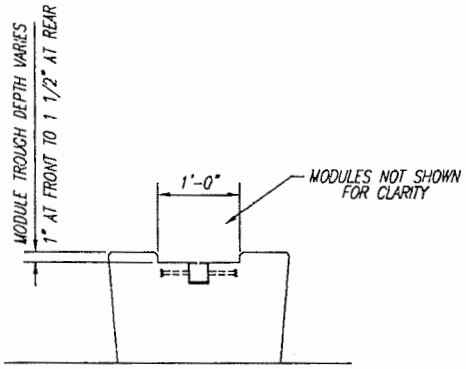
Except cases of damage by the contractor or that caused by his operations, all work required for the repair and/or replacement of damaged terminals will be paid for as "Extra Work" in accordance with the Standard Specifications.



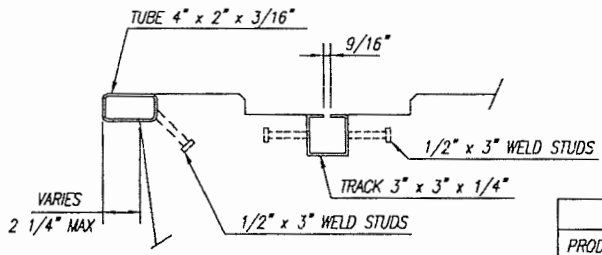
PLAN VIEW



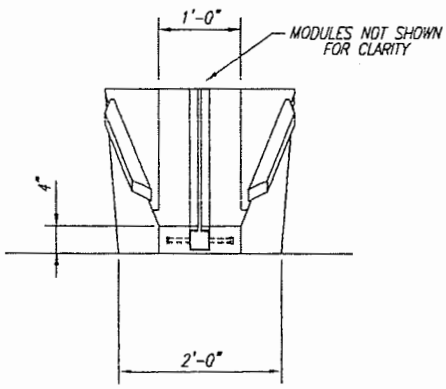
ELEVATION VIEW



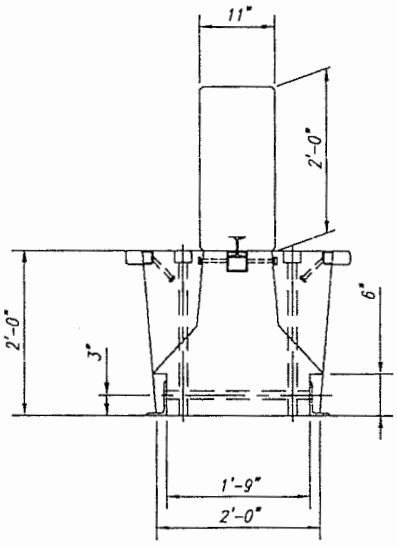
SECTION A–A



TRACK & BUMPER DETAIL



FRONT ELEVATION VIEW



REAR ELEVATION VIEW

BILL OF MATERIAL

PRODUCT CODE	QTY	DESCRIPTION
50500B	10	MODULES x 2'-11 1/2"
50511B	1	BASE x 30'-0"
50508A	1	SPLICE ANGLE x 3'-6" RT
50509A	1	SPLICE ANGLE x 3'-6" LT
5906W	1	ACRYLINK COATING (1 GAL)
5052G	2	1 1/8" ø x 25" HEX HD E
4963G	4	1 1/8" WASHER
3976G	2	1 1/8" HEX NUT
4516G	6	7/8"ø STUD x 6" (FULL TH
3725G	6	7/8" WASHER
3735G	6	7/8" HEX NUT
4747G	1	CHEMICAL GROUT (1 QT)
3900G	12	1" WASHER
5665G	SEE SCH	1" ø HEX HD PIN x 48"
5642G		1" ø HEX HD PIN x 42"
5650G		1" ø HEX HD PIN x 36"
5641G		1" ø HEX HD PIN x 30"
5646G		1" ø HEX HD PIN x 24"
5643G		1" ø HEX HD PIN x 18"

INTEROFFICE MEMO

RESEARCH UNIT
Office Phone: (503) 986-2700
Fax Phone: (503) 986-2844

April 20, 1998

TO: See Distribution List

FROM: Alice Passannante
Research Analyst

SUBJECT: **ADIEM II End Terminal for Concrete Barrier (Construction Report)**

Enclosed is the subject report for your information and/or distribution. If you have any questions regarding this report, please call me at 986-2843.

If you do not wish to retain the report, please return to us for reuse.

Enclosure:

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Mike Dunning, Operations (1)
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