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 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 National Cooperative Highway Research Program (NCHRP) Report 350 guidelines. The other tests run and the corresponding TTI test reports submitted earlier for 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beams forming the center channel in the carrier arm in which the "feet" of the individual expendable modules slide have been replaced by a C-shaped, 76-mm X 76-mm X 6.35-mm, cold formed channel.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 groundline to a final width of 610 mm. The original design maintained a constant width of 610 mm throughout its entire length at the groundline.

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 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,

(original signed by Dwight A. Horne)

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

2 Enclosures
Acceptance Letter CC-38

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