U.S. Department
of Transportation
**Federal Highway
Administration**

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

January 27, 1998

Refer to: HNG-14

King K. Mak, P.E.
Research Engineer
The Texas A&M University System
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College Station, Texas 77843-3135

Dear Mr. Mak:

In your December 11, 1997, letter you requested the Federal Highway Administration's acceptance of proposed design changes to the Slotted Rail Terminal (SRT) as an alternative to the current design. Briefly, these modifications consist of the elimination of the ground-level strut between the first two posts in the terminal (and the use of a reinforced concrete footing at the first post with either a concrete footing or a 2177-mm long steel foundation tube with a soil plate at the second post) and the substitution of a rounded W-beam end section (*Guide for Standardized Highway Barrier Hardware Designation RWE03a*) for the current one-piece, wrap-around buffered W-beam end section. You provided an analysis of numerous crash tests of the Breakaway Cable Terminal (BCT) and early developmental designs of the SRT to support your assertion that the changes would not affect the performance of the SRT and that additional full-scale testing was not needed.

We concur with your proposal to replace the current end section with the standard RWE03a end section. However, we need additional information on the more significant changes in the anchorage design. We do not believe tests of the BCT are directly applicable to the SRT because the BCT is a much stiffer system, having only two weakened posts and an intact W-beam rail element (i.e., no cut-outs/slots) that is bolted to each post. Consequently, the tensile forces transmitted through the rail to the cable end-anchor in a downstream impact would be less with the BCT than would occur in a similar impact with the SRT. In addition, even though the calculated impact severity is higher in the 25-degree National Cooperative Highway Research Program (NCHRP) Report 230 test with a 4500-pound sedan than in the 20-degree Report 350 test with a 2000-kg pickup truck, recent experience with the NCHRP Report 350 testing has shown conclusively that a successful NCHRP Report 230 test with a passenger car does not guarantee similar performance with the 2000-kg pickup truck. On the other hand, more information on Test No. 220536-13 (NCHRP Report test 3-35), which was run to qualify the current design as a NCHRP Report 350 terminal, might be persuasive if it reveals no movement in the first and second posts. Some details on this test were included in

your October 1995 report, "NCHRP Report 350 Compliance Testing of the W-beam Slotted Rail Terminal," but no information on end-anchorage movement was included. Our review of the crash test video tape submitted with the report failed to shed any light on this aspect of the test. If you can provide a more detailed analysis of this test, we may be able to conclude that the proposed modified anchorage is acceptable without rerunning Test 3-35. We would point out, however, that the NCHRP Report 350 strength test of the original MELT design resulted in the end post pivoting on the strut and pulling several inches out of the ground. This indicates to us that the strut is essential in the current anchorage design, and that its elimination and the subsequent use of a concrete footing at post No. 1 must be conclusively justified.

A second concern we have is the effect that a different foundation design at the second post might have on Test 3-34, the critical impact point (CIP) test. In reviewing the test you originally submitted to us for acceptance of the SRT under the NCHRP Report 350 guidelines, we noted that the second post (a weakened wood post set only in soil) showed significant lateral deflection. With your proposed modified anchorage design, this second post can be set in a concrete foundation and, in this less yielding foundation, may fail in the CIP test, resulting in unacceptable performance. Thus, we believe that test 3-34 is necessary to show that this change will not degrade system performance. If test 3-34 is passed with the second post set in concrete, we will accept a steel tube with a soil plate at post No. 2 as an alternate design without additional testing.

As a general comment, members of my staff have observed numerous problems in the past when concrete footings were used with BCT installations. Since relatively small volumes of concrete are required, installation costs tend to be significantly higher than tube foundations, particularly in remote or isolated locations. Also, if the reinforcing is omitted or the excavation for the footing is conical rather than cylindrical or the existing soil is weak or saturated, the anchor is likely to fail if the guardrail is hit just downstream from the end. For these reasons, we believe it is essential that acceptable soil and foundation details for posts 1 and 2 be determined and clearly specified if your proposed changes prove to be otherwise acceptable.

Please do not hesitate to call Mr. Richard Powers at (202) 366-1320, or Mr. James Hatton at (202) 366-1329, if you wish to discuss this response in detail.

Sincerely yours,

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

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