June 18, 1998

Refer to: HNG-14

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

Dear Mr. Mak:

On June 9 you wrote to Mr. Henry Rentz, Director, Office of Engineering, requesting the Federal Highway Administration’s (FHWA) acceptance of modifications to the Slotted Rail Terminal (SRT) design that was first approved as an National Cooperative Highway Report Program (NCHRP) Report 350 Test Level 3 (TL-3) terminal on December 4, 1995. Included with your request were copies of the Texas Transportation Institute report, “Optimization of the W-Beam Slotted Rail Terminal,” dated May 1998, a composite video tape of the crash tests conducted, and drawings of the modified design.

This modified design, called the Improved Slotted Rail Terminal (ISRT-3), included a reduction in the end offset from 1.22 m to 0.91 m, a reduction in the length of the parabolic flare from 11.4 m to 8.9 m, an increase in the spacing between posts 3 to 9 from 0.95 m to 1.27 m, and the addition of a third set of 305-mm long slots in the second 3.81-m section of w-beam. In addition to these changes, the ISRT-3 uses redesigned slot guards, eliminates the w-beam backup plates, and specifies that the w-beam rail element be bolted to all posts except posts 7 and 8. Enclosure 1 shows the design and layout of the ISRT-3.

To support your request, you ran four full-scale crash tests: NCHRP Report 350 tests 3-30, 3-31, 3-34, and 3-35. All tests were run on the ISRT-3 design except 3-34 which was run on a similar design (called ISRT-4) having the original SRT-350 four-foot flare over its full 11.4-m length. Enclosure 2 contains the summaries of each of the four tests.

Based on our review of the information you sent, we agree that the ISRT-3, as tested, meets the evaluation criteria for an NCHRP Report 350 TL-3 terminal. Therefore, it may be used on the National Highway System (NHS) when it is specified by, or acceptable to, the responsible transportation agency. Because it remains a proprietary device, use of the ISRT-3 on Federal-aid projects, except exempt, non-NHS projects, is still subject to the conditions listed in Title 23, Code of Federal Regulations, Section 635.411.
You also requested that the ISRT-3 be accepted for use with any one of four different foundation tubes: 1.82-m or 1.98-m long steel tubes without soil plates, and 1.52-m or 1.37-m long steel tubes with soil plates. We agree that any one of these combinations may be used.

Please call Mr. Richard Powers at (202) 366-1320 if you have any questions on this action or if you wish to discuss any of the above in more detail.

Sincerely yours,

(Original signed by Seppo I. Sillan)

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

2 Enclosures
Acceptance Letter CC-51
End Anchorage Assembly (See Detail E)
Rounded W-Beam End Section (See Detal C)
140 x 190 x 1143 Wooden Breakaway Post in Steel Foundation Tube (See Detail G)
150 x 200 x 1830 Wooden CRT Post (See Detail H)

Tangent line projected from the face of the first two post blocks in the tangent section of rail

Plan

3810 Section of Slotted Rail
(See Detail A)

3810 Section of Slotted Rail
(See Detail B)

3810 Section of Std W-Beam
Guardrail

Slotted Bearing Plate
(See Detail F)

Slotguard (See Detail D)

Ground Strut
(See Detail I)

1905 1905

6 spaces ø 1270 = 7620

Elevation

Notes: Posts 3 through 8 are CRT posts
Posts 7 and 8 not connected to rail

Modified SRT w/ 0.9m Offset

Revised on 5/4/98
DETAIL A
3810 SLOTTED RAIL ELEMENT

Existing 19 x 64 Post Slot (typ.)

Note: At Location shown, cut three 13 mm slots. One on each peak
and one in the valley of the W-beam.

DE Template
3810 SLOTTED RAIL ELEMENT

Existing 19 x 64 Post Slot (typ.)

Note: At Location shown, cut three 13 mm slots. One on each peak
and one in the valley of the W-beam.

DE Template
3810 SLOTTED RAIL ELEMENT

Slotted W-beam
24 x 30 Slot (typ.)
for 16-mm guardrail bolt

24 x 30 SLot (Typ.)

25
25

DETAIL D
SLOTGUARD

SECTION A-A

REVISED ON 5/4/98
DETAIL G
SHORT BREAKAWAY WOODEN POST

DETAIL H
WOODEN CRT POST

DETAIL I
GROUND STRUT

Revised on 5/4/98
Figure 19. Summary of results for test 220546-6, NCHRP Report 350 test 3-30.
Figure 11. Summary of results for test 220546-5, NCHRP Report 350 test 3-31.
### General Information
- **Test Agency:** Texas Transportation Institute
- **Test No.:** 220546-8
- **Date:** 06/19/98

### Test Article
- **Type:** Terminal
- **Name:** Improved SRT
- **Installation Length (m):** 53.3
- **Material or Key Elements:** Slotted W-beam guardrail with 1220 mm flare
- **Soil Type and Condition:** Standard Soil, Dry

### Test Vehicle
- **Type:** Production
- **Designation:** 1994 Geo Metro
- **Model:** Geo Metro
- **Mass (kg) Curb:** 770
- **Load Test Inertial:** 820
- **Dummy:** 75
- **Gross Static:** 895

### Impact Conditions
- **Speed (km/h):** 101.1
- **Angle (deg):** 15.7
- **Exit Conditions**
  - **Speed (km/h):** 57.4
  - **Angle (deg):** 17.5
- **Occupant Risk Values**
  - **Impact Velocity (m/s):**
    - x-direction: 8.3
    - y-direction: 4.7
  - **THIV (km/h):** 26.0
  - **Ride-Down Accelerations (g's):**
    - x-direction: 9.1
    - y-direction: 10.9
  - **PHD (g's):** 13.8
  - **ASI:** 0.8
  - **Max. 0.050 s Average (g's):**
    - x-direction: 8.8
    - y-direction: 5.0
    - z-direction: 2.7

### Test Article Deflections (mm)
- **Dynamic:** 0.94
- **Permanent:** 0.62

### Vehicle Damage
- **Exterior:** D1FR4
- **CDC:** D1FZEV4
- **Maximum Exterior:**
  - **Vehicle Crush (mm):** 320
  - **Interior:**
    - **ODCI:** RS0010300
    - **Max. Occ. Compartment Deformation (mm):** 40

### Post Impact Behavior
- (During 1.0 s after impact)
  - **Max. Yaw Angle (deg):** 35
  - **Max. Pitch Angle (deg):** 2
  - **Max. Roll Angle (deg):** 8

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**Figure 35.** Summary of results for test 220546-8, NCHRP Report 350 test 3-34.
### General Information
- **Test Agency**: Texas Transportation Institute
- **Test No.**: 220546-7
- **Date**: 04/24/98

### Test Article
- **Type**: Terminal
- **Name**: Improved SRT
- **Installation Length (m)**: 63.3
- **Material or Key Elements**: Slotted W-beam guardrail with 915 mm flare
- **Soil Type and Condition**: Standard Soil, Dry

### Test Vehicle
- **Type**: Production
- **Designation**: 2000P
- **Model**: 1995 Chevrolet 2500 pickup truck
- **Mass (kg)**: Curb: 2062, Dummy: No dummy, Gross Static: 2000

### Impact Conditions
- **Speed (km/h)**: 96.2
- **Angle (deg)**: 16.5

### Exit Conditions
- **Speed (km/h)**: 28.3
- **Angle (deg)**: 22.1

### Occupant Risk Values
- **Impact Velocity (m/s)**: 6.5
- **x-direction**: 6.5
- **y-direction**: 4.5
- **THIV (km/h)**: 23.0
- **Ride-Down Accelerations (g/s)**: 10.6
- **x-direction**: 7.6
- **y-direction**: 6.9
- **PHD (g/s)**: 0.8
- **ASI**: 0.3
- **Max. 0.050 s Average (g/s)**: 4.1
- **x-direction**: 5.3
- **y-direction**: 5.6
- **z-direction**: 4.1

### Vehicle Damage
- **Exterior**: VDS: 01FL4, CDC: 012YEW3
- **Maximum Exterior Vehicle Crush (mm)**: 585
- **Interior**: OCDI: FSO000000
- **Max. Occ. Compartment Deformation (mm)**: 10

### Post-Impact Behavior
- **(during 1.0 s after impact)**
  - **Max. Taw Angle (deg)**: 40
  - **Max. Roll Angle (deg)**: 8

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*Figure 27. Summary of results for test 220546-7, NCHRP Report 350 test 3-35.*