U.S. Department of Transportation
Federal Highway Administration

1200 New Jersey Ave., SE
Washington, D.C. 20590

December 23, 2011

In Reply Refer To:
HSST/ B-224

Maura Sullivan
Mass DOT Highway Division
Accelerated Bridge Program
10 Park Plaza, Room 6500
Boston, MA 02116

Dear Ms. Sullivan:

This letter is in response to your request for the Federal Highway Administration (FHWA) to review a roadside safety system for eligibility for reimbursement under the Federal-aid highway program.

Name of system:	T401 (Based on crash test of T4)
Type of system:	Bridge Railing
Test Level:	NCHRP Report 350 TL-2 or TL-3
Testing conducted by:	Texas Transportation Institute (TTI)
Task Force 13 Designator:	SBB09c
Date of request:	September 8, 2011
Date initially acknowledged:	September 8, 2011
Date all information rec'd:	December 8, 2011

Decision:
The following device is eligible, with details provided below:

- Texas Type T401 Bridge Railing

Based on a review of crash test results and an engineering analysis of the modifications made on the original railing, the device described herein meets the crashworthiness criteria of the National Cooperative Highway Research Program (NCHRP) Report 350, the device is eligible for reimbursement under the Federal-aid highway program. Eligibility for reimbursement under the Federal-aid highway program does not establish approval or endorsement by the FHWA for any particular purpose or use.

The FHWA, the Department of Transportation, and the United States Government do not endorse products or services and the issuance of a reimbursement eligibility letter is not an endorsement of any product or service.

Description
This railing is 33-inches high with an 18-inch concrete parapet and a steel ellipse or rectangular tube 15 inches above the concrete. It has twin one-inch cut-plate posts spaced a maximum of 10 ft. apart. It features a bolt anchorage system for the steel rail posts that may be drilled and epoxy anchored allowing slip-forming of the concrete parapet. Its parapet is thicker than the T4 rail,

FHWA:HSST:NArtimovichr:sf:x61331:12/20/11
File: s://directory folder/HSST/Artimovich/B224_T401.dotx
cc: HSSI (NArtimovich)

from which its design is derived.

Requirements
Roadside safety devices should meet the guidelines contained in the NCHRP Report 350 or the American Association of State Highway and Transportation Officials' Manual for Assessing Safety Hardware (MASH). The FHWA Memorandum "Identifying Acceptable Highway Safety Features" of July 25, 1997 provides further guidance on crash testing requirements of longitudinal barriers.

Crash Testing
The Texas Type T4 (A) Bridge Rail was tested to NCHRP Report 350 Test 3-11. The report is summarized in the enclosed "Figure 11" from the TTI report. The railing contained and redirected the vehicle. The vehicle did not penetrate, underride, or override the installation. Maximum permanent deflection of the rail during the test was 5 mm. No detached elements, fragments, or other debris were present to penetrate the occupant compartment, or to show potential for penetrating the occupant compartment, nor to present undue hazard to others in the area. Maximum occupant compartment deformation was 158 mm in the right floor pan to instrument panel location. The vehicle remained upright during the collision and after loss of contact with the installation. The vehicle trajectory may intrude into adjacent traffic lanes as it came to rest 6.1 m toward traffic lanes. Longitudinal occupant impact velocity was 8.5 m/s, and the longitudinal ridedown acceleration was -9.7 g's. Exit angle at loss of contact was 11.3 degrees which was 46 percent of the impact angle.

Damage to the Texas T4 (A) bridge rail was extensive. The flange on the impact side of post 4 was marred and chipped as were the base plate and front bolts. Both the top and bottom of the rail element were scarred to a distance of 190 mm from the impact face of the rail. Structural cracks in the concrete portion of the rail occurred 400 mm from the center of post 4. One extended 85 mm down the field side of the concrete parapet and another radiated from the right rear bolt and extended 95 mm down the rear. A section of concrete (200 mm x 390 mm) broke out of the rear of the concrete beam deck under the bolt on the upstream field side and exposed the bolt. Maximum dynamic deflection of the rail during the test was not attainable and maximum permanent deformation of the metal rail element was 5 mm. Total length of contact of the vehicle with the bridge rail was 4.3 m.

Because of the extent of the damage to the railing, additional static and dynamic testing was done to the basic design of the T4. The modified railing includes a thicker concrete parapet and drilled and epoxied bolts to anchor the rail to the top of the parapet. The modified design was designated at the T401, the subject of this letter.

Findings
The Texas Type T4 (A) Bridge Rail successfully contained and redirected the vehicle which remained upright during and after the collision. Improvements to the T4 to strengthen the concrete parapet and improve the constructability of the steel railing resulted in the T401 bridge railing. Because these modifications to the T4 do not adversely affect the crash test performance, the T401 system described in this letter and enclosures is considered eligible for reimbursement on Federal-aid highway projects. It should be installed under the range of conditions tested, when such use is acceptable to a highway agency.

Please note the following standard provisions that apply to FHWA eligibility letters:

- This letter provides a AASHTO/ARTBA/AGC Task Force 13 designator that should be used for the purpose of the creation of a new and/or the update of existing Task Force 13 drawing for posting on the on-line 'Guide to Standardized Highway Barrier Hardware' currently referenced in AASHTO Roadside Design Guide.
- This finding of eligibility is limited to the crashworthiness characteristics of the systems and does not cover their structural features, nor conformity with the Manual on Uniform Traffic Control Devices.
- Any changes that may adversely influence the crashworthiness of the system will require a new letter.
- Should the FHWA discover that the qualification testing was flawed, that in-service performance reveals unacceptable safety problems, or that the system being marketed is significantly different from the version that was crash tested, we reserve the right to modify or revoke this letter.
- You will be expected to supply potential users with sufficient information on design and installation requirements to ensure proper performance.
- You will be expected to certify to potential users that the hardware furnished has essentially the same chemistry, mechanical properties, and geometry as that submitted for review, and that it will meet the crashworthiness requirements of the FHWA and the NCHRP Report 350.
- To prevent misunderstanding by others, this letter of eligibility is designated as number B-224 and shall not be reproduced except in full. This letter and the test documentation upon which it is based are public information. All such letters and documentation may be reviewed at our office upon request.
- This letter shall not be construed as authorization or consent by the FHWA to use, manufacture, or sell any patented system for which the applicant is not the patent holder. The finding of eligibility is limited to the crashworthiness characteristics of the candidate system, and the FHWA is neither prepared nor required to become involved in issues concerning patent law. Patent issues, if any, are to be resolved by the applicant.

Sincerely yours,

Michael S. Griffith
Director, Office of Safety Technologies
Office of Safety

Enclosures

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of Transportation
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Sincerely yours,

Michael S. Griffith

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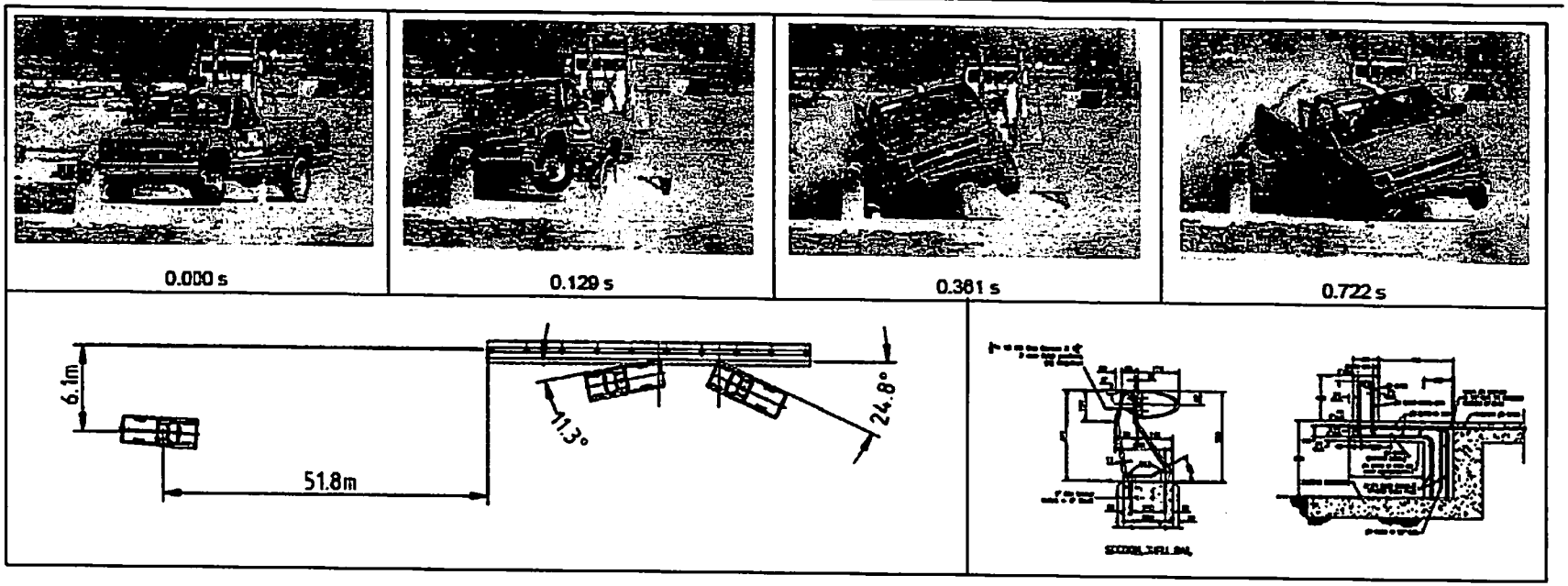
Director, Office of Safety Technologies
Office of Safety

Enclosures



General Information
- Test Agency ..... Texas Transportation Institute
- Test No. 418049-7
- Date 2/1/99

Test Article
- Type ..... Bridge Rail
- Name or Manufacturer .... Texas T-4
- Installation Length (m) 23.0
- Material or Key Elements .. Vertical Concrete Wall with Aluminum Posts and Railing
- Soil Type and Condition .... Concrete deck, Dry

Test Vehicle
- Type ..... Production
- Designation 2000P
- Model ..... 1995 Chevrolet 2500 pickup truck
- Mass (kg)
  - Curb 2071
  - Test Inertial 2000
  - Dummy ..... No Dummy
  - Gross Static 2000

Impact Conditions
- Speed (km/h) 101.4
- Angle (deg) 24.8

Exit Conditions
- Speed (km/h) 71.7
- Angle (deg) 11.3

Occupant Risk Values
- Impact Velocity (m/s)
  - x-direction 8.5
  - y-direction 7.2
- THIV (km/h) 35.3
- Ridedown Accelerations (g's)
  - x-direction ..... -9.7
  - y-direction ..... -6.8
- PHD (g's) 21.9
- ASI 1.50
- Max. 0.050-s Average (g's)
  - x-direction ..... -11.0
  - y-direction ..... -11.6
  - z-direction 4.9

Test Article Deflections (m)
- Dynamic ..... N/A
- Permanent 0.005

Vehicle Damage
- Exterior
  - VDS 01FRQ3
  - CDC ..... 01FREK4 & 01RDEW4
- Maximum Exterior
  - Vehicle Crush (mm) 600
- Interior
  - OCDI FS111500001
- Max. Occ. Compart. Deformation (mm) 158

Post-Impact Behavior (during 1.0 s after impact)
- Max. Yaw Angle (deg) ..... -48
- Max. Pitch Angle (deg) ..... -5
- Max. Roll Angle (deg) 18

Figure 11. Summary of Results for Test 418049-7, *NCHRP Report 350* Test 3-11.

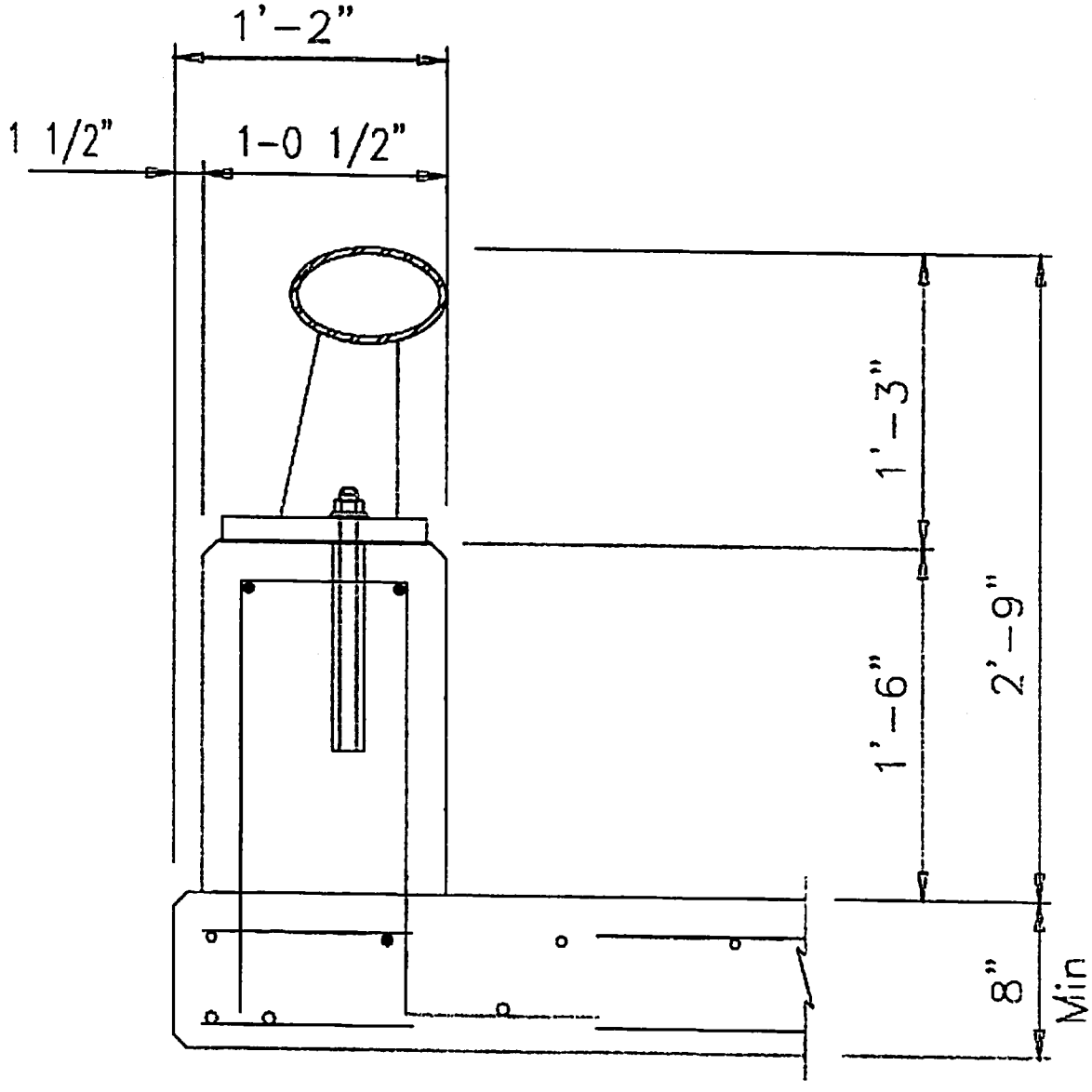


Figure 3-15. Cross Section of T401 Bridge Rail.