U.S. Department
of Transportation
Federal Highway Administration

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

January 30, 2017

In Reply Refer To:
HSST-1/B-274

Mr. Aris Stathopoulos, P.E.
New York Metropolitan Transportation Authority (MTA)
Bridges and Tunnels
2 Broadway, 22nd Floor
New York, NY, 10004

Dear Mr. Stathopoulos:

This letter is in response to your November 29, 2016 request for the Federal Highway Administration (FHWA) to review a roadside safety device, hardware, or system for eligibility for reimbursement under the Federal-aid highway program. This FHWA letter of eligibility is assigned FHWA control number B-274 and is valid until a subsequent letter is issued by FHWA that expressly references this device.

Decision

The following devices are eligible, with details provided in the form which is attached as an integral part of this letter:

- Triborough Bridge and Tunnel Authority (TBTA) Bridge Rail

Scope of this Letter

To be found eligible for Federal-aid funding, new roadside safety devices should meet the crash test and evaluation criteria contained in the American Association of State Highway and Transportation Officials' Manual for Assessing Safety Hardware (MASH). However, the FHWA, the Department of Transportation, and the United States Government do not regulate the manufacture of roadside safety devices. Eligibility for reimbursement under the Federal-aid highway program does not establish approval, certification or endorsement of the device for any particular purpose or use.

This letter is not a determination by the FHWA, the Department of Transportation, or the United States Government that a vehicle crash involving the device will result in any particular outcome, nor is it a guarantee of the in-service performance of this device. Proper manufacturing, installation, and maintenance are required in order for this device to function as tested.

This finding of eligibility is limited to the crashworthiness of the system and does not cover other structural features, nor conformity with the Manual on Uniform Traffic Control Devices.

Eligibility for Reimbursement

Based solely on a review of crash test results and certifications submitted by the manufacturer, and the crash test laboratory, FHWA agrees that the device described herein meets the crash test and evaluation criteria of the American Association of State Highway and Transportation Officials' Manual for Assessing Safety Hardware (MASH). Therefore, the device is eligible for reimbursement under the Federal-aid highway program if installed under the range of tested conditions.

Name of system: TBTA Bridge Rail
Type of system: Bridge Barrier
Test Level: MASH Test Level 5 (TL5)
Testing conducted by: Texas A&M Transportation Institute (TamTI)
Date of request: November 4, 2016
Date initially acknowledged: November 6, 2016
Date of completed package: November 29, 2016

FHWA concurs with the recommendation of the accredited crash testing laboratory as stated within the attached form.

Full Description of the Eligible Device

The device and supporting documentation, including reports of the crash tests or other testing done, videos of any crash testing, and/or drawings of the device, are described in the attached form.

Notice

If a manufacturer makes any modification to any of their roadside safety hardware that has an existing eligibility letter from FHWA, the manufacturer must notify FHWA of such modification with a request for continued eligibility for reimbursement. The notice of all modifications to a device must be accompanied by:

- Significant modifications – For these modifications, crash test results must be submitted with accompanying documentation and videos.
- Non-signification modifications – For these modifications, a statement from the crash test laboratory on the potential effect of the modification on the ability of the device to meet the relevant crash test criteria.

FHWA's determination of continued eligibility for the modified hardware will be based on whether the modified hardware will continue to meet the relevant crash test criteria.

Any user or agency relying on this eligibility letter is expected to use the same designs, specifications, drawings, installation and maintenance instructions as those submitted for review.

Any user or agency relying on this eligibility letter, is expected to ensure that the hardware used has the same chemistry, mechanical properties, and geometry as that submitted for review, and that it will meet the test and evaluation criteria of the AASHTO MASH.

Issuance of this letter does not convey property rights of any sort or any exclusive privilege. This letter is based on the premise that information and reports submitted by you are accurate and correct. We reserve the right to modify or revoke this letter if: (1) there are any inaccuracies in the information submitted in support of your request for this letter, (2) the qualification testing was flawed, (3) in-service performance or other information reveals safety problems, (4) the system is significantly different from the version that was crash tested, or (5) any other information indicates that the letter was issued in error or otherwise does not reflect full and complete information about the crashworthiness of the system.

Standard Provisions

- To prevent misunderstanding by others, this letter of eligibility designated as FHWA control number B-274 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 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.

- If the subject device is a patented product it may be considered to be proprietary. If proprietary systems are specified by a highway agency for use on Federal-aid projects: (a) they must be supplied through competitive bidding with equally suitable unpatented items; (b) the highway agency must certify that they are essential for synchronization with the existing highway facilities or that no equally suitable alternative exists; or (c) they must be used for research or for a distinctive type of construction on relatively short sections of road for experimental purposes. Our regulations concerning proprietary products are contained in Title 23, Code of Federal Regulations, Section 635.411.

Sincerely,

Scott T. Johnson

Director, Office of Safety Technologies

Office of Safety

Enclosures

Request for Federal Aid Reimbursement Eligibility of Highway Safety Hardware

Submitter	Date of Request:	11-4-2016	◉ New ○ Resubmission
	Name:	Michael Zdenek, P.E.	
	Company:	HNTB Corporation	
	Address:	Empire State Building, 56th Floor, New York, NY, 10118	
	Country:	United States of America	
	To:	Michael S. Griffith, Director FHWA, Office of Safety Technologies	

I request the following devices be considered eligible for reimbursement under the Federal-aid highway program.

Device & Testing Criterion - Enter from right to left starting with Test Level

!-!-!

System Type	Submission Type	Device Name / Variant	Testing Criterion	Test Level
'B': Rigid/Semi-Rigid Barriers (Roadside, Median, Bridge Railings)	◉ Physical Crash Testing ○ Engineering Analysis	TBTA Bridge Rail	AASHTO MASH	TL5

By submitting this request for review and evaluation by the Federal Highway Administration, I certify that the product(s) was (were) tested in conformity with the AASHTO Manual for Assessing Safety Hardware and that the evaluation results meet the appropriate evaluation criteria in the MASH.

Individual or Organization responsible for the product:

Contact Name:	Aris Stathopoulos, P.E.	Same as Submitter ☐
Company Name:	MTA Bridges and Tunnels	Same as Submitter ☐
Address:	2 Broadway, 22nd Floor, New York, NY, 10004	Same as Submitter ☐
Country:	United States of America	Same as Submitter ☐

Enter below all disclosures of financial interests as required by the FHWA `Federal-Aid Reimbursement Eligibility Process for Safety Hardware Devices' document.

HNTB: HNTB Corporation is a paid consultant for MTA-TBTA for this project and eligibility request. HNTB has no further financial interest in the use of this barrier system.

TTI: Texas A&M Transportation Institute was contracted by HNTB to perform analysis and full-scale crash testing of the TBTA VN Bridge Rail design.

PRODUCT DESCRIPTION

(•) New Hardware or Significant Modification ( ) Modification to Existing Hardware

The test installation was a 132 ft long (post to post) steel bridge rail with four rail tubes mounted on 17 posts. The bridge rail was comprised of four HSS steel tubes. The rail measured 3 ft-6 inches in height above the bridge deck, and the posts were equally spaced at 8 ft-3 inches along the length of the installation. The centerlines of the rails were located 40½ inches, 30 inches, 18 inches, and 7½ inches above the paved surface of the bridge deck. Seventeen fabricated steel posts, each 3 ft-7¾ inches in overall height , supported the four rails at equal post spacing of 8 ft-3 inches along the length of the rail. Each railing post was a built up welded structure that was comprised of a W8×28 beam, 3 ft 6 inches tall, that was beveled at the top 1¾-inch downward to the field side.

The first two posts (right to left) were attached to a concrete foundation. Posts 3-9 were attached to a 49 ft-6 inch long surrogate composite bridge span. Posts 10-17 were also mounted on a concrete foundation. Since the surrogate deck adds significant cost to testing, the bridge deck was limited to a length that would take most of the loading from the vehicle impact. The remaining length of the rail, which sustains much less load, was attached to a concrete foundation to reduce installation cost.

CRASH TESTING

By signature below, the Engineer affiliated with the testing laboratory, agrees in support of this submission that all of the critical and relevant crash tests for this device listed above were conducted to meet the MASH test criteria. The Engineer has determined that no other crash tests are necessary to determine the device meets the MASH criteria.

Engineer Name:	Nauman Sheikh, P.E.	
Engineer Signature:	Nauman Sheikh — Digitally signed by Nauman Sheikh DN: cn=Nauman Sheikh, o=Texas A&M Transportation Institute, ou, email=n-sheikh@tti.tamu.edu, c=US Date: 2016.11.07 16:44:19 -06'00'	
Address:	TTI, TAMUS MS 3135, College Station, TX 77843-3135	Same as Submitter ☐
Country:	USA	Same as Submitter ☐

A brief description of each crash test and its result:

Required Test Number	Narrative Description	Evaluation Results
5-10 (1100C)	Test 603911-1, June 7, 2016, Report 603911-1-3 A 2010 Kia Rio test vehicle, traveling at an impact speed of 62.5 mi/h, contacted the the TBTA Bridge Rail 3.1 ft upstream of the splice between posts 4 and 5 at an impact angle of 24.7 degrees. The TBTA Bridge Rail contained and redirected the 1100C vehicle. The vehicle did not penetrate, underride, or override the installation. Maximum dynamic deflection during the test was 1.5 inches. No detached elements, fragments, or other debris were present to penetrate or show potential for penetrating the occupant compartment, or to present hazard to others in the area. Maximum occupant compartment deformation was 2.25 inches in the right front floor pan area and 2.0 inches in the right front firewall area. The 1100C vehicle remained upright during and after the collision event. Maximum roll and pitch angles were 9 degrees and 8 degrees, respectively. Occupant risk factors were within the limits specified in MASH. The TBTA steel bridge rail performed acceptably for MASH Test 5-10.	PASS
5-11 (2270P)	Test 603911-2, June 9, 2016, Report 603911-1-3 A 2010 Dodge RAM 1500 pickup truck, traveling at an impact speed of 64.3 mi/h, contacted the TBTA steel bridge rail 4.0 ft upstream of the splice between posts 4 and 5 at an impact angle of 24.8 degrees. The TBTA Bridge Rail contained and redirected the 2270P vehicle. The vehicle did not penetrate, underride, or override the installation. Maximum dynamic deflection during the test was 2.0 inches. No detached elements, fragments, or other debris were present to penetrate or show potential for penetrating the occupant compartment, or to present hazard to others in the area. Maximum occupant compartment deformation was 5.0 inches in the right front firewall area. The 2270P vehicle remained upright during and after the collision event. Maximum roll and pitch angles were 10 degrees and 4 degrees, respectively. Occupant risk factors were within the limits specified in MASH. The TBTA steel bridge rail performed acceptably for MASH Test 5-11.	PASS

Required Test Number	Narrative Description	Evaluation Results
5-12 (36000V)	Test 603911-3, June 17, 2016, Report 603911-1-3 A 2006 International 8600 tractor with 1997 Stoughton AVW 5357-S-C-AR van trailer, traveling at an impact speed of 49.9 mi/h, contacted the bridge rail 6.0 inches downstream of the splice between posts 4 and 5 at an impact angle of 15.1 degrees. The TBTA Bridge Rail contained and redirected the 36000V vehicle. The vehicle did not penetrate, underride, or override the installation. Maximum dynamic deflection during the test was 2.0 inches. No detached elements, fragments, or other debris were present to penetrate or show potential for penetrating the occupant compartment, or to present hazard to others in the area. No occupant compartment deformation or intrusion was noted. The 36000V vehicle remained upright during and after the collision event. Maximum roll and pitch angles were 11 degrees and 14 degrees, respectively. The TBTA steel bridge rail performed acceptably for MASH Test 5-12.	PASS
5-20 (1100C)	Device is not a transition	Non-Relevant Test, not conducted
5-21 (2270P)	Device is not a transition	Non-Relevant Test, not conducted
5-22 (36000V)	Device is not a transition	Non-Relevant Test, not conducted

Full Scale Crash Testing was done in compliance with MASH by the following accredited crash test laboratory (cite the laboratory's accreditation status as noted in the crash test reports.):

Laboratory Name:	Texas AM Transportation Institute	
Laboratory Signature:	Darrell L. Kuhn — Digitally signed by Darrell L. Kuhn DN: cn=Darrell L. Kuhn, o=Texas A&M Transportation Insitute, ou=Proving Ground, email=d-kuhn@tti.tamu.edu, c=US Date: 2016.11.08 10:15:53 -06'00'	
Address:	TTI, TAMUS MS 3135, College Station, TX 77843-3135	Same as Submitter ☐
Country:	USA	Same as Submitter ☐
Accreditation Certificate Number and Dates of current Accreditation period :	Certificate Number: 2821.01 Valid To: April 30, 2017	

Submitter Signature*: Michael Zdenek — Digitally signed by Michael Zdenek
Date: 2016.11.09 09:34:39 -05'00'

Submit Form

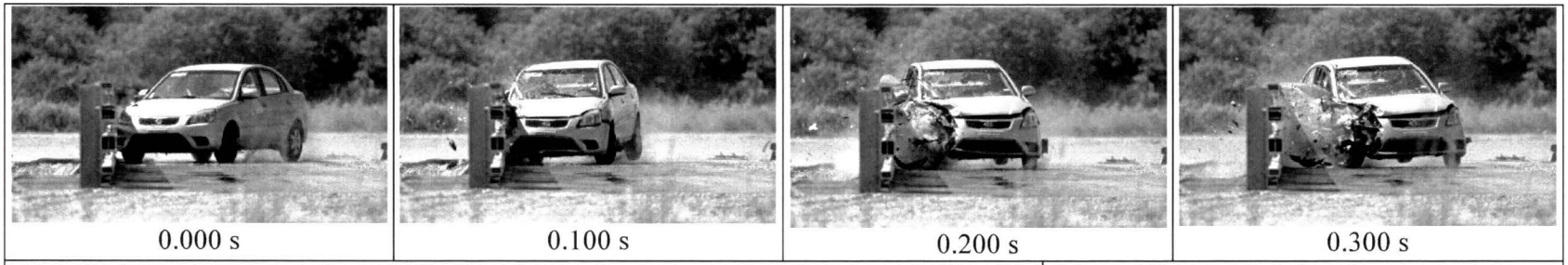
ATTACHMENTS

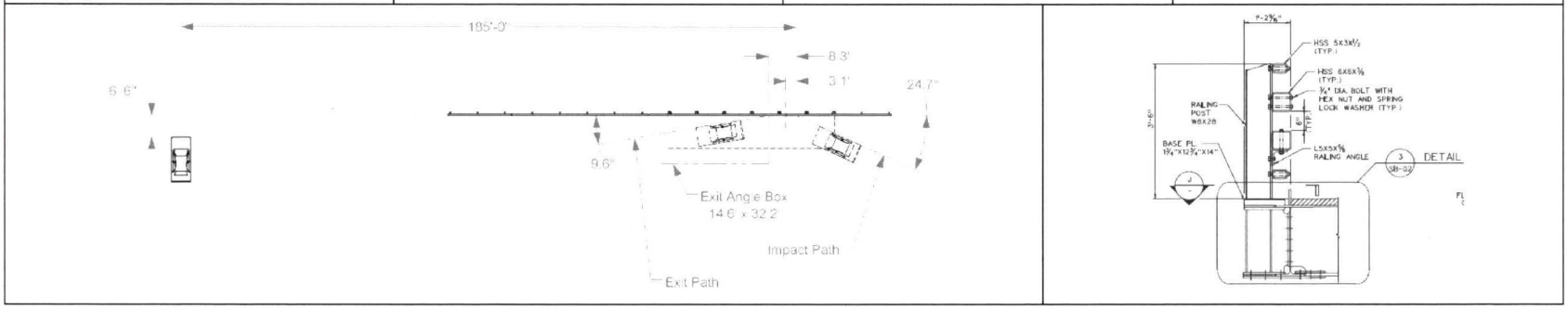
Attach to this form:

1) Additional disclosures of related financial interest as indicated above.
2) A copy of the full test report, video, and a Test Data Summary Sheet for each test conducted in support of this request.
3) A drawing or drawings of the device(s) that conform to the Task Force-13 Drawing Specifications [Hardware Guide Drawing Standards]. For proprietary products, a single isometric line drawing is usually acceptable to illustrate the product, with detailed specifications, intended use, and contact information provided on the reverse. Additional drawings (not in TF-13 format) showing details that are relevant to understanding the dimensions and performance of the device should also be submitted to facilitate our review.

FHWA Official Business Only:

Eligibility Letter		
Number	Date	Key Words





General Information
- Test Agency ..... Texas A&M Transportation Institute (TTI)
- Test Standard Test No. ..... MASH Test 5-10
- TTI Test No. 603911-1
- Test Date 2016-06-07

Test Article
- Type ..... Bridge Rail
- Name ..... TBTA Bridge Rail
- Installation Length ..... 132 ft long (post to post)
- Material or Key Elements ... Quadruple rail steel bridge rail 3 ft-6 inches in height mounted on 17 posts attached either to a 49 ft-6 inch bridge span (posts 3-9), or to a concrete foundation up to the bridge span and beyond the bridge span

Soil Type and Condition ..... Concrete Bridge Deck

Test Vehicle
- Type/Designation 1100C
- Make and Model ..... 2010 Kia Rio
- Curb ..... 2478 lb
- Test Inertial ..... 2425 lb
- Dummy ..... 165 lb
- Gross Static ..... 2590 lb

Impact Conditions
- Speed ..... 62.5 mi/h
- Angle ..... 24.7 degrees
- Location/Orientation ..... 3.1 ft upstrm of splice btw 4 & 5

Impact Severity ..... 55 kip-ft

Exit Conditions
- Speed ..... 48.3 mi/h
- Angle ..... 9.6 degrees

Occupant Risk Values
- Longitudinal OIV ..... 22.0 ft/s
- Lateral OIV ..... 34.8 ft/s
- Longitudinal Ridedown ..... 4.1 g
- Lateral Ridedown ..... 10.9 g
- THIV ..... 44.8 km/h
- PHD ..... 10.9 g
- ASI 2.82

Max. 0.050-s Average
- Longitudinal ..... –13.1 g
- Lateral ..... –21.2 g
- Vertical ..... –3.2 g

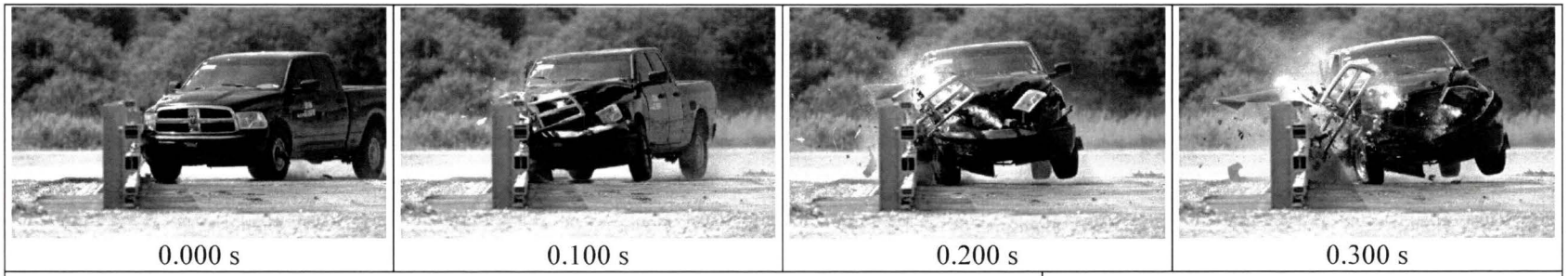
Post-Impact Trajectory
- Stopping Distance ..... 185 ft dwnstrm
  6.5 ft twd traffic

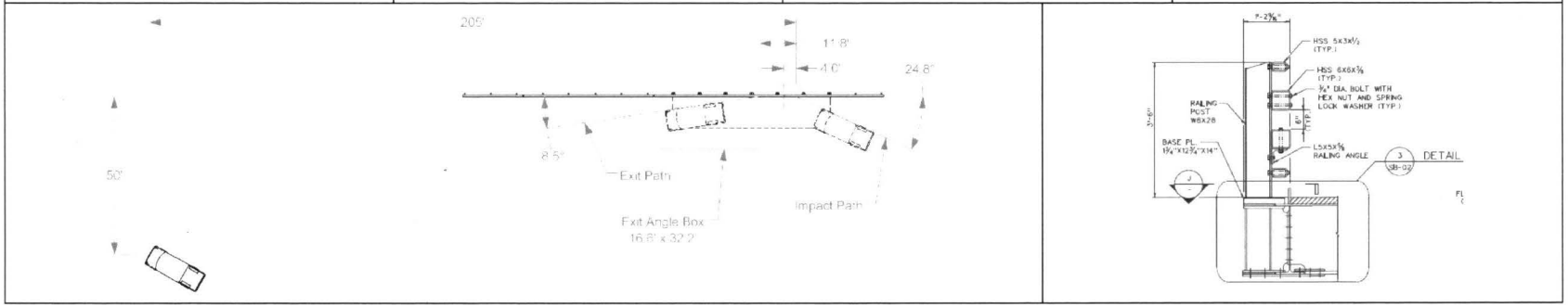
Vehicle Stability
- Maximum Yaw Angle ..... 74 degrees
- Maximum Pitch Angle ..... 8 degrees
- Maximum Roll Angle ..... 9 degrees
- Vehicle Snagging ..... No
- Vehicle Pocketing ..... No

Test Article Deflections
- Dynamic ..... 1.5 inches
- Permanent ..... 0.5 inch
- Working Width ..... 15.5 inches

Vehicle Damage
- VDS 01RFQ4
- CDC 01FREW3
- Max. Exterior Deformation ..... 10.5 inches
- OCDI RF0013000
- Max. Occupant Compartment Deformation ..... 2.25 inches

Figure 5.7. Summary of Results for *MASH* Test 5-10 on TBTA Bridge Rail.





General Information

Test Agency	Texas A&M Transportation Institute (TTI)
Test Standard Test No.	MASH Test 5-11
TTI Test No.	603911-2
Test Date	2016-06-09

Test Article

Type	Bridge Rail
Name	TBTA Bridge Rail
Installation Length	132 ft long (post to post)
Material or Key Elements	Quadruple rail steel bridge rail 3 ft-6 inches in height mounted on 17 posts attached either to a 49 ft-6 inch bridge span (posts 3-9), or to a concrete foundation up to the bridge span and beyond the bridge span
Soil Type and Condition	Concrete Bridge Deck

Test Vehicle

Type/Designation	2270P
Make and Model	2010 Dodge RAM 1500 Pickup Truck
Curb	5009 lb
Test Inertial	5052 lb
Dummy	165 lb
Gross Static	5217 lb

Impact Conditions

Speed	64.3 mi/h
Angle	24.8 degrees
Location/Orientation	4.0 ft upstream of splice btw 4 and 5
Impact Severity	123 kip-ft

Exit Conditions

Speed	51.9 mi/h
Angle	8.5 degrees

Occupant Risk Values

Longitudinal OIV	17.4 ft/s
Lateral OIV	28.5 ft/s
Longitudinal Ridedown	6.0 g
Lateral Ridedown	10.7 g
THIV	37.1 km/h
PHD	10.8 g
ASI	1.92
Max. 0.050-s Average	
Longitudinal	−8.5 g
Lateral	−15.2 g
Vertical	2.8 g

Post-Impact Trajectory

Stopping Distance	205 ft dwnstrm 50 ft twd traffic

Vehicle Stability

Maximum Yaw Angle	43 degrees
Maximum Pitch Angle	4 degrees
Maximum Roll Angle	10 degrees
Vehicle Snagging	No
Vehicle Pocketing	No

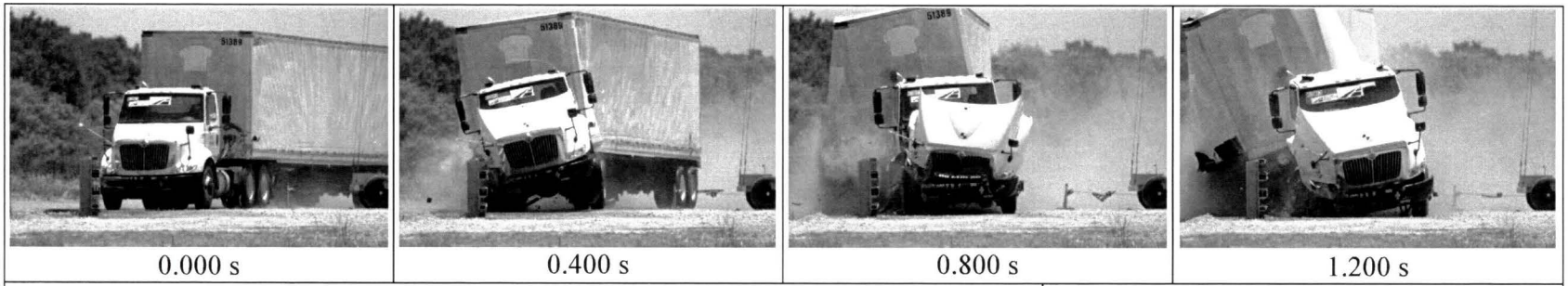
Test Article Deflections

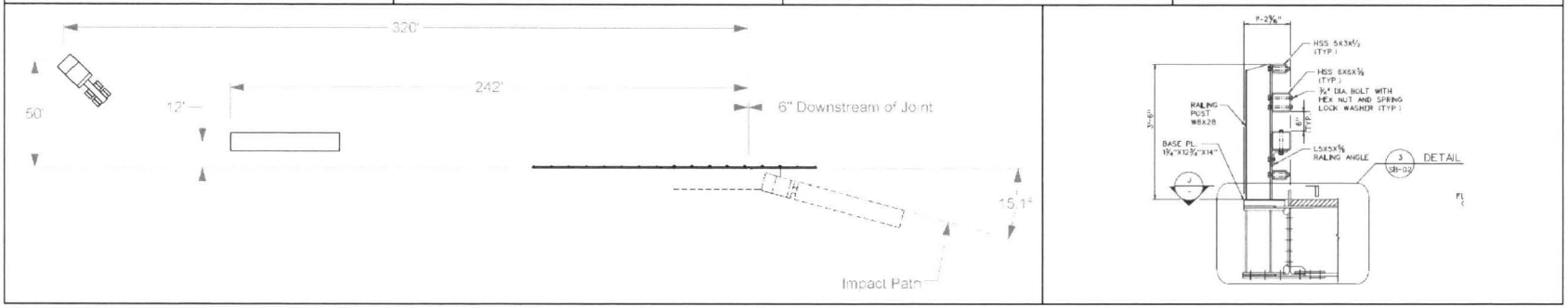
Dynamic	2.0 inches
Permanent	0.75 inch
Working Width	15.8 inches

Vehicle Damage

VDS	01RFQ4
CDC	01FREW4
Max. Exterior Deformation	16.0 inches
OCDI	RF0030000
Max. Occupant Compartment Deformation	5.0 inches

Figure 6.7. Summary of Results for *MASH* Test 5-11 on TBTA Bridge Rail.





General Information
- Test Agency ..... Texas A&M Transportation Institute (TTI)
- Test Standard Test No. ..... MASH Test 5-12
- TTI Test No. 603911-3
- Test Date 2016-06-17

Test Article
- Type ..... Bridge Rail
- Name ..... TBTA Bridge Rail
- Installation Length ..... 132 ft long (post to post)
- Material or Key Elements ... Quadruple rail steel bridge rail 3 ft-6 inches in height mounted on 17 posts attached either to a 49 ft-6 inch bridge span (posts 3-9), or to a concrete foundation up to the bridge span and beyond the bridge span

Soil Type and Condition ..... Concrete Bridge Deck

Test Vehicle
- Type/Designation 36000V
- Make and Model ..... 2006 International 8600 tractor with 1997 Stoughton AVW 5357-S-C-AR van trailer
- Curb ..... 29,870 lb
- Gross Static & Inertial ..... 79,620 lb

Impact Conditions
- Speed ..... 49.9 mi/h
- Angle ..... 15.1 degrees
- Location/Orientation ..... 6.0 inches dwnstrm of splice btw 4 & 5

Impact Severity ..... 450 kip-ft

Exit Conditions
- Speed ..... 43.1 mi/h
- Angle ..... 6.4 degrees

Occupant Risk Values
- Longitudinal OIV ..... 12.1 ft/s
- Lateral OIV ..... 16.7 ft/s
- Longitudinal Ridedown ..... 8.7 g
- Lateral Ridedown ..... 10.4 g
- THIV ..... 23.1 km/h
- PHD ..... 11.0 g
- ASI 1.46

Max. 0.050-s Average
- Longitudinal ..... -6.6 g
- Lateral ..... -8.5 g
- Vertical ..... 9.1 g

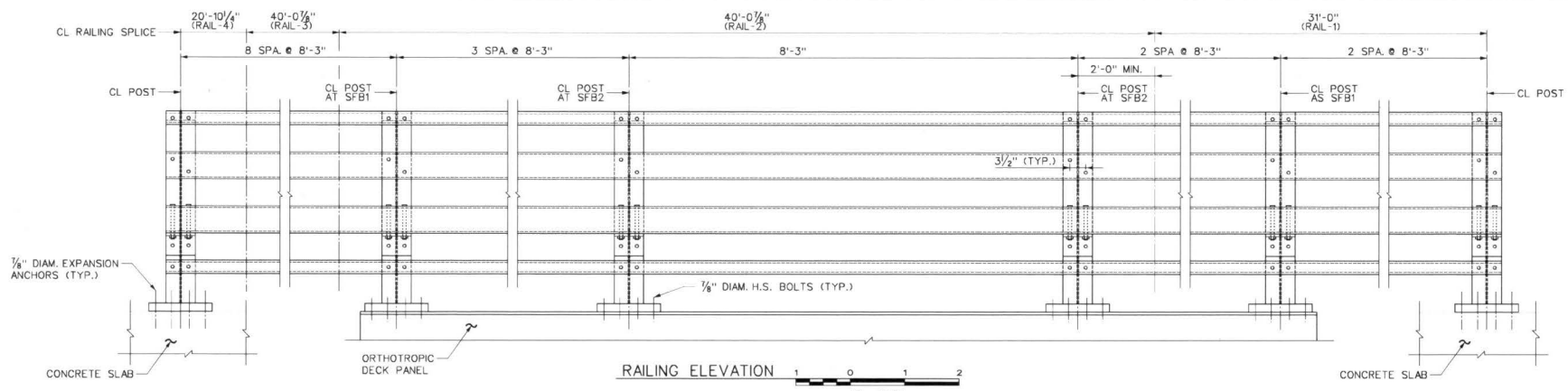
Post-Impact Trajectory
- Stopping Distance ..... 320 downstream 50 ft twd traffic

Vehicle Stability
- Maximum Yaw Angle ..... 40 degrees
- Maximum Pitch Angle ..... 14 degrees
- Maximum Roll Angle ..... 11 degrees
- Vehicle Snagging ..... No
- Vehicle Pocketing ..... No

Test Article Deflections
- Dynamic ..... 2.0 inches
- Permanent ..... 0.6 inches
- Working Width ..... 62.0 inches

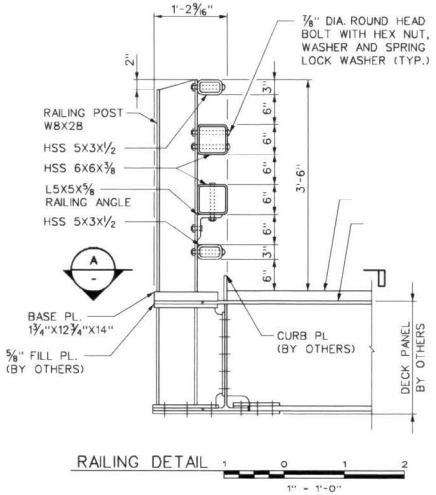
Vehicle Damage
- CDC .....
- Max. Exterior Deformation ..... 20.0 inches
- Max. Occupant Compartment Deformation ..... None

Figure 7.9. Summary of Results for *MASH* Test 5-12 on TBTA Bridge Rail.



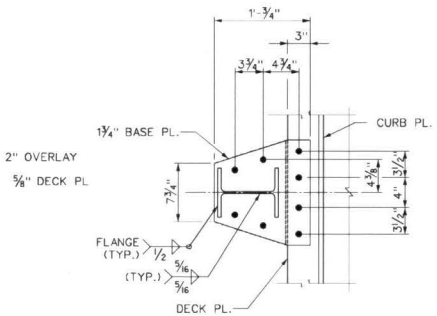
RAILING ELEVATION

1" = 1'-0"



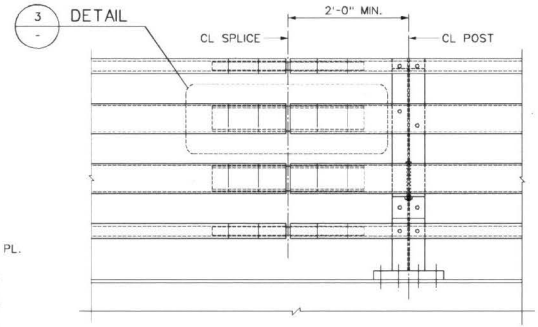
RAILING DETAIL

1" = 1'-0"



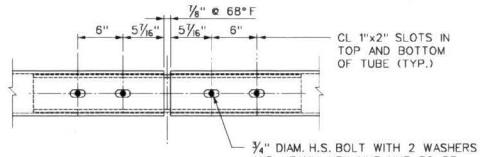
SECTION

1½" = 1'-0"



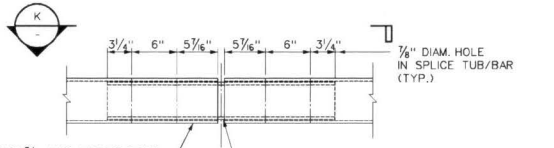
SPLICE ELEVATION

1" = 1'-0"



SECTION

1" = 1'-0"



DETAIL

1" = 1'-0"

NOTES:

1. ANCHOR BOLTS SHALL HAVE A MINIMUM EMBEDMENT LENGTH OF 6¼".
2. ALL BOLTS FOR THE GALVANIZED STEEL RAILING AND RAILING CONNECTION SHALL BE GALVANIZED ⅞ INCH DIAMETER HIGH STRENGTH BOLTS CONFORMING TO ASTM A325 TYPE I, WITH THREADS EXCLUDED FROM THE SHEAR PLANE, UNLESS OTHERWISE NOTED. ALL NUTS SHALL CONFORM TO ASTM A563 GRADE DH OR ASTM A194 GRADE 2H. ALL WASHERS SHALL BE HARDENED STEEL WASHERS CONFORMING TO ASTM F436.
3. RAILING SPLICE LOCATIONS SHALL BE REVIEWED AND VERIFIED BY THE ENGINEER.

REV.	DESCRIPTION	DATE	APP'D.

"IT IS A VIOLATION OF THE PROFESSIONAL LICENSE LAW FOR ANY PERSON TO ALTER THIS DRAWING IN ANY WAY. UNLESS ACTING UNDER THE DIRECTION OF A LICENSED PROFESSIONAL ENGINEER/ARCHITECT AS APPLICABLE. THE ALTERING ENGINEER/ARCHITECT SHALL AFFIX HIS/HER SEAL AND THE NOTATION 'ALTERED BY' FOLLOWED BY HIS/HER SIGNATURE AND DATE OF ALTERATION."

DRAWN BY	E. COVINGTON,C
DESIGNED BY	E. COVINGTON
CHECKED BY	M. ZDENEK
SCALE:	AS NOTED

HNTB

DECK DETAILS TL-5 CRASH TESTING OF 4 RAIL STEEL BARRER

DRAWING TITLE: STEEL RAILING DETAILS – 1

PROJECT NO.

CONTRACT NO.

DRAWING NO. SB-01

SHEET 1 OF 1

DATE FEBRUARY 3, 2016

REVISION NO.

$$Sign$$ $$Permit$$ $$Date$$ $$Time$$ $$User$$

Texas A&M Transportation Institute
Proving Ground

Texas A&M Transportation Institute
3135 TAMU
College Station, TX 77843-3135

979-845-6375
Fax: 979-845-6107
http://tti.tamu.edu/crashtesting

Test Report No. 603911-1-3
Test Report Date: September 2016

Crash Test No. 603911-3 – *MASH* Test 2-12
RE: Fuel Tank Damage

Excerpt from report:

7.6 VEHICLE DAMAGE

Figures 7.6 through 7.8 shows the damage sustained by the vehicle. The front bumper, hood, front axle, right front springs and U-bolts, right front tire and rim, right fuel tank, and right steps of the tractor were damaged. Maximum exterior crush to the tractor was 20.0 inches in the side plane at the right front corner at bumper height. No occupant compartment deformation or intrusion was noted. Figure 7.8 shows the interior of the vehicle. The trailer broke apart near the fifth wheel and all of the tires and rims on the right side were damaged.

TTI Proving Ground Response 2017-01-17:
The fuel tank was only deformed/dented. No punctures or seam ruptures were noted.

If additional information is needed, please contact

Wanda L. Menges

Wanda L. Menges
Research Specialist
TTI Proving Ground