



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

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

July 7 2017

In Reply Refer To:
HSST-1/B-285

Mr. Hani Nassif
RIME Laboratory
Rutgers, The State University of New Jersey
96 Frelinghuysen Rd,
Piscataway, NJ 08854

Dear Mr. Hani Nassif:

This letter is in response to your May 10, 2017 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-285 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:

- NJDOT Balustrade Pulaski Skyway Bridge Parapet

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: NJDOT Balustrade Pulaski Skyway Bridge Parapet

Type of system: Bridge Barrier

Test Level: MASH Test Level 4 (TL4)

Testing conducted by: Texas AM Transportation Institute

Date of request: May 10, 2017

Date initially acknowledged: June 22, 2017

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.

You are expected to certify to potential users that the hardware furnished 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 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-285 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 yours,



Robert Ritter
Acting Director, Office of Safety
Technologies
Office of Safety

Enclosures

Request for Federal Aid Reimbursement Eligibility of Highway Safety Hardware

Submitter	Date of Request:	May 10, 2017	<input checked="" type="radio"/> New <input type="radio"/> Resubmission
	Name:	Hani Nassif	
	Company:	RIME Laboratory - Rutgers, The State University of New Jersey	
	Address:	96 Frelinghuysen Rd, Piscataway, NJ 08854	
	Country:	U.S.A.	
	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)	<input checked="" type="radio"/> Physical Crash Testing <input type="radio"/> Engineering Analysis	NJDOT Balustrade/a Pulaski Skyway Bridge Parapet	AASHTO MASH	TL4

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:	Lynn Middleton	Same as Submitter <input type="checkbox"/>
Company Name:	New Jersey Department of Transportation	Same as Submitter <input type="checkbox"/>
Address:	Office of Legislative, Administrative & Regulatory Actions, 1035 Burlington Ave, Trenton, NJ 08625	Same as Submitter <input type="checkbox"/>
Country:	U.S.A.	Same as Submitter <input type="checkbox"/>

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

The RIME Team at Rutgers University was awarded a research funding contract in 2013 in response to a Request For Proposal (RFP) announced by the NJDOT Research Bureau to conduct research, design and evaluate a New Jersey historic bridge balustrade. The design is non-proprietary and Rutgers RIME Team has no further financial interest in the marketing or use of this design.

PRODUCT DESCRIPTION

- New Hardware or Significant Modification
 Modification to Existing Hardware

This balustrade is an open-faced concrete barrier with top rail, curb, and post columns. The test installation is a 156 ft. and 1-1/4 in. long steel reinforced concrete bridge parapet, and deck comprises of six 26-ft. long segments. Each 26-ft. long segment of this 44-in. tall system is comprised of two 13-ft. long sections. The top rail is 7-in. tall and 16-in. deep, and the bottom of the top rail measures 37-in. above the bridge deck. The rail is integral to, and sat atop, eleven 19-in. tall reinforced concrete posts per section. The nine interior posts are each 8-in. wide x 10-in. deep, and the end posts are each 12-in. wide x 10-in. deep, and all posts are integral to an 18-in. tall x 16-in. deep curb. The window spacing between posts is 6-in. The bridge parapet contains 1/4-in. wide expansion control joints along the length of the parapet between 26-ft long segment. Furthermore, the bridge parapet contains cold contraction joints (with no space) located between 13-ft. long section at the halfway point of each 26-ft. long segment. Longitudinal reinforcement does not extend across the cold contraction joints in the barrier. All exposed edges have a 3/4-in. chamfer.

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:	William F. Williams	
Engineer Signature:	William Willams	Digitally signed by William Willams DN: cn=William Williams, o=Texas Transportation Insitue, ou=CEF, email=w-williams@tti.tamu.edu, c=US Date: 2017.04.25 15:16:35 -05'00'
Address:	3135 TAMU, College Station, TX 77843-3135	Same as Submitter <input type="checkbox"/>
Country:	U.S.A.	Same as Submitter <input type="checkbox"/>

A brief description of each crash test and its result:

Required Test Number	Narrative Description	Evaluation Results
4-10 (1100C)	Test 607451-3; 2016-12-21; Report TTI 607451-1-3; 2,429 lb small passenger car (2010 Kia Rio) impacting at 62.5 mph and 25.0 degrees; The vehicle did not penetrate, underide, or override the installation. Maximum dynamic deflection during the test was 0.5 in. 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 3.5 in. in the left toe pan area. The vehicle remained upright during and after the collision event. Maximum roll and pitch angles were 11 degrees and 4 degrees, respectively. Occupant risk factors were within the limits specified in MASH.	PASS

Required Test Number	Narrative Description	Evaluation Results
4-11 (2270P)	Test 607451-2; 2016-12-20; Report TTI 607451-1-3; 5,037 lb pick up truck (2011 Dodge RAM 1500) impacting at 62.5 mph and 24.0 degrees; The vehicle did not penetrate, underride, or override the installation. Maximum dynamic deflection of the bridge parapet during the test was 1.0 in. 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 2.0 in. in the left kick panel/toe pan area. The vehicle remained upright during and after the collision event. Maximum roll and pitch angles were 24 degrees and 6 degrees, respectively. Occupant risk factors were within the preferred limits specified in MASH.	PASS
4-12 (10000S)	Test 607451-1; 2016-12-16; Report TTI 607451-1-3; 22,030 lb single unit truck (2006 International 4200) impacting at 57.4 mph and 15.3 degrees; The vehicle did not penetrate, underride, or override the installation. Maximum dynamic deflection of the bridge parapet during the test was 4.4 in. 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 8.0 in. in the left kick panel/toe pan area.	PASS
4-20 (1100C)		Non-Relevant Test, not conducted
4-21 (2270P)		Non-Relevant Test, not conducted
4-22 (10000S)		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	Darrell L. Kuhn 2017.04.25 15:34:27 -05'00'
Address:	Roadside Safety & Physical Security, Texas A&M University System, 3135 TAMU, College Station, TX 77843-3135	Same as Submitter <input type="checkbox"/>
Country:	U.S.A.	Same as Submitter <input type="checkbox"/>
Accreditation Certificate Number and Dates of current Accreditation period :	ISO 17025 Laboratory, Testing Certificate # 2821.01 Expires April 30, 2019	

Submitter Signature

Digitally signed by Hani Nassif
 *. DN: cn=Hani Nassif, o=Rutgers, The State University of NJ, ou=Dept. of Civil & Env. Eng., email=nassif@soe.rutgers.edu, c=US
 Date: 2017.05.09 22:10:31 -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

Table 8.4. Assessment Summary for MASH TL-4 Tests on Pulaski Skyway Bridge Parapet.

Evaluation Factors	Evaluation Criteria	Test No. 607451-1	Test No. 607451-2	Test No. 607451-3
Structural Adequacy	A	S*	S	S
Occupant Risk	D	S	S	S
	F	N/A	S	S
	G	S	N/A	N/A
	H	N/A	S	S
	I	N/A	S	S
Test No.	MASH Test 4-12	MASH Test 4-11	MASH Test 4-10	
Pass/Fail	Pass	Pass	Pass	

* S = Satisfactory

U = Unsatisfactory

N/A = Not Applicable



General Information

Test Agency..... Texas A&M Transportation Institute (TTI)
 Test Standard Test No..... MASH Test 4-12
 TTI Test No. 607451-1
 Test Date 2016-12-16

Test Article

Type Bridge Rail
 Name..... Pulaski Skyway Bridge Parapet
 Installation Length..... 156 ft-1¼ inches
 Material or Key Elements Twelve 13 ft long sections w/16-inch wide x 44 inch tall rail with 7-inch tall x 16-inch wide rail atop 19-inch tall concrete posts 8 inches wide x 10 inches deep spaced on 14-inch centers, atop 18-inch tall x 16-inch wide curb

Soil Type and Condition Concrete Bridge Deck, Dry

Test Vehicle

Type/Designation..... 10000S
 Make and Model 2006 International 4200
 Curb 12,180 lb
 Test Inertial 22,030 lb
 Dummy 165 lb
 Gross Static 22,195 lb

Impact Conditions

Speed57.4 mi/h
 Angle15.3 degrees
 Location/Orientation5.1 ft upstream of open joint

Impact Severity.....169 kip-ft

Exit Conditions

SpeedRemained in
 Angle contact to end

Occupant Risk Values

Longitudinal OIV13.1 ft/s
 Lateral OIV6.9 ft/s
 Longitudinal Ridedown2.4 g
 Lateral Ridedown4.1 g
 THIV16.9 km/h
 PHD4.3 g
 ASI0.95
 Max. 0.050-s Average
 Longitudinal-3.4 g
 Lateral2.9 g
 Vertical7.4 g

Post-Impact Trajectory

Stopping Distance248 ft downstrm
 25 ft twd field side

Vehicle Stability

Maximum Yaw Angle 16 degrees
 Maximum Pitch Angle 8 degrees
 Maximum Roll Angle 12 degrees
 Vehicle Snagging No
 Vehicle Pocketing No

Test Article Deflections

Dynamic4.4 inches
 Permanent2.1 inches
 Working Width20.1 inches

Vehicle Damage

VDS 11LFQ5
 CDC 11FLEW4
 Max. Exterior Deformation 14.0 inches
 OCDI LF000000
 Max. Occupant Compartment Deformation 8.0 inches

Figure 5.7. Summary of Results for MASH Test 4-12 on the Pulaski Skyway Bridge Parapet.

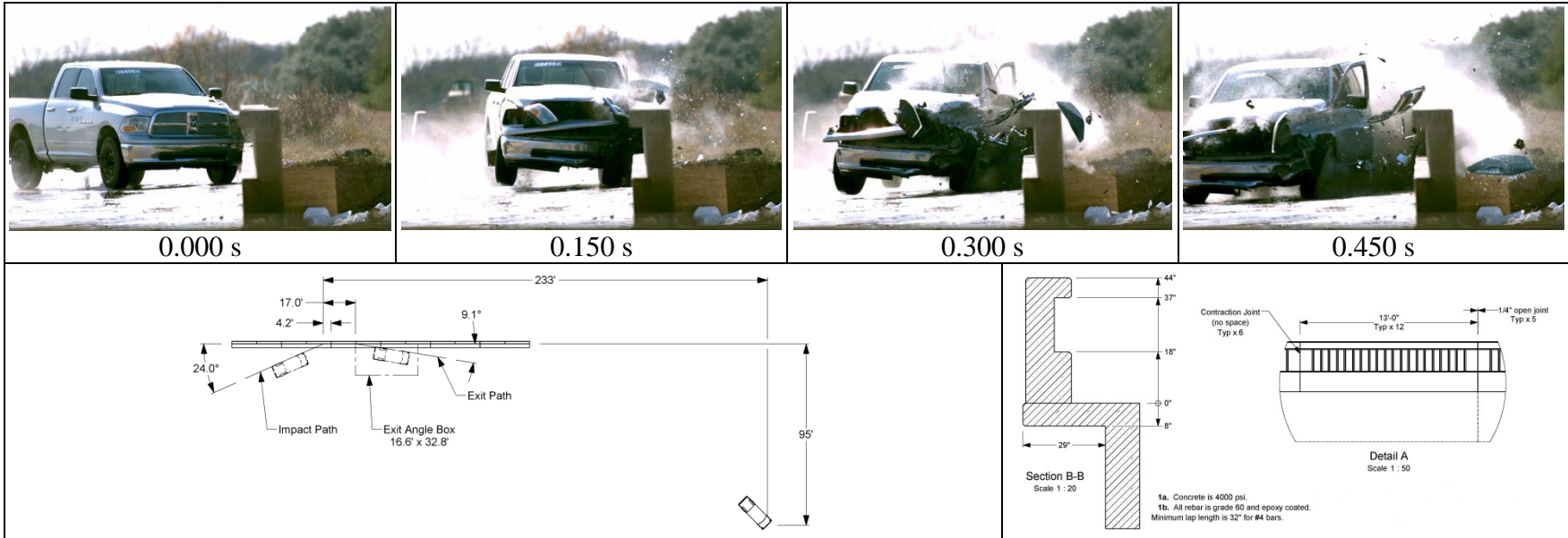
Table 8.1. Performance Evaluation Summary for MASH Test 4-12 on the Pulaski Skyway Bridge Parapet.

Test Agency: Texas A&M Transportation Institute

Test No.: 607451-1

Test Date: 2016-12-16

MASH Test 4-12 Evaluation Criteria	Test Results	Assessment
<p>Structural Adequacy</p> <p>A. <i>Test article should contain and redirect the vehicle or bring the vehicle to a controlled stop; the vehicle should not penetrate, underride, or override the installation although controlled lateral deflection of the test article is acceptable.</i></p>	<p>The Pulaski Skyway Bridge Parapet contained and redirected the 10000S vehicle. The vehicle did not penetrate, underride, or override the installation. Maximum dynamic deflection during the test was 4.4 inches.</p>	<p>Pass</p>
<p>Occupant Risk</p> <p>D. <i>Detached elements, fragments, or other debris from the test article should not penetrate or show potential for penetrating the occupant compartment, or present an undue hazard to other traffic, pedestrians, or personnel in a work zone.</i></p>	<p>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.</p>	<p>Pass</p>
<p><i>Deformations of, or intrusions into, the occupant compartment should not exceed limits set forth in Section 5.3 and Appendix E of MASH.</i></p>	<p>Maximum occupant compartment deformation was 8.0 inches in the left kick panel/toe pan area.</p>	<p>Pass</p>
<p>G. <i>It is preferable, although not essential, that the vehicle remain upright during and after collision.</i></p>	<p>The 10000S vehicle remained upright during and after the collision event.</p>	<p>Pass</p>



General Information

Test Agency..... Texas A&M Transportation Institute (TTI)
 Test Standard Test No..... MASH Test 4-11
 TTI Test No. 607451-2
 Test Date 2016-12-20

Test Article

Type Bridge Rail
 Name..... Pulaski Skyway Bridge Parapet
 Installation Length..... 156 ft-1¼ inches
 Material or Key Elements Twelve 13 ft long sections w/16-inch wide x 44 inch tall rail with 7-inch tall x 16-inch wide rail atop 19-inch tall concrete posts 8 inches wide x 10 inches deep spaced on 14-inch centers, atop 18-inch tall x 16-inch wide curb

Soil Type and Condition Concrete Bridge Deck, Dry

Test Vehicle

Type/Designation..... 2270P
 Make and Model 2011 Dodge RAM 1500
 Curb..... 4936 lb
 Test Inertial..... 5037 lb
 Dummy 165 lb
 Gross Static..... 5202

Impact Conditions

Speed62.5 mi/h
 Angle24.0 degrees
 Location/Orientation4.2 ft upstream of joint

Impact Severity.....109 kip-ft

Exit Conditions

Speed51.1 mi/h
 Angle9.1 degrees

Occupant Risk Values

Longitudinal OIV18.0 ft/s
 Lateral OIV28.9 ft/s
 Longitudinal Ridedown.....4.4 g
 Lateral Ridedown8.9 g
 THIV37.8 km/h
 PHD9.0 g
 ASI.....2.05
 Max. 0.050-s Average
 Longitudinal-9.5 g
 Lateral.....15.9 g
 Vertical.....-2.9 g

Post-Impact Trajectory

Stopping Distance.....233 ft dwnstrm
 95 ft twd traffic

Vehicle Stability

Maximum Yaw Angle32 degrees
 Maximum Pitch Angle6 degrees
 Maximum Roll Angle24 degrees
 Vehicle SnaggingNo
 Vehicle PocketingNo

Test Article Deflections

Dynamic.....1.0 inch
 Permanent0.25 inch
 Working Width.....17.0 inches

Vehicle Damage

VDS 11LFQ5
 CDC..... 11FLEW4
 Max. Exterior Deformation..... 14.0 inches
 OCDI.....LF000000
 Max. Occupant Compartment Deformation2.0 inches

Figure 6.7. Summary of Results for MASH Test 4-11 on the Pulaski Skyway Bridge Parapet.

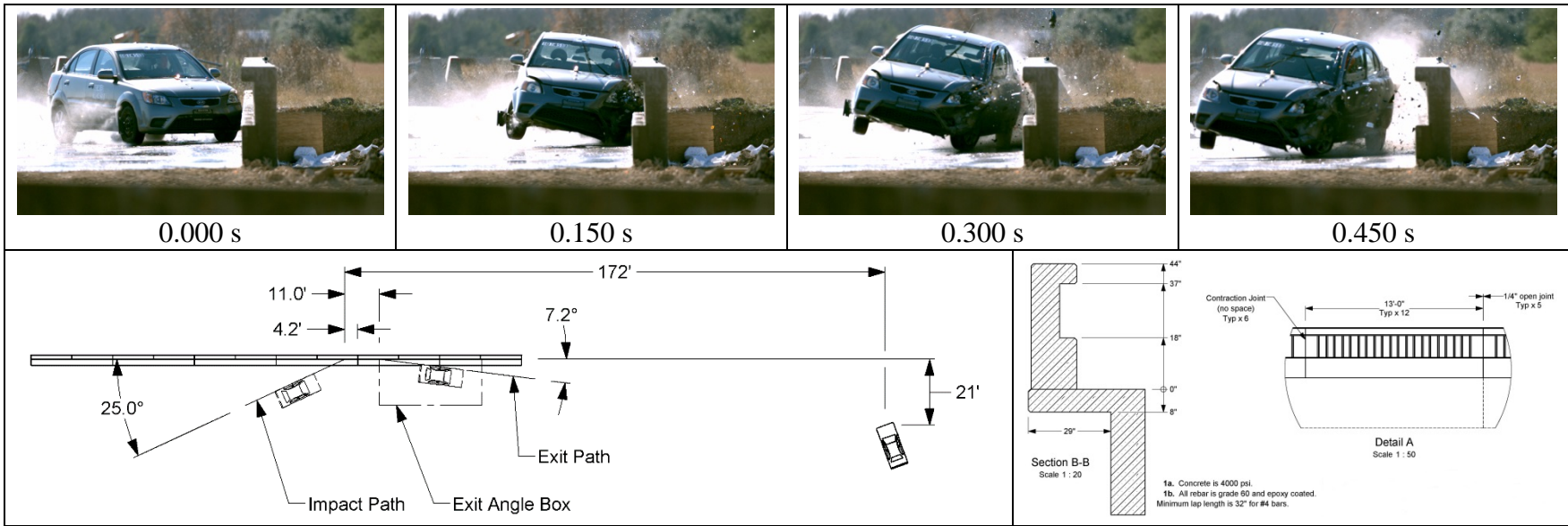
Table 8.2. Performance Evaluation Summary for MASH Test 4-11 on the Pulaski Skyway Bridge Parapet.

Test Agency: Texas A&M Transportation Institute

Test No.: 607451-2

Test Date: 2016-12-20

MASH Test 4-11 Evaluation Criteria	Test Results	Assessment
<u>Structural Adequacy</u>		
A. <i>Test article should contain and redirect the vehicle or bring the vehicle to a controlled stop; the vehicle should not penetrate, underride, or override the installation although controlled lateral deflection of the test article is acceptable.</i>	The Pulaski Skyway Bridge Parapet contained and redirected the 2270P vehicle. The vehicle did not penetrate, underride, or override the installation. Maximum dynamic deflection of the parapet during the test was 1.0 inch.	Pass
<u>Occupant Risk</u>		
D. <i>Detached elements, fragments, or other debris from the test article should not penetrate or show potential for penetrating the occupant compartment, or present an undue hazard to other traffic, pedestrians, or personnel in a work zone.</i>	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.	Pass
<i>Deformations of, or intrusions into, the occupant compartment should not exceed limits set forth in Section 5.3 and Appendix E of MASH.</i>	Maximum occupant compartment deformation was 2.0 inches in the left kick panel/toe pan area.	Pass
F. <i>The vehicle should remain upright during and after collision. The maximum roll and pitch angles are not to exceed 75 degrees.</i>	The 2270P vehicle remained upright during and after the collision event. Maximum roll and pitch angles were 24 degrees and 6 degrees, respectively.	Pass
H. <i>Longitudinal and lateral occupant impact velocities should fall below the preferred value of 30 ft/s, or at least below the maximum allowable value of 40 ft/s.</i>	Longitudinal OIV was 18.0 ft/s, and lateral OIV was 28.9 ft/s.	Pass
I. <i>Longitudinal and lateral occupant ridedown accelerations should fall below the preferred value of 15.0 g, or at least below the maximum allowable value of 20.49 g.</i>	Maximum longitudinal ridedown was 4.4 g, and maximum lateral ridedown was 8.9 g.	Pass



General Information

Test Agency..... Texas A&M Transportation Institute (TTI)
 Test Standard Test No..... MASH Test 4-10
 TTI Test No. 607451-3
 Test Date..... 2016-12-21

Test Article

Type Bridge Rail
 Name..... Pulaski Skyway Bridge Parapet
 Installation Length..... 156 ft-1¼ inches
 Material or Key Elements.... Twelve 13 ft long sections w/16-inch wide x 44 inch tall rail with 7-inch tall x 16-inch wide rail atop 19-inch tall concrete posts 8 inches wide x 10 inches deep spaced on 14-inch centers, atop 18-inch tall x 16-inch wide curb

Soil Type and Condition Concrete Bridge Deck, Dry

Test Vehicle

Type/Designation..... 1100C
 Make and Model 2010 Kia Rio
 Curb..... 2518 lb
 Test Inertial..... 2429 lb
 Dummy 165 lb
 Gross Static 2594 lb

Impact Conditions

Speed62.5 mi/h
 Angle25.0 degrees
 Location/Orientation.....4.2 ft upstream of open joint

Impact Severity.....57 kip-ft

Exit Conditions

Speed50.4 mi/h
 Angle7.2 degrees

Occupant Risk Values

Longitudinal OIV23.0 ft/s
 Lateral OIV31.5 ft/s
 Longitudinal Ridedown4.2 g
 Lateral Ridedown11.0 g
 THIV42.5 km/h
 PHD11.3 g
 ASI2.79
 Max. 0.050-s Average
 Longitudinal-13.3 g
 Lateral.....-20.2 g
 Vertical.....-4.0 g

Post-Impact Trajectory

Stopping Distance.....172 ft downstrm
 21 ft twd traffic

Vehicle Stability

Maximum Yaw Angle44 degrees
 Maximum Pitch Angle4 degrees
 Maximum Roll Angle11 degrees
 Vehicle Snagging.....No
 Vehicle PocketingNo

Test Article Deflections

Dynamic.....0.5 inch
 PermanentNegligible
 Working Width.....16.5 inches

Vehicle Damage

VDS 11LFQ4
 CDC..... 11FLEW4
 Max. Exterior Deformation.....9.0 inches
 OCDI.....LF0003000
 Max. Occupant Compartment Deformation3.5 inches

Figure 7.7. Summary of Results for MASH Test 4-10 on the Pulaski Skyway Bridge Parapet.

Table 8.3. Performance Evaluation Summary for MASH Test 4-10 on the Pulaski Skyway Bridge Parapet.

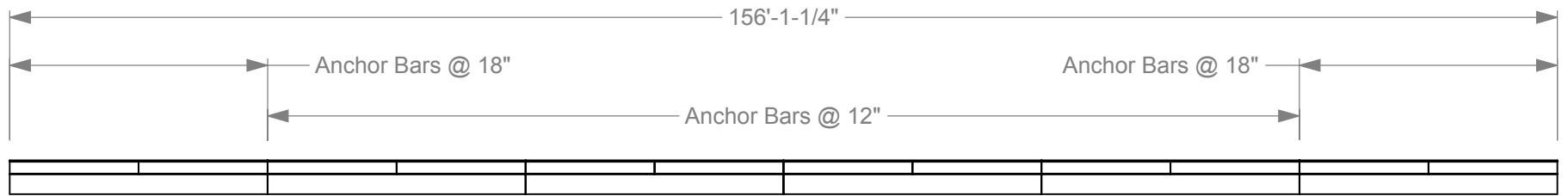
Test Agency: Texas A&M Transportation Institute

Test No.: 607451-3

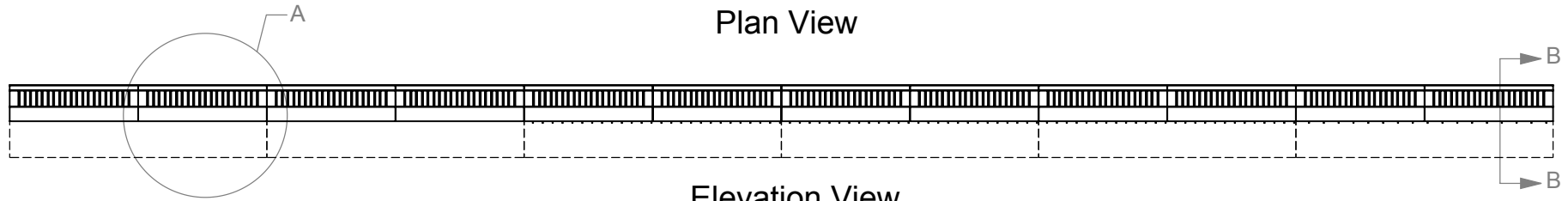
Test Date: 2016-12-21

MASH Test 4-10 Evaluation Criteria	Test Results	Assessment
<u>Structural Adequacy</u>		
A. <i>Test article should contain and redirect the vehicle or bring the vehicle to a controlled stop; the vehicle should not penetrate, underride, or override the installation although controlled lateral deflection of the test article is acceptable.</i>	The Pulaski Skyway Bridge Parapet contained and redirected the 1100C vehicle. The vehicle did not penetrate, underride, or override the installation. Maximum dynamic deflection during the test was 0.5 inch.	Pass
<u>Occupant Risk</u>		
D. <i>Detached elements, fragments, or other debris from the test article should not penetrate or show potential for penetrating the occupant compartment, or present an undue hazard to other traffic, pedestrians, or personnel in a work zone.</i>	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.	Pass
<i>Deformations of, or intrusions into, the occupant compartment should not exceed limits set forth in Section 5.3 and Appendix E of MASH.</i>	Maximum occupant compartment deformation was 3.5 inches in the left toe pan area.	Pass
F. <i>The vehicle should remain upright during and after collision. The maximum roll and pitch angles are not to exceed 75 degrees.</i>	The 1100C vehicle remained upright during and after the collision event. Maximum roll and pitch angles were 11 degrees and 4 degrees, respectively.	Pass
H. <i>Longitudinal and lateral occupant impact velocities should fall below the preferred value of 30 ft/s, or at least below the maximum allowable value of 40 ft/s.</i>	Longitudinal OIV was 23.0 ft/s, and lateral OIV was 31.5 ft/s.	Pass
I. <i>Longitudinal and lateral occupant ridedown accelerations should fall below the preferred value of 15.0 g, or at least below the maximum allowable value of 20.49 g.</i>	Maximum longitudinal ridedown was 4.2 g, and maximum lateral ridedown was 11.0 g.	Pass

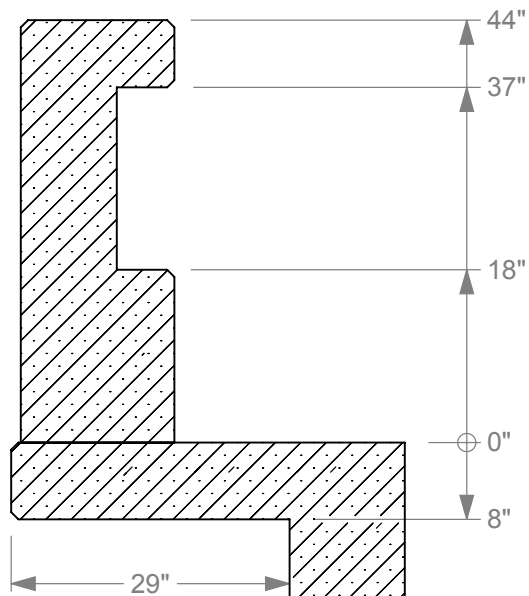
Test Installation



Plan View

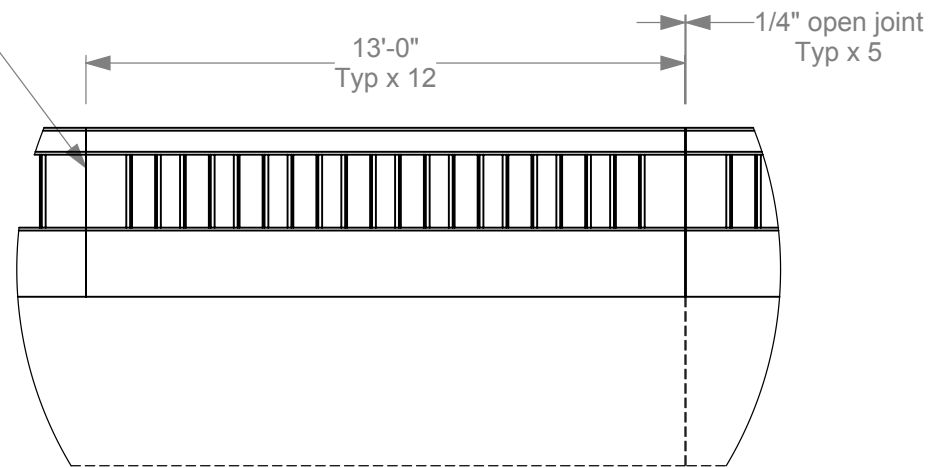


Elevation View



Section B-B
Scale 1 : 20

Contraction Joint
(no space)
Typ x 6



Detail A
Scale 1 : 50

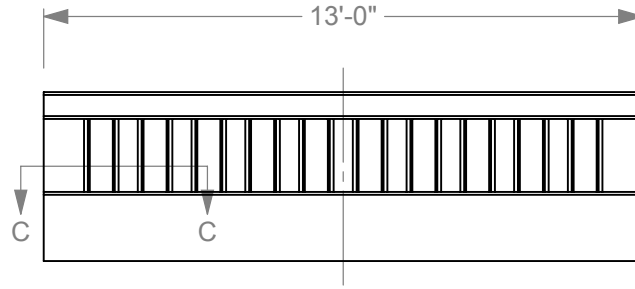
- 1a. Concrete is 4000 psi.
- 1b. All rebar is grade 60 and epoxy coated.
Minimum lap length is 32" for #4 bars.



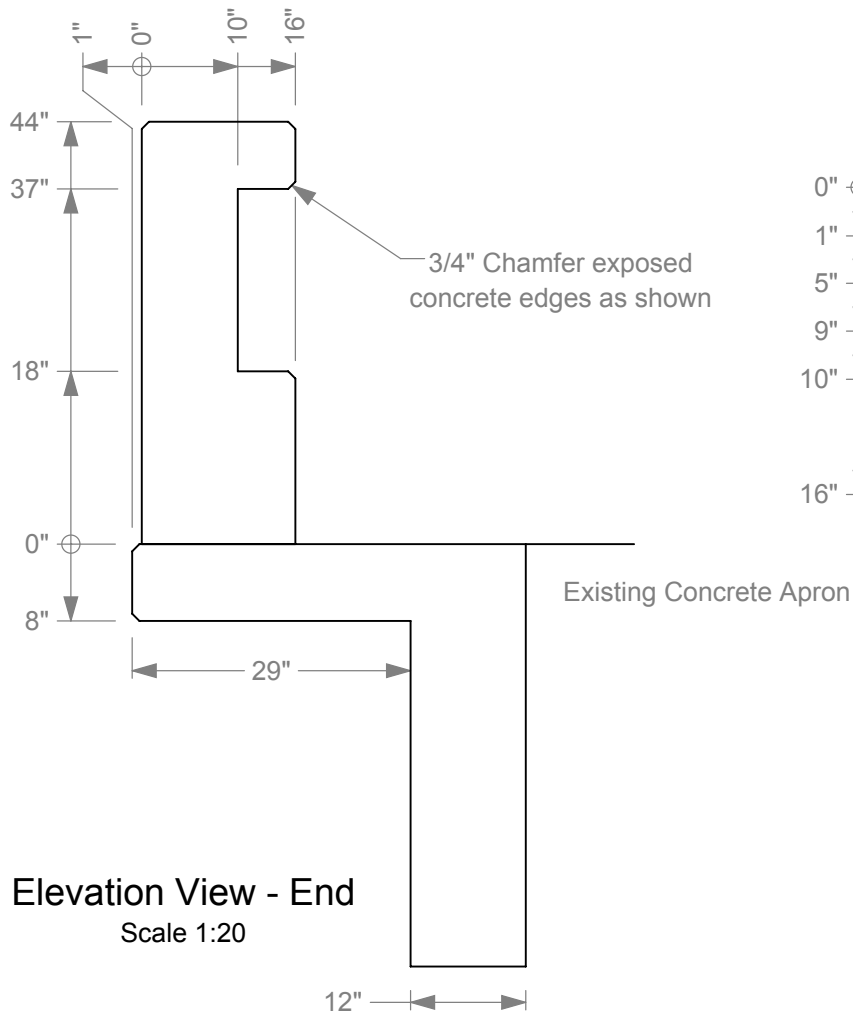
Roadside Safety and
Physical Security Division -
Proving Ground

Project 607451	Rutgers University Parapet	2016-09-16
Drawn By GES	Scale 1:200	Sheet 1 of 5 Test Installation

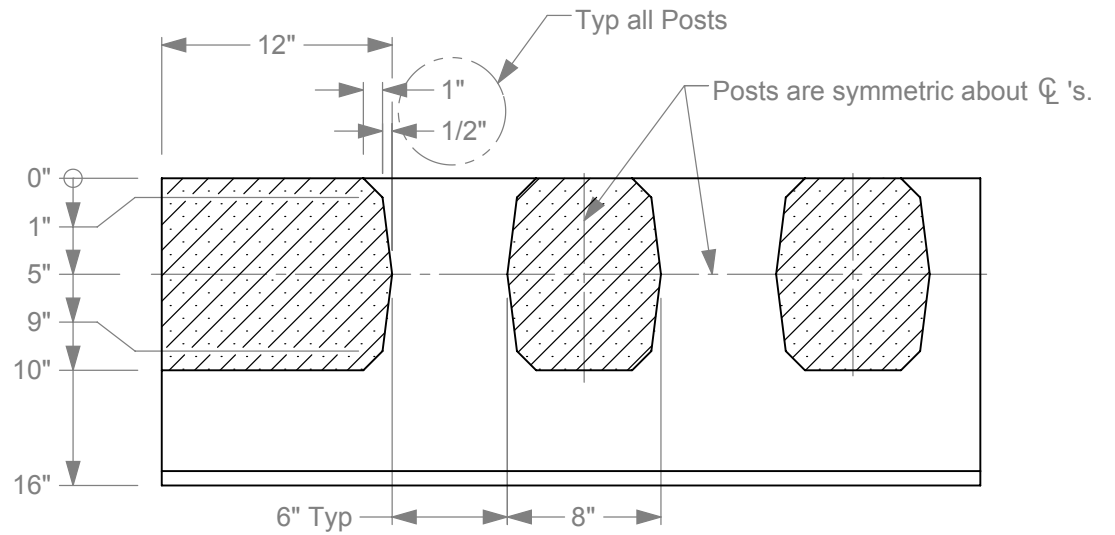
Concrete Details



Typical Parapet Section
Elevation View



Elevation View - End
Scale 1:20

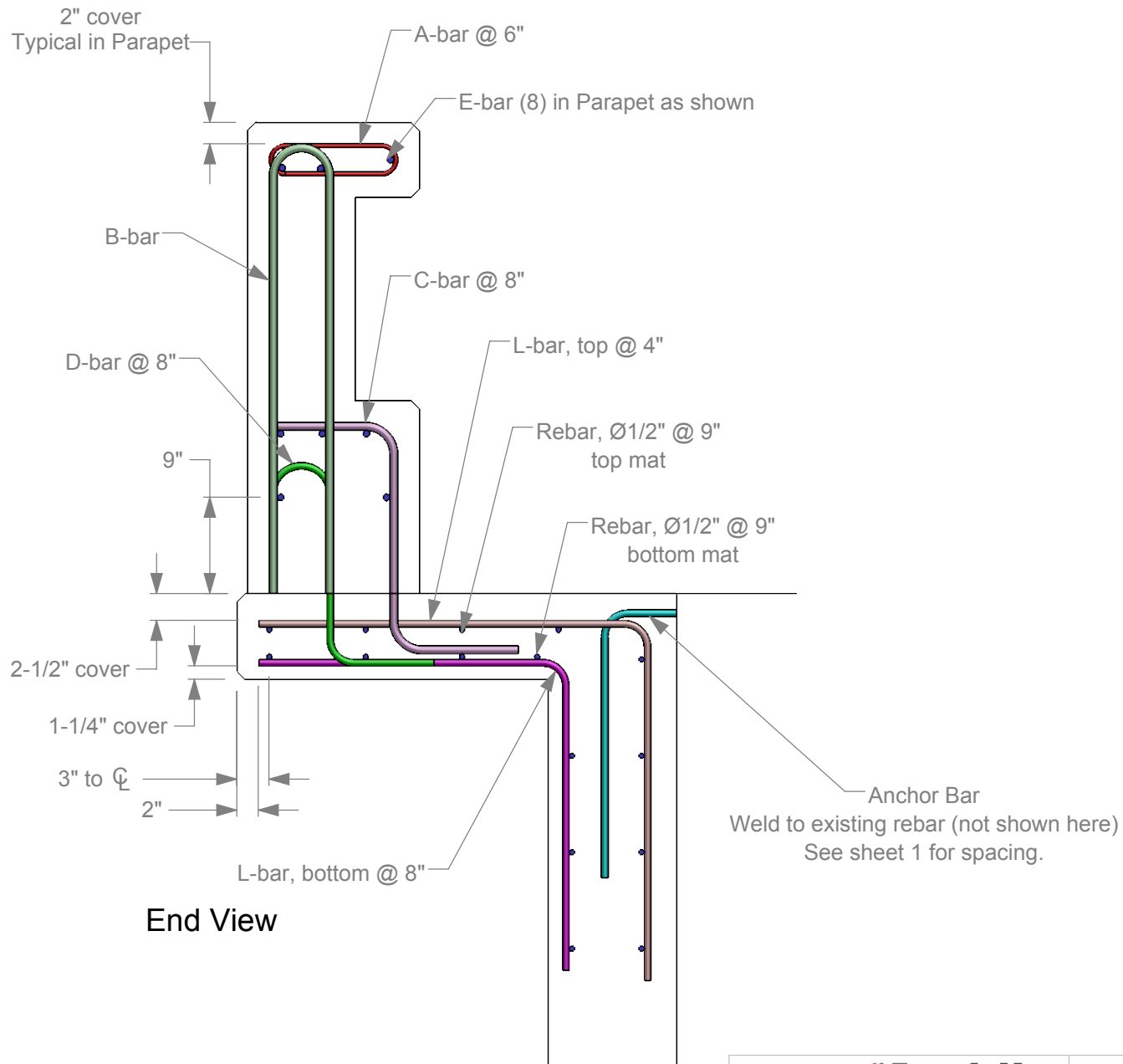


Section C-C
Scale 1 : 10



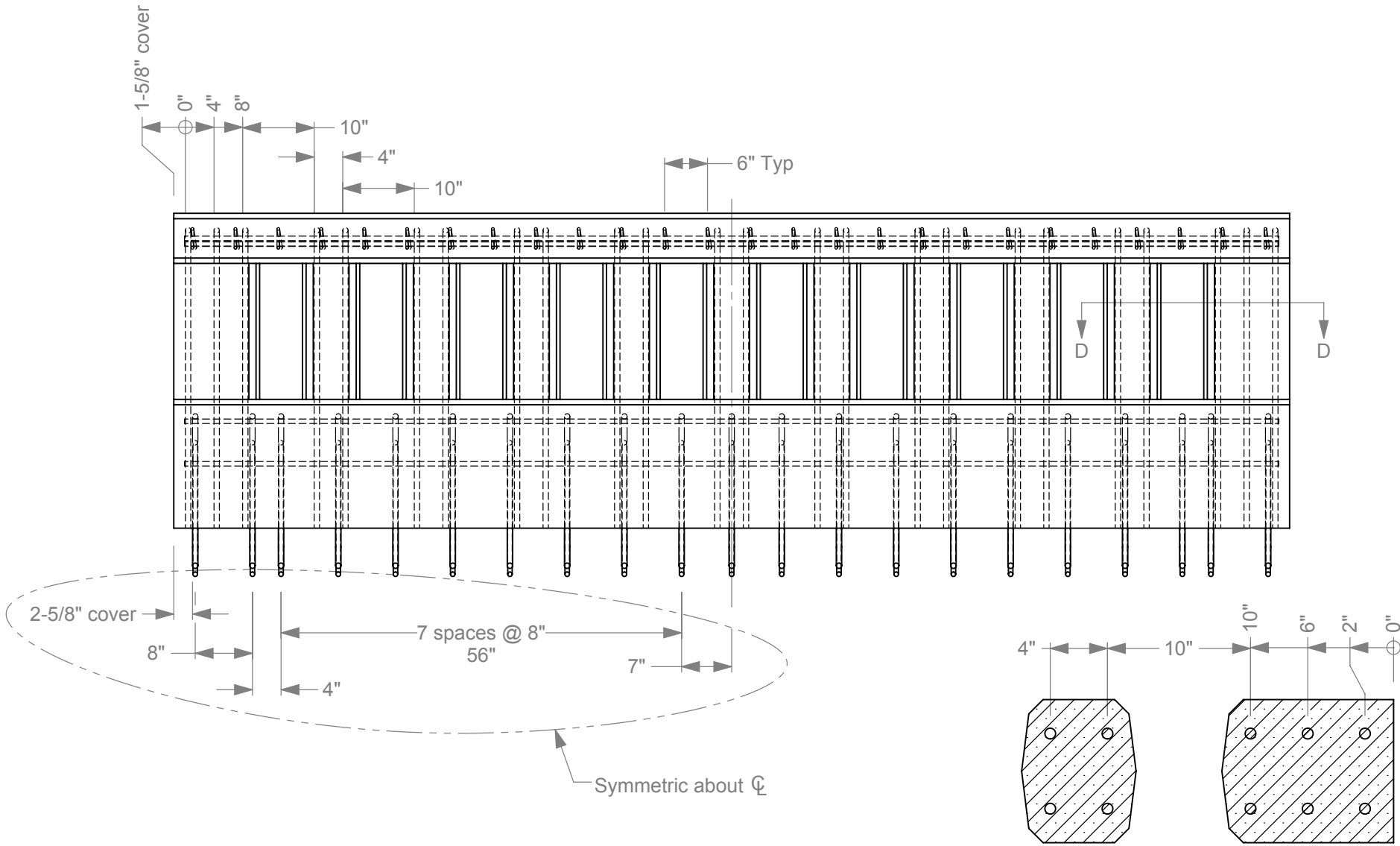
Roadside Safety and
Physical Security Division -
Proving Ground

Project 607451	Rutgers University Parapet	2016-09-16
Drawn By GES	Scale 1:50	Sheet 2 of 5 Concrete Details



Roadside Safety and
Physical Security Division -
Proving Ground

Project 607451	Rutgers University Parapet	2016-09-16
Drawn By GES	Scale 1:15	Sheet 3 of 5 Rebar Details-End



Section D-D

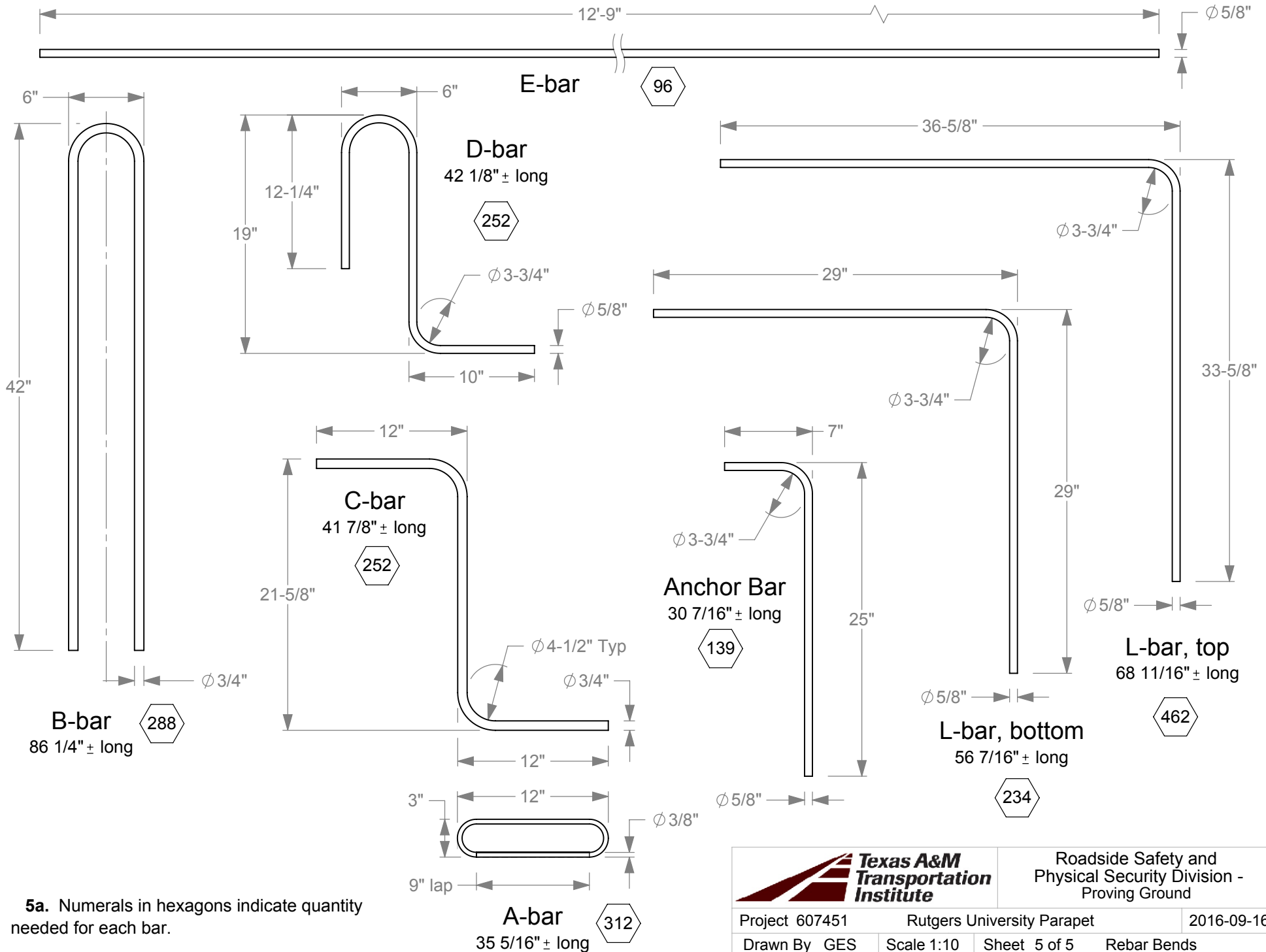
Scale 1 : 10



Roadside Safety and Physical Security Division - Proving Ground

Project 607451 Rutgers University Parapet 2016-09-16

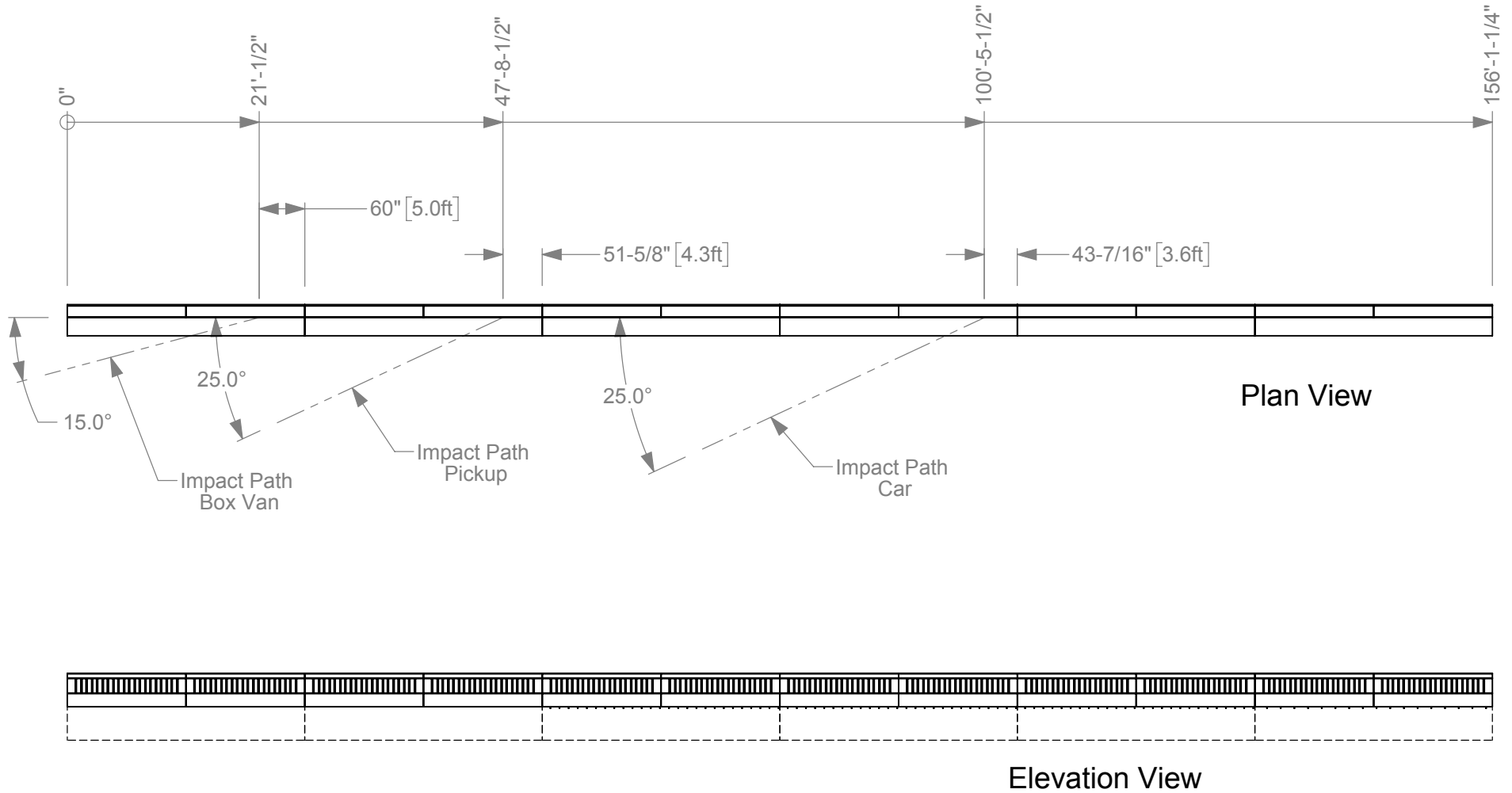
Drawn By GES Scale 1:20 Sheet 4 of 5 Rebar Details-Elevation



5a. Numerals in hexagons indicate quantity needed for each bar.

		Roadside Safety and Physical Security Division - Proving Ground	
Project	607451	Rutgers University	Parapet
Drawn By	GES	Scale	1:10
Sheet	5 of 5	Rebar Bends	
		2016-09-16	

Test Installation



Roadside Safety and
Physical Security Division -
Proving Ground

Project 607451	Rutgers University Parapet	2016-12-15
Drawn By GES	Scale 1:200	Sheet 1 of 1 Test Installation