May 27, 2020

U.S. Department of Transportation
Federal Highway Administration

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

In Reply Refer To:
HSST-1/B-339

Mr. Ahmad Hammad
WSP USA Inc.
2200 Western Court, Suite 120
Lisle, IL 60532
USA

Dear Mr. Hammad:

This letter is in response to your February 7, 2020 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-339 and is valid until a subsequent letter is issued by FHWA that expressly references this device.

Decision

The following device is eligible within the length-of-need, with details provided in the form which is attached as an integral part of this letter:

- F-Shape Barrier on Cantilevered Bridge Deck with Noise Wall Panels

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'(AASHTO) 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 AASHTO's 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: F-Shape Barrier on Cantilevered Bridge Deck with Noise Wall Panels
Type of system: Bridge Barrier
Test Level: MASH Test Level 5 (TL5)
Testing conducted by: Texas A&M Transportation Institute.
Date of request: February 7, 2020

FHWA concurs with the recommendation of the accredited crash testing laboratory on 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

This eligibility letter is issued for the subject device as tested. Modifications made to the device are not covered by this letter. Any modifications to this device should be submitted to the user (i.e., state DOT) as per their requirements.

You are expected to supply potential users with sufficient information on design, installation and maintenance requirements to ensure proper performance.

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 AASHTO's 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-339 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.

- This FHWA eligibility letter is not an expression of any Agency view, position, or determination of validity, scope, or ownership of any intellectual property rights to a specific device or design. Further, this letter does not impute any distribution or licensing rights to the requester. This FHWA eligibility letter determination is made based solely on the crash-testing information submitted by the requester. The FHWA reserves the right to review and revoke an earlier eligibility determination after receipt of subsequent information related to crash testing.

Sincerely,

Michael S. Griffith

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

Enclosures

Request for Federal Aid Reimbursement Eligibility of Highway Safety Hardware

Submitter	Date of Request:	February 07, 2020	◉ New ○ Resubmission
	Name:	Paul Kovacs, P.E., Chief Engineering Officer	
	Company:	Illinois State Toll Highway Authority	
	Address:	2700 Ogden Avenue, Downers Grove, IL 60515	
	Country:	USA	
	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	◉ Physical Crash Testing ○ Engineering Analysis	F-Shape Barrier on Cantilevered Bridge Deck with Noise Wall Panels	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:	Ahmad Hammad, PhD, PE, SE	Same as Submitter ☐
Company Name:	WSP USA Inc.	Same as Submitter ☐
Address:	2200 Western Court, Suite 120, Lisle, IL 60532	Same as Submitter ☐
Country:	USA	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.

Texas A&M Transportation Institute (TTI) was contracted by WSP USA Inc. (WSP) to perform full-scale crash testing of the 6-ft Tall Illinois Tollway F-Shape Barrier on Cantilevered Bridge Deck with Noise Abatement Wall Panels. There are no shared financial interests in the 6-ft Tall Illinois Tollway F-Shape Barrier on Cantilevered Bridge Deck with Noise Abatement Wall Panels by TTI, or between WSP and TTI, other than costs involved in the actual crash tests and reports for this submission to FHWA. **690900-ITG 1-3**

PRODUCT DESCRIPTION

Help

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

The installation was 90 ft-½ inch long and consisted of a 6-ft tall reinforced concrete F-shape concrete parapet anchored to a cantilevered reinforced concrete deck. A ½-inch joint in the deck and parapet was located 30 ft from the upstream end of the installation. W8×48 posts were secured to the back of the parapet, spaced at 11 ft-8 inches on center. These posts supported noise abatement panels that extended 18 ft above grade.

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:	D. Lance Bullard, Jr. P.E.	
Engineer Signature:	D. Lance Bullard, Jr. Digitally signed by D. Lance Bullard, Jr. Date: 2020.02.07 13:07:50 -06'00'	
Address:	3100 SH 47, Bldg 7091, Bryan TX 77807	Same as Submitter ☐
Country:	USA	Same as Submitter ☐

A brief description of each crash test and its result: Help

Required Test Number	Narrative Description	Evaluation Results
5-10 (1100C)	Test 5-10 involves an 1100C vehicle impacting the test article at a target impact speed of 62 mi/h ±2.5 mi/h and a target impact angle of 25° ±1.5°. The target CIP was determined using the information provided in MASH Section 2.2.1, Section 2.3.2, and Table 2-7 and was for the left corner of the front bumper to impact at 3.6 ft upstream of the barrier joint. The results of the test conducted on September 26, 2019, are found in TTI Test Report number 690900-ITG1-3. The test vehicle was traveling at an impact speed of 62.2 mi/h as it made contact with the barrier 3.9 ft upstream of the barrier joint at an impact angle of 25.1°. After loss of contact with the barrier, the vehicle came to rest 242 ft downstream of the impact point and 50 ft towards the traffic side. The barrier contained and redirected the 1100C vehicle. The vehicle did not penetrate, underride, or override the installation. The 1100C vehicle exited within the exit box criteria. Working width was 43.0 inches to the field side of post support protrusions. There was no measurable dynamic deflection during the test, or permanent deformation observed afterwards, for either the barrier or the wall. No detached elements, fragments, or other debris were present to penetrate or show potential for penetrating the occupant compartment, or present hazard to others in the area. Maximum exterior crush to the vehicle was 9.5 inches in the front plane at the left front corner at bumper height. Maximum occupant compartment deformation was 2.5 inches in the left floor pan area. The 1100C vehicle remained upright during and after the collision event. Maximum roll and pitch angles were 10° and 9°, respectively. Longitudinal OIV was 21.0 ft/s, and lateral OIV was 30.8 ft/s. Longitudinal occupant ridedown acceleration was 3.2 g, and lateral occupant ridedown acceleration 9.6 g. The occupant risk factors were within the MASH preferred limits. The 6-ft tall Illinois Tollway F-Shape Barrier with Noise Abatement Wall Panels performed acceptably for MASH test 5-10.	PASS

Required Test Number	Narrative Description	Evaluation Results
5-11 (2270P)	Test 5-11 involves a 2270P vehicle impacting the test article at a target impact speed of 62 mi/h ±2.5 mi/h and a target impact angle of 25° ±1.5°. The target CIP was determined using the information provided in MASH Section 2.2.1, Section 2.3.2, and Table 2-7 and was for the left corner of the front bumper to impact at 4.3 ft upstream of the barrier joint. The results of the test conducted on September 27, 2019 are found in TTI Test Report number 690900-ITG1-3. The test vehicle was traveling at an impact speed of 61.7 mi/h as it made contact with the barrier 5.2 ft upstream of the barrier joint at an angle of 26.7°. After loss of contact with the barrier, the vehicle came to rest 186 ft downstream of the impact point and 2 ft towards the traffic side. The barrier contained and redirected the 2270P vehicle. The vehicle did not penetrate, underride, or override the installation. The 2270P vehicle exited within the exit box criteria. Working width was 43.0-inches to the field side of post support protrusions. There was no measurable dynamic deflection during the test, or permanent deformation observed afterwards, for either the barrier or the wall. No detached elements, fragments, or other debris were present to penetrate or show potential for penetrating the occupant compartment, or present hazard to others in the area. Maximum exterior crush to the vehicle was 15.0 inches in the front plane at the left front corner at bumper height. Maximum occupant compartment deformation was 4.0 inches in the left front firewall area. The 2270P vehicle remained upright during and after the collision event. Maximum roll and pitch angles were 9° and 15°, respectively. Longitudinal OIV was 20.0 ft/s, and lateral OIV was 29.2 ft/s. Longitudinal occupant ridedown acceleration was 3.7 g, and lateral occupant ridedown acceleration 9.8 g. The occupant risk factors were within the MASH preferred limits. The 6-ft tall Illinois Tollway F-Shape Barrier with Noise Abatement Wall Panels performed acceptably for MASH test 5-11.	PASS

5-12 (36000V)	Test 5-12 involves a 36000V vehicle impacting the test article at a target impact speed of 50 mi/h ±2.5 mi/h and a target impact angle of 15° ±1.5°. The target CIP was determined using the information provided in MASH Section 2.2.1, Section 2.3.2, and Table 2-7 and was for the left corner of the front bumper to impact at 1ft downstream of the barrier joint. The results of the test conducted on October 2, 2019 are found in TTI Test Report number 690900-ITG1-3. The test vehicle was traveling at an impact speed of 50.5 mi/h as it made contact with the barrier 0.9 ft downstream of the barrier joint at an angle of 15.2°. After loss of contact with the barrier, the vehicle came to rest 279 ft downstream of the impact point and 16 ft towards the field side. The barrier contained and redirected the 36000V vehicle. The vehicle did not penetrate, underride, or override the installation. The 36000V vehicle exited within the exit box criteria. The trailer broke at its ⅓rd point. Working width was 47.1 inches to the field side of the wall posts at the top of the posts. The maximum dynamic deflection during the test was 9.6 inches at the top of the noise abatement wall panel, and 3.3 inches at the top of the F-Shape barrier. The maximum permanent deformation was 0.5 inch at the top of the wall panel, and 0.4 inch at the top of the barrier just downstream of the joint. No detached elements, fragments, or other debris were present to penetrate or show potential for penetrating the occupant compartment, or present hazard to others in the area Maximum exterior crush to the vehicle was 12.0 inches in the front plane at the left front corner at bumper height. No occupant compartment deformation or intrusion was observed. The 36000V vehicle remained upright during and after the collision event. Maximum roll was 11°. Longitudinal OIV was 4.3 ft/s, and lateral OIV was 17.1 ft/s. Longitudinal occupant ridedown acceleration was 10.2 g, and lateral occupant ridedown acceleration 5.6 g. The occupant risk factors were within the MASH preferred limits. The 6-ft tall Illinois Tollway F-Shape Barrier with Noise Abatement Wall Panels performed acceptably for MASH test 5-12.	PASS

5-20 (1100C)	This product is not a transition system.	Non-Relevant Test, not conducted
5-21 (2270P)	This product is not a transition system.	Non-Relevant Test, not conducted
5-22 (36000V)	This product is not a transition system.	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 A&M Transportation Institute	
Laboratory Signature:	Digitally signed by Darrell L. Kuhn 'Date: 2020.02.07 12:49:09 -06'00	
Address:	3100 SH 47, Bldg 7091, Bryan TX 77807	Same as Submitter ☐
Country:	USA	Same as Submitter ☐
Accreditation Certificate Number and Dates of current Accreditation period :	ISO 17025-2017 Laboratory A2LA Certificate Number: 2821.01 Valid To: April 30, 2021	

Submitter Signature*: Paul D. Kovacs Digitally signed by Paul D. Kovacs Date: 2020.02.07 15:18:12 -06'00'

Submit Form

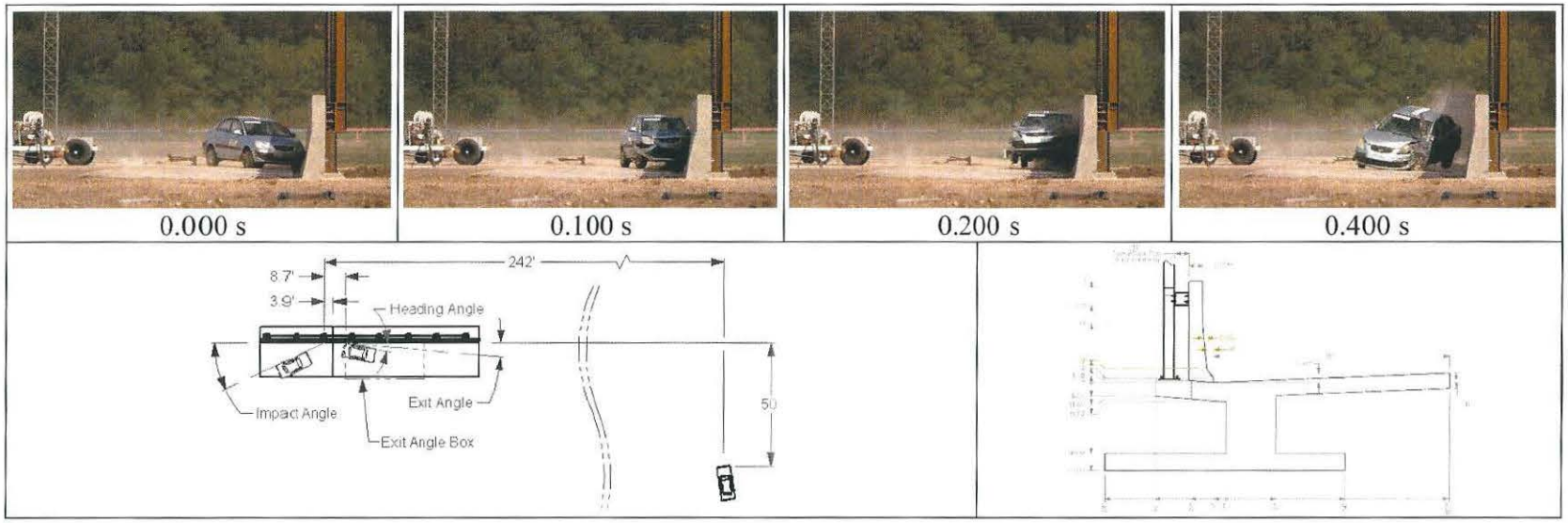
ATTACHMENTS

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. 690900-ITG1
- Test Date 2019-09-26

Test Article
- Type ..... Longitudinal Barrier – Concrete Bridge Rail
- Name ..... 6-ft Tall Illinois Tollway F-Shape Barrier on cantilevered bridge deck with noise abatement panels
- Installation Length ..... 90 ft-½ inch
- Material or Key Elements ..... 6-ft tall F-Shape reinforced concrete barrier anchored to cantilevered reinforced concrete deck with noise abatement panels that extended to 18 ft above grade
- **Soil Type and Condition** ... Concrete Deck, Dry

Test Vehicle
- Type/Designation 1100C
- Make and Model ..... 2009 Kia Rio
- Curb ..... 2431 lb
- Test Inertial ..... 2413 lb
- Dummy ..... 165 lb
- Gross Static ..... 2578 lb

Impact Conditions
- Speed ..... 62.2 mi/h
- Angle ..... 25.1°
- Location/Orientation ..... 3.9 ft upstream of barrier joint

Impact Severity ..... 56 kip-ft

Exit Conditions
- Speed ..... 53.1 mi/h
- Trajectory/Heading Angle ... 2.4° / 7.3°

Occupant Risk Values
- Longitudinal OIV ..... 21.0 ft/s
- Lateral OIV ..... 30.8 ft/s
- Longitudinal Ridedown ..... 3.2 g
- Lateral Ridedown ..... 9.6 g
- THIV ..... 11.3 m/s
- ASI 2.76

Max. 0.050-s Average
- Longitudinal ..... -11.6 g
- Lateral ..... 18.7 g
- Vertical ..... -4.3 g

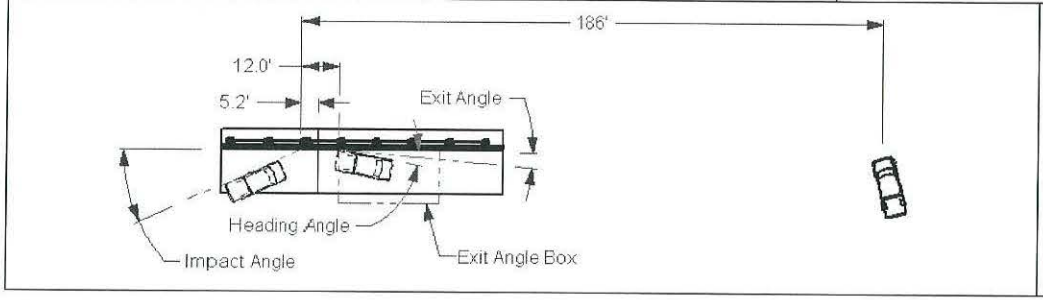
Post-Impact Trajectory
- Stopping Distance ..... 242 ft downstream 50 ft toward traffic

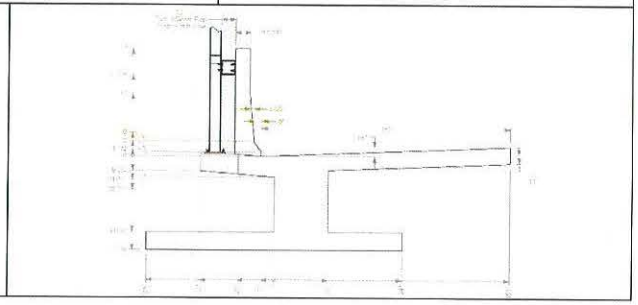
Vehicle Stability
- Maximum Yaw Angle ..... 58°
- Maximum Pitch Angle ..... 9°
- Maximum Roll Angle ..... 10°
- Vehicle Snagging ..... No
- Vehicle Pocketing ..... No

Test Article Deflections
- Dynamic ..... None
- Permanent ..... None
- Working Width, Barrier ..... 43.0 inches
- Height of Working Width, Barrier ... 1.5 inches

Vehicle Damage
- VDS 11LFQ5
- CDC 11FLEW4
- Max. Exterior Deformation ..... 9.5 inches
- OCDI FL0110000
- Max. Occupant Compartment Deformation ..... 2.5 inches

Figure 5.6. Summary of Results for *MASH* Test 5-10 on 6-ft Tall Illinois Tollway F-Shape Barrier on Cantilevered Bridge Deck with Noise Abatement Panels.





General Information
- Test Agency ..... Texas A&M Transportation Institute (TTI)
- Test Standard Test No. .... MASH Test 5-11
- TTI Test No. 690900-ITG2
- Test Date 2019-09-27

Test Article
- Type ..... Longitudinal Barrier – Concrete Bridge Rail
- Name ..... 6-ft Tall Illinois Tollway F-Shape Barrier on cantilevered bridge deck with noise abatement panels
- Installation Length ..... 90 ft-½ inch
- Material or Key Elements . 6-ft tall F-Shape reinforced concrete barrier anchored to cantilevered reinforced concrete deck with noise abatement panels that extended to 18 ft above grade

Soil Type and Condition ... Concrete Deck, Dry

Test Vehicle
- Type/Designation 2270P
- Make and Model ..... 2014 RAM 1500 Pickup
- Curb ..... 4943 lb
- Test Inertial ..... 5014 lb
- Dummy ..... 165 lb
- Gross Static ..... 5179 lb

Impact Conditions
- Speed ..... 61.7 mi/h
- Angle ..... 26.7°
- Location/Orientation ..... 5.2 ft upstream of barrier joint

Impact Severity ..... 129 kip-ft

Exit Conditions
- Speed ..... 50.6 mi/h
- Trajectory/Heading Angle ... 5.5° / 8.4°

Occupant Risk Values
- Longitudinal OIV ..... 20.0 ft/s
- Lateral OIV ..... 29.2 ft/s
- Longitudinal Ridedown ..... 3.7 g
- Lateral Ridedown ..... 9.8 g
- THIV ..... 11.0 m/s
- ASI 2.06

Max. 0.050-s Average
- Longitudinal ..... -9.9 g
- Lateral ..... 16.3 g
- Vertical ..... -3.1 g

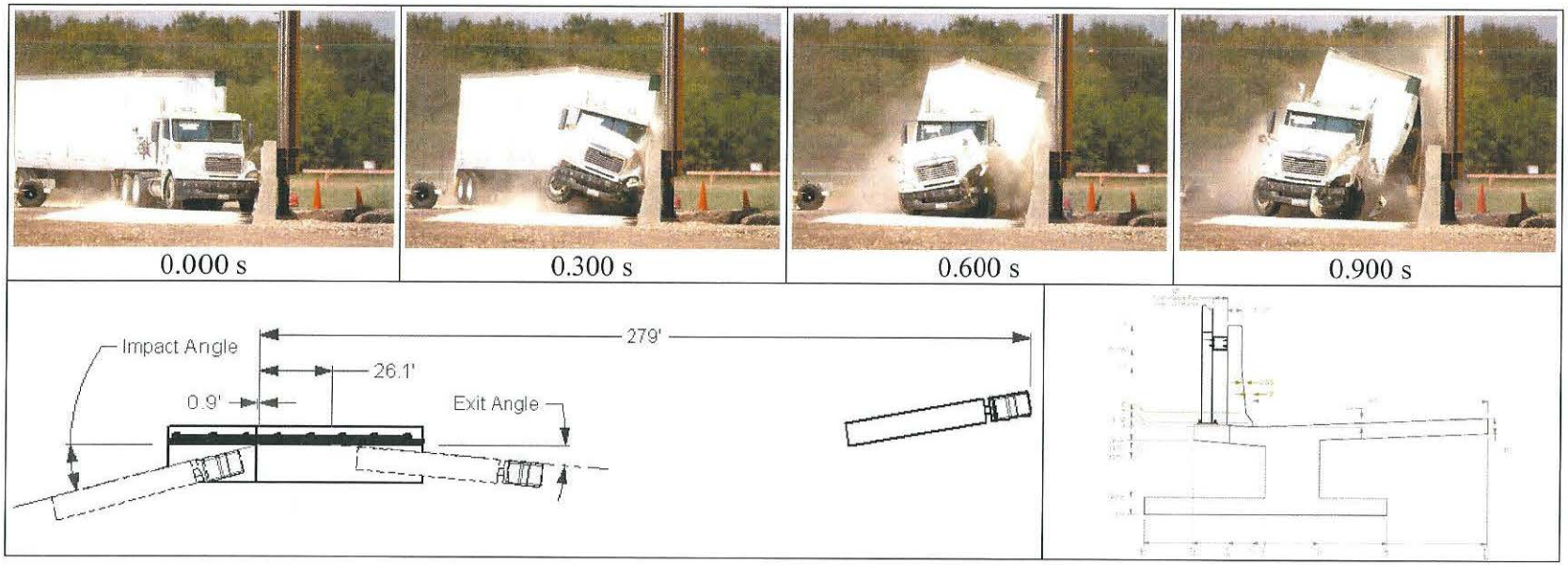
Post-Impact Trajectory
- Stopping Distance ..... 186 ft downstream 2 ft toward traffic

Vehicle Stability
- Maximum Yaw Angle ..... 45°
- Maximum Pitch Angle ..... 15°
- Maximum Roll Angle ..... 9°
- Vehicle Snagging ..... No
- Vehicle Pocketing ..... No

Test Article Deflections
- Dynamic ..... None
- Permanent ..... None
- Working Width, Barrier ..... 43.0 inches
- Height of Working Width, Barrier ... 1.5 inches

Vehicle Damage
- VDS 11LFQ5
- CDC 11FLEW4
- Max. Exterior Deformation ..... 15.0 inches
- OCDI FL0010000
- Max. Occupant Compartment Deformation ..... 4.0 inches

Figure 6.6. Summary of Results for *MASH* Test 5-11 on 6-ft Tall Illinois Tollway F-Shape Barrier on Cantilevered Bridge Deck with Noise Abatement Panels.



General Information
- Test Agency: Texas A&M Transportation Institute (TTI)
- Test Standard Test No.: MASH Test 5-12
- TTI Test No.: 690900-ITG3
- Test Date: 2019-10-02

Test Article
- Type: Longitudinal Barrier - Concrete Bridge Rail
- Name: 6-ft Tall Illinois Tollway F-Shape Barrier on cantilevered bridge deck with noise abatement panels
- Installation Length: 90 ft-½ inch
- Material or Key Elements: 6-ft tall F-Shape reinforced concrete barrier anchored to cantilevered reinforced concrete deck with noise abatement panels that extended to 18 ft above grade

Soil Type and Condition: Concrete Deck, Dry

Test Vehicle
- Type/Designation: 36000V
- Make and Model: 2004 Freightliner w/1998 Lufkin 53-ft trailer
- Curb: 30,270 lb
- Test Inertial: 80,000 lb
- Dummy: No dummy
- Gross Static: 80,000 lb

Impact Conditions
- Speed: 50.5 mi/h
- Angle: 15.2°
- Location/Orientation: 11 inches dwnstrm of joint

Impact Severity: 469 kip-ft

Exit Conditions
- Speed: 41.7 mi/h
- Trajectory/Heading Angle: 8.3° / 3.6°

Occupant Risk Values
(over fifth wheel)
- Longitudinal OIV: 4.3 ft/s
- Lateral OIV: 17.1 ft/s
- Longitudinal Ridedown: 10.2 g
- Lateral Ridedown: 5.6 g
- THIV: 18.4 km/h
- ASI: 0.84

Max. 0.050-s Average
- Longitudinal: -2.8 g
- Lateral: 7.0 g
- Vertical: 1.8 g

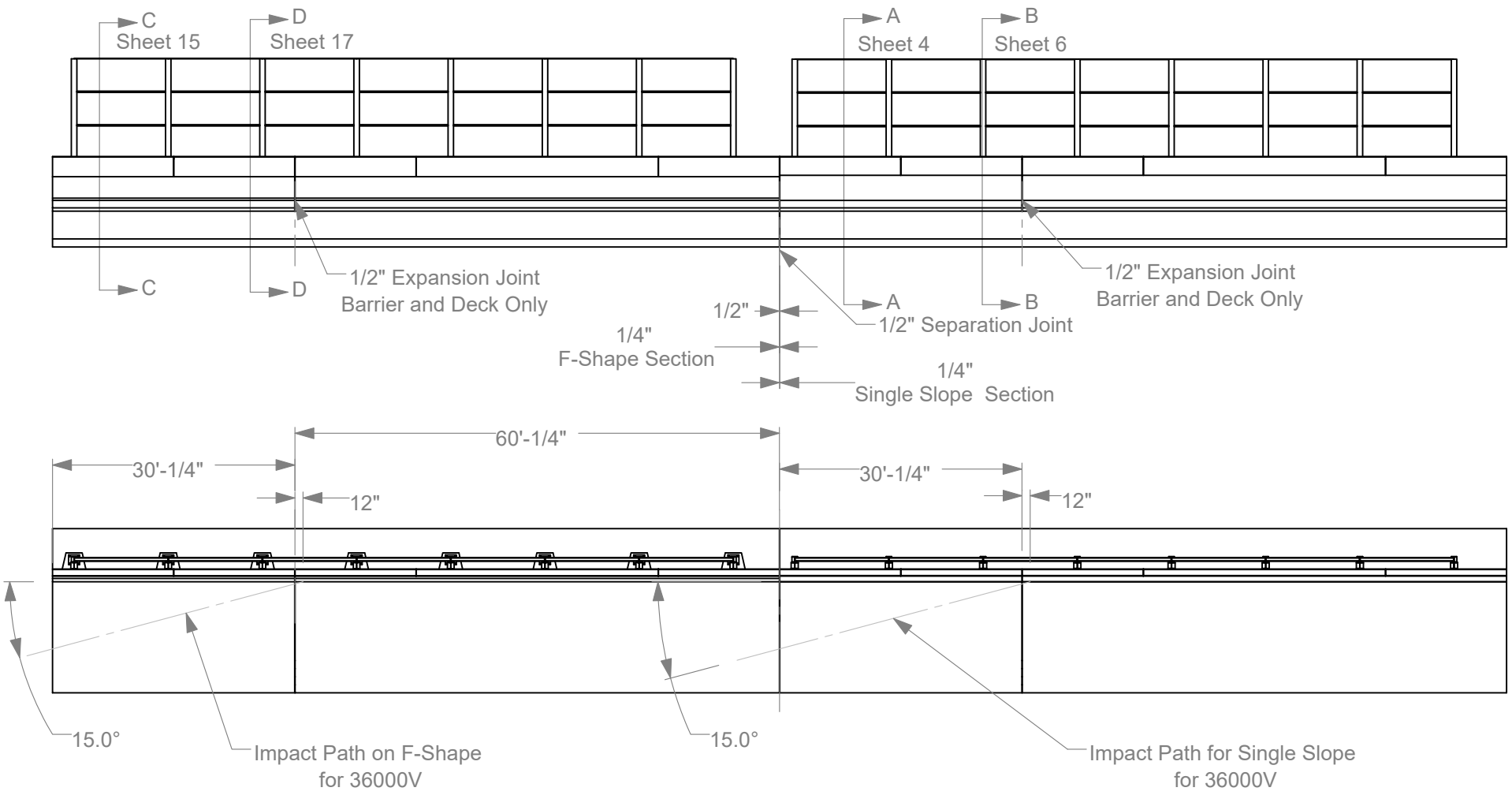
Post-Impact Trajectory
- Stopping Distance: 279 ft downstream 16 ft twd field side

Vehicle Stability
- Maximum Yaw Angle: 25°
- Maximum Pitch Angle: 5°
- Maximum Roll Angle: 11°
- Vehicle Snagging: No
- Vehicle Pocketing: No

Test Article Deflections
- Dynamic: 3.3 inches (barrier) 9.6 inches (wall)
- Permanent: 0.4 inch (barrier) 0.5 inch (wall)
- Working Width, Top of Wall: 47.1 inches
- Height of Working Width, Wall: 18 ft

Vehicle Damage
- VDS: NA
- CDC: 11FLEW3
- Max. Exterior Deformation: 12.0 inches
- OCDI: NA
- Max. Occupant Compartment Deformation: None

Figure 7.12. Summary of Results for *MASH* Test 5-12 on 6-ft Tall Illinois Tollway F-Shape Barrier on Cantilevered Bridge Deck with Noise Abatement Panels.



REINFORCEMENT BARS

REINFORCEMENT BARS, INCLUDING EPOXY-COATED REINFORCEMENT BARS, SHALL CONFORM TO THE REQUIREMENTS OF AASHTO M-31 (ASTM A706), GRADE 60, DEFORMED BARS.

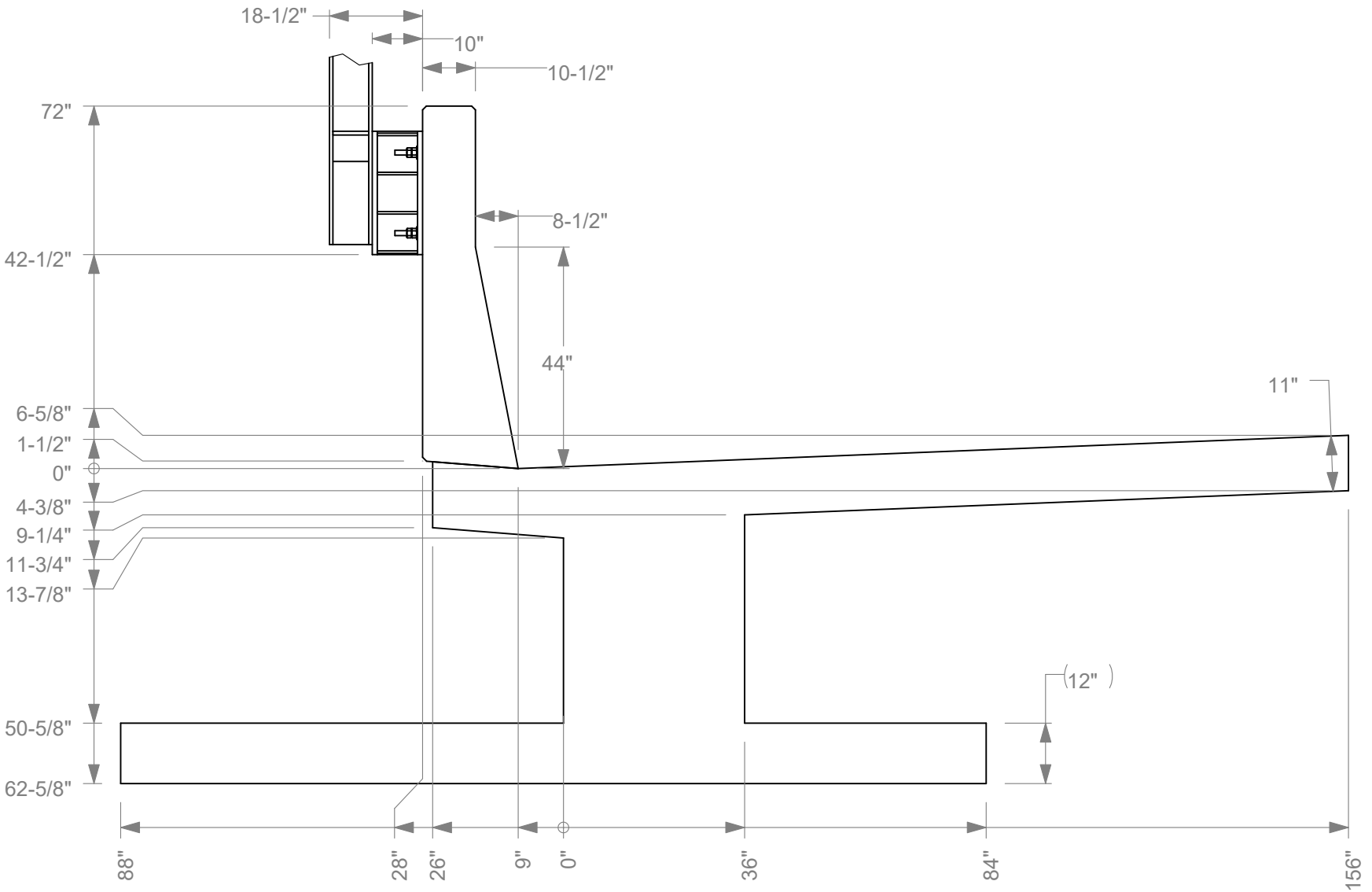
CAST-IN-PLACE CONCRETE

ALL EXPOSED CONCRETE EDGES SHALL HAVE A ¾" X 45º CHAMFER, EXCEPT WHERE SHOWN OTHERWISE.

ALL CONCRETE = 4,000 PSI

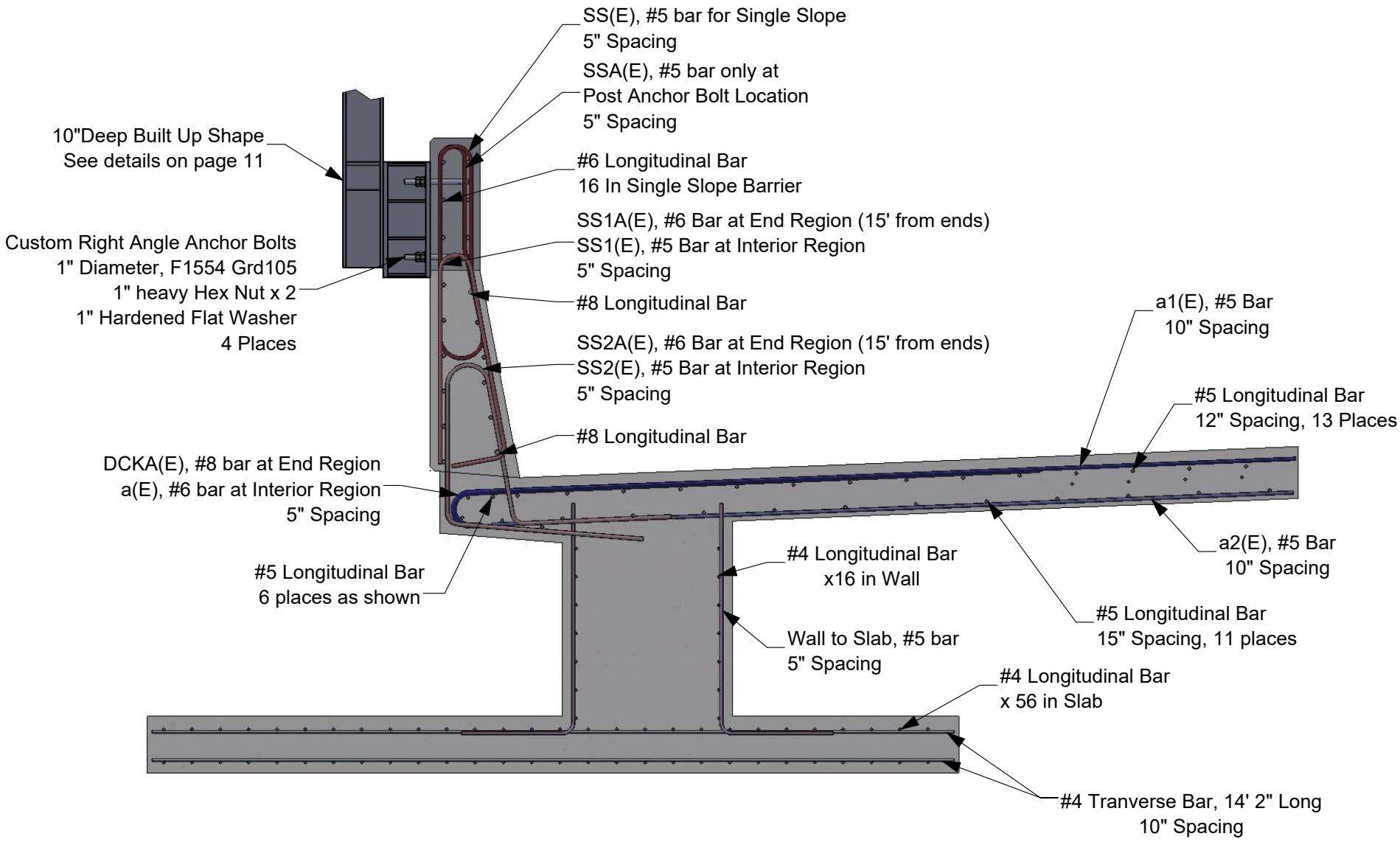
Texas A&M Transportation Institute	Roadside Safety and Physical Security Division - Proving Ground		
Project #690900-ITG FShape and Single Slope			2019-08-22
Drawn by BLG	Scale 1:225	Sheet 1 of 35 Test Installation	

Q:\Accreditation-17025-2017\EIR-000 Project Files\690900\ITG - Illinois Tollway GEC - Akram\Drafting\Bridge Deck models\2019-08-22\690900-ITG, Bridge Deck Sin



Single Slope
End View

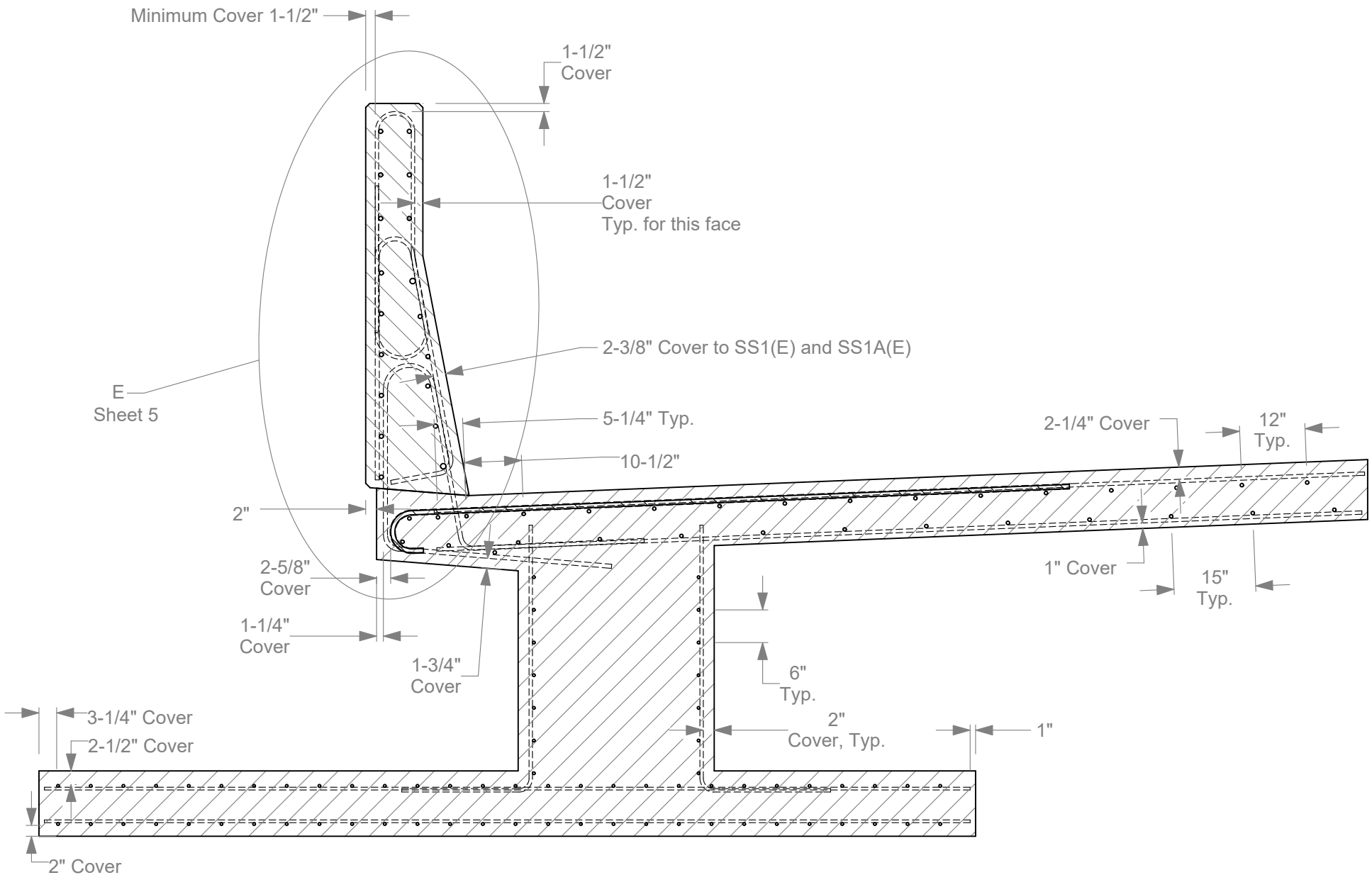
Texas A&M Transportation Institute	Roadside Safety and Physical Security Division - Proving Ground	
Project #690900-ITG FShape and Single Slope		2019-08-22
Drawn by BLG	Scale 1:30	Sheet 2 of 35 Single Slope End



Single Slope
End View

3a. All Rebar is 60 ksi rated
3b. All Epoxy Coated Rebar is designated with (E)

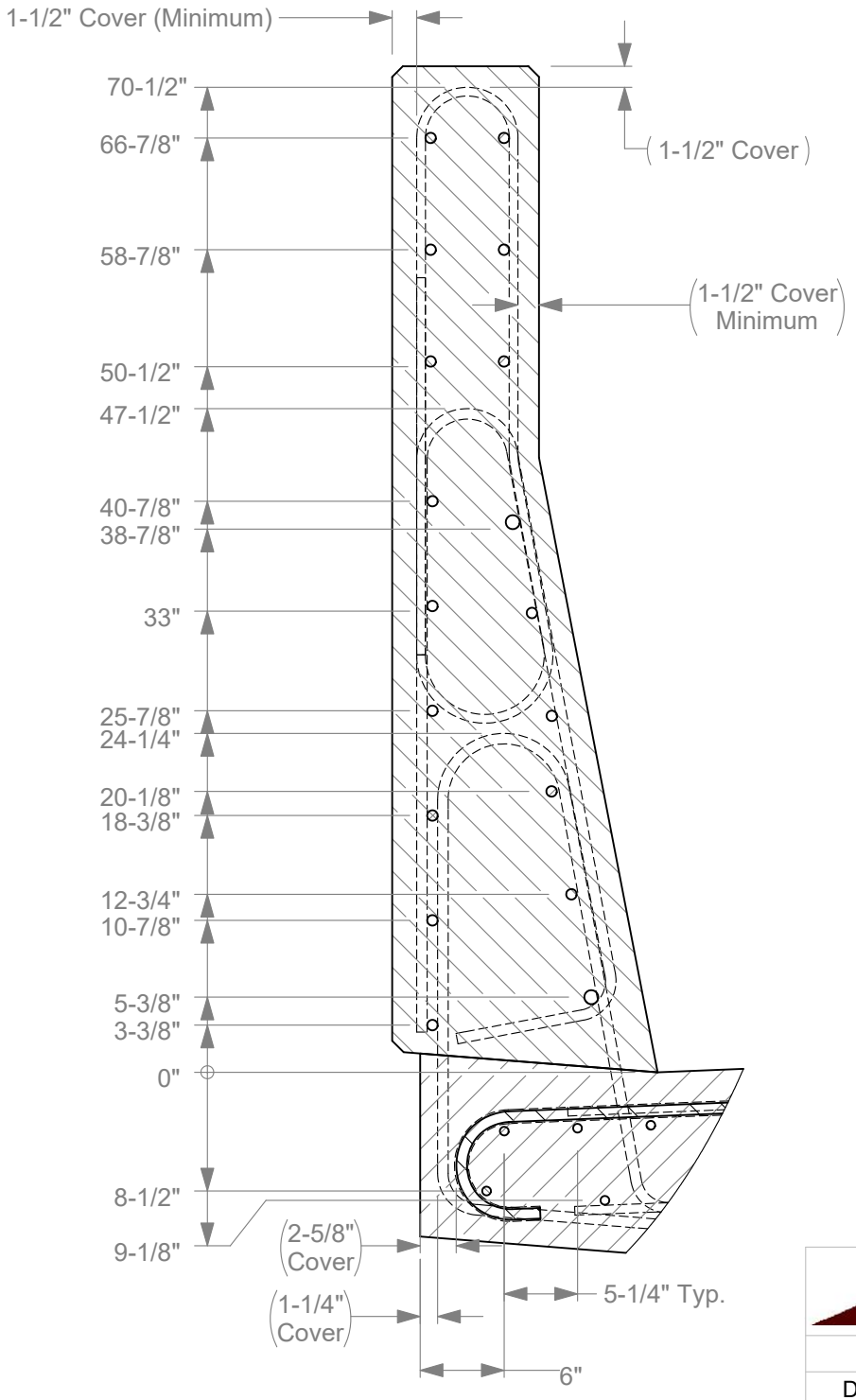
Texas A&M Transportation Institute	Roadside Safety and Physical Security Division - Proving Ground	
Project #690900-ITG FShape and Single Slope		2019-08-22
Drawn by BLG	Scale 1:30	Sheet 3 of 35 Single Slope bar Callout



Section A-A
Single Slope
Away from NAW Posts

4a. All Rebar is 60 ksi rated
4b. All Epoxy Coated Rebar is designated with (E)

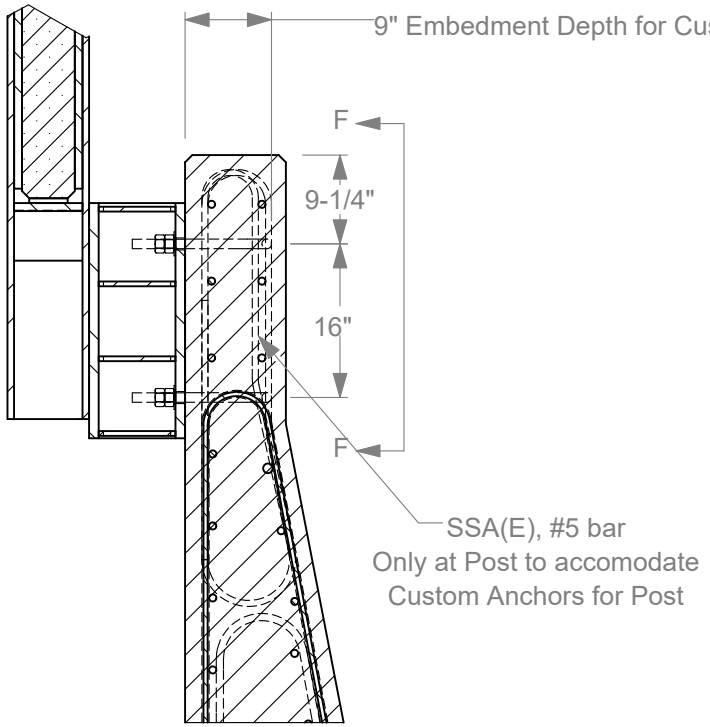
Texas A&M Transportation Institute		Roadside Safety and Physical Security Division - Proving Ground	
Project #690900-ITG FShape and Single Slope			2019-08-22
Drawn by BLG	Scale 1:25	Sheet 4 of 35 Single Slope bar Locations	



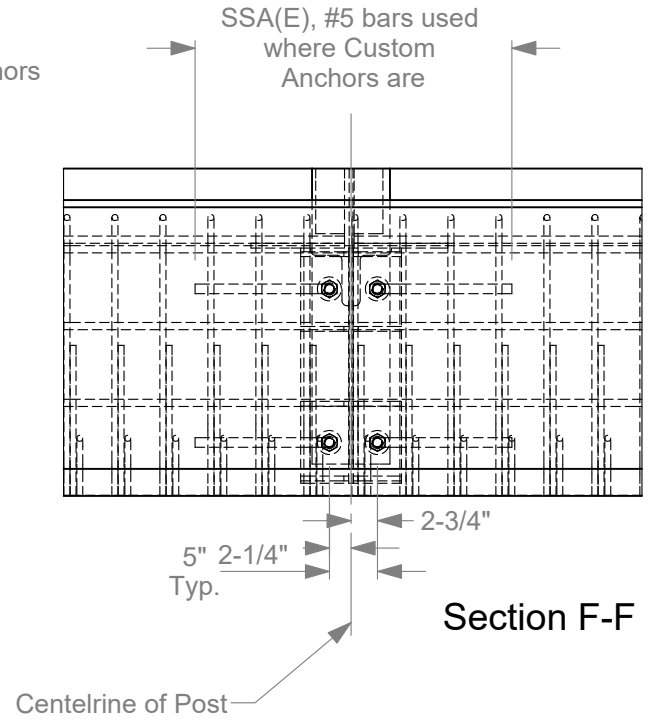
Detail E

Texas A&M Transportation Institute	Roadside Safety and Physical Security Division - Proving Ground	
Project #690900-ITG FShape and Single Slope		2019-08-22
Drawn by BLG	Scale 1:13	Sheet 5 of 35 Single Slope bar Locations 2

Q:\Accreditation-17025-2017\EIR-000 Project Files\690900\ITG - Illinois Tollway GEC - Akram\Drafting\Bridge Deck models\2019-08-22\690900-ITG, Bridge Deck Sin



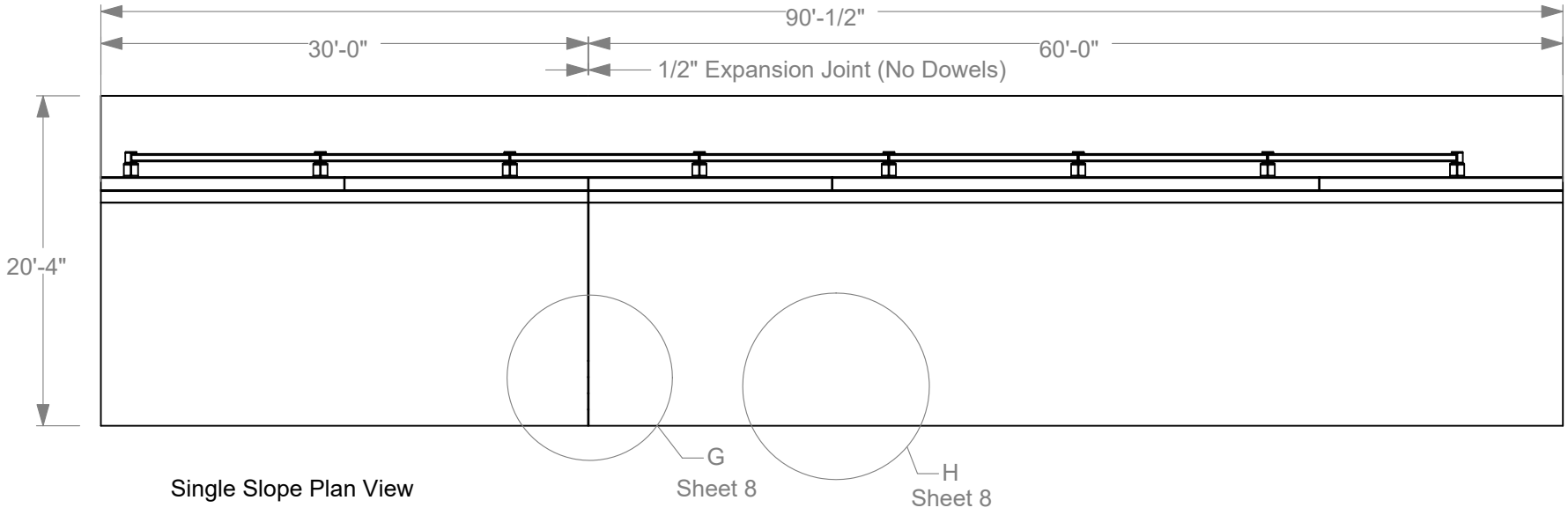
Section B-B
Single Slope



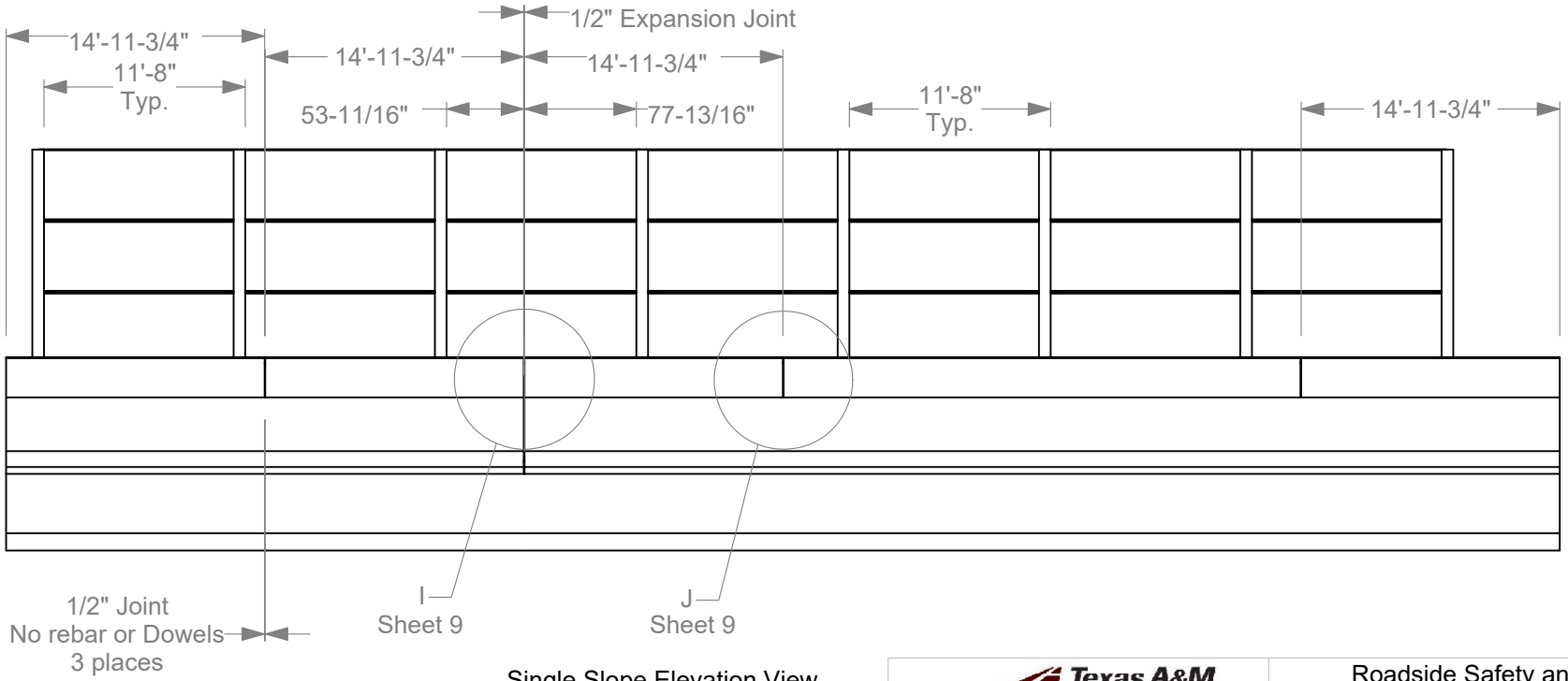
Section F-F

6a. All Rebar is 60 ksi rated
6b. All Epoxy Coated Rebar is designated with (E)

Texas A&M Transportation Institute	Roadside Safety and Physical Security Division - Proving Ground	
Project #690900-ITG FShape and Single Slope		2019-08-22
Drawn by BLG	Scale 1:20	Sheet 6 of 35 Single Slope at Post



Single Slope Plan View

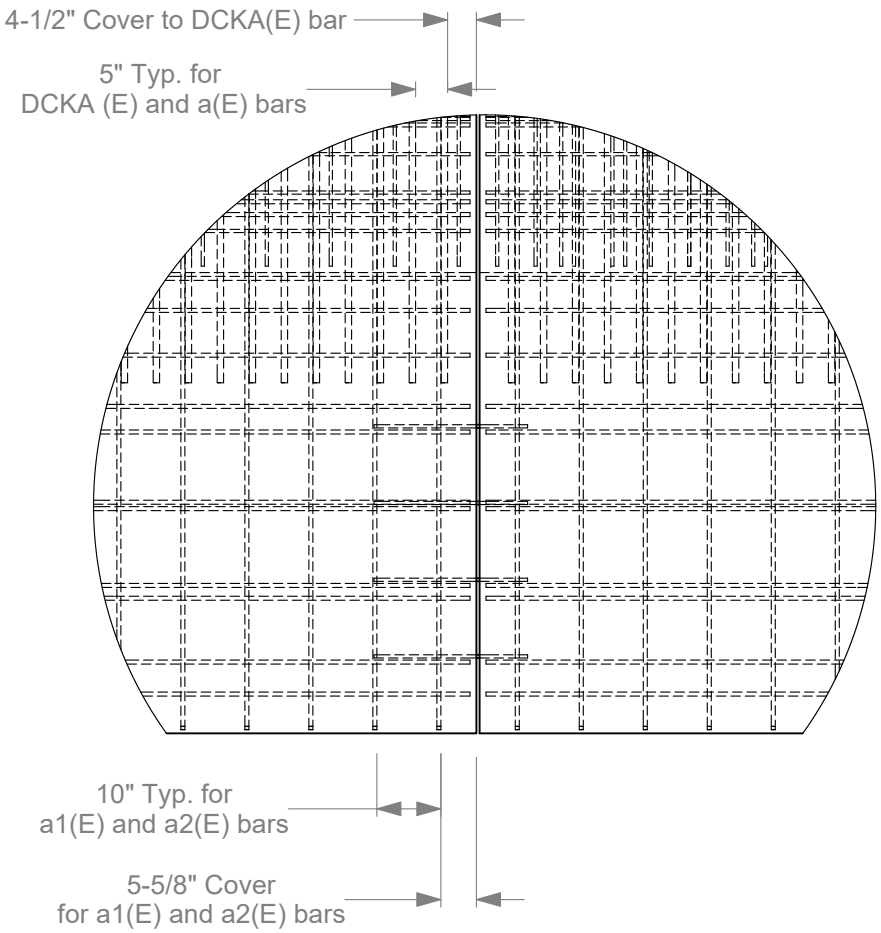


Single Slope Elevation View

Texas A&M Transportation Institute	Roadside Safety and Physical Security Division - Proving Ground	
Project #690900-ITG FShape and Single Slope		2019-08-22
Drawn by BLG	Scale 1:125	Sheet 7 of 35 Single Slope Deck Views

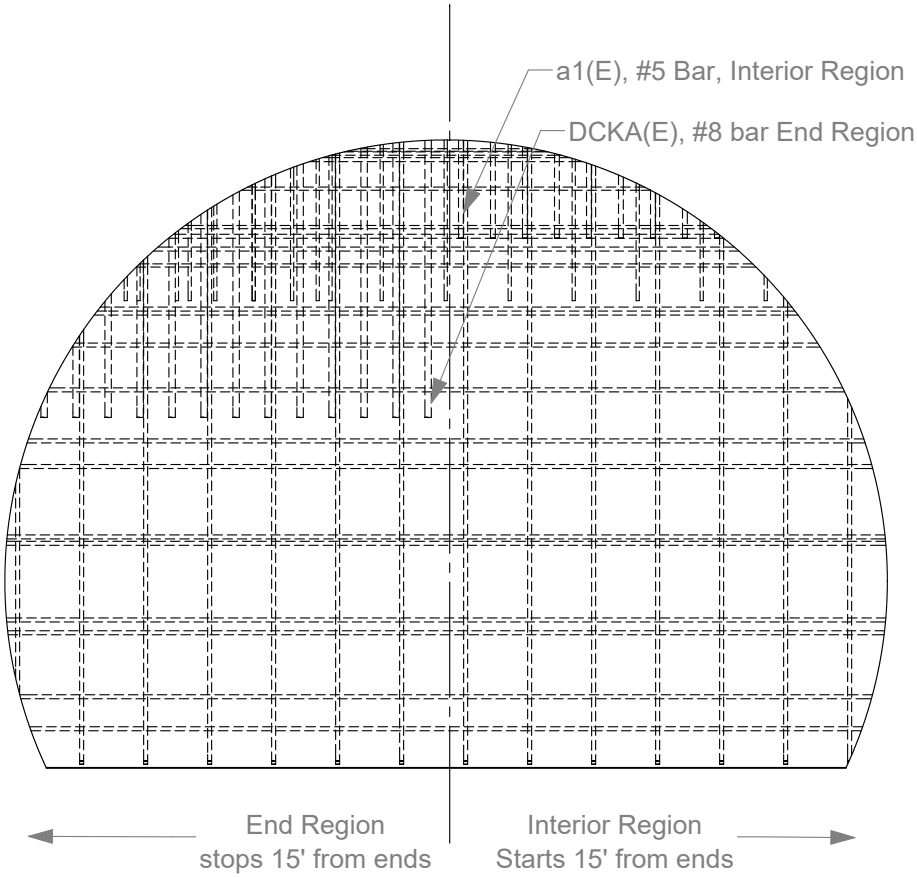
Detail G

Single Slope at
Expansion Joint



Detail H

Single Slope at
End Region transition to Interior Region

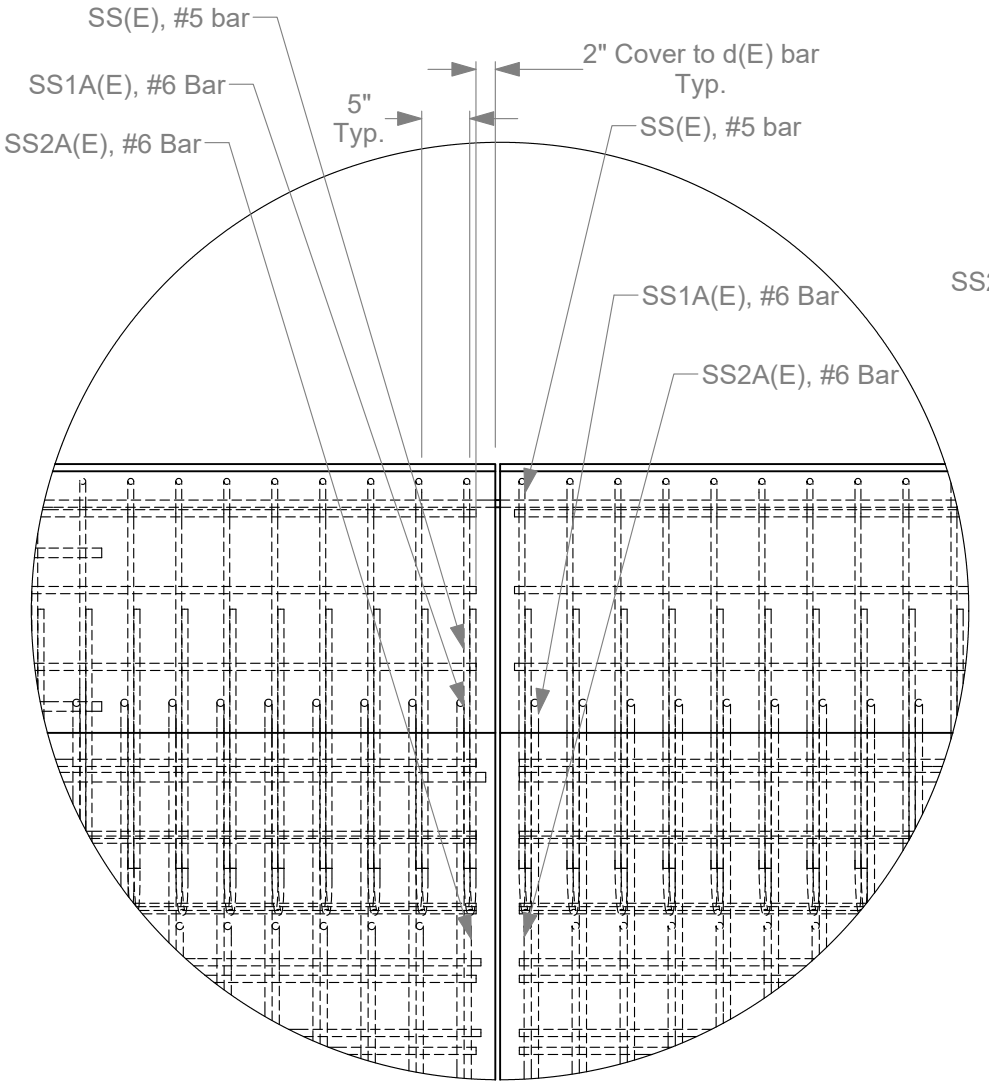


8a. All Rebar is 60 ksi rated
8b. All Epoxy Coated Rebar is designated with (E)

Texas A&M Transportation Institute	Roadside Safety and Physical Security Division - Proving Ground		
Project #690900-ITG FShape and Single Slope			2019-08-22
Drawn by BLG	Scale 1:30	Sheet 8 of 35	SS Deck Rebar Locations

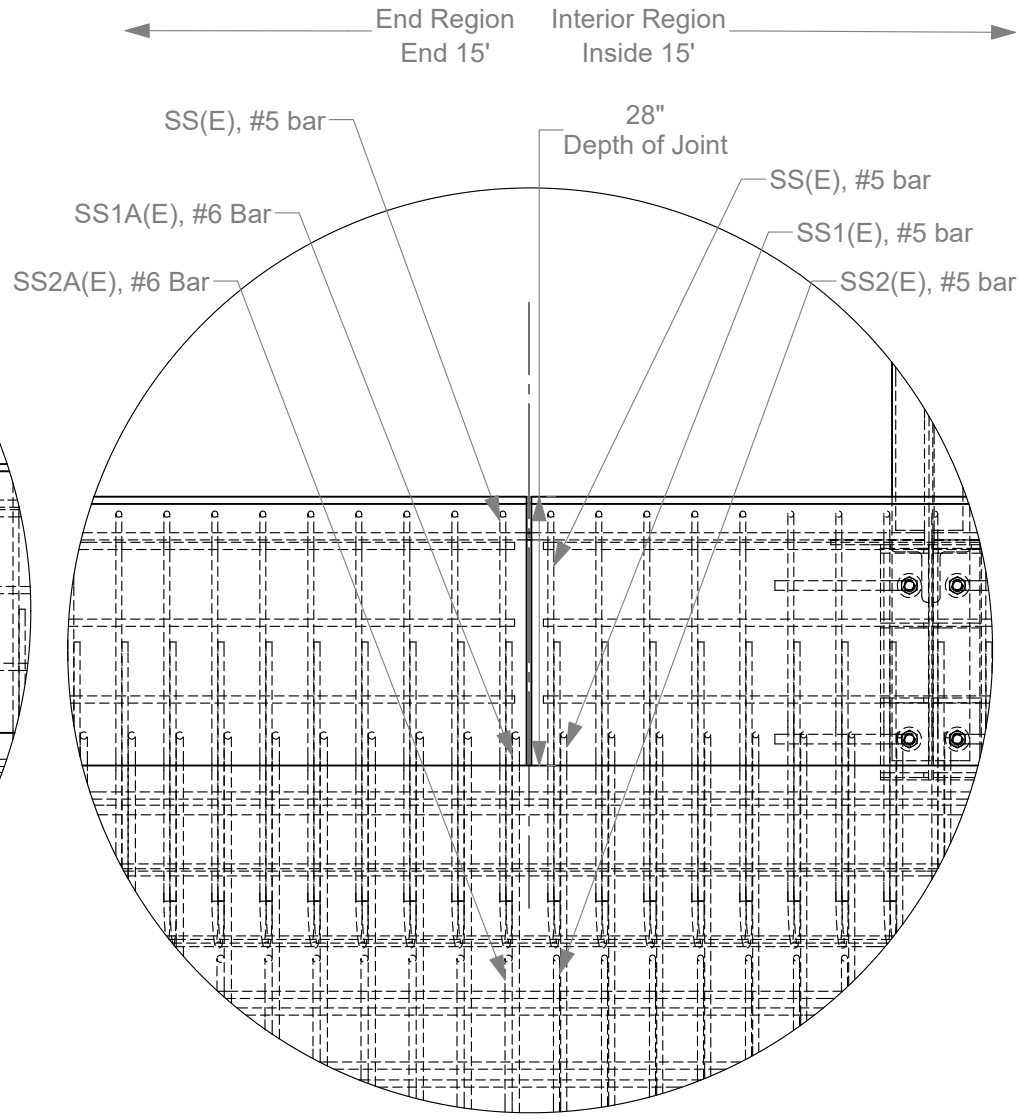
Detail I

Single Slope barrier
at Expansion Joint



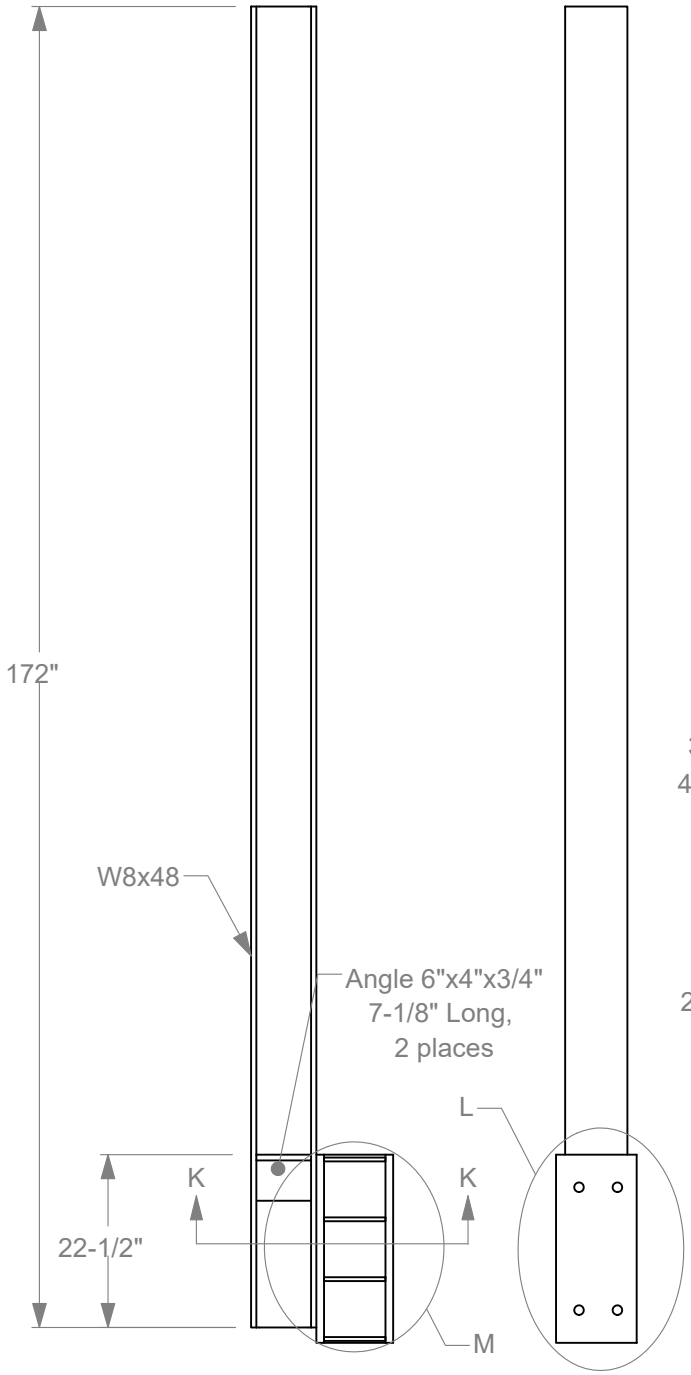
Detail J

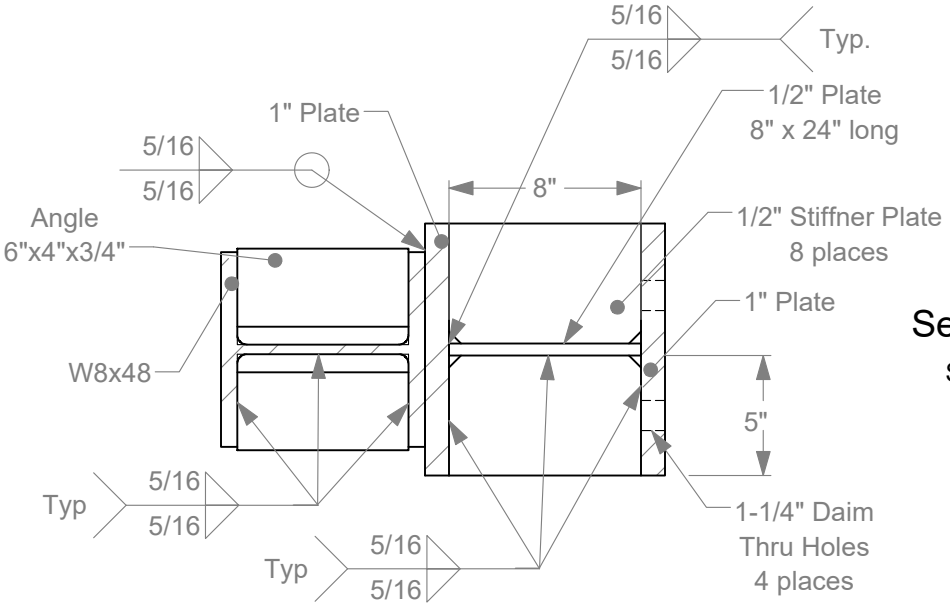
Single Slope Barrier at
end region to
interior region transition



9a. All Rebar is 60 ksi rated
9b. All Epoxy Coated Rebar is designated with (E)

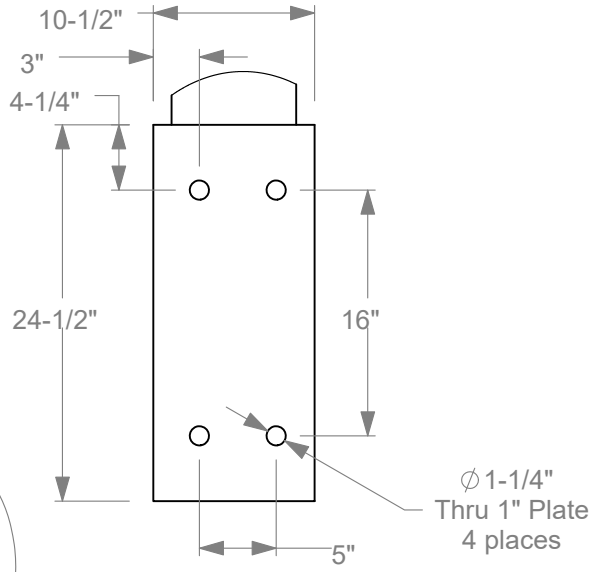
Texas A&M Transportation Institute	Roadside Safety and Physical Security Division - Proving Ground	
Project #690900-ITG FShape and Single Slope		2019-08-22
Drawn by BLG	Scale 1:20	Sheet 9 of 35 SS Barrier Rebar Locations





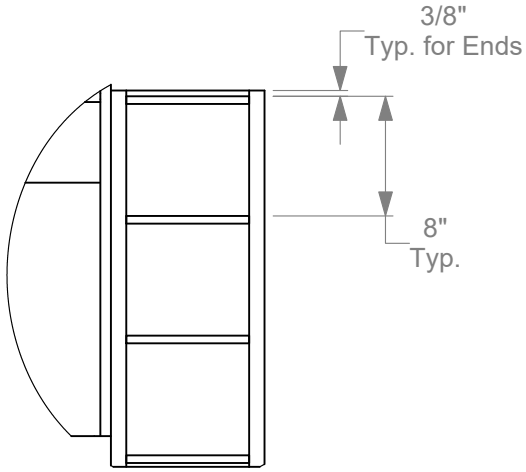
Section K-K

Scale 1 : 8



Detail L

Scale 2 : 25

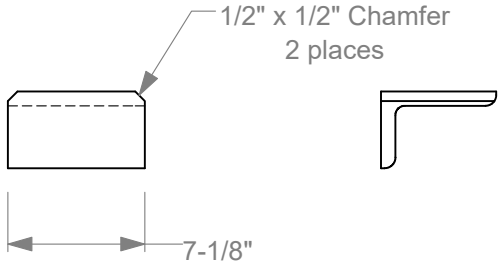


Detail M

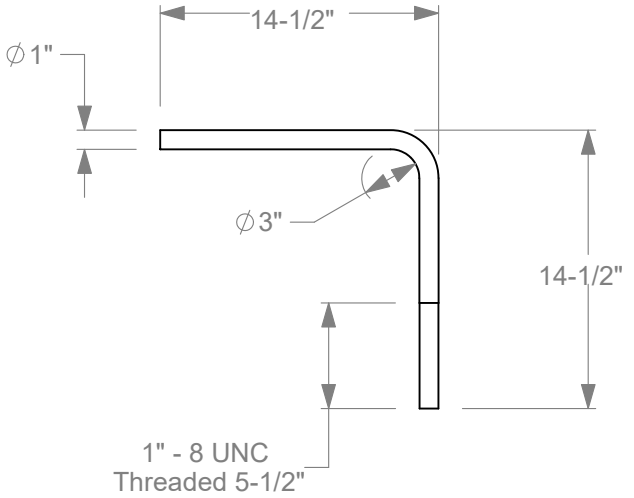
Scale 2 : 25

10a. All Steel plate, beams and angles shall be A36 (minimum 36 ksi yield) material

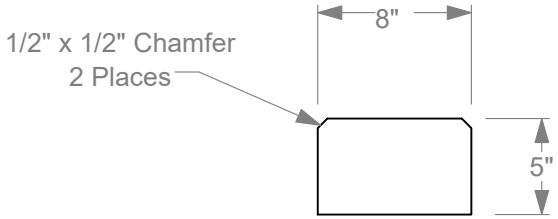
Texas A&M Transportation Institute	Roadside Safety and Physical Security Division - Proving Ground	
Project #690900-ITG FShape and Single Slope		2019-08-22
Drawn by BLG	Scale 1:25	Sheet 10 of 35 SS NAW Post Details



Angle, 6"x4"x3/4"
2 needed per post



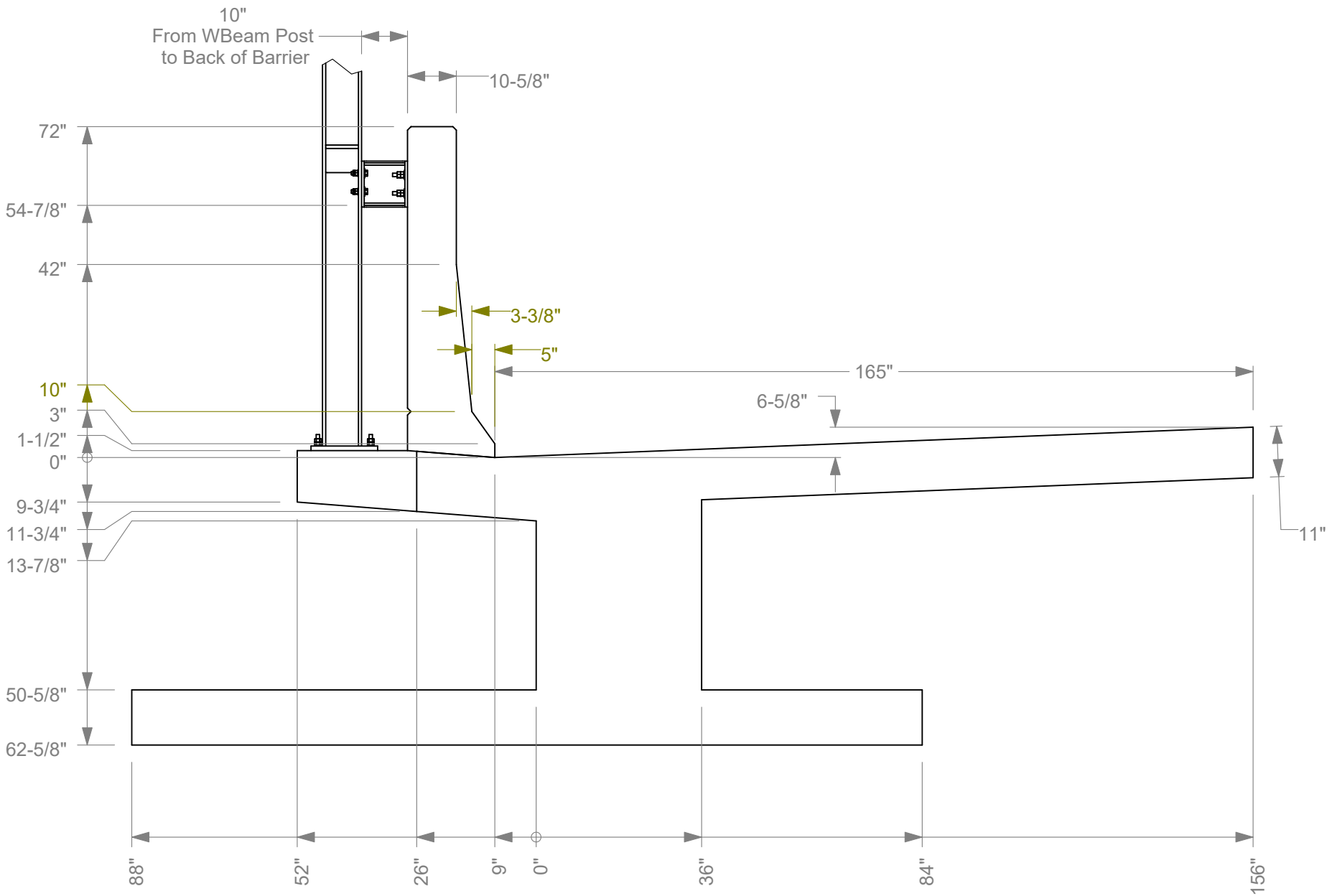
Custom Right Angle Anchor
F1554 Grd 105
4 needed per post



Stiffner Plate, 1/2" thick
8 needed per post

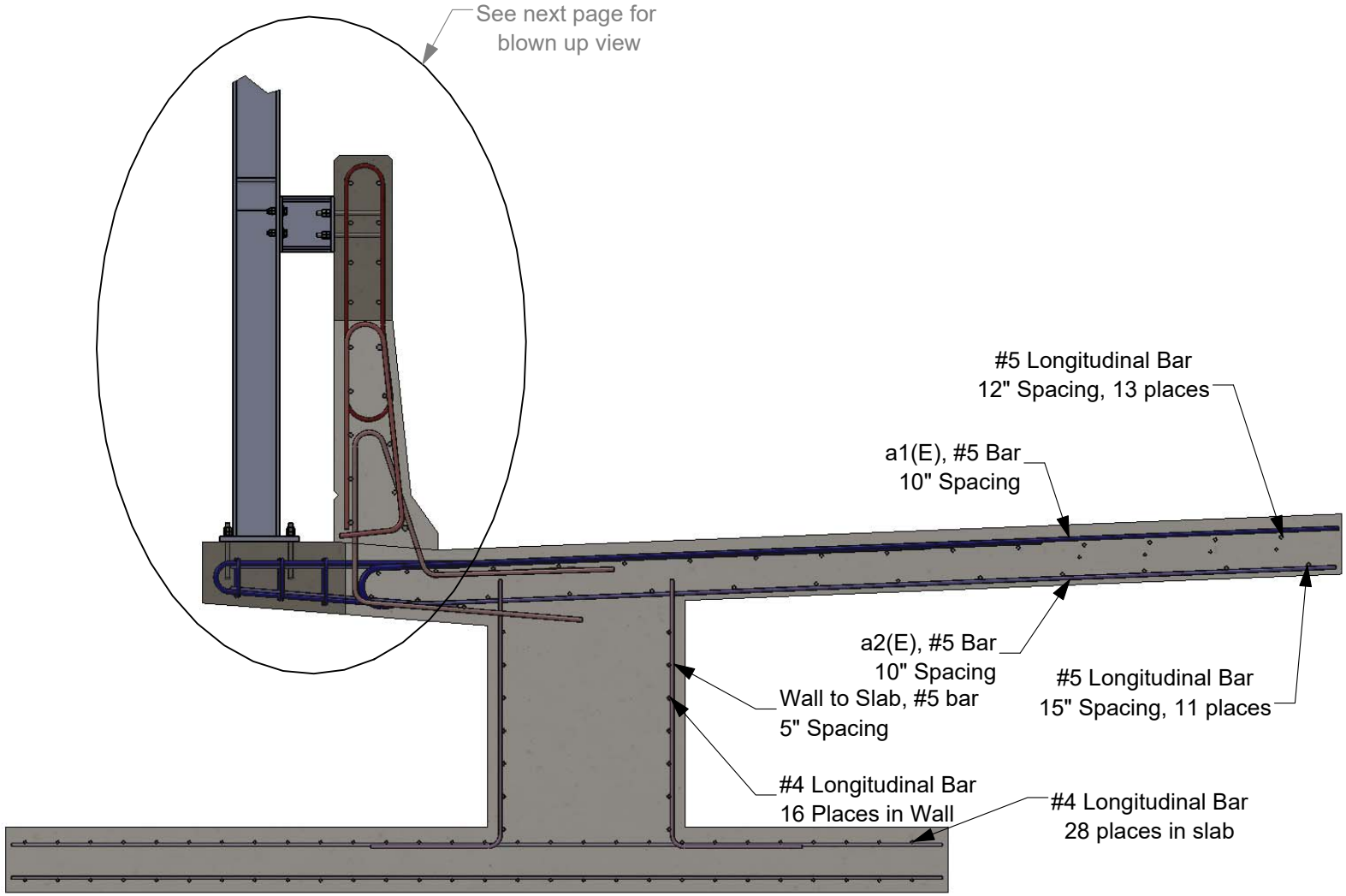
11a. All Steel plate, beams and angles shall be A36 (minimum 36 ksi yield) material

Texas A&M Transportation Institute	Roadside Safety and Physical Security Division - Proving Ground		
Project #690900-ITG FShape and Single Slope			2019-08-22
Drawn by BLG	Scale 1:10	Sheet 11 of 35 SS Post Build Up Details	



End View
F-Shape

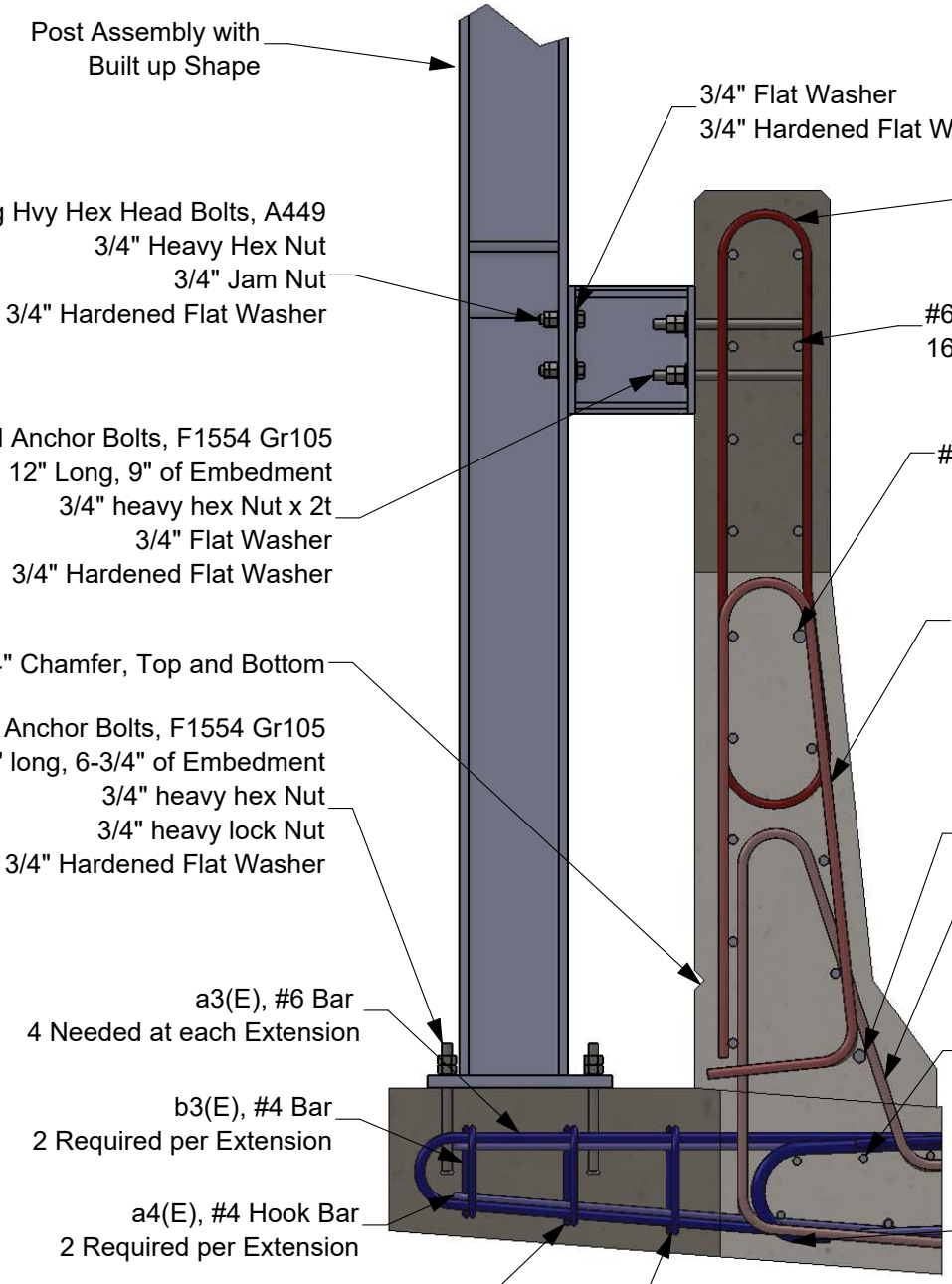
Texas A&M Transportation Institute	Roadside Safety and Physical Security Division - Proving Ground	
Project #690900-ITG FShape and Single Slope		2019-08-22
Drawn by BLG	Scale 1:30	Sheet 12 of 35 FShape End View



End View
F-Shape

13a. All Rebar is 60 ksi rated
13b. All Epoxy Coated Rebar is designated with (E)

Texas A&M Transportation Institute	Roadside Safety and Physical Security Division - Proving Ground	
Project #690900-ITG FShape and Single Slope		2019-08-22
Drawn by BLG	Scale 1:30	Sheet 13 of 35 FShape bar Callout



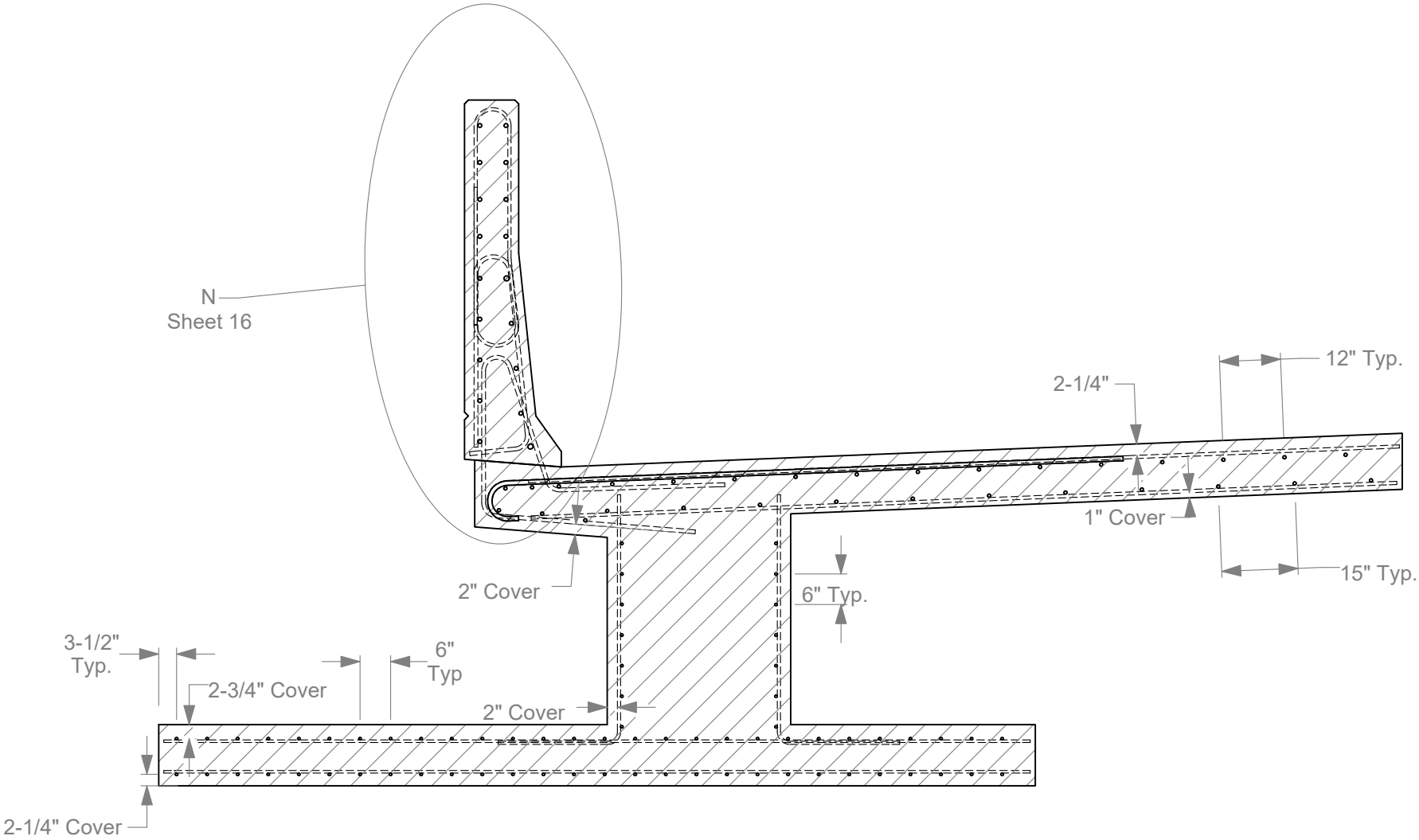
End View
F-Shape

14a. All Rebar is 60 ksi rated
14b. All Epoxy Coated Rebar is designated with (E)

Texas A&M Transportation Institute

Roadside Safety and Physical Security Division - Proving Ground

Project #690900-ITG FShape and Single Slope		2019-08-22
Drawn by BLG	Scale 1:15	Sheet 14 of 35 FShape bar Callout, 2

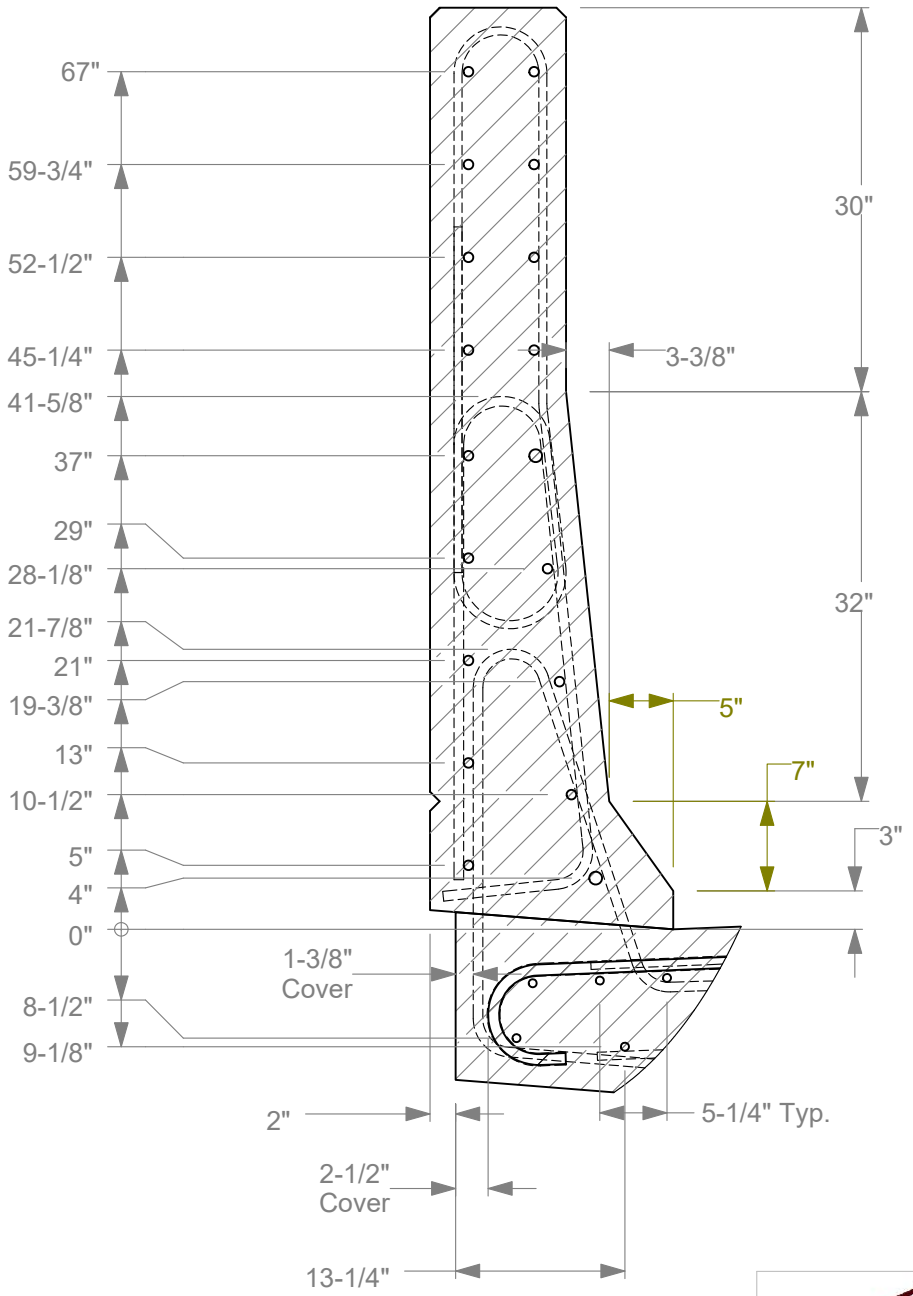


Section C-C

F-Shape at Extension

15a. All Rebar is 60 ksi rated
15b. All Epoxy Coated Rebar is designated with (E)

Texas A&M Transportation Institute		Roadside Safety and Physical Security Division - Proving Ground	
Project #690900-ITG FShape and Single Slope			2019-08-22
Drawn by BLG	Scale 1:30	Sheet 15 of 35 FShape bar Location	

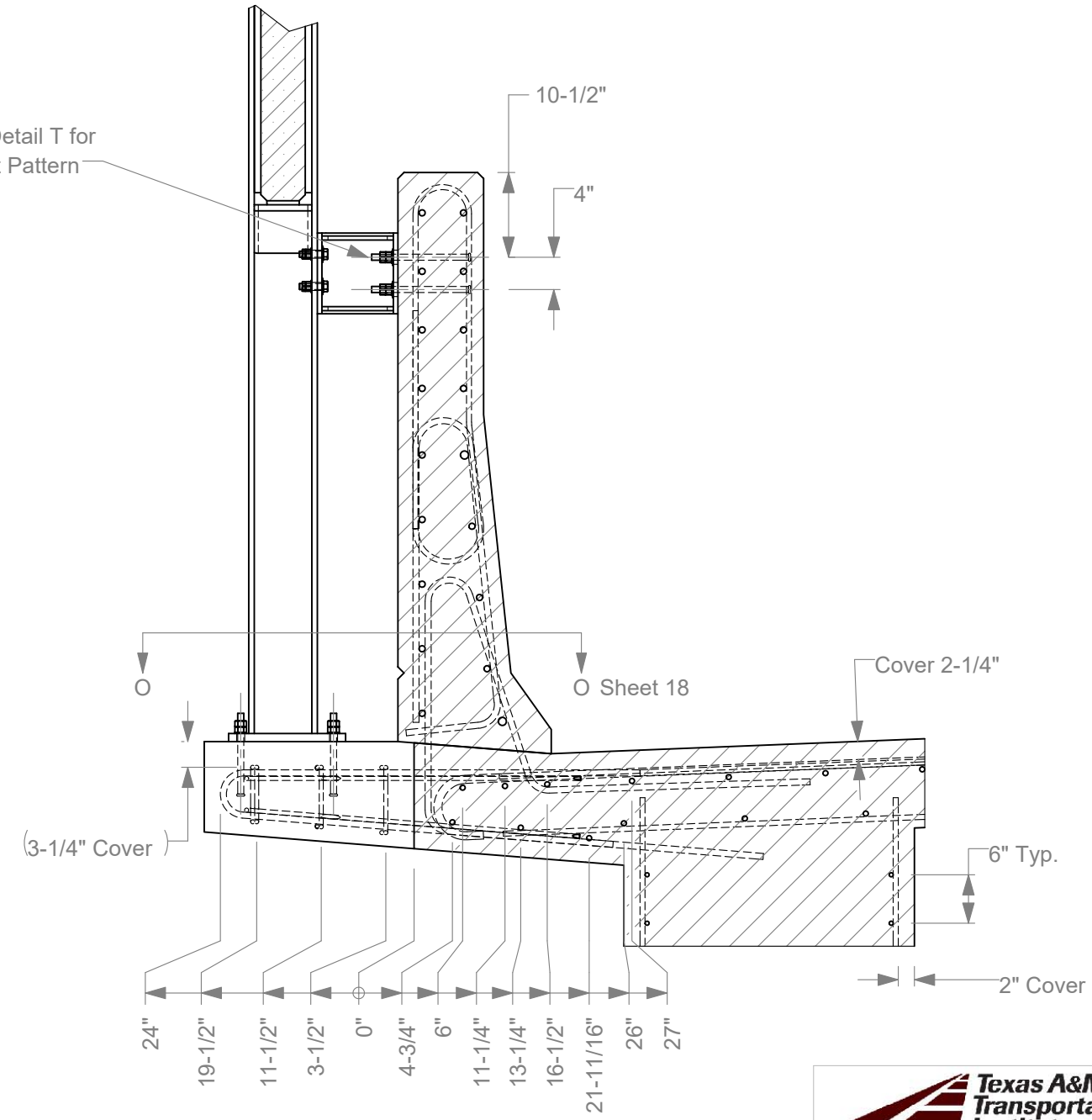


Detail N

Scale 1 : 15

16a. All Rebar is 60 ksi rated
16b. All Epoxy Coated Rebar is designated with (E)

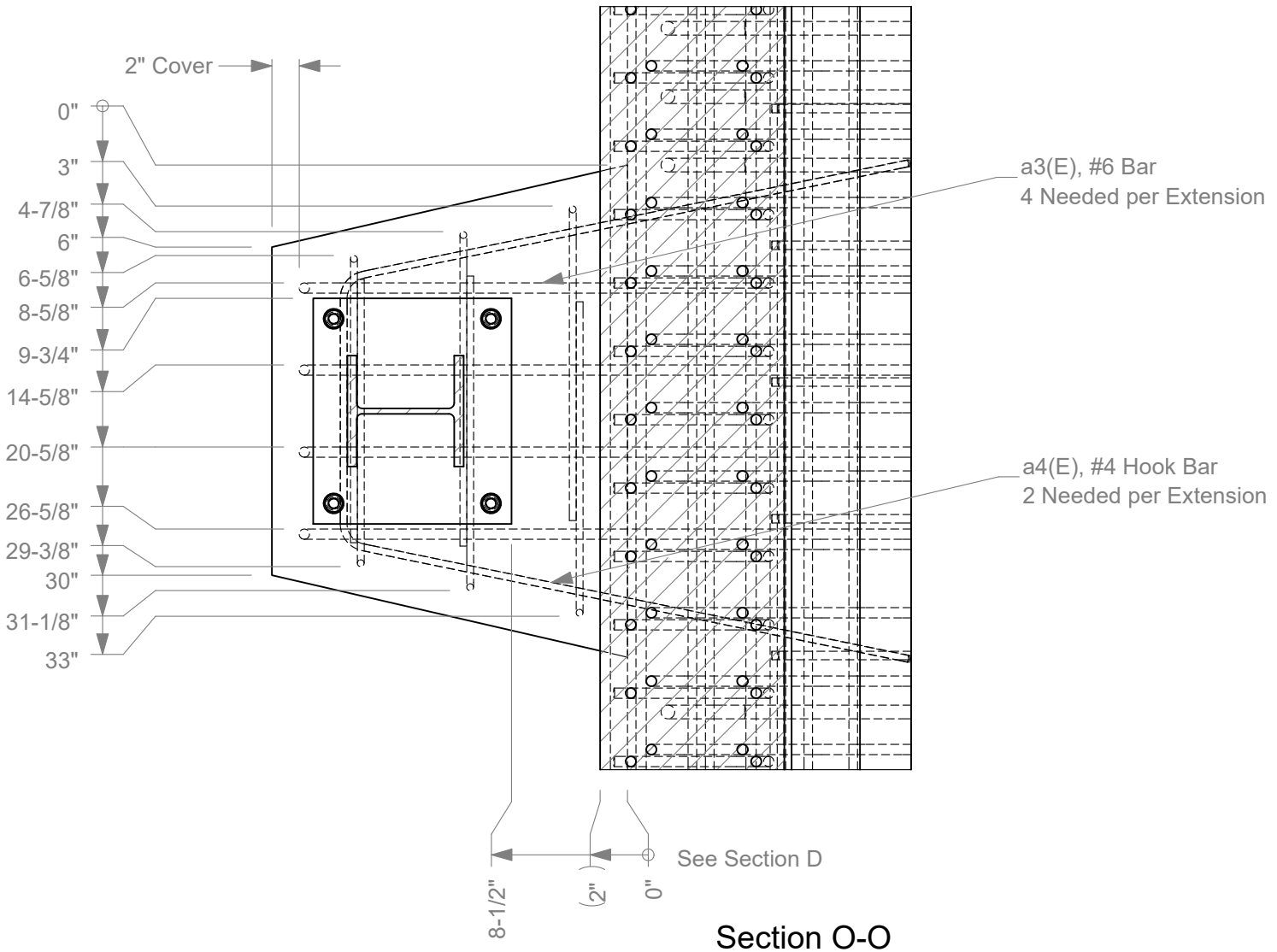
Texas A&M Transportation Institute	Roadside Safety and Physical Security Division - Proving Ground		
Project #690900-ITG FShape and Single Slope			2019-08-22
Drawn by BLG	Scale 1:30	Sheet 16 of 35 FShape bar Location, 2	



Section D-D

17a. All Rebar is 60 ksi rated
17b. All Epoxy Coated Rebar is designated with (E)

Texas A&M Transportation Institute	Roadside Safety and Physical Security Division - Proving Ground		
Project #690900-ITG FShape and Single Slope			2019-08-22
Drawn by BLG	Scale 1:20	Sheet 17 of 35 FShape Ext. Rebar Loc.	



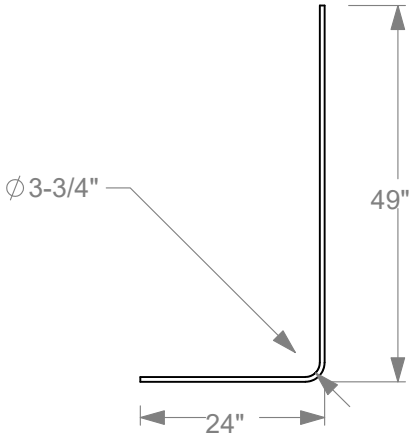
Section O-O

Texas A&M Transportation Institute	Roadside Safety and Physical Security Division - Proving Ground	
Project #690900-ITG FShape and Single Slope		2019-08-22
Drawn by BLG	Scale 1:12	Sheet 18 of 35 FShape Extension Detail

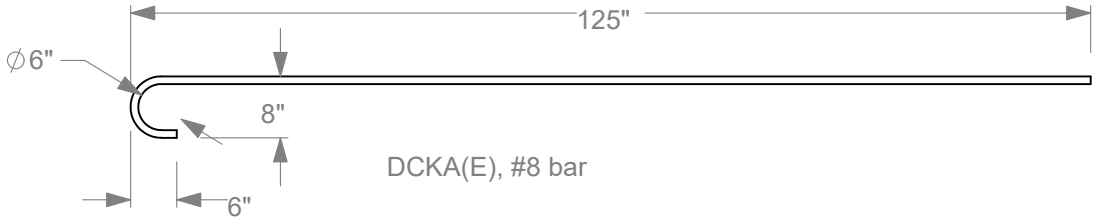
a1(E), #5 Bar

a2(E), #5 Bar

DCK(E), #6 Bar



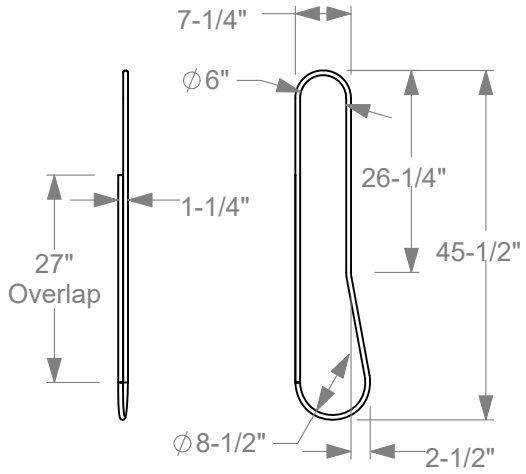
Wall to Slab, #5 bar



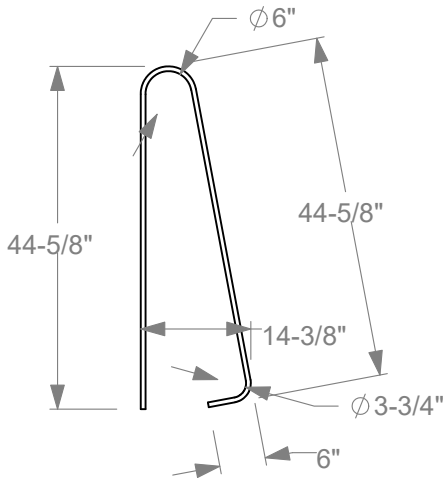
DCKA(E), #8 bar

19a. All Rebar is 60 ksi rated
19b. All Epoxy Coated Rebar is designated with (E)

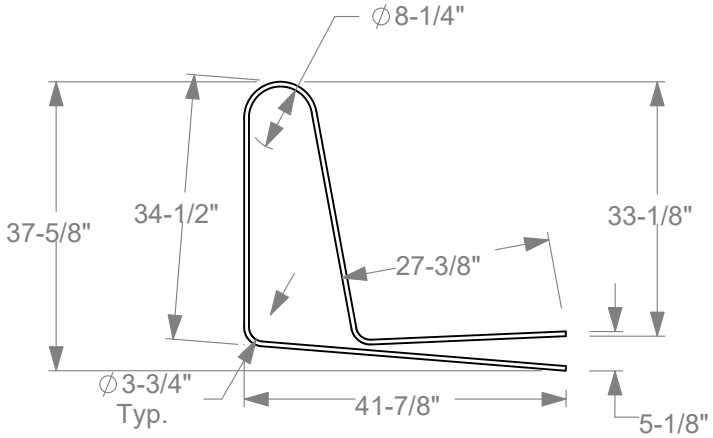
Texas A&M Transportation Institute	Roadside Safety and Physical Security Division - Proving Ground	
Project #690900-ITG FShape and Single Slope		2019-08-22
Drawn by BLG	Scale 1:25	Sheet 19 of 35 Deck Rebar Details



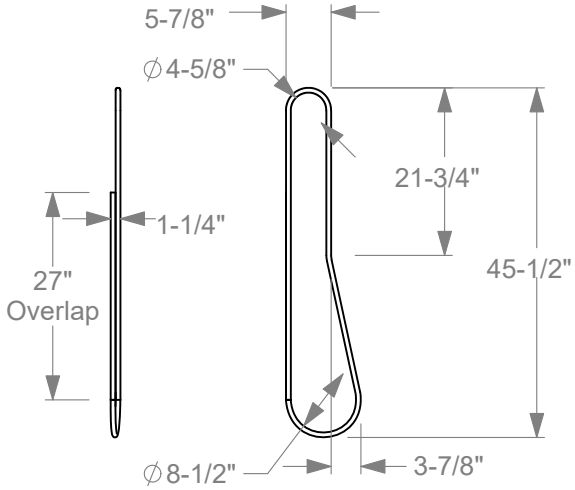
SS(E), #5 bar



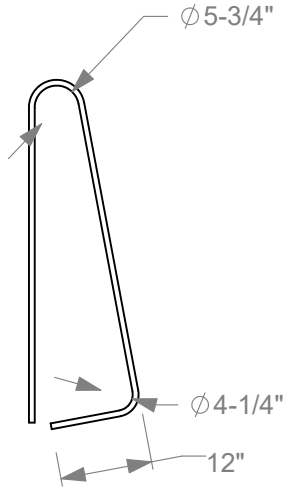
SS1(E), #5 bar
Interiors



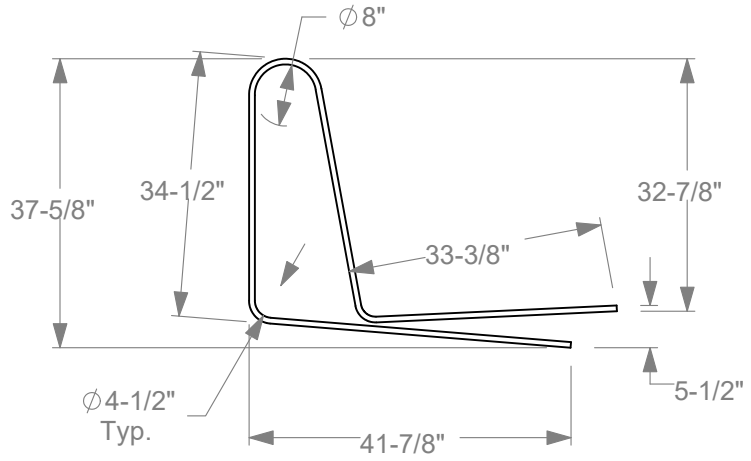
SS2(E), #5 bar
Interiors



SSA(E), #5 bar



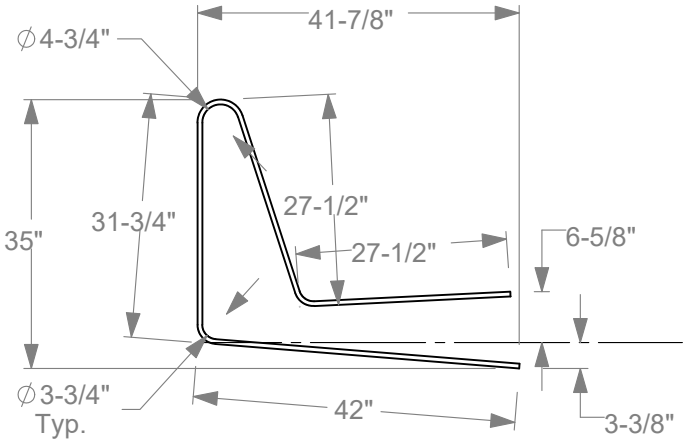
SS1A(E), #6 Bar
Ends
Only difference is
Rebar size and dimensions shown



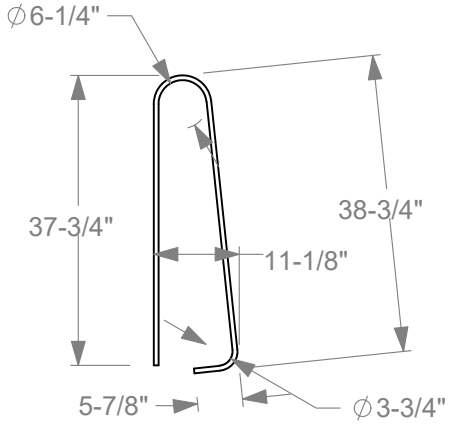
SS2A(E), #6 Bar
Ends

20a. All Rebar is 60 ksi rated
20b. All Epoxy Coated Rebar is designated with (E)

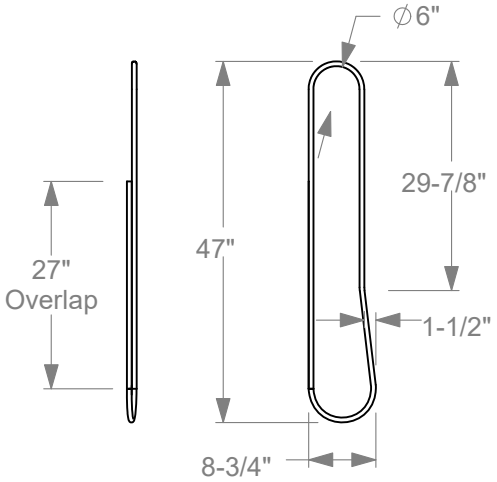
Texas A&M Transportation Institute	Roadside Safety and Physical Security Division - Proving Ground	
Project #690900-ITG FShape and Single Slope		2019-08-22
Drawn by BLG	Scale 1:25	Sheet 20 of 35 Single Slope Rebar



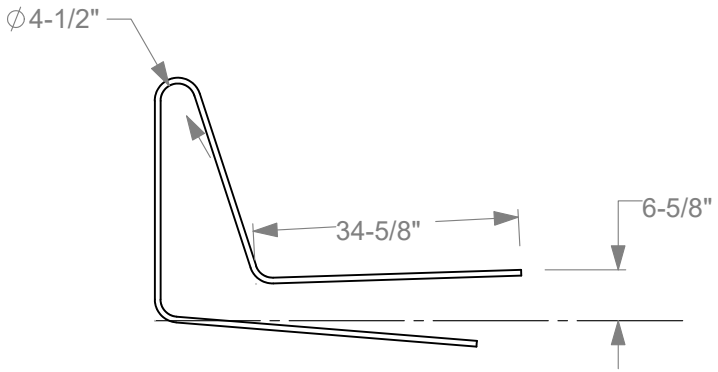
FS2(E), #5 bar
Interior for F-Shape



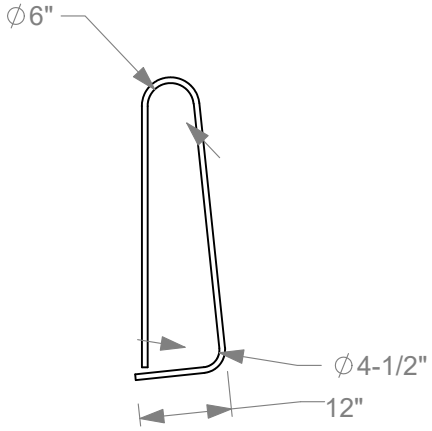
FS1(E), #6 bar
Interior for F-Shape



FS(E), #5 bar
for F-Shape



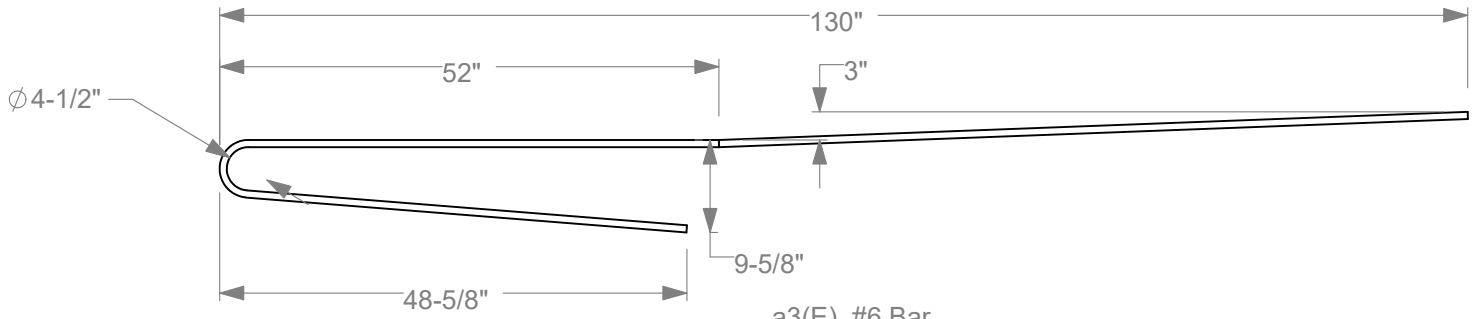
FSA2(E), #6 bar
for F-Shape, Ends
All other Dimensions similar to FS2(E) above



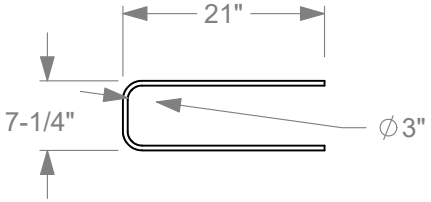
FSA1(E), #6 bar
For F-Shape, Ends
All other Dimensions similar to FS1(E) above

21a. All Rebar is 60 ksi rated
21b. All Epoxy Coated Rebar is designated with (E)

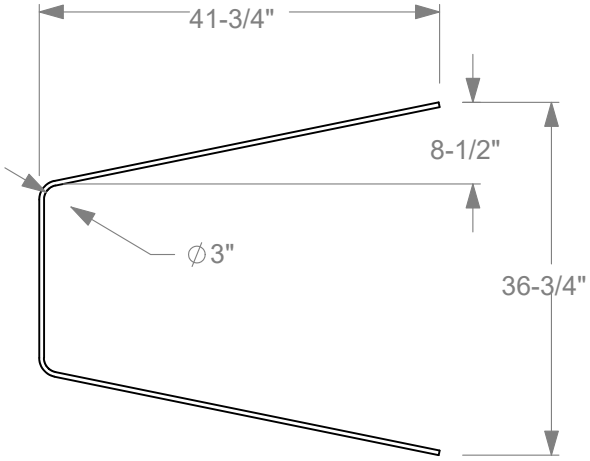
Texas A&M Transportation Institute	Roadside Safety and Physical Security Division - Proving Ground	
Project #690900-ITG FShape and Single Slope		2019-08-22
Drawn by BLG	Scale 1:25	Sheet 21 of 35 FShape Rebar



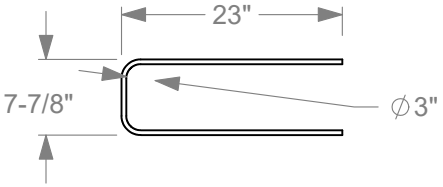
a3(E), #6 Bar



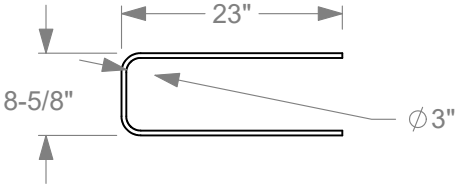
b3(E), #4 Bar



a4(E), #4 Hook Bar



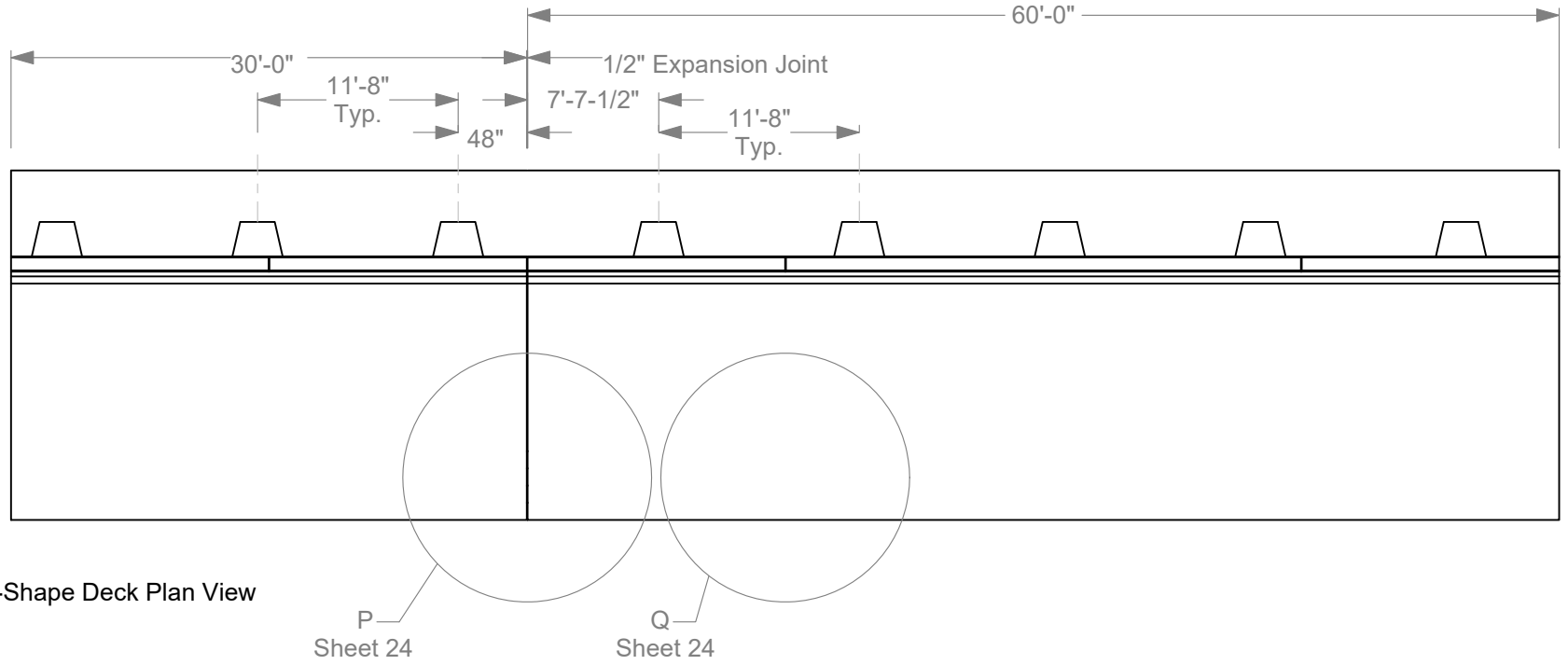
b4(E), #4 Bar



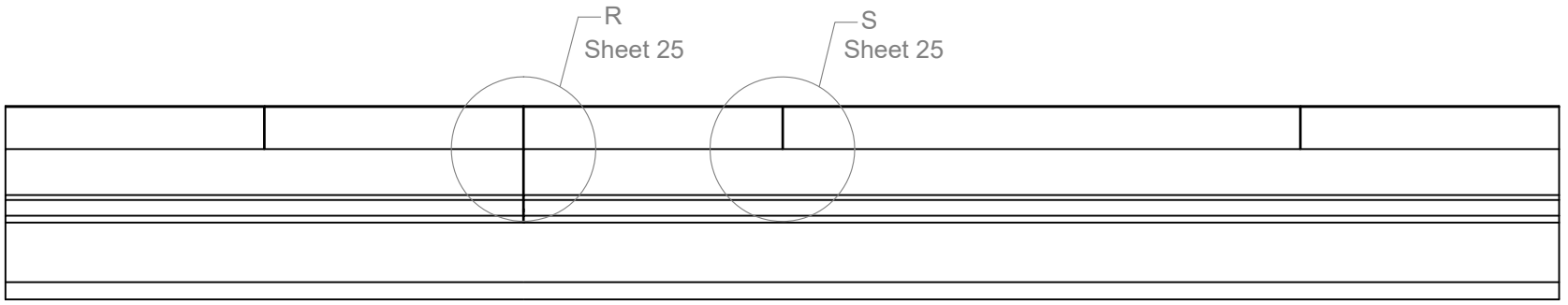
b5(E), #4 Bar

22a. All Rebar is 60 ksi rated
22b. All Epoxy Coated Rebar is designated with (E)

Texas A&M Transportation Institute	Roadside Safety and Physical Security Division - Proving Ground		
Project #690900-ITG FShape and Single Slope			2019-08-22
Drawn by BLG	Scale 1:20	Sheet 22 of 35 FShape Extension Rebar	

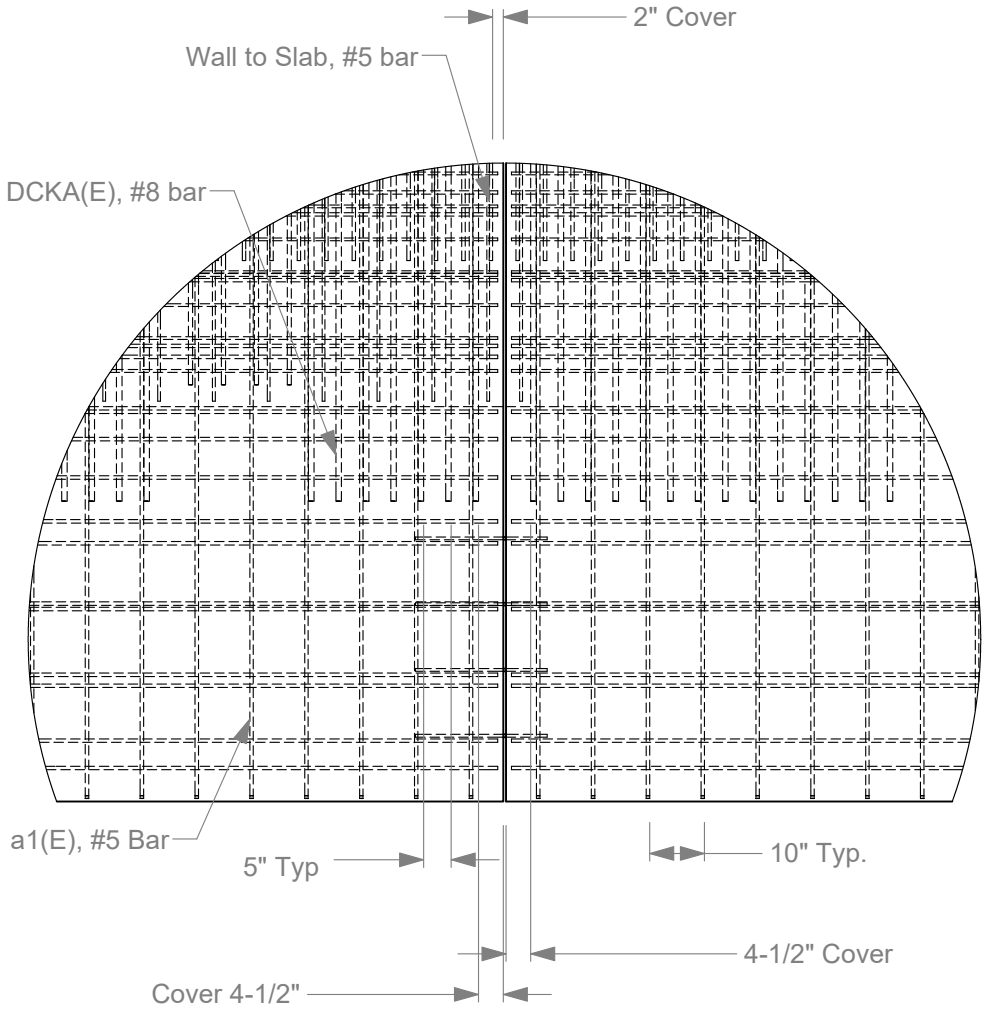


F-Shape Deck Plan View



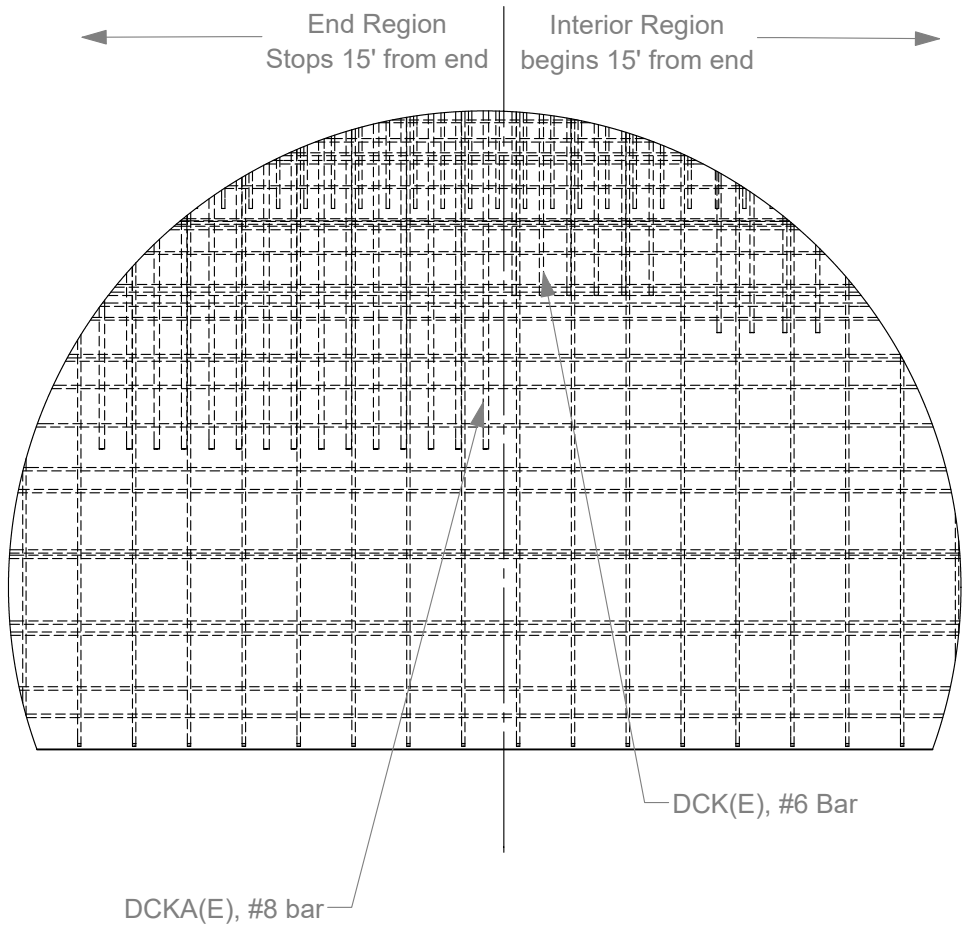
F-Shape Deck Elevation View

Texas A&M Transportation Institute	Roadside Safety and Physical Security Division - Proving Ground	
Project #690900-ITG FShape and Single Slope		2019-08-22
Drawn by BLG	Scale 1:125	Sheet 23 of 35 FShape Deck Views



Detail P

Deck Expansion Joint

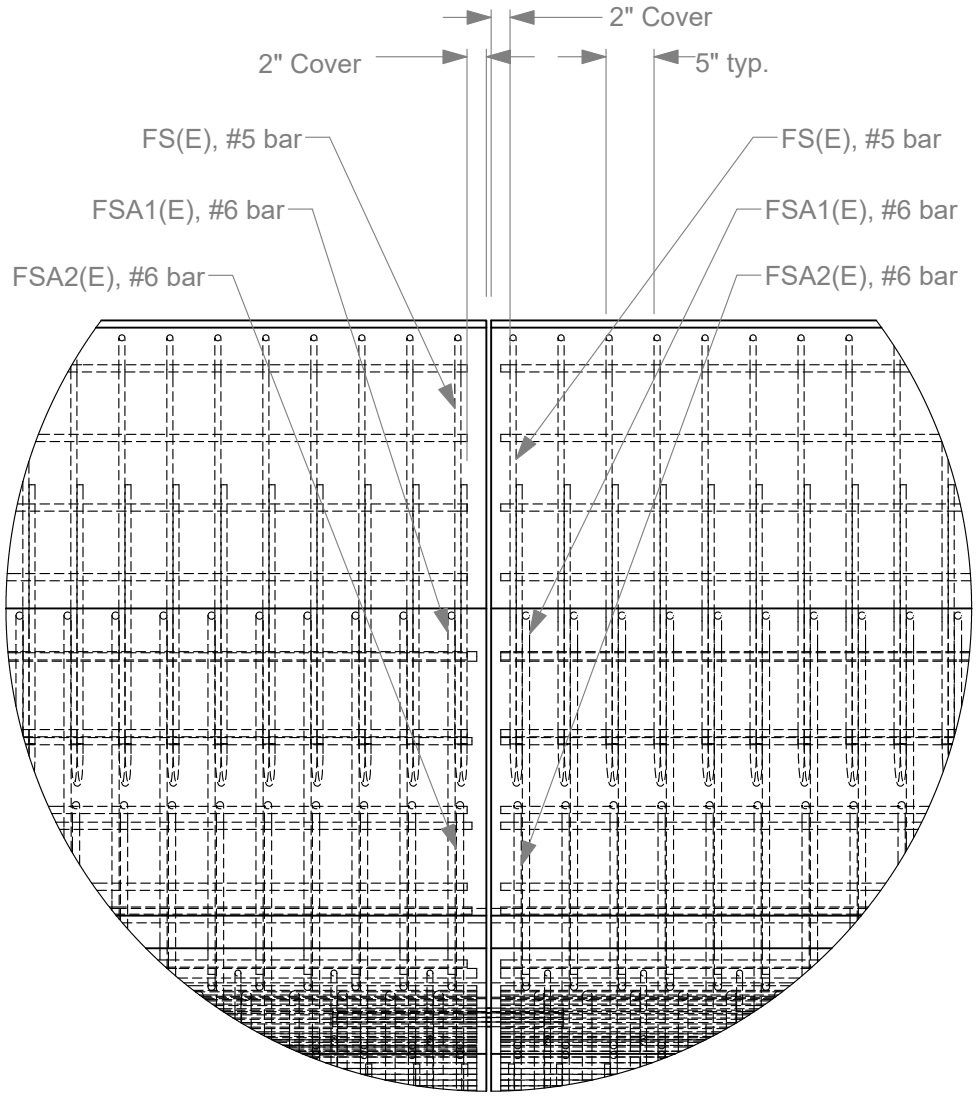


Detail Q

Deck End to Interior Region Transition

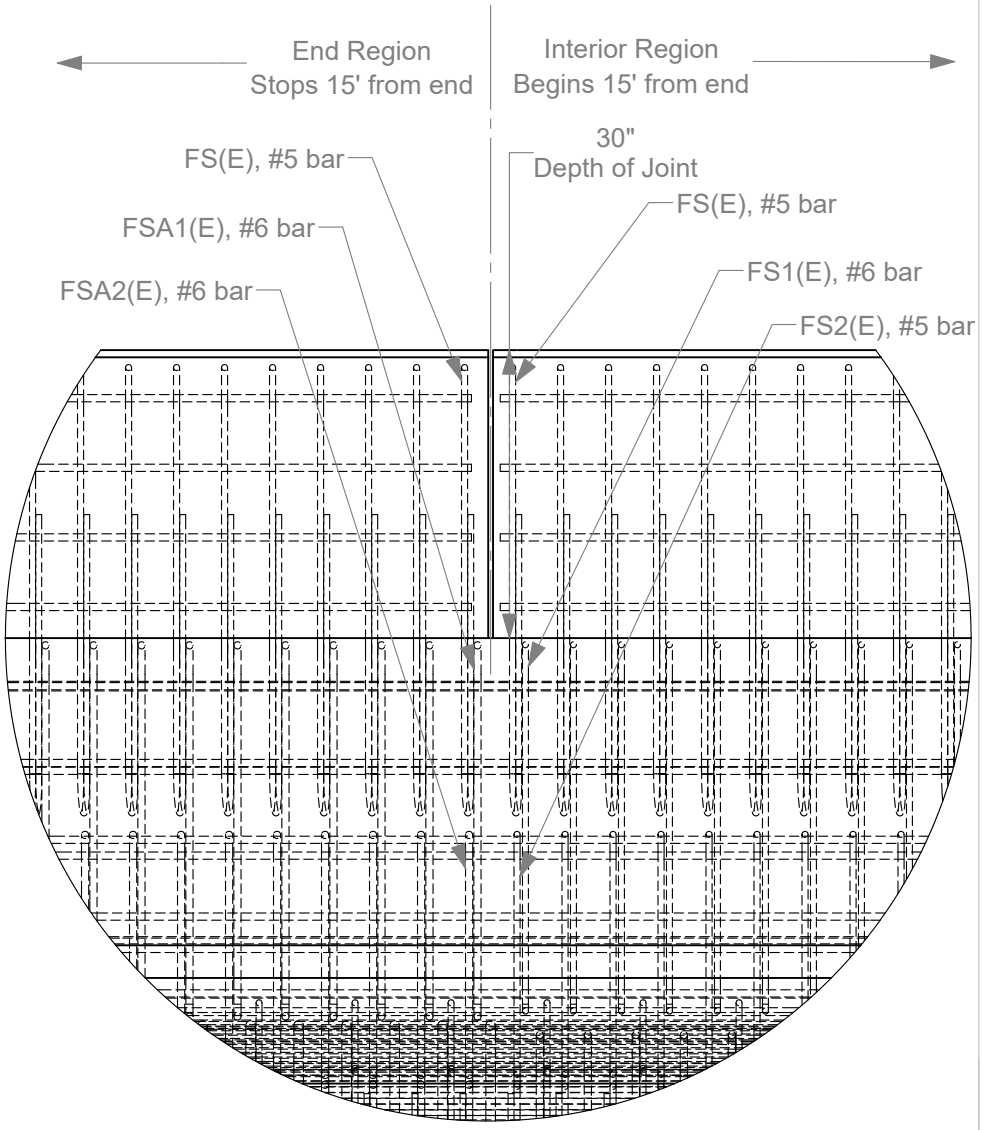
24a. All Rebar is 60 ksi rated
24b. All Epoxy Coated Rebar is designated with (E)

Texas A&M Transportation Institute	Roadside Safety and Physical Security Division - Proving Ground	
Project #690900-ITG FShape and Single Slope		2019-08-22
Drawn by BLG	Scale 1:35	Sheet 24 of 35 FShape Deck Detail



Detail R

Barrier at Expansion Joint

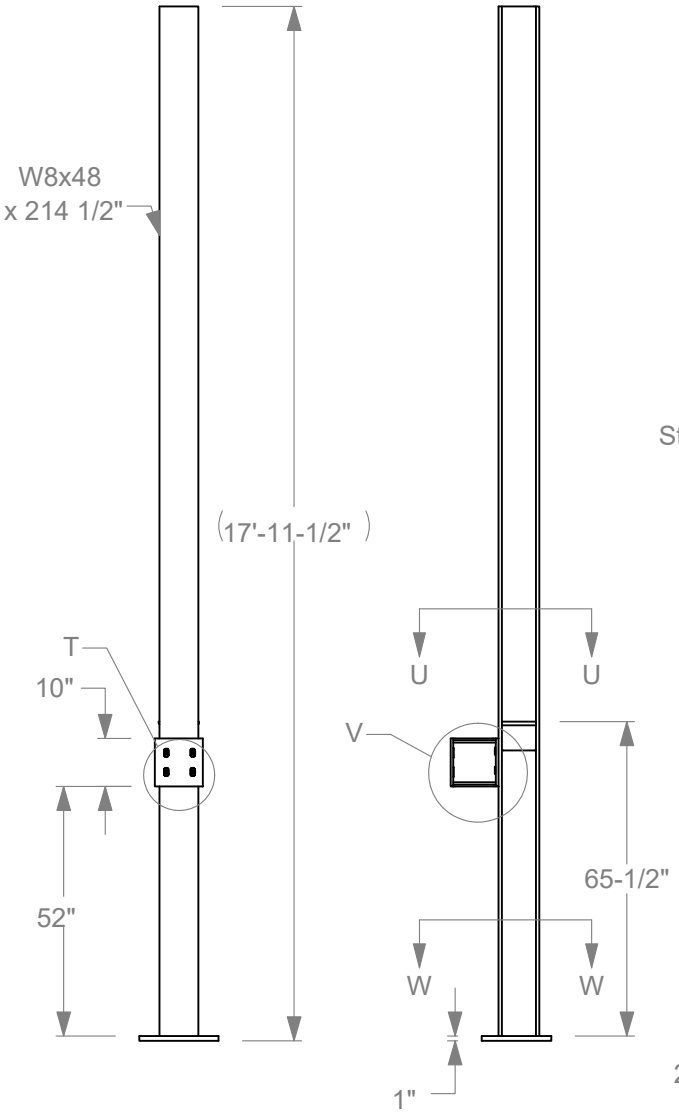


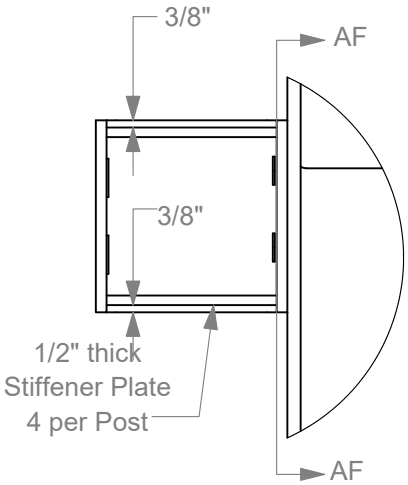
Detail S

Barrier End to Interior Region Transition

25a. All Rebar is 60 ksi rated
25b. All Epoxy Coated Rebar is designated with (E)

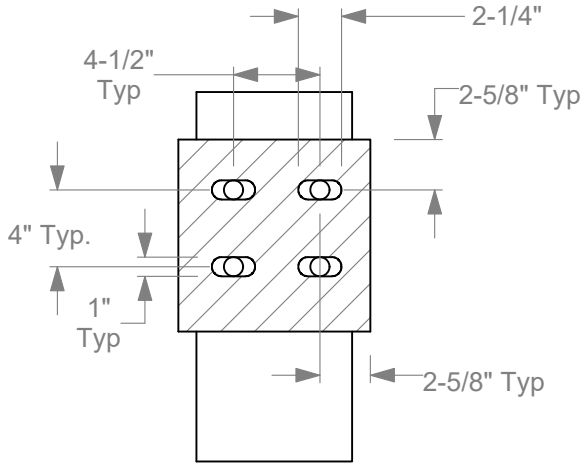
Texas A&M Transportation Institute		Roadside Safety and Physical Security Division - Proving Ground	
Project #690900-ITG FShape and Single Slope			2019-08-22
Drawn by BLG	Scale 1:20	Sheet 25 of 35 FShape Barrier Detail	





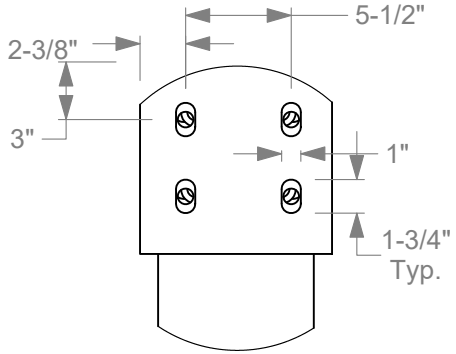
Detail V

Scale 1 : 10



Section AF-AF

Scale 1 : 10

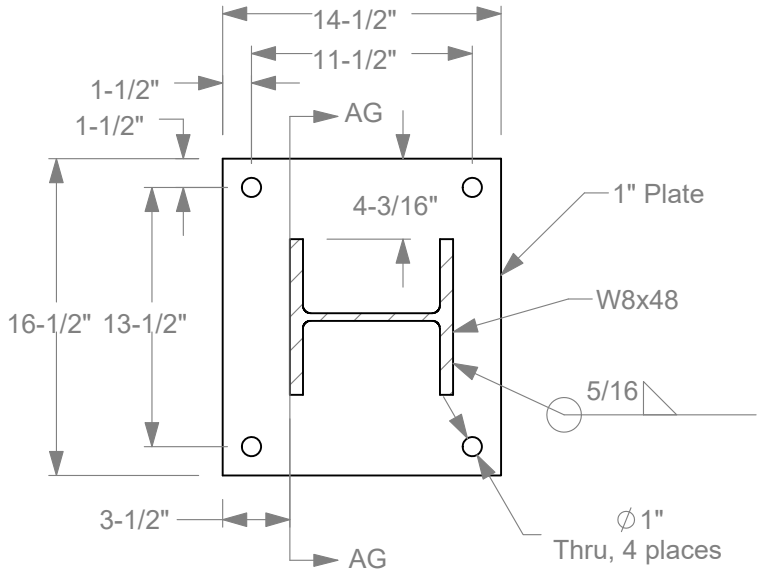


Detail T

Scale 1 : 10

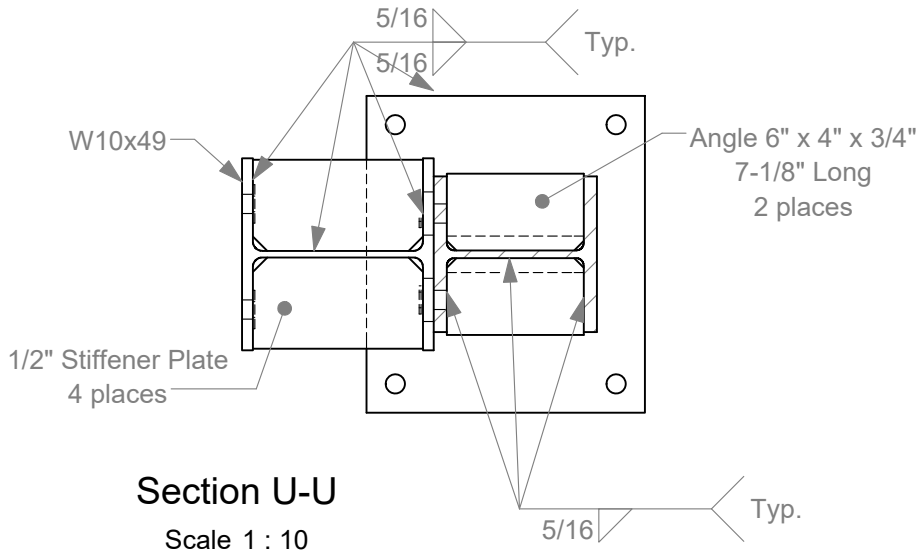
26a. All Steel plate, beams and angles shall be A36 (minimum 36 ksi yield) material

Texas A&M Transportation Institute	Roadside Safety and Physical Security Division - Proving Ground		
Project #690900-ITG FShape and Single Slope			2019-08-22
Drawn by BLG	Scale 1:40	Sheet 26 of 35 FShape NAW Post Details	



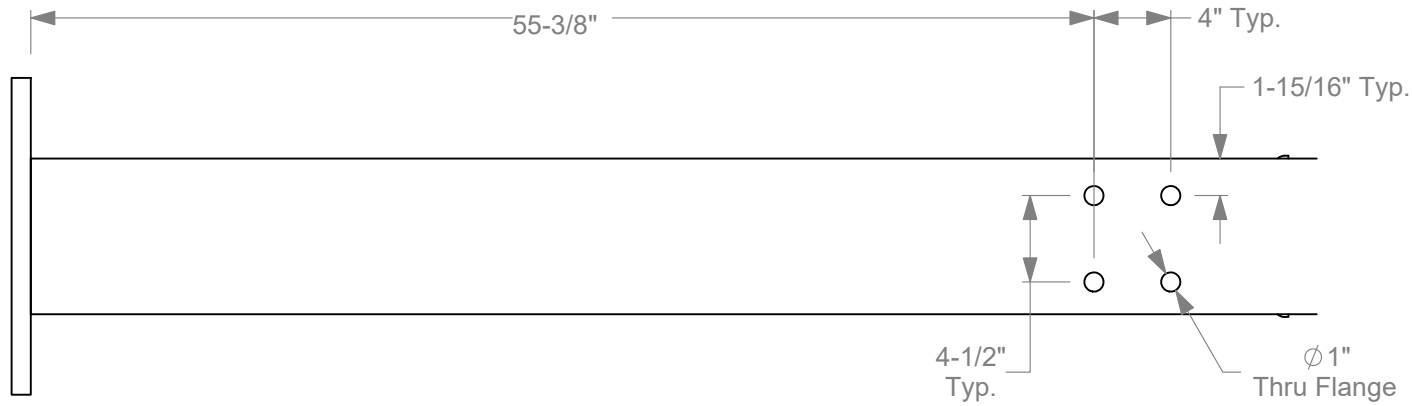
Section W-W

Scale 1 : 10



Section U-U

Scale 1 : 10

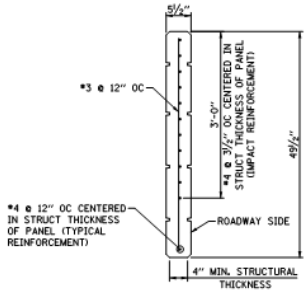


Section AG-AG

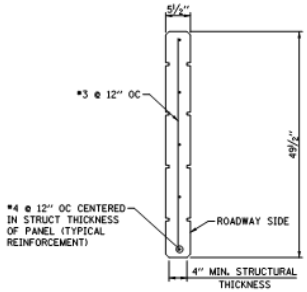
Scale 1 : 10

27a. All Steel plate, beams and angles shall be A36 (minimum 36 ksi yield) material

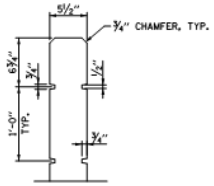
Texas A&M Transportation Institute	Roadside Safety and Physical Security Division - Proving Ground	
Project #690900-ITG FShape and Single Slope		2019-08-22
Drawn by BLG	Scale 1:40	Sheet 27 of 35 FShape NAW Post 2



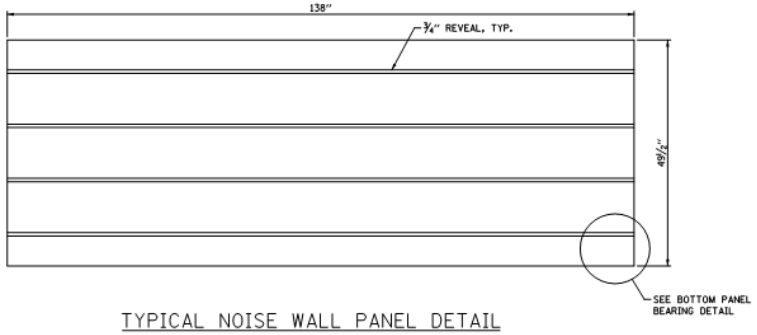
TOP PANEL



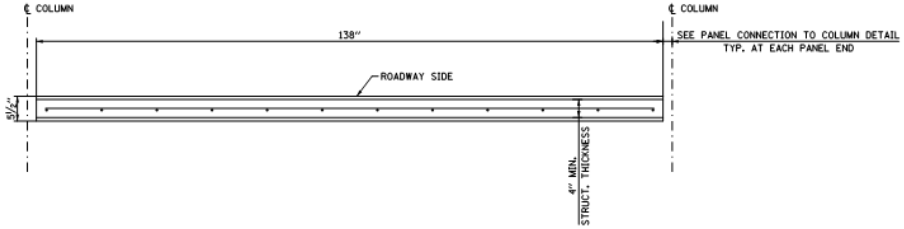
BOTTOM AND CENTER PANEL



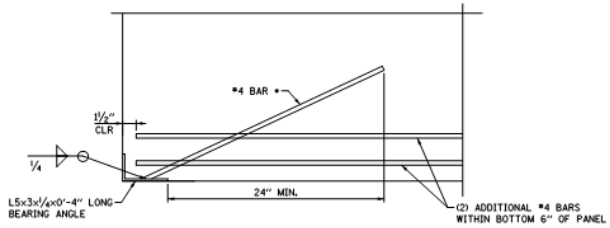
REVEAL DETAIL



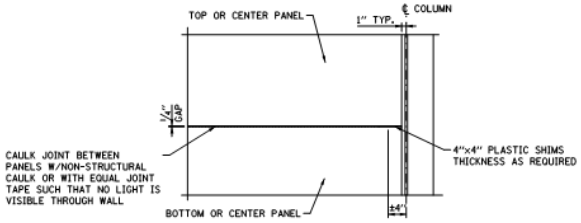
TYPICAL NOISE WALL PANEL DETAIL



TYPICAL PLAN VIEW THRU NOISE ABATEMENT WALL

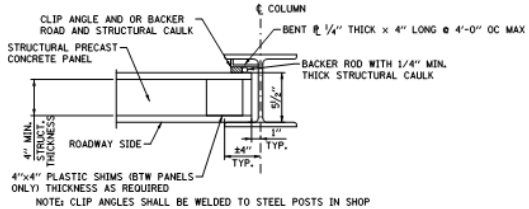


BOTTOM PANEL BEARING DETAIL



HORIZONTAL JOINT DETAIL

* E70 ELECTRODES ARE NOT PERMITTED FOR GRADE 60 REINFORCEMENT. REFER TO AWS D1.1 TABLE 3.1 - PREQUALIFIED BASE METAL-FILLER MATERIAL COMBINATIONS FOR MATCHING STRENGTH AND AWS D1.4 TABLE 5.1 MATCHING FILLER METAL REQUIREMENTS. USE E90 ELECTRODES FOR ASTM A615 REBAR.



PANEL CONNECTION TO COLUMN DETAIL

27A. ALL REBAR IS 60KSI RATED
27B. ALL REBAR IS EPOXY COATED
27C. CONCRETE CLASS "F" WITH COMPRESSIVE STRENGTH OF 4,000PSI MINIMUM

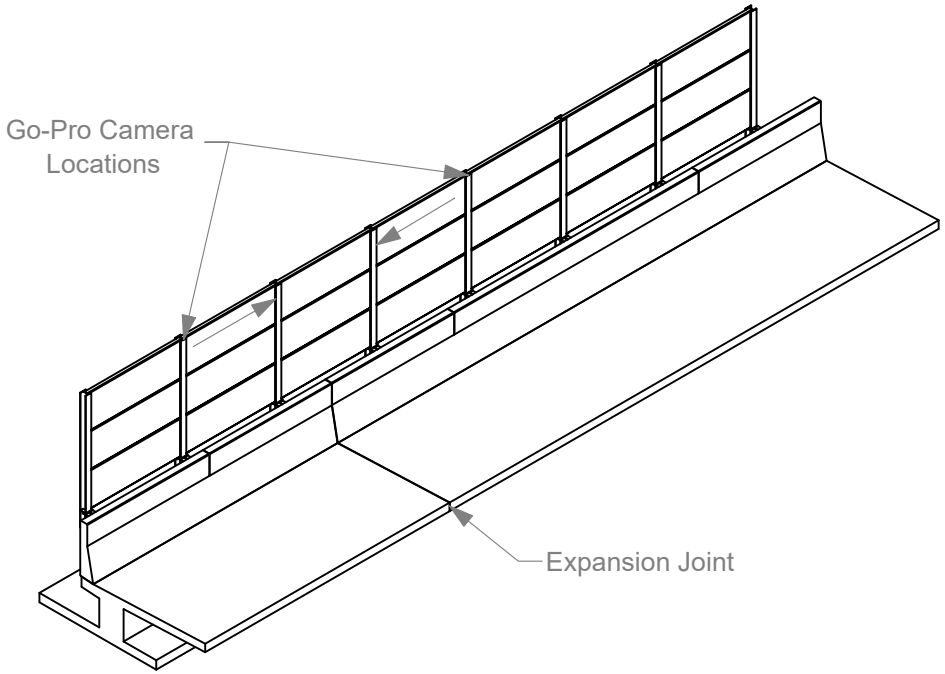
NOISE ABATEMENT WALL DETAILS BRIDGE DECK

SHEET 1 OF 1

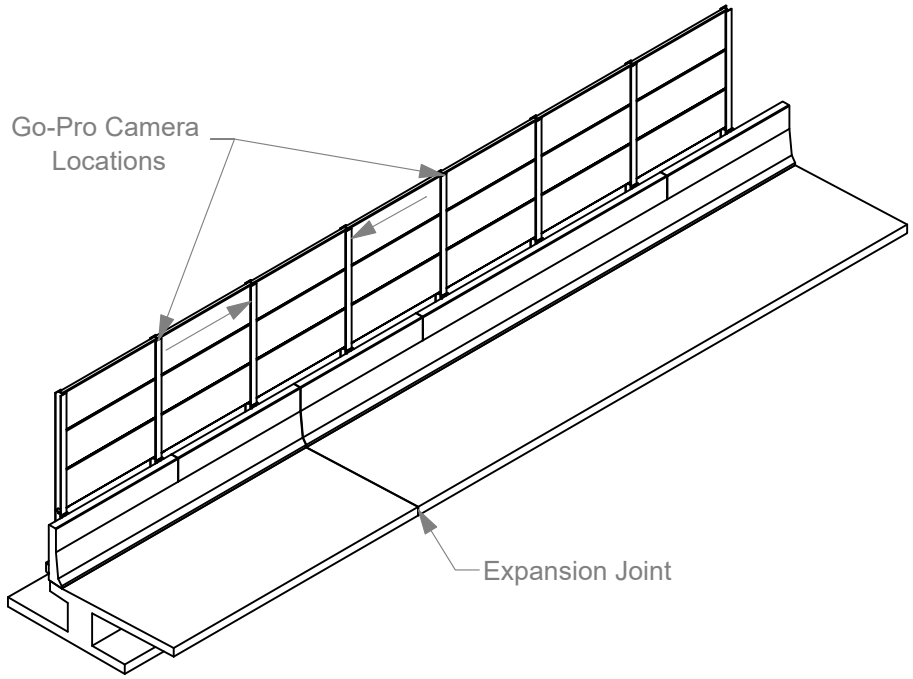
Texas A&M Transportation Institute

Roadside Safety and Physical Security Division - Proving Ground

Project #690900-ITG FShape and Single Slope		2019-08-22
Drawn by BLG	Scale 1:25	Sheet 28 of 35 Noise Abatement Wall



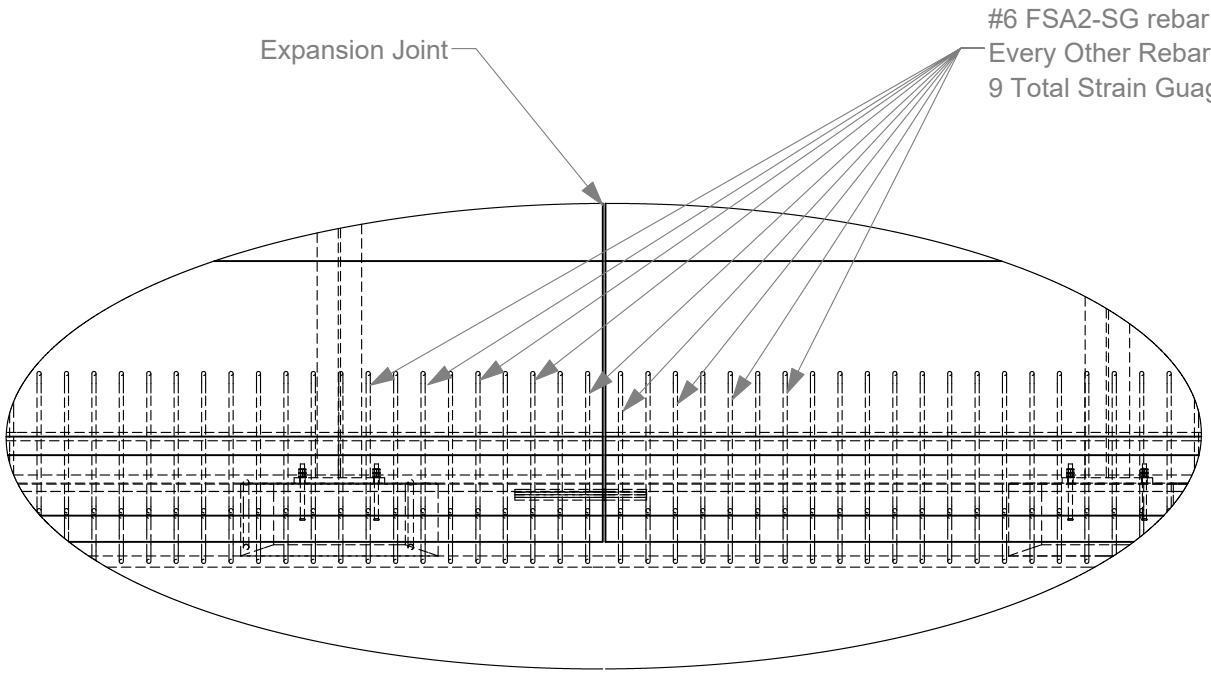
Single Slope Barrier



F-Shape Barrier

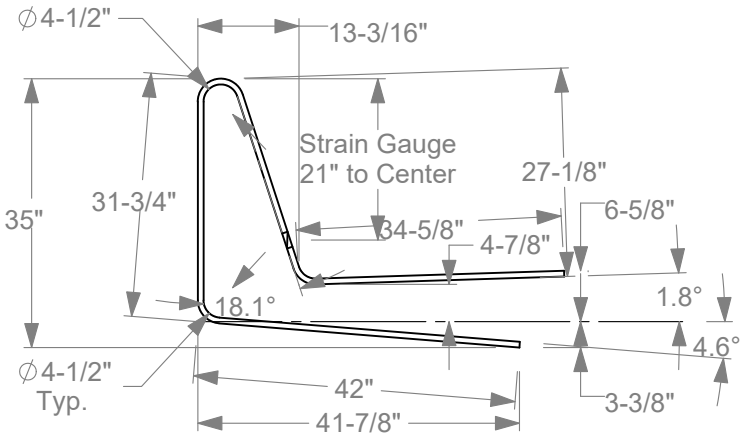
Go-Pro Cameras:
Camera to be mounted on top of NAW post, facing along the front of the NAW toward the impact zone near the full joint in the barrier and deck

Texas A&M Transportation Institute	Roadside Safety and Physical Security Division - Proving Ground	
Project #690900-ITG FShape and Single Slope		2019-08-22
Drawn by BLG	Scale 1:200	Sheet 29 of 35 Camera Location

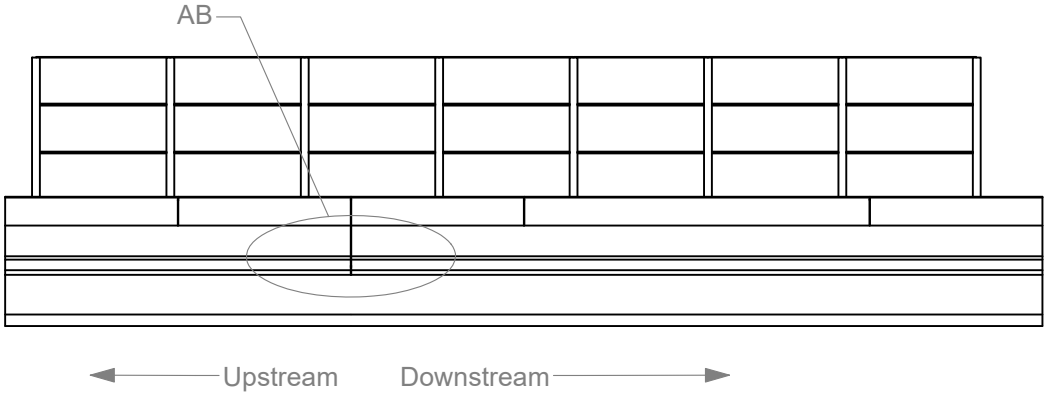


Detail AB

Scale 1 : 35

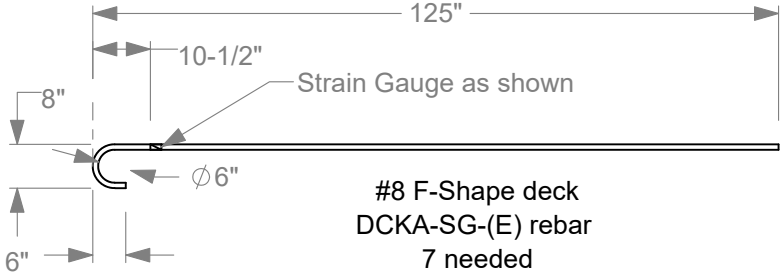


#6 F-Shape
FSA2-SG-(E)
9 Needed

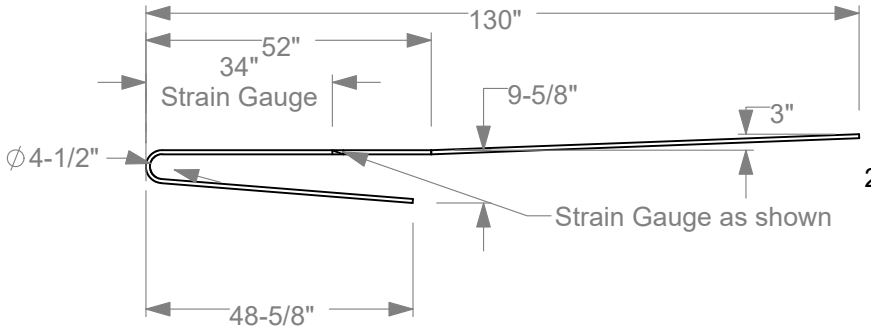


Elevation view of Fshape deck

Texas A&M Transportation Institute		Roadside Safety and Physical Security Division - Proving Ground	
Project #690900-ITG FShape and Single Slope			2019-08-22
Drawn by BLG	Scale 1:220	Sheet 30 of 35 Strain Gauges, FShape Barrier	



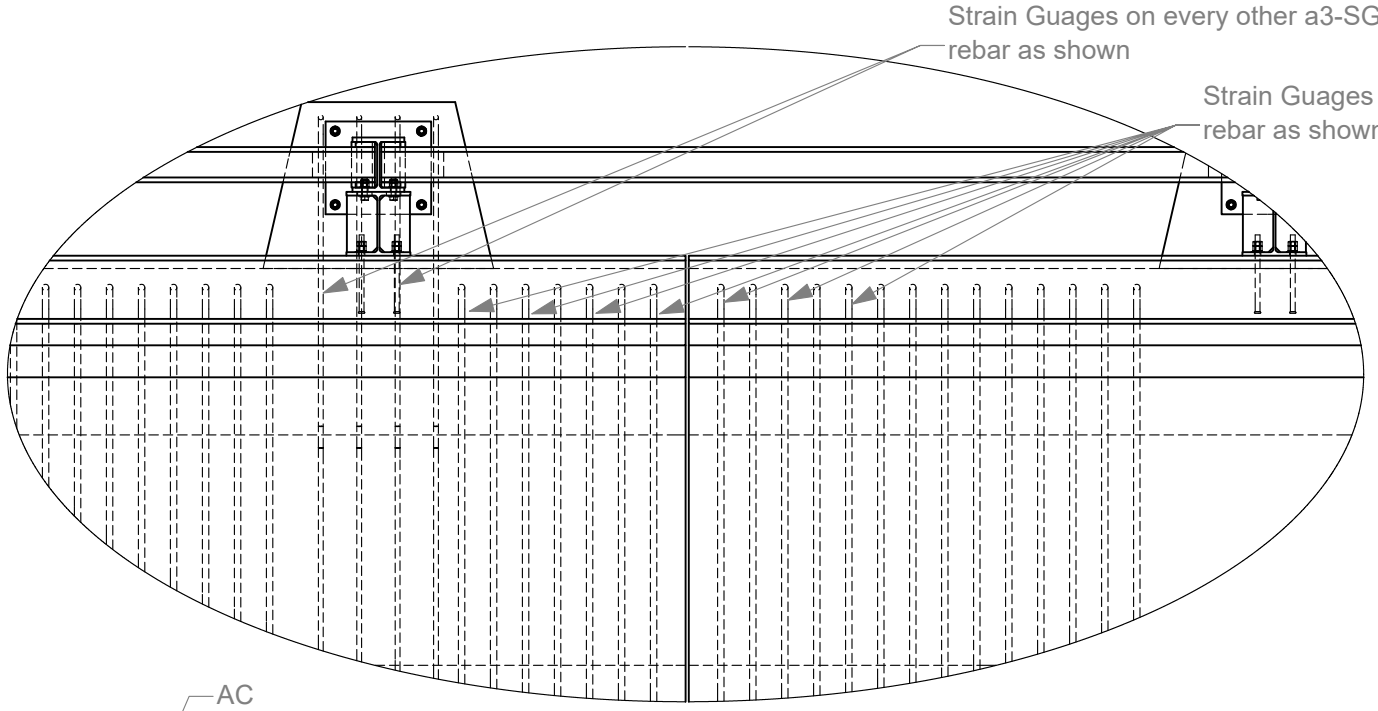
#8 F-Shape deck
DCKA-SG-(E) rebar
7 needed

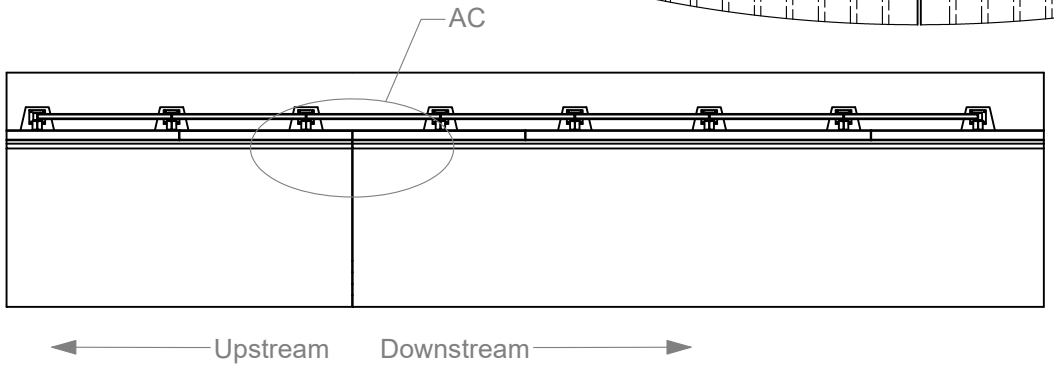


#6 FShape deck
a2-SG-(E) rebar
2 needed (2 Total)

Detail AC

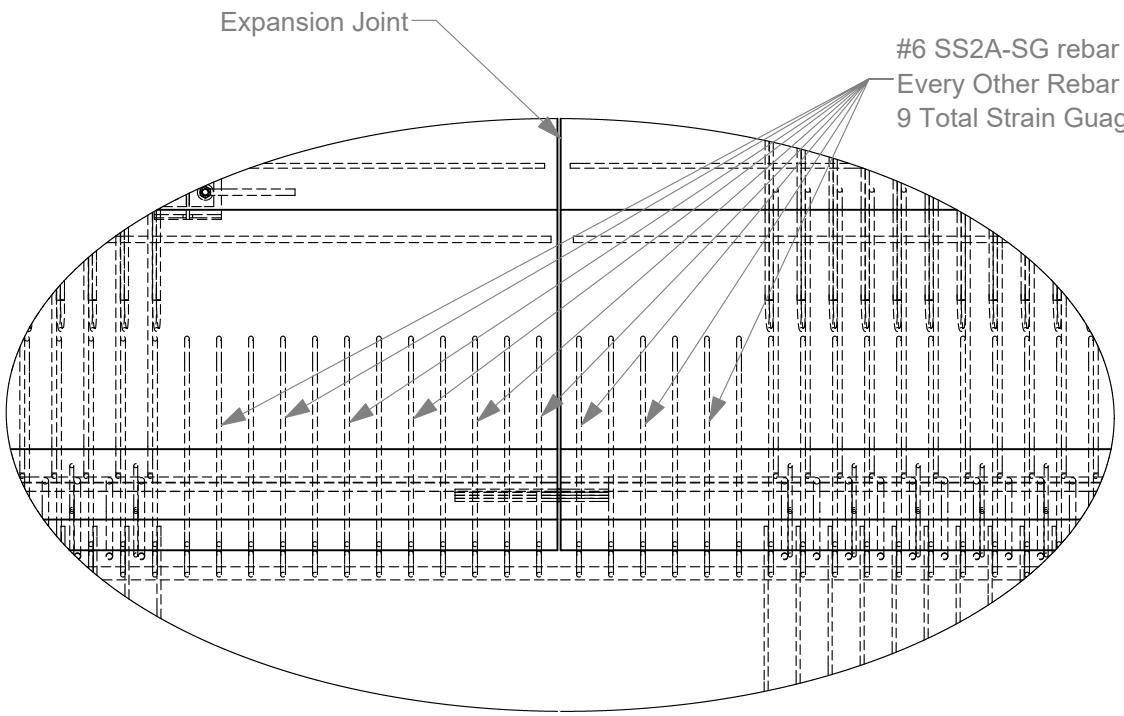
Scale 1 : 30





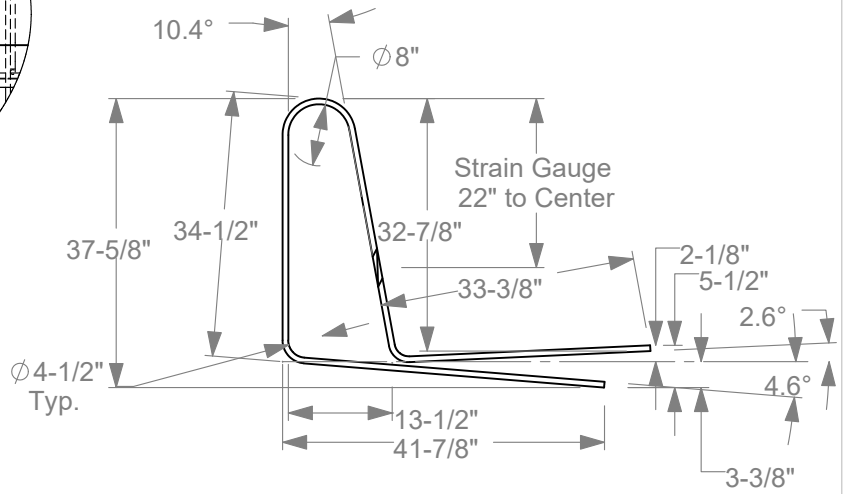
Plan view of Fshape deck

Texas A&M Transportation Institute	Roadside Safety and Physical Security Division - Proving Ground		
Project #690900-ITG FShape and Single Slope			2019-08-22
Drawn by BLG	Scale 1:250	Sheet 31 of 35 Strain Gauges, FShape Deck	

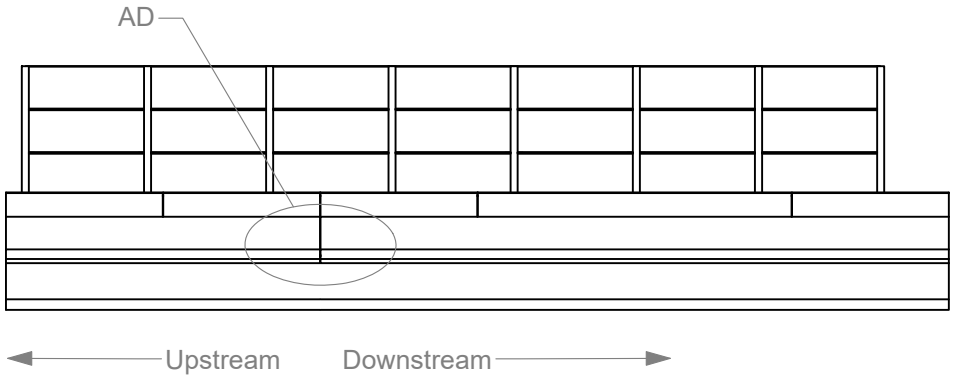


Detail AD

Scale 1 : 30

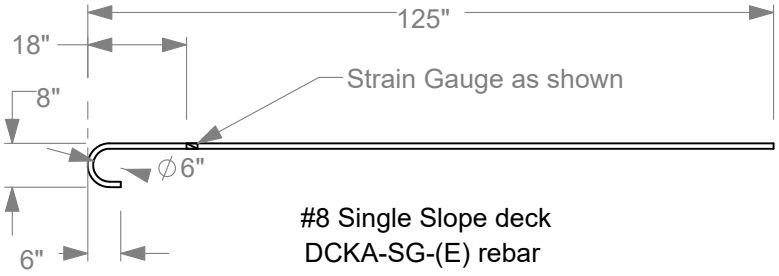


#6 Single Slope
SS2A-SG-(E)
9 Needed

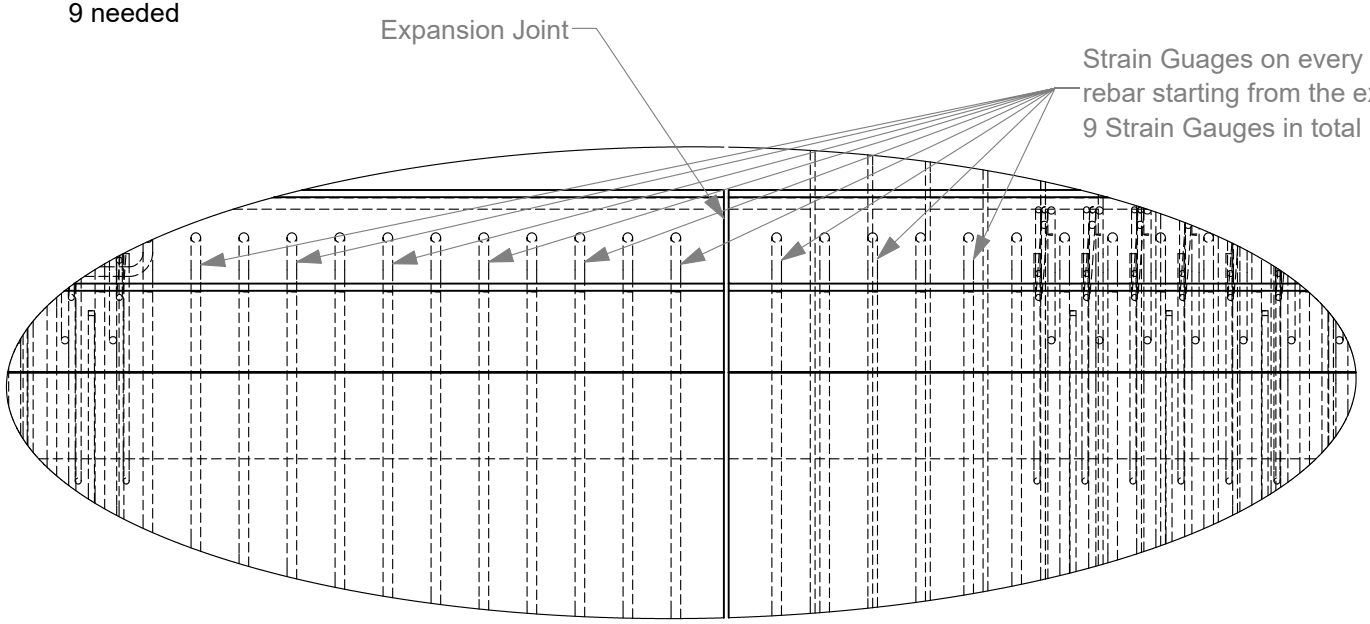


Elevation View of Single Slope

Texas A&M Transportation Institute		Roadside Safety and Physical Security Division - Proving Ground	
Project #690900-ITG FShape and Single Slope			2019-08-22
Drawn by BLG	Scale 1:220	Sheet 32 of 35 Strain Gauges, SS Barrier	

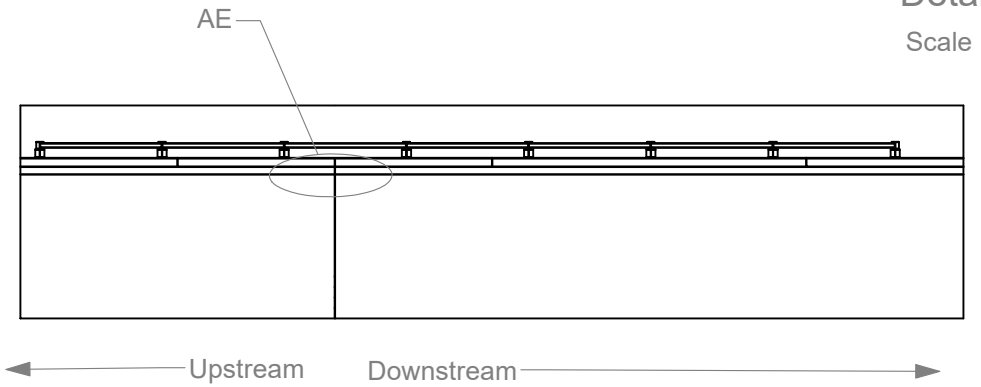


#8 Single Slope deck
DCKA-SG-(E) rebar
9 needed



Detail AE

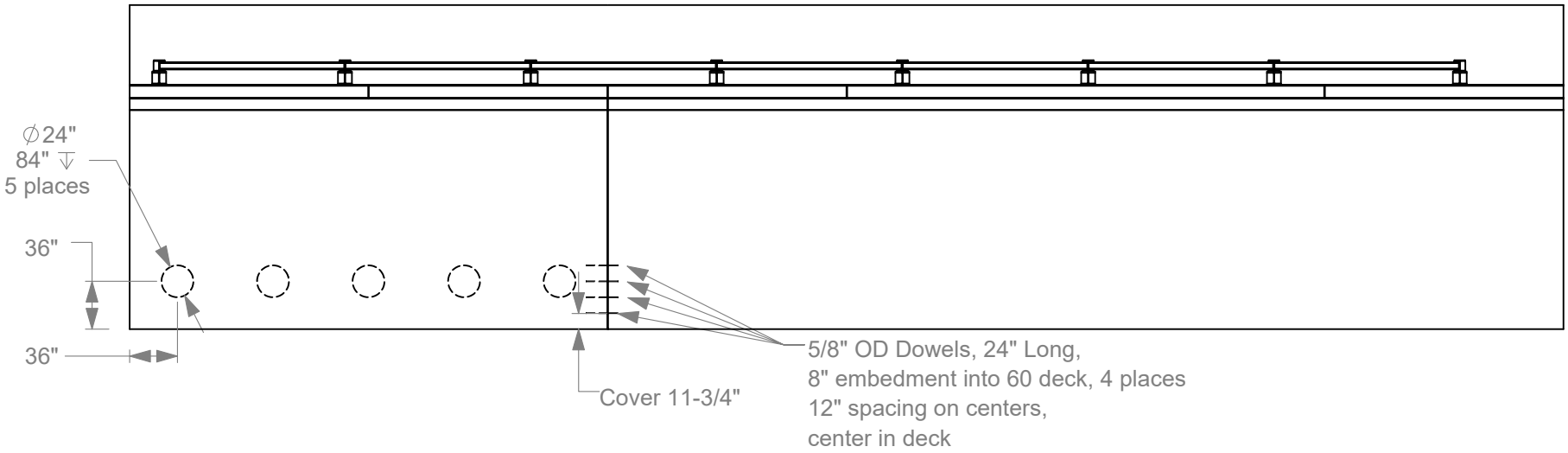
Scale 1 : 20



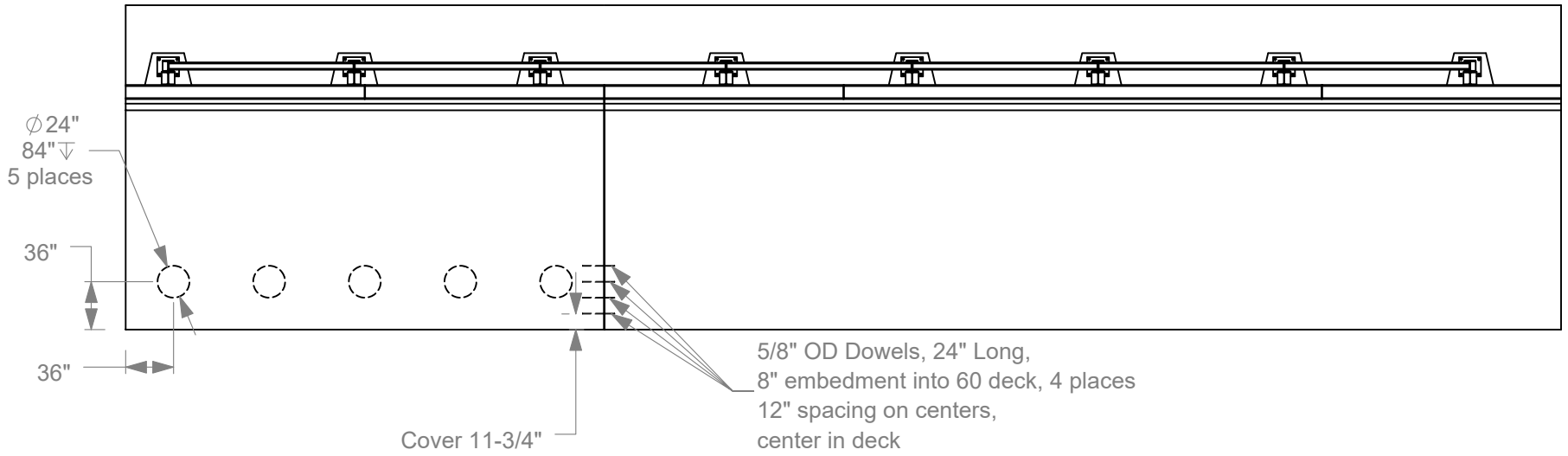
Plan view of Single Slope deck

Texas A&M Transportation Institute	Roadside Safety and Physical Security Division - Proving Ground		
Project #690900-ITG FShape and Single Slope			2019-08-22
Drawn by BLG	Scale 1:250	Sheet 33 of 35 Strain Gauges, SS Deck	

Single Slope Plan View

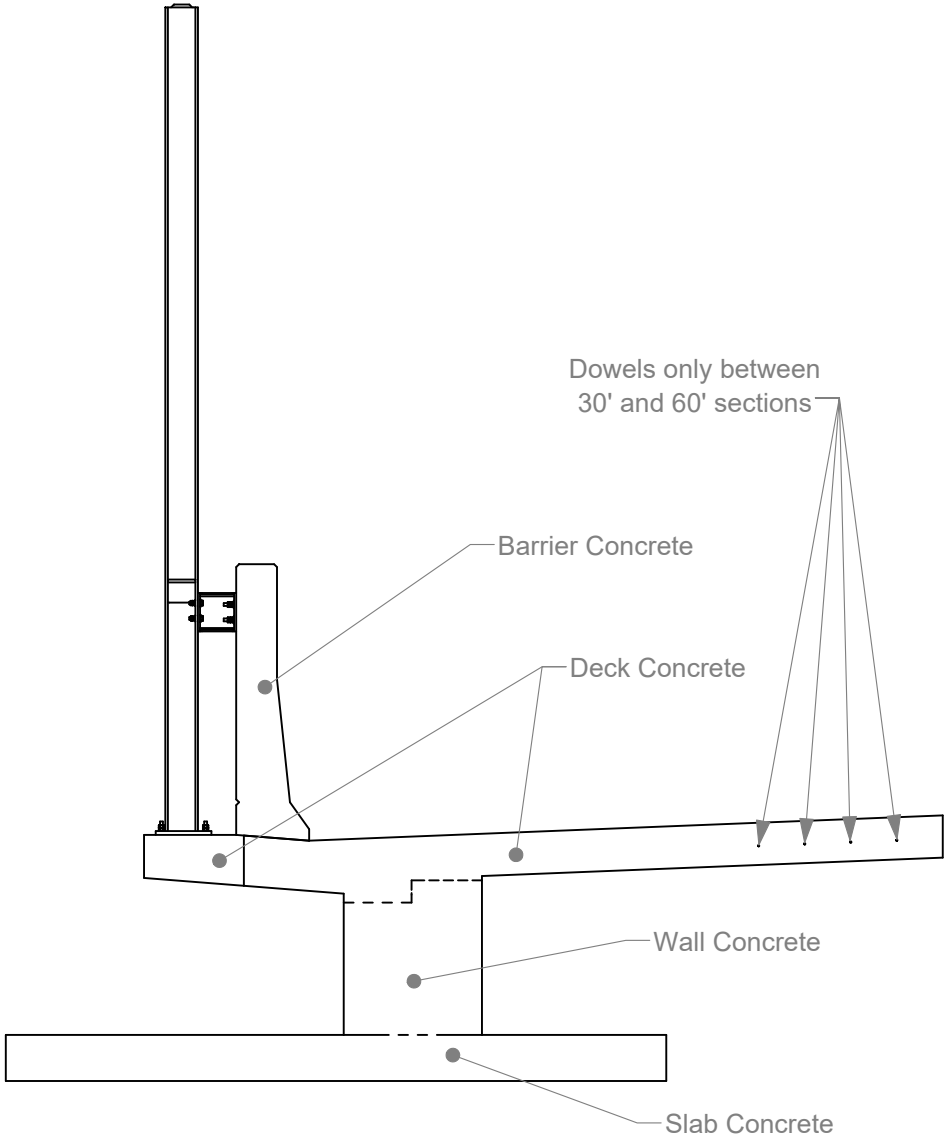


F-Shape Plan View

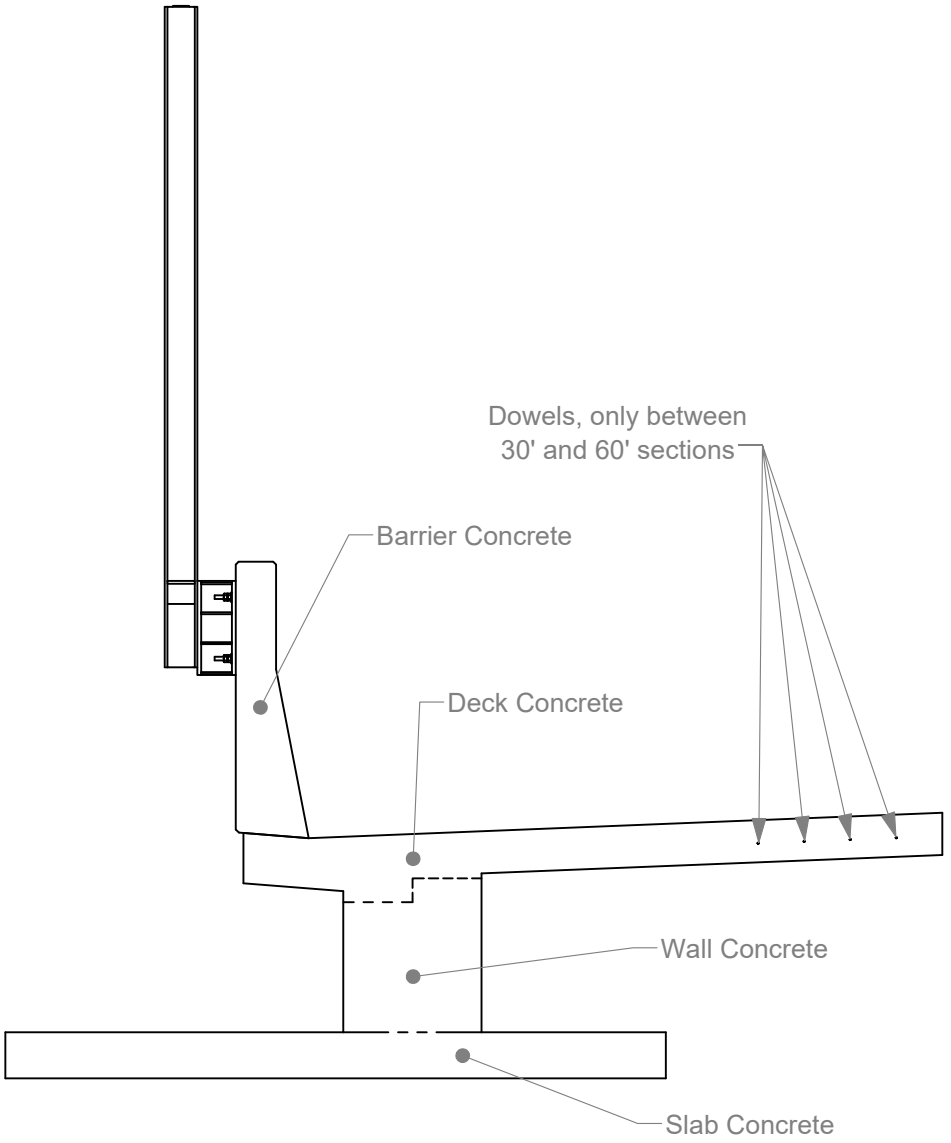


Texas A&M Transportation Institute	Roadside Safety and Physical Security Division - Proving Ground	
Project #690900-ITG FShape and Single Slope		2019-08-22
Drawn by BLG	Scale 1:250	Sheet 34 of 35 Deck Pile Locations

Q:\Accreditation-17025-2017\EIR-000 Project Files\690900\ITG - Illinois Tollway GEC - Akram\Drafting\Bridge Deck models\2019-08-22\690900-ITG, Bridge Deck Sin



F-Shape End View



Single Slope End View

Texas A&M Transportation Institute	Roadside Safety and Physical Security Division - Proving Ground	
Project #690900-ITG FShape and Single Slope		2019-08-22
Drawn by BLG	Scale 1:250	Sheet 35 of 35 Concrete Location