Texas A&M Transportation Institute
Proving Ground

Test Report No. 619551-01

EVALUATION OF *MASH* TL-3 TRANSITION DESIGN WITH A STORM DRAIN – CRASH TEST OF 1100C VEHICLE (SMALL CAR)

Sponsored by

Roadside Safety Pooled Fund

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16. Abstract

The purpose of the tests reported herein was to assess the performance of the TL-3 Transition with a Storm Drain Inlet according to the safety-performance evaluation guidelines included in the second edition of the American Association of State Highway and Transportation Officials (AASHTO) *Manual for Assessing Safety Hardware* (*MASH*) (*1*). The crash test was performed in accordance with *MASH* Test 3-20:

1. ***MASH* Test 3-20:** An 1100C vehicle weighing 2420 lb impacting the Longitudinal Barrier while travelling at 62 mi/h and 25 degrees.

This report provides details on the TL-3 Transition with a Storm Drain Inlet, the crash tests and results, and the performance assessment of the TL-3 Transition with a Storm Drain Inlet for *MASH* TEST 3-20 Longitudinal Barrier evaluation criteria.

The TL-3 Transition with a Storm Drain Inlet met the performance criteria for *MASH* TEST 3-20 Longitudinal Barrier. The installation was developed and tested to MASH Test 3-21 in Test Report No. 615251-01.

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EVALUATION OF *MASH* TL-3 TRANSITION DESIGN WITH A STORM DRAIN – CRASH TEST OF 1100C VEHICLE (SMALL CAR)

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The results reported herein apply only to the article tested. The full-scale crash test was performed according to TTI Proving Ground quality procedures and American Association of State Highway and Transportation Officials (AASHTO) Manual for Assessing Safety Hardware, Second Edition (*MASH*) guidelines and standards.

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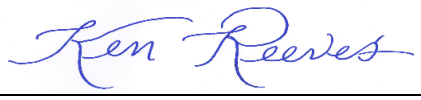

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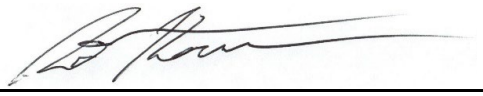

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SI* (MODERN METRIC) CONVERSION FACTORS

APPROXIMATE CONVERSIONS TO SI UNITS

Symbol	When You Know	Multiply By	To Find	Symbol
		LENGTH		
in	inches	25.4	millimeters	mm
ft	feet	0.305	meters	m
yd	yards	0.914	meters	m
mi	miles	1.61	kilometers	km
		AREA		
in^2	square inches	645.2	square millimeters	mm^2
ft^2	square feet	0.093	square meters	m^2
yd^2	square yards	0.836	square meters	m^2
ac	acres	0.405	hectares	ha
mi^2	square miles	2.59	square kilometers	km^2
		VOLUME		
fl oz	fluid ounces	29.57	milliliters	mL
gal	gallons	3.785	liters	L
ft^3	cubic feet	0.028	cubic meters	m^3
yd^3	cubic yards	0.765	cubic meters	m^3
	NOTE: volumes greater than 1000L shall be shown in m^3			
		MASS		
oz	ounces	28.35	grams	g
lb	pounds	0.454	kilograms	kg
T	short tons (2000 lb)	0.907	megagrams (or metric ton")	Mg (or "t")
		TEMPERATURE (exact degrees)		
°F	Fahrenheit	5(F-32)/9 or (F-32)/1.8	Celsius	°C
		FORCE and PRESSURE or STRESS		
lbf	poundforce	4.45	newtons	N
lbf/in^2	poundforce per square inch	6.89	kilopascals	kPa

APPROXIMATE CONVERSIONS FROM SI UNITS

Symbol	When You Know	Multiply By	To Find	Symbol
		LENGTH		
mm	millimeters	0.039	inches	in
m	meters	3.28	feet	ft
m	meters	1.09	yards	yd
km	kilometers	0.621	miles	mi
		AREA		
mm^2	square millimeters	0.0016	square inches	in^2
m^2	square meters	10.764	square feet	ft^2
m^2	square meters	1.195	square yards	yd^2
ha	hectares	2.47	acres	ac
km^2	Square kilometers	0.386	square miles	mi^2
		VOLUME		
mL	milliliters	0.034	fluid ounces	oz
L	liters	0.264	gallons	gal
m^3	cubic meters	35.314	cubic feet	ft^3
m^3	cubic meters	1.307	cubic yards	yd^3
		MASS		
g	grams	0.035	ounces	oz
kg	kilograms	2.202	pounds	lb
Mg (or "t")	megagrams (or "metric ton")	1.103	short tons (2000lb)	T
		TEMPERATURE (exact degrees)		
°C	Celsius	1.8C+32	Fahrenheit	°F
		FORCE and PRESSURE or STRESS		
N	newtons	0.225	poundforce	lbf
kPa	kilopascals	0.145	poundforce per square inch	lb/in^2

*SI is the symbol for the International System of Units

Chapter 1. INTRODUCTION

The purpose of the test reported herein was to complete the assessment of the performance of the Sponsor's TL-3 Transition with a Storm Drain Inlet according to the safety-performance evaluation guidelines included in the American Association of State Highway and Transportation Officials (AASHTO) *Manual for Assessing Safety Hardware* (*MASH*), Second Edition (*1*). The TL-3 Transition with a Storm Drain Inlet pass the *MASH* evaluation criteria under *MASH* Test 3-21 conducted in earlier project (**2).** The crash test was performed in accordance with *MASH* Test 3-20.

Chapter 2. SYSTEM DETAILS

2.1. TEST ARTICLE AND INSTALLATION DETAILS

The installation consisted of a 50-foot-long length of need W-beam guardrail embedded in crushed concrete, which transitioned to a single W-beam guard rail mounted to wingwall posts. From there the rail transitioned to a section of Thrie-beam rail before terminating into a concrete parapet mounted on a moment slab. The wingwall posts for the W-beam and Thrie-beam were mounted onto concrete, with a drain inlet placed at posts 16 and 17. The rails were held at a consistent height of 31 inches to the top of the rail, and the parapet was 32 inches tall, 12 inches wide, and 16 feet long. On the upstream end, the length of need rail terminated with a steel rail terminal.

Figure 2.1 presents the overall information on the TL-3 Transition with a Storm Drain Inlet, and Figure 2.2 thru Figure 2.7 provide photographs of the installation. Appendix A provides further details on the TL-3 Transition with a Storm Drain Inlet. Drawings were provided by the Texas A&M Transportation Institute (TTI) Proving Ground, and construction was performed by MBC Management Inc. and supervised by TTI Proving Ground personnel.

2.2. DESIGN MODIFICATIONS DURING TESTS

No modifications were made to the installation during the testing phase.

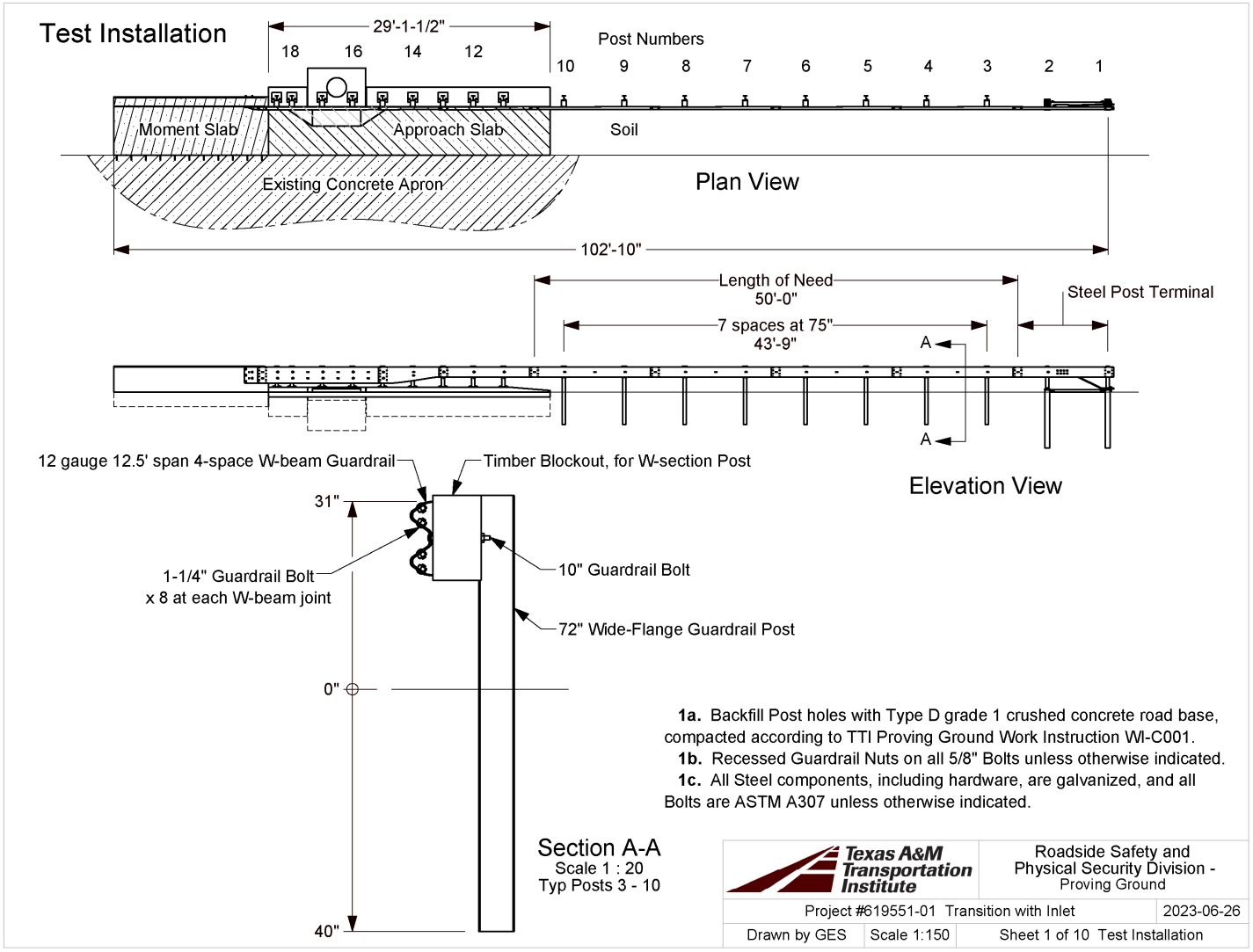


Figure 2.1. Details of TL-3 Transition with a Storm Drain Inlet.

Figure 2.2. TL-3 Transition with a Storm Drain Inlet prior to Testing.

Figure 2.3. TL-3 Transition with a Storm Drain Inlet at the Transition prior to Testing.

Figure 2.4. In-line View of the TL-3 Transition with a Storm Drain Inlet prior to Testing.

Figure 2.5. Field Side View of the TL-3 Transition with a Storm Drain Inlet prior to Testing.

Figure 2.6. Post 16 of the TL-3 Transition with a Storm Drain Inlet prior to Testing.

Figure 2.7. Posts of the TL-3 Transition with a Storm Drain Inlet at the Transition prior to Testing.

2.3. MATERIAL SPECIFICATIONS

Appendix B provides material certification documents for the materials used to install/construct the TL-3 Transition with a Storm Drain Inlet. Table 2.1 shows the average compressive strengths of the concrete on 2023-06-27, the day of the test. Other concrete structures for this project were repurposed from project 615251, which tested the same system to MASH 3-21 standards. At the time of the 3-21 testing, all concrete met or exceeded the desired design strength. Further details for that concrete can be found in Appendix B of this report.

Table 2.1. Concrete Strength.

Location	Design Strength (psi)	Avg. Strength (psi)	Age (days)	Detailed Location
Beams	3600	3740	25	Straight beam and repaired a section of the tapered beam

2.4. SOIL CONDITIONS

The test installation was installed in standard soil meeting Type 1 Grade D of AASHTO standard specification M147-17 “Materials for Aggregate and Soil Aggregate Subbase, Base, and Surface Courses.”

In accordance with Appendix B of *MASH*, soil strength was measured the day of the crash test. During installation of the TL-3 Transition with a Storm Drain Inlet for full-scale crash testing, two 6-ft long W6×16 posts were installed in the immediate vicinity of the TL-3 Transition with a Storm Drain Inlet using the same fill materials and installation procedures used in the test installation and the standard dynamic test.

On the day of Test 3-20, 2023-06-27, loads on the post at deflections were as follows: the backfill material in which the TL-3 Transition with a Storm Drain Inlet was installed met/did not meet minimum *MASH* requirements for soil strength. Displacement was not measured at 10 and 15 inches as the actual load at 5 inches greatly exceeded the minimum load value required.

Table 2.2. Soil Strength.

Displacement (in)	Minimum Load (lb)	Actual Load (lb)
5	4420	11,000*
10	4981	n/a
15	5282	n/a

Chapter 3. TEST REQUIREMENTS AND EVALUATION CRITERIA

3.1. CRASH TEST PERFORMED/MATRIX

Table 3.1 shows the test conditions and evaluation criteria for *MASH* Test 3-20 for Longitudinal Barrier. The target critical impact points (CIPs) for each test were determined using the information provided in *MASH* Section 2.2.1 and Section 2.3.2. Figure 3.1 shows the target CIP for *MASH* Test 3-20 on the TL-3 Transition with a Storm Drain Inlet.

Table 3.1. Test Conditions and Evaluation Criteria Specified for *MASH* Test 3-20 Longitudinal Barrier.

Test Designation	Test Vehicle	Impact Speed	Impact Angle	Evaluation Criteria
3-20	1100C	62 mi/h	25º	A, D, F, H, I

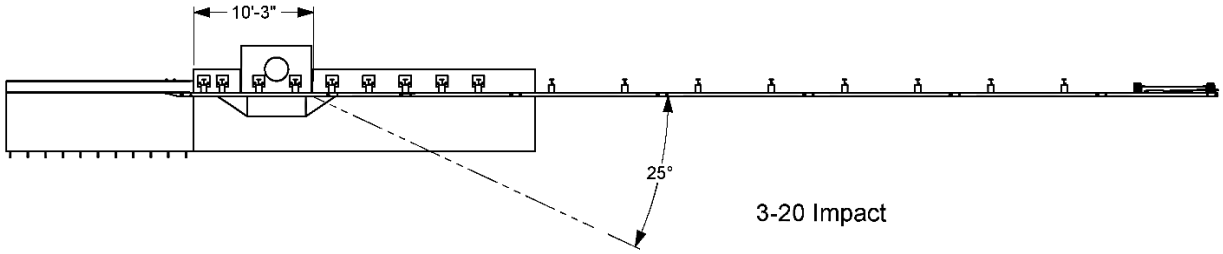


Figure 3.1. Target CIP for *MASH* Test 3-20 Tests on TL-3 Transition with a Storm Drain Inlet.

The crash tests and data analysis procedures were in accordance with guidelines presented in *MASH*. Chapter 4 presents brief descriptions of these procedures.

3.2. EVALUATION CRITERIA

The appropriate safety evaluation criteria from Tables 2.2 and 5.1 of *MASH* were used to evaluate the crash test reported herein. Table 3.1 lists the test conditions and evaluation criteria required for *MASH* Test 3-20, and Table 3.2 provides detailed information on the evaluation criteria.

Table 3.2. Evaluation Criteria Required for *MASH* Testing.

Evaluation Factors	Evaluation Criteria
A.	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.
D.	Detached elements, fragments, or other debris from the test article should not penetrate or show potential for penetrating the occupant compartment, or present undue hazard to other traffic, pedestrians, or personnel in a work zone. Deformations of, or intrusions into, the occupant compartment should not exceed limits set forth in Section 5.2.2 and Appendix E of *MASH*.
F.	The vehicle should remain upright during and after collision. The maximum roll and pitch angles are not to exceed 75 degrees.
H.	Occupant impact velocities (OIV) should satisfy the following limits: Preferred value of 30 ft/s, or maximum allowable value of 40 ft/s.
I.	The occupant ridedown accelerations should satisfy the following: Preferred value of 15.0 g, or maximum allowable value of 20.49 g.

Chapter 4. TEST CONDITIONS

4.1. TEST FACILITY

The full-scale crash test reported herein was performed at the TTI Proving Ground, an International Standards Organization (ISO)/International Electrotechnical Commission (IEC) 17025-accredited laboratory with American Association for Laboratory Accreditation (A2LA) Mechanical Testing Certificate 2821.01. The full-scale crash test was performed according to TTI Proving Ground quality procedures, as well as *MASH* guidelines and standards.

The test facilities of the TTI Proving Ground are located on The Texas A&M University System RELLIS Campus, which consists of a 2000-acre complex of research and training facilities situated 10 mi northwest of the flagship campus of Texas A&M University. The site, formerly a United States Army Air Corps base, has large expanses of concrete runways and parking aprons well suited for experimental research and testing in the areas of vehicle performance and handling, vehicle-roadway interaction, highway pavement durability and efficacy, and roadside safety hardware and perimeter protective device evaluation. The sites selected for construction and testing are along the edge of an out-of-service apron/runway. The apron/runway consists of an unreinforced jointed-concrete pavement in 12.5-ft × 15-ft blocks nominally 6 inches deep. The aprons were built in 1942, and the joints have some displacement but are otherwise flat and level.

4.2. VEHICLE TOW AND GUIDANCE SYSTEM

For the 1100C vehicle, it was towed into the test installation using a steel cable guidance and reverse tow system. A steel cable for guiding the test vehicle was tensioned along the path, anchored at each end, and threaded through an attachment to the front wheel of the test vehicle. An additional steel cable was connected to the test vehicle, passed around a pulley near the impact point and through a pulley on the tow vehicle, and then anchored to the ground such that the tow vehicle moved away from the test site. A 2:1 speed ratio between the test and tow vehicle existed with this system. Just prior to impact with the installation, the test vehicle was released and ran unrestrained. The vehicle remained freewheeling (i.e., no steering or braking inputs) until it cleared the immediate area of the test site.

4.3. DATA ACQUISITION SYSTEMS

4.3.1. Vehicle Instrumentation and Data Processing

The test vehicle was instrumented with a self-contained onboard data acquisition system. The signal conditioning and acquisition system is a multi-channel data acquisition system (DAS) produced by Diversified Technical Systems Inc. The accelerometers, which measure the x, y, and z axis of vehicle acceleration, are strain gauge type with linear millivolt output proportional to acceleration. Angular rate sensors,

measuring vehicle roll, pitch, and yaw rates, are ultra-small, solid-state units designed for crash test service. The data acquisition hardware and software conform to the latest SAE J211, Instrumentation for Impact Test. Each of the channels is capable of providing precision amplification, scaling, and filtering based on transducer specifications and calibrations. During the test, data are recorded from each channel at a rate of 10,000 samples per second with a resolution of one part in 65,536. Once data are recorded, internal batteries back these up inside the unit in case the primary battery cable is severed. Initial contact of the pressure switch on the vehicle bumper provides a time zero mark and initiates the recording process. After each test, the data are downloaded from the DAS unit into a laptop computer at the test site. The Test Risk Assessment Program (TRAP) software then processes the raw data to produce detailed reports of the test results.

Each DAS is returned to the factory annually for complete recalibration and to ensure that all instrumentation used in the vehicle conforms to the specifications outlined by SAE J211. All accelerometers are calibrated annually by means of an ENDEVCO® 2901 precision primary vibration standard. This standard and its support instruments are checked annually and receive a National Institute of Standards Technology (NIST) traceable calibration. The rate transducers used in the data acquisition system receive calibration via a Genisco Rate-of-Turn table. The subsystems of each data channel are also evaluated annually, using instruments with current NIST traceability, and the results are factored into the accuracy of the total data channel per SAE J211. Calibrations and evaluations are also made anytime data are suspect. Acceleration data are measured with an expanded uncertainty of ±1.7 percent at a confidence factor of 95 percent (k = 2).

TRAP uses the DAS-captured data to compute the occupant/compartment impact velocities, time of occupant/compartment impact after vehicle impact, and highest 10-millisecond (ms) average ridedown acceleration. TRAP calculates change in vehicle velocity at the end of a given impulse period. In addition, maximum average accelerations over 50-ms intervals in each of the three directions are computed. For reporting purposes, the data from the vehicle-mounted accelerometers are filtered with an SAE Class 180-Hz low-pass digital filter, and acceleration versus time curves for the longitudinal, lateral, and vertical directions are plotted using TRAP.

TRAP uses the data from the yaw, pitch, and roll rate transducers to compute angular displacement in degrees at 0.0001-s intervals, and then plots yaw, pitch, and roll versus time. These displacements are in reference to the vehicle-fixed coordinate system with the initial position and orientation being initial impact. Rate of rotation data is measured with an expanded uncertainty of ±0.7 percent at a confidence factor of 95 percent (k = 2).

4.3.2. Anthropomorphic Dummy Instrumentation

An Alderson Research Laboratories Hybrid II, 50th percentile male anthropomorphic dummy, restrained with lap and shoulder belts, was placed in the front seat on the impact side of the 1100C vehicle. The dummy was not instrumented.

4.3.3. Photographic Instrumentation Data Processing

Photographic coverage of the test included three digital high-speed cameras:

- One located overhead with a field of view perpendicular to the ground and directly over the impact point.
- One placed upstream from the installation at an angle to have a field of view of the interaction of the rear of the vehicle with the installation.
- A third placed with a field of view parallel to and aligned with the installation at the downstream end.

A flashbulb on the impacting vehicle was activated by a pressure-sensitive tape switch to indicate the instant of contact with the TL-3 Transition with a Storm Drain Inlet. The flashbulb was visible from each camera. The video files from these digital high-speed cameras were analyzed to observe phenomena occurring during the collision and to obtain time-event, displacement, and angular data. A digital camera recorded and documented conditions of each test vehicle and the installation before and after the test.

Chapter 5. *MASH* TEST 3-20 (CRASH TEST 619551-01-1)

5.1. TEST DESIGNATION AND ACTUAL IMPACT CONDITIONS

See Table 5.1 for details of *MASH* impact conditions for this test and Table 5.2 for the exit parameters. Figure 5.1 and Figure 5.2 depict the target impact setup.

Table 5.1. Impact Conditions for *MASH TEST 3-20,* Crash Test 619551-01-1.

Test Parameter	Specification	Tolerance	Measured
Impact Speed (mi/h)	62	±2.5 mi/h	62.6
Impact Angle (deg)	25	±1.5°	25.3
Impact Severity (kip-ft)	51	≥51 kip-ft	58.3
Impact Location	123 inches upstream from the downstream edge of the concrete	±1 ft	121.3 inches upstream from the downstream edge of the concrete

Table 5.2. Exit Parameters for *MASH TEST 3-20,* Crash Test 619551-01-1.

Exit Parameter	Measured
Speed (mi/h)	49.1
Trajectory (deg)	10.8
Heading (deg)	10.3
Brakes applied post impact (s)	1.75
Vehicle at rest position	215 ft downstream of impact point 55 ft to the traffic side facing 10° left
Comments:	Vehicle remained upright and stable Vehicle crossed the exit box at 42 ft downstream from loss of contact

[a] Not less than 32.8 ft downstream from loss of contact for cars and pickups is optimal.

Figure 5.1. TL-3 Transition with a Storm Drain Inlet/Test Vehicle Geometrics for Test 619551-01-1.

Figure 5.2. TL-3 Transition with a Storm Drain Inlet/Test Vehicle Impact Location 619551-01-1.

5.2. WEATHER CONDITIONS

Table 5.3 provides the weather conditions for 619551-01-1.

Table 5.3. Weather Conditions 619551-01-1.

Date of Test	2023-06-27
Wind Speed (mi/h)	8
Wind Direction (deg)	186
Temperature (°F)	89
Relative Humidity (%)	72
Vehicle Traveling (deg)	195

5.3. TEST VEHICLE

Figure 5.3 and Figure 5.4 show the 2017 Nissan Versa used for the crash test. Table 5.4 shows the vehicle measurements. Figure C.1 in Appendix C.1 gives additional dimensions and information on the vehicle.

Figure 5.3. Impact Side of Test Vehicle before Test 619551-01-1.

Figure 5.4. Opposite Impact Side of Test Vehicle before Test 619551-01-1.

Table 5.4. Vehicle Measurements for Test 619551-01-1.

Test Parameter	Specification	Tolerance	Measured
Dummy (if applicable)[a] (lb)	165	N/A	165
Inertial Weight (lb)	2420	±55	2437
Gross Static[a] (lb)	2585	±55	2602
Wheelbase (inches)	98	±5	102.4
Front Overhang (inches)	35	±4	32.5
Overall Length (inches)	169	±8	175.4
Overall Width (inches)	65	±3	66.7
Hood Height (inches)	28	±4	30.5
Track Width[b] (inches)	59	±2	58.4
CG aft of Front Axle[c] (inches)	39	±4	41.1
CG above Ground[c,d] (inches)	N/A	N/A	N/A

Note: N/A = not applicable; CG = center of gravity.

[a] If a dummy is used, the gross static vehicle mass should be increased by the mass of the dummy.

[b] Average of front and rear axles.

[c] For test inertial mass.

[d] 2270P vehicle must meet minimum CG height requirement.

5.4. TEST DESCRIPTION

Table 5.5 lists events that occurred during Test 619551-01-1. Figures C.4, C.5, and C.6 in Appendix C.2 present sequential photographs during the test.

Table 5.5. Events during Test 619551-01-1.

Time (s)	Events
0.0000	Vehicle impacted the installation
0.0140	Post 16 began to lean toward field side
0.0200	Post 15, 17, and 18 began to lean toward field side
0.0380	Vehicle began to redirect
0.0630	Windshield began to crack due to flexing of vehicle body
0.0860	Front passenger side window breaks due to dummy head contact
0.1500	Vehicle was parallel with installation
0.2520	49.1 mi/h at a trajectory/heading of 10.8 and 10.3 degrees respectively

5.5. DAMAGE TO TEST INSTALLATION

The concrete was damaged at post 15, and the rail was scuffed and deformed between posts 15 and 18. The drop inlet top was pushed back 0.5-inch. Post 15 was leaning 1 degree to the field side, and posts 16 and 17 were leaning 2 degrees. Table 5.6 describes the deflection and working width of the TL-3 Transition with a Storm Drain Inlet. Figure 5.5 and Figure 5.6 show the damage to the TL-3 Transition with a Storm Drain Inlet.

Table 5.6. Deflection and Working Width of the TL-3 Transition with a Storm Drain Inlet for Test 619551-01-1.

Test Parameter	Measured
Permanent Deflection/Location	1 inch toward field side, at post 16
Dynamic Deflection	1.9 inches toward field side between posts 16 and 17
Working Width [a] and Height	52.3 inches, at a height of 0.0 inches at the traffic side of the rail to the field side edge of the inlet cover

[a] Per *MASH*, “The working width is the maximum dynamic lateral position of any major part of the system or vehicle. These measurements are all relative to the pre-impact traffic face of the test article.” In other words, working width is the total barrier width plus the maximum dynamic intrusion of any portion of the barrier or test vehicle past the field side edge of the barrier.

Figure 5.5. Traffic Side of the TL-3 Transition with a Storm Drain Inlet at Impact Location after Test 619551-01-1.

Figure 5.6. Field Side of the TL-3 Transition with a Storm Drain Inlet at Impact Location after Test 619551-01-1.

5.6. DAMAGE TO TEST VEHICLE

Figure 5.7 and Figure 5.8 show the damage sustained by the vehicle. Figure 5.9 and Figure 5.10 show the interior of the test vehicle. Table 5.7 and Table 5.8 provide details on the occupant compartment deformation and exterior vehicle damage. Figures C.2 and C.3 in Appendix C.1 provide exterior crush and occupant compartment measurements.

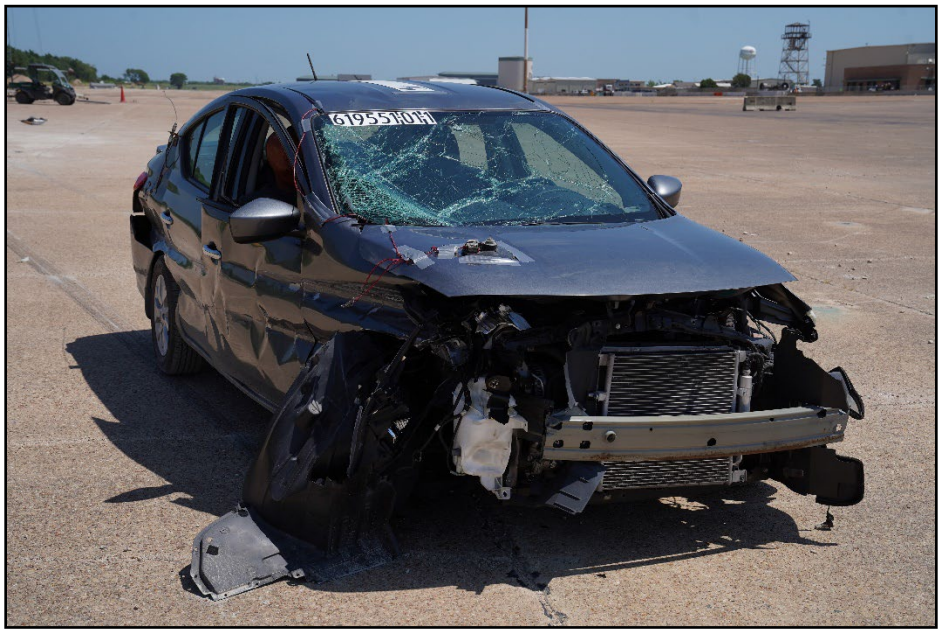


Figure 5.7. Impact Side of Test Vehicle after Test 619551-01-1.

Figure 5.8. Rear Impact Side of Test Vehicle after Test 619551-01-1.

Figure 5.9. Overall Interior of Test Vehicle after Test 619551-01-1.

Figure 5.10. Interior of Test Vehicle on Impact Side after Test 619551-01-1.

Table 5.7. Occupant Compartment Deformation 619551-01-1.

Test Parameter	**Specification** (inches)	**Measured** (inches)
Roof	≤4.0	0.0
Windshield	≤3.0	2.75
A and B Pillars	≤5.0 overall/≤3.0 lateral	0.75
Foot Well/Toe Pan	≤9.0	1.0
Floor Pan/Transmission Tunnel	≤12.0	0.0
Side Front Panel	≤12.0	0.75
Front Door (above Seat)	≤9.0	0.0
Front Door (below Seat)	≤12.0	2.0

Table 5.8. Exterior Vehicle Damage 619551-01-1.

Side Windows	The front right side window shattered, but it was not caused by penetration by the test article.
Maximum Exterior Deformation	9 inches in the front plane at the right corner at bumper height
VDS	01RFQ5
CDC	01FREW3
Fuel Tank Damage	None
Description of Damage to Vehicle:	The bumper, grill, right front fender, right front wheel, right front control arm, frame rail, headlights, windshield, right front a-pillar, right doors, right quarter fender, right tail light, and right front side window were damaged. The top of the right front door had a 2.75-inch gap. The windshield had extensive cracking due to flexing of the body, but there were no holes and no tearing in the laminate.

5.7. OCCUPANT RISK FACTORS

Data from the accelerometers were digitized for evaluation of occupant risk, and the results are shown in Table 5.9. Figure C.7 in Appendix C.3 shows the vehicle angular displacements, and Figures C.8 through C.10 in Appendix C.4 show acceleration versus time traces.

Table 5.9. Occupant Risk Factors for Test 619551-01-1.

Test Parameter	Specification [a]	Measured	Time
OIV, Longitudinal (ft/s)	≤40.0 *30.0*	20	0.0787 seconds on right side of interior
OIV, Lateral (ft/s)	≤40.0 *30.0*	33.7	0.0787 seconds on right side of interior
Ridedown, Longitudinal (g)	≤20.49 *15.0*	4.9	0.0787 - 0.0887 seconds
Ridedown, Lateral (g)	≤20.49 *15.0*	10.5	0.1791 - 0.1891 seconds
Theoretical Head Impact Velocity (THIV) (m/s)	N/A	11.9	0.0773 seconds on right side of interior
Acceleration Severity Index (ASI)	N/A	2.63	0.0516 - 0.1016 seconds
50-ms Moving Avg. Accelerations (MA) Longitudinal (g)	N/A	-11.3	0.0360 - 0.0860 seconds
50-ms MA Lateral (g)	N/A	-19.7	0.0207 - 0.0707 seconds
50-ms MA Vertical (g)	N/A	2.4	0.0097 - 0.0597 seconds
Roll (deg)	≤75	3.9	0.0559 seconds
Pitch (deg)	≤75	2.9	0.1585 seconds
Yaw (deg)	N/A	39.9	0.6031 seconds

[a] *Values in italics are the preferred MASH values*

5.8. TEST SUMMARY

Figure 5.11 summarizes the results of *MASH* Test 619551-01-1.

0.000 s

0.100 s

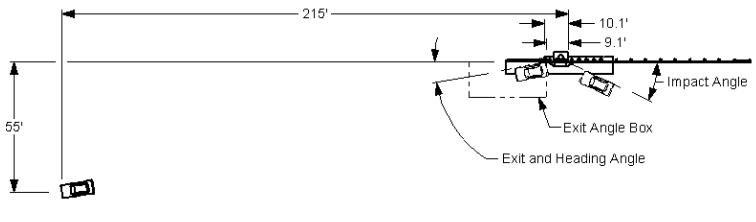
0.200 s

0.300 s

Test Agency	Texas A&M Transportation Institute (TTI)
Test Standard/Test No.	*MASH* 2016, Test 3-20
TTI Project No.	619551-01-1
Test Date	2023-06-27
TEST ARTICLE	
Type	Longitudinal Barrier
Name	TL-3 Transition with a Storm Drain Inlet
Length	102 feet 10 inches
Key Materials	Thrie-beam & W-beam rail. 72-inch wide-flange guardrail post, wingwall post, pre-cast drop inlet, Concrete parapet
Soil Type and Condition	Type D Grade 1 crushed concrete, damp
TEST VEHICLE	
Type/Designation	1100C
Year, Make and Model	2017 Nissan Versa
Inertial Weight (lb)	2437
Dummy (lb)	165
Gross Static (lb)	2602
IMPACT CONDITIONS	
Impact Speed (mi/h)	62.6
Impact Angle (deg)	25.3
Impact Location	121.3 inches upstream from the downstream edge of the concrete
Impact Severity (kip-ft)	58.3
EXIT CONDITIONS	
Exit Speed (mi/h)	49.1
Trajectory/Heading Angle (deg)	10.8 / 10.3
Exit Box Criteria	Vehicle crossed the exit box a 42 ft downstream from loss of contact.
Stopping Distance	215 ft downstream 55 ft to the traffic side
TEST ARTICLE DEFLECTIONS	
Dynamic (inches)	1.9
Permanent (inches)	1
Working Width / Height (inches)	52.3 / 0.0
VEHICLE DAMAGE	
VDS	01RFQ5
CDC	01FREW3
Max. Ext. Deformation (inches)	9
Max Occupant Compartment Deformation	2.75 inches in the windshield

OCCUPANT RISK VALUES

Long. OIV (ft/s)	20	Long. Ridedown (g)	4.9	Max 50-ms Long. (g)	-11.3	Max Roll (deg)	3.9
Lat. OIV (ft/s)	33.7	Lat. Ridedown (g)	10.5	Max 50-ms Lat. (g)	-19.7	Max Pitch (deg)	2.9
THIV (m/s)	11.9	ASI	2.63	Max 50-ms Vert. (g)	2.4	Max Yaw (deg)	39.9



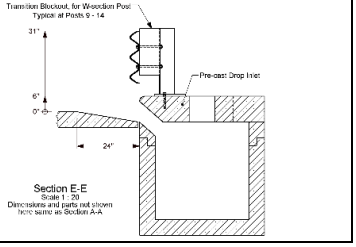


Figure 5.11. Summary of Results for *MASH* Test 3-20 on TL-3 Transition with a Storm Drain Inlet.

Chapter 6. SUMMARY AND CONCLUSIONS

6.1. ASSESSMENT OF TEST RESULTS

The crash test reported herein was performed in accordance with *MASH* Test 3-20 on the TL-3 Transition with a Storm Drain Inlet.

6.2. CONCLUSIONS

Table 6.1 shows that the TL-3 Transition with a Storm Drain Inlet met the performance criteria for *MASH* Test 3-20 Longitudinal Barrier.

Table 6.1. Assessment Summary for *MASH* Test 3-20 Tests on TL-3 Transition with a Storm Drain Inlet.

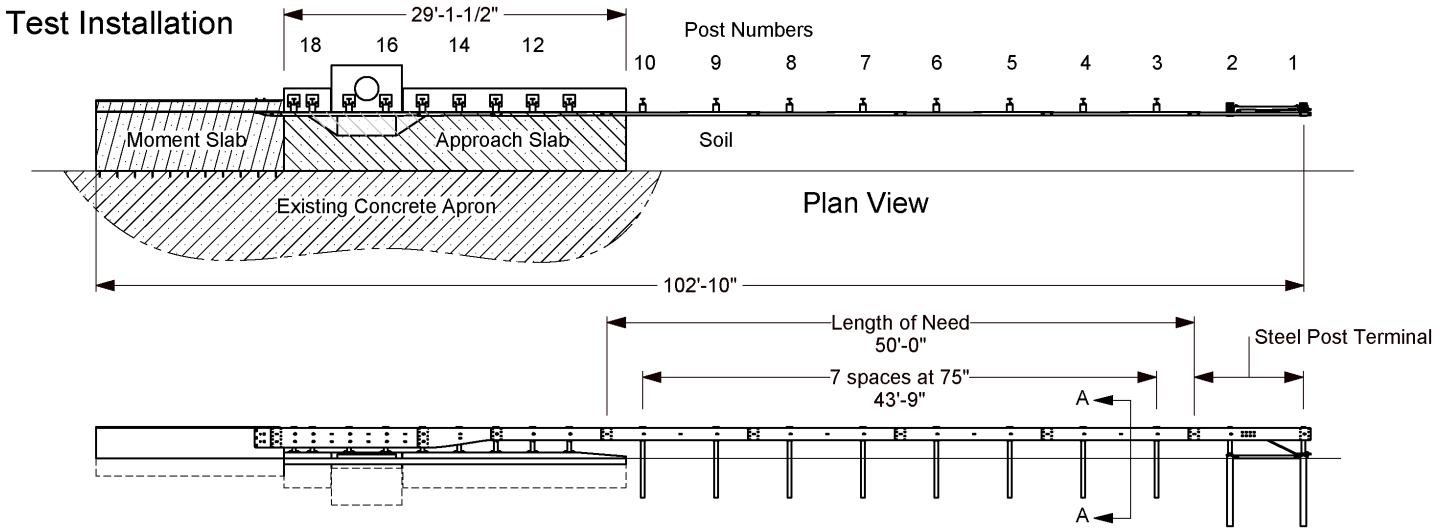
Evaluation Criteria	Description	Test 619551-01-1
A	Contain, Redirect, or Controlled Stop	S
D	No Penetration into Occupant Compartment	S
F	Roll and Pitch Limit	S
H	OIV Threshold	S
I	Ridedown Threshold	S
Overall		Pass

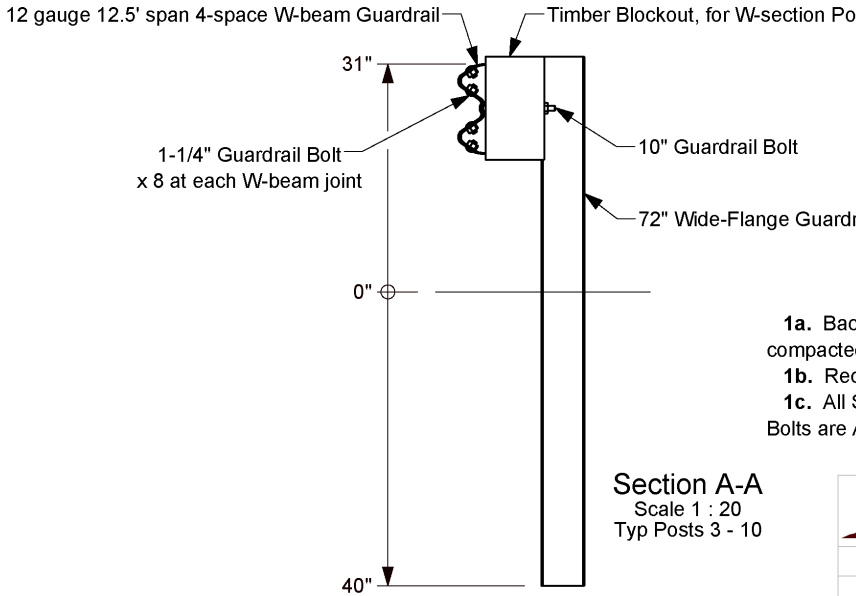
Note: S = Satisfactory; N/A = Not Applicable.
[1] See Table 3.2 for details

REFERENCES

1. AASHTO. *Manual for Assessing Safety Hardware*, Second Edition. American Association of State Highway and Transportation Officials, Washington, DC, 2016.
2. Abu-Odeh, Akram; Schroeder, William J.L., *MASH TL-3 Transition Design with a Storm Drain*, Texas A&M Transportation Institute, College Station, TX, 2023

APPENDIX A. DETAILS OF TL-3 TRANSITION WITH A STORM DRAIN INLET





Section A-A
Scale 1 : 20
Typ Posts 3 - 10

1a. Backfill Post holes with Type D grade 1 crushed concrete road base, compacted according to TTI Proving Ground Work Instruction WI-C001.
1b. Recessed Guardrail Nuts on all 5/8" Bolts unless otherwise indicated.
1c. All Steel components, including hardware, are galvanized, and all Bolts are ASTM A307 unless otherwise indicated.

Texas A&M Transportation Institute		Roadside Safety and Physical Security Division - Proving Ground	
Project #619551-01 Transition with Inlet			2023-06-26
Drawn by GES	Scale 1:150	Sheet 1 of 10 Test Installation	

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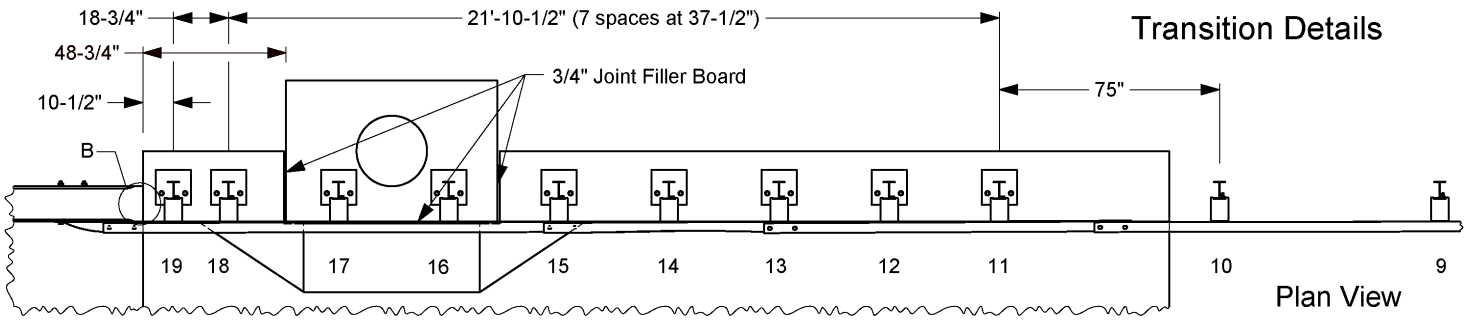

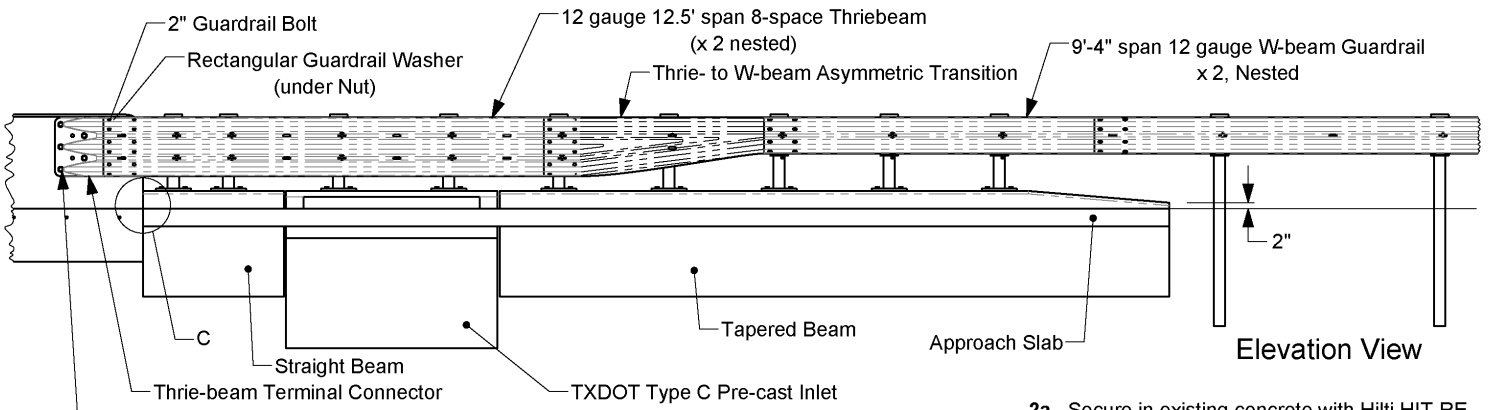

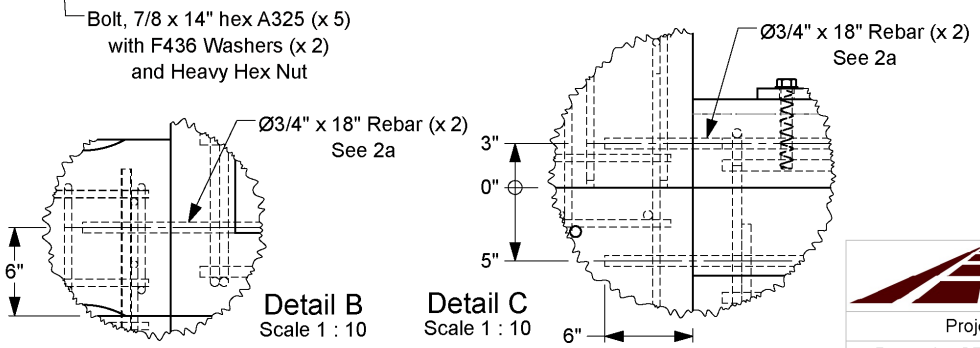

2a. Secure in existing concrete with Hilti HIT-RE 500 V3 epoxy according to manufacturer's instructions.

2b. Excavate 6" below Pre-cast Inlet. Place 4" of Type A Grade 1 crushed limestone road base, compacted to 90% of standard proctor density, then 2" of Washed Sand. Backfill around all concrete with Type A Grade 1 crushed limestone road base, compacted to 90% of standard proctor density.

Transition Details

Texas A&M Transportation Institute	Roadside Safety and Physical Security Division - Proving Ground		
Project #619551-01 Transition with Inlet			2023-06-26
Drawn by GES	Scale 1:50	Sheet 2 of 10 Transition Details	

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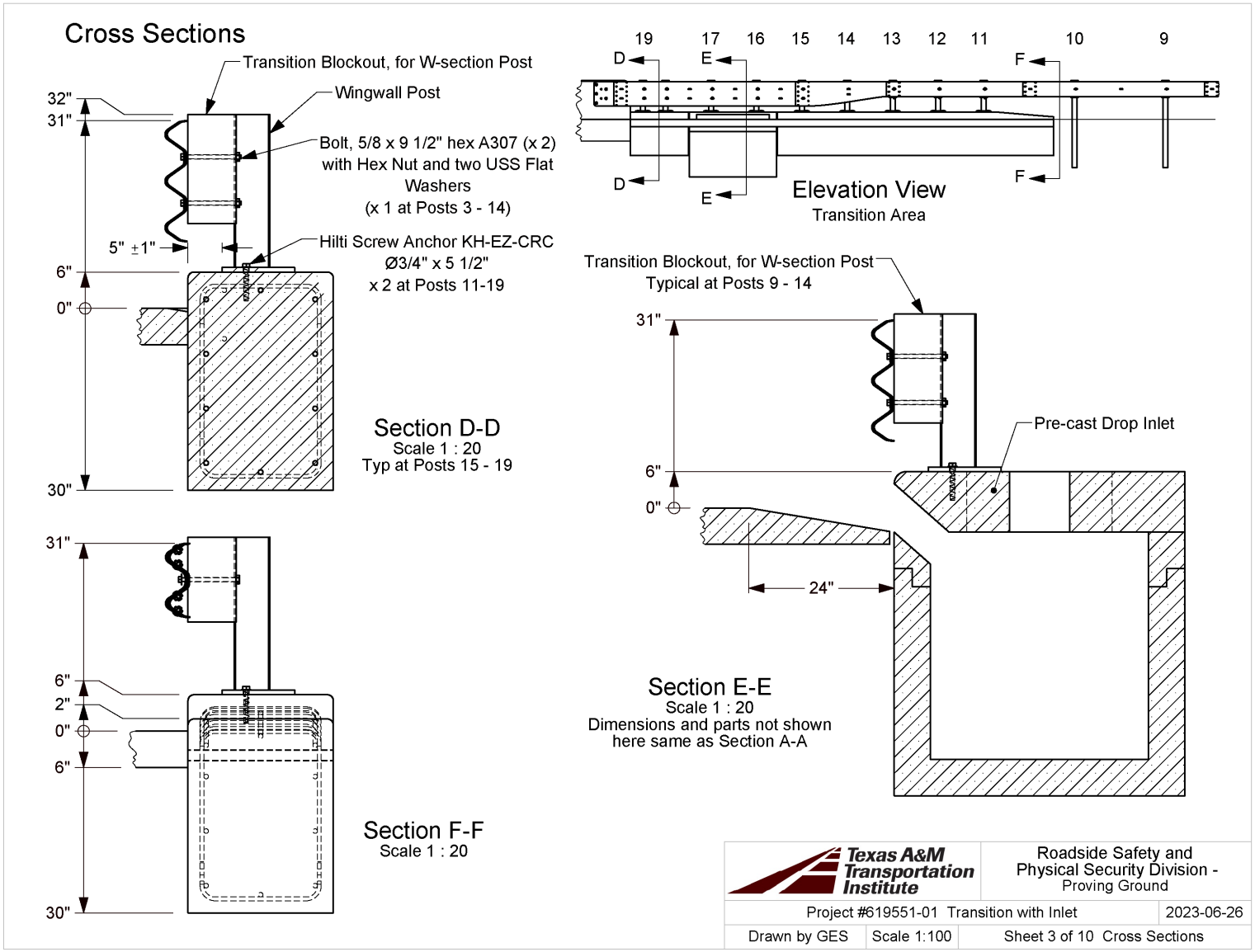

Texas A&M Transportation Institute	Roadside Safety and Physical Security Division - Proving Ground	
Project #619551-01 Transition with Inlet		2023-06-26
Drawn by GES	Scale 1:100	Sheet 3 of 10 Cross Sections

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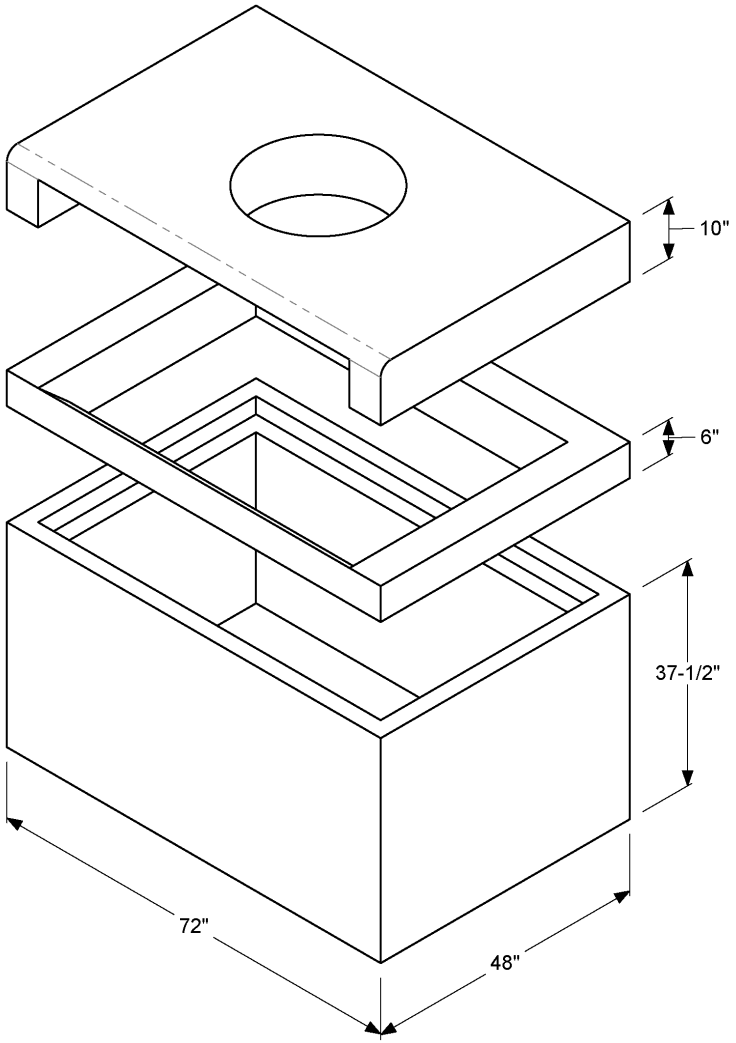
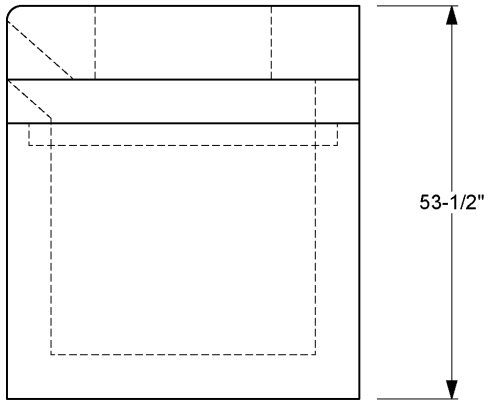
Drop Inlet Dimensions





Texas A&M Transportation Institute		Roadside Safety and Physical Security Division - Proving Ground	
Project #619551-01 Transition with Inlet			2023-06-26
Drawn by GES	Scale 1:20	Sheet 4 of 10 Drop Inlet Dimensions	

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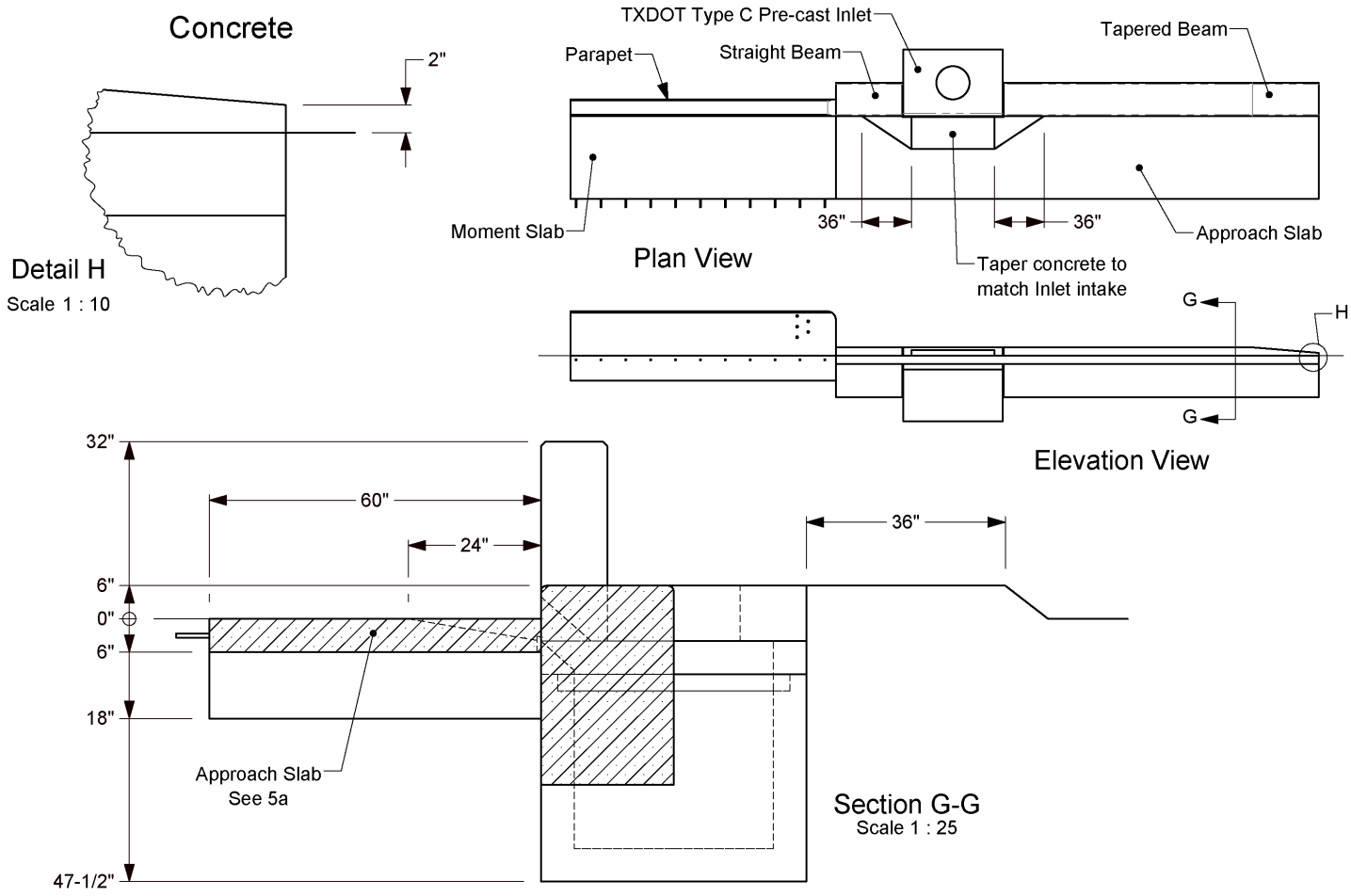

5a. Approach Slab is 3000 psi concrete, with one layer of #3 rebar (not shown here), with 1-1/2" cover at top. Space longitudinal bars at 12", with 12" laps, and transverse bars at 36".

Texas A&M Transportation Institute		Roadside Safety and Physical Security Division - Proving Ground	
Project #619551-01 Transition with Inlet			2023-06-26
Drawn by GES	Scale 1:100	Sheet 5 of 10 Concrete	

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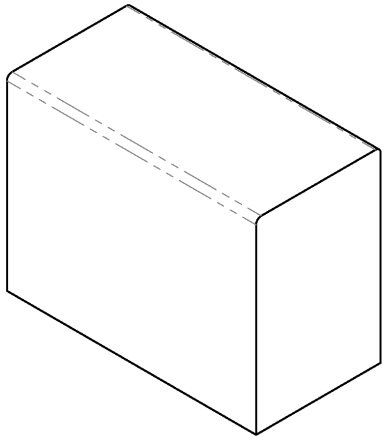
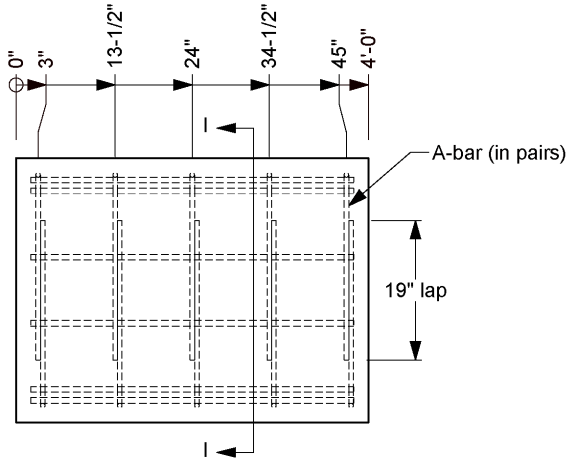
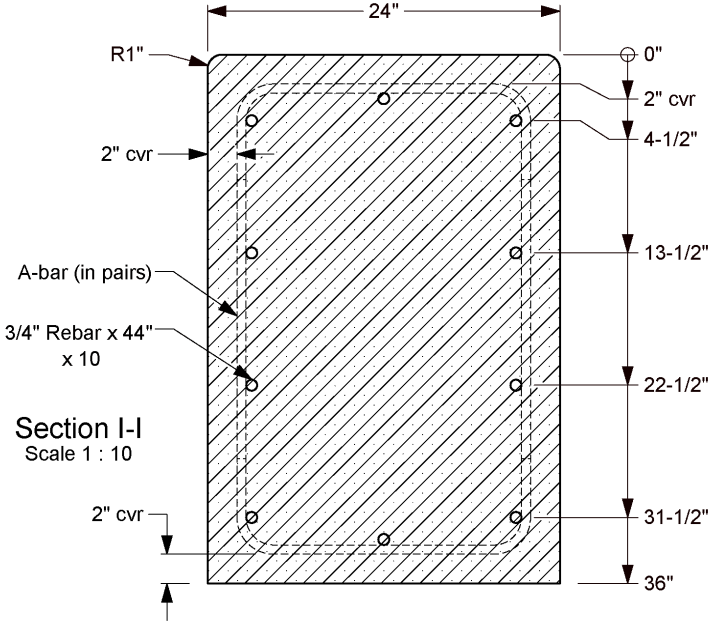


Straight Beam

Tx DoT Class C Concrete (3600 psi)
(Anchor bars not shown, see Detail Views on sheet 2)





Section I-I
Scale 1 : 10

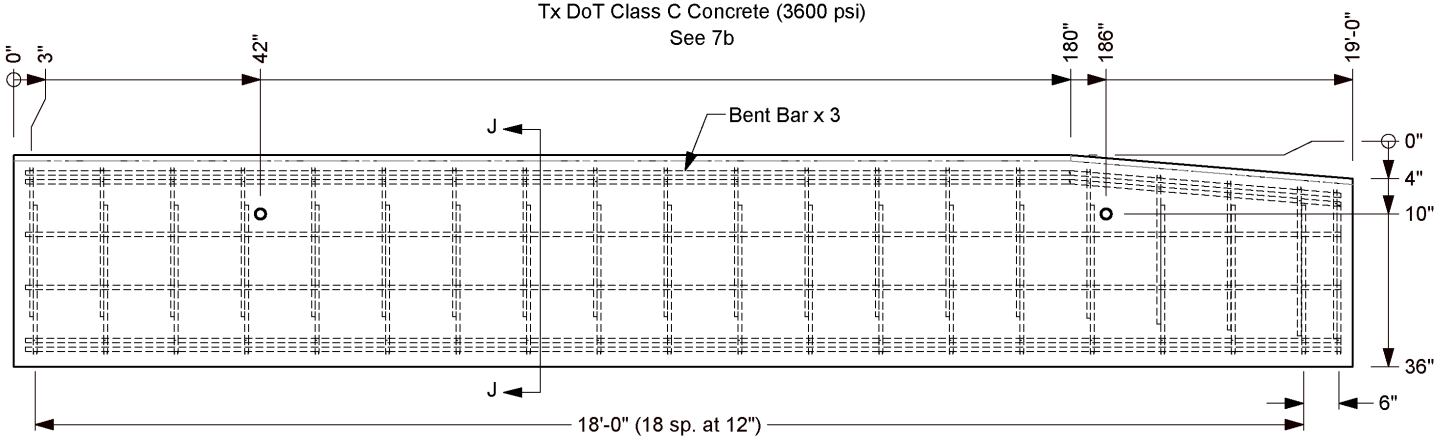
6a. All rebar dimensions are to center of bar unless otherwise indicated by "cvr" (cover).

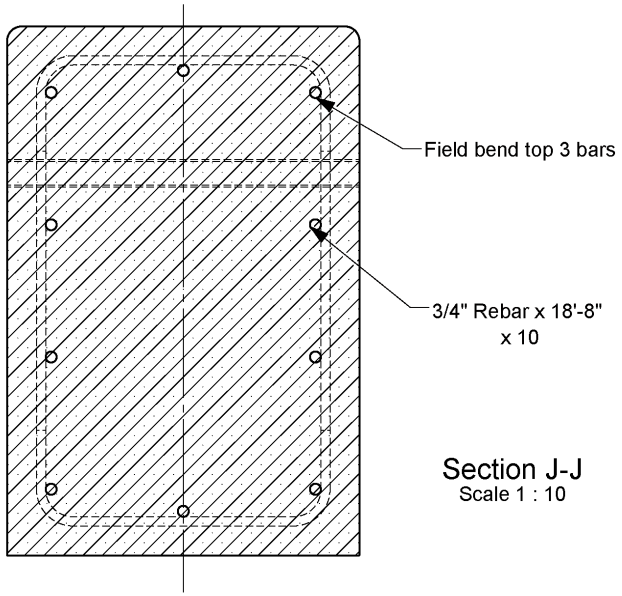
Texas A&M Transportation Institute	Roadside Safety and Physical Security Division - Proving Ground	
Project #619551-01 Transition with Inlet		2023-06-26
Drawn by GES	Scale 1:20	Sheet 6 of 10 Straight Beam

S:\Accreditation-17025-2017\EIR-000 Project Files\619551-01 - Transition with Inlet - Akram\Drafting, 619551\619551 Drawing

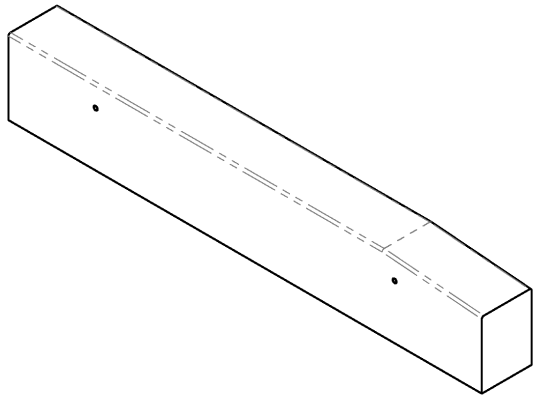
Tapered Beam

Tx DoT Class C Concrete (3600 psi)
See 7b





Section J-J
Scale 1 : 10



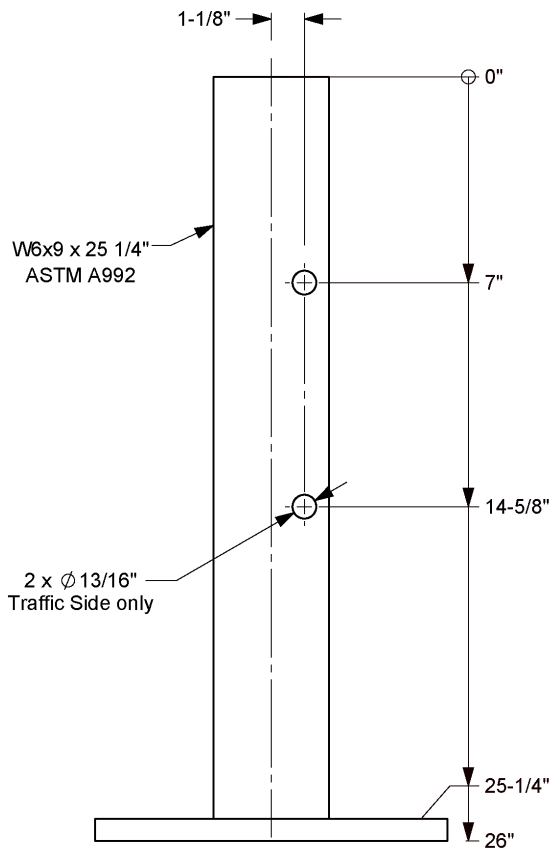
7a. All rebar dimensions are to center of bar unless otherwise indicated by "cvr" (cover).

7b. See Straight Beam (previous sheet) for all details not shown here.

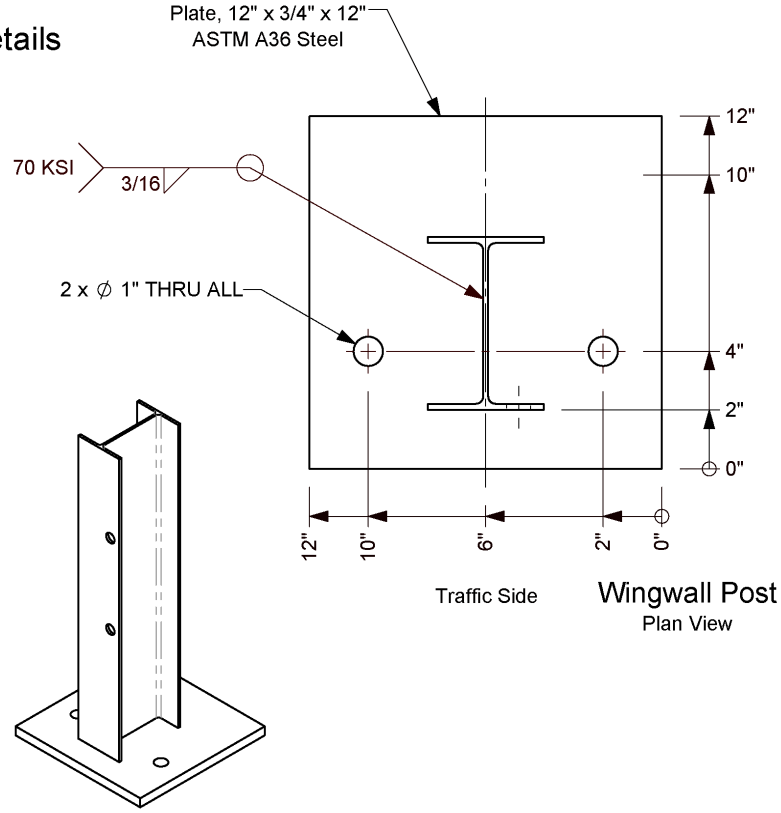
Texas A&M Transportation Institute	Roadside Safety and Physical Security Division - Proving Ground	
Project #619551-01 Transition with Inlet		2023-06-26
Drawn by GES	Scale 1:25	Sheet 7 of 10 Tapered Beam

S:\Accreditation-17025-2017\EIR-000 Project Files\619551-01 - Transition with Inlet - Akram\Drafting, 619551\619551 Drawing

Post Details



Wingwall Post
Elevation View
Typical @ Posts 16 - 22



Wingwall Post
Plan View

8a. All welding must be performed by certified welders using industry standard practices.
8b. Galvanize all components after fabrication is complete.

Texas A&M Transportation Institute	Roadside Safety and Physical Security Division - Proving Ground	
Project #619551-01 Transition with Inlet		2023-06-26
Drawn by GES	Scale 1:5	Sheet 8 of 10 Post Details

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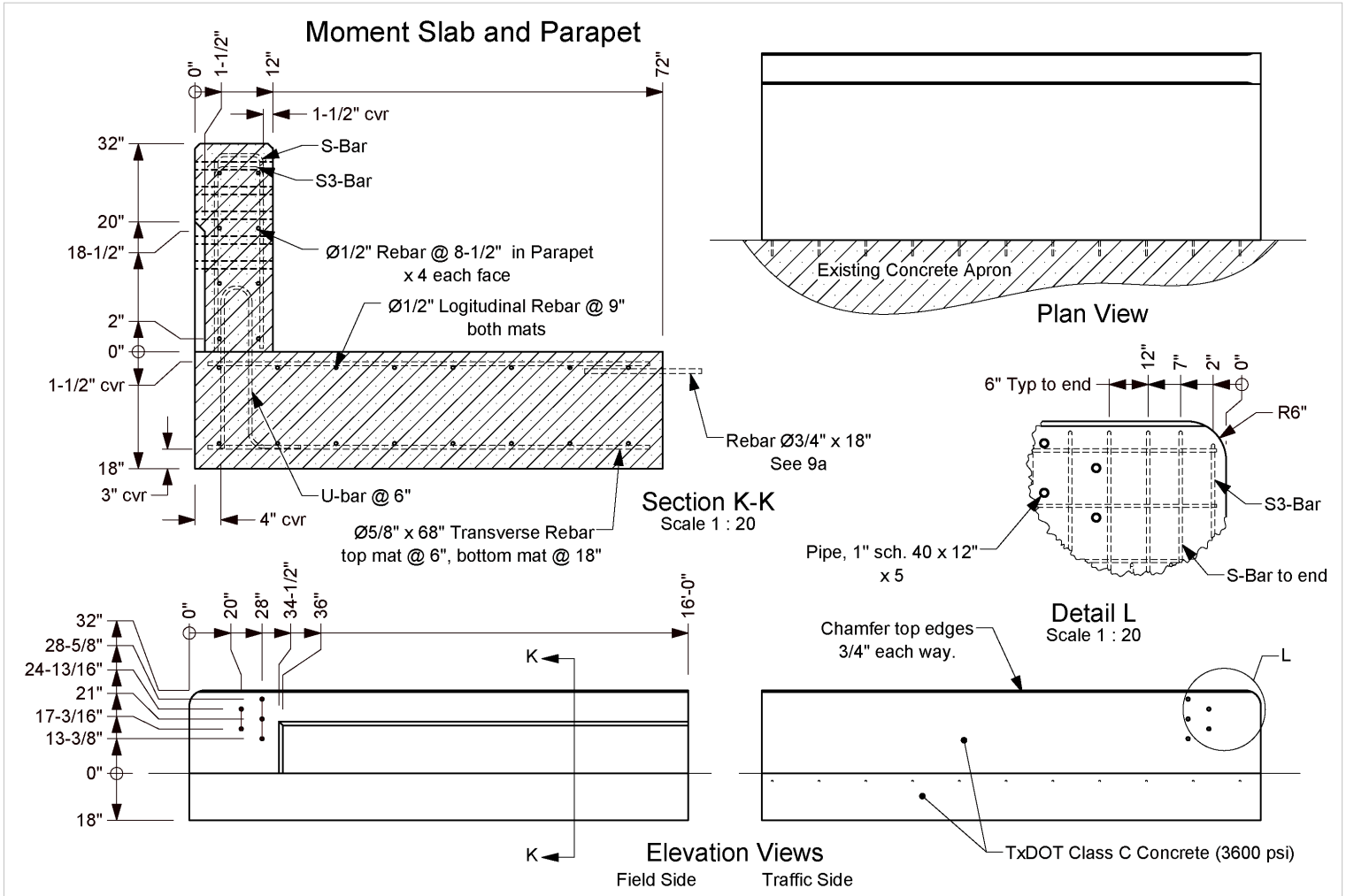


9a. Secure in existing concrete apron with Hilti HIT-RE 500 V3 epoxy according to manufacturer's instructions, with 6" embedment at 18" spacing.

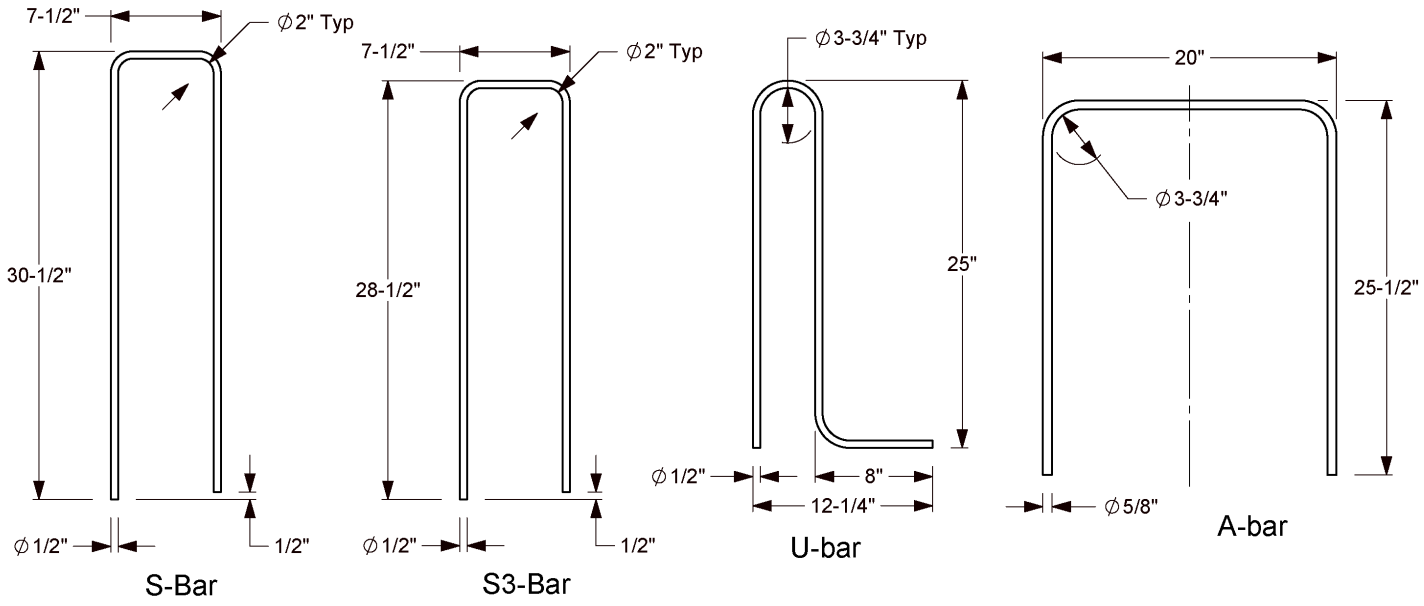
9b. All rebar dimensions are to center unless otherwise indicated by "cvr" (cover).

9c. All rebar is grade 60.

Texas A&M Transportation Institute		Roadside Safety and Physical Security Division - Proving Ground
Project #619551-01 Transition with Inlet		2023-06-26
Drawn by GES	Scale 1:50	Sheet 9 of 10 Moment Slab and Parapet

S:\Accreditation-17025-2017\EIR-000 Project Files\619551-01 - Transition with Inlet - Akram\Drafting, 619551\619551 Drawing

Rebar Bends



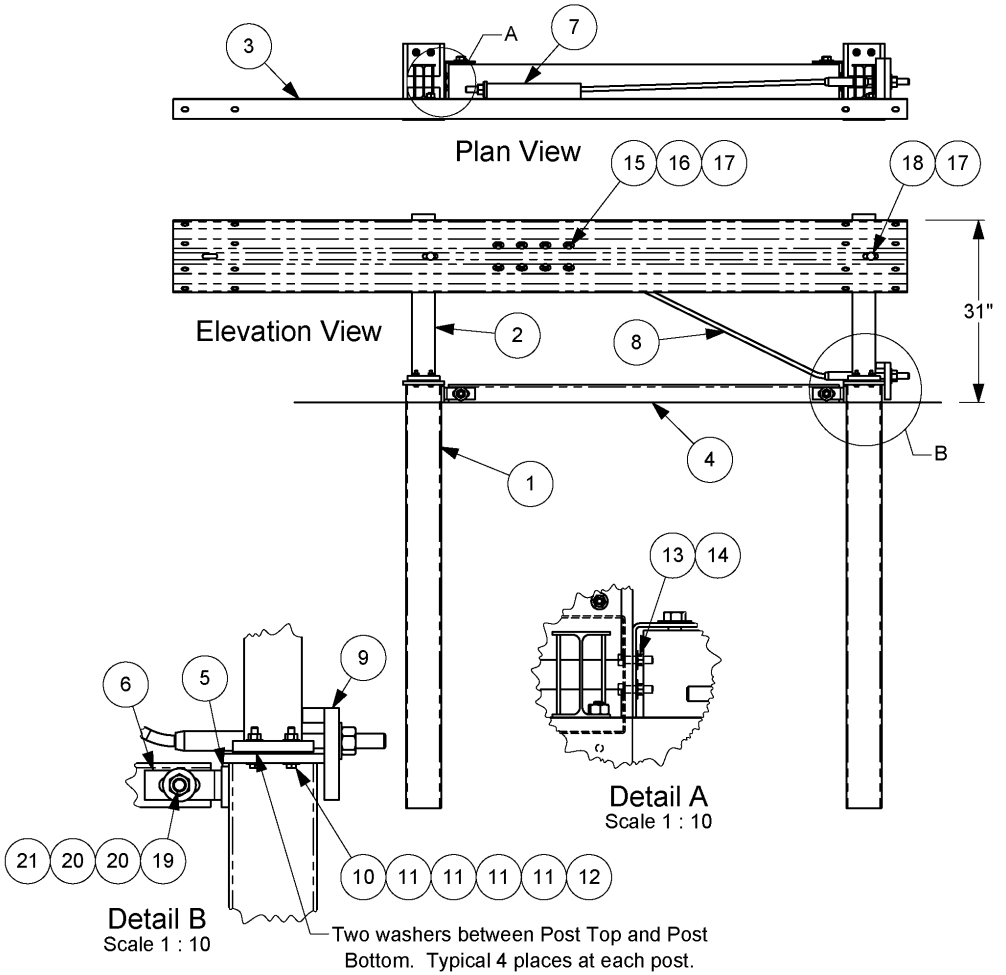
10a. All bars on this sheet are grade 60 rebar.

Texas A&M Transportation Institute	Roadside Safety and Physical Security Division - Proving Ground	
Project #619551-01 Transition with Inlet		2023-06-26
Drawn by GES	Scale 1:10	Sheet 10 of 10 Rebar Bends

S:\Accreditation-17025-2017\EIR-000 Project Files\619551-01 - Transition with Inlet - Akram\Drafting, 619551\619551 Drawing

Terminal Details

#	Part Name	QTY.
1	Post Bottom	2
2	Post Top	2
3	9'-4" span Terminal Rail	1
4	Strut	1
5	Strut Spacer	2
6	Strut Bracket	2
7	Guardrail Anchor Bracket	1
8	Anchor Cable Assembly	1
9	Bearing Plate	1
10	Bolt, 7/16 x 2 1/2" hex	8
11	Washer, 7/16 F844	32
12	Nut, 7/16 heavy hex	8
13	Nut, 1/2 hex	4
14	Washer, 1/2 F844	4
15	Bolt, 5/8 x 1 1/2" hex	8
16	Washer, 5/8 F844	8
17	Recessed Guardrail Nut	10
18	1-1/4" Guardrail Bolt	2
19	Bolt, 7/8 x 8 1/2" hex	2
20	Washer, 7/8 F844	4
21	Nut, 7/8 hex	2

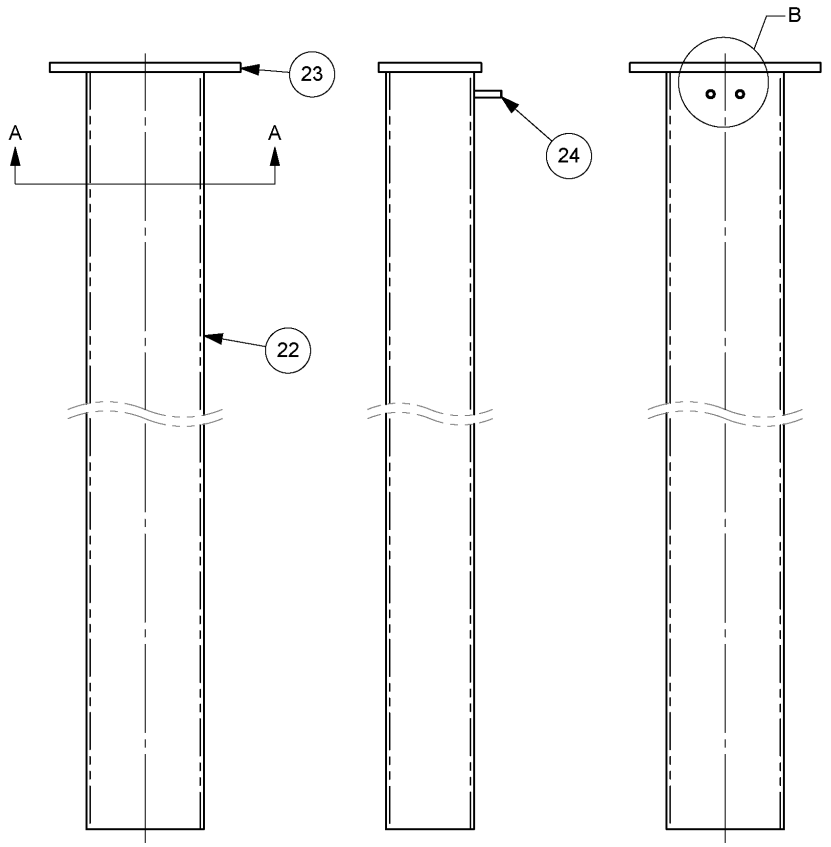


1a. 7/16" x 2-1/2" Bolts are ASTM A449. All other Bolts are ASTM A307. All Nuts (except Recessed Guardrail Nuts) are ASTM A563A unless otherwise indicated.

1c. All steel parts shall be galvanized.

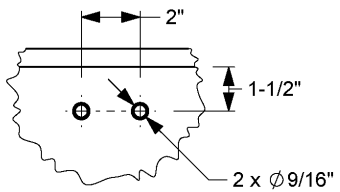
Texas A&M Transportation Institute	Roadside Safety and Physical Security Division - Proving Ground	
Project # Terminal		2022-07-08
Drawn by GES	Scale 1:25	Sheet 1 of 6 Terminal Details

T:\Drafting Department\Solidworks\Standard Parts\Guardrail Parts and Subs\Guardrail Drawings\Midwest Terminal

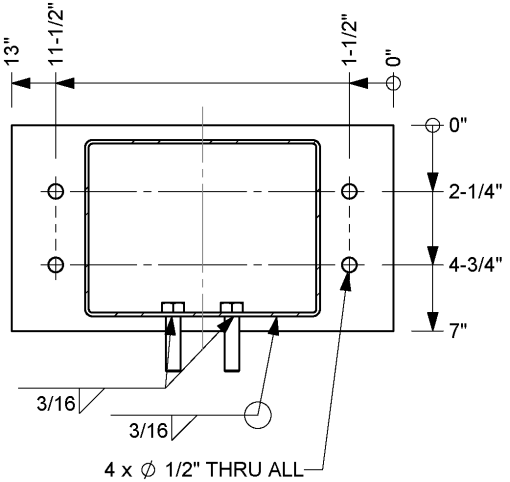


Elevation Views

Post Bottom



Detail B
Scale 1 : 5

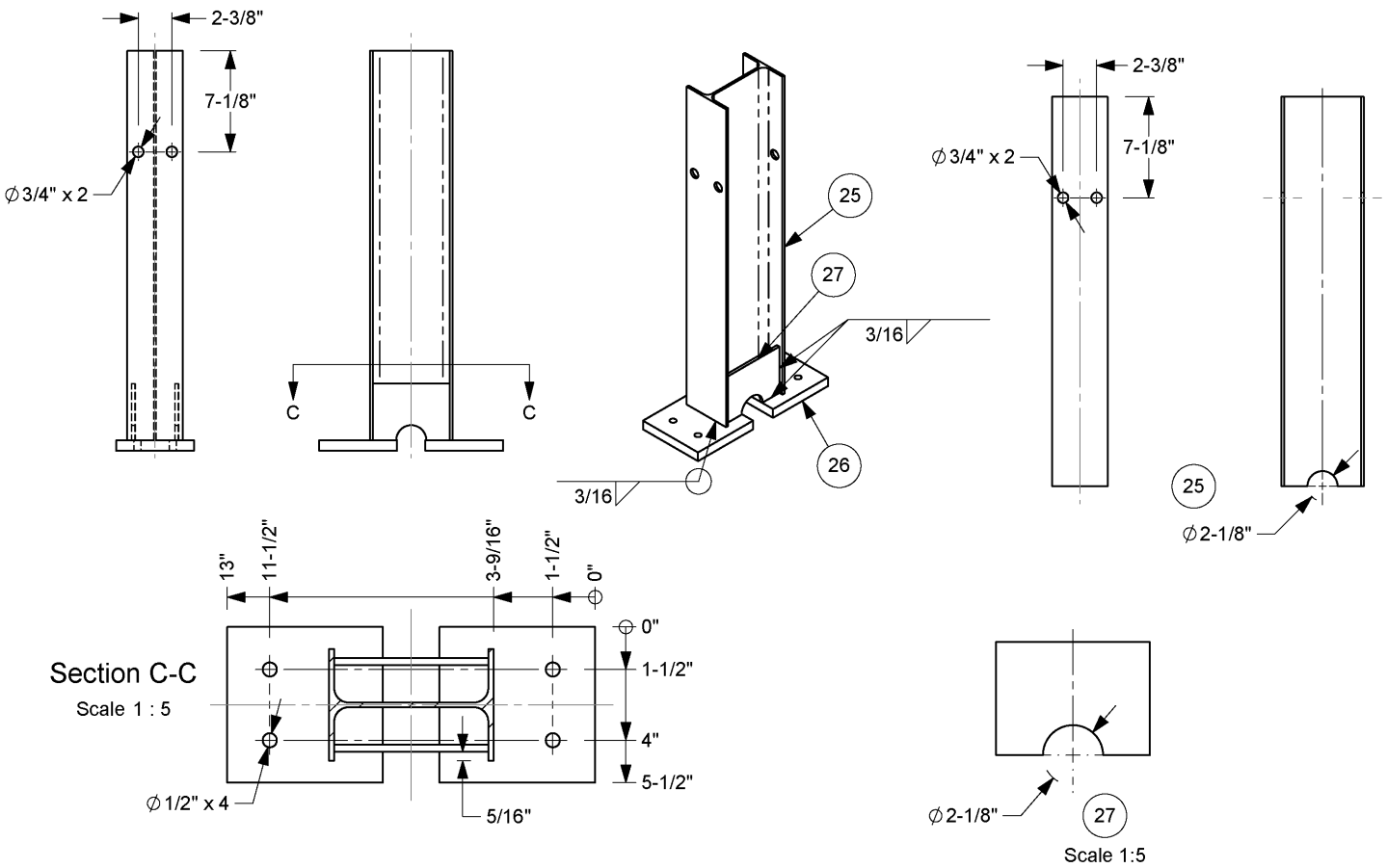


Section A-A
Scale 1 : 5

#	Description	Length	Material	Qty
22	HSS 8" x 6" x 1/8"	72"	ASTM A500 Grade B	1
23	Plate, 7" x 5/8"	13"	ASTM A36	1
24	Bolt, 1/2 x 2 hex		ASTM A307	2

Texas A&M Transportation Institute	Roadside Safety and Physical Security Division - Proving Ground	
Project # Terminal		2022-07-08
Drawn by GES	Scale 1:10	Sheet 2 of 6 Post Bottom

T:\Drafting Department\Solidworks\Standard Parts\Guardrail Parts and Subs\Guardrail Drawings\Midwest Terminal

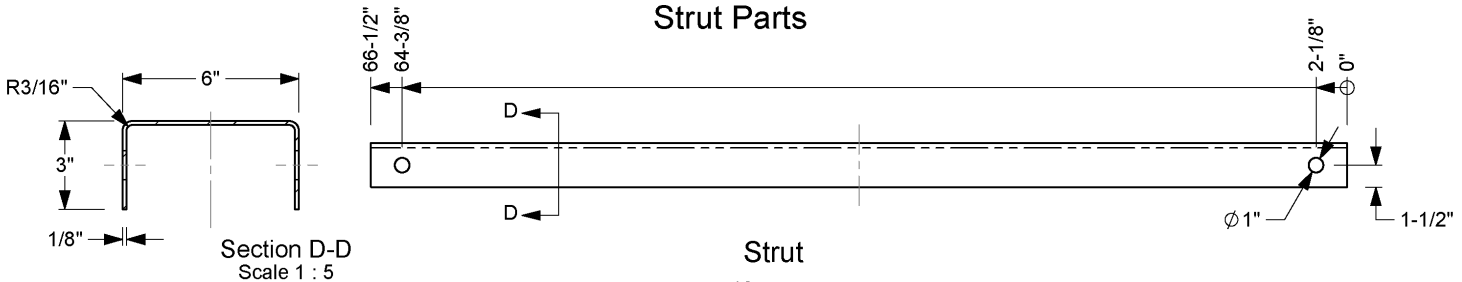


#	Description	Length	Material	Qty
25	W6x8.5	27 1/2"	ASTM A992	1
26	Plate, 5 1/2" x 3/4"	5 1/2"	ASTM A36	2
27	Plate, 5 7/16" x 1/4"	4"	ASTM A36	2

Texas A&M Transportation Institute	Roadside Safety and Physical Security Division - Proving Ground		
	Project # Terminal		2022-07-08
Drawn by GES	Scale 1:10	Sheet 3 of 6 Post Top	

T:\Drafting Department\Solidworks\Standard Parts\Guardrail Parts and Subs\Guardrail Drawings\Midwest Terminal

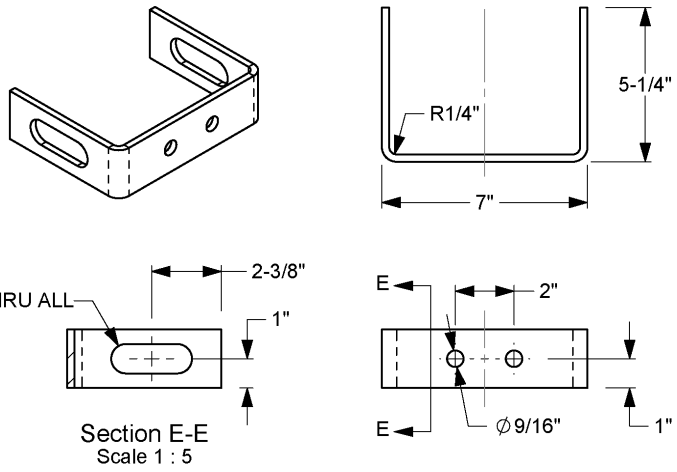
Strut Parts



Section D-D
Scale 1 : 5

Strut

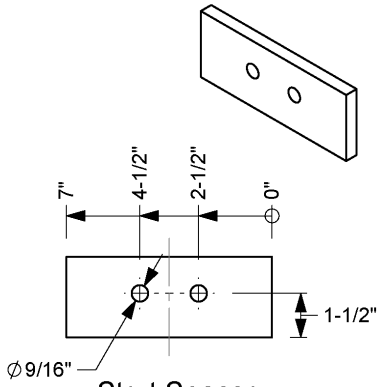
10 gauge
ASTM A36



Section E-E
Scale 1 : 5

Strut Bracket

Plate, 2" x 1/4"
ASTM A36 - Scale 1:5

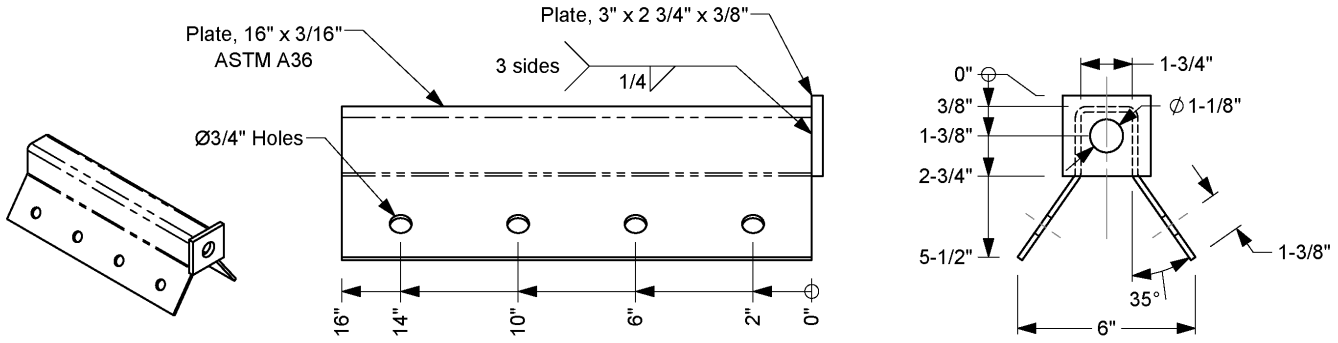


Strut Spacer

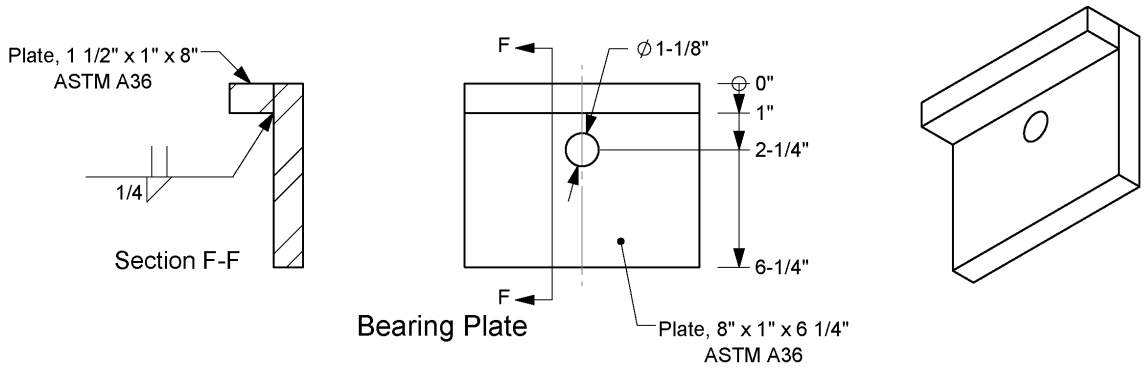
Plate, 2 3/4" x 1/2"
ASTM A36 - Scale 1:5

Texas A&M Transportation Institute	Roadside Safety and Physical Security Division - Proving Ground	
Project # Terminal		2022-07-08
Drawn by GES	Scale 1:10	Sheet 4 of 6 Strut Parts

T:\Drafting Department\Solidworks\Standard Parts\Guardrail Parts and Subs\Guardrail Drawings\Midwest Terminal



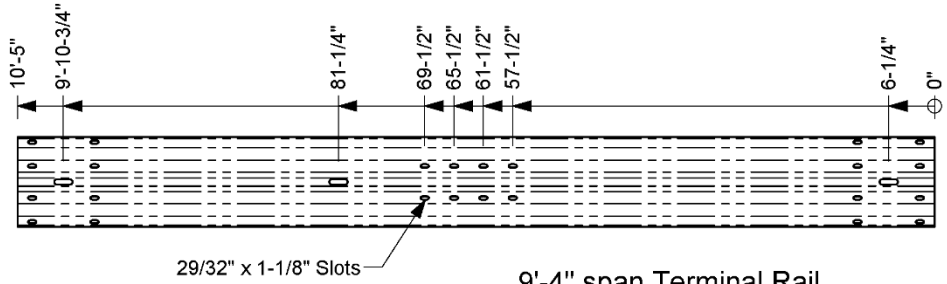
Guardrail Anchor Bracket



Bearing Plate

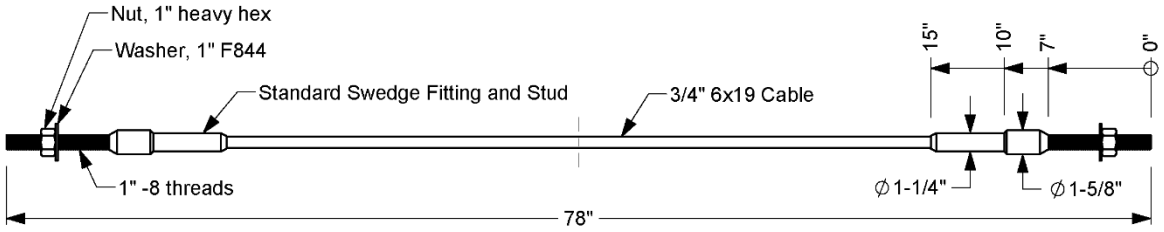
Texas A&M Transportation Institute	Roadside Safety and Physical Security Division - Proving Ground	
Project # Terminal		2022-07-08
Drawn by GES	Scale 1:5	Sheet 5 of 6 Assorted Parts A

T:\Drafting Department\Solidworks\Standard Parts\Guardrail Parts and Subs\Guardrail Drawings\Midwest Terminal



9'-4" span Terminal Rail

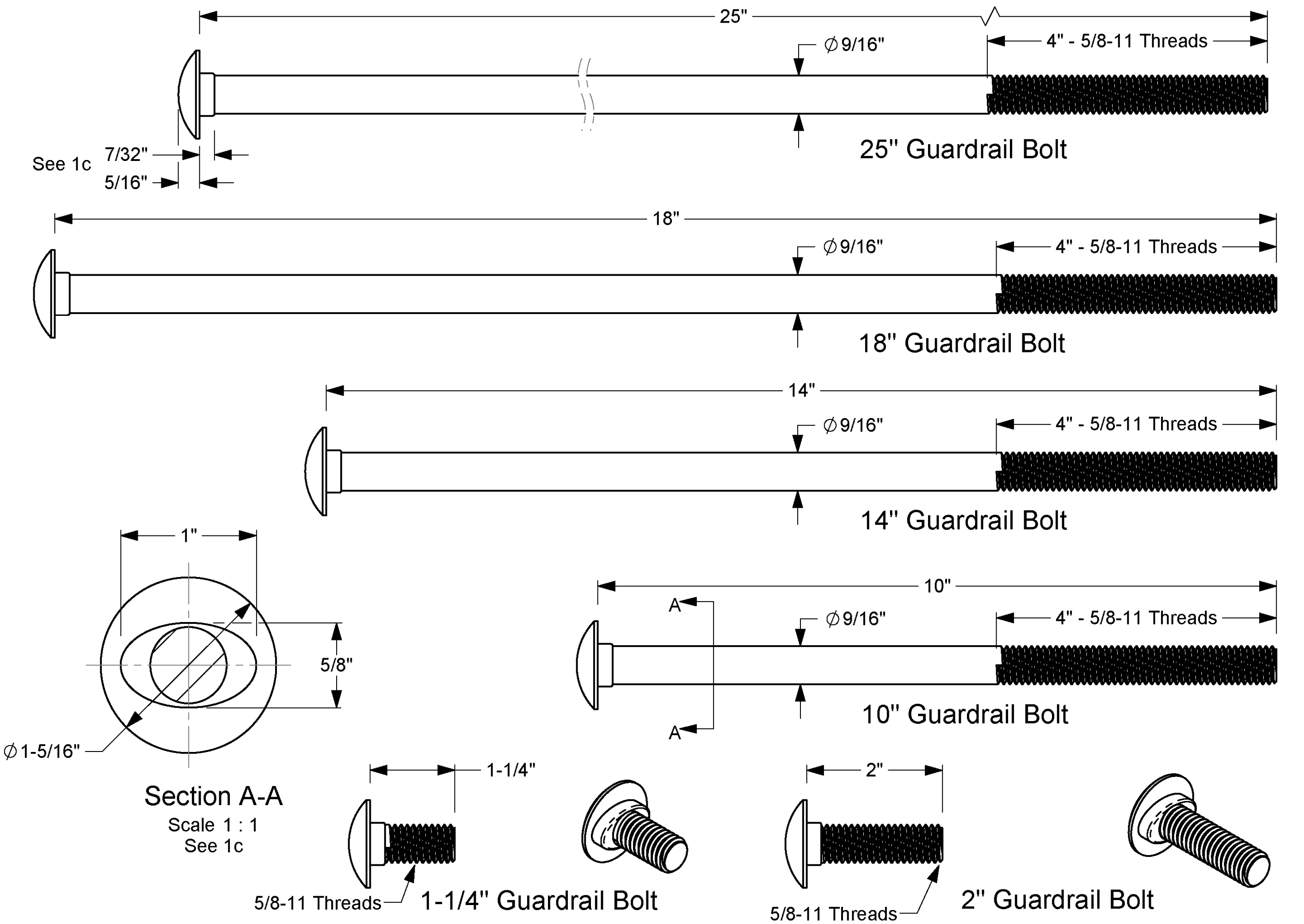
Scale 1:20 - See 4-space W-beam Guardrail drawing for cross-section and other dimensions.



Anchor Cable Assembly

Texas A&M Transportation Institute		Roadside Safety and Physical Security Division - Proving Ground	
Project # Terminal			2022-07-08
Drawn by GES	Scale 1:5	Sheet 6 of 6 Assorted Parts B	

T:\Drafting Department\Solidworks\Standard Parts\Guardrail Parts and Subs\Guardrail Drawings\Midwest Terminal

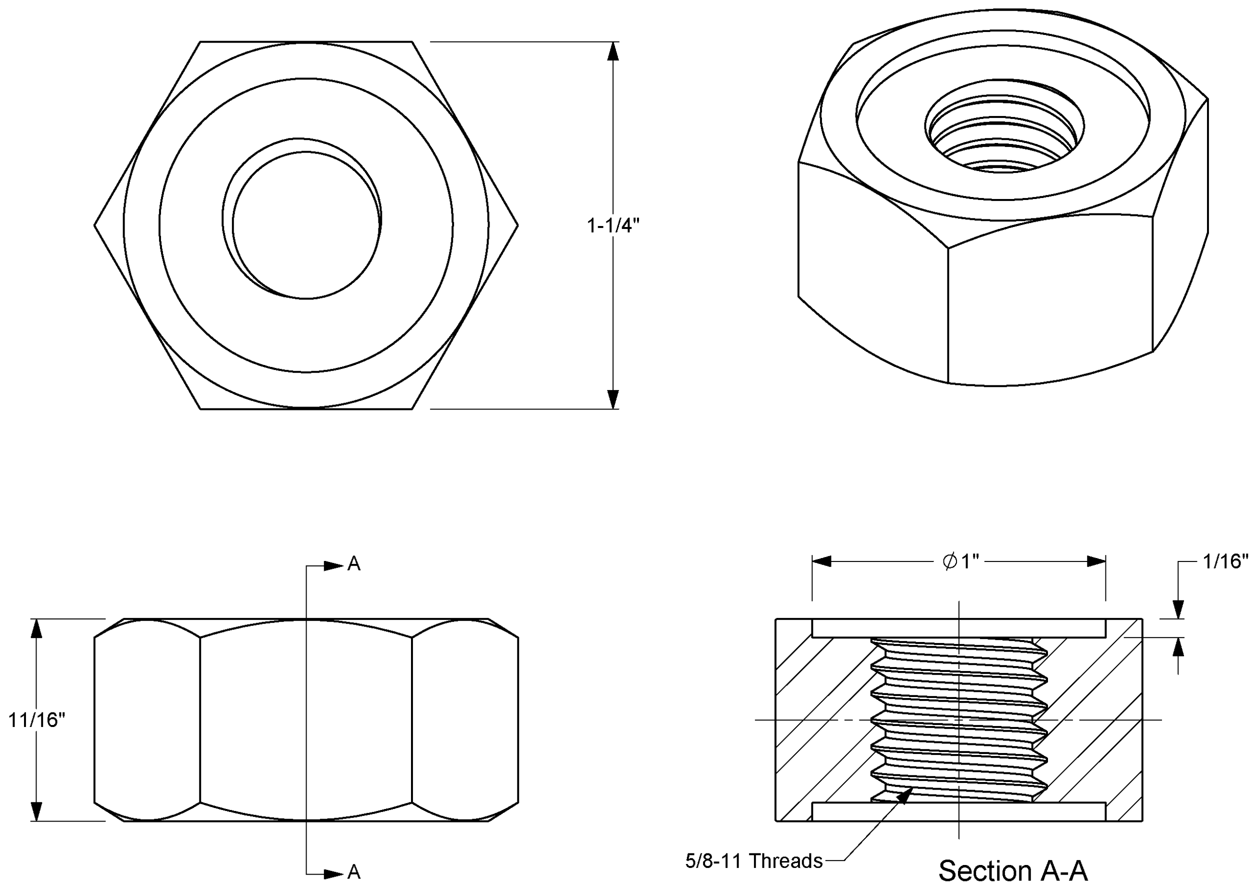


1a. Material is ASTM A307.
1b. All bolt sizes not used in all projects. See system drawing.
1c. Head and shoulder dimensions typical all lengths.

Texas A&M Transportation Institute	Roadside Safety and Physical Security Division - Proving Ground	
Guardrail Bolt		2020-07-08
Drawn by GES/WS	Scale 1:2	Sheet 1 of 1

T:\Drafting Department\Solidworks\Standard Parts\Guardrail Parts and Subs\Guardrail Drawings\Guardrail Bolt

Recessed Guardrail Nut



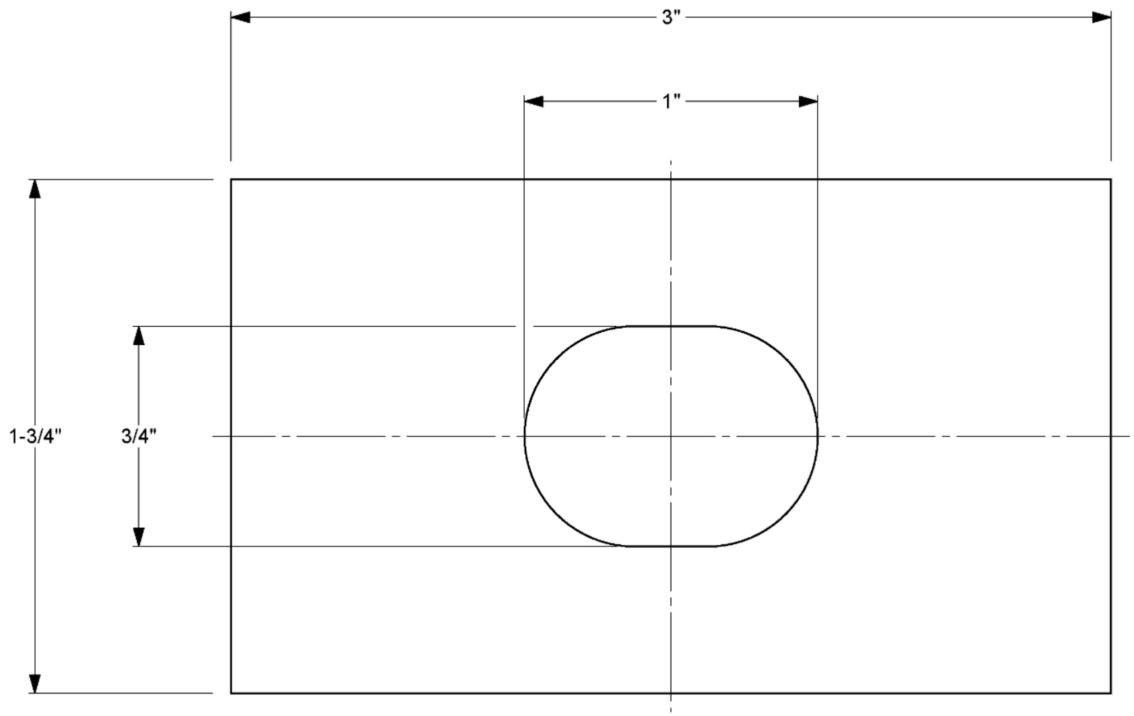
1a. Material is ASTM A 563 Grade A.

Texas A&M Transportation Institute		Roadside Safety and Physical Security Division - Proving Ground	
Recessed Guardrail Nut			2022-07-18
Drawn by GES	Scale 2:1	Sheet 1 of 1	

T:\Drafting Department\Solidworks\Standard Parts\Guardrail Parts and Subs\Guardrail Drawings\Nut, Recessed Guardrail

Rectangular Guardrail Washer

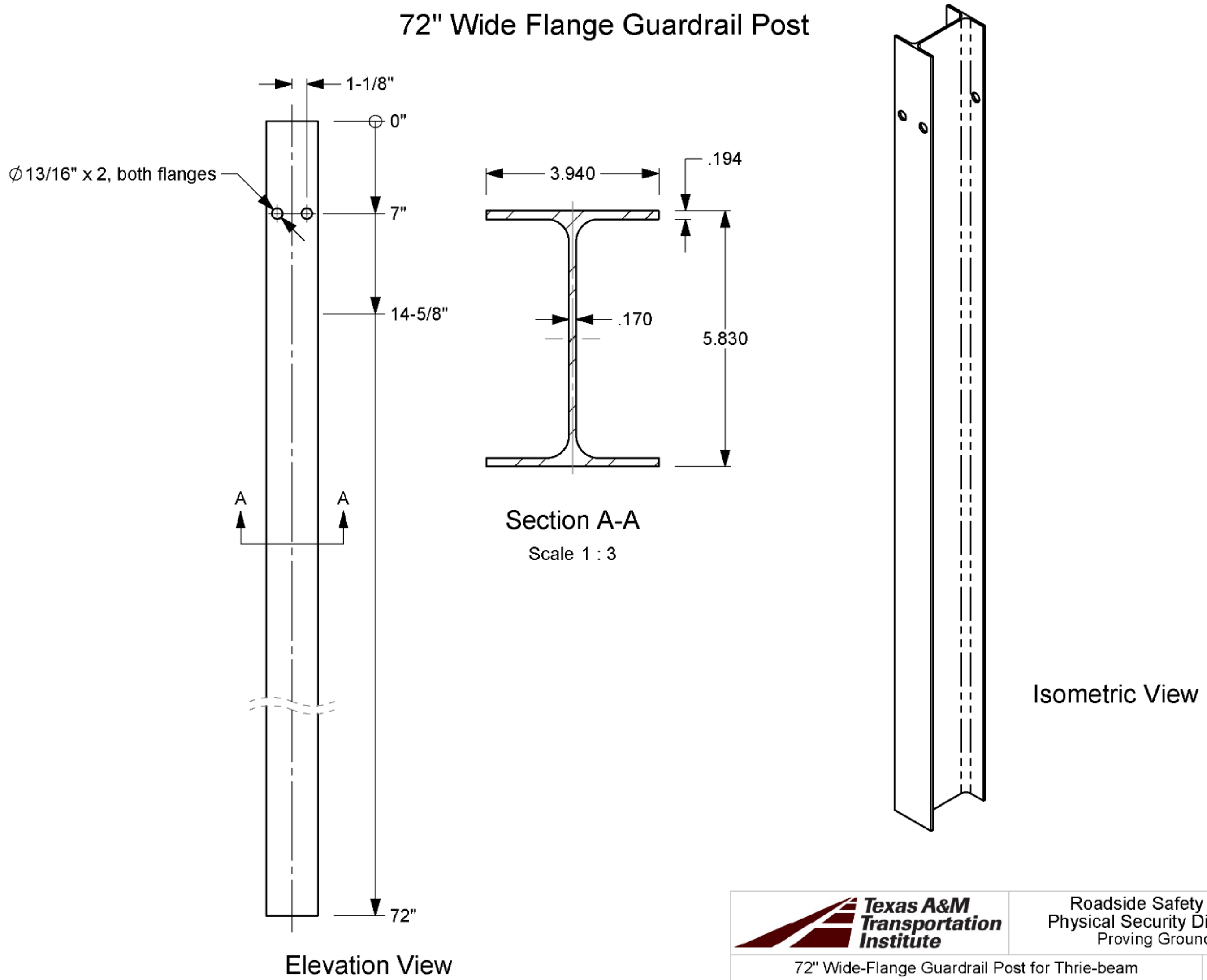
0.20" thick



Texas A&M Transportation Institute	Roadside Safety and Physical Security Division - Proving Ground	
Rectangular Guardrail Washer		2022-07-08
Drawn by GES	Scale 2:1	Sheet 1 of 1

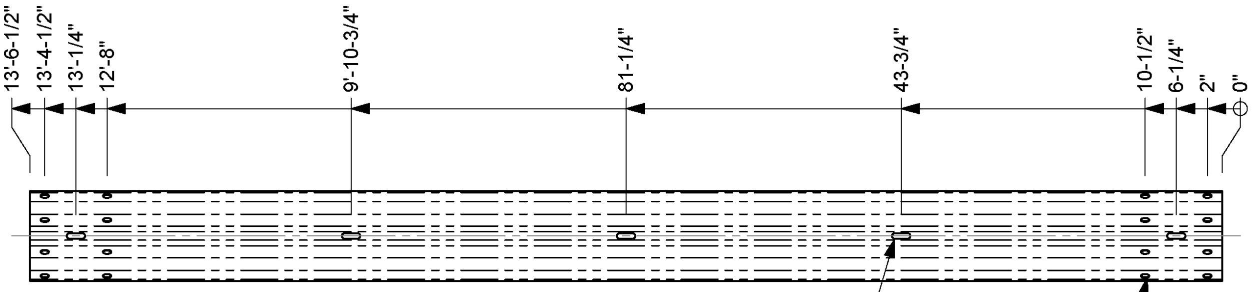
T:\Drafting Department\Solidworks\Standard Parts\Guardrail Parts and Subs\Guardrail Drawings\Washer, rect.

72" Wide Flange Guardrail Post

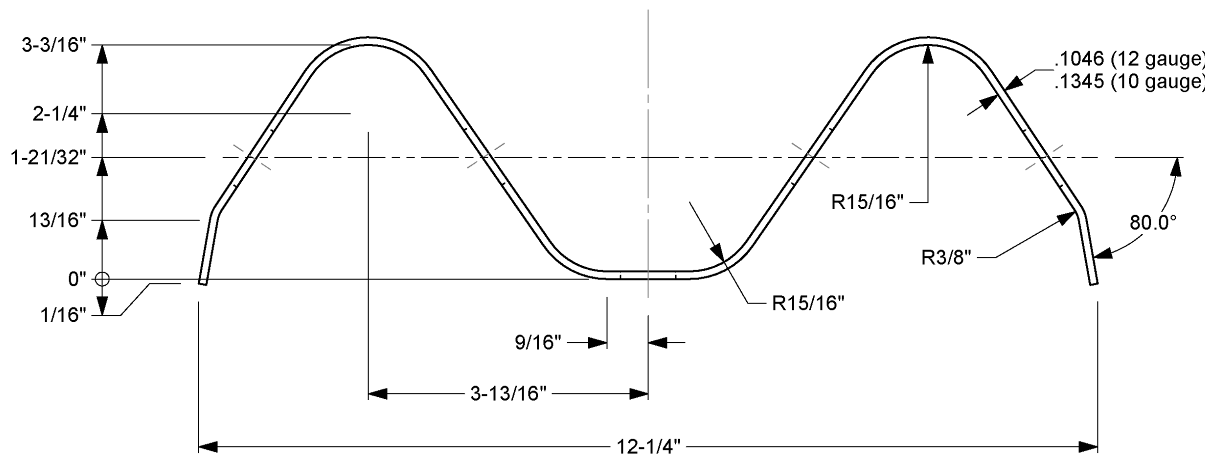


Texas A&M Transportation Institute	Roadside Safety and Physical Security Division - Proving Ground	
72" Wide-Flange Guardrail Post for Thrie-beam		2022-07-08
Drawn by GES	Scale 1:10	Sheet 1 of 1

T:\Drafting Department\Solidworks\Standard Parts\Guardrail Parts and Subs\Guardrail Drawings\Post, 72" Wide Flange for W-beam



Elevation View



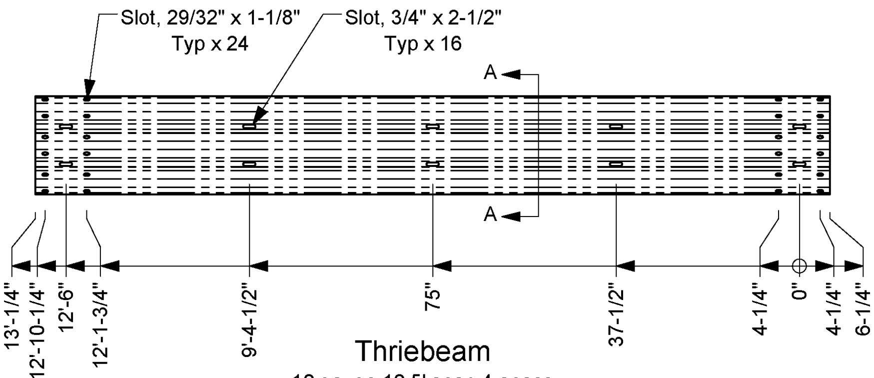
Section View

1a. Manufacture per AASHTO M180 specifications.

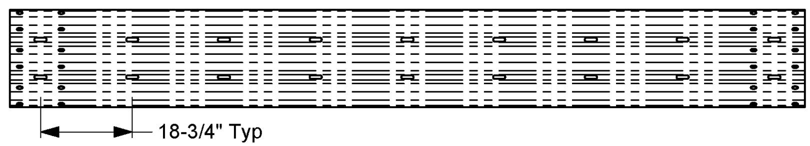
1b. 4-space Guardrail is shown. Slots typical x 3 for 2-space W-beam spaced at 75", and typical x 9 for 8-space W-beam spaced at 18-3/4". Slots are typical x 4 at 37-1/2" for 9'-4-1/2" span W-beam.

Texas A&M Transportation Institute		Roadside Safety and Physical Security Division - Proving Ground	
W-beam Guardrail			2022-07-13
Drawn by GES	Scale 1:20	Sheet 1 of 1	

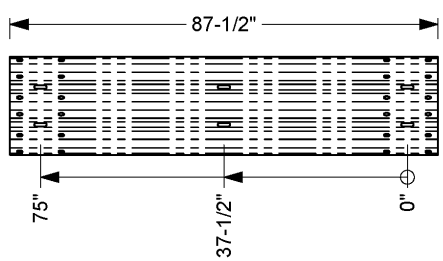
T:\Drafting Department\Solidworks\Standard Parts\Guardrail Parts and Subs\Guardrail Drawings\W-Beam Guardrail



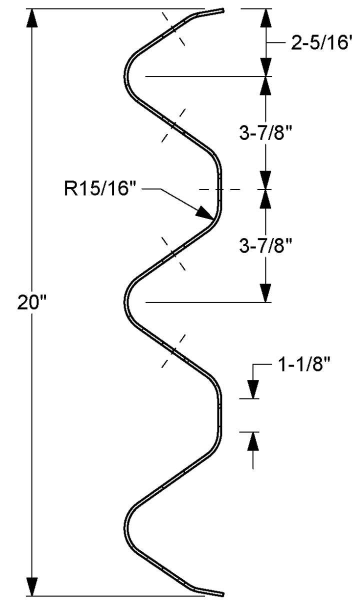
Thriebeam
12 gauge 12.5' span 4-space



Thriebeam
12 gauge 12.5' span 8-space
Dimensions not shown here same as 4-space Thriebeam



Thriebeam
12 gauge 75" span
Dimensions not shown here same as 4-space Thriebeam



Section A-A
Scale 1 : 5
Typical all Thriebeams

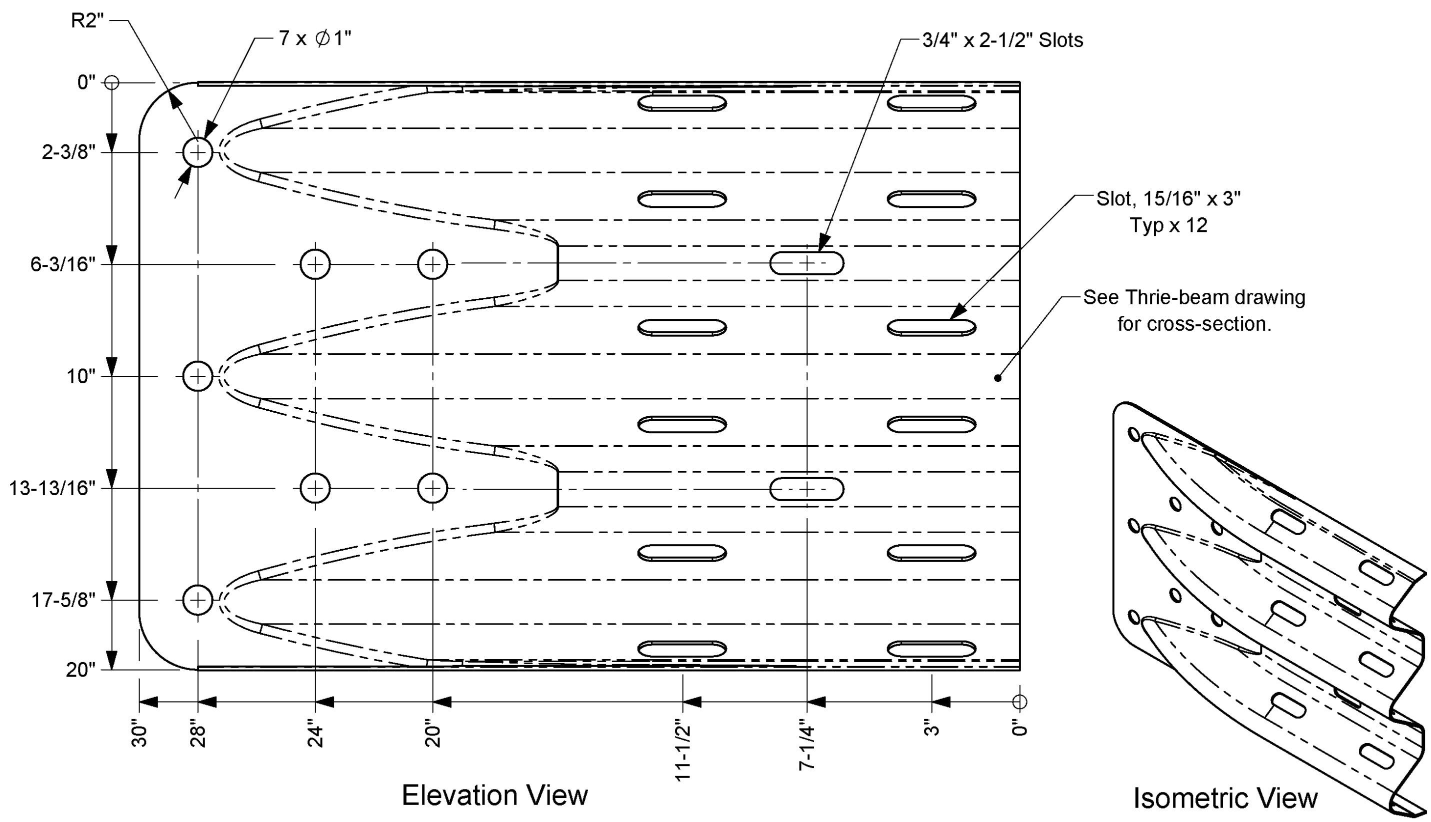
1a. 12 gauge is 0.1046" before galvanizing and 0.1084" after, and 10 gauge is 0.1345" before galvanizing and 0.1382" after.
1b. Not all versions shown here used in all installations.

Texas A&M Transportation Institute	Roadside Safety and Physical Security Division - Proving Ground	
Thrie-beam		2022-07-13
Drawn by GES	Scale 1:30	Sheet 1 of 1

T:\Drafting Department\Solidworks\Standard Parts\Guardrail Parts and Subs\Guardrail Drawings\Thrie-Beam

Thrie-beam End Shoe

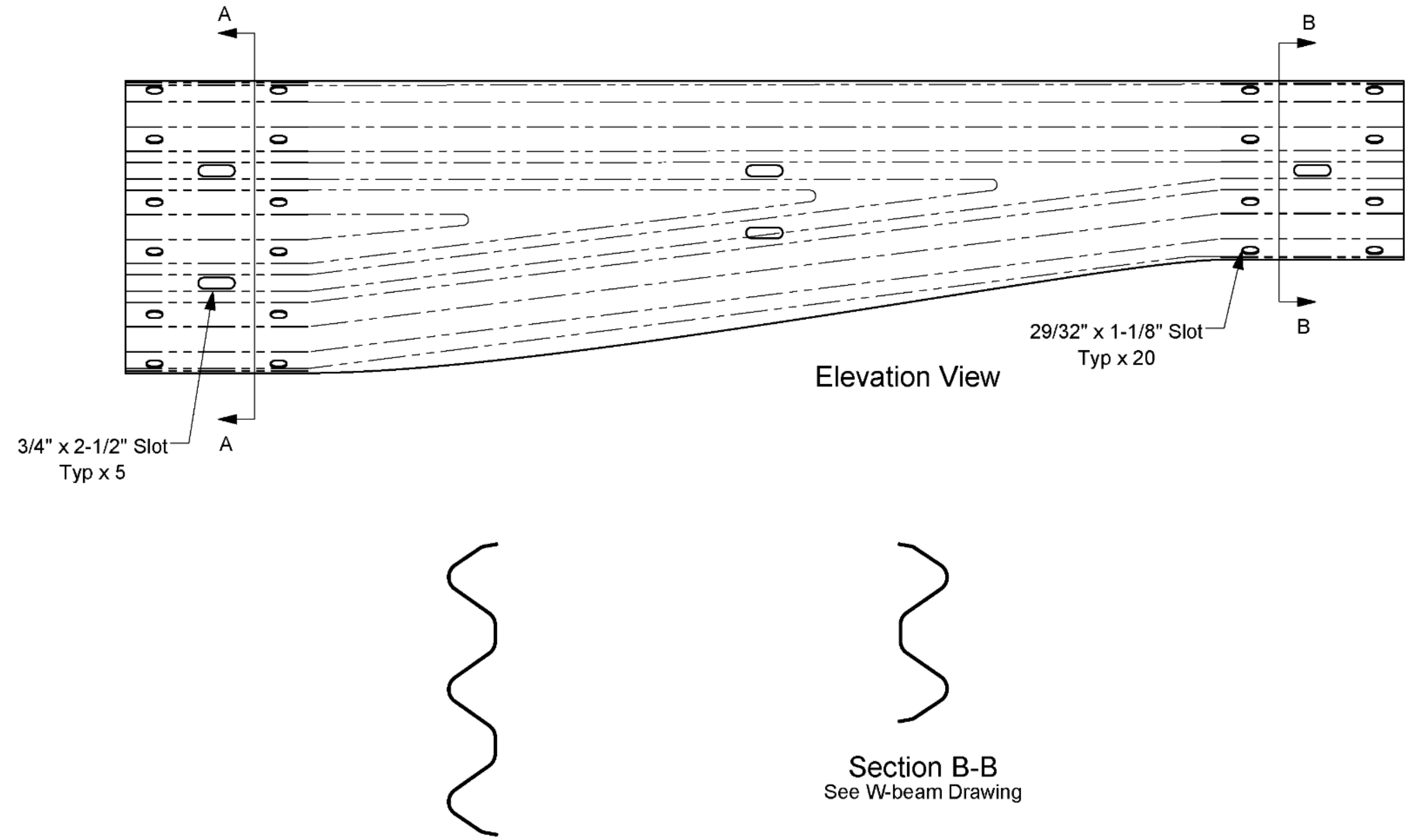
10 gauge (0.1345" before galvanizing)



Texas A&M Transportation Institute	Roadside Safety and Physical Security Division - Proving Ground	
Thrie-beam Terminal Connector		202-07-18
Drawn by GES	Scale 1:5	Sheet 1 of 1

Thrie to W-Beam, asymmetric

10 gauge



Section A-A
See Thrie-beam Drawing

Texas A&M Transportation Institute	Roadside Safety and Physical Security Division - Proving Ground
Thrie- to W-beam Asymmetric Transition	2022-07-18
Drawn by GES · Scale 1:10	Sheet 1 of 1

T:\Drafting Department\Solidworks\Standard Parts\Guardrail Parts and Subs\Guardrail Drawings\Thrie to W-Beam, asymmetric

APPENDIX B. SUPPORTING CERTIFICATION DOCUMENTS

Certified Analysis

615251

VALTIR

Valtir, LLC
2548 N.E. 28th St.
Ft Worth (THP), TX 76111 Phn:(817) 665-1499
Customer: TEXAS A&M TRANSPORTATION INSTI
ROADSIDE SAFETY & PHYSICA
BUSINESS OFFICE
3135 TAMU
COLLEGE STATION, TX 77843-3135
Project: STOCK

Order Number: 1352772 Prod Ln Grp: 0-OE2.0
Customer PO: 612541
BOL Number: 89568 Ship Date:
Document #: 1
Shipped To: TX
Use State: TX

As of: 11/11/22

Qty	Part #	Description	Spec	CL	TY	Heat Code/ Heat	Yield	TS	Elg	C	Mn	P	S	Si	Cu	Cb	Cr	Vn
4	11G	12/12'6/3'1.5/S			2	F13122												
			M-180	A	2	277506	65,000	84,374	24.3	0.200	0.790	0.016	0.004	0.010	0.120	0.000	0.080	0.001
			M-180	A	2	277540	59,744	76,903	26.9	0.180	0.740	0.010	0.004	0.010	0.100	0.001	0.050	0.002
			M-180	A	2	277541	61,280	79,207	25.9	0.190	0.730	0.010	0.002	0.020	0.100	0.001	0.040	0.001
	11G				2	F13922												
			M-180	A	2	279432	63,794	82,495	22.6	0.180	0.730	0.015	0.002	0.020	0.090	0.000	0.070	0.003
			M-180	A	2	279435	64,684	84,763	23.1	0.190	0.730	0.013	0.002	0.030	0.090	0.000	0.060	0.002
			M-180	A	2	279436	63,668	82,065	23.1	0.200	0.720	0.012	0.003	0.010	0.090	0.000	0.060	0.002
			M-180	A	2	279440	53,591	83,174	24.2	0.200	0.740	0.009	0.003	0.020	0.110	0.000	0.060	0.002
			M-180	A	2	279442	60,706	78,007	24.6	0.170	0.730	0.008	0.004	0.010	0.100	0.001	0.050	0.001
4	211G	T12/12'6/3'1.5/S				F12722												
			M-180	A		276319	61,591	79,925	24.4	0.190	0.750	0.011	0.002	0.020	0.110	0.000	0.100	0.001
			M-180	A		276319	61,591	79,925	24.4	0.190	0.750	0.011	0.002	0.020	0.110	0.000	0.100	0.001
			M-180	A		276349	60,441	80,006	25.8	0.190	0.730	0.009	0.003	0.010	0.110	0.000	0.080	0.001
			M-180	A		276349	60,441	80,006	25.8	0.190	0.730	0.009	0.003	0.010	0.110	0.000	0.080	0.001
			M-180	A		276350	60,512	80,175	23.4	0.190	0.740	0.009	0.005	0.010	0.120	0.000	0.070	0.001
			M-180	A		276350	60,512	80,175	23.4	0.190	0.740	0.009	0.005	0.010	0.120	0.000	0.070	0.001
			M-180	A		276351	60,982	80,245	23.0	0.190	0.740	0.009	0.003	0.010	0.120	0.000	0.080	0.001
			M-180	A		276351	60,982	80,245	23.0	0.190	0.740	0.009	0.003	0.010	0.120	0.000	0.080	0.001
			M-180	A		276800	60,651	80,504	24.4	0.190	0.720	0.008	0.003	0.020	0.090	0.000	0.060	0.001
			M-180	A		276800	60,651	80,504	24.4	0.190	0.720	0.008	0.003	0.020	0.090	0.000	0.060	0.001
9	533G	6'0 POST/8.5/DDR/7	A-36			1114803	54,500	67,500	28.3	0.070	0.840	0.007	0.022	0.230	0.130	0.015	0.040	0.002
	533G		A-36			2104723	54,000	66,200	26.0	0.070	80.000	0.013	0.020	0.200	0.100	0.014	0.040	0.002
	533G		A-36			59106347	62,348	76,348	27.0	0.080	0.970	0.013	0.018	0.170	0.290	0.013	0.150	0.001

Certified Analysis

VALTIR

Valtir, LLC
2548 N.E. 28th St.
Ft Worth (THP), TX 76111 Phn:(817) 665-1499
Customer: TEXAS A&M TRANSPORTATION INSTI
ROADSIDE SAFETY & PHYSICA
BUSINESS OFFICE
3135 TAMU
COLLEGE STATION, TX 77843-3135
Project: STOCK

Order Number: 1352772 Prod Ln Grp: 0-OE2.0
Customer PO: 612541
BOL Number: 89568 Ship Date:
Document #: 1
Shipped To: TX
Use State: TX

As of: 11/11/22

Qty	Part #	Description	Spec	CL	TY	Heat Code/ Heat	Yield	TS	Elg	C	Mn	P	S	Si	Cu	Cb	Cr	Vn
1	975G	T10/END SHOE	M-180	B	2	270936	48,995	60,112	35.8	0.050	0.480	0.012	0.003	0.020	0.110	0.000	0.070	0.001
24	3320G	3/16"X1.75"X3" WASHER	FAST			108093												
11	4076B	WD BLK RTD 6X8X14	WOOD			4850												
10	6149B	WD BLK RTD 6X8X18	WOOD			7080												
6	14784G	7'0 POST/8.5#/3HI TX	A-36			59106347	62,348	76,348	27.0	0.080	0.970	0.013	0.018	0.170	0.290	0.013	0.150	0.001
3	14785G	6'0 POST/8.5#/3HI TX/7:7	A-36			59106347	62,348	76,348	27.0	0.080	0.970	0.013	0.018	0.170	0.290	0.013	0.150	0.001
1	32218G	T10/TRAN/TB:WB/ASYM/RT	MISC			833M66260												

Upon delivery, all materials subject to Valtir, LLC Storage Stain Policy QMS-LQ-002.

ALL STEEL USED WAS MELTED AND MANUFACTURED IN USA AND COMPLIES WITH THE BUY AMERICA ACT, 23 CFR 635.410.
ALL GUARDRAIL MEETS AASHTO M-180, ALL STRUCTURAL STEEL MEETS ASTM A36 UNLESS OTHERWISE STATED.

ALL COATINGS PROCESSES OF THE STEEL OR IRON ARE PERFORMED IN USA AND COMPLIES WITH THE "BUY AMERICA ACT", 23 CFR 635.410.
ALL GALVANIZED MATERIAL CONFORMS WITH ASTM A-123 (US DOMESTIC SHIPMENTS)
ALL GALVANIZED MATERIAL CONFORMS WITH ASTM A-123 & ISO 1461 (INTERNATIONAL SHIPMENTS)

FINISHED GOOD PART NUMBERS ENDING IN SUFFIX B,P, OR S, ARE UNCOATED

Certified Analysis

VALTIR

Valtir, LLC
2548 N.E. 28th St.
Ft Worth (THP), TX 76111 Phn:(817) 665-1499
Customer: TEXAS A&M TRANSPORTATION INSTI
ROADSIDE SAFETY & PHYSICA
BUSINESS OFFICE
3135 TAMU
COLLEGE STATION, TX 77843-3135

Order Number: 1352772 Prod Ln Grp: 0-OE2.0
Customer PO: 612541
BOL Number: 89568 Ship Date:
Document #: 1
Shipped To: TX
Use State: TX

As of: 11/11/22

Project: STOCK

BOLTS COMPLY WITH ASTM A-307 SPECIFICATIONS AND ARE GALVANIZED IN ACCORDANCE WITH ASTM A-153, UNLESS OTHERWISE STATED.

NUTS COMPLY WITH ASTM A-563 SPECIFICATIONS AND ARE GALVANIZED IN ACCORDANCE WITH ASTM A-153, UNLESS OTHERWISE STATED.
WASHERS COMPLY WITH ASTM F-436 SPECIFICATION AND/OR F-844 AND ARE GALVANIZED IN ACCORDANCE WITH ASTM F-2329, UNLESS OTHERWISE STATED.
3/4" DIA CABLE 6X19 ZINC COATED SWAGED END AISI C-1035 STEEL ANNEALED STUD 1" DIA ASTM 449 AASHTO M30, TYPE II BREAKING STRENGTH – 46000 LB

State of Texas, County of Tarrant. Sworn and subscribed before me this 11 st day of November, 2022 .

Notary Public:
Commission Expires: / /

Angela Ruth Humphrey
My Commission Expires
6/24/2026
Notary ID 133827723

Valtir, LLC
Certified By:
Quality Assurance

Certified Analysis

VALTIR

Valtir, LLC
2548 N.E. 28th St.
Ft Worth (THP), TX 76111 Phn:(817) 665-1499
Customer: TEXAS A&M TRANSPORTATION INSTI
ROADSIDE SAFETY & PHYSICA
BUSINESS OFFICE
3135 TAMU
COLLEGE STATION, TX 77843-3135
Project: STOCK

Order Number: 1353394 Prod Ln Grp: 0-OE2.0
Customer PO: 615251
BOL Number: 89569 Ship Date:
Document #: 1
Shipped To: TX
Use State: TX

As of: 11/11/22

Qty	Part #	Description	Spec	CL	TY	Heat Code/ Heat	Yield	TS	Elg	C	Mn	P	S	Si	Cu	Cb	Cr	Vn
4	11G	12/12'6/3'1.5/S			2	F13122												
			M-180	A	2	277506	65,000	84,374	24.3	0.200	0.790	0.016	0.004	0.010	0.120	0.000	0.080	0.001
			M-180	A	2	277540	59,744	76,903	26.9	0.180	0.740	0.010	0.004	0.010	0.100	0.001	0.050	0.002
			M-180	A	2	277541	61,280	79,207	25.9	0.190	0.730	0.010	0.002	0.020	0.100	0.001	0.040	0.001
	11G				2	F13222												
			M-180	A	2	2122871	58,100	81,100	23.0	0.210	0.750	0.009	0.003	0.020	0.070	0.002	0.040	0.003
			M-180	A	2	2122872	50,800	74,300	26.0	0.220	0.790	0.009	0.002	0.030	0.080	0.001	0.040	0.003
			M-180	A	2	2122872	61,000	83,300	,999.0	0.220	0.790	0.009	0.002	0.030	0.080	0.000	0.040	0.003
			M-180	A	2	277506	65,000	84,374	24.3	0.200	0.790	0.016	0.004	0.010	0.120	0.000	0.080	0.001
			M-180	A	2	277540	59,744	76,903	26.9	0.180	0.740	0.010	0.004	0.010	0.100	0.001	0.050	0.002
			M-180	A	2	277541	61,280	79,207	25.9	0.190	0.730	0.010	0.002	0.020	0.100	0.001	0.040	0.001
			M-180	A	2	277542	61,872	79,516	25.8	0.200	0.760	0.009	0.005	0.010	0.100	0.000	0.050	0.001
8	533G	6'0 POST/8.5/DDR/7	A-36			1114803	54,500	67,500	28.3	0.070	0.840	0.007	0.022	0.230	0.130	0.015	0.040	0.002
	533G		A-36			2104723	54,000	66,200	26.0	0.070	80.000	0.013	0.020	0.200	0.100	0.014	0.040	0.002
	533G		A-36			59106347	62,348	76,348	27.0	0.080	0.970	0.013	0.018	0.170	0.290	0.013	0.150	0.001
40	3320G	3/16"X1.75"X3" WASHER	FAST			108093												
135	3340G	5/8" GR HEX NUT	FAST			22-35-011												
40	3360G	5/8"X1.25" GR BOLT	A307-3360G			A15007-8												
40	3400G	5/8"X2" GR BOLT	A307-3400G			A14956-9												
15	3500G	5/8"X10" GR BOLT A307	A307-3500G			A20068-2												

Certified Analysis

VALTIR

Valtir, LLC
2548 N.E. 28th St.
Ft Worth (THP), TX 76111 Phn:(817) 665-1499
Customer: TEXAS A&M TRANSPORTATION INSTI
ROADSIDE SAFETY & PHYSICA
BUSINESS OFFICE
3135 TAMU
COLLEGE STATION, TX 77843-3135

Project: STOCK

Order Number: 1353394 Prod Ln Grp: 0-OE2.0
Customer PO: 615251
BOL Number: 89569 Ship Date:
Document #: 1
Shipped To: TX
Use State: TX

As of: 11/11/22

Qty	Part #	Description	Spec	CL	TY	Heat Code/ Heat	Yield	TS	Elg	C	Mn	P	S	Si	Cu	Cb	Cr	Vn
14	4076B	WD BLK RTD 6X8X14	WOOD			4850												
6	6149B	WD BLK RTD 6X8X18	WOOD			7080												
2	10967G	12/9'4.5/3'1.5/S			2	F14522												
			M-180	A	2	279437	63,668	82,065	23.1	0.200	0.720	0.012	0.003	0.010	0.090	0.000	0.060	0.002
			M-180	A	2	281434	61,121	79,287	26.0	0.180	0.740	0.014	0.004	0.010	0.120	0.000	0.050	0.004
			M-180	A	2	281442	61,762	80,996	25.6	0.019	0.730	0.012	0.004	0.010	0.110	0.000	0.060	0.002
			M-180	A	2	281442	61,762	80,996	25.6	0.019	0.730	0.012	0.004	0.010	0.110	0.000	0.060	0.002
	10967G		RHC		2	L12822												
			M-180	A	2	275639	62,212	82,063	25.3	0.190	0.073	0.014	0.003	0.020	0.140	0.000	0.080	0.002
			M-180	A	2	275642	63,791	82,357	23.2	0.190	0.740	0.015	0.005	0.010	0.120	0.000	0.100	0.002
			M-180	A	2	275875	61,764	79,897	23.9	0.190	0.730	0.011	0.001	0.010	0.110	0.000	0.060	0.002
			M-180	A	2	276471	61,104	80,038	25.5	0.190	0.720	0.011	0.003	0.010	0.110	0.000	0.050	0.001
			M-180	A	2	276472	62,468	79,978	25.4	0.200	0.730	0.011	0.002	0.010	0.110	0.000	0.050	0.001
			M-180	A	2	276474	63,174	81,018	24.8	0.190	0.720	0.009	0.002	0.020	0.100	0.000	0.060	0.001
			M-180	A	2	276477	61,527	80,001	24.7	0.190	0.720	0.012	0.005	0.010	0.100	0.000	0.060	0.001
			M-180	A	2	276478	60,258	79,671	21.8	0.200	0.740	0.010	0.005	0.010	0.110	0.000	0.050	0.002
			M-180	A	2	276480	62,278	80,531	24.5	0.200	0.720	0.010	0.004	0.010	0.100	0.001	0.050	0.002
			M-180	A	2	276481	60,277	78,610	23.2	0.190	0.740	0.009	0.004	0.010	0.110	0.000	0.050	0.001
			M-180	A	2	276800	60,651	80,504	24.4	0.190	0.720	0.008	0.003	0.020	0.090	0.001	0.060	0.000
2	12365G	T12/12'6/8@1'6.75/S				F14522												
			M-180	A		279437	63,668	82,065	23.1	0.200	0.720	0.012	0.003	0.010	0.090	0.000	0.060	0.002
			M-180	A		281434	61,121	79,287	26.0	0.180	0.740	0.014	0.004	0.010	0.120	0.000	0.050	0.004
			M-180	A		281442	61,762	80,996	25.6	0.019	0.730	0.012	0.004	0.010	0.110	0.000	0.060	0.002

Certified Analysis

VALTIR

Valtir, LLC
2548 N.E. 28th St.
Ft Worth (THP), TX 76111 Phn:(817) 665-1499
Customer: TEXAS A&M TRANSPORTATION INSTI
ROADSIDE SAFETY & PHYSICA
BUSINESS OFFICE
3135 TAMU
COLLEGE STATION, TX 77843-3135

Order Number: 1353394 Prod Ln Grp: 0-OE2.0
Customer PO: 615251
BOL Number: 89569 Ship Date:
Document #: 1
Shipped To: TX
Use State: TX

As of: 11/11/22

Project: STOCK

Qty	Part #	Description	Spec	CL	TY	Heat Code/ Heat	Yield	TS	Elg	C	Mn	P	S	Si	Cu	Cb	Cr	Vn
			M-180	A		281442	61,762	80,996	25.6	0.019	0.730	0.012	0.004	0.010	0.110	0.000	0.060	0.002
	12365G		RHC		2	L31318												
			M-180	A	2	222038	63,780	82,280	22.9	0.190	0.750	0.012	0.002	0.030	0.100	0.000	0.070	0.001
			M-180	A	2	222878	64,680	81,820	25.2	0.180	0.740	0.012	0.003	0.020	0.130	0.000	0.070	0.002
	12365G		RHC		2	L34919												
			M-180	A	2	245021	64,480	83,940	22.2	0.190	0.700	0.013	0.004	0.020	0.060	0.000	0.060	0.001
			M-180	A	2	245984	62,860	80,840	26.2	0.190	0.720	0.008	0.003	0.010	0.080	0.000	0.050	0.000
1	32218G	T10/TRAN/TB:WB/ASYM/RT	MISC			833M66260												

Upon delivery, all materials subject to Valtir, LLC Storage Stain Policy QMS-LQ-002.

ALL STEEL USED WAS MELTED AND MANUFACTURED IN USA AND COMPLIES WITH THE BUY AMERICA ACT, 23 CFR 635.410.
ALL GUARDRAIL MEETS AASHTO M-180, ALL STRUCTURAL STEEL MEETS ASTM A36 UNLESS OTHERWISE STATED.

ALL COATINGS PROCESSES OF THE STEEL OR IRON ARE PERFORMED IN USA AND COMPLIES WITH THE "BUY AMERICA ACT", 23 CFR 635.410.
ALL GALVANIZED MATERIAL CONFORMS WITH ASTM A-123 (US DOMESTIC SHIPMENTS)
ALL GALVANIZED MATERIAL CONFORMS WITH ASTM A-123 & ISO 1461 (INTERNATIONAL SHIPMENTS)

FINISHED GOOD PART NUMBERS ENDING IN SUFFIX B,P, OR S, ARE UNCOATED

BOLTS COMPLY WITH ASTM A-307 SPECIFICATIONS AND ARE GALVANIZED IN ACCORDANCE WITH ASTM A-153, UNLESS OTHERWISE STATED.

NUTS COMPLY WITH ASTM A-563 SPECIFICATIONS AND ARE GALVANIZED IN ACCORDANCE WITH ASTM A-153, UNLESS OTHERWISE STATED.
WASHERS COMPLY WITH ASTM F-436 SPECIFICATION AND/OR F-844 AND ARE GALVANIZED IN ACCORDANCE WITH ASTM F-2329, UNLESS OTHERWISE STATED.
3/4" DIA CABLE 6X19 ZINC COATED SWAGED END AISI C-1035 STEEL ANNEALED STUD 1" DIA ASTM 449 AASHTO M30, TYPE II BREAKING STRENGTH – 46000 LB

Certified Analysis

VALTIR

Valtir, LLC
2548 N.E. 28th St.
Ft Worth (THP), TX 76111 Phn:(817) 665-1499
Customer: TEXAS A&M TRANSPORTATION INSTI
ROADSIDE SAFETY & PHYSICA
BUSINESS OFFICE
3135 TAMU
COLLEGE STATION, TX 77843-3135

Order Number: 1353394 Prod Ln Grp: 0-OE2.0
Customer PO: 615251
BOL Number: 89569 Ship Date:
Document #: 1
Shipped To: TX
Use State: TX

As of: 11/11/22

Project: STOCK

State of Texas, County of Tarrant. Sworn and subscribed before me this 11st day of November, 2022 .

Notary Public:
Commission Expires: / /

Angela Ruth Humphrey
My Commission Expires
6/24/2026
Notary ID 133827723

Angela Ruth Humphrey

Certified By: Valtir LLC

Quality Assurance

Certified Analysis

615251
A-frm
inlet

VALTIR

Valtir, LLC
2548 N.E. 28th St.
Ft Worth (THP), TX 76111 Phn:(817) 665-1499
Customer: TEXAS A&M TRANSPORTATION INSTI
ROADSIDE SAFETY & PHYSICA
BUSINESS OFFICE
3135 TAMU
COLLEGE STATION, TX 77843-3135
Project: STOCK

Order Number: 1358011 Prod Ln Grp: 0-OE2.0
Customer PO: 615251
BOL Number: 91067 Ship Date:
Document #: 1
Shipped To: TX
Use State: TX

As of: 5/19/23

Qty	Part #	Description	Spec	CL	TY	Heat Code/ Heat	Yield	TS	Elg	C	Mn	P	S	Si	Cu	Cb	Cr	Vn
1	975G	T10/END SHOE	M-180	B		279257	48,897	60,212	37.8	0.050	0.470	0.010	0.002	0.020	0.090	0.001	0.060	0.001
2	12365G	T12/12'6/8@1'6.75/S				F11523												
			M-180		A	285738	63,677	82,257	22.4	0.200	0.740	0.008	0.002	0.020	0.100	0.001	0.060	0.002
			M-180		A	285747	61,339	80,344	26.1	0.200	0.740	0.008	0.004	0.010	0.090	0.000	0.050	0.002
			M-180		A	285752	62,974	81,111	24.6	0.190	0.730	0.009	0.002	0.010	0.090	0.000	0.050	0.001
						287476												
1	32218G	T10/TRAN/TB:WB/ASYM/RT	MISC			140456												
	32218G		M-180	B	2	C89858	59,300	81,600	24.2	0.200	0.490	0.014	0.002	0.030	0.090	0.000	0.060	0.001

Upon delivery, all materials subject to Valtir, LLC Storage Stain Policy QMS-LQ-002.

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NUTS COMPLY WITH ASTM A-563 SPECIFICATIONS AND ARE GALVANIZED IN ACCORDANCE WITH ASTM A-153, UNLESS OTHERWISE STATED.
WASHERS COMPLY WITH ASTM F-436 SPECIFICATION AND/OR F-844 AND ARE GALVANIZED IN ACCORDANCE WITH ASTM F-2329, UNLESS OTHERWISE STATED.
3/4" DIA CABLE 6X19 ZINC COATED SWAGED END AISI C-1035 STEEL ANNEALED STUD 1" DIA ASTM 449 AASHTO M30, TYPE II BREAKING STRENGTH – 46000 LB

2023-10-16

66

TR No. 619551-01

Texas A&M Transportation Institute	QF 7.3-01 Concrete Sampling	Doc. No. QF 7.3-01	Revision Date: 2020-07-29
Quality Form	Revised by: B.L. Griffith Approved by: D. L. Kuhn	Revision: 7	Page: 1 of 1

Project No: 615251 **Casting Date:** 12/6/2022 **Mix Design (psi):** 3600

Name of Technician Taking Sample: Terracon

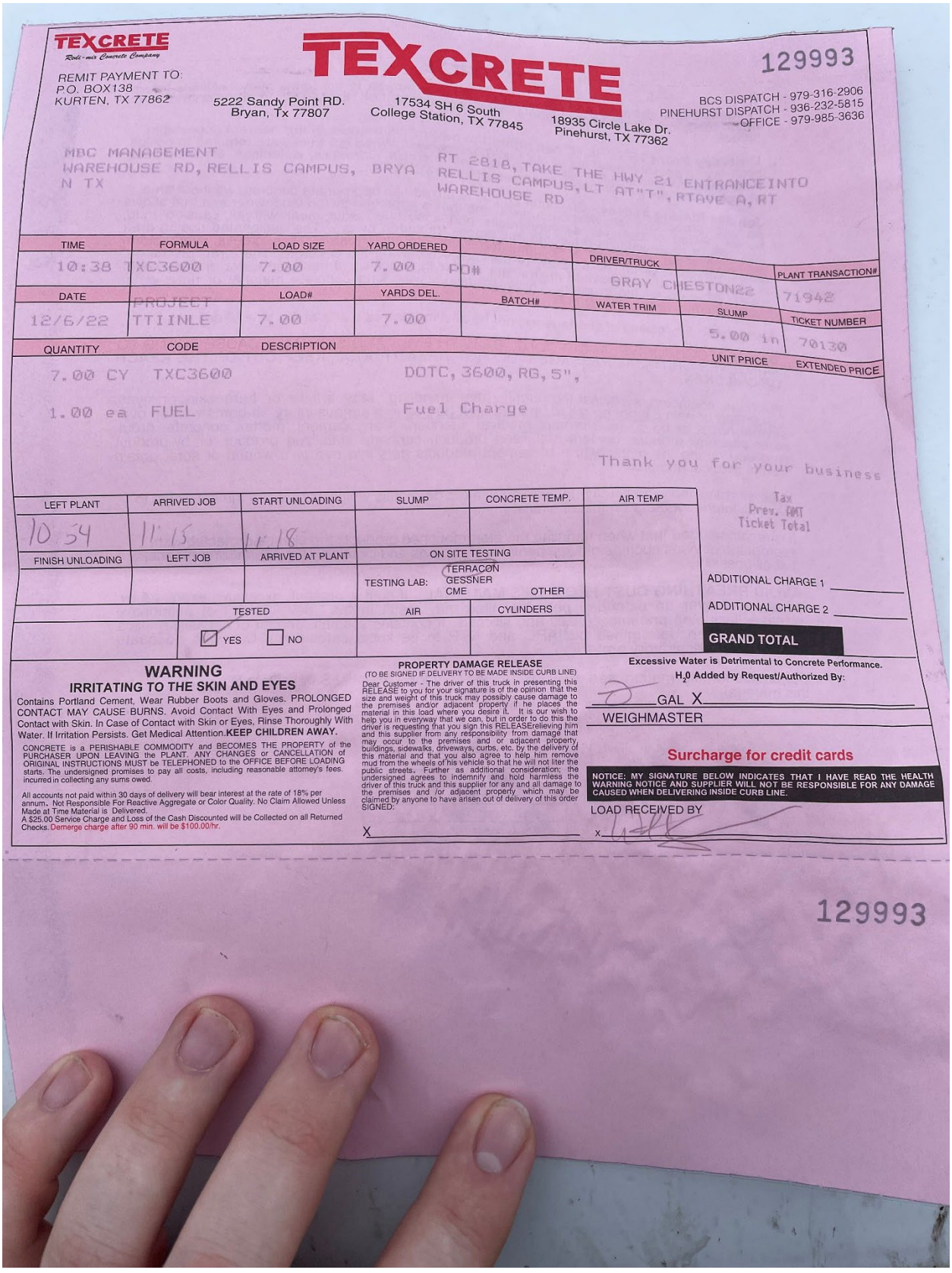
Name of Technician Breaking Sample: Terracon

Signature of Technician Taking Sample: Terracon

Signature of Technician Breaking Sample: Terracon

Load No.	Truck No.	Ticket No.	Location (from concrete map)
T1	Gray Cheston22	70130	Moment Slab and Parapet

Load No.	Break Date	Cylinder Age	Total Load (lbs)	Break (psi)	Average



TEXCRETE
Ready-mix Concrete Company

REMIT PAYMENT TO:
P.O. BOX138
KURTEN, TX 77862

TEXCRETE

5222 Sandy Point RD.
Bryan, Tx 77807

17534 SH 6 South
College Station, TX 77845

18935 Circle Lake Dr.
Pinehurst, TX 77362

129993

BCS DISPATCH - 979-316-2906
PINEHURST DISPATCH - 936-232-5815
OFFICE - 979-985-3636

MBC MANAGEMENT
WAREHOUSE RD, RELLIS CAMPUS, BRYA
N TX

RT 2818, TAKE THE HWY 21 ENTRANCEINTO
RELLIS CAMPUS, LT AT"T", RTAVE A, RT
WAREHOUSE RD

TIME	FORMULA	LOAD SIZE	YARD ORDERED		DRIVER/TRUCK		PLANT TRANSACTION#
10:38	TXC3600	7.00	7.00	PO#	GRAY CHESTON22		71942
DATE	PROJECT	LOAD#	YARDS DEL.	BATCH#	WATER TRIM	SLUMP	TICKET NUMBER
12/6/22	TTIINLE	7.00	7.00			5.00 in	70130

QUANTITY	CODE	DESCRIPTION	UNIT PRICE	EXTENDED PRICE
7.00 CY	TXC3600	DOTC, 3600, RG, 5",		
1.00 ea	FUEL	Fuel Charge		

Thank you for your business

LEFT PLANT	ARRIVED JOB	START UNLOADING	SLUMP	CONCRETE TEMP.	AIR TEMP
10:54	11:15	11:18			
FINISH UNLOADING	LEFT JOB	ARRIVED AT PLANT	ON SITE TESTING		
			TESTING LAB: TERRACON GESSNER CME OTHER		
	TESTED		AIR	CYLINDERS	
	☑ YES ☐ NO				

Tax
Prev. AMT
Ticket Total

ADDITIONAL CHARGE 1 _____

ADDITIONAL CHARGE 2 _____

GRAND TOTAL

WARNING
IRRITATING TO THE SKIN AND EYES

Contains Portland Cement. Wear Rubber Boots and Gloves. PROLONGED CONTACT MAY CAUSE BURNS. Avoid Contact With Eyes and Prolonged Contact with Skin. In Case of Contact with Skin or Eyes, Rinse Thoroughly With Water. If Irritation Persists. Get Medical Attention. **KEEP CHILDREN AWAY.**

CONCRETE is a PERISHABLE COMMODITY and BECOMES THE PROPERTY of the PURCHASER UPON LEAVING the PLANT. ANY CHANGES or CANCELLATION of ORIGINAL INSTRUCTIONS MUST be TELEPHONED to the OFFICE BEFORE LOADING starts. The undersigned promises to pay all costs, including reasonable attorney's fees. incurred in collecting any sums owed.

All accounts not paid within 30 days of delivery will bear interest at the rate of 18% per annum. Not Responsible For Reactive Aggregate or Color Quality. No Claim Allowed Unless Made at Time Material is Delivered.
A $25.00 Service Charge and Loss of the Cash Discounted will be Collected on all Returned Checks. Demerge charge after 90 min. will be $100.00/hr.

PROPERTY DAMAGE RELEASE
(TO BE SIGNED IF DELIVERY TO BE MADE INSIDE CURB LINE)

Dear Customer - The driver of this truck in presenting this RELEASE to you for your signature is of the opinion that the size and weight of this truck may possibly cause damage to the premises and/or adjacent property if he places the material in this load where you desire it. It is our wish to help you in everyway that we can, but in order to do this the driver is requesting that you sign this RELEASErelieving him and this supplier from any responsibility from damage that may occur to the premises and or adjacent property, buildings, sidewalks, driveways, curbs, etc. by the delivery of this material and that you also agree to help him remove mud from the wheels of his vehicle so that he will not liter the public streets. Further as additional consideration; the undersigned agrees to indemnify and hold harmless the driver of this truck and this supplier for any and all damage to the premises and /or adjacent property which may be claimed by anyone to have arisen out of delivery of this order SIGNED:

X _____

Excessive Water is Detrimental to Concrete Performance.
H_2O Added by Request/Authorized By:

_____ GAL X _____
WEIGHMASTER

Surcharge for credit cards

NOTICE: MY SIGNATURE BELOW INDICATES THAT I HAVE READ THE HEALTH WARNING NOTICE AND SUPPLIER WILL NOT BE RESPONSIBLE FOR ANY DAMAGE CAUSED WHEN DELIVERING INSIDE CURB LINE.

LOAD RECEIVED BY

X _____

129993

CONCRETE COMPRESSIVE STRENGTH TEST REPORT

Report Number: A1171057.0257
Service Date: 12/06/22
Report Date: 01/24/23 Revision 1 -
Task: PO# 615251

Terracon
6198 Imperial Loop
College Station, TX 77845-5765
979-846-3767 Reg No: F-3272

Client
Texas Transportation Institute
Attn: Bill Griffith
TTI Business Office
3135 TAMU
College Station, TX 77843-3135

Project
Riverside Campus
Riverside Campus
Bryan, TX

Project Number: A1171057

Material Information
Specified Strength: 3,600 psi @ 28 days

Mix ID: TXC3600 DOTC, 3600, RG 5"
Supplier: Texcrete
Batch Time: **Plant:**
Truck No.: 122 **Ticket No.:** 70130

Sample Information
Sample Date: 12/06/22 **Sample Time:** 1130
Sampled By: Austin Holcomb
Weather Conditions: 70s - Mostly Cloudy
Accumulative Yards: 7 **Batch Size (cy):** 7
Placement Method: Chute
Water Added Before (gal): 5
Water Added After (gal): 0
Sample Location: Bridge Deck Footings w/ Curb Tie-in on the West Side of the Restricted Access Lot (PO# 615251 - 106)
Placement Location: Footings

Field Test Data

Test	Result	Specification
Slump (in):	5 1/4	
Air Content (%):	3.8	
Concrete Temp. (F):	79	
Ambient Temp. (F):	74	
Plastic Unit Wt. (pcf):		
Yield (Cu. Yds.):		

Laboratory Test Data

Set No.	Spec ID	Cyl. Cond.	Avg Diam. (in)	Area (sq in)	Date Received	Date Tested	Age at Test (days)	Max Load (lbs)	Comp Strength (psi)	Frac Type	Tested By
1	A	Good	6.00	28.27		01/02/23	27 F	102,730	3,630	5	CRM
1	B	Good	6.00	28.27		01/02/23	27 F	106,930	3,780	5	CRM
1	C	Good	6.00	28.27		01/02/23	27 F	103,410	3,660	5	CRM
1	D						Hold				

Initial Cure: Outside Plastic Lids **Final Cure:** Field Cured **Sample Description:** 6-inch diameter cylinders

Comments: **Not tested for plastic unit weight. F = Field Cured**

Note: Reported air content does not include Aggregate Correction Factor (ACF).
Bridge Deck Footings w/ Curb Tie-in on the West Side of the Restricted Access Lot to be used in High-Speed & Autonomous Vehicle Testing PO# 615251 - 106 (See Drawing)

Contractors and Client were informed if any slumps, temperatures, air readings, and/or Concrete Times were recorded out of range of job specifications. The data provided is for all Concrete that has been accepted and used by the Contractors on-site.

Approximately 7 yds were poured at
the Riverside Campus For the Bridge Deck Footings w/ Curb Tie-in on the West Side of the Restricted Access Lot to be used in High-Speed & Autonomous Vehicle Testing (PO# 615251 - 106)

Weather: 70s, Mostly Cloudy

CONCRETE COMPRESSIVE STRENGTH TEST REPORT

Report Number: A1171057.0257
Service Date: 12/06/22
Report Date: 01/24/23 Revision 1 -
Task: PO# 615251

Terracon
6198 Imperial Loop
College Station, TX 77845-5765
979-846-3767 Reg No: F-3272

Client
Texas Transportation Institute
Attn: Bill Griffith
TTI Business Office
3135 TAMU
College Station, TX 77843-3135

Project
Riverside Campus
Riverside Campus
Bryan, TX

Project Number: A1171057

Samples Made By: Terracon
Services: Obtain samples of fresh concrete at the placement locations (ASTM C 172), perform required field tests and cast, cure, and test compressive strength samples (ASTM C 31, C 39, C 1231).

Terracon Rep.: Austin Holcomb
Reported To: Adam w/ TTI
Contractor: MBC Management
Report Distribution:
(1) Texas Transportation Institute, Bill Griffith

Start/Stop: 1030-1245

Reviewed By: Alexander Dunigan
Project Manager

Test Methods: ASTM C 31, ASTM C143, ASTM C231, ASTM C1064

Photo Log

Report Number: A1171057.0257
Service Date: 12/06/22
Report Date: 01/24/23 Revision 1 -
Task: PO# 615251

Terracon
6198 Imperial Loop
College Station, TX 77845-5765
979-846-3767 Reg No: F-3272

(P1) 12.06.2022-A

(P2) 12.06.2022-B

Terracon
6198 Imperial Loop
College Station, TX 77845-5765
979-846-3767 Reg No: F-3272

(P3) 12.06.2022-C

(P4) 12.06.2022-D

Terracon
6198 Imperial Loop
College Station, TX 77845-5765
979-846-3767 Reg No: F-3272

(P5) 12.06.2022-E

Texas A&M Transportation Institute	QF 7.3-01 Concrete Sampling	Doc. No. QF 7.3-01	Revision Date: 2020-07-29
Quality Form	Revised by: B.L. Griffith Approved by: D. L. Kuhn	Revision: 7	Page: 1 of 1

Project No: 615251 **Casting Date:** 12/12/2022 **Mix Design (psi):** 3600

Name of Technician Taking Sample: Terracon

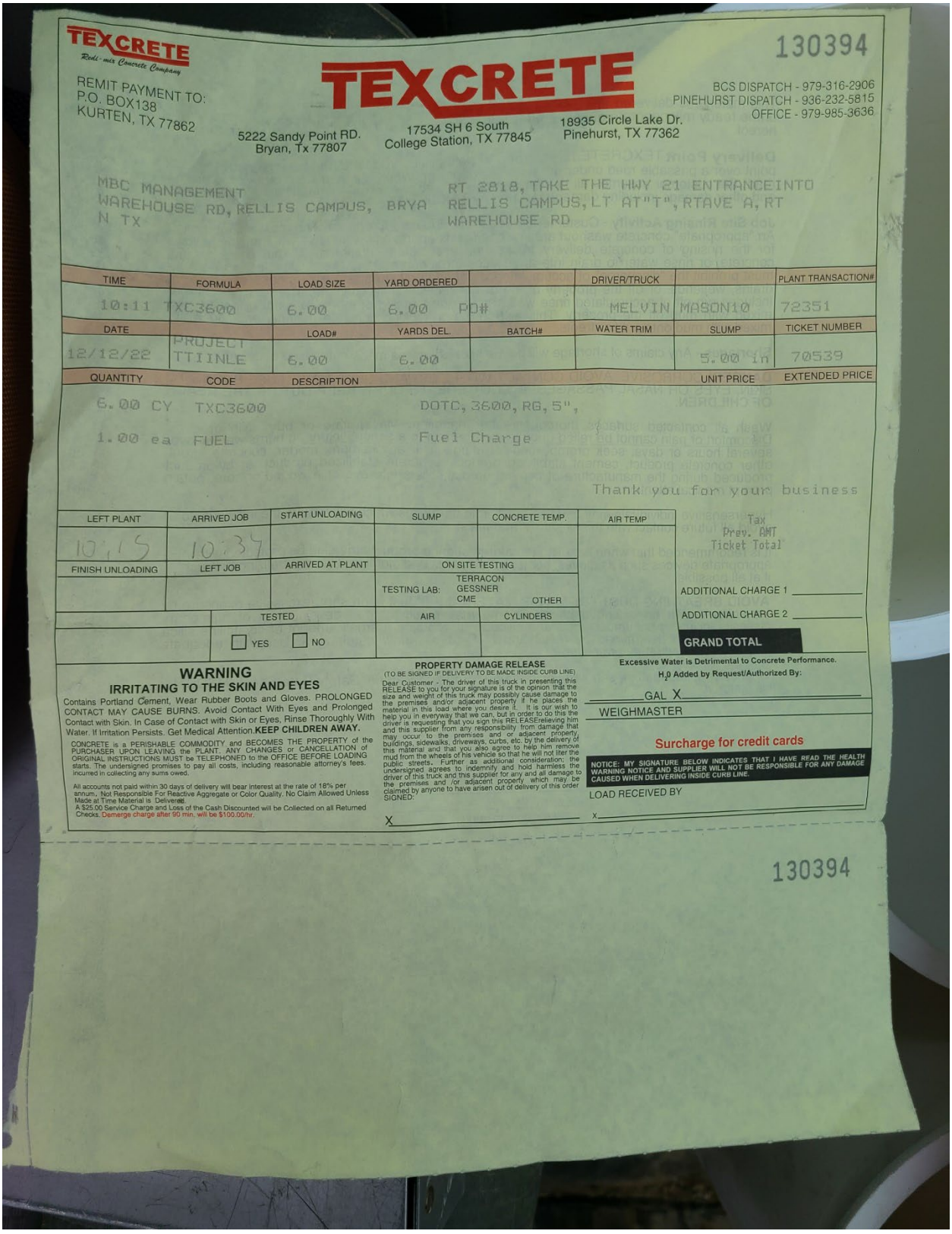
Name of Technician Breaking Sample: Terracon

Signature of Technician Taking Sample: Terracon

Signature of Technician Breaking Sample: Terracon

Load No.	Truck No.	Ticket No.	Location (from concrete map)
T1	MelvinMason10	130394	100% of wall transition, small and large section

Load No.	Break Date	Cylinder Age	Total Load (lbs)	Break (psi)	Average



TEXCRETE
Redi-mix Concrete Company

130394

REMIT PAYMENT TO:
P.O. BOX138
KURTEN, TX 77862

TEXCRETE

5222 Sandy Point RD.
Bryan, Tx 77807

17534 SH 6 South
College Station, TX 77845

18935 Circle Lake Dr.
Pinehurst, TX 77362

BCS DISPATCH - 979-316-2906
PINEHURST DISPATCH - 936-232-5815
OFFICE - 979-985-3636

MBC MANAGEMENT
WAREHOUSE RD, RELLIS CAMPUS, BRYA
N TX

RT 2818, TAKE THE HWY 21 ENTRANCEINTO
RELLIS CAMPUS, LT AT "T", RTAVE A, RT
WAREHOUSE RD

TIME	FORMULA	LOAD SIZE	YARD ORDERED		DRIVER/TRUCK		PLANT TRANSACTION#
10:11	TXC3600	6.00	6.00	PO#	MELVIN	MASON10	72351
DATE		**LOAD#**	**YARDS DEL.**	**BATCH#**	**WATER TRIM**	**SLUMP**	**TICKET NUMBER**
12/12/22	PROJECT TTIINLE	6.00	6.00			5.00 in	70539

QUANTITY	CODE	DESCRIPTION	UNIT PRICE	EXTENDED PRICE
6.00 CY	TXC3600	DOTC, 3600, RG, 5",		
1.00 ea	FUEL	Fuel Charge		

Thank you for your business

LEFT PLANT	ARRIVED JOB	START UNLOADING	SLUMP	CONCRETE TEMP.	AIR TEMP
10:15	10:37				
FINISH UNLOADING	**LEFT JOB**	**ARRIVED AT PLANT**	**ON SITE TESTING**		
			TESTING LAB: TERRACON GESSNER CME OTHER		
	TESTED		**AIR**	**CYLINDERS**	
	☐ YES ☐ NO				

Tax
Prev. AMT
Ticket Total
ADDITIONAL CHARGE 1 _____
ADDITIONAL CHARGE 2 _____
GRAND TOTAL

WARNING
IRRITATING TO THE SKIN AND EYES

Contains Portland Cement, Wear Rubber Boots and Gloves. PROLONGED CONTACT MAY CAUSE BURNS. Avoid Contact With Eyes and Prolonged Contact with Skin. In Case of Contact with Skin or Eyes, Rinse Thoroughly With Water. If Irritation Persists, Get Medical Attention. **KEEP CHILDREN AWAY.**

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All accounts not paid within 30 days of delivery will bear interest at the rate of 18% per annum. Not Responsible For Reactive Aggregate or Color Quality. No Claim Allowed Unless Made at Time Material is Delivered.
A $25.00 Service Charge and Loss of the Cash Discounted will be Collected on all Returned Checks. Demerge charge after 90 min, will be $100.00/hr.

PROPERTY DAMAGE RELEASE
(TO BE SIGNED IF DELIVERY TO BE MADE INSIDE CURB LINE)

Dear Customer - The driver of this truck in presenting this RELEASE to you for your signature is of the opinion that the size and weight of this truck may possibly cause damage to the premises and/or adjacent property if he places the material in this load where you desire it. It is our wish to help you in everyway that we can, but in order to do this the driver is requesting that you sign this RELEASErelieving him and this supplier from any responsibility from damage that may occur to the premises and or adjacent property, buildings, sidewalks, driveways, curbs, etc. by the delivery of this material and that you also agree to help him remove mud from the wheels of his vehicle so that he will not liter the public streets. Further as additional consideration; the undersigned agrees to indemnify and hold harmless the driver of this truck and this supplier for any and all damage to the premises and /or adjacent property which may be claimed by anyone to have arisen out of delivery of this order

SIGNED:
X _____

Excessive Water is Detrimental to Concrete Performance.
H_2O Added by Request/Authorized By:
_____GAL X_____
WEIGHMASTER

Surcharge for credit cards

NOTICE: MY SIGNATURE BELOW INDICATES THAT I HAVE READ THE HEALTH WARNING NOTICE AND SUPPLIER WILL NOT BE RESPONSIBLE FOR ANY DAMAGE CAUSED WHEN DELIVERING INSIDE CURB LINE.

LOAD RECEIVED BY
x _____

130394

CONCRETE COMPRESSIVE STRENGTH TEST REPORT

Report Number: A1171057.0260
Service Date: 12/12/22
Report Date: 01/24/23 Revision 2 -
Task: PO# 615251

Terracon
6198 Imperial Loop
College Station, TX 77845-5765
979-846-3767 Reg No: F-3272

Client
Texas Transportation Institute
Attn: Bill Griffith
TTI Business Office
3135 TAMU
College Station, TX 77843-3135

Project
Riverside Campus
Riverside Campus
Bryan, TX

Project Number: A1171057

Material Information
Specified Strength: 3,600 psi @ 28 days

Mix ID: TXC3600
Supplier: Texcrete
Batch Time: 1011 **Plant:**
Truck No.: MASON10 **Ticket No.:** 70539

Sample Information
Sample Date: 12/12/22 **Sample Time:** 1050
Sampled By: Randy Rippstein
Weather Conditions: Cloudy, Heavy wind
Accumulative Yards: 6 **Batch Size (cy):** 6
Placement Method: Direct Discharge
Water Added Before (gal): 0
Water Added After (gal): 0
Sample Location: Top of beam north end
Placement Location: South West side runway

Field Test Data

Test	Result	Specification
Slump (in):	6 1/2	
Air Content (%):	1.5	
Concrete Temp. (F):	80	
Ambient Temp. (F):	64	
Plastic Unit Wt. (pcf):	147.6	
Yield (Cu. Yds.):		

Laboratory Test Data

Set No.	Spec ID	Cyl. Cond.	Avg Diam. (in)	Area (sq in)	Date Received	Date Tested	Age at Test (days)	Max Load (lbs)	Comp Strength (psi)	Frac Type	Tested By
1	B	Good	6.00	28.27		01/03/23	22 F	108,620	3,840	5	CRM
1	C	Good	6.00	28.27		01/03/23	22 F	111,780	3,950	5	CRM
1	D	Good	6.00	28.27		01/03/23	22 F	113,300	4,010	5	CRM
1	A	Good					Hold			3	BFM

Initial Cure: Outside Plastic Lids **Final Cure:** Field Cured **Sample Description:** 6-inch diameter cylinders

Comments: **F = Field Cured**
Note: Reported air content does not include Aggregate Correction Factor (ACF).

Samples Made By: Terracon
Services: Obtain samples of fresh concrete at the placement locations (ASTM C 172), perform required field tests and cast, cure, and test compressive strength samples (ASTM C 31, C 39, C 1231).

Terracon Rep.: Randy Rippstein
Reported To: Bill w/ TTI
Contractor: MBC Management
Report Distribution:
(1) Texas Transportation Institute, Bill Griffith

Start/Stop: 0900-1100

Reviewed By:
Alexander Dunigan
Project Manager

Test Methods: ASTM C 31, ASTM C143, ASTM C231, ASTM C1064

Texas A&M Transportation Institute	QF 7.3-01 Concrete Sampling	Doc. No. QF 7.3-01	Revision Date: 2020-07-29
Quality Form	Revised by: B.L. Griffith Approved by: D. L. Kuhn	Revision: 7	Page: 1 of 1

Project No: 615251 **Casting Date:** 12/21/2022 **Mix Design (psi):** 3600

Name of Technician Taking Sample: Terracon

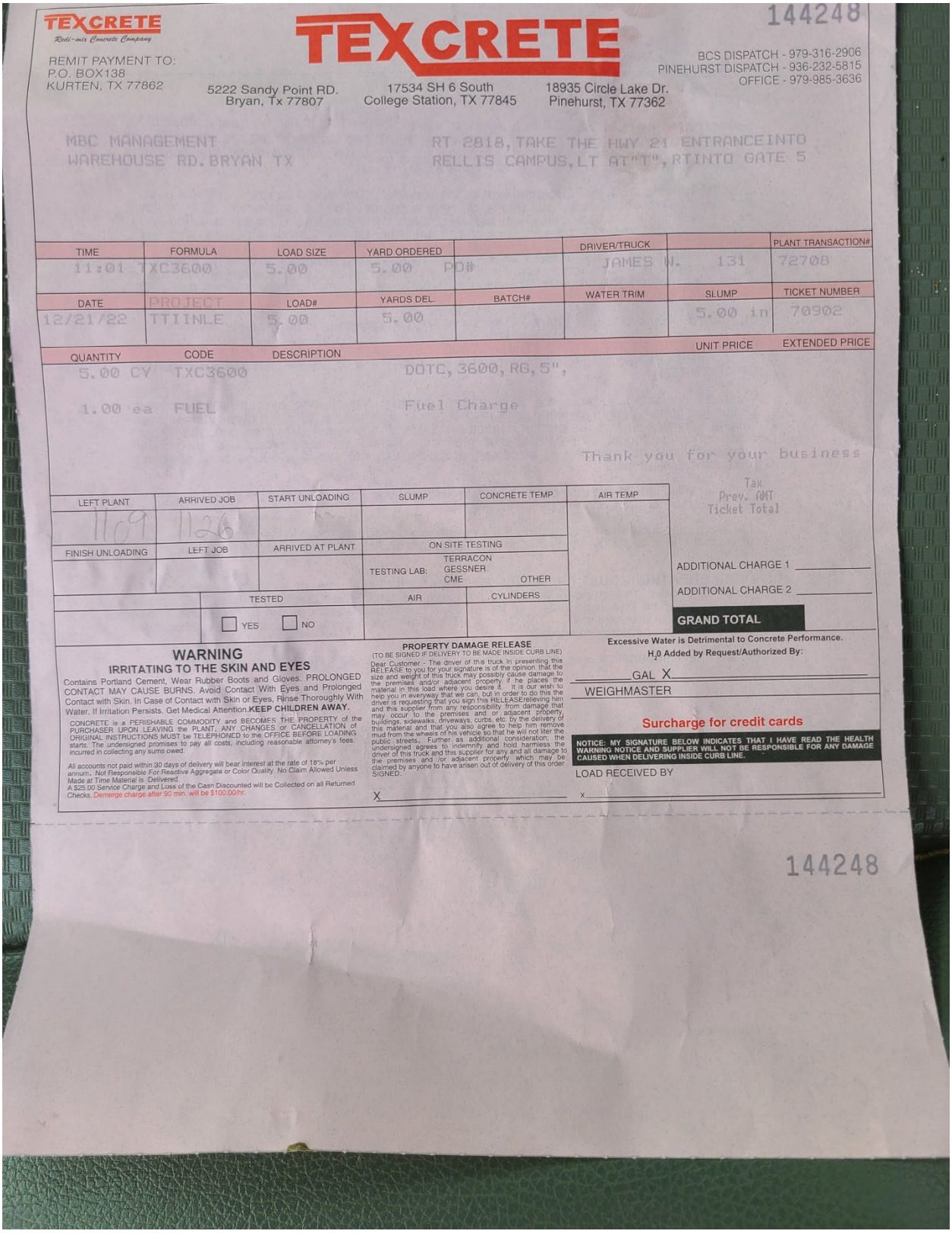
Name of Technician Breaking Sample: Terracon

Signature of Technician Taking Sample: Terracon

Signature of Technician Breaking Sample: Terracon

Load No.	Truck No.	Ticket No.	Location (from concrete map)
T1	James N.131	144248	100% of Parapet and Approach Slab

Load No.	Break Date	Cylinder Age	Total Load (lbs)	Break (psi)	Average



TEXCRETE
Ready-mix Concrete Company

REMIT PAYMENT TO:
P.O. BOX138
KURTEN, TX 77862

TEXCRETE

5222 Sandy Point RD.
Bryan, Tx 77807

17534 SH 6 South
College Station, TX 77845

18935 Circle Lake Dr.
Pinehurst, TX 77362

144248

BCS DISPATCH - 979-316-2906
PINEHURST DISPATCH - 936-232-5815
OFFICE - 979-985-3636

MBC MANAGEMENT
WAREHOUSE RD. BRYAN TX

RT 2818, TAKE THE HWY 21 ENTRANCEINTO
RELLIS CAMPUS, LT AT "T", RTINTO GATE 5

TIME	FORMULA	LOAD SIZE	YARD ORDERED		DRIVER/TRUCK		PLANT TRANSACTION#
11:01	TXC3600	5.00	5.00	PO#	JAMES W.	131	72708

DATE	PROJECT	LOAD#	YARDS DEL.	BATCH#	WATER TRIM	SLUMP	TICKET NUMBER
12/21/22	TTIINLE	5.00	5.00			5.00 in	70902

QUANTITY	CODE	DESCRIPTION	UNIT PRICE	EXTENDED PRICE
5.00 CY	TXC3600	DOTC, 3600, RG, 5",		
1.00 ea	FUEL	Fuel Charge		

Thank you for your business

LEFT PLANT	ARRIVED JOB	START UNLOADING	SLUMP	CONCRETE TEMP	AIR TEMP
1109	1126				

FINISH UNLOADING	LEFT JOB	ARRIVED AT PLANT	ON SITE TESTING
			TESTING LAB: TERRACON GESSNER CME OTHER

TESTED	AIR	CYLINDERS
☐ YES ☐ NO		

Tax
Prev. AMT
Ticket Total

ADDITIONAL CHARGE 1 _____

ADDITIONAL CHARGE 2 _____

GRAND TOTAL

WARNING
IRRITATING TO THE SKIN AND EYES

Contains Portland Cement. Wear Rubber Boots and Gloves. PROLONGED CONTACT MAY CAUSE BURNS. Avoid Contact With Eyes and Prolonged Contact with Skin. In Case of Contact with Skin or Eyes, Rinse Thoroughly With Water. If Irritation Persists, Get Medical Attention. **KEEP CHILDREN AWAY.**

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PROPERTY DAMAGE RELEASE
(TO BE SIGNED IF DELIVERY TO BE MADE INSIDE CURB LINE)

Dear Customer - The driver of this truck in presenting this RELEASE to you for your signature is of the opinion that the size and weight of this truck may possibly cause damage to the premises and/or adjacent property if he places the material in this load where you desire it. It is our wish to help you in everyway that we can, but in order to do this the driver is requesting that you sign this RELEASErelieving him and this supplier from any responsibility from damage that may occur to the premises and or adjacent property buildings, sidewalks, driveways, curbs, etc. by the delivery of this material and that you also agree to help him remove mud from the wheels of his vehicle so that he will not liter the public streets. Further, as additional consideration, the undersigned agrees to indemnify and hold harmless the driver of this truck and this supplier for any and all damage to the premises and /or adjacent property which may be claimed by anyone to have arisen out of delivery of this order SIGNED:

X _____

Excessive Water is Detrimental to Concrete Performance.
H_2O Added by Request/Authorized By:

_____GAL X_____

WEIGHMASTER

Surcharge for credit cards

NOTICE: MY SIGNATURE BELOW INDICATES THAT I HAVE READ THE HEALTH WARNING NOTICE AND SUPPLIER WILL NOT BE RESPONSIBLE FOR ANY DAMAGE CAUSED WHEN DELIVERING INSIDE CURB LINE.

LOAD RECEIVED BY

X _____

144248

CONCRETE COMPRESSIVE STRENGTH TEST REPORT

Report Number: A1171057.0262
Service Date: 12/21/22
Report Date: 01/24/23 Revision 1 - 34-day test results
Task: PO# 615251

Terracon
6198 Imperial Loop
College Station, TX 77845-5765
979-846-3767 Reg No: F-3272

Client
Texas Transportation Institute
Attn: Bill Griffith
TTI Business Office
3135 TAMU
College Station, TX 77843-3135

Project
Riverside Campus
Riverside Campus
Bryan, TX

Project Number: A1171057

Material Information
Specified Strength: 3,000 psi @ 28 days

Mix ID: TXC3600
Supplier: Texcrete
Batch Time: 1101 **Plant:**
Truck No.: 131 **Ticket No.:** 70902

Sample Information
Sample Date: 12/21/22 **Sample Time:** 1150
Sampled By: Austin Holcomb
Weather Conditions: 40s, Fog / Mostly Cloudy
Accumulative Yards: 5 **Batch Size (cy):** 5
Placement Method: Chute
Water Added Before (gal): 3
Water Added After (gal): 0
Sample Location: Pavement near Storm Drain & TTI Wall connected to footing PO# 615251-106 (See Drawing)
Placement Location: Pavement & TTI Wall for Crash Testing

Field Test Data

Test	Result	Specification
Slump (in):	5 3/4	
Air Content (%):	3.4	
Concrete Temp. (F):	63	
Ambient Temp. (F):	44	
Plastic Unit Wt. (pcf):		
Yield (Cu. Yds.):		

Laboratory Test Data

Set No.	Spec ID	Cyl. Cond.	Avg Diam. (in)	Area (sq in)	Date Received	Date Tested	Age at Test (days)	Max Load (lbs)	Comp Strength (psi)	Frac Type	Tested By
1	A	Good	6.00	28.27		01/03/23	13 F	88,010	3,110	3	CRM
1	B	Good	6.00	28.27		01/03/23	13 F	84,180	2,980	5	CRM
1	C	Good	6.00	28.27		01/03/23	13 F	79,550	2,810	5	CRM
1	D	Good	6.00	28.27		01/24/23	34 F	104,690	3,700	2	AWD

Initial Cure: Covered with Plastic **Final Cure:** Field Cured **Sample Description:** 6-inch diameter cylinders

Comments: **Not tested for plastic unit weight. F = Field Cured**
Note: Reported air content does not include Aggregate Correction Factor (ACF).
Lot Pavement Extension near Storm Drain and TTI Crash Wall PO# 615251 - 106

Contractors and Client were informed if any slumps, temperatures, air readings, and/or Concrete Times were recorded out of range of job specifications. The data provided is for all Concrete that has been accepted and used by the Contractors on-site.

Approximately 9 yds were poured at
Riverside Campus For the Lot Pavement Extension near the Storm Drain and TTI Crash Wall PO# 615251 - 106 on the West Side of the Open Lot Near the Mobile Mini Job Trailer (See Drawing).

Weather: 40s, Fog / Mostly Cloudy

CONCRETE COMPRESSIVE STRENGTH TEST REPORT

Report Number: A1171057.0262
Service Date: 12/21/22
Report Date: 01/24/23 Revision 1 - 34-day test results
Task: PO# 615251

Terracon
6198 Imperial Loop
College Station, TX 77845-5765
979-846-3767 Reg No: F-3272

Client
Texas Transportation Institute
Attn: Bill Griffith
TTI Business Office
3135 TAMU
College Station, TX 77843-3135

Project
Riverside Campus
Riverside Campus
Bryan, TX

Project Number: A1171057

Samples Made By: Terracon
Services: Obtain samples of fresh concrete at the placement locations (ASTM C 172), perform required field tests and cast, cure, and test compressive strength samples (ASTM C 31, C 39, C 1231).

Terracon Rep.: Austin Holcomb
Reported To: Bill with TTI
Contractor: MBC Management
Report Distribution:
(1) Texas Transportation Institute, Bill Griffith

Start/Stop: 1030-1300

Reviewed By: Alexander Dunigan
Project Manager

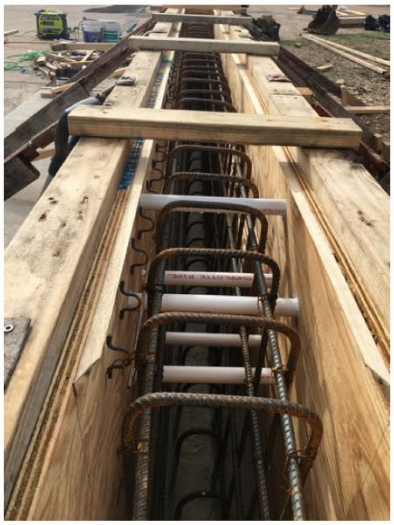
Test Methods: ASTM C 31, ASTM C143, ASTM C231, ASTM C1064

Photo Log

Report Number: A1171057.0262
Service Date: 12/21/22
Report Date: 01/24/23 Revision 1 - 34-day test results
Task: PO# 615251

Terracon
6198 Imperial Loop
College Station, TX 77845-5765
979-846-3767 Reg No: F-3272

(P1) 12.21.2022-A



(P2) 12.21.2022-B

Terracon
6198 Imperial Loop
College Station, TX 77845-5765
979-846-3767 Reg No: F-3272

(P3) 12.21.2022-C

(P4) 12.21.2022-D

Terracon
6198 Imperial Loop
College Station, TX 77845-5765
979-846-3767 Reg No: F-3272

(P5) 12.21.2022-E

Texas A&M Transportation Institute	QF 7.3-01 Concrete Sampling	Doc. No. QF 7.3-01	Revision Date: 2020-07-29
Quality Form	Revised by: B.L. Griffith Approved by: D. L. Kuhn	Revision: 7	Page: 1 of 1

Project No: 615251 **Casting Date:** 5/26/2023 **Mix Design (psi):** 3600

Name of Technician Taking Sample: Terracon

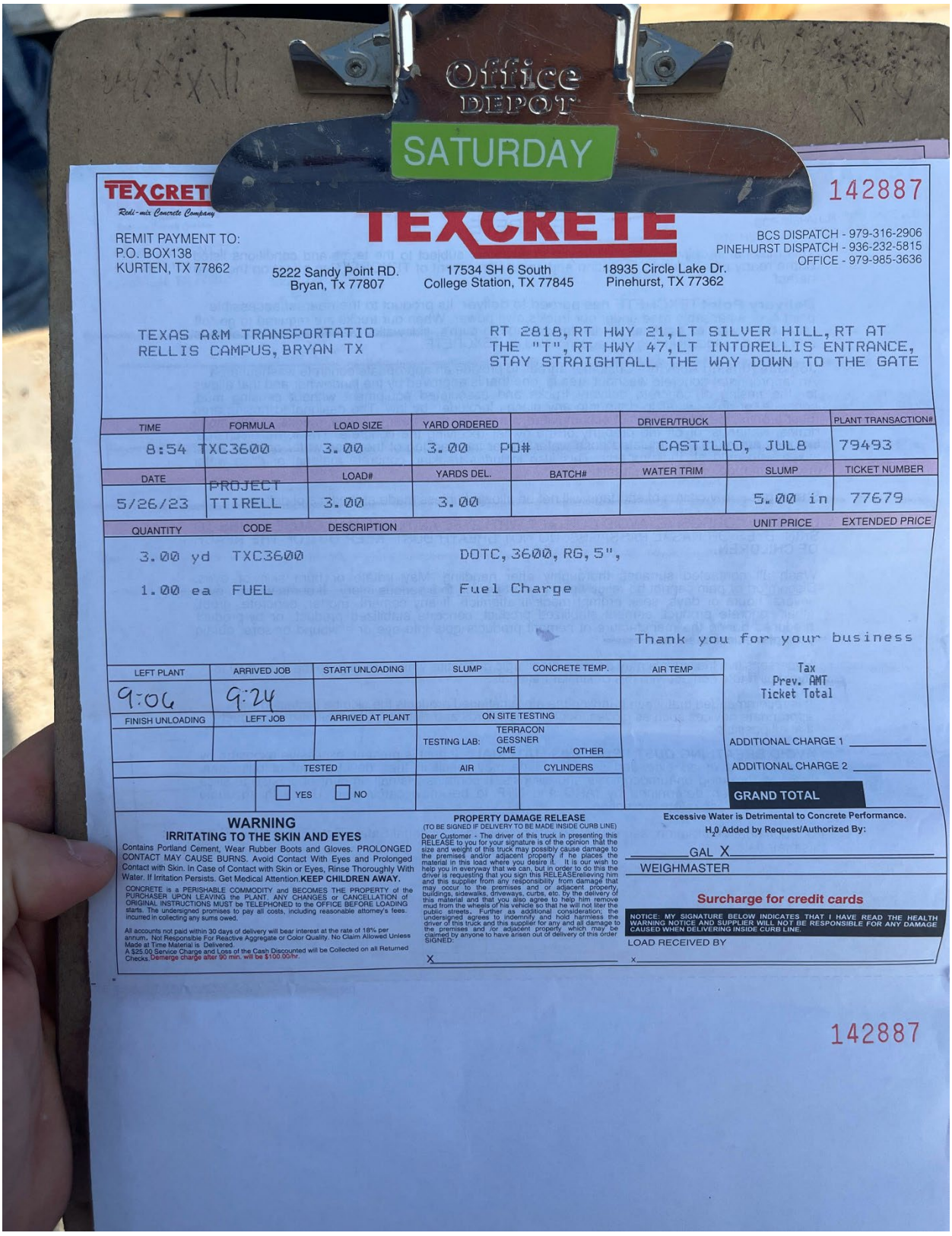
Name of Technician Breaking Sample: Terracon

Signature of Technician Taking Sample: Terracon

Signature of Technician Breaking Sample: Terracon

Load No.	Truck No.	Ticket No.	Location (from concrete map)
T1	Castillo, JUL8	77679	Straight beam and repaired section of tapered beam

Load No.	Break Date	Cylinder Age	Total Load (lbs)	Break (psi)	Average



TEXCRETE Redi-mix Concrete Company

142887

TEXCRETE

REMIT PAYMENT TO:
P.O. BOX138
KURTEN, TX 77862

5222 Sandy Point RD.
Bryan, Tx 77807

17534 SH 6 South
College Station, TX 77845

18935 Circle Lake Dr.
Pinehurst, TX 77362

BCS DISPATCH - 979-316-2906
PINEHURST DISPATCH - 936-232-5815
OFFICE - 979-985-3636

TEXAS A&M TRANSPORTATIO
RELLIS CAMPUS, BRYAN TX

RT 2818, RT HWY 21, LT SILVER HILL, RT AT THE "T", RT HWY 47, LT INTORELLIS ENTRANCE, STAY STRAIGHTALL THE WAY DOWN TO THE GATE

TIME	FORMULA	LOAD SIZE	YARD ORDERED		DRIVER/TRUCK		PLANT TRANSACTION#
8:54	TXC3600	3.00	3.00	PO#	CASTILLO, JUL8		79493
DATE	**PROJECT**	**LOAD#**	**YARDS DEL.**	**BATCH#**	**WATER TRIM**	**SLUMP**	**TICKET NUMBER**
5/26/23	TTIRELL	3.00	3.00			5.00 in	77679

QUANTITY	CODE	DESCRIPTION	UNIT PRICE	EXTENDED PRICE
3.00 yd	TXC3600	DOTC, 3600, RG, 5",		
1.00 ea	FUEL	Fuel Charge		

Thank you for your business

LEFT PLANT	ARRIVED JOB	START UNLOADING	SLUMP	CONCRETE TEMP.	AIR TEMP
9:06	9:24				

FINISH UNLOADING	LEFT JOB	ARRIVED AT PLANT	ON SITE TESTING
			TESTING LAB: TERRACON GESSNER CME OTHER

TESTED	AIR	CYLINDERS
☐ YES ☐ NO		

Tax
Prev. AMT
Ticket Total

ADDITIONAL CHARGE 1 _____

ADDITIONAL CHARGE 2 _____

GRAND TOTAL

WARNING
IRRITATING TO THE SKIN AND EYES

Contains Portland Cement. Wear Rubber Boots and Gloves. PROLONGED CONTACT MAY CAUSE BURNS. Avoid Contact With Eyes and Prolonged Contact with Skin. In Case of Contact with Skin or Eyes, Rinse Thoroughly With Water. If Irritation Persists. Get Medical Attention. **KEEP CHILDREN AWAY.**

CONCRETE is a PERISHABLE COMMODITY and BECOMES THE PROPERTY of the PURCHASER UPON LEAVING the PLANT. ANY CHANGES or CANCELLATION of ORIGINAL INSTRUCTIONS MUST be TELEPHONED to the OFFICE BEFORE LOADING starts. The undersigned promises to pay all costs, including reasonable attorney's fees, incurred in collecting any sums owed.

All accounts not paid within 30 days of delivery will bear interest at the rate of 18% per annum. Not Responsible For Reactive Aggregate or Color Quality. No Claim Allowed Unless Made at Time Material is Delivered.
A $25.00 Service Charge and Loss of the Cash Discounted will be Collected on all Returned Checks. Demerge charge after 90 min. will be $100.00/hr.

PROPERTY DAMAGE RELEASE
(TO BE SIGNED IF DELIVERY TO BE MADE INSIDE CURB LINE)

Dear Customer - The driver of this truck in presenting this RELEASE to you for your signature is of the opinion that the size and weight of this truck may possibly cause damage to the premises and/or adjacent property if he places the material in this load where you desire it. It is our wish to help you in everyway that we can, but in order to do this the driver is requesting that you sign this RELEASErelieving him and this supplier from any responsibility from damage that may occur to the premises and or adjacent property, buildings, sidewalks, driveways, curbs, etc. by the delivery of this material and that you also agree to help him remove mud from the wheels of his vehicle so that he will not liter the public streets. Further as additional consideration, the undersigned agrees to indemnify and hold harmless the driver of this truck and this supplier for any and all damage to the premises and /or adjacent property which may be claimed by anyone to have arisen out of delivery of this order SIGNED:

X _____

Excessive Water is Detrimental to Concrete Performance.
H_2O Added by Request/Authorized By:

_____GAL X _____
WEIGHMASTER

Surcharge for credit cards

NOTICE: MY SIGNATURE BELOW INDICATES THAT I HAVE READ THE HEALTH WARNING NOTICE AND SUPPLIER WILL NOT BE RESPONSIBLE FOR ANY DAMAGE CAUSED WHEN DELIVERING INSIDE CURB LINE.

LOAD RECEIVED BY

X _____

142887

CONCRETE COMPRESSIVE STRENGTH TEST REPORT

Report Number: A1171057.0274
Service Date: 05/26/23
Report Date: 06/21/23
Task: PO# 615251

Terracon
6198 Imperial Loop
College Station, TX 77845-5765
979-846-3767 Reg No: F-3272

Client
Texas Transportation Institute
Attn: Bill Griffith
TTI Business Office
3135 TAMU
College Station, TX 77843-3135

Project - A1171057
Riverside Campus
Riverside Campus
Bryan, TX

Permit No.: N/A

Material Information

Specified Strength: 3,600 psi @ 28 days

Mix ID: TXC3600
Supplier: Texcrete
Batch Time: 0854 **Plant:**
Truck No.: 8 **Ticket No.:** 77679

Sample Information

Sample Date: 05/26/23 **Sample Time:** 0936
Sampled By: David Carpio
Weather Conditions: Clear
Accumulative Yards: 5 **Batch Size (cy):** 3
Placement Method: Direct Discharge
Water Added Before (gal): 0
Water Added After (gal): 0
Sample Location: Inlet Box
Placement Location: Inlet Box
Sample Description: 6-inch diameter cylinders

Field Test Data

Test	Result	Specification
Slump (in):	4	
Air Content (%):		
Concrete Temp. (F):	84	
Ambient Temp. (F):	77	
Plastic Unit Wt. (pcf):		
Yield (Cu. Yds.):		

Laboratory Test Data

Set No.	Spec ID	Cyl. Cond.	Avg Diam. (in)	Area (sq in)	Date Received	Date Tested	Age at Test (days)	Max Load (lbs)	Comp Strength (psi)	Frac Type	Tested By
1	A	Good	6.00	28.27		06/20/23	25 F	107,620	3,810	2	BRR
1	B	Good	6.00	28.27		06/20/23	25 F	104,210	3,690	2	BRR
1	C	Good	6.00	28.27		06/20/23	25 F	105,310	3,720	2	BRR
1	D						Hold				

Initial Cure: Covered with Blanket **Final Cure:** Field Cured

Comments: **Not tested for plastic unit weight. F = Field Cured**
Note: Reported air content does not include Aggregate Correction Factor (ACF).

Samples Made By: Terracon
Services: Obtain samples of fresh concrete at the placement locations (ASTM C 172), perform required field tests and cast, cure, and test compressive strength samples (ASTM C 31, C 39, C 1231).

Terracon Rep.: David Carpio
Reported To: Adam w/ TTI
Contractor: MBC Management
Start/Stop: 0800-1030

Report Distribution:
(1) Texas Transportation Institute, Bill Griffith (1) Texas Transportation Institute, Adam Mayer

Reviewed By:
Alexander Dunigan, P.E.
Project Manager

Test Methods: ASTM C 31, ASTM C143, ASTM C231, ASTM C1064

APPENDIX C. *MASH* TEST 3-20 (CRASH TEST 619551-01-1)

C.1. VEHICLE PROPERTIES AND INFORMATION

Date: 2023-06-27 Test No.: 619551-01-1 VIN No.: 3NICN7AP5HL808543

Year: 2017 Make: Nissan Model: Versa

Tire Inflation Pressure: 36 PSI Odometer: 100155 Tire Size: P185/65R15

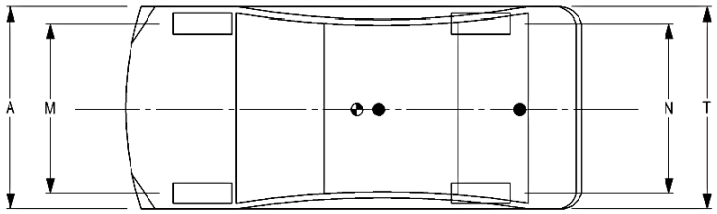
Describe any damage to the vehicle prior to test: None

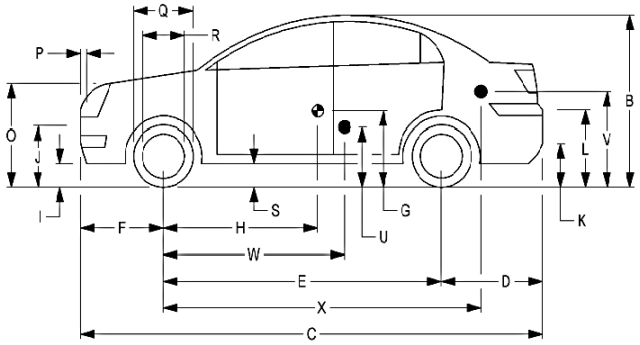
● Denotes accelerometer location.

NOTES: None

Engine Type: 4 CYL
Engine CID: 1.6 L
Transmission Type:
☑ Auto or ☐ Manual
☑ FWD ☐ RWD ☐ 4WD
Optional Equipment:
None

Dummy Data:
Type: 50th Percentile Male
Mass: 165 lb
Seat Position: IMPACT SIDE





Geometry: inches

A	66.70	F	32.50	K	12.50	P	4.50	U	15.50
B	59.60	G	0.00	L	26.00	Q	24.00	V	21.25
C	175.40	H	41.13	M	58.30	R	16.25	W	41.00
D	40.50	I	7.00	N	58.50	S	7.50	X	79.75
E	102.40	J	22.50	O	30.50	T	64.50		
	Wheel Center Ht Front	11.50		Wheel Center Ht Rear	11.50		W-H	-0.13	

RANGE LIMIT: A = 65 ±3 inches; C = 169 ±8 inches; E = 98 ±5 inches; F = 35 ±4 inches; H = 39 ±4 inches; O (Top of Radiator Support) = 28 ±4 inches
(M+N)/2 = 59 ±2 inches; W-H < 2 inches or use MASH Paragraph A4.3.2

GVWR Ratings:		**Mass:** lb	Curb	Test Inertial	Gross Static
Front	1750	M_{front}	1435	1458	1543
Back	1687	M_{rear}	986	979	1059
Total	3389	M_{Total}	2421	2437	2602

Allowable TIM = 2420 lb ±55 lb | Allowable GSM = 2585 lb ± 55 lb

Mass Distribution:
lb LF: 768 RF: 690 LR: 481 RR: 498

Figure C.1. Vehicle Properties for Test 619551-01-1.

Date: 2023-06-27 Test No.: 619551-01-1 VIN No.: 3NICN7AP5HL808543

Year: 2017 Make: Nissan Model: Versa

VEHICLE CRUSH MEASUREMENT SHEET[1]

Complete When Applicable	
End Damage	Side Damage
Undeformed end width _____	Bowing: B1 _____ X1 _____
Corner shift: A1 _____	B2 _____ X2 _____
A2 _____	
End shift at frame (CDC)	Bowing constant
(check one)	$\frac{X1+X2}{2}$ = _____
< 4 inches _____	
≥ 4 inches _____	

Note: Measure C_1 to C_6 from Driver to Passenger Side in Front or Rear Impacts – Rear to Front in Side Impacts.

Specific Impact Number	Plane* of C-Measurements	Direct Damage		Field L**	C_1	C_2	C_3	C_4	C_5	C_6	±D
		Width*** (CDC)	Max**** Crush								
1	AT FRONT BUMPER	13	9	32	-	-	-	-	-	-	+10
2	ABOVE FRONT BUMPER	15	7.25	50	-	-	-	-	-	-	49
	Measurements recorded										
	☑ **inches or** ☐ **mm**										

[1]Table taken from National Accident Sampling System (NASS).

*Identify the plane at which the C-measurements are taken (e.g., at bumper, above bumper, at sill, above sill, at beltline, etc.) or label adjustments (e.g., free space).

Free space value is defined as the distance between the baseline and the original body contour taken at the individual C locations. This may include the following: bumper lead, bumper taper, side protrusion, side taper, etc. Record the value for each C-measurement and maximum crush.

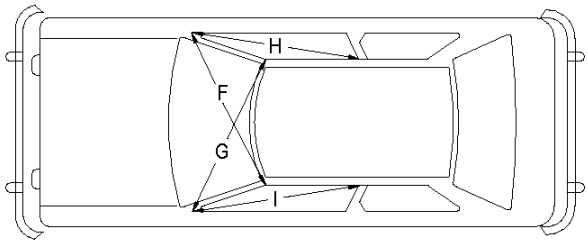
**Measure and document on the vehicle diagram the beginning or end of the direct damage width and field L (e.g., side damage with respect to undamaged axle).

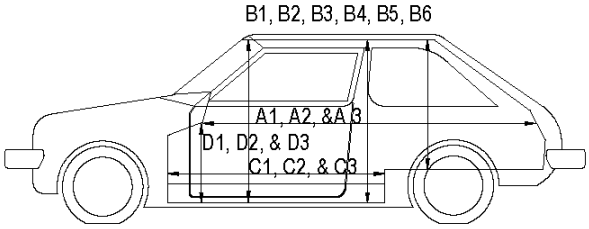
***Measure and document on the vehicle diagram the location of the maximum crush.

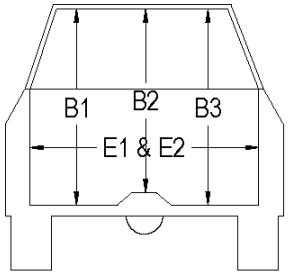
Note: Use as many lines/columns as necessary to describe each damage profile.

Figure C.2. Exterior Crush Measurements for Test 619551-01-1.

Date:	2023-06-27	Test No.:	619551-01-1	VIN No.:	3NICN7AP5HL808543
Year:	2017	Make:	Nissan	Model:	Versa







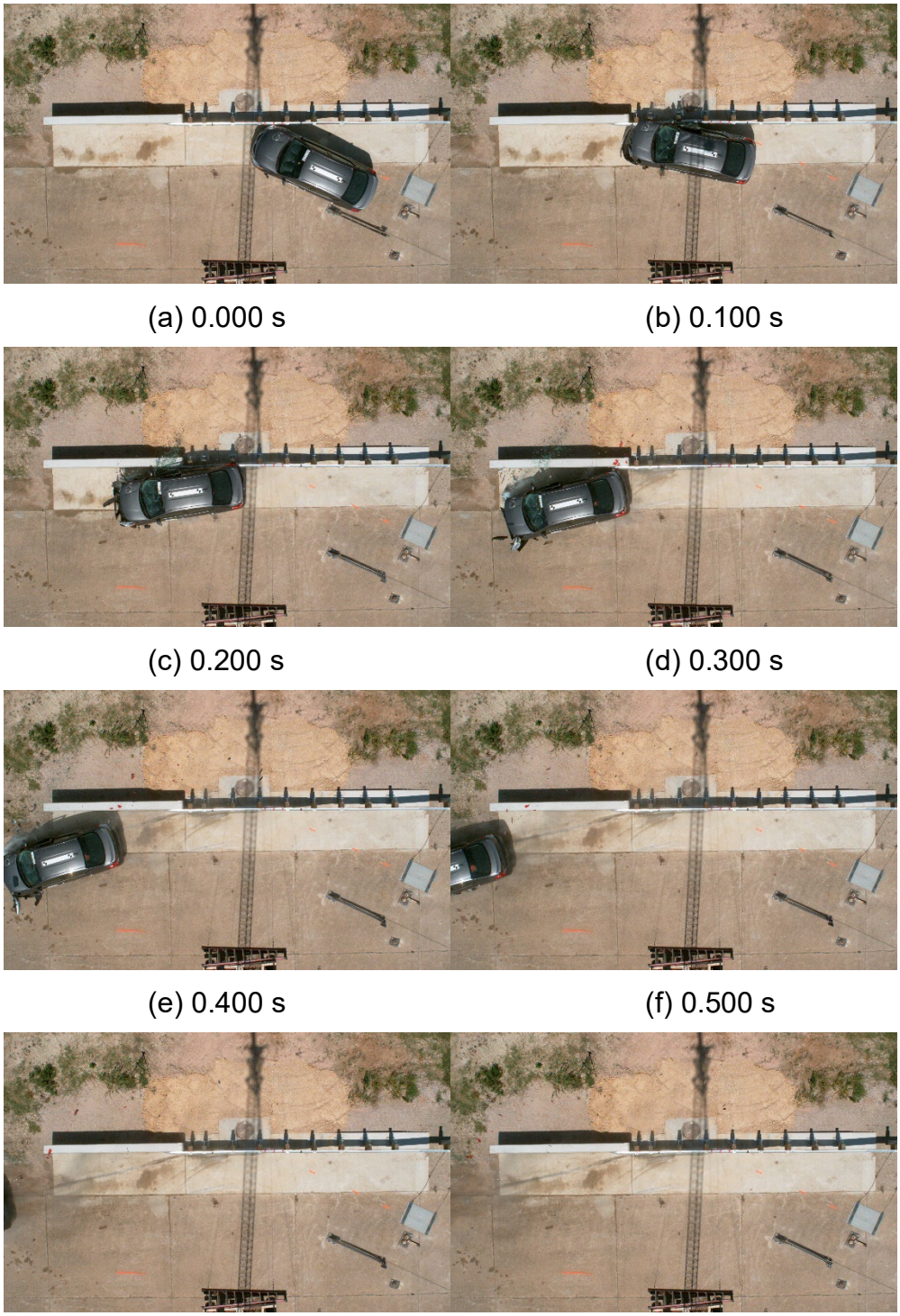
OCCUPANT COMPARTMENT DEFORMATION MEASUREMENT

	Before	After (inches)	Differ.
A1	67.50	67.50	0.00
A2	67.25	67.25	0.00
A3	67.75	67.75	0.00
B1	40.50	40.50	0.00
B2	39.00	39.00	0.00
B3	40.50	40.50	0.00
B4	36.25	36.25	0.00
B5	36.00	36.00	0.00
B6	36.25	36.25	0.00
C1	26.00	26.00	0.00
C2	0.00	0.00	0.00
C3	26.00	25.00	-1.00
D1	9.50	9.50	0.00
D2	0.00	0.00	0.00
D3	9.50	9.50	0.00
E1	51.50	51.50	0.00
E2	51.00	49.00	-2.00
F	51.00	50.25	-0.75
G	51.00	51.00	0.00
H	37.50	37.50	0.00
I	37.50	37.50	0.00
J*	51.00	50.25	-0.75

*Lateral area across the cab from driver's side kick panel to passenger's side kick panel.

Figure C.3. Occupant Compartment Measurements for Test 619551-01-1.

C.2. SEQUENTIAL PHOTOGRAPHS



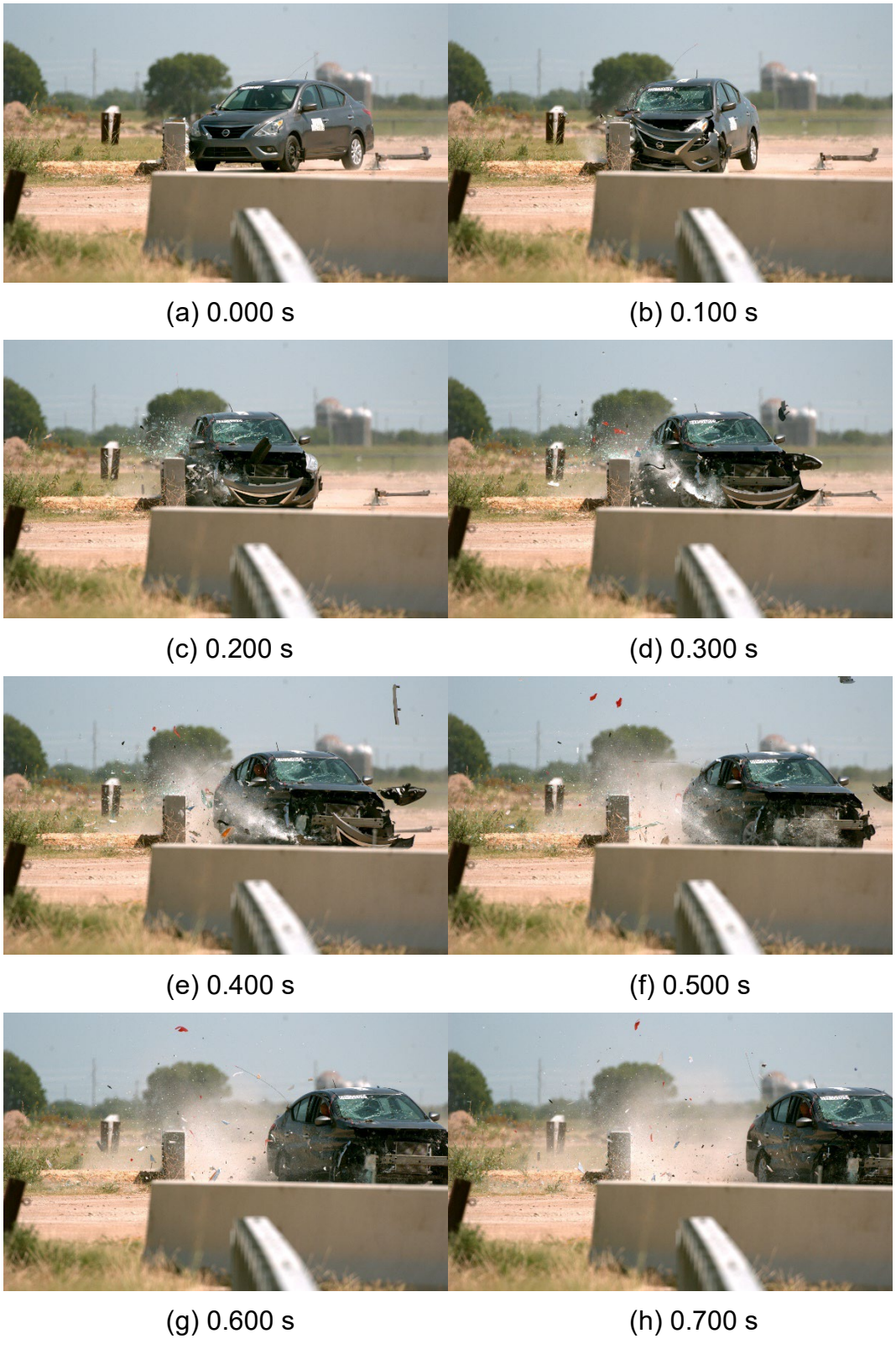
(a) 0.000 s (b) 0.100 s

(c) 0.200 s (d) 0.300 s

(e) 0.400 s (f) 0.500 s

(g) 0.600 s (h) 0.700 s

Figure C.4. Sequential Photographs for Test 619551-01-1 (Overhead Views).



(a) 0.000 s (b) 0.100 s

(c) 0.200 s (d) 0.300 s

(e) 0.400 s (f) 0.500 s

(g) 0.600 s (h) 0.700 s

Figure C.5. Sequential Photographs for Test 619551-01-1 (Frontal Views).

(a) 0.000 s (b) 0.100 s

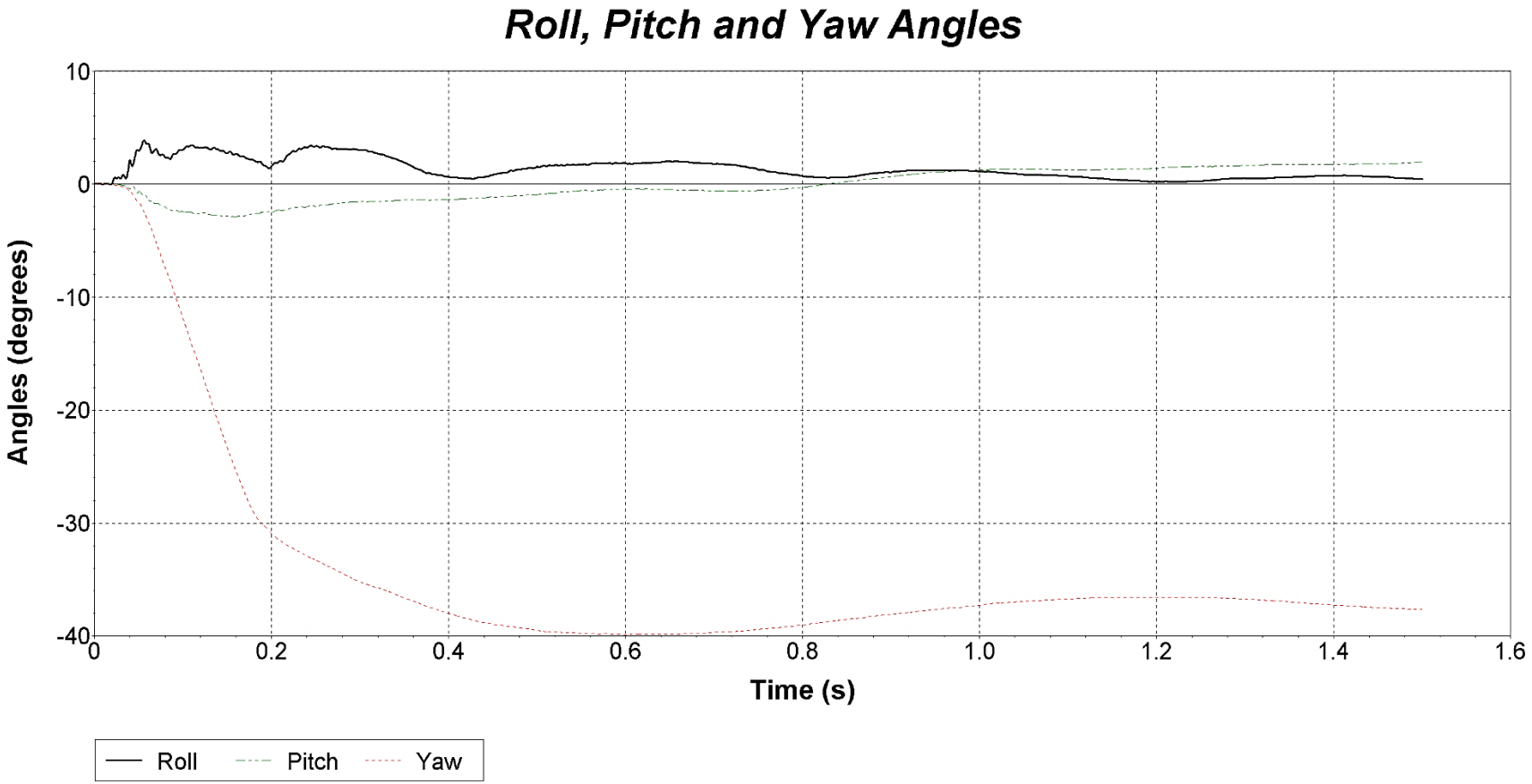
(c) 0.200 s (d) 0.300 s

(e) 0.400 s (f) 0.500 s

(g) 0.600 s (h) 0.700 s

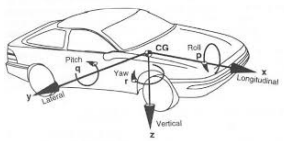
Figure C.6. Sequential Photographs for Test 619551-01-1 (Rear Views).

C.3. VEHICLE ANGULAR DISPLACEMENTS



Axes are vehicle-fixed.
Sequence for determining orientation:

1. Yaw.
2. Pitch.
3. Roll.



Test Number: 619551-01-1
Test Standard Test Number: *MASH* Test 3-20
Test Article TL-3 Transition With A Storm Drain Inlet
Test Vehicle: 2017 Nissan Versa
Inertial Mass: 2437 lbs
Gross Mass: 2602 lbs
Impact Speed: 62.6 mi/h
Impact Angle: 25.3°

Figure C.7. Vehicle Angular Displacements for Test 619551-01-1.

C.4. VEHICLE ACCELERATIONS

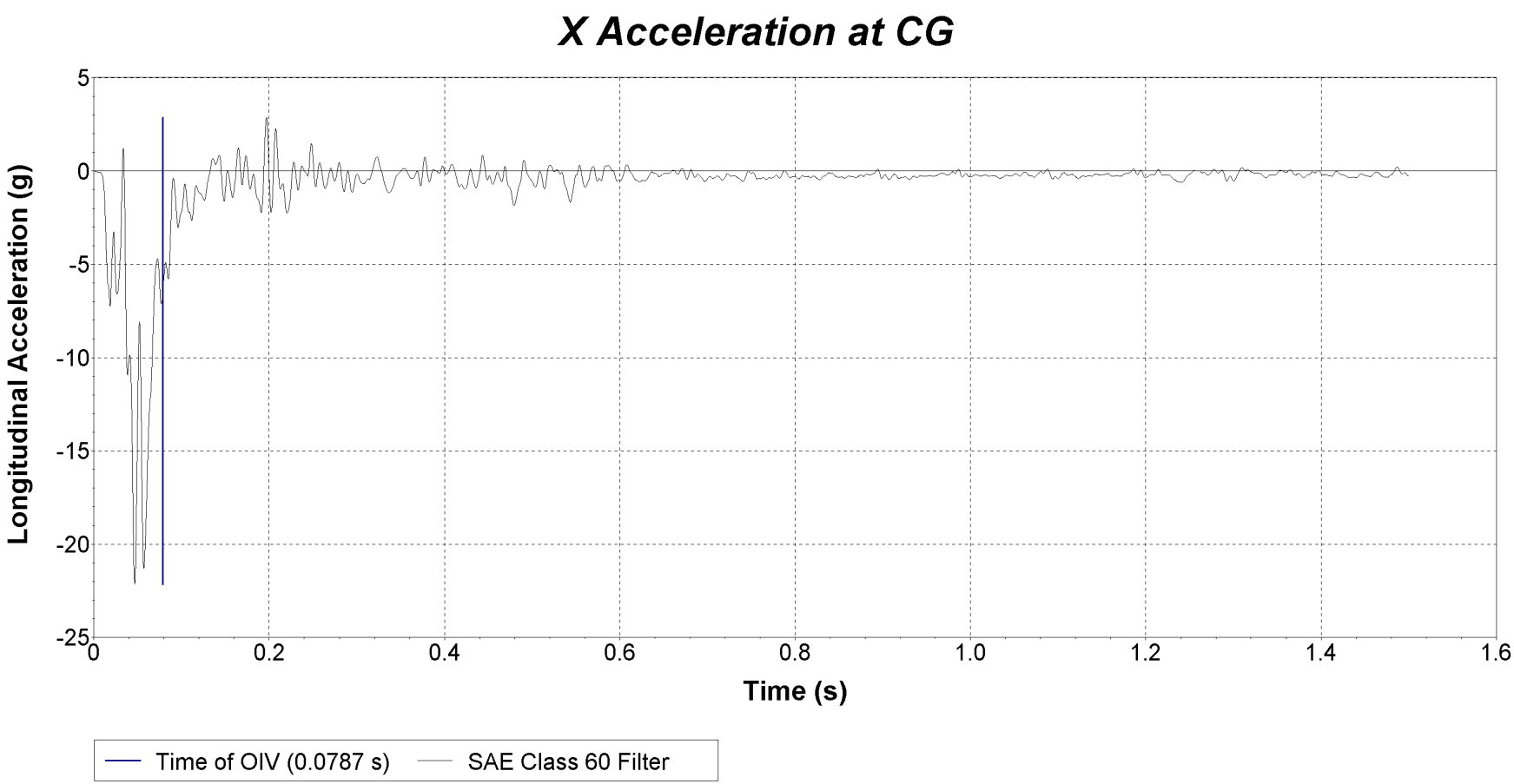


Figure C.8. Vehicle Longitudinal Accelerometer Trace for Test 619551-01-1 (Accelerometer Located at Center of Gravity).

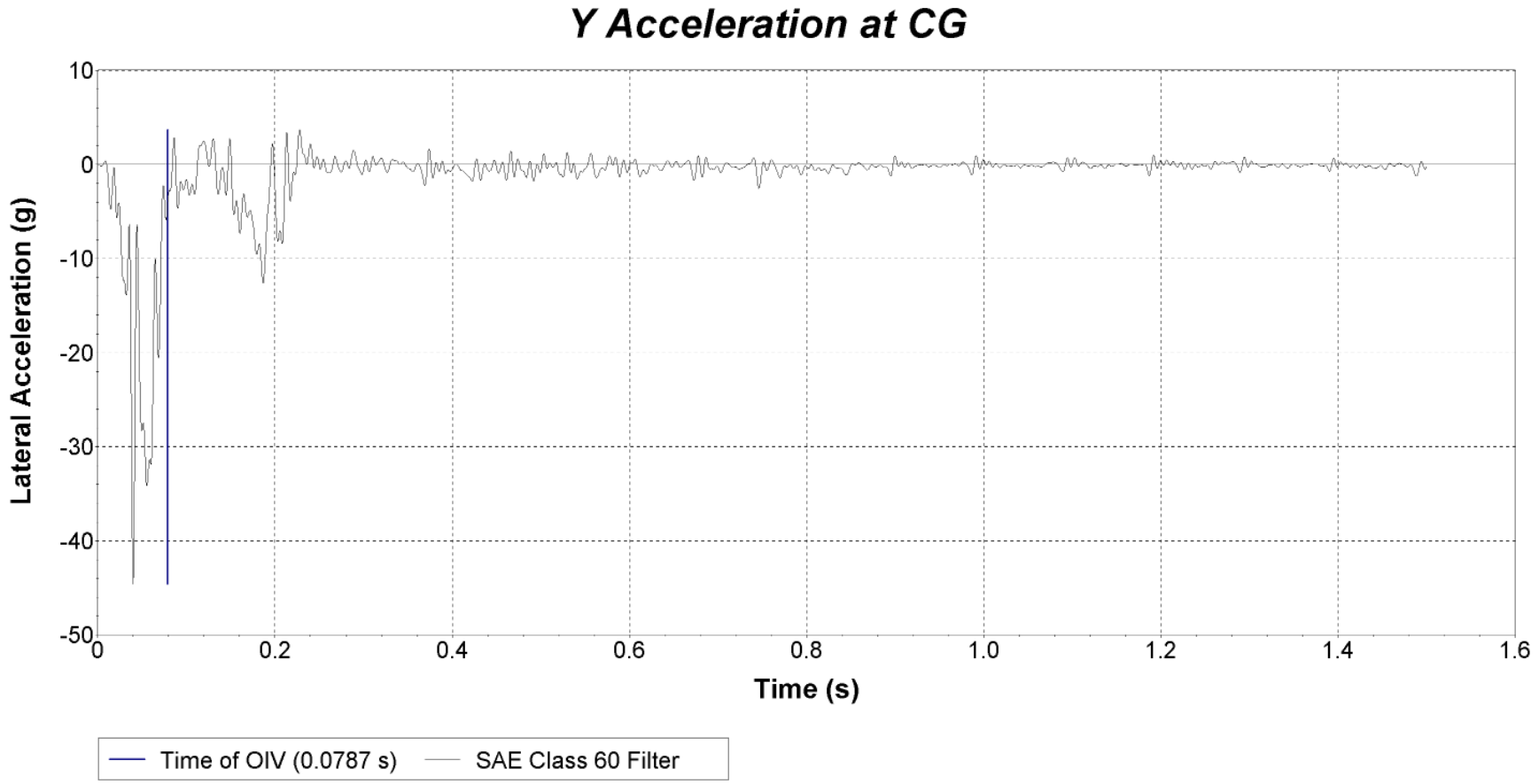


Figure C.9. Vehicle Lateral Accelerometer Trace for Test 619551-01-1 (Accelerometer Located at Center of Gravity).

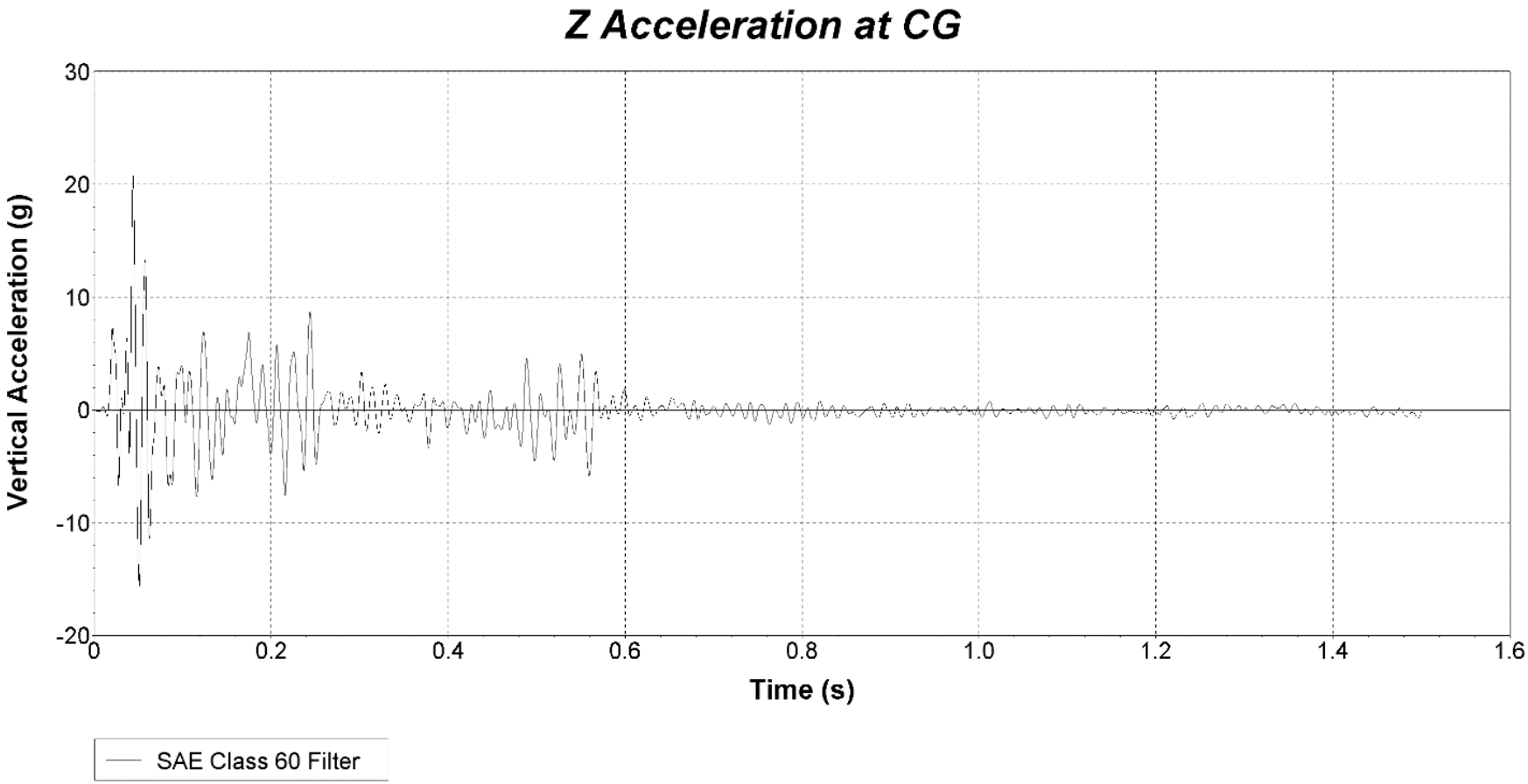


Figure C.10. Vehicle Vertical Accelerometer Trace for Test 619551-01-1 (Accelerometer Located at Center of Gravity).