

# MASH TEST 5-12 EVALUATION OF TxDOT T80SS BARRIER WITH SOUNDWALL





# Test Report 0-7086-R4

**Cooperative Research Program** 

### TEXAS A&M TRANSPORTATION INSTITUTE COLLEGE STATION, TEXAS

# **TEXAS DEPARTMENT OF TRANSPORTATION**

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Transportation (TxDOT) T80SS b guidelines included in the Americ Manual for Assessing Safety Hard	<i>Iware (MASH)</i> . The crash test was pe V vehicle weighing 79,300 lb impac	ne safety-performance evaluation Transportation Officials (AASHTO) reformed in accordance with MASH
	assessment of the TxDOT T80SS bar	soundwall, a description and results or rier with soundwall for <i>MASH</i>

The TxDOT T80SS barrier with soundwall met the performance criteria for *MASH* Test 5-12 for longitudinal barriers.

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# MASH TEST 5-12 EVALUATION OF TXDOT T80SS BARRIER WITH SOUNDWALL

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# DISCLAIMER

This research was performed in cooperation with the Texas Department of Transportation (TxDOT) and the Federal Highway Administration (FHWA). The contents of this report reflect the views of the authors, who are responsible for the facts and the accuracy of the data presented herein. The contents do not necessarily reflect the official view or policies of FHWA or TxDOT. This report does not constitute a standard, specification, or regulation.

This report is not intended for construction, bidding, or permit purposes. The engineer in charge of the project was Roger P. Bligh, P.E. #78550.

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# **TTI PROVING GROUND DISCLAIMER**

The results of the crash testing reported herein apply only to the article tested.

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# TABLE OF CONTENTS

List of Figure	°S	Х
List of Tables	5	X
Chapter 1.	Introduction	.1
1.1. Backgr	ound	1
1.2. Objecti	ve	1
Chapter 2.	System Details	3
2.1. Test A1	ticle and Installation Details	3
2.2. Design	Modifications during Tests	3
2.3. Materia	al Specifications	3
Chapter 3.	Test Requirements and Evaluation Criteria	7
3.1. Crash 7	Fest Performed/Matrix	7
3.2. Evaluat	tion Criteria	7
Chapter 4.	Test Conditions	9
4.1. Test Fa	cility	9
4.2. Vehicle	e Tow and Guidance System	9
4.3. Data A	cquisition System	9
4.3.1.	Vehicle Instrumentation and Data Processing	9
4.3.2.		11
4.3.3.	Photographic Instrumentation Data Processing	11
Chapter 5.	MASH Test 5-12 (Crash Test No. 440861-4)1	13
5.1. Test De	esignation and Actual Impact Conditions	13
5.2. Weathe	er Conditions	13
5.3. Test Ve	ehicle	13
5.4. Test De	escription	14
	e to Test Installation	
5.6. Damag	e to Test Vehicle	15
5.7. Vehicle	e Instrumentation	15
Chapter 6.	Summary and Conclusions	21
6.1. Assess	ment of Test Results	21
6.2. Conclu	sions	21
Chapter 7.	Implementation	23
	, 	
Appendix A.	Details of T80SS Barrier with Soundwall	27
Appendix B.	Supporting Certification Documents	31
Appendix C.	MASH Test 5-12 (Crash Test No. 440861-4)	57
C.1. Vehicle	e Properties and Information	57
C.2. Sequen	tial Photographs	58
	e Angular Displacements	
C.4. Vehicle	e Accelerations	52

# LIST OF FIGURES

Figure 2.1.	Details of TxDOT T80SS Barrier with Soundwall.	4
Figure 2.2.	TxDOT T80SS Barrier with Soundwall prior to Testing	5
Figure 3.1.	Target CIP for MASH Test 5-12 on TxDOT T80SS Barrier with	
	Soundwall.	7
Figure 5.1.	TxDOT T80SS Barrier with Soundwall/Test Vehicle Geometrics for	
-	Test No. 440861-4.	13
Figure 5.2.	Test Vehicle before Test No. 440861-4.	14
Figure 5.3.	TxDOT T80SS Barrier with Soundwall after Test No. 440861-4	16
Figure 5.4.	Field Side of TxDOT T80SS Barrier with Soundwall after Test No.	
C	440861-4.	17
Figure 5.5.	Test Vehicle after Test No. 440861-4.	18
Figure 5.6.	Interior of Test Vehicle after Test No. 440861-4.	18
Figure 5.7.	Summary of Results for MASH Test 5-12 on TxDOT T80SS Barrier with	
C	Soundwall.	19

# LIST OF TABLES

# Page

Test Conditions and Evaluation Criteria Specified for MASH TL-5	
Longitudinal Barriers.	7
Evaluation Criteria Required for MASH TL-5 Longitudinal Barriers.	8
Events during Test No. 440861-4.	14
Performance Evaluation Summary for MASH Test 5-12 on TxDOT T80SS	
Barrier with Soundwall.	22
	Longitudinal Barriers. Evaluation Criteria Required for <i>MASH</i> TL-5 Longitudinal Barriers. Events during Test No. 440861-4. Performance Evaluation Summary for <i>MASH</i> Test 5-12 on TxDOT T80SS

# **Chapter 1. INTRODUCTION**

### **1.1. BACKGROUND**

Noise barriers, or soundwalls, are structures designed to abate noise in areas neighboring a highway. Sound sources in the highway environment include vehicle engine and exhaust noise, tire-pavement noise, and aerodynamic noise, which vary by vehicle type and speed. There are many types of soundwall designs. Concrete soundwalls work by redirecting the travel of sound away from a location.

When a soundwall is needed across a bridge structure, design options become more limited. When a truck impacts a bridge rail, the lean of the truck over the top of the bridge rail defines what is referred to as the working width or zone of influence. It is typically impractical and cost prohibitive to locate a bridge-mounted soundwall outside the working width of the bridge rail due to the additional deck width that would be required. If the soundwall is located inside the barrier working width, it must be designed to accommodate the associated vehicle impact loads.

Vehicle impact conditions for the design of longitudinal barriers such as bridge rails are prescribed in *MASH*. *MASH* defines six different test levels that increase in impact severity. TxDOT wished to evaluate the impact performance of a concrete soundwall mounted on top of a concrete bridge rail supported on a cantilevered deck to *MASH* Test Level 5 (TL-5) impact conditions. Such a design can provide a cost-effective, crashworthy solution when a bridge-mounted soundwall is needed.

### **1.2. OBJECTIVE**

The purpose of the test reported herein was to assess the performance of the TxDOT T80SS barrier with soundwall according to the safety-performance evaluation guidelines included in *MASH*. The crash test was performed in accordance with *MASH* Test 5-12, which involves a 36000V tractor-van trailer vehicle weighing 79,300 lb impacting the longitudinal barrier while traveling at 50 mi/h and 15 degrees.

This report provides details on the TxDOT T80SS barrier with soundwall, a description and results of the crash test, and a performance assessment of the TxDOT T80SS barrier with soundwall for *MASH* Test 5-12 longitudinal barrier evaluation criteria.

# Chapter 2. SYSTEM DETAILS

## 2.1. TEST ARTICLE AND INSTALLATION DETAILS

The test installation was 120 ft long and consisted of a steel-reinforced concrete deck, barrier parapet, and soundwall. The 30-inch-wide, 12-inch-thick deck cantilever was anchored to the foundation wall. The single-slope parapet was 42 inches tall, 12 inches wide at top, and 20 inches wide at bottom, with a continuous slope on the traffic side. The field side of the single-slope parapet had a 1½-inch inset from the deck to a height of 19½ inches. The soundwall was 9 inches wide and 54 inches tall, bringing the total height of the parapet soundwall system to 96 inches from grade. The soundwall was centered on the top of the single-slope parapet, providing an offset of 1½ inches from the top traffic and field side corners of the parapet to the faces of the soundwall.

There was a single 2-inch-wide joint through the deck, parapet, and soundwall 30 ft downstream from the end of the installation. This joint was reinforced with four 1-inch-diameter rebar dowels. One end of each dowel was cast into the concrete, and the other side was in a PVC sleeve to allow movement across an expansion joint. Two dowel bars were in the parapet and two were in the sound wall.

Figure 2.1 presents the overall information on the TxDOT T80SS barrier with soundwall, and Figure 2.2 provides photographs of the installation. Appendix A provides further details on the TxDOT T80SS barrier with soundwall. Drawings were provided by the TTI Proving Ground, and construction was performed by MBC Management and supervised by TTI Proving Ground personnel.

### 2.2. DESIGN MODIFICATIONS DURING TESTS

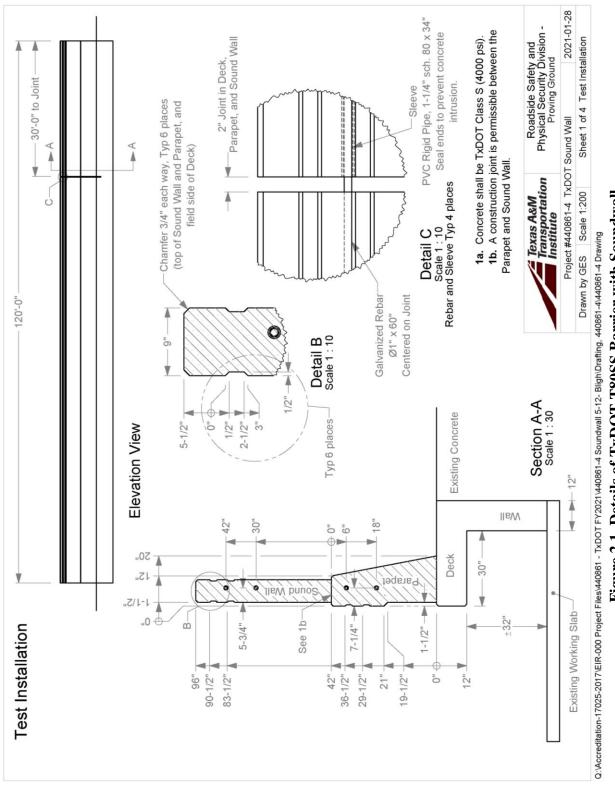
No modifications were made to the installation during the testing phase.

### 2.3. MATERIAL SPECIFICATIONS

The specified compressive strength of the concrete used in the support wall, deck, parapet, and soundwall was 4000 psi. The average compressive strengths of the concrete were as follows:

- North of Joint Support wall: 5,620 psi at 91 days of age on June 30, 2021.
- South of Joint Support wall: 5,530 psi at 86 days of age on June 30, 2021.
- North of Joint Deck: 5475 psi at 91 days of age on June 30, 2021.
- South of Joint Deck: 5,530 psi at 86 days of age on June 30, 2021.
- Barrier North of Expansion Joint: 4,953 psi at 35 days of age on May 19, 2021.
- Barrier South of Expansion Joint: 6,897 psi at 76 days of age on June 30, 2021.
- Soundwall North of Expansion Joint: 5,533 psi at 71 days of age on June 30, 2021.
- Soundwall South of Expansion Joint: 5,306 psi at 69 days of age on June 30, 2021.

Appendix B provides material certification documents for the materials used to install/construct the TxDOT T80SS barrier with soundwall.



# Figure 2.1. Details of TxDOT T80SS Barrier with Soundwall.



Figure 2.2. TxDOT T80SS Barrier with Soundwall prior to Testing.

# **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* TL-5 for longitudinal barriers. This report presents testing of the TxDOT T80SS barrier with soundwall in accordance with *MASH* Test 5-12 evaluation criteria. The target critical impact point (CIP) for *MASH* Test 5-12 was determined using the information provided in *MASH* Section 2.3.2.1 and *MASH* Table 2-8. Figure 3.1 shows the target CIP for *MASH* Test 5-12 on the TxDOT T80SS barrier with soundwall, which was 12 inches downstream of the centerline of the joint in the deck, parapet, and soundwall.

Table 3.1. Test Conditions and Evaluation Criteria Specified for MASH TL-5Longitudinal Barriers.

Test Article	Test	Test	Imp Condi		Evaluation
	Designation	Vehicle	Speed	Angle	Criteria
	5-10	1100C	62 mi/h	25°	A, D, F, H, I
Longitudinal Barrier	5-11	2270P	62 mi/h	25°	A, D, F, H, I
	5-12	36000V	50 mi/h	15°	A, D, G

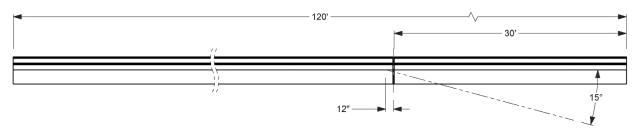


Figure 3.1. Target CIP for MASH Test 5-12 on TxDOT T80SS Barrier with Soundwall.

*MASH* also recommends performing Test 5-10 with the 1100C passenger car and Test 5-11 with the 2270P pickup truck. However, based on the acceptable impact performance of a single-slope barrier of similar profile in previous testing with both design passenger vehicles, these tests were not considered necessary (2, 3). The 1100C passenger car would not interact with the added soundwall. While the pickup truck might have some minimal contact with the offset soundwall, the face of the soundwall is continuous with no edges or surfaces to create snagging.

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 tests reported herein. Table 3.1 lists the test conditions and evaluation criteria

required for *MASH* Test 5-12, and Table 3.2 provides detailed information on the evaluation criteria. An evaluation of the crash test results is presented in Chapter 6.

Evaluation Factors	Evaluation Criteria
Structural Adequacy	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.
Occupant Risk	Deformations of, or intrusions into, the occupant compartment should not exceed limits set forth in Section 5.2.2 and Appendix E of MASH.
	<i>G.</i> It is preferable, although not essential, that the vehicle remain upright during and after the collision.

Table 3.2. Evaluation Criteria Required for MASH TL-5 Longitudinal Barriers.

# **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 site selected for construction and testing of the TxDOT T80SS barrier with soundwall was at the end of an out-of-service runway. The runway consists of an unreinforced jointed-concrete pavement in 12.5-ft × 15-ft blocks nominally 6 inches deep. The runways were built in 1942, and the joints have some displacement but are otherwise flat and level.

### 4.2. VEHICLE TOW AND GUIDANCE SYSTEM

The vehicle was placed in ninth gear for the *MASH* 5-12 test. With the vehicle idling, the clutch was remotely engaged to allow the truck to be pushed to speed. Once at speed, within the power band of the gear, the clutch was remotely released. The accelerator was then remotely depressed, and the vehicle accelerated under its own power to the required speed. 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. The vehicle was released and ran unrestrained just prior to impact with the installation. 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 SYSTEM

### 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 16-channel Tiny Data Acquisition System (TDAS) Pro 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 TDAS Pro hardware and software conform to the latest SAE J211, Instrumentation for Impact Test. Each of the 16 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 up the data 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 TDAS Pro 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 of the TDAS Pro units 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<sup>®</sup> 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 Rateof-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  $\pm 1.7$  percent at a confidence factor of 95 percent (k = 2).

TRAP uses the data from the TDAS Pro 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 are measured with an expanded uncertainty of  $\pm 0.7$  percent at a confidence factor of 95 percent (k = 2).

Placement of the electronic instrumentation in the 36000V vehicle is described below and shown in **Error! Reference source not found.**:

- (A) The front accelerometers were placed on the truck frame rail 19.0 inches rearward of the front axle, 20.0 inches to the left of the longitudinal centerline, at height of 26.0 inches above ground surface.
- (B) The accelerometers and rate transducers at the rear of the tractor were placed 106.0 inches rearward of the front axle, on the longitudinal centerline, at a height of 32.0 inches above ground surface.
- (C) The rear accelerometers were placed inside the trailer on the floor 695.0 inches rearward of the front axle, on the longitudinal centerline, at a height of 49.0 inches above ground surface.

# 4.3.2. Anthropomorphic Dummy Instrumentation

*MASH* does not recommend or require use of a dummy in the 36000V vehicle, and no dummy was placed in the vehicle.

### 4.3.3. Photographic Instrumentation Data Processing

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

- One placed 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 TxDOT T80SS barrier with soundwall. 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 5-12 (CRASH TEST NO. 440861-4)

# 5.1. TEST DESIGNATION AND ACTUAL IMPACT CONDITIONS

*MASH* Test 5-12 involves a 36000V vehicle weighing 79,300 lb  $\pm$  1100 lb impacting the CIP of the longitudinal barrier at an impact speed of 50 mi/h  $\pm$  2.5 mi/h and an angle of 15 degrees  $\pm$  1.5 degrees. The CIP for *MASH* Test 5-12 on the TxDOT T80SS barrier with soundwall was 12 inches  $\pm$  12 inches downstream of the centerline of the expansion joint. Figure 3.1 and Figure 5.1 depict the target impact setup.



Figure 5.1. TxDOT T80SS Barrier with Soundwall/Test Vehicle Geometrics for Test No. 440861-4.

The 36000V vehicle weighed 80,030 lb, and the actual impact speed and angle were 50.4 mi/h and 14.3 degrees. The actual impact point was 20.9 inches downstream of the centerline of the expansion joint. Minimum target impact severity (IS) was 404 kip-ft, and actual IS was 415 kip-ft.

# 5.2. WEATHER CONDITIONS

The test was performed on the afternoon of July 1, 2021. Weather conditions at the time of testing were as follows: wind speed: 5 mi/h; wind direction: 187 degrees (vehicle was traveling at a heading of 350 degrees); temperature: 90°F; relative humidity: 66 percent.

### 5.3. TEST VEHICLE

Figure 5.2 shows the 2013 International 8600 tractor with 1988 Great Dane 7311TCHL53 trailer used for the crash test. The vehicle's test inertia weight was 80,030 lb, and its gross static weight was 80,030 lb. The height to the lower edge of the vehicle bumper was 14.0 inches, and height to the upper edge of the bumper was 29.5 inches. The height to the center of gravity of the vehicle's ballast was 73.0 inches. Table C.1 in Appendix C.1 gives additional dimensions and information on the vehicle. The vehicle was directed into the installation using a cable guidance system, and was released to be freewheeling and unrestrained just prior to impact.



Figure 5.2. Test Vehicle before Test No. 440861-4.

# 5.4. TEST DESCRIPTION

Table 5.1 lists events that occurred during Test No. 440861-4. Figures C.1 and C.2 in Appendix C.2 present sequential photographs during the test.

Time (s)	Events
0.0000	Vehicle impacts the soundwall
0.0280	Vehicle begins to redirect
0.1630	Front corner of the trailer contacts the soundwall
0.1720	Left front tire lifts off the pavement
0.7230	Vehicle travels parallel with the soundwall
0.7700	Right rear corner of the trailer contacts the soundwall
1.3370	Vehicle loses contact with the soundwall

Table 5.1. Events during Test No. 440861-4.

For longitudinal barriers, it is desirable for the vehicle to redirect and exit the barrier within the exit box criteria (not less than 65.6 ft for heavy vehicles). The test vehicle exited within the exit box criteria defined in *MASH*. The vehicle rode off the end of the TxDOT T80SS barrier with soundwall. After loss of contact with the barrier, the brakes were applied, and the vehicle came to rest 239 ft downstream of the point of impact and 34 ft toward the traffic side of the soundwall.

# 5.5. DAMAGE TO TEST INSTALLATION

Figure 5.3 and Figure 5.4 show the damage to the TxDOT T80SS barrier with soundwall. The downstream section of the soundwall had spalled concrete at the joint. There was gouging and scuffing of the concrete at impact and upstream and downstream of impact. There were minor cracks in the deck at the joint. There were also minor cracks on the field side of the soundwall downstream from the joint. Two of the vertical cracks ran from the top to the bottom of the barrier and were measured at 32 inches and 44 inches downstream from the center of the joint. A third vertical crack ran from the middle of the barrier to near the bottom and was measured at 108 inches downstream from the center of the joint. There was one 93-inch-long horizontal crack, which began at the downstream edge of the joint and was measured at

54 inches from the underside of the deck. There was some deflection of the soundwall at the joint. The soundwall on the upstream side of the expansion joint had a permanent deflection of <sup>1</sup>/<sub>8</sub> inch at 12 inches from the top of the wall. The soundwall on the downstream side of the expansion joint had a permanent deflection of <sup>5</sup>/<sub>8</sub> inch at a location 37<sup>1</sup>/<sub>2</sub> inches from the top, <sup>1</sup>/<sub>4</sub> inch at a location 44 inches from the top, and <sup>1</sup>/<sub>4</sub> inch at a location 5<sup>1</sup>/<sub>2</sub> inches from the base of the soundwall. The downstream section of the deck at the joint was <sup>1</sup>/<sub>2</sub> inche below the section upstream of the joint at 2 inches toward the traffic side from the toe of the single-slope parapet. Working width<sup>\*</sup> was 20.4 inches, and height of working width was 94.9 inches. Maximum dynamic deflection during the test was 1.9 inches, and there was no permanent deformation observed.

### 5.6. DAMAGE TO TEST VEHICLE

Figure 5.5 shows the damage sustained by the vehicle. The front bumper, left front axle spring assembly, hood, right door, right front tire and rim, right front outer tandem tire and rim, right fuel tank (deformed only; no visible cuts or holes; no leaks), right side steps, right front corner of the trailer, and right rear upper corner of the trailer were damaged. The windshield had cracks radiating upward and inward from the lower right corner. Maximum exterior crush to the vehicle was 18.0 inches in the front plane at the right front corner at bumper height. No occupant compartment deformation or intrusion was observed. Figure 5.6 shows the interior of the vehicle.

# 5.7. VEHICLE INSTRUMENTATION

Data from the accelerometers were digitized for informational purposes only and are reported in Figure 5.7. Figure C.3 in Appendix C.3 shows the vehicle angular displacements, and Figures C.4 through C.12 in Appendix C.4 show acceleration versus time traces. Figure 5.7 summarizes pertinent information from the test.

<sup>\*</sup> 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 5.3. TxDOT T80SS Barrier with Soundwall after Test No. 440861-4.



Note: Cracks outlined with black marker for visualization.

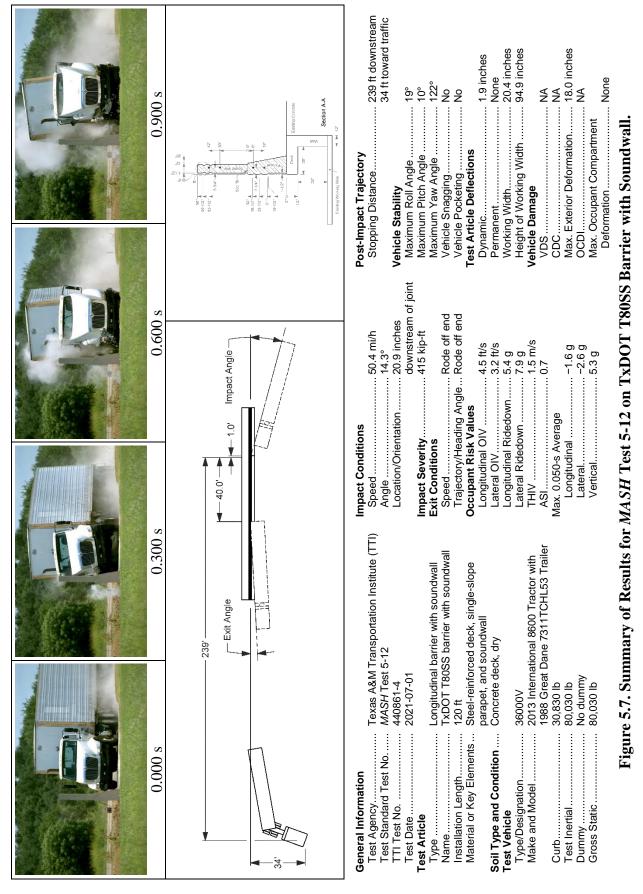
Figure 5.4. Field Side of TxDOT T80SS Barrier with Soundwall after Test No. 440861-4.



Figure 5.5. Test Vehicle after Test No. 440861-4.



Figure 5.6. Interior of Test Vehicle after Test No. 440861-4.



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# Chapter 6. SUMMARY AND CONCLUSIONS

## 6.1. ASSESSMENT OF TEST RESULTS

The crash test reported herein was performed in accordance with *MASH* Test 5-12, which involves a 36000V tractor-van trailer impacting the TxDOT T80SS barrier with soundwall at a nominal impact speed and angle of 50 mi/h and 15 degrees. Table 6.1 provides an assessment of the test based on the applicable safety evaluation criteria for *MASH* Test 5-12 for longitudinal barriers.

### 6.2. CONCLUSIONS

The TxDOT T80SS barrier with soundwall met the performance criteria for *MASH* Test 5-12 for longitudinal barriers.

	Table 6.1. Performance Evaluation Summary for <i>h</i>	Summary for MASH Test 5-12 on TxDOT T80SS Barrier with Soundwall.	ı Soundwall.
Tes	Test Agency: Texas A&M Transportation Institute	Test No.: 440861-4	Test Date: 2021-07-01
	MASH Test 5-12 Evaluation Criteria	Test Results	Assessment
Str	<u>Structural Adequacy</u>		
А.	Test article should contain and redirect the vehicle or	The TxDOT T80SS barrier with soundwall	
	bring the vehicle to a controlled stop; the vehicle	contained and redirected the 36000V vehicle.	
	should not penetrate, underride, or override the	The vehicle did not penetrate, underride, or	Pass
	installation although controlled lateral deflection of	override the installation. Maximum dynamic	
	the test article is acceptable.	deflection during the test was 1.9 inches.	
Oct	Occupant Risk		
D.	Detached elements, fragments, or other debris from	No detached elements, fragments, or other debris	
	the test article should not penetrate or show potential	from the soundwall were present to penetrate or	
	for penetrating the occupant compartment, or present	show potential for penetrating the occupant	
	an undue hazard to other traffic, pedestrians, or	compartment, or present hazard to others in the	Dage
	personnel in a work zone.	area.	1 400
	Deformations of, or intrusions into, the occupant	No occupant compartment deformation or	
	compartment should not exceed limits set forth in	intrusion was observed.	
	Section 5.2.2 and Appendix E of MASH.		
Ŀ.	It is preferable, although not essential, that the vehicle	The 36000V vehicle remained upright during and	
	remain upright during and after collision.	after the collision event.	rass

TR No. 0-7086-R4

# **Chapter 7. IMPLEMENTATION\***

Based on the results of the testing and evaluation reported herein, the TxDOT T80SS barrier with concrete soundwall is considered suitable for implementation as a *MASH* TL-5 barrier system. The *MASH* matrix for TL-5 longitudinal barriers consists of three tests: Tests 5-10, 5-11, and 5-12. *MASH* Test 5-12 was performed under this project and successfully met all *MASH* evaluation criteria.

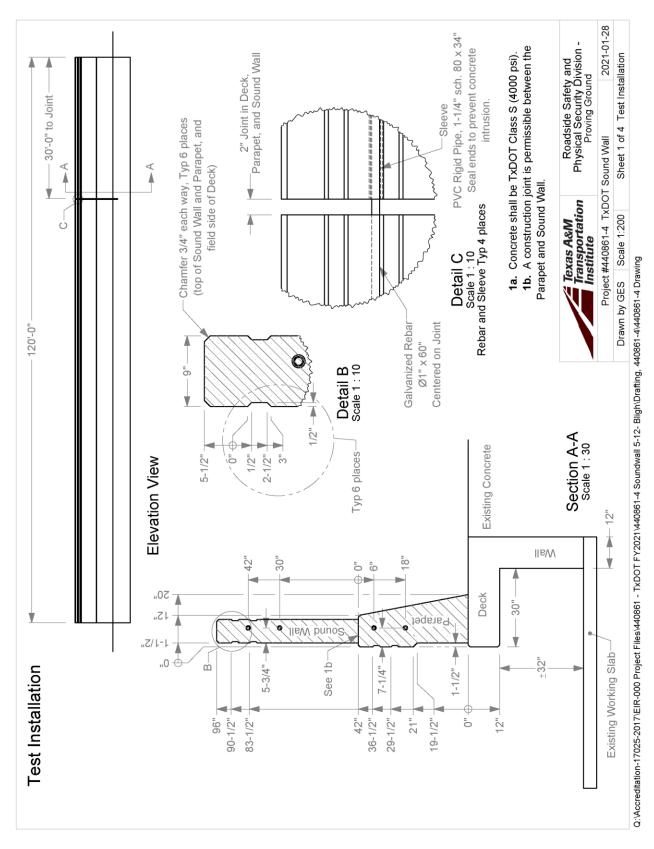
*MASH* also recommends performing Test 5-10 with the 1100C passenger car and Test 5-11 with the 2270P pickup truck. However, based on the acceptable impact performance of a single-slope barrier of similar profile in previous testing with both design passenger vehicles, these tests were not considered necessary (2, 3). The 1100C passenger car would not interact with the added soundwall. While the 2270P pickup truck might have some minimal contact with the offset soundwall, the face of the soundwall is continuous with no edges or surfaces to create snagging.

Statewide implementation of this barrier and soundwall combination can be achieved by TxDOT's Bridge Division through development of a standard detail sheet. The barrier details provided in Appendix A can be used for this purpose.

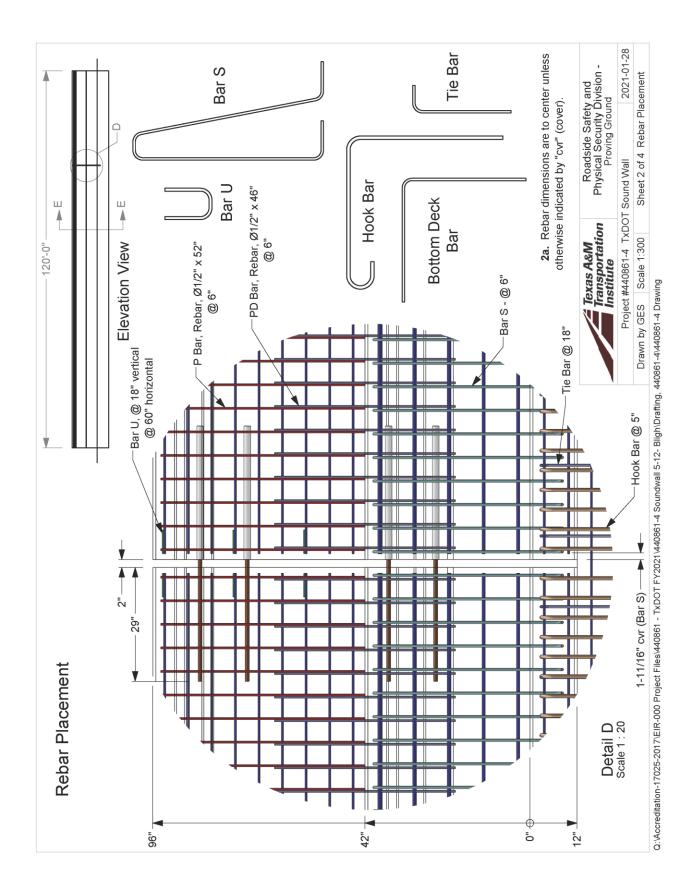
<sup>\*</sup> The opinions/interpretations identified/expressed in this section of the report are outside the scope of TTI Proving Ground's A2LA Accreditation.

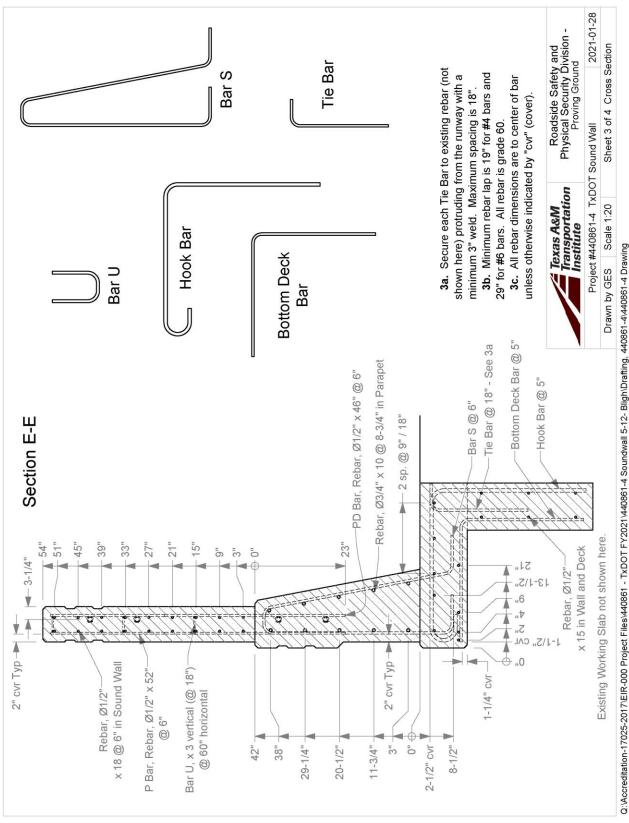
# REFERENCES

- 1. AASHTO. *Manual for Assessing Roadside Safety Hardware, Second Edition.* American Association of State Highway and Transportation Officials, Washington, DC, 2016.
- 2. FHWA Safety Roadway Departure Eligibility Letter B-339 (https://safety.fhwa.dot.gov/roadway\_dept/countermeasures/reduce\_crash\_severity/barrie\_ rs/pdf/b339.pdf).
- 3. W. F. Williams, R. P. Bligh, and W. L. Menges. *MASH Test 3-11 of the TxDOT Single Slope Bridge Rail (Type SSTR) on Pan-Formed Bridge Deck*. Report FHWA/TX-11/9-1002-3, Texas A&M Transportation Institute, College Station, TX, March 2011.

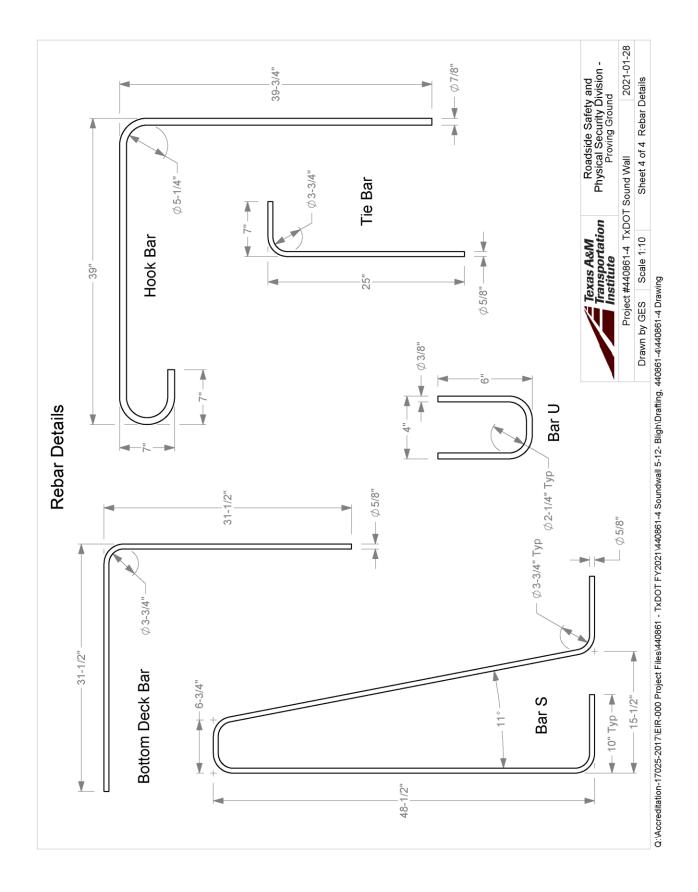


# APPENDIX A. DETAILS OF T80SS BARRIER WITH SOUNDWALL









TR No. 0-7086-R4

	exas A&M ansportation stitute	Sam	Concrete pling	Doc. No. QF <b>7.3-</b> 01	Revision Date: 2020-0 <b>7-</b> 29
Quality	y Form	Revised by: B.L. Griffi Approved by: D. L. Ku		Revision: 7	Page: 1 of 1
Project No:	440861-04	Casting Date:	3/31/2021	Mix Design (psi):	4000
Name of Technician Taking Sample	Terr	acon	Name of Technician Breaking Sample	Terr	acon
Signature of Technician Taking Sample	Terr	acon	Signature of Technician Breaking Sample		acon
Load No.	Truck No.	Ticket No.	Locat	ion (from concrete	e map)
T1	6678594	7212		100% of wall	
Т2	6678665	7211	110 feet o	f deck starting from	n the North
Т3	6678983	7165	10 fee	t of deck from Joint	t North
Load No.	Break Date	Cylinder Age	Total Load (lbs)	Break (psi)	Average

# APPENDIX B. SUPPORTING CERTIFICATION DOCUMENTS

		BILLING			TICKET NO.
	Ma	rtin Mari	etta		6678594
Martin	<b>1</b> 1	503 LBJ Freew			
Mariet	tta r	Suite 400			
		Junuo, 17 1020			
TO JOB	ARRIVE JOB SITE	BEGIN POUR	FINISH POUR	LEAVE JOB SIT	E ARRIVE PLANT
Al Land March	A DU .		:	:	:
OB AT CUSTOMER	S REQUEST	GAL. CUSTO	OMER SIGNATURE		
		GAL			
		DELI	ERY OF THESE	MATERIALS IS S	UBJECT TO THE
RENGTH. ANY W	VATER ADDED IN F		OF AS ACCEPTE	DNS ON THE RE D BY SIGNATUR	VERSE SIDE RE ABOVE.
ND DELIVERY ADDR	RESS	PLANT	TRUCK ORI	DER NO. SLUMP	P.O. #/JOB/LOT
IENT YAN TX 7780	7	617		6 5.00	TTI-THRIE BEAM
		CHARLES	BALANGA		03/31/21
		782823		3 10.00	20.00
	DE00	RIPTION		UNIT PRI	CE AMOUNT
NSTRUCTIONS HT LEONARD RE ND ROUND ABC	D, RIGHT 47, LEFT I DUT TO GATE, CUS	NTO RELLIS, TOMER TO MEET	TYOU		
			FOR OFFICE U	SE ONLY FOR	И:
016114 lix Code 05D605 lb 18266 lb 16 14375 lb 16 5700 lb 16 5700 lb 16 1734 lb 02 228 0 Num Batches Design W/C: 0.453	user 6 Returned Batched 18240 lb 14340 lb 5680 lb 1730 lb 2 228 oz 1 Water/Cement: 0.45	678594 Qty I % Var% Moisture -0.14% 0.80% M -0.24% 4.00% M -0.21% 0.00% 4 T Design	91404 Mix Age ctual Wat 17 gl 69 gl 207 gl 309.2 gl A	11:31 Seq Loa D 925 Actual 293.5 gl 1.5 gl / CYDS	3/31/21 ad ID 574
	TO JOB  TO JOB  TO JOB  TO JOB  TO DELIVERY ADDED  TER ADDED TO  RENGTH. ANY V  UMP IS AT CUS  TO DELIVERY ADDE  TO DELIVERY ADDE  PRODUCT CO  SOS  PRODUCT CO  SOS  PRODUCT CO  SOS  PRODUCT CO  TO  TI LEONARD RE  SE ALKALI BURN  ND REVERSE SID  TI VET  CO  T	Marietta       1         Marietta       1	Martin Marie         Marietta       Stos LBJ Freew Suite 400 Dallas, TX 7523         TO JOB       ARRIVE JOB SITE       BEGIN POUR         Image: Stress of the		Martin Marietta         Marietta         Stad BJ Freeway Suite 400 Jallas, TX 7523         Marietta         <

	Martir Mariet	ר 1	rtin I	Freewa 400	ay 4			TICKET NO. 6678665
LOAD TIME	TO JOB	ARRIVE JOB SITE	BEGIN	POUR	FINISH	POUR LE	AVE JOB SITE	ARRIVE PLANT
11:46	12:02	12:27	12	35	:		:	:
ALLOWABLE WATE TEST CYLINDER TA CYLINDER TAKEN ADDITIONAL WA REDUCE ITS ST	ATER ADDED TO RENGTH. ANY W	NO BY REAFTER WATER THIS CONCRETE ATER ADDED IN	WILL	L. X DELIN	IS AND CO	THESE MA	TERIALS IS S ON THE RE BY SIGNATUR	UBJECT TO THE VERSE SIDE RE ABOVE.
CUSTOMER NAME	SLUMP IS AT CUS and delivery addr MENT XYAN, TX 77807	ESS		PLANT 617 DRIVER NA LARRY JA CUSTOME 782823		ORDER 2016 PROJECT 100138	NO. SLUMP 5.00 CUM. QTY 20.00	P.O. #JOB/LOT TTI-THRIE BEAM DATE 03/31/21 ORDERED QTY 20.00
10.00 DSE SPECIAL DELIVERY RIGHT 2818, RIG STRAIGHT AROU THERE	INSTRUCTIONS HT LEONARD RD	TXDOT CLASS S , RIGHT 47, LEFT UT TO GATE, CUS	INTO REL STOMER	LIS, TO MEET	YOU	SALES		
	JSE ALKALI BURNS ON REVERSE SIDE				FOR OFF	ICE USE OF	VLY FORM:	
7211 Load Size I 10.00 CYDS I Material Desig SAND-1 1812 SAND-1 1800 CMT-//II 570 H20 258 ZY-610 23 Actual	777135 11x Code DSD60S n Qty Required 10 18266 lb 10 18266 lb 10 5700 lb 10 5700 lb 10 1734 lb 02 228 02 Num Batches: Design WC: 0.453 Water in Truck:	Aser 6 Returned Batched 18280 lb 14380 lb 5675 lb 1734 lb 227 oz 1 Water/Cement: 0.45 0.0 gl Adjust Wa	6678665 Qty %Var%Mc 0.08%0,-0.10%4,-0.44% 0.02% -0.44% 5 T ater: 0.0	M bisture Act 80% M 00% M Design 0 gl / Load	91. ix Age ual Wat 18 gl 69 gl 208 gl 208 gl 309.2 gl Trim Water	406 Seq D Actual	Load 9257 294.1 gi To A ( CYDS	3/31/21 ID 6 xdd: 15.0 gi

Marie Marie	t <b>in 1</b>	BILLING <b>Intin Marie</b> 503 LBJ Freewa Suite 400 Dallas, TX 75234	ay			CKET NO. 6678983
LOAD TIME TO JOB	ARRIVE JOB SITE	BEGIN POUR	FINISH PC	UR LEA	VE JOB SITE	ARRIVE PLAN
13:11 1 :20	7 :	:	:		:	:
ADDITIONAL WATER ADDED REDUCE ITS STRENGTH. AN	atch) NO BY JAFTER WATE TO THIS CONCRETE IY WATER ADDED IN	GAL. X	IS AND COM	ESE MATI	ERIALS IS S ON THE REV SIGNATUR	UBJECT TO TH /ERSE SIDE E ABOVE.
OF SPECIFIED SLUMP IS AT		PLANT	TRUCK	ORDER N	O. SLUMP	P.O. #/JOB/LOT
MBC MANAGEMENT	2007	617 DRIVER N	7165	2016	5.00	TTI-THRIE BE
3100 SH 47, BRYAN, TX 77	/807	CHATHAI	M, DEXTER			03/31/21 ORDERED QT
A CONTRACTOR		CUSTOME 782823	ER NUMBER	PROJECT 100138	CUM. QTY 22.00	22.00
2.00 DSD60S	TXDOT CLASS S					
2.00 DSD60S SPECIAL DELIVERY INSTRUCTIONS RIGHT 2818, RIGHT LEONAR STRAIGHT AROUND ROUND	B D RD RIGHT 47 LEF	T INTO RELLIS.	TYOU		STAX	
SPECIAL DELIVERY INSTRUCTIONS RIGHT 2818, RIGHT LEONAR STRAIGHT AROUND ROUND THERE	3 D RD, RIGHT 47, LEF ABOUT TO GATE, CI	T INTO RELLIS.	TYOU	SALE		
SPECIAL DELIVERY INSTRUCTIONS RIGHT 2818, RIGHT LEONAR STRAIGHT AROUND ROUND	B D RD, RIGHT 47, LEF ABOUT TO GATE, CU DURNS.	T INTO RELLIS.		ΤΟΤΑΙ		:

Report Number: A1171057.0172 Service Date: 03/31/21 **Report Date:** 07/01/21 Revision 1 - 91-day results Task: PO# 440861-4



College Station, TX 77845-5765 979-846-3767 Reg No: F-3272

Texas Transportation Institute     Riverside Campus       Attn: Gary Gerke     Riverside Campus	
TITI Business Office     Bryan, TX       3135 TAMU     TAMU	
College Station, TX 77843-3135 Project Number: A1171057	
Material Information Sample Information	
Specified Strength:         Sample Date:         03/31/21         Sample Time:         1           Sampled By:         Ethan Boultinghouse	215
Mix ID: DSD60S Weather Conditions: Overcast moderate wind	
Supplier: Martin Marietta Accumulative Yards: 10/20 Batch Size (cy): 1	0
Batch Time: 1131 Plant: 517 Placement Method: Direct Discharge	
Truck No.: 7212 Ticket No.: 6678594 Water Added Before (gal): 5	
Field Test DataWater Added After (gal):0Sample Location:35Ft east 3Ft south of metal bridg	ð
Test Result Specification north ending	
Slump (in): 6 Not specified Placement Location: PO 440861-4	
Air Content (%):     2.8     Not specified	
Concrete Temp. (F): 70 40 - 95	
Ambient Temp. (F):         64         40 - 95	

## Laboratory Test Data

Plastic Unit Wt. (pcf):

Yield (Cu. Yds.):

Labo	ratory Te	st Data				Age at	Maximum	Compressive		
Set	Specimen	Avg Diam.	Area	Date	Date	Test	Load	Strength	Fracture	Tested
No.	ID	(in)	(sq in)	Received	Tested	(days)	(lbs)	(psi)	Туре	By
1	A	6.01	28.37		06/30/21	91	163,990	5,780	1	SLS
1	В	6.01	28.37		06/30/21	91	162,020	5,710	3	SLS
1	С	6.01	28.37		06/30/21	91	152,710	5,380	4	SLS
						Aver	age (91 days)	5,620		
1	D					Hold				
Initial	Cure: Outsi	ide Plastic Lid	ls	Final Cu	re: Field Cure	d				
	1 31.1	D	1							

Comments: Note: Reported air content does not include Aggregate Correction Factor (ACF).

Not specified

#### 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).

Start/Stop: 1100-1400

Terracon Rep.: Ethan Boultinghouse

Reported To:

Contractor:

### **Report Distribution:**

(1) Texas Transportation Institute, Gary Gerke (1) Terracon Consultants, Inc., Alex Dunigan, P.E.

147.2

(1) Texas Transportation Institute, Bill Griffith

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

The tests were performed in general accordance with applicable ASTM, AASHTO, or DOT test methods. This report is exclusively for the use of the client indicated above and shall not be reproduced except in full without the written consent of our company. Test results transmitted herein are only applicable to the actual samples tested at the location(s) referenced and are not necessarily indicative of the properties of other apparently similar or identical materials. Page 1 of 3

CR0001, 11-16-12, Rey 6

Report Number: A1171057.0172 Service Date: 03/31/21 **Report Date:** 07/01/21 Revision 1 - 91-day results PO# 440861-4 Task:



College Station, TX 77845-5765 979-846-3767 Reg No: F-3272

Client				Project			
Texas Transp Attn: Gary G TTI Business	erke	tute		Riverside Campus Riverside Campus Bryan, TX			
3135 TAMU College Static	on, TX 7784	3-3135		Project Number: A1171057			
Material In	formatio	n		Sample Information			
Specified Str	ength:			Sample Date: Sampled By:	03/31/21 Ethan Boul	Sample Time: Itinghouse	1240
Mix ID:	DSD60S			Weather Conditions:		oderate wind	
Supplier:	Martin Ma	rietta		Accumulative Yards:	2020	Batch Size (cy):	10
Batch Time:	1140	Plant:	517	Placement Method:	Direct Disc	charge	
Truck No.:	7211	Ticket No.:	6678665	Water Added Before (gal):	25	-	
Field Test	Data			Water Added After (gal): Sample Location:	0 35Ft east 2	0Ft south of metal b	ridge
Test		Result	Specification	-	north endin	Ig	-
Slump (in):		6	Not specified	Placement Location:	PO 440861	1-4	
Air Content	(%):	2.6	Not specified				
Concrete Ter	np. (F):	69	40 - 95				
Ambient Ten	np. (F):	64	40 - 95				

## Laboratory Test Data

Plastic Unit Wt. (pcf):

Yield (Cu. Yds.):

Labo	ratory Te	st Data				Age at	Maximum	Compressive		
Set	Specimen	Avg Diam.	Area	Date	Date	Test	Load	Strength	Fracture	Tested
No.	ID	(in)	(sq in)	Received	Tested	(days)	(lbs)	(psi)	Туре	By
2	A	6.01	28.37		06/30/21	91	175,400	6,180	3	SLS
2	В	6.01	28.37		06/30/21	91	143,100	5,040	2	SLS
2	С	6.01	28.37		06/30/21	91	169,370	5,970	1	SLS
						Aver	age (91 days)	5,730		
2	D					Hold				
Initial	Cure: Outsi	ide Plastic Lic	ls	Final Cu	re: Field Cu	red				
2 2 2 2	A B C D	6.01 6.01 6.01	28.37 28.37 28.37		06/30/21 06/30/21 06/30/21	91 91 91 <b>Aver</b> Hold	175,400 143,100 169,370	6,180 5,040 5,970	<u>- Type</u> 3 2 1	SL SL

Comments: Note: Reported air content does not include Aggregate Correction Factor (ACF).

Not specified

#### 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).

Start/Stop: 1100-1400

Terracon Rep.: Ethan Boultinghouse

Reported To:

Contractor:

### **Report Distribution:**

(1) Texas Transportation Institute, Gary Gerke (1) Terracon Consultants, Inc., Alex Dunigan, P.E.

146.8

(1) Texas Transportation Institute, Bill Griffith

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

The tests were performed in general accordance with applicable ASTM, AASHTO, or DOT test methods. This report is exclusively for the use of the client indicated above and shall not be reproduced except in full without the written consent of our company. Test results transmitted herein are only applicable to the actual samples tested at the location(s) referenced and are not necessarily indicative of the properties of other apparently similar or identical materials. Page 2 of 3

CR0001, 11-16-12, Rey 6

 Report Number:
 A1171057.0172

 Service Date:
 03/31/21

 Report Date:
 07/01/21
 Revision 1 - 91-day results

 Task:
 PO# 440861-4



143K.	10// +	40001 4		/	17 040 570	Reg 10.1 5272	
Client				Project			
Texas Transpo	ortation Ins	titute		Riverside Campus			
Attn: Gary G				Riverside Campus			
TTI Business	Office			Bryan, TX			
3135 TAMU							
College Static	on, TX 778	43-3135		Project Number: A1171057			
Material In	formatio	on		Sample Information			
Specified Str	ength:			Sample Date:	03/31/21	Sample Time:	1345
•	0			Sampled By:	Ethan Bou	ltinghouse	
Mix ID:	DSD60S			Weather Conditions:	Overcast, 1	moderate wind	
Supplier:	Martin M	arietta		Accumulative Yards:	22/22	Batch Size (cy):	2
Batch Time:	1311	Plant:	517	Placement Method:	Direct Dis	charge	
Truck No.:	7165	Ticket No.:	6678983	Water Added Before (gal):	5	ç	
	<b>.</b> .			Water Added After (gal):	0		
Field Test	Data			Sample Location:	35Ft East	45Ft south of metal b	ridge
Test		Result	Specification	-	north endir	ng	•
Slump (in):		6 1/2	Not specified	Placement Location:	PO 44086	1-4	
Air Content	(%):	3.0	Not specified				
Concrete Ter	np. (F):	70	40 - 95				

### Laboratory Test Data

Ambient Temp. (F): Plastic Unit Wt. (pcf):

Yield (Cu. Yds.):

	•					Age at	wiaximum	Compressive		
Set	Specimen	Avg Diam.	Area	Date	Date	Test	Load	Strength	Fracture	Tested
No.	ID	(in)	(sq in)	Received	Tested	(days)	(lbs)	(psi)	Туре	By
3	A	6.01	28.37		06/30/21	91	147,970	5,220	4	SLS
3	В	6.01	28.37		06/30/21	91	149,990	5,290	4	SLS
3	С	6.01	28.37		06/30/21	91	146,160	5,150	1	SLS
						Aver	age (91 days)	5,220		
3	D					Hold				
Initial	Cure: Outsi	ide Plastic Lic	ls	Final Cu	are: Field Cured					

Comments: Note: Reported air content does not include Aggregate Correction Factor (ACF).

40 - 95

Not specified

#### 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.: Ethan Boultinghouse

**Reported To:** 

Contractor:

#### **Report Distribution:**

(1) Texas Transportation Institute, Gary Gerke (1) Terracon Consultants, Inc., Alex Dunigan, P.E. (1) Texas Transportation Institute, Bill Griffith

64

147.4

**Reviewed By:** 

Start/Stop: 1100-1400

Age at Maximum Compressive

Alexander Dunigan

Project Manager

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

The tests were performed in general accordance with applicable ASTM, AASHTO, or DOT test methods. This report is exclusively for the use of the client indicated above and shall not be reproduced except in full without the written consent of our company. Test results transmitted herein are only applicable to the actual samples tested at the location(s) referenced and are not necessarily indicative of the properties of other apparently similar or identical materials.

CR0001, 11-16-12, Rev.6

	exas A&M ansportation stitute y Form	QF 7.3-01 Sam Revised by: B.L. Griffi Approved by: D. L. Ku	pling <sup>th</sup>	Doc. No. QF 7.3-01 Revision: 7	Revision Date: 2020-07-29 Page: 1 of 1
Project No:	440861-04	Casting Date:	4/5/2021	Mix Design (psi):	4000
Name of Technician Taking Sample	Terr	acon	Name of Technician Breaking Sample		acon
Signature of Technician Taking Sample	Terr	acon	Signature of Technician Breaking Sample	Terr	acon
Load No.	Truck No.	Ticket No.	Locat	ion (from concrete	e map)
T1	7130	6687524		South Wall and	Deck
Load No.	Break Date	Cylinder Age	Total Load (lbs)	Break (psi)	Average

			BILLI	NG				6687524	
12	Martin Marie	Ma n 1 tta 1	503 LBJ Suite Dallas, T)	Freewa 400	ay				PLANT
	TO 100	ARRIVE JOB SITE	BEGIN	POUR	FINISH PC	DUR LEA	VE JOB SITE	ARRIVE	
LOAD TIME	TO JOB	ARTICL BOD ONE					•		
10:33		-				UDE			
WATER ADDED ON	JOB AT CUSTOMER	S REQUEST 5	GAL		OMER SIGNAT	UKE			
ALLOWABLE WATE	R (withheld from batch	ו)	GAL	x					O THE
PEDLICE ITS ST	ATER ADDED TO	NO BY ORE AFTER WATE THIS CONCRETE WATER ADDED IN	WILL	DELI TERM HERE	VERY OF T IS AND CO OF AS ACO	HESE MAT	ERIALS IS S ON THE REV Y SIGNATUR	E ABOVE	•
OF SPECIFIED	SLUMP IS AT CU	STOMER'S RISK.		PLANT	TRUCK	ORDER		P.O. #/JO	
CUSTOMER NAME	AND DELIVERY ADD	RESS		617	7130	2015	5.00	TTI-THR	E BEAM
MBC MANAGE	RYAN, TX 7780	17	and the second	DRIVER N				04/05/21	
0.00 01147, 0				Jeremy F	R NUMBER	PROJECT	CUM. QTY	ORDERE	DQTY
			And in case of the local division in which the local division in which the local division is not the local division of the local division in the local div	00310				9.00	
LOAD QUANTITY 9.00 DSE	PRODUCT CC	DDE DES TXDOT CLASS S	SCRIPTION	782823		100138	9.00 UNIT PRIO		AMOUNT
9.00 DSE ECIAL DELIVERY IN GHT 2818, RIGH RAIGHT AROUN	ISTRUCTIONS	DL -		782823		SALE	UNIT PRIC		AMOUNT
9.00 DSE ECIAL DELIVERY IN GHT 2818, RIGH RAIGHT AROUN ERE NGER! MAY CAUS	ISTRUCTIONS T LEONARD RD ID ROUND ABOU	, RIGHT 47, LEFT UT TO GATE, CU		782823	ET YOU	SALE	UNIT PRI	CE	MOUNT
9.00 DSE FECIAL DELIVERY IN GHT 2818, RIGH RAIGHT AROUN IERE NGERI MAY CAUS	ISTRUCTIONS T LEONARD RD ID ROUND ABOU	, RIGHT 47, LEFT UT TO GATE, CU		782823	ET YOU	SALE	UNIT PRIC	CE	AMOUNT
9.00 DSE ECIAL DELIVERY IN GHT 2818, RIGH RAIGHT AROUN ERE NGER! MAY CAUS EE WARNINGS OF	STRUCTIONS T LEONARD RD ID ROUND ABOU REVERSE SIDE Siver U 66950 u x Code D605	, RIGHT 47, LEFT UT TO GATE, CU	SCRIPTION SCRIPTION INTO REL STOMER Disp Ti 6687524 Qty % Var% M 0.06% 1	LLIS, TO MEE	TYOU FOR OF Num T <sup>2</sup> 9	SALE	ESTAX AL D Time 10:33 cq Loa	CE	

5 1/4

1.5

72

65

147.6

Report Number: A1171057.0175 Service Date: 04/05/21 Report Date: 07/01/21 Revision 1 - 86-day results PO# 440861-4 Task:



Client				Project			
Texas Transpo	ortation Inst	itute		Riverside Campus			
Attn: Gary Go	erke			Riverside Campus			
TTI Business	Office			Bryan, TX			
3135 TAMU							
College Statio	on, TX 7784	3-3135		Project Number: A1171057			
Material In	formatio	n		Sample Information			
Specified Str	ength: 4,0	00 psi@ 4	4 days	Sample Date:	04/05/21	Sample Time:	1138
-				Sampled By:	Adam Hill	-	
Mix ID:	DSD60S			Weather Conditions:	Partly cloud	ly low wind	
Supplier:	Martin Ma	rietta		Accumulative Yards:	9/9	Batch Size (cy):	9
Batch Time:	1033	Plant:	617	Placement Method:	Direct Disc	harge	
Truck No.:	7130	Ticket No.:	6687524	Water Added Before (gal):	5	-	
				Water Added After (gal):	0		
Field Test	Data			Sample Location:	North edge	bottom of footing	
Test		Result	Specification	Placement Location:	PO # 44080	51-4	

### Laboratory Test Data

Slump (in):

Air Content (%):

Yield (Cu. Yds.):

Concrete Temp. (F):

Ambient Temp. (F):

Plastic Unit Wt. (pcf):

Labo	ratory Te	st Data				Age at	Maximum	Compressive		
Set	Specimen	Avg Diam.	Area	Date	Date	Test	Load	Strength	Fracture	Tested
No.	ID	(in)	(sq in)	Received	Tested	(days)	(lbs)	(psi)	Туре	By
1	A	6.01	28.37		06/30/21	86	164,550	5,800	1	SLS
1	В	6.01	28.37		06/30/21	86	161,560	5,700	1	SLS
1	С	6.01	28.37		06/30/21	86	144,720	5,100	2	SLS
						Aver	age (86 days)	5,530		
1	D					Hold				
Initial	Cure: Outsi	ide		Final Cu	ire:					

Comments: Average compressive strength of 86 day cylinders complies with the specified strength.

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.: Adam Hill Reported To: Gary Gerke with TTi

Contractor:

**Report Distribution:** 

(1) Texas Transportation Institute, Gary Gerke (1) Terracon Consultants, Inc., Alex Dunigan, P.E. (1) Texas Transportation Institute, Bill Griffith

Start/Stop: 1030-1215

**Reviewed By:** Hexander Dunigan

Project Manager

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

The tests were performed in general accordance with applicable ASTM, AASHTO, or DOT test methods. This report is exclusively for the use of the client indicated above and shall not be reproduced except in full without the written consent of our company. Test results transmitted herein are only applicable to the actual samples tested at the location(s) referenced and are not necessarily indicative of the properties of other apparently similar or identical materials.

CR0001, 11-16-12, Rev.6

Page 1 of 1

	exas A&M ansportation stitute y Form	QF 7.3-01 Sam Revised by: B.L. Griffi Approved by: D. L. Ku	<b>pling</b> ա	Doc. No. QF 7.3-01 Revision: 7	Revision Date: 2020-07-29 Page: 1 of 1
Project No:	440861-04	Casting Date:	4/14/2021	Mix Design (psi):	4000
Name of Technician Taking Sample	Terr	acon	Name of Technician Breaking Sample		acon
Signature of Technician Taking Sample	Terr	acon	Signature of Technician Breaking Sample		acon
Load No.	Truck No.	Ticket No.	Locat	ion (from concrete	e map)
T1	7211	6713607	80 ft we	est from the expans	ion joint
Т2	7102	6713716	The rest of	the west end of the	e installation
Load No.	Break Date	Cylinder Age	Total Load (lbs)	Break (psi)	Average

	<b>TICKET NO.</b> 6713607
BILLING Martin Marietta Marietta Billing Martin Marietta Suite 400 Dallas, TX 75234	
IIIIII IIIIIIIIIIIIIIIIIIIIIIIIIIIIIII	JOB SITE ARRIVE PLANT
LOAD TIME TO JOB ARRIVE JOB STUD	eter in any sheams les
ADDITIONAL WATER ADDED TO THIS CONCRETE WILL TERMS AND CONDITIONAL WATER ADDED TO THIS CONCRETE WILL	
OF SPECIFIED SLUMP IS AT CUSTOMER'S RISK.       CUSTOMER NAME AND DELIVERY ADDRESS       MBC MANAGEMENT       3100 SH 47, BRYAN, TX 77807	5.0 #/ IOB/I OT
COSTOMER NOMBER	10.00 16.00 UNIT PRICE AMOUNT
und ar sore, dotain trompt medical a territor many sevelop, an allergie dermatitis which will require the odivious/life avoid us signifier materials	
SPECIAL DELIVERY INSTRUCTIONS	witerti bebrainnigen in witer such as gloves b
RIGHT 2818, RIGHT LEONARD RD, RIGHT 47, LEFT INTO RELLIS, STRAIGHT AROUND ROUND ABOUT TO GATE, CUSTOMER TO MEET YOU THERE TOTAL	AX
DANGERI MAY CAUSE ALKALI BURNS. SEE WARNINGS ON REVERSE SIDE. FOR OFFICE USE ONLY	Y FORM:
TruckDriverUserDisp Ticket NumTicket ID7211777135user671360791808Load SizeMix CodeReturnedQtyMix AgeSeq10.00 CYDSDSD60SBatched% Var% MoistureActualWatMaterialDesign QtyRequiredBatched% Var% MoistureActualWatSAND-11812 lb18322 lb18300 lb-0.12%1.10% M24 glCMT-VII570 lb5700 lb5685 lb-0.28%204 glZY-61023 oz1288 oz1229 oz0.44%204 glLoad40065 lbDesign W/C:0.454TDesign 309 2 glActualSump:500 inWaterin Truck:0.0454TDesign 309 2 glActual	Time Date 10:27 4/14/21 Load ID 92979
AGGI SCALE B 1 ST 60 lb ET 0 lb CEMI SCALE B 1 ST 10 lb ET 0 lb CEMI SCALE B 1 ST 10 lb ET 0 lb WATI SCALE B 1 ST 10 lb ET 0 lb WATI SCALE B 1 ST 10 lb ET 0 lb WATI SCALE B 1 ST 10 lb ET 0 lb WATI SCALE B 1 ST 10 lb ET 0 lb WATI SCALE B 1 ST 10 lb ET 0 lb WATI SCALE B 1 ST 10 lb ET 0 lb WATI SCALE B 1 ST 10 lb ET 0 lb WATI SCALE B 1 ST 10 lb ET 0 lb WATI SCALE B 1 ST 10 lb ET 0 lb WATI SCALE B 1 ST 10 lb ET 0 lb WATI SCALE B 1 ST 10 lb ET 0 lb WATI SCALE B 1 ST 10 lb ET 0 lb WATI SCALE B 1 ST 10 lb ET 0 l	<sup>297,4</sup> gl ToAdd: 11.8 gl YDS DIB ET OID

	4			BILLI	NG				
SPECIAL DELIVERY INSTRUCTIONS       1503 LBJ Freeway Suite 400 Dallas, TX 7523         CAD TIME       TO JOB       ARRIVE JOB SITE       BEGIN POUR       EINISH POUR       EAVE JOB SITE       ARRIVE PLANT         10:46       :			Mar	tin N	larie	tta			0,10,11
Image: To JOB ARRIVE JOB SITE BEGIN POUR FINISH POUR LEAVE JOB SITE ARRIVE PLANT         10:46       :       <		Martin							
Image: To JOB ARRIVE JOB SITE BEGIN POUR FINISH POUR LEAVE JOB SITE ARRIVE PLANT         10:46       :       <		Mariet	ta	Suite	400				
CAD TIME     TO JOB     ARRIVE 300 SITE     DEMINIOUR     TIMONIOUR     DEMONSTRY       10:46     :     :     :     :     :     :     :     :       TER ADDED ON JOB AT CUSTOMER'S REQUEST     CAL     :     :     :     :     :     :       TO TALE     WEST ONE     OF OR     CUSTOMER'S IGRATURE     :     :     :     :       TO TALE WATER ADDED TO THIS CONCRETE WILL     DELIVERY OF THESE MATERIALS IS SUBJECT TO THE     THE REVERSE SIDE       DEDUCE ITS STRENGTH. ANY WATER ADDED IN EXCESS     DELIVERY OF THESE MATERIALS IS SUBJECT TO THE       TOTOMAL WATER ADDED TO THIS CONCRETE WILL     THE REVERSE SIDE       TOSTOMER NAME AND DELIVERY ADDRESS     PLANT     THUCK     ORDER NO. SLUMP     PO. #JOBIOT       TOTOMAL WATER ADDED TO THIS CONCRETE WILL     THUCK     ORDER NO. SLUMP     PO. #JOBIOT       TOTOMAL WATER ADDED TO THIS CONCRETE WILL     THUCK     ORDER NO. SLUMP     PO. #JOBIOT       TOTOMER NAME ADD DELIVERY ADDRESS     PLANT     THUCK     ORDER NO. SLUMP     PO. #JOBIOT       TOTOMER NAME ADD DELIVERY ADDRESS     PLANT     THUCK     ORDER NO. SLUMP     PO. #JOBIOT       TOTAL     TOTAL     DATE     Soft Goodwin     GUINT ORDER     OTAL       SPECIAL DELIVERY INSTRUCTIONS     TXDOT CLASS S     SALES TAX     T		Mana		allas, I	A 1525-				
CAD TIME     TO JOB     ARRIVE 300 SITE     DEMINIOUR     TIMONIOUR     DEMONSTRY       10:46     :     :     :     :     :     :     :     :       TER ADDED ON JOB AT CUSTOMER'S REQUEST     CAL     :     :     :     :     :     :       TO TALE     WEST ONE     OF OR     CUSTOMER'S IGRATURE     :     :     :     :       TO TALE WATER ADDED TO THIS CONCRETE WILL     DELIVERY OF THESE MATERIALS IS SUBJECT TO THE     THE REVERSE SIDE       DEDUCE ITS STRENGTH. ANY WATER ADDED IN EXCESS     DELIVERY OF THESE MATERIALS IS SUBJECT TO THE       TOTOMAL WATER ADDED TO THIS CONCRETE WILL     THE REVERSE SIDE       TOSTOMER NAME AND DELIVERY ADDRESS     PLANT     THUCK     ORDER NO. SLUMP     PO. #JOBIOT       TOTOMAL WATER ADDED TO THIS CONCRETE WILL     THUCK     ORDER NO. SLUMP     PO. #JOBIOT       TOTOMAL WATER ADDED TO THIS CONCRETE WILL     THUCK     ORDER NO. SLUMP     PO. #JOBIOT       TOTOMER NAME ADD DELIVERY ADDRESS     PLANT     THUCK     ORDER NO. SLUMP     PO. #JOBIOT       TOTOMER NAME ADD DELIVERY ADDRESS     PLANT     THUCK     ORDER NO. SLUMP     PO. #JOBIOT       TOTAL     TOTAL     DATE     Soft Goodwin     GUINT ORDER     OTAL       SPECIAL DELIVERY INSTRUCTIONS     TXDOT CLASS S     SALES TAX     T									
TER ADDED ON JOB AT CUSTOMER'S REQUEST       GAL         CUSTOMER SIGNATURE       GAL         CUSTOMER SIGNATURE       GAL         ST CYLINDER TAKEN       YES       NO       BY         DINTIONAL WATER ADDED TO THIS CONCRETE WILL       DELIVERY OF THESE MATERIALS IS SUBJECT TO THE         EDUCE ITS STREMOTH. ANY WATER ADDED IN EXCESS       DELIVERY OF THESE MATERIALS IS SUBJECT TO THE         FS PECIFIED SLUMP IS AT CUSTOMER'S RISK.       DELIVERY ADDRESS       PLANT         SUSTOMER NAME AND DELIVERY ADDRESS       PLANT       TRUCK       ORDER NO.         SUSTOMER NAME AND DELIVERY ADDRESS       PLANT       TRUCK       ORDER NO.       SLUMP       PO. #JOBALOT         SUSTOMER NAME AND DELIVERY ADDRESS       PLANT       TRUCK       ORDER NO.       SLUMP       PO. #JOBALOT         SUSTOMER NAME AND DELIVERY ADDRESS       PLANT       TRUCK       ORDER NO.       SLUMP       PO. #JOBALOT         SUSTOMER NAME AND DELIVERY ADDRESS       PLANT       TRUCK       ON OTHER SLUMP       DATE         SUSTOMER NAME AND DELIVERY ADDRESS       PLANT       TRUCK       OATHER ADDRESS       DATE         SUSTOMER NAMAGEMENT       SUSTOMER NUMBER       PROJECT       CUM 14/21       CUSTOMER NUMBER       PO. #JOBALOT         STRECIAL DELIVERY INSTRUCTIONS       TXDOT CLASS S	LOAD TIME	TO JOB	ARRIVE JOB SITE	BEGIN	POUR	FINISH P	OUR LEA	VE JOB SITE	ARRIVE PLANI
THER ADDED ON TODE OWNER WATER ADDED TO THE SCONCETER WILL       GAL         X	10:46			Undul	Insmal			ax. 1. 10	e se
OWABLE WATER (withheld from batch)		IOB AT CUSTOMER	'S REQUEST	GAI		MER SIGNA	TURE	1000 200 G	-stay and sales
SPECIAL DELIVERY INSTRUCTIONS       DESCRIPTION         SPECIAL DELIVERY INSTRUCTIONS       CONTRACT AND UNIT PRICE         ADD OLDARD RD, RIGHT 47, LEFT INTO RELLIS, STRAIGHT AROUND ROUND ABOUT TO GATE, CUSTOMER TO MEET YOU       SALES TAX         COLOR TARGENTARY       TXDOT CLASS S         SPECIAL DELIVERY INSTRUCTIONS       TXDOT CLASS S         STRAIGHT AROUND RO, RIGHT 47, LEFT INTO RELLIS, STRAIGHT AROUND ROUND ABOUT TO GATE, CUSTOMER TO MEET YOU       SALES TAX         THERE       TOTAL         DANGE MANNING SON REVERSE SIDE       FOR OFFICE USE ONLY FORM:         Truck       Driver       User         Disp Ticket Num Science       Office Tig Tig To Add       91.011 (11.011)         Truck       Driver       User       Disp Ticket Num Ticket ID       Time Date         Truck       Driver       User       Disp Ticket Num Ticket ID       Time Date         COLD SD60S       User       Disp Ticket Num Ticket ID       Time Date         Truck       Driver       User       Disp Ticket Num Ticket ID       Disp Ticket IV         Dadd Size       Mix Code       Returned       Qty       Mix Age       Seq       Load ID         Gad Size       Mix Rode       Tig Tig To Add       94.90       Office Tig To Add       94.90         Mix Bobins	OWABLE WATE	R (withheld from batc	h)	GAI	X	1 30000	Suredo	יה נפרוח "לו	
Delitional water ADDED to THIS CONCRETE WILL EDUCE ITS STRENGTH. ANY WATER ADDED IN EXCESS FSPECIAL DELIVERY ADDRESS MBC MANAGEMENT 100 SH 47, BRYAN, TX 77807 SCHORDER NUMER PROJECT CUMP P.O. #JOB/LOT T111 THRE BEAM DRIVER NAME AND DELIVERY ADDRESS MBC MANAGEMENT 100 SH 47, BRYAN, TX 77807 SCHORDER NUMER PROJECT CUMP P.O. #JOB/LOT T111 THRE BEAM DRIVER NAME AND DELIVERY ADDRESS MBC MANAGEMENT 100 SH 47, BRYAN, TX 77807 SPECIAL DELIVERY INSTRUCTIONS RIGHT 2618, RIGHT LEONARD RD, RIGHT 47, LEFT INTO RELLIS, STRAIGHT AROUND ROUND ABOUT TO GATE, CUSTOMER TO MEET YOU STRAIGHT AROUND ROUND ABOUT TO GATE, CUSTOMER TO MEET YOU THERE DATE SIZE MIX COde TTUCK Driver User Disp Ticket Num Ticket ID Time Date 101:46 4/14/21 TOTAL THERE TTUCK DRIVERS SIDE TTUCK DR	INDER TAKEN	BEF	ORE AFTER WATER		DELIN	ERY OF T	HESE MATE	RIALS IS SU	UBJECT TO THE
F SPECIFLD SLUMMP IS AT CUSTOMER'S KISK.       PLANT       TRUCK       ORDER NO.       SLUMP       P.O. #JOB/LOT         USTOMER NAMA GEMENT       3100 SH 47, BRYAN, TX 77807       PLANT       TRUCK       ORDER NO.       SLUMP       P.O. #JOB/LOT         BC MANAGEMENT       3100 SH 47, BRYAN, TX 77807       DRIVER NAME       DATE       DATE         Scott Goodwin       QUID ANTITY       PRODUCT CODE       DESCRIPTION       DATE         CUSTOMER NUMBER       PROJECT       CUM Y       ORDERD GTY       782823       100138       16.00       16.00         LOAD QUANTITY       PRODUCT CODE       DESCRIPTION       UNIT PRICE       AMOUNT       6.00       16.00         6.00       DSD60S       TXDOT CLASS S       SALES TAX       SALES TAX         STRAIGHT AROUND ROUND ABOUT TO GATE, CUSTOMER TO MEET YOU       TOTAL       TOTAL         THERE       EE       FOR OFFICE USE ONLY FORM:       SEE WARNINGS ON REVERSE SIDE         SEE WARNINGS ON REVERSE SIDE       FOR OFFICE USE ONLY FORM:       D       91809       10:46 4/14/21         Truck       Driver       User       Disp Ticket Num       Ticket ID       Time Date         7102       968908       User       G113716       91809       10:46 4/14/21 <t< td=""><td></td><td>ATER ADDED TO</td><td>THIS CONCRETE</td><td>WILL</td><td>HERE</td><td>OF AS AC</td><td>CEPTED BY</td><td>SIGNATUR</td><td>E ABOVE.</td></t<>		ATER ADDED TO	THIS CONCRETE	WILL	HERE	OF AS AC	CEPTED BY	SIGNATUR	E ABOVE.
USTOMER NAME AND DELIVERT AUDRESS         ABC MANAGEMENT 3100 SH 47, BRYAN, TX 77807         SPECIAL DELIVERY INSTRUCTIONS 6.00 DSD603 TXDOT CLASS S         SPECIAL DELIVERY INSTRUCTIONS 6.00 DSD603 TXDOT CLASS S         SPECIAL DELIVERY INSTRUCTIONS RIGHT 2818, RIGHT LEONARD RD, RIGHT 47, LEFT INTO RELLIS, STRAIGHT AROUND ROUND ABOUT TO GATE, CUSTOMER TO MEET YOU THERE       SALES TAX TOTAL         DANGERIMAY CAUSE ALKALI BURNS. SEE WARNINGS ON REVERSE SIDE.         SEE WARNINGS ON REVERSE SIDE.         Truck Driver User Disp Ticket Num Ticket ID Time Date 0.00 CYDS DSD603         Truck Driver User Disp Ticket Num Ticket ID Time Date 0.00 CYDS DSD605         Truck Driver User Disp Ticket Num Ticket ID Time Date 0.00 CYDS DSD605         Truck Driver User Disp Ticket Num Ticket ID Time Date 0.00 CYDS DSD605         Truck Driver User Disp Ticket Num Ticket ID Time Date 0 92980         Truck Driver User Disp Ticket Num Ticket ID Time Date 0 92980         Truck Driver User Disp Ticket Num Ticket ID Time Date 0 92980         Truck Driver User Disp Ticket Num Ticket ID Time Date 0 92980         Truck Driver User Disp Ticket Num Ticket ID Time Date 0 92980         Tool 0 1000 Tool 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	E OPECIEIED	SLUMP IS AT CL	JSTOMER'S RISK.	eadmus	PLANT	TRUCK	ORDER NO	). SLUMP	
3100 SH 47, BRYAN, 1X 77807       Scott Goodwin       04/14/21         CUSTOMER NUMBER       PROJECT       CUM, GTY       ORDERED GY         100 SD GUANTITY       PRODUCT CODE       DESCRIPTION       UNIT PRICE       AMOUNT         6,00       DSD60S       TXDOT CLASS S       UNIT PRICE       AMOUNT         8,00       DSD60S       TXDOT CLASS S       SALES TAX       TRICHTONS         RIGHT 2818, RIGHT LEONARD RD, RIGHT 47, LEFT INTO RELLIS, STRAIGHT ACOUND ROUND ABOUT TO GATE, CUSTOMER TO MEET YOU       SALES TAX       TOTAL         THERE       DANGERI MAY CAUSE ALKALI BURNS.       FOR OFFICE USE ONLY FORM:       SEE WARNINGS ON REVERSE SIDE.       FOR OFFICE USE ONLY FORM:         Truck       Driver       User       Disp Ticket Num Ticket ID Time Date       10:46 4/14/21         Load Size       Mix Code       Returned       Qty       Mix Age       Seq       Load ID         Antal       1020 b       902980       50 0       0.05% 0       14 gi       14 gi </td <td>USTOMER NAM</td> <td></td> <td>DRESS</td> <td></td> <td>617</td> <td></td> <td>2020</td> <td>5.00</td> <td></td>	USTOMER NAM		DRESS		617		2020	5.00	
LOAD QUANTITY     PRODUCT CODE     DESCRIPTION     16.00       6.00     DSD60S     TXDOT CLASS S         SPECIAL DELIVERY INSTRUCTIONS     TXDOT CLASS S         RIGHT 2818, RIGHT LEONARD RD, RIGHT 47, LEFT INTO RELLIS,     SALES TAX       STRAIGHT AROUND ROUND ABOUT TO GATE, CUSTOMER TO MEET YOU     TOTAL         DANGERI MAY CAUSE ALKALI BURNS:     FOR OFFICE USE ONLY FORM:       SEE WARNINGS ON REVERSE SIDE:     FOR OFFICE USE ONLY FORM:       Truck     Driver     User       Disp Ticket Num     Ticket ID     Time Date       10:2     968908     user       6:00     CYDS DSD60S     SVark Mixiture Actual Val       Material     Design OV     Required     SVark Mixiture Actual Val       1:00:0     9:10:0     0:00:0     -0:05:0       2:00:0     3:20:0     -0:05:0     -0:05:0       7:00     2:30:0     0:01:0     -1:30:0       1:01:0:0     0:01:0     0:01:0     -1:30:0       1:02:0:0     0:02:0     -0:05:0     -1:00:0	100 SH 47,	BRYAN, TX 778	307		Scott Goo	dwin		GIL IA	04/14/21
IDENTIFY       PRODUCT CODE       DESCRIPTION       UNIT PRICE       AMOUNT         6.00       DSD60S       TXDOT CLASS S       INTO TRICE       AMOUNT         6.00       DSD60S       TXDOT CLASS S       SALES TAX         SPECIAL DELIVERY INSTRUCTIONS RIGHT 2818, RIGHT LEONARD RD, RIGHT 47, LEFT INTO RELLIS, STRAIGHT AROUND ROUND ABOUT TO GATE, CUSTOMER TO MEET YOU       SALES TAX         STRAIGHT AROUND ROUND ABOUT TO GATE, CUSTOMER TO MEET YOU         THERE         DANGERI MAY CAUSE ALKALI BURNS. SEE WARNINGS ON REVERSE SIDE.         Truck       Driver         Disp Ticket Num Ticket ID Time Date 91809         Truck Driver         User         OISp Ticket Num Ticket ID Time Date 91809         Load Size Mix Code         Returned       Qty         OISP Ticket Num Ticket ID Time Date 91210         Load Size Mix Code       Returned       Qty       Mix Age       Seq       Load ID 92980         COD Source 1080 b       -0.08%       400% Mit 419       23.00       Nom Batches       1         Code Size b       103.05 b       0.03 b       -0.085 b       1.065 b       -0.085 b       -0.085 b       -0.085 b </td <td></td> <td></td> <td></td> <td></td> <td>CUSTOME</td> <td>RNUMBER</td> <td></td> <td></td> <td>a period and a second second</td>					CUSTOME	RNUMBER			a period and a second
GAD QUANIITY       PRODUCT CODE         6.00       DSD60S       TXDOT CLASS S         SPECIAL DELIVERY INSTRUCTIONS       SALES TAX         RIGHT 2818, RIGHT LEONARD RD, RIGHT 47, LEFT INTO RELLIS.       SALES TAX         STRAIGHT AROUND ROUND ABOUT TO GATE, CUSTOMER TO MEET YOU       TOTAL         THERE       TOTAL         DANGERI MAY CAUSE ALKALI BURNS.       FOR OFFICE USE ONLY FORM:         SEE WARNINGS ON REVERSE SIDE.       FOR OFFICE USE ONLY FORM:         Truck       Driver       User         Disp Ticket Num Ticket ID       Time Date         7102       968908       user         6.00       CYDS DSD60S       Stath of the s		and the second second	S worsen evenue	COUDTION	782823	1128.6.01	100138		
TRAIGHT AROUND ROUND ABOUT TO GAME.       THERE       THERE       DANGERI MAY CAUSE ALKALI BURNS.       SEE WARNINGS ON REVERSE SIDE.       FOR OFFICE USE ONLY FORM:       SEE WARNINGS ON REVERSE SIDE.       Truck Driver User Disp Ticket Num Ticket ID Time Date       7102     968908     user 6713716     91809     10:46 4/14/21       Load Size Mix Code Returned Qty Mix Age Seq Load ID       6.00     CYDS DSD60S     % Var% Moisture Actual Wat     14 gl       Trage 1812 Ib 10993 Ib 8620 Ib -0.012% 1.10% M 41 gl       SAND-1     1380 Ib 3420 Ib 3335 Ib -0.73% 4.00% M 41 gl       CMT-WI 570 Ib 1307 Jb 1004 Ib -1.28% 120 gl     126 JC -0.58% 120 gl       24008 Ib Design WV: 0.435 T     0.989 1855 gl Actual 176.1 gl TOAdd: 94 gl       12402 24008 Ib Design WV: 0.435 T     0.0 gl / Load Trim Water: 1.3 gl / CYDS       24008 Ib Design WV: 0.045 I     0.0 gl / Load Trim Water: 1.3 gl / CYDS       12402 24008 Ib Design WV: 0.0455 T     0.0 gl / Load Trim Water: 1.3 gl / CYDS       12403 10 Design WV: 0.0455 I     0.0 gl / Load Trim Water: 1.3 gl / CYDS       12403 12 Design WV: 0.0455 I     0.0 gl / Load Trim Water: 1.3 gl / CYDS       12403 12 Design WV: 0.0455 I     0.0 gl / Load Trim Water: 1.3 gl / CYDS				T INTO RE	ELLIS,		SALES	ТАХ	
SEE WARNINGS ON REVERSE SIDE.         Truck       Driver       User       Disp Ticket       Num       Ticket       ID       Time       Date         7102       968908       user       6713716       91809       10:46       4/14/21         Load       Size       Mix Code       Returned       Qty       Mix Age       Seq       Load ID         6.00       CYDS       DSD60S       Batched       % Var% Moisture       Actual       Wat         17RG       1812 lb       10993 lb       Batched       % Var% Moisture       Actual       Wat         SAND-1       1880 lb       8020 lb       -0.12%       1.10% M       41 gl         SAND-1       1380 lb       3335 lb       -0.73%       120 gl         H20       258 lb       137 oz       136 oz       -0.58%       120 gl         2Y-610       23 oz       137 oz       136 oz       -0.58%       120 gl       Actual       176.1 gl       ToAdd:       9.4 gl         Load       24008 lb       Design MVIC:       0.436 T       Design 185.5 gl       Actual       176.1 gl       ToAdd:       9.4 gl         Load       24008 lb       Design MVIC:       0.0 gl / Load       Trim W	STRAIGHT A	AROUND ROUND	ABOUT TO GATE, CI	USTOMER	TO MEE	T YOU	TOTAL	and a to	
TruckDriverUserDisp TicketNumTicket IDTimeDate7102968908user67137169180910:464/14/21Load SizeMix CodeReturnedQtyMix AgeSeqLoad ID6.00CYDS DSD60SBatched% Var% MoistureActualWat1"RG1812 lb109993 lb9620 lb-0.12%1.10% M14 glSAND-11380 lb3420 lb3395 lb-0.73%120 glH201256 lb1071 lb1004 lb-1.28%120 glH201256 lb137 oz136 oz-0.58%120 glYr-61023 ozNum Batches:1Vater/Cement:0.0 gl / LoadTim Water:-1.3 gl / CYDSLoad24008 lbDesign WrC:0.436 TDesign 185.5 glActual176.1 glToAdd:9.4 glLoad24008 lbDesign Nrc:0.0 gl / Adjust Water:0.0 gl / LoadTim Water:-1.3 gl / CYDSLoad24008 lbDesign WrC:0.456 TDesign 185.5 glActualTim Water:-1.3 gl / CYDSLoad24008 lbDesign WrC:0.0 gl / Adjust Water:0.0 gl / LoadTim Water:-1.3 gl / CYDSLoad24008 lbWater in Truck:0.0 gl / LoadTim Water:-1.3 gl / CYDSETLoad24008 lbDesign WrC:0.57 lbET0.16WATI SCALE B 1 ST-2.16ET0.16	DANGER! MA	Y CAUSE ALKALI B	URNS. SIDE.			FOR OFF	ICE USE ONI	Y FORM:	
Material         Design Oty         Required 1'RG         10980 lb 10980 lb SAND-1         -0.12% 14 gl         1.10% M         14 gl           1'RG         1812 lb 1825 lb         10980 lb 8625 lb         0.06% 4.00% M         41 gl           SAND-1         1380 lb         3420 lb         3625 lb         0.06% 4.00% M         41 gl           CMT-I/II         570 lb         3420 lb         3395 lb         -0.73% 1004 lb         120 gl           H20         23 oz         137 oz         136 oz         0.58%         120 gl           ZY-610         23 oz         137 oz         136 oz         0.58%         120 gl           Actual         Vamm Batchest         1         Water/Cement:         0.456 T         Design         185.5 gl         Actual         176.1 gl         To Add:         9.4 gl           Load         24008 lb         Design W/C:         0.453         Water/Cement:         0.456 T         0.0 gl / Load         Trim Water:         -1.3 gl / CYDS           Clump:         5.00 in         Water in Truck:         0.0 gl Adjust Water:         0.0 gl / Load         Trim Water:         -2 lb         ET         0 lb			TI- o M	Disp T	icket	Num Ti	cket ID	Time D 10.46 4	ate /14/21
Load 2000 to Water in Truck: 0.0 gr Added State B 1 ST 10 lb ET 0 lb WAT SOALE D TO T	7102 Load Siz	968908 e Mix Code	1	Qty		Mix Age	Seq	Load	ID
	7102 Load Siz 6.00 CY Material 1"RG SAND-1 CMT-VII H20 ZY-610	968908 ce Mix Code Design Qty Req 1812 lb 10 1380 lb 55 570 lb 1 286 lb 1 230 oz	Batched           10983 lb         10980 lb           1625 lb         8620 lb           1420 lb         3395 lb           1017 lb         1004 lb           137 oz         136 oz           1atches:         1	Qty % Var% -0.12% -0.06% -0.73% -1.28% -0.58%	Moisture 1.10% M 4.00% M	Mix Age Actual Wat 14 gl 41 gl 120 gl 185.5 gl	Seq D Actual	Load 92980 176.1 gl To Ad CYDS	ID ) Id: 9.4 gl
CONTRACTOR OF THE OWNER OF	7102 Load Siz 6.00 CY Material 1''RG SAND-1 CMT-I/II H20 ZY-610 Actual Load 24000 Clump: 500	968908 Ce Mix Code DS DSD60S Design Qty Req 1812 lb 11 1380 lb 5 570 lb 5 258 lb 1 23 oz Num I 8 lb Design W/C: in Water in Truck	Batched           1993 Ib         10990 Ib           6625 Ib         6620 Ib           1420 Ib         3395 Ib           1017 Ib         1004 Ib           137 oz         136 oz           3atchest         1           0.453         Water/Cement:           c:         0.0 gl         Adjust	Qty % Var% -0.12% -0.06% -0.73% -1.28% -0.58%	Moisture // 1.10% M 4.00% M Design 0.0 gl / Lo	Mix Age Actual Wat 14 gl 41 gl 120 gl 185.5 gl ad Trim Wat	Seq D Actual	Load 92980 176.1 gl To Ad CYDS	ID ) Id: 9.4 gl
	7102 Load Siz 6.00 CY Material 1"RG SAND-1 CMT-VII H20 ZY-610 Actual Load 24000 Clump: 5.00	968908 Ce Mix Code DS DSD60S Design Qty Req 1812 lb 11 1380 lb 5 570 lb 5 258 lb 1 23 oz Num I 8 lb Design W/C: in Water in Truck	Batched           1993 Ib         10990 Ib           6625 Ib         6620 Ib           1420 Ib         3395 Ib           1017 Ib         1004 Ib           137 oz         136 oz           3atchest         1           0.453         Water/Cement:           c:         0.0 gl         Adjust	Qty % Var% -0.12% -0.06% -0.73% -1.28% -0.58%	Moisture // 1.10% M 4.00% M Design 0.0 gl / Lo	Mix Age Actual Wat 14 gl 41 gl 120 gl 185.5 gl ad Trim Wat	Seq D Actual	Load 92980 176.1 gl To Ad CYDS	ID ) Id: 9.4 gl

147.5

Report Number: A1171057.0178 Service Date: 04/14/21 Report Date: 07/01/21 Revision 2 - PO # Task: PO# 440861-4



Client				Project			
Texas Transpo	rtation Instit	ute		Riverside Campus			
Attn: Gary Ge	rke			Riverside Campus			
TTI Business	Office			Bryan, TX			
3135 TAMU							
College Statio	n, TX 77843	-3135		Project Number: A1171057			
Material Inf	ormation	1		Sample Information			
Specified Str	ength:			Sample Date:	04/14/21	Sample Time:	1137
-	2			Sampled By:	David Carp	pio	
Mix ID:	DSD60S			Weather Conditions:	Cloudy, lig	ht wind	
Supplier:	Martin Mari	ietta		Accumulative Yards:	10/16	Batch Size (cy):	10
Batch Time:	1027	Plant:	617	Placement Method:	Direct Disc	harge	
Truck No.:	7211	Ticket No.:	6713607	Water Added Before (gal):	11	-	
				Water Added After (gal):	0		
Field Test I	Data			Sample Location:	39' North o	of South end of soun	d barrier
Test		Result	Specification		wall		
Slump (in):		6		Placement Location:	Sound wal	l barrier	
Air Content (	%):	1.1					
Concrete Ten	ıp. (F):	78					
Ambient Ten	p. (F):	73					

## Laboratory Test Data

Plastic Unit Wt. (pcf):

Yield (Cu. Yds.):

Labo	ratory le	st Data				Age at	Maximum	Compressive		
Set	Specimen	Avg Diam.	Area	Date	Date	Test	Load	Strength	Fracture	Tested
No.	ID	(in)	(sq in)	Received	Tested	(days)	(lbs)	(psi)	Туре	By
1	A	6.00	28.27		05/19/21	35 F	137,840	4,880	5	AJH
1	в	6.00	28.27		05/19/21	35 F	142,330	5,030	5	AJH
1	С	6.00	28.27		05/19/21	35 F	153,770	5,440	5	AJH
1	D					Hold				
Initial	Cure: Outsi	ide Plastic Lid	ls	Final Cu	ire:					

Comments: F = Field Cured

Note: Reported air content does not include Aggregate Correction Factor (ACF).

Samples Made By: Terracon Obtain samples of fresh concrete at the placement locations (ASTM C 172), perform required field tests and cast, cure, and Services: test compressive strength samples (ASTM C 31, C 39, C 1231). Terracon Rep.: David Carpio Start/Stop: 1015-1315 Reported To: Will Contractor: **Report Distribution:** (1) Texas Transportation Institute, Gary Gerke (1) Terracon Consultants, Inc., Alex Dunigan, P.E.

(1) Texas Transportation Institute, Bill Griffith

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

The tests were performed in general accordance with applicable ASTM, AASHTO, or DOT test methods. This report is exclusively for the use of the client indicated above and shall not be reproduced except in full without the written consent of our company. Test results transmitted herein are only applicable to the actual samples tested at the location(s) referenced and are not necessarily indicative of the properties of other apparently similar or identical materials.

CR0001, 11-16-12, Rev.6

Page 1 of 2

Report Number:	A1171057.	0178
Service Date:	04/14/21	
Report Date:	07/01/21	Revision 2 - PO #
Task:	PO# 44086	51-4



Task: PO# 4	40801-4		9.	/9-840-3/0/	Reg No: F=52/2	
Client			Project			
Texas Transportation Ins	titute		Riverside Campus			
Attn: Gary Gerke			Riverside Campus			
TTI Business Office			Bryan, TX			
3135 TAMU						
College Station, TX 778	43-3135		Project Number: A1171057			
Material Informatio	on		Sample Information			
Specified Strength:			Sample Date:	04/14/21	Sample Time:	1215
			Sampled By:	David Carp		
Mix ID: DSD60S			Weather Conditions:	Cloudy, light		
Supplier: Martin M	arietta		Accumulative Yards:	16/16	Batch Size (cy):	6
Batch Time:	Plant:	617	Placement Method:			
Truck No.:	Ticket No.:		Water Added Before (gal):	9		
			Water Added After (gal):	0		
Field Test Data			Sample Location:	9' south of 1	north end of sound v	vall
Test	Result	Specification	Sumpre Botunioni	barrier	iorai viia or ooana i	
Slump (in):	6		Placement Location:	Sound wall	barrier	
Air Content (%):	1.0					
Concrete Temp. (F):	77					
Ambient Temp. (F):	73					
Plastic Unit Wt. (pcf):	147.5					

## Laboratory Test Data

Yield (Cu. Yds.):

Labo	ratory Te	st Data				Age at	Maximum	Compressive		
Set	Specimen	Avg Diam.	Area	Date	Date	Test	Load	Strength	Fracture	Tested
No.	ID	(in)	(sq in)	Received	Tested	(days)	(lbs)	(psi)	Туре	By
2	A	6.00	28.27		05/19/21	35 F	128,750	4,550	5	AJH
2	в	6.00	28.27		05/19/21	35 F	142,720	5,050	4	AJH
2	С	6.00	28.27		05/19/21	35 F	134,780	4,770	5	AJH
2	D					Hold				
Initial	Cure: Outsi	ide Plastic Lid	ls	Final Cu	ire:					

Comments: F = Field Cured

Note: Reported air content does not include Aggregate Correction Factor (ACF).

Samples Made By: Terracon

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

Terracon Rep.: David Carpio Reported To: Will Contractor:

#### Report Distribution:

(1) Texas Transportation Institute, Gary Gerke (1) Terracon Consultants, Inc., Alex Dunigan, P.E. (1) Texas Transportation Institute, Bill Griffith

Start/Stop: 1015-1315 Reviewed By: Alexander Dunigan

Project Manager

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

The tests were performed in general accordance with applicable ASTM, AASHTO, or DOT test methods. This report is exclusively for the use of the client indicated above and shall not be reproduced except in full without the written consent of our company. Test results transmitted herein are only applicable to the actual samples tested at the location(s) referenced and are not necessarily indicative of the properties of other apparently similar or identical materials.

CR0001, 11-16-12, Rev.6

Page 2 of 2

	exas A&M ansportation stitute	Sam	Concrete pling	Doc. No. QF 7.3-01	Revision Date: 2020-07-29
Quality	y Form	Revised by: B.L. Griffi Approved by: D. L. Ku		Revision: 7	Page: 1 of 1
Project No:	440861-04	Casting Date:	4/15/2021	Mix Design (psi):	4000
Name of Technician Taking Sample	Terr	acon	Name of Technician Breaking Sample		acon
Signature of Technician Taking Sample	Terr	acon	Signature of Technician Breaking Sample		acon
Load No.	Truck No.	Ticket No.	Locat	ion (from concrete	e map)
т1	9019	6717070	East of the	e expansion joint ur	ntil the end
Load No.	Break Date	Cylinder Age	Total Load (lbs)	Break (psi)	Average

		Marti	<b>n</b> tta	artin 1503 LB Suit	LING <b>Marie</b> J Freewa te 400 TX 75234	y			TICKET NO. 6717070
Г	LOAD TIME	TO JOB	ARRIVE JOB SITE	E BEGII	NPOUR	FINISH P	POUR	LEAVE JOB SIT	E ARRIVE PLANT
389	11:44	:	:		-	1	24	:	
A Ti C`	NATER ADDED ON JU ALLOWABLE WATER EST CYLINDER TAKE YLINDER TAKEN DDITIONAL WAT			ER E WILL	AL. X	ERY OF T	HESE N	IATERIALS IS NS ON THE RE	SUBJECT TO THE
	TOUCH ITC STOP	NGIH ANY W	ATER ADDED IN TOMER'S RISK.	EXCESS	HERE	OF AS AC	CEPTED	BY SIGNATU	RE ABOVE.
OF	SPECIFIED SLU	DELIVERY ADDRE	ESS	-	PLANT	TRUCK		ER NO. SLUMP	
ME	C MANAGEME	NT			617	9019	2033		COLUMNOOD/LOT
310	00 SH 47, BRYA	AN, TX 77807			DRIVER NA WATTS, R	ME	X	0.00	TTI-THRIE BEAM
					CUSTOMER	RNUMBER	PROJECT	01111	04/15/21
	DAD QUANTITY			CRIPTION	782823		100138	CUM. QTY 6.00	ORDERED QTY 6.00
SPEC	IAL DELIVERY INST	RUCTIONS						1	C
20	IAL DELIVERY INST IT 2818, RIGHT L		RIGHT 47. LEFT	INTO RE	LLIS.		SAI	LES TAX	d
RIGH STRA THER	IT 2818, RIGHT L AIGHT AROUND RE	.Eonard RD, I Round Abou <sup>-</sup>	RIGHT 47, LEFT T TO GATE, CU	INTO RE	LLIS, TO MEET	YOU	SAI TO		
RIGH STRA THER DANG	IT 2818, RIGHT L AIGHT AROUND	EONARD RD, I ROUND ABOU	RIGHT 47, LEFT T TO GATE, CU	INTO RE STOMER	LLIS, TO MEET		TO		

1.3

80

67

146.4

6.0

Report Number: A1171057.0180 Service Date: 04/15/21 **Report Date:** 07/01/21 Revision 2 - 76-day results Task: PO# 440861-4



Client	Project
Texas Transportation Institute Attn: Gary Gerke TTI Business Office 3135 TAMU	Riverside Campus Riverside Campus Bryan, TX
College Station, TX 77843-3135	Project Number: A1171057
Material Information	Sample Information
Specified Strength: 4,000 psi @ 28 days Mix ID: DSD60S	Sample Date:     04/15/21     Sample Time:     1220       Sampled By:     Justin Maass       Weather Conditions:     Cloudy, light wind
Supplier:         Martin Marietta           Batch Time:         1145         Plant:         617           Truck No.:         9019         Ticket No.:         6717070	Accumulative Yards: 6/6 Batch Size (cy): 6 Placement Method: Direct Discharge Water Added Before (gal): 5 Water Added After (gal): 0
Field Test Data       Test     Result     Specification       Slump (in):     6 3/4     Not specified	Sample Location: South west end of south wall Placement Location: Sound wall

### Laboratory Test Data

Air Content (%):

Yield (Cu. Yds.):

Concrete Temp. (F):

Ambient Temp. (F):

Plastic Unit Wt. (pcf):

Labo	ratory Te	st Data				Age at	Maximum	Compressive		
Set	Specimen	Avg Diam.	Area	Date	Date	Test	Load	Strength	Fracture	Tested
No.	ID	(in)	(sq in)	Received	Tested	(days)	(lbs)	(psi)	Туре	By
1	A	6.01	28.37		06/30/21	76 F	195,350	6,890	1	SLS
1	в	6.01	28.37		06/30/21	76 F	194,610	6,860	4	SLS
1	С	6.01	28.37		06/30/21	76 F	196,960	6,940	2	SLS
1	D					Hold				
Initial	Cure: Outsi	ide Plastic Lid	s	Final Cu	ure: Field Cu	red				

Comments: F = Field Cured

Note: Reported air content does not include Aggregate Correction Factor (ACF). None

Not specified

40 - 95

40 - 95

Not specifed

### Samples Made By: Terracon

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

Terracon Rep.: Justin Maass Reported To: A&M contractors

#### Contractor: **Report Distribution:**

(1) Texas Transportation Institute, Gary Gerke (1) Terracon Consultants, Inc., Alex Dunigan, P.E. (1) Texas Transportation Institute, Bill Griffith

Reviewed By:

Start/Stop: 1115-1345

Alexander Dunigan

Project Manager

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

The tests were performed in general accordance with applicable ASTM, AASHTO, or DOT test methods. This report is exclusively for the use of the client indicated above and shall not be reproduced except in full without the written consent of our company. Test results transmitted herein are only applicable to the actual samples tested at the location(s) referenced and are not necessarily indicative of the properties of other apparently similar or identical materials.

CR0001, 11-16-12, Rev.6

Page 1 of 1

Project No: 440861-04 Casting Date: 4/20	7	Page: 1 of 1
Name of Technician Name of Technician	0/2021 Mix Design (psi)	: 4000
Technician Technician B	ature of Breaking	racon
Load No. Truck No. Ticket No.	Location (from concret	e map)
T1 7133 6723543 Sound	dwall, from expansion joir	nt 65 feet west
T2 9019 6723674	Soundwall, remaining 5	5 feet
Load No. Break Date Cylinder Age Total Load	d (lbs) Break (psi)	Average
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		┨────┤
<b>├</b> ─── <b>├</b> ─── <b>├</b> ───		<b> </b>
		Į
		1 1

			BILLING	;					723674
	Martin Marie	<b>n</b> 15	rtin Ma <sup>03 LBJ Fr Suite 40 Pallas, TX</sup>	eewa	y				
					FINISH P	DUR	LEAVE	JOB SITE	ARRIVE PLANT
LOAD TIME 9:52	TO JOB	ARRIVE JOB SITE	BEGIN PO	UR	:			:	:
LLOWABLE WATER ST CYLINDER TA YLINDER TAKEN DDITIONAL WA EDUCE ITS ST IF SPECIFIED S USTOMER NAME A IBC MANAGEI 100 SH 47, BF	TER ADDED TO RENGTH. ANY SLUMP IS AT CU AND DELIVERY ADD MENT RYAN, TX 7780	h) ORE AFTER WATER O THIS CONCRETE WATER ADDED IN E STOMER'S RISK. DRESS	WILL EXCESS PL 61 DF W CL	TERM HERE ANT 7 RIVER NA	IS AND CC OF AS AC	ORD 201	BY S FR NO. 5	IGNATUR	JBJECT TO TH VERSE SIDE E ABOVE. P.O. #/JOB/LOT TTI-THRIE BE/ DATE 04/20/21 ORDERED QTY 12.00 E AMOUNT
PECIAL DELIVERY IGHT 2818, RIC TRAIGHT ARO HERE		RD, RIGHT 47, LEFT SOUT TO GATE, CU	INTO RELL STOMER TO	.IS, D MEE	ΤΥΟυ		ALES T	AX	
ANGER! MAY CA	USE ALKALI BUR	INS.			FOR OF	FICE US	E ONL	Y FORM	:
ruck 019 oad Size .00 CYDS	Driver 726255 Mix Code DSD60S sign Qty Require 12 b 10960	User	Disp Tic 6723674 Qty	:ket	Num T: 9 Mix Ag	1940 e	ID Seq D	Time 9:52 Loa 931	Date 4/20/21

			BILLING	;					723674
	Martin Marie	<b>n</b> 15	rtin Ma <sup>03 LBJ Fr Suite 40 Pallas, TX</sup>	eewa	y				
					FINISH P	DUR	LEAVE	JOB SITE	ARRIVE PLANT
LOAD TIME 9:52	TO JOB	ARRIVE JOB SITE	BEGIN PO	UR	:			:	:
LLOWABLE WATER ST CYLINDER TA YLINDER TAKEN DDITIONAL WA EDUCE ITS ST IF SPECIFIED S USTOMER NAME A IBC MANAGEI 100 SH 47, BF	TER ADDED TO RENGTH. ANY SLUMP IS AT CU AND DELIVERY ADD MENT RYAN, TX 7780	h) ORE AFTER WATER O THIS CONCRETE WATER ADDED IN E STOMER'S RISK. DRESS	WILL EXCESS PL 61 DF W CL	TERM HERE ANT 7 RIVER NA	IS AND CC OF AS AC	ORD 201	BY S FR NO. 5	IGNATUR	JBJECT TO TH VERSE SIDE E ABOVE. P.O. #/JOB/LOT TTI-THRIE BE/ DATE 04/20/21 ORDERED QTY 12.00 E AMOUNT
PECIAL DELIVERY IGHT 2818, RIC TRAIGHT ARO HERE		RD, RIGHT 47, LEFT SOUT TO GATE, CU	INTO RELL STOMER TO	.IS, D MEE	ΤΥΟυ		ALES T	AX	
ANGER! MAY CA	USE ALKALI BUR	INS.			FOR OF	FICE US	E ONL	Y FORM	:
ruck 019 oad Size .00 CYDS	Driver 726255 Mix Code DSD60S sign Qty Require 12 b 10960	User	Disp Tic 6723674 Qty	:ket	Num T: 9 Mix Ag	1940 e	ID Seq D	Time 9:52 Loa 931	Date 4/20/21

78

70

147.6

6.0

Report Number: A1171057.0185 Service Date: 04/20/21 Report Date: 07/01/21 Revision 2 - 71-day results PO# 440861-4 Task:



College Station, TX 77845-5765 979-846-3767 Reg No: F-3272

Client				Project			
Texas Transpo	ortation Insti	tute		Riverside Campus			
Attn: Gary Ge	erke			Riverside Campus			
TTI Business	Office			Bryan, TX			
3135 TAMU							
College Static	n, TX 77843	3-3135		Project Number: A1171057			
Material Inf	formation	า		Sample Information			
Specified Str	ength: 4,0	00 psi @ 23	8 days	Sample Date:	04/20/21	Sample Time:	1000
-	-		-	Sampled By:	Justin Maa	SS	
Mix ID:	DSD60S			Weather Conditions:	Clear, light	t wind	
Supplier:	Martin Mar	rietta		Accumulative Yards:	6/12	Batch Size (cy):	6
Batch Time:	0930	Plant:	Bryan	Placement Method:	Bucket & 1	ift	
Truck No.:	7133	Ticket No.:	6723543	Water Added Before (gal):	10		
				Water Added After (gal):	0		
Field Test I	Data			Sample Location:	Center of a	11	
Test		Result	Specification	Placement Location:	Sound wal	l North half, upper h	alf and
Slump (in):		5 3/4			of wall		
Air Content (	(%):	1.2					

## Laboratory Test Data

Concrete Temp. (F): Ambient Temp. (F):

Plastic Unit Wt. (pcf):

Yield (Cu. Yds.):

Labo	ratory Te	st Data				Age at	Maximum	Compressive		
Set	Specimen	Avg Diam.	Area	Date	Date	Test	Load	Strength	Fracture	Tested
No.	ID	(in)	(sq in)	Received	Tested	(days)	(lbs)	(psi)	Туре	By
1	A	6.01	28.37		06/30/21	71 F	157,220	5,540	3	SLS
1	в	6.01	28.37		06/30/21	71 F	159,650	5,630	2	SLS
1	С	6.01	28.37		06/30/21	71 F	166,280	5,860	1	SLS
1	D					Hold				
Initial	Cure: Outsi	ide Plastic Lid	ls	Final Cu	ire:					

Initial Cure: Outside Plastic Lids

Comments: F = Field Cured

Note: Reported air content does not include Aggregate Correction Factor (ACF). None

#### Samples Made By: Terracon

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

Terracon Rep.: Justin Maass **Reported To:** 

Contractor:

Report Distribution: (1) Texas Transportation Institute, Gary Gerke (1) Terracon Consultants, Inc., Alex Dunigan, P.E.

(1) Texas Transportation Institute, Bill Griffith

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

The tests were performed in general accordance with applicable ASTM, AASHTO, or DOT test methods. This report is exclusively for the use of the client indicated above and shall not be reproduced except in full without the written consent of our company. Test results transmitted herein are only applicable to the actual samples tested at the location(s) referenced and are not necessarily indicative of the properties of other apparently similar or identical materials. Page 1 of 2

CR0001, 11-16-12, Rev.6

Start/Stop: 0900-1130

Report Number: A1171057.0185 Service Date: 04/20/21 Report Date: 07/01/21 Revision 2 - 71-day results PO# 440861-4 Task:



College Station, TX 77845-5765 979-846-3767 Reg No: F-3272

Client			Project			
Texas Transportation I Attn: Gary Gerke TTI Business Office 3135 TAMU	nstitute		Riverside Campus Riverside Campus Bryan, TX			
College Station, TX 77	843-3135		Project Number: A1171057			
Material Informat	ion		Sample Information			
Specified Strength:	4,000 psi @ 2	8 days	Sample Date: Sampled By:	04/20/21 Justin Maas	Sample Time:	1050
Mix ID: DSD60	S		Weather Conditions:	Clear, light	wind	
Supplier: Martin	Marietta		Accumulative Yards:	12/12	Batch Size (cy):	6
Batch Time: 0952	Plant:	Bryan	Placement Method:	Bucket & li	ift	
Truck No.: 9019	Ticket No.:	6723674	Water Added Before (gal):	13		
Field Test Data			Water Added After (gal): Sample Location:	0 10ft from N	Jorth end	
Test	Result	Specification	Placement Location:	Sound wal	l, North half, upper	half of
Slump (in):	6			wall		
Air Content (%):	1.3					

#### Laboratory Test Data

Concrete Temp. (F): Ambient Temp. (F):

Plastic Unit Wt. (pcf):

Yield (Cu. Yds.):

Labo	ratory Te	st Data				Age at	Maximum	Compressive		
Set	Specimen	Avg Diam.	Area	Date	Date	Test	Load	Strength	Fracture	Tested
No.	ID	(in)	(sq in)	Received	Tested	(days)	(lbs)	(psi)	Туре	By
2	A	6.01	28.37		06/30/21	71 F	161,530	5,690	1	SLS
2	в	6.01	28.37		06/30/21	71 F	153,200	5,400	4	SLS
2	С	6.01	28.37		06/30/21	71 F	144,180	5,080	2	SLS
2	D					Hold				

Initial Cure: Outside Plastic Lids

Comments: F = Field Cured

Note: Reported air content does not include Aggregate Correction Factor (ACF). None

Final Cure:

#### Samples Made By: Terracon

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

Terracon Rep.: Justin Maass **Reported To:** 

Contractor:

## Report Distribution:

(1) Texas Transportation Institute, Gary Gerke (1) Terracon Consultants, Inc., Alex Dunigan, P.E. (1) Texas Transportation Institute, Bill Griffith

77

70

148.0

12.0

Reviewed By:

Start/Stop: 0900-1130

Hexander Dunigan Project Manager

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

The tests were performed in general accordance with applicable ASTM, AASHTO, or DOT test methods. This report is exclusively for the use of the client indicated above and shall not be reproduced except in full without the written consent of our company. Test results transmitted herein are only applicable to the actual samples tested at the location(s) referenced and are not necessarily indicative of the properties of other apparently similar or identical materials. Page 2 of 2

CR0001. 11-16-12. Rev.6

Quality	exas A&M ansportation stitute y Form	QF 7.3-01 Samj Revised by: B.L. Griffi Approved by: D. L. Kui	pling <sup>th</sup>	Doc. No. QF 7.3-01 Revision: 7	Revision Date: 2020-07-29 Page: 1 of 1
Project No:	Project No: 440861-04 Casting Date			Mix Design (psi):	4000
Name of Technician Taking Sample	e of Technician				acon
Signature of Technician Taking Sample	Terr	acon	Signature of Technician Breaking Sample		acon
Load No.	Truck No.	Ticket No.	Locat	ion (from concrete	e map)
T1	4280	6731090	Remai	ining section of Sou	ndwall
Load No.	Break Date	Cylinder Age	Total Load (lbs)	Break (psi)	Average

			BILLING						
	Martin	Mar 15	BILLING <b>tin Ma</b> 03 LBJ Fr Suite 4	ariet	ta		TICKET 67310	NO. 990	
100		D	allas, TX	75234					
	TO JOB	ARRIVE JOB SITE	BEGIN PO	OUR	FINISH POUR	R LEAVE	JOB SITE	ARRIVE PLANT	
9:49	•				•		-	•	1 10 - 1
WATER ADDED ON J ALLOWABLE WATER			GAL.		MER SIGNATUR	RE			
TEST CYLINDER TAK CYLINDER TAKEN			R WILL EXCESS	TER	VERY OF TH MS AND COM EOF AS ACC	IDITIONS C	ON THE REV	IBJECT TO THE ERSE SIDE E ABOVE.	
REDUCE ITS STR OF SPECIFIED SL CUSTOMER NAME AN	UMP IS AT CUS	ESS		PLANT 618	TRUCK 4280	ORDER 1	10. SLUMP 5.00	P.O. #/JOB/LOT	
MBC MANAGEM	ENT AN, TX 77807		101	DRIVER	NAME	2001	3.00	TTI-THRIE BEA	AM
3100 31 47, 510	7.0.1			CUSTO	Albrecht MER NUMBER		CUM. QTY	04/22/21 ORDERED QT	
LOAD QUANTITY	PRODUCT CO	DE DE:	SCRIPTION	782823	State State	100138	4.00 UNIT PR	4.00 ICE AMOU	INT
PECIAL DELIVERY IN RIGHT 2818, RIGH TRAIGHT AROUN THERE		D, RIGHT 47, LEF DUT TO GATE, C	T INTO R	ELLIS, R TO M	EET YOU		LES TAX		
RIGHT 2818, RIGH TRAIGHT AROUN HERE	T LEONARD RI ID ROUND ABC	15.	T INTO R	ELLIS, R TO M		то	TAL		
AIGHT 2818, RIGH TRAIGHT AROUN THERE DANGER! MAY CAUS SEE WARNINGS O Truck D 4280 9	T LEONARD RI ID ROUND ABO SE ALKALI BURN N REVERSE SIE river 34547 ix Code SD60S Oty Required b 747 ib 7262 ot 280 ib 7260 ib	USET USET USET Returned Batched bb 706 b bb 7190 b c 91 oz bb 2270 b bb 7340 b bb 7340 b bb 3 Water/Cement: 0.0 gl Adjut AGG SCALE2 B	Disp 7 673109 % Var% -5.48% < -1.00% -0.22% -0.01% 0.01% 0.4455 T st Water:	Ficke 90 % 6 Moisture 0.20% M 4.00% M Desig	FOR C t Num T Mix AC Actual Wa 85 gl 2 gl 26 gl 26 gl 124.3 gl	TO DFFICE USE Cicket 0495 ge S D t	TAL ONLY FOI D Time 9:49 eq Lo 96	Date 4/22/2: Dad ID 579 To Add: 11.1	gl

1.1

73

68

149.3

Task:	PO# 440861	-4
Report Date:	07/01/21	Revision 2 - 69-day results
Service Date:	04/22/21	
Report Number:	A1171057.0	186



Task: PO# 440801-4	9/9-840-3/0/ Keg No: F-32/2
Client	Project
Texas Transportation Institute	Riverside Campus
Attn: Gary Gerke	Riverside Campus
TTI Business Office	Bryan, TX
3135 TAMU	
College Station, TX 77843-3135	Project Number: A1171057
Material Information	Sample Information
Specified Strength: 4,000 psi @ 28 days	Sample Date: 04/22/21 Sample Time: 1059
	Sampled By: David Carpio
Mix ID: Class S	Weather Conditions: Clear, light wind
Supplier: Martin Marietta	Accumulative Yards: 4/4 Batch Size (cy): 4
Batch Time: 0949 Plant: 618	Placement Method: Direct Discharge
Truck No.: 4280 Ticket No.: 6731090	Water Added Before (gal): 9
	Water Added After (gal): 0
Field Test Data	Sample Location: 12' North of South end ; 6' from bottom
Test Result Specification	•
Slump (in): 5 1/2	_
• 3 6	

## Laboratory Test Data

Air Content (%):

Yield (Cu. Yds.):

Concrete Temp. (F):

Ambient Temp. (F):

Plastic Unit Wt. (pcf):

Laboratory Test Data					Age at	Maximum	Compressive			
Set	Specimen	Avg Diam.	Area	Date	Date	Test	Load	Strength	Fracture	Tested
No.	ID	(in)	(sq in)	Received	Tested	(days)	(lbs)	(psi)	Туре	By
1	Α	6.01	28.37		06/30/21	69 F	154,950	5,460	2	SLS
1	в	6.01	28.37		06/30/21	69 F	153,150	5,400	2	SLS
1	С	6.01	28.37		06/30/21	69 F	143,600	5,060	4	SLS
1	D					Hold				
Initial	Cure: Outsi	ide Plastic Lid	s	Final Cu	ire: Field Cu	red				

Comments: F = Field Cured

Note: Reported air content does not include Aggregate Correction Factor (ACF).

#### Samples Made By: Terracon

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

Terracon Rep.: David Carpio Reported To: Will

## Contractor:

**Report Distribution:** (1) Texas Transportation Institute, Gary Gerke (1) Terracon Consultants, Inc., Alex Dunigan, P.E.

(1) Texas Transportation Institute, Bill Griffith

Start/Stop: 1000-1145 **Reviewed By:** Alexander Dunigan

Project Manager

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

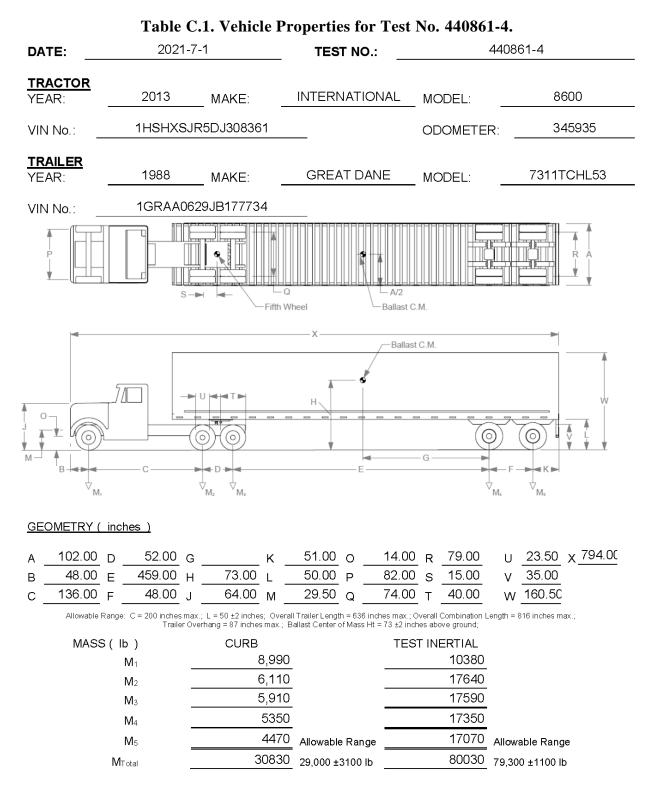
The tests were performed in general accordance with applicable ASTM, AASHTO, or DOT test methods. This report is exclusively for the use of the client indicated above and shall not be reproduced except in full without the written consent of our company. Test results transmitted herein are only applicable to the actual samples tested at the location(s) referenced and are not necessarily indicative of the properties of other apparently similar or identical materials.

CR0001, 11-16-12, Rev.6

Page 1 of 1

## APPENDIX C. MASH TEST 5-12 (CRASH TEST NO. 440861-4)

## C.1. VEHICLE PROPERTIES AND INFORMATION



# C.2. SEQUENTIAL PHOTOGRAPHS















Figure C.1. Sequential Photographs for Test No. 440861-4 (Overhead and Frontal Views).

















Figure C.1. Sequential Photographs for Test No. 440861-4 (Overhead and Frontal Views) (Continued).



0.000 s



0.150 s



0.300 s



0.450 s

Figure C.2. Sequential Photographs for Test No. 440861-4 (Rear View).



0.600 s



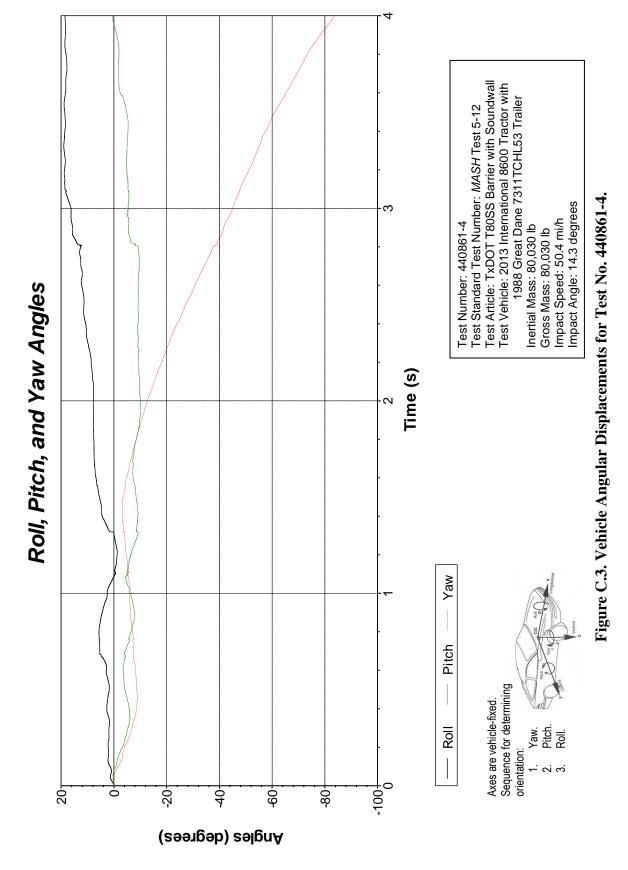
0.750 s



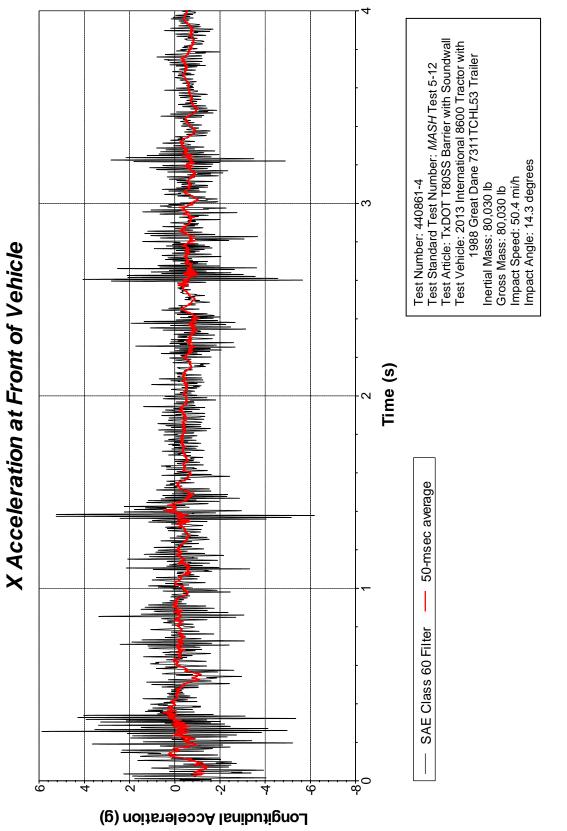
0.900 s



1.050 s

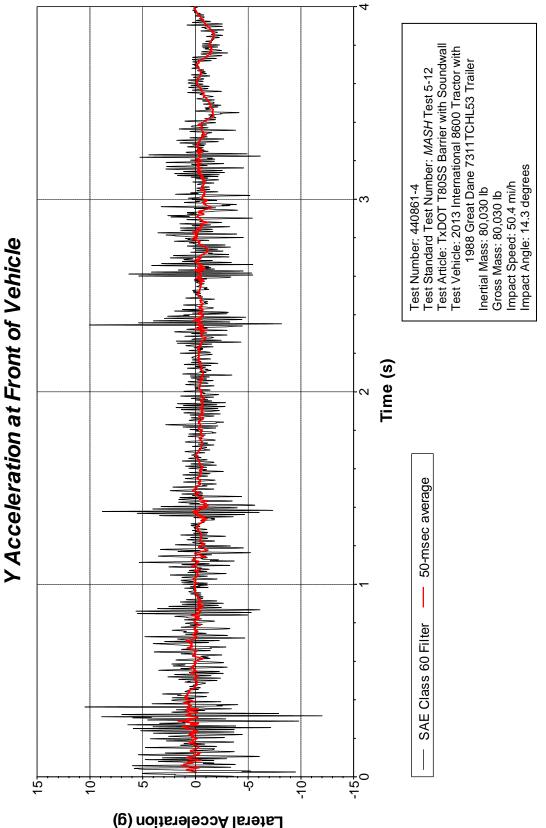


## C.3. VEHICLE ANGULAR DISPLACEMENTS





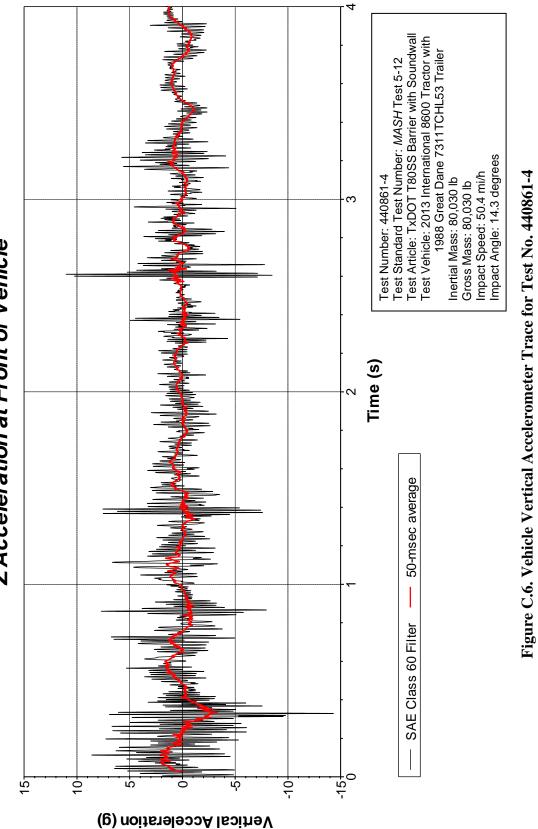
2021-09-30



TR No. 0-7086-R4

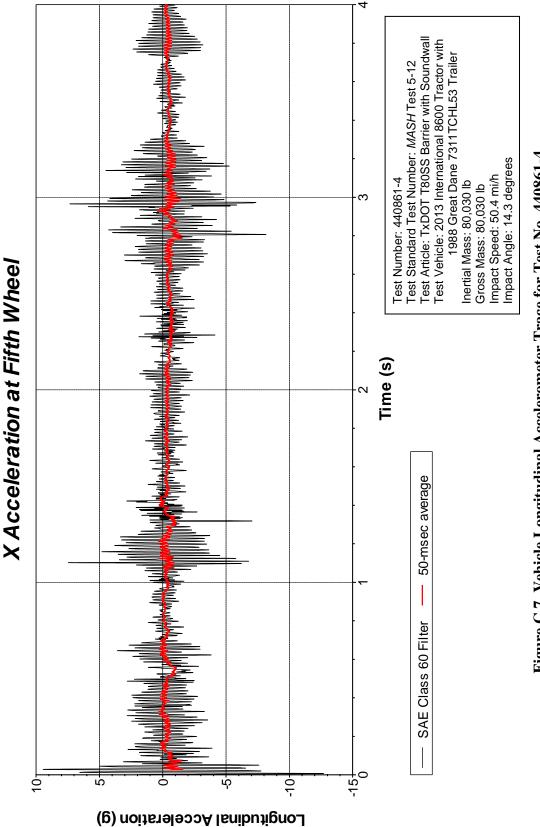
Figure C.5. Vehicle Lateral Accelerometer Trace for Test No. 440861-4

(Accelerometer Located at Front).



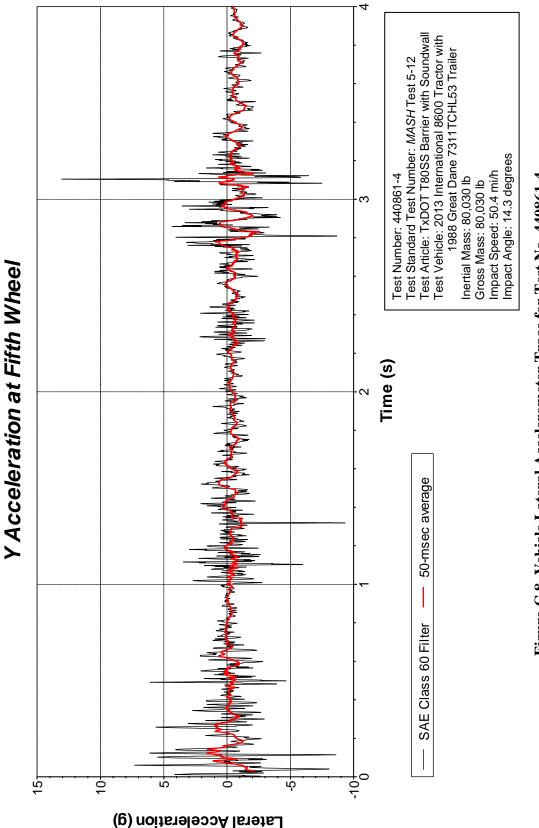


(Accelerometer Located at Front).

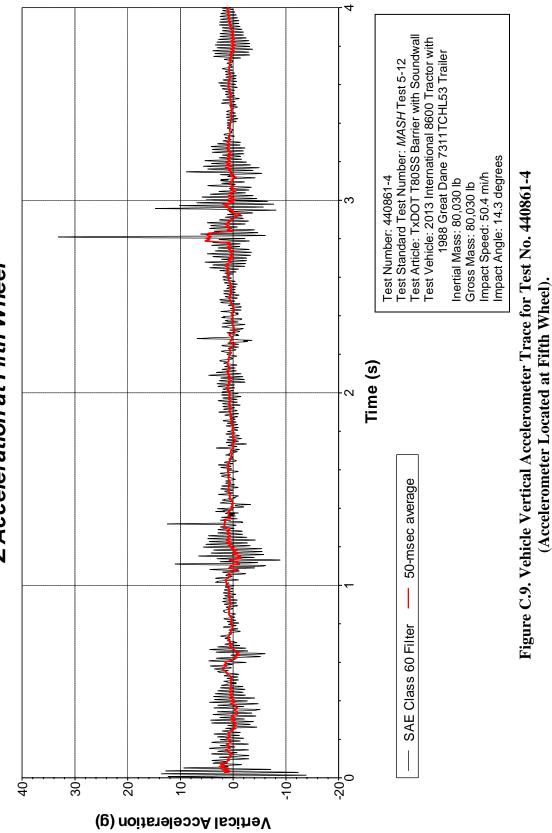




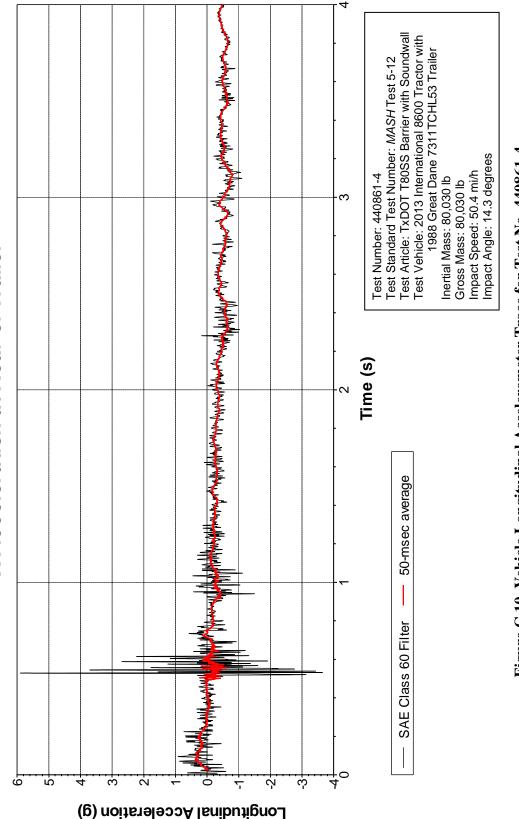
2021-09-30





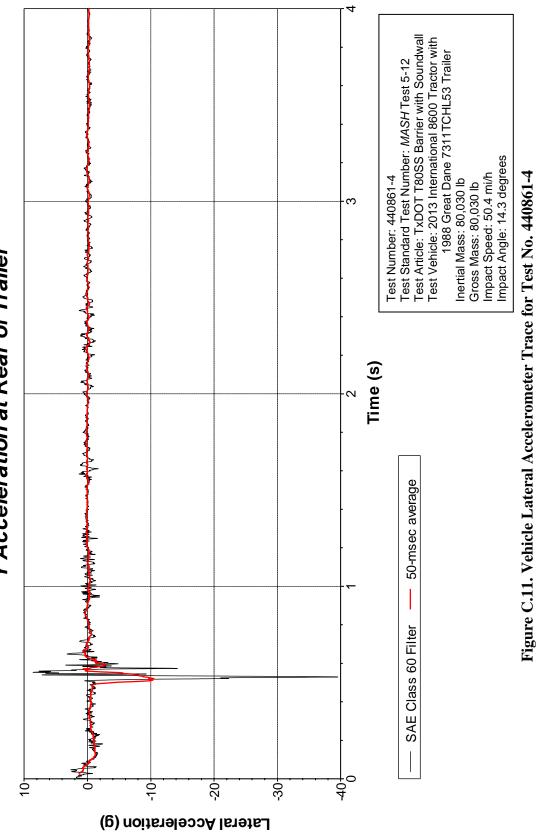






X Acceleration at Rear of Trailer

Figure C.10. Vehicle Longitudinal Accelerometer Trace for Test No. 440861-4 (Accelerometer Located at Rear of Trailer).





(Accelerometer Located at Rear of Trailer).

		Test Number: 440861-4 Test Standard Test Number: <i>MASH</i> Test 5-12 Test Article: TxDOT T80SS Barrier with Soundwall Test Vehicle: 2013 International 8600 Tractor with 1988 Great Dane 7311TCHL53 Trailer Inertial Mass: 80,030 lb Gross Mass: 80,030 lb Impact Speed: 50.4 mi/h Impact Angle: 14.3 degrees
	 L	Test Number: 440861-4 Test Standard Test Number Test Article: TxDOT T80SS Test Vehicle: 2013 Internati 1988 Great Dane 7 Inertial Mass: 80,030 lb Gross Mass: 80,030 lb Impact Speed: 50.4 mi/h Impact Angle: 14.3 degrees
	 Time (s)	60 Filter — 50-msec average
		SAE Class 60 F



(Accelerometer Located at Rear of Trailer).