Proposal
For
Bidding Purposes

For Construction of:

Lehi UTA Pedestrian Bridge

A Federal Project

For Utah Transit Authority

FULL PROPOSAL SHALL BE COMPLETED AND SIGNED TO BE DEEMED RESPONSIVE

IS YOUR SUBCONTRACTOR LIST INCLUDED???

IF NOT

YOUR BID WILL BE CONSIDERED IRREGULAR

AND WILL BE REJECTED!!!

SUBMIT THE ENCLOSED PROPOSAL BOND FORM WITH YOUR PROPOSAL.

USE OF OTHER FORMS MAY SUBJECT YOUR BID TO REJECTION.

NOTE: Use of other forms may limit the bond below an amount equal to five percent of the bid total.

SUBMIT ALL THE BID ANAYSIS SHEETS IN THE PROPOSAL

USE OF OTHER FORMS MAY SUBJECT YOUR BID TO REJECTION.

Proposal Bond

A corporation duly organized and authorized to do business under the state of Utah, as surety, are held and firmly bound unto the State in the full sum of five (5) percent of the total amount of the bid proposal of said principal for the work hereinafter described, for the payment of which, well and truly to be made, we bind our heirs, executors, administrators and assigns, and successors and assigns, firmly by these presents.

NOW, THEREFORE, If the said proposal bid by said principal be accepted, and the contract be awarded to said principal, and if said principal shall duly make and enter into and execute said contract and shall furnish a contract bond as required by the Utah Transit Authority (UTA) then this obligation shall be null and void, otherwise it shall remain and be in full force and effect.

IN TESTIMONY WHEREOF, The principal and surety have caused these presents to be signed and sealed this _____ day of _____, year_____.

_____
Principal

_____
Surety

_____
Attorney-in-fact

PROPOSAL - LEHI PEDESTRIAN BRIDGE 2/6/2025

Item #	Description	Unit	Quantity	Unit Price	Bid Amount
1	MOBILIZATION	LS	1.00		
2	TRAFFIC CONTROL	LS	1.00		
3	SURVEY	LS	1.00		
4	DUST CONTROL AND WATERING	LS	1.00		
5	POTHOLE	LS	1.00		
6	ROADWAY EXCAVATION	CY	3,627.00		
7	REMOVE ASPHALT PAVEMENT	SY	846.00		
8	REMOVE CONCRETE PAD	SF	56.00		
9	REMOVE FENCE	LF	960.00		
10	REMOVE CONCRETE PAVEMENT	SF	420.00		
11	RELOCATE BENCH	EA	1.00		
12	RELOCATE PERGOLA	EA	1.00		
13	UNTREATED BASE COURSE	TN	773.00		
14	BORROW	CY	11,196.00		
15	HMA - 1/2 INCH	TN	212.00		
16	PORTLAND CEMENT CONCRETE PAVEMENT	SY	47.00		
17	CONCRETE SIDEWALK	CF	7,244.00		
18	4 FT CHAIN LINK FENCE	LF	940.00		
19	5 FT CHAIN LINK FENCE	LF	1,033.00		
20	LOOSE RIPRAP	CY	20.00		
21	CONCRETE LINED DITCH	LF	45.00		
22	CONCRETE LINED DITCH - MSE WALL	LF	585.00		
23	DRAINAGE PIPE - 12 INCH, SMOOTH, LEAK-RESISTANT	LF	73.00		
24	DRAINAGE PIPE - 15 INCH, SMOOTH, LEAK-RESISTANT	LF	190.00		
25	DRAINAGE PIPE - 18 INCH, SMOOTH, LEAK-RESISTANT	LF	150.00		
26	DRAINAGE PIPE - 18 INCH, REINFORCED CONCRETE, LEA	LF	315.00		
27	DRAINAGE PIPE - 24 INCH, SMOOTH, LEAK-RESISTANT	LF	243.00		
28	CONCRETE DRAINAGE STRUCTURE DB 1	EA	1.00		
29	CONCRETE DRAINAGE STRUCTURE 4 FT WIDE X 1 FT TO	EA	1.00		
30	CONCRETE DRAINAGE STRUCTURE 4 FT WIDE X 3 FT TO	EA	2.00		
31	CONCRETE DRAINAGE STRUCTURE 8 FT WIDE X 5 FT TO	EA	1.00		
32	CIRCULAR END SECTION 12 INCH	EA	3.00		
33	CIRCULAR END SECTION 15 INCH	EA	2.00		
34	CIRCULAR END SECTION 18 INCH	EA	1.00		
35	CIRCULAR END SECTION 24 INCH	EA	1.00		
36	4 FOOT STANDARD MANHOLE 7 FT TO 9 FT DEEP - CB 11	EA	1.00		
37	CAST-IN-PLACE CONCRETE CONSTANT SLOPE BARRIER	FT	364.00		
38	CAST-IN-PLACE CONCRETE CONSTANT SLOPE BARRIER - 42 INCH, APPROACH END SECTION	EA	2.00		
39	CRASH CUSHION TYPE B (MASH)	EA	2.00		
40	CHECK DAM - FIBER ROLL	EA	49.00		

PROPOSAL - LEHI PEDESTRIAN BRIDGE 2/6/2025

Item #	Description	Unit	Quantity	Unit Price	Bid Amount
41	SILT FENCE	LF	1,230.00		
42	DROP-INLET BARRIER	EA	13.00		
43	PIPE-INLET BARRIER	EA	1.00		
44	STABILIZED CONSTRUCTION ENTRANCE	EA	2.00		
45	MSE WALL-A	SF	3,954.00		
46	MSE WALL-B	SF	3,485.00		
47	MSE WALL-C	SF	3,035.00		
48	AESTHETICS - FORMLINER AND TINTED CONCRETE SEAI	LS	1.00		
49	BROADCAST SEED	1,000 SF	72.00		
50	HECP TYPE 1	1,000 SF	72.00		
51	STRIP, STOCKPILE, AND SPREAD TOPSOIL (PLAN QUANT	SY	9,200.00		
52	REMOVE SIGN	EA	3.00		
53	SIGN PANEL LESS THAN 20 SQUARE FEET	EA	14.00		
54	SMALL SIGN TUBULAR STEEL POST BASE (B2A)	EA	14.00		
55	SIGN POST P2	EA	14.00		
56	GRANULAR BACKFILL BORROW (PLAN QUANTITY)	CY	50.00		
57	DRILLED SHAFTS, 60 INCH	LF	188.00		
58	7 FT CHAIN LINK FENCE	LF	1,069.00		
59	REINFORCING STEEL - COATED (PLAN QUANTITY)	LB	113,569.00		
60	STRUCTURAL CONCRETE (EST LUMP QTY 453 CU YD)	LS	1.00		
61	AESTHETICS - FORMLINER	LS	1.00		
62	PRESTRESSED CONCRETE MEMBER 91 FT 0 INCH TYPE UB	EA	1.00		
63	PRESTRESSED CONCRETE MEMBER 96 FT 11 INCH TYPE U	EA	1.00		
64	PRESTRESSED CONCRETE MEMBER 120 FT 7 INCH TYPE U	EA	1.00		
65	PRESTRESSED CONCRETE MEMBER 122 FT 4 INCH TYPE U	EA	2.00		
66	PRESTRESSED CONCRETE MEMBER 127 FT 1 INCH TYPE U	EA	1.00		
67	PRESTRESSED CONCRETE MEMBER 151 FT 4 INCH TYPE U	EA	2.00		
68	STRUCTURAL STEEL (EST LUMP QTY 1,508 LB)	LS	1.00		
69	ABUTMENT EXPANSION BEARING	EA	4.00		
70	BENT FIXED BEARING	EA	12.00		
71	COMPRESSION JOINT SEAL	LF	32.00		
72	AESTHETICS - TINTED CONCRETE SEALER	LS	1.00		
	SWPPP	LS	1.00		
	PUBLIC INFORMATION	LS	1.00		
	QA / QC	LS	1.00		

TOTAL BID:

UTA - LEHI PEDESTRIAN BRIDGE

Subcontractor List

To Be Submitted with the Bid Proposal

Project Name _____

Failure to list subcontractors with whom the bidder, if awarded the contract, will directly subcontract for performance of the work

To the extent the Project includes one or more categories of work referenced in the bid item work. Subcontractors need to be listed below to perform such work, the bidder certifies that the work will either (i) be performed by the bidder itself, or (ii) be performed by a lower tier subcontractor who will not contract directly with the bidder.

Work to be performed _____

_____

_____

_____

Subcontractor Name _____

Work to be performed _____

_____

_____

_____

Subcontractor Name _____

Work to be performed _____

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Subcontractor Name _____

Work to be performed _____

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Subcontractor Name _____

Work to be performed _____

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NOTE: Use blank pages if additional subcontractors need to be listed.

Subcontractor Name

Work to be performed

Subcontractor Name

Work to be performed

Subcontractor Name

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Subcontractor Name

Work to be performed

Subcontractor Name

Work to be performed

Contractor Certification
Wage Law Compliance - Responsibility Criteria

FAILURE TO RETURN THIS CERTIFICATION AS PART OF THE BID PROPOSAL PACKAGE WILL MAKE THIS BID NONRESPONSIVE AND INELIGIBLE FOR AWARD

I hereby certify, under penalty of perjury under the laws of the State of "Utah", on behalf of the firm identified below that, to the best of my knowledge and belief, this firm has NOT been determined by a final and binding citation and notice of assessment issued by the "Utah" State Department of Labor and Industries or through a civil judgment entered by a court of limited or general jurisdiction to have willfully violated

BIDDER NAME: _____
Name of Contractor/Bidder - Print full legal entity name of firm

By: _____ _____
Signature of authorized person — Print name of person making certifications for firm

Title: _____ Place: _____
Title of person signing certificate — Print city and state where signed

Date: _____

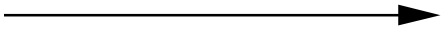
UTA -
LEHI PEDESTRIAN BRIDGE

Proposal - Signature Page

The bidder is hereby advised that by signature of this proposal he/she is deemed to have acknowledged all requirements and signed all certificates contained herein.

Receipt is hereby acknowledged of addendum(s) No.(s) _____ , _____ & _____

Signature of Authorized Official(s)



_____

_____

Firm Name _____

Address _____

_____

_____

Contractor's License No. _____

Federal ID No. _____

Note:

(1) This proposal form is not transferable and any alteration of the firm's name entered hereon without prior permission from the Secretary of Transportation will be cause for considering the proposal irregular and subsequent rejection of the bid.

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UTA - LEHI PEDESTRIAN BRIDGE

SPECIAL PROVISION

NOTE:
ANY SPECIFICATION NOT FOUND WITH IN THE PROJECT SPECIAL PROVISIONS CAN BE FOUND IN THE 2020 UDOT STANDARDS & 2017 APWA STANDARDS

February 18, 2020

SPECIAL PROVISION

CONTRACT: 18-2399TP
PROJECT: LEH_OP_1

SECTION 02056M

EMBANKMENT, BORROW, AND BACKFILL

Add Article 1.2 Paragraph B

B. Section 02721: Untreated Base Course (UTBC)

Delete Article 1.5 Paragraph B and replace with the following:

B. Engineering proposal for alternate materials or trench configurations for drainage pipe bedding and pipe backfill as outlined in this Section, Article 2.4 B.

Delete Article 2.2 Paragraph B and replace with the following:

B. Granular Borrow
   1. Classification A-1-a. Refer to AASHTO M 145
   2. Non-plastic.
   3. Meet gradation requirements in Table 1.

Table 1

Granular Borrow Gradation Option 1	
Sieve Size	**Percent Passing**
3 inch	90 - 100
1 inch	60 - 100
1/2 inch	30 - 80
No. 4	25 - 65
No. 10	0 - 50
No. 40	0 - 30
No. 200	0 - 15

   4. UTBC meeting the requirements of Section 02721 may be used upon approval of the Engineer.

Delete Article 2.2 Paragraph D and replace with the following:

D. Free-Draining Granular Backfill
   1. Meet the following gradation:

Table 2

Free Draining Granular Backfill Gradation	
Sieve Size	**Percent Passing**
1½ inch	90-100
1 inch	20-55
¾ inch	0-15
⅜ inch	0-5

December 18, 2019

SPECIAL PROVISION

CONTRACT: 18-2399TP
PROJECT: LEH_OP_1

SECTION 02466S

DRILLED SHAFTS

Delete Section 02466 in its entirety and replace with the following:

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Drilled shafts for bridge, overhead sign/VMS, and general structure foundations

B. Integrity testing

1.2 RELATED SECTIONS

A. Section 03055: Portland Cement Concrete

B. Section 03211: Reinforcing Steel and Welded Wire

C. Section 03310: Structural Concrete

D. Section 03390: Concrete Curing

1.3 REFERENCES

A. AASHTO M 31: Deformed and Plain Carbon and Low-Alloy Steel Bars for Concrete Reinforcement

B. ASTM A 706: Deformed and Plain Low-Alloy Steel Bars for Concrete Reinforcement

C. ASTM C 1107: Packaged Dry, Hydraulic-Cement Grout (Nonshrink)

D. ASTM D 6760: Integrity Testing of Concrete Deep Foundations by Ultrasonic Crosshole Testing

E. ASTM D 7949: Thermal Integrity Profiling of Concrete Deep Foundations

1.4 DEFINITIONS

A. Contaminated Concrete – Concrete where localized mix proportions have been changed by the placement process, such as with excess water or segregation; or concrete containing unintended materials, such as soil or rock from the excavation.

B. Crosshole Sonic Logging (CSL) – Non-Destructive Testing (NDT) method to measure uniformity and integrity of the concrete in deep foundations through use of measured ultrasonic pulses between parallel CSL pipes.

C. Oversized Drilled Shaft – A drilled shaft foundation that is larger in diameter than the supported column and that has a reinforcing steel cage larger than and independent of the column's reinforcing steel cage.

D. Shaft Inspection Device (SID) – Instrumentation used to inspect the bottom of drilled shaft hole

E. Thermal Integrity Profiling (TIP) – Non-Destructive Testing (NDT) method to measure uniformity and integrity of the concrete in deep foundations through temperature measurements associated with the heat of hydration generated by concrete as it cures.

F. Thermal Wire Cable – A series of thermal sensors and wires arranged to position sensors at specific depths along the length of the drilled shaft. The cable is connected to a recording apparatus to collect thermal data for reporting.

1.5 SUBMITTALS

A. Drilled shaft contractor qualifications for review. Include the following:
   1. A list of at least three projects completed in the last three years in which the drilled shaft contractor has installed drilled shafts of a diameter and length similar to those shown, and in similar subsurface conditions
      a. Include names and phone numbers of owner's representatives who can verify the drilled shaft contractor's participation on the listed projects.
   2. Name, contact information, and experience record of the drilled shaft superintendent who will be in charge of drilled shaft operations for this project
      a. Include responsibilities as a supervisor on at least three of the listed projects.

3. Drilled shaft contractor's quality control methods to verify that shafts are installed according to this Section

B. Drilled Shaft Installation Plan for review. Include at least the following:
   1. Equipment to be used, such as cranes, drills, augers, bits, tremies, concrete pumps, casings, and inspection devices
   2. Construction operation sequence
   3. Methods to excavate and clean the shaft holes
      a. Provide provisions to verify required final shaft cutoff elevation.
   4. Methods to maintain drilled shaft hole stability during excavation and concrete placement
      a. Include at least the following where casing is provided:
         1) Casing details, size, length, materials, and thickness
         2) Description of the method of advancing the casing
      b. Provide specifications, procedure, and example inspection report for SID to be used.
   5. Details of reinforcing steel placement including support and centralization methods
   6. Details of concrete placement, curing, and protection, including concrete placement times
      a. Use a concrete mix that is compatible with placement methods.
      b. Describe the method to maintain the concrete slump to keep it workable, for example, admixtures such as retarders or high range water reducers.
      c. Description of the method to place concrete under water, where encountered

C. Containment and Disposal Plan for review
   1. Include the proposed methods to dispose of drilling spoils and to contain and dispose of water if encountered

D. Drilled Shaft Integrity Testing Plan for review, when integrity testing is required. Include at least the following:
   1. Method to be used: CSL or TIP
   2. Independent integrity testing organization's qualifications
      a. Provide a list of at least three projects completed in the last three years in which the integrity testing organization has tested drilled shafts of a diameter and length similar to those shown, and with the same testing method to be used
   3. Testing procedures and equipment specifications
   4. Materials, length, and connection details
   5. Installation details

E. Construction documentation for information
   1. SID inspection reports when SID is required
      a. Include recordings from the SID inspections
         1) Include the date of recording, shaft number, and camera position in the recording.
   2. Drilled shaft construction logs
      a. Use the “Drilled Shaft Construction Logs” template found at the Department’s website for each shaft.
         1) Refer to http://www.udot.utah.gov/go/standardsreferences.

F. Integrity testing reports for review within seven calendar days, when integrity testing is required
   1. Submit report within three calendar days of integrity test if test results identify substandard concrete integrity, anomalies, or are inconclusive.
   2. Include at least the following:
      a. Test results
      b. Drilled shaft location, details, layout of testing equipment, date and time of test
      c. Logs showing initial pulse arrival time, and energy/amplitude versus depth for each pipe pair tested for CSL testing
      d. Logs showing temperature measurements versus depth for each thermal wire cable, and the average temperature of all thermal wire cables for TIP testing
      e. Zones of substandard integrity in the logs
      f. Recommendations for additional NDT if test results are inconclusive
   3. Provide interpretation and analysis of the recorded measurements by a Professional Engineer (PE) or Professional Structural Engineer (SE) licensed in the State of Utah having at least three years of experience in the interpretation of CSL/TIP results
      a. Provide the seal of the PE or SE on the report.

1.6 ACCEPTANCE

A. The Department may accept drilled shafts at a reduced price when the concrete compressive strength is less than the specified 28-day minimum compressive strength. Refer to Section 03055.
   1. The Department applies the pay factor for 28-day compressive strength to the measured length of each shaft containing concrete with tested strength less than the specified compressive strength.

B. Drilled shafts will be accepted based on the integrity testing results when required, meeting construction tolerances, and other construction documentation.
   1. NDT methods may be used to evaluate possible shaft defects, such as Single-hole Sonic Logging, Gamma-Gamma Nuclear Density Logging, 3D Tomography, and surface Sonic Echo and Impulse Response tests.
      a. The Contractor is responsible for the costs of NDT testing
      b. Provide a NDT testing firm or consultant experienced and competent in the chosen NDT methods.
   2. The Engineer may require coring of the shaft to verify shaft conditions if the integrity testing and NDT results are inconclusive.
      a. The Contractor is responsible for coring costs, including grouting of core holes.

PART 2 PRODUCTS

2.1 CONCRETE

A. Class AA(AE) unless shown otherwise. Refer to Section 03055.
   1. Provide target slump of at least $6^1/_2$ inch.
   2. Modify as follows when placed under water:
      a. Use at least seven bags of cement per cubic yard.
      b. Use high range water reducers.

2.2 REINFORCING STEEL

A. Vertical bars
   1. Overhead sign/VMS structure foundations
      a. Use coated bars meeting AASHTO M 31, Grade 60. Refer to Section 03211.
   2. Oversized drilled shaft foundations
      a. Use uncoated bars meeting AASHTO M 31, Grade 60. Refer to Section 03211.
   3. Other foundations
      a. Use uncoated bars meeting ASTM A 706, Grade 60. Refer to Section 03211.
         1) Bars meeting AASHTO M 31, Grade 60 may be substituted if they meet the ductility requirements of ASTM A 706.

B. Spiral bars
   1. AASHTO M 31, Grade 60. Refer to Section 03211.
      a. Use coated bars in overhead sign/VMS structure foundations.
      b. Use uncoated bars in other drilled shaft foundations.

2.3 CASINGS

A. Use smooth and clean, non-corrugated steel casings.

B. Provide casing with sufficient strength to withstand handling, driving stresses, and loads from earth and wet concrete.

C. Size the casing to have an inside diameter of at least the diameter of the drilled shaft as shown, but not more than six inches larger.

2.4 EQUIPMENT

A. Use drilling equipment capable of drilling holes to the required diameter, location, alignment, and to a depth of at least 10 ft beyond the depths shown in the type of materials present at the shaft locations.

B. Use equipment capable of installing and removing casing.

C. Use SID capable of providing underwater video inspection to determine cleanliness of bottom of shaft excavation when required. SID must include at least the following:
   1. A camera sealed inside a watertight jacket
   2. A probe to measure the amount of loose or disturbed material at the bottom of the drilled shaft hole
   3. A recording device capable of documenting the SID inspection

D. Use lifting equipment capable of placing the full length of the reinforcing steel cage into the drilled shaft.

E. Use concrete pumping equipment capable of pumping at least 50 yd^3/h against a 20 ft head of concrete measured from the discharge end of the pump hose extension of the tremie pipe when placing concrete underwater.
   1. Use a rigid steel pipe pump hose extension for the tremie pipe with tight couplings straight to within ½ inch in 10 ft.
      a. Length of extension – At least the depth of the shaft.
      b. Inside diameter – Greater than or equal to the concrete pump discharge hose but not more than one half the inside diameter of the reinforcing steel cage.

F. Use core drilling equipment in good condition and capable of delivering a smooth flow of power to the bit, both in rotation and down thrust.
   1. Use a positive displacement type pump, capable of delivering at least 15 gallons of water per minute at 200 psi.
      a. Equip pump with a relief valve set to release at a maximum of 200 psi, and equipped with a pressure gauge ranging from 0 psi to 1,000 psi.

PART 3 EXECUTION

3.1 GENERAL

A. Follow the authorized Drilled Shaft Installation Plan and Containment and Disposal Plan. Follow the authorized Drilled Shaft Integrity Testing Plan when applicable.

B. Begin installation of drilled shafts after embankment is placed and compacted.

C. Form drilled shaft to at least 12 inches below finished ground surface where top of shaft elevation is above finished ground surface.

D. Refer to Section 03310 for forms, form removal, and construction joints.

3.2 DRILLED SHAFT HOLES

A. Excavation
   1. Drill straight, vertical holes to the tip elevations shown or as determined by Engineer.
   2. Do not use slurry or rely on water for drilled shaft hole support during drilling operations.
   3. Do not begin drilling for a shaft located three diameters center to center, or closer, to an adjacent completed shaft until at least 48 hours after placing concrete for the completed shaft.
   4. Do not begin drilling for a shaft located between three and five diameters center to center from an adjacent completed shaft until at least 24 hours after placing concrete for the completed shaft.
   5. Drill hole in a continuous operation without interruption.
      a. Notify the Engineer and protect the drilled shaft hole if the excavation operation is stopped.
         1) Install a safety cover.
         2) Use a temporary casing to protect the safety of the shaft excavation, surrounding soil, adjacent facilities, and stability of the sidewalls.

3) The Engineer will evaluate design impacts to the shaft due to delays in completion.

6. Provide a clean, flat, and level bottom surface.
   a. Remove loose material from the bottom of the drilled shaft holes before placing concrete.
   b. Use an SID when shown.
      1) Remove loose or disturbed material until at least 50 percent of the bottom of each drilled shaft hole has less than ½ inch of loose or disturbed material.
      2) The maximum depth of loose or disturbed material at any location is 1 inch.

C. Casing
   1. Drill or oscillate casing to provide direct contact with the soil throughout its length
   2. Furnish and place temporary casing when necessary to prevent the drilled shaft hole from caving
      a. Full length casings are required where groundwater is present
      b. Have full length casings on site where groundwater is anticipated

D. Spoils
   1. Drilling spoils and their disposal are the responsibility of the Contractor.

3.3 CONSTRUCTION TOLERANCES

A. Plan location
   1. Top of shaft within 3 inch horizontally of plan.

B. Alignment
   1. Not more than 2 percent (1:50) from vertical

C. Reinforcing steel cage
   1. No more than 2 inch above or below the plan elevation.

3.4 REINFORCING STEEL PLACEMENT

A. Verify bottom cleanliness in the presence of the Engineer immediately before placement of the reinforcing steel.
   1. Use an SID when shown.

B. Rigidly brace the reinforcing steel cage with additional reinforcing steel as needed to retain its configuration during handling and installation.
   1. Do not use loose bars.

2. Provide an opening in the center of the cage to allow tremie access.
3. Use centralizers to maintain reinforcing steel cage position in drilled shaft hole.
4. Pick cage in several locations as necessary to maintain cage shape and alignment during placement.

C. Protect integrity testing instrumentation from damage during installation, handling and construction.
   1. Do not allow temporary bracing to free-fall when cut loose.

D. Rigidly brace column reinforcing steel cage projecting above the top of drilled shaft, if applicable.

3.5 MISCELLANEOUS EMBEDDED ELEMENT PLACEMENT

A. Securely position anchor bolts, anchor bolt templates, and conduit, if applicable.

3.6 CONCRETE PLACEMENT

A Dry Hole Placement
   1. Place concrete immediately after placing the reinforcing steel cage.
      a. Begin concrete placement within 16 hours of completion of drilling the shaft hole.
      b. Place concrete in a continuous operation.
   2. Use a tremie or spout to prevent concrete from striking the steel reinforcing cage.
      a. Do not allow the free-fall of concrete to exceed 5 ft.
   3. Vibrate the concrete within at least 10 ft from top of shaft.
   4. Remove contaminated concrete from the top of the shaft.
      a. Remove and dispose of muck, laitance, and contaminated concrete.

B. Water In Hole Placement
   1. Place concrete immediately after placing the reinforcing steel cage.
      a. Begin concrete placement within 16 hours of completion of drilling the shaft hole.
      b. Place concrete in a continuous operation.
   2. Use a tremie to place concrete
      a. Purge the tremie pipe of water.
         1) Insert a sturdy plastic ball or equivalent into the top of the pump hose extension before connecting the hose from the concrete pump.

2) The ball must fit snugly into the pump hose extension when the hose is filled. The hose must be strong enough to resist rupture.
3) Prime the hose and pipe with cement slurry.

3. Lower a small diameter pole with an attached flat plate into the hole to determine the top surface of concrete.
   a. Mark both pole and tremie pipe so that the length of penetration can be immediately determined.
   b. Prevent the end of the tremie pipe from becoming plugged with soil from the bottom of the hole.
4. Begin pumping the concrete immediately after setting the reinforcing cage and lowering tremie pipe in the hole.
   a. Do not begin raising the tremie pipe until the concrete surface is 10 ft above the bottom of the pipe.
5. Keep the bottom of the tremie pipe at least 5 ft below the top of the concrete until the placement is complete.
   a. Provide a positive hold down to maintain distance below top of concrete if the pipe floats.
6. Remove casing as the concrete is placed.
   a. Keep the bottom of the casing between 5 ft and 8 ft below the top of the concrete surface when withdrawing.
   b. Prevent concrete separation when withdrawing the casing.
7. Do the following if the tremie pipe plugs, equipment breaks down or loss of the seal at the end of the pipe occurs:
   a. Pull the tremie pipe, reset it 2 ft below the top of the concrete, and purge it.
   b. Lower the tremie pipe to at least 5 ft below the top of the placement and continue pumping concrete until all contaminated concrete has lifted to the top of the shaft.
8. Continue pumping concrete until the water and contaminated concrete is expelled.
   a. Remove and dispose of muck, laitance, and contaminated concrete.

C. Finishing
1. Remove scum, laitance, loose gravel, and sediment from the surface of the shaft concrete before placing fresh concrete against the existing concrete.
   a. Do not place fresh concrete above the top of shaft before authorization of integrity test report.
2. Level high spots from the surface of the shaft concrete that would make placement of steel reinforcing as shown more difficult.
3. Cure exposed concrete according to section 03390.

3.7 INTEGRITY TESTING

A. Perform integrity testing on drilled shafts as shown.

B. Crosshole Sonic Logging
   1. General Requirements
      a. Meet the requirements of ASTM D 6760.
      b. Conduct CSL testing no sooner than 72 hours after concrete placement and as recommended by the CSL testing organization.
         1) The Engineer may require a longer time if special retarders, mix designs, or other factors result in slower-setting concrete.
      c. Notify the Engineer of substandard concrete integrity or inconclusive results immediately
   2. CSL Pipe Preparation
      a. Use Schedule 40 steel pipes with an inside diameter of 1½ inch to 2 inch that are compatible with the equipment and methods of the CSL testing organization.
         1) Do not use galvanized steel.
         2) Provide pipes with a round, regular internal diameter free of defects or obstructions.
         3) Provide pipes that are watertight and free from corrosion with clean internal and external faces.
         4) Use threaded pipe joints with watertight couplings for pipe extensions.
            a) Do not wrap joints with tape or other compounds.
         5) Fit pipes with a watertight shoe on the bottom and a removable cap on the top.
      b. Space CSL pipes equally around the inside of the reinforcing steel cage:
         1) Shafts with diameters up to 48 inch
            a) Install four pipes
         2) Shafts with diameters greater than 48 inch
            a) Install one pipe for each foot of diameter rounding up
         3) Position pipes parallel to each other and at least 2 inch clear to longitudinal reinforcing.
      c. Attach the pipes securely to the interior of the reinforcement cage.
         1) Wire-tie to the reinforcing steel cage at least every 3 ft, or as required for the pipes to stay in position during placement of reinforcing cage and concrete.

d. Extend the pipes from 6 inch above the bottom of shaft to at least 3 ft above the top of shaft, or if the shaft top is subsurface, at least 3 ft above the ground or water surface.
    1) Do not allow the pipes to rest on the bottom of the drilled shaft hole.
e. Fill the pipes with clean, potable water as soon as possible after placement of the reinforcing steel (no later than four hours after placement) and cap or seal the pipe tops to keep out debris.
    1) Use an ethylene glycol mixture instead of water if shaft construction occurs during winter months and the air temperature near the exposed pipe ends is expected to drop below 30 degrees between the time of concrete placement and the authorization of the integrity test report.
    2) Avoid excessive torque, hammering, or other stresses which could break the bond between the tubes and the concrete when removing caps or plugs from the pipes after concrete placement.

3. Sealing the pipes
    a. Dewater and grout the CSL pipes after the integrity test report has been authorized, required repair of defects has been completed, and the shaft has been repaired to the Engineer's satisfaction.
        1) Post-repair CSL testing may be required to indicate the quality of the repair.
    b. Fill the dewatered CSL pipes with non-shrink grout according to ASTM C 1107.

C. Thermal Integrity Profiling
1. General Requirements
    a. Meet the requirements of ASTM D 7949, Method B: Embedded Thermal Sensors.
    b. Conduct TIP testing near the time of peak temperature in the concrete, usually between 12 hours and 4 calendar days after concrete placement, and as recommended by the TIP testing organization.
    c. Notify the Engineer of substandard concrete integrity or inconclusive results immediately
2. Embedded Thermal Sensors
    a. Space thermal wire cables equally around the inside of the reinforcing steel cage and parallel to the longitudinal reinforcing steel.
        1) Shafts with diameters up to 48 inch
            a) Install four cables

2) Shafts with diameters greater than 48 inch
   a) Install one cable for each foot of diameter rounding up
   b) An additional cable may be added to establish an even number of cables to simplify interpretation of results
3) Extend cables to 6 inch from the bottom of shaft.
4) Place cables at least 2 inch away from longitudinal reinforcing steel.
5) Arrange sensors in a straight line with each sensor spaced at 20 inch or less and at approximately the same elevation as sensors along other thermal sensor wire cables.

b. Provide a #4 guide bar for each thermal sensor wire cable.
   1) Guide bars are in addition to the reinforcing steel shown.
   2) Attach the cables to the guide bar using nylon zip-ties at 1½ to 2 inch above and below each sensor.
      a) Do not leave unsecured cable which can be snagged and damaged by the tremie or flowing concrete.

c. Verify each thermal sensor is functioning after placement of reinforcing steel cage and before concrete placement.

d. Connect each thermal sensor wire cable to a recording apparatus shortly after concrete placement.
   1) Document which cable is connected to which recording apparatus.
   2) Attach the recording apparatus to a secure location well above the top of the concrete.

3.8 CORE DRILLING OF DRILLED SHAFT CONCRETE

A. Take core samples from each defective shaft to the extent necessary to fully identify the anomaly and determine a course of action when directed by the Engineer.

B. Use a new diamond set bit having at least four waterways for each hole.
   1. Use a drill bit size HW or larger.

C. Use core barrel size HW or larger, M series, double-tubed, with a chromed inner barrel.
   1. Replace the bit or core barrel at any time inspection indicates excessive wear or loss of diamonds.

D. Set the core drill machine so that the drill force will be vertical and so that there will not be more than 5 ft of laterally unsupported drill rod between the bottom of the drill spindle (chuck) and the top of the shaft concrete when the hydraulic feed is in the up position.
   1. Use braced casing or rigidly braced guides to prevent lateral whip when longer laterally unsupported sections of the drill stem are necessary.

E. Keep an accurate coring log.
   1. Place the cores in a suitable wooden crate marked showing the shaft depth at each interval of core recovery.
   2. Provide the cores and two copies of the coring log of inspection and testing.

F. Grout the core hole in the shaft when quality of the concrete in the shaft, as represented by the core samples, is determined to be sound, and notification to continue construction is given by the Engineer
   1. Use non-shrink grout according to ASTM C 1107
   2. Completely grout the core hole without voids.

END OF SECTION

November 20, 2019

SPECIAL PROVISION

CONTRACT: 18-2399TP
PROJECT: LEH_OP_1

SECTION 02745M

ASPHALT MATERIAL

Delete Tables 1-9 and replace with the following:

Specification, Compliance, and Rejection Limits for Performance-Graded Asphalt Binders (Applied to the Mix)			
Property	**Specification Limit**	**Compliance Limit**	**Rejection Limit**
G*/sinδ of the original PGAB at high grade temp, (kPa) Rule of 86 or lower	1.00 Min.	0.84 Min.	0.70 Min.
G* of the original PGAB at high grade temp, (kPa)	1.30 Min.	1.25 Min.	1.11 Min.
δ (phase angle) of the original PGAB at high grade temperature, (degrees C). Rule of 92 Binders Rule of 98 Binders	 74.0 Max. 71.0 Max.	 75.0 Max. 72.0 Max.	 77.0 Max. 74.0 Max.
G*/sinδ of the RTFO Residue, (kPa)	2.20 Min.	1.87 Min.	1.53 Min.
Elastic Recovery of RTFO Residue, (%) Rule of 92 Binders Rule of 98 Binders Rule of 104 Binders	 80 Min. 85 Min. 90 Min.	 75 Min. 80 Min. 85 Min.	 65 Min. 70 Min. 75 Min.
G*/sinδ of the PAV Residue, (kPa)	5000 Max.	5250 Max.	5700 Max.
Stiffness of the PAV Residue at the specified low grade temperature +10ºC, (MPa)	300 Max.	311 Max.	355 Max.
	150 Min.	145 Min.	125 Min.
Slope (m-value) of the Creep Curve at the specified low grade temperature +10ºC	0.300 Min.	0.295 Min.	0.266 Min.
Failure Strain of PAV Residue in Direct Tension at the specified low grade temperature +10ºC, (%) Rule of 92, 98, or 104 Binders	Report		
Failure Stress of PAV Residue in Direct Tension at the specified low grade temperature +10ºC, (MPa) Rule of 92, 98, or 104 Binders	Report		
Delta Tc of PAV Residue from additional BBR test (use two BBR tests). Rule of 92, 98, or 104 Binders	-1.0 Min.	-2.0 Min.	-3.0 Min.

Table 2

PG58-34		
Original Binder		
Dynamic Shear Rheometer, AASHTO T-315	@ 58° C, G*, kPa	1.30 Min.
	@ 58° C, phase angle, degrees	74.0 Max.
Rotational Viscometer, AASHTO T 316	@ 135° C, Pa.s	3 Max.
Flash Point, AASHTO T 48	°C	260 Min.
RTFO Residue, AASHTO T 240		
Dynamic Shear Rheometer, AASHTO T 315	@ 58° C, G*/sinδ, kPa	2.20 Min.
Elastic Recovery, AASHTO T 301 mod (a)	%	80 Min.
PAV Residue, 20 hours, 2.10 MPa, 100° C, AASHTO R 28		
Dynamic Shear Rheometer, AASHTO T 315	@ 16° C, kPa	5,000 Max.
Bending Beam Rheometer, AASHTO T 313	@ -24° C, S, MPa	300 Max. 150 Min.
	@ -24° C, m-value	0.300 Min.
Direct Tension Test, AASHTO T 314	@ -24° C, Failure Strain, %	(c)
	@ -24° C, Failure Stress (b), MPa	(c)
Delta Tc from additional BBR test, ASTM D7643	@ -30° C	-1.0 Min.

(a) Modify paragraph 4.5 as follows: Stop the ductilometer after 20 cm has been reached and within 2 seconds. Sever the specimen at its center with a pair of scissors.

(b) No allowances will be given for passing at a colder grade.

(c) Report test results for DTT with acceptance testing, DTT not required for qc testing

Table 3

PG64-28		
Original Binder		
Dynamic Shear Rheometer, AASHTO T-315	@ 64° C, G*, kPa	1.30 Min.
	@ 64° C, phase angle, degrees	74.0 Max.
Rotational Viscometer, AASHTO T 316	@ 135° C, Pa.s	3 Max.
Flash Point, AASHTO T 48	°C	260 Min.
RTFO Residue, AASHTO T 240		
Dynamic Shear Rheometer, AASHTO T 315	@ 64° C, G*/sinδ, kPa	2.20 Min.
Elastic Recovery, AASHTO T 301 mod (a)	%	80 Min.
PAV Residue, 20 hours, 2.10 MPa, 100° C, AASHTO R 28		
Dynamic Shear Rheometer, AASHTO T 315	@ 22° C, kPa	5,000 Max.
Bending Beam Rheometer, AASHTO T 313	@ -18° C, S, MPa	300 Max. 150 Min.
	@ -18° C, m-value	0.300 Min.
Direct Tension Test, AASHTO T 314	@ -18° C, Failure Strain, %	(c)
	@ -18° C, Failure Stress (b), MPa	(c)
Delta Tc from additional BBR test, ASTM D7643	@ -24° C	-1.0 Min.

(a) Modify paragraph 4.5 as follows: Stop the ductilometer after 20 cm has been reached and within 2 seconds. Sever the specimen at its center with a pair of scissors.

(b) No allowances will be given for passing at a colder grade.

(c) Report test results for DTT with acceptance testing, DTT not required for qc testing

Table 4

PG64-34		
Original Binder		
Dynamic Shear Rheometer, AASHTO T-315	@ 64° C, G*, kPa	1.30 Min.
	@ 64° C, phase angle, degrees	71.0 Max.
Rotational Viscometer, AASHTO T 316	@ 135° C, Pa.s	3 Max.
Flash Point, AASHTO T 48	°C	260 Min.
RTFO Residue, AASHTO T 240		
Dynamic Shear Rheometer, AASHTO T 315	@ 64° C, G*/sinδ, kPa	2.20 Min.
Elastic Recovery, AASHTO T 301 mod (a)	%	85 Min.
PAV Residue, 20 hours, 2.10 MPa, 100° C, AASHTO R 28		
Dynamic Shear Rheometer, AASHTO T 315	@ 19° C, kPa	5,000 Max.
Bending Beam Rheometer, AASHTO T 313	@ -24° C, S, MPa	300 Max. 150 Min.
	@ -24° C, m-value	0.300 Min.
Direct Tension Test, AASHTO T 314	@ -24° C, Failure Strain, %	(c)
	@ -24° C, Failure Stress (b), MPa	(c)
Delta Tc from additional BBR test, ASTM D7643	@ -30° C	-1.0 Min.

(a) Modify paragraph 4.5 as follows: Stop the ductilometer after 20 cm has been reached and within 2 seconds. Sever the specimen at its center with a pair of scissors.

(b) No allowances will be given for passing at a colder grade.

(c) Report test results for DTT with acceptance testing, DTT not required for qc testing

Table 5

PG70-22		
Original Binder		
Dynamic Shear Rheometer, AASHTO T-315	@ 70° C, G*, kPa	1.30 Min.
	@ 70° C, phase angle, degrees	74.0 Max.
Rotational Viscometer, AASHTO T 316	@ 135° C, Pa.s	3 Max.
Flash Point, AASHTO T 48	°C	260 Min.
RTFO Residue, AASHTO T 240		
Dynamic Shear Rheometer, AASHTO T 315	@ 70° C, G*/sinδ, kPa	2.20 Min.
Elastic Recovery, AASHTO T 301 mod (a)	%	80 Min.
PAV Residue, 20 hours, 2.10 MPa, 100° C, AASHTO R 28		
Dynamic Shear Rheometer, AASHTO T 315	@ 28° C, kPa	5,000 Max.
Bending Beam Rheometer, AASHTO T 313	@ -12° C, S, MPa	300 Max. 150 Min.
	@ -12° C, m-value	0.300 Min.
Direct Tension Test, AASHTO T 314	@ -12° C, Failure Strain, %	(c)
	@ -12° C, Failure Stress (b), MPa	(c)
Delta Tc from additional BBR test, ASTM D7643	@ -18° C	-1.0 Min.

(a) Modify paragraph 4.5 as follows: Stop the ductilometer after 20 cm has been reached and within 2 seconds. Sever the specimen at its center with a pair of scissors.

(b) No allowances will be given for passing at a colder grade.

(c) Report test results for DTT with acceptance testing, DTT not required for qc testing

Table 6

PG70-28		
Original Binder		
Dynamic Shear Rheometer, AASHTO T-315	@ 70° C, G*, kPa	1.30 Min.
	@ 70° C, phase angle, degrees	71.0 Max.
Rotational Viscometer, AASHTO T 316	@ 135° C, Pa.s	3 Max.
Flash Point, AASHTO T 48	°C	260 Min.
RTFO Residue, AASHTO T 240		
Dynamic Shear Rheometer, AASHTO T 315	@ 70° C, G*/sinδ, kPa	2.20 Min.
Elastic Recovery, AASHTO T 301 mod (a)	%	85 Min.
PAV Residue, 20 hours, 2.10 MPa, 100° C, AASHTO R 28		
Dynamic Shear Rheometer, AASHTO T 315	@ 25° C, kPa	5,000 Max.
Bending Beam Rheometer, AASHTO T 313	@ -18° C, S, MPa	300 Max. 150 Min.
	@ -18° C, m-value	0.300 Min.
Direct Tension Test, AASHTO T 314	@ -18° C, Failure Strain, %	(c)
	@ -18° C, Failure Stress (b), MPa	(c)
Delta Tc from additional BBR test, ASTM D7643	@ -24° C	-1.0 Min.

(a) Modify paragraph 4.5 as follows: Stop the ductilometer after 20 cm has been reached and within 2 seconds. Sever the specimen at its center with a pair of scissors.

(b) No allowances will be given for passing at a colder grade.

(c) Report test results for DTT with acceptance testing, DTT not required for qc testing

Table 7

PG70-34		
Original Binder		
Dynamic Shear Rheometer, AASHTO T-315	@ 70° C, G*, kPa	1.30 Min.
	@ 70° C, phase angle, degrees	71.0 Max.
Rotational Viscometer, AASHTO T 316	@ 135° C, Pa.s	3 Max.
Flash Point, AASHTO T 48	°C	260 Min.
RTFO Residue, AASHTO T 240		
Dynamic Shear Rheometer, AASHTO T 315	@ 70° C, G*/sinδ, kPa	2.20 Min.
Elastic Recovery, AASHTO T 301 mod (a)	%	90 Min.
PAV Residue, 20 hours, 2.10 MPa, 100° C, AASHTO R 28		
Dynamic Shear Rheometer, AASHTO T 315	@ 22° C, kPa	5,000 Max.
Bending Beam Rheometer, AASHTO T 313	@ -24° C, S, MPa	300 Max. 150 Min.
	@ -24° C, m-value	0.300 Min.
Direct Tension Test, AASHTO T 314	@ -24° C, Failure Strain, %	(c)
	@ -24° C, Failure Stress (b), MPa	(c)
Delta Tc from additional BBR test, ASTM D7643	@ -30° C	-1.0 Min.

(a) Modify paragraph 4.5 as follows: Stop the ductilometer after 20 cm has been reached and within 2 seconds. Sever the specimen at its center with a pair of scissors.

(b) No allowances will be given for passing at a colder grade.

(c) Report test results for DTT with acceptance testing, DTT not required for qc testing

Table 8

PG76-22		
Original Binder		
Dynamic Shear Rheometer, AASHTO T-315	@ 76° C, G*, kPa	1.30 Min.
	@ 76° C, phase angle, degrees	71.0 Max.
Rotational Viscometer, AASHTO T 316	@ 135° C, Pa.s	3 Max.
Flash Point, AASHTO T 48	°C	260 Min.
RTFO Residue, AASHTO T 240		
Dynamic Shear Rheometer, AASHTO T 315	@ 76° C, G*/sinδ, kPa	2.20 Min.
Elastic Recovery, AASHTO T 301 mod (a)	%	85 Min.
PAV Residue, 20 hours, 2.10 MPa, 100° C, AASHTO R 28		
Dynamic Shear Rheometer, AASHTO T 315	@ 31° C, kPa	5,000 Max.
Bending Beam Rheometer, AASHTO T 313	@ -12° C, S, MPa	300 Max. 150 Min.
	@ -12° C, m-value	0.300 Min.
Direct Tension Test, AASHTO T 314	@ -12° C, Failure Strain, %	(c)
	@ -12° C, Failure Stress (b), MPa	(c)
Delta Tc from additional BBR test, ASTM D7643	@ -18° C	-1.0 Min.

(a) Modify paragraph 4.5 as follows: Stop the ductilometer after 20 cm has been reached and within 2 seconds. Sever the specimen at its center with a pair of scissors.

(b) No allowances will be given for passing at a colder grade.

(c) Report test results for DTT with acceptance testing, DTT not required for qc testing

Table 9

PG76-28		
Original Binder		
Dynamic Shear Rheometer, AASHTO T-315	@ 76° C, G*, kPa	1.30 Min.
	@ 76° C, phase angle, degrees	71.0 Max.
Rotational Viscometer, AASHTO T 316	@ 135° C, Pa.s	3 Max.
Flash Point, AASHTO T 48	°C	260 Min.
RTFO Residue, AASHTO T 240		
Dynamic Shear Rheometer, AASHTO T 315	@ 76° C, G*/sinδ, kPa	2.20 Min.
Elastic Recovery, AASHTO T 301 mod (a)	%	90 Min.
PAV Residue, 20 hours, 2.10 MPa, 100° C, AASHTO R 28		
Dynamic Shear Rheometer, AASHTO T 315	@ 28° C, kPa	5,000 Max.
Bending Beam Rheometer, AASHTO T 313	@ -18° C, S, MPa	300 Max. 150 Min.
	@ -18° C, m-value	0.300 Min.
Direct Tension Test, AASHTO T 314	@ -18° C, Failure Strain, %	(c)
	@ -18° C, Failure Stress (b), MPa	(c)
Delta Tc from additional BBR test, ASTM D7643	@ -24° C	-1.0 Min.

(a) Modify paragraph 4.5 as follows: Stop the ductilometer after 20 cm has been reached and within 2 seconds. Sever the specimen at its center with a pair of scissors.

(b) No allowances will be given for passing at a colder grade.

(c) Report test results for DTT with acceptance testing, DTT not required for qc testing

February 20, 2020

SPECIAL PROVISION

CONTRACT: 18-2399TP
PROJECT: LEH_OP_1

SECTION 02831S

MSE RETAINING WALLS – GENERAL REQUIREMENTS

Add Section 02831.

PART 1 GENERAL

1.1 SECTION INCLUDES

A. General requirements for mechanically stabilized earth (MSE) retaining walls of the following types:
   1. Concrete panel MSE retaining walls using metal or geogrid soil reinforcing elements.

1.2 RELATED SECTIONS

A. Section 02832: MSE Backfill

B. Section 02833: Concrete Panel MSE Retaining Wall

1.3 REFERENCES

A. AASHTO M 111: Zinc (Hot-dip Galvanized) Coatings on Iron and Steel Products

B. AASHTO LRFD Bridge Design Specifications

C. UDOT Geotechnical Manual of Instruction (GMOI)

1.4 DEFINITIONS Not Used

1.5 SUBMITTALS

A. Contractor-selected retaining wall system for information before the preconstruction conference.
   1. Refer to this Section, Article 2.1.

2. Include the Wall Company's construction manual for the selected wall system.

B. Samples for verification.
   1. Concrete Panel MSE Retaining Walls
      a. Panel surface texture and color before casting of the panels.

C. Working Drawings
   1. Retaining wall drawings for review.
      a. Include the following:
         1) Plans, profiles, cross sections, quantities, and details for each retaining wall.
         2) Cast-in-place concrete coping/cap to the facing panels/blocks.
            a) Aesthetically pleasing
            b) Adequately supports fence or barrier or both as shown.
            c) Do not use precast coping without the Engineer's prior approval.
         3) Measures for protecting metal soil reinforcement and metal reinforcement connections from corrosion.
         4) Provisions for facilities which penetrate the wall face or soil reinforcing elements, such as drainage catch basins, piping, foundation elements, guard-rail posts, and other buried facilities.
         4) Surface and subsurface drainage details.
         5) Architectural treatment details for wall facing elements and concrete color as shown.
         6) Structure number details
      b. Include supporting calculations sufficient to demonstrate that the retaining walls are designed according to the required criteria.
         1) Provide MSE retaining wall system that can resist pedestrian railing loading as defined by AASHTO LRFD Bridge Design Specifications (i.e. Sections 13.8 and 13.9).
         2) Specifically, design walls components for the pedestrian loading that is applied to the fence and show how those loads are resisted by the fence to coping connection and the coping to precast panel connection.
      c. Provide the seal of a Professional Engineer (PE) or Professional Structural Engineer (SE) licensed in the State of Utah on the drawings and calculations.

D. Casting and Shipping Schedules

1. A tentative casting schedule for information at least 14 calendar days in advance to make inspection and testing arrangements.
2. A tentative shipping schedule for information at least 14 calendar days before shipping precast elements to the job site.

E. Certificate of compliance for incorporated materials with copies of results of any tests performed.

F. Test results for source material of MSE Backfill for review. Include the following:
1. Organic content
2. Sodium sulfate soundness
3. Gradation
4. Plasticity Index
5. Internal friction angle
6. Electrochemical properties

G. Request to use MSE backfill meeting the metal reinforcement gradation in a wall that uses geogrid reinforcement for review, when applicable.
1. Include test results and calculations for determining the installation damage reduction factor.
2. Refer to Section 02832.

H. Final Field Observations Report from the Wall Company that certifies that the completed wall(s) meet(s) Department and Wall Company requirements.

1.6 ACCEPTANCE

A. Non-Conformance of MSE Backfill
1. MSE backfill placed and found to be out of conformance with the electrochemical property requirements in Section 02832 may be allowed to remain in place at a reduced price according to this article as determined by the Engineer.
2. Evaluate the MSE backfill to determine whether the wall system meets the required design life when deviations exceed those listed for a pay factor of 0.50 in Table 1.
    a. The wall may be accepted with a pay factor less than 0.50 if the Wall Company and the Engineer determine that the wall system meets the required design life.

B. Wall facing measurements for acceptance will be at Substantial Completion of the Project.

C. Non-Conformance for Out-of-Tolerance Wall Facing Elements

1. Wall facing elements that do not conform to the specified tolerances may be allowed to remain in place at a reduced price provided structural adequacy can be demonstrated.
2. The Wall Company and the Engineer will evaluate wall facing element cases when deviations exceed those listed for a pay factor of 0.50 in Table 2 to determine whether the wall system has sufficient structural integrity and is aesthetically acceptable.
    a. The wall may be accepted at a pay factor less than 0.50 if the Wall Company and the Engineer determine that the wall system has sufficient structural integrity and is aesthetically acceptable.

D. Price adjustment calculation.
1. The lowest applicable pay factor from Table 1 or Table 2 will be applied to the entire wall.
    a. The Engineer will apply only the lowest pay factor due to non-conforming backfill (resistivity, pH, chlorides, or sulfates) or out-of-tolerance MSE wall facing elements (horizontal alignment, vertical alignment, plumbness, levelness, joint width, or joint offset).
    b. The Engineer may determine the controlling deviation by visual inspection.
2. The Engineer will use the price in the Contractor's bid schedule and the lowest applicable pay factor from Table 1 or Table 2 to calculate the price adjustment.

Table 1

Pay Factors For Non-Conforming MSE Backfill						
Electro-chemical Property	**Pay Factor**	**Deviations of MSE Backfill Electrochemical Test Results from the Limits Specified in Section 02832***				
		1 Test	**Avg. of 2 Tests**	**Avg. of 3 Tests**	**Avg. of 4 Tests**	**Avg. of 5 or More Tests**
Resistivity (ohm-cm)	1.00	0 to 200	0 to 190	0 to 180	0 to 170	0 to 150
	0.95	201 to 400	191 to 380	181 to 360	171 to 340	151 to 300
	0.90	401 to 600	381 to 570	361 to 540	341 to 510	301 to 450
	0.80	601 to 800	571 to 760	541 to 720	511 to 680	451 to 600
	0.70	801 to 1000	761 to 950	721 to 900	681 to 850	601 to 750
	0.60	1001 to 1200	951 to 1140	901 to 1080	851 to 1020	751 to 900
	0.50[a]	over 1200	over 1140	over 1080	over 1020	over 900
	[a] No one test below 1600 ohm-cm will be accepted.					
pH	1.00	0 to 0.20	0 to 0.18	0 to 0.16	0 to 0.14	0 to 0.12
	0.90	0.21 to 0.40	0.19 to 0.36	0.17 to 0.32	0.15 to 0.28	0.13 to 0.24
	0.80	0.41 to 0.60	0.37 to 0.54	0.33 to 0.48	0.29 to 0.42	0.25 to 0.36
	0.70	0.61 to 0.80	0.55 to 0.72	0.49 to 0.64	0.43 to 0.56	0.37 to 0.48
	0.60	0.81 to 1.00	0.73 to 0.90	0.65 to 0.80	0.57 to 0.70	0.49 to 0.60
	0.50[b]	---	over 0.90	over 0.80	over 0.70	over 0.60
	[b] No one test below 5.0 or above 10.0 will be accepted					
Chlorides (ppm)	1.00	0 to 14	0 to 12	0 to 10	0 to 8	0 to 6
	0.95	15 to 28	13 to 24	11 to 20	9 to 16	7 to 12
	0.90	29 to 42	25 to 36	21 to 30	17 to 24	13 to 18
	0.80	43 to 56	37 to 48	31 to 40	25 to 32	19 to 24
	0.70	57 to 70	49 to 60	41 to 50	33 to 40	25 to 30
	0.60	71 to 84	61 to 72	51 to 60	41 to 48	31 to 36
	0.50[c]	over 84	over 72	over 60	over 48	over 36
	[c] No one test above 200 ppm will be accepted.					
Sulfates (ppm)	1.00	0 to 50	0 to 45	0 to 40	0 to 35	0 to 30
	0.95	51 to 90	46 to 80	41 to 70	36 to 60	31 to 50
	0.90	91 to 130	81 to 115	71 to 100	61 to 85	51 to 70
	0.80	131 to 170	116 to 150	101 to 130	86 to 110	71 to 90
	0.70	171 to 210	151 to 185	131 to 160	111 to 135	91 to 110
	0.60	211 to 250	186 to 220	161 to 190	136 to 160	111 to 130
	0.50[d]	over 250	over 220	over 190	over 160	over 130
	[d] No one test above 500 ppm will be accepted.					

* Refer to Section 02832 for electrochemical property requirements and minimum sampling and testing frequency. The Engineer determines locations and additional tests required to evaluate the overall MSE backfill mass.

Table 2

Pay Factors For Out-Of-Tolerance MSE Wall Facing Elements*						
Measurement Type	**Pay Factor**	**Wall Facing Measurements**				
		1 to 5%**	**6 to 10%****	**11 to 20%****	**21 to 30%****	**30% or more****
Applicable to All MSE Wall Types (Concrete Panel, Modular Block, and Wire Face)						
Horizontal Alignment (percent) Spec: 0.7%	1.00	Up to 1.10	Up to 1.05	Up to 1.00	Up to 0/95	Up to 0.90
	0.90	over 1.10	over 1.05	over 1.00	over 0.95	over 0.90
	0.80	over 1.50	over 1.40	over 1.30	over 1.20	over 1.10
	0.70	over 1.90	over 1.75	over 1.60	over 1.45	over 1.30
	0.60	over 2.30	over 2.10	over 1.90	over 1.70	over 1.50
	0.50	over 2.80	over 2.50	over 2.30	over 2.00	over 1.80
Vertical Alignment* (percent)** Spec: 0.7%	1.00	up to 1.10	up to 1.05	up to 1.00	up to 0.95	up to 0.90
	0.90	over 1.10	over 1.05	over 1.00	over 0.95	over 0.90
	0.80	over 1.50	over 1.40	over 1.30	over 1.20	over 1.10
	0.70	over 1.90	over 1.75	over 1.60	over 1.45	over 1.30
	0.60	over 2.30	over 2.10	over 1.90	over 1.70	over 1.50
	0.50	over 2.80	over 2.50	over 2.30	over 2.00	over 1.80
Levelness (percent) Spec: 0.5%	1.00	up to 0.85	up to 0.80	up to 0.76	up to 0.73	up to 0.70
	0.90	over 0.85	over 0.80	over 0.76	over 0.73	over 0.70
	0.80	over 1.25	over 1.15	over 1.06	over 0.98	over 0.90
	0.70	over 1.65	over 1.50	over 1.36	over 1.23	over 1.10
	0.60	over 2.05	over 1.85	over 1.66	over 1.48	over 1.30
	0.50	over 2.60	over 2.30	over 2.10	over 1.80	over 1.60

Table 2 (continued)

Pay Factors For Out-Of-Tolerance MSE Wall Facing Elements*						
Measurement Type	**Pay Factor**	**Wall Facing Measurements**				
		1 to 5%**	**6 to 10%****	**11 to 20%****	**21 to 30%****	**30% or more****
Applicable to Concrete Panel MSE Retaining Walls Only						
Plumbness (percent) Spec: Positive: 0.7% Negative: -0.3%	0.50	up to 2.20	up to 2.00	up to 1.80	up to 1.60	up to 1.50
	0.60	over 1.90	over 1.70	over 1.50	over 1.40	over 1.20
	0.70	over 1.57	over 1.42	over 1.30	over 1.18	over 1.06
	0.80	over 1.32	over 1.21	over 1.12	over 1.03	over 0.94
	0.90	over 1.07	over 1.00	over 0.94	over 0.88	over 0.82
	0.95	over 0.82	over 0.79	over 0.76	over 0.73	over 0.70
	1.00	0.82 to -0.42	0.79 to -0.39	0.76 to -0.36	0.73 to -0.33	0.70 to -0.30
	0.95	over -0.57	over -0.52	over -0.47	over -0.43	over -0.39
	0.90	over -0.72	over -0.65	over -0.58	over -0.53	over -0.48
	0.80	over -0.87	over -0.78	over -0.69	over -0.63	over -0.57
	0.70	over -1.02	over -0.91	over -0.80	over -0.73	over -0.66
	0.60	over -1.20	over -1.20	over -1.00	over -0.90	over -0.80
	0.50	up to -1.50	up to -1.35	up to -1.20	up to -1.10	up to -1.00
Joint Width (inches) Spec: 0.5 to 1.2	0.80	under 0.02	under 0.08	under 0.14	under 0.20	under 0.26
	0.90	under 0.22	under 0.26	under 0.30	under 0.34	under 0.38
	0.95	under 0.42	under 0.44	under 0.46	under 0.48	under 0.5
	1.00	0.42 to 1.28	0.44 to 1.26	0.46 to 1.24	0.48 to 1.22	0.50 to 1.20
	0.95	over 1.28	over 1.26	over 1.24	over 1.22	over 1.20
	0.90	over 1.48	over 1.44	over 1.40	over 1.36	over 1.32
	0.80	over 1.68	over 1.62	over 1.56	over 1.50	over 1.44
	0.70	over 1.88	over 1.80	over 1.72	over 1.64	over 1.56
	0.60	over 2.08	over 1.98	over 1.88	over 1.78	over 1.68
	0.50	over 2.30	over 2.20	over 2.10	over 2.00	over 1.90
Joint Offset (inches) Spec: 0.4	1.00	up to 0.48	up to 0.46	up to 0.44	up to 0.42	up to 0.40
	0.90	over 0.48	over 0.46	over 0.44	over 0.42	over 0.40
	0.80	over 0.76	over 0.70	over 0.64	over 0.58	over 0.52
	0.70	over 1.04	over 0.94	over 0.84	over 0.74	over 0.64
	0.60	over 1.32	over 1.18	over 1.04	over 0.90	over 0.76
	0.50	over 1.70	over 1.50	over 1.30	over 1.10	over 0.90

* The applicable pay factor for any one tolerance is the lowest pay factor value from the five percentage ranges of out-of-tolerance wall measurements. Tolerances are according to Sections 02833.

** Wall percentage corresponding to out-of-tolerance measurements. Wall percentage is based on either face area, lineal footage, or number of joints, as applicable.

1.7 WALL COMPANY'S TECHNICAL REPRESENTATIVE

A. Provide a qualified representative from the selected Wall Company. The Wall Company's technical representative must:
   1. Have at least five years of experience with MSE wall design and construction.
   2. Provide technical support and training to the Contractor's wall construction crew(s) and the Department's inspectors regarding proper quality control for construction of the walls.
      a. The Wall Company's technical representative trains new crew member(s) if one or more construction crew members change.
   3. Be directly involved and provide technical assistance during all phases of wall construction.
   4. Be present during wall construction for at least the first five working days of wall construction and until all aspects of wall construction have been satisfactorily demonstrated to the Wall Company's technical representative and the Engineer.
      a. The Wall Company's technical representative is to subsequently visit the site at least once every 10,000 sq ft of wall face construction, or as otherwise determined by the Engineer.
      b. The Wall Company's technical representative is to be at the project site for at least the first five working days of both the first and second stage of wall construction for two-stage wall systems.
   5. Meet with the Engineer near the conclusion of each site visit to report on the observed wall construction procedures and provide a copy of the field report.

PART 2 PRODUCTS

2.1 MSE RETAINING WALL TYPES

A. Use a Department approved retaining wall system of the retaining wall type shown.
   1. A list of approved retaining wall systems is maintained by the Department.
      a. Refer to Department's website for Department approved retaining wall systems. Refer to https://www.udot.utah.gov/main/uconowner.gf?n=36182607030006780

2. Provide a complete retaining wall system from the Wall Company.
    a. Obtain wall system components from the Wall Company or the Wall Company's authorized supplier.
3. Wall system and system components must meet the Wall Company's published requirements.

B. Concrete Panel MSE Retaining Wall
1. Refer to Section 02833.

C. Use only one retaining wall system for each wall type shown.
1. Do not change the wall system after the preconstruction conference without the Engineer's approval.

2.2 DESIGN REQUIREMENTS

A. Design retaining walls according to the UDOT GMOI and the AASHTO LRFD Bridge Design Specifications, as modified by the following:
1. Provide seismic design according to the UDOT GMOI.
2. Design retaining wall panel and block connections in all cases to hold the facing elements in place during the seismic event corresponding to 3 percent probability of exceedance in 75 years.
    a. Use the factored site acceleration, A_s, shown.
3. The Wall Company is responsible for all stability calculations, except global stability and bearing capacity.
4. Provide a service life of at least 75 years.
5. The Wall Company is responsible to verify that drainage features do not negatively impact the wall system.
6. Design the retaining wall to accommodate drainage features to function properly through/beneath the wall without negatively impacting the wall system.
    a. This includes checking the drainage system details, and developing appropriate MSE soil reinforcement design details in the vicinity of the drainage features (pipes, catch basins, for example) within the reinforcement mass, and for the outlet point at the wall face.
7. Provide corrosion protection for metal soil and exposed facing reinforcement by one of the following two measures:
    a. Provide sacrificial steel sufficient for a corrosion rate of at least 0.80 mils per exposed surface per year after 16 years of corrosion protection service allowed for the galvanized coating.

    b. Provide a protective geomembrane (either PVC or HDPE) of at least 30 mils thickness at least 2 ft below the base of the

pavement section (below the bottom of the granular borrow layer).

1) Slope the geomembrane at a grade of 4 percent downwards towards the back of the reinforced mass (for example, away from the wall face), and lapped upward against the back side of the wall facing.
2) Design the metal soil reinforcement to provide sacrificial steel sufficient for the following minimum corrosion rates per exposed surface per year, after 16 years of corrosion protection service for the galvanized coating:
    a) Above the Geomembrane: 0.80 mils
    b) Below the Geomembrane: 0.50 mils

8. Use a vertical spacing of primary soil reinforcement not exceeding 30 inch for single-stage walls, or 24 inch for two-stage walls to provide a coherent MSE reinforced soil mass.
    a. This may require modification of panels.
9. Provide horizontal benches with at least a 4 ft width at the base of walls founded on earth slopes as shown.

B. Modify the soil reinforcement design using one of the following alternatives where the soil reinforcement conflicts with obstructions in the wall soil reinforcement zone, such as piles, drilled shafts, guardrail posts, catch basins, drop inlets, and culverts:

1. Design the surrounding soil reinforcement layers to carry the additional load that would have been carried by the severed reinforcement.
2. Place a structural frame around the obstruction which is capable of transferring loads from the soil reinforcement on one side of the obstruction to the soil reinforcement on the other side of the obstruction.
3. Splay the soil reinforcement around the obstruction if the soil reinforcement consists of discrete strips or bar mats rather than continuous sheets.

PART 3 EXECUTION Not Used

END OF SECTION

September 11, 2018

SPECIAL PROVISION

CONTRACT: 18-2399TP
PROJECT: LEH_OP_1

SECTION 02832S

MSE BACKFILL

Add Section 02832.

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Mechanically Stabilized Earth (MSE) backfill used in constructing MSE retaining walls and Reinforced Soil Slopes (RSS).

1.2 RELATED SECTIONS

A. Section 02056: Embankment, Borrow, and Backfill

1.3 REFERENCES

A. AASHTO T 27: Sieve Analysis of Fine and Coarse Aggregates

B. AASHTO T 90: Determining the Plastic Limit and Plasticity Index of Soils

C. AASHTO T 99: Moisture-Density Relations of Soils Using a 2.5-kg (5.5-lb) Rammer and a 305-mm (12 in.) Drop

D. AASHTO T 104: Soundness of Aggregate by Use of Sodium Sulfate or Magnesium Sulfate

E. AASHTO T 236: Direct Shear Test of Soils Under Consolidated Drained Conditions

F. AASHTO T 267: Determination of Organic Content in Soils by Loss on Ignition

G. AASHTO T 288: Determining Minimum Laboratory Soil Resistivity

H. AASHTO T 289: Determining pH of Soil for Use in Corrosion Testing

I. AASHTO T 290: Determining Water-Soluble Sulfate Ion Content in Soil

J. AASHTO T 291: Determining Water-Soluble Chloride Ion Content in Soil

K. AASHTO T 310: In-Place Density and Moisture Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)

L. FHWA Publication No. FHWA-NHI-09-087, Corrosion/Degradation of Soil Reinforcements for Mechanically Stabilized Earth Walls and Reinforced Soil Slopes

1.4 DEFINITIONS

A. Light Equipment Zone – Zone within 3 ft of the back face of the wall facing units and within 2 ft of obstructions.

1.5 SUBMITTALS Not Used

1.6 ACCEPTANCE

A. The Engineer will obtain on-site samples during construction and perform testing at the following frequencies:
   1. Gradation: Every 5,000 yd^3 of backfill used
   2. Electrochemical: Every 10,000 yd^3 of backfill used

B. Density
   1. The Engineer will perform at least one in-place moisture/density determination per lift of backfill for each 100 ft of wall length (at least two tests per lift) tested according to AASHTO T 310.
      a. Tests will be conducted at random locations or at specific locations or both as determined by the Engineer.

PART 2 PRODUCTS

2.1 MSE BACKFILL

A. Use backfill that:
   1. Is free from frozen, organic, and otherwise deleterious materials.
   2. Has an organic content less than one-half of one percent as determined by AASHTO T 267 on the portion of the material finer than the No. 10 sieve.
   3. Is substantially free of shale or other soft particles of poor durability.

4. Has soundness loss meeting one of the following when tested according to AASHTO T 104:
    a. No more than 15 percent after a test duration of five cycles when using a sodium sulfate solution.
    b. No more than 30 percent after a test duration of four cycles when using a magnesium sulfate solution.

B. Conform to the gradation limits in Table 1 as determined by AASHTO T 27.

Table 1

MSE Backfill Gradation (percent passing)		
Sieve Size	**Metal Reinforcement**	**Geogrid Reinforcement**
4 inch	100	–
¾ inch	–	100
No. 40	0 – 60	0 – 60
No. 200	0 –15	0 –15

1. The MSE backfill gradation for metal reinforcement in Table 1 may be used with geogrid reinforcement under the following conditions:
    a. The Wall Company performs site and material specific installation damage testing using a representative sample of the proposed MSE backfill material.
        1) Refer to FHWA-NHI-09-087 for testing protocols.
    b. The installation damage reduction factor determined by the test is not less than 1.2.
        1) Refer to FHWA-NHI-09-087 for determination of the installation damage reduction factor.
    c. The test results are certified by a professional engineer licensed in the State of Utah.
    d. The Engineer may request additional material specific installation damage testing when a change in the backfill characteristics from the original tested representative sample is suspected.

C. Use backfill with a Plasticity Index (PI) of 6 or less, as determined by AASHTO T 90.

D. Use backfill with an internal friction angle of not less than 34 degrees as determined by AASHTO T 236.

1. Use a sample of the material compacted to 95 percent of maximum density at optimum moisture content as determined by AASHTO T 99, Method D.
2. Internal friction angle testing is not required for backfill material that has at least 80 percent of the material retained on the 3/4 inch sieve.

E. Meet the electrochemical properties in Table 2.

Table 2

Electrochemical Properties			
Property	**Metal Reinforcement**	**Geogrid Reinforcement**	**Test Method**
Resistivity	Minimum 3000 ohm-cm, at 100% saturation*	N/A	AASHTO T 288
pH	6.0 – 10.0	5.5 – 10.0**	AASHTO T 289
Chlorides	Maximum 100 ppm	N/A	AASHTO T 291
Sulfates	Maximum 200 ppm	N/A	AASHTO T 290

* Do not follow Note 6 of AASHTO T 288 to find lowest possible resistivity (where soil is in a slurry state). Saturate soil to 100% saturation where a sheen of water is observed at the top surface of the sample in the soil box.

** Maximum pH value for polyester geogrid is 9.0 unless long-term immersion testing performed according to FHWA-NHI-09-087 shows acceptable performance. For pH > 8.0, use a durability reduction factor (RF_D) of 1.3 for polyester geogrid.

2.2 FREE DRAINING GRANULAR BACKFILL

A. Refer to Section 02056.
1. Use a maximum particle size of 3/4 inch for applications using geogrid soil reinforcement.

B. Meet the electrochemical properties in Table 2.

PART 3 EXECUTION

3.1 BACKFILL PLACEMENT

A. General

1. Closely follow the erection of each course of wall facing units (concrete panel, modular block, or welded wire) with backfill placement.
    a. Complete backfilling in front of single-stage walls before backfilling more than 4 ft above the bottom of the lowermost facing element.
    b. Wire facing: Place MSE backfill in front of wire facing elements in lifts not to exceed 10 inch thickness before compaction (loose).
    c. Compact backfill in front of the wall facing element(s) to at least 95 percent of the maximum dry density, according to AASHTO T 99.
2. Place backfill in a manner to avoid damage or disturbance of the wall materials, misalignment of facing panels or modular blocks, and damage to soil reinforcement and facing members.
3. Place backfill using methods that ensure that no voids exist directly beneath the soil reinforcing elements.
4. Place MSE backfill in lifts not to exceed 12 inch thickness before compaction (loose).
    a. Decrease the lift thickness as necessary to obtain the specified density.
    b. Place backfill in uniformly thick layers.
5. Begin MSE backfill placement 3 ft from the wall face and proceed away from the wall when placing backfill over the soil reinforcement to prevent the soil reinforcement from bunching towards the wall face.
6. Place each layer of MSE backfill in a level manner before placing subsequent backfill layers.
7. Operate placement and compaction equipment parallel to the wall face.
    a. Rubber-tired equipment may be used over the reinforcement at speeds less than 5 mph.
        1) Avoid sudden braking and sharp turning.
    b. Do not use sheeps-foot or other grid-type rollers for compacting backfill within the limits of the soil reinforcement.
8. Initial stage of wall construction:
    a. Do not place or compact backfill against the facing units until the first layer of soil reinforcement has been installed and one lift of MSE backfill has been placed and compacted over the reinforcement layer to avoid pushing the facing units out of alignment.

9. Subsequent layers of MSE backfill for concrete panel and modular block walls:
    a. Place and compact the MSE backfill to an elevation 2 inch above the reinforcement connection from a point approximately 18 inch behind the back face of the to the end of the soil reinforcement zone, unless otherwise shown at specific locations in the authorized retaining wall drawings.
10. Do not proceed with the placement of each layer of soil reinforcement and overlying lift of MSE backfill until the Engineer indicates and records that MSE backfill placement and density requirements (including in the light equipment zone) have been met.
11. Slope the top of the MSE backfill along the wall such that the upper soil reinforcement layer is covered with at least 16 inch of MSE backfill.

B. Free Draining Granular Backfill
1. Single-stage wall systems
    a. Place free draining granular backfill within a zone behind the wall measured at least 30 inch from the front face of the wall facing and at least 12 inch in width at the bottom of each backfill lift.
2. Two-stage wall systems
    a. Place free draining granular backfill in a zone at least 24 inch in width behind the first-stage wire/grid facing of two-stage wall systems and behind the wire/grid facing of internal phased-construction walls
3. Internal phased-construction walls
    a. Place free draining granular backfill in the zone at least 24 inch in width behind the wire/grid facing.
4. Place and compact according to the light equipment zone requirements.

C. Compaction
1. Compact MSE backfill to at least 95 percent of the maximum density, according to AASHTO T 99, Method D.
2. Light equipment zones
    a. Use a maximum lift thickness within this zone as warranted by the type of compaction equipment used, but not greater than 8 inch.
    b. Compact backfill using at least three passes of a suitable lightweight or medium-weight (hand-held or hand-guided) mechanical roller, tamper, or vibratory compactor.
    c. Use compaction equipment with a static weight of less than 800 lb within this zone when compacting a thin leveling lift along the reinforcement connections level.

d. Compact to within 3 inch of the facing units.
e. Exercise care in the compaction process to avoid misalignment of the facing units.

D. Moisture Content
1. Place MSE backfill with the moisture content at optimum moisture, or between optimum moisture and four percent below optimum moisture.
a. Determine the optimum moisture content according to AASHTO T 99, Method D.
b. Remove MSE backfill with placement moisture content in excess of the optimum moisture content.
1) MSE backfill may be reused, provided it is aerated or otherwise reworked until the moisture content is uniform and acceptable throughout the entire lift.
2. Maintain the moisture content of the MSE backfill uniform throughout each layer during placement and compaction.

3.2 PROTECTION OF THE WORK

A. Remove water to a depth of at least 1 ft below the lowest point of the wall excavation at least 24 hours before placing MSE backfill.
1. Continue to remove water until:
a. Backfill placement in front of the wall facing (including for the first stage of two-stage walls) is complete, and
b. MSE backfill height exceeds 4 ft.

B. At the end of each day's operation, slope the backfill away from the wall to direct runoff of rainwater away from the wall face.

C. Do not allow surface runoff from adjacent areas or groundwater to enter the wall construction site, including at the front face of the wall.

END OF SECTION

September 11, 2018

SPECIAL PROVISION

CONTRACT: 18-2399TP
PROJECT: LEH_OP_1

SECTION 02833S

CONCRETE PANEL MSE RETAINING WALL

Add Section 02833.

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Concrete panel mechanically stabilized earth (MSE) retaining wall using metal or geogrid soil reinforcing elements.

1.2 RELATED SECTIONS

A. Section 02317: Structural Excavation and Backfill

B. Section 02832: MSE Backfill

C. Section 03055: Portland Cement Concrete

D. Section 03211: Reinforcing Steel and Welded Wire

E. Section 03310: Structural Concrete

F. Section 03390: Concrete Curing

1.3 REFERENCES

A. AASHTO M 111: Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

B. AASHTO M 232: Zinc Coating (Hot-Dip) on Iron and Steel Hardware

C. ASTM A 572: High-Strength Low-Alloy Columbium-Vanadium Structural Steel

D. ASTM A 641: Zinc-Coated (Galvanized) Carbon Steel Wire

E. ASTM A 709: Structural Steel for Bridges

F. ASTM A 1011: Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength

G. ASTM A 1064: Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete

H. ASTM D 3960: Determining Volatile Organic Compound (VOC) Content of Paints and Related Coatings

I. ASTM D 4595: Standard Test Method for Tensile Properties of Geotextiles by the Wide-Width Strip Method

J. ASTM D 5262: Standard Test Method for Evaluating the Unconfined Tension Creep and Creep Rupture Behavior of Geosynthetics

K. ASTM F 3125: High Strength Structural Bolts, Steel and Alloy Steel, Heat Treated, 120 ksi and 105 ksi Minimum Tensile Strength

L. UDOT Quality Management Plan

1.4 DEFINITIONS Not Used

1.5 SUBMITTALS Not Used

1.6 ACCEPTANCE

A. Concrete Wall Panels
   1. Meet 28-day minimum compressive strength of 4000 psi.
   2. Visually free of defects and will be rejected if they have:
      a. Defects due to imperfect molding.
      b. Honeycombing.
      c. Open texture on front face.
      d. Cracks or spalls that exceed the limits specified in this Section, Article 3.5.

PART 2 PRODUCTS

2.1 MATERIALS

A. Concrete.
   1. Precast Panels
      a. Class AA(AE). Refer to Section 03055.
   2. Coping
      a. Class AA(AE). Refer to Section 03055.
   3. Leveling Pad
      a. Class A or Class B. Refer to Section 03055.

B. Reinforcing Steel
   1. Use coated reinforcing steel according to Section 03211.

C. Form-Liner Materials
   1. Use a form-liner that produces uniform texture and patterns and releases the sculpted concrete surface without damage.
   2. Provide solid backing and form supports so that the form-liners remain in place during concrete placement.
   3. Use a form release agent that meets the following:
      a. A manufacturer's recommended liquid-release agent that will not bond with, stain, or adversely affect precast concrete surfaces and will not impair subsequent surface or joint treatments of precast concrete.
      b. A non-petroleum release agent meeting EPA requirements.
         1) Limit Volatile Organic Compound (VOC) content to 250 grams / liter or less. Refer to ASTM D 3960.
      c. A release agent that is not detrimental to concrete strength or durability and that does not impart color, tint, or texture to the finished product.

D. Soil Reinforcing Elements
   1. Metal reinforcing elements
      a. Strips
         1) Hot rolled from steel bars according to ASTM A 572; or cold-formed according to ASTM A 572 or ASTM A 1011.
         2) Grade 65.
      b. Welded Wire and Grid
         1) Refer to ASTM A 1064.
      c. Galvanize according to AASHTO M 111 or ASTM A 641 with a coating thickness of at least 3.4 mils.

2. Geogrid reinforcing elements
    a. Use geogrid consisting of a regular grid network of integrally connected, discontinuous, select high-density polyethylene or polypropylene resin polymer tensile elements.
        1) Aperture geometry sufficient to permit significant mechanical interlock with the surrounding soil or rock or both.
        2) Geogrid structure to be dimensionally stable and be able to retain its geometry under manufacture, transport, and installation.
    b. Meet creep rupture test for 75 year design life according to ASTM D 5262.
    c. Meet ultimate tensile strength from wide-width tests based on minimum average roll values, according to ASTM D 4595, and utilize geogrid reinforcement reduction factors as appropriate for the Project.

E. Loop Embeds
1. As provided by the Wall Company.
2. Galvanize according to AASHTO M 111 with a coating thickness of at least 3.4 mils.

F. Tie Strips
1. Shop fabricated, hot rolled steel conforming to ASTM A 709, Grade 50, ASTM A 1011 Grade 50 or equivalent.
2. Galvanize according to AASHTO M 111 with a coating thickness of at least 3.4 mils.

G. Panel Fasteners
1. Bolts and nuts to be hexagonal cap screw and galvanize coated, meeting ASTM F 3125, Grade A 325 and AASHTO M 232.

H. Other Fasteners
1. Fasteners to wingwalls and abutment walls, if required, are provided by the Wall Company.

I. Filter Fabric
1. Type and grade recommended by the Wall Company.

J. Adhesive
1. According to Wall Company's standard.

K. Bearing Pads
1. Horizontal rubber bearing pads of the type and grade recommended and supplied by the Wall Company.

L. Lifting Devices
1. According to Wall Company's standard.

M. Two-Stage Retaining Wall Systems
1. Wire Facing
a. Shop fabricated of cold-drawn steel wire conforming to the minimum requirements of ASTM A 1064.
1) Galvanize according to ASTM A 641 or AASHTO M 111 with a coating thickness of at least 3.4 mils.
2. Connector Rods
a. Fabricated from cold-drawn steel wire according to ASTM A 1064.
1) Galvanize according to ASTM A 641 or AASHTO M 111 with a coating thickness of at least 3.4 mils.
3. Hairpin Connectors
a. Shop fabricated of hot-rolled steel according to ASTM A 572, Grade 50 or equivalent.
1) Galvanize according to AASHTO M 111 with a coating thickness of at least 3.4 mils.

N. MSE Backfill
1. Refer to Section 02832.

2.2 PRECAST CONCRETE WALL PANELS

A. Follow the authorized retaining wall drawings.

2.3 FABRICATION

A. Use a Department prequalified supplier of precast concrete products according to the UDOT Quality Management Plan 505: Precast/ Prestressed Concrete Structures.

B. Precast Concrete Panels
1. Cast the panels to dimensional tolerances according to Precast Concrete Institute (PCI) or National Precast Concrete Association (NPCA), and as shown.
a. Do not cast panels on site.
b. Cast in metal forms.
c. Achieve uniformity of appearance, color, texture, and pattern.
d. Produce a concrete panel with smooth, solid surfaces free of voids and air pockets.

2. Permanently mark each panel with the casting date, and the panel identification number on the rear of each panel so it is legible during installation.
3. Provide the surface texture architectural treatment as shown.
    a. The thickness of the architectural treatment is in addition to the required design thickness.
    b. Use a concrete form-liner to achieve the required concrete texture.
    c. Provide panel faces that are free of joint marks, grain, and other obvious defects. Provide corners including false joints that are uniform, straight, and sharp.
4. Concrete Finish
    a. Provide an ordinary surface finish according to Section 03310 for front face of panels.
        1) The thickness of the architectural treatment is in addition to the required design thickness.
    b. Provide a uniform surface finish for the back face of panels.
        1) Roughly screen the finish to eliminate open pockets of aggregate and surface distortions in excess of $^1/_4$ inch.
5. Provide concrete cover to the reinforcing steel of at least 2 inch.
6. Set tie strip guides at back face.
7. Place concrete in each unit without interruption.
    a. Vibrate with equipment necessary to prevent stone pockets or cleavage planes.
    b. Use clean, unused form oil.
8. Cast panels on a flat area or approved architectural treatment, with the front face down.
9. Place concrete in each unit without interruption.
    a. Vibrate with approved equipment to prevent stone pockets or cleavage planes.
    b. Use clean, unused form oil.
10. Cure according to Section 03390.

C. Soil Reinforcement Connections
1. Cast at least two soil reinforcement connection levels into all full-size concrete panels.
    a. Where only two connection levels are cast in panels, locate the levels in two different horizontal planes separated by at least one-third the panel height.

2.5 QUALITY CONTROL

A. Precast Concrete Wall Panels
   1. Document test results. The quality control file will contain at least the following information:
      a. Element identification
      b. Date and time of cast
      c. Concrete cylinder test results
      d. Quantity of used concrete and the batch printout
      e. Form stripping date and repairs if applicable
      f. Location/number of blockouts and lifting inserts
      g. Temperature and moisture of curing period
      h. Lifting device details, requirements, and inserts

PART 3 EXECUTION

3.1 GENERAL

A. Haul, store, and ship wall materials in a manner that minimizes the potential of producing defects.
   1. Store panels to avoid damage to connection pieces, such that the tie strips do not bend.
   2. Store soil reinforcement products as recommended by the Wall Company.
   3. Inspect soil reinforcement and attachment devices to ensure they are true to size and free from defects that may impair their strength and durability.
   4. Prevent mud, wet concrete, epoxy, and other contaminants from coming in contact with and affixing to the soil reinforcement and inserts, that would interfere with the geogrid connections.

B. Construct the retaining wall system according to the authorized retaining wall drawings, and the Wall Company's construction manual and recommendations.
   1. Apply the stricter of the two requirements where the Department's and the Wall Company's requirements differ.

3.2 EXCAVATION AND FOUNDATION PREPARATION

A. Excavate and prepare foundation to the lines and grades shown, or as directed by the Engineer.
   1. Refer to Section 02317.
   2. Make the width of excavation equal to or greater than the length of soil reinforcing elements.
   3. Compact the foundation using at least three passes of a lightweight, steel, smooth-drum vibratory roller, or as determined by the Engineer before the wall construction.
   4. Over-excavate unsuitable foundation soils and replace with MSE backfill, or with other suitable material as directed by the Engineer.

3.3 LEVELING PAD

A. Place the cast-in-place concrete leveling pad upon a properly placed and compacted foundation.
   1. A gap no more than 3 inch wide may be left between the end of the leveling pad and the adjacent higher concrete panel where the wall steps up if shown in the authorized retaining wall drawings. If such is the case,
      a. Provide that the backfill in the zone behind the gap is fully retained, and
      b. Properly backfill the gap before the remaining backfill in front of the wall face is placed.
   2. Place leveling pad to a thickness of at least 6 inches.
      a. Place after the required settlement has been achieved from the first-stage wall construction for two-stage wall systems.
   3. Provide a level surface so that the concrete panels are in complete contact with the leveling pad.

B. Do not place concrete panels until leveling pad has been placed for at least 12 hours.

3.4 WALL CONSTRUCTION

A. Backfilling Single-Stage Retaining Walls
   1. Place panels on successive horizontal lifts in the sequence shown in the authorized retaining wall drawings as backfill placement proceeds.
   2. Place panels initially at a slight batter towards the backfill as recommended by the Wall Company to compensate for outward rotation of the panels from fill placement and compaction.

3. Place and compact required backfill in front of base wall panel before the third row of panels are placed, or within 14 calendar days of beginning wall construction, whichever comes first.

B. Backfilling Two-Stage Retaining Walls
   1. Closely follow the erection of each course of wire facing when placing MSE backfill for the first stage of two-stage retaining walls.
      a. Place the MSE backfill in two approximately equal lifts and compact with lightweight equipment according to Section 02832.
      b. Avoid damage or disturbance to the wall materials or misalignment of the wire facing.
   2. Construct the first-stage facing within 2 inch of the design vertical and horizontal alignments (excluding bulging).
   3. Prevent significant bulging of the first-stage facing between reinforcing layers.
      a. Where bulging exceeds 3 inch between reinforcing layers, remove and reconstruct this portion of the wall.
      b. Measure bulging by holding a plumb straight-edge, or a plumb-bob string in front of the wall face.
         1) The bulge measurement is the horizontal distance between the straight edge or plumb-bob string set at the location of maximum bulge and the reinforcement layer immediately above or below the bulge (whichever is greater).
   4. Proceed with placement of the second-stage wall panels after receiving notification from the Engineer that the required first-stage settlement has been achieved.

C. Place bearing pads as required by the Wall Company to prevent concrete-to-concrete contact between panels.

D. Use rubber, wood, or metal shims as necessary to make final adjustments to the wall panel to facilitate level placement of the panel.
   1. Do not leave wood shims at any location.

E. Place soil reinforcement normal to the face of the wall in plan view where possible.
   1. Skew discrete reinforcement where required to splay the reinforcement around obstructions.
      a. Limit the skew angle to no more than 15 degrees, unless authorized by the Engineer.
         1) Follow the Wall Company’s requirements when a skew angle exceeding 15 degrees is authorized.
   2. Provide at least 2 inch clear distance between soil reinforcement and piles or other metallic obstructions.

3. Do not exceed horizontal spacing between soil reinforcement of 7 ft.
4. Place the top level of soil reinforcement a distance below the top of the wall as shown in the authorized retaining wall drawings.
    a. Place the top level of soil reinforcement at least 3 inch below the bottom of the barrier slab lip or the bottom of the concrete gutter behind the coping.
5. Gradually deflect the top soil reinforcement elements downward to avoid conflicts with paving and subgrade preparation.
    a. Consider special conditions such as where roadway super-elevation is anticipated.
    b. Limit the deflection of the reinforcement elements to not more than 8 inch or as otherwise shown in the authorized retaining wall drawings.

F. Use a crescent or socket-head ratchet wrench to securely hand-tighten the nut where reinforcement elements are connected using bolts and nuts.
1. Place the nut on top of the connection.
2. Do not use pneumatic equipment.

G. Geogrid Installation
1. Verify the correct orientation (roll direction) of the geogrid.
2. Place geogrid on compacted backfill.
3. Connect geogrid to the concrete panels.
4. Pull the geogrid taut to eliminate loose folds and remove slack in the geogrid at the wall unit connections, pretension the geogrid, and stake or otherwise secure the back edge of the geogrid before and during backfill and compaction.
5. Follow the Wall Company's overlap requirements for uniaxial and biaxial geogrids.

H. Limit the skew angle of the connector rods between the concrete panels and the first stage facing in two-stage retaining walls to not more than 15 degrees horizontally and vertically, unless authorized by the Engineer.
1. Follow the Wall Company’s requirements when a skew angle exceeding 15 degrees is authorized.

I. Construct wall facing to the following tolerances.
1. Horizontal alignment
    a. Not to exceed 0.7 percent (for example, 2.5 inch in 30 ft).
2. Vertical alignment
    a. Not to exceed 0.7 percent (for example, 0.85 inch in 10 ft).
3. Plumbness from top of wall to bottom of wall
    a. Positive (into the retained mass)
        1) Not to exceed 0.7 percent (for example, 1.7 inch in 20 ft of wall height).

b. Negative (away from the retained mass)
1) Not to exceed 0.5 percent (for example, 1.2 inch in 20 ft of wall height).

4. Levelness
a. Not to exceed 0.5 percent (for example, 1.2 inch in 20 ft).

I. Install concrete wall panels so that joints are uniform.
1. Maximum allowable offset in any panel joint is 0.40 inch.
2. Joint width is 1.2 inch maximum and 0.50 inch minimum.

J. Check panel tolerance and reset before placement of the next panel if out of tolerance.

K. Cover horizontal and vertical joints between panels with filter fabric.

3.5 WALL COPING

A. Refer to Section 03310 for concrete placing and finishing.

B. Refer to Section 03390 for concrete curing.

3.6 CRACK AND SPALL REPAIR CRITERIA FOR CONCRETE PANELS

A. A fully penetrating crack is defined as a crack extending through the cross-section of the precast panel from the front face to the back face of the unit.

B. Cracks at Front Face of Panel:
1. Panels with one or two partially penetrating cracks with widths less than or equal to 12 mils are acceptable.
2. Reject panels with fully penetrating cracks, or cracks wider than 12 mils.
3. No more than two cracks per individual panel are allowed without further evaluation.

C. Cracks at Back Face of Panel:
1. Partially penetrating cracks with widths less than or equal to 12 mils are acceptable.
2. Partially penetrating cracks with widths between 12 mils and 30 mils are acceptable when repaired with surface sealant according to subparagraph F, Crack Repair Procedures.
3. Evaluate partially penetrating cracks wider than 30 mils for acceptance with epoxy injection according to subparagraph F, Crack Repair Procedures.

4. No more than two repairable cracks per individual panel are allowed without further evaluation.

D. Spalls at Front Face of Panel:
   1. Spalls with widths less than 4.0 inch and depths less than 2.0 inches may be repaired with a patching material acceptable to the Engineer of the same color as panel concrete. Resultant repair to be approved by the Engineer.
   2. Reject panels with spalls wider than 4.0 inch or deeper than 2.0 inch.
   3. Measure spall depth from the structural thickness of the panel excluding architectural surface finish.
   4. Panels with more than two spalls are subject to further evaluation before acceptance.

E. Spalls at Back Face of Panel:
   1. Spalls with widths less than 4.0 inch and depths less than 2.0 inch may be repaired with a patching material acceptable to the Engineer. Resultant repair to be approved by the Engineer.
   2. Reject panels with spalls wider than 4.0 inch or deeper than 2.0 inch.
   3. Panels with more than four spalls are subject to further evaluation before acceptance.

F. Crack Repair Procedures:
   1. Surface Sealing: Prepare surface and apply a sealant acceptable to the Engineer according to manufacturer's instructions.
   2. Epoxy Injection: Prepare surface and inject cracks with Department-approved product according to manufacturer's instructions.

G. Spall Repair Procedures:
   1. Prepare surface and apply patching material according to Manufacturer's instructions, and as acceptable to the Engineer.

END OF SECTION

June 20, 2019

SPECIAL PROVISION

CONTRACT: 18-2399TP
PROJECT: LEH_OP_1

SECTION 03055S

PORTLAND CEMENT CONCRETE

Delete Section 03055 in its entirety and replace with the following:

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Portland Cement Concrete.

1.2 RELATED SECTIONS

A. Section 03390: Concrete Curing

1.3 REFERENCES

A. AASHTO M 6: Fine Aggregate for Hydraulic Cement Concrete

B. AASHTO M 80: Coarse Aggregate for Hydraulic Cement Concrete

C. AASHTO M 85: Portland Cement

D. AASHTO M 154: Air-Entraining Admixtures for Concrete

E. AASHTO M 157: Ready-Mixed Concrete

F. AASHTO M 194: Chemical Admixtures for Concrete

G. AASHTO M 295: Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete

H. AASHTO M 307: Silica Fume Used in Cementitious Mixtures

I. AASHTO T 160: Length Change of Hardened Hydraulic Cement Mortar and Concrete

J. AASHTO T 325: Estimating the Strength of Concrete in Transportation Construction by Maturity Tests

K. AASHTO T 358: Surface Resistivity Indication of Concrete's Ability to Resist Chloride Ion Penetration

L ASTM C 150: Portland Cement

M. ASTM C 595: Blended Hydraulic Cements

N. ASTM C 1157: Hydraulic Cement

O. ASTM C 1567: Determining the Potential Alkali-Silica Reactivity of Combinations of Cementitious Materials and Aggregate (Accelerated Mortar-Bar Method)

P. ASTM C 1602: Mixing Water Used in the Production of Hydraulic Cement Concrete

Q. American Concrete Institute (ACI) Manual of Concrete Practice

R. UDOT Materials Manual of Instruction

S. UDOT Minimum Sampling and Testing Requirements

T. UDOT Quality Management Plan

U. AASHTO T 121: Density (Unit Weight), Yield, and Air Content (Gravimetric) of Concrete

V. ASTM C 1116: Fiber-Reinforced Concrete

W. ASTM C 1609: Flexural Performance of Fiber-Reinforced Concrete (Using Beam With Third-Point Loading)

X. ICC Evaluation Service (ICC-ES) AC32: Concrete with Synthetic Fibers

1.4 DEFINITIONS

A. Cold Weather Protection Period: The required time during which the concrete is maintained at or above a specific temperature to prevent freezing of the concrete and to provide the necessary strength development for structural safety.

B. Fibrillated Microfiber – Fibrillated synthetic fibers with diameters or equivalent diameters less than 0.012 inch.

C. Macrosynthetic Fiber – Synthetic fibers with diameters or equivalent diameters greater than 0.012 inch.

1.5 SUBMITTALS

A. Mix design for all AAA, AA, and A concrete classes to be used for approval.
   1. The Department approves concrete mix designs based on trial batch test results or on Department project history.
      a. The Department will monitor approved mix designs on the performance of compressive strength on all projects, according to the UDOT Materials Manual of Instruction. The Department will revoke approval if a mix is determined to be uncontrolled.
   2. Include at least the following:
      a. The proposed mix design.
      b. Target slump value.
      c. Trial batch test results.
      d. Test results verifying that coarse and fine aggregates meet this Section, Article 2.2, paragraph B.
      e. Test results for the proposed mix design for potential reactivity of coarse and fine aggregates according to UDOT Quality Management Plan 506: Ready-Mix Concrete.
      f. Test results demonstrating the ability of the combinations of cementitious materials and aggregates to control the reactivity when using potentially reactive aggregates in a mix design.
      g. Written plan for admixtures. Refer to this Section, Article 2.2, paragraph D.
      h. Well-graded combined aggregate gradation for the mix design when used.
         1) Provide targets for each required sieve (listed in Tables 4 and 5) for control and acceptance.
         2) Submit the coarseness factor, 0.45 power chart, percentage retained (8-18 gradation chart) or a combination of methodologies.
         3) Identify the aggregate size and number of component stockpiles.
         4) Provide gradations for each component stockpile and the target percentages of each stockpile used to achieve the total combined gradation.
      i. Test results establishing a density (unit weight) target of freshly mixed concrete according to AASHTO T 121 when using Class AA(LSF) and AA(ES) concrete.

B. Mix design, manufacturer's product data, or manufacturer's labeling for Class B concrete for approval.

C. Cold Weather Concreting Plan and Hot Weather Concreting Plan for review.
   1. Include the following:
      a. Detailed procedures for the placement, protection, curing, and temperature monitoring of concrete during cold and hot weather.
      b. Procedures to be implemented upon abrupt changes in weather conditions or equipment failures.
      c. Refer to this Section, Article 3.1, paragraph D for cold weather concreting requirements and Article 3.1, paragraph E for hot weather concreting requirements.
   2. Allow the Engineer 10 calendar days to review the plans.
      a. The Engineer may grant an increase in contract time when this review and approval time is exceeded.
      b. This review period applies each time the plans are submitted.
   3. Do not begin cold weather concreting before the Cold Weather Concreting Plan is approved.
   4. Do not begin hot weather concreting before the Hot Weather Concreting Plan is approved.
   5. Not required for precast concrete members provided by prequalified suppliers. Refer to this Section, Article 3.1, subparagraph D1 for cold weather. Refer to this Section, Article 3.1 paragraph E3 for hot weather.

1.6 ACCEPTANCE

A. Sampling and testing for strength, air entrainment, and slump is according to UDOT Minimum Sampling and Testing Requirements.
   1. The following exceptions apply when using Class AA(LSF) and AA(ES) concrete mixes:
      a. Slump tests are suspended.
      b. Test fresh concrete density (unit weight) according to AASHTO T 121 at the same frequency as Air Content and Concrete Temperature.
         1) Batch fails if the unit weight of the fresh concrete in the field varies more than ± 5 lb/ft^3 from the target density for fresh concrete established by the mix design.

B. The Department rejects the portion of a lot represented by a strength test that is more than 500 psi below the 28 Day Minimum Compressive Strength *f 'c* (psi) in Table 1.

1. The Engineer may accept reject material based on the materials dispute resolution process. The Department applies a 0.50 pay factor to the pay item for the quantity represented if reject material is allowed to remain in-place.

PART 2 PRODUCTS

2.1 CONCRETE CLASSES AND MIX REQUIREMENTS

A. Use only concrete mixes that have a Department approved mix design.
1. Refer to the requirements in Table 1.

Table 1

Concrete Classes and Mix Requirements							
Class	**Coarse Aggregate Size**	**Maximum Water / Cementi-tious Ratio******	**Maximum Percent Shrinkage at 28 days AASHTO T 160**	**Chloride Ion Penetration AASHTO T 358 Table 1**	**Air Content Percent (%) ***	**Mix Design Compressive Strength *f'*cr (psi)**	**28 Day Minimum Compressive Strength *f'*c (psi) ****
AAA(AE)	1" to No. 4 ¾" to No. 4	0.40	N/A	N/A	5.0 - 7.5	6,200 or f'c +1200	5,000 or as shown
AA(LSF)	1" to No. 4 ¾" to No. 4	0.42	0.035	Low to Negligible	5.0 - 7.5	5,200	4,000
AA(LS)	1" to No. 4 ¾" to No. 4	0.40	0.035	Low to Negligible	5.0 - 7.5	5,200	4,000
AA(P)	2" to No. 4 1½" to No. 4 1" to No. 4	0.44	0.042	N/A	4.0 - 7.0 4.5 - 7.5 5.0 - 7.5	5,200	4,000
AA(ES)***	1½" to No. 4 1" to No. 4 ¾" to No. 4	0.42	0.035	Low to Negligible	4.5 - 7.5 5.0 - 7.5 5.0 - 7.5	5,200	4,000
AA(AE)	2" to No. 4 1½" to No. 4 1" to No. 4 ¾" to No. 4	0.44	N/A	N/A	4.0 - 7.0 4.5 - 7.5 5.0 - 7.5 5.0 - 7.5	5,200	4,000
A	1½" to No. 4 1" to No. 4 ¾" to No. 4	0.53 0.53 0.48	N/A	N/A	N/A	3,900	3,000
A(AE)	1½" to No. 4 1" to No. 4 ¾" to No. 4	0.53 0.53 0.48	N/A	N/A	4.5 - 7.5	3,900	3,000
B or B(AE)		0.62	N/A	N/A	N/A 3.0 - 6.0	3,250	2,500

Table 1 Notes:

* Values listed represent in-place air content. Make necessary adjustments for impacts to air content due to placement.

** For *f*'c over 4,000 psi, design and proportion mixes according to ACI Manual of Concrete Practice 301: Specifications for Concrete and project specific criteria. Use air content percent in Table 1 for these mixes according to the class specified and the coarse aggregate size.

*** For Class AA(ES), achieve at least 3,000 psi at 24 hr.

****The Water/Cementitious ratios are the maximum allowed. Mix design w/cm ratios are established in the trial batch and will remain within the tolerances of this section article 2.6 during production.

Acronym Definitions:

AE = air-entrained
LSF = low shrinkage with fiber
LS = low shrinkage
P = pavement
ES = early strength

B. Maximum nominal size of coarse aggregate:
   1. Not larger than $^1/_5$ the narrowest dimension between sides of forms.
   2. Not larger than ⅓ the depth of slabs.
   3. Not larger than ¾ the minimum clear distance between reinforcing bars or between bars and forms, whichever is less.

C. Do not exceed water/cementitious ratio.
   1. Calculate the water/cementitious ratio (w/c) by weight according to the following formula:

$$\frac{w}{c} = \frac{Water}{Cement + Pozzolan}$$

D. Do not exceed 30 percent total pozzolan in any mix unless approved or otherwise specified.

E. Use 94 lb additional cementitious material per cubic yard to the amounts determined in the mix design for concrete deposited in water.

F. Slump tolerance
   1. Establish the target slump by mix design trial batch.
   2. The target slump tolerance is the acceptable variation from the maximum target slump.
   3. Do not exceed a 9 inch slump.

Table 2

Target Slump Tolerance (inch)		
	Target Slump	
	3 inch or less	More than 3 inch
Plus tolerance	0	0
Minus tolerance	1 ½ inch	2 ½ inch

G. Class AA(LSF) and AA(ES) concrete mixes require the following in addition to the requirements in Table 1:
   1. Synthetic Fiber Reinforcement according to this Section, paragraph 2.2F.
      a. Provide fibrillated microfibers and macrosynthetic fibers
   2. A well-graded combined aggregate gradation according to this Section, paragraph 2.2 B3.

2.2 MATERIALS

A. Cement
   1. Use Type II Portland Cement or equivalent according to Table 3 unless otherwise specified. Type III Portland Cement or equivalent may be used for precast items.
   2. Blended Hydraulic Cement
      a. Blended hydraulic cement substituted for Portland Cement:
         1) Use ASTM C 1567 to verify that expansion is less than 0.1 percent 14 days after the zero reading.
         2) Refer to the equivalent cements listed in Table 3.
      b. Do not exceed 30 percent total pozzolan limit when adding fly ash to a blended hydraulic cement.
         1) Submit documentation of the total pozzolan content with the mix design.

Table 3

Portland Cement/Blended Hydraulic Cement Equivalencies		
AASHTO M 85 Equivalent Alkalis 0.80 max percent	**ASTM C 595**	**ASTM C 1157**
*Type I	IP, IL, IT	GU
Type II	IP(MS), IT(MS)	MS
Type III	-	HE
*Type V	IP(HS), IT(HS)	HS

*Use only when specified

   3. Do not mix cements originating from different sources.
   4. Do not use air-entrained cement.

B. Aggregate

1. Coarse Aggregate

a. Use coarse aggregate that meets AASHTO M 80 physical properties. Use one of the gradations in Table 4.

b. Do not exceed percentages of deleterious substances as specified in AASHTO M 80, Table 1, for Class A aggregates.

Table 4

Coarse Aggregate Gradations - Percent Passing (by weight)									
Aggregate Size (inches or sieve size)	**2½**	**2**	**1½**	**1**	**¾**	**½**	**⅜**	**No. 4**	**No. 200**
2 to No. 4	100	95-100		35-70		10-30		0-5	0-1
1½ to No. 4		100	95-100		35-70		10-30	0-5	0-1
1 to No. 4			100	95-100		25-60		0-10	0-1
¾ to No. 4				100	90-100		20-55	0-10	0-1

2. Fine Aggregate

a. Use fine aggregate that meets AASHTO M 6 physical properties. Use the gradation in Table 5.

b. Do not exceed percentages of deleterious substances as specified in AASHTO M 6, Table 1, for class A aggregates, using option “b” for material finer than the No. 200 sieve.

Table 5

Fine Aggregate Gradation	
Sieve Size	**Percent Passing (by weight)**
⅜ inch	100
No. 4	95 to 100
No. 16	45 to 80
No. 50	10 to 30
No. 100	2 to 10
No. 200	0 to 3.0

3. A well-graded combined aggregate gradation may replace the gradation requirements in Tables 4 and 5 and is required for AA(LSF) and AA(ES) concrete classes.

a. Proportion combined aggregates using any combination of the 0.45 power chart, the 8-18 percent-retained and the Coarseness Factor charts in the UDOT Materials Manual of Instruction, Section 975: Guidelines for Well-Graded Combined Aggregate Gradations.

1) Determine a combined gradation for the mix design. Provide targets for each sieve size (3/4", ½", 3/8", #4, #8, #16, #30, #50, #100)
2) Provide a combined gradation within the tolerances of Table 6 and with less than 3 percent passing the #200 sieve.
3) Maintain gradations within zone II of the coarseness factor chart.

Table 6

Tolerances for a Well Graded Combined Aggregate Gradation	
Sieve Size	**Percent Passing Allowable Tolerance**
¾ ", ½", 3/8"	± 10%
#4, #8	± 5%
#16, #30, #50	± 4%
#100	± 3%

C. Water
1. Use potable water or water that meets ASTM C 1602, including Table 1.

D. Admixtures
1. Do not use calcium chloride.
2. Air Entrainment according to AASHTO M 154, including Section 5.
3. Water Reducing Agents
   a. Refer to AASHTO M 194.
   b. High Range Water Reducer (HRWR) – Submit a written plan for approval with the trial batch that details ingredients, production methods, handling, and placing.
4. Accelerators – Refer to AASHTO M 194.
5. Set Retarding and Hydration Stabilizing Admixtures – Refer to AASHTO M 194.
   a. Establish and inform the Engineer of the effective life of the set-retarding or stabilizing admixture by trial batch if admixtures are required due to haul times exceeding the time limitations in this Section, Article 3.1, paragraph A.
   b. Do not exceed manufacturer's recommendations for the use of the set retarding admixture.
   c. Do not re-dose the concrete with additional set retarding admixture.
   d. Add admixture at the batch plant at the time of initial batching operations.
   e. Show on batch tickets the amount of admixture used.

f. Time of placement is established by the trial batch and supersedes the requirements in this Section, Article 3.1, paragraph A.

6. Site-added air-entrainment – Refer to AASHTO M 154.
   a. Limit the use of site-added air-entraining agents to one addition per load, regardless of quantity.
   b. Use pre-measured admixtures.
   c. Record amount used on batch ticket.
   d. Rotate the drum at least 30 revolutions at the mixing speed recommended by the manufacturer.

E. Pozzolan
1. Fly Ash
   a. Class F according to AASHTO M 295 except Table 1.
      1) Loss on Ignition (LOI) Not to exceed 3 percent.
      2) Allowable CaO content Not to exceed 15 percent.
      3) Label the storage silo for fly ash to distinguish it from cement.
      4) Use different size unloading hoses and fittings for cement and fly ash.
2. Natural Pozzolan (Class N)
   a. Refer to AASHTO M 295.
   b. May use instead of fly ash provided that the expansion does not exceed 0.1 percent. Refer to ASTM C 1567.
3. Silica Fume
   a. Refer to AASHTO M 307.

F. Synthetic Fiber Reinforcement
1. Fibrillated microfiber
   a. Use fibrillated polypropylene fibers at 2 lb/yd^3 of concrete mix.
2. Macrosynthetic fiber
   a. Use 4 lb/yd^3 of concrete mix.
   b. Provide a minimum flexural strength ratio ($R_{e,3}$) of 25 percent when tested according to ASTM C 1609.
3. Store the fibers in a dry, covered area, free of contamination.
4. Evaluate trial batches to verify workability of the concrete.
5. Conform to ASTM C 1116, Type III and the requirements of ICC-ES AC32 Section 3.1.1 (plastic shrinkage reinforcement) and Section 3.1.2 (shrinkage and temperature reinforcement).
6. Do not introduce fibers at the same time as the cement is being introduced.
7. Mix for at least five minutes after the addition of the fibers.

2.3 MIX DESIGN

A. Design mixes to meet the requirements of this Section and project specific criteria.

B. The Contractor assumes responsibility for the compatibility of admixtures with the mix design and their potential effects on concrete properties.

C. Design the cementitious system to mitigate potential alkali-aggregate reactivity.
   1. Use at least 20 percent pozzolan by weight of the total cementitious system.

D. Obtain approval from the Engineer for the project specific application of an approved mix design.

2.4 TRIAL BATCHES

A. Use the same components in the trial batches that will be used in the project.
   1. Accelerators and site-added air-entrainment can be incorporated in the trial batch but are not required.

B. Use Department certified TTQP Concrete and Concrete Strength Testing personnel to perform trial batches and strength tests.

C. The Department or its certified representative may witness the trial batch.

D. Mix concrete trial batches according to the UDOT Materials Manual of Instruction 974: Guidelines for Portland Cement Concrete Mix Design Trail Batches.

E. Use a Department qualified laboratory to verify trial batch compressive and flexural strength testing.

2.5 AGGREGATE STOCKPILES

A. Construct stockpile platforms so that subgrades are prevented from intruding into aggregates.

B. Build stockpiles at least two days before use.

C. Provide an operator and front-end loader to help the Engineer take aggregate samples.

D. Provide separate stockpiles for coarse and fine aggregates.

E. Construct stockpiles to minimize segregation of aggregates

F. Allow washed aggregates to drain to uniform moisture content before use (12 hours minimum).

2.6 BATCH MATERIALS

A. Batch Tolerances. Refer to AASHTO M 157.
   1. Cementitious Material : ± 1 percent of the required mass
   2. Aggregate: ± 2 percent of the required mass
   3. Total Water: ± 3 percent of the required mix amount

B. Batch Size
   1. Do not load trucks in excess of the rated mixing capacity.
   2. Maintain an accurate and legible truck load-rating plate on the truck.
   3. Maintain a minimum individual batch size of 2 yd^3.

PART 3 EXECUTION

3.1 LIMITATIONS

A. Timing – Deliver, place, and consolidate concrete as follows unless otherwise specified:
   1. Within 90 minutes of batching when the air temperature is below 80 degrees F.
   2. Within 75 minutes of batching when the air temperature is between 80 and 85 degrees F.
   3. Within 60 minutes of batching when the air temperature is above 85 degrees F.

B. Concrete Temperature – Place concrete when the concrete temperature is between 50 and 90 degrees F unless otherwise specified.

C. Pumping and Conveying Equipment
   1. Do not use equipment or a combination of equipment and the configuration of that equipment that causes a loss of entrained air content that exceeds one-half of the range of air content allowed by specification.
      a. Replace, reconfigure, or repair equipment that does not meet this requirement.

   2. Contractor is responsible to verify and monitor air loss.

D. Cold Weather – Comply with the following when placing, finishing, curing, and protecting concrete exposed to cold weather during the protection period. Cold weather applies when the temperature is forecast to fall below 35 degrees F during the protection period.

1. Provide necessary cold weather protection for placing, finishing, curing and protecting in-place concrete such as covers, insulation, and heat.
    a. Follow the authorized Cold Weather Concreting Plan when placing cast-in-place concrete.
    b. Follow the prequalified supplier's approved Quality Control Plan when fabricating precast concrete members.
2. Concrete materials
    a. Do not use chemical anti-freeze additives in the concrete. This does not apply to normal accelerators. Refer to AASHTO M 194.
    b. Remove and replace concrete damaged by frost action at no additional cost to the Department.
    c. Do not use material containing frost or lumps.
3. Determine the concrete compressive strength by one of the following methods:
    a. Field cured cylinders cured and protected the same as the concrete being protected.
    b. Maturity method. Refer to AASHTO T 325.
4. Maintain the temperature of the concrete at or above 50 degrees F during and after placement until the end of the protection period.
    a. Measure the specified concrete temperature at the concrete surface. Use surface thermometers insulated from the surrounding air.
5. Placing concrete
    a. Do not place concrete during adverse weather including rain, snow, and high winds without adequate protection approved by the Engineer.
    b. Do not proceed with the placement of concrete if the temperature of all contact surfaces, including reinforcement, is less than 36 degrees F or greater than 95 degrees F.
    c. Cease placement operations when the ambient temperature is 40 degrees F and decreasing unless adequate precautions are taken according to the approved Cold Weather Concreting Plan.
6. Protection of in-place concrete
    a. Maintain the concrete above 50 degrees F during placement and until the end of the protection period.

1) The protection period is the time required for the concrete to reach a compressive strength of at least 3,500 psi.
2) Extend the duration of the protection period at least 24 hr beyond the termination of the cure before exposing the concrete to freezing temperatures when curing by the water method. Refer to Section 03390.

b. Comply with the following when heating is required.
1) Adequately vent combustion-type heaters that produce carbon monoxide.
2) Position heaters and ducts so the hot dry air does not cause areas of the concrete surface to overheat or dry.
3) Keep concrete surfaces moist to avoid excessive loss of moisture from the concrete when applying external heat.

7. Termination of protection
a. Limit the drop in temperature of concrete surfaces to 40 degrees F during any 24 hour period when removing cold weather protection until the surface temperature of the concrete reaches that of the ambient air temperature.

E. Hot Weather – Comply with the following when placing, finishing, curing, and protecting concrete exposed to hot weather during the protection period.
1. Hot weather limitations apply at any time of the year when a combination of high ambient temperature, high concrete temperature, low relative humidity, and high wind speed have the potential to impair the quality of freshly mixed or hardened concrete by accelerating the rate of moisture loss and the rate of cement hydration, or otherwise causes detrimental results.
2. Monitor site conditions, including air temperature, relative humidity, and wind speed, to assess the need for evaporation control measures.
a. Begin monitoring no later than 1 hour before beginning concrete placing operations.
b. Continue to monitor site conditions at intervals of 20 minutes or less until required curing procedures are applied.
3. Provide necessary hot weather protection.
a. Follow the approved Hot Weather Concreting Plan when placing cast-in-place concrete.
b. Follow the prequalified supplier’s approved Quality Control Plan when fabricating precast concrete members.

c. Initiate evaporation control measures when concrete and air temperatures, relative humidity of the air, and wind speed have the capacity to evaporate free water from the fresh concrete surface at a rate equal to or greater than 0.2 $lb/ft^2/hr$.

1) Determine the evaporation rate of surface moisture using the NRMCA Nomograph in Appendix B of ACI 305.1.

4. Cool all surfaces that will come in contact with the concrete to below 95 degrees F

3.2 CYLINDER STORAGE DEVICE

A. Provide and maintain cylinder storage device.

1. Maintain cylinders at a temperature range of 60 degrees F to 80 degrees F for the initial 16 hour curing period.
2. Do not move the cylinders during this period.
3. Equip the storage device with an automatic 24 hour temperature recorder that continuously records on a time/temperature chart with an accuracy of ±1 degree F.
4. Have the storage device available at the point of placement at least 24 hours before placement.
5. Stop placement of concrete if the storage device is not provided or cannot accommodate the required number of test cylinders. Cylinder strength results may not be disputed if storage devices are not provided.
6. Use water containing hydrated lime if water is to be in contact with cylinders.
7. The Engineer may require a 24 hour test run to determine the storage device capability to maintain and record temperature.

END OF SECTION