

TEXAS PARKS AND WILDLIFE

TECHNICAL SPECIFICATIONS

FOR

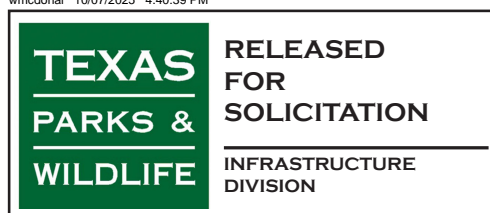
PROJECT NUMBER MR12735
GALVESTON ISLAND STATE PARK
GALVESTON COUNTY, TEXAS

GREEN FLUSH RESTROOM



Wm. M. McDonald Jr.
10/03/25

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Project Number MR12735
Green Flush Restroom
Galveston Island Texas State Parks

Technical Specifications

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DIVISION 13 – SPECIAL CONSTRUCTION

SECTION 133400 – FABRICATED ENGINEERED STRUCTURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions apply to this Section.

1.2 SUMMARY

- A. Section includes the prefabricated restroom building.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Submit building plans sealed by a State of Texas Engineer for owner's approval.

PART 2 - PRODUCTS

2.1 PREFABRICATED RESTROOM BUILDING

- A. Green Flush Restrooms “Durango II” model with covered porch as supplied by Green Flush Restrooms, 1420 N Columbia Ridge Way, Washougal, WA 98671, or approved equal.
 - 1. Contact Co-Owner Kyle Earlywine at 360-718-7595, ext. 4 for additional information and pricing.
 - 2. Refer to Attachment #1 for manufacturer specifications.
 - 3. Prefabricated restroom shall be compliant with all applicable provisions of the 2012 Texas Accessibility Standards.

PART 3 - EXECUTION

3.1 BUILDING PAD PREPARATION

- A. Excavate and prepare the building pad for the prefabricated restroom concrete vault to depths and dimensions shown on the drawing details and manufacturer's instructions.

3.2 BUILDING INSTALLATION

- A. Coordinate building delivery date schedule with Green Flush.
- B. Green Flush will rent the crane needed to install the restroom and send a staff member to provide technical support during the installation. Contractor shall coordinate with Green Flush manufacturer for installation information.
- C. Contractor shall provide a licensed plumber to relocate the exterior water line, install water valve, and make water line connections to the building shown on site plan.
- D. Construct concrete walks connecting the prefabricated restroom building to the existing sidewalk after the building installation.

ATTACHMENT #1 – GREEN FLUSH RESTROOM MANUFACTURER SPECIFICATION

		2/21/2025 15:36
CUSTOMER:	GREENFLUSH TECHNOLOGIES (GALVESTON ISLAND STATE PARK PROJECT, TX)	
SALESPERSON:	KEN EARLYWINE	
ESTIMATOR:	JUSTIN LANCE	
FACTORY:	IN	
BUILDING:	18'-8"X12'-10" CMU BLDG. INCLUDES COVERED PORCH DURANGO II MODEL W/ PORCH	
UNITS:	(1) 18'-8"X12'-10" MODULE INCLUDES PORCH AND OVERHANG	
CODE:	2024	2015 IBC/ TX (NO ENERGY CODE COMPLIANCE)
STATE:	TX	
QUOTE #	51209-8	
FRAME:		
	TYPE:	PERIMETER
	MAIN BEAM:	L8"X4"X1/2"X19.6#/FT ANGLE AROUND PERIMETER
	MISC.:	PRIME PAINT ANGLE IRON
	X-MEMBER:	NONE
	HITCH:	NONE
	AXLES:	NONE
	MISC.:	(8) BOLT-ON LIFTING LUGS SET IN CONCRETE
	MISC.:	(8) 1/2"X9"X16" STEEL COVER PLATES THAT ARE BOLTED TO THE LIFTING LUG PLATES AFTER THE LIFTING LUGS ARE REMOVED. THESE HANG DOWN OVER THE VAULT WALL FOR TIE DOWN TO RESIST LATERAL MOVEMENT.
FLOOR:		
	BTM BOARD:	NONE
	INSULATION:	NONE
	JOISTS:	NONE
	DECKING:	NONE
	MISC.:	8" THICK 4000 PSI STD. WEIGHT CONCRETE FLOOR W/ #4 RE-BAR 6" O.C. THE LONG WAY AND 12" ON CENTER THE SHORT WAY. (INTEGRAL COLOR)
	MISC.:	XYPEX E5 CONCRETE ADMIXTURE
	MISC.:	IMPEDE INTRASEAL FLOOR SEALER
	COVERING:	NONE (LIGHT BROOMED CONCRETE FINISH)
	DUCT:	
	MISC.:	INSTALL (1) 25 1/2" O.D. FIBERGLASS MANHOLE COVER W/ 8" HIGH NOMINAL RIGID FOAM IN CONCRETE FOR ACCESS TO INGROUND WASTE

		(UNDER TREATED WOOD 2X & BOTH ANCHORED TO BLOCK W/ ALTHREAD ROD)
	MISC:	PAINT INT. CABIN WALLS 2-COATS 1-COLOR PAINT (WHITE ONLY IN MECH. ROOM) PRIME ALL WALLS W/ CMU BLOCK FILLER PRIOR TO PAINT – INTERIOR AND EXTERIOR
		WALLS ONLY- EXPOSED BLOCK IN MECHANICAL ROOM TO BE PAINTED WHITE)
		(HARDI-PANEL CEDARMILL PAINTED ABOVE CMU- INSTALL HORIZONTAL)
		(NO WAINSCOT)
		(INCLUDES AN ANGLED WALL 48" HIGH AT URINAL) COVERED BY FRP
	COLOR:	TO BE SELECTED FROM MANUFACTURERS STD COLORS
	INSULATION:	R-15 ABOVE BLOCK WALLS
	ROOF:	
	RAFTERS:	2X8 S.P.F. #2 @ 16" O.C. 3:12 GABLE PITCH (30# SNOW LOAD)
	MISC.:	2X10 DBL. RIDGE BEAM OR AS REQUIRED
	CEILING:	PAINTED 5/16" HARDI-PANEL (CEDAR MILL PATTERN) OVER 7/16" OSB. ALL MAERIALS TO RECEIVE PAINT SHALL BE PRIMED FIRST. (EXPOSED ON PORCH AREA)
		FINISHED CEILING HEIGHT OF 8'-0" TO 10'-4" (FOLLOWS PITCH OF RAFTERS)
	INSULATION	R-22 UNFACED (KRAFT FACED WHERE REQ'D W/ GYP)
	SHEATHING	5/8" CDX PLYWOOD
	ROOFING:	26 GA CENTRALGUARD HORIZON-LOC STEEL STANDING SEAM' (W/ FASTENERS 6" O.C.-150 MPH)
	MISC.:	OVER ICE-SHIELD TYPE UNDERLAYMENT (2 SQ. MIN.)
	MANSARD:	NONE
	OVERHANG:	ON THE SIDEWALLS AND 4" OVERHANG
	OVERHANG:	6" ON EAVE SIDES AND 6" ON GABLE WALLS (W/ PAINTED LP SMART PANEL (CEDAR TEXT.) SOFFIT- VENTED AS REQUIRED) (WITH CEDAR 1X FASCIA SIZED AS REQUIRED (W/ SEMI-TRANSPARENT STAIN)
	MISC.:	DECORATIVE ROUGH SAWN RED CEDAR TIMBER BEAMS IN CENTER OF GABLE AND ALONG CEILING AND PORCH FRONT (STAINED SEMI-TRASPARENT STAIN) W/ STAINLESS STEEL GUSSETT SUPPORTS & (2) 6"X6"X8' ROUGH SAWN CEDAR POSTS
	DOORS:	
	EXT. DOOR:	36X84 18 GAUGE INSUL. COMMERCIAL STL. W/ 16 GA. STL.JAMB (FIBERGLASS) 4" HEAD AND 88" HIGH DOOR HARDWARE PRESSURE RATINGS +46.83/-53.24

		(STEEL JAMB TO BE WELDED FRAME)
		BLANK DOOR(S)
		W/ STAINLESS BALL BEARING HINGES W/ NRP AND WEATHERSTRIPPING
		FURNISH DOORS WITH SCHLAGE B660P SINGLE CYLINDER DEADBOLTS w/ INSIDE THUMBTURN, 626 SATIN CHROME FINISH AND DON-JO #CFK7115 PULL PLATES w/ DEADBOLT HOLE AND 3/4" ROUND PULL 6" CTC. PUSH PLATE ON INSIDE TO BE DON-JO #CFK71. PULL & PUSH PLATES TO HAVE US32D/630 STAINLESS STEEL FINISH. FURNISH DOOR SWEEPS & CLOSERS. ALL DOOR HARDWARE AND LOUVERS TO BE MARINE GRADE.
		PEMCO THRESHOLDS AND DOOR SWEEPS ON ALL DOORS
		(1) MARINE GRADE STOREROOM DOOR WITH STAY CHAIN ONLY
		(2) MARINE GRADE CABIN DOOR WITH LCN CLOSER 4040XP CUSH-N-STOP (GRADE I)
		(2) MARINE GRADE CABIN DOOR WITH TICE 34X10 INTERIOR KICKPLATE ON PUSH SIDE
		(2) MARINE GRADE DOOR WITH 24"WX12"H OPERABLE DOOR LOUVER GRILLES
	MISC.:	CONTRACTOR SHALL COORDINATE KEYING OF LOCKS WITH PARK MANAGER.
		QTY OF (3)
	INT DOOR:	NONE
	WINDOWS:	
	SIZE:	24" X 32" HORIZONTAL ARCYLIC BLOCK (RATED TO 150MPH) HY-LITE LINE PRODUCT
		WINDOWS RATED TO MEET 150 MPH WIND SPEED
	GLAZING:	INSUL. GLASS BLOCK GLAZING (OBSCURE GLASS)
	INT. TRIM:	FRP W/ OUTSIDE CORNER TRIM ONLY
	BLINDS:	NONE
		QTY OF (2)
	ELECTRICAL:	120V SOLAR ELECTRIC ONLY
	SES SYSTEM:	CUSTOM QUOTE FOR ENTIRE SES SYSTEM
	MISC.:	(4) "LUMERA" SOLAR 220W M6 BIFACIAL MONOCRYSTALLINE SOLAR PANEL
	MISC.:	RAILS, MOUNTING COMPONENTS FOR 4 SOLAR PANELS
	MISC	VICTRON ENERGY SMART SOLAR MPPT 150/60-TR CHARGE CONTROLLER
	MISC.:	(1) VICTRON BATTERY MONITOR BMV-712 BLACK SMART BLUETOOTH MONITOR
	MISC:	(1) VICTRON ENERGY BATTERY SWITCH ON/OFF 275 A
	MISC.:	(2) VICTRON ENERGY 12V/165 AH GEL DEEP CYCLE BATT
	MISC:	(1) DIHOOL 60 AMP SOLAR DISCONNECT SWITCH AC DC UNIVERSAL MINI CIRC BREAKERS
		2 POLE DIN RAIL MOUNT DC CIRCUIT BREAKER

	MISC.:	(1) DIHOOL 120 AMP SOLAR DISCONNECT SWITCH AC DC UNIVERSAL MINI CIRC BREAKERS
		12-400 V POLE SOLAR

	MISC:	5 WAY DISTRIBUTION PROTECTION BOX, ABS/PC ALLOY TRANS COVER IP66 W.DIN RAIL
	MISC	LABOR TO INSTALL AT WHITLEY MANUFACTURING PLANT
	MISC	RV ROOF BOX ALL WIRE, BATTERY CABL, DELIVERY, ASSEMBLY
	MISC:	ELECRIC HANDRYERS
	MISC.:	BATTERY CUSTOM HOUSING PRVIDED BY WHITLEY
	MISC.:	GROUNDING BLOCK W/ WIRE TO FRAME BY MFR. (GROUNDING OF BLDG. AT SITE IS BY OTHERS)
	WIRING:	LOW VOLTAGE WIRING ONLY FOR ITEMS NOTED ABOVE
	INT. LIGHTS	HARRIS 300 CP INC OR EQUAL (NO DECOR PACK) WITH 12VDC A19 LED BULB 12 WATT QTY OF (3)
	EXT. LIGHTS	HARRIS 300 CP INC OR EQUAL W/ DECOR PACK WITH 12VDC A19 LED BULB 12 WATT QTY OF (2) (LOCATED IN THE MECHANICAL ROOM)
	SWITCHES:	110V 20 AMP (TOGGLE ONLY IN MECH. ROOM)
	SWITCHES:	12V OCCUPANCY SENSOR FOR RESTROOM LIGHT
	PLUMBING:	
	WTR CLST:	CHINA TANK TYPE (1-HANDICAPPED) W/ TANK LID GUARD & OPEN FRONT SEAT AND SEAL (STEALTH BY NIAGARA 0.8 GPF SINGLE BUTTON FLUSH) WITH TANK LID RESTRAINT ANGLE BOLTED TO THE WALL QTY OF (2)
	URINAL:	VIRTUOUS CHINA URINAL KOHLER K-4991-ER
	MISC.:	EXPOSED URINAL FLUSH VALVE SLOAN ROYAL 186- .125 GPF QTY OF (2)
	LAVATORY:	CHINA WALL HUNG (HANDICAPPED) (PRO-FLO #PF5411WH 19"X17" CHINA WALL HUNG) WITH SLOAN METERED FAUCET (2)
	WATER HTR.:	12 VOLT WATER HEATER
	MISC.:	SINK TRAP GUARD QTY OF (2)
	MISC.:	QUAD CLOSE TRAP SEAL (SMITH #2692-02) FOR FLOOR DRAIN QTY OF (2)
	FLOOR DRAIN:	LOW PROFILE FLOOR DRAIN W/VENT ZURN ZN4512IP5BP (ZURN-Z451 W/ INTEGRAL SHALLOW TRAP) WITH TRAP PRIMER AND VENT AND LINE CAST IN FLOOR

		QTY OF (2)
	HOSE BIBB:	TAMPER PROOF EXTERIOR WOODFORD WALL HYDRANT B65P-CC
	HOSE BIBB:	FROST PROOF (1/2" WITH REMOVABLE HANDLE- "WOODFORD 24P")
		QTY OF (1)

	MISC.:	RIGID FOAM SUPPLY INSULATION IN THE MECHANICAL CHASE AS REQUIRED
	SUPPLY:	TYPE PEX (WITH (2) 3-WAY DRAIN VALVES FOR WINTERIZATION) (INSTALL DRAIN VALVES ON THE SUPPLY SIDE OF PUMPS)
	DWV:	SCH 40 PVC
		MULTIPLE DROPS W/ WASTE DROPS STUBBED THRU FLOOR FOR DISCHARGE
		DIRECTLY INTO WASTE SIDE OF VAULT (ANY REQ'D. MANIFOLDING BY OTHERS)
		TOP CAP FOR WASTE LEVEL MONITORING SENSORS (SENSORS BY GREENFLUSH.)
		(PVC MATERIAL FOR SENSOR SLEEVES IS TO BE THINNER "SEWER AND DRAIN" TYPE
	MISC:	PVC WASTE LEVEL INDICATOR- PER KEN'S DESIGN
	MISC:	WATER HAMMER ARRESTOR
	R.RM. ACCESS	TOILET PAPER HOLDER (DBL. ROLL- "ROYCE ROLLS TP2")
	R.RM. ACCESS	GRAB BARS (2) OF EACH SIZE 18, 36, 42
		QTY OF (6)
	R.RM. ACCESS	COAT HOOK- "B-212" (CONFIRM LOCATION ON WALL)
		QTY OF (2)
	R.RM. ACCESS	6"X8" BRUSHED ALUMINUM UNISEX RESTROOM SIGN ADJACENT TO DOOR (ADA)
		QTY OF (2)
	R.RM. ACCESS	SIGNAGE DECAL "DO NOT OPEN MANHOLE WHILE KNEELING"
	R.RM. ACCESS	"DANGER: CONFINED SPACE-DO NOT ENTER WITHOUT PROPER EQUIPMENT
		AND SUPPORT PERSONALE." SIGN AT MAN HOLE AREA.
	H.V.A.C.	NO AC OR HEAT IS INCLUDED
	VENTILATION	DUCTED FAN BETTER BOAT BRAND 12V 130 CFM 2.5A 270 CFM (6A)
		INSTALL IN MECHAN ROOM DUCT TO CABIN EXPELL TO WALL DIFFUSER
		INTO A TTHEN DAYLIGHT TO OUTSIDE WITH DIFUSER
	FURNISHINGS:	

		N/A
	MISC.:	(1) METAL FILE FOLDER FOR O/M MANUALS
	STATE LABELS:	TX
	CODES:	2015 IBC/ NM COMPLIANCE (NO ENERGY CODE COMPLIANCE)
	SEALED DWGS:	TX
	THIRD PARTY:	THIRD PARTY LABEL
NOTES:		USE GROUP UTILITY
		TYPE VB CONSTRUCTION (UNPROTECTED)
		OCCUPANT LOAD OF (2)
		MIN FIRE SEPARATION OF 11'
		(PROTECTED OPENINGS, IF REQUIRED ARE TO BE BY OTHERS)
		MANUFACTURERS LIMITED WARRANTY IS FOR 1
		YEAR FROM THE DATE OF THE MANUFACTURERS
		COMPLETION DATE ONLY.
		WHITLEY MFG. IS NOT RESPONSIBLE FOR LIQUIDATED DAMAGES.
		WHITLEY MFG. IS NOT RESPONSIBLE FOR LOCAL CODES.
		<u>EXCEPTIONS, NOTES, & CLARIFICATIONS:</u>
		WHITLEY STANDARD WARRANTY APPLIES UNLESS STATED OTHERWISE
		WARRANTY CLAIMS NOT REPORTED AND APPROVED WILL NOT BE CONSIDERED FOR REIMBURSEMENT.
		ALL WINDOWS AND DOORS WILL HAVE A VERTICAL BATTEN AT CORNERS FOR A CONTROL JOINT
		RESTROOM SHALL BE ENGINEERED FOR 150 MPH WIND SPEEDS.

END OF SECTION 321723

SECTION 312000 - EARTH MOVING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Excavating and filling for rough grading the Site.
 - 2. Preparing subgrades for, slabs-on-grade, walks, and pavements.
 - 3. Excavating and backfilling for buildings and structures.
 - 4. Subbase course for concrete walks.
 - 5. Subbase course base course for asphalt paving.

1.3 DEFINITIONS

- A. Backfill: Soil material or controlled low-strength material used to fill an excavation.
 - 1. Initial Backfill: Backfill placed beside and over pipe in a trench, including haunches to support sides of pipe.
 - 2. Final Backfill: Backfill placed over initial backfill to fill a trench.
- B. Base Course: Aggregate layer placed between the subbase course and hot-mix asphalt paving.
- C. Bedding Course: Aggregate layer placed over the excavated subgrade in a trench before laying pipe.
- D. Borrow Soil: Satisfactory soil imported from off-site for use as fill or backfill.
- E. Drainage Course: Aggregate layer supporting the slab-on-grade that also minimizes upward capillary flow of pore water.
- F. Excavation: Removal of material encountered above subgrade elevations and to lines and dimensions indicated.
- G. Fill: Soil materials used to raise existing grades.
- H. Structures: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below the ground surface.

- I. Subbase Course: Aggregate layer placed between the subgrade and base course for hot-mix asphalt pavement, or aggregate layer placed between the subgrade and a cement concrete pavement or a cement concrete or hot-mix asphalt walk.
- J. Subgrade: Uppermost surface of an excavation or the top surface of a fill or backfill immediately below subbase, drainage fill, drainage course, or topsoil materials.
- K. Utilities: On-site underground pipes, conduits, ducts, and cables as well as underground services within buildings.

1.4 FIELD CONDITIONS

- A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during earth-moving operations.
 - 1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
 - 2. Provide alternate routes around closed or obstructed traffic ways if required by Owner or authorities having jurisdiction.
- B. Do not commence earth-moving operations until temporary site fencing and erosion- and sedimentation-control measures specified are in place.
- C. Do not commence earth-moving operations until plant-protection measures specified in Section 015639 "Temporary Tree and Plant Protection" are in place.
- D. The following practices are prohibited within protection zones:
 - 1. Storage of construction materials, debris, or excavated material.
 - 2. Parking vehicles or equipment.
 - 3. Foot traffic.
 - 4. Erection of sheds or structures.
 - 5. Impoundment of water.
 - 6. Excavation or other digging unless otherwise indicated.
 - 7. Attachment of signs to or wrapping materials around trees or plants unless otherwise indicated.
- E. Do not direct vehicle or equipment exhaust towards protection zones.
- F. Prohibit heat sources, flames, ignition sources, and smoking within or near protection zones.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

- A. General: Provide borrow soil materials when sufficient satisfactory soil materials are not available from excavations.

- B. Satisfactory Soils: Soil Classification [Groups GW, GP, GM, SW, SP, and SM according to ASTM D 2487] [Groups A-1, A-2-4, A-2-5, and A-3 according to AASHTO M 145], or a combination of these groups; free of rock or gravel larger than 3 inches in any dimension, debris, waste, frozen materials, vegetation, and other deleterious matter.
- C. Unsatisfactory Soils: Soil Classification [Groups GC, SC, CL, ML, OL, CH, MH, OH, and PT according to ASTM D 2487] [Groups A-2-6, A-2-7, A-4, A-5, A-6, and A-7 according to AASHTO M 145], or a combination of these groups.
 - 1. Unsatisfactory soils also include satisfactory soils not maintained within 2 percent of optimum moisture content at time of compaction.
- D. Base Course: Crushed limestone base meeting TxDOT Item 247, Type A, Grade 1.

2.2 ACCESSORIES

- A. Warning Tape: Acid- and alkali-resistant, polyethylene film warning tape manufactured for marking and identifying underground utilities, 6 inches (150 mm) wide and 4 mils (0.1 mm) thick, continuously inscribed with a description of the utility; colored as follows:
 - 1. Red: Electric.
 - 2. Yellow: Gas, oil, steam, and dangerous materials.
 - 3. Orange: Telephone and other communications.
 - 4. Blue: Water systems.
 - 5. Green: Sewer systems.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earth-moving operations.
- B. Protect and maintain erosion and sedimentation controls during earth-moving operations.
- C. Protect subgrades and foundation soils from freezing temperatures and frost. Remove temporary protection before placing subsequent materials.

3.2 DEWATERING

- A. Prevent surface water and ground water from entering excavations, from ponding on prepared subgrades, and from flooding Project site and surrounding area.
- B. Protect subgrades from softening, undermining, washout, and damage by rain or water accumulation.

1. Reroute surface water runoff away from excavated areas. Do not allow water to accumulate in excavations. Do not use excavated trenches as temporary drainage ditches.

3.3 EXPLOSIVES

- A. Explosives: Do not use explosives.

3.4 EXCAVATION, GENERAL

- A. Unclassified Excavation: Excavate to subgrade elevations regardless of the character of surface and subsurface conditions encountered. Unclassified excavated materials may include rock, soil materials, and obstructions. No changes in the Contract Sum or the Contract Time will be authorized for rock excavation or removal of obstructions.

1. If excavated materials intended for fill and backfill include unsatisfactory soil materials and rock, replace with satisfactory soil materials.
2. Remove rock to lines and grades indicated to permit installation of permanent construction.

- B. Classified Excavation: Excavate to subgrade elevations. Material to be excavated will be classified as earth and rock. Do not excavate rock until it has been classified and cross sectioned by Architect. The Contract Sum will be adjusted for rock excavation according to unit prices included in the Contract Documents. Changes in the Contract Time may be authorized for rock excavation.

1. Earth excavation includes excavating pavements and obstructions visible on surface; underground structures, utilities, and other items indicated to be removed; and soil, boulders, and other materials not classified as rock or unauthorized excavation.
 - a. Intermittent drilling; blasting, if permitted; ram hammering; or ripping of material not classified as rock excavation is earth excavation.
2. Rock excavation includes removal and disposal of rock. Remove rock to lines and subgrade elevations indicated to permit installation of permanent construction.

3.5 EXCAVATION FOR STRUCTURES

- A. Excavate to indicated elevations and dimensions within a tolerance of plus or minus 1 inch. If applicable, extend excavations a sufficient distance from structures for placing and removing concrete formwork, for installing services and other construction, and for inspections.

1. Excavations for Footings and Foundations: Do not disturb bottom of excavation. Excavate by hand to final grade just before placing concrete reinforcement. Trim bottoms to required lines and grades to leave solid base to receive other work.

- B. Excavations at Edges of Tree- and Plant-Protection Zones:

1. Excavate by hand or with an air spade to indicated lines, cross sections, elevations, and subgrades. If excavating by hand, use narrow-tine spading forks to comb soil and expose

roots. Do not break, tear, or chop exposed roots. Do not use mechanical equipment that rips, tears, or pulls roots.

2. Cut and protect roots according to requirements in Section 015639 "Temporary Tree and Plant Protection."

3.6 EXCAVATION FOR WALKS AND PAVEMENTS

- A. Excavate surfaces under walks and pavements to indicated lines, cross sections, elevations, and subgrades.

3.7 EXCAVATION FOR UTILITY TRENCHES

- A. Excavate trenches to indicated gradients, lines, depths, and elevations.
 1. Beyond building perimeter, excavate trenches to allow installation of top of pipe below frost line.
- B. Excavate trenches to uniform widths to provide the following clearance on each side of pipe or conduit. Excavate trench walls vertically from trench bottom to 12 inches higher than top of pipe or conduit unless otherwise indicated.
- C. Trench Bottoms: Excavate and shape trench bottoms to provide uniform bearing and support of pipes and conduit. Shape subgrade to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits. Remove projecting stones and sharp objects along trench subgrade.
 1. For pipes and conduit less than 6 inches in nominal diameter, hand-excavate trench bottoms and support pipe and conduit on an undisturbed subgrade.
 2. For pipes and conduit 6 inches or larger in nominal diameter, shape bottom of trench to support bottom 90 degrees of pipe or conduit circumference. Fill depressions with tamped sand backfill.
 3. For flat-bottomed, multiple-duct conduit units, hand-excavate trench bottoms and support conduit on an undisturbed subgrade.
 4. Excavate trenches 6 inches deeper than elevation required in rock or other unyielding bearing material to allow for bedding course.
- D. Trench Bottoms: Excavate trenches 4 inches deeper than bottom of pipe and conduit elevations to allow for bedding course. Hand-excavate deeper for bells of pipe.
 1. Excavate trenches 6 inches deeper than elevation required in rock or other unyielding bearing material to allow for bedding course.
- E. Trenches in Tree- and Plant-Protection Zones:
 1. Hand-excavate to indicated lines, cross sections, elevations, and subgrades. Use narrow-tine spading forks to comb soil and expose roots. Do not break, tear, or chop exposed roots. Do not use mechanical equipment that rips, tears, or pulls roots.
 2. Do not cut main lateral roots or taproots; cut only smaller roots that interfere with installation of utilities.

3. Cut and protect roots according to requirements in Section 015639 "Temporary Tree and Plant Protection."

3.8 SUBGRADE INSPECTION

- A. Notify Architect when excavations have reached required subgrade.
- B. If Architect determines that unsatisfactory soil is present, continue excavation and replace with compacted backfill or fill material as directed.
- C. Proof-roll subgrade below the building slabs and pavements with a pneumatic-tired and loaded 10-wheel, tandem-axle dump truck weighing not less than 15 tons to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.
 1. Completely proof-roll subgrade in one direction, repeating proof-rolling in direction perpendicular to first direction. Limit vehicle speed to 3 mph.
 2. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by Architect, and replace with compacted backfill or fill as directed.
- D. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by Architect, without additional compensation.

3.9 UNAUTHORIZED EXCAVATION

- A. Fill unauthorized excavation under foundations or wall footings by extending bottom elevation of concrete foundation or footing to excavation bottom, without altering top elevation. Lean concrete fill, with 28-day compressive strength of 2500 psi, may be used when approved by Architect.
 1. Fill unauthorized excavations under other construction, pipe, or conduit as directed by Architect.

3.10 STORAGE OF SOIL MATERIALS

- A. Stockpile borrow soil materials and excavated satisfactory soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
 1. Stockpile soil materials away from edge of excavations. Do not store within drip line of remaining trees.

3.11 BACKFILL

- A. Place and compact backfill in excavations promptly, but not before completing the following:
 1. Construction below finish grade including, where applicable, subdrainage, damp proofing, waterproofing, and perimeter insulation.
 2. Surveying locations of underground utilities for Record Documents.
 3. Testing and inspecting underground utilities.

4. Removing concrete formwork.
5. Removing trash and debris.
6. Removing temporary shoring, bracing, and sheeting.
7. Installing permanent or temporary horizontal bracing on horizontally supported walls.

B. Place backfill on subgrades free of mud, frost, snow, or ice.

3.12 SOIL FILL

A. Plow, scarify, bench, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so fill material will bond with existing material.

B. Place and compact fill material in layers to required elevations as follows:

1. Under grass and planted areas, use satisfactory soil material.
2. Under walks and pavements, use satisfactory soil material.
3. Under steps and ramps, use engineered fill.
4. Under building slabs, use engineered fill.
5. Under footings and foundations, use engineered fill.

C. Place soil fill on subgrades free of mud, frost, snow, or ice.

3.13 SOIL MOISTURE CONTROL

A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill soil layer before compaction to within 2 percent of optimum moisture content.

1. Do not place backfill or fill soil material on surfaces that are muddy, frozen, or contain frost or ice.
2. Remove and replace, or scarify and air dry, otherwise satisfactory soil material that exceeds optimum moisture content by 2 percent and is too wet to compact to specified dry unit weight.

3.14 COMPACTION OF SOIL BACKFILLS AND FILLS

A. Place backfill and fill soil materials in layers not more than 8 inches in loose depth for material compacted by heavy compaction equipment and not more than 4 inches in loose depth for material compacted by hand-operated tampers.

B. Place backfill and fill soil materials evenly on all sides of structures to required elevations and uniformly along the full length of each structure.

C. Compact soil materials to not less than the following percentages of maximum dry unit weight according to ASTM D 698:

1. Under structures, building slabs, steps, and pavements, scarify and recompact top 12 inches (300 mm) of existing subgrade and each layer of backfill or fill soil material at 95 percent.

2. Under walkways, scarify and recompact top 6 inches below subgrade and compact each layer of backfill or fill soil material at 92 percent.
3. Under turf or unpaved areas, scarify and recompact top 6 inches below subgrade and compact each layer of backfill or fill soil material at 85 percent.
4. For utility trenches, compact each layer of initial and final backfill soil material at 85 percent.

3.15 GRADING

- A. General: Uniformly grade areas to a smooth surface, free of irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.
 1. Provide a smooth transition between adjacent existing grades and new grades.
 2. Cut out soft spots, fill low spots, and trim high spots to comply with required surface tolerances.
- B. Site Rough Grading: Slope grades to direct water away from buildings and to prevent ponding. Finish subgrades to elevations required to achieve indicated finish elevations, within the following subgrade tolerances:
 1. Turf or Unpaved Areas: Plus or minus 1 inch.
 2. Walks: Plus or minus 1 inch.
 3. Pavements: Plus or minus 1/2 inch.
- C. Grading inside Building Lines: Finish subgrade to a tolerance of 1/2 inch when tested with a 10-foot (3-m) straightedge.

3.16 SUBBASE AND BASE COURSES UNDER PAVEMENTS AND WALKS

- A. Place subbase course and base course on subgrades free of mud, frost, snow, or ice.
- B. On prepared subgrade, place subbase course and base course under pavements and walks as follows:
 1. Install separation geotextile on prepared subgrade according to manufacturer's written instructions, overlapping sides and ends.
 2. Place base course material over subbase course under hot-mix asphalt pavement.
 3. Shape subbase course and base course to required crown elevations and cross-slope grades.
 4. Place subbase course and base course 6 inches or less in compacted thickness in a single layer.
 5. Place subbase course and base course that exceeds 6 inches in compacted thickness in layers of equal thickness, with no compacted layer more than 6 inches thick or less than 3 inches thick.
 6. Compact subbase course at optimum moisture content to required grades, lines, cross sections, and thickness to not less than 95 percent of maximum dry unit weight according to ASTM D 698.

- C. Pavement Shoulders: Place shoulders along edges of subbase course and base course to prevent lateral movement. Construct shoulders, at least 12 inches wide, of satisfactory soil materials and compact simultaneously with each subbase and base layer to not less than 95percent of maximum dry unit weight according to ASTM D 698.

3.17 DRAINAGE COURSE UNDER CONCRETE SLABS-ON-GRADE

- A. Place drainage course on subgrades free of mud, frost, snow, or ice.
- B. On prepared subgrade, place and compact drainage course under cast-in-place concrete slabs-on-grade as follows:
 - 1. Install subdrainage geotextile on prepared subgrade according to manufacturer's written instructions, overlapping sides and ends.
 - 2. Place drainage course 6 inches or less in compacted thickness in a single layer.
 - 3. Place drainage course that exceeds 6 inches in compacted thickness in layers of equal thickness, with no compacted layer more than 6 inches thick or less than 3 inches thick.
 - 4. Compact each layer of drainage course to required cross sections and thicknesses to not less than 95 percent of maximum dry unit weight according to ASTM D 698.

3.18 FIELD QUALITY CONTROL

- A. Special Inspections: Owner will engage a qualified special inspector to perform the following special inspections:
 - 1. Determine prior to placement of fill that site has been prepared in compliance with requirements.
 - 2. Determine that fill material classification and maximum lift thickness comply with requirements.
 - 3. Determine, during placement and compaction, that in-place density of compacted fill complies with requirements.
- B. Testing Agency: Owner will engage a qualified geotechnical engineering testing agency to perform tests and inspections.
- C. Allow testing agency to inspect and test subgrades and each fill or backfill layer. Proceed with subsequent earth moving only after test results for previously completed work comply with requirements.
- D. Footing Subgrade: At footing subgrades, at least one test of each soil stratum will be performed to verify design bearing capacities. Subsequent verification and approval of other footing subgrades may be based on a visual comparison of subgrade with tested subgrade when approved by Architect.
- E. Testing agency will test compaction of soils in place according to ASTM D 1556, ASTM D 2167, ASTM D 2937, and ASTM D 6938, as applicable. Tests will be performed at the following locations and frequencies:

1. Paved and Building Slab Areas: At subgrade and at each compacted fill and backfill layer, at least one test for every 2000 sq. ft. or less of paved area or building slab but in no case fewer than three tests.
 2. Foundation Wall Backfill: At each compacted backfill layer, at least one test for every 100 feet or less of wall length but no fewer than two tests.
 3. Trench Backfill: At each compacted initial and final backfill layer, at least one test for every 150 feet or less of trench length but no fewer than two tests.
- F. When testing agency reports that subgrades, fills, or backfills have not achieved degree of compaction specified, scarify and moisten or aerate, or remove and replace soil materials to depth required; recompact and retest until specified compaction is obtained.

3.19 PROTECTION

- A. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.
- B. Repair and reestablish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions.
1. Scarify or remove and replace soil material to depth as directed by Architect; reshape and recompact.
- C. Where settling occurs before Project correction period elapses, remove finished surfacing, backfill with additional soil material, compact, and reconstruct surfacing.
1. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to greatest extent possible.

3.20 DISPOSAL OF SURPLUS AND WASTE MATERIALS

- A. Remove surplus satisfactory soil and waste materials, including unsatisfactory soil, trash, and debris, and legally dispose of them off Owner's property.
- B. Transport surplus satisfactory soil to designated storage areas on Owner's property. Stockpile or spread soil as directed by Architect.
1. Remove waste materials, including unsatisfactory soil, trash, and debris, and legally dispose of them off Owner's property.

END OF SECTION 312000

SECTION 321313 - CONCRETE PAVING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Concrete paving and walkways.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Other Action Submittals:
 - 1. Design Mixtures: For each concrete paving mixture. Include alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

1.4 INFORMATIONAL SUBMITTALS

- A. Material Certificates: For the following, from manufacturer:
 - 1. Cementitious materials.
 - 2. Steel reinforcement and reinforcement accessories.
 - 3. Admixtures.
 - 4. Curing compounds.
 - 5. Applied finish materials.
 - 6. Bonding agent or epoxy adhesive.
 - 7. Joint fillers.

1.5 QUALITY ASSURANCE

- A. Ready-Mix-Concrete Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.

1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities" (Quality Control Manual - Section 3, "Plant Certification Checklist").
- B. Testing Agency Qualifications: Qualified according to ASTM C 1077 and ASTM E 329 for testing indicated.
 1. Personnel conducting field tests shall be qualified as ACI Concrete Field-Testing Technician, Grade 1, according to ACI CP-1 or an equivalent certification program.
- C. Concrete Testing Service: Engage a qualified testing agency to perform material evaluation tests and to design concrete mixtures.

1.6 PROJECT CONDITIONS

- A. Traffic Control: Maintain access for vehicular and pedestrian traffic as required for other construction activities.

PART 2 - PRODUCTS

2.1 FORMS

- A. Form Materials: Plywood, metal, metal-framed plywood, or other approved panel-type materials to provide full-depth, continuous, straight, and smooth exposed surfaces.
 1. Use flexible or uniformly curved forms for curves. Do not use notched and bent forms.
- B. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and that will not impair subsequent treatments of concrete surfaces.

2.2 STEEL REINFORCEMENT

- A. Deformed-Steel Welded Wire Reinforcement: ASTM A 497/A 497M, flat sheet.
- B. Reinforcing Bars: ASTM A 615/A 615M, Grade 60; deformed.
- C. Deformed-Steel Wire: ASTM A 496/A 496M.
- D. Joint Dowel Bars: ASTM A 615/A 615M, Grade 60 plain-steel bars. Cut bars true to length with ends square and free of burrs.
- E. Tie Bars: ASTM A 615/A 615M, Grade 60, deformed.
- F. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars, welded wire reinforcement, and dowels in place. Manufacture bar supports according to CRSI's "Manual of Standard Practice" from steel wire, plastic, or precast concrete of greater compressive strength than concrete specified, and as follows:

1. Equip wire bar supports with sand plates or horizontal runners where base material will not support chair legs.
2. For epoxy-coated reinforcement, use epoxy-coated or other dielectric-polymer-coated wire bar supports.

2.3 CONCRETE MATERIALS

- A. Cementitious Material: Use the following cementitious materials, of same type, brand, and source throughout Project:
 - a. Portland Cement: ASTM C 150, gray portland cement.
- B. Normal-Weight Aggregates: ASTM C 33, uniformly graded. Provide aggregates from a single source.
 1. Maximum Coarse-Aggregate Size: 3/4-inch nominal.
 2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.
- C. Water: Potable and complying with ASTM C 94/C 94M.
- D. Air-Entraining Admixture: ASTM C 260.
- E. Chemical Admixtures: Admixtures certified by manufacturer to be compatible with other admixtures and to contain not more than 0.1 percent water-soluble chloride ions by mass of cementitious material.
 1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
 2. Retarding Admixture: ASTM C 494/C 494M, Type B.
 3. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
 4. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.
 5. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.
 6. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017M, Type II.

2.4 CURING MATERIALS

- A. Absorptive Cover: AASHTO M 182, Class 3, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. dry or cotton mats.
- B. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.
- C. Water: Potable.
- D. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, dissipating.

2.5 RELATED MATERIALS

- A. Joint Fillers: ASTM D 1751, asphalt-saturated cellulosic fiber or ASTM D 1752, cork or self-expanding cork in preformed strips.

- B. Expansion Joint Sealant: Masterseal SL-1 sealant, limestone color, or approved equal.
- C. Expansion Joint Cap: ½” Snap-Cap Expansion Joint Cap or approved equal.

2.6 CONCRETE MIXTURES.

- A. Prepare design mixtures, proportioned according to ACI 301, for each type and strength of normal-weight concrete, and as determined by either laboratory trial mixtures or field experience.
 - 1. Use a qualified independent testing agency for preparing and reporting proposed concrete design mixtures for the trial batch method.
 - 2. When automatic machine placement is used, determine design mixtures and obtain laboratory test results that meet or exceed requirements.
- B. Proportion mixtures to provide normal-weight concrete with the following properties:
 - 1. Compressive Strength (28 Days): 4000 psi.
 - 2. Maximum Water-Cementitious Materials Ratio at Point of Placement: 0.50.
 - 3. Slump Limit: 4 inches, plus or minus 1 inch.

2.7 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, and mix concrete materials and concrete according to ASTM C 94/C 94M. Furnish batch certificates for each batch discharged and used in the Work.
 - 1. When air temperature is between 85 and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine exposed subgrades and subbase surfaces for compliance with requirements for dimensional, grading, and elevation tolerances.
- B. Proof-roll prepared subbase surface below concrete paving to identify soft pockets and areas of excess yielding.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Remove loose material from compacted subbase surface immediately before placing concrete.

3.3 EDGE FORMS AND SCREED CONSTRUCTION

- A. Set, brace, and secure edge forms, bulkheads, and intermediate screed guides to required lines, grades, and elevations. Install forms to allow continuous progress of work and so forms can remain in place at least 24 hours after concrete placement.
- B. Clean forms after each use and coat with form-release agent to ensure separation from concrete without damage.

3.4 STEEL REINFORCEMENT

- A. General: Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.
- B. Clean reinforcement of loose rust and mill scale, earth, ice, or other bond-reducing materials.
- C. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during concrete placement. Maintain minimum cover to reinforcement.
- D. Install welded wire reinforcement in lengths as long as practicable. Lap adjoining pieces at least one full mesh and lace splices with wire. Offset laps of adjoining widths to prevent continuous laps in either direction.
- E. Install fabricated bar mats in lengths as long as practicable. Handle units to keep them flat and free of distortions. Straighten bends, kinks, and other irregularities, or replace units as required before placement. Set mats for a minimum 2-inch overlap of adjacent mats.

3.5 JOINTS

- A. General: Form construction, isolation, and contraction joints and tool edges true to line, with faces perpendicular to surface plane of concrete. Construct transverse joints at right angles to centerline unless otherwise indicated.
 - 1. When joining existing paving, place transverse joints to align with previously placed joints unless otherwise indicated.
- B. Construction Joints: Set construction joints at side and end terminations of paving and at locations where paving operations are stopped for more than one-half hour unless paving terminates at isolation joints.
 - 1. Continue steel reinforcement across construction joints unless otherwise indicated. Do not continue reinforcement through sides of paving strips unless otherwise indicated.
 - 2. Provide tie bars at sides of paving strips where indicated.
 - 3. Butt Joints: Use bonding agent at joint locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
 - 4. Keyed Joints: Provide preformed keyway-section forms or bulkhead forms with keys unless otherwise indicated. Embed keys at least 1-1/2 inches into concrete.

Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or coat with asphalt one-half of dowel length to prevent concrete bonding to one side of joint.

- C. Contraction Joints: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of the concrete thickness, as follows:
1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint with grooving tool to a 1/4-inch or 3/8-inch radius. Repeat grooving of contraction joints after applying surface finishes. Eliminate grooving-tool marks on concrete surfaces.
 - a. Tolerance: Ensure that grooved joints are within 3 inches either way from centers of dowels.
 2. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch-wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before developing random contraction cracks.
 - a. Tolerance: Ensure that sawed joints are within 3 inches either way from centers of dowels.
- D. Expansion Joints: Install doweled 1/2" asphalt expansion joints at where indicated. Lubricate or coat with asphalt one-half of dowel length to prevent concrete bonding to one side of joint. Cap top of asphalt expansion joint with 1/2" Snap-Cap Expansion Joint Cap. After concrete has cured remove top of Snap-Cap and seal top of joint limestone color Masterseal SL-1 sealant.
- E. Edging: After initial floating, tool edges of paving, gutters, curbs, and joints in concrete with an edging tool to a 1/4-inch or 3/8-inch radius. Repeat tooling of edges after applying surface finishes. Eliminate edging-tool marks on concrete surfaces.

3.6 CONCRETE PLACEMENT

- A. Before placing concrete, inspect and complete formwork installation, steel reinforcement, and items to be embedded or cast-in.
- B. Remove snow, ice, or frost from subbase surface before placing concrete. Do not place concrete on frozen surfaces.
- C. Moisten subbase to provide a uniform dampened condition at time concrete is placed. Do not place concrete around manholes or other structures until they are at required finish elevation and alignment.
- D. Comply with ACI 301 requirements for measuring, mixing, transporting, and placing concrete.
- E. Do not add water to concrete during delivery or at Project site. Do not add water to fresh concrete after testing.

- F. Deposit and spread concrete in a continuous operation between transverse joints. Do not push or drag concrete into place or use vibrators to move concrete into place.
- G. Consolidate concrete according to ACI 301 by mechanical vibrating equipment supplemented by hand spading, rodding, or tamping.
 - 1. Consolidate concrete along face of forms and adjacent to transverse joints with an internal vibrator. Keep vibrator away from joint assemblies, reinforcement, or side forms. Use only square-faced shovels for hand spreading and consolidation. Consolidate with care to prevent dislocating reinforcement dowels and joint devices.
- H. Screed paving surface with a straightedge and strike off.
- I. Commence initial floating using bull floats or darbies to impart an open-textured and uniform surface plane before excess moisture or bleed water appears on the surface. Do not further disturb concrete surfaces before beginning finishing operations or spreading surface treatments.
- J. Curbs and Gutters: Use design mixture for automatic machine placement. Produce curbs and gutters to required cross section, lines, grades, finish, and jointing.
- K. Slip-Form Paving: Use design mixture for automatic machine placement. Produce paving to required thickness, lines, grades, finish, and jointing.
 - 1. Compact subbase and prepare subgrade of sufficient width to prevent displacement of slip-form paving machine during operations.
- L. Cold-Weather Placement: Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing, or low temperatures. Comply with ACI 306.1 and the following:
 - 1. When air temperature has fallen to or is expected to fall below 40 deg F, uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 deg F and not more than 80 deg F at point of placement.
 - 2. Do not use frozen materials or materials containing ice or snow.
 - 3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in design mixtures.
- M. Hot-Weather Placement: Comply with ACI 301 and as follows when hot-weather conditions exist:
 - 1. Cool ingredients before mixing to maintain concrete temperature below 90 deg F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated in total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
 - 2. Cover steel reinforcement with water-soaked burlap so steel temperature will not exceed ambient air temperature immediately before embedding in concrete.
- N. General: Do not add water to concrete surfaces during finishing operations.
- O. Float Finish: Begin the second floating operation when bleed-water sheen has disappeared and concrete surface has stiffened sufficiently to permit operations. Float surface with power-driven

floats or by hand floating if area is small or inaccessible to power units. Finish surfaces to true planes. Cut down high spots and fill low spots. Refloat surface immediately to uniform granular texture.

1. Medium-to-Fine-Textured Broom Finish: Draw a soft-bristle broom across float-finished concrete surface perpendicular to line of traffic to provide a uniform, fine-line texture.

3.7 CONCRETE PROTECTION AND CURING

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.
- B. Comply with ACI 306.1 for cold-weather protection.
- C. Evaporation Retarder: Apply evaporation retarder to concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete but before float finishing.
- D. Begin curing after finishing concrete but not before free water has disappeared from concrete surface.
- E. Curing Methods: Cure concrete by:
 1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:
 - a. Water.
 - b. Continuous water-fog spray.
 - c. Absorptive cover, water saturated and kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers.

3.8 PAVING TOLERANCES

- A. Comply with tolerances in ACI 117 and as follows:
 1. Elevation: 3/4 inch.
 2. Thickness: Plus 3/8-inch, minus 1/4 inch.
 3. Lateral Alignment and Spacing of Dowels: 1 inch.
 4. Vertical Alignment of Dowels: 1/4 inch.
 5. Joint Spacing: 3 inches.
 6. Contraction Joint Depth: Plus 1/4 inch, no minus.
 7. Joint Width: Plus 1/8 inch, no minus.

3.9 FIELD QUALITY CONTROL

- A. Testing and Inspections: Owner will engage a qualified testing agency to perform construction testing. Construction inspections and inspection reports will be provided by TPWD inspector.

- B. Testing Services: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:
1. Testing Frequency: Obtain at least one composite sample for each 5000 sq. ft. or fraction thereof of each concrete mixture placed each day.
 - a. When frequency of testing will provide fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.
 2. Slump: ASTM C 143/C 143M; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.
 3. Air Content: ASTM C 231, pressure method; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
 4. Concrete Temperature: ASTM C 1064/C 1064M; one test hourly when air temperature is 40 deg F and below and when it is 80 deg F and above, and one test for each composite sample.
 5. Compression Test Specimens: ASTM C 31/C 31M; cast and laboratory cure one set of three standard cylinder specimens for each composite sample.
- C. Strength of each concrete mixture will be satisfactory if average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi.
- D. Test results shall be reported in writing to Architect, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.
- E. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.
- F. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect.
- G. Concrete paving will be considered defective if it does not pass tests and inspections.
- H. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
- I. Prepare test and inspection reports.

3.10 REPAIRS AND PROTECTION

- A. Remove and replace concrete paving that is broken, damaged, or defective or that does not comply with requirements in this Section. Remove work in complete sections from joint to joint unless otherwise approved by Architect.
- B. Drill test cores, where directed by Architect, when necessary to determine magnitude of cracks or defective areas. Fill drilled core holes in satisfactory paving areas with portland cement concrete bonded to paving with epoxy adhesive.
- C. Protect concrete paving from damage. Exclude traffic from paving for at least 14 days after placement. When construction traffic is permitted, maintain paving as clean as possible by removing surface stains and spillage of materials as they occur.
- D. Maintain concrete paving free of stains, discoloration, dirt, and other foreign materials. Sweep paving not more than two days before date scheduled for Substantial Completion inspections.

END OF SECTION 321313

DIVISION 32 - EXTERIOR IMPROVEMENTS

SECTION 321723 - PAVEMENT MARKINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions apply to this Section.

1.2 SUMMARY

- A. Section includes painted markings applied to concrete pavement.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include technical data and tested physical and performance properties.

1.4 FIELD CONDITIONS

- A. Environmental Limitations: Proceed with pavement marking only on clean, dry surfaces and at a minimum ambient or surface temperature of 40 degrees F and not exceeding 95 degrees F.

PART 2 - PRODUCTS

2.1 PAVEMENT-MARKING PAINT

- A. Pavement-Marking Paint: MPI #32, alkyd traffic-marking paint.
 - 1. Color: As specified on drawings.
- B. Glass Beads: AASHTO M 247, Type 1.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that pavement is dry and in suitable condition to begin pavement marking according to manufacturer's written instructions.

- B. Proceed with pavement marking only after unsatisfactory conditions have been corrected.

3.2 PAVEMENT MARKING

- A. Do not apply pavement-marking paint until layout, colors, and placement have been verified with TPWD inspector.
- B. Allow paving to age for a minimum of 30 days before starting pavement marking or after manufacturer certifies the volatiles have dissipated or the paint is not affected.
- C. Sweep and clean surface to eliminate loose material and dust.
- D. Apply paint with mechanical equipment to produce pavement markings, of dimensions indicated, with uniform, straight edges. Apply at manufacturer's recommended rates to provide a minimum wet film thickness of 15 mils.
 - 1. Apply graphic symbols and lettering with paint-resistant, die-cut stencils, firmly secured to pavement. Mask an extended area beyond edges of each stencil to prevent paint application beyond the stencil. Apply paint so that it cannot run beneath the stencil.
 - 2. Broadcast glass beads uniformly into wet markings at a rate of 6 lb. /gal.
 - 3. Replace asphalt and restripe if the paints curls and lifts any asphalt.

3.3 PROTECTING AND CLEANING

- A. Protect pavement markings from damage and wear during remainder of construction period.
- B. Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION 321723