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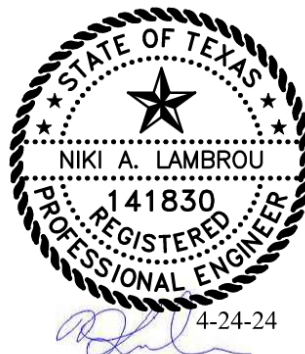
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SECTION 022000

GENERAL REQUIREMENTS FOR CONCRETE REPAIR

PART 1 – GENERAL

1.1 SUMMARY

- A. General requirements for kettle concrete repair.

PART 2 – PRODUCTS

2.1 MATERIALS

- A. The Contractor shall supply all materials necessary for the repair and restoration of deteriorated concrete areas. In general the work shall consist of furnishing all labor, equipment, materials, and incidentals necessary to renovate the existing concert kettles and shall consist of:
 - 1) Cleaning and prepping all surfaces with high pressure water including removing all debris.
 - 2) Removing the deteriorated concrete as shown and described on the Drawings and in this Specification, including saw cutting the perimeter of the repair area.
 - 3) Preparing the surface of the concrete for the repair, including abrasive cleaning, cleaning of existing reinforcement, and applying bonding agent to the surface.
 - 4) Supplying materials and the mixing and placing of concrete repair mortar or concrete as shown and described on the Drawings and in this Specification including vibrating, finishing and curing. All repair material shall be NSF 64 approved.
 - 5) Supplying, fabricating, constructing, maintaining and removing temporary works, including falsework and formwork.
- B. The intent of the project is for the contractor to work closely with the engineer and supplier in determine the exact repair method for each kettle.
- C. During the shop submittal process the contractor shall submit their intended patching and repair methods and specific products that will be used for each kettle.
- D. Prior to the start of any work the contractor shall coordinate all staging and storage areas, truck routes, concrete washout areas and work times with the TPWD Construction Manager.
- E. During the performance of work the contractor shall coordinate all work with the material supplier closely.
- F. Photograph all repairs areas immediately prior to and after making repairs. Note pond number on pictures. All photographs shall be submitted to TPWD upon the completion of work in a binder with the photographs labeled.

2.2 PREPARATION OF AREAS TO BE REPAIRED

- A. Pressure wash and clean all concrete prior to the start including areas not to be repaired.
- B. All loose, cracked or otherwise unsuitable or defective concrete shall be removed from the existing structure. The final extent of removal shall be determined by TPWD after inspection of prepared surfaces.
- C. Feathered edges at the surface are not permitted. The surface edge of the repaired area shall be cut

with a saw, drilled, or chipped to leave a sharp edge with a minimum of a 0.75-inch depth face perpendicular to the face.

- D. The top side of the repairs shall be shaped to a uniform, fairly straight face that is sloped upward on a 1-inch rise for each 3 inches of depth of cut toward the face from which the repair material will be placed. The repair area shall be conical in shape with the large end at the surface from which repair material will be placed.
- E. The bottom and vertical or near vertical sides of repairs shall be cut sharply and approximately perpendicular to the face of the wall. All interior corners shall be rounded to a minimum radius of 1 inch.
- F. Where reinforcement is encountered, the concrete directly in contact with the sides of the reinforcement shall be removed to provide at least 1-inch clear distance between the reinforcement and the in place concrete. Refer to specifications and details for exact distances.
- G. Before the concrete repair material is placed, all oil and grease shall be steam or solvent cleaned from all reinforcement and surfaces to which the repair material is required to bond. If solvent cleaning is used, solvents and solvent residue shall not impair the repair material or its bonding strengths.
- H. After removal of all oil and grease, the reinforcement shall be cleaned to remove any loose, flaky rust, mill scale, and other coatings or foreign substances that would impair bonding of the repair material to the reinforcement. The prepared faces of the repair hole shall be cleaned by high pressure water jets or compressed air jetting with water to remove all loose particles and dust. The repair hole shall be free of chips, sawdust, debris, free water, ice, snow, or other harmful substances or coat.
- I. If any of the above preparation works contradicts the manufacturers' recommendation report discrepancies to the engineer immediately.

2.3 SELECTION OF CONCRETE REPAIR MATERIAL

- A. Only one brand of concrete repair material shall be used in any single repair operation unless compatibility between brands can be proven with actual test or performance data.
- B. A conventional concrete mix to be used as a replacement concrete repair material shall be ready-mix concrete that meets all the specified salient features for repair material and conforms to ASTM C94. Option A from section 5 of ASTM C94 shall apply.
- C. The contractor is responsible for the selection and proper application of the concrete repair material. At least 14 days before installation, the contractor shall provide the engineer for approval all technical data for the repair material. The technical data shall include the design mix and test results to verify satisfactory conformance to the salient feature requirements. If a proprietary material is used, the manufacturer's recommended preparation, use, and installation specifications shall also be submitted 14 days before installation. Concrete repair material shall not be placed before approval. The contractor shall have the manufacturer's representative onsite to observe the application of their product for one day.

2.4 FORMS

- A. Forming material shall be wood, plywood, steel, or other approved material and shall be mortar tight. The forms and associated falsework shall be substantial and unyielding and shall be constructed so that the finished repair conforms to the specified dimensions and contours. Form surfaces shall be smooth and free from holes, dents, sags, or other irregularities.
- B. Before the forms are set into place, the surface of the form shall be lined with plastic sheeting or coated with a nonstaining form release agent compatible with the repair material being used. This prevents bonding of the repair material to the forms. If the forms are lined with plastic, the plastic shall be stretched taut to remove all wrinkles and folds and maintain a smooth condition during the placement and curing of the repair material.
- C. Metal ties or anchorage within the forms shall be equipped with cones, she-bolts, or other devices that

permit their removal to a minimum depth of 1 inch without injury to the concrete or repair material. Ties designed to break off below the surface of the concrete shall not be used without cones.

- D. All visible edges and corners included in the repair location shall be shaped the same as adjacent or similar edges or corners of the structure being repaired.
- E. Forms shall be constructed to facilitate consolidation and complete filling of the repair void, and, when all surfaces are formed, to facilitate applying pressure to the repair material immediately after placement.

PART 3 - EXECUTION

3.1 MIXING, CONVEYING, AND PLACING

- A. Proprietary repair material shall be mixed and conveyed to the forms according to manufacturer's written recommendations. Material that cannot be placed within the manufacturer's time requirements shall not be placed in the forms and shall be discarded offsite at locations selected by the contractor.
- B. Concrete repair material shall not be placed until the subgrade, forms, and steel reinforcement have been repaired and inspected by TPWD.
- C. The contractor shall have all equipment and material required for curing available at the site ready for use before placement of repair material begins.
- D. The concrete repair material shall be deposited as closely as possible to its final position in the forms and shall be worked into the corners and angles of the forms and around all reinforcement and embedded items in a manner to prevent segregation of aggregates or excessive laitance. The depositing of repair material shall be regulated so that the material can be consolidated with a minimum of lateral movement.
- E. Unless otherwise approved, concrete repair material shall not be dropped from a height greater than recommended by the manufacturer or 5 feet, whichever is less.
- F. Unless otherwise specified, all concrete repair material required for each repair location shall be placed in one continuous operation. Successive layers or batches shall be placed at a rate sufficient to prevent setting of material between successive layers.
- G. At the time of placement of repair material, the existing concrete surface shall be damp and without free water unless otherwise specified or required by the manufacturer of the proprietary repair material being used.

3.2 CONSOLIDATING

- A. Concrete repair material shall be consolidated to ensure positive contact of repair material with all repair surfaces and reinforcing steel, to remove entrapped air pockets and voids, and to maximize the density of the repair material.
- B. Proprietary repair material shall be consolidated in accordance with the manufacturer's recommendations.
- C. Conventional concrete mix repair material shall be consolidated with internal type mechanical vibrators. Vibration shall be supplemented by spading, rodding, or hand tamping as necessary to ensure smooth and dense concrete along form surfaces, in corners, and around embedded items.
- D. The location, manner, and duration of the application of the vibrators shall be such as to secure maximum consolidation of the concrete repair material without causing segregation of the mortar and coarse aggregate and without causing water or cement paste to flush to the surface. Vibration shall compact the concrete repair material and bring it into intimate contact with the forms and embedded items while removing voids and pockets of entrapped air.
- E. The contractor shall provide sufficient vibrators to properly consolidate the concrete repair material

immediately after it is placed.

- F. The internal vibration of thin slabs (less than 9 inches) may be augmented using surface vibrators when approved by the engineer. Consolidation of the concrete repair material from the top surface down, along with a leveling effect to assist the finishing operation, may be provided by vibrating screeds, plate or grid vibratory tampers, or vibrating roller screeds. The contractor's plan, including equipment selection and specifications, shall be submitted during the shop submittal process.

3.3 REMOVAL OF FORMS

- A. Unless otherwise approved, forms shall not be removed sooner than the minimum time recommended by the manufacturer of the repair material or 48 hours, whichever is greater.
- B. Forms shall be removed in a manner to prevent damage to the concrete repair material. Supports shall be removed in a manner that permits the repair material to take the stresses caused by its own weight, uniformly and gradually.

3.4 FINISHING FORMED SURFACES

- A. All repaired surfaces shall be true and even, and shall be free of open or rough spaces, depressions, or projections. Immediately after the removal of forms:
- B. All bulges, fins, form marks, or other irregularities that in the judgment of the engineer will adversely affect the appearance or function of the structure shall be removed. All form bolts and ties shall be removed to a minimum depth of 1 inch below the surface of the repair. The cavities produced by form ties and all other holes of similar size and depth shall be thoroughly cleaned.
- C. After the interior surface has been kept continuously wet for at least 3 hours, the cavities shall be carefully repaired with a compatible patching mortar or packed with a dry patching mortar mixed not richer than one part cement and three parts sand.
- D. Dry patching mortar shall be mixed in advance and allowed to stand without addition of water until it has reached the stiffest consistency that will permit placing. Manipulation of the mortar with a trowel during this period shall be performed as required to ensure the proper consistency.
- E. Holes resulting from form bolts or straps that pass through the wall shall be entirely filled with mortar to form a dense, well-bonded unit. The mortar shall be tamped into place with a rod slightly smaller than the hole being filled. The hardened mortar shall be sound and free from shrinkage cracks.
- F. All repaired areas shall be cured as specified or recommended by the manufacturer.

3.5 FINISHING UNFORMED SURFACES

- A. All exposed surfaces of the concrete repair material shall be accurately screeded to grade and finished to match adjacent surfaces, unless otherwise specified. Water shall not be sprinkled or in any manner added to the surface of conventional concrete mix repair material during finishing operations. Joints and edges on unformed surfaces shall be shaped the same as adjacent or similar edges or corners of the structure being repaired.
- B. Proprietary repair material shall be finished in accordance with the manufacturer's recommendations.

3.6 CURING

- A. The repair material shall be protected against premature surface drying, rainfall, and freezing for at least 72 hours. For proprietary repair material, the manufacturer's recommendations for curing shall be followed. Replacement concrete repair material shall be protected from drying and freezing for 7 days after placement.
- B. If curing compound is used, it shall be non-solvent type and shall conform to ASTM C309, Type 1-D, Class B, non-pigmented with a fugitive dye, unless otherwise specified. Curing compounds shall not

be used if specifically prohibited by the proprietary repair material user guides.

3.7 REMOVAL OR REPAIR

- A. When the repaired area is honeycombed, damaged, or otherwise defective, the contractor shall remove and replace the ENTIRE defective repair. The engineer determines the required extent of removal, replacement, and/or repair. Removal and repair activities shall be performed only when the engineer is present. No additional payment will be allowed for repairing defective areas.

3.8 DISPOSAL

- A. Unless otherwise specified, all concrete and other debris resulting from the repair works shall be removed from the site and disposed of at location(s) of the contractor's selection. The contractor is responsible for complying with all local, State, and Federal regulations pertaining to the disposal of such waste.

END OF SECTION

GENERAL

1.1 WORK INCLUDES

A. Base Bid:

1. Contractor

- a. The work covered by these specifications consists of installing single sided textured Linear Low Density Polyethylene (LLDPE) geomembrane, in the Production Ponds, shown on the project Drawings. All work shall be done in strict accordance with the project Drawings, these specifications and the Contractor's approved Shop Drawings. All work is subject to the terms and conditions of the contract.
- b. Sufficient material shall be furnished to cover all areas as shown on the Drawings including seam areas, anchor trenches, appurtenances and structures as required. The Fabricator/Installer of the liner shall allow for shrinkage and wrinkles in the field panels, installing the membrane free of stress or tension.

B. Alternate Bid:

1. Contractor: Same as above.

1.3 RELATED WORK

C. Specified Elsewhere:

1. 310513 Soils for Earthwork

1.4 SUMMARY—GRI TEST METHOD GM17

- C. Standard Specification for Test Properties, Testing Frequency and Recommended Warranty for Single Sided Linear Low Density Polyethylene (LLDPE) Textured Geomembranes. Geosynthetic Research Institute (GRI) does not warrant any materials produced according to this. specification.

D. SCOPE:

1. This specification covers flexible polyethylene geomembranes in thickness of 40 mils (1.14mm).
2. This specification sets forth a minimum average or maximum average physical, mechanical and endurance properties that must be met by the geomembrane being manufactured.
3. In the context of quality systems and management, this specification represents manufacturing quality control (MQC).

E. REFERENCED DOCUMENTS:

1. ASTM Standards

- | | | |
|----|----------|--|
| a | D 792 | Standard Test Method for Density and Specific Gravity (Relative Density) of Plastics by Displacement |
| b. | D1004-03 | Standard Test Method for Initial Tear Resistance of |

- c. D1505-03 Plastic Film and Sheeting
Standard Test Method for Density of Plastics by the Density-Gradient Technique
- d. DI 603-01 Standard Test Method for Carbon Black in Olefin Plastics
- e. D3895-04 Standard Test Method for Oxidative-Induction Time of Polyolefins by Differential Scanning Calorimetry
- f. D4833-00e1 Standard Test Method for Index Puncture Resistance of Geotextiles, Geomembranes, and Related Products
- g. D4873-02 Standard Guide for Identification, Storage, and Handling of Geosynthetics Rolls and Samples
- h. D5199-01 Standard Test Method for Measuring Nominal Thickness of Geo Synthetics
- i. D5261 Test Method for Measuring Mass per Unit Area of Geotextiles
- j. D5323-92(2006) Practice of Determination of 2% Secant Modulus for Polyethylene Geomembranes
- k. D5721-95 (2002) Standard Practice for Air-Oven Aging of Polyolefin Geomembranes
- l. D5885-04 Standard Test Method for Oxidation Induction Time of Polyolefin Geosynthetics by High Pressure Differential Scanning Calorimetry
- m. D 5994-98 (2003) Standard Test Methods for Measuring Core Thickness of Textured Geomembranes
- n. D6392-99 Standard Test Method for Determining the Integrity of Nonreinforced Geomembrane Seams Produced Using Thermo-Fusion Methods
- o. D6693-04 Standard Test Method for Determining Tensile Properties of Nonreinforced Polyethylene and

Nonreinforced Flexible Polypropylene Geomembranes

- 2. GRI Standards
 - a. GM 11 Accelerated Weathering of Geomembranes using a Fluorescent UVA-Condensation Exposure Device
 - b. GM 16 Test Method for Observation of Surface Cracking of Geomembranes
 - c. GM 17 Test Properties, Testing Frequency and Recommended Warranty for Linear Low Density Polyethylene (LLDPE) Textured Geomembranes.
- 3. U.S. Environmental Protection Agency Technical Guidance Document “Quality Control Assurance and Quality Control for Waste containment Facilities.” EPA/600/R-93/182, September 1993. 305 pgs.

F. DEFINITIONS

- 1. Manufacturing Quality Control (MQC) — A planned system of inspections that is used to directly monitor and control the manufacture of a material which is factory originated. MQC is normally performed by the manufacturer of geosynthetic materials and is necessary to ensure minimum (or maximum) specified values in the manufactured product. MQC refers to measures taken by the manufacturer to determine compliance with the requirements for materials and workmanship as stated in certification documents and contract specifications. Ref. EPA/600/R-93-182
- 2. Manufacturing Quality Assurance (MQA) — A planned system of activities that provides assurance that the materials were constructed as specified in the certification documents and contract specifications. MQA includes manufacturing facility inspections,

verifications, audits, and evaluation of the raw materials (resins and additives) and geosynthetic products to assess the quality of the manufactured materials. MQA refers to measures taken by the MQA organization to determine if the manufacturer is in compliance with the product certification and contract specifications for the project. ref. EPA/600/R-93/182

3. Formulation, n — The mixture of a unique combination of ingredients identified by type, properties, and quantity. For flexible polyethylene geomembranes a formulation is defined as the exact percentages and types of resin(s), additives, and carbon black or colorants.
4. Rework, n — Polymer which has been converted into a geosynthetic material and then ground into chips for reintroduction into the extruder without leaving the plant, e.g., edge trim, out-of-spec thickness material, etc.

1.5 SUBMITTALS

- C. The LLDPE roll goods shall be factory fabricated into large panels. The Fabricator shall furnish a proposed LLDPE geomembrane panel layout which is to be approved in writing by the Architect/Engineer prior to the installation. The Drawings shall show the extent, the direction of factory seams and the size of panels, consistent with the requirements of the project Drawings. These details shall include the recommended termination details of the geomembrane. Except for special requirements due to configuration and/or terminating the geomembrane, maximum use of large size panels shall be made to reduce field seaming to a minimum.

1.6 WARRANTY

- C. Provide a written warranty/guarantee that as a minimum states that the liner furnished/installed is:
 1. To be furnished free of manufacturing defects in workmanship or material for a period of one year from the time of Final Acceptance.
 2. Shall not develop cracks/holes due to ultra-violet degradation and/or weathering for a period of 20 years from the date of Final Acceptance. "Normal weathering" does not include physical damage caused by Acts of God, casualty, or catastrophe such as (but not limited to) earthquakes, fire, explosion, floods, lighting, piercing hail, tornadoes, or exposure of the membrane to harmful chemicals, corrosive air pollution, mechanical abuse by machinery, equipment, people or animals, or excessive flexures, pressures or stress from any source.
 3. Should defects or weathering degradation within the scope of the above warranty occur, supplier will refund to the Owner's the pro-rata part for the unexpired term of the warranty of the Owner's original cost of such product (noted on the warranty).
 4. The warranty shall be 20 years.
 5. Venue for Suits. The venue for any suit arising from this contract will be in a court of competent jurisdiction in Travis County, Texas, or as may otherwise designated in the Supplementary General Conditions. Any dispute regarding warranty claims will not be subject to binding arbitration.
- D. Provide a sample warranty with Shop Drawings for review by Owner prior to shipment.

2. PRODUCTS

2.1 MATERIALS

- A. Material Classification and Formulation
 1. This specification covers flexible textured polyethylene.
 2. The polyethylene resin from which the geomembrane is made shall conform to the definition presented in Article 1.3.C.
 3. The polyethylene resin shall be virgin material with no more than 10% rework. If rework is used, it must be an approved polyethylene formulation similar to the parent material.

4. No post-consumer resin (PCR) of any type shall be added to the formulation.
 5. Roofing liner is not an approved equal.
 6. The LLDPE shall be a single sided textured material.
- B. Physical, Mechanical and Endurance Property Requirements
1. The geomembrane shall conform to the test property requirements prescribed in Table 1 is in English units. It is to be understood that the table refers to the latest revision of the referenced test methods and practices.
 2. Details of the endurance-related procedures, i.e., the oven aging and weatherometer procedures, are as follows:
 - a. Oven Aging per ASTM D5721-95 (2002) — This incubation process uses forced air ovens set at 85° C and measures the change in high pressure oxidation induction time (HPOIT) on the removed test specimens after 90 days. Note that this requires an initial and unaged determination of the as-received HPOIT value, i.e., before incubation. The specimens are also evaluated for their cracking potential per GRI GM11.
 - b. UV Fluorescent per GRI GM 11 — This simulated weathering exposure uses a UV fluorescent device with 340 nm wavelength bulbs and measures the change in high pressure oxidative induction time (**HPOIT**) after 1600 hours on the removed test specimens. The cycle cam is set to provide 24-hour cycles as follows: 20 hours UV cycle at 75° C followed by 4 hour condensation at 60° C. Note that this requires an initial and unexposed determination of the as-received HPOIT value, i.e., before incubation. The specimens are also evaluated for their cracking potential per GRI GM 16.
 3. The various properties of the polyethylene geomembrane shall be tested at the minimum frequencies shown in Table 1. If the specific manufacturer's quality control guide is more stringent and is certified accordingly, it must be followed in like manner.
- C. Workmanship and Appearance
1. General manufacturing procedures shall be performed in accordance with the manufacturer's internal quality control guide and/or documents.
- D. MQC Sampling
1. Sampling shall be in accordance with the specific test methods listed in Table 1. If no sampling protocol is stipulated in the particular test method, then test specimens shall be taken even spaced across the entire roll width.
 2. The average of the test results should be calculated per the particular standard cited and compared to the minimum value listed in these tables, hence the values listed are the minimum average values and are designated as "min. ave."
- E. MQC Retest and Rejection
1. If the results of any test do not conform to the requirements of this specification, retesting to determine acceptance or rejection should be done in accordance with the manufacturing protocol as set forth in the manufacturer's quality manual.
- F. Packaging and Marking
1. It is standard within the industry for finished rolls to be adequately protected to keep the material clean and dry until used. Although there are different methods for protection, it is sometimes required that finished rolls are covered with an outer layer of protection. The issue is to be decided upon by the various parties involved.
 2. The geomembranes shall be rolled onto a substantial core or core segments and held firm by dedicated straps/slings, or other suitable means. The rolls must be adequate for safe transportation to the point of delivery, unless otherwise specified in the contract or order.
 3. The geomembranes can also be folded in an accordion manner and placed on a wooden

pallet. The entire package is to be protected by a cardboard enclosure and the entire assembly banded together with plastic strapping.

G. Certification

1. Upon request of the purchaser in the contract or order, a manufacturer's certification that the material was manufactured and tested in accordance with this specification, together with a report of the test results, shall be furnished at the time of shipment

Table 1 — Flexible Polyethylene Textured Geomembranes

<u>Property</u>	<u>Test Method</u> <u>ASTM or GRI</u>	<u>Test Value</u> <u>40 mils</u>
1. Thickness – mils (Textured)	D 5994-98 (2003)	
a. Minimum average		38
b. Lowest individual of 8 of 10 readings		36
c. Lowest individual of 10 readings		34
2. Asperity Height, mils (Textured)	GM 12	10
3. Tensile Properties ¹	D6693-04	
a. Break Strength, lb/in		152-
b. Break Elongation, %		800
4. Axi-Symetric Break Strain, %	D5617-04	30
5. Tear Resistance, lb	D1004-03	22
6. Puncture Resistance - lb	D4833-00el	44 (Textured)
7. 2% Modulus, lb/in ² (max)	D5323	60,000
8. Oxidative Induction Time (OIT)	D3895-04	100
a. Standard OIT, minutes		
9. Carbon Black Content ² - %	D1603	2.0 – 3.0
10. Carbon Black Dispersion	D5596-03	Note 3
11. Oven Aging at 85° C	D3895-04	
a. Standard OIT - % retained after 90 days	D5721-95 (2002)	35
12. Ultraviolet Light Resistance ⁴		
a. High Pressure OIT ⁵ - % retained after 1600 hrs.	GM11, D5885-04	35
13. Sheet Density, g/cc (max.)	D1505-03, <u>D792</u>	0.939
14. Seam Properties	D6392-04 (@2in/min)	
a. Shear Strength, lb/in		60
b. Peel Strength, lb/in – Hot Wedge		<u>50</u>
Extrusion Fillet		<u>40</u>
15. Roll Dimensions		
a. Width (feet)		22.5
b. Length (feet)		700
c. Area (square feet)		15,750
d. Gross weight (pounds, approx.)		3,900

NOTES

- (1) Machine direction (MD) and cross machine direction (XMD) average values should be on the basis of 5 test specimens each direction. Break elongation is calculated using a gauge length of 2.0 inches.
- (2) Other methods such as ASTM D 4218 or microwave methods are acceptable if an appropriate correlation can be established.
- (3) Carbon black dispersion for 10 different views: Nine in Categories 1 and 2 with one allowed in Category 3.
- (4) The condition of the test should be 20 hr. UV cycle at 75°C followed by 4 hr. condensation at 60°C.
- (5) UV resistance is based on percent retained value regardless of the original HP-)IT value.

3. EXECUTION

3.1 SUBGRADE PREPARATION

- A. The surfaces on which the lining is to be placed shall be maintained in a firm, clean, dry and smooth condition during the lining installation. Anchor trenches All surfaces shall be free of rocks, roots, gravel, grade stakes or debris that may puncture the LLDPE geomembrane.

3.2 GEOMEMBRANE INSTALLATION

- A. The LLDPE geomembrane shall be placed over the prepared surfaces in such a manner as to insure minimum handling and in accordance with the approved Shop Drawings. The liner shall be installed such that the textured side is exposed. The lining shall be sealed to all structures and other openings in accordance with details shown on the Drawings and Shop Drawings. The geomembrane lining shall be closely fitted and sealed around all inlets, outlets and other projections through the lining, using prefabricated fittings where possible as shown in the construction details. Liner sheets, damaged from any cause, shall be removed, repaired or covered with additional sheeting.
- B. Only those LLDPE sheets of lining material which can be anchored and seamed together the same day shall be unpackaged and placed into position. In areas that high wind is prevalent, the lining installation should begin on the upwind side of the project and proceed downwind. The leading edge of the liner shall be secured at all times with sandbags sufficient to hold it down during high winds. The leading edges of the liner material left exposed after the day's work shall be anchored to prevent damage or displacement due to wind.
- C. Materials, equipment or other items shall not be dragged across the surface of the LLDPE liner or be allowed to slide down slopes on the lining. All parties walking or working on the LLDPE lining material shall wear soft-sole shoes.
- D. Liner shall attach to concrete as shown on plans and shall not be attached until concrete compressive strength test (per concrete spec requirements) show that minimum concrete compressive strength has been reached.
- E. Contractor shall follow manufacturer requirements regarding acceptable liner temperature for installation.

3.3 FIELD SEAMS

- A. Lap joints shall be used to seal factory fabricated LLDPE sheets together in the field. The lap joint shall be formed by lapping the edges of the sheets 4 inches to 6 inches. The top sheet shall be placed "upslope" of the bottom sheet. The contact surfaces of the sheets shall be wiped clean of all dirt, dust, moisture and other foreign matter. A minimum 1½ inch bond shall apply to all seams.

- B. Extreme care should be taken throughout the work to avoid fishmouths, wrinkles, folds or pleats in the seam area. Where fishmouths do occur, they should be slit out far enough from the seam to dissipate them, lapped, seamed together in the lapped area and patched.
- C. Any necessary repairs to the LLDPE geomembrane shall be done using an additional piece of the specified LLDPE sheeting applied as above for lap joints. Unsupported LLDPE material may be used to provide a patch over lapped joints where three or more layers come together. Exposed edges can be patched with a capping strip of unsupported LLDPE approved "Edge Caulk" or extrusion weld.
- D. Cleanup within the lining area shall be an ongoing responsibility of the Contractor. Particular care should be taken to ensure that no stones, scrap material, trash, tools or other unwanted items are trapped beneath the geomembrane liner.
- E. All field seams shall be made with hot air or hot wedge welding techniques in accordance with Sections 7 and 8 of the EPA Technical Guidance Document: Inspection Techniques for the Fabrication of Geomembrane Field Seams.

3.4 CONNECTIONS AND APPURTENANCES

- A. Pipe Penetrations of Liner: All pipe penetrations of the liner shall be sealed with a shroud made of same material as liner as shown in the Drawings, and Shop Drawings. Stainless steel clamps, contact adhesives, and sealants shall be installed and sealed as required to insure a watertight installation.
- B. Joints to Structures: All curing compounds and coatings shall be completely removed from the joint area. Joining of the liner to concrete shall be made with a concrete adhesive compatible with the liner, and mechanically fastened as shown on the Drawings. Unless otherwise shown on the Drawings, the minimum width of the adhered area to the concrete will be 6 inches (15 cm.). Anchoring devices shall be placed as indicated on the Drawings around the perimeter of the structure and sealed as required to insure a watertight installation.
- C. Air-Gas Vents: An air-gas venting system shall be installed under the liner and vented along the perimeter of the pond.

3.5 INSPECTION AND TESTING

- A. Inspection
 - 1. Upon completion of the liner installation, all seams shall be visually inspected for compliance with these specifications. In addition to visual inspection, all field seams shall be checked using an air lance nozzle directed on the upper edge and surface to detect any loose edges or ripples indicating unbonded areas within the seam (per ASTM D4437).
 - 2. All field seams, on completion of the work shall be tightly bonded. Any geomembrane surface showing injury due to scuffing, penetration by foreign objects, or distress from other causes shall be replaced or repaired. All exposed edges shall be capped with a strip of LLDPE or "Edge Caulk" or extrusion weld.
- B. Repairs: Any repairs made to the LLDPE lining shall be patched with the LLDPE lining material. Patches shall be cut with rounded corners and shall extend a minimum of 4 inches in each direction from the damaged area. The entire surface of the patch shall be bonded to the LLDPE lining material.
- C. Testing of LLDPE Field Seams
 - 1. Test seams are to be made by each seaming crew, at the beginning of the seaming process, and every four (4) hours thereafter, or every time equipment is changed. Each seaming crew and the materials they are using must be traceable and identifiable to their test seams. The samples shall be numbered, dated, identified as to the personnel making the seam, and location made by appropriate notes on a print of the panel layout for the project. The completed field seam sample shall measure not less than 14 inches in width and 24 inches in length.

2. The field test seams are to be tested for seam strength and peel adhesion. Seam shear strength shall be tested in accordance with ASTM D751 as modified in Annex A of NSF 54 and shall have a value as stated herein. The peel adhesion shall be tested in accordance with ASTM D413 as modified in Annex A of NSF 61 and shall have a value as stated herein.
 3. If a test seam fails to meet the field seam design specification, then additional test seam samples will have to be made by the same seaming crew, using the same tools, equipment and seaming materials, and retested.
- D. Pond Leak Testing: Fill each pond to the normal operating level. Monitor pond leakage from water elevation drops and from the underdrain system discharge. Inspect and repair leaking seams/attachments until any single pond's leakage rate is under 100 gallons per day.

END OF SECTION 02777

SECTION 031330

CONCRETE REPAIRS

PART 1 – SCOPE

1.1 SUMMARY

- A. The work shall consist of removal of unsuitable concrete; surface and face preparation; forming; and furnishing, placing, finishing, and curing concrete repair material as required to repair structures designated on the drawings.

PART 2 – PRODUCTS

2.1 REPAIRS - Sikacrete 211 SCC Plus, as manufactured by Sika Corporation, or approved equal.

2.2 REPAIRS TO OVERHEAD AND VERTICAL SURFACES - SikaQuick® VOH as manufactured by Sika Corporation, or approved equal.

PART 3 – EXECUTION

3.1 PROTECTION OF EXISTING FACILITIES

- A. Protect all adjacent facilities, surfaces and equipment from damage.
- B. Photograph existing conditions at each pond, including geomembrane pond liners, stainless steel liner battens and bolts, and pipes and valves.
- C. Pond liners, battens and batten anchor bolts shall be removed.
 - 1) Remove battens by loosening and removing the stainless steel anchor bolt nuts.
 - 2) Carefully roll liner away from work area and dispose.
 - 3) Perform curb installation per drawings. Concrete compressive strength Tests (per concrete spec requirements) show that minimum compressive strength has been reached before liner installation.

- d. Anchor Bolt Nuts shall be torqued to 15 ft-lbs. Contractor shall be responsible in making sure that batten strips are applying adequate clamping pressure during installation so that the liner will not pull out and/or rip from the bolts.

3.2 SURFACE PREPARATION

- A. All loose, cracked or otherwise unsuitable or defective concrete shall be removed from the existing structure as shown on the drawings or specified in Section 18. The final extent of removal shall be determined by TPWD after inspection of prepared surfaces.
- B. Feathered edges at the surface will not be permitted. The surface edge of the repaired area shall be cut with a saw, drilled, or chipped to leave a sharp edge with a minimum of a 3/4-inch depth face perpendicular to the face of the wall.
- C. The top-side of the repair hole shall be shaped to a uniform fairly straight face which is sloped upward on a one (1) inch rise for each three (3) inches of depth of cut toward the face from which the repair material will be placed. The repair hole shall be conical in shape with the large end at the surface from which repair material will be placed.
- D. The bottom and vertical or near vertical sides of the hole shall be cut sharply and approximately perpendicular to the face of the wall. All interior corners shall be rounded to a minimum radius of one (1) inch.
- E. Where reinforcement is encountered, the concrete directly in contact with the sides of the reinforcement shall be removed to provide at least 1-inch clear distance between the reinforcement and the in-place concrete.
- F. Prior to placement of concrete repair material, all oil and/or grease shall be steam or solvent cleaned from all reinforcement and surfaces to which the repair materials are required to bond. If solvent cleaning is used, solvents and solvent residues shall not impair the repair material or its bonding strengths.
- G. After removal of all oil and grease, the reinforcement shall be cleaned to remove any loose, flaky rust, mill scale, and other coatings or foreign substances that would impair bonding of the repair material to the reinforcement. The prepared faces of the repair hole shall be cleaned by high pressure water jets or compressed air jetting with water to remove all loose particles and dust. The repair hole shall be free of chips, sawdust, debris, free water, ice, snow, or other harmful substances or coatings.

3.3 DISPOSAL

- A. Unless otherwise specified, all concrete and other debris resulting from the repair works shall be removed from the site and disposed of at location(s) of the Contractor's selection. The Contractor is responsible for complying with all local, state, and federal regulations pertaining to the disposal of such waste.

3.4 HANDLING AND MEASUREMENT OF MATERIAL

- A. For all types of repair materials, the cementitious components shall be kept dry and protected from contamination until incorporated in the mix. Broken containers or bags of pre-measured and pre-mixed components will not be accepted.
- B. Handling and measurement of pre-packaged proprietary materials shall follow the manufacturer's recommendations and requirements. Handling and measurement of components which are not pre-packaged or pre-measured shall be in accordance with the requirements listed below and the manufacturer's requirements. A copy of the manufacturer's written requirements will be provided to the Engineer 14-days prior to installation.
- C. Measuring tanks for mixing water or liquid shall be of adequate capacity to furnish the maximum amount of mixing water or liquid required per approved batch. Measuring tanks shall provide the means for readily and accurately measuring the amount of water or liquid required. Accuracy of water measurement shall be plus or minus one (1) percent.

3.5 FORMS

- A. Forming material shall be wood, plywood, steel or other approved material and shall be mortar tight. The forms and associated false-work shall be substantial and unyielding and shall be constructed so that the finished repair will conform to the specified dimensions and contours. Form surfaces shall be smooth and free from holes, dents, sags or other irregularities.
- B. To prevent bonding of the repair materials to the forms, prior to setting the forms into place, the surface of the form shall be lined with plastic sheeting or coated with a non-staining form release agent compatible with the repair material being used. If the forms are lined with plastic, the plastic shall be stretched taut removing all wrinkles and folds and maintain a smooth condition during the placement and curing of the repair material.
- C. Metal ties or anchorage within the forms shall be equipped with cones, she-Bolts or other devices that permit their removal to a minimum depth of one (1) inch without injury to the concrete or repair material. Ties designed to break-off below the surface of the concrete shall not be used without cones.
- D. All visible edges and corners included in the repair location shall be shaped the same as adjacent or similar edges or corners of the structure being repaired.
- E. Forms shall be constructed to facilitate consolidation and complete filling of the repair void, and when all surfaces are formed, to facilitate applying pressure to the repair material immediately after placement.

3.6 MIXING, CONVEYING AND PLACING

- A. Proprietary repair material shall be mixed and conveyed to the forms according to manufacturer's written recommendations. Material that cannot be placed within the manufacturer's time requirements shall not be placed in the forms and shall be discarded off-site at locations selected by the Contractor.
- B. Concrete repair material shall not be placed until the subgrade, forms and steel reinforcement have been inspected and approved by TPWD.

- C. The Contractor shall have all equipment and materials required for curing available at the site ready for use before placement of repair material begins.
- D. No concrete repair material shall be placed without prior approval of the Owner's Designated Representative (ODR). The Contractor shall give reasonable notice to the ODR each time concrete repair material is scheduled for placement. Such notice shall be adequate to allow the ODR sufficient time to review and approve the subgrade, forms, steel reinforcement and other preparations for compliance with the specifications. Other preparations include, but are not limited to, the mixing and delivery equipment and system, placing and finishing equipment and system, schedule of work, work force, and heating and cooling facilities as applicable. All deficiencies are to be corrected before concrete repair material is mixed for placement.
- E. The concrete repair material shall be deposited as closely as possible to its final position in the forms and shall be worked into the corners and angles of the forms and around all reinforcement and embedded items in a manner to prevent segregation of aggregates or excessive laitance. The depositing of repair material shall be regulated so that the material can be consolidated with a minimum of lateral movement.
- F. Unless otherwise approved, concrete repair material shall not be dropped from a height greater than recommended by the manufacturer or five (5) feet whichever is less.
- G. Unless otherwise specified, all concrete repair material required for each repair location shall be placed in one continuous operation. Successive layers or batches shall be placed at a rate sufficient to prevent setting of material between successive layers.
- H. At the time of placement of repair material, existing concrete surfaces shall be damp, without free water, unless otherwise specified or required by manufacturer of the proprietary repair material being used.

3.7 REMOVAL OF FORMS

- A. Unless otherwise approved, forms shall not be removed sooner than the minimum time recommended by the manufacturer of the repair material or 48-hours whichever is greater.
- B. Forms shall be removed in a manner to prevent damage to the concrete repair material. Supports shall be removed in a manner that will permit the repair material to take the stresses due to its own weight uniformly and gradually.

3.8 FINISHING OF FORMED SURFACES

- A. All repaired surfaces shall be true and even, and shall be free of open or rough spaces, depressions or projections.
- B. Immediately after the removal of forms:
 - 1) All bulges, fins, form marks or other irregularities which in the judgment of TPWD will adversely affect the appearance or function of the structure shall be removed. All form bolts and ties shall be removed to a minimum depth of one (1) inch below the surface of the repair. The cavities produced by form ties and all other holes of similar size and depth shall be thoroughly cleaned and, after the interior surfaces have been kept continuously wet for at least three (3) hours, shall be carefully repaired with a compatible patching mortar or packed with a dry patching mortar mixed not richer than one (1) part cement and three (3) parts

sand. Dry patching mortar shall be mixed in advance and allowed to stand without addition of water until it has reached the stiffest consistency that will permit placing. Manipulation of the mortar with a trowel during this period shall be performed as required to insure the proper consistency.

- 2) Holes resulting from form bolts or straps which pass through the wall shall be entirely filled with mortar to form a dense, well-bonded unit. The mortar shall be tamped into place with a rod slightly smaller than the hole being filled. The hardened mortar shall be sound and free from shrinkage cracks.
- 3) All repaired areas shall be cured as specified in Paragraph 3.10.

3.9 FINISHING UNFORMED SURFACES

- A. All exposed surfaces of the concrete repair material shall be accurately screeded to grade and finished to match adjacent surfaces, unless otherwise specified. Water shall not be sprinkled or in any manner added to the surface of conventional concrete mix repair material during finishing operations.
- B. Proprietary repair materials shall be finished in accordance with the manufacturer's recommendations.
- C. Joints and edges on unformed surfaces shall be shaped the same as adjacent or similar edges or corners of the structure being repaired.

3.10 CURING

- A. The repair material shall be protected against premature surface drying, rainfall, and freezing for a minimum of 72-hours. For proprietary repair materials, the manufacturer's recommendations for curing shall be followed. Replacement concrete repair material shall be protected from drying and freezing for seven (7) days after placement.
- B. If curing compound is used, it shall be non-solvent type and shall conform to ASTM C 309, Type 1-D, Class B, non-pigmented with a fugitive dye, unless otherwise specified. Curing compounds shall not be used if specifically prohibited by the proprietary repair material user guides.

3.11 REMOVAL OR REPAIR

- A. When the repaired area is honeycombed, damaged or otherwise defective, the Contractor shall remove and replace the defective repair.

3.12 CONCRETE REPAIR IN COLD WEATHER

- A. For proprietary repair materials, the manufacturer's recommendation together with the requirements below will be followed.
- B. For conventional concrete mix repair material, the requirements below shall be followed.
- C. Concrete repairing in cold weather shall be performed in accordance with ACI 306, Cold Weather Concreting, of which some specific interpretations are set forth below.

- D. Cold weather concrete repairing shall apply when the three-day average daily outdoor temperature at the job site is less than 40°F. When cold weather conditions exist on the job site, the following additional provisions shall apply:
- 1) The temperature of the concrete repair material at the time of placing shall not be less than 55°F nor more than 90°F. The temperature of the mixing water shall not exceed 140°F when the cement is added nor shall aggregate temperature exceed 150°F.
 - 2) Concrete structures shall be immediately protected after placement of the concrete repair material. The temperature of the concrete repair material at the concrete surface shall be maintained at not less than 55°F nor more than 90°F during the seven (7) day protection period.
 - 3) Proper methods of covering, insulating, housing, or heating concrete structures shall be implemented.
 - 4) Exhaust flue gases from combustion heaters shall be vented to the outside of the heating enclosure.
 - 5) Following the completion of the protection period, the concrete repair material shall be allowed to cool gradually. The concrete repair material surface shall not have a temperature decrease in excess of 40°F in a 24-hour period.
 - 6) Concrete repair material placed during cold weather not meeting the cold weather definition above, shall be protected by proper methods for a minimum of 24-hours after placement.

3.13 CONCRETE REPAIR IN HOT WEATHER

- A. For proprietary repair materials, the manufacturer's recommendation together with the requirements below shall be followed.
- B. For replacement concrete repair material, the requirements below shall be followed.
- C. For the purpose of this specification, hot weather is defined as any combination of the following conditions that may impair the quality of the freshly mixed and/or hardened concrete repair material by accelerating the rate of moisture loss and rate of cement hydration, or any other action that could contribute to detrimental results:
- 1) High ambient temperature
 - 2) High concrete temperature
 - 3) Low relative humidity
 - 4) Wind velocity
 - 5) Solar radiation
- D. Whenever the above conditions exist or when climatic conditions are such that the temperature of the concrete repair material may reasonably be expected to exceed 90°F at the time of delivery to the work site or during the placement operations, the following provisions shall apply:
- 1) The Contractor shall maintain the temperature of the concrete repair material below 90°F during mixing, conveying, and placing.
 - 2) Exposed concrete repair material surfaces which tend to dry or set too rapidly shall be continuously moistened by means of fog sprays or other suitable means to maintain adequate moisture during the period between placement and finishing, and following finishing. Water shall not be sprinkled or added directly to the surface of the concrete repair prior to, or during, finishing.
 - 3) Finishing of slabs and other exposed or non-formed surfaces shall be started as soon as the condition of the concrete repair material allows and shall be completed without delay.

- 4) Formed surfaces shall be kept completely and continuously moist for the duration of the curing period or until the application of the curing compound is completed.
- 5) Concrete repair material surfaces, especially flat-work placed with large surface areas, shall be covered with wet burlap or other similar material as soon as the concrete repair material has sufficiently hardened and shall be kept continuously moist for a minimum of 24-hours for the initial curing period. This protective method shall be continued for the required curing period or until the application of curing compound is completed.
- 6) Moist curing may be discontinued before the end of the curing period if white, or other pigmented curing compound is applied immediately.
- 7) Under extreme conditions of high ambient temperature, high concrete temperature, low relative humidity, wind velocity and exposure to solar radiation, the Engineer may (1) restrict placement to the most favorable time of day, (2) restrict the depth of layers to assure coverage of the previous layer while it will still respond readily to vibration, (3) suspend placement until conditions improve, and (4) require removal of forms, repair, patching and re-application of wet curing by small areas at a time.

END OF SECTION

SECTION 033005

REINFORCEMENT FOR CONCRETE

PART 1 – GENERAL

1.1 SUMMARY

- A. Replacement reinforcement.

PART 2 – PRODUCTS

2.1 MATERIALS

- A. Use deformed steel bar reinforcement unless otherwise specified or allowed.
- B. Deformed Steel Bar Reinforcement - Provide deformed reinforcing steel conforming to one of the following:
- 1) ASTM A615, Grades 60, 75, or 80;
 - 2) ASTM A996, Type A, Grade 60;
 - 3) ASTM A996, Type R, Grade 60, permitted in concrete pavement only (Furnish ASTM A996, Type R bars as straight bars only and do not bend them. Bend tests are not required.); or
 - 4) ASTM A706, Grades 60 or 80.
- C. The nominal size, area, and weight of reinforcing steel bars this Item covers are shown in Table 1.

Table 1
Size, Area, and Weight of Reinforcing Steel Bars

Bar Size Number (in.)	Diam (in.)	Area (sq. in.)	Weight per Foot (lbs.)
3	0.375	0.11	0.376
4	0.500	0.20	0.668
5	0.625	0.31	1.043
6	0.750	0.44	1.502
7	0.875	0.60	2.044
8	1.000	0.79	2.670

- D. Weldable Reinforcing Steel. Provide reinforcing steel conforming to ASTM A706 or with a maximum carbon equivalent (C.E.) of 0.55% if welding of reinforcing steel is required or desired. Provide a report showing the percentages of elements necessary to establish C.E. for reinforcing steel that does not meet ASTM A706, in order to be structurally welded.

PART 3 - EXECUTION

- A. Storage. Store reinforcement above the ground on platforms, skids, or other supports, and protect it from damage and deterioration. Ensure reinforcement is free from dirt, paint, grease, oil, and other foreign materials when it is placed in the work. Use reinforcement free from defects such as cracks and delaminations. Rust, surface seams, surface irregularities, or mill scale will not be cause for rejection if the minimum cross-sectional area of a hand wire-brushed specimen meets the requirements for the

size of steel specified.

- B. Splices - Lap-splice, weld-splice, or mechanically splice bars as required.

Table 6
Minimum Lap Requirements for Steel Bar Sizes through No. 11

Bar Size Number (in.)	Uncoated Lap Length	Coated Lap Length
3	1 ft. 4 in.	2 ft. 0 in.
4	1 ft. 9 in.	2 ft. 8 in.
5	2 ft. 2 in.	3 ft. 3 in.
6	2 ft. 7 in.	2 ft. 11 in.

- 1) Ensure welded splices conform to the requirements of Section 05 55 01, "Field Welding." Field-prepare ends of reinforcing bars if they will be butt-welded. Delivered bars must be long enough to permit weld preparation.
- 2) Install mechanical coupling devices in accordance with the manufacturer's recommendations at locations shown on the plans. Protect threaded male or female connections, and ensure the threaded connections are clean when making the connection. Do not repair damaged threads.
- 3) Mechanical coupler alternate equivalent strength arrangements, to be accomplished by substituting larger bar sizes or more bars, will be considered if approved in writing before fabrication of the systems.

- C. Placing. Place reinforcement as near as possible to the original position.

- 1) Locate the reinforcement accurately in the forms, and hold it firmly in place before and during concrete placement by means of bar supports that are adequate in strength and number to prevent displacement and keep the reinforcement at the proper distance from the forms. Provide bar supports in accordance with the CRSI Manual of Standard Practice. Use Class 1 supports, approved plastic bar supports, precast mortar, or concrete blocks when supports are in contact with removable or stay-in-place forms. Bar supports in contact with soil or subgrade must be approved.
- 2) Place individual bar supports in rows at 4-ft. maximum spacing in each direction. Place continuous type bar supports at 4-ft. maximum spacing. Use continuous bar supports with permanent metal deck forms.
- 3) Clean mortar, mud, dirt, debris, oil, and other foreign material from the reinforcement before concrete placement. Do not place concrete until authorized.
- 4) Stop placement until corrective measures are taken if reinforcement is not adequately supported or tied to resist settlement, reinforcement is floating upward, truss bars are overturning, or movement is detected in any direction during concrete placement.

END OF SECTION

DIVISION 3 - CONCRETE

SECTION 033000 - CONCRETE WORK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY:

- A. This Section specifies cast-in place concrete, including formwork, reinforcing, mix design, placement procedures, and finishes.

1.3 SUBMITTALS:

- A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.
 - 1. Product data for proprietary materials and items, including reinforcement and forming accessories, admixtures, patching compounds, and others as requested by Owner.
 - 2. Shop drawings for reinforcement, prepared for fabrication, bending, and placement of concrete reinforcement. Comply with ACI SP-66 (88), "ACI Detailing Manual," showing bar schedules, stirrup spacing, diagrams of bent bars, and arrangement of concrete reinforcement. Include special reinforcement required for openings through concrete structures.
 - 3. Laboratory test reports for concrete materials and mix design test.
 - 4. Materials certificates in lieu of materials laboratory test reports when permitted by Owner and Structural Engineer. Materials certificates shall be signed by manufacturer and Contractor, certifying that each material item complies with or exceeds specified requirements. Provide certification from admixture manufacturers that chloride content complies with specification requirements.

1.4 QUALITY ASSURANCE:

- A. Codes and Standards: Comply with provisions of following codes, specifications, and standards, except where more stringent requirements are shown or specified:
 - 1. ACI 301, "Specification for Structural Concrete for Buildings".
 - 2. ACI 318, "Building Code Requirements for Reinforced Concrete."

3. Concrete Reinforcing Steel Institute (CRSI), "Manual of Standard Practice."
- B. Materials and installed work may require testing and retesting at any time during progress of work. Retesting of rejected materials for installed work, shall be done at Contractor's expense.

PART 2 - PRODUCTS

2.1 FORM MATERIALS:

- A. Forms for Exposed Finish Concrete: Plywood, metal, metal-framed plywood faced, or other acceptable panel-type materials, to provide continuous, straight, smooth, exposed surfaces.

2.2 REINFORCING MATERIALS:

- A. Reinforcing Bars: ASTM A 615, Grade 60, deformed.
- B. Supports for Reinforcement: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire fabric in place. Use wire-bar-type supports complying with CRSI specifications.

2.3 CONCRETE MATERIALS:

- A. Portland Cement: ASTM C 150, Type I.
1. Use one brand of cement throughout project unless otherwise acceptable to Owner.
- B. Fly Ash: Maximum 20%. ASTM C 618
- C. Minimum Compressive Strength: 5,000 psi
- D. Maximum w/cm ratio: 0.40
- E. Normal Weight Aggregates: ASTM C 33 and as herein specified. Provide aggregates from a single source for exposed concrete.
1. Fine aggregates shall have the fineness modulus held between 2.3 and 3.1.
 2. Coarse aggregates shall range from fine to coarse and shall be retained on No. 4 sieve. Aggregate size shall not exceed 3/4".
 3. Aggregates shall not be alkali-silica reactive.
 4. Aggregates shall not be alkali-carbonate reactive.
- F. Water: Potable.
- E. Admixtures, General: Provide admixtures for concrete that contain not more than 0.1 percent chloride ions.

1. Air-Entraining Admixture: ASTM C 260, certified by manufacturer to be compatible with other required admixtures.
2. Corrosion Inhibitor Admixture: ASTM C1582

2.4 RELATED MATERIALS:

- A. Moisture-Retaining Cover: One of the following, complying with ASTM C 171. Concrete shall be moisture cured for 7 days or until first cylinder break as specified below.
1. Waterproof paper.
 2. Polyethylene film.
 3. Polyethylene-coated burlap.

2.5 PROPORTIONING AND DESIGN OF MIXES:

- A. Prepare design mixes for each type and strength of concrete by either laboratory trial batch or field experience methods as specified in ACI 301. If trial batch method used, use an independent testing facility acceptable to Architect and Structural Engineer for preparing and reporting proposed mix designs. The testing facility shall not be the same as used for field quality control testing.
- B. Submit written reports to Owner of each proposed mix for each class of concrete at least 15 days prior to start of work. Do not begin concrete production until proposed mix designs have been reviewed by Owner and Structural Engineer.
- C. Design mixes to provide normal weight concrete with the following properties, as indicated on drawings and schedules:
1. 5000-psi, 28-day compressive strength.
- D. Adjustment to Concrete Mixes: Mix design adjustments may be requested by Contractor when characteristics of materials, job conditions, weather, test results, or other circumstances warrant, as accepted by Owner and Structural Engineer. Laboratory test data for revised mix design and strength results must be submitted to and accepted by Owner and Structural Engineer before using in work.
- E. Use air-entraining admixture in exterior exposed concrete. Add air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having total air content of 6.0 percent with a tolerance of plus or minus 1-1/2 percent with a maximum 3/4 inch aggregate.
- F. Slump Limits: Proportion and design mixes to result in concrete slump at point of placement as follows:
1. Ramps, slabs, and sloping surfaces: Not more than 3 inches.
 2. Reinforced foundation systems: Not less than 1 inch and not more than 3

inches.

a. For pumped concrete only: not more than 5 inches.

3. Other concrete: Not more than 4 inches.

2.6 CONCRETE MIXING:

A. Job-Site Mixing: Not allowed except for thrust blocking.

B. Ready-Mix Concrete: Comply with requirements of ASTM C 94, and as specified.

1. When air temperature is between 85 deg F (30 deg C) and 90 deg F (32 deg C), reduce mixing and delivery time from 1-1/2 hours to 75 minutes, and when air temperature is above 90 deg F (32 deg C), reduce mixing and delivery time to 60 minutes.

PART 3 - EXECUTION

3.1 GENERAL:

A. Coordinate the installation of joint materials, base flashing, and vapor retarders with placement of forms and reinforcing steel.

3.2 FORMS:

A. General: Design, erect, support, brace, and maintain formwork to support vertical and lateral, static and dynamic loads that might be applied until concrete structure can support such loads. Construct formwork so concrete members and structures are of correct size, shape, alignment, elevation, and position. Maintain formwork construction tolerances complying with ACI 347.

3.3 PLACING REINFORCEMENT:

A. General: Comply with Concrete Reinforcing Steel Institute's recommended practice for "Placing Reinforcing Bars," for details and methods of reinforcement placement and supports and as herein specified.

1. Avoiding cutting or puncturing vapor retarder during reinforcement placement and concreting operations.

B. Clean reinforcement of loose rust and mill scale, earth, ice, and other materials that reduce or destroy bond with concrete.

C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcing by metal chairs, runners, bolsters, spacers, and hangers, as approved by Owner.

D. Place reinforcement to obtain at least minimum coverages for concrete protection. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during concrete placement operations. Set wire ties so ends are directed

into concrete, not toward exposed concrete surfaces.

- E. Inspection: The Contractor shall notify structural engineer at a minimum of 72 hours in advance to permit ample time for checking of steel position and other preparation for placing concrete.

3.4 JOINTS:

- A. Construction Joints: Locate and install construction joints as indicated or, if not indicated, locate so as not to impair strength and appearance of the structure, as approved by the Structural Engineer.
 - 1. Continue reinforcement across construction joints except as otherwise indicated.
 - 2. Use bonding agent on existing concrete surfaces that will be joined with fresh concrete.
- B. Tooled Joints: Form weakened plane joints in fresh concrete by grooving top 1" portion with a recommended cutting tool and finishing edges with a jointer.
- C. Expansion Joints: Provide pre-molded joint filler for expansion joints abutting the building structure and in the sidewalk where indicated on sheet S1.
 - 1. Extend joint fillers full width and depth of joint, not less than ½ inch or more than 1" below finished surface where joint sealer is indicated.
 - 2. Protect top edge of joint filler dressing placement of concrete and remove after placement on both sides.
 - 3. Finish edges of concrete at joint filler with a jointer.
 - 4. Fillers and Sealants: Comply with requirements of applicable sections of Division 7 for preparation of joints, materials, installation and performance.

3.5 INSTALLATION OF EMBEDDED ITEMS:

- A. General: Set and build into work anchorage devices, dowels, and other embedded items required for other work that is attached to or supported by cast-in-place concrete. Use setting drawings, diagrams, instructions, and directions provided by suppliers of items to be attached thereto.
- B. Forms for Slabs: Set edge forms, bulkheads, and intermediate screed strips for slabs to obtain required elevations and contours in finished surfaces. Provide and secure units to support screed strips using strike-off templates or compacting-type screeds.

3.6 CONCRETE PLACEMENT:

- A. Inspection: Before placing concrete, inspect and complete formwork installation, subgrade preparation, reinforcing steel, anchor bolts, and items to be embedded or

cast in. Notify other crafts to permit installation of their work; cooperate with other trades in setting such work.

- B. General: Comply with ACI 304, "Recommended Practice for Measuring, Mixing, Transporting, and Placing Concrete," and as herein specified.
- C. Placing Concrete Slabs: Deposit and consolidate concrete slabs in a continuous operation, within limits of construction joints, until the placing of a panel or section is completed.
 - 1. Consolidate concrete during placing operations so that concrete is thoroughly worked around reinforcement and other embedded items and into corners.
 - 2. Bring slab surfaces to correct level with straightedge and strike off. Use bull floats or darbies to smooth surface, free of humps or hollows. Do not disturb slab surfaces prior to beginning finishing operations.
 - 3. Do not step on reinforcing during concrete placement to maintain reinforcing in proper position.
- D. Cold-Weather Placing:
 - 1. Comply with provisions of ACI 306 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
 - 2. When air temperature has fallen to or is expected to fall below 40 deg F do not place concrete.
- E. Hot-Weather Placing: When hot weather conditions exist that would seriously impair quality and strength of concrete, place concrete in compliance with ACI 305 and as herein specified.
 - 1. Cool ingredients before mixing to maintain concrete temperature at time of placement below 90 deg F (32 deg C). Mixing water may be chilled, or chopped ice may be used to control temperature provided water equivalent of ice is calculated to total amount of mixing water.
 - 2. Cover reinforcing steel with water-soaked burlap if it becomes too hot, so that steel temperature will not exceed the ambient air temperature immediately before embedment in concrete.
 - 3. Fog spray forms, reinforcing steel, and subgrade just before concrete is placed.
 - 4. Use water-reducing retarding admixture when required by high temperatures, low humidity, or other adverse placing conditions, when acceptable to Owner.
- F. Inclement Weather: Concrete placement should not be started when there is a

probability of inclement weather occurring. The Contractor should provide adequate protection for freshly placed concrete should inclement weather is inevitable.

3.8 FINISH SURFACES:

- A. Smooth Form Finish: Provide a smooth-formed finish on formed concrete surfaces exposed to view or to be covered with a coating material such as kettle walls and curb. This is an as-cast concrete surface obtained with selected form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch defective areas with fins and other projections completely removed and smoothed.
- B. Grout-Cleaned Finish: Provide grout-cleaned finish to scheduled concrete surfaces that have received smooth form finish treatment.
 - 1. Combine one part portland cement to 1-1/2 parts fine sand by volume, and a 50:50 mixture of acrylic or styrene butadiene-based bonding admixture and water to consistency of thick paint. Blend standard portland cement and white portland cement, amounts determined by trial patches, so that final color of dry grout will match adjacent surfaces.
 - 2. Thoroughly wet concrete surfaces, apply grout to coat surfaces, and fill small holes. Remove excess grout by scraping and rubbing with clean burlap. Keep damp by fog spray for at least 36 hours after rubbing.
- C. Nonslip Broom Finish: Apply nonslip broom finish to walking areas.
 - 1. Immediately after float finishing, slightly roughen concrete surface by brooming with fiber-bristle broom perpendicular to main traffic route.

3.10 CONCRETE CURING AND PROTECTION:

- A. General:
 - 1. Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. In hot, dry, and windy weather, protect concrete from rapid moisture loss before and during finishing operations with an evaporation-control material. Apply in accordance with manufacturer's instructions after screeding and bull floating, but before power floating and troweling.
 - 2. Start initial curing as soon as free water has disappeared from concrete surface after placing and finishing. Weather permitting, keep continuously moist for not less than 7 days.
 - 3. Begin final curing procedures immediately following initial curing and before concrete has dried. Continue final curing for at least 7 days in accordance with ACI 301 procedures. Avoid rapid drying at end of final curing period.

B. Curing Methods: Perform curing of concrete by moist curing, by moisture-retaining cover curing, and by combinations thereof, as herein specified.

1. Provide moisture curing by following methods.
 - a. Keep concrete surface continuously wet by covering with water.
 - b. Use continuous water-fog spray.
 - c. Cover concrete surface with specified absorptive cover, thoroughly saturate cover with water, and keep continuously wet. Place absorptive cover to provide coverage of concrete surfaces and edges, with 4-inch lap over adjacent absorptive covers.

3.11 REMOVAL OF FORMS:

A. Formwork not supporting weight of concrete, such as sides of beams, walls, columns, and similar parts of the work, may be removed after cumulatively curing at not less than 50 deg F (10 deg C) for 24 hours after placing concrete, provided concrete is sufficiently hard to not be damaged by form-removal operations, and provided curing and protection operations are maintained.

3.12 CONCRETE SURFACE REPAIRS:

A. Patching Defective Areas: Repair and patch defective areas with cement mortar immediately after removal of forms, when acceptable to Owner.

1. Mix dry-pack mortar consisting of one part portland cement to 2 1/2 parts fine aggregate passing a No. 16 mesh sieve, using minimum water required for handling and placing.
2. Cut out honeycomb, rock pockets, voids over 1/4 inch in any dimension, and holes left by tie rods and bolts, down to solid concrete but in no case to a depth of less than 1 inch. Make edges of cuts perpendicular to the concrete surface. Thoroughly clean, dampen with water, and brush-coat the area to be patched with specified bonding agent. Place patching mortar before bonding compound has dried.
3. For exposed-to-view surfaces, blend white portland cement and standard portland cement so that, when dry, patching mortar will match color surrounding. Provide test areas at inconspicuous location to verify mixture and color match before proceeding with patching. Compact mortar in place and strike-off slightly higher than surrounding surface.

B. Repair of Formed Surfaces: Remove and replace concrete having defective surfaces if defects cannot be repaired to satisfaction of Owner. Surface defects, as such, include color and texture irregularities, cracks, spalls, air bubbles, honeycomb, rock pockets, fins and other projections on surface, and stains and other discolorations that cannot be removed by cleaning. Flush out form tie holes, fill with dry-pack mortar, or precast cement cone plugs secured in place with

bonding agent.

1. Repair concealed formed surfaces, where possible, that contain defects that affect the durability of concrete. If defects cannot be repaired, remove and replace concrete.

3.13 LINER ATTACHMENT:

- A. General: Liner shall attach to concrete as shown on plans and shall not be attached until concrete compressive strength test show that minimum concrete compressive strength has been reached.

3.14 QUALITY CONTROL TESTING DURING CONSTRUCTION:

- A. General: The Owner will employ a testing laboratory to perform tests and to submit test reports.
- B. Sampling and testing for quality control during placement of concrete may include the following, as directed by Owner.
 1. Sampling Fresh Concrete: ASTM C 172, except modified for slump to comply with ASTM C 94.
 - a. Slump: ASTM C 143; one test at point of discharge for each day's pour of each type of concrete; additional tests when concrete consistency seems to have changed.
 - b. Air Content: ASTM C 173, volumetric method for lightweight or normal weight concrete; ASTM C 231 pressure method for normal weight concrete; one for each day's pour of each type of air-entrained concrete.
 - c. Concrete Temperature: Test hourly when air temperature is 40 deg F (4 deg C) and below, when 80 deg F (27 deg C) and above, and each time a set of compression test specimens is made.
 - d. Compression strength:
 - 1). Compression Test Specimen: ASTM C 31; one set of 4 standard cylinders for each compressive strength test, unless otherwise directed. Mold and store cylinders for laboratory-cured test specimens except when field-cure test specimens are required.
 - 2.) Compressive Strength Tests: ASTM C 39; one set for each day's pour exceeding 1 cu. yd. plus additional sets for each 50 cu. yds. more than the first 25 cu. yds. of each concrete class placed in any one day; one specimen tested at 7 days, one specimen tested at 14 days, one specimen tested at 28 days, and one specimen

retained in reserve for later testing if required.

- 3.) When frequency of testing will provide fewer than 5 strength tests for a given class of concrete, conduct testing from at least 5 randomly selected batches or from each batch if fewer than 5 are used.
- C. Test results will be reported in writing to Project Manager, Structural Engineer, Ready-Mix Producer, and Contractor within 24 hours after tests. Reports of compressive strength tests shall contain the project identification name and number, date of concrete placement, name of concrete testing service, concrete type and class, location of concrete batch in structure, design compressive strength at 28 days, concrete mix proportions and materials, compressive breaking strength, and type of break for both 7-day tests and 28-day tests.
- D. Additional Tests: The testing service will make additional tests of in-place concrete when test results indicate specified concrete strengths and other characteristics have not been attained in the structure, as directed by Owner. Testing service may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42, or by other methods as directed. Contractor shall pay for such tests when unacceptable concrete is verified.

END OF SECTION

SECTION 039300

CONCRETE REHABILITATION

PART 1 – GENERAL

1.1 SUMMARY

This specification describes the patching or overlay of interior and/or exterior horizontal surfaces and formed vertical and overhead surfaces with portland cement concrete.

1.2 QUALITY ASSURANCE

- A. Manufacturing qualifications: The manufacturer of the specified product shall be ISO 9001/9002 certified and have in existence a recognized ongoing quality assurance program independently audited on a regular basis.
- B. Contractor qualifications: Contractor shall be qualified in the field of concrete repair and protection with a successful track record of 5 years or more. Contractor shall maintain qualified personnel who have received product training by a manufacturer's representative
- C. Install materials in accordance with all safety and weather conditions required by manufacturer or as modified by applicable rules and regulations of local, state and federal authorities having jurisdiction. Consult Material Safety Data Sheets for complete handling recommendations.

1.3 DELIVERY, STORAGE, AND HANDLING

- A. All materials must be delivered in original, unopened containers with the manufacturer's name, labels, product identification, and batch numbers. Damaged material must be removed from the site immediately.
- B. Store all materials off the ground and protect from rain, freezing or excessive heat until ready for use.
- C. Condition the specified product as recommended by the manufacturer.

1.4 JOB CONDITIONS

- A. Environmental Conditions: Do not apply material if it is raining or snowing or if such conditions appear to be imminent. Minimum application temperature 45°F (7°C) and rising.
- B. Protection: Precautions should be taken to avoid damage to any surface near the work zone due to mixing and handling of the specified material.

1.5 SUBMITTALS

- A. Submit two copies of manufacturer's literature, to include: Product Data Sheets, and appropriate Material Safety Data Sheets (MSDS).

1.6 WARRANTY

- A. Provide a written warranty from the manufacturer against defects of materials for a period of one (1) year, beginning with date of substantial completion of the project.

PART 2 - PRODUCTS

2.1 MANUFACTURER

A. Sikacrete 211 SCC Plus, as manufactured by Sika Corporation, is considered to conform to the requirements of this specification.

2.2 MATERIALS

A. Portland cement concrete:

- 1) The repair concrete shall be self-consolidating and polymer modified. It shall be comprised of selected portland cements, specially graded aggregates, admixtures for controlling setting time and plasticizers for workability as well as silica fume and a migrating corrosion inhibitor.
- 2) The materials shall be non-combustible, both before and after cure.
- 3) The materials shall be supplied as a factory-blended unit.
- 4) The portland cement concrete must be placeable from 1 in. to 8 in. in depth and appropriate for full-slab depth repair and replacement.

B. The portland cement concrete aggregate shall conform to ASTM C-33 similar to No.8 distribution per ASTM C-33, Table II) and be clean, well-graded, having low absorption and high density.

2.3 PERFORMANCE CRITERIA

A. Typical Properties of the mixed portland cement concrete:

- 1) Initial spread: SCC, 27-33 in. approx.
- 2) Spread at 30 min: > 15 in.
- 3) Application time: 60 min.

B. Typical Properties of the cured portland cement concrete:

- 1) Compressive Strength (ASTM C-39 modified)
 - a. 1 day: 2,000 psi min. (13.8 MPa)
 - b. 7 day: 6,000 psi min. (41.4 MPa)
 - c. 28 day: 7,000 psi min. (48.3MPa)
- 2) Flexural Strength (ASTM C-78) @ 28 days: 1,000 psi (6.9 MPa)
- 3) Splitting Tensile Strength (ASTM C-496) @ 28 days: 1,000 psi (6.9 MPa)
- 4) Bond Strength (ASTM C-882 modified) @ 28 days: 2,500 psi (17.2 MPa)
- 5) Shrinkage (ASTM C-157): < 0.05%
- 6) Chloride ion permeability (ASTM C-1202): < 650 Coulombs
- 7) The portland cement concrete shall not produce a vapor barrier.

Note: Above tests performed with curing conditions @ 71°F – 75°F and 45-55% relative humidity.

PART 3 - EXECUTION

3.1 SURFACE PREPARATION

- A. Areas to be repaired must be clean, sound, and free of contaminants. All loose and deteriorated concrete shall be removed by mechanical means. Mechanically prepare the concrete substrate to obtain an exposed aggregate surface with a minimum surface profile of +/- 1/8 in. (CSP 7-8 per ICRI Guidelines). Saturate surface with clean water. Substrate should be saturated surface dry (SSD) with no standing water during application. Area to be patched shall not be less than 1 in. in depth.
- B. Where reinforcing steel with active corrosion is encountered, sandblast the steel to a white metal finish to remove all contaminants and rust. Where corrosion has occurred due to the presence of chlorides, the steel shall be high pressure washed after mechanical cleaning. Prime steel with 2 coats of Sika Armatec 110 EpoCem as directed by manufacturer. (See Spec Component SC-201-0699)

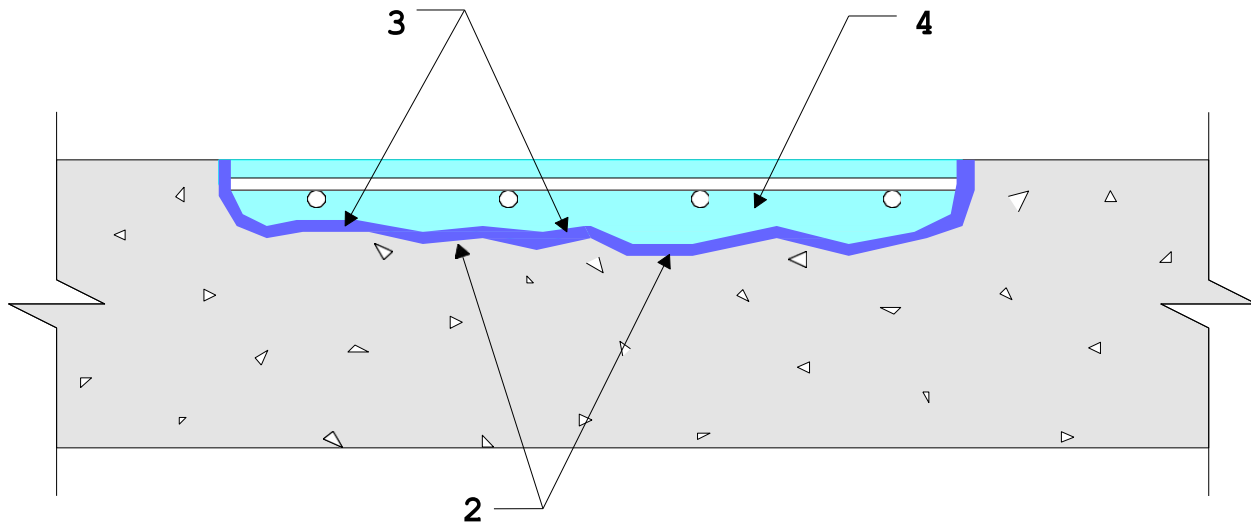
3.2 MIXING AND APPLICATION

- A. Start mixing with 5.5 pints of water. An additional 0.5 pint can be added if needed. Do not overwater, as excess water will cause segregation. Add entire contents of one bag of Sikacrete 211 SCC Plus while continuing to mix to a uniform consistency, maximum 3 minutes. Mechanically mix with a low- speed (400-600 rpm) drill or in an appropriate-size mortar mixer or concrete mixer.
- B. Placement Procedure: Pre-wet surface to SSD (Saturated Surface Dry) with no standing water. Ensure good intimate contact with the substrate is achieved. To accomplish this, material should be scrubbed into substrate filling all pores and voids. While the scrub coat is still plastic, force material against edge of repair, working toward center. If repair area is too large to fill while scrub coat is still wet use Sika Armatec 110 EpoCem in lieu of scrub coat. After filling, consolidate, then screed. Allow concrete to set to desired stiffness, then finish with trowel, manual or power, for smooth surface. Broom or burlap drag for rough surface.
- C. Alternatively the material may be poured or pumped into formed areas. To ensure proper filling and adhesion vibrate the material during placement or pump the repair material under pressure. Vibrate form while pouring or pumping. Pump with a variable pressure pump. Continue pumping until a 3 to 5 psi increase in normal line pressure is evident then STOP pumping. Form should not deflect. Vent to be capped when steady flow is evident, and forms stripped when appropriate.
 - 1) As per ACI recommendations for portland cement concrete, curing is required. Moist cure with wet burlap and polyethylene, a fine mist of water or a water-based* compatible curing compound. Moist curing should commence immediately after finishing. Protect newly applied material from rain, sun, and wind until compressive strength is 70% of the 28-day compressive strength. To prevent from freezing cover with insulating material. Setting time is dependent on temperature and humidity.
***Pretesting of curing compound is recommended.**
- D. Adhere to all procedures, limitations and cautions for the portland cement mortar in the manufacturer's current printed technical data sheet and literature.

3.3 CLEANING

- A. The uncured portland cement mortar can be cleaned from tools with water. The cured portland cement mortar can only be removed mechanically.
- B. Leave finished work and work area in a neat, clean condition without evidence of spillovers onto adjacent areas.

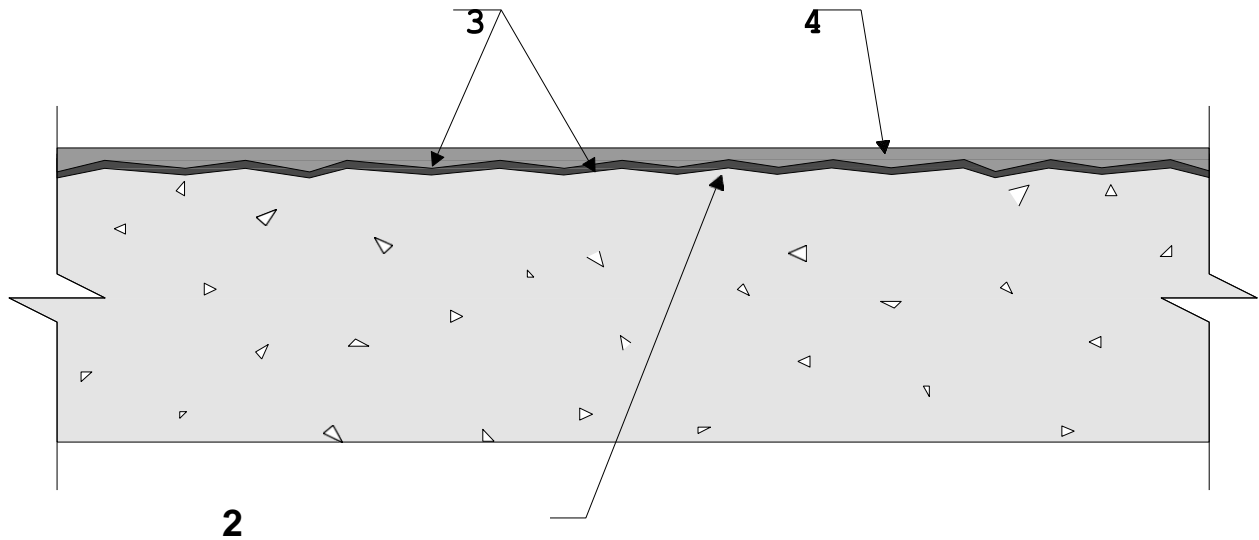
SC-117 Sikacrete 211 SCC Plus Pourable Repair



1. Repair area should not be less than 1" in depth.
2. Substrate should be saturated surface dry (SSD) with no standing water.
3. Apply scrub coat to substrate, filling all pores and voids.
4. While scrub coat is still wet pour Sikacrete 211 SCC Plus.

Note: If repair area is too large to fill while scrub coat is still wet, use Sika Armatec 110 EpoCem in lieu of the scrub coat.

SC-117 Sikacrete 211SCC Plus Overlay

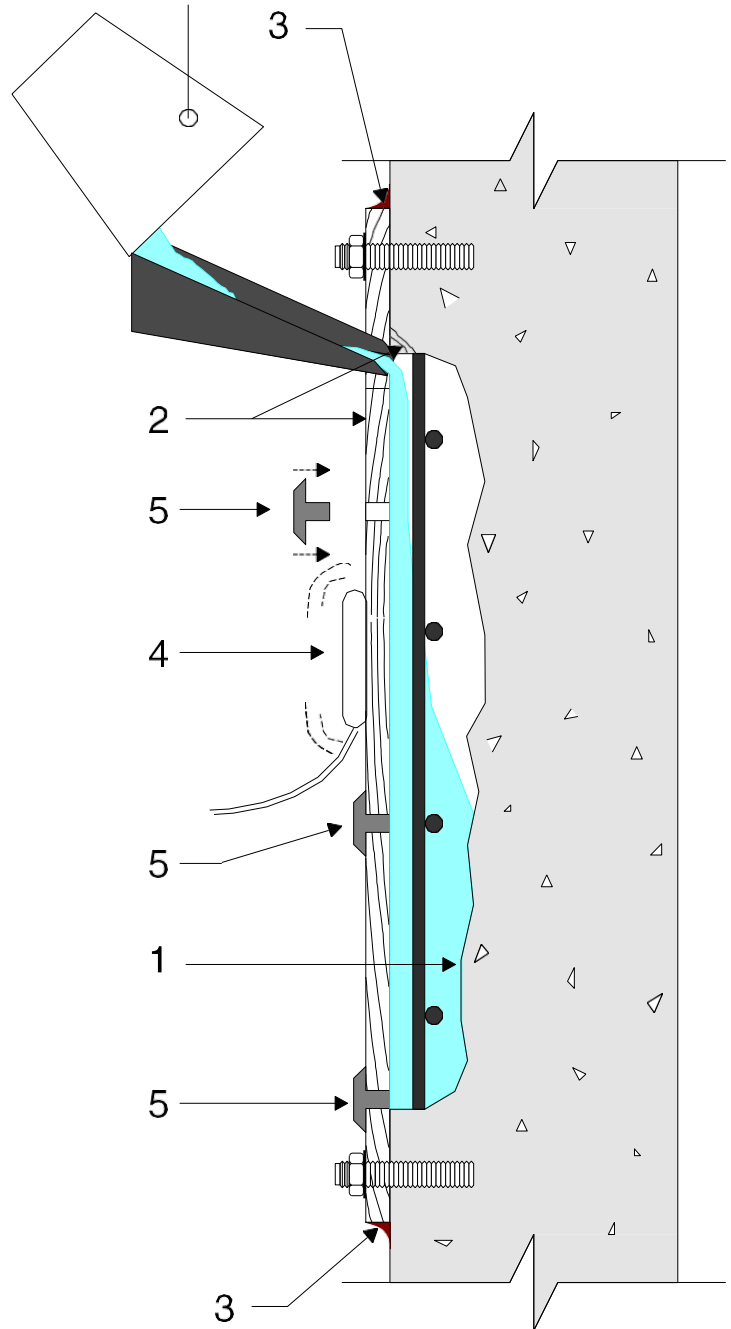


1. Repair area should not be less than 1" in depth.
2. Substrate should be saturated surface dry (SSD) with no standing water.
3. Apply scrub coat to substrate, filling all pores and voids.
4. While scrub coat is still wet apply Sikacrete 211 SCC Plus.
5. Adhere to industry guidelines with respect to control and expansion joints.

Note: If repair area is too large to fill while scrub coat is still wet, use Sika Armatec 110 EpoCem in Lieu of the scrub coat.

SC-117 Sikacrete 211 SCC Plus Form and Pour

1. Pre-wet surface to SSD.
2. Set form and chip spot for pour box. Apply release agent to form, or use plastic lined plywood.
3. Run bread of Sikaflex 1a around form edge, let cure, and then anchor form. Fill with water to check for water tightness. Let drain to no free standing water.
4. Vibrate form while pouring Sikacrete 211 SCC Plus.
5. Vent to be capped when steady flow is evident.
6. Strip form when appropriate.
7. Dry pack anchor holes with Sika mortar.



END OF SECTION

SECTION 040513

VERTICAL OVERHEAD REPAIR MORTAR

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

- A This Specification shall be read as a whole by all parties concerned. Each Section may contain more or less the complete Work of any trade. The Contractor is solely responsible to make clear to the Subcontractors the extent of their Work and coordinate overlapping Work.

1.2 SYSTEM DESCRIPTION

- A This specification describes the patching of interior and/or exterior vertical and overhead surfaces with a rapid setting portland cement mortar.

1.3 REFERENCES

- A. The following standards are applicable to this section:
 - (ASTM C496) Splitting Tensile Strength
 - (ASTM C109) Compressive Strength
 - (ASTM C293) Flexural Strength
 - (ASTM C882) Slant Shear Bond Strength
 - (ASTM C157) Volume Change
 - (ICRI No. 210.3) Direct Tensile Bond Strength

1.5 QUALITY ASSURANCE

- A Manufacturing qualifications: The manufacturer of the specified product shall be ISO 9001 certified and have in existence a recognized ongoing quality assurance program independently audited on a regular basis.
- B Contractor qualifications: Contractor shall be qualified in the field of concrete repair and protection with a successful track record of 5 years or more. Contractor shall maintain qualified personnel who have received product training by a manufacturer's representative.
- C Store and apply materials in accordance with all safety requirements, taking into consideration weather conditions, as specified by manufacturer or as modified by applicable rules and regulations of authorities having jurisdiction. Consult Material Safety Data Sheets for complete handling recommendations.

1.6 DELIVERY, STORAGE AND HANDLING

- A All materials must be delivered in original, unopened containers with the manufacturer's name, labels, product identification, and batch numbers. Damaged material or unsealed pails must be removed from the site immediately.
- B Store all materials off the ground and protect from rain, freezing or excessive heat until ready for use.
- C Store and handle the specified product as recommended by the manufacturer.

1.7 JOB CONDITIONS

- A. Environmental Conditions: Do not apply material if it is raining or snowing or if such conditions appear to be imminent. Minimum application temperature 40°F (5°C) and rising.
- B. Protection: Precautions should be taken to avoid damage to packaging

1.8 SUBMITTALS

- A. Submit two copies of manufacturer's actual literature including: Product Data Sheets and appropriate Material Safety Data Sheets (MSDS).

1.9 WARRANTY

- A. Provide a written warranty from the manufacturer against defects of materials for a period of one (1) year, beginning with date of substantial completion of the project

PART 2 - PRODUCTS

2.1 MANUFACTURER

- A. SikaQuick[®] VOH, as proposed by Sika Corporation, is considered to conform to the requirements of this specification.

2.2 MATERIAL

- A. Vertical Overhead Repair Mortar shall be SikaQuick VOH, fast setting, cementitious repair mortar manufactured by Sika Corp
- B. The material shall be high build mortar made with a specialty cement blend
- C. The material shall be a one-component repair material manufactured by Sika Corporation

2.3 PERFORMANCE CRITERIA

- A. Typical Properties of the cementitious repair mortar:
 - 1) Aspect: Powder
 - 2) Color: concrete grey
 - 3) Mixing Ratio: 6 – 6.5 pints/unit
 - 4) Comply with the following test methods:
 - a. Splitting Tensile Strength 300 psi (1 day)
 - b. Compressive Strength >1000 psi (3 hrs)
 - c. Flexural Strength 400 psi (1 day)
 - d. Direct Tensile Bond Strength substrate failure
 - e. Expansion <0.05%
 - f. Shrinkage <0.05%

PART 3 - EXECUTION

3.1 SURFACE PREPARATION

- A. Areas to be repaired must be clean, sound, and free of contaminants. All loose and deteriorated concrete shall be removed by mechanical means. Mechanically prepare the concrete substrate to obtain a surface profile of +/- 1/8" (CSP 6 or greater as per ICRI Guidelines) with a new exposed aggregate surface. Area to be patched shall not be less than

1/4" in depth.

- B. Where reinforcing steel with active corrosion is encountered, sandblast the steel to a white metal finish to remove all contaminants and rust. Where corrosion has occurred due to the presence of chlorides, the steel shall be high pressure washed after mechanical cleaning. Prime steel with 2 coats of Sika Armatec 110 EpoCem as directed by manufacturer.

3.2 MIXING AND APPLICATION

- A. Mechanically mix in appropriate sized mortar mixer or with a Sika jiffy paddle and low speed (400-600 rpm) drill. Pour approximately 5 pints of water into the mixing container. Add the powder while continuing to mix. Mix to a uniform consistency for a maximum of three minutes. Add up to another ½ pint of water to mix if a greater flow is desired. Should smaller quantities be needed, be sure the proper water/powder ratio is maintained and that the dry material is uniformly blended before mixing the components together. Mix only that amount of material that can be placed in 30 minutes. Do not retemper material.
- B. Mixing of the rapid-setting portland cement concrete: Pour 5 to 5 1/2 pints of water into the mixing container. Add the powder while continuing to mix. Add correct amount of the pre-approved coarse aggregate, and continue mixing to a uniform consistency. Mixing time should be 3 minutes maximum.
- C. Placement Procedure: At the time of application, the substrate should be saturated surface dry with no standing water. Mortar and/or concrete must be scrubbed into substrate filling all pores and voids. While the scrub coat is still plastic, force material against the edge of the repair, working toward the center. After filling, consolidate, then screed. Allow mortar or concrete to set to desired stiffness, then finish with a trowel for a smooth surface. Broom or burlap drag for rough surface. Areas where the depth of the repair is less than 2-inches overhead and 3-inches vertical shall be repaired with one lift of the rapid setting portland cement mortar. Areas that exceed these depths must be repaired with multiple lifts.
- D. As per ACI recommendations for portland cement concrete, curing is required. Moist cure with wet burlap and polyethylene, a fine mist of water or a water-based* compatible curing compound. Moist curing should commence immediately after finishing and continue for 48 hours. Protect newly applied material from rain, sun, and wind until compressive strength is 70% of the 28-day compressive strength. To prevent from freezing cover with insulating material. Setting time is dependent on temperature and humidity. *Pretesting of curing compound is recommended.
- E. Adhere to all procedures, limitations and cautions for this product in the manufacturer's current printed technical data sheet and literature.

3.3 CLEANING

- A. The uncured material can be cleaned from tools with water. The cured cement mortar can only be removed mechanically.
- B. Leave finished work and work area in a neat, clean condition without evidence of spillovers onto adjacent areas.

END OF SECTION

SECTION 055001

FIELD WELDING

Part 1 – GENERAL

1.1 SUMMARY

- A. Field-weld metal members using the shielded metal arc or flux cored arc welding processes.

1.2 INFORMATIONAL SUBMITTALS

- A. Welding Certificates

1.3 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

PART 2 – PRODUCTS

2.1 MATERIALS

- A. Provide electrodes for shielded metal arc welding (SMAW) conforming to the requirements of the latest edition of ANSI/AWS A5.1 or ANSI/AWS A5.5.
- B. Provide electrodes for flux cored arc welding (FCAW) conforming to the requirements of the latest edition of ANSI/AWS A5.20 or ANSI/AWS A5.29.
- C. Table 1 shows the classes of electrodes required. Use electrodes with the type of current, with the polarity, and in the positions permitted by AWS A5.1 and A5.5 for SMAW. AWS A5.20 and A5.29 specifications govern for FCAW. Obtain approval for electrode use on steel not listed in Table 1.

Table 1
Classification of Electrodes Permitted

Type of Steel (ASTM Standards)	Electrode Specification	Process	Filler Metal Requirements
A709 Gr. HPS 70W Reinforcing steel Grade 40	AWS A5.5	SMAW	E9018-M-H8R
	AWS A5.1 or A5.5	SMAW	E70XX
Reinforcing steel Grade 60 Permanent metal deck	AWS A5.5	SMAW	E90XX

forms	AWS A5.1 or A5.5	SMAW	E6010 E6011 E6013 E7018
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Note—Low-hydrogen electrodes applicable to the lower strength base metal may be used in joints involving base metals of different yield points or strengths.

2.2 EQUIPMENT

- A. Provide welding equipment meeting the requirements of the approved welding procedure specifications (WPS), if required, and capable of making consistent high-quality welds.

PART 3 - EXECUTION

3.1 PROCEDURE QUALIFICATION

- A. Use the proper classification and size of electrode, arc length, voltage, and amperage for the thickness of the material, type of groove, welding positions, and other circumstances of the work.

3.2 ELECTRODE CONDITION

- A. SMAW. Do not use electrodes with flux that has been wet, cracked, or otherwise damaged.
- B. FCAW. Protect or store welding wire coils removed from the original package to keep their characteristics or welding properties intact. Do not use coils or portions of coils that are rusty.
- C. Special Applications. Dry electrodes for fracture-critical applications or when welding steel not shown in Table 1 in accordance with the manufacturer's specifications and AASHTO/AWS D1.5.

3.3 ENVIRONMENTAL CONDITIONS

- A. Do not weld when the air temperature is lower than 20°F; when surfaces are wet or exposed to rain, snow, or wind; or when operators are exposed to inclement conditions. Provide wind breaks to protect welding operations from winds greater than 5 mph.

3.4 ASSEMBLY AND FITUP

- A. Verify that ends of members to be welded are prepared in accordance with the welded joint detail specified.
- B. Bring all members into correct alignment and hold them in position by acceptable clamps while welding.

3.5 WELD QUALITY

- A. Provide welds that are sound throughout with no cracks in the weld metal or weld pass. Completely fuse the weld metal and the base metal and each subsequent pass. Keep welds free from overlap, and keep the base metal free from undercut more than 1/100 in. deep when the direction of undercut is transverse to the primary stress in the part that is undercut. Fill all craters to the full cross-section of the welds.

3.6 CORRECTIONS

- A. When welding is unsatisfactory or indicates inferior workmanship, the Engineer will require corrective measures and approve the subsequent corrections.
 - 1) Slope the sides of the area to be welded enough to permit depositing new metal were corrections require depositing additional weld metal.
 - 2) Use a smaller electrode than that used for the original weld where corrections require depositing additional weld metal. Clean surfaces thoroughly before re-welding.

- 3) Remove cracked welds completely and repair. Remove the weld metal for the length of the crack if crack length is less than half the length of the weld plus 2 in. beyond each end of the crack, and repair.
- 4) Restore the original conditions where work performed after making a deficient weld has made the weld inaccessible or has caused new conditions making the correction of the deficiency dangerous or ineffectual by removing welds, members, or both before making the necessary corrections; otherwise, compensate for the deficiency by performing additional work according to a revised and approved design.
- 5) Cut apart and re-weld improperly fitted or misaligned parts.
- 6) Slag Inclusions. Remove the parts of the weld containing slag, and replace them with sound weld metal.
- 7) Removal of Base Metal during Welding. Clean and form full size by depositing additional weld metal using stringer beads.

3.7 WELDING REINFORCING STEEL.

- A. Base Metal. Provide weldable reinforcing steel in conformance with Section 03 30 05, "Reinforcement for Concrete."
- B. Preheat and Interpass Temperature. Minimum preheat and interpass temperatures are shown in Table 5. Preheat reinforcing steel when it is below the listed temperature for the size and carbon equivalency range of the bar being welded so that the cross-section of the bar is above the minimum temperature for at least 6 in. on each side of the joint. Allow bars to cool naturally to ambient temperature after welding is complete. Do not accelerate cooling.

**Table 5
Minimum Preheat and Interpass Temperature for Reinforcing Steel**

Carbon Equivalent	Size of Reinforcing Bar	Temperature (°F)
Up to and including 0.40	Up to 11 inclusive	None
	14 and 18	50
0.41 through 0.45 inclusive	Up to 11 inclusive	None
	14 and 18	100
0.46 through 0.55 inclusive	Up to 6 inclusive	None
	7 to 11 inclusive	50
	14 and 18	200
Unknown	Up to 18 inclusive	500

- C. Joint Types. Use butt splices for all No. 7 and larger bars. Use lap splices for No. 6 and smaller bars.
- D. Make groove welds in lap splices at least 4 in. long, and weld them on each side of the lap joint as shown in Figure 7. For No. 5 and smaller bars, weld from one side of the lap when it is impractical to weld from both sides of the joint if approved by the Engineer, but in this case make the weld at least 6 in. long.
- E. Make all butt splices in the flat position. Make all welds for butt splices, except horizontal welds on vertical bars, as shown in Figures 8 and 9. The back-up strip is required when access to the splice is from the top only. When bars can be rotated or access to the splice is available from 2 sides, the double bevel splice may be used, and this type weld requires gouging out the root pass similar to a flange splice on structural steel. The root pass may be made using E7010 or E8010 electrodes for all double

beveled splices. Preheat the steel to 400°F, if using E7010 or E8010 electrodes, and then completely remove the root pass before welding the opposite side. Make horizontal splices on vertical bars as shown in Figure 10. Provide alignment strips as shown in Figures 9 and 10 to hold bars during welding operation. Trim alignment strips after welding is complete.

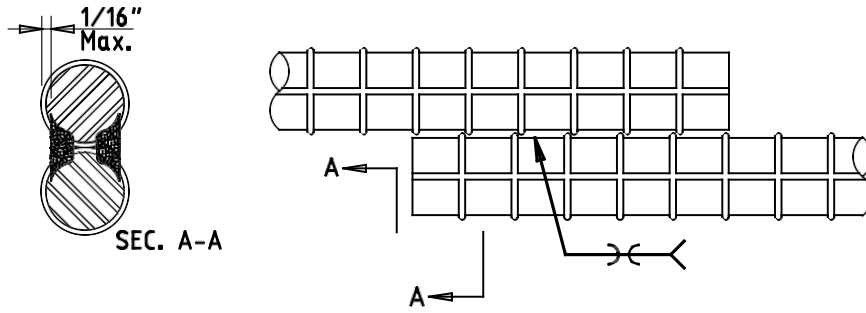


Figure 7
Direct Lap Joint with Bars in Contact

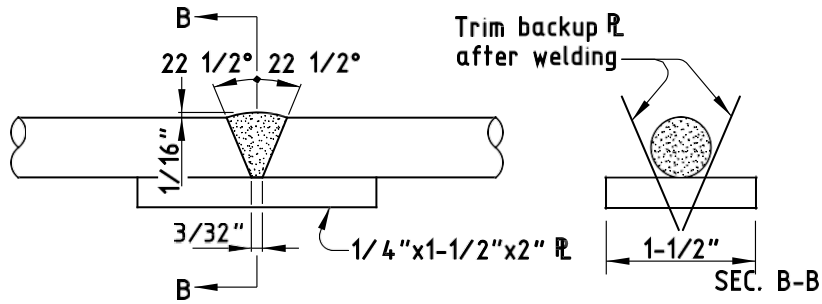


Figure 8
Single Bevel V-Groove Weld in Horizontal Position

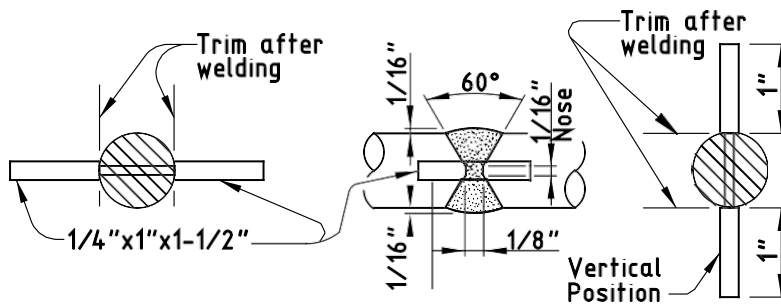


Figure 9
Double Bevel V-Groove Weld in Horizontal Position

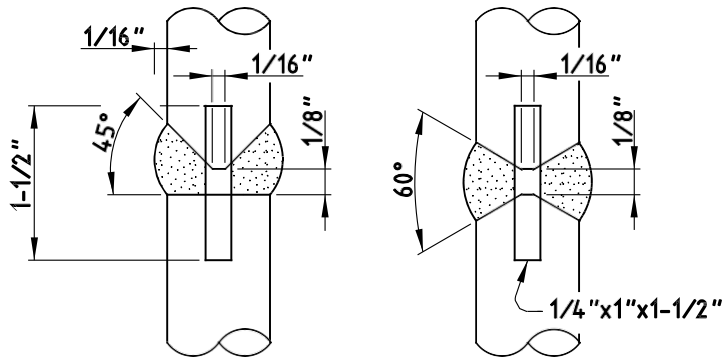


Figure 10
Double Bevel V-Groove Weld in Vertical Position

END OF SECTION

SECTION 310513
SOILS FOR EARTHWORK

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Subsoil materials.

1.2 REFERENCES

- A. ASTM International:
1. ASTM D698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³ (600 kN-m/m³)).
 2. ASTM D1557 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (6,000 ft-lbf/ft³ (2,700 kN-m/m³)).
 3. ASTM D2487 - Standard Classification of Soils for Engineering Purposes (Unified Soil Classification System).

1.3 QUALITY ASSURANCE

- A. Furnish each subsoil material from single source throughout the Work.
- B. Sustainable Design Requirements:
1. Regional Materials: Furnish materials extracted, processed, and manufactured within 500 miles of Project.

PART 2 PRODUCTS

2.1 SUBSOIL MATERIALS

2.2 SOURCE QUALITY CONTROL

- A. Section [01 40 00 - Quality Requirements {01400 - Quality Requirements}: Testing and Inspection Services] Testing and analysis of soil material.
- B. Testing and Analysis of Subsoil Material: Perform in accordance with [ASTM D698.] [ASTM D1557.] [AASHTO T180.]

- C. When tests indicate materials do not meet specified requirements, change material and retest.
- D. Furnish materials of each type from same source throughout the Work.

PART 3 EXECUTION

3.1 EXCAVATION

- A. Excavate subsoil and topsoil from areas designated. Strip topsoil to full depth of topsoil in designated areas.
- B. Stockpile excavated material meeting requirements for subsoil materials
- C. Remove excess excavated materials not intended for reuse, from site.
- D. Remove excavated materials not meeting requirements for subsoil materials from site.

3.2 STOCKPILING

- A. Stockpile materials on site at location indicated.
- B. Stockpile in sufficient quantities to meet Project schedule and requirements.
- C. Separate differing materials with dividers or stockpile apart to prevent mixing.
- D. Prevent intermixing of soil types or contamination.
- E. Direct surface water away from stockpile site to prevent erosion or deterioration of materials.
- F. Stockpile unsuitable materials on impervious material and cover to prevent erosion and leaching, until disposed of.

3.3 STOCKPILE CLEANUP

- A. Remove stockpile, leave area in clean and neat condition.

END OF SECTION