

E.PROFORMANCE FOR NON-HYDROSTATIC WATERPROOFING AND VAPOR INTRUSION MITIGATION SPECIFICATION

SECTION 02 56 16 – GAS CONTAINMENT

SECTION 02 56 19.13 – FLUID-APPLIED GAS BARRIER

SECTION 07 14 16 – COLD FLUID-APPLIED WATERPROOFING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the contract, including general and supplementary conditions, and Division 1 specification section, apply to this section.

1.2 SECTION INCLUDES

- A. The installation of materials designed to provide below grade waterproofing and vapor intrusion protection when installed per project specification, this section covers the waterproofing and vapor intrusion membrane, along with the following:
 - 1. Surface preparation and substrate treatment
 - 2. Auxiliary materials
 - 3. Prefabricated drainage mat
 - 4. Foundation drain

1.3 RELATED SECTIONS

- A. Section 02 24 00: Environmental Assessment
- B. Section 02 32 00: Geotechnical Investigation
- C. Section 03 15 00: Concrete Accessories
- D. Section 03 30 00: Cast-in-Place Concrete
- E. Section 03 40 00: Precast Concrete
- F. Section 07 90 00: Joint Protection
- G. Section 31 30 00: Earthwork Methods
- H. Section 33 41 00: Subdrainage

1.4 PERFORMANCE REQUIREMENTS

- A. General: Provide a waterproofing system that prevents the passage of water under non-hydrostatic conditions, methane gas, contaminant vapor, and complies with the physical requirements as demonstrated by testing performed by an independent testing agency.

1.5 SUBMITTALS

- A. Product Data: For each type of waterproofing specified submit manufacturer's printed technical data, tested physical and performance properties, instructions for evaluating, preparing, and treating substrates, and installation instructions.
- B. Shop Drawings: Project specific drawings showing locations and extent of waterproofing, details for substrate joints and cracks, sheet flashing, penetrations, transitions, and termination conditions.
- C. Samples: Submit two standard size samples of each of the following:
 - 1. Individual components of the specified composite membrane system.
- D. Applicator Certification: Submit written confirmation at the time of bid that applicator is currently approved by the membrane manufacturer.

1.6 QUALITY ASSURANCE

- A. Applicator Qualifications: Waterproofing applicator shall be an EPRO Authorized Applicator who is trained and performs work that in accordance with EPRO standards and policies. For project requiring a no-dollar-limit labor and material warranty, the waterproofing applicator must be E.Assurance Certified at the time of bid.
- B. Third Party Inspection: Independent inspection of the composite system installation may be required based on project conditions and desired warranty coverage. Inspection reports shall be submitted directly to the composite waterproofing manufacturer and made available to other parties per the owners' direction. For projects requiring a no-dollar-limit labor and material warranty, an independent inspector must be E.Assurance Certified and comply with the documentation requirements.
- C. Pre-Construction Meeting: A meeting shall be held prior to application of the waterproofing system to assure proper substrate preparation, confirm installation conditions, and any additional project specific requirements. Attendees of the meeting shall include, but are not limited to the following:
 - 1. EPRO representative
 - 2. EPRO certified applicator
 - 3. Third party inspector
 - 4. General contractor
 - 5. Owners representative
 - 6. Concrete/Shotcrete contractor
 - 7. Rebar contractor
 - 8. Project design team
 - 9. All appropriate related trades
- D. Field Sample: Apply each assembly of the composite membrane system field sample to 100 ft² (9.3 m²) to demonstrate proper application techniques and establish a standard of workmanship that meets the project and manufacturer's requirements.

1. Notify composite membrane system manufacturer representative, architect, certified inspector, and other appropriate parties one week in advance of the dates and times when field sample will be prepared.
2. If architect and certified inspector determines that field sample does not meet requirements; reapply composite membrane system until field sample is approved.
3. Retain and maintain approved field sample during construction in an undisturbed condition as a standard for judging the completed composite membrane system. An undamaged field sample may become part of the completed work.

E. Materials: Composite membrane system and auxiliary materials shall be single sourced.

1.7 MATERIAL DELIVERY, STORAGE AND DISPOSAL

- A. Delivery: Deliver materials to site labeled with manufacturer's name, product brand name, material type, and date of manufacture. Upon the arrival of materials to the jobsite, inspect materials to confirm material has not been damaged during transit.
- B. Storage: Proper storage of onsite materials is the responsibility of the certified applicator. Consult product data sheets to confirm storage requirements. Storage area shall be clean, dry, and protected from the elements. If ambient air temperatures are expected to fall below 40°F, precautions will need to be taken to protect any polymer modified asphalt product from near freezing temperatures. Protect stored materials from direct sunlight.
- C. Disposal: Remove and replace any material that cannot be properly applied in accordance with local regulations and specification section 01 74 19.

1.8 PROJECT CONDITIONS

- A. Substrate Review: Substrates shall be reviewed by the certified applicator and accepted prior to application.
- B. Penetrations: All plumbing, electrical, mechanical, and structural items to be passing through the composite membrane system shall be properly spaced, positively secured in their proper positions, and appropriately protected prior to system application and throughout the construction phase. Braided grounding rods are not allowed to pass through the membrane in waterproofing applications.
- C. Reinforcement Steel: Waterproof membrane shall be installed before placement of reinforcing steel. Any anchor bolts, or other methods, of securing reinforcement steel must be in place prior to the application of the polymer modified asphalt. Piano wire, shotcrete wire rods, or similar methodologies, are prohibited from penetrating the system post installation. When penetrations occur after the system is installed, it is the responsibility of the general contractor to notify the waterproofing applicator to immediately make repairs prior to the placement of overburden.
- D. Clearance: Minimum clearance of 24 inches is required for application of spray applied polymer modified asphalt, **e.spray**. For areas with less than 24-inch clearance, the product may be applied by hand using **e.roll**.
- E. Overspray: Protect all adjacent areas not receiving waterproofing. Masking is necessary to prevent unwanted overspray from adhering to, or staining, areas not receiving the membrane. Once **e.spray** adheres to a surface it is extremely difficult to remove.
- F. Weather Limitations: Perform work only when existing and forecast weather conditions are within manufacturer's recommendations.

1. Spray Applied Polymer Modified Asphalt Membrane: Minimum ambient temperature must be 40°F (7°C) and rising. For applications temperatures below 38 degrees, but greater than +19°F/-7°C, special equipment and material handling is needed. Substrate shall be clean and free from standing moisture.
2. EPRO applicators reserve the right not to install product when application conditions might be within manufactures acceptance, but ambient conditions may limit a successful application.

1.9 WARRANTY

- A. General Warranty: The special warranty specified in this section shall not deprive the owner of other rights the owner may have under other provisions of the contract documents, and shall be in addition to, and run concurrent with, other warranties made by the contractor under requirements of the contract documents.
- B. Special Warranty: Submit a written warranty signed by waterproofing manufacturer agreeing to replace system materials that do not conform with manufactures published specifications, or are deemed to be defective. Warranty does not include failure of waterproofing due to failure of soil substrate prepared and treated according to requirements or formation of new joints and cracks in the specially applied concrete that exceed 1/8 inch (3.175 mm) in width.
 1. Warranty Period: 5 years after date of substantial completion. Longer warranty periods are available upon request.
 2. Coverage: Manufacturer will guarantee that the material provided is free of defects for the warranty period.
- C. Additional Warranty Options: Upgraded warranties are available by contacting the manufacturer. These warranties may have additional requirements and approval must be granted in accordance to the manufacturer's warranty requirements. Additional warranty options include:
 1. Standard Labor and Material (E.Series L&M): Manufacturer will provide non-prorated coverage for the warranty term, agreeing to repair or replace material that does not meet requirements or remain watertight.
 2. No-Dollar-Limit Labor and Material Warranty (E.Assurance NDL): Manufacturer will provide a non-prorated, no-dollar-limit, coverage for the warranty term, agreeing to repair or replace material that does not meet requirements or remain watertight.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable Manufacturer: EPRO Services, Inc. (EPRO), P.O. Box 347; Derby, KS 67037; Tel: (800) 882-1896; Email: info@eproinc.com; Web: www.euproinc.com
- B. Underslab: E.Proformance Underslab (96 mils) – **e.base 205**, **e.spray** (60 mils), **e.shield 205**
- C. Shoring Walls: E.Proformance Shoring (90 mils) – **e.drain 12ds**, **e.drain**, **e.spray** (60 mils)
- D. Cast-in-Place Walls: E.Proformance Wall (70 mils) – **e.spray** (60 mils), **e.shield 110**, **e.drain**

2.2 SYSTEM PHYSICAL PROPERTIES

A. The physical properties listed in this section reflect testing on the entire composite system. Physical properties of the individual system composite can be found in Specification Section 2.3.

1. **E.Proformance Underslab** assembly consists of a 60 mil layer of **e.spray** (polymer modified asphaltic membrane) sandwiched between the **e.base 205** base sheet and **e.shield 205** top sheet (HDPE membranes thermally bonded to a geotextile fabric). E.Proformance underslab is ideal for moisture protection on sites that may also contain methane gas, contaminated soil, or contaminated groundwater.

PROPERTIES	TEST METHOD	VALUE
Tensile Strength	ASTM D412	662 psi
Elongation	ASTM D412	45%
Adhesion to Concrete	ASTM D903	8 lbf/in
Puncture Resistance	ASTM D1709	310 lbf
Hydrostatic Head Resistance	ASTM D5385	100 psi (231 ft)
Water Vapor Transmission	ASTM E96	.033 perms
Soil Burial	ASTM D4068	Passed
Heat Aging	ASTM D4068	Passed
Environmental Stress Cracking	ASTM D1693	Passed
Oil Resistance	ASTM D543 & D412	Passed
Methane Transmission	ASTM D1434	Passed
TCE Diffusion Rate		$7.1 \times 10^{-19} \text{ m}^2/\text{sec}$
Benzene Diffusion Rate		$7.1 \times 10^{-19} \text{ m}^2/\text{sec}$

2. **E.Proformance Shoring** becomes fully integrated with the foundation wall by applying a 60 mil layer of **e.spray** (polymer modified asphaltic membrane) to **e.drain** (30 mil HDPE 3/8" dimpled drain mat). E.Proformance shoring assembly provides ideal waterproofing protection for structures without significant presence of water

PROPERTIES	TEST METHOD	VALUE
Tensile Strength	ASTM D412	688 psi
Elongation	ASTM D412	696%
Adhesion to Concrete	ASTM D903	15.6 lbf/in
Puncture Resistance	ASTM D1709	116 lbf/in
Hydrostatic Head Resistance	ASTM D5385	100 psi (231 ft)
Water Vapor Transmission	ASTM E96	.021 perms

3. **E.Proformance Wall** utilizes a 60 mil layer of **e.spray** (polymer modified asphalt membrane), and **e.shield 110** (10 mil polyolefin protection layer) to provide a system that addresses sites with nominal waterproofing risk on shallow foundations.

PROPERTIES	TEST METHOD	VALUE
Tensile Strength	ASTM D412	926.05 psi
Elongation	ASTM D412	763%
Adhesion to Concrete	ASTM D903	20.0 lbf/in
Puncture Resistance	ASTM D1709	81.3 lbf
Hydrostatic Head Resistance	ASTM D5385	100 psi (231 ft)

Water Vapor Transmission	ASTM E96	.07 perms
Methane Transmission	ASTM D1434	Passed

2.3 WATERPROOFING MATERIALS

A. Polymer Modified Asphalt

1. **e.spray:** **e.spray** is a non-hazardous, low-viscosity, water-based, anionic asphalt emulsion modified with a blend of synthetic polymerized rubbers and proprietary additives. **e.spray** is highly stable during transit and proper storage, but becomes highly reactive during the spray application to form a rapidly cured membrane with exceptional bonding, elongation, and hydrophobic characteristics.

PROPERTIES	TEST METHOD	VALUE
Color		Brown to Black
Solvent Content		No Solvents
Shelf Life		6 Months
Tensile Strength	ASTM D412	32 psi
Elongation	ASTM D412	4140%
Resistance to Decay	ASTM E154 Section 13	4% Perm Loss
Accelerated Aging	ASTM G23	No Effect
Moisture Vapor Transmission	ASTM E96	0.026 g/ft ² /hr
Hydrostatic Water Pressure	ASTM D751	26 psi
Perm Rating	ASTM E96	0.21 perms
Methane Transmission Rate	ASTM D1434	0
Adhesion to Concrete & Masonry	ASTM C836 & C704	20 lbf/inch
Adhesion to HDPE	ASTM C836	28.363 lbf/inch
Adhesion to Polypropylene Fabric	ASTM C836	31.19 lbf/inch
Hardness	ASTM C836	80
Crack Bridging	ASTM C836-00	No Cracking
Low Temp. Flexibility		No Cracking at -20° C
Packaging: 55 gallon drum, 275 gallon tote, 330 gallon tote		

2. **e.roll:** **e.roll** is a medium viscosity water-based, polymer-modified anionic asphalt emulsion, which exhibits exceptional bonding, elongation and waterproofing characteristics.

PROPERTIES	TEST METHOD	VALUE
Color		Brown to Black
Solvent Content		No Solvents
Shelf Life		6 Months
Tensile Strength	ASTM D412	32 psi
Elongation	ASTM D412	3860%
Resistance to Decay	ASTM E154 SECTION 13	9% Perm Loss
Accelerated Aging	ASTM G23	No Effect
Moisture Vapor Transmission	ASTM E96	0.071 g/ft ² /hr
Hydrostatic Water Pressure	ASTM D751	28 psi
Perm Rating	ASTM E96	0.17 perms
Methane Transmission Rate	ASTM D14334	0
Adhesion to Concrete & Masonry	ASTM C836	1 lbf/inch
Hardness	ASTM C836	85
Crack Bridging	ASTM C836	No Cracking
Low Temp. Flexibility	ASTM C836-00	No Cracking at -20° C
Packaging: 5 gallon bucket		

B. Geocomposite Base Sheet

1. **e.base 205: e.base 205** is a base course comprised of an HDPE film and non-woven polypropylene geotextile fabric. The film is cross laminated to create ridges that enhance the bond between the **e.base 205** and **e.spray**.

PROPERTIES	TEST METHOD	VALUE
Film Material		HDPE
Film Color		Gray
Fabric Material		Non-woven Polypropylene
Fabric Color		White
Film Thickness		5 Mil
Composite Thickness		18 Mil
Tensile @ ULT	ASTM D882	TD: 32.0 lbs/in MD: 37.3 lbs/in
Elongation @ ULT	ASTM D882	TD: 65.3% MD: 51.0%
Dart Impact	ASTM D1709	Method A: >1070 grams Method B: 894 grams
Modulus	ASTM D882	TD: 270.6 lbs/in MD: 295.5 lbs/in
Elmendorf Tear	ASTM D1922	TD: 5,140 grams MD: 5,260 grams
Puncture-Prop Tear	ASTM D2582	TD: 13,250 grams Sled: 1-lb MD: 11,290 grams Sled: 1-lb
Beach Puncture Tear	ASTM D751	TD: 165 in-lbs MD: 160 in-lbs
Water Permeance	ASTM E96	0.11 perms
Dimensions: 12' x 150'		
Weight: 108 pounds		

C. Geocomposite Protection Course

1. **e.shield 205: e.shield 205** is an extremely durable, high strength protection course made from the lamination of HDPE film and nonwoven polypropylene geotextile fabric.

PROPERTIES	TEST METHOD	VALUE
Film Material		HDPE
Film Color		Gray
Fabric Material		Non-woven Polypropylene
Fabric Color		White
Film Thickness		5 Mil
Composite Thickness		18 Mil
Tensile @ ULT	ASTM D882	TD: 32.0 lbs/in MD: 37.3 lbs/in
Elongation @ ULT	ASTM D882	TD: 65.3% MD: 51.0%
Dart Impact	ASTM D1709	Method A: >1070 grams Method B: 894 grams
Modulus	ASTM D882	TD: 270.6 lbs/in MD: 295.5 lbs/in
Elmendorf Tear	ASTM D1922	TD: 5,140 grams

		MD: 5,260 grams
Puncture-Prop Tear	ASTM D2582	TD: 13,250 grams Sled: 1-lb
		MD: 11,290 grams Sled: 1-lb
Beach Puncture Tear	ASTM D751	TD: 165 in-lbs
		MD: 160 in-lbs
Water Permeance	ASTM E96	0.11 perms
Dimensions: 12' x 150'		
Weight: 108 pounds		

D. Polyolefin Sheet Membrane

1. **e.shield 110:** *e.shield 110* is a red 10 mil geomembrane made from a custom blend of polyolefin copolymers.

PROPERTIES	TEST METHOD	VALUE
Film Material		Polypropylene
Film Color		Red
Film Thickness		10 Mil
Classification	ASTM E1745	Class A, B & C
Water Vapor Permeance	ASTM F1249	0.018 perms
Tensile Strength	ASTM D882	58 lbf/inch
Puncture Resistance	ASTM 1709	3000 grams
Life Expectancy	ASTM E154	Indefinite
Chemical Resistance	ASTM E154	Unaffected
Low Temp. Impact	ASTM D1790	Resistant to 105° C
Methane Gas Modified	ASTM D1434	298.01 GTR
ACI 302.1 R-96 Min. Thickness 10-mils		Exceeds
Dimensions: 12' X 150'		
Weight: 99 pounds		

E. Prefabricated Drainage

1. **e.drain:** *e.drain* features a lightweight three-dimensional, highly flexible high density polyethylene (HDPE) core and a polypropylene geotextile filter fabric. The filter fabric is bonded to the dimples of the HDPE core.

PROPERTIES	TEST METHOD	VALUE
DIMPLED CORE		
Core		HDPE
Core Material Thickness		30 Mil
Color		Brown
Dimple Height	ASTM D1777-96	.31 inch
Compressive Strength	ASTM D6364-06	5,200 lbs./ft ²
Flow rate	ASTM D4716	5.1 gal/min/ft
FILTER FABRIC		
Grab Tensile	ASTM D4632-91	130 lbs
CBR Puncture Resistance	ASTM D6241	40 lbs
Apparent Operating Size	ASTM D4751-99	70 sieve size (.0212 mm)
Water Flow Rate	ASTM D4491-99	55 gpm/ ft ²
UV Resistance	ASTM D4355-92	70% (500 hrs)

Dimensions: 6' x 65.7', 8' x 65.7'
Weight: 6' rolls = 60 lbs., 8' rolls = 73 lbs.

2. **e.drain 12ds**: **e.drain 12ds** features a lightweight three-dimensional, highly flexible polypropylene core and a non-woven geotextile filter fabric. The filter fabric is bonded to the dimples of the polypropylene core to prevent clogging within the drain.

PROPERTIES	TEST METHOD	VALUE
DIMPLED CORE		
Core Material		Polypropylene
Color		Black
Compressive strength	ASTM D1621	9,500 PSF (455 kN/m ²)
Thickness	ASTM D1777	1 Inch
Flow rate	ASTM D4716	30 gpm/ft of width
FILTER FABRIC		
CBR puncture	ASTM D6241	250 lbs
Grab tensile strength	ASTM D4632	100 lbs
AOS	ASTM D4751	70 U.S. sieve
Permitivity	ASTM D4491	2.0 sec ⁻¹
Flow rate	ASTM D4491	140 gpm/ft ²
UV resistance	ASTM D4355	70% (500 hrs)
Dimensions: 165' x 12" x 1"		
Weight: 65 pounds		

2.4 AUXILIARY MATERIALS

- A. General: All accessory products shall be provided by the specified waterproofing manufacturer. Auxiliary products used in lieu of, or in addition to, the manufactures products must be approved in writing by EPRO prior to installation.
- B. Reinforcement Fabric: Manufacturer's polyester fabric, **e.poly** is available in 6 inch, 12 inch, and 40 inch widths.
- C. Detailing Material: **e.roll**, a roller applied water based high viscosity polymer modified asphaltic material OR **e.trowel**, a trowel applied water based high viscosity polymer modified asphaltic material.
- D. Backer Rod: Closed cell polyethylene foam
- E. Water Stop: A single row **e.stop b** shall be placed at all cold joints, construction joints, penetrations, and steel beams in back lagged conditions. Water stop is not required at lift joints.
- F. Termination Bar: **e.term hd**, or approved alternate
- G. Fastener: **e.fastener**, or approved alternate
- H. Shot Pins: Minimum 1-inch galvanized steel pins with ¾ inch aluminum washer.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Comply with project documents, manufacturer's product information, including product application and installation guidelines, pre-job punch list, as well as, manufacturer's shipping and storage recommendations.

3.1.2 SURFACE PREPARATION

- A. The general contractor shall engage the certified waterproofing contractor and certified inspector to ensure surfaces are prepared in accordance with manufacturer's instructions. Unless, explicitly stated in the contract documents, the waterproofing contractor is not responsible for surface preparation.
- B. Examine all substrates, areas, and conditions under which the composite membrane system will be installed, applicator and inspector must be present. Do not proceed with installation until unsatisfactory conditions have been corrected and a surface prep requirements have been met. If conditions exist that are not addressed in this section notify inspector and contact EPRO for additional clarification.
- C. Soil Substrates: Native soil and sand substrates shall be uniformly compacted to meet structural and building code requirements. All surfaces shall be free from protrusions and debris that may compromise the membrane system. Free standing water must be removed prior to application.
- D. Aggregate Substrates: Aggregate substrates shall be compacted to meet structural and building code requirements and then rolled flat to provide a uniform substrate. $\frac{3}{4}$ inch minus aggregate with no more than one fractured face is recommended, but other aggregates substrates may be approved by the manufacturer provided they do not create sharp angular protrusions that may compromise the waterproofing/vapor intrusion system.
- E. Working Slab: Mud slab, rat slab, or other concrete working slab shall have a uniform plane with a light broom or light trowel finish.
- F. Wood Lagging: Wood lagging shoring should extend to the lowest level of the waterproofing installation with any voids or cavities exterior of the lagging timbers filled with compacted soil or cementitious grout. Interior surface of lagging boards should be planar, with no greater than 1-inch variance in a 12-inch plane, and fit tight together with gaps less than 2 inches (25 mm). Gaps in excess of 2 inches should be filled with cementitious grout, compacted soil, wood, extruded polystyrene (20 psi min.) or EPRO approved polyurethane spray foam. Plywood or other surface treatment may be used over large lagging gaps up to 6 inches, if soil conditions permit. All lagging board nails and other mechanical projections shall be removed or flattened. Install a protection material over all soldier piles with raised lagging hanger bolts, form tie rods, or other irregular surface; protection material should extend a minimum 6 inches (150 mm) to both sides of the steel piling. **e.drain** and **e.drain 12ds** base drain system should be connected to an operative water discharge system.
- G. Shotcrete, Secant Pile, Rock Face, or Caisson Shoring Walls: Interior surface of retention walls should be planar without irregular surface conditions and a light trowel finish. Voids and sharp transitions that leave a void space to the outside of the drainage and waterproofing installation need to be filled to create a uniform and planer surface. Irregular rock and concrete, void pockets greater than $\frac{3}{4}$ inch, cracks, sharp concave transitions should be completely filled or smoothed with cementitious grout, shotcrete, or other solid material approved by the manufacturer.
- H. Sheet Piles: Minimum $\frac{1}{2}$ inch plywood must be butt jointed to form a uniform substrate that spans deviations created by the piles. Voids between the plywood and shoring shall be filled with high strength grout or other suitable material.

- I. Negative Side Internal Bracing: Internal shoring bracing, such as rakers, should be uniform and circular when interfacing with the shoring wall. Irregular bracing, such as soldier piles, creates problematic detailing and is not an approved material at the wall interface.
- J. Cast-in-Place or Shotcrete Walls: Application to green concrete is acceptable provided the substrate is prepared in accordance with manufacturers specifications and published instructions.
 - 1. Provide a clean, dust-free, and dry substrate for waterproofing application.
 - 2. Surfaces shall be power washed to remove grease, oil, form release agents or any other penetrating contaminants from the concrete. No agents shall be visible prior to the application of **e.spray**.
 - 3. Remove all fins, ridges, and other protrusions.
 - 4. Fill honeycomb, aggregate pockets, tie holes, and other voids with hydraulic cement, or rapid-set grout.
- K. Precast Concrete Walls:
 - 1. Provide a clean, dust-free, and dry substrate for waterproofing application.
 - 2. Surfaces shall be power washed to remove grease, oil, form release agents, or any other penetrating contaminants from the concrete. No agents shall be visible prior to the application of **e.spray**.
 - 3. Remove all fins, ridges, and other protrusions.
 - 4. Fill honeycomb, aggregate pockets, tie holes, and other voids with hydraulic cement, or rapid-set grout.
 - 5. Fill precast panel and control joints with a suitable backer rod material.

3.2 UNDERSLAB MEMBRANE INSTALLATION – E.PROFORMANCE UNDERSLAB

- A. General: The underslab composite membrane system shall be installed under strict accordance with the manufactures guideline and project specifications. The underslab system shall transition to, and overlap the vertical waterproofing membrane as specified.
- B. Termination: The underslab system shall terminate a minimum of 2 feet past the top of a mat slab, or onto the perimeter footings along the base of the foundation wall. Coordination between the applicator, inspector, general contractor and concrete contractor is crucial and necessary to ensure proper installation of the termination detail.
- C. Transition to Vertical Walls: When transitioning the horizontal underslab system vertically to a blindside shoring wall, the first layer of drainage shall be installed prior to the placement of any concrete at the perimeter of the excavation, and prior to the placement of any other system materials. The first lift of the composite membrane system shall extend a minimum of 4 feet past the first lift of rebar.

3.2.1 GEOCOMPOSITE BASE COURSE

- A. Whenever possible roll out **e.base 205** in the same direction over the substrate. When multiple pours will occur, extend the **e.base 205** a minimum of 2 feet past the pour joint.
- B. Overlap **e.base 205** a minimum of 6 inches.

- C. At the seam overlap peel back the top layer of **e.base 205** and apply 30 mils into the overlapping seam, making certain to apply **e.spray** to both the top of the bottom sheet and the bottom of the top sheet. Embed the top sheet into the bottom sheet.

3.2.2 SEALING OF PENETRATIONS

- A. Sealing of Standard Penetrations: Prepare membrane penetrations so they are free of any material that will inhibit a direct bond to the penetration surface: foam, insulation, protective coatings, etc.
1. Trim **e.base 205** to within 1/8 inch of the penetration.
 2. Install optional target piece if desired, per Specification Section 3.2.2.B.
 3. Install **e.stop b** around the base of the penetration.
 4. Apply **e.roll** 3 inches horizontally and 3 inches vertically around the base of the penetration.
 5. Embed **e.poly** reinforcement fabric 3 inches horizontally and 3 inches vertically around the base of the penetration.
 6. Apply a second layer of **e.roll** to reinforcement fabric until the **e.poly** reinforcement fabric is fully saturated. Secure **e.poly** reinforcement fabric to penetration with a cable tie.
- B. OPTIONAL Target Piece: An optional target piece can be installed around each penetration to achieve a tight seal or aid in the construction process. It is not required, but also not discouraged.
1. Cut a target piece of **e.base 205** so that it extends a minimum of 6" from the base of the penetration.
 2. On the target piece create two offsetting "x" to the inside diameter of the pipe to create a total of 8 triangular flanges.
 3. Slide target piece over the penetration with the triangular flanges facing up.
 4. Secure the **e.base 205** target piece to the underlying **e.base 205** by applying 30 mils of **e.spray** under the target piece.
 5. Continue sealing penetration per Specification Section 3.2.2.A.3.
- C. Soldier Pile Penetrations: Sealing of soldier piles in the field or in a back lagged condition.
1. Clean pile to remove any dirt or rust.
 2. Trim **e.base 205** to within 1/8 inch of the soldier pile.
 3. Create a uniform collar around each soldier pile penetration by cutting a target piece of **e.base 205** for each interior and exterior face of the soldier pile. Each target piece of **e.base 205** shall extend 6 inches vertically up the soldier pile and 12 inches horizontally from the base of the soldier pile. If applying in a back lagged condition, cut target piece so it also extends minimum 6 inches horizontally from the base of the soldier pile.
 4. Apply 30 mils of **e.roll** to the underlying **e.base 205** and embed the **e.base 205** target piece into the **e.roll**.
 5. Apply a 30 mil coat of **e.roll** onto all of underlying vertical surfaces.
 6. Embed **e.base 205** into the vertically applied **e.roll**.

7. Apply **e.roll** onto the **e.base 205** collar and extend **e.roll** 3 inches beyond the edge of the collar in all directions.
8. Embed **e.poly** reinforcement fabric into the previously applied **e.roll** and then saturate fabric with another application of **e.roll**.
9. 1 row of **e.stop b** shall be installed vertically on the interior cross section of the soldier pile and extend from the top of the collar to the top of wall.

3.2.3 POLYMER MODIFIED ASPHALT MEMBRANE

- A. Mask off adjoining surfaces where unwanted **e.spray** polymer modified asphalt membrane may impact other construction trades.
- B. Commence application of **e.spray** polymer modified asphalt when ambient air temperatures are within manufacturer recommendations.
- C. Surfaces that will receive the membrane must be clean and free from standing moisture.
- D. Start installing **e.spray** in presence of approved 3rd party inspector.
- E. Apply one application of **e.spray** waterproofing in accordance to manufacturer's instructions in order to obtain a seamless membrane with a minimum dry film thickness of 60 mils (1.5 mm).
- F. Apply **e.spray/e.roll** in and around penetrations and cavities to ensure the formation of monolithic seal around all penetrations.
- G. Apply **e.spray/e.roll** to prepared wall terminations and vertical surfaces to heights indicated according to manufacturer's recommendations and details. (if applicable)
- H. Verify film thickness of waterproofing every 1000 ft² (93 m²).

3.2.4 GEOCOMPOSITE PROTECTION COURSE

- A. Install **e.shield 205** protection course perpendicular to the direction of base course.
- B. Overlap **e.shield 205** seams a minimum of 6 inches.
- C. Secure the seams of **e.shield 205** by applying 30 mils of **e.spray** in-between the seam overlap. Apply a second 30 mil layer of **e.spray** on top of the seam overlap, completely covering the seam overlap.
- D. Do not penetrate the membrane system once it has been applied. If the waterproofing system is penetrated, immediately contact the applicator. Failure to bring the breach of the membrane to the applicators attention and not allowing adequate time to make the necessary repair will result in voidance of warranty.

3.3 SHORING WALL INSTALLATION – E.PROFORMANCE SHORING

- A. General: The composite membrane system shall be installed to the shoring system under strict accordance with the manufactures guideline and project specifications. This section describes the installation process for the system application to a shored wall condition.
- B. Sequencing: The first lift of the composite membrane system shall be installed prior to the placement of any concrete at the perimeter of the excavation and prior to any transition from the underslab system to vertical system. This initial drainage and underslab barrier shall extend a minimum of 4 feet past the first lift of rebar.

3.3.1 PREFABRICATED STRIP DRAIN

- A. Install **e.drain 12ds** horizontally against the shoring wall at specified elevation above the design water table. Allow for positive drainage flow into water discharge system. Attach to shoring using washered mechanical fasteners.

3.3.2 PREFABRICATED DRAINAGE MAT

- A. Drainage Orientation: Install drainage panels either horizontally or vertically with the geotextile fabric facing the soil retention system.
- B. Horizontal Installation: Install **e.drain** horizontally along the bottom of the excavation and secure using **e.fasteners**.
 - 1. Install the next lift of drainage and overlap the next layer of drainage a minimum of 6 inches. A shingling effect should be created by making certain the new drainage layer is placed inside the previously installed drainage layer at the overlap.
- C. Vertical Installation: Install **e.drain** vertically from the top of the excavation and secure using **e.fasteners**.
 - 1. Install vertically in one direction and overlap the vertical seam a minimum of 6 inches. A shingling effect should be created by making certain the new drainage layer is placed inside the previously installed drainage layer at the overlap.
- D. Back Lagged Condition: Install **e.drain** vertically and overlap onto the soldier pile a minimum of 6 inches.
- E. Fasten Pattern: Using **e.fasteners** secure seam overlaps 12 inches on center. Fasten the field of drain mat using an alternating pattern every 3 feet. The pattern shall be one fastener every 6 feet on center, and two evenly spaced fasteners every 3 feet.
- F. Overlap: Drainage overlaps shall be detailed using **e.spray/e.roll** polymer modified asphalt and **e.poly** reinforcement fabric.
 - 1. Pull the fabric of the bottom overlap sheet back and spray apply a minimum 30-mil coat of **e.spray/e.roll** a minimum of 6 inches onto the dimples, press firmly together.
 - 2. Apply a 30 mil coat of **e.spray/e.roll** 6 inches to either side of the overlap seam. Embed a 6 inch strip of polyester into the seam extending out 3" on either side of the seam, then apply a second 30-mil coat of **e.spray/e.roll** over the polyester.
- G. Place anchors or tie backs through the drainage mat by slitting vertically and sliding over the anchor as snug as possible.

3.3.3 SEALING OF PENETRATIONS

- A. Standard Pipe Penetrations: Standard penetration detailing should occur around all penetrations that are in place prior the membrane application, this includes soil nails, rock anchors, and tiebacks (non-hydrostatic).
 - 1. Prepare membrane penetrations so they are free of any material that will inhibit a direct bond to the penetration surface: foam, insulation, protective coatings, etc.
 - 2. Trim **e.drain** to within 1/8 inch of the penetration.
 - 3. Apply **e.roll** 3 inches horizontally and 3 inches vertically around the base of the penetration.

4. Install **e.stop b** around the base of the penetration.
 5. Embed reinforcement fabric 3 inches horizontally and 3 inches vertically around the base of the penetration.
 6. 6-inch **e.poly** reinforcement fabric is acceptable for most penetrations, for soil nails, rock anchors, and tiebacks (non-hydrostatic) 12-inch **e.poly** reinforcement fabric is required.
 7. Apply a second layer of **e.roll** 3 inches to reinforcement fabric until the reinforcement fabric is fully saturated.
- B. Rebar Rods: Wire ties, steel fasteners, or anchor bolts used to secure concrete reinforcement can be detailed prior to or after the application of **e.spray**. Any installation of wire ties, rebar rods, steel fasteners, or anchor bolts must be detailed per manufactures instruction using one of two methodologies.
- C. Rebar Rod Detail Option 1: Sealing with water stop.
1. Cut a 1" piece of **e.stop b**.
 2. Insert rebar rod into shoring wall through the 1" piece of **e.stop b**.
 3. Rebar rods shall be secured directly perpendicular to the vertical wall. Each rod shall be secured without the need of any additional support.
- D. Rebar Rod Detail Option 2: Sealing with reinforcement detail.
1. Rebar rods shall be secured directly perpendicular to the vertical wall. Each rod shall be secured without the need of any additional support.
 2. Apply **e.roll** 3 inches horizontally and 3 inches vertically around the base of the penetration.
 3. Embed **e.poly** reinforcement fabric 3 inches horizontally and 3 inches vertically around the base of the penetration.
 4. 6-inch **e.poly** reinforcement fabric is acceptable for most penetrations, for soil nails, rock anchors, and tiebacks (non-hydrostatic) 12-inch **e.poly** reinforcement fabric is required.
 5. Apply a second layer of **e.roll** 3 inch to reinforcement fabric until the reinforcement fabric is fully saturated.

3.3.4 POLYMER MODIFIED ASPHALT MEMBRANE

- A. Mask off adjoining surfaces where unwanted **e.spray** polymer modified asphalt membrane may impact other construction trades.
- B. Commence application of **e.spray** polymer modified asphalt when ambient air temperatures are within manufacturer recommendations.
- C. Surfaces that will receive the membrane must be clean and free from standing moisture.
- D. Start installing **e.spray** in presence of approved 3rd party inspector.
- E. Moving from the low point to the high point of the wall, apply one application of **e.spray** waterproofing in accordance to manufacturer's instructions in order to obtain a seamless membrane with a minimum dry film thickness of 60 mils (2 mm).

- F. Apply **e.spray/e.roll** in and around penetrations and cavities to ensure the formation of monolithic seal around all penetrations.
- G. Apply **e.spray/e.roll** to prepared wall terminations and vertical surfaces to heights indicated according to manufacturer's recommendations and details. (if applicable)
- H. Verify film thickness of waterproofing every 1000 ft² (93 m²).

3.3.5 TERMINATION AT TOP OF GRADE

- A. The system shall extend 2 feet past the top of the wall and be temporarily secured in place.
- B. When the wall is extended or a slab is placed at the top of wall, the cold joint shall be reinforced by applying 30 mils of **e.roll** on 3 inches of either side of the joint, embedding 6-inch **e.poly** reinforcement fabric, and then saturating the fabric with another application of 30 mils of **e.roll**.
- C. Trim the system to grade height and attach to the wall with a termination bar.
- D. Apply a reinforcement detail or bead of low VOC acrylic caulking over the top of the termination bar and continue transition per project drawings.

3.3.6 WATERSTOP INSTALLATION

- A. Place one row of **e.stop b** at all cold joints and concrete to steel beam connections.

3.4 POSITIVE SIDE CONCRETE WALL INSTALLATION – E.PROFORMANCE WALL

- A. General: The composite membrane system shall be installed to the positive side vertical wall under strict accordance with the manufacture's guideline and project specifications. This section describes the installation process for the system application to a freestanding cast-in-place concrete or shotcrete wall.
- B. Green Concrete: Application to green concrete is acceptable. Ambient temperatures, humidity, and concrete mix ratio can create blistering. If applying the system within 7 days of concrete placement contact manufacturer for further instruction.

3.4.2 TREATMENT OF CRACKS, JOINTS, AND REPAIRED AREAS

- A. Treat, rout, and fill cracks larger than 1/8 inch with hydraulic cement or rapid set grout.
- B. The following areas shall receive a reinforcement detail of **e.roll** and reinforcement fabric:
 1. All cracks less than 1/8 inch.
 2. All previously repaired cracks.
 3. All cold joints.
- C. Reinforcement Detail: Apply a 30 mil coat of **e.roll** to desired area extending 3 inches beyond the joint or area of repair. Embed a joint reinforcing strip into the **e.roll**. Apply a second 30 mil coat of **e.roll** over **e.poly** reinforcement fabric ensuring full saturation.

3.4.3 DETAILING OF TRANSITIONS

- A. Corners: A reinforcement detail shall be applied to all transitions including all inside and outside corners, and all transitions from a horizontal to vertical planes.

- B. Underslab Transition: When the underslab membrane transitions to a positive side concrete wall, the underslab membrane will terminate 2 feet above the slab to wall cold joint.
- C. The underslab membrane will be fastened to the wall using mechanical fasteners every 12 inches on center.
- D. Fasteners shall be place within three inches from the top of membrane.
- E. A reinforcement detail shall be centered on the edge of the membrane and fully encapsulate the mechanical fasteners.
- F. Reinforcement Detail: Apply a 30 mil coat of **e.roll** to desired area extending 3 inches beyond the joint or area of repair. Embed a joint reinforcing strip into the **e.roll**. Apply a second 30 mil coat of **e.roll** over **e.poly** reinforcement fabric ensuring full saturation.

3.4.4 SEALING OF PENETRATIONS

- A. Standard Pipe Penetrations: Prepare membrane penetrations so they are free of any material that prohibit the material to bond directly to the penetration surface: foam, insulation, protective coatings, etc.
 - 1. Install **e.stop b** around the base of the penetration.
 - 2. Apply **e.roll** 3 inches horizontally and 3 inches vertically around the base of the penetration.
 - 3. Embed **e.poly** reinforcement fabric 3 inches horizontally and 3 inches vertically around the base of the penetration.
 - 4. Apply a second layer of **e.roll** to the **e.poly** reinforcement fabric until the reinforcement fabric is fully saturated, and then secure the reinforcement fabric to the penetration with a cable tie.
 - 5. Cut a target piece of **e.poly** reinforcement fabric to the outside diameter of the penetration.
 - 6. Place target piece around the penetration and embed into existing saturated reinforcement fabric, saturate fabric with **e.roll**.

3.4.5 POLYMER MODIFIED ASPHALT MEMBRANE

- A. Mask off adjoining surfaces where unwanted **e.spray** polymer modified asphalt membrane may impact other construction trades.
- B. Commence application of **e.spray** polymer modified asphalt when ambient air temperatures are within manufacturer recommendations.
- C. Surfaces that will receive the membrane must be clean and free from standing moisture.
- D. Start installing **e.spray** in presence of approved 3rd party inspector.
- E. Apply a 10 mil primer coat of un-catalyzed **e.spray** and allow to set. The primer coat is designed to reduce that amount of potential blistering that may occur as the concrete continues to release moisture.
- F. Moving from the low point to the high point of the wall, apply one application of **e.spray** or multiple coats of **e.roll** in accordance to manufacturer's instructions in order to obtain a seamless membrane with a minimum dry film thickness of 60 mils (2 mm).

- G. Apply **e.spray/e.roll** in and around penetrations and cavities to ensure the formation of monolithic seal around all penetrations.
- H. Apply **e.spray/e.roll** to prepared wall terminations and vertical surfaces to heights indicated according to manufacturer's recommendations and details. (if applicable)
- I. Verify film thickness of waterproofing every 1000 ft² (93 m²).

3.4.6 POLYOLEFIN PROTECTION COURSE

- A. Install **e.shield 110** protection course vertically or horizontally, either way is acceptable.
- B. Overlap **e.shield 110** seams a minimum 6 inches.
- C. Secure **e.shield 110** to **e.spray** with Sta'-Put Quick Grip LVOC spray adhesive, or approved alternate.
- D. Secure **e.shield 110** protection course seams with **e.tape**.

3.4.7 PREFABRICATED DRAINAGE MAT INSTALLATION

- A. Horizontal Installation: Starting from one corner, run **e.drain** horizontally along the base of the foundation.
 1. Secure drainage panels to the wall by using approved adhesives, adhesive strips, or fastened with shot pins or as recommended by manufacturer.
 2. Install the next layer of **e.drain** in the same manner and overlap the next layer of drain mat 6 inches over the first layer of drain mat, thus creating a "shingle" effect. Continue this process to the top of the wall.
 3. Terminate the drainage and membrane system using a termination bar and a reinforcement detail.
 4. Care shall be taken when backfilling against the membrane in order to prevent any damage during the backfill process. Angular rock 1 inch or greater shall not be used without written approval from the manufacturer.
 5. Backfill in lifts, taking precaution to not backfill above the previously placed **e.drain**.
- B. Vertical Installation: Starting from the top of wall, install **e.drain** from the top of the wall to the base of the foundation.
 1. Overlap each roll of **e.drain** 6 inches on vertical overlaps and 6 inches on horizontal overlaps.
 2. Secure drainage panels to the wall by using approved adhesives, adhesive strips, or fastened with shot pins or as recommended by manufacturer.
 3. Secure **e.drain** with a termination bar at the top of grade and no greater than 3 inches from the top of the drain.
 4. Secure **e.drain** using approved adhesives.
- C. Geocomposite Strip Drain: If using **e.drain 12ds**, secure strip drain at the bottom of the footing or just above the design water table.

- D. Do not penetrate or damage the composite membrane system once it has been applied. If the system is penetrated or damaged, contact the applicator immediately. Failure to bring the breach of the system to the applicator's attention and not allowing adequate time to make the necessary repair will result in voiding any warranty.

3.4.8 TERMINATION AT TOP OF GRADE

- A. Termination at the top of grade shall be done with using a termination bar. Secure the termination bar every 12 inches on center and the center a reinforcement detail on the termination bar.
- B. Reinforcement Detail - Apply a 30 mil coat of **e.roll** to desired area extending 3 inches beyond the joint or area of repair. Embed a joint reinforcing strip into the **e.roll**. Apply a second 30 mil coat of **e.roll** over **e.poly** reinforcement fabric ensuring full saturation.

3.5 FIELD QUALITY CONTROL

- A. Smoke Test: Conduct smoke test on all under slab areas upon installation of the base sheet, the sealing all of penetrations, and application of **e.spray**. All deficient areas shall be noted and marked for repair, then the necessary repairs shall be made. Refer to manufacturer's smoke testing protocol for additional guidance.
- B. Independent inspectors and certified applicators shall document the amount of **e.spray** used and document quantities in the inspection report.

3.6 CURING PROTECTING AND CLEANING

- A. Allow for **e.spray** to fully bond with the substrate, generally this occurs 24 to 48 hours after application depending on ambient weather conditions.
- B. Take care to prevent contamination and damage during application stages and curing. All machinery, other trades, and general construction, shall NOT take place over the membrane until inspection is complete and concrete has been placed.
- C. Prevent damage during the placement of overburden.

3.7 REPAIRS

- A. Shoring and Underslab:
 - 1. Inspect damaged area to determine which system components have been damaged.
 - 2. If the base sheet has not been compromised, patch only the areas that have been damaged by re-installing the damaged materials. The patch should extend 6 inches beyond the damaged area.
 - 3. If the base sheet has been breached but no additional system components have been installed, install a patch below and above the base sheet that extends 6 inches beyond the damaged area. Area shall be sealed using the specified method for sealing the base sheet.
 - 4. If the damaged area has breached the base sheet and additional components have been installed over the base sheet, the area will require removal of the overlying components to expose the base sheet.
 - 5. If the damage is less than 3 inches, the base sheet will need to be opened up to create a minimum 4-inch diameter circle to allow access.

6. Place a minimum 8-inch diameter coupon under the base sheet and seal using the specified method for seaming the base sheet. If heat welding the seam, probe the seam to ensure a uniform seal.
7. Apply a reinforcement detail of **e.roll** and reinforcement fabric 6 inches beyond the edge of the repair area.
8. Apply the remaining layers as specified.

B. Concrete Walls:

1. Inspect damaged area to determine which system components have been damaged.
2. Only patch the areas that have been damaged by re-installing the damaged materials. The patch should extend 6 inches beyond the damaged area.

End of Section