SPECIAL PROVISION FOR WATERPROOFING

Description

This work shall consist of furnishing and applying waterproofing material on concrete bridge decks or other surfaces as shown on the plans.

Materials

(a) **Epoxy-resin compounds and aggregates for surface application** shall conform to the requirements of Section 243. Epoxy resin shall be Type EP-5, low viscosity for concrete bridge deck applications and Type EP-3B/EP-3T for concrete beam ends and concrete substructure seat applications.

(b) **Membrane and primer** shall conform to the requirements of Section 213.

416.03—Procedures

(a) **Epoxy-resin**: Containers, tools, and mechanical equipment shall be free from solvents, loose material, and deposits of hardened material.

Epoxy resin shall not be applied when the concrete surface or the ambient air temperature is below 50 degrees F unless otherwise permitted by the manufacturer’s instructions.

1. **Surface preparation**: Surfaces on which epoxy compounds are to be applied shall be free from grease, dirt, dust, paint, mill scale, curing compound, laitance, and other foreign material.

   Concrete surfaces on which epoxy compounds are to be used shall be sandblasted sufficiently to expose the sound concrete. Surfaces that are not to receive epoxy compounds shall be protected from sandblasting. Immediately following sandblasting, the surface shall be thoroughly cleaned.

   Before epoxy compounds are applied to metal surfaces, surfaces shall be sandblasted to a bright metallic luster.

   Wood surfaces shall be sanded to the texture of new wood.

2. **Mixing**: Epoxy mortar shall be made by blending sand, epoxy resin, and hardener in accordance with the manufacturer’s instructions.

   Batch sizes shall be limited to the maximum batch size recommended by the manufacturer. Mixed epoxy compounds shall be used within the manufacturer’s specified pot life. Solvents or other materials shall not be added to the mixture.

3. **Application**: Masking shall be used to form straight edges. Epoxy resin shall not be allowed to flow into or over expansion joints. The first coat of epoxy resin shall be applied at the rate of 1 gallon per 75 square feet. Sand shall be broadcast into the wet epoxy in sufficient quantity, approximately 11 pounds per square yard, to cover the epoxy completely. Sand shall be firmly
embedded so that at least 95 percent of the deck area displays a sand surface after brooming. Brooming shall not be performed until the epoxy resin has cured sufficiently to prevent tearing. After curing, unbonded sand shall be broomed from the surface and may be reused if uncontaminated. The second coat of epoxy resin shall be applied at the rate of 1 gallon of epoxy per 50 square feet. Requirements pertaining to masking, epoxy, flow, sand broadcasting, percentage of embedment, curing, and brooming shall also apply to the second coat of epoxy resin. Applications of Epoxy Type EP-3B/EP-3T for concrete beam ends and concrete substructure seat applications will not require sand to be broadcast into the material.

At edges of the waterproofing system and at any point where it is punctured by appurtenances such as drains or pipes, suitable provisions shall be made to prevent water from getting between the waterproofing and the waterproofed surface.

4. **Curing:** Curing time shall conform to the manufacturer’s recommendations. During this time, both pedestrian and vehicular traffic shall be barred from freshly placed surfaces.

(b) **Membrane:**

1. **Waterproofing membrane system.** Section 213 of the current VDOT Specifications states that “Membrane shall conform to the requirements of ASTM D6153”. ASTM Standard D6153 contains the following requirements for physical properties of membranes:
   - Permeability shall be determined in accordance with Test Method E96/E96M water method.
   - Pliability shall be determined in accordance with Test Method D146, except that the test temperature of the test specimen shall be –18°C after 24 h and 180° bend over a 6-mm (1/4-in.) mandrel.

   The system shall consist of one of the following systems in accordance with the requirements of ASTM Standard D6153:

   Type I – Cold applied elastomeric. Type I covers cold liquid applied chemically curing membrane materials which prevent the passage of water from the asphalt surface course to or through the bridge deck. A membrane protection course as specified by the membrane manufacturer is required.

   Type III – Preformed sheet membrane. Type III covers preformed membrane systems which prevent the passage of water from the asphalt surface course to or through the bridge deck.

   The type of system to be used will be as specified on the plans.

2. **Construction:** On new decks, the waterproofing membrane system shall not be placed until at least 28 days after deck concrete placement unless otherwise directed by the Engineer.

   Each phase of the bridge deck construction shall be completed, including the placing of the surface course overlay, before traffic may be placed on that portion of the bridge structure. In order to minimize possible damage to the membrane, exposure of the membrane shall be minimized. Only vehicles necessary for construction will be permitted on the structure during and after the placing of the membrane system, and such vehicles shall be rubber tired or have rubber-covered treads. The Contractor shall be responsible for maintaining the condition of the membrane system throughout construction.
All methods employed in performing the work and equipment, tools, and machinery used for handling materials and executing any part of the work shall be subject to the approval of the Engineer before the work is started, and whenever found unsatisfactory, they shall be changed and improved as required. Equipment, tools, machinery, and containers used shall be kept clean and maintained in satisfactory working condition.

The Contractor shall furnish the services of a competent field representative of the approved manufacturer to be present at the work site prior to any use of materials. The representative shall instruct the Contractor and the Engineer on installation and inspection procedures and to inspect the condition of the prepared surfaces. The representative will remain on the job site until the completion of the work.

Work shall not be performed during wet weather conditions. In addition, work shall not be performed when the deck and ambient air temperatures are below manufacturer’s limits + 5 degrees F. The deck surface shall be thoroughly dry at the time of the application of the primer or liquid membrane.

Concrete parapet surfaces and railing, including armor plates for the joint seals, shall be protected to prevent their being defaced by primer or membrane material. Should defacement occur, the Contractor shall clean surfaces on the structure to the satisfaction of the Engineer.

Between the time the bridge deck is cleaned and prepared for primer and the time the membrane system is placed, no vehicles shall be operated on the area being treated. Only the necessary personnel and equipment to perform the required work will be allowed on the treated surface, and only at such time and in such manner as approved by the Engineer. Care shall be taken to prevent sudden starts, stops, or turns by equipment. All other traffic shall be maintained on portions of the structure that are not being given the membrane protection.

3. **Preparation of concrete deck:** Surfaces that are to be covered shall be thoroughly cleaned by the use of shot blasting, followed by the use of air jets, mechanical sweepers, hand brooms, or other approved methods, or as required by the Engineer, until the surface is free of sand, clay, dust, and loose or foreign matter. Water shall not be used to clean the deck unless authorized by the Engineer.

Any accumulations of oil or grease shall be scraped off of the surface and cleaned with a strong caustic solution. The resulting residue shall be thoroughly flushed away with clean water. Cleaned areas shall be primed without delay as soon as they are dry. Dust and dirt shall be blown off with air jets immediately preceding application of primer or liquid membrane.

Any sharp concrete protrusions on the deck surface that would puncture the membrane shall be removed prior to application of the membrane.

4. **Construction procedures:**

**Type I Membrane System**

Testing - Random tests for adequate tensile bond strength shall be conducted on the substrate by the applicator on site using an Elcometer Adhesion Tester Model 106 or similar at a minimum frequency of three tests per 5,000 square feet. Smaller areas shall
receive a minimum of three tests. Should the tensile bond strengths be lower than 100 psi on concrete (or failure within the concrete) or 290 psi on steel, the Engineer may request further surface preparation.

Application - Application can proceed while air and substrate temperature are between 32°F and 104°F providing the substrate is above the dew point. Outside these temperatures the manufacturer shall be consulted. All components of the system shall be measured and mixed strictly in accordance with the manufacturer's recommendations. Mixing shall be done with either an air driven high speed paddle or an explosion proof mixer. Prior to the application of any materials, the surface must be clean and free from loose debris, moisture, oil, grease or other contaminants.

1. Primer. A single coat of spray, roller or brush applied primer is required for all steel and concrete surfaces. This primer shall cure tack free before application of the waterproofing membrane.

2. Membrane. The waterproofing membrane shall be spray applied with suitable equipment approved by the manufacturer, in two color differentiated coats, each with a wet film thickness of 60 mils per coat providing a finished minimum thickness of 80 mils on any peak. Checks for wet film thickness shall be carried out typically every 100 square feet. The membrane shall cure between coats and before application of the tack coat.

3. Tack Coat. A tack coat, supplied by the same manufacturer, shall be applied directly to the waterproofing membrane prior to surfacing.

Repairs:

1. Patching. If an area is left untreated or the membrane becomes damaged, a patch repair shall be carried out to restore the integrity of the system. The damaged area shall be cut back to sound material and wiped with solvent (e.g., acetone) up to a width of at least 4 inches on the periphery, removing tack coat and any contaminants. The substrate shall be primed, if necessary, followed by the application of membrane. A continuous layer shall be obtained over the substrate with a 4-inch overlap onto the existing membrane.

2. Overlapping. Where the membrane is to be joined to existing cured material and at day joints, the new application shall overlap the existing one by at least 4 inches. No preparation shall be necessary unless the existing materials are contaminated with tack coat or dirt in which case the repair/overlap area shall first be wiped with solvent (e.g., acetone).

Protection - During all stages of application, the membrane shall be protected by the Contractor from damage by construction operations.

Final Review - The Engineer and the applicator shall jointly review the deck area(s) in which the completed system has been installed, prior to surfacing. Any irregularities or other items which do not meet the requirements of the Engineer shall be addressed at this time.
Type III Membrane System

Application - A prime coat shall be applied to areas that will be covered with membrane within the following 24 hours. Any areas not covered within 24 hours must be re-primed. The primer material and rate of coverage shall meet the specifications of the manufacturer. The primer shall be allowed to dry one hour or until tack free before placing the membrane. The membrane shall not be applied at temperatures below 40°F.

All corners such as at curbs shall be double covered by using an initial strip of 12-inch minimum width, placed along the axis of the corner. Inside corners should be finished with a fillet, and outside corners should be rounded. Areas around drains or other protrusions should be double covered with the membrane for a minimum of 6 inches in each direction then liberally coated with an approved mastic.

Before applying the membrane, the direction of operation of the paving equipment shall be ascertained. Unless otherwise approved, each phase of Type III membrane construction shall begin at the low point of the surface to be waterproofed and shingled so that water will run over and not against any laps. At deck joints, the membrane shall extend to the edge of the joint opening as shown on the plans.

Type III membrane shall be applied to the primed curb and bridge deck surfaces by either hand methods or mechanical applicators. Type III membranes shall be placed in such a manner that a shingling effect will be achieved, and any water that accumulates will drain toward the curb and the drainpipes. Each strip shall be overlapped a minimum of 4 inches. The membrane sections shall be placed so that end laps will be in the direction of the paving operation.

An adhesive or a wide tipped torch shall be used, if necessary, to ensure a good seal of the membrane joints. Hand rollers or other satisfactory pressure apparatus shall be used on the applied membrane to ensure firm and uniform contact with the primed concrete surfaces. Special care shall be used at the curb face to ensure that the membrane is uniformly and positively adhering to the concrete.

Type III membranes shall be free of wrinkles, air bubbles, and other placement defects. Any torn or cut areas or narrow overlaps shall be patched using a satisfactory adhesive and by placing sections of the membrane over the defective area in such a manner that the patch extends at least 6 inches beyond the defect. The patch shall be rolled or firmly pressed onto the surface.

5. Material Requirements:

Type I Membrane System

a. Primer shall be a 100-percent solvent-free reactive, acrylic-based, two-component resin.

b. Membrane shall consist of an acrylic resin based two coat, 100 percent solvent-free reactive, two-component elastomeric membrane. Each coat shall be 60 mils (1.5 mm) thick and differentially pigmented for quality control. In addition the membrane shall meet or exceed the following properties, backed by a certificate of conformity, as related to laboratory prepared samples tested at 68°F (20°C) and a 24-hour cure, where applicable.
<table>
<thead>
<tr>
<th>Test</th>
<th>Method</th>
<th>Required Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cure Time 30 Minutes</td>
<td>/A</td>
<td></td>
</tr>
<tr>
<td>Water Vapor 0.026 gr/ft2/hr</td>
<td>ASTM E96</td>
<td></td>
</tr>
<tr>
<td>Transmission (0.18 g/m2/hr)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adhesion to Concrete 100 psi</td>
<td>ASTM D4541</td>
<td></td>
</tr>
<tr>
<td>Adhesion to Steel 290 psi</td>
<td>ASTM D4541</td>
<td></td>
</tr>
<tr>
<td>Tensile Strength 435 psi</td>
<td>ASTM D638, Method A, Die C</td>
<td></td>
</tr>
<tr>
<td>Min. Elongation at break 100%</td>
<td>ASTM D638, Method A, Die C</td>
<td></td>
</tr>
<tr>
<td>Low Temperature Pass @ -13°F</td>
<td>$\frac{1}{4}$&quot; (6.35 mm) mandrel @ -13°F (-25°C)</td>
<td></td>
</tr>
<tr>
<td>Crack Bridging Pass @ 25 cycles, 0.0625 in. -15°F 1.6 mm, -26°C</td>
<td>ASTM C836</td>
<td></td>
</tr>
<tr>
<td>Type III Membrane System</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>The waterproofing membrane shall be provided in rolled sheet form. One face of the membrane shall be adhesive and protected with an easily removable coated backing paper to prevent adhesion of the membrane to itself. The membrane shall be composed of rubberized or polymer modified asphalt, reinforced with a fiberglass or polypropylene mesh.</td>
<td></td>
</tr>
<tr>
<td>a. Primer shall either conform to ASTM 041 or be as specified by the membrane manufacturer.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>b. Sheet Membrane shall conform to the following specifications.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Test</td>
<td>Method</td>
<td>Required</td>
</tr>
<tr>
<td>-------------------------------</td>
<td>-------------------------------</td>
<td>------------------</td>
</tr>
<tr>
<td>Thickness 60 mils (+/- 5 mils)</td>
<td>-</td>
<td>50 lbs/in. (88 N/cm) 25% elongation, min</td>
</tr>
<tr>
<td>Tensile Strength 200 lbs. (890 N) min.</td>
<td>Per ASTM D882</td>
<td></td>
</tr>
<tr>
<td>Pliability No cracks or splits</td>
<td>Per ASTM D146 At -15°F (-26° C) with 1&quot; (25.4 mm) mandrel</td>
<td></td>
</tr>
<tr>
<td>Puncture Resistance 0.1 perms (.066 m perms). max.</td>
<td>ASTM E154</td>
<td></td>
</tr>
<tr>
<td>Permeance</td>
<td>ASTM E96</td>
<td></td>
</tr>
</tbody>
</table>