Section 710. WATERPROOFING AND PROTECTIVE COVERS

710.01. Description. This work consists of providing and placing membrane waterproofing and protective covers.

710.02. Materials. Provide materials in accordance with the following:

Water	911
Joint and Waterproofing Materials	914
Mortar and Grout	702

Provide one of the following waterproofing types as required.

A. **Preformed.** Preformed waterproofing membrane and expansion joint waterproofing selected from the Qualified Products List; including a manufacturer-specified surface primer.

B. **Shotcrete.** Shotcrete material consisting of a premixed, latex-modified portland cement, and fine aggregates, as recommended by the manufacturer for use as a pneumatically applied concrete; secure the Engineer's approval, before use on the project.

710.03. Construction.

A. **Joint Waterproofing – Preformed.** Where concrete joints require waterproofing, use preformed waterproofing.

Provide preformed joint waterproofing at least 18 inches wide.

Apply the preformed waterproofing membrane system to the concrete surface at least 4 hours after removing the forms.

Prepare and prime the surface for at least 12 inches on each side of the joint. Complete preparatory work if the air and concrete temperatures are above 40 °F and the surfaces are dry. Clean the surface, designated for coverage, by using a solvent and scraping to remove deleterious materials, including oil, grease, old waterproofing material, and asphalt residue.

Before applying the primer, remove protrusions that could puncture the membrane, or cause a void with a diameter greater than ¾ inch. Remove dust from the concrete surface with compressed, oil-free air. Fill surface imperfections, potholes and spalls with a Department-approved epoxy mortar, mortar, or concrete and cure. Cure cement-based patching mixtures at least 24 hours before installing the membrane.

Apply the primer with a roller or brush, in accordance with the manufacturer's recommendations, over the entire concrete surface

required for membrane coverage. Provide an additional application of primer if the membrane is not placed within the time specified by the membrane system manufacturer.

Apply the membrane in accordance with the manufacturer's recommendations. Remove the release paper from the back surface of the membrane immediately before placing. Center the membrane over the concrete joint, straight and wrinkle-free. Immediately after applying each sheet, hand roll with a roller, using pressure necessary to remove air voids and ensure complete adhesion. Overlap seams at least 6 inches.

Before backfilling, demonstrate to the Engineer that the entire surface of membrane has fully adhered to the underlying concrete surface. The Engineer may reject waterproofing membrane systems that exhibit a loss of adhesion to the concrete surface. Repair punctures, tears, wrinkles, or other imperfections in the installed membrane. Make repairs by applying a patch of membrane over the damaged material, or remove and replace the membrane. Size patches to extend 6 inches beyond the perimeter of the repair area.

B. **Expansion Joint Waterproofing – Preformed.** Apply a two-layer, preformed joint waterproofing membrane system at integral and semi-integral abutment backwall locations. Apply expansion joint waterproofing in accordance with subsection 710.03.A, except as modified by this subsection 710.03.B

Provide a preformed waterproofing membrane that is at least 18 inches wide.

Do not apply primer to the two beveled surfaces next to the expansion joint at the interface of the abutment wall and backwall, required to receive the bond breaker tape.

Apply a bond breaker tape, or equivalent material, to the face of each beveled surface next to the expansion joint at the interface of the abutment wall and backwall, to prevent the membrane fold from adhering to these concrete surfaces.

Center the membrane over the concrete joint, making it straight and wrinkle-free, and insert it full-depth into the beveled cavity of the expansion joint to provide slack in the membrane for bridge movement.

Apply a second layer of membrane over the first layer. Do not use bond breaker tape for this second layer. Before applying the second layer of membrane, coat the entire exposed surface of the first layer of membrane, including the fold, with primer. Center the second layer of

membrane over the concrete joint, making it straight and wrinkle-free. Ensure this second layer conforms to, and fully adheres to the first layer of membrane.

C. **Deck Waterproofing – Preformed.**

1. **Construction Procedure.** Prime and place the membrane when the air and concrete temperatures are above 40 °F and the surfaces are dry.

   Allow concrete, including grout and repair areas, to cure for at least seven days before applying the primer. Clean the surface using a solvent, and by scraping to remove deleterious material, including oil or grease. Remove sharp protrusions by grinding. Remove old membrane material or asphalt residue using methods approved by the Engineer. Fill potholes and spalls with a diameter greater than ¾ inch with a Department-approved epoxy mortar, cement mortar, or concrete and cure as required. Correct elevation differences in the tops of box beams, such as those resulting from camber variation, by wedging with cement mortar or concrete. Sweep and clean surfaces with brooms and compressed air, as required.

   After cleaning the deck, apply the primer, using a roller, brush, squeegee, or mechanical means, to the surface of the deck and 2 inches to 3 inches up the vertical face of the curb. Prime only those surfaces that can be covered by membrane the same day. Allow the primer to dry to a non-tacky condition before applying the membrane. Drying time may vary from ½ hour to 1½ hours, depending on the air temperature. Small bubbles on the primer are normal and do not affect the bond

   After the primer has cured or dried, apply a Department-approved liquid fillet material to all inside corners. Apply a Department-approved mastic to locations where membrane edges will fall, including the curb face, raised expansion dams, or drain castings. Apply an 8-inch strip of the sheet membrane to the vertical surface of the curb so it comes to a height equal to the planned depth of hot mix asphalt (HMA). Place an 8-inch wide strip of sheet membrane, centered over transverse joints or cracks wider than $^{3}/_{16}$ inch. Do not place the strip at raised steel expansion dams. Firmly press the membrane into the primer and mastic.

   Starting at the low, or down-slope side of the deck, place the membrane either by hand or with equipment designed for this purpose. Shingle-lap successive strips of membrane. Place the

membrane, ensuring it is straight, wrinkle free with no bubbles or air spaces under it.

Overlap the edges and ends of the membrane at least 6 inches. At the drain spouts, cut the membrane and turn it down into the spouts or bleeder pipes. Apply a continuous bead of Department-approved mastic along the base of raised expansion dams, butt the sheet membrane up to the dam and press into the mastic.

Immediately after installation of each sheet of membrane, hand roll with a roller that weighs enough to ensure total contact with the deck. Patch torn or cut areas, or narrow overlaps, by placing sections of the membrane over the areas so the patch extends at least 6 inches beyond the defect in all directions. Roll the patch or press firmly in place and apply a Department-approved mastic to the edges.

Remove the separation sheet of plastic or paper as specified by the manufacturer, during the installation of the membrane and before the application of the HMA. Remove stones or other foreign matter found under the membrane after application and patch the area as described in this subsection 710.03.C.1.

Do not allow vehicles, except HMA hauling units and the approved rubber-tired paver on the completed waterproofing membrane.

2. **Placing HMA Over Waterproofing Membrane.** Place the HMA mixture at a temperature from 250 °F to 350 °F according to section 501 after placing the membrane. Pave only on a clean and dry membrane surface. Use rubber-tired equipment. Inspect equipment and remove burrs on tires, stones, or sharp projections that could damage the membrane. If the rubber-tired machine skids during warm weather, broadcast fine sand or cement in the tire paths. Avoid excessive use of cement or sand that would prevent adhesion of the HMA.

   Preheat paver screeds, but turn burners off during paving to avoid damaging the membrane. Deliver the HMA directly from the hauling unit to the paver. Do not stop the paver with a full hopper. Prevent build up of material in the auger. Keep the level of the HMA in the auger just below the level of the auger shaft. Do not damage the membrane when restarting paving operations. Avoid sudden stops or sharp turns with the compaction rollers.

   After rolling the surface, apply a fillet or cove seal using the asphalt-mineral, fiber-solvent caulking material, supplied with the membrane. Apply the seal at the curb line to form a ¾ inch by ¾ inch triangular seal along the edge of the new surface, the full length of the curb.

D. **Shotcrete.** Pneumatically eject the shotcrete mixture from a mixer or gun through a hose and discharge nozzle, under regulated pressure. Add the liquid latex component at the mixer or gun, or at the nozzle, depending on equipment type and material manufacturer's recommendations.

1. **Test Panels.** Demonstrate to the Engineer, the ability of nozzle operators to correctly apply shotcrete. Use test panels, simulating job conditions, for each gun shooting position (down, horizontal, and overhead) required on the project. Use the same shotcrete material on test panels as proposed for use on the project. Use a panel 2 feet by 2 feet square and at least 3 inch thick, or the same thickness required on the project, whichever is greater. Ensure at least half the panel area has the same reinforcing steel pattern required on the project.

   After shotcrete application, keep test panels continuously moist and above 40 °F for 5 days. Remove at least 5 cores from the test panels and test for compressive strength in accordance with ASTM C 39. Cut cores with a diameter of at least 3 inches meeting a length-to-diameter ratio (L/D) of at least 1.0. Adjust core strengths in accordance with ASTM C 42 if the L/D is less than 2.0. Ensure the average compressive strength of the cores is at least 85 percent of the required compressive strength with no individual core having a compressive strength below 75 percent of the required compressive strength.

   Take additional cores through the reinforcing steel so the Engineer can evaluate the soundness of the shotcrete behind the steel. The Engineer will examine the cored surfaces and require additional cores or saw cuts if necessary to evaluate soundness and uniformity of deposited material. The Engineer will evaluate the test panels and cores to verify shotcrete surfaces are dense and free from laminations, voids, and sand pockets.

2. **Surface Preparation.** If applying shotcrete to protect waterproofing, perform the work immediately after the completion of waterproofing.

   If using shotcrete to repair concrete members, remove unsound concrete from the existing substrate and concrete contaminated by chemicals or oils. Saw cut and repair the edges of the area required for repair, and patch to a depth of at least ½ inch. If using impact tools to remove concrete, provide tools that will not damage sound concrete surrounding and beneath the area being removed.

Use galvanized or epoxy-coated welded wire reinforcing on repairs greater than 2 inches deep. Place the reinforcing at mid-depth of the repair, and at least 1 inch below the surface. Attach the reinforcing to sound concrete with stainless steel anchoring devices spaced in a grid no greater than 18 inches by 18 inches. Use anchors that can support three times the weight of shotcrete allocated to each anchor.

Blast-clean the prepared area and remove traces of dirt, oil, and loose material. Follow with an oil-free air blast to remove abrasive material and dust.

3. **Shotcrete Placement.** Pre-wet the surface with the liquid latex component immediately before placement of shotcrete.

   Balance air and material to ensure a steady flow, and to prevent "slugging" of material, plugging, and excess rebound. Apply the mortar using pneumatic equipment that sprays the mix onto the prepared surface at a high enough velocity to produce a compacted dense homogeneous mass, with no sagging or sloughing.

   Place each layer of shotcrete in several passes over a section of the work area. Divide large expanses into smaller areas and apply shotcrete to its full thickness before moving to the next area. Avoid laminations during placement.

   Keep the nozzle 2 feet to 6 feet from the work. Hold the nozzle as near to perpendicular to the surface as possible, and never more than 45 degrees to the surface.

   Remove rebound and overspray that does not fall clear. Do not salvage or recycle rebound and overspray.

   Do not apply shotcrete under the following conditions.

   a. High wind preventing proper application;
   b. Surface temperature below 45 °F; or
   c. Rain causing washouts or sloughing of the fresh shotcrete.

4. **Curing.** Cure shotcrete and provide temperature protection in accordance with subsection 706.03.N.3.

5. **Testing.** The Engineer may require cutting cores from the completed work for compression testing. If the Engineer orders tests, obtain and test at least three cores in accordance with subsection 710.03.D.1.

710.04. Measurement and Payment.

Pay Item	Pay Unit
Joint Waterproofing	Square Foot
Joint Waterproofing, Railroad	Square Foot
Shotcrete	Square Foot, Cubic Foot
Membrane, Preformed Waterproofing	Square Foot
Joint Waterproofing, Expansion	Square Foot

A. **Joint Waterproofing.** The Engineer will measure **Joint Waterproofing** by area based on a width of 18 inches and the plan length of joints requiring treatment.

B. **Joint Waterproofing, Expansion.** The Engineer will measure **Joint Waterproofing, Expansion** by area based on an 18 inch width and the plan length of joints requiring treatment. The Engineer will not measure the area of folds or overlapped material for payment. The unit price for **Joint Waterproofing, Expansion** includes the cost of preparing the concrete surfaces and installing the two-layer preformed expansion joint waterproofing membrane system.

C. **Membrane, Preformed Waterproofing.** The Engineer will measure **Membrane, Performed Waterproofing** by the area covered, with no allowance for laps, patches, the 8-inch strips over transverse joints or cracks, or the 8-inch strip applied to the vertical surface of the curb. The Engineer will not deduct the areas of expansion dams or drain spouts.

The unit price for **Membrane, Performed Waterproofing** includes the cost of cleaning the deck; applying the primer, liquid fillet material, and mastic; applying, rolling, and repairing the membrane; and applying the final cove seal mastic along the curb line.

D. **Shotcrete.** The unit price for **Shotcrete** includes the cost of surface preparation; providing, mixing, and applying shotcrete material; test panels, and coring.

E. **Removing HMA Surface.** If required, the Engineer will measure, and the Department will pay for removing HMA surface separately, as **HMA Surface, Rem** in accordance with subsection 501.04. The unit price for **HMA Surface, Rem** includes the cost of removing old membrane.

The Engineer will measure, and the Department will pay for scarifying, hand chipping, and patching, if required, separately in accordance with subsection 712.04. If the Department cannot determine the amount of scarifying, hand chipping, and patching required before removal of the

HMA surface, the Department will pay for this work by force account in accordance with subsection 109.05.D.

F. **Wedging Along Joints.** The Engineer will measure and the Department will pay for required wedging along joints between prestressed concrete box beams, inspected and accepted by the Department, separately as **Patching Mortar or Conc** in accordance with subsection 712.04.

The Engineer will measure, and the Department will pay for the HMA mixture separately in accordance with subsection 501.04.