Section 710. WATERPROOFING AND PROTECTIVE COVERS

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

710.02 Materials. Materials shall meet the following requirements.

Waterproofing Agent: Asphalt Cement WOA 904
Waterproofing Primer: RC-250 904
Water 911
Bituminized Cotton Fabric 914
Fiberglass Fabric 914

Preformed waterproofing membrane and expansion joint waterproofing shall be selected from the Qualified Products List.

The selected preformed waterproofing membrane or expansion joint waterproofing system must include a manufacturer's specified surface primer, which is to be used to prepare the concrete surface prior to applying the membrane.

Waterproofing agent: asphalt cement WOA meeting the requirements of ASTM D 449, Type II shall be used.

When the waterproofing agent for membrane waterproofing is asphalt cement WOA , the primer shall be RC-250.

The material supplied for use as shotcrete shall be a product recommended by the manufacturer for use as a pneumatically applied concrete and will require approval of the Engineer prior to its use on the project.

710.03 Construction.

A. **Joint Waterproofing.** Where joints in concrete are to be waterproofed, the waterproofing shall be either hot applied or preformed.

1. **Hot Applied.** The surface for a distance of 12 inches each side of the joint shall be prepared and primed. This work shall only be done when the air and concrete temperatures are above 40 °F and the surfaces are dry. The entire surface to be covered shall be cleaned of all foreign materials such as: oil, grease, old waterproofing material, and asphalt residue, by scraping, and the use of a suitable solvent. All rod holes and other voids greater than ¾ inch in diameter shall be filled with an approved epoxy mortar, portland cement mortar, or concrete and allowed to cure as directed. All sharp protrusions shall be removed by grinding. New concrete, including repair areas, shall be at least seven days old before applying the prime coat. Dust shall be removed from the concrete surface by brushblasting with compressed, oil free air.

The priming coat shall be applied at a rate of not less than one gallon per 100 square feet of surface. Sufficient time shall elapse before applying the waterproofing fabric to allow the prime coat to thoroughly set. A second mopping of hot asphalt shall then be applied and a 10-inch wide strip of waterproofing fabric shall be pressed into it and centered over the joint. This shall be followed by a third mopping of hot asphalt, 24 inches wide, and a strip of fabric 18 inches wide applied and centered over the joint. A fourth mopping of hot asphalt shall then be applied completely covering the fabric and lapping onto the concrete. The second, third and fourth moppings of hot asphalt (temperature recommended by supplier) shall be applied at a rate of not less than 4½ gallons per 100 square feet of surface.

2. **Preformed.** Preformed joint waterproofing shall be a minimum 20 inches in width.

   The preformed waterproofing membrane system may be applied to the concrete surface a minimum of four hours after removal of the forms.

   The surface for a distance of 12 inches each side of the joint shall be prepared and primed. This work shall only be done when the air and concrete temperatures are above 40 °F and the surfaces are dry. The entire surface to be covered shall be cleaned of all foreign materials, such as oil, grease, old waterproofing material, and asphalt residue by scraping, and the use of a suitable solvent. All protrusions that could potentially cause a void beneath the membrane greater than ¾ inch in diameter, or puncture the membrane, shall be removed prior to application of the primer. Dust shall be removed from the concrete surface with compressed, oil free air. Surface imperfections, potholes and spalls shall be filled with an approved epoxy mortar, Portland cement mortar, or concrete and allowed to cure. Portland cement based patching mixtures must be cured for a minimum of 24 hours prior to installation of the membrane.

   The primer may be applied with a roller or brush according to the manufacturers recommendations. The primer shall be applied over the entire concrete surface to receive the membrane. An additional application of primer may be required if the membrane is not applied to the concrete surface within the designated time after priming, as specified by the membrane system manufacturer.

   The membrane shall be applied according to the manufacturers recommendations. The release paper shall be removed from the back surface of the membrane immediately prior to placement of the membrane. The membrane shall be centered over the concrete joint, in a straight, wrinkle-free manner. After each sheet of membrane is applied, it shall be hand rolled immediately with a suitable roller, with sufficient pressure to remove all air voids and ensure complete adhesion. All seams shall be overlapped a minimum of 6 inches.

   Prior to backfilling, the Contractor shall demonstrate to the Engineer that the entire surface of membrane has fully adhered to the underlying concrete surface. Any punctures, tears, wrinkles, or other imperfections in the installed membrane shall be repaired as directed by the Engineer. Repairs may be made by either removing and replacing the membrane, or by applying an additional localized layer of membrane over

the damaged material. All seams shall be overlapped a minimum of 6 inches. Loss of adhesion of the membrane to the concrete surface at any time shall be basis for rejection of the preformed waterproofing membrane system.

B. **Expansion Joint Waterproofing.** A two-layer preformed joint waterproofing membrane system shall be applied at integral and semi-integral abutment backwall locations shown on the plans.

The preformed waterproofing membrane shall be a minimum 18 inches wide.

The preformed waterproofing membrane system may be applied to the concrete surface a minimum of four hours after removal of the forms.

The surface for a distance of 12 inches each side of the joint shall be prepared and primed. This work shall only be done when the air and concrete temperatures are above 40 °F and the surfaces are dry. The entire surface to be covered shall be cleaned of all foreign materials, such as oil, grease, old waterproofing material, and asphalt residue by scraping, and the use of a suitable solvent. All protrusions that could potentially cause a void beneath the membrane greater than ¾ inch in diameter, or puncture the membrane, shall be repaired prior to application of the primer. Dust shall be removed from the concrete surface with compressed, oil free air. Surface imperfections, potholes and spalls shall be filled with an approved epoxy mortar, Portland cement mortar, or concrete and allowed to cure. Portland cement based patching mixtures must be cured 24 hours minimum prior to installation of the membrane.

A bond breaker tape, or equivalent material, shall be applied to the face of each of the two beveled surfaces, directly adjacent to the expansion joint at the abutment wall/backwall interface, to prevent adhesion of the membrane fold to these concrete surface.

The primer may be applied with a roller or brush according to the manufacturer's recommendations. The primer shall be applied over the entire exposed concrete surface to receive the membrane. Primer shall not be applied to the two beveled surfaces directly adjacent to the expansion joint at abutment/backwall interface that receive the bond breaker tape. An additional application of primer may be required if the membrane is not applied to the concrete surface within the designated time after priming, as specified by the membrane system manufacturer.

The first layer of membrane shall be applied to the primed concrete surfaces according to the manufacturer's recommendations. The release paper shall be removed from the back surface of the membrane immediately prior to placement of the membrane. The membrane shall be centered over the concrete joint, in a straight, wrinkle-free manner, and inserted full-depth into the beveled cavity of the expansion joint to provide slack in the membrane for bridge movement. The membrane shall then be hand rolled immediately with a suitable roller, with sufficient pressure to remove all air voids and complete adhesion. All seams shall be overlapped a minimum of 6 inches.

A second layer of membrane shall then be applied over the first layer in a similar manner. Bond breaker tape is not required for this second layer. Prior to applying the second layer of membrane, the entire exposed surface of the first layer of membrane, including the fold, shall be coated with primer. The second layer of membrane shall be centered over the concrete joint in a straight, wrinkle-free manner, and shall conform, and fully adhere, to the underlying first layer of membrane.

Prior to backfilling, the Contractor shall demonstrate to the Engineer that the entire surface of membrane has fully adhered to the underlying concrete surface. Any punctures, tears, wrinkles, or other imperfections to the membrane shall be repaired, as directed by the Engineer. Repairs may be made by either removing and replacing the membrane, or by applying an additional localized layer of membrane over the damaged material. All seams shall be overlapped a minimum of 6 inches. Loss of adhesion of the membrane to the concrete surface at any time shall be basis for rejection of the preformed joint waterproofing membrane system.

C. **Preformed Waterproofing Membrane.**

1. **Construction Procedure.** Priming and placement of the membrane shall only be done when the air and concrete temperatures are above 40 °F and the surfaces are dry.

   Concrete, including grout and repair areas, shall be allowed to cure for at least seven days before applying the primer. The entire surface to be membraned shall be cleaned of all foreign materials such as oil or grease by scraping and the use of a suitable solvent, and any sharp protrusions shall be removed by grinding. Any old membrane material or asphalt residue shall be removed by methods approved by the Engineer. Potholes and spalls greater than ¾ inch in diameter shall be filled with an approved epoxy mortar, Portland cement mortar, or concrete and allowed to cure as directed. Elevation differences in the tops of box beams, such as those resulting from camber variation, shall be wedged with Portland cement mortar or concrete. All surfaces shall then be swept and cleaned by brooms and compressed air as directed.

   After the deck has been cleaned, apply the primer. The primer may be applied by roller, brush, squeegee, or mechanical means and shall be applied to only the deck surface and 2 to 3 inches up the vertical face of the curb. Prime only those surfaces that will receive membrane that day. Allow the primer to dry so that it is not tacky when walked on. This drying time may vary from ½ hour to 1-½ hours depending on the air temperature. The appearance of small bubbles on the primer is normal and does not affect the subsequent bond.

   After the primer has sufficiently cured or dried, an approved liquid fillet material shall be applied to all inside corners before installation of the membrane. Prior to the membrane installation an approved mastic shall be applied to the curb face, raised expansion dams, or drain castings where membrane edges will be located. An 8-inch strip of the sheet membrane shall be applied to the vertical surface of the curb to a height at least equal to the depth of HMA mixture, or as specified by the Engineer, and firmly pressed into the primer and mastic.

Starting at the low or down slope side of the deck, the membrane shall be placed by either hand methods or by mechanical means with equipment designed for this purpose. The membrane shall be installed in a shingle-lap manner so that any accumulation of moisture will drain off over the seams. The membrane shall be placed in a straight, wrinkle free manner with no bubbles or air spaces under the membrane.

All edges and ends of the membrane shall be overlapped a minimum of 6 inches. At the drain spouts, the membrane shall be cut and turned down into the spouts or bleeder pipes to prevent any moisture from seeping under the membrane. An 8-inch wide strip of membrane shall be placed and centered over transverse joints or cracks greater than $^{3}/_{16}$ inch in width prior to placing membrane sheets, except not at raised steel expansion dams. A continuous bead of approved mastic shall be applied along the base of raised expansion dams with the sheet membrane butted up to the dam and pressed into the mastic.

After each sheet of the membrane has been installed, it shall be hand rolled immediately with a suitable roller of sufficient weight to ensure total contact with the deck. Any torn or cut areas, or narrow overlaps, shall be patched by placing sections of the membrane over the defective areas so that the patch extends a minimum of 6 inches beyond the defect in all directions. The patch shall be rolled or pressed firmly in place and an approved mastic shall be applied to the terminations.

The separation sheet of plastic or paper shall be removed as specified by the manufacturer during the installation of the membrane and prior to the application of the hot HMA mixture. The separation sheet shall be discarded in a proper manner.

If any stones or other foreign matter are found under the membrane after application, they shall be removed and the area patched in the manner previously described.

No vehicles, except HMA hauling units and the approved rubber-tired paver will be permitted on the completed waterproofing membrane.

2. **Placing of the HMA Mixture.** The HMA mixture having a temperature ranging from 250 °F to 350 °F maximum shall be placed using standard procedures as soon as possible after membrane placement. Paving shall not be started following rain until the membrane surface is dry. Rubber-tired equipment shall be used. Equipment should be inspected for burrs on tires, stones, or sharp projections which could damage the membrane. In the event of skidding of the rubber-tired machine during warm weather, a very small amount of fine sand or cement may be broadcast in the tire paths. Excess use of cement or sand could prevent adhesion of the HMA mixture.

   The HMA mixture shall not be dumped in windrows on the membrane, but shall be delivered directly from the hauling unit to the paver hopper. Pavers shall avoid stopping with a full hopper, and build up of material in the auger shall be prevented. If a stop is necessary, extreme care shall be used in restarting. Paver screeds shall be preheated, but burners should not be on during paving to avoid damaging the membrane. The level of the HMA mixture in the auger shall be kept just below the

level of the auger shaft. Sudden stops or sharp turns shall be avoided by the compaction rollers.

After the HMA surface has been rolled, a fillet or cove seal shall be applied at the curb line to form a ¾ by ¾ inch triangular seal along the edge of the new surface, the full length of the curb, using the asphalt-mineral, fiber-solvent caulking material supplied with the membrane.

D. **Shotcrete.** Shotcrete shall consist of a premixed, latex modified, Portland cement and fine aggregate pneumatically ejected from a mixer/gun through a hose and discharge nozzle, all under regulated pressure. The liquid latex component may be added at the mixer/gun or at the nozzle, depending on equipment type and material manufacturer's recommendations.

1. **Nozzle Operators.** All nozzle operators shall demonstrate to the Engineer the ability to correctly and successfully gun latex modified shotcrete. Test panels simulating job conditions shall be gunned for each shooting position (down, horizontal, overhead) which will be encountered in the structure. The shotcrete material shall be the same as proposed for use on the project. The panel shall be 4 square feet in area and of the same thickness as required on the project, but not less than 3 inches. At least one-half the panel area shall contain the same reinforcing steel pattern which will be encountered on the project.

   Test panel(s) shall be kept continuously moist and above 40 °F for five days. At least five cores shall be removed from the test panels and tested for compressive strength according to ASTM C 39. Cores shall have a minimum diameter of 3 inches and length to diameter ratio (L/D) of at least 1.0. Core strengths shall be adjusted according to ASTM C 42 if L/D is less than 2.0. The average compressive strength of the cores shall be at least 85 percent of the required compressive strength with no individual core testing below 75 percent of the required compressive strength.

   Additional cores shall be taken through the reinforcing steel so that the soundness of the shotcrete behind the steel may be evaluated. All cored surfaces shall be examined and additional cores or saw cuts made when this is considered necessary to evaluate soundness and uniformity of deposited material. All cut surfaces should be dense and free from laminations, voids and sand pockets.

2. **Surface Preparation.** When shotcrete is to be applied as protection for waterproofing, the work shall be done immediately after the waterproofing is complete, in order that the surface remain clean and free from contamination of any kind.

   When shotcrete is used for repair of concrete members, all unsound concrete will be removed from the existing substrate. Concrete which is contaminated by chemicals or oils shall be removed. The edges of the repair are to be saw cut and patched to a minimum depth of ½ inch.

   If impact tools are used to remove concrete, they shall be chosen to eliminate damage to sound concrete surrounding and beneath the area to be removed.

Galvanized or epoxy-coated welded wire reinforcing is to be used on all repairs greater than 2 inches in depth, and is to be placed at mid-depth of the repair, and in no case closer than 1 inch from the surface. The reinforcing is to be attached to sound concrete with stainless steel anchoring devices spaced no farther apart than an 18 by 18 inch grid capable of withstanding three times the weight of shotcrete contributing to each anchor.

Prior to shotcreting, the area shall be blast cleaned to thoroughly clean and remove all traces of dirt, oil, and loose material, followed by an oil-free air blast to remove abrasive and dust.

3. **Placement.** The surface to be gunned shall be prewetted with the liquid latex component immediately prior to placement.

   A suitable balance of air and material is to be maintained to assure a steady flow and to prevent "slugging" of material, plugging, and excess rebound. Liquid is to be added in the correct proportions so that the deposited material is neither too dry, creating sandy pockets, nor too wet, causing sagging or sloughing off.

   Each layer of shotcrete is to be placed in several passes over a section of the work area. Large expanses shall be subdivided into smaller areas with each subdivision gunned to its full thickness before moving to the next. Placement in this manner should avoid laminations.

   The distance of the nozzle from the work should normally be 2 to 6 feet. The nozzle shall be held as near to perpendicular to the surface as possible, and never at more than 45 degrees to the surface. Angled shooting creates a rolling or wavy surface which can trap rebound and overspray.

   Rebound and overspray shall not be included in the work; if it does not fall clear, it must be removed. Rebound and overspray shall not be salvaged and later recycled.

   Gunning is not to begin or continue under the following weather conditions:

   a. High winds preventing proper application.

   b. Surface temperatures below 45 °F.

   c. Rains causing washout or sloughing of the fresh shotcrete.

4. **Curing.** Curing and temperature protection shall be as specified in subsection 706.03.N.3.

5. **Testing.** The Engineer may require that cores be taken from the completed work for compression testing. If tests are ordered, a minimum of three cores shall be taken and tested according to subsection 710.03.D.1.

710.04 Measurement and Payment.

Contract Item (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** will be measured by area based on a width of 18 inches and plan quantities of joint length to be treated.

B. **Membrane, Preformed Waterproofing** will be measured by 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 areas of the expansion dams or the drain spouts will not be deducted.

The work includes cleaning the deck, applying the primer, liquid fillet material, and mastic, where required, applying, rolling, and repairing (where needed) the membrane, and applying the final cove seal mastic along the curb line.

C. **Joint Waterproofing Expansion,** includes preparing the concrete surfaces and installing the two-layer preformed expansion joint waterproofing membrane system. **Joint Waterproofing, Expansion** will be measured by area based on a width of 18 inches and plan quantities of joint length to be treated. No additional compensation will be made for area of folds, or overlapped material.

D. **Shotcrete** includes surface preparation; furnishing, mixing and applying shotcrete material; and all test panels and coring as required.

E. HMA Surface, Remove, when necessary, will be measured and paid for separately according to subsection 502.04. Removing old membrane will be considered to be included in the pay item for HMA Surface, Remove.

Scarifying, hand chipping, and patching, when necessary, will be measured and paid for separately according to subsection 712.04, except that when it is not feasible to determine the amount of scarifying, hand chipping, and patching required prior to removal of the HMA surface, payment will be by force account.

F. Any necessary wedging along joints between prestressed concrete box beams that have been inspected and accepted by the Department will be measured and paid for separately as Patching Mortar or Concrete according to subsection 712.04.

The HMA mixture will be measured and paid for separately according to subsection 502.04.