ITEM 458

WATERPROOFING FOR STRUCTURES

458.1. Description. This Item shall govern for the furnishing and placing of waterproofing on concrete and steel bridge decks of railroad structures and on other structures as shown on the plans and in accordance with this Item.

458.2. Types. The type of waterproofing will be shown on the plans or in the contract proposal and shall be one of the following:

1) Type 1. Type 1 waterproofing shall consist of a butyl rubber membrane applied to a surface with a proper adhesive, without protective planking, and in accordance with the details shown on the plans. Unless otherwise specified, the thickness shall be 1.5 millimeters.

2) Type 2. Type 2 waterproofing shall consist of one (1) asphaltic primer coat and one (1) mopping of asphalt.

3) Type 3. Type 3 waterproofing shall consist of one (1) asphaltic primer coat and two (2) mopplings of asphalt. When shown on the plans, waterproofing at construction joints of foundation structures shall be supplemented by two (2) layers of treated cotton fabric with a third mopping of asphalt placed over the outer layer of fabric.

4) Type 4. Type 4 waterproofing shall consist of a self-adhering polyethylene with a rubberized asphalt mastic material.

5) Type 5. Type 5 waterproofing shall consist of a single component, coal tar modified, urethane coating.

6) Type 6. Type 6 waterproofing shall consist of a self-adhering, built-up membrane of rubberized asphalt formed on a preformed board, with cold applied asphaltic primer.

7) Type 10. When Type 10 waterproofing is shown on the plans, the Contractor may furnish either Type 1, Type 4, Type 5 or Type 6.

8) Type RR-1. Type RR-1 waterproofing shall consist of a butyl rubber membrane with a protective course of asphalt plank or asphalt mat of the specified thickness.

9) Type RR-2. Type RR-2 waterproofing shall consist of a self-adhering membrane of rubberized asphalt formed on plastic film, with cold applied asphaltic primer, and protected with two (2) layers of ten (10) millimeters thick asphaltic panels.

10) Type RR-3. Type RR-3 waterproofing shall consist of a self-adhering built-up membrane of rubberized asphalt formed on a preformed board, with cold applied asphaltic primer.

11) Type RR-10. When Type RR-10 waterproofing is shown on the plans, the Contractor may furnish either Type RR-1, Type RR-2 or Type RR-3.

Butyl rubber membrane
(2) Asphalt for mopping above ground
(3) Asphalt for mopping below ground
(4) Asphaltic primer
(5) Treated cotton fabric
(6) Self-adhering polyethylene
(7) Coal tar modified urethane
(8) Rubberized asphalt with preformed board membrane
(9) Asphalt plank
(10) Asphalt mat
(11) Rubberized asphalt with plastic film
(12) Asphalitic panels
(13) Plastic cement
(14) Cold asphalt base emulsion

Materials for waterproofing shall not be used until approved by the Engineer. Materials requiring sampling and testing shall be delivered to the work site a minimum of three (3) weeks prior to use to allow for sampling and testing. Materials for waterproofing may be tested and approved prior to delivery to the work site, when authorized by the Engineer.

458.4. Construction Methods.

(1) General. Waterproofing material shall be stored in a manner to prevent damage. The material shall be kept dry at all times and shall be stored in a warm area prior to use in cold weather and out of direct sunlight in hot weather.

Asphalt planks, asphalt mats and asphalitic panels shall be stored so as to prevent warping and breaking.

Concrete decks and other unformed concrete surfaces to be waterproofed shall have a wood float finish. All concrete surfaces to be waterproofed shall cure for not less than seven (7) days before waterproofing application.

Steel or concrete deck surfaces to be waterproofed shall be clean, dry, smooth and free of fins, sharp edges, and loose material. Grinders shall be used, if necessary, to remove protrusions that would puncture waterproofing membrane. The surfaces shall be free of such contaminants as form release agents, wax base curing compounds, oil and grease; if these contaminants are present, they shall be removed by abrasive blast cleaning. There shall be no depressions or pockets in horizontal surfaces of finished waterproofing.

Unless otherwise required, expansion joints and other grooves shall be filled with plastic cement conforming to these specifications. Joints shall be dry and clean when filled. They shall be overfilled slightly to allow for shrinkage in drying.

The area to be waterproofed shall be thoroughly swept, vacuumed or air blown to remove all dust, dirt and loose foreign material. After the deck is clean, it shall be maintained in a clean condition until completion of waterproofing.

After the deck waterproofing work has started, no vehicular or equipment traffic shall be allowed on the bridge until after the work is complete and an adequate ballast cushion has been placed on the deck. The waterproofing shall be protected against damage from any source.
When asphalt waterproofing is shown on the plans as a protection for back of abutments, retaining walls or footings, asphalt for mopping below ground shall be used unless otherwise specified. Asphalt waterproofing on bridge decks shall be asphalt for mopping above ground.

(2) Type 1. Type 1 waterproofing shall not be applied in wet weather, or when the ambient temperature is below 10 °C. The rubber membrane shall be free from punctures, pockets or folds.

The membrane shall be turned into drainage holes and castings without break. Special care shall be taken to make the waterproofing effective along the sides and ends of members to be waterproofed.

Expansion joints and other grooves shall be filled with plastic cement conforming to these specifications. Joints and grooves shall be dried and cleaned immediately before filling and shall be overfilled slightly to allow for shrinkage in drying.

The butyl membrane shall be installed by first applying the adhesive as recommended by the butyl rubber membrane manufacturer to the surface to be waterproofed and at necessary splices in a solid area extending from the edges back about one (1) meter. Apply the butyl rubber membrane. Press the membrane firmly and uniformly in place against the previously applied adhesive. Avoid wrinkles and buckles. All splices, laps and flashing shall be made in accordance with the butyl rubber manufacturer's recommended procedures.

(3) Type 2. When Type 2 waterproofing is specified, the asphalt primer shall be in place at least 24 hours and shall be dry prior to the asphalt mopping. The primer shall be well worked in to give a uniform coating. To provide uniform coating, the asphalt for mopping shall be heated in kettles equipped with armored thermometers, but shall not be heated above 175 °C. While being heated the asphalt shall be stirred frequently. The mop coating shall require not less than 1.6 liters per square meter of surface. If imperfections appear in the coating additional coatings shall be applied until the imperfections are corrected.

(4) Type 3. When Type 3 waterproofing is specified, the asphalt primer shall be in place at least 24 hours and shall be dry prior to the first asphalt mopping. The primer shall be well worked in to give a uniform coating. To provide uniform coating, the asphalt for mopping shall be heated in kettles equipped with armored thermometers, but shall not be heated above 175 °C. While being heated the asphalt shall be stirred frequently. Minimum coverage for each mop coating shall be 1.6 liters per square meter of surface. If imperfections appear in the coating, additional coatings shall be applied until the imperfections are corrected.

At construction joints, the surfaces to be waterproofed shall be mopped in sections. While the first mopping of asphalt is still hot, a strip of cotton fabric 375 millimeters wide shall be laid on the mopping and pressed into place. Each mopping thereafter shall be so applied that it will completely cover and seal the cotton fabric. End laps of the cotton fabric shall be not less than 300 millimeters.

(5) Type 4. Type 4 waterproofing shall be applied in the following manner:

Unwrap the roll and press the adhesive surface into contact with the concrete, horizontally, secure the free end, then unroll slowly, using hand pressure to smooth the membrane in place and help make a tight bond with the concrete. Adjacent strips shall be overlapped a minimum of 25 millimeters over the previously laid strip. Backfilling may be started as soon as the initial horizontal strip has been applied.
(6) **Type 5.** Type 5 waterproofing shall be applied in two (2) coats to produce a minimum cured film thickness of 1.5 millimeters. Unless otherwise shown on the plans, the application may be made using a roller, squeegee, brush or spray equipment. Application of the second coat shall be made within 16 hours after the initial coat. The manufacturer's instructions shall be followed with regard to the maximum time allowed between coats and any treatment of the initial coat required if this maximum time should be exceeded. Ambient temperature at the time of application of the waterproofing shall be not less than 5 °C.

Backfilling shall not commence until the second coat of waterproofing has cured sufficiently to prevent damage by the backfilling operation.

(7) **Type 6.** Type 6 waterproofing shall be applied by first applying the primer at a rate of 0.4 liter per square meter of surface, or at the rate recommended by the manufacturer, and allowing it to dry to a tacky surface before placing the waterproofing membrane.

The primer and waterproofing membrane board panels shall be applied only when the substrate temperatures are above 10 °C.

All joints shall be sealed by centering the 150 millimeters gusset tape over the joint and pressing firmly into position. The panels and jointing tape must be rolled in with sufficient pressure to assure maximum adhesion, conformance to substrate and elimination of air bubbles. The manufacturer's recommendations for installation shall also be considered.

Backfilling should begin as soon as the application of Type 6 waterproofing is completed and accomplished within 48 hours after the material is applied to a nonhorizontal surface.

(8) **Type RR-1.** Type RR-1 waterproofing shall be applied to dry surfaces and when the ambient temperature is above 10 °C. The rubber membrane shall be free from punctures, pockets or folds.

The membrane shall be turned into drainage castings without break. Special care shall be taken to make the waterproofing effective along the sides and ends of girders and at stiffeners, gussets, etc. Grooves shall be filled with plastic cement.

The butyl membrane shall be installed by first applying the adhesive as recommended by the butyl rubber membrane manufacturer to ballast retainers, ends of deck and at necessary splices in a solid area extending from the edges back about one (1) meter. Apply the butyl rubber membrane. Press the membrane firmly and uniformly in place against the previously applied adhesive. Avoid wrinkles and buckles. All splices, laps and flashing shall be made in accordance with the butyl rubber manufacturer's recommended procedures.

As soon as practicable after membrane placement, its protective cover shall be placed. The membrane surface shall be cleaned of all dirt and other foreign material just prior to placing the cover material. A coating of cold asphalt emulsion shall be applied over the butyl rubber membrane at the minimum rate of 1.6 liters per square meter of surface and the asphalt plank or mat placed thereon.

The minimum thickness of protection shall be 25 millimeters and shall consist of asphalt plank or asphalt mat laid as provided hereafter. As successive planks are laid, the edges and ends of adjacent planks already laid shall be coated heavily with cold asphalt emulsion. The planks shall be laid tight against those previously laid so that the emulsion will completely fill the joints and be squeezed out the top. After all planks have been laid, any joints not completely full shall be filled with emulsion. When two (2) layers of planks are used to obtain the required 25 millimeters cover
thickness, the vertical joints of the second layer shall be offset not less than 100 millimeters transversely and 300 millimeters longitudinally from the joints in the lower layer.

Asphalt mat protection shall be applied in the same manner, except that the longitudinal butt joints in a single layer shall be staggered approximately 600 millimeters. When more than one (1) thickness of asphalt mat is required, the same procedure shall be followed with all vertical joints offset at least 300 millimeters. A follow-up coating of asphalt emulsion approximately 150 millimeters in width shall be placed over all joints of the top layer.

Where deck waterproofing is carried over the back wall and down the back of the abutment for only several feet for the purpose of providing a proper flashing for the deck waterproofing, "Above Ground" moppings of asphalt as defined in Departmental Material Specification D-9-6300 shall be used.

(9) Type RR-2. Type RR-2 waterproofing shall not be done when ambient, substrate or material temperatures are below 5 °C or above 40 °C; or when wet or damp surfaces will restrict the full bonding of materials.

Primer shall be applied to concrete decks with a brush or roller at a rate of one (1) liter per 6.25 to 8.5 square meters of surface until the surface is completely coated. Primer shall dry one (1) hour or more, until tack-free, prior to application of membrane. If not covered with membranes within 36 hours, the surface shall be reprimed.

Steel decks shall not be primed.

Construction and control joints shall be covered by 1.6 millimeters thick galvanized sheet metal, of the width shown on the plans, centered on the joint. Joints in sheet metal shall be lapped 50 millimeters and corners of sheet metal shall be rounded to a 13 millimeters radius.

An inverted strip of membrane (plastic side down), 150 millimeters wider than the sheet metal, shall be centered over the sheet metal and the joint. This shall then be covered with a full width of membrane placed rubberized-asphalt side down and centered on the joint prior to placing membrane over the entire deck surface.

Inside corners shall be filled with a 13 millimeters fillet of mastic.

All inside and outside corners shall receive an initial 300 millimeters wide strip of membrane placed rubberized-asphalt side down and centered along the axis of the corner.

Membrane shall be laid with laps parallel to the long direction of the deck. If there is a deck slope normal to the laps, membrane shall be laid from the low point to the high point across the fall line so that the laps shed water as do shingles on a roof. Membrane shall be rolled onto the surface using care to eliminate any wrinkles or air spaces so that a smooth surface results. Succeeding strips of membrane shall be laid with a minimum 65 millimeters side and end overlap.

The 65 millimeters overlap shall be rolled down firmly and completely using a rubberized wheel-type roller weighing approximately 45 kilograms.

Membrane applied to sloping or vertical surfaces shall be rolled down firmly over the entire areas covered.
The outside edges of membrane shall be rolled as specified above and shall be finished with a trowelled bead of mastic.

Areas within 150 millimeters of drains and protrusions shall receive a double layer of membrane. Mastic shall be liberally applied to the seams and the contact area between the membrane and drain or protrusion.

A careful inspection of the membrane shall be made and any holes, tears, misaligned or wrinkled seams or other discontinuities shall be patched with a piece of membrane extending at least 65 millimeters beyond the imperfection.

Membrane protection shall be placed as soon as possible after completion of the membrane application, but not more than five (5) days later.

Semi-mastic shall be used to bond asphaltic panels together and to the membrane. The bond coat shall be applied with a brush at a rate of 0.8 liter per square meter to completely coat the surface. Asphaltic panels shall be placed while the bond coat is still tacky.

The first layer of asphaltic panels on the horizontal surface shall be laid on the bond coat with joints staggered not less than 450 millimeters, another bond coat, as specified in the preceding paragraph, shall be applied filling all joints in the asphaltic panels, and a second layer of asphaltic panels shall be laid with joints staggered not less than 450 millimeters from the joints in the first layer. Following application of the bond coat, one (1) layer of asphaltic panels shall then be placed and rolled firmly on any sloping or vertical surfaces. All joints in asphaltic panels shall be laid tight and shall be completely sealed with semi-mastic at the completion of the work.

Asphaltic weathercoating shall be flowed on the exterior top surface of the protection course. This coating shall be rivuleted in surface, shall be of sufficient thickness to provide complete dimensional stability to the material when stored outdoors in direct sunlight. A suitable bond breaking film or coating shall be applied, to function as a release sheet. During installation, the asphalt-saturated felt side shall be placed against the membrane waterproofing; the side with the bond breaking film or coating shall be exposed to the ballast rock.

**(10) Type RR-3.** Type RR-3 waterproofing shall not be placed when ambient, substrate or material temperatures are below 5 °C or when wet or damp surfaces will restrict the full bonding of materials.

Primer shall be applied to concrete decks with a brush or roller at a rate of 0.4 liter per square meter until the surface is completely coated. Primer shall dry one (1) hour or more, until tack-free, prior to application of membrane. If not covered with membrane within 36 hours, the surface shall be reprimed.

Steel decks shall not be primed.

Construction, expansion and control joints of the deck shall be covered by galvanized sheet metal having a nominal thickness of 1.6 millimeters, of the width shown on the plans, centered on the joint. Joints in sheet metal shall be lapped 50 millimeters and corners of sheet metal shall be rounded to a 13 millimeters radius.

An inverted strip of membrane (board side down), 150 millimeters wider than the sheet metal, shall be centered over the sheet metal and the joint. This shall then be covered with a full width of membrane, placed rubberized-asphalt side down, centered on the joint prior to placing
membrane over the entire deck surface.

    Inside corners shall be filled with a 13 millimeters fillet of mastic.
    All inside and outside corners shall receive an initial 300 millimeter wide strip of membrane
    placed rubberized-asphalt side down and centered along the axis of the corner.

    Strips of membrane shall be butt-jointed parallel to the long direction of deck, with 150
    millimeter gusset tape provided by the membrane manufacturer, applied directly over the joint.

    Membrane and gusset-taped joints shall be rolled down firmly onto the surface over the
    entire area covered, including any sloping or vertical surfaces. Care in the rolling shall be used to
    eliminate any wrinkles or air spaces so that a smooth surface results.

    Rolling shall be accomplished using a rubberized wheel-type roller weighing approximately
    45 kilograms.

    Outside edges of membrane shall be rolled and shall be finished with a trowelled bead of
    mastic including the contact area between the membrane and a drain or protrusion.

    A careful inspection of the membrane shall be made and any holes, tears, misaligned or
    wrinkled seams or other discontinuities shall be patched with a piece of membrane extending at
    least 65 millimeters beyond the imperfection.

    **458.5. Measurement.** When shown on the plans to be a pay item, this Item will be
    measured by the square meter of waterproofing, complete in place.

    **458.6. Payment.** The work performed, materials furnished and all labor, tools, equipment
    and incidentals necessary to complete the work under this Item will not be paid for directly, but
    will be considered subsidiary to the various bid items of the contract, unless this Item is specified as
    a pay item in the contract.

    When waterproofing is specified as a pay item, the work performed and materials furnished
    in accordance with this Item and measured as provided under "Measurement" will be paid for at
    the unit price bid for "Waterproofing", of the type specified. This price shall be full compensation
    for furnishing all materials, labor, tools, equipment and incidentals necessary to complete the work.

    Waterproofing for retaining walls will not be paid for directly but will be considered
    subsidiary to Item 423, "Retaining Wall".