

WATERPROOFING FOR CONCRETE STRUCTURES

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Waterproofing for Concrete Structures

NG 2001 General

- 1 The most opportune periods for installing waterproofing systems are the spring, summer and autumn when climatic conditions are most favourable.
- 2 Specification requirements for unformed finishes to concrete bridge decks are given in sub-Clause 1708.4.
- 3 Specification requirements for restrictions on curing liquids, compounds and membranes are given in sub-Clause 1710.5.
- 4 The use of ventilating layers, partial bonding or bond breakers is not permitted in the Specification as they provide an easy passage for water to pass under the membrane. The pumping action produced by the passage of vehicle wheels exacerbates the problem and leads rapidly to the general failure of the adhesion and disruption of the surfacing.
- 5 Fillets are generally formed in sharp internal angles to ensure the fitting and shaping of prefabricated sheet and minimum thickness of sprayed membrane in the angle.

Outgassing

- 6 The design of many bridge decks includes voids, which contain air, and air may be held within the concrete itself. This contained air can move in and out of voids with temperature and barometric pressure changes and such air movement through pores in the bridge deck top surface can cause pinholes in primers and thence blister the membrane. It is less likely to affect sheet membranes, but can cause pinholes, blowholes or blisters in liquid applied membranes whilst in the partially cured condition.
- 7 The greatest risk of outgassing occurs following rainfall and during early summer mornings.

NG 2002 Protection of Bridge Deck Waterproofing During Construction

- 1 Before granting permission for rubber tyred plant and equipment to travel on bridge deck waterproofing, the Engineer should satisfy himself that the surface is and remains free of all loose materials and stable enough to withstand traction forces.

NG 2003 Materials for Waterproofing Concrete Bridge Decks

Proprietary Waterproofing Systems

- 1 As soon as possible after the Contract has been awarded, the Engineer should ensure that the Contractor provides the PWS (Proprietary Waterproofing System) Data Sheets.
- 2 Should the Engineer call for tests, it is important that uniform methods of testing be used. Details of the tests, test methods and criteria can be obtained from the LAB.
- 3 A bonding agent or liquid waterproofing membrane/adhesive has set or cured when it has become sufficiently stabilized to prevent movement of the waterproofing system during the laying of an additional protective layer or surfacing.
- 4 Unless otherwise described in the particular PWS Data Sheet, the primer should be thoroughly dry or cured before the membrane is applied. Where solvent based primers are used, any excess primer that has not been removed is likely to 'skin over' but give the appearance of being dry. The trapped solvent will expand rapidly under the application of hot bitumen and lead to failure of the membrane.

NG 2004 Materials for Waterproofing Below Ground Concrete Surfaces

- 1 The Engineer should consider whether the upper surface of buried concrete structures such as subways should be waterproofed with a material complying with Clause 2003 or whether materials complying with Clause 2004 are suitable for the purpose.
- 2 Buried concrete structures which need to be waterproofed with a material complying with Clause 2003 should be identified on the Drawings.
- 3 The Engineer should specify in Appendix 20/2 any restrictions on the materials in Clause 2004 which may be used for any particular structure.

NG 2005 Workmanship for Waterproofing Concrete Bridge Decks

General

- 1 Prior to laying the waterproofing, the primed surface should be inspected and any entrapped aggregate or debris removed. Should the primed area be damaged it should be made good using the appropriate primer and allowing the necessary evaporation or cure time.

Blistering and Blowholes

- 2 Moisture in the concrete deck, incomplete coverage by primer, unevaporated solvents in primers and general outgassing can lead to blistering of prefabricated sheet waterproofing, together with blowholes in mastic asphalt and liquid applied membranes. The waterproofing system and the additional protective layer should be covered as quickly as possible with the road surfacing in order to minimize the risk of blistering which is usually more prevalent in the late spring and early summer, during clear sunny weather.

Application of Waterproofing Into Angles, Including Chases

Sheet Membranes

- 3 Efforts by the operative to seat the sheet into a sharp angle can result in weakening or hidden damage to the membrane. There is also a

tendency for the sheet to resist bending sharply into an angle and to draw away leaving a hollow which may give rise to blistering and puncturing when the surfacing is applied.

Spray Applied Membranes

- 4 With inadequate equipment or poor application technique there can be a tendency for sprayed coatings not to enter right into the angle but to build up thickness on the adjacent margins resulting in a thinning of the membrane in the angle. Spraying technique, material rheology and equipment can be selected to minimize these faults.

Vacuoles and pin/blow holes can also be caused by the above inadequacies.

Priming for Mastic Asphalt

- 5 When using mastic asphalt it is necessary that the concrete is first primed before the mastic asphalt is applied to the clean primed surface.
- 6 As a guide, for the evaporation of solvent from a spirit based primer, 20 hours should elapse when the temperature is between 10°C and 16°C before mastic asphalt is applied.

Mastic Asphalt

- 7 Satisfactory results for waterproofing have been obtained with mastic asphalt complying with BS 6925, types R988 and T1097. The former may prove slightly more economical and less susceptible to blistering. The latter is generally preferred for use in service bays as it is more likely to retain an adequate resistance to impact damage. It will usually be more economical to specify one type for the whole of the work. The type required should be shown on the Drawings and cross-referenced in Appendix 20/2.
- 8 Mastic asphalt complying with BS 1447 (Mastic asphalt for roads and footways) is unsuitable for waterproofing bridge decks.
- 9 The use of ventilating layers, isolating membranes and bond breakers to avoid blistering and blow holes is an established practice in roofing and building work but is not appropriate for bridge decks. Notwithstanding the Specification, asphalt paviors may on their own initiative wish to use some form of bond breaker, e.g. lightly dusting with sand, limestone dust or dry cement but this practice should not be permitted.

- 10 Blistering of mastic asphalt can occur and blow holes commonly appear during laying. Both effects can usually be attributed to moisture, but can often be prevented by working to the lower limit of the temperature range.
- 11 Mastic asphalt is laid in 2 or 3 coats and in multi-coat work it is not permitted to leave any blow holes to be made good by the application of the next coat. The Specification expressly precludes this practice and all blow holes should be made good before laying a subsequent coat. The making good of blisters or 'blows' is covered in CP 144 : Part 4 : 1970.
- 12 An acceptable method of intimately bonding the two mating edges of a joint is to prepare a clean vertical edge to the material already laid and overlap it with a minimum of 50 mm with the new material. When the heat has penetrated the original material the overlap should be struck off and the fused joint completed with the edge of a float.

Proprietary Waterproofing Systems

- 13 The method of sealing the edges of the waterproofing system and around interruptions such as gullies should be shown on the Drawings. Most manufacturers of proprietary systems show examples in their marketing literature.
- 14 Before commencing each stage of installation the surface should be inspected, using the guide lines given in NG 2005.1, to check the complete evaporation of solvent, the removal of any entrapped aggregate or debris and that necessary repairs have been carried out.
- 15 Where oxidised bitumen is used as a bonding agent for sheet material it should not be heated to a temperature in excess of that necessary to secure an effective bond. The required temperature of the bitumen will depend on the air and deck temperature at the time of laying. It should not be heated above 260°C and it is normally suitable for application at a temperature of approximately 240°C. Overheating and prolonged heating of the bitumen compound will drive off volatile oils leaving the residue hard and brittle and unsuitable for bonding layers together. A suitable thermometer should be used to monitor the temperature of the bonding bitumen.
- 16 Proprietary waterproofing systems, including where necessary a tack coat and also the additional protective layer, should be covered without undue delay with road surfacing materials in order to minimise the risk of blistering. Should blistering occur, repairs

should be in accordance with the PWS Data Sheets and the manufacturer's installation procedure, to the satisfaction of the Engineer.

- 17 In considering the Contractor's additional information submitted with the PWS Data Sheet to cater for site conditions, the Engineer may need to call for a site procedure trial.

Additional Bituminous Protection

- 18 Where the waterproofing system is to be overlaid with hot rolled surfacing materials, additional protection consisting of red tinted bituminous protection complying with sub-Clause 2003.4 is required. When it is necessary for the additional protective layer to be trafficked by plant and equipment, e.g. where there is delay in surfacing, any damage is to be made good before surfacing is laid. The areas and thickness, normally 20 mm \pm 2 mm, should be shown on the Drawings.

APPENDIX 20/1

(SPECIFICATION FOR ROAD WORKS)

FORM PWS PROPRIETARY WATERPROOFING SYSTEM DATA SHEET

ANNEX 'A'

Manufacturer or Marketing Group:

Product:

TAB Certificate No.:

Preamble

This waterproofing system is to be installed in accordance with this Annex and the Specification.

Should there be any contradiction between the requirements of this Annex and the Specification, the Specification requirement shall take precedence unless otherwise agreed by the Engineer.

All materials of the waterproofing system are to be as stated on the PWS (Proprietary Waterproofing System) Data Sheet.

No substitution of any of the stated materials is permitted.

General Requirements

Immediately before the application of the primer or laying of the waterproofing system or protective layer, the concrete surface or primed surface shall be clean, dry and free from ice, frost, laitance, loose aggregate, dust and other debris and also where the adhesion to the concrete would be impaired, free from curing liquids, compounds and membranes.

On any structure, providing no damage results, plant and equipment all fitted only with rubber tyres may stand or travel on the waterproofing system solely for the purposes of laying an additional protective layer or surfacing material on that structure. All such plant and equipment shall have its tyre treads regularly inspected and any embedded stones removed.

The permission of the Engineer shall be obtained before the plant, equipment, and traffic is permitted onto the waterproofing system.

Rollers shall not be permitted to stand or travel directly on the waterproofing system.

Where it is necessary for plant, equipment or traffic to stand or travel on the waterproofing system, suitable temporary protection is to be provided to the satisfaction of the Engineer.

Particular Requirements

NG SAMPLE APPENDIX 20/2: WATERPROOFING FOR CONCRETE STRUCTURES

/Note to compiler: This should include:]

- 1** Requirements for mastic asphalt if different from the requirements of sub-Clause 2003.2.
- 2** Any restrictions on the use of proprietary materials for waterproofing below-ground concrete surfaces [2004.4].
- 3** Where sealing with primer is not required prior to the application of tar or bitumen waterproofing [2006.1].
- 4** Type of mastic asphalt (see NG2005.7)
- 5** List of waterproofing materials for waterproofing below-ground concrete structures (the Engineer should complete a list of acceptable waterproofing materials)

