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Notes for Guidance on the Specification for Waterproofing for Concrete Structures

CC-GSW-02000

April 2019

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**Updates to TII Publications resulting in changes to
Notes for Guidance on the Specification for Waterproofing for Concrete Structures CC-GSW-02000**

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Amendment Details:

This document supersedes the December 2010 publication of CC-GSW-02000. The following principal amendments have been incorporated into this document:

- a) The document has been re-formatted in line with the current TII standards
- b) Guidance has been removed where also covered in DN-STR-03009 and CC-SPW-02000 and a reference to the same inserted.
- c) Paragraph 2.3.4 – additional guidance is given for the application of bridge deck waterproofing to “young concrete”
- d) Paragraph 2.3.5 – 7 days suggested as period of covering a waterproofing system with road surfacing materials.
- e) Paragraph 3.1 – requirement added for surfaces to be impregnated to be identified on drawings.

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1. Buried Concrete Surfaces

1.1 General

Buried concrete surfaces to be protected with an epoxy resin shall be clearly identified on the drawings. DN-STR-03012 sets the standard required in this regard.

1.2 Materials

Not used.

1.3 Workmanship

Not used.

1.4 Testing Requirements

Not used.

2. Bridge Deck Waterproofing

2.1 General

Concrete surfaces to be protected with a bridge deck waterproofing system shall be clearly identified on the drawings. DN-STR-03012 sets the standard in this regard.

2.2 Materials

As soon as possible after the Contract has been awarded, the Employer's Representative should ensure that the Contractor provides the NSAI Agrément Certificate or equivalent for the proposed bridge deck waterproofing system.

In considering the Contractor's additional information submitted with the NSAI Agrément Certificate or equivalent to cater for site conditions, the Employer's Representative may need to call for a site procedure trial to confirm the appropriateness of the waterproofing system to local site conditions.

2.3 Workmanship

2.3.1 General

A bonding agent or liquid waterproofing membrane/adhesive has set or cured when it has become sufficiently stabilised to prevent movement of the waterproofing system during the laying of an additional protective layer or surfacing.

Unless otherwise described in the particular NSAI Agrément Certificate or equivalent, 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.

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.

Good detailing is essential in ensuring the long-term performance of a bridge deck waterproofing system, including the use of fillets and chamfers. Refer to DN-STR-03009 for the requirements in this regard.

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 permitted systems show examples in their marketing literature.

2.3.2 Surface Preparation

Before commencing each stage of installation, the surface should be inspected to check the complete evaporation of solvent, the removal of any entrapped aggregate or debris and that necessary repairs have been carried out.

2.3.3 Temperature Requirements

The most opportune periods for installing waterproofing systems are the spring, summer and autumn when climatic conditions are most favourable.

2.3.4 Concrete Age Requirements

'Young' concrete tends to have higher surface moisture content, therefore extra care is needed to ensure that the required moisture content has been achieved before application of the waterproofing system. Considerable flame drying may be required. After a period of sustained rainfall, it is likely that the substrate will be saturated, flame drying may dry the immediate surface, but a significant amount of moisture may remain. Care should be taken to establish that the substrate has an acceptable moisture content before application of waterproofing. Moisture content should be measured and be found to be below 6%. The accuracy of measurement should be accounted for (i.e. hand-held moisture meters have an accuracy $\pm 2\%$).

2.3.5 Defects and Repairs

Should the primed area be damaged it should be made good using the appropriate primer and allowing the necessary evaporation or curing time.

Moisture in the concrete deck, incomplete coverage by primer, unevaporated solvents in primers and general outgassing can lead to pin/blow holes (continuous or non-continuous) in liquid applied membranes. Permitted waterproofing systems, including where necessary a tack coat and also the additional protective layer, should be covered without undue delay and within seven days unless agreed otherwise with the Employer's Representative, with road surfacing materials in order to minimise the risk of blistering. The risk of blistering is usually more prevalent in the late spring and early summer, during clear sunny weather. Should blistering occur, repairs should be in accordance with the NSAI Agrément Certificate or equivalent, to the satisfaction of the Employer's Representative

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. The provision of fillets and spraying technique, material rheology and equipment can be selected to minimize these faults. Further guidance is given in DN-STR-03009.

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

2.3.6 Expansion Joints

Not used.

2.3.7 Outgassing

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 liquid applied membrane whilst in the partially cured condition. As concrete ages, the size of the pores decreases, therefore concrete aged less than 28 days may be more prone to outgassing than older concrete.

Research has shown that the predominant cause of outgassing is a change in concrete temperature that gives rise to expansion of air in the pore structure of the concrete. The rate of outgassing is related to both the rate of temperature change and to the air permeability of the concrete. However, it should be noted that outgassing occurs significantly more where primers containing solvents have been used, than from temperature changes alone. This is usually because the primer is not fully cured or set and excess solvent from the primer may still be present, which may then be activated when the membrane is applied (or subsequently when subjected to sunlight or the application of the asphalt). Care should therefore be taken to ensure that primers are set or fully cured in accordance with the manufacturer's instructions before the application of the membrane.

Under the conditions which simulate outgassing it has been found that thin fast gelling membranes are most susceptible to blistering while the thin slower gelling membranes are most prone to pin/blow holing.

2.4 Protection

Before rubber tyred plant and equipment are allowed to travel on bridge deck waterproofing, it should be ensured that the surface is, and remains, free of all loose materials and is stable enough to withstand traction forces.

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.

2.5 Testing Requirements

Non-destructive testing in accordance with CC-SPW-02000 shall be included to verify the soundness of the waterproofing layer.

2.6 Repair and Replacement

Any additional requirements for the repair or replacement of bridge deck waterproofing systems should be described in Appendix 20/1. Issues that may need to be considered include:

- i. information on existing waterproofing systems;
- ii. requirements for removal of existing surfacing;
- iii. requirements for removal of existing bridge deck waterproofing or protective layer;
- iv. requirements for examination of deck concrete by the Employer's Representative for testing or repairs;
- v. requirements for preparation work;
- vi. requirements for the replacement waterproofing system.

3. Exposed Concrete Surfaces

3.1 General

Concrete surfaces to be impregnated with a hydrophobic pore liner shall be clearly identified on the drawings. DN-STR-03012 sets the standard in this regard.

Impregnation is carried out by spraying concrete surfaces with a hydrophobising material that penetrates the concrete and reacts with the silicates and moisture present. This produces a water repellent but vapour permeable layer that inhibits the ingress of water and/or chloride and sulfate ions. Effectiveness of this layer is determined by the quality of the hydrophobisation and the strength and permanence of the bond between the surface protection system and the concrete substrate. The depth of penetration will vary depending on concrete quality and moisture content. Impregnation is known to be effective for at least 15 years provided it has been applied correctly. Longer service lives are anticipated. However, it is considered advisable until further experience is gained to assume that reapplication will be necessary after about 15 years.

3.2 Materials

Not used.

3.3 Workmanship

3.3.1 Surface Preparation

It should be ensured that curing membranes and release agents, where they have been used, have been removed or are fully degraded before impregnation is carried out. This is particularly important to check when surface protection systems are to be applied less than a month after the concrete was placed.

Water jetting or steam cleaning should not in general be used to remove contamination, solid deposits or curing membranes. In exceptional circumstances, where there is substantial contamination, these methods may be used with care, subject to a satisfactory trial being undertaken. However, impregnation should not commence for a minimum of 48 hrs from completion of the cleaning works and remains subject to the other application and surface condition requirements, particularly the need for a period of surface dryness of the concrete substrate for a period of 24 hours in advance of the impregnation operation.

The surface protection system should not be applied until the concrete surface has been dry for 24 hours because absorption of the hydrophobic impregnant will be restricted if damp, reducing its effectiveness. Artificial drying of the concrete surface is not permitted, as this may lead to increased moisture at the surface by capillary action from within the concrete, when the drying equipment is removed.

Where the NSAI Agrément Certificate or equivalent for a system allows for its application outside of these requirements, it must be agreed in writing with the Employer's Representative prior to commencement of the Works and the system shall be applied strictly in accordance with the requirements of this Certificate.

3.3.2 Application

The type of nozzle used, and spraying distance should be in accordance with the manufacturer's instructions.

Depending on climatic conditions, it may be necessary to protect surfaces to be treated to ensure that they are surface dry before impregnation.

The required coverage of each coat should be in accordance with the manufacturer's specification and must be regularly monitored by determining the quantities of the material used on particular areas of each structure. Achieving the required rate may result in some loss of material, by run down and evaporation. Application of surface protection systems can be judged by a characteristic 'wet look' to the concrete.

It is important to apply the surface protection system before the concrete receives its first exposure to salts, subject to the prior degradation of any curing membranes, because a substantial amount of contaminants can enter the concrete by capillary adsorption during this initial exposure. This may be particularly important in a marine environment.

3.3.3 Protective Measures

Surface protection systems may have deleterious effects that need to be controlled during the application of the material. Prior to application, protective measures must be implemented to prevent contamination of watercourses and damage to humans, animals, vegetation and vehicles.

Impregnation over or adjacent to watercourses will require protective sheeting or complete encapsulation beneath the structure to be impregnated.

Impregnation on structures over or adjacent to roads will require protective sheeting or complete encapsulation. Consideration should also be given to the introduction of appropriate traffic management and safety measures.

Vegetation that could be subject to spray needs to be covered or otherwise protected, and the protective covering must be maintained in position and in good condition.

Surface protection systems could have a softening effect when it comes into contact with elastomeric bearings, painted steel surfaces, bituminous materials and joint sealants, and these items should be protected during application. The protective measures must be maintained in position and in good condition.

3.4 Testing Requirements

It is essential that volumes of impregnation material delivered to site, used on site and for disposal, are accurately monitored.

4. NG Sample Appendices

NG SAMPLE APPENDIX 20/1: WATERPROOFING FOR CONCRETE STRUCTURES

[Note to compiler: This should include:]

1. Any restrictions on the use of alternative or proprietary materials for waterproofing below-ground concrete surfaces [Section 1.2 of CC-SPW-02000].
2. Any additional requirements for non-destructive integrity test(s) compatible with the waterproofing system [Section 2.5 of CC-SPW-02000].
3. Known details of existing waterproofing system where repair or replacement is required [Section 2.6 of CC-SPW-02000].
4. Additional requirements for the repair or replacement of existing waterproofing systems [Section 2.6 of CC-SPW-02000].

5. References

5.1 TII Publications (Standards) References

DN-STR-03012 – Design for Durability.

DN-STR-03009 – Waterproofing and Surfacing of Concrete Bridge Decks.

CC-SPW-02000 – Waterproofing for Concrete Structures.



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