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# Standard Practice for Use of Portland Cement Concrete Bridge Deck Water Barrier Membrane Systems[1]

This standard is issued under the fixed designation D4071; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

## 1. Scope

1.1 This practice covers liquid applied, preformed, or built-up water barrier membrane systems and their application; overlaid with bituminous concrete wearing courses, for use in the protection of bridge decks from deleterious effects of deicing salts. Material use and specifications should be adapted to conform to job and user requirements for new construction or existing structures. This practice is written as a guide for the use of bridge deck water barrier systems only.

1.2 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.* Specific precautionary statements are given in Section 10.

## 2. Referenced Documents

2.1 *ASTM Standards:*[2]

D3743 Terminology Relating to Bridge Deck and Substructure Protection (Withdrawn 2004)[3]

2.2 *Other Documents:*

NCHRP Synthesis Report 57 Durability of Concrete Bridge Decks[4]

## 3. Terminology

3.1 For definitions of terms used in this practice, refer to Terminology D3743.

## 4. Significance and Use

4.1 This practice provides a guide for factors to be considered prior to waterproofing bridge decks with water barrier membrane systems. It will provide guidance for specification of materials, application of membrane systems, and placement of bituminous wearing courses. It may be used as a guide for new construction or for rehabilitation of existing structures.

## 5. Bridge Design and Specification Consideration

5.1 Proper use of water barrier membranes with bituminous concrete wearing courses requires consideration of certain elements during the design stage of new or existing bridges to be treated and covered with a bituminous concrete wearing course.

5.2 New bridge deck designs must include provision for dead loads including future systems.

5.3 The deck surface finish should be specified to allow proper use of the intended membrane system. Manufacturers' recommendations for surface finish should be reviewed for guidance on finishing freshly placed concrete or for repair of existing deck surfaces.

5.4 Surface drains should be designed to allow positive drainage to minimize the penetration of water through the bituminous wearing course.

5.5 Joint systems should be designed to provide adequate termination points for the membrane. Membranes should not be placed over expansion joints. Dams or expansion assemblies should be provided to the height of the bituminous wearing course.

5.6 Curbs or parapets, or both, should be designed for functional terminations. Manufacturers of membrane systems should be consulted for recommended termination details. If rough surfaces (such as granite curbs) are specified, a treatment should be specified to provide the surface smoothness required for the proper use of the membrane. Treatment of rough curbs may be achieved with a leveling surface treatment with epoxy mortar or other suitable materials.

5.7 Decks should include weepholes to provide drainage for water which penetrates through the bituminous wearing course to the membrane level.

[1] This practice is under the jurisdiction of ASTM Committee D04 on Road and Paving Materials and is the direct responsibility of Subcommittee D04.32 on Bridges and Structures.

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[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

[3] The last approved version of this historical standard is referenced on www.astm.org.

[4] Available from the National Cooperative Highway Reseacrh Program (NCHRP), Keck Center of the National Academies Transportation Research Board, 500 Fifth Street, NW Washington, DC 20001.

5.8 For bridges with significant grades (usually over 4 %) or those which are subject to traffic acceleration, deceleration, or radial stresses (such as on ramps), the use of membrane systems may cause overlay movement. Membrane manufacturers should be consulted for limitations on membrane use.

5.9 Service life and maintenance requirements should be considered when designing the water barrier and wearing surface.

5.10 Specified materials should be chemically and physically compatible with specific emphasis on proper adhesion of the membrane and the bituminous wearing course.

## 6. Bridge Construction

6.1 A preconstruction conference should be held to assure that the contractor is aware of all construction requirements which affect the membrane system.

6.2 Inspectors should ensure that surface finish of the concrete deck is acceptable for the use of the intended membrane system, usually an even float finish.

6.3 Concrete decks or other components should be cured and dried for the required minimum time before installation of the membrane. Limitations on curing methods or curing materials should be observed. In most cases, the use of membrane curing compounds containing wax or oil should be prohibited.

6.4 Care should be exercised to avoid the use of materials which are chemically or physically incompatible with the membrane system to be used.

## 7. Membrane Application

7.1 A preconstruction conference should be held to schedule membrane application and placement of the bituminous wearing course.

7.2 Prior to application, the bridge deck should be inspected, deficiencies noted, and repairs made.

7.3 Cleaning should be done prior to application of any of the membrane system components. Grease and oil should be removed.

7.4 Membranes and bituminous concrete overlays should be applied only during dry weather and within the acceptable temperature range.

7.5 Manufacturers' specifications or technical representatives should be consulted to ensure that proper methods recommended by the manufacturer are used.

7.6 Termination details should be thoroughly inspected to ensure that they are watertight.

7.7 The membrane should be placed in such a manner that overlaps in preformed or built-up systems will not trap water or interfere with placement of the bituminous wearing course.

7.8 Placement and subsequent treatment such as rolling should be inspected to assure that bubbles or blisters resulting from deck moisture outgassing are minimized. Large bubbles or blisters should be punctured or repaired, or both, as specified. A bituminous mix with sand or fine aggregate may be used as an underlayment for membranes to minimize bubbling or blistering.

7.9 Membrane terminations at drains, joints, and curbs should be properly sealed to prevent water entry at these critical areas.

7.10 The completed membrane system application should be inspected and repairs made in accordance with specifications.

7.11 Membrane systems should be protected in accordance with specifications.

7.12 Traffic should not be allowed on the unprotected membrane system except as required for placement of the bituminous wearing course.

## 8. Bituminous Wearing Course

8.1 The bituminous wearing course should be designed to provide a completely bonded system and to provide the required service life. Chemical and physical compatibility of all components including tack coats, (if required) should be determined.

8.2 The bituminous wearing course thickness, aggregate size and gradation, asphalt type and quantity, should be determined by the service life requirements. It should conform to minimum thickness requirements recommended by the membrane manufacturer.

8.3 Placement of the bituminous wearing course should be completed within the time period specified. Generally, membranes should be exposed for the shortest possible time. Some liquid applied systems may require a minimum time for curing of the membrane.

8.4 Weather limitations, dry surfaces, and ambient temperature requirements should be observed.

8.5 The bituminous wearing course should be placed at a temperature range specified for the membrane system being used.

8.6 The type of bituminous placing equipment should be chosen in accordance with specifications or membrane manufacturer's recommendations, or both, to prevent physical damage to the membrane.

8.7 The bituminous wearing course should be placed in a direction to avoid damage to the membrane.

8.8 Special requirements concerning compaction equipment or methods should be observed.

## 9. Rehabilitation of Existing Structures

9.1 In addition to the considerations contained in Sections 5 through 8, the use of membrane systems and bituminous wearing courses on existing bridge decks require additional considerations.

9.1.1 Experience has shown that placement of a membrane system on an actively corroding, chloride-contaminated bridge deck will not stop corrosion. Its effect on the rate of corrosion is not yet known. NCHRP Synthesis Report 57 should be consulted for additional guidance on this matter.

9.1.2 The structural capability of the bridge must be determined for the added dead load of the membrane system and bituminous wearing course.

9.1.3 Requirements for surface and membrane level drainage should be considered. Existing drains should be raised and membrane level weepholes should be provided if drainage will be impeded at the membrane level.

9.1.4 Expansion joints should be replaced or raised to allow for the elevation change of the bituminous wearing course.

9.1.5 Curbs or parapets should be examined to assure that satisfactory membrane system terminations can be made.

9.1.6 Deck and curb surfaces must be repaired to provide a sound substrate and a proper surface for the use of membrane systems. Repair materials specified should be chemically compatible with the membrane. Adequate curing time should be allowed for repair materials before application of the membrane system.

9.1.7 Cleaning should be clearly specified, particularly with regard to removal of grease or oil from existing deck surfaces.

9.1.8 Traffic control methods should be considered. If work is required under traffic conditions, membrane and bituminous wearing course placement must be scheduled to allow for overlapping membrane when traffic is rerouted from one lane to another.

## 10. Safety

10.1 Procedures for safe handling of all components of membrane systems should be determined and observed. Manufacturer's recommendations should be followed.

10.2 Questions regarding toxicity should be considered and proper safeguards should be employed.

10.3 Traffic control should be sufficient to prevent traffic accidents or unusual safety hazards to working personnel.

## 11. Keywords

11.1 bridge deck; membrane; protective systems; water barrier; waterproofing