Waterproofing Technical Information

This attachment contains additional information for each of the seven sub-sections of the *Contract Specifications* (*CS*), Section 54, *Waterproofing*.

1 – Waterproofing - General

Shown in Figures 1-4 are photographs for waterproofing at Bridge No 44-0144, Granite Canyon Bridge, in District 5.

Figure 1. Concrete Surface Prepared for Application of Silane Waterproofing per SSPC-SP 13/NACE No. 6

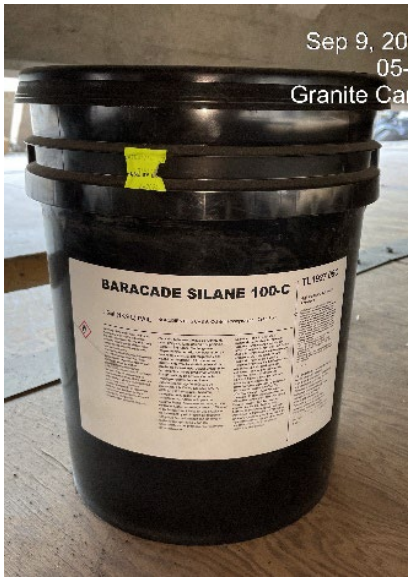

Figure 2. Silane Waterproofing Material

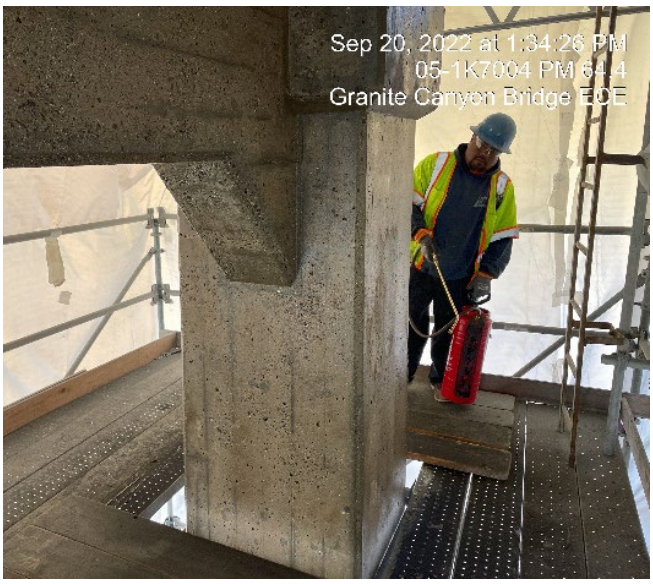

Figure 3. Applying Silane Waterproofing

Figure 4. Silane Waterproofing Tested 7 Days After Application Depicts Proper Water Beading on Treated Surface

Shown in Figures 5 and 6 is sheet waterproofing membrane for column casings on Bridge No. 33-0351, Calaveras Road Separation, in District 4.

Figure 5. Waterproofing for Column Casing

Figure 6. Waterproofing for Column Casing

2 – Asphalt Membrane Waterproofing and Dampproofing

Additional information corresponding to the *CS*, Section 54-2, *Waterproofing – Asphalt Membrane Waterproofing and Dampproofing*, for BCM 54 include the following:

1. Examples of where this type of waterproofing could be utilized include:
   a. Bridge decks and tunnels, for situations where monolithic waterproofing membrane is desirable
   b. Tank lining
   c. Buildings with pitched or flat roofs
   d. Buildings with concrete or masonry foundation walls that retain earth and enclose interior spaces and floors below grade, from the top of the footing to the finished grade.
2. What is dampproofing and waterproofing?

   The National Precast Concrete Association/Precast Magazines/Precast Inc. Magazine/2014 – March-April, *Damp Proofing Vs. Waterproofing: Part 1*, includes the following definitions:

   "Further, the American Concrete Institute (ACI 515.1) defines waterproofing as a treatment of a surface or structure to resist the passage of water under hydrostatic pressure, whereas dampproofing is defined as a treatment of a surface or structure to resist the passage of water in the absence of hydrostatic pressure."
3. The definition of "skip" referenced in item 4 of the first paragraph of the *CS*, Section 54-2.03C, *Waterproofing – Asphalt Membrane Waterproofing and Dampproofing – Construction – Dampproofing*, from Materials Engineering and Testing Services (METS) is:

   "Discontinuities or any holes in the coating that would allow water to infiltrate".

   Synonyms: holidays, voids, discontinuities, vacations.
4. A good resource for understanding waterproofing for concrete bridge decks is the National Cooperative Highway Research Program (NCHRP) research paper titled, *Waterproofing Membranes for Concrete Bridge Decks*.

3 – Preformed Membrane Waterproofing

Additional information corresponding to the *CS*, Section 54-3, *Waterproofing – Preformed Membrane Waterproofing*, for BCM 54 include the following:

1. Examples of where this type of waterproofing could be utilized include:
    a. Bridge decks
    b. Pump plants
    c. Tunnels
    d. Sump areas of mechanic facilities
    e. Building foundations and/or portions of buildings that are subjected to wet environments, such as basements.

4 – Waterproofing and Cover

Additional information corresponding to CS, Section 54-4, *Waterproofing – Waterproofing and Cover*, for BCM 54 include the following:

1. Examples of where this type of waterproofing could be utilized include:
    a. Deck surfaces of railroad underpasses.
2. The American Railway Engineering and Maintenance-of-Way Association (AREMA) is a North American railway industry group. It publishes recommended practices for the design, construction, and maintenance of railway infrastructure, which are requirements in the United States and Canada. Per the *CS*, waterproofing and cover must be applied per the *AREMA Manual for Railway Engineering*.

5 – Deck Seal

Additional information corresponding to the *CS*, Section 54-5, *Waterproofing – Deck Seal*, for BCM 54 include the following:

1. Examples of where this type of waterproofing could be utilized include:
    a. Low average daily traffic count, where freeze-thaw cycles and de-icing salt are used.
    b. Sidehill viaducts.
    c. To avoid a drastic profile change when there is a thick asphalt concrete overlay on an existing bridge deck that requires replacement.
    d. To comply with the 1976 Federal Highway Administration requirement for a deck protective system when deicing salts are applied to the deck. AASHTO T-277 Chloride Ion Permeability test is utilized in some states to test the impermeability of the deck seal against the deicing salts.
2. An item to check for during the constructability review is to verify the curb is sealed for the full depth of the new overlay on the project plans.

3. An informative resource containing AASHTO and ASTM references is the:

   National Cooperative Highway Research Program (NCHRP) Synthesis 425, *Waterproofing Membranes for Concrete Bridge Decks*, [2012].

6 – Slurry Leveling Course

Additional information corresponding to the *CS*, Section 54-6, *Waterproofing – Slurry Leveling Course*, for BCM 54 include the following:

1. Examples of where this type of waterproofing could be utilized include:
   a. Corrective maintenance (but can serve as preventative measure also) for areas containing structural and cosmetic depressions caused by deterioration underneath pavement surfaces. Aggregate-based slurry seals larger cracks on the surface.
2. An informative resource from the Division of Maintenance, Office of Pavement Preservation, is:

   Maintenance Technical Advisory Guide (MTAG) Volume I - Flexible Pavement Preservation Second Edition, Chapter 8, *Slurry Seals*.

7 – Silane Waterproofing Treatment

Additional information corresponding to the *CS*, Section 54-7, *Waterproofing – Silane Waterproofing Treatment*, for BCM 54 include the following:

1. Examples of where this type of waterproofing could be utilized include:
   a. Concrete barriers, when salt is used to de-ice roadway surfaces in freeze/thaw areas.
   b. Silane waterproofing is NOT used for bridge decks or roadway surfaces.
2. The first paragraph of the Authorized Material List for *Silane Reactive Penetrating Sealers* has useful background information and states:

   "Silane Reactive Penetrating Sealers must penetrate into concrete and masonry substrates and chemically react to form covalent bonds with naturally occurring minerals in the substrate. Silane Reactive Penetrating Sealers line the pores of concrete and masonry substrates with a hydrophobic coating, but do not form a surface film."
3. From the Xiameter manufacturer's product data sheet, silane is described as:

   "Silane is a small molecule to allow for deep penetration into the cementitious surface. This material reacts with moisture in the air and in the substrate in the presence of an alkaline or acidic environment to produce hydroxy groups. These hydroxy groups will bond with the substrate and itself to produce a hydrophobic

treatment that inhibits water absorption into the substrate. An alkaline environment, such as new concrete, will catalyze the reaction and speed the formation of the hydrophobic surface. XIAMETER® OFS-6341 Silane is high purity, undiluted Noctyltriethoxy-silane. When diluted with an appropriate solvent, it can be used in the formulation of water repellent products. Upon proper application, the formulated product will penetrate and provide water repellency by chemically reacting with the cementitious substrate. Treated substrates are hydrophobic and retain their original appearance."

4. According to Corrosionpedia, hydrophobic is described as:

   "Hydrophobic is a property of a substance that repels water. It means lacking affinity for water and tending to repel or not to absorb water. Hydrophobic molecules tend to be non-polar molecules and group together. Oils and fats are hydrophobic. Hydrophobic materials often do not dissolve in water or in any solution that contains a largely aqueous environment. Hydrophobic materials are often used to remove oil from water, manage oil spills, and chemical separation processes that require the removal of non-polar substances from polar compounds. Hydrophobic surfaces decrease corrosion rates, and therefore are used in corrosion resistance. The opposite of hydrophobic is hydrophilic, water-loving. Surface-active agents contain both hydrophobic and hydrophilic groups on the same molecules."

5. An Associate Chemical Testing Engineer from METS was contacted on 07-23-2018 for a variety of questions to gain better understanding of silane waterproofing treatment. See below for the questions asked followed by their responses:

   a. Question: Why does the following requirement exist: "For Caltrans projects in the South Coast Air Quality Management District (SCAQMD), Silane Reactive Penetrating Sealers can only be used for reinforced concrete bridge structures within 5 miles of the ocean or above 4000 ft. in elevation."

      Answer: It is SCAQMD's view that chloride migration into the concrete is only a concern within 5 miles of the ocean and using the silane to mitigate damage from freeze-thaw weathering is only necessary above 4000ft. in elevation.

   b. Question: Is silane hazardous? Why does the following requirement exist: "Silane treatment selected for use must comply with the volatile organic compound limits for the air quality district where the project is located."

      Answer: Silane in the liquid form is flammable and hazardous. Once it reacts with concrete it is not hazardous, but that process generates methanol or ethanol vapor which is a VOC. The VOC limit for the category of "Reactive Penetrating Sealers" is 350g/L.

c. Question: What is an example of architecture coating?

   Answer: Generally, it said to be a coating that is applied to stationary structures or their appurtenances. PWB-145E is a waterborne latex primer Caltrans uses to paint structural steel on our bridges.

d. Question: Do you know of specific current or past projects where silane was used?

   Answer: Not off the top of my head, but there are some bridges it has been used on within the past 2 yrs.