Cleaning and Protecting Concrete – Surface Preparation, Application, and Inspection

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Cleaning and Protecting Concrete – Surface Preparation, Application, and Inspection

Topics of Discussion:

• Cleaning - *Methods of surface preparation and associated standards*

• Materials - *Coatings and water repellents used on concrete*

• Inspection - *Verifying the quality of installation, including:*
  – *New SSPC guide for detecting moisture in concrete*
  – *New SSPC standard for inspecting and classifying pinholes in coatings*
Underlying Theme

Problems with painting/sealing concrete have plagued the Building Industry for decades – Answers are Transferable
Methods of Surface Preparation and Standards/Guides
Industry Standards and Guides

- SSPC-SP13/NACE No. 6, Surface Preparation of Concrete
- SSPC-SP12/NACE No. 5, Surface Preparation and Cleaning of Metals by Water Jetting Prior to Recoating
- SSPC Dry Blast Cleaning Standards under development:
  - Very Thorough Blast Cleaning
  - Thorough Blast Cleaning
  - Brush Blast Cleaning
- ICRI Guideline No. 310.2, Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, and Polymer Overlays
Industry Standards and Guides (con’t)

• ASTM Standard Practices
  – ASTM D4258, Surface Cleaning Concrete for Coating
  – ASTM D4259, Abrading Concrete
  – ASTM D4260, Liquid and Gelled Acid Etching of Concrete
  – ASTM D4261, Surface Cleaning Concrete Masonry Units for Coating
Methods of Surface Preparation

• Air/Detergent/Water Cleaning
  – Air Blast Cleaning
  – Water Cleaning (Low Pressure)
  – Detergent Cleaning
  – Water Jetting (High Pressure and Ultra-High Pressure)

• Chemical Cleaning
  – Acid Etching
  – Chemical Stripping

• Mechanical Cleaning
  – Power Tool Cleaning
  – Dry Abrasive Blast Cleaning
  – Wet Abrasive Blast Cleaning
Methods of Surface Preparation (con’t)

• Air Blast Cleaning, Water Cleaning, Steam Cleaning, Vacuum Cleaning
  – SSPC-SP13/NACE 6
  – ASTM D4258, ASTM D4261

• Detergent Cleaning
  – SSPC-SP13/NACE No. 6
  – ICRI Guideline No. 310.2
  – ASTM D4258, ASTM D4261
Surface Preparation/Cleaning Methods in Standards/Guides

- **Water Jetting**
  - SSPC-SP13/NACE No. 6
  - ICRI Guideline No. 310.2
  - ASTM D4259

- **Acid Etching**
  - SSPC-SP13/NACE No. 6
  - ICRI Guideline No. 310.2
  - ASTM D4260
Surface Preparation/Cleaning Methods in Standards/Guides (con’t)

• Chemical Stripping
  – Effective method of paint removal, but not addressed in the standards/guides

• Power Tool Cleaning
  – SSPC-SP13/NACE No. 6
  – ICRI Guideline No. 310.2
  – ASTM D4259
Surface Preparation/Cleaning Methods in Standards/Guides

- **Dry Abrasive Blast Cleaning**
  - SSPC-SP13/NACE No. 6
  - ICRI Guideline No. 310.2
  - ASTM D4259

- **SSPC Standards under development:**
  - Very Thorough Blast Cleaning
  - Thorough Blast Cleaning
  - Brush Blast Cleaning
Surface Preparation/Cleaning Methods in Standards/Guides

• Wet Abrasive Blast Cleaning
  – SSPC-SP13/NACE No. 6
  – ASTM D4259

In 2005, SSPC/NACE published joint WAB standards for steel:

• SSPC-SP5 (WAB)
• SSPC-SP10 (WAB)
• SSPC-SP6 (WAB)
• SSPC-SP14 (WAB)
• SSPC-SP7 (WAB)
Coatings, Water Repellents, Stains
Coating Expectations

- Coatings
  - Enhance aesthetics and image
  - Protect substrates from deterioration
  - Minimize intrusion of moisture
  - Bridge fine gaps or openings in concrete
  - Remain intact
Coating Material Selection

- Organizations such as Green Seal and Master Painters Institute (MPI) identify performance criteria for various generic types of architectural coatings.

- Society for Protective Coatings (SSPC) publishes standards for the performance of industrial coatings and some architectural coatings (e.g., Paint 46, Elastomeric, Water Based, High Build, Flat, Performance-Based Coating for Masonry and Concrete).
Coating Material Selection (con’t)

- MPI provides a list of approved products
- Over 230 categories based on generic type, gloss, VOC

<table>
<thead>
<tr>
<th>MPI#</th>
<th>Category Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Aluminum Paint</td>
</tr>
<tr>
<td>2</td>
<td>Aluminum Paint, Heat Resistant (Up to 427°C - 800°F)</td>
</tr>
<tr>
<td>3</td>
<td>Primer, Alkali Resistant, Water Based</td>
</tr>
<tr>
<td>3 X-Green</td>
<td>Primer, Alkali Resistant, Water Based</td>
</tr>
<tr>
<td>4</td>
<td>Block Filler, Latex, Interior/Exterior</td>
</tr>
<tr>
<td>4 X-Green™</td>
<td>Block Filler, Latex, Interior/Exterior</td>
</tr>
<tr>
<td>5</td>
<td>Primer, Alkyd/Oil for Exterior Wood</td>
</tr>
<tr>
<td>6</td>
<td>Primer, Latex for Exterior Wood</td>
</tr>
<tr>
<td>8</td>
<td>Alkyd, Exterior Flat (MPI Gloss Level 1)</td>
</tr>
<tr>
<td>9</td>
<td>Alkyd, Exterior Gloss (MPI Gloss Level 6)</td>
</tr>
<tr>
<td>10</td>
<td>Latex, Exterior Flat (MPI Gloss Level 1)</td>
</tr>
<tr>
<td>10 RR</td>
<td>Latex, Recycled (Remanufactured), Exterior Flat (G1)</td>
</tr>
<tr>
<td>10 RC</td>
<td>Latex, Recycled (Consolidated), Exterior Flat (G1)</td>
</tr>
<tr>
<td>11</td>
<td>Latex, Exterior Semi-Gloss (MPI Gloss Level 5)</td>
</tr>
<tr>
<td>11 RR</td>
<td>Latex, Recycled (Remanufactured), Exterior Semi-Gloss (MPI Gloss Level 5)</td>
</tr>
<tr>
<td>11 RC</td>
<td>Latex, Recycled (Consolidated), Exterior Semi-Gloss (MPI Gloss Level 5)</td>
</tr>
<tr>
<td>13</td>
<td>Stain, Exterior, Solvent Based, Semi-Transparent</td>
</tr>
</tbody>
</table>
Coating Material Selection (con’t)

- Acrylic Block filler (MPI #4)
- Acrylic elastomeric (MPI #113)
- Alkali Resistant Water Based Primer (MPI #3)
- High-Performance Latex (MPI #311 and #315)
- Acrylic Texture Coat (MPI #42)
- Hydrophobic Paints (no MPI number)
- Silicone Resin Emulsion Paints (no MPI number)
Coating Material Selection (con’t)

- Acrylic Block filler (MPI #4):
  - Block fillers are used to fill the porosity of the substrate.
  - For exterior use, the block filler should not contain any polyvinyl acetate (PVA). PVA is water sensitive and could lead to blistering and disbonding if water becomes trapped beneath the film.
Coating Material Selection (con’t)

• Acrylic elastomeric (MPI #113):
  – Excellent barrier to bulk water, passing wind-driven rain tests
  – Good tensile strength/elongation
  – Tolerate some movement and fine cracking (~16 mils wide)
  – Lower permeance, can reduce ability of water vapor to escape
Coating Material Selection (con’t)

- Alkali Resistant Water Based Primer (MPI #3):
  - These primers are suitable for use on alkaline surfaces such as concrete and masonry and are used beneath latex or acrylic finish coats

- Latex Texture Coat (MPI #42):
  - These products contain an aggregate in order to create a textured finish on concrete surfaces such as pre-cast and tilt-up.
Coating Material Selection (con’t)

• High-Performance Latex (MPI #311 and #315):
  – Good weathering characteristics, lower wind-driven rain resistance than acrylic elastomerics, but potentially higher permeance
  – The difference in the product numbers is related to gloss (#311 is 35 to 70 units at 60°; #315 is a maximum of 35 units).
Coating Material Selection (con’t)

- Hydrophobic or “Lotus Effect” Paint (no MPI number):
  - Protect substrates by providing water repellency and resistance to soiling, mold and mildew.
  - High permeance allows vapor to escape.
Coating Material Selection (con’t)

• Silicone Resin Emulsion Paints (no MPI number):
  – Provide excellent water repellent characteristics
  – High permeance allows vapor to escape.
  – An acrylic silane/siloxane sealer is often applied first on porous substrates.
  – When using silicone coatings, the same type of material is frequently used for future overcoating

• Epoxy/Urethane
  – Excellent water resistance
  – Urethane – glossy, pleasing appearance
  – Typically lower permeance
Coating Material Selection (con’t)

- Acrylic Block filler (MPI #4)
- Acrylic elastomeric (MPI #113)
- Alkali Resistant Water Based Primer (MPI #3)
- High-Performance Latex (MPI #311 and #315)
- Acrylic Texture Coat (MPI #42)
- Hydrophobic Paints (no MPI number)
- Silicone Resin Emulsion Paints (no MPI number)
- Epoxy/Urethane
Water Repellents
Water Repellent Expectations

- **Water Repellents**
  - Enhance aesthetics and brand
  - Protect substrate from deterioration
  - Minimize intrusion of moisture
  - Penetrate fine cracks to make surface hydrophobic
Clear Water Repellents

- Control moisture intrusion on above-grade vertical surfaces, such as integrally colored block, stone, concrete, terra cotta, brick or other unpainted material.
Clear Water Repellents

- **Paintable Water Repellent (MPI #34):**
  - Clear water repellents (typically silane/siloxane) that penetrate into, and seal the surface of the concrete.
  - MPI indicates that the products on this list can be painted.

- **Non-Paintable Water Repellent (MPI #117):**
  - Clear water repellents (typically silane/siloxane) that penetrate into the surface of the concrete, causing it to be hydrophobic.
  - MPI indicates that the products on this list can not be painted and should only be used when the surface will be resealed with the same product in the future.
Pigmented Water Repellent Stains

- Pigmented Water Repellent Stains:
  - Stains are available as both solvent- and water-based. Chemistries vary.

- Mineral Water Repellent Stains:
  - Available in many colors, these stains are high-permeance potassium silicate materials that penetrate the surface to create a hard, insoluble silicate.
  - Good color retention.
Water Repellent Summary

- Paintable Water Repellent (MPI #34) – silane/siloxane
- Non-Paintable Water Repellent (MPI #117) – silane/siloxane
- Pigmented Water Repellent Stains
- Mineral Water Repellent Stains
Test Patches to Confirm Coating Appearance and Compatibility

- Test patches of surface preparation, and coating work should be undertaken to:
  - Confirm the quality of surface preparation
  - Determine compatibility of coatings and water repellent
    - solvent borne repellent may not be compatible with a pre-existing water borne water repellent
  - Agree on appearance
    - Provide a visual and tactile representation of the specification requirements
  - Clearly establish the expectations of the work and resolve discrepancies before production work begins
Benefit of Coating Test Patches

• Establish the appearance of repairs

• Establish the degree of surface preparation required, e.g.,
  – Amount of paint to be removed
  – Extent of chalk to be removed
  – Roughening required or permitted

• Establish quality of paint application required, e.g.,
  – Coverage and continuity
  – Frequency of pinholes allowed
Coating Test Patches (con’t)
Quality of Installation
Verifying Quality of Installation

- Surface Preparation
- Ambient Conditions
- Moisture Content
- Material, Mixing, and Application
- Number of Coats and Thickness
- Dry Time and Cleanliness between Coats
- Continuity and Coverage
Inspection - Surface Preparation
Inspection – Ambient Conditions
Inspection of Moisture Content

- SSPC-Guide 23, Field Methods for the Determination of Moisture in Concrete and Masonry Walls and Ceilings, EIFS, and Stucco
  - Method 1 - Plastic Sheet Method
  - Method 2 - Electrical Impedance Moisture Meter
  - Method 3 - Radio Frequency Moisture Meter
  - Method 4 - Electrical Conductivity (Resistance) Moisture Meter
  - Method 5 - Relative Humidity Probes

- Tables
  - Table 1 - Suggested Test Frequency of Walls Prior to Painting
  - Table 2 - Suitability of Test Methods/Probe Configurations on Various Substrate Types
  - Table 3 - Portion of Substrate Assessed and Reporting Units
Inspection - Moisture Content
Inspection - Moisture Content (con’t)
### TABLE 1
**SUGGESTED TEST FREQUENCY OF WALLS PRIOR TO PAINTING**

<table>
<thead>
<tr>
<th>Area Being Coated in a Given Day</th>
<th>Method 1 Plastic Sheet*</th>
<th>Method 2 Impedance</th>
<th>Method 3 Radio Frequency</th>
<th>Method 4 Conductivity</th>
<th>Method 5 RH**</th>
</tr>
</thead>
<tbody>
<tr>
<td>≤ 10 m² (≤ 1000 ft²)</td>
<td>3 tests</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11 to 500 m² (1001 to 5000 ft²)</td>
<td>5 tests</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>501 to 1000 m² (5001 to 10,000 ft²)</td>
<td>10 tests</td>
<td></td>
<td>Locate test zones every 7 to 10 m (25 to 35 ft) of wall, and test at 3 heights within each zone.</td>
<td>Same as Method 1</td>
<td></td>
</tr>
<tr>
<td>&gt; 1000 m² (&gt;10,000 ft²)</td>
<td>10 tests for first 1000 m² (10,000 ft²) plus 1 test for each additional 175 m² (2,000 ft²)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Test frequency differs from recommendations in ASTM D4263.
** One probe in cavity and one probe in mortar joint in each location.
**SSPC-Guide 23 (con’t)**

### TABLE 2
**SU宜ABILITY OF TEST METHODS/PROBE CONFIGURATIONS ON VARIOUS SUBSTRATE TYPES**

<table>
<thead>
<tr>
<th>Substrate Types/Textures</th>
<th>Method 1 Plastic Sheet</th>
<th>Method 2 Impedance</th>
<th>Method 3 Radio Frequency</th>
<th>Method 4 Conductivity*</th>
<th>Method 5 RH Probe</th>
</tr>
</thead>
<tbody>
<tr>
<td>Poured Concrete/ Tilt up</td>
<td>Good</td>
<td>Good</td>
<td>Good</td>
<td>Good</td>
<td>Good</td>
</tr>
<tr>
<td>Precast - smooth</td>
<td>Good</td>
<td>Good</td>
<td>Good</td>
<td>Good</td>
<td>Good</td>
</tr>
<tr>
<td>Precast - textured</td>
<td>Marginal</td>
<td>Poor</td>
<td>Marginal</td>
<td>Good</td>
<td>Good</td>
</tr>
<tr>
<td>Smooth CMU</td>
<td>Good</td>
<td>Good</td>
<td>Good</td>
<td>Good</td>
<td>Good</td>
</tr>
<tr>
<td>Split-faced CMU</td>
<td>Marginal</td>
<td>Poor</td>
<td>Marginal</td>
<td>Good</td>
<td>Good</td>
</tr>
<tr>
<td>Grout (when surrounded by block)</td>
<td>Good</td>
<td>Poor</td>
<td>Good</td>
<td>Good</td>
<td>Good</td>
</tr>
<tr>
<td>EIFS, Stucco</td>
<td>Good</td>
<td>Good</td>
<td>Good</td>
<td>Good</td>
<td>Good</td>
</tr>
<tr>
<td>Painted Surfaces</td>
<td>Marginal</td>
<td>Marginal</td>
<td>Good</td>
<td>Good</td>
<td>Good</td>
</tr>
</tbody>
</table>

* For detection of moisture below the surface, holes must be drilled in the substrate. See Section 4.4.1.

### TABLE 3
**PORITION OF SUBSTRATE ASSESSED AND REPORTING UNITS**

<table>
<thead>
<tr>
<th>Measurement Characteristics</th>
<th>Method 1 Plastic Sheet</th>
<th>Method 2 Impedance</th>
<th>Method 3 Radio Frequency</th>
<th>Method 4 Conductivity*</th>
<th>Method 5 Relative Humidity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Substrate Depth</td>
<td>Bulk</td>
<td>Top 25 mm (1 inch)</td>
<td>Top 19 mm (3/4 inch)</td>
<td>Surface*</td>
<td>Bulk</td>
</tr>
<tr>
<td>Reporting Units</td>
<td>None (visual)</td>
<td>% moisture (relative scale)</td>
<td>Relative Scale</td>
<td>Relative Scale</td>
<td>% of moisture Saturation</td>
</tr>
</tbody>
</table>

* If nails are driven into the substrate, or holes are drilled to obtain subsurface readings, see Section 4.4.1.
Inspection – Materials, Mixing, and Application
Inspection – Number of Coats and Thickness
Inspection – Number of Coats and Thickness (con’t)

- Can measure film or estimate based on coverage rates and amount of product used
Inspection – Dry Time and Cleanliness between Coats
Inspection – Continuity and Coverage
SSPC-PA 18, Standard for Visual Evaluation of Pinholes in a Concrete or Masonry Coating (to be published by Dec 2017)

- Classifies the pinholes based on frequency

<table>
<thead>
<tr>
<th>Classification</th>
<th>Number of Pinholes per Evaluation Spot</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td>0 pinholes</td>
</tr>
<tr>
<td>Low</td>
<td>1 to 10 pinholes</td>
</tr>
<tr>
<td>Moderate</td>
<td>11 to 20 pinholes</td>
</tr>
<tr>
<td>High</td>
<td>&gt;20 pinholes</td>
</tr>
</tbody>
</table>
SSPC-PA 18, Standard for Visual Evaluation of Pinholes in a Concrete or Masonry Coating

- Provides acceptance criteria based on service environment

<table>
<thead>
<tr>
<th>Classification</th>
<th>Service Environment</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td>Interior atmospheric coatings applied to areas such as medical, food, drug, or pharmaceutic clean rooms, or areas frequently wet or washed down</td>
</tr>
<tr>
<td></td>
<td>Immersion coatings</td>
</tr>
<tr>
<td></td>
<td>Floor coatings</td>
</tr>
<tr>
<td>Moderate or less</td>
<td>Atmospheric coatings applied to interior and exterior surfaces in general areas</td>
</tr>
</tbody>
</table>
SSPC-PA 18, Standard for Visual Evaluation of Pinholes in a Concrete or Masonry Coating

- Defines the size of each spot to be examined as approximately 1 sq ft (size of a block face), termed evaluation spot
- Defines the number of evaluation spots to be examined based on the size of area painted
- Describes a process for making additional evaluations around non-conforming areas to map out the extent of the deficiencies

<table>
<thead>
<tr>
<th>Size of Area</th>
<th>Number of Evaluation Spots</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;300 sq ft</td>
<td>1 spot for each 100 sq ft</td>
</tr>
<tr>
<td>300 sq ft to &lt;1,000 sq ft</td>
<td>1 spot in 3 different 100 sq ft areas</td>
</tr>
<tr>
<td>&gt;1,000 sq ft</td>
<td>1 spot in 3 different 100 sq ft areas in each 1,000 sq ft</td>
</tr>
</tbody>
</table>
Summary

• Surface Preparation
  – Standards (ASTM, SSPC, NACE, ICRI)
  – Water/detergent/pressure washing/water jetting
  – Chemical stripping, acid etching
  – Power tool, dry blast cleaning, wet blast cleaning

• Coatings for Concrete
  – Block fillers, latex, acrylic, acrylic elastomeric, hydrophobic, silicone resin emulsion paint, epoxy, urethane
Summary (con’t)

• Water Repellents for Concrete
  – Silane, siloxane, silane/siloxane blends, clear paintable (acrylic), pigmented stains (water-borne and solvent-borne), mineral (potassium silicate) stains
Summary (con’t)

• Verifying the quality of material installation
  – Surface Preparation
  – Ambient Conditions
  – Moisture Content (SSPC Guide 23)
  – Mixing and Application
  – Number of Coats and Thickness
  – Dry time and Cleanliness Between Coats
  – Continuity and Coverage (SSPC-PA 18)
Summary (con’t)

- Learn from the building industry
- Solutions are transferable
Questions?

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