CONCRETE REPAIR & PREPARATION

FOUNDATION FOR STRONG PERFORMANCE

The Hard Facts

- Concrete is the 2nd Most Consumed Substance in the World Behind Water
- Approximately 10 Billion Tons (20,000,000,000,000 Pounds) Of Concrete is Produced Globally, Annually
- Approximately 1.7 Billion Tons of Steel is Produced Globally, Annually

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MBX MONTIPOWER INDUSTRIAL BRISTLE BLASTER SYSTEM
Innovative Power Tool Surface Preparation · Near-White Metal Clean w/3 mil Profile

Coatings Industry News

Main News Page

Longest 3D-Printed Concrete Pedestrian Bridge Finished

More

Monday, January 21, 2019

Earlier this month, the world's longest 3D-printed concrete pedestrian bridge was completed in Shanghai's Wisdom Bay Industrial Park, a project designed and developed by professor Xu Weiguo, from Tsinghua University (School of Architecture)—Zoina Land Joint Research Center for Digital Architecture.

The 26.3-meter-long (86.2-foot-long), 3.6-meter-wide bridge, built in collaboration with Shanghai Wisdom Bay Investment Management Company, was inspired by the ancient Anji Bridge in Zhaoxian, China.

3D-Printed Concrete Pedestrian Bridge

To create the single-arch bridge, Weiguo's team developed a 3D-printing concrete system that implemented digital design and smart technology, according to Tsinghua University. The handrails are shaped like flowing ribbons, creating an impression of light, elegant movement across the pond.

Tsinghua University

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CONCRETE REPAIR & PREPARATION

Why Line or Coat Concrete

- Aesthetics
- Resistance From Chemical Attack
- Prevention of Corrosion From Carbonation & Chloride Attack
- Abrasion & Impact Protection

Tonight's Discussion

- Coatings and Linings are Effective in Providing Barrier Protection of Concrete from the Compounds and Exposures that Attack Concrete Structures that Lead to Complex and Costly Repairs.

- Appropriate Surface Preparation of Concrete is the Single Most Important Step to Prevent Premature Coatings or Linings Failure and Subsequent Concrete Deterioration.

- Tonight We Will Discuss These Ideas and Solutions.

What Successful Lining and Coating Performance Requires

- … a concrete surface that is suitable for application and adhesion of the specified protective coating system.

  SSPC-SP 13/NACE No. 6 Surface Preparation of Concrete

What Successful Lining and Coating Performance Requires

- Sound
- Clean
- Dry
- Profiled

Sound

- Strength
- Cohesiveness
- Without Excessive Voids or Cracks

Clean

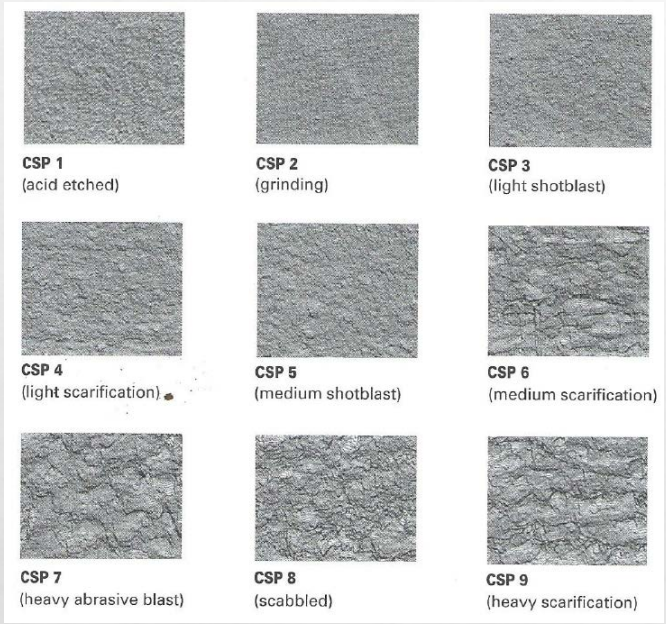
Removal of

- Dirt
- Oil
- Grease
- Chemicals
- Existing Incompatible Coatings

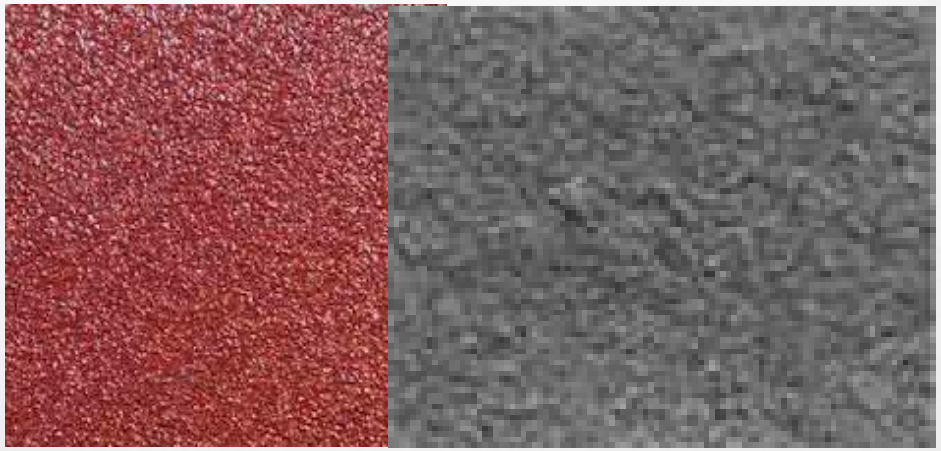
Dry

- Qualitative – Visible
- Quantitative - < 3 Pounds/1000 Square Feet in a 24-hour period

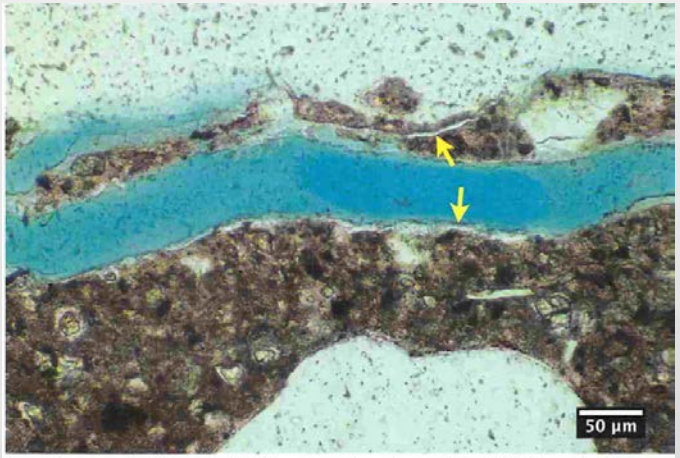
PROFILED



Profile Inspection Using 60 Grit Sandpaper



Common Concrete Issues



Amorphous metasilicate gel (yellow arrows) - a byproduct of ASR weathering

Concrete Repair & Preparation

Common Concrete Issues

Concrete Repair & Preparation

Cleaning

- Vacuum Cleaning
- Air Blast Cleaning
- Water Cleaning
- Detergent Cleaning
- Steam Cleaning
  Per ASTM D 4258

Profiling - Blasting

- Dry Abrasive Blasting
- Wet Abrasive Blasting
- Vacuum-Assisted Abrasive Blasting
- Centrifugal Shot Blasting
- High Pressure Waterjetting (Hydrodemolition)
  Per ASTM D 4259

Profiling – Impact Tools

- Scarifying
- Planing
- Scabbling
- Rotary peening,

  Per ASTM D 4259

Profiling – Power Tool

- Circular Grinding

- Sanding

- Wire Brushing
  Per ASTM D 4259

Surface Prep Acceptance Criteria

Table 1:
Suggested Acceptance Criteria for Concrete Surfaces After Surface Preparation

Property	Test Method	Light Service[A]	Severe Service[B]
Surface tensile strength	See Paragraph A1.6	1.4 MPa (200 psi) min.	2.1 MPa (300 psi) min.
Surface profile	Visual comparison[16]	Fine (150) abrasive paper min.	Coarse (60) abrasive paper min.
Surface cleanliness	Visible dust[11]	No significant dust	No significant dust
Residual contaminants	Water drop[15,22]	0° contact angle	0° contact angle
pH	ASTM D 4262[18]	(pH of rinse water) -1, +2[C]	(pH of rinse water) -1, +2[C]
Moisture content[D]	ASTM D 4263[19]	No visible moisture	No visible moisture
Moisture content[D]	ASTM F 1869[20]	15 g/24 hr/m^2 (3 lb/24 hr/1,000 ft^2) max.	15 g/24 hr/m^2 (3 lb/24 hr/1,000 ft^2) max.
Moisture content[D]	ASTM F 2170[21]	80% max.	80% max.

[A] Light service refers to surfaces and coatings that have minimal exposure to traffic, chemicals, and changes in temperature.
[B] Severe service refers to surfaces and coatings that have significant exposure to traffic, chemicals, and/or changes in temperature.
[C] The acceptance criterion for ASTM D 4262 is as follows: The pH readings following the final rinse shall not be more than 1.0 lower or 2.0 higher than the pH of the rinse water (tested at the beginning and end of the final rinse cycle) unless otherwise specified.
[D] Any one of these three moisture content test methods is acceptable.

Per SSPC – SP 13 / NACE No. 6

Surface Profile Range - ICRI

Table 7.1: Protective Systems

Material to be applied	Concrete Surface Profile									
	CSP 1	CSP 2	CSP 3	CSP 4	CSP 5	CSP 6	CSP 7	CSP 8	CSP 9	CSP 10
Sealers, 0 to 3 mils (0 to 0.075 mm)	■									
Thin films, 4 to 10 mils (0.01 to 0.025 mm)	■	■								
High-build coatings, 10 to 40 mils (0.025 to 1.0 mm)			■	■	■					
Self-leveling toppings, 50 mils to 1/8 in. (1.2 to 3 mm)				■	■	■				
Polymer overlays, 1/8 to 1/4 in. (3 to 6 mm)					■	■	■	■		
Concrete overlays and repair materials, >1/4 in. (>6 mm)					■	■	■	■	■	■

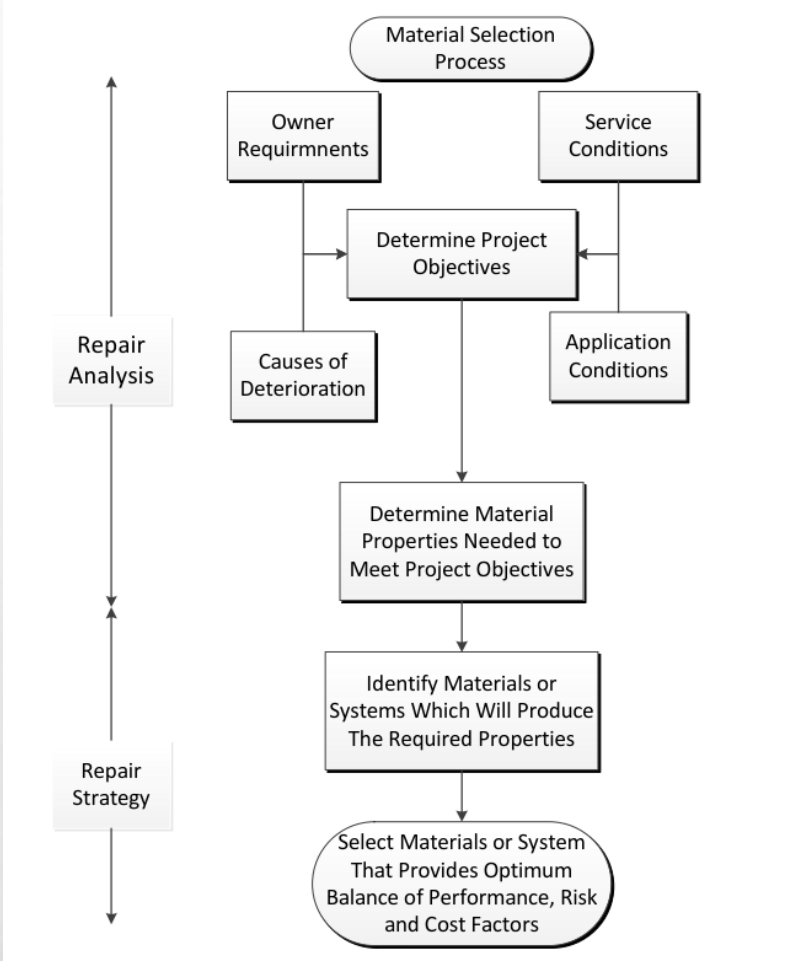
Concrete Repair – Spalls & Deterioration

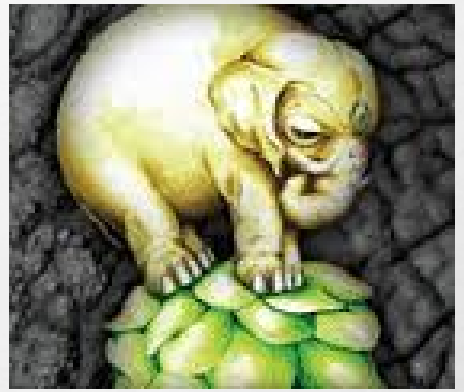
- Concrete Removal – Squared Frame
- Expose Corroded Reinforcement ¼ Inch + Dimension of Repair Material Largest Aggregate

- Recoat any Exposed Epoxy Coated Rebar
- Corrosion Inhibitors
- Saturate Surface Dry or Dry

Repair Material Selection Process

- ICRI CRM1-1010 The Material Selection Process
- Reference Sited From ACI Manual of Concrete Practice





Repair Material Selection Process

- Required Appearance
- Expected Life of Repair
- Load Carrying Requirements
- Exposure Conditions
- Application Conditions
- Application Method & Placement Properties
- Coating or Lining Specified
- Required Surface Preparation For Coating or Lining
- Timing & Budget

Repair Material Selection

- Portland Cement Concrete
- Portland Cement Mortars
- Polymer Modified Portland Cement Mortars
- Epoxy Mortars

Cracks & Joints

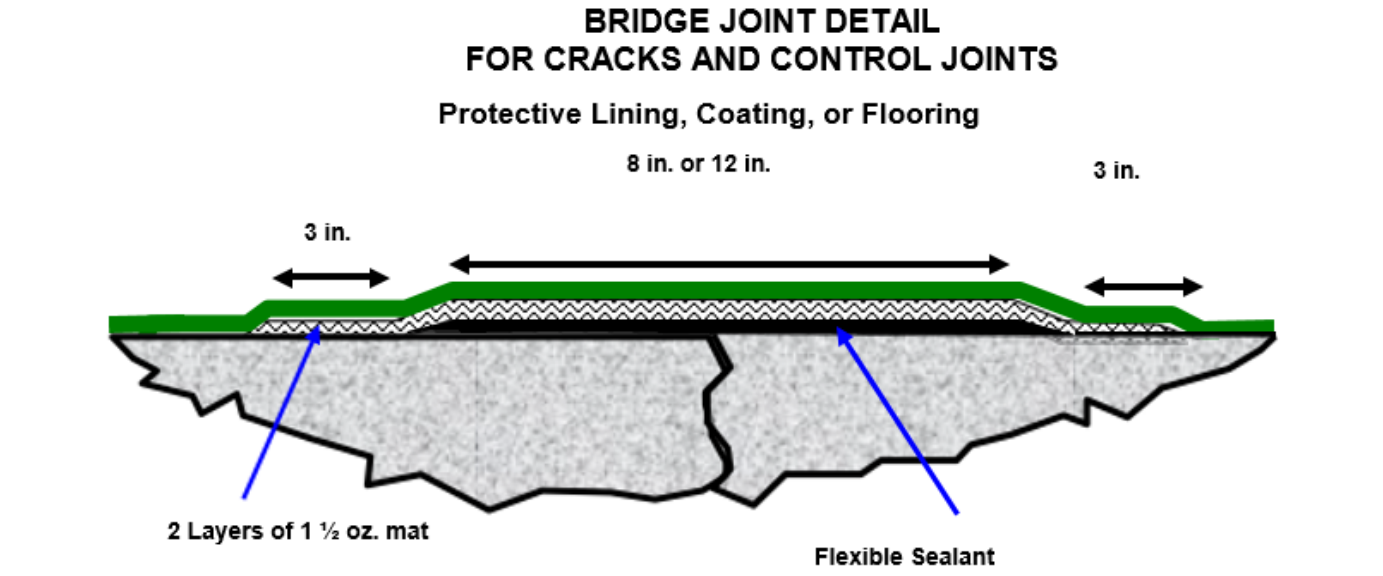
- Non Moving Cracks – Cracks which usually form from shrinkage during the concrete curing process. Non-moving cracks do not change position significantly after first forming.

Cracks & Joints

- Moving Cracks - Caused from expansion and contraction with temperature changes or other influences such as settlement of the foundation, loads from pump bases or tank foundations.
  - Provide chemical spills easy access through the containment system into underlying soil and groundwater.

Cold Joint / Crack Detail

- Bridge Joint
- Maximum movement capability is 0.005 in. (5 mils) per inch of sealant width.



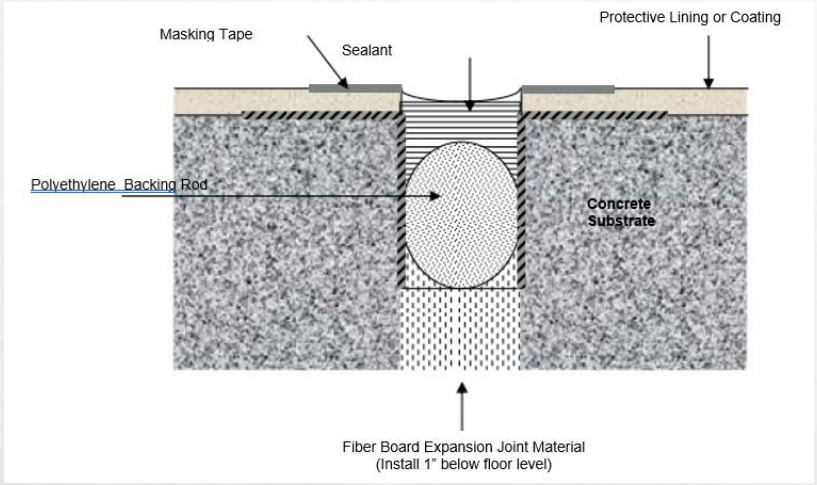
Structural Repairs

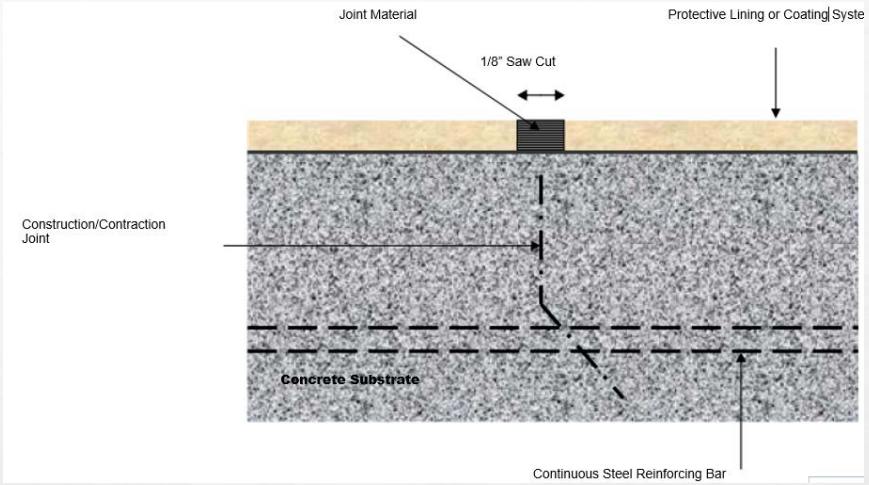
- Epoxy Injection
- Stitching

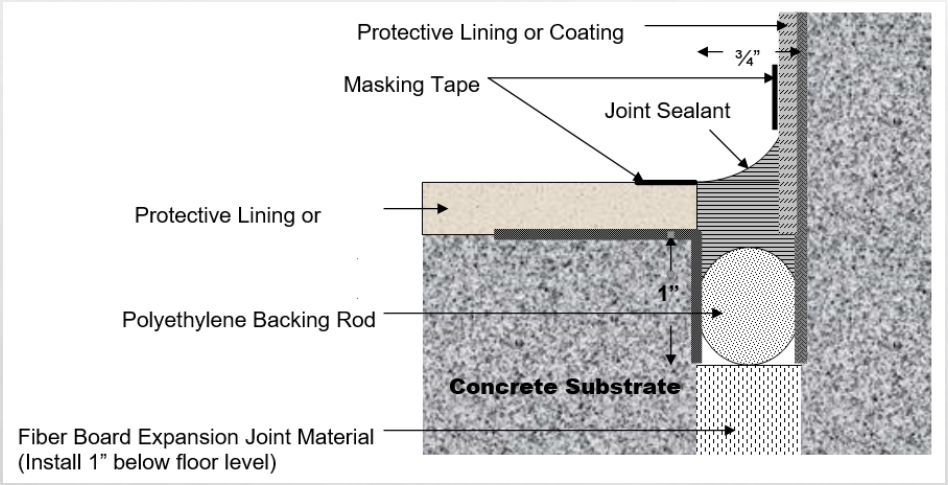
Cold, Control & Expansion Joints

- Allowing for expansion and contraction of a concrete slab without generating potentially damaging forces within the slab itself or the surrounding structures.

Control & Expansion Joints



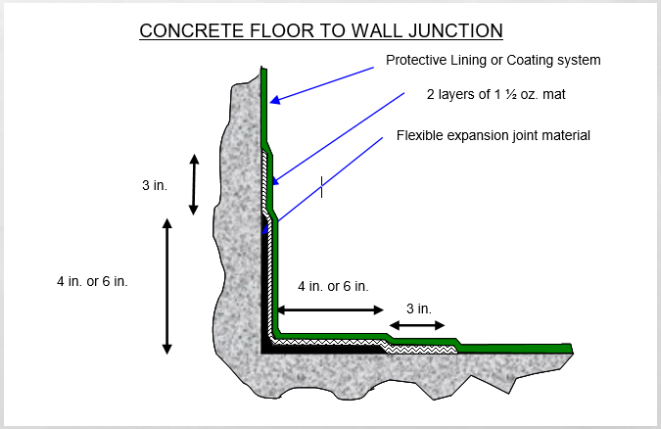




Concrete Repair & Preparation

Hinge Joint Concrete - Concrete

- This procedure is recommended for use in conjunction with chemical resistant systems over concrete joints where the concrete floor and wall meet.
  - Maximum movement capability is equal to or greater than a bridge joint, which is 0.005 in. (5 mils) per inch of unbonded width.
  - Typically the hinge joint is designed to handle approximately 1/16 to 1/8 inch movement.



Moisture Drive & Vapor Barriers

- Vapor barriers prevent moisture vapor emissions, from passing through the cured concrete slab.
  - A common cause of blistering and adhesion-related coating failures including Alkali Silica Reaction (ASR)

Moisture Drive & Vapor Barriers

- Slabs on grade specified to receive a protective coating or lining should be placed over a continuous vapor barrier.
  - Constructed of polyethylene plastic that is overlayed and taped.
  - Typically achieved using a 15–30 mil thick, reinforced polyethylene sheet material.

Moisture Drive & Vapor Barriers

- Remediation
  - Crystalline Technology that fills concrete capillaries and blocks moisture drive
  - Waterproof Cementitious Mortars and Coatings
  - Moisture Tolerant Primers
  - Beneath Slab and Behind Wall Hydrophobic and Hydrophilic Grouts

Conclusion

- Creating "… a concrete surface that is suitable for application and adhesion of the specified protective coating system"
- Will "Prevent Premature Coatings or Linings Failure and Will Deliver a Quality Concrete Coating or Lining Project.

Questions