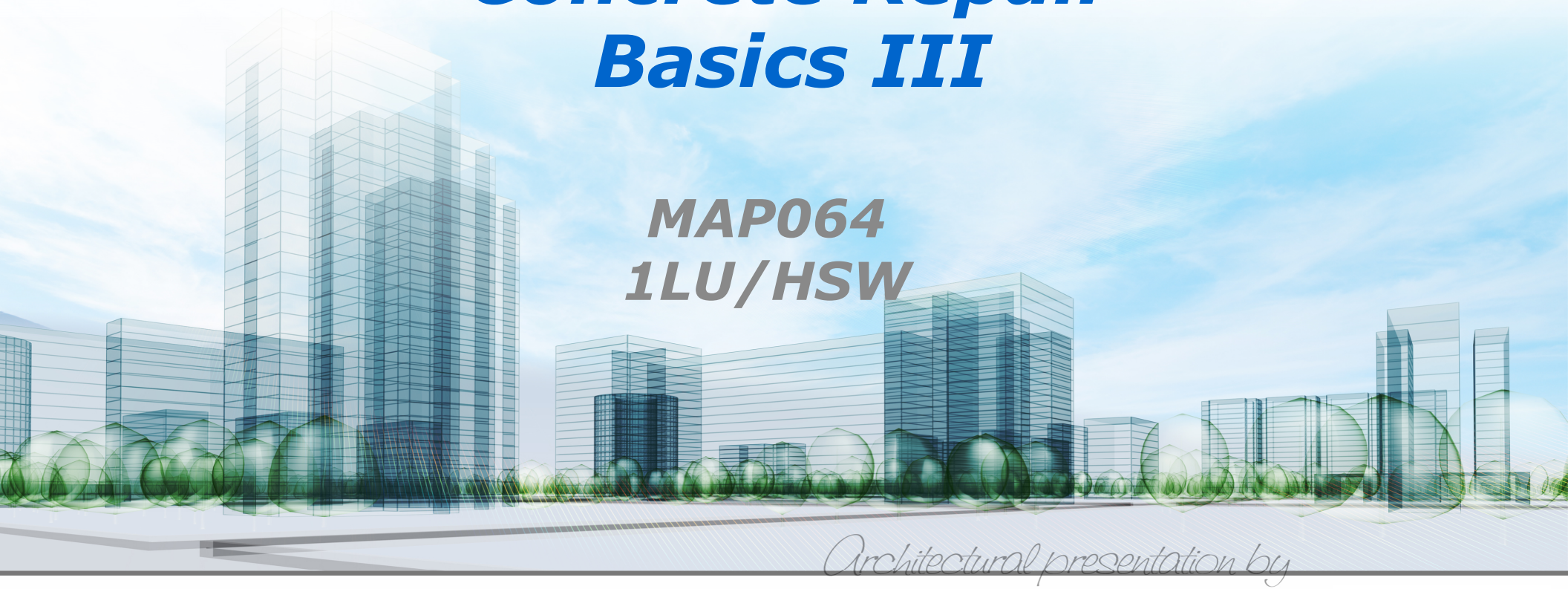
Concrete Repair Basics III

MAP064
1LU/HSW



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Program Number: MAP064

Concrete Repair Basics III

Learning Objectives

1. Understand the process of repairing, protecting and enhancing concrete structures
2. Learn about good surface preparation practices, concrete surface profiles, and how to repair deteriorated concrete
3. Identify the different methods to apply repair mortars depending on the type of repair and the material requirements for the job

What Is Concrete Restoration?

CONCRETE RESTORATION

is not “patching”….

It is restoring a structure to its

original design specifications

or better, increases lifespan and enhancing its value.

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What Is Concrete Restoration?

Achieving a long-lasting restoration begins with formulating a repair strategy which includes:

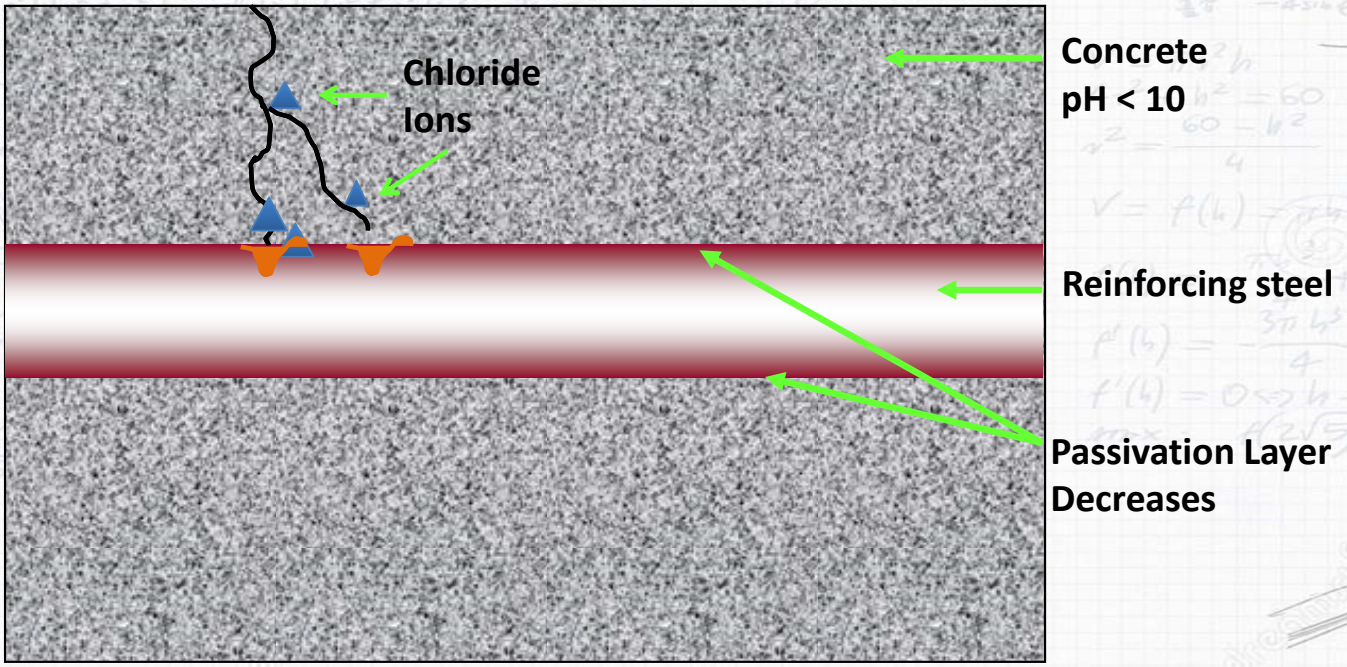
Diagnosis of the damage and the cause of the problem.

Repair process using the right materials and methods.

Enhance the value by incorporating a maintenance plan to extend the service life of the restored structure.

Chloride-Induced Corrosion

CORROSION AND CHLORIDE IONS – Exposure of reinforced concrete to chloride ions is the primary cause of premature corrosion of steel reinforcement.



Chloride-Induced Corrosion

WHY IS CORROSION A CONCERN?

Steel provides the tensile properties needed in structural concrete. It prevents the failure of concrete structures which are subjected to tensile and flexural stresses due to traffic, winds, dead loads, and thermal cycling.

When reinforcement corrodes, the formation of rust leads to a loss of bond between the steel and the concrete, causes delamination and spalling, and the integrity of the structure can be affected.

Corrosion results in the formation of rust which has 2 to 4 times the volume of the original steel.

What Could Go Wrong?

Surface Preparation

Proper ***Surface Preparation*** is a key element in determining the success of a concrete restoration project.

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Surface Preparation

SURFACE PROFILE – The topographic contour of the exposed surface of the material or substrate.

Proper surface preparation will open the pore structure of the concrete substrate and establish profiles suitable for the application of the protective system or repair material.

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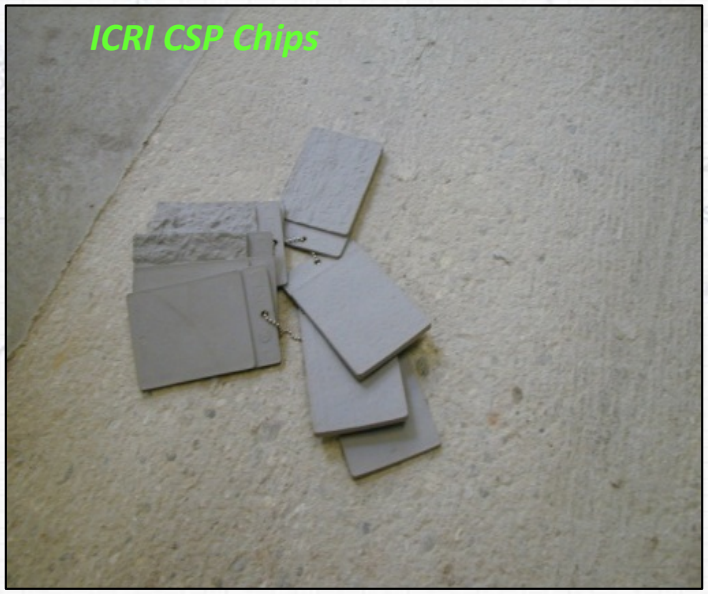
Concrete Surface Profiles

Material to be Applied	CSP 1	CSP 2	CSP 3	CSP 4	CSP 5	CSP 6	CSP 7	CSP 8	CSP 9
Sealers- 0-3 mils (0 - .075 mm)									
Thin Films - 4-10 mils (.01 - .025 mm)									
High-Build Coatings - 10-40 mils (.025 - 1.0 mm)									
Self-Leveling Toppings - 50 mils- 1/8 inch (1.2 - 3 mm)									
Polymer Overlays - 1/8 - 1/4 inch (3 - 6 mm)									
Concrete Overlays and Repair Materials > 1/4" (> 6mm)									

Surface Preparation

ICRI - International Concrete Repair Institute

Technical Guide No. 310.2R-2013 - Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, Polymer Overlays, and Concrete Repair.



ICRI CSP (Concrete Surface Profile) ***Chips***

An excellent tool for verifying the concrete surface preparation in the field

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Surface Preparation

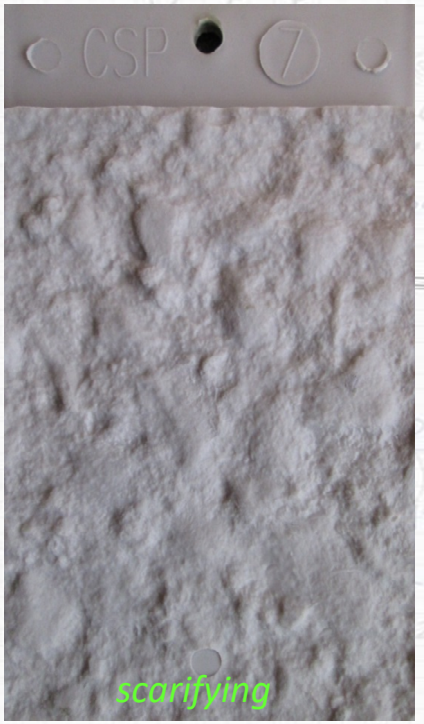
ICRI Guide No. 310.2R-2013 - Preferred surface preparation methods to obtain a ***CSP***

Surface Preparation Methods	CSP 1	CSP 2	CSP 3	CSP 4	CSP 5	CSP 6	CSP 7	CSP 8	CSP 9	CSP 10
Detergent scrubbing	■									
Low-pressure water cleaning	■									
Grinding	■	■								
Acid etching	■	■	■							
Needle scaling		■	■	■						
Abrasive blasting		■	■	■	■	■	■			
Shotblasting		■	■	■	■	■	■	■	■	
High and ultra high-pressure water			■	■	■	■	■	■	■	■
Scarifying				■	■	■	■			
Surface Retarder (2)					■	■	■	■	■	■
Scabbling							■	■	■	
Rotomilling							■	■	■	
Chipping /jackhammers							■	■	■	■

Surface Preparation

When prepping for flooring like CVT tile and carpet

For installation of overlays, toppings and mortars



For removing heavy floor tile mastics and epoxy materials

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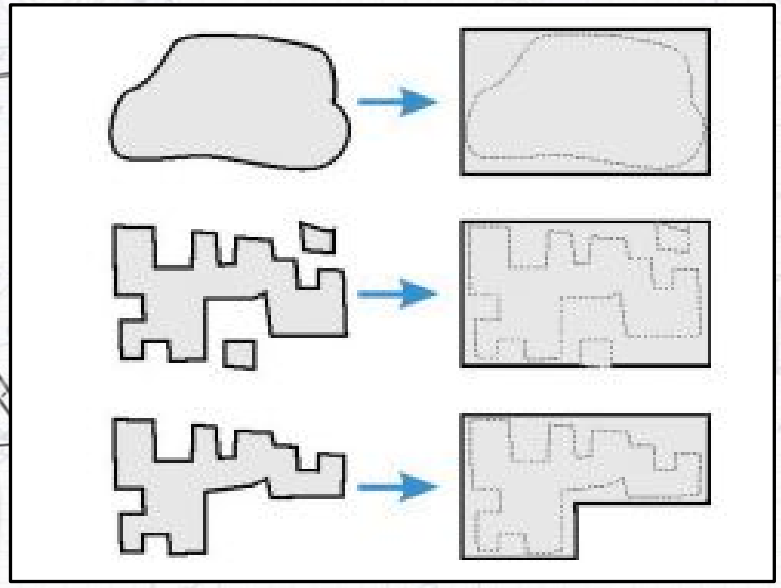
Surface Preparation

ICRI 310.1R-2008 - ***Guide for Surface Preparation for the Repair of Deteriorated Concrete Resulting from Reinforcing Steel Corrosion.***

- Removal Geometry and Configuration of Repair Area
- Concrete Removal/Surface Preparation
  - Exposing and Undercutting of Reinforcing Steel
  - Preparation of the Repair Perimeter
  - Cleaning of the Concrete Surface and Reinforcing Steel
- Inspection and Repair of Reinforcing Steel

Surface Preparation

ICRI 310.1R-2008 - Removal Geometry and Configuration of Repair Area



Repair configurations should be kept as simple as possible, preferably squared or rectangular with square corners.

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Surface Preparation

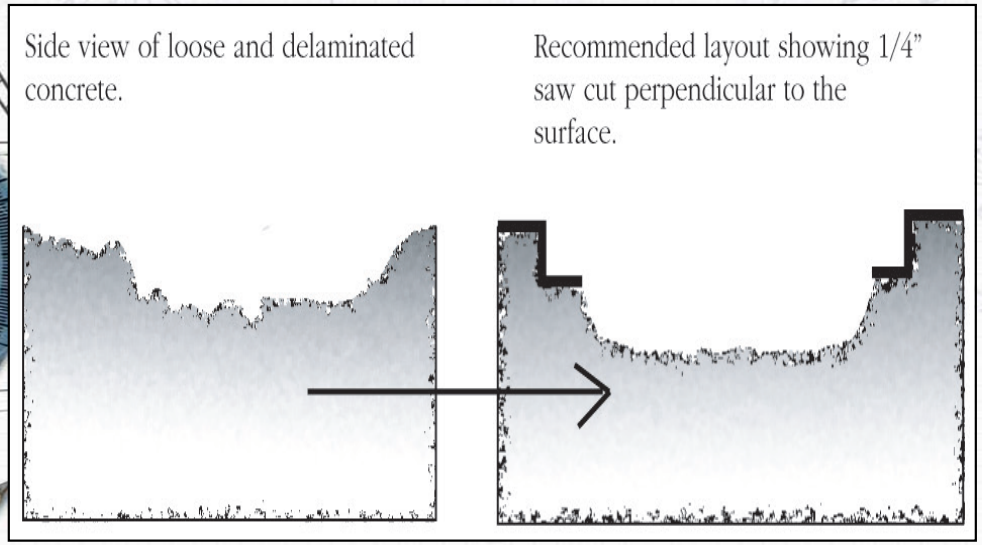
ICRI 310.1R-2008 - Concrete Removal/Surface Preparation
Exposing and Undercutting of Reinforcing Steel

- Undercutting will provide clearance under the reinforcing steel for cleaning and full bar circumference bonding to the repair material and the surrounding concrete.
- Provide a minimum of 0.75 in. clearance between exposed reinforced steel and surrounding concrete or 0.25 in. larger than the coarse aggregate in the repair mortar, whichever is greater.

Surface Preparation

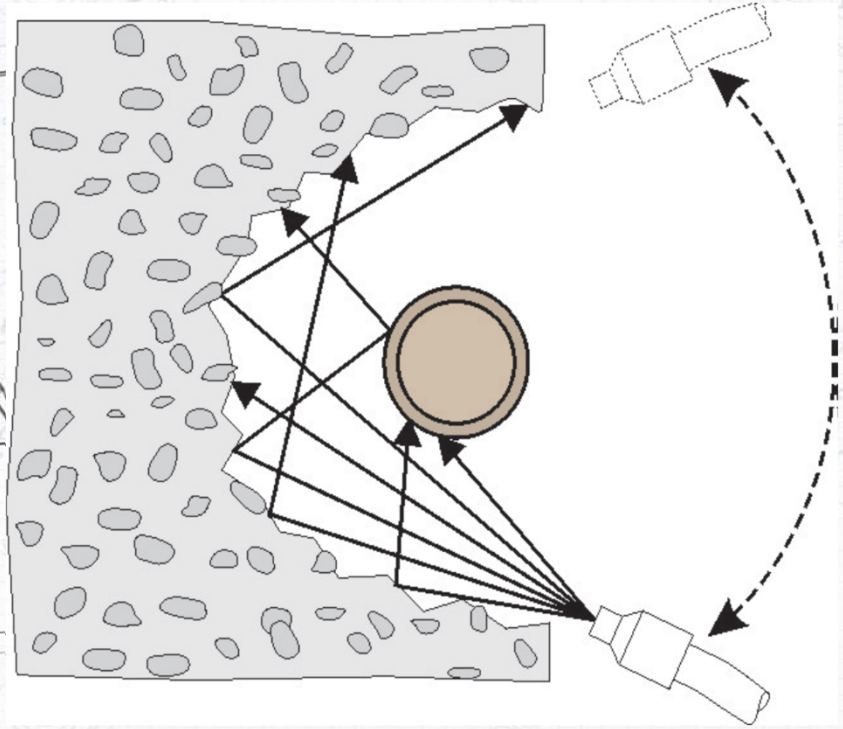
ICRI 310.1R-2008 - Preparation of the Repair Perimeter

- The perimeter of the repair area should be saw cut to manufacture's recommendations to provide a vertical edge for the repair material.
- This will avoid featheredging of the repair material.



Surface Preparation

CLEANING OF THE CONCRETE SURFACE AND REINFORCING STEEL



- All concrete, corrosion products, and scale should be removed from the reinforcing steel by oil-free abrasive blasting or high- pressure water blasting

- Verify that the reinforcing steel and concrete surface are free from dirt, oil, cement fines (slurry), or any material that might interfere with the bond of the repair mortar

Surface Preparation

ICRI 310.1R-2008 – Inspection and Repair of Reinforcing Steel

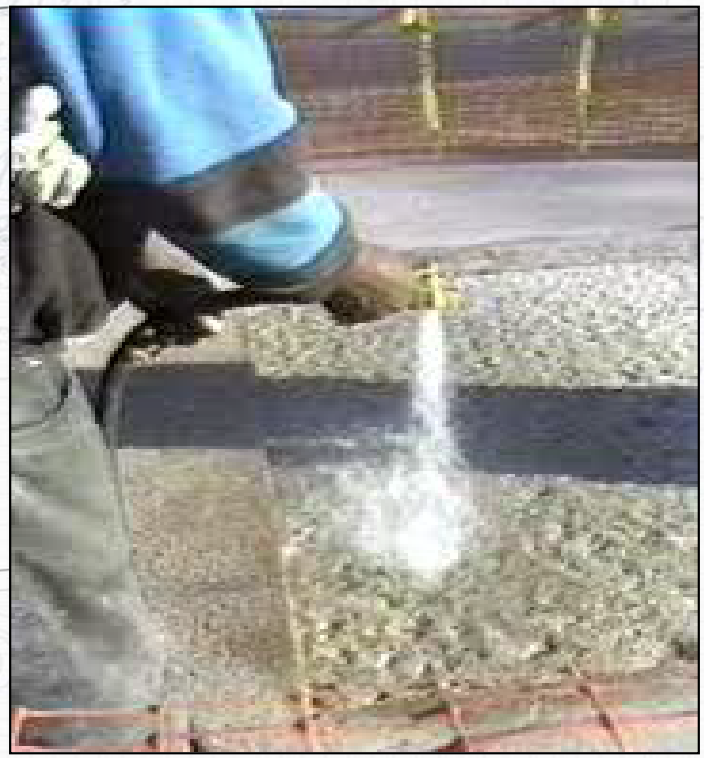
If reinforcing steel has lost cross-sectional area, a structural engineer should be consulted.

Repair reinforcing steel by replacing the damaged/deteriorated steel or placing supplemental reinforcing steel in the affected section.

ACI 318 – Building Code Requirements for Structural Concrete

Placement Process

ICRI 320.1R-1996 – Guideline for Selecting Application Methods for the Repair of Concrete Surfaces



Moisture Conditioning

SSD - Saturated Surface-Dry

When applying cement-based mortars to existing concrete, the saturation prevents rapid drying of the product and improves its bond to the surface.

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Placement Process

SCRUB COAT – To the saturated area, place a small amount of the mixed mortar onto the area and scrub it well with a stiff brush. While the scrub coat is still wet, install the repair mortar.

Do not add extra water or liquid to this scrub coat, as that will create a weak bond line at the repair.

BONDING AGENTS

- Provides additional bond strength
- Prevents moisture loss from the repair mortar to the existing substrate.

Application Methods

ICRI 320.1R-1996 – Guide for Selecting Application Methods for the Repair of Concrete Surfaces.

ICRI 320.2R – Guide for Selecting and Specifying Materials.

TROWEL APPLIED – Horizontal, vertical and overhead applications. Repair material is mixed into a trowel able, non-sag consistency. It is pressed into the substrate to achieve contact without voids.

Material requirements – fine grained material, easily finished, with non-sag properties to stay in place in vertical or overhead applications.

ACI RAP-6 & RAP-7: Spall Repair by Hand Application

Application Methods

FORM AND POUR - Partial Depth Replacement

Material requirements – concrete or mortar with low shrinkage, low water/cement ratio, and highly flowable.

Repair materials are poured into the formwork and consolidated by rodding or conventional vibration if product requires.

Best application – columns, walls, and exterior slab edges.

ACI RAP-4: Surface Repair Using Form-and-Pour Techniques

Application Methods

FORM AND POUR - Full Depth Placement

Material Requirements – cast-in-place concrete or repair mortar with low shrinkage, low water-cement ratio, and a highly workable mixture.

The area in question can be removed and replaced in total.

Best Application – when deterioration is extensive throughout the member.

ACI RAP-5: Surface Repair Using Form-and-Pour Techniques

Application Methods

FORM-AND-PUMP – Full Depth Placement

Material requirements – pumpable, good flow characteristics, aggregate size compatible with size of cavity and space between bars.

Repair material is mixed and pumped via concrete line connected to the formwork until the cavity is filled.

Best application – overhead and vertical applications when congested reinforcement.

ACI RAP-5: Surface Repair Using Form-and-Pump Techniques

Application Methods

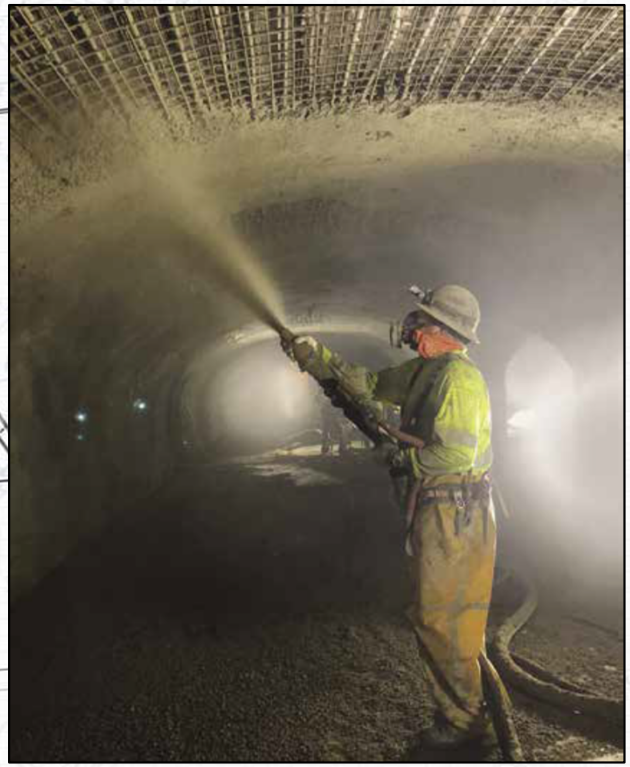
FORM-AND-PUMP – Full Depth Placement

Before

After

Application Methods

WET-MIX SHOTCRETE



Material requirements – pumpable, low-slump mixture which does not sag when impacted on the prepared surface.

Pre-batched and mixed repair material is placed into a concrete pump and transported via pump line to an exit nozzle. The repair material is propelled onto the surface by a compressed air.

ACI RAP-12: Concrete Repair by Shotcrete Application

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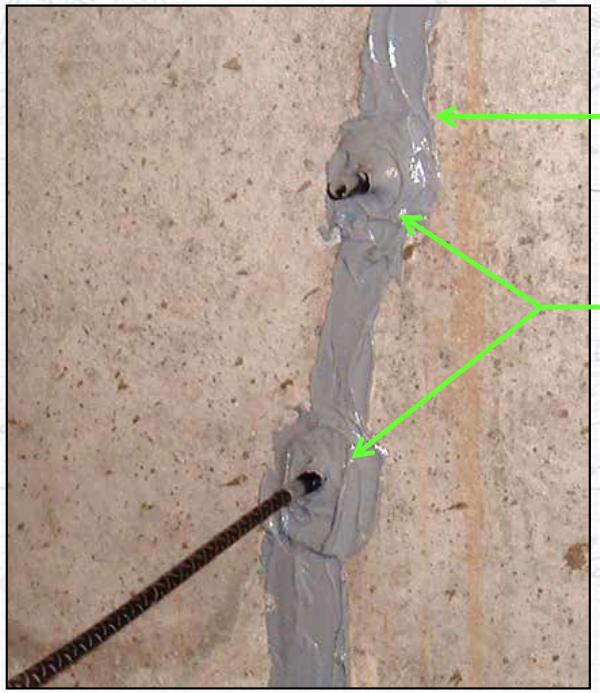
How to Repair…

HAIRLINE AND STATIC CRACKS

- Low or ultra-low viscosity epoxy resin
- Moisture-tolerant
- High-bond strength

ACI RAP 2 – Crack Repair by Gravity Fed with Resin

STRUCTURAL CRACKS



ACI RAP 1 – Structural Crack Repair by Epoxy Injection

This concludes the AIA CES program: ***MAP064***
"Concrete Repair Basics III"

This course qualifies for the following credits: ***1 LU/HSW hour***
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