



ACI E706 RAP Bulletin 3 Spall Repair by Low-Pressure Spraying

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BASF Construction Chemicals

and Patrick “Doc” Watson who wrote the document!



American Concrete Institute

Always advancing



Fred Goodwin is a chemist with >30 years of experience in the construction chemicals industry, including cement manufacture, research, development, and technical support of grouts, adhesives, coatings, shotcrete, stucco, flooring, and concrete repair materials. He has been with BASF and its predecessors for 28 years and is an active member of ICRI, ACI, ASTM, NACE, SDC, and SSPC. He is a fellow of ASTM, ACI and ICRI, and current chair of the ICRI Technical Activities Committee (TAC) and SSPC 8.3 Commercial Floor Coatings. He was awarded the ASTM Award of Merit in 2016, the JCPL Editors Award in 2006, 2010, and 2012 as well as the ACI 2011 Delmar Bloem Distinguished Service Award and the ACI Foundation – SDC Council – 2015 Roumain Innovation in Concrete Award. He is certified by NACE as a Corrosion Technologist and was recently named as a Top 25 Innovative Thinker by Technology Publishing, and frequently speaks at industry events. He currently heads the BASF Construction Chemicals Global Corrosion Control Competency Center.



ACI RAP Bulletin 3

FIELD GUIDE TO
CONCRETE REPAIR
APPLICATION PROCEDURES

Spall Repair by Low-Pressure Spraying



The Concrete Convention
and Exposition



low-pressure spall repair spray - Similar to wet-mix shotcrete but sprayed at a much lower velocity.

- Low-pressure spall repair spray comes in the form of prepackaged mortar.
- The spray is applied using small concrete pumps or heavy-duty grout pumps to force the low-slump mortar through a hose.
- Air is added at the nozzle to impel the mortar.
- Bond with the prepared substrate is achieved through a combination of
 - proper surface preparation,
 - low-velocity impact, and
 - the material properties of the prepackaged mortar.

When do I use this method?

For

- Surface Repairs
- Structural Repairs
- Cosmetic Renovation.
- Vertical Repairs
- Overhead Repairs

Successful applications have included:

Bridges

Building & Bridge Piers

Structural Slab Undersides

Tank Walls (Interior and Exterior)

Stadiums

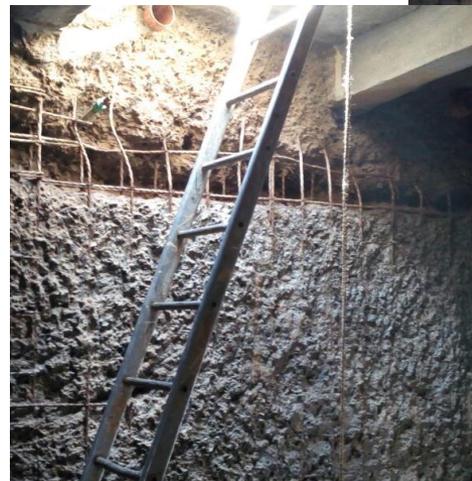
Tunnels

Retaining Walls

Typically applied 1/2 to 4 in. (13 to 100 mm) in a single lift.

Thicknesses > 6 in. (150 mm) usually in multiple lifts.

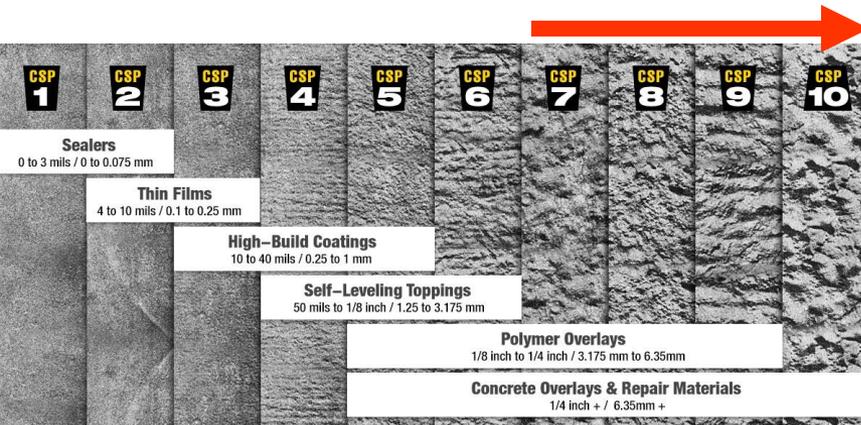
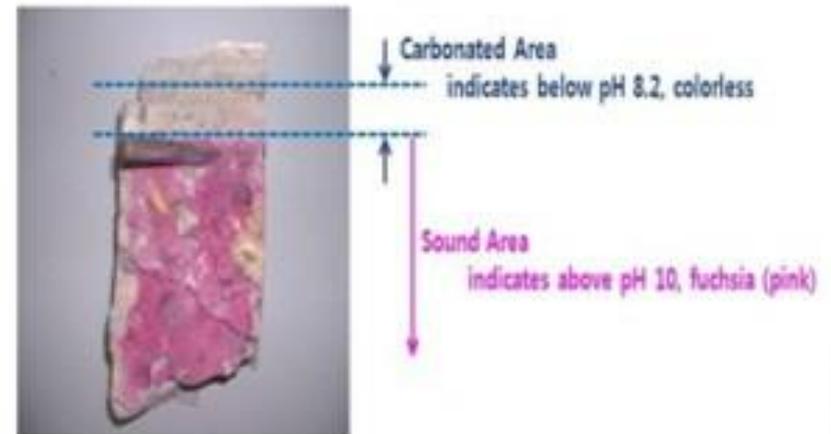
Repair applications >4 in. (100 mm) thickness, other methods may be more economical

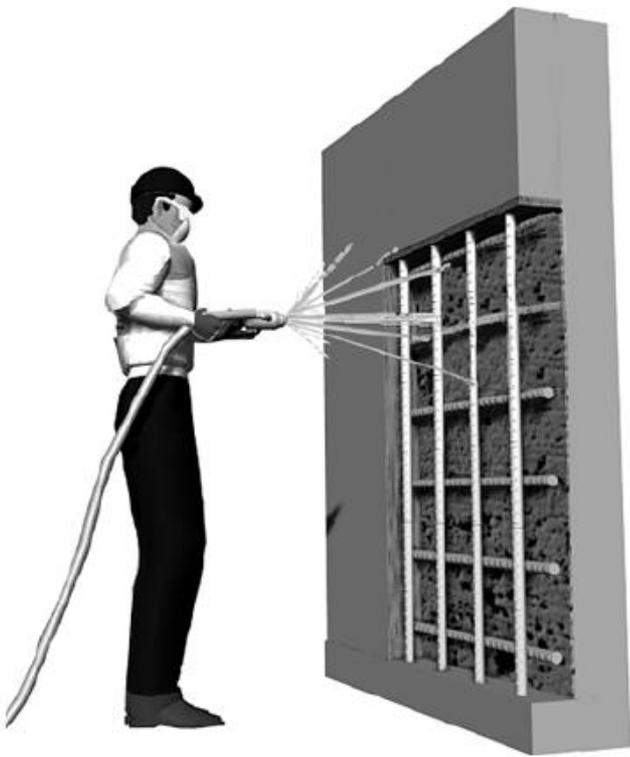


How do I prepare the surface?



- Desired roughness profile of the prepared surface (CSP) (typically >7)
- Method of preparation
 - Hydrodemolition
 - Sandblasting
 - Pneumatic hammers
- Check for contamination of the surface by
 - Chemicals
 - Oils
 - Soaps
 - Carbonation (pH indicator >11.5)





- Required substrate saturation
- Reinforcing requirements per
 - Mortar manufacturer
 - Engineer
 - Owner
- Treatment of existing cracks and joints:
 - Repair the cracks?
 - ❖ How?
 - Fill the joints?
 - ❖ If so, how and with what?



How do I select the right material?

Low-pressure spray-applied repair materials are proprietary, prepackaged cementitious products.

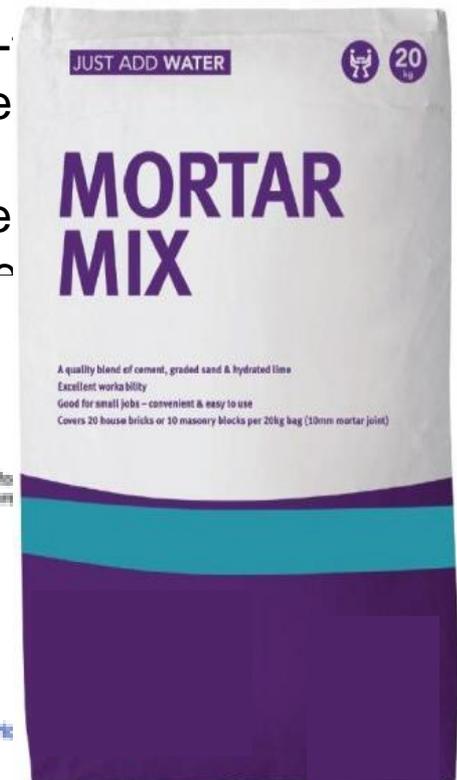
Specifiers, applicators, and owners should consult *ICRI Guideline No. 320.2R*, “A Guide for Selecting and Specifying Materials for Repair of Concrete Surfaces.”

Consult the American Concrete Institute publications on concrete repair by ACI Committee 546, Repair of Concrete.

Refer to manufacturers’ data sheets for material properties.

Physical property requirements such as bond strength, freeze-permeability, and flexural strength will vary from proje

When low-pressure spray-applied materials are used, some re



TECHNICAL GUIDELINES

Prepared by the International Concrete Repair Institute May 2009



Guideline No. 320.2R-2009 (formerly No. 03733)
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Guide for Selecting and Specifying Materials for Repair of Concrete Surfaces

Guide to Concrete Repair

Reported by ACI Committee 546

ACI 546R-14



Guide to Materials Selection for Concrete Repair

Reported by ACI Committee 546

ACI 546.3R-14



Guide for Structure

Americ

What equipment do I need?

Concrete or grout pumps suitable for low-pressure spray.

Field experience has shown that ball valve pumps are not suitable.

Short stroke, swing-type piston pumps or heavy-duty rotor-stator pumps perform well;

- If using a rotor-stator or “moyno” type pump, have a backup rotor on hand at the job site;

- Air compressor with pressure gages and controls.

(Some pumps come equipped with built-in air compressors and controls.)

- A suitable mixer for mixing the mortar is needed.

A backup mixer is recommended in case of breakdown.

(Some repair type pumps come equipped with mortar mixers.);

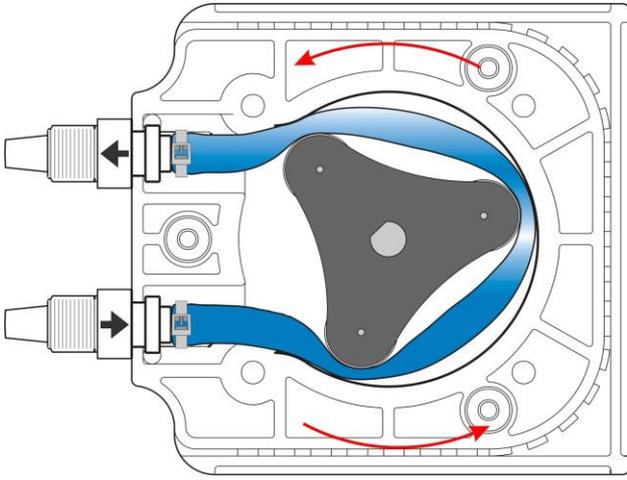
- A water measuring device, preferably a meter.

(Many repair-type pumps equipped with mixers include built in water meters.)

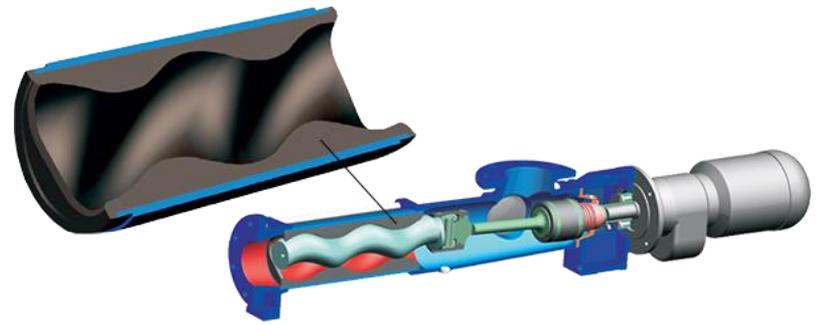
- A means of communication between the pump and mixer operators and the nozzleman;

All finishing, handling, and testing tools required by specification or good concreting practices.

Common Pumps for Low-Pressure Spray



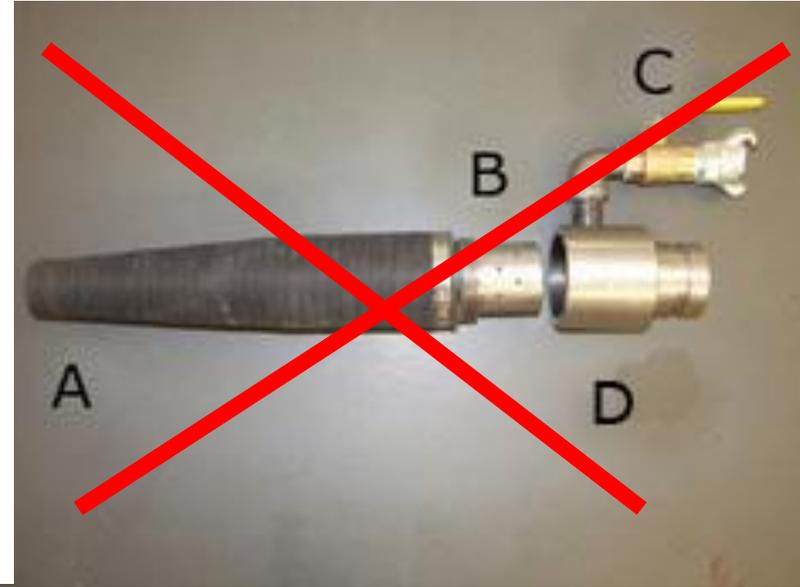
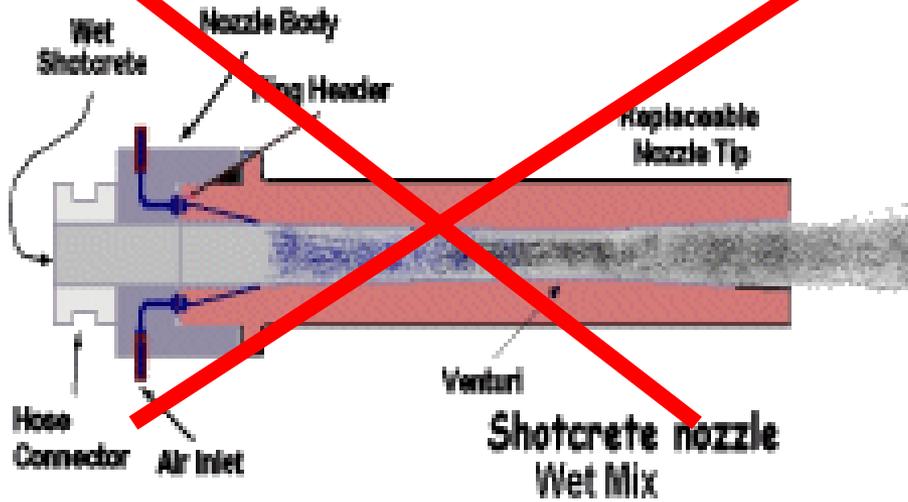
Peristaltic/Squeeze/Carousel Pumps



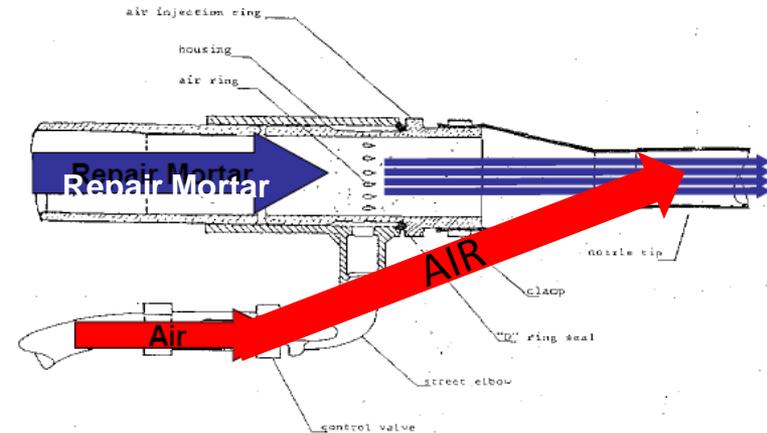
Rotor-Stator "Moyno" Pumps



Common Nozzles for Low-Pressure Spray



Wet Mix (Low Velocity)



Common Nozzles for Low-Pressure Spray



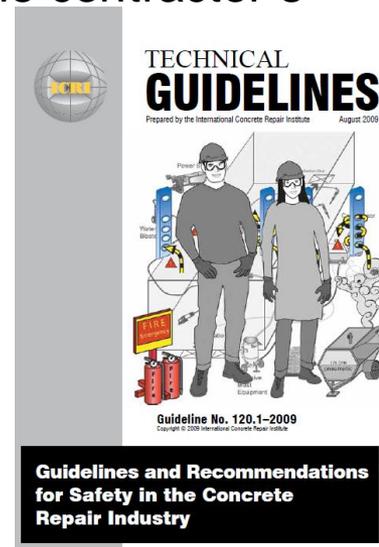
<https://www.youtube.com/watch?v=GnZi6kE56tQ>



What are the safety considerations?

Material Safety Data Sheets (MSDS) should be on hand;

- Safety equipment: all machinery and equipment being used must have the correct safety equipment, guards, and warnings in place;
- Protective clothing: protective gloves for workers in contact with wet, cementitious material;
- Protective eyewear: safety glasses or face shields will be needed for all workers;
- Eyewash facilities should be provided;
- Respirators: dust masks will be needed for workers operating the material mixer;
- Ventilation of closed spaces: confirm that adequate ventilation is available before operating equipment that emits dangerous exhaust;
- Secured storage should be available for all hazardous materials;
- Fuel for equipment operation needs a safe storage area, well marked and visible;
- A safety meeting with all involved should be held and led by the prime contractor's safety manager prior to beginning repair operations.



Preconstruction meeting

Include representatives from all participating parties

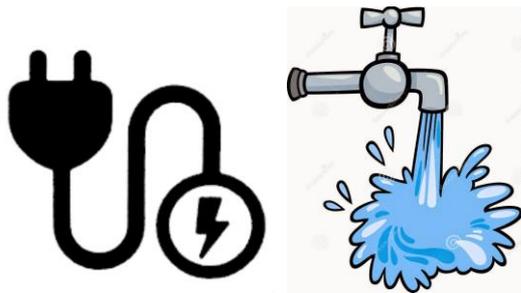
owner, engineer, contractor, materials manufacturer, etc.

Specifically address the parameters, means, methods, and materials necessary to achieve the repair objectives.



The prejob (preconstruction) meeting agenda might include:

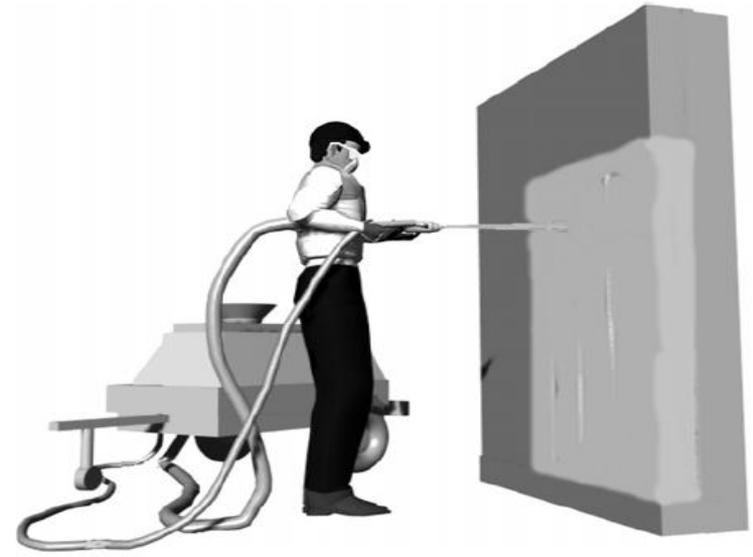
- On-site availability of power;
- On-site availability of water;
- Site accessibility;
- Debris removal and disposal;
- Dust, odor, and emissions control;
- Confirmation that all materials documentation is on hand—for example, SDS sheets;
- Methods of curing and time required for curing;
- Possible emergencies and breakdowns—what to do if they occur;
- Finish requirements;
- Testing required
- All other concerns that could affect the progress of the repair.



Repair procedure

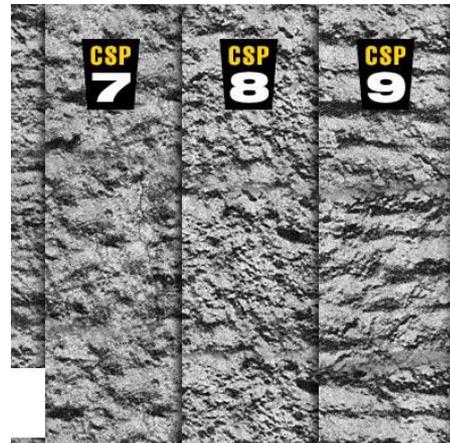
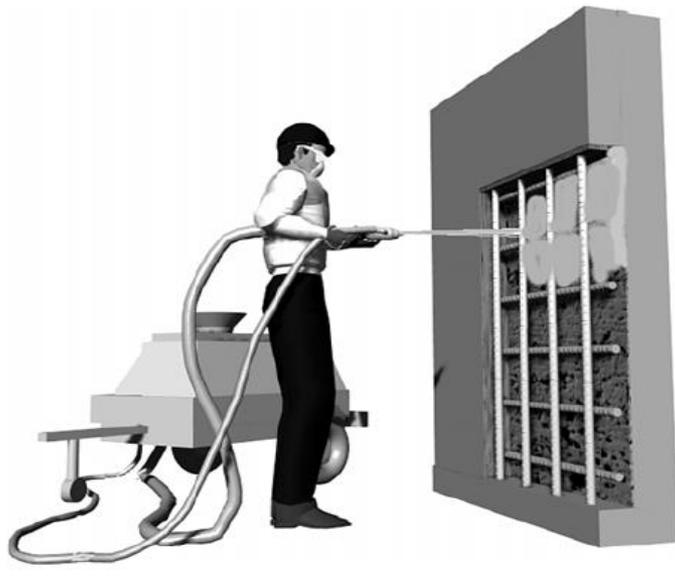
32. Apply the repair.

- Inspect and approve the surface preparation.
- Presaturate the prepared substrate. Twenty-f...
- Prepared saturated surface should be satur...
- mortar is sprayed;
- Install the specified reinforcement;
- Install/apply bonding agents, corrosion inhibit...
- Mix the repair mortar and load it into pump hc...
- Begin spray operations with pump, compress...
- Apply the mortar at the thickness recommen...



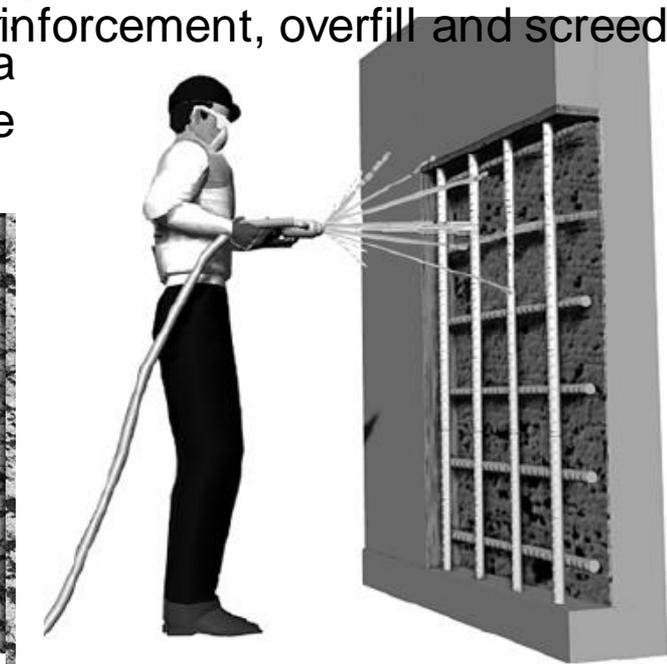
Encapsulate reinforcement, overfill and screed

Most low-pressure spray materials require a thickness of the total application layer excee



Polymer Overlays
ch to 1/4 inch / 3.175 mm to 6.35mm

Concrete Overlays & Repair Materials
1/4 inch + / 6.35mm +



als, use of an

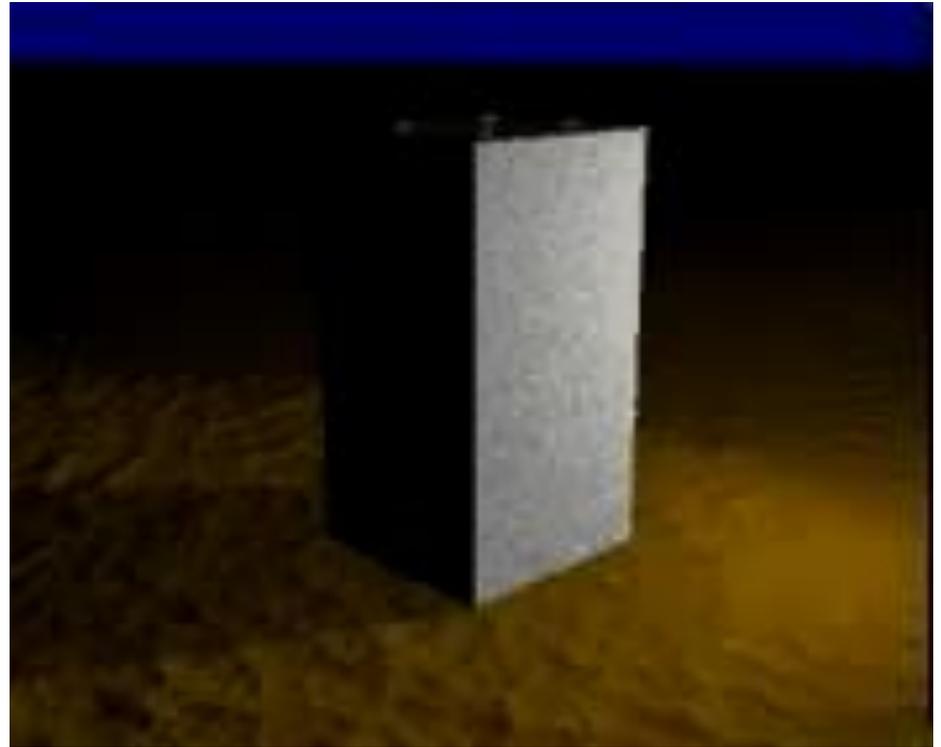
Presaturate

Apply and verify consolidation



<https://www.youtube.com/watch?v=rLNX4a0iJoE>





Finish, Cure, and Coat (if required)

Proper curing is important

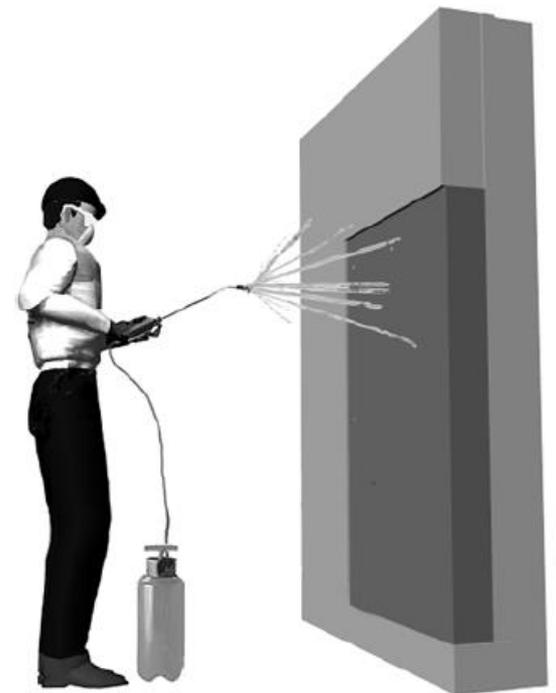
Should be conducted in accordance with ACI 308.1 “Standard Specification for Curing Concrete.”

Additional curing information is available from ACI 308R “Guide to Curing Concrete.”

For most cementitious low-pressure spray-applied mortars, application of a curing compound that complies with the moisture retention requirements ASTM C 309 is satisfactory (or C1315).

As an alternate, moist cure for 7 days.

Always refer to the mortar manufacturer’s instructions for specific curing methods and materials recommended for the product selected.



Cure the applied mortar

How do I check the repair?

Requirements may include:

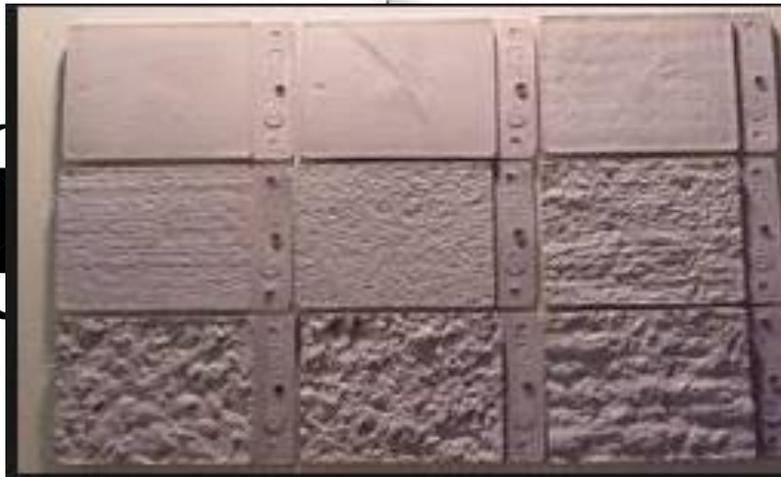
- Before and after photos;
- Confirmation of acceptable surface preparation.

This can include the prepared surface profile and the pH of the prepared surface. A pH of 11.5 or greater is recommended;

- Confirm repair depth;
- Material property tests performed by a qualified testing agency.

This is usually done to confirm the material manufacturers' published material properties;

- In-place direct tensile strength tests of the prepared surface;
- In-place bond direct tensile tests of the hardened, cured repair;
- Confirmation that all materials used were as specified, cross checking material purchase orders with quantities estimated and with actual quantities billed.





SUCCESS

IF AT FIRST YOU DON'T SUCCEED, REDEFINE SUCCESS AND
CELEBRATE YOUR VICTORY.



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Advancing concrete knowledge



Questions



THANK YOU!

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BASF Construction Chemicals, EB-T