

April 5
ICRI 2022 Spring Convention



Product or Application Failure

Perhaps a Lack of Training Regarding Existing Weather Conditions?

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Learning Objectives

1. Develop an understanding of the various weather-related conditions that can impact performance of materials and application quality.
2. Understand repair material, membrane and protective coating products physical properties, performance, and temperature limitations.
3. Learn about application mitigation techniques and strategies when confronting severe weather conditions and the work must proceed.
4. Understand best practices for problem-solving and getting issues resolved before and/or after the fact.

Cold Weather Concreting

Guide to Cold Weather
Concreting

Reported by ACI Committee 306

ACI 306R-16

ACI Definition:

- When for more than 3 consecutive days, the following conditions exist:
- The average daily ambient temperature is less than 40 F (5 C) and
- The ambient temperature is not greater than 50 F (10 C) for more than 1/2 of any 24-hour period

Cold Weather Concreting

Setting Time of Conventional Concrete @ Various Temperatures:

- 70 F – 6 hours
- 60 F – 8 hours
- 50 F – 11 hours
- 40 F – 14 hours
- 32 F – Concrete freezes

An aerial photograph of Orioles Park at Camden Yards, a baseball stadium. The field is green with a brown infield and a yellow pitcher's mound. The stadium seating is blue and white. The stadium is surrounded by brick buildings and a parking lot. A road with cars is visible at the bottom of the image.

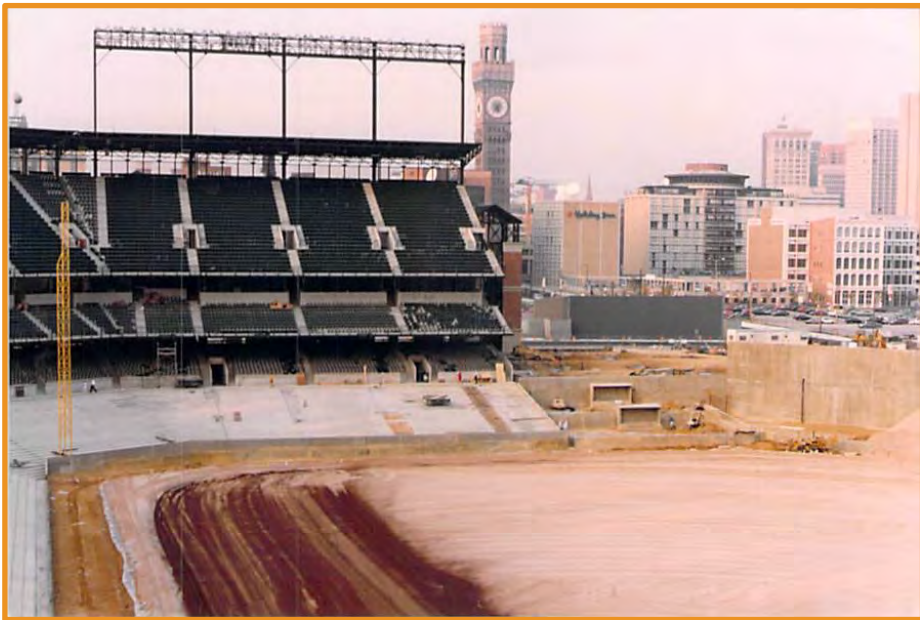
Concrete Repair in Cold Weather Conditions

Orioles Park at Camden Yards

Lower-level Mezzanine Steps & Seating Areas

Remove and Replace Horizontal Surfaces

Dec. thru Feb. - 1992



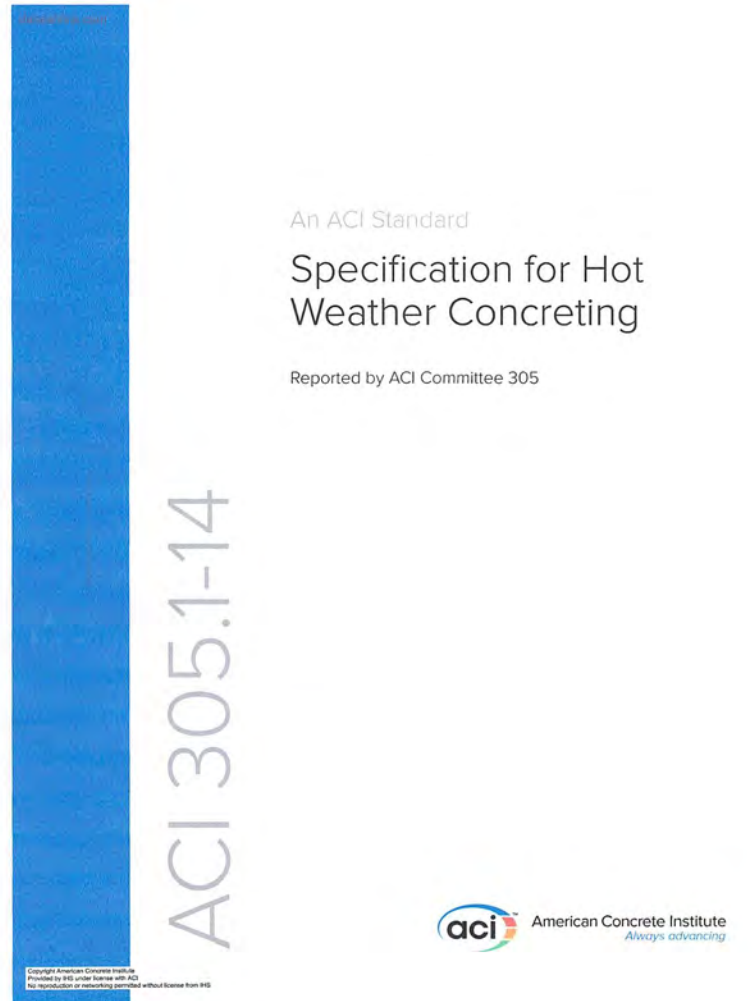
- Concrete placed using slipform pavers
- Produced unlevel horizontal surfaces
- Posed problems for installation of seating
- Opening day just a few months away
- Remove and relevel concrete treading
- Replace with 2-component screed mortar



- Construct & erect enclosures
- Provide portable heaters inside
- Vent heater emissions to outside
- Cure with insulated blankets
- Play ball!! Opening Day April 6, 1992
- Rick Sutcliff pitches a shutout
- Baltimore defeats Cleveland 2-0



Hot Weather Concreting



ACI Definition:

- Any period of high temperature in which special precautions need to be taken to ensure proper handling, placing, finishing and curing of concrete.
- When the ambient temperature is greater than 80 F (27C) or has a probability of rising to that temperature when placing.
- Humidity, wind and solar radiation also play a significant role in concrete performance in hot weather.

Hot Weather Concreting



Impact on Fresh Concrete Properties:

- Accelerated hydration and setting time
- Increased water demand and rapid slump loss
- Rapid slump loss
- Potential for plastic shrinkage cracking
- Very difficult to control air content
- Requires prompt and early curing practice
- Timely saw-cutting/tooling control joints

Hot Weather Concreting



Impact on Hardened Concrete Properties:

- Lower compressive strengths
- Reduction in watertightness
- Compromised concrete durability
- Significant increase in drying shrinkage
- Very difficult to control air content
- Requires prompt and early curing practice
- Timely saw-cutting/tooling control joints

- Repair Material Description
- Composition Properties
- Material Properties
- Packaging & Storage
- How to Use Material
 - Surface Prep
 - Mixing
 - Cleanup
 - Safety



TECHNICAL GUIDELINES

Prepared by the International Concrete Repair Institute August 2012

Guideline for Inorganic Repair Material Data Sheet Protocol

Guideline No. 320.3R-2012

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TYPICAL PHYSICAL PROPERTIES @ 75°F (24°C)

Water Demand.....3 quarts/bag

Working Time.....20 minutes

Compressive Strength (ASTM C109):

4 Hour.....2,225 psi

1 Day.....3,175 psi

7 Day.....5,575 psi

28 Day..... 6,125 psi

Tensile Strength (ASTM C190):

7 Day.....435 psi

28 Day.....585 psi

Flexural Strength (ASTM C348):

7 Day.....845 psi

28 Day.....1,400 psi

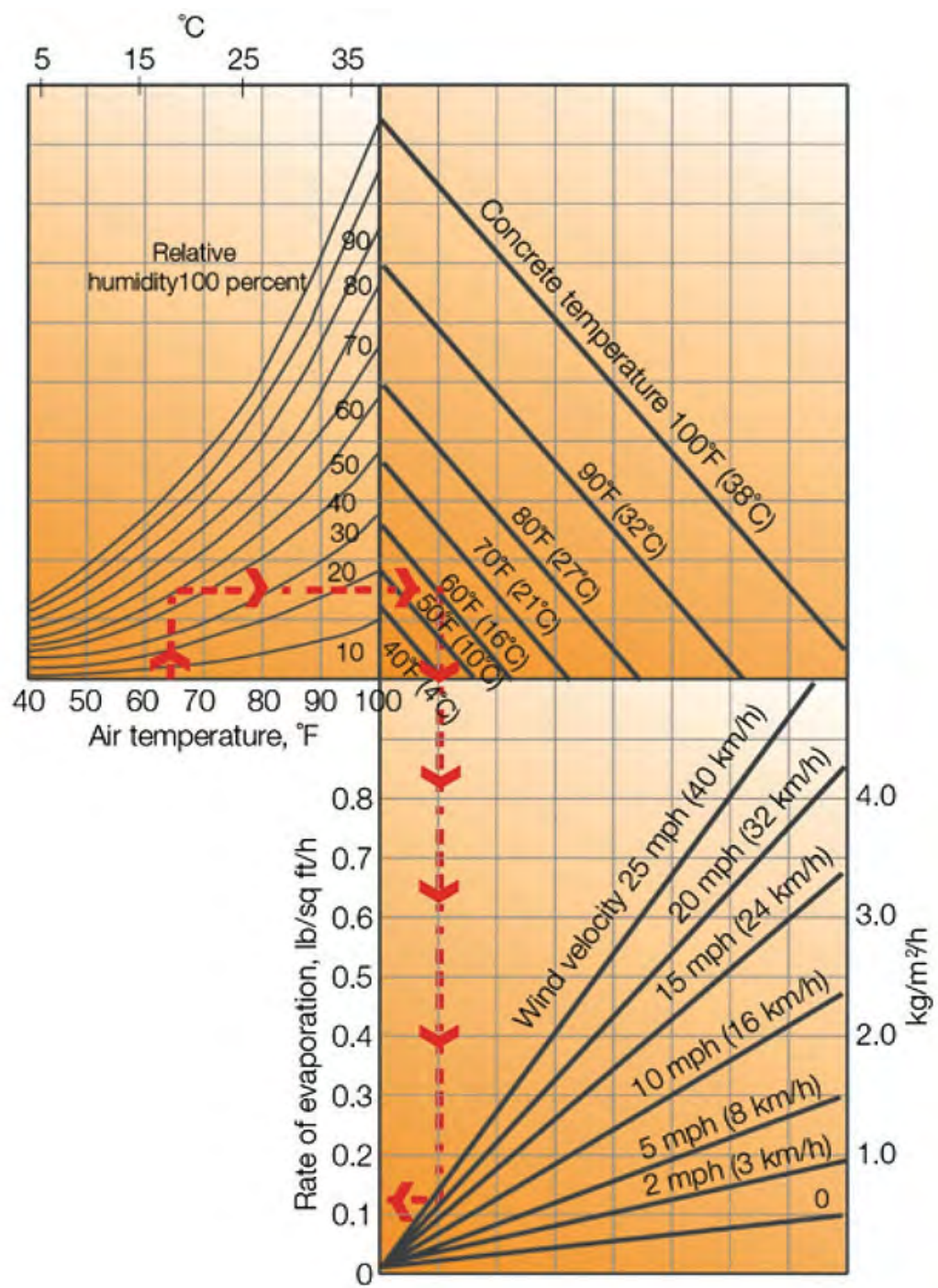
Adhesion (ACI 503.R)> 290 psi

Water Absorption (ANSI A118.7).....< 4.0%

Shrinkage (ASTM C157)<.04 %

Initial Set (ASTM C191)31 min.

Final Set (ASTM C191)39 min.



Rate of Evaporation

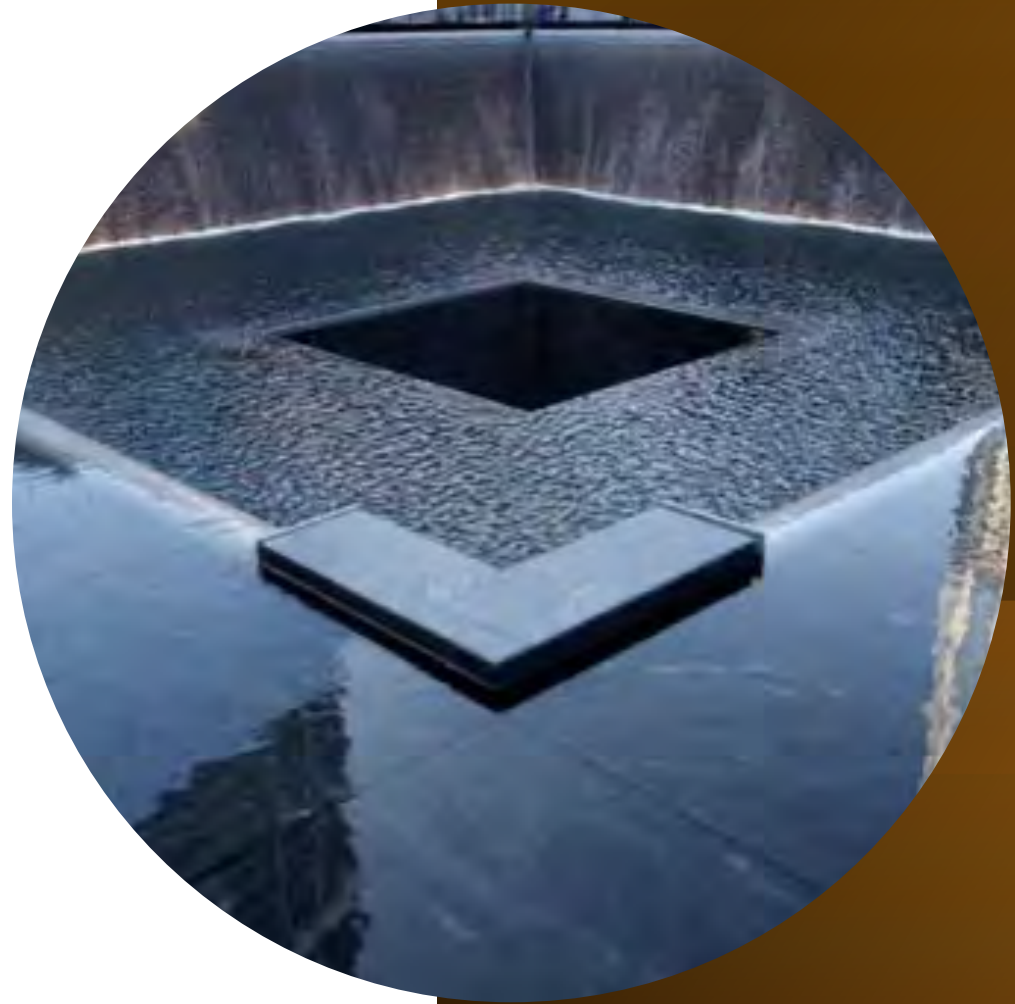
Decorative Protective Coating Application in Direct Sunlight

World Trade Center

911 Memorial Fountains

Cementitious Coating for Concrete Pavers

August - 2011





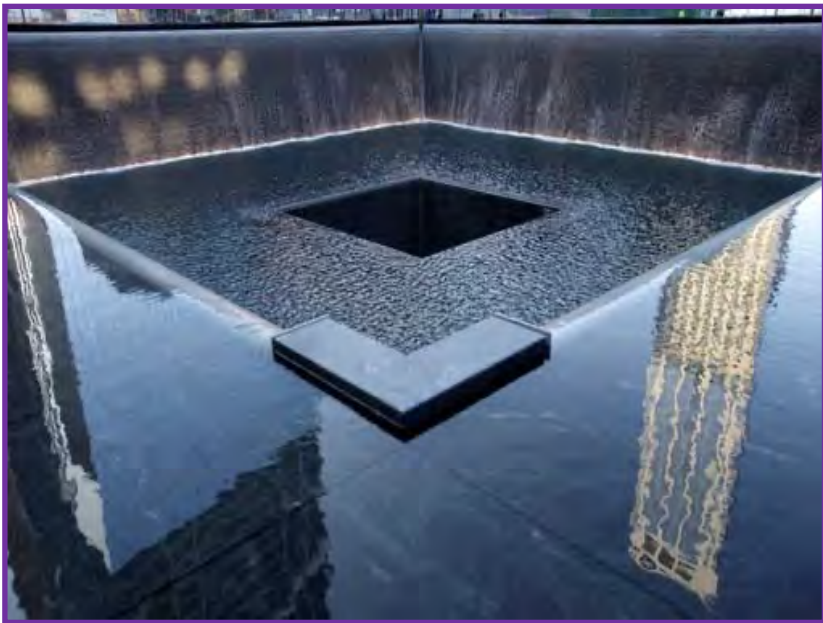
- Custom color concrete pavers
- Architect chooses color to match granite walls
- Vision of Design – “Reflecting Absence”
- Installed over urethane waterproof membrane
- Fountain filled with 18” of water
- Didn't turn out so well – Now what?
- Vapor permeable coating will be required
- Black cementitious coating selected



- Proper application procedures
- To ensure consistent finish color
- Apply final coat after sunset
- Sufficient manpower to complete quickly
- Recommended procedures not followed
- Didn't turn out so well – Now what?
- Material or application failure?



- Corrective measures
- Apply a final coat after sunset
- Manpower to complete within 5 hours or less
- End result – perfect! No color variegation.





Mid-Summer Blistering Heat

Military Mout Villages

Live Fire Range Training

Undisclosed Locations



About Mout Villages

- Mout is an acronym for Military Operations in Urban Terrain.
- Live fire training facilities on military bases to replicate urban settings in middle east.
- Villages are located out in the middle of nowhere on the base with no power, no water, no protection from the elements.
- Work is generally performed during spring and summer seasons when heat and evaporation rates become excessive.





Scope of Work

- Clean and mechanically prepare steel container surfaces for stucco application.
- Spray apply polymer-modified cementitious coating/primer.
- Install and attach metal lath or gavineel metal panels.
- Mix and machine-apply prepackaged single-component, polymer-modified, microfiber reinforced, stucco mortar.
- Highlight with special details and atmospheric effects.

Excessive Heat and Rapid Evaporation



- Overnight lows around 75F turning 85 – 90F between 11am and noon.
- Resulting substrate temperatures in direct sunlight reach 112F and higher.
- Adding liquid retarders when mixing prepackaged material are fruitless.

Excessive Heat and Rapid Evaporation



- Onsite storage of materials extremely difficult during the hottest months.
- Necessary to begin work at sunrise. Halt work typically between 11am to 12pm.
- Materials are covered with tarps but still impossible to precondition at moderate temps.





About Chula Vista Center

One of the most highly recognized regional outdoor shopping malls in San Diego County.

Serves a trade area that is home to one million residents within a 10 mile radius.

Houses the closest full line departments stores to the Mexican border.

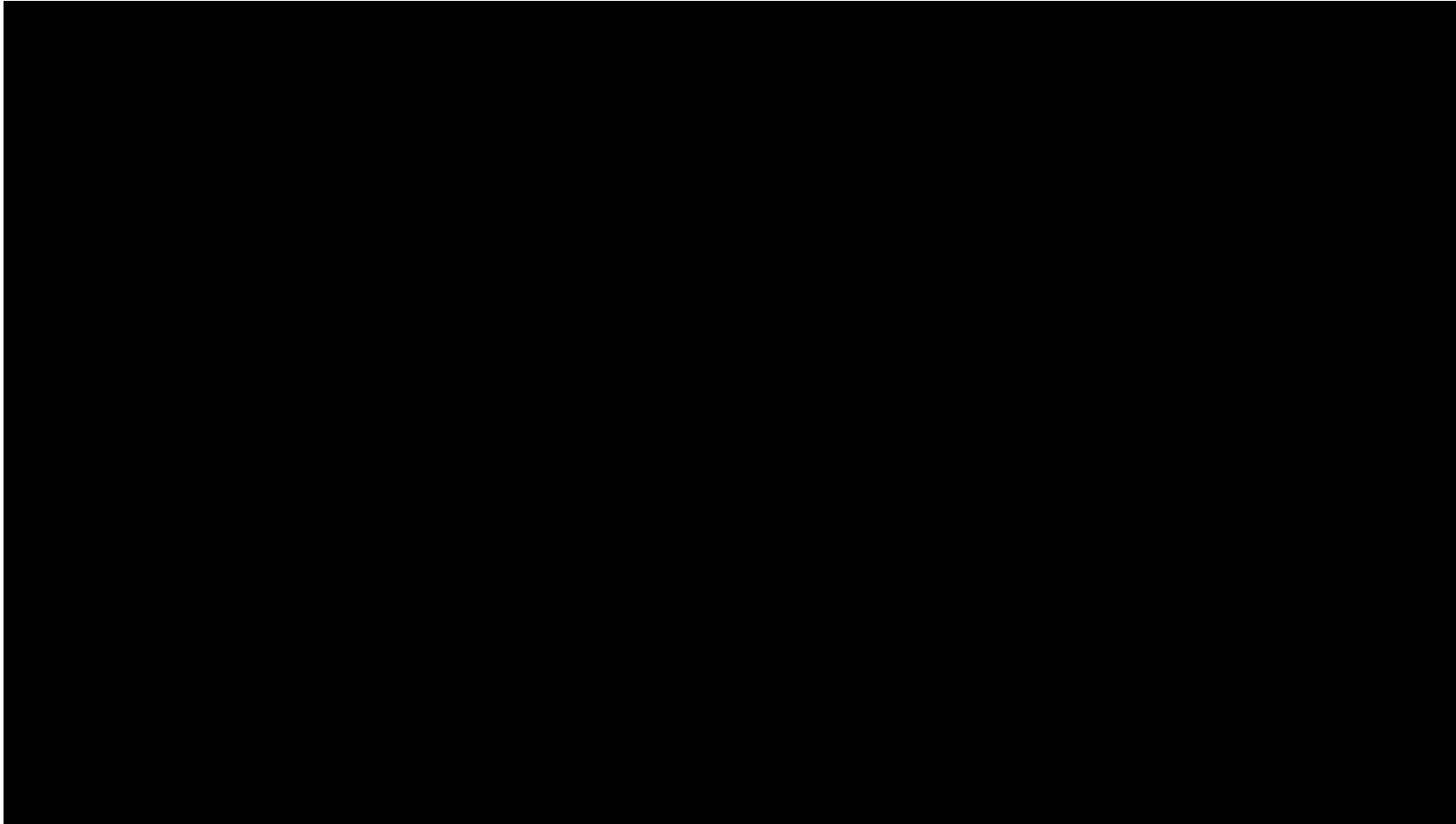
Extremely popular mixed-use retail and entertainment attraction with both local and Mexican national shoppers.

Scope of Work

- Remove existing sealant joints
- Profile substrate via shot blasting
- Install custom made 26' long stainless steel trench drain
- Complete detailing at column covers utilizing extruded silicone
- Apply colloidal silicate reactive primer
- Install sealant in control joints
- Install breathable polymer modified cementitious waterproofing system with texture and pigmented top coat
- Install sealant in expansion joints

Rain Event of a Century

Chula Vista Mall – San Diego



San Diego broke its all-time July rainfall record Saturday when 1.03 inches fell. That broke not only the July single-day record of 0.83 inches set July 25, 1902, but also the record for an entire July's rainfall, which was 0.92 inches July 1-31, 1902.

It's also more rain than San Diego saw in all of January this year; on average, January is the second-wettest month and July the second-driest, with January averaging 66 times more rainfall than July. The only other time July has out-dampened January in San Diego was 1976, when July had 0.02 inch to January's trace.

San Diego added to its total Sunday with another 0.66 inch of rain as of 11 p.m. The month-to-date total of 1.70 inches, which fell in less than 36 hours, is more rainfall than San Diego had seen in the previous 101 Julys combined; a total of 1.68 inches fell during July from 1914 through 2014 in San Diego.

Moisture in Concrete Slabs

- High moisture content in concrete substrates will migrate via capillary action which can lead to premature failure, discoloration, interfere with polymerization of deck coating, compromise adhesion, and potential for delamination.
- The source of moisture content can be internal (mix water) or external (environmental).
- It's not about 28 days – consider moisture content, factors that influence evaporation, concrete slab thickness and permeability.



Guide to Specification Issues for Architects and Engineers

Concrete International - April 2003

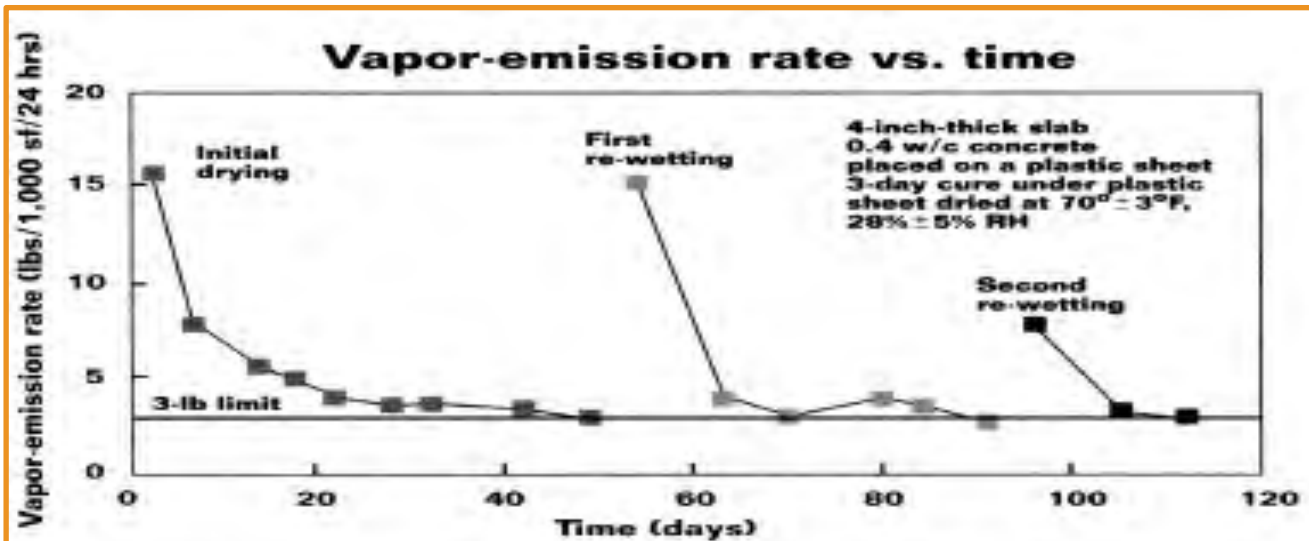


Fig. 2.12—Even with a low w/cm and a 3-day cure under plastic sheeting, these slabs took approximately 7 weeks to dry to a 3 lb/1000 ft²/24 h (1.5 kg/100 m²/24 h) emission rate. After rewetting, the slabs took several weeks to again reach the 3 lb/1000 ft²/24 h (1.5 kg/100 m²/24 h) emission rate (Suprenant and Malisch 1998c).

Treat Split Slabs the same as slabs-on-grade

On Site Moisture Testing

#3 Plastic Sheet Test



Sheet
LP2
Created
Aug 01, 2015 @ 15:48
bkennedy@appliedrestoration.com

Status
Description
4

[Open](#)



August 01, 2015 at 15:49

#4 Plastic Sheet Test



Sheet
LP2
Created
Aug 01, 2015 @ 15:52
bkennedy@appliedrestoration.com

Status
Description
5

[Open](#)



August 01, 2015 at 15:52



Osmosis in Action



Water Line



New Deck Coating and Hurricane Harvey

Houston, TX

Undisclosed location

Top Level of Metal Pan Deck Garage

August - 2017

Questions?

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