Concrete Moisture and pH Testing
What Are We Measuring?

Scott M. Tarr, P.E. FACI
NORTH TARR
CONCRETE CONSULTING, P.C.

STarr@NorthSTarrConcrete.com

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What We Want to Avoid
Moisture 101

Moisture is Found Naturally in Three States

Solid

Liquid

Gas
Moisture 101
Moisture 101

Sources of Liquid Moisture and Vapor

• Concrete
How much free water?
Moisture 101

Typical 4000 psi concrete

- Water-to-cement ratio 0.50
- 32 gal of water/cu yd = 267 lbs/cu yd
- Water needed for hydration  w/c 0.25 = 133.5 lbs
- Leaves 133.5 lbs free water/yd

= 1,650 lbs free-water/1,000 sq ft (4” slab)
Every truckload delivers over 100 gallons of free water at no extra charge.

That’s Free Water!
Moisture 101

Sources of Liquid Moisture and Vapor

- Concrete
Moisture 101

Sources of Liquid Moisture and Vapor

- Concrete
- Irrigation
- Broken Pipes
- Condensation (dewpoint or “adsorption”)

Guidance to Concrete Solutions

NORTH S. TARR CONCRETE CONSULTING, P.C.
# Moisture 101

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<th>Air Temp (F)</th>
<th>10%</th>
<th>20%</th>
<th>30%</th>
<th>40%</th>
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Dew Point (Concrete Surface Temperature)
Dewpoint Condensation

INBOUND
Warm Humid Air

OUTBOUND
Dehumidified Air
Warm Slab Above Dewpoint Temperature
Moisture 101

Sources of Liquid Moisture and Vapor

- Concrete
- Irrigation
- Broken Pipes
- Condensation (dewpoint or “adsorption”)
- Fill Course (cushion or blotter layer)
Moisture 101
Moisture 101

Sources of Liquid Moisture and Vapor

- Concrete
- Irrigation
- Broken Pipes
- Condensation (dewpoint or “adsorption”)
- Fill Course (cushion or blotter layer)
- Adhesives
- Maintenance
Moisture 101

Groundwater Sources of Moisture

- Hydrostatic Pressure
- Capillary Action
- Vapor Diffusion
Hydrostatic Pressure
Hydrostatic Pressure
Capillary Action

Water

Narrow Glass Straw
Capillary Action

Wide Glass Straw

Water
Capillary Action
Vapor Diffusion

Lower Vapor Pressure

Concrete

Higher Vapor Pressure
Vapor Diffusion
### Vapor Pressure For Various Temperatures And Relative Humidities

(Pounds Per Square Inch)

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Water Vapor Pressure Differential - Vapor Diffusion

70°F and 30% RH
= 0.108 psi

55°F and 100% RH = 0.214 psi
Water Vapor Pressure Differential

70°F and 30% RH = 0.108 psi

Vapor Barrier / Retarder

55°F and 100% RH = 0.214 psi
Vapor Retarder

Note Condensed Water Droplets Under Vapor Retarder.
Vapor Diffusion

Concrete

Lower Vapor Pressure

Higher Vapor Pressure
Vapor Diffusion
Vapor Diffusion
Slab Curling/Warping
Moisture Gradient

Slab with a vapor retarder immediately below
Slab Curling/Warping
Moisture Gradient

Slab Relative Humidity Gradient

Relative Humidity, Percent

Slab Depth, in.

55% RH Gradient
What is a Triathlete?

- Resistance Meter
- Mass Loss
- Plastic Sheet
- Surface RH (Hood Test)
- Mat Bond
What Moisture is Measured?

Meter CaCl
Basics of Slab Moisture

- Initial Concrete Placement
- After Surface Drying – Moisture Gradient
- Moisture Equilibration After Covering
Basics of Slab Moisture

- Initial Concrete Placement
- After Surface Drying – Moisture Gradient
- Moisture Equilibration After Covering
Basics of Slab Moisture

- Initial Concrete Placement
- After Surface Drying – Moisture Gradient
- Moisture Equilibration After Covering
Basics of Slab Moisture

- Initial Concrete Placement
- After Surface Drying – Moisture Gradient
- Moisture Equilibration After Covering

Guidance to Concrete Solutions

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Slab Depth

% RH

~100%

40% Slab Depth

ASTM F 2170
Discrepancy Between Manufacturers???
Guidance to Concrete Solutions

Basics of Slab Moisture

- Initial Concrete Placement
- After Surface Drying – Moisture Gradient
- Moisture Equilibration After Covering

And If You Think Moisture is Tricky to Measure... What About pH???
In Las Vegas, they make a big deal about pH...
But in Science...

pH
Is a measure of hydrogen ions in *solution*
pH Testing

- You are a chemist preparing a solution
- Clean Surface
- Distilled or Deionized Water
- Puddle 1 inch Diameter
- 60 Seconds +/- 5 Seconds
- Wet Paper and Immediately Compare to Chart
Don’t let moisture take a bite out of you or your business
Thank You!
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