Concrete Scaling

SIDEWALK CLOSED

Henry B. Prenger, P.E.
Surface Deterioration

- Pop Outs
- Mortar flaking
- Scaling
Pop Outs
Mortar Flaking
Factors Affecting Scaling

• Permeable and poor-quality concrete due to:
  – High water-cementitious material ratio
  – Excessive slump for prevailing job conditions
  – Overworking of wet concrete
  – Premature finishing operations
  – Inadequate curing
  – Low compressive strength at the surface

• Inadequate air content for concrete exposed to freeze and thawing

• Deicing Salts
I’ve been posting my letters in the dog poo box for TWO YEARS

ALF, 91, CONFUSES DISPOSAL BIN FOR NEARBY POSTBOX

WENT short-sighted pensioner, All Spence, 91, found himself in the post box for a card. He hoped he hadn’t missed the post collection.

Empty
For scaling resistance, you need:

- A good mix design (4000 psi / .45 wcr)
- Good plastic properties (slump and air)
- Proper inspection
- Good finishing practices
- Proper curing
- To seal the concrete
- To place concrete at the proper time of the year
## Mix Design

<table>
<thead>
<tr>
<th>Suggested Mixture Design</th>
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<tbody>
<tr>
<td>Modified Maryland SHA Mix 6</td>
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<tr>
<td><strong>Strength (psi)</strong></td>
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<tr>
<td><strong>Wcr (max)</strong></td>
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<tr>
<td><strong>Cementitious Factor (lbs.)</strong></td>
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<tr>
<td><strong>Air (%)</strong></td>
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<td><strong>Slump (in.)</strong></td>
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<tr>
<td><strong>Coarse Aggregate Size (ASTM C33)</strong></td>
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<tr>
<td><strong>Concrete Temperature (°F)</strong></td>
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<tr>
<td><strong>Max Slag Cement Replacement (%)</strong></td>
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<tr>
<td><strong>Min / Max Fly Ash Replacement (%)</strong></td>
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Slump and Air
Sealing
Slag Cement, Fly Ash and De-Icing Salts
The Deleterious Chemical Effects of Concentrated Deicing Solutions on Portland Cement Concrete

Study SD2002-01
Executive Summary

Prepared by
Michigan Tech Transportation Institute
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De-Icer Scaling

ASTM 672

OPC 30% Slag 40% Slag 50% Slag
Inadequate Air Void System

Fig. 3 Representative area of concrete in Core Sample M7OLS A5E 7/29 Lot 7959-B showing the air-void system; millimeter scale.
Bleed Water Finished into Surface
High WCR in Surface of Concrete
No Air in Top Surface
Where do we go from here?
Best Practices for Exterior Flatwork Finishing

ADMINISTERED BY THE NRMCA
Finishers
Inspectors
Deliverables

• Booklet in plain simple terms on important factors in finishing exterior concrete
• Keep it simple and focused on what causes scaling
• Straight forward test (one for finishers and one for inspectors)
• Should there be a prerequisite for years of experience
• Have a practical part where participants can see the effect of water on concrete
• Spanish and English
Safety
Bleed Water and S
Jointing
Challenges

• Spanish translation
  – Work with finishers, utilize Spanish speakers in industry
• Finding suitable sites for practical
  – NRMCA
  – Partner with Ready Mix
  – Use actual sites
• Finding suitable sites for presentation and testing
• How many people on a crew need to be certified
• Losing certification for improper finishing (legal issues)
Thanks to:

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• Vulcan Materials
• LafargeHolcim
• Priority Construction