Concrete Pavement Surface Defects

Peter Taylor

Overview

- Definitions
- Causes
- Prevention

The Problem

- Not new...
- Various forms

The Problem

- Popouts
  - Inverted pyramids
  - Cracked aggregate
  - Progresses with deeper aggregates over time
### Popouts
- **Causes**
  - Porous aggregate
- **Prevention**
  - Don’t use it
- **Repair**
  - Enjoy

### Mortar Flaking
- **Causes**
  - Smooth aggregate
  - Over worked
  - Worked late
  - Poor curing
- **Prevention**
  - Workmanship
- **Repair**
  - Enjoy

### The Problem
- **Freeze thaw**
  - Loss of paste
  - Progressive with time
  - Worse in wet zones

### Freeze Thaw
- **Causes**
  - Saturated freezing
  - Insufficient air
### Freeze Thaw

- **Prevention**
  - Limit SCM dose (~25% fly ash, 50% slag cement)
  - Sufficient air
    - Harder to saturate bubbles
    - Have to be close enough
  - w/cm

- **Repair**
  - Protect
  - Replace

### The Problem

- **Flakes**
  - Surface peels off
  - Sound material below
  - Often around the aggregate

### Flaking

- Causes are debated...
  - Salt crystallization
  - Soft surface
  - Soft below surface
  - Overworked surface
  - System chemistry
  - Osmosis
  - Glue spalling
  - Cryogenic suction

### Salt Crystallization
Salt Crystallization

- Salts expand when they precipitate
- Not necessarily cold weather

Soft Surface

- Water added to the concrete
  - At the truck - “add 10!”
  - Blessing
- Inadequate curing
  - Hydration stopped early

Soft Below the Surface

- Finished before bleeding ended
  - Bleed water trapped
- Over finished
- “Crusting”

Effect of finishing

Mass loss vs. Cycles

- Initial setting
- After fabrication
- After bleeding slows down/stops
**System Chemistry**

- Cement alkali and C₃A content
- SCM
  - Type
  - Dosage

**Slag Cement**

- Improves all mechanical properties
- Yet scaling tests are worse
- Increases AFm phases in the concrete
  - Which convert to Freidel’s salt with chloride salts
  - Unstable in acidic environments

**Cold**

- Osmosis
  - Pressures from salt gradients
  - Glue spalling
    - Ice shrinks while bonded to the surface
  - Cryogenic suction
    - Water moves toward ice

**Test methods**

- Air void system – ASTM C 457
  - Very aggressive
- Scaling - BNQ
  - Similar to ASTM C 672 except
    - Finishing is early & with a wooden ruler
    - Curing is longer
    - Presoaked in solution before cycling
### Prevention

- **Finishing**
  - No added water
  - After bleeding ends
  - Minimum work

### Repair

- **Depends on causes**
  - Do nothing
  - See if damage progresses
  - Grind
    - Restores ride
    - Reduces thickness
  - Sealants
    - May slow further distress

### But Wait

- Cements are changing
  - Set times move
  - Bleeding moves
  - Strength gain rate moves
- The weather is also a factor

### But Wait

- More change is coming
- Means finishing practices must also move
- We need better tools to indicate when the slab is ready
Closing

- It's always been hard
- We have to pay attention
- Define expectations
- It is possible to do good things