Joint Deterioration Findings to Date
The problem?

- Some joints are deteriorating faster than we would like
What Does it Look Like?

• Mechanical
What Does it Look Like?

- Mechanical
What Does it Look Like?

• Shadowing
What Does it Look Like?

• Incremental Cracking
What Does it Look Like?

• Incremental Cracking
What Does it Look Like?

- Bottom Up Moisture
What Does it Look Like?

• Bottom Up Moisture
What Does it Look Like?

- Trapped Moisture
What Does it Look Like?

• Common Observations
What Does it Look Like?

- Common Observations
What Does it Look Like?

• Common Observations
What can be causing it?

• Chemical
• Mechanical
• Frost
Chemical?

• ASR
• Sulfate
• Doubt it
Mechanical?

• Traffic
  ➢ Unlikely – stress is ~50psi
Mechanical?

• Sawing
  ➢ Maybe
Frost?

- Common features
  - Marginal air
  - Abundant water
  - Deposits in air voids
  - Cold weather
Purdue Work

- Damage depends on saturation

![Relative Dynamic Modulus (N=6)](chart.png)

- 12% Paste Air
- 31% Paste Air

Li et al. to be Submitted
Purdue Work

- Saturation rate influenced by air and w/c

![Experimental Procedures](image)

- Degree of Saturation is more important (Castro et al. Submitted)

![Graphs of S(%) vs Time (d)](image)

12% Paste Air

31% Paste Air

Li et al. to be Submitted

Jason Weiss
Purdue Work

• Some salts prevent drying

One-sided condition, 50 +/- 2% RH, 23 +/- 1°C

• Lower or no water loss or gain with higher salt concentrations

• Drying behavior explained by differences in solution and environmental RH

Spragg et al 2010
Interfacial Zone?
Questions

• Why only at joints?
  • Trapped water
  • Trapped salts
  • Sawing damage
• Why in some joints
  • Batch variability
  • Drainage
• Why now?
  • Marginal air
  • Marginal w/cm
  • Salting
So

- Water has to be prevented from saturating the concrete
  - Prevent water from ponding in the joint
  - Prevent water from penetrating from the base
- Permeability of the concrete should be as low as practically feasible
- The air void system in the in-place concrete must be adequate
Prevention

• New concrete
  • Ensure the system can dry out
  • Don’t push the envelope on air
  • Watch the w/cm

• Monitor saw condition
• Choose salts carefully
Prevention

- New concrete
- Avoid joint details with reservoirs
Repairs / Prevention

- Existing Concrete
  - Sealants
  - Partial depth
  - Full depth
  - Overlay

- Damage in top third
- Damage below the saw-cut
- Damage from the bottom
- Full depth damage
Future Tasks

Work in collaboration with Purdue and Michigan Tech

- Sampling and testing from field
- In-situ sub-base permeability
- Tests on Sealants

- Effect of gradation on stress at corner
- Interfacial Transition Zone
- Capillary size and suction
Future Tasks

Work by John Kevern, MO

• Vary sawing parameters
• Monitor temperatures
• Core and look for bruising

• At ISU – vary saw condition
The aim...

- A long lasting joint