

# ***Michigan Rapid Set Pavement Repairs***

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# Accelerated Opening-to-Traffic Pavement In General,

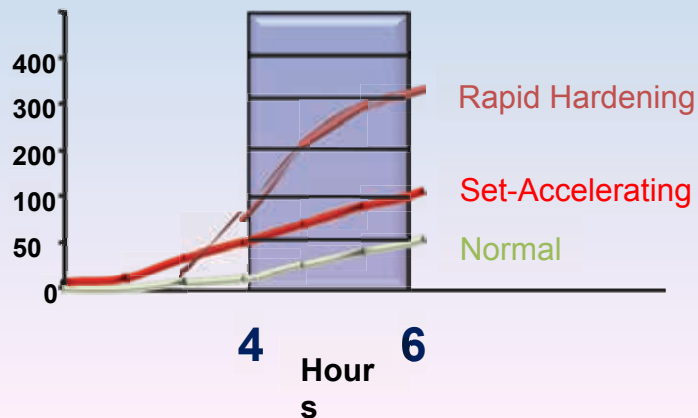
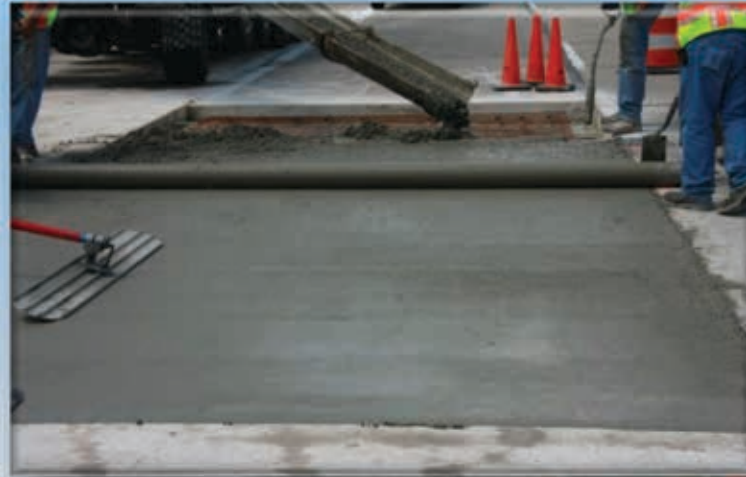
- **MDOT Fast Set Mixtures (obsolete)**
  - High cement content
  - Calcium chloride set accelerator
  - 300 psi within 8 hour at opening to traffic
  - Moderate cost
  - Little work time
  - 5-7 years service life
- **MDOT Moderate Set Mixtures (obsolete)**
  - High cement content
  - Calcium chloride set accelerator
  - 500 psi within 24 hours at opening to traffic
  - Moderate cost
  - Little work time
  - Approximately 10 years service life
- **MDOT Current Durable Patching Mixture**
  - Moderate cement content
  - Minimal non-chloride set accelerator
  - 300 psi within 72 hours at opening to traffic
  - Moderate cost
  - Estimated 15 years service life
- **Several Proprietary Products on the Market**
  - \$\$\$\$
  - Very limited application



# What are we Striving to Achieve Now?

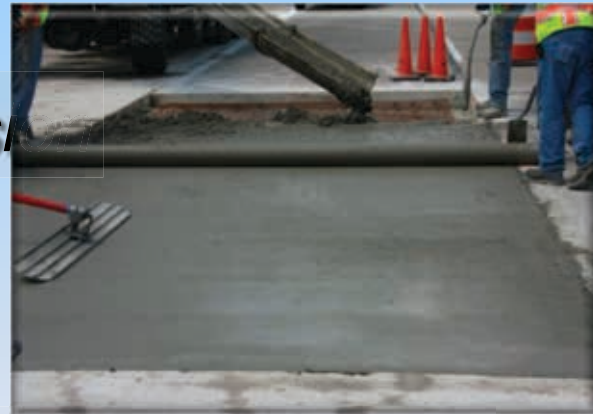
- *Cast-in-Place Rapid Setting Concrete Mixtures that are...*

- *Cost-effective*
- *User-friendly*
- *Timely – mobility*
- *“Durable”*



# Our Plan

- *Research Team*
  - *MDOT Materials*
  - *University of Michigan – Dr. Will Hans*
- *Defined suite of materials*
- *Designed the mixture criteria*
- *Project specific special provisions*
- *Currently refining,*
  - *Placability / finishability*
  - *Materials selection*
  - *Targeted 1 hour work time with minimal slump loss*
  - *Opening to traffic 6 hours from batching*



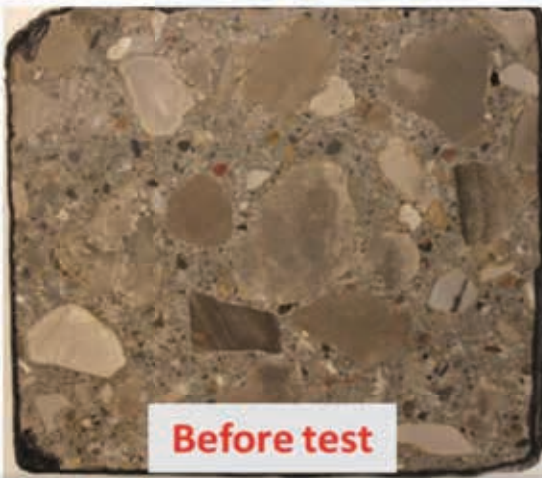
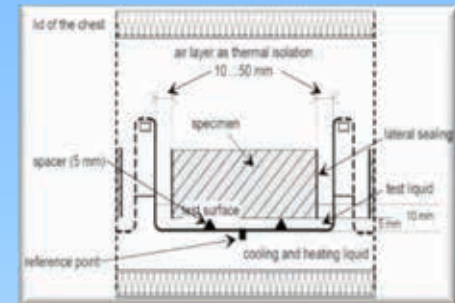
# *Rapid Set Mixture Details*

- *Mixture constituents:*
  - *Coarse aggregate - Clean, low absorption, high crushed content*
  - *Fine Aggregate – 2NS*
  - *658 lbs/cyd Type I*
    - *Holcim-St Gen, or*
    - *St Mary's*
  - *25 oz/cwt “SikaSet” non-chloride accelerator*
  - *25 oz/cwt “Rapid 1” Hardening admixture*
  - *8 oz/cwt of “Viscocrete 2100” HRWR*
  - *AEA of their choice*
  - *w/cm: 0.31 - 0.32*
- *Field trials – 300 psi flex. at approx. 6 hours from batching to OTT*

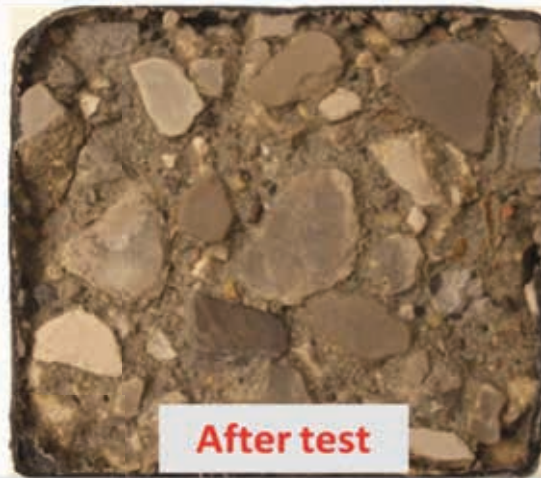
# Lab Durability Testing – Typical Concrete



## UM Modified RILEM Test



Before test



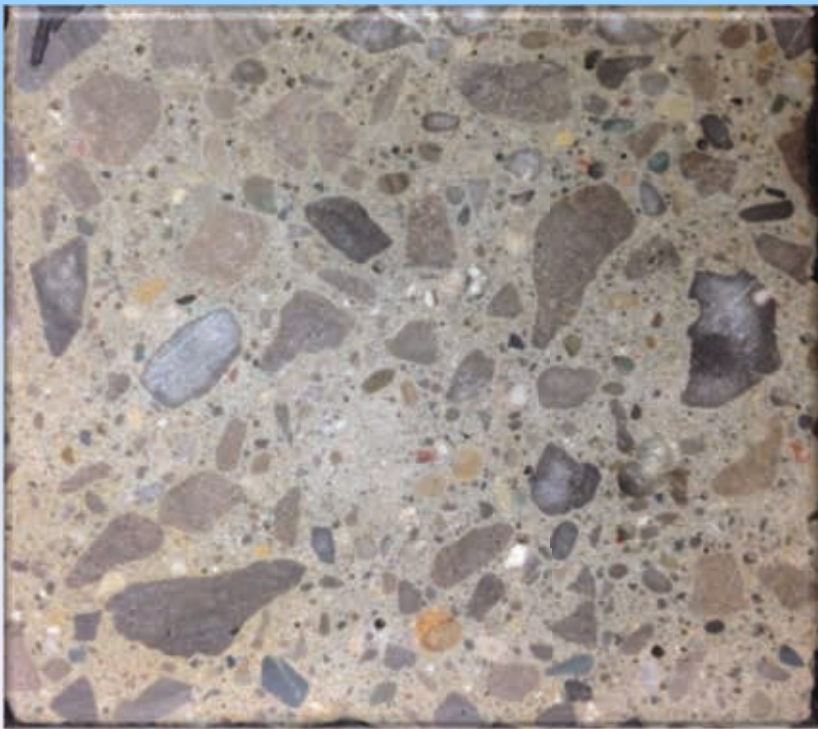
After test

Typical concrete scaled surface profile after 80 F-T cycles

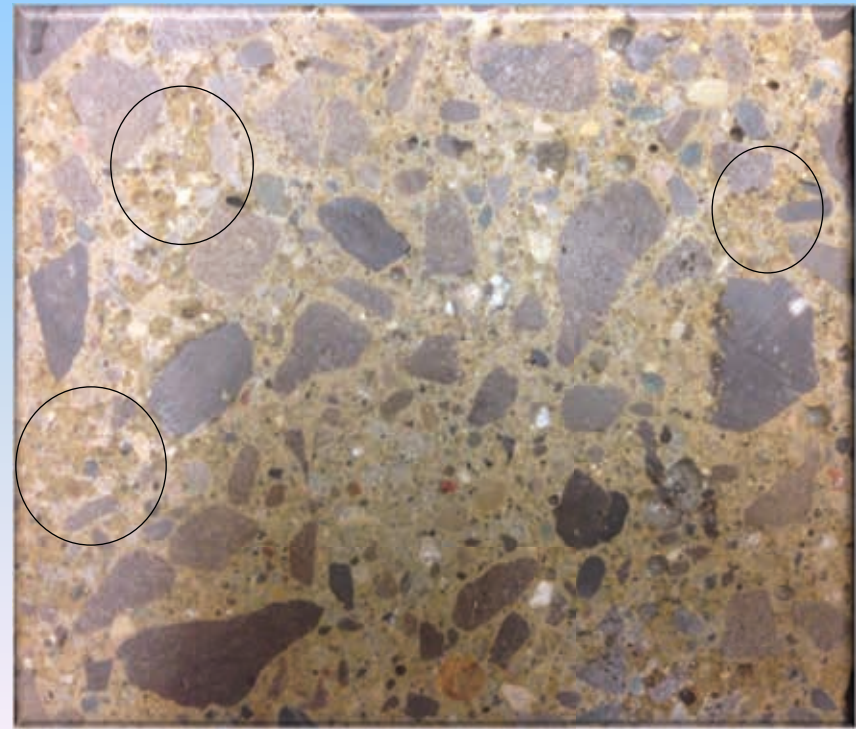
# *Rapid Set Field Trial*

## *UM Modified RILEM Test*

*Before 56 cycles*

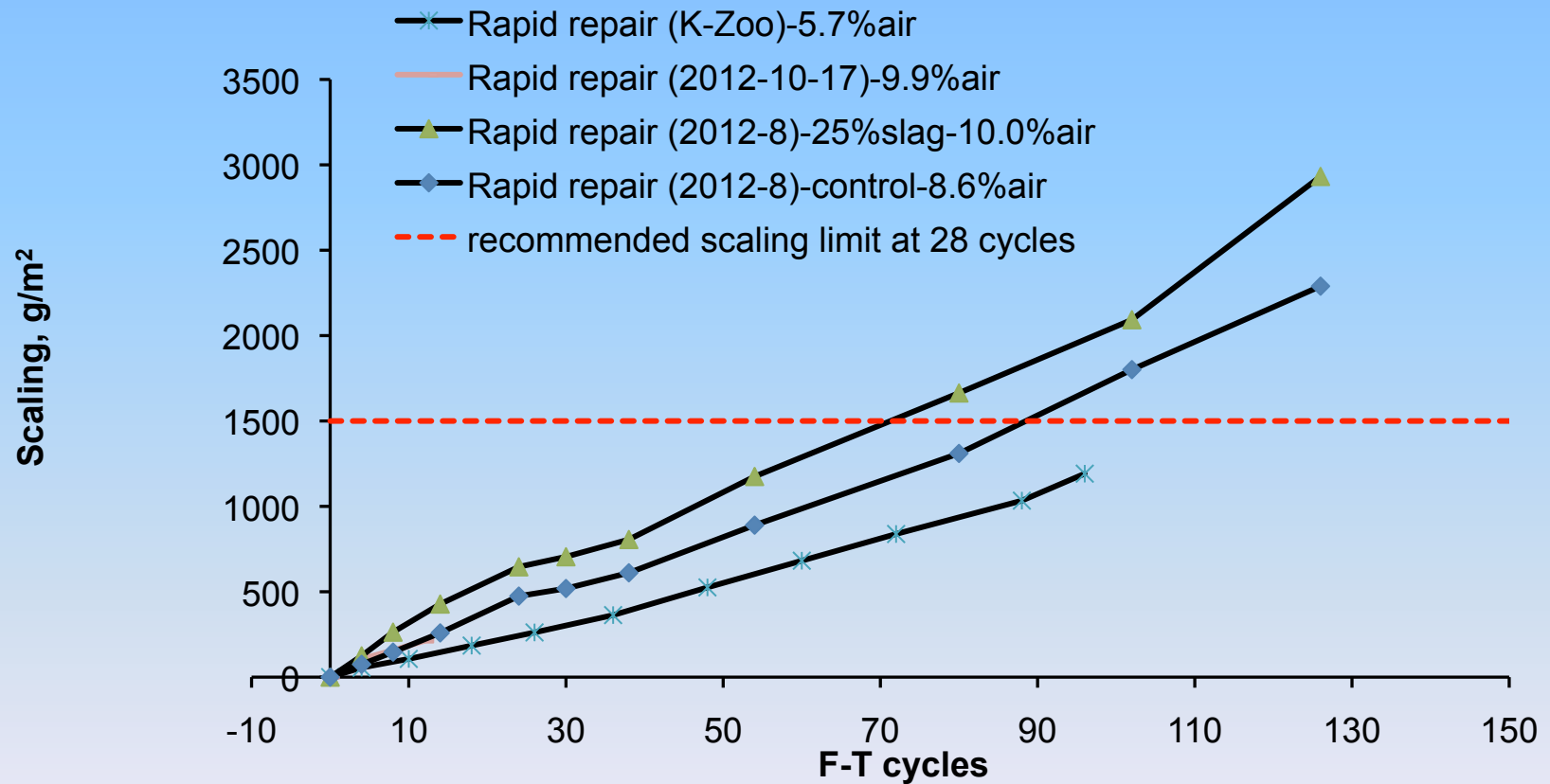


*After 56 cycles*



# Lab Testing: Durability Testing

## UM Modified RILEM Test





# *Lab Shrinkage Testing*



# *What We Know So Far:*

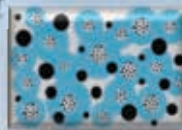
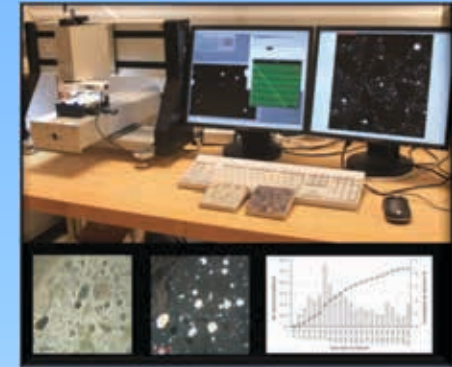
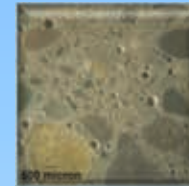
- *Aggregate Qualities*
  - *Clean, low absorption, high crushed content, SSD at batching*
- *Goal – 80° to 88° F concrete temperature*
  - *Heated sand...not recommended*
    - *25 minute pot life*
    - *Admixtures burn off too soon*
  - *Heated water...140 deg. F*
    - *50 minute pot life*
- *Temperature Limitations*
  - *Tested at ambient temperatures: 40's, 50's, 60's, and 80's F*
- *Admixture Combinations*
  - *Specific combination required*
  - *Cold weather protection still required*

## *What We Know So Far (cont.):*

- *Construction Process – Most practices do not change*
  - *Haul Time – 60 minutes pot life*
  - *Blankets (2 layers of R7)*
  - *Tooled joints – no realistic sawing window*
  - *Curing samples – move beams onto slab 2.5 hrs after batching*
- *Not all patches on a job require the Rapid Set mixture*

# In the Works

- **Laboratory evaluations at UM**
  - Durability testing (high resolution microscopy, modified Rilem)
  - Evaluation with different combinations
- **In the Field**
  - Several maintenance patches (approx. 100 total)
  - 5 contracts via Preventive Maintenance program
    - 1 – 200 foot Rapid Set repair
    - 2 – smaller projects with less than 20 repairs, diamond ground
    - 1 – 90+ repairs
    - 1 – 500+ repairs
      - 50 exposed in PCCP
      - Rest overlaid with HMA
- **Currently underway**
  - Trial using 25 percent slag cement
    - Delayed set a little
    - Durability testing yet to be done
  - Trial using internal curing
  - Continue to monitor long-term performance
- **Keep in mind,**
  - 15 year anticipated service life
  - Mobility emphasis



# *Keeping it in Perspective:*

- *Again - Not all patches on a job may require the Rapid Set mixture*
  - *Mobility will drive cost for the project*
  - *“Engineered” mobility schedule*
    - *Approximate material cost:*
      - *Typical 7 sack with NC accelerator - \$90 per cyd*
      - *Rapid Set mixture - \$140 to \$150 per cyd*
    - *Contractor unit bid price:*
      - *\$80 per syd for 7 sack with NC mixture (\$640 per typical 6x12 repair)*
      - *\$240 per syd for Rapid Set mixture (\$1920 per typical 6x12 repair)*
      - *Three times the cost*
    - *Say, 300 repairs in weekend closure*
      - *If all 300 via NC - \$192,000*
      - *If all 300 via Rapid Set - \$576,000 (3X)*
      - *If 200 via NC and last 100 via Rapid Set - \$320,000 (1.7X)*

# *Precast Pavement Repairs*

## *2013-14*

- *I-94 in Southwest Michigan*
- *Mainline PCC pavement under bridge overpasses*
- *Lots of random cracking after installation*
- *Investigation currently underway*



# Questions?



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