



# Improving Performance of Longitudinal Construction Joints in Construction

MAAPT 58<sup>th</sup> Annual Asphalt Conference  
December 7, 2011, Saint Louis Park, MN  
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# Outline

- Why Longitudinal Joints?
  - Pavement Management Data
- Joint Treatments: What's been done (MN) & how are they performing?
  - Fog Seals (Emulsion & Rejuvenator)
  - Joint Adhesive
  - Wedge Joint
  - Echelon Paving & Joint Heaters
- Summary





# Why Focus on Long. Jts.?

- Safety
  - Motorcycles
  - Loss of Pavement Markings
  - Rumble Strip Deterioration
- Increased Costs
  - Maintenance
  - Reduced Service Life





# Long. Jt. Distress

- Long. Jt. distress reduces Surface Rating more than any other measured distress.
- Previously, transverse cracking was #1, but ... Lukanen, 2011 Found:
  - Use of -34 binders has reduced the rate of thermal crack development by:
    - 90% in earlier pavements (prior to PG)
    - 95% in pavements built in 1970's - 80's
      - 1970's: nonwear=recipe; wear=designed
      - 1980's: Hot mixed recycle for non-wear





# Pavement Mgt. Data

Long. Jt. distress is:

- *Earlier, more frequent & in higher severity* compared to historical data
- Occurring at *different rates* around the state (regional differences)
- On average, affecting divided & undivided roadways *at the same rate*
- Reduced by 33% at age 10 & 50% at age 15 by the presence of chip seals & crack treatments





# Causes of Deterioration

- **Lack of Density at (or near) Cold Joint**
  - Typically 2 -3% less dense than mat
  - Unconfined compaction at edge of first pass
- **Improper Construction Practices**
  - Raking of the Joint
  - Overlapping of New Mat with Old Mat





# Diluted Emulsion Fog Seal

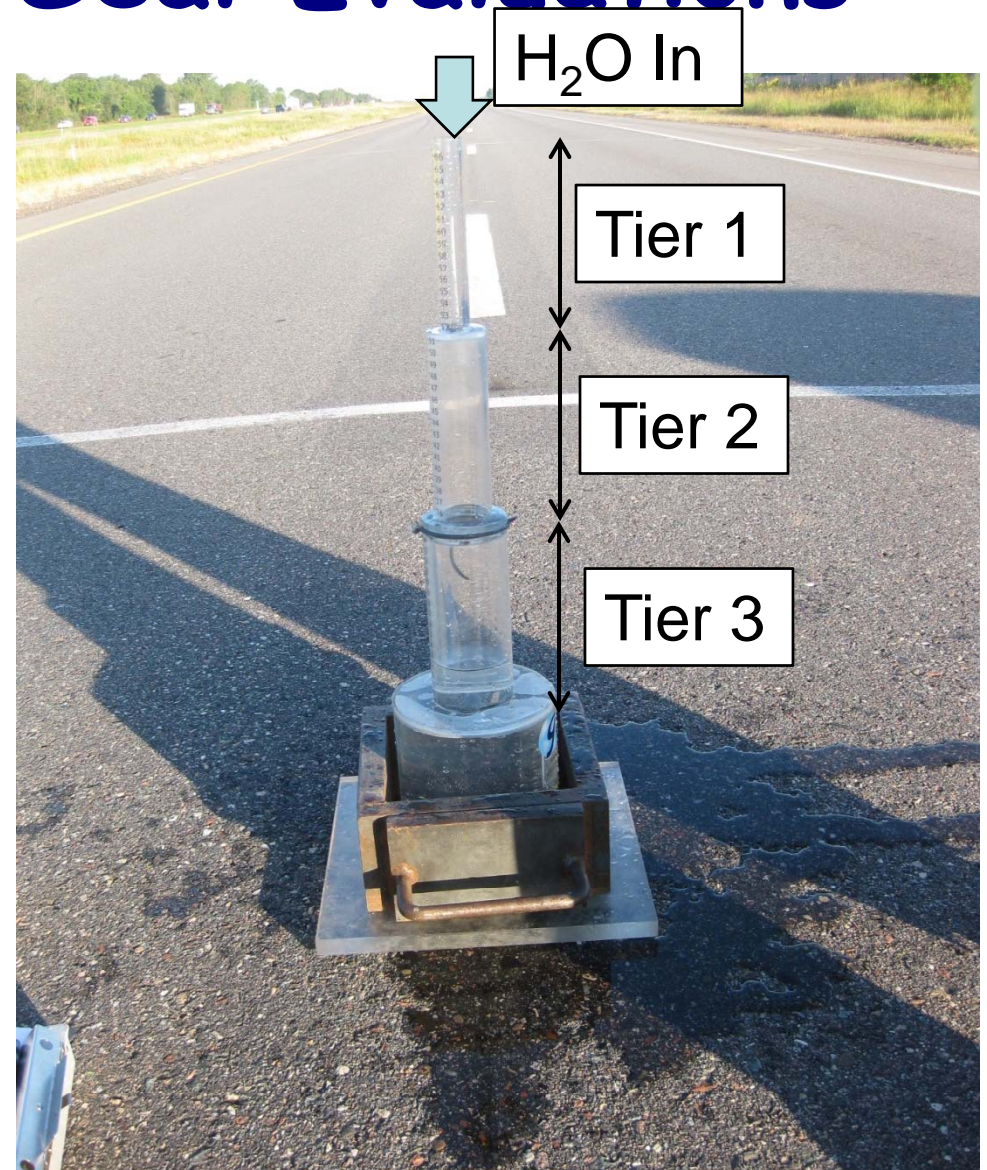
- Applied 1 foot either side of long. jt.
- Seals and water proofs *area*
- Striping: wait 14 days for cure or grind!
- 2011: 6 Projs, \$2.77/Gal (\$488/mile)





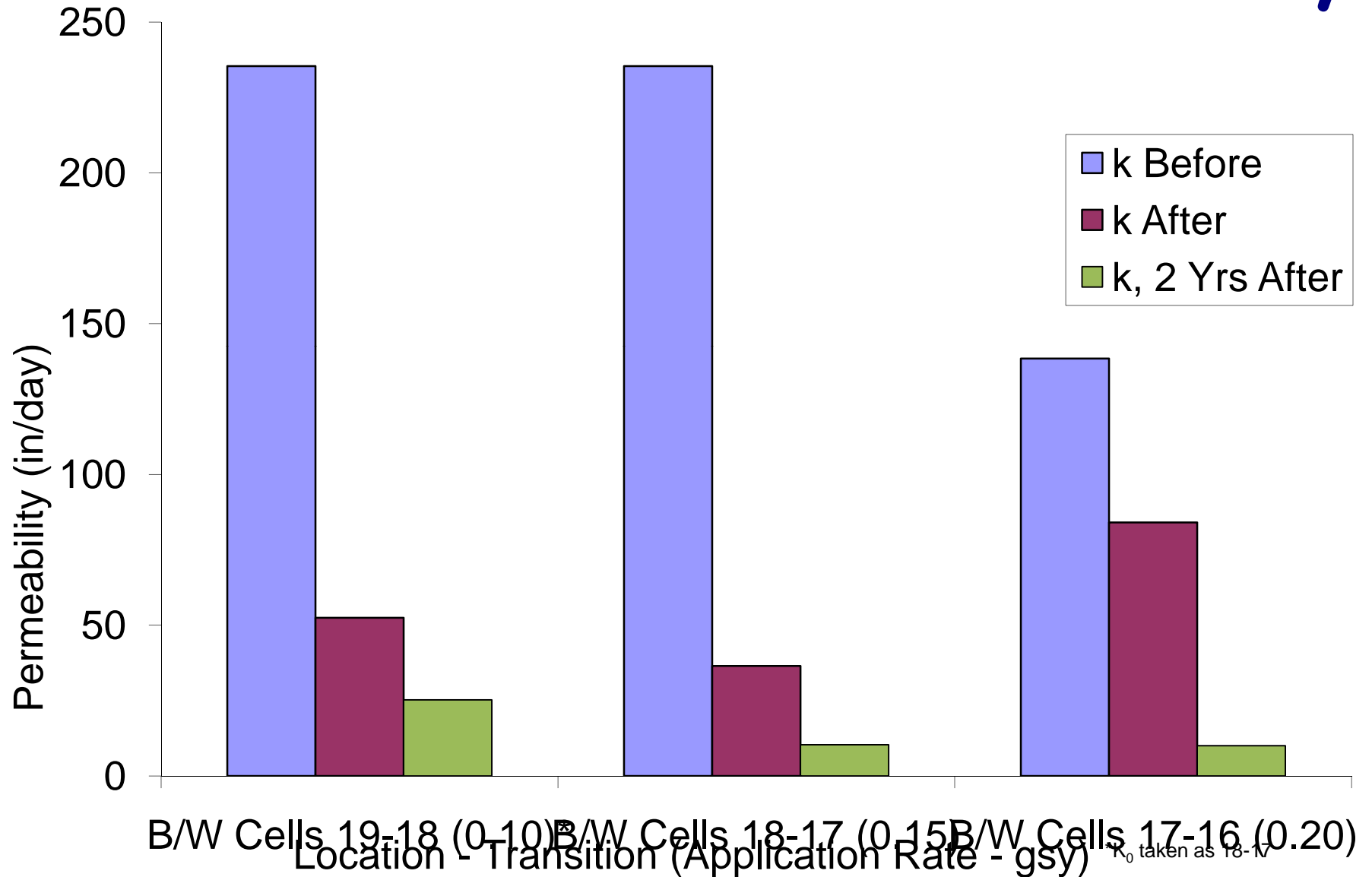
# MnROAD Fog Seal Evaluations

- Measure Time for water to “fall” a given distance
- Relative Values & Changes
- 4 Fog Seal Application Rates
- No Loss in Permeability after 2 years





# Effect of Time on Permeability





# Joint Adhesive

- 1/8" Thick Rubberized Sealer
- Waterproof
- Bind passes together
- Initial seal to *most vulnerable area*





# Joint Adhesive Use

- TH 22 M&OL (2003) 3 test sections
  - Jt. Adhesive + Ctrl + Density Spec.
  - 2011: All sections have low severity Long. Jt. Distress (Chip Seal in 2008)
- 2011 MnDOT Use
  - 128 miles on 9 Projects avg. cost \$0.48/LF (\$2,534/Mile)





# Joint Stabilizer (JointBond)

- *Penetrating, Clear Colored Emulsion*
- Rejuvenator
- Sealer?





# Joint Stabilizer Projects

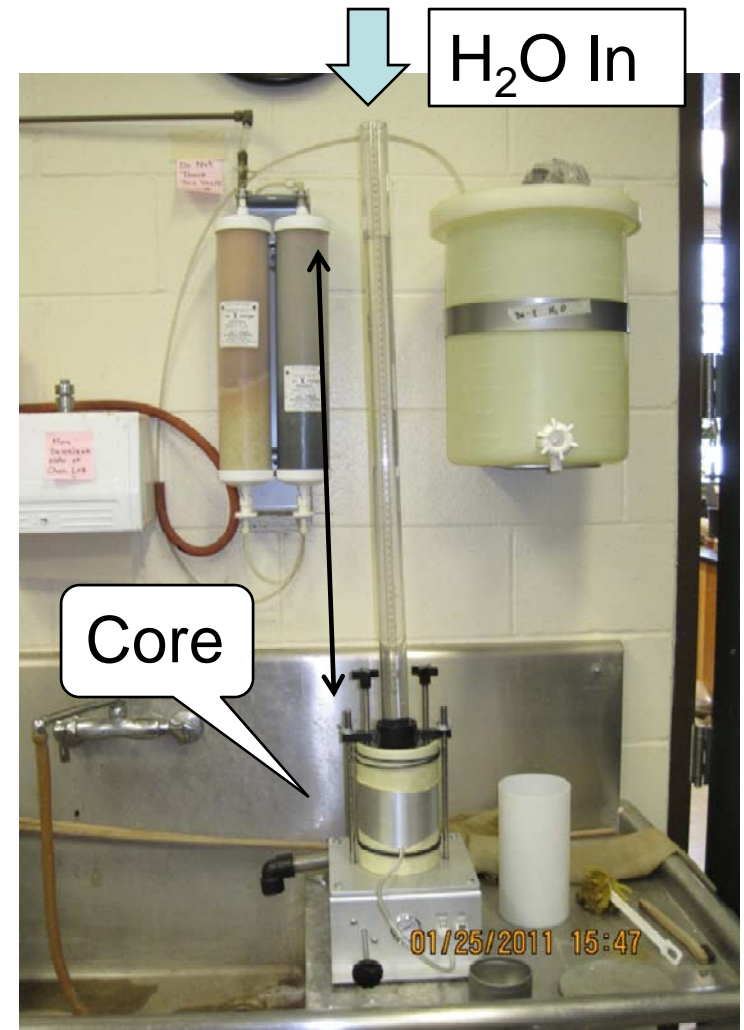
- Oldest: MnROAD & TH 95 (2008)
- Largest: TH 30 (D7) 2011 52,232 LF (9.9 mi) at \$0.65/LF (\$3,432/mile)
- Test Sections: TH 10 (D3) M&OL
  1. Joint Stabilizer (JointBond)
  2. JointBond + Adhesive
  3. Adhesive
  4. CTRL





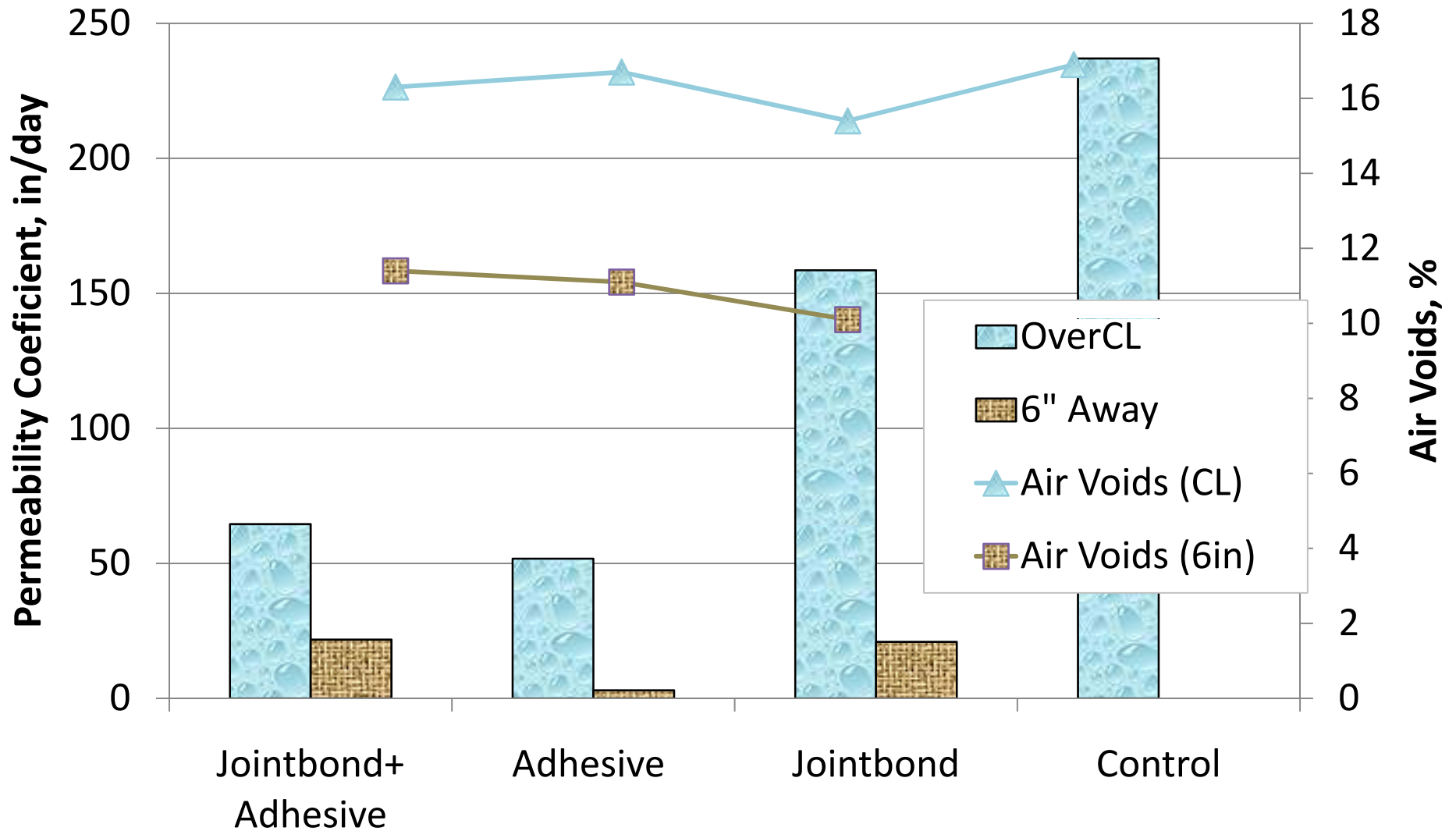
# Permeability Testing (TH 10)

- Measure Time for water to “fall” a given distance:
  - 7% Air Voids ~20 min
  - 15% Air Voids ~1.5 min
- Less variable than field measurements
- H<sub>2</sub>O can only travel down





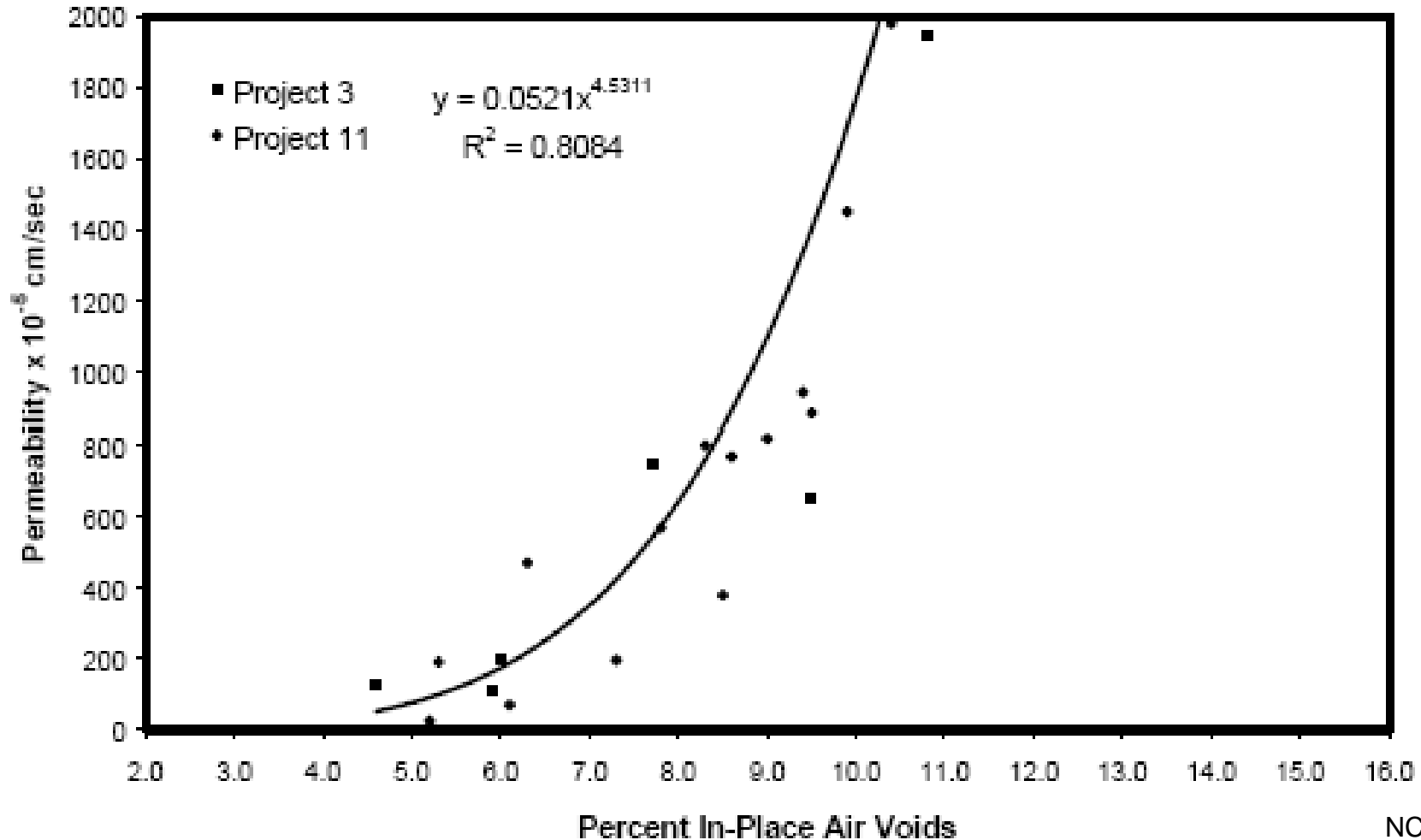
# Effect of Joint Treatments





# Permeability/Density, NCAT

In-Place Air Voids vs. Permeability - 19.0 NMAAS Mixes



NCAT, 2001





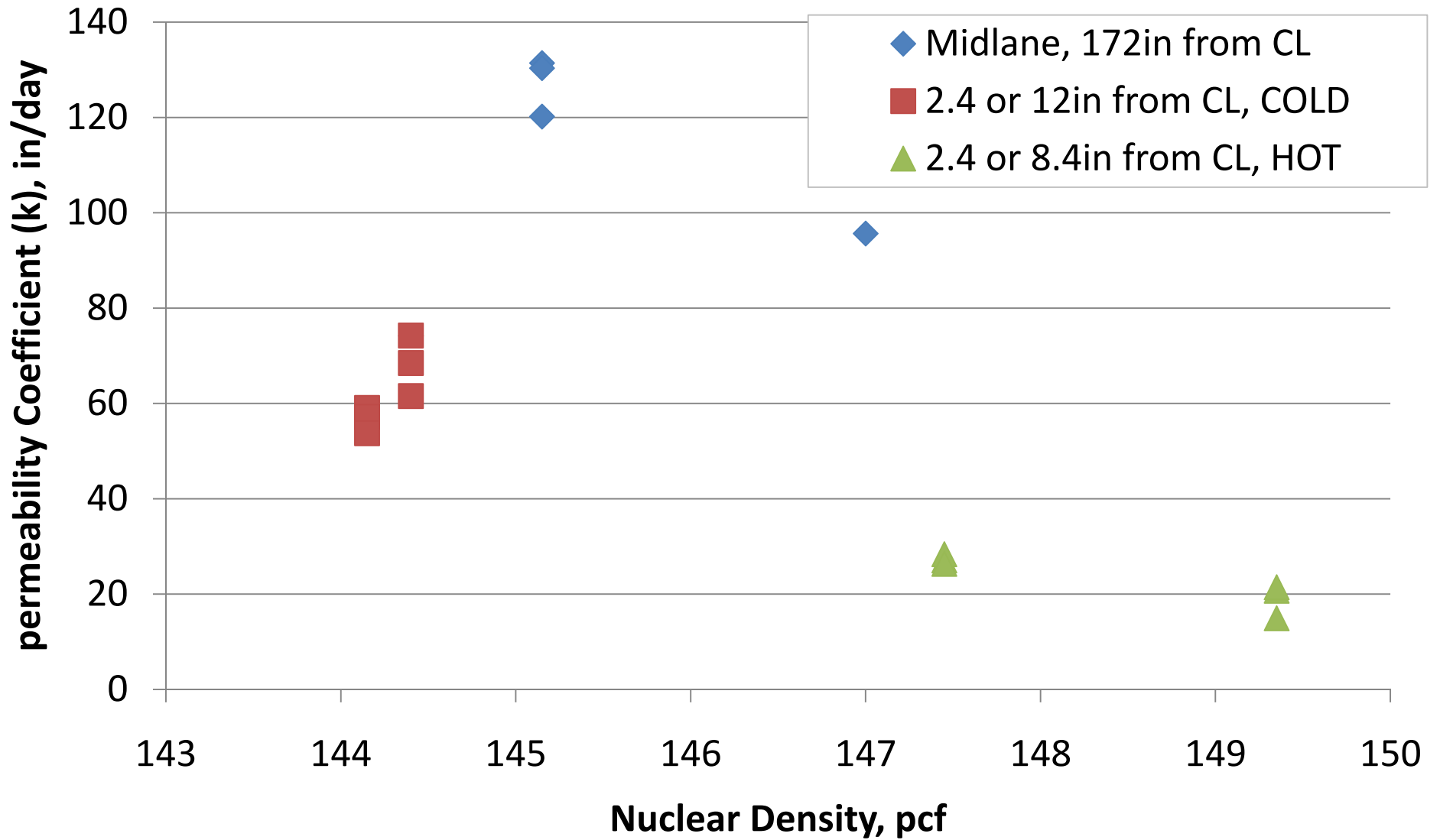
# Wedge Joint (Notched/Taper)

- Not to be Confused with "Safety Edge"
- Difficult to Compact
- Used for Traffic Management
  - No drop-off => No Nightly Match-Up
  - Increased Use in 2011





# Effect of Wedge, Location





# Echelon Paving (TH 494)

## TH 55 to TH 94 completed in 2002





# TH 494 Performance

- 2010: *Low Severity* Distress over most of Project (Long. Jt. Invisible in Some Sections)
- “What would Pavement look like if Echelon Paving had not been Used?”

TH 494 (2001), 10 yr. old Surface



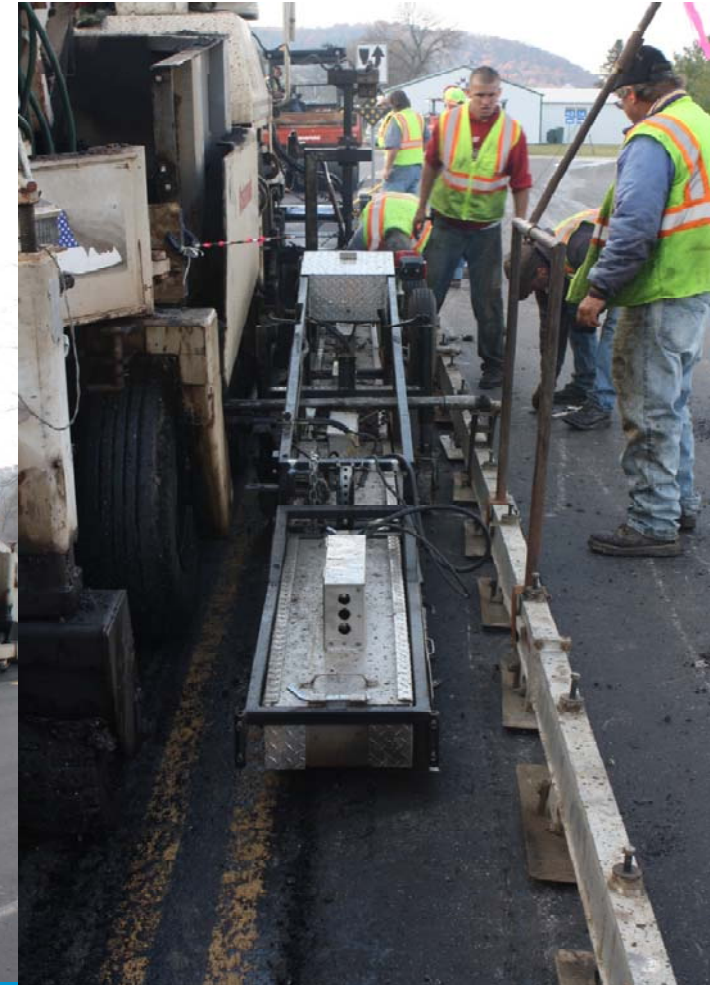
494 (2010), 8 yr. old

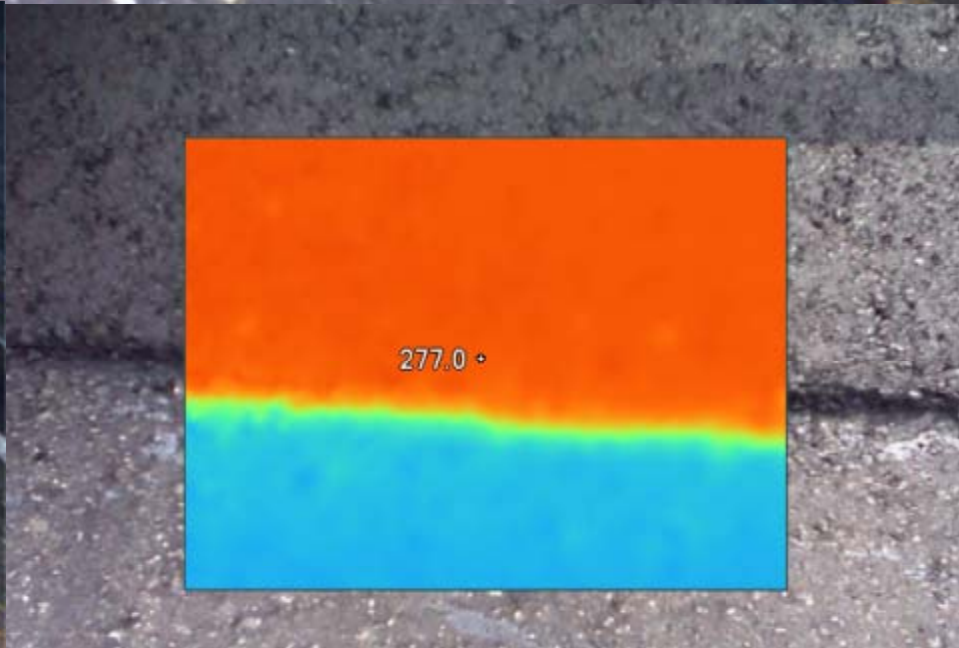
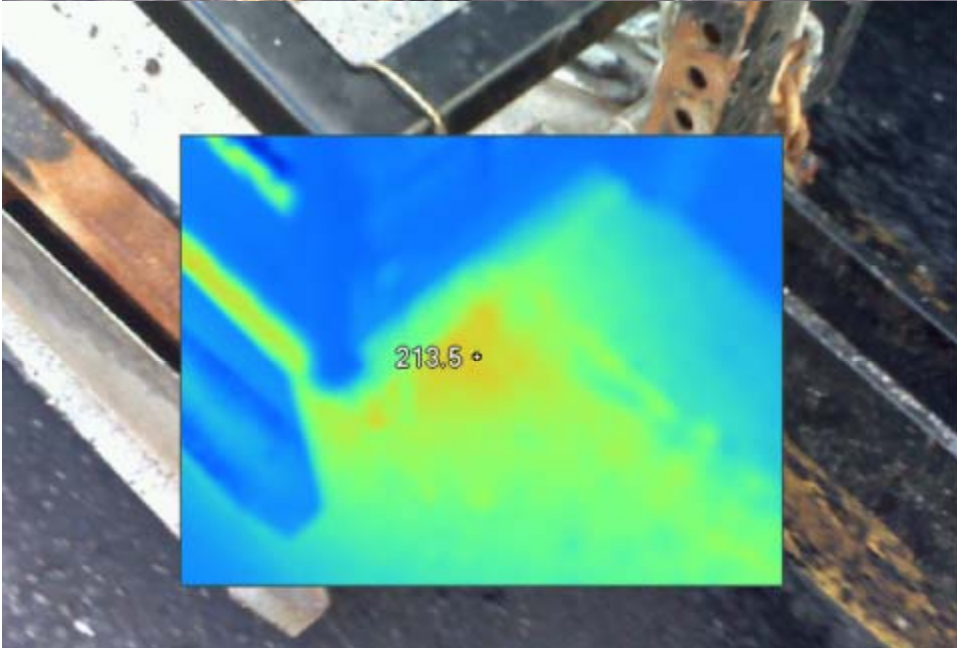
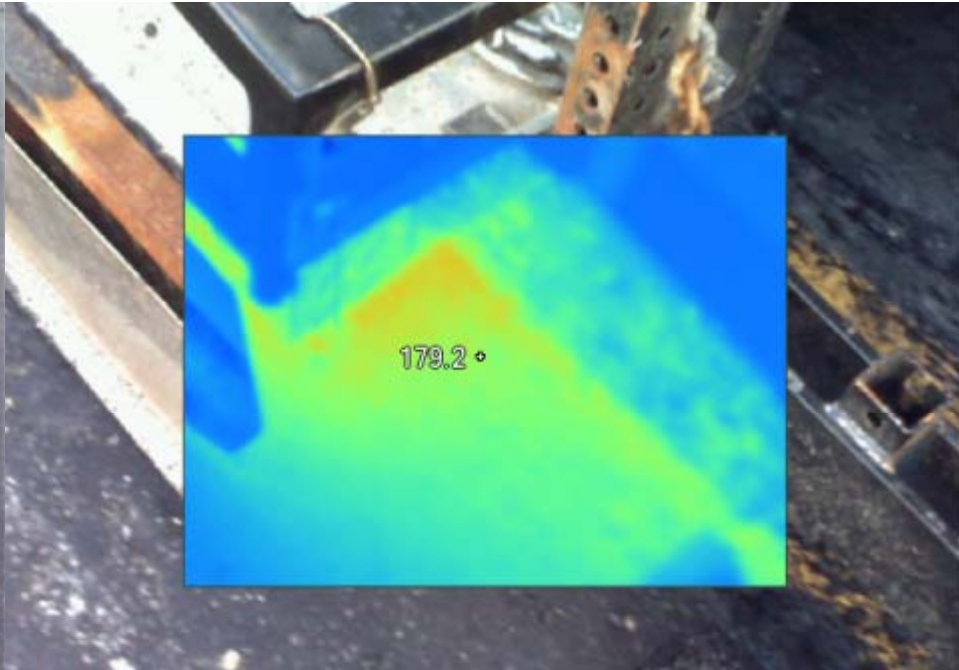




# Joint Heater (Heat Cold Mat)

- Propane heater attached to paver
- Heats for ~ 20 seconds







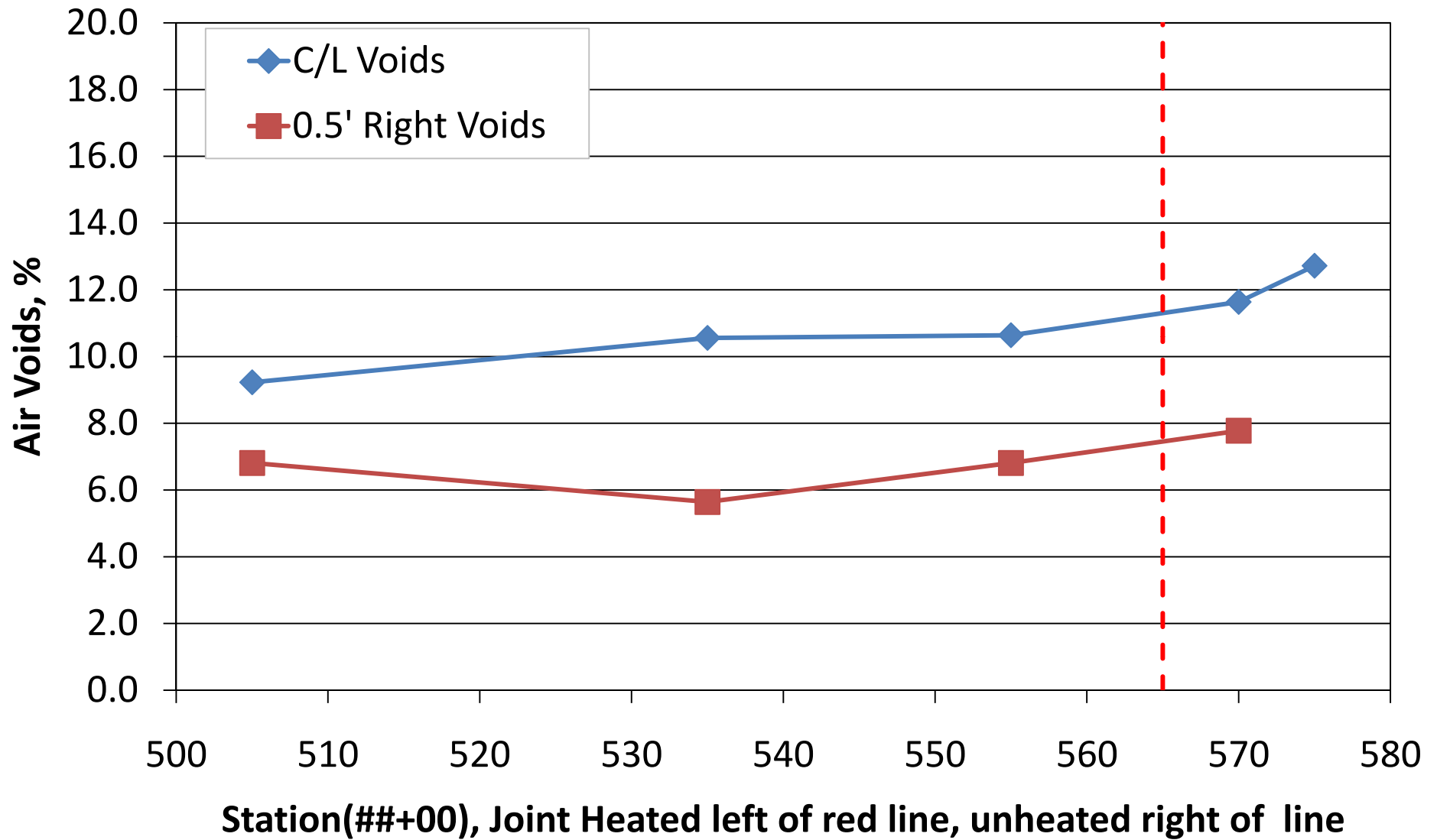
# Joint Heater

- Used on TH 16, both lifts of 10.3 mile Mill & OL at a cost of \$0.15/LF (\$792/Mile) ... least expensive option
- After initial investment, primary expense is propane fuel
- Doesn't give us hot-hot (echelon paving), but may be a close second
- On average, reduced AV by 2% at CL Jt. (smaller reduction 6" away)





# Effect of Heater, Location





# Summary

- Long Jt distress is having a negative impact on pavement performance and durability
- Long Joint “Enhancements” may help mitigate poor performance through sealing





# Summary

- Density is the most important quality indicator and Long. Joint heaters may help, but need more data
- Cores over CL provide valuable information (density & permeability)





# Thank You!

