Impact of Sealed Joints on Performance of Thin Whitetopping at MnROAD

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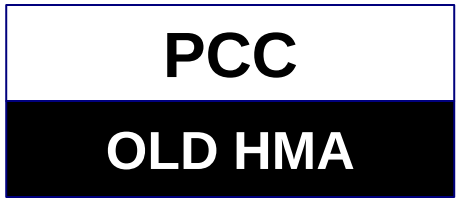
Tom Burnham, P.E.
Minnesota Department of Transportation

Office of Materials and Road Research

Outline

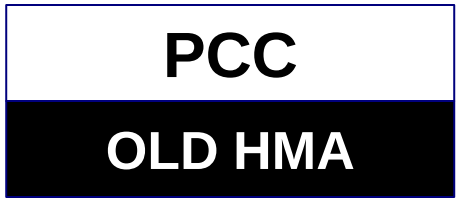
- Whitetopping
- Joint sealing concepts
- MnROAD Test Sections
- Test Section Performance
- Conclusions and Recommendations

Whitetopping



- A pavement rehabilitation technique
- Concrete over distressed asphalt pavement
- Asphalt milled to maintain grade and improve layer bonding
- More often an “inlay” than an “overlay”
- Typically concrete layer thicknesses range = 3” to 7.5”
- Smaller panel sizes for thinner overlays

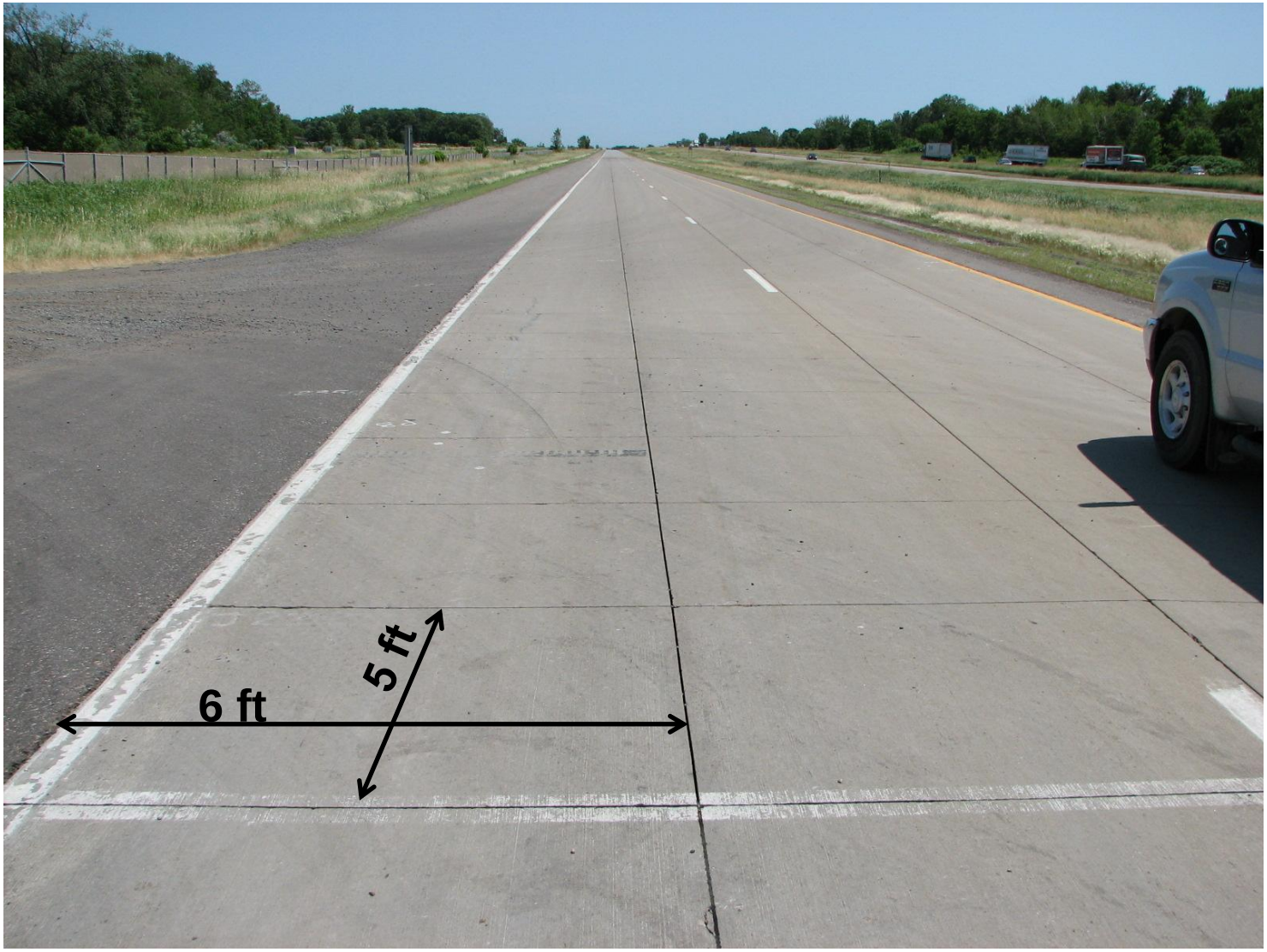
Whitetopping



Typical terms

- Ultrathin Whitetopping (UTW) = 3” to 4.5” [Requires bond]
- Thin Whitetopping (TWT) = 5” to 7.5” [Bond adds life]
- Bonded Concrete Overlays of Asphalt Pavements (BCOA) = UTW
- Unbonded Concrete Overlays of Asphalt Pavements (UBCOA) = TWT

MnROAD Cell 61



History in Minnesota

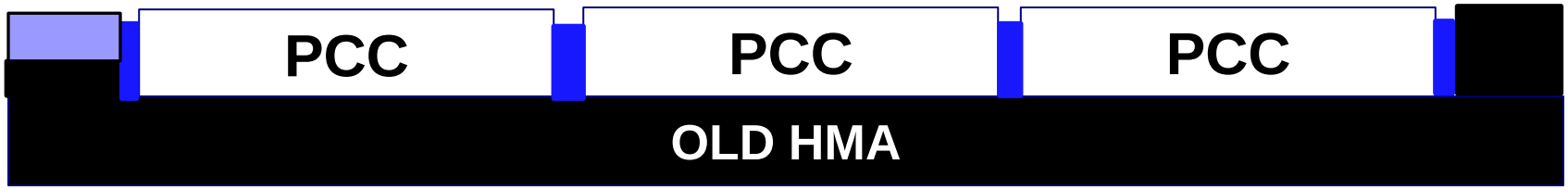
- First “modern” project
  - Olmsted County CSAH 10 (1982) [6” TWT]
- First Mn/DOT project (included test sections)
  - TH30 Amboy (1993) [6” TWT]
- Test Sections
  - MnROAD UTW & TWT (1997) [3”, 4”, 6”]
  - MnROAD TWT (2004) [4” to 5”]
  - MnROAD TWT (2008) [6”]
- First Mn/DOT “production” project
  - I-35 North Branch (2009) [6” TWT]

History in Minnesota

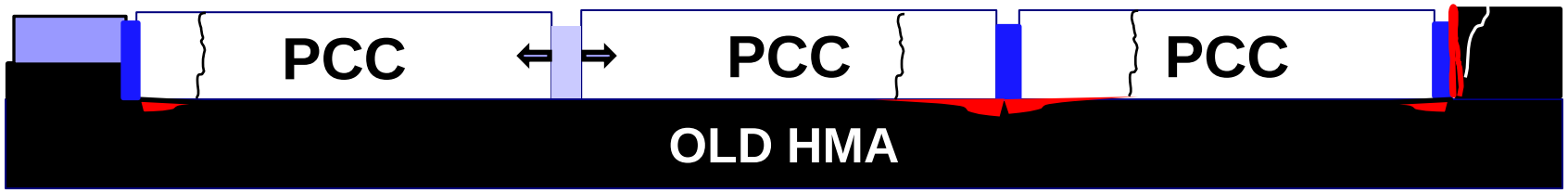
- Other Minnesota projects
  - Kellogg Blvd St. Paul (2000)
  - CSAH 7 Hutchinson (2009)
  - CSAH 46 Albert Lea (2009)
  - TH23 Marshall (2009/10)
  - CSAH 9 Harris (2010)
  - TH 56 West Concord (2010)
  - Olmsted County CSAH 22 (2011)
  - Anoka County CSAH 22 & CSAH 18 (2011)
  - McLeod County CSAH 2 & CSAH 25 (2011)

Many others currently under consideration as option in Alternate Bid projects

Why Seal or Fill Joints?



Unsealed joints fill with water due to “bathtub” design

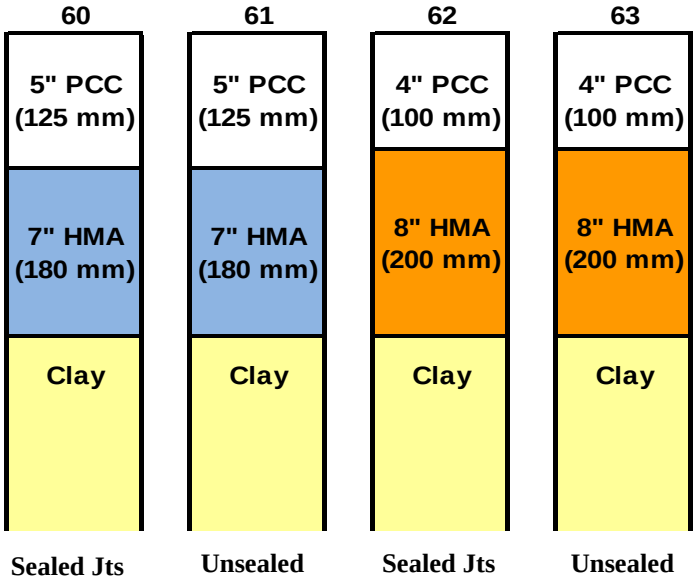


Results:

- Water deteriorates bond between layers
- Panels crack due to loss of support
- Ice expansion can move panels apart = more water in joint
- Water erosion deteriorates asphalt shoulders

Why Seal or Fill Joints?

MnROAD Test Sections (2004)



- Cells 60 and 62 constructed with single saw cut joints filled with hot-pour asphalt sealant
- Cells 61 and 63 constructed with no sealant
- Panel size = 5 ft. L x 6 ft. W [1.52 m L x 1.83 m]

Traffic

- I-94 live interstate traffic
- “Accelerated” loading for 4” and 5” PCC
- CESAL’s 2004-2011 = 6.5 million

Performance

Sections with sealed/filled joints performed better!

Panel Cracking (Fall 2010)

Unsealed Joints

4" PCC = 55% cracked panels

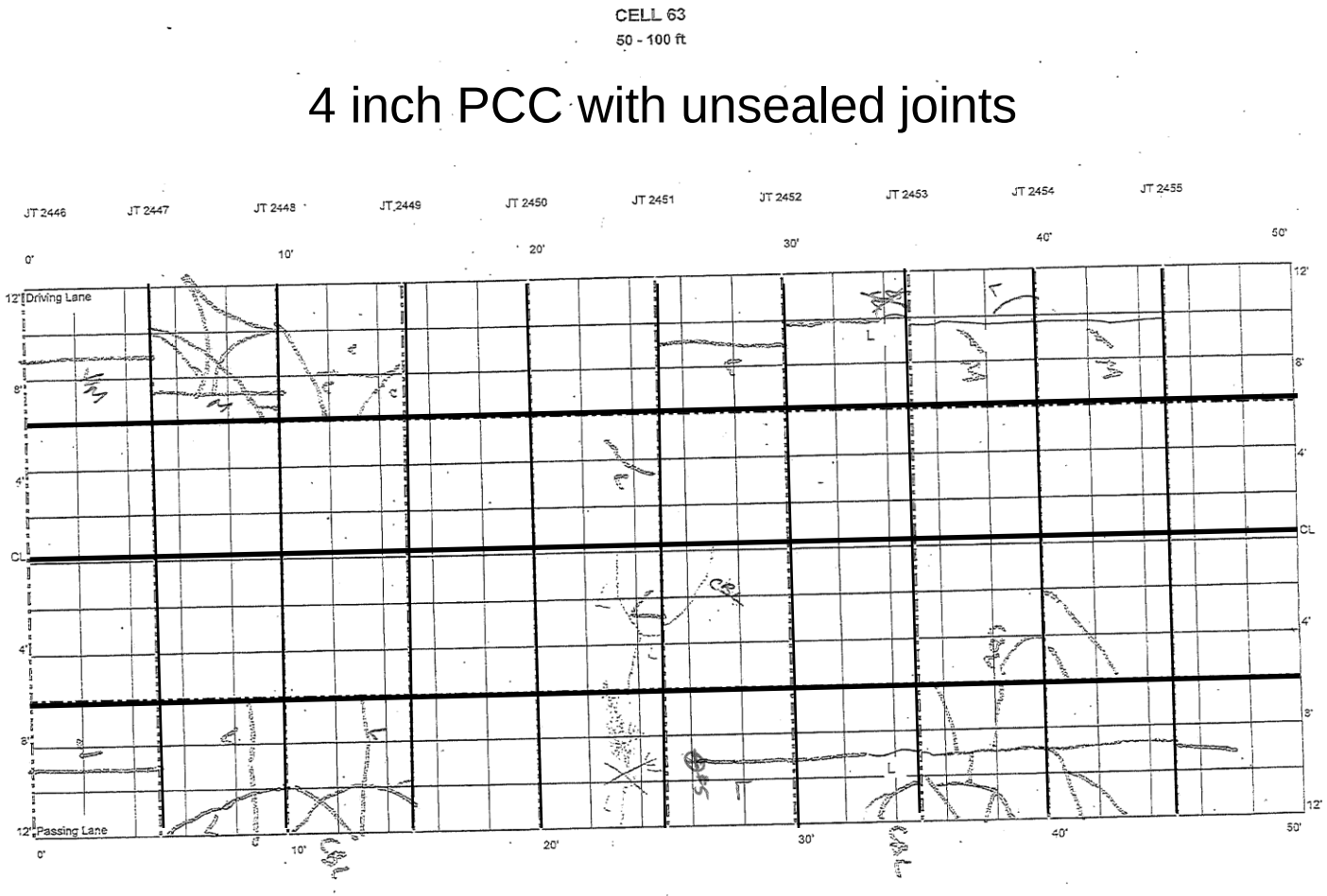
5" PCC = 8% cracked panels

Sealed Joints

4" PCC = 11% cracked panels

5" PCC = 11% cracked panels

Distress Survey

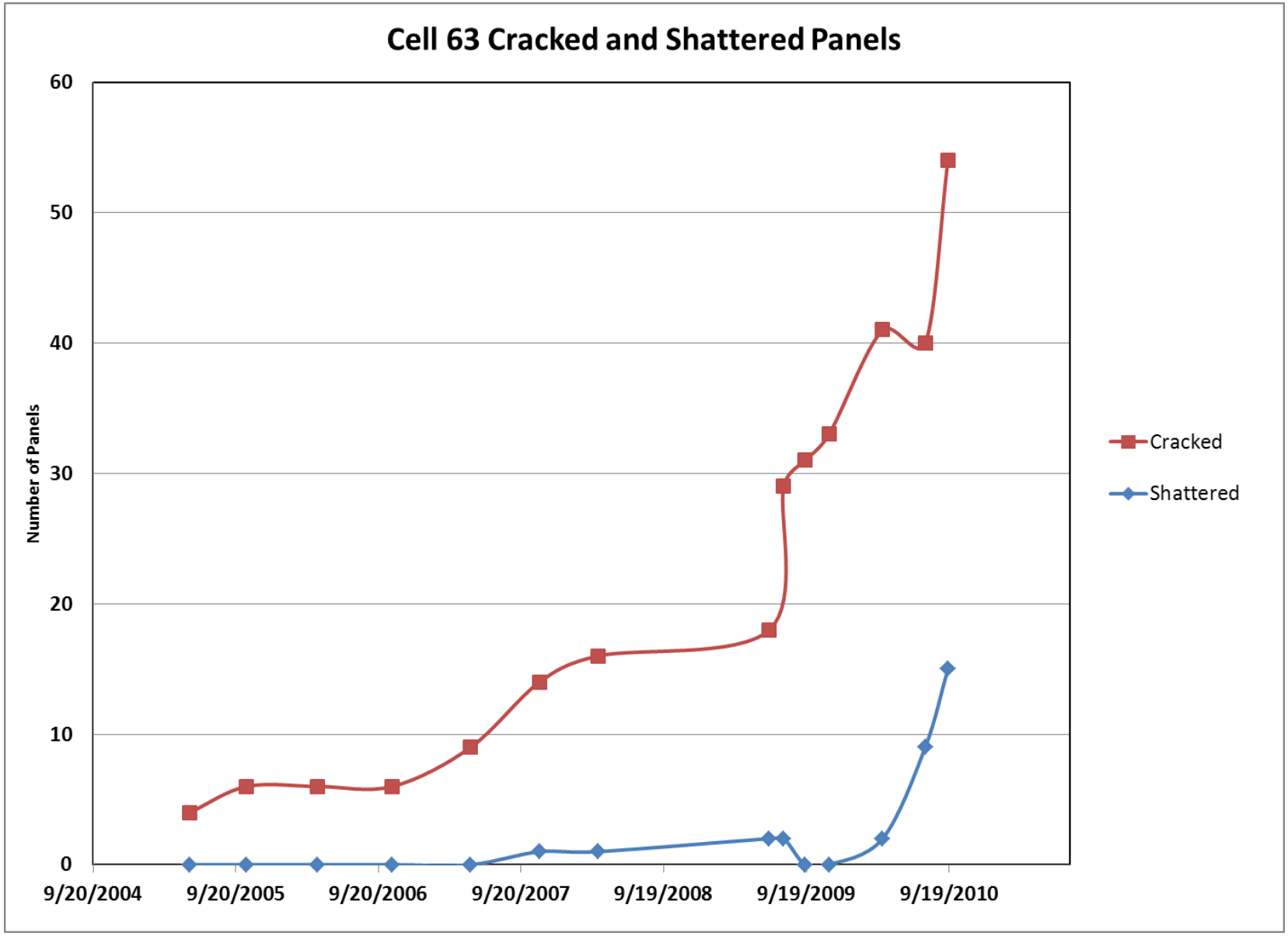


4 inch PCC with unsealed joints

Cell 63 (Fall 2010)

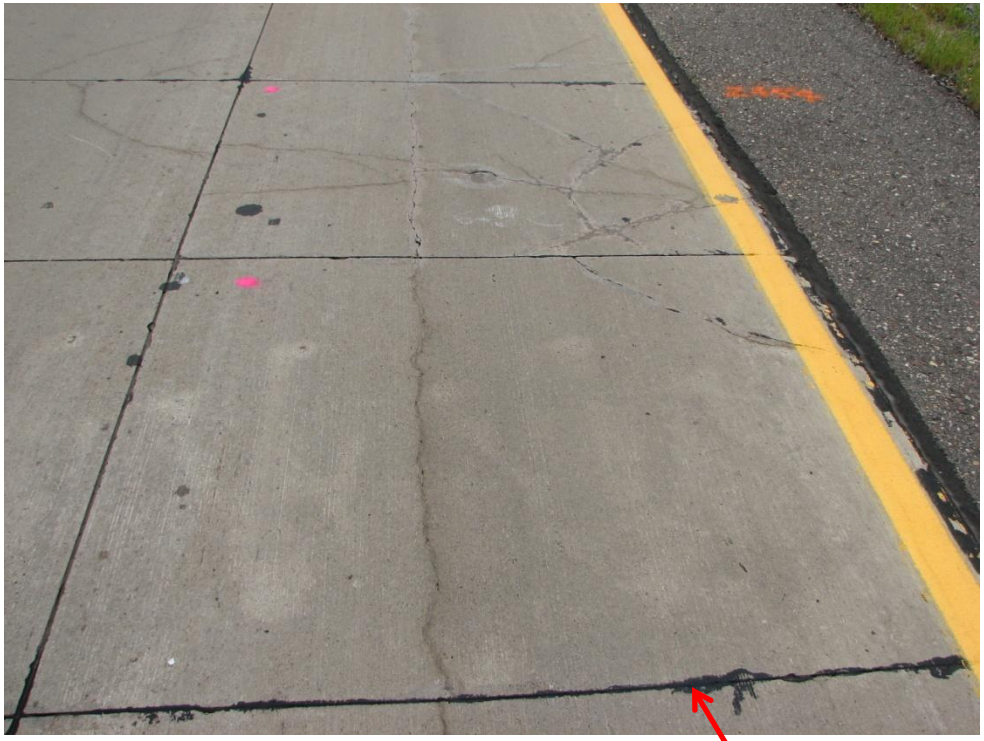
4 inch PCC with unsealed joints

Cracked and “shattered” panels


Cell 63 Cracked and Shattered Panels
Number of Panels
60
50
40
30
20
10
0
9/20/2004
9/20/2005
9/20/2006
9/20/2007
9/19/2008
9/19/2009
9/19/2010
Cracked
Shattered

Cell 63 (Spring 2011)

4 inch PCC with unsealed joints

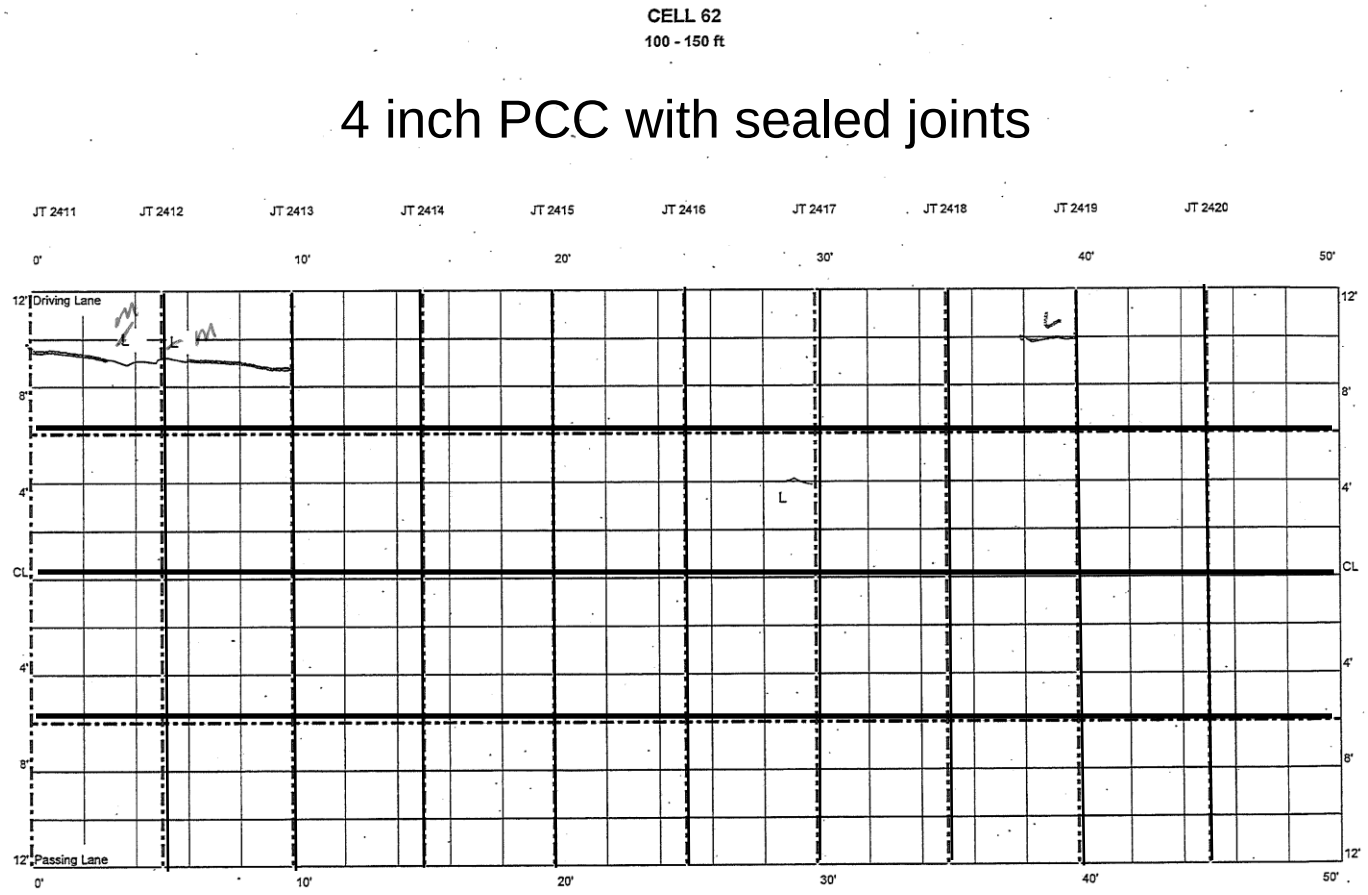


Joints sealed in Fall 2010 to slow deterioration

Cell 63 (2010)

4 inch PCC with unsealed joints

Distress Survey



4 inch PCC with sealed joints

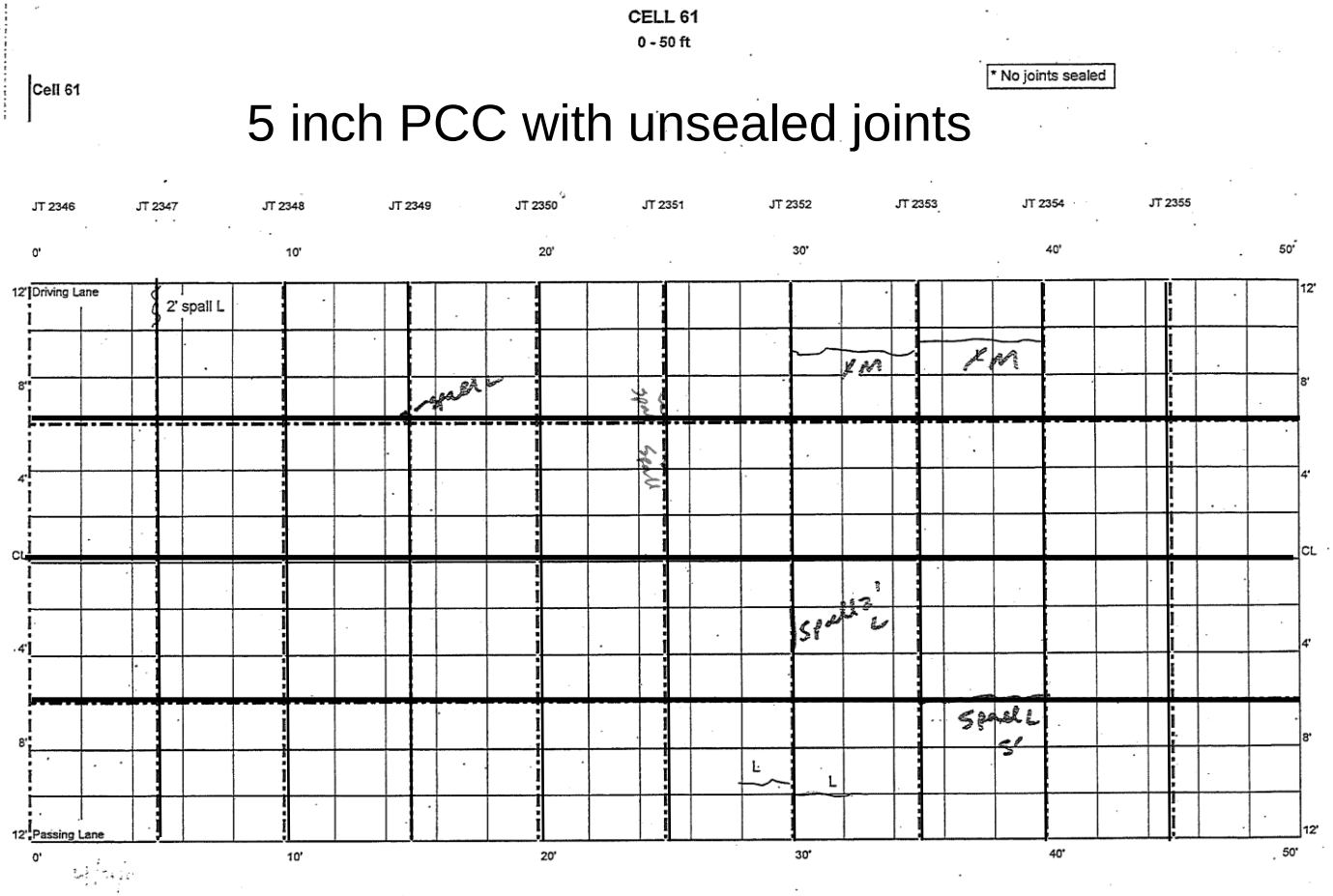
Cell 62 (2010)

4 inch PCC with sealed joints

“Tight”joints (virtually no spalling)

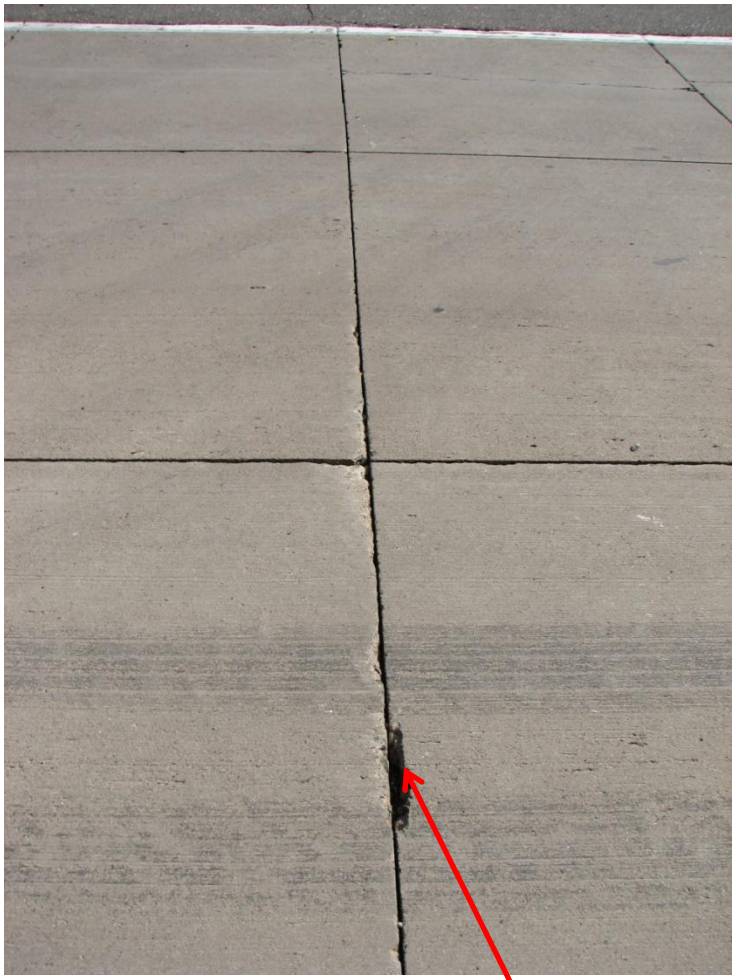
Unbonded, with some HMA deterioration

Distress Survey



Cell 61 (2010)

5 inch PCC with unsealed joints



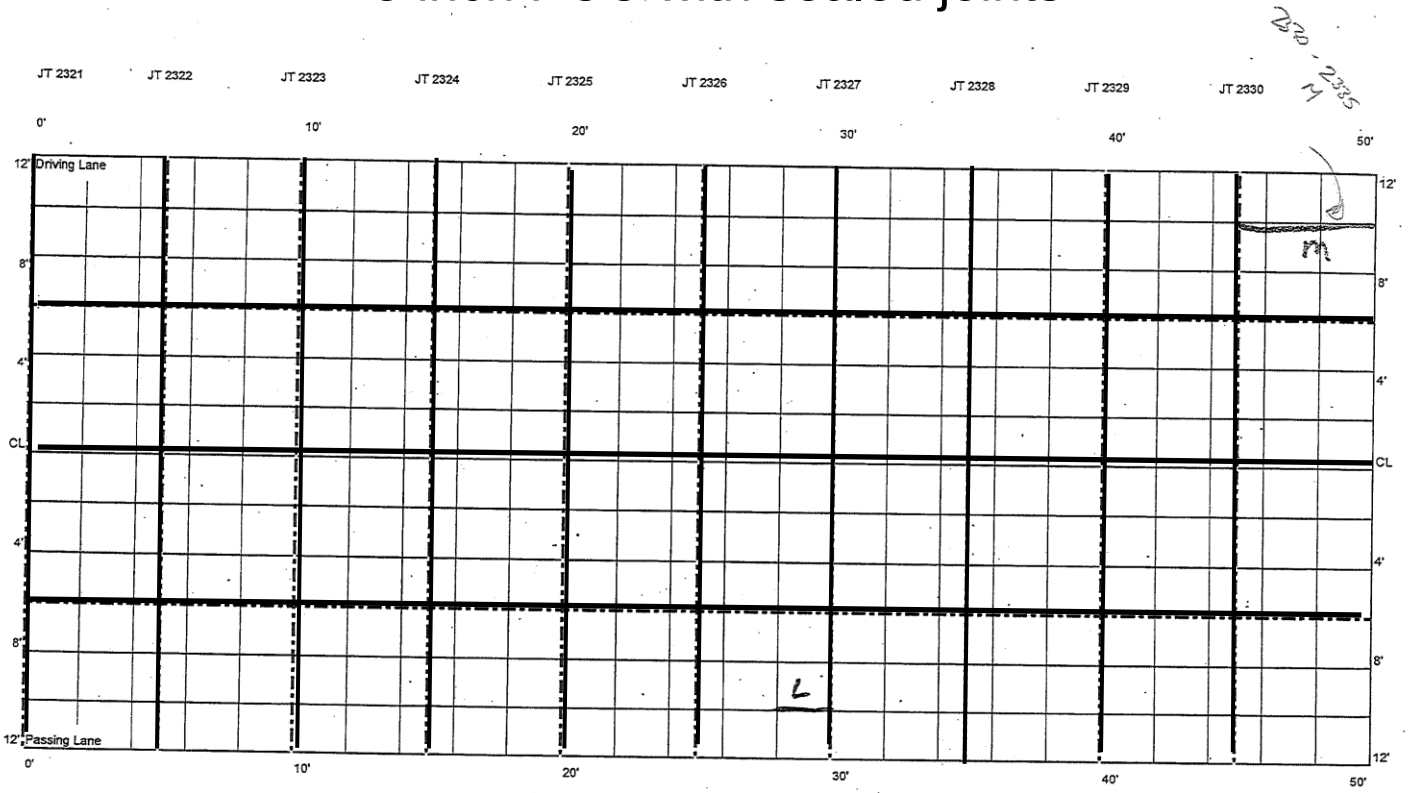
Spalling

Unbonded, with some HMA deterioration

Distress Survey

CELL 60
100 - 150 ft

5 inch PCC with sealed joints



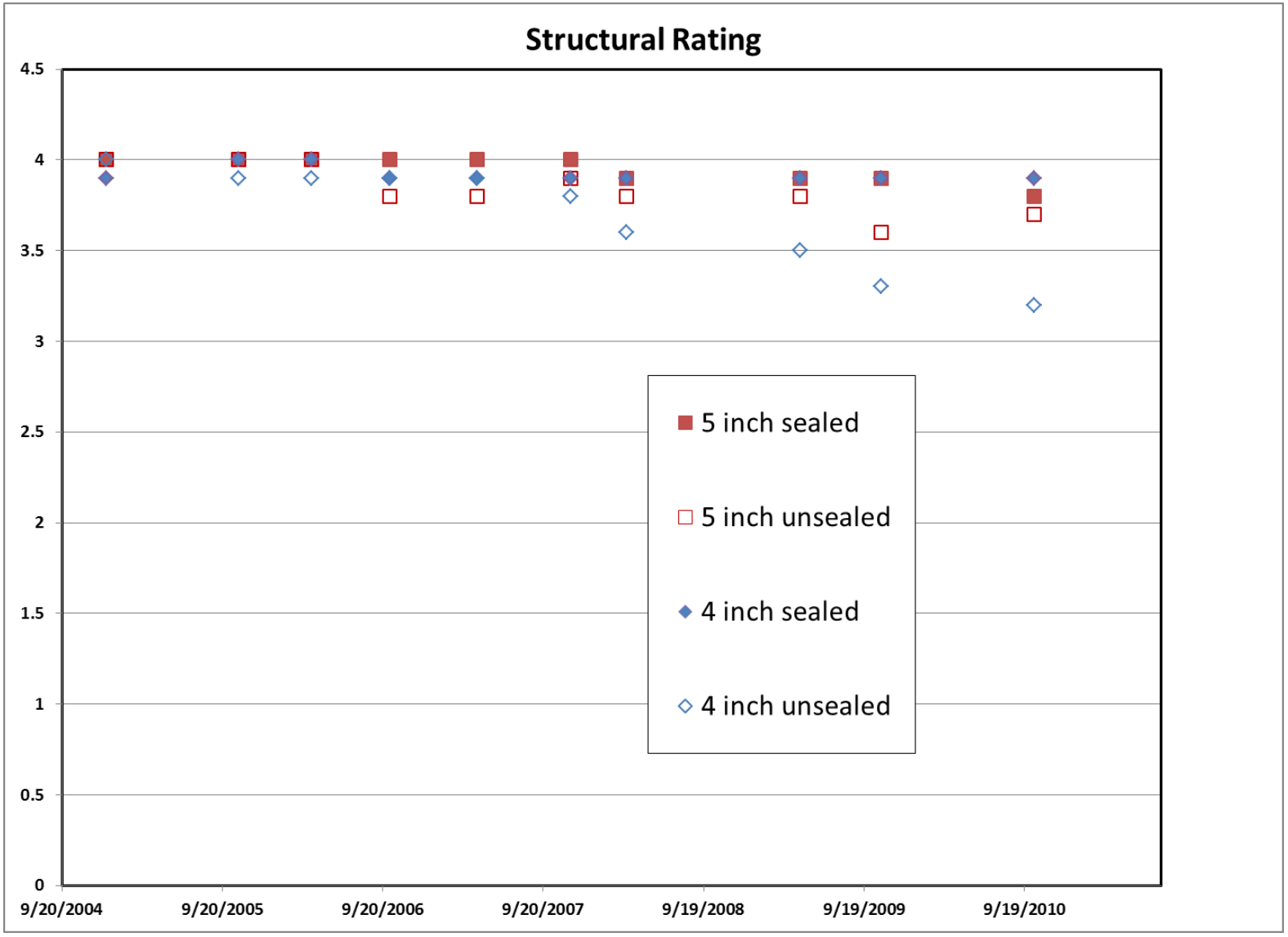
Cell 60 (2010)

5 inch PCC with sealed joints

“Tight”joints (virtually no spalling)

Unbonded, no HMA deterioration

Performance



Sealing Cost Beneficial?

- Narrow joints, but a lot of them!
- Cost of hot pour asphalt sealant for Cell 60
  - 220 ft long, all joints, including lane/shoulder
  - Approx. 21 gals of sealant @ $0.60/lb= $107.10
  - Approx. $2600/mile
  - Labor cost? (Usually bid as incidental)

Conclusions

- MnROAD ultrathin (4”) whitetopping test sections have shown a significant difference in performance related to joint sealing
  - Loss of critical layer bonding and heavy traffic have resulted in substantial cracking in panels with unsealed joints
- MnROAD thin (5”) whitetopping test sections have shown a noticeable difference in joint performance related to joint sealing
  - Widening joints
  - Increased joint spalling

Recommendations

- Seal joints in whitetopping inlays
  - Protects layer bonding = slows panel cracking
  - Reduces joint spalling/panel separation
  - Extends shoulder life
- Determine cost effectiveness of sealing for thicker whitetopping designs
  - Currently monitoring 6” thick MnROAD whitetopping Cells 114-914, constructed in 2008 with unsealed joints
- Provide adequate drainage path for water
  - Keep the water out, or find a way to get it out fast!

Questions?