Unbonded Concrete Overlays of Concrete and Composite Pavements (UCOCP)


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PennDOT District 11/12 & ACPA Pennsylvania Chapter Concrete Pavement Field Bus Tour
Concrete Pavement Issues Meeting
8/6/15

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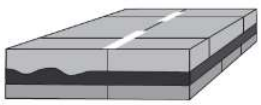
Unbonded Concrete Overlays of Concrete and Composite Pavements (UCOCP)

Existing concrete pavement

- Thicker than bonded concrete overlays – typ. 4 to 11 in
- Restore structural capacity
  - Moderately to significantly deteriorated pavements

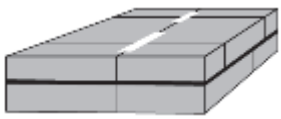
Existing concrete pavement

- Serves as a stable and uniform support layer
- Few, if any, pre-overlay repairs required
- Designed as a new concrete pavement on an existing base with no bond



Composite pavement

or



Existing concrete pavement

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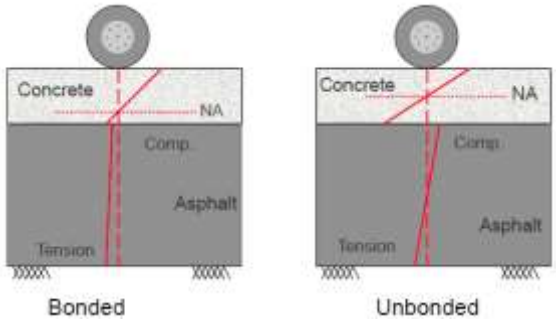
Bonded vs Unbonded Overlays



CP Tech Center Concrete Overlay Guide

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Types of interlayers

- Asphalt interlayer
  - Open or dense graded
  - New or existing HMA
- Nonwoven geotextile interlayer
  - Fabric thickness dependent on existing distress & slab thickness
  - Drainage

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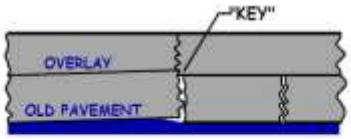
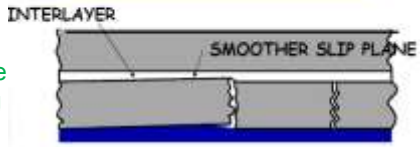
Role of interlayer

- Drainage (Fabric & open graded HMA)
- Slip plane
- Stress absorption

Reflective Cracking



No Reflective Cracking



Photos courtesy of John Donahue of MoDOT

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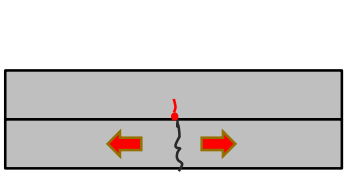
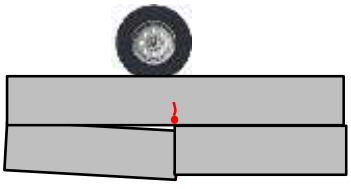
Role of interlayer

Thermal Movements

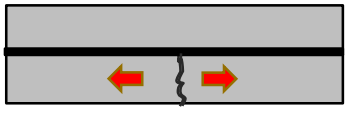
Differential Deflections

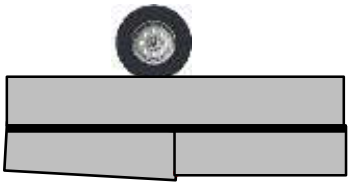
Reflective Cracking





No Reflective Cracking





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SR 50, Bridgeville, PA: Unbonded Overlay
Millers Run Rd to Washington Co. line
Pittsburgh
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Construction
~ 1 in HMA overlay
Existing PCC
Moisten interlayer prior to paving
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Construction

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Construction

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Pavement ME Limitations

- Modeled as newly constructed JPCP
  - Existing slab is base layer
- Only considers HMA interlayers
- Limited calibration database

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Goals of laboratory experiment

Characterize …

1. Stiffness of interlayer system
2. Friction along interlayer
3. Ability to prevent reflective cracking
4. Direct tensile strength

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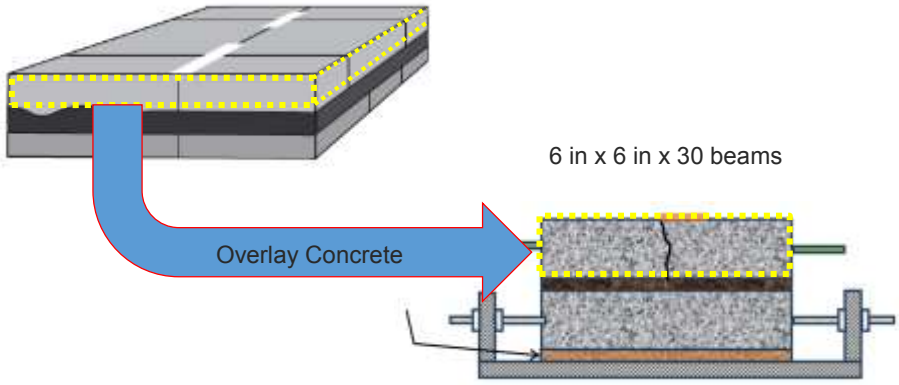
Laboratory specimens



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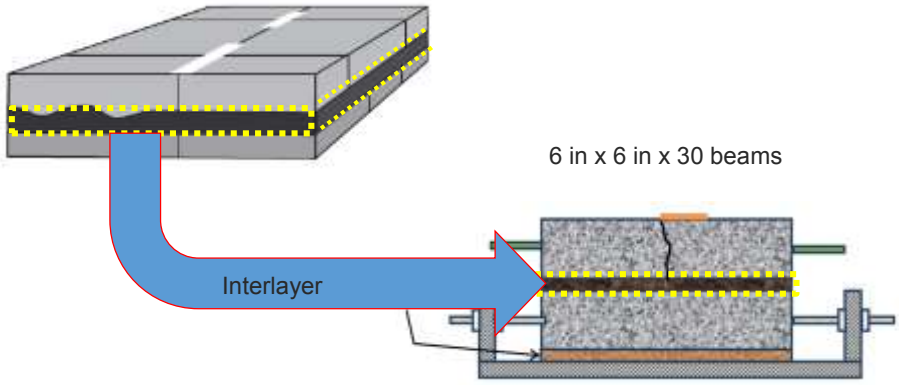
Laboratory specimens



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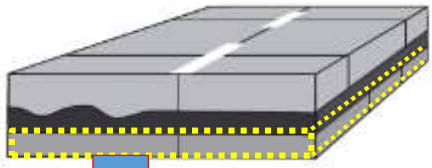
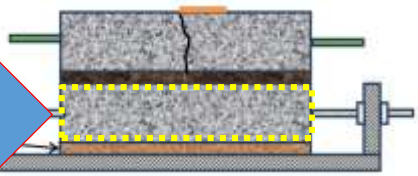
Laboratory specimens



6 in x 6 in x 30 beams

Existing Concrete



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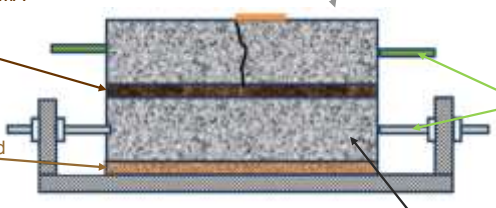
Specimen setup

Overlay Concrete
- Conventional Paving Mix
- Target flexural strength = 650 psi

Interlayer
- Geotextile fabric
- Open & Dense HMA



Threaded Steel Rods

Two layers of neoprene pad
- Fabcell-25
- k = 200 psi/in

Existing Concrete
- HES Mix – simulate aged concrete
- Target flexural strength = 850 psi

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Asphalt interlayers

Asphalt on PCC from in-service pavements

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Asphalt interlayers

Roadway	Asphalt Description	Ave. Asphalt Thickness
US-131, MI	Old, dense graded	1 in
Unknown, MI	Old, open-graded	2 in
I-94, MnROAD	Old, dense graded, milled	0.875 in
I-94, MnROAD	Old, dense graded, unmilled	2.75 in
US-169, MN	New, open graded (PASRC)	1.75 in
SR-50, PA	New, dense graded	1 in

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Samples from SR 50

Thanks to Jim Foringer, Elwood Balog & PennDOT D-11, and Golden Triangle Construction and PM Anthony Pastin

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Pennsylvania

SR 50
~ 1 inch
New dense graded HMA

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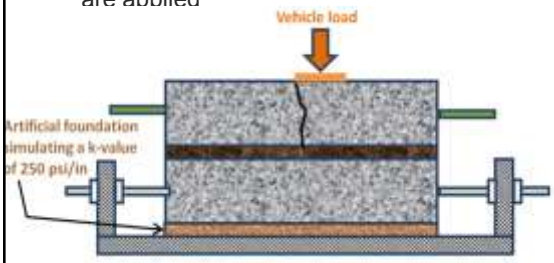
1. Characterize stiffness of interlayer system

Reduced stiffness
- differential movements absorbed by interlayer
- Large deflections when vehicle loads are applied



Properties Monitored
- Max deflections
- Differential deflections
- LTE

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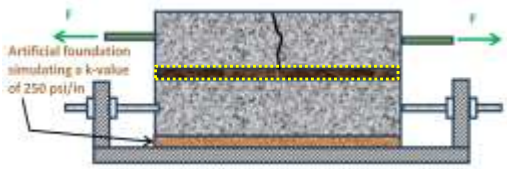
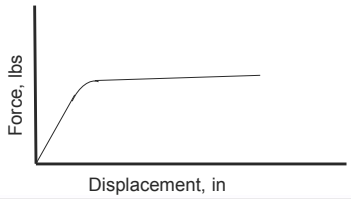
2. Characterize friction along interlayer (Friction interface)



- Similar setup for first beam test
- Friction dictates shear transfer between layers
- Force (F) vs. horizontal displacement relationship



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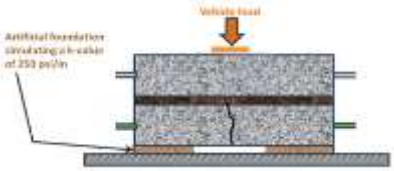
3. Characterize ability to prevent reflective cracking

- Load increased until reflective crack generated



Sufficient “cushion” to prevent reflective cracking?

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4. Direct tension test

- Effect of curling warping stresses
- Measure vertical deformations within interlayer

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Thank You

Any Questions?

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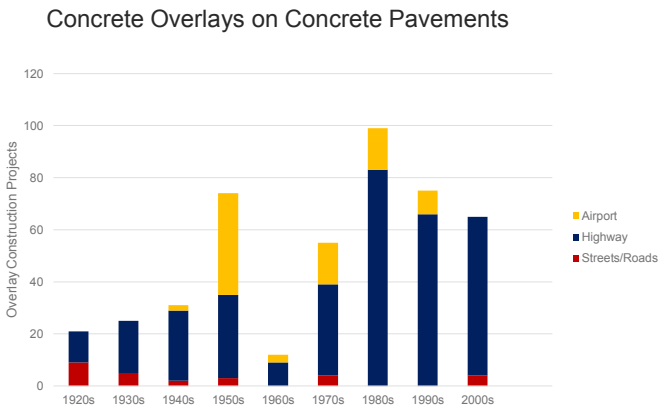
Unbonded concrete overlays in the US



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ACPA Overlay Explorer

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Michigan

Dense graded samples cut from MI

SR 131 Unbonded Overlay
~ 1 inch
aged dense graded HMA

Unknown In-service Overlay
~ 2 inch
aged open graded high asphalt content

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Thanks to Andrew Bennett, Ben Krom, and John Staton of the Michigan Department of Transportation

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Minnesota

Open graded PASSRC from Minnesota

HMA overlay from I-94 MnROAD
~ 2.75 inch unmilled/~ 0.875 inch aged milled
Aged dense graded HMA overlay from

US-169
~ 1.75 inch
New open graded high AC HMA (PASSRC)

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Thanks to Thomas Burnham, Robert Strommen and Jack Herndon at the MnROAD Research Facility, Derek Tompkins of the University of Minnesota

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