Concrete Overlays and Inlays

Southeastern States Pavement Management and Design Conference
New Orleans, LA      May 11-13, 2009
States with Concrete Overlay Experience

- With concrete overlay experience (mainly overlays on asphalt)
- With little known concrete overlay experience

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Classes of Concrete Overlays

**Concrete Overlays**

- **Bonded Resurfacing Group**
  - Bonded Concrete Resurfacing of Concrete Pavements
  - Bonded Concrete Resurfacing of Asphalt Pavements
  - Bonded Concrete Resurfacing of Composite Pavements

- **Unbonded Resurfacing Group**
  - Unbonded Concrete Resurfacing of Concrete Pavements
  - Unbonded Concrete Resurfacing of Asphalt Pavements
  - Unbonded Concrete Resurfacing of Composite Pavements

**Bond is integral to design**

**Old pavement is base**
Bonded Resurfacing Family

- Thin overlays (2” – 5”).
- Constructed over concrete, asphalt, and composites.
- Bond is critical!

Bonded Resurfacing Family

- Bonded Concrete Resurfacing of Concrete Pavements
- Bonded Concrete Resurfacing of Asphalt Pavements
- Bonded Concrete Resurfacing of Composite Pavements
Feasibility

- HMA pavements with reasonable structural integrity.
  - Limited structural (fatigue) cracking.
  - No stripping or raveling in HMA layers.
  - HMA thickness after milling > 3 in to 4 in.
- Rutting in HMA layers is ok.
- Non-load associated cracking is ok.
Thin Bonded Concrete Overlays of Asphalt Pavements

Square Slabs
(2 by 2 ft to 6 by 6 ft)

Milled Surface

Existing Asphalt Pavement

Relatively Thin Slabs
(2 to 6 in)
Ultra-Thin Whitetopping
Savannah (2001 ±)
Research – mid 1990’s to 2004

- Instrumented test sections
- Developed practical Guidelines for Design & Construction of UTW and TWT
  - Design rationale: ADT, MR, E, k-value, etc.
  - Optimum thickness
  - Joint spacing
  - Treatment of the existing surface
  - Use of dowel and tie bars

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CDOT Recommendations

- Min. AC thickness after milling = 5 in.
- Need good bond between AC and PCC
- Preferred Design (Colorado after 2000)
  - TWT – 5 or 6 in. thick & 6 x 6 ft joint spacing
  - Deformed tie bars at longitudinal joints
  - Dowels not necessary
  - Fibers not necessary
- TWT viable rehab for ACP using LCCA
Parker Road TWT Project
May-November, 2004

- 6 lanes, ~ 2 miles (6x6x6)
- ADT – 52,000 vpd
- LCCA performed
- Total cost: ~$5,000,000
- Concrete cost: ~$2.1 million
Design
- TWT thickness: 6 inches
- Cross slope correction to 2%

Concrete:
- 1.5 inch Aggregate
- 28 Day Compressive Strength = 4,200 psi
- 4 to 8% Air Content

6 x 6 ft Joint Spacing
- #4 epoxy coated tie bars at the longitudinal joints @ 30 in.
- Single cut and silicone sealed

Paving width – 36 ft
Bonded Concrete Overlays of Asphalt/Composite Pavements - Keys to Success

- Bonding is critical.
- Small square panels reduce curling, warping, & shear stresses at bond (1 to 1.5 times thickness).
- Mill if necessary to correct crown, remove surface distresses, improve bonding. Be sure to leave 3” of HMA after milling.
- HMA surface temperature below 120 F before paving.
- Transverse joints must be sawed T/3.
- Joints in the overlay should not be placed in wheel paths, if possible.
- Application of curing compound or curing methods must be timely and thorough.
Unbonded Resurfacing Family

- Thicker overlays than bonded.
- Constructed on existing concrete, asphalt, or composite pavements.
- Bond is not considered in the design. However, some bonding still exists.
Uses and Advantages - Unbonded Concrete Overlays

- Typically used when existing pavement is significantly deteriorated:
  - Severe rutting.
  - Potholes.
  - Alligator cracking.
  - Shoving and pumping.
  - Exhibits past D-cracking and ASR.

- Used when underlying pavements and subbase are stable and uniform except for isolated areas (minimal pre-overlay repairs).
Separator Layer

- Required for good performance.
  - Isolate overlay from existing pavement:
    - Prevent reflection cracking.
    - Prevent bonding/mechanical interlocking.
  - Provide level surface for overlay construction.

- Recommended interlayer material:
  - 1-2 inch dense-graded HMA.
  - GEOTEXTILE ?? (Missouri Demo – Sept 2008).
I-85 Anderson County, SC

- Constructed 1963
  - 9 inches Jointed Plain Concrete
  - 25 foot joint spacing w/o load transfer
  - Asphalt shoulders
- First rehabilitation 1978
- Second rehabilitation 1991
- By 1996, distress was at very high levels
I-85 Anderson County, SC

1998 - Funding shortage, decided to rubblize northbound lane only

- ADT = 38,000, 35% trucks
- Assumed rubblized structural coefficient = 0.30
- Overlay thickness = 8 inches
I-85 Anderson County

Massive problems:
- No traffic without two lifts on rubblized PCC
- Extended lane closures
- Post-rubblized deflections in excess of 100 mils
- Overlay increased from 8 to 12 inches
- Reconstruction between bridges
- 6 mile traffic jams, numerous complaints
- Chain collision accident with multiple fatalities
What to do for the southbound lane?
- Condition was very poor
- No suitable detour available
- Traffic volumes justified widening from four to six lanes
- Decided to do unbonded concrete overlay
I-85 Anderson County

- Project let February 13, 2001
- A+B bid prices
- Low bidder – Lane Construction
  - A = $60,945,869.20
  - B = $4,117,500.00
  - Total = $65,063,369.20
Unbonded Concrete Overlays of Concrete Pavements - Keys to Success

- Full-depth repairs are required only where structural integrity is lost at isolated spots.
- Separator layer (normally 1” asphalt) is important to isolate unbonded overlay from underlying pavement and minimize reflective cracking.
- With heavy truck traffic, adequate drainage design may be important to reduce pore pressure in asphalt separation layer.
- Faulting of 3/8 in. or less in the existing concrete pavement is not a concern when asphalt separation layer is 1 in. or more.
- Shorter joint spacing helps minimize curling and warping stresses. Transverse joints at 1.5 times thickness for <6” and 2 times thickness 6” or greater up to 15’.
- No need to match joints with those of the underlying concrete pavement.
Asphalt condition can be a good indicator of the underlining concrete pavement condition.

Review the profile grade line for significant deviation.

Localized areas of weakness can be strengthened through patching. Milling can remove a number of asphalt surface distresses.
Design Basics: Conventional Unbonded Overlay Over Asphalt

- **Thickness:**
  - Designed as new pavement on asphalt base.
  - Assumes no bonding to the existing asphalt.

- **Jointing:**
  - Spacing - same as new concrete pavement.
  - Depth - adjust for AC distortion.
  - Reinforcing & dowels - same as new pavement.
Concrete Inlays
Existing Pavement
Scope of Work

- Mill Existing Asphalt Surface to varying depths up to 14” in places.
- Place 10” Plain Jointed Concrete Pavement in areas where severe rutting and shoving existed.
- Place Superpave Asphalt Mixes in areas with less severe rutting and shoving.
Lane Closure Details

- Lane Closures allowed around the clock from Sunday 8:00pm until Friday 6:00am

- Any other lane closures would be limited to 8:00 pm until 6:00am each night.
Time Constraints

Removal of Existing Pavement and Placement of Concrete Pavement Limited to TWO WEEKS
I-55, Carroll Co., MS
Warranty Project

- Completed Spring 2002 w/ 10-year warranty
- 7.1 miles of 4-lane interstate
- 10” thick
- 196,969 sq. yds. @ $20.40/sy
- 78 days SB, 32 days NB
- PI= 1.9 SB, 3.1 NB
  
  Grinding: 22 SB, 20 NB
CONCRETE INLAY
I-75 Cobb/Cherokee Co., GA

May 2007  October 2008
Project Overview

- 170,000 ADT Section of I-75
- Trucks: 11% MU; 3% SU
- 650,000 SY PCC = 217,000 CY
- 91 Lane Miles Reconstruction
- 3 Construction Stages
- Lane Closure Restrictions
- Holiday Shut Downs
- Full Grind on ALL Completed PCC Pavement
- Paving start March 2007
- Project Completion April 2009
Concrete Overlay Guide, Second Edition

Contents:
- Overview of Overlay Families
- Overlay types and uses
- Evaluations & Selections
- Six Overlay Summaries
- Design Section
- Miscellaneous Design Details
- Overlay Materials Section
- Work Zones under Traffic
- Key Points for Overlay Construction
- Accelerated Construction
- Specification Considerations
- Repairs of Overlays
Concrete Overlays – Expected Service Life

- Thickness of 2 to 6 in. – 15 to 25 years
- Thickness > 6 in. – 20 to 30+ years

Overlay service life is dependent upon:

• Sound overlay structural design - compatible with expected traffic and site conditions, and
• Good construction practices
Summary

- Both bonded and unbonded concrete overlays have shown excellent performance if designed and constructed correctly.
- The choice of overlay type is based on the condition of the existing roadway and the desired objectives.
- Pre-overlay repairs are generally not required for most projects.
- Fast-track techniques are frequently employed to promote early opening to traffic.
Questions?