Concrete Overlays

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FOUNT OF ALL KNOWLEDGE
TAP OF OCCASIONAL INSIGHT
BUCKET OF USELESS TRIVIA
SPRINKLER OF DUBIOUS FACTS
PUDDLE OF MISLEADING STATISTICS
Why overlay with concrete?

• Concrete is the longer lasting pavement solution; can last 30 or more years with minimal maintenance.
• Concrete can be the cheaper solution when long-term maintenance and user costs are figured.
• Get in, get out, stay out...
What are the concrete options?

• Remove 5 to 12 inches of existing pavement and replace with concrete. (Unbonded Overlay)
• Remove 0 to 5 inches of existing pavement and overlay with concrete. (Bonded Overlay)
What’s the distinction between the options?

• An unbonded overlay with concrete is designed in a similar manner to a traditional pavement.
• It may depend on the material underneath for support, but does not depend on being bonded.
• However, bonding does improve performance.
Concrete pavement design principles

- PCC pavements are rigid
- Vehicle loads are distributed over large areas (beam strength) (15-20 ft)
- Minor deflections
- Low subgrade pressures
- Subgrade uniformity is more important than strength
Asphalt pavements are flexible

- Distribution of loads depends largely on pavement thickness
- Load on subgrade is more concentrated
- Deflections are much higher
- Subgrade strength/stiffness is very important
Thin bonded overlay design principles

- Asphalt surface is unable to resist traffic braking or accelerating forces.
- Hybrid structure is sufficient to carry traffic loads.
Thin bonded overlay design principles

- Maintaining bond is critical to keeping the two layers acting as a single unit. If bond is lost, stresses in concrete layer will increase greatly.
Bonded versus unbonded behavior

Bonded

Unbonded

Tension 0 Compression

Tension 0 Compression
Suitable candidates for bonded overlay

- Stable support conditions (localized weak areas can be strengthened)
- Surface distresses
  - Rutting/shoving of surface layer (not deep)
  - Top down cracking (mostly age-related)
- Minimum of 3 inches of asphalt remaining after milling.
Poor candidates for bonded overlay

- Significant structural deterioration
  - High severity fatigue cracking
  - Rutting of base and subgrade
- Stripping of asphalt layers
- Poor drainage
- Inadequate or uneven support
- Inadequate base structure
Selection of bonded overlay thickness

- Several methodologies available
  - PavementDesigner.org
  - University of Pittsburg BCOA-ME
  - FHWA Pooled Fund Study 5-165
BCOA-ME

• Available online
  - Search for “BCOA concrete asphalt”
• Software runs at University of Pittsburgh over the web from data input online.
• No cost to use
• Site contains lots of background information and documentation.
The bonded concrete overlay of asphalt mechanistic-empirical design procedure (BCOA-ME) was developed at the University of Pittsburgh under the FHWA Pooled Fund Study TPF 5-165. This pavement structure has been referred to as thin and ultra-thin whitetopping. This site is a repository for all information relating to the BCOA-ME. The information has been sorted based on its intended use and can be retrieved by clicking on the appropriate tab below. The BCOA-ME can be run directly from this site by clicking on the “Design Guide” tab below.
Joint layout

- Avoid placing longitudinal joints in wheelpath.
- Smaller slab sizes (less than 6’ x 6’) sometimes (but not always) reduce overlay thickness.
- Need to balance reduction in thickness with increase in joint sawing and potential maintenance, if sealed.
Material considerations

- Concrete
  - May use high-early strength to facilitate construction.
  - Consider using fibers in concrete when overlay thickness is 4 inches or less.
  - Fiber type and quantity should be selected to achieve a minimum residual strength of 20%.
Construction considerations

• A milled surface enhances the bond, especially for overlays 4 inches or less.

• Milling depth should:
  - Remove surface distortions > 2 inches deep
  - Match curb or adjacent structure elevations
  - Account for changes in cross slope prior to placement of surface layer. (But, don’t mill too much!)
Construction considerations

• Ensure the milled surface is clean
  - Sweep the surface thoroughly
  - Remove dust with compressed air

• Mist the surface prior to concrete placement
  - Reduce surface temperatures
  - Reduce moisture absorption from concrete
  - No standing water
Construction considerations
Construction considerations
Construction considerations
Examples
US-501 and 378, Conway, SC - 2004
US-501 and 378, Conway, SC - 2004

• Extremely severe rutting
• Pavement was approximately 15 inches thick
• Coring revealed that a layer about 10 inches down was the source of instability
US-501 and 378, Conway, SC - 2004

- Decided to mill 10” to 14” to restore cross slope.
- 10” thick overlay of plain jointed concrete with 1.5” dowels and 15’ joint spacing.
US-501 and 378, Conway, SC - 2004
US-501 and 378, Conway, SC - 2004
US-501 and 378, Conway, SC - 2005

• Scope of work
  - Work was done in February during low season
  - Had to maintain traffic in one direction
  - Could have 24-hour closures from Sunday at 8 PM to Friday at 6 AM.
  - Had to finish concrete paving in two weeks.
US-501 and 378, Conway, SC - 2005
US-501 and 378, Conway, SC - 2005
US-501 and 378, Conway, SC - 2005
I-385, Laurens County, SC
I-385, Laurens County, SC

- 14 centerline miles – unbonded overlay
- Milled 6” existing asphalt
- Replaced with 10” Plain Jointed PCC, RCC shoulder
- Constructed commenced January 2, 2010
- Ribbon cutting July 23, 2010 (202 days later)
I-385, Google Maps, March 2009
US-82 and US-84, Waycross, GA

• Thin bonded overlay
• 4 inches thick
• Let July 2003
US-82 and US-84, Waycross, GA
US-82 and US-84, Waycross, GA
US-82 and US-84, Waycross, GA
SR-25 at Brampton Rd, Garden City, GA
SR-25 at Brampton Rd, Garden City, GA
Blossom Street at Assembly, Columbia, SC
Blossom Street at Assembly, Columbia, SC
Harden Street at Gervais, Columbia, SC
THE CAROLINAS FIRST
ULTRA-THIN WHITETOPPING INTERSECTION
PROJECT

Wednesday, August 7, 1996
11:00 a.m. - 3:00 p.m.
Alamance County Chamber of Commerce Parking Lot
610 South Lexington Ave. @ Intersection Morehead Street
Burlington, North Carolina

Conventional whitetopping is the construction practice of placing concrete over an existing, deteriorated surface, such as asphalt, to provide a new riding surface. Two
E. Morehead Street, Burlington, NC – 8/7/1996
Guide to
CONCRETE OVERLAYS
Sustainable Solutions for Resurfacing and Rehabilitating Existing Pavements
May 2014

A practical approach to understanding and successfully using concrete overlays, from selection to opening
The great author considers his response to the question.
Thank you!

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