Annual Meeting of the City Engineers Association of Minnesota

Concrete Matters: Overlays, Specs and Design

Presented by:
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Concrete Paving Association of MN
January 30, 2013
Are Concrete Overlays New - NO

- 1918 Terre Haute IN – 3”- 4”
- 1926 OH – 6” over brick
- 1931 Chicago – 5”
- ...
- 100 +/- built around the country 1983 and older
Concrete Overlay Guide second edition

Contents

1. Overview of Overlay Families
2. Overlay types and uses
3. Evaluations & Selections
4. Six Overlay Summaries (11”x17 “sheets)
5. Design Section
6. Miscellaneous Design Details
7. Overlay Materials Section
8. Work Zones under Traffic
9. Key Points for Overlay Construction
10. Accelerated Construction
11. Specification Considerations
12. Repairs of Overlays
Benefits of Concrete Overlays

• Provides cost effective solutions - $ for $ the best long term rehabilitation option
• Construct quick and conveniently
  – Typically, no need to remove existing pavement
  – Little pre-overlay repairs required in most cases
  – Uses standard concrete paving equipment
  – Accelerated practices can be used - can be opened in a day
Benefits of Concrete Overlays

• Can be repaired easily
• Durable - Olmsted Co 10 (1982 – 30 years old)
  – Very little maintenance required
  – Stays smooth longer
• Inherent sustainable properties
  – Cool
  – Long life
  – Improved mileage
Benefits of Concrete Overlays

• Increased safety
  – Better skid resistance
  – No rutting or shoving
  – Improved visibility

• Partial bond creates composite section adding to design life

• Short panels reduce curling and warping stresses as well as minimizing expansion/contraction
Uses and Key Issues for Each Concrete Overlay

- Bonded Concrete Overlays of Concrete Pavements
- Bonded Concrete Overlays of Asphalt or Composite
- Unbonded Concrete Overlays of Concrete Pavements
- Unbonded Concrete Overlays of Asphalt or Composite
Concrete Overlays
Service Life Expectations

• 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
Overlay Selection

Overlay Selection Flow Chart

Pavement Condition Rankings
(based on existing pavement conditions)

Concrete Pavement Condition

Good or Better (Concrete)
Structurally and materially sound but in need of increased structural capacity, improved rideability or skid resistance, or removal of surface defects.

Asphalt/Composite Pavements Condition

Good or Better (Asphalt/Composite)
Structurally and materially sound but needing increased structural capacity, improved rideability or skid resistance, or removal of surface defects.

Can spot surface repairs and/or spot structural repairs cost-effectively solve any deficiencies, bringing the pavement to “Good Condition” before overlay is constructed?

Yes

Can a 2.5 in. (50–125 mm) bonded overlay design cost-effectively meet future traffic loads and design life requirements?

Yes

Can a 4 in. (100 mm) or greater unbonded overlay design cost-effectively meet future traffic loads and design life requirements?

Yes

Are there any indications of potential future durability problems, such as early-age NAV or unstable conditions?

No

If existing pavement is concrete, can joints in overlay be sealed to match joints in the existing concrete pavement?

Yes

Design Bonded Overlay (2–5 in. [50–125 mm])

Or

Design Unbonded Overlay (4–5 in. [100–125 mm])

No

If milling is used for rehabilitation, can milling remove major surface and structural deficiencies and still maintain a minimum of 3–4 in. (75–100 mm) of existing pavement to serve as base for a new unbonded overlay?

Yes

Consider on-site recycling and reconstruction options.

1. Mill or crush pavement as granular material; recycle as base or shoulder material. (Although not a mainstream approach, concrete pavements may be crushed as long as they are uniform and the subgrade is stable enough to support rehabilitation. See page 30.)

2. Place full-depth concrete.

Or

Construct full-depth pavement replacement

Figure 10. Flowchart process for selecting concrete overlay type.
Types of Concrete Overlays

**Bonded**

2” – 5”

- Bonded Concrete Overlays of Concrete Pavements
  – previously called bonded overlays –

- Bonded Concrete Overlays of Asphalt Pavements
  – previously called ultra-thin whitetopping –

- Bonded Concrete Overlays of Composite Pavements

**Unbonded**

4” – 11”

- Unbonded Concrete Overlays of Concrete Pavements
  – previously called unbonded overlays –

- Unbonded Concrete Overlays of Asphalt Pavements
  – previously called conventional whitetopping –

- Unbonded Concrete Overlays of Composite Pavements
Concrete Unbonded Overlay of Concrete
Fig. 1. Concrete overlay of poor condition concrete pavement
Unbonded Overlays Can be Placed over Poor Concrete Pavements
Separator Layer

• Required for good performance
  – Isolate overlay from existing distress
    ▪ Prevent reflection cracking
    ▪ Prevent bonding/mechanical interlocking
  – Provide level surface for overlay construction

• Recommended interlayer material:
  – 1-2 in HMA
  – Geotextile (Missouri Demo – Sept 2008)

• Must keep cool
• OK to haul on it as long as demonstrate no damage
Geotextile Separation Layer (Interlayer)

No turn

Minimize wrinkles
Concrete Unbonded Overlay of HMA or Composite Pavement
Unbonded Concrete on Asphalt/Composite Pavements

- New unbonded resurfacing
- Need for milling determined based on degree of surface distortions
- Existing deteriorated composite pavement
- Full-depth repair patches
- Fatigue cracks (alligator cracking)
- Block cracking
- Shoving
- Pumping
- Rutting
- Longitudinal & transverse thermal cracking
- Sub-drainage
Semi-Uniform Platform

Removed 6 in of existing 9-in HMA Pavement

Remaining HMA severely damaged from trucks hauling away millings
Widened Pavements

- Tiebars stapled to asphalt if overlay is < 5 in. (12.7 cm)
- If ≥ 6 in. (15.2 cm) then place tiebar in the center of the overlay
- Keep joint out of wheel line where possible
- Sawcut joint only if joint is in the wheel path
- 3–6 ft (0.9–1.8 m) concrete widening unit
- Extend tiebar only if wheel loads are to be on concrete widening

Previous widen with asphalt or concrete

Bonded or Unbonded Overlay of Asphalt or Composite. (Previously widen with asphalt or concrete. To be widen with new overlay)
Overlay for Two Lane Roadway with Paved Shoulders (Conventional Paver)

**COMPLETED OVERLAY**

**STAGE 1**

Typically less than 0.25 mi (0.40 km) without pilot car

Base shoulder widening
See legend for materials.

Traffic control device

Vehicle traffic 11 ft (3.35 m) min.

Existing subbase

Existing pavement

Surface repair and overlay surface preparation

Separation layer (for unbonded overlay)

Construction area

Existing shoulder

Traffic control device

Existing shoulder

1. Vehicle traffic 11 ft (3.35 m) min.

2. Base shoulder widening

See legend for materials.

Remaining shoulder

Paved shoulder

12 ft (3.66 m) lane

12 ft (3.66 m) lane

Existing shoulder

Existing shoulder

Paved shoulder

Paved shoulder

Paved shoulder

Paved shoulder

Rumble strip

Finished shoulder

Concrete overlay

Separation layer (for unbonded overlay)

Existing pavement

Pavement marking
Unbonded Over Asphalt/Composite
Keys to Success

- Milling to eliminate surface distortions of 2 in. or more
- Complete repairs at isolated spots where structural integrity needs restoring
- Concrete patches in the existing pavement should be separated from the overlay
- Surface temperature of existing asphalt pavement should be maintained **below** 120°F when placing overlay
- Partial bonding between the overlay and the existing asphalt pavement is acceptable and may even improve load-carrying capacity
County Road D-38 from Sergeant Bluff east 0.7 miles
Constructed in IA in 1960
Overlay Type: Unbonded on Asphalt
Application: Highway
Overlay Thickness: 6 in.
Click for more details...
Waseca Co., 7" Nominal
• No problems evident by overlaying 27 ft over 24 ft
  – Narrower pavements also possible (examples TH 212 near Olivia – 27' over 20')
TH 53 Near Twig MN 5” OL
### 1997 & 2004 Whitetopping

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- **HMA**: Hot-Mix Asphalt
- **1993**: Year of application
- **58-28**: Blend of aggregate types
- **Trans**: Transition layer
- **Tined**: Tined layer
- **Polypro**: Polypropylene layer
- **Clay**: Clay layer
- **Turf**: Turf layer
- **noseal**: No sealant applied
- **sealed**: Sealed with asphalt
- **Oct**: Month of inspection
**MnROAD Phase II Mainline Details**

- Cell 5
- Unbonded Overlay
- 300’ – 4”
- 300’ – 5”
- 1” asphalt bond breaker or fabric bond breaker
- No steel
- 15’ joint spacing

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- Cell 14
- Whitetopping – poor asphalt
- 6” x 6’ x 6’
- No seal
- 1” dowels in driving lane, no dowels in passing lane
- Vary milling 3” to 6”
I-35 North of Twin Cities
“6 x 6 x 6”
I-35 North of Twin Cities

“6 x 6 x 6”
Humboldt Co., Iowa

- Route C26
- 10 mile overlay
- Alternate bid
- 4” PCC on milled AC vs 3” AC on 4” CIP
- Low PCC bid - $1,505,616
- Low AC bid - $1,593,777
- 5.5% savings
- Additional life???
Humboldt Co, IA - C26
Washington Co
Washington Co
Moorhead
Moorhead
Moorhead
Olmsted Co
Questions???

Thanks