INTRODUCTION TO CONCRETE OVERLAYS

Who is supporting this webinar?

Introductions

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- Questions are encouraged since we are practicing physical distancing!

The Concrete Overlay Webinar Series

I. Introduction to Concrete Overlays
II. Overview of Concrete Overlays / Existing Pavement Evaluation and Overlay Selection
III. Concrete Overlay Design
IV. Plans, Maintenance of Traffic and Construction
V. Maintenance of Concrete Overlays and Resources Available to you.

And throughout - examples of how concrete overlays are performing around the country

THE CP TECH CENTER

The National Concrete Pavement Technology Center (CP Tech Center) at Iowa State University is a national hub for concrete pavement research and TECHNOLOGY TRANSFER.

MISSION:
- Help street and road agencies find answers to their concrete pavement-related questions.
- Identify critical concrete pavement research needs and discover sustainable solutions.
- Help agencies, industry, and businesses incorporate advanced, sustainable solutions and new technologies into their day-to-day practices.
Today’s Challenge: Fix now or pay more later

- Our roads are getting old. We can:
  - Toss them out and start again
  - A long term solution
  - Creates a disposal headache
  - Takes energy to move them out of the way
  - Takes time = traffic delays

What’s This All About and Why Bother?

• Our roads are getting old. We can:
  - Patch them – buy a few years
  - Limited materials usage, energy and traffic impact
  - Short term solution
  - Unreliable
  - Smoothness is poor

Why Bother?

• Another tool to consider

System of Concrete Overlays on Asphalt or Concrete

- Banded Overlay Family
  - Old pavement is part of the structure
  - Existing pavement has to be in good/fair condition
  - Existing surface must be clean, rough and hard

- Unbanded Overlay Family
  - Old pavement is base
  - Existing pavement can be in poor condition
  - Asphalt or geotextile separation layer required

- Thinner
- Thicker
Bonded and Unbonded Concrete Overlays

- **Unbonded**
  - Must not bond to concrete
  - Some bonding to asphalt is OK
- **Bonded**
  - Must bond to concrete
  - Existing asphalt must be
    - Thick enough
    - Fair condition

**Expected Service Life**

- 2 to 6 in. thick — 15 to 25 years
- > 6 in. thick — >20 years

**Assuming:**
- Sound structural design
- Good construction practices

**How, in simple terms?**

- Evaluate the pavement in place
- Design the overlay
- If needed — grind & repair damage
- Prepare interface
- Pave
- Cure and cut joints

**Thickness Design**

- ME Design includes option for overlays on asphalt based on BCOA method (Vandenbossche@Pitt)
- PavementDesigner.org
- AASHTO 93
- OptiPave

**Manholes, Inlets and Other In-Pavement Structures**

- Telescoping rings
- Boxout for slip form paving
Treatment of Existing Curb

- Leave the existing curb in place
- Remove the curb
- Remove the curb and gutter
- Overlay the curb

Concrete Overlay Details

Pre-overlay Repair & Surface Preparation

- Full-depth repair of deteriorated joints
- Partial-depth repair of severely spalled areas
- Load transfer restoration or full-depth repair of working cracks
- Surface preparation
  - Mechanical preparation
  - Clean the surface

Separation Layer

Options for a Separation Layer

- 1" asphalt
  - A stress relief layer
  - Can help prevent keying of the overlay in faulted concrete pavements
  - Stripping of the asphalt binder can occur due to poor drainage and heavy truck traffic.
### The Mixture

- Conventional requirements:
  - w/cm
  - Air
  - SCM dose
  - Combined aggregate gradation
  - Paste content

### Joints

- Panel sizes depend on type and thickness of overlay
  - Bonded:
    - Smaller panels
    - Bonded on concrete: match existing
    - Cut full depth
  - Unbonded:
    - Thinner overlay = smaller panels
    - Saw depth: T/3

### Dowel Basket Anchorage

- If dowels are needed then fasteners are required to prevent tipping

### Constructing Overlays Under Traffic

- Safety
- Traffic Flow
- Work Zone Space
- Impact to shoulder

### Two Lane Paving With Detour

- Faster
- Safer
- Traffic control is simpler
- More effort needed on public relations

### Stringless Paving

- GPS and Total station
- Increases clearances
- Improved smoothness
Curing

• Not Optional

Research: A Joint-Free Test Section

• Unbonded concrete overlay in Worth County, IA
• Typical Section:
  • 6 in with 12 x 12 ft panels
  • Geotextile interlayer
  • 4 lb/cy structural synthetic fibers
• 600 ft test section:
  • 7.5 lb/cy structural synthetic fibers
  • Increased cementitious content from 570 lbs to 640 lbs for workability
  • No transverse sawed joints – pavement allowed to crack on its own

Joint-Free Test Section

• Initial crack pattern:
  • 7 transverse cracks in 600 ft after 11 days (6 after 72 hours)

Internal Curing and Warping

• Two overlays built in 2018 in IA
• Both with ¼ mile IC test sections
• Both showing reduced movements with changing weather

Do they work?

• ACPA.org
  ➢ Resources: Project Explorers: Concrete Overlays

Nationwide Concrete Overlay Usage

Data compiled by ACPA and/or various paving associations and other sources, including Bid Express, Oman Systems and DOT websites.
Concrete Overlay Experience Around the Country

- Interstate 70 near Grand Junction, Colorado
- A Rural Road in Mitchell County, Iowa
- Executive Airport in Charleston, S.C.

Iowa's History of Concrete Overlays
- Over 2,000 centerline miles of concrete overlays have been constructed in Iowa since the late 1970s.
- Over half constructed since 2006
- Primarily on the rural county highway system
Iowa’s History of Concrete Overlays

- Early experimentation
  - Bonded concrete overlays of concrete
  - Many BCOC projects were constructed over the years, but have fallen out of favor since the 1980s and 1990s

- “Whitetopping” projects emerge in the 1970s
  - Concrete over asphalt
  - By late 1970s and 1980s, they begin to be constructed regularly on county highways

- Prevailing early whitetopping designs: 6 inch PCC over HMA
  - The two layers will tend to bond together, but the bond was not considered in design or construction

- 1980s: Unbonded concrete overlays of concrete (UBCOC)
  - Again, predominantly on county highways
  - HMA interlayer became the standard
  - 2000s: geotextile interlayer is introduced

- 1990s: Experiments begin with “ultra-thin whitetopping”
  - Thin PCC overlay (3-6 inches)
  - Designed to bond to underlying HMA for structural support (bond is critical to the design)
  - Shorter joint spacings help reduce stresses, slab curling

Construction today:

- Many Iowa counties continue to build UBCOC projects and 6+ inch PCC overlays of asphalt (BCOA/UBCOA) with conventional joint spacing
- In some Iowa cities and counties (and with Iowa DOT), thinner BCOA designs have become popular
Performance History of Iowa’s Concrete Overlays

- Concrete overlays have been used successfully in Iowa for decades
- Despite this history, unanswered questions:
  - What kind of service life can we expect from a new PCC overlay?
  - From our existing overlays?
- 2017 CP Tech Center performance review:

Performance History of Iowa’s Concrete Overlays

- Performance data obtained through the Iowa Pavement Management Program (IPMP)
- Automated pavement condition data collected for local agencies
- Performance characterized by PCI (Pavement Condition Index)
  - IRI (smoothness)
  - Transverse Cracking
  - Joint Spalling
  - D-Cracking
  - (Faulting considered separately)

Performance History of Iowa’s Concrete Overlays

- Results (PCI):
  - All overlay types together

Performance History of Iowa’s Concrete Overlays

- Results (IRI):
  - All overlay types together

Performance History of Iowa’s Concrete Overlays

- Key findings and trends:
  - Overall performance of Iowa’s overlays has been excellent
  - Good performance from each of BCOA, UBCOA & UBCOC
    - Overlays of asphalt performed slightly better than UBCOC
    - BCOC: less successful overall, but performed well in context of design life expectations

Performance History of Iowa’s Concrete Overlays

- Key findings and trends:
  - Thickness
    - In general, thicker overlays have performed better for all overlay types (e.g. for BCOA, 6 in. > 5 in. > 4 in.)
  - Transverse joint spacing
    - Good early performance from BCOA short slab designs
    - Older designs with conventional joint spacing performed well over longer periods of time
  - Traffic – inconclusive
    - Most of these projects are low volume, <1,000 vpd
Performance History of Iowa’s Concrete Overlays

- Lessons learned from Iowa performance history:
  - Based on performance history to date, we can design concrete overlays to last 30+ years
  - Concrete overlays are very well-suited to county highways
  - Good success to date on other types of highways as well

Pottawattamie County, IA, Constructed 1993

Performance History of Iowa’s Concrete Overlays

- With proper materials, construction and design, there is still plenty of room to improve performance!

12 ft Joint Spacing, less than 20 years old

Resources

https://cptechcenter.org/concrete-overlays/

QUESTIONS?