What is ACPA?

- World's largest trade association representing the interests of those involved with the design, construction, and preservation of concrete pavements
- Supports research and promotion to improve the quality of concrete pavements and expand their use
- Provides engineering expertise, design tools, pavement specifications, construction best practices, and education to members and agencies

- Executive Director: Angela Folkestad, P.E.
- Pavement Engineer: Sarah Sanders, P.E.
Concrete (Rigid) vs. Asphalt (Flexible) Pavement

- All pavement is rocks held together with a binder
- Concrete carries load in pavement structure
- Exerts less pressure on base materials
- Better for heavy loads
- Strength is important
- Asphalt relies on strength of base materials and subgrade
- Requires more thickness and layers
- Characteristics change with ambient temperature

Materials in a Concrete Pavement Section

- Conventional Concrete Pavement
- Concrete Overlay (Whitetopping)
- Asphalt Pavement
- Soil-cement
- Cement-treated base
- Full Depth Reclamation
- Cement-modified soil

Concrete Pavement Types

- Jointed Plain
  - Undoweled
  - Doweled
- Jointed Reinforced
- Continuously Reinforced

Thin Concrete Overlays on Asphalt Pavements

- Rely on existing asphalt pavement to provide additional load-carrying capacity, and bond to existing asphalt pavement to form a monolithic section
- Add structural capacity where traffic loads have increased or are anticipated to increase
- Eliminate surface defects such as rutting and shoving
- Improve surface characteristics (friction, noise, and smoothness)
Concrete Overlay (Whitetopping)
Ultra-Thin Concrete Overlay (Whitetopping)

- <5" concrete layer on top existing asphalt pavement
- Steps taken to bond the new concrete to existing asphalt
- Short joint spacing
- May or may not contain fibers

Unbonded Concrete Overlays

Concrete Inlays

- The same methodology can be applied to replace portions of ACC pavements.

Concrete Inlays

- Replace deteriorated ACC lanes with PCC...the result can again be much cheaper than the overlay alternative.
Concrete Inlays

Definition

"Roller-Compacted Concrete (RCC) is a no-slump concrete that is compacted by vibratory rollers."

- Zero slump (consistency of damp gravel)
- No forms
- No reinforcing steel
- No finishing
- Consolidated with vibratory rollers

Concrete pavement placed in a different way!

Jointing Concrete Pavements

ROLLER COMPACTED CONCRETE

Jointed Plain Concrete Pavement (JPCP)

Plan

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Dowel Bars

- Smooth steel bar
- Promotes load transfer between panels
- Prevents Faulting
- Size dependent on thickness
- Need to have one side oiled to prevent bonding
- Pavement moves around bars
- Epoxy coated for corrosion resistance
Tie Bars

- Deformed steel bars
- Placed across joints to hold faces tight
- Supplement aggregate interlock
- Designed to overcome subbase resistance to slab contraction

Pavement Texture

- Transverse Tining
- Longitudinal Tining
- Diamond Ground
- Macrotexture (Burlap Drag)

Pavement Surface Texture

Microtexture
- Provides direct tire-pavement contact
- Contributes to adhesion component of friction

Macrotexture
- Allows for rapid drainage of water from pavement
- Provides hysteresis component of friction

Figure 18. Normalized distributions of CO2O levels for conventional concrete pavement textures.
1st Pavement Design Equation

- 1926 - Prof. Westergaard, University of Illinois published equations for stresses and deflections of concrete pavement
- Bureau of Public Roads (forerunner of FHWA) conducted 4 years of testing and published a very complete report on the “Structural Design of Concrete Pavements” to test Westergaard’s equation.

\[ d = \sqrt{\frac{p}{c s}} \]

- \( d \) = thickness
- \( c \) = stress coefficient
- \( p \) = wheel load
- \( s \) = allowable tensile stress

AASHO Road Test (1958-1960)

- Wholly empirical
- Included 368 concrete and 468 asphalt sections
- Focus was highway pavement

1986-93 JPCP AASHTO 93 Equation

- Performance Estimated Subjectively
  - Present Serviceability Index (PSI)
    - 4.0 - 5.0 = Very Good
    - 3.0 - 4.0 = Good
    - 2.0 - 3.0 = Fair
    - 1.0 - 2.0 = Poor
    - 0.0 - 1.0 = Very Poor
  - "Failure" at the Road Test considered @ 1.5
  - Typical U.S. state agency terminal serviceability in practice = 2.5

Pavement ME Design

- Not “perfect” & not intended to be a “final” product
- Complex
- For highways and NOT street, road, parking lot, etc.
AASHTO 93 vs. ME

Wide range of structural and rehabilitation designs

Limited structural sections

50+ million load reps

1.1 million load reps

1 set of materials

New and diverse materials

All climates over 20-50 years

1 climate/2 years

Need and Relevance – Addressing Demand

• High price point and learning curve for AASHTOWares's Pavement ME

• Non-DOT agency audience seeking affordable easy-to-understand design tools for pavement solutions, especially where traffic levels are low to moderate

• Consultants have similar needs and value quick-access design tools, providing quick answers

Pavement Designer-Overview and Background

• ACPA, NRMCA, and PCA partnership, with a contribution from the RCC Council to develop a website application to design cement-based solutions for:
  • Streets and Local Roads
  • Parking Lots
  • Intermodal Industrial Facilities

• Design guidance and tools for:
  • Jointed-Plain Concrete Pavements
  • Continuously Reinforced Concrete Pavement
  • Concrete Overlays
  • Roller Compacted Concrete
  • Cement Modified Soils
  • Cement-Treated Base
  • Full-Depth Reclamation

PavementDesigner

Questions?