Long Life Concrete Pavements – Wisconsin’s Experiences

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OR

Long Life Concrete Pavements
FHWA Goals for HPCP

- Increasing the service life.
- Decreasing construction time.
- Lowering life-cycle costs.
- Lowering maintenance costs.
- Constructing ultra-smooth ride quality pavements.
- Incorporating recycled or waste products while maintaining quality.
- Utilizing innovative construction equipment or procedures.
- Utilizing innovative quality initiatives.
Goals of HPCP in WI

- Incorporate as many of the FHWA goals as possible
- Do a comprehensive review of Minnesota efforts
- First pavement thickness designed utilizing MEPDG
- 50 year service life goal with no maintenance
- Utilize as much as possible the WisDOT Standard Specifications including quality management program and IRI Ride
QMP Concrete Pavement

- Incorporated all of Section 7 of Standard Specs on quality management
- Contractors know this well
- HPCP pavement builds on what we always do anyway
QMP IRI Ride

• Incorporated the then new IRI spec in 2009 into HPCP
• Now standard specifications
QMP Ride

- Segment IRI
- Localized Roughness
HPCP Additional Specifications

• QMP Concrete Pavement Special Requirements
• HPC Pavement Requirements for Concrete Pavement
QMP Concrete Pavement
Special Requirements

• Revised the rejectable concrete strength specification to 3000 psi from 2500 psi
• Revised the PWL strength specification to 4500 psi lower specification limit from 3700 psi

• WisDOT wanted better than average concrete on these projects
Additional Concrete Mix Requirements

• Concrete mix design approval requires a flexural strength of 650 psi or greater.
• Contractor required to fabricate beams for flexural strength and cylinders for split tensile strength and break them at 28 days for information to WisDOT
• Acceptance and pay continues to be on compressive strength
THIS HAS EVOLVED

- Flexural strength is now being required starting in 2016
- Rejectable strength 500 psi
- Lower specification limit is 650 psi

- PWL specification pay equations similar to compressive.
HPC Pavement Requirements for Concrete Pavement
MATERIALS
Supplementary Cementitious Materials

- Limits the maximum amount of ground granulated blast furnace slag to 30%
  - Currently 50%
  - Performance concerns on existing pavements with up to 50%

- Limits the maximum combination of fly ash and slag to 30%
  - Consistent with current specifications
HPC Dowel Bars

- 316L Stainless Steel Cladding
- 316L Stainless Steel Tubes
- Solid Stainless Steel
- UNS Z41121 Zinc Alloy Cladding
- CRT Bar – Conventional steel with fiber composite outer coating
HPC Dowels
DOWELCAD

• Adjustments to standards
• Project specific dowel design
• Shoulder design
HPC Curing Materials

- Desire to use a better cure than the traditional wax based cure
- Goal was a stronger more durable concrete surface
- Surface scaling issues in WI after the winters of 2007-2008
- Reviewed the MNDOT research project
- PAMS Resin based material retained 5 times the moisture in MNDOT research
HPC Curing Materials

• Furnish poly-alpha-methylstyrene membrane curing compound conforming to AASHTO M 148, type 2 as modified below.
  
  – Total Solids (% by weight of compound)  42 Minimum
  – % Reflectance in 72 hours (ASTM E1347)  65 Minimum
  – Loss of Water, kg/m² in 24 hours (ASTM C156)  0.15 Maximum
  – Loss of Water, kg/m² in 72 hours (ASTM C156)  0.40 Maximum
  – VOC content (g/L)  350 Maximum
  – Infrared Spectrum, Vehicle  100% alpha methylstyrene
HPC Curing Materials

• PAMS is now standard spec
• Success on the first HPCP jobs in construction and application
• Cost difference small

• Advantageous for industry to move forward with better materials.
Curing Concrete

• Requires use of only impervious coating method
• Must be applied within 30 minutes of finishing pavement
  – This has been an issue
• This was later removed.
• Contractor now manages.
HPC Concrete Aggregates

- Remove the marginal aggregates from consideration
- First HPCP projects on Interstate 94 in the Southeast
  - Limestone
  - Kettle Moraine gravel deposits
- Commitment to adjust as projects move around the state.
HPC Concrete Aggregates on SE Projects

• Coarse aggregate – 100% crushed limestone
• Reduced chert content from 5% to 3%
• Percent wear reduced to 30% from current 50%
• Soundness reduced to 6% from current 12%
• Freeze-Thaw average loss kept at 18%
Aggregate Availability?

• WisDOT analyzed aggregate data base and identified up to 30 sources able to meet specifications
• Industry argued that many were beyond the economical haul distances
• Commitment by WisDOT to analyze this for every project being proposed to use HPCP spec
New Aggregate Requirements
Starting in 2017

• Aggregates must be optimized.
• The definition of optimized has been set by specification
• Allows contractor to propose reduced cementitious per new National Center mix design process
• Minimum cementitious is 520 pounds per cubic yard.
The TARANTULA curve!!!!

Tarantula

COARSE SAND
Greater than 15% on the sum of #8, #16, and #30

FINE SAND
#30 - #200 between 24 and 34%

Excessive amount that decreases workability and promotes segregation and edge slumping.

Excessive amount creates workability issues
Tining

- As soon as practical after floating
- Self propelled machine tied to the stringline
- Longitudinal tining required (for noise)
- ¾ -inch uniform spacing
- No tines within two inches of a planned sawed longitudinal joint (minimize spalling potential)
- Again, all of this is now standard spec
Joints Treated with Penetrating Sealer

Treat sawed surfaces of transverse and longitudinal joints with a silane joint sealant found on the Departments Approved Products list for Concrete Protective Surface Treatments. Prepare surface by pressure washing all saw slurry from sawed joints and allow to dry thoroughly prior to application of silane sealer. Apply the product directly to the interior of the sawed joint. Do not use the broadcast spray method of application.
Extended Delivery Time

• Prohibited the use of a retarder in the concrete in order to extend mixing time

• Message sent to industry is they want local produced concrete
Central Mix Concrete

- Requires mixing by central mix plants
- Higher quality more consistent concrete is the goal
Delivery

• One hour

• This was later revised to follow the new standard specs

• This HPCP process once again influenced standard specs
Spec Delivery Time

• Section 501.3.5.2
• Agitator trucks with paddle not constantly rotating and Dump trucks:
  – Conc. temp. \( \geq 85^\circ F \) = 30 minutes.
  – Conc. temp. \( < 85^\circ \geq 60^\circ F \) = 45 minutes
  – Conc. temp. \( < 60^\circ F \) = 60 minutes
  – Conc. temp. \( \geq 60^\circ F \) with retarding admix = 60 minutes

• Agitator Trucks with paddle constantly rotating and Ready-Mix trucks:
  – Conc. temp. \( \geq 60^\circ F \) = 60 minutes.
  – Conc. temp. \( \geq 60^\circ F \) with retarding admix = 90 minutes
  – Conc. Temp. \( < 60^\circ F \) = 90 minutes
Hot Weather Concrete

- Contractor must submit a temperature control plan
- If concrete temperature at point of placement exceeds 80 degrees, temperature control plan goes into effect
- If air temp exceeds 80 degrees, asphalt base must be moist during concrete placement
- If concrete temperature exceeds 90 degrees, paving is stopped.
- Any work performed for the purpose of lowering temperature of the concrete is incidental.
ASPHALT BASE

• 3-inch asphalt base directly beneath concrete
  – Weather resistant paving surface
  – Trucking insensitive
  – Improved ride over aggregate bases

• Not required structurally
WisDOT HPCP TO DATE

• Approved for use on a corridor basis
• Approved by Chief Pavement and Materials Engineer in Central Office
• All criteria is evaluated for use on each corridor for quality issues, pavement performance in the area and cost effectiveness
HPCP Corridors

• **Interstate 94**
  – Southeast Region
  – Wisconsin/Illinois state line to downtown Milwaukee Marquette Interchange
  – Construction years 2009-????

• **U.S.H. 41**
  – Northeast Region
  – Oshkosh to Green Bay
  – Construction years 2010-2016

• **Interstate 39/90**
  – Southwest Region
  – Beloit to Madison
  – Construction Years 2016 - 2022
HPCP Cost Impacts – I.H. 94

• Approximately $3-$4 per square yard additional cost
• 10-12% additional cost for concrete pavement
• 1-2% increase on project costs

• THIS DOES NOT INCLUDE THE ADDITIONAL COST OF THE ASPHALT BASE
HPCP Cost Impacts – U.S.H. 41

• USH 41 did not include HPC dowels in the typical section
• Approximately $1 per square yard additional cost
• 2-3% additional cost for concrete pavement
• Less than 1% increase on project costs

• THIS DOES NOT INCLUDE THE ADDITIONAL COST OF THE ASPHALT BASE
Discussion & Questions

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