



Concrete Pavement Tour/Meeting Minutes

Valley Forge, Pennsylvania
August 30-31, 2017



The 2017 ACPA Pennsylvania Chapter/PennDOT concrete pavement tour and follow-up meeting, hosted by PennDOT Engineering District 6 with the cooperation of the Pennsylvania Turnpike Commission and the Pennsylvania Aggregates & Concrete Association, was held August 30 & 31, 2017 in Valley Forge, PA.

Tour Overview

On August 30, welcoming remarks were made by District 6 Assistant District Executive for Construction George Dunheimer. An overview of the day along with a safety briefing was provided by Assistant Construction Engineer Brian Early, District Materials Engineer Dave Borkowski, District Pavement Engineer Vicente Morales, and ACPA Pennsylvania Chapter staff members John Becker and Rich Jucha.

The tour covered active concrete construction paving operations on US-422 and two projects on Interstate 95, along with a tour of the Castor Materials Ready-Mixed Concrete Plant. Different methods were to be observed in constructing the concrete pavements, including fixed-forms on the US-422 project, a bridge deck paving machine with concrete being pumped up to grade on the I-95 project in downtown Philadelphia, and slip-form paving on the I-95/Turnpike Interchange. Unfortunately, with all paving operations commencing early morning and all paving operations taking place simultaneously, paving operations were only observed on the US-422 project and at the tail end of the I-95 project in Philadelphia.

The tour included commentary by PennDOT and industry personnel during travel between project sites on several projects/corridors constructed with concrete as well as commentary about sites of historical/local interest. Of particular note was the drive through on I-676 of the first pre-cast concrete patching project constructed in Pennsylvania in 2009 and the first project constructed with a pilot Long Life Concrete Pavement specification, completed earlier this year. Commentary by the PennDOT District 6 Design Unit about ongoing and future I-95 corridor improvements was most informative.

The ACPA Pennsylvania Chapter extended its appreciation to PennDOT Engineering District 6 for their hospitality as this year's hosts and the continued assistance and support from PennDOT Central Office. The Chapter also recognized the Pennsylvania Aggregates & Concrete Association, the Pennsylvania Turnpike Commission staff, as well as representatives from J. D. Eckman, Castor Materials, James J. Anderson Construction, and J.D. Morrissey Construction for their cooperation and efforts in making this year's tour successful and informative.

Meeting Overview

On Thursday, August 31, a follow-up meeting was held in Valley Forge. This was a mix of briefings and dialogue as well as PowerPoint presentations. Items that attendees suggested as follow-up items for the Concrete Pavement Quality Committee are listed in Appendix A. Discussions and presentations from this meeting are summarized below.

PennDOT Concrete Pavement Initiatives (led by George W. McAuley, P.E., Deputy Secretary)

McAuley provided an overview on PennDOT efforts to encourage best practices and innovations.

He started with a brief overview of his background and his approach to managing change. He stated that to implement new technologies, PennDOT will assume reasonable risks in piloting new concepts and to deploy and implement those that hold promise for extending the life of infrastructure investments. He cited examples, such as LLCP, with improved mix designs and the promise of improved durability. He cited the need to continue to evaluate the performance of precast patches in District 3. McAuley puts a high priority on building relationships between the Department and industry, on partnering and increased

use of quality control data to improve performance. He spoke about TQI efforts and initiatives, citing work force development and calling on the many experienced meeting participants to mentor and train those with less work experience who will ultimately be the future leaders of PennDOT and the industry.

McAuley also cited the cracking that has developed on the Interstate 81 unbonded overlay project that was part of last year's tour. He stated that concrete overlays can be a cost-effective option for extending pavement life, unfortunately a critical detail was overlooked by many on this project. Becker concurred and stated that he will later provide a brief explanation of why these slabs cracked; see Appendix B.

Innovative Testing Concepts (Neal W. Fannin, P.E., PennDOT & Richard R. Jucha, P.E., ACPA/PA);

Fannin and Jucha presented via PowerPoint updates on some of the innovative testing devices and process that have been implemented and that are in the works. Particularly:

- The use of AASHTO PP-84-17 as a guide to develop engineered concrete pavement mixes through strength, shrinkage, freeze-thaw durability, permeability, aggregate properties and workability characteristics.
- Further use of Long-life Concrete Pavement and continued modifications to the specification, specifically refinement of the dowel bar section.
- Use of the Super-Air Meter for acceptance. This will require additional research and data collection.
- Continuing the study on Permeability (a Transport Property) using AASHTO T-277 with further evaluation using AASHTO T-358 Surface Resistivity and w/c ratios below 0.45 for areas with deicer applications.
- Optimized aggregate gradations in all concrete mixes.
- Standard use of the Box Test for slip-form paving and the Maturity Meter for acceptance.
- Non-destructive testing of pavement thickness using imbedded plates (PTM 605) and Magnetic Imaging Tomography.
- Standard use of Tied Corner Repairs (Bottom Half Repairs) as described in the National Concrete Pavement Technology Center Guide for replacing slab edges and corners that deteriorated beyond one-half the thickness of the pavement slab.
- Use of the Next Generation Concrete Surface through new grinding and grooving techniques to improve ride and friction qualities beyond current methods.
- Consideration for using laser and ultrasonic techniques to measure real time smoothness during paving.

Overview of the Tour (George A. Dunheimer, P.E., ADE/Construction)

Assistant District Executive Dunheimer presented via PowerPoint highlights of the sites visited on Wednesday. He thanked the contractors for working with the Department and industry and in accommodating the group in showing ongoing and completed work. Technical issues precluded the showing of a drone video of the I-95 (GR3) project so this video was subsequently posted on-line at www.LongerLifePavement.com/Tours/.

District 6 Program Overview (Kenneth M. McClain, P.E., District Executive)

District Executive McClain presented via PowerPoint an update of ongoing District 6 initiatives.

Observations from the Tour and Roundtable Discussion on Concrete Pavement Topics/Issues (Joseph S. Robinson, P.E., PennDOT Construction Quality Assurance & John M. Becker, P.E. ACPA/PA)

A roundtable discussion on observations from the tour and pertinent concrete pavement topics was led by Joe Robinson and facilitated by John Becker. These topics were primarily observations made on noteworthy practices as well as on opportunities for improving and enhancing the quality of concrete pavement. Commentary made by participants added much value and insight on these topics.

OBSERVATIONS FROM THE TOUR:

- Approach slabs for bridges exhibit longitudinal cracks; moment slabs on pavements on I-95 (GR-3) exhibit transverse cracks.
- Dowel bar basket placement and stability during concrete placement continues to be an issue. Robinson noted that dowel bar assembly shipping wires continue to be cut but that there are efforts to change the specifications to allow the contractor the option to leave them intact.
- The I-95 (GR3) project included 100% surface grinding of both pavement and bridge decks, other contracts did not. A comment made is that if we are doing 100% grinding, why do we transversely tined? Dunheimer stated that future contracts will specify a longitudinal tined surface which will provide a consistent longitudinal texture (tined or ground).
- A question was raised if upcoming I-95 contracts will be done using Section 530 (LLCP) specifications; the District will investigate. Fannin replied that PennDOT District 2 has an upcoming alternate design alternate bid project (LLCP versus LLAP), District 11 has one LLCP project pending, the Turnpike has three LLCP projects that were awarded but that have not commenced paving, and that most Districts are trending towards using LLCP on high-type facilities.
- Opportunities for improvement include the following:
 - Spray cure was inconsistent and thin on all projects visited.
 - Joints should be sawn to match mainline. Moment slabs joint spacing is 30-foot while mainline pavement joint spacing is 15-foot. Almost all approach slabs exhibited sympathy longitudinal hairline cracks off the pavement longitudinal joints. It was suggested that early entry saws could be considered for bridge approach slabs and moment slabs, matching pavement longitudinal joints, to reduce the potential for cracking. Early entry saws would avoid cutting reinforcing steel in the moment slabs and approach slabs. Sawed joints would minimize future maintenance concerns since a neat early entry joint can be sealed much easier than a crack. Dialogue between pavement engineers and bridge engineers was encouraged.
 - Shimming of forms, if and where allowed, needs to be clarified to define what is acceptable. Sometimes shimming is done exceptionally well where no mortar extrudes below the forms, other times the practice leaves room for improvement. Robinson stated that this needs to be addressed since there are times when fixed-form paving is the only means of paving.

OTHER OBSERVATIONS:

- It was stated that over the past 20 years we have had four or five projects where mainline cracking has occurred in the year following mainline placement operations, where shoulders are subsequently placed under different environmental conditions. Typically, every third or fourth joint opens up first following saw-cutting and these joints become dominant, i.e. exhibiting the most movement. When adjacent shoulders are placed later in the year, these shoulders cause the mainline movement to be restrained sometimes resulting in mainline shear cracking.
 - Becker stated that on one project, cracking was avoided because the Department directed the contractor to mark all dominant joints and to plunge cut the shoulder. This is a viable option to consider in areas where we do not have dowelled shoulders. One contractor has avoided this type cracking by marking all dominant joints and tooling the shoulder joints at those locations. Becker suggested that another approach could be investigated where dominant joints are marked and early entry saws employed to encourage the development of dominant joints in the shoulder matching the dominant joints in the mainline.
 - Robinson concurred that this may be worth considering.
 - Kovach was concerned that tooling would need to be deep. Clarke stated that construction of shoulders and that shoulder saw-cutting needs to be evaluated on a case-by-case basis.

- Staudt noted that with sawing of shoulder joints, slurry intrusion is an issue and it is difficult to remove slurry from joints because adjacent joints often have filler protecting it.

MISCELLANEOUS:

- Section 530 (LLCP) was discussed. Slip form paving is required but there are areas of paving that are piecemeal. Robinson stated that on long pavement runs slip forming should remain the only option. A comment was made that the focus should be on performance based rather than prescriptive based, and that means & methods should be at the discretion of the contractor.

FOLLOW-UP ACTIONS:

- Discussions are needed with PennDOT Construction, Pavements, and Structures since approach slabs and moment slabs are considered part of the structure, regarding if joints should be saw-cut or tooled into bridge approach slabs and moment slabs to control cracking.
- Kovach suggested that action needs to be taken regarding addressing shoulder joints, whether that be including expansion joint material or other methods.
- Robinson stated that, until the specification is formally changed, contractors may make a written request through the District to Central Office allowing them the option to not cut shipping wires.
- Fannin stated that the LLCP dowel specification will be revised. The specification currently lists many available dowel types that can be used for LLCP and was based on Minnesota DOT specifications; this list will be replaced by a requirement that use of long-life dowel bars meet specific material requirements.
- Becker stated that we have low-speed IRI specifications, but that additional guidance needs to be developed so that when applied to city improvement projects, the project special provisions and quantities should include provisions for additional diamond grinding (if project specifications require curb & gutter to be left in place), reconstructing the curb & gutter so that the contractor can meet appropriate IRI specifications, or if curb & gutter is to be left in place that standard straight-edge requirements be used in lieu of IRI specifications.
- Keefe requested that a Next Generation Concrete Surface specification be developed for PennDOT use. Kohler agreed to work with the CPQI in developing a specification.

WRAP UP:

Discussions concluded at 12:15 p.m. Becker and Robinson thanked District 6, the presenters, and all attendees for their participation. Action items will be developed by Robinson and Becker and established in consultation with the Concrete Pavement Quality Committee for their October 24 meeting.

A survey was issued to all participants to allow them to evaluate the value of this tour and to gather feedback for future tours. All presentations, a copy of the tour handouts, and these minutes will be posted on the Chapter's website at www.LongerLifePavement.com. If you have any questions, please contact the staff of the ACPA Pennsylvania Chapter at 717-441-3506.

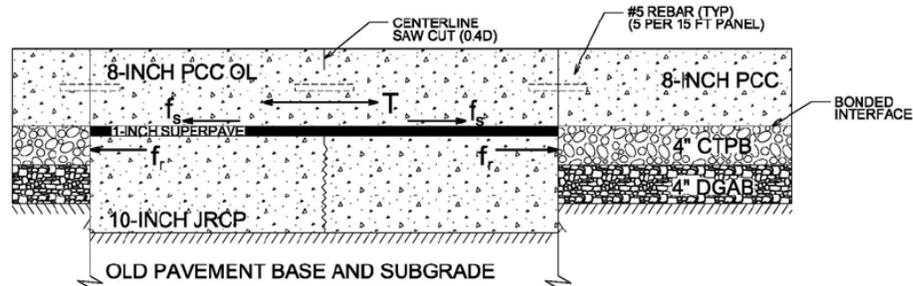
These minutes were prepared by John M. Becker, P.E., and Richard R. Jucha, P.E., ACPA Pennsylvania Chapter on October 18 and reviewed/approved by PennDOT District 6 and Central Office staff prior to distribution.

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APPENDIX A
Summary of Topics for Consideration by the
Concrete Pavement Quality Committee
(from edited survey responses & meeting commentary)

- Improving long term performance
- Inconsistencies
- Improving Long Life Concrete Pavement specifications
 - Long life dowel specifications
- Joints
 - Matching pavement and moment slab joints
 - Addressing cracking on approach slabs
 - Addressing dominant joints to reduce cracking potential
- Improving ride quality
 - Guidance on when to use ride specifications on urban projects
- Grinding/Grooving
 - Total pavement grinding
 - NextGen specifications
 - Diamond grooving
- Materials and workmanship
 - Promote best practices
 - Incentives for better placement procedures
 - Proper sizing of fixed-forms; shimming forms
 - Fixed-form paving vs. slip-form paving
 - Mix design improvements
- Testing
 - Innovations for improving quality & construction efficiencies

APPENDIX B
Brief Explanation of Unbonded Overlay Cracking
Interstate 81



An opinion of the cause of cracking (small, often hairline frown or smile cracks) that developed primarily in the mainline (along the inside and outside longitudinal mainline shoulder joints) and primarily at dominant mainline transverse joints is explained below. This cracking was observed in the northbound lanes.

The configuration of the overlay and shoulder may have contributed to the development of unusually high transverse stresses in the pavement. The reconstructed shoulders on either side of the travel lanes comprise 8 inches of PCC surface that is well-bonded to 4 inches of cement-treated permeable base – effectively creating a 12-inch structure that was constructed tightly against the original JRCP pavement, and extends up to 3 inches below the top of that pavement. When tied to the overlay, the resulting structure effectively “caps” the underlying JRCP on both the top and sides, forming a “C-clamp” on the underlying pavement. When the overlay shrinks (due to either drying shrinkage or thermal contraction), the transverse component of that shrinkage is restrained by the shoulder structure (the legs of the “C-clamp” being held tight against the original pavement, which may result in the development of unusually high transverse stresses (in the back of the “C-clamp”).

To reduce the potential for this type of cracking to develop in the southbound lanes and in the northbound lanes where cracking had not yet developed, the outside shoulder/driving lane joint and the inside shoulder/passing lane joint were saw-cut in the overlay sections to sever the tie-bars. Cracked slabs were repaired with full-depth patches. Geofabric material used as the separation layer between the patches and the JRCP, and the patches were diamond ground to restore ride.

To reduce the potential for this type of cracking to develop on new projects (standard construction or overlay), a similar base should be used for both the mainline pavement and the shoulder.