Overlay Field Application Program Implementation Site Visit Report On Pennsylvania SR-119, SR-1032 and Mon-Fayette (43)

FEBRUARY 25, 2009

Pennsylvania Department of Transportation

Pennsylvania Turnpike Commission

National Concrete Pavement Technology Center

Tech Center

U.S.Department of Transportation

Federal Highway Administration

Background

The Concrete Overlay Field Application Program is administered by FHWA and the National Concrete Pavement Technology Center (CP Tech Center). The overall objective of this program is to increase the awareness and knowledge of concrete overlay applications among state departments of transportation (DOT), contractors, and engineering consultants. Expert teams have been assembled from across the U.S. to assist DOTs and strengthen the DOTs' confidence in concrete overlay solutions.

Pennsylvania Department of Transportation (PennDOT) has elected to be one of the six states to participate in the FHWA/CP Tech Center Program and previously received a one day workshop on concrete overlays which is part of the Field Application and Concrete Pavement Technology Program. Following the February 24, 2009 workshop a bus tour was held on February 25, 2009 to review five potential concrete overlay projects.

Site Visit

A site visit was conducted on February 25, 2009 to evaluate five potential concrete overlay projects (Table 1 and Figure 1):

Project Name	Project Description	Length (mi.)	ADT (2007)	No. of Lanes
#1. SR-119 Penn State to Pechin Road	Urban arterial, open ditch section	2.2	12,500 (12% trucks)	5
#2. SR-119 Bell Drive to WalMart	Divided suburban route, open ditch section	1.7	11,500 (6% trucks)	4
#3. SR-119 Everson Road Overpass to Westmoreland County Line	Divided rural route, open ditch section with moderate cut/fill sections	2.8	11,250 (12% trucks)	4
#4. SR-1032 Southpointe Blvd. at I-79	Raised median suburban route, open ditch section	0.7	2,500 (10% trucks)	4
#5. Mon-Fayette Expressway Turnpike Route 43	Divided rural primary route, open ditch section	2.0	5,500 (7% trucks)	4

Table 1 Potential Overlay Projects Reviewed

An expert team of four met with representatives from PennDOT, Pennsylvania Turnpike Commission, Federal Highway Administration and American Concrete Pavement Association, Pennsylvania Chapter (Table 2). A primary objective of the site visit was to identify which roadways are viable candidates for a future concrete overlay.

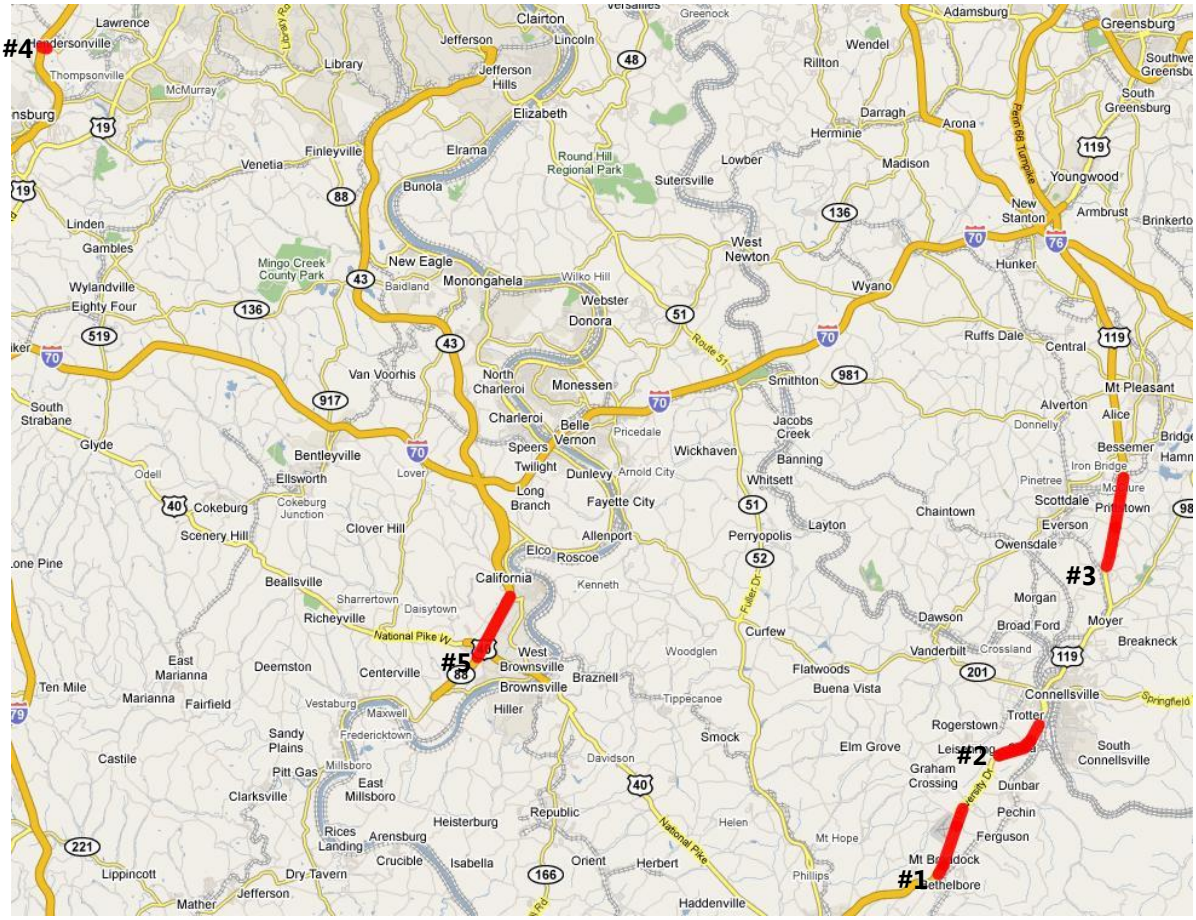

Figure 1 Approximate Location of Proposed Overlays

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Table 2 PA Overlay Implementation Site Visit Attendees

All of the projects reviewed were deemed to be candidates for the implementation of a concrete overlay. The expert team is suggesting that project #1, the Penn State section of SR-119 (Figure 2) be the focus of PennDOT's initial concrete overlay implementation efforts. This is in concurrence with the

informational sheets provided by PennDOT which identified the Penn State section as PennDOT's number one priority. Projects #2, #3, #4 and #5 are also discussed in this report however not to the same level of detail as the primary candidate as suggested by the expert team.

#1 SR-119 Penn State to Pechin Road

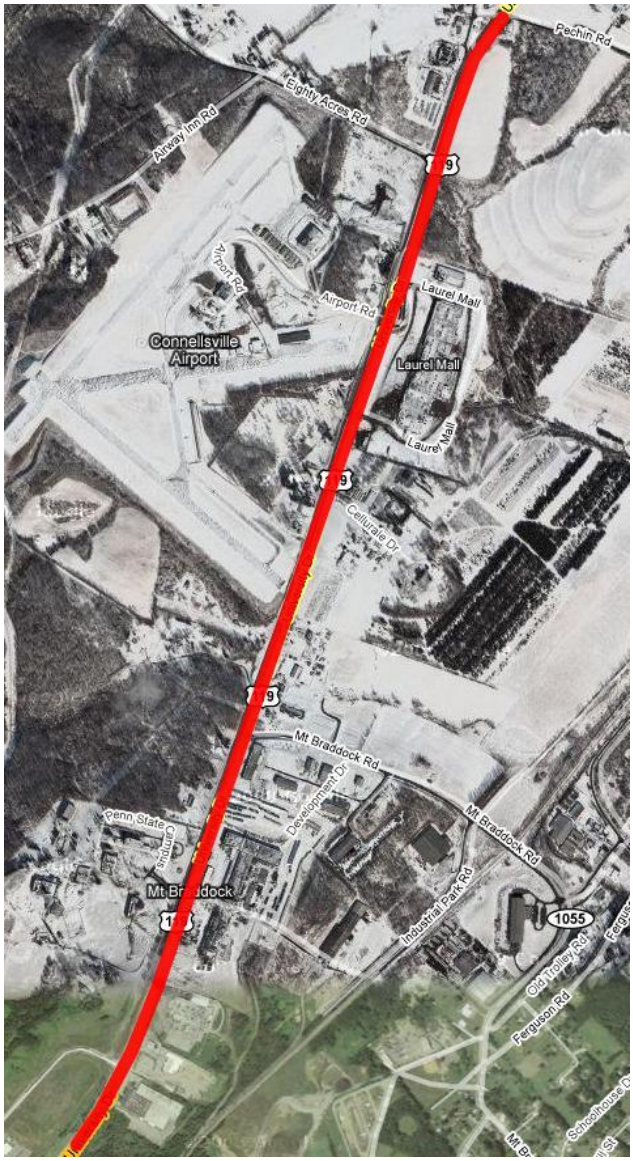

Figure 2 SR-119 Penn State Project

Existing Conditions

Information provided by PennDOT in conjunction with observations made during the site visit provides the basis for the assumed existing typical section. Descriptions of the original construction and maintenance history suggest that there may be considerable variability in the existing pavement section throughout the length of the project. This section of roadway was originally constructed in 1947 and 1955 as a two lane facility and later widened and overlaid to its current state as a five lane roadway. Cores taken 18' right and left of centerline show an average asphalt thickness of 13.8". Figure 3 is a sketch of the typical section based on historical information and discussions during the site visit. Actual conditions across the entire width and length of the roadway should be verified through additional core samples (discussed in detail later).

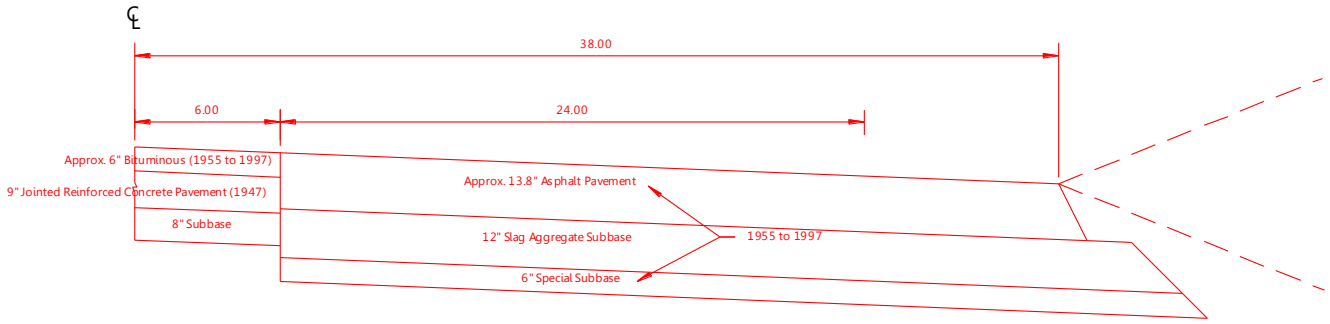

Figure 3 Existing Typical Section

Periodic maintenance has been performed throughout the length of the pavement on an as-needed basis. Figures 4 through 7 show the condition of the existing pavement as photographed on 25FEB2009.

Figure 4 SR-119 Looking South (near the north limits of the project)

Figure 5 Typical Distress (fatigue cracking)

Figure 6 Fatigue Cracking with Moderate Rutting

Figure 7 Typical Distress (Fatigue Cracking)

Overlay Implementation Plan

The overlay implementation team feels the SR-119 Penn State project is an excellent candidate for a bonded overlay (approx. 6"), provided at least 3" of sound asphalt remains after any milling operations. An unbonded overlay is also an option for this section. However, the thickness required for an equivalent life as compared to a bonded overlay may result in additional costs as well as present more challenges for matching side roads and driveways. Few if any overhead vertical clearance issues are present. Matching and/or transitioning into the side roads and entrances will present a challenge. However, this is minimized by utilizing a bonded overlay design. The final change in profile grade will be a function of the overlay design and the milling depth.

Bonding the overlay to the existing composite and full depth asphalt section takes full advantage of the existing support condition provided by the in-situ pavement. Condition and thickness of the existing asphalt layers should be the determining factor on the final overlay design. Because the bond is critical to performance of the overlay, a minimum of 3" of sound asphalt should be left immediately beneath the concrete overlay. The following recommendations are based on the conditions observed at the site and additional information provided to the team by PennDOT prior to and during the site visit.

1. Perform additional site investigations to confirm that the existing typical section is consistent with historical records.
    a. Core the existing pavement and shoulders to determine the condition of the materials, depth of any distress, moisture condition underneath the concrete pavement and to verify the thicknesses of layers. Cores should be taken at approximately 1,000' intervals (each direction) spread across both lanes and shoulders, at areas representative of typical distresses and at longitudinal joints. Cores should also be located in areas which will characterize the different phases of construction.

2. Design a bonded concrete overlay – overlay thickness is entirely dependent upon: expected life of the overlay, anticipated traffic loading and budget. Final design thickness of the overlay will be dependent upon PennDOT's treatment of the balance between expected life and budget constraints. Overlay thickness design should be evaluated using AASHTO 1993, 1998 and/or M-E Design Guide pavement design procedures.
    a. Assume a 6" thick bonded overlay (Figures 8 and 9), it is not the intent of this report to influence PennDOT's pavement design procedures, a thinner overlay may be the solution that best meets PennDOT's objectives for rehabilitating this roadway. Details of a thinner or thicker overlay can be provided at the time PennDOT arrives at a final design thickness. Probable alternative overlay thicknesses may range from approximately 4" up to 7", depending upon the desired life of the overlay.

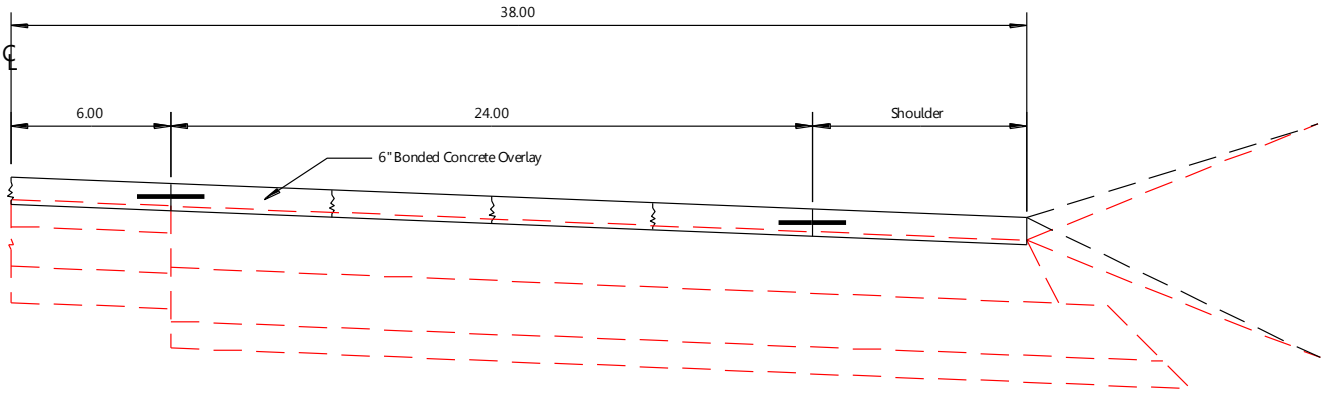

Figure 8 Typical Section 6" Bonded Concrete Overlay

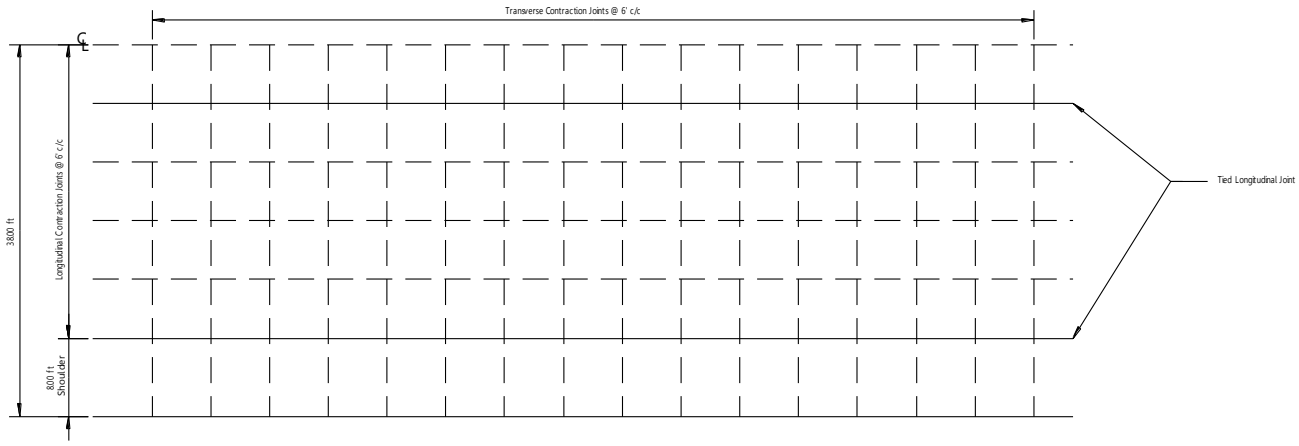

Figure 9 Plan View Joint Layout of 6" Bonded Concrete Overlay

3. Design and construction issues to consider:
    a. Mill the existing pavement (approx. 1") to provide a clean and sound bonding surface, avoid leaving a thin layer of an asphalt lift that may delaminate
    b. Minimal pre-overlay repairs should be required – based on Minnesota's experience, removing loose material at existing cracks with compressed air at approximately 100 psi is adequate. Cracks greater than 4" in width should be filled with bituminous patching material (Table 7 – Guide to Concrete Overlays 2nd Edition), cracks from 2" to 4" may also be filled with bituminous patching material
    c. Specify a minimum curing compound application rate of 100 ft^2/gal (as compared to a normal rate of 150 ft^2 /gal)
    d. Saw joints at T/3 (single cut 1/8" to 3/16")
    e. Fill joints using a hot pour material

Next Steps to Overlay Implementation

The following items summarize what steps are necessary to move forward with the successful implementation of a concrete overlay on SR-119.

- To obtain additional funding from the FHWA, notify Gina Ahlstrom by letter (a sample can be provided by request) stating this project is representative of similar locations in Pennsylvania and that this overlay implementation will assist the PennDOT in applying similar concrete overlay solutions in the future. Provide FHWA with a project number and approximate construction date.
- Perform additional site investigation to confirm existing pavement conditions and support values
- Determine overlay thickness using AASHTO 1993, 1998 and/or M-E Design Guide pavement design procedures
- Provide the overlay team with an updated proposed overlay typical section and details for review and comment – examples of other DOT specifications and plan details will be provided to PennDOT by the overlay implementation team which are applicable to the final overlay design
- Should PennDOT choose to pursue a concrete overlay on one of the other projects that were reviewed, the overlay implementation team will supplement this report with additional details for that project.

#2 SR-119 Bell Drive to WalMart

The Bell Drive to WalMart section is a composite pavement in the southbound lanes (approx. 10" asphalt on a 7" parabolic concrete pavement constructed in 1927). The northbound lanes consist of approximately 10" asphalt on a 12" slag subbase on a 6" special subbase. Similar to the Penn State section either a bonded or unbonded overlay could be constructed. Cores should be taken to characterize the thickness and condition of the existing asphalt layers. Raising profile grade throughout this section may present more complications than other projects that were reviewed due to the number of side roads and driveways. Thus, a bonded overlay may be the best choice for this project.

The condition of existing asphalt layers and transitioning into existing elevations will be key factors that will influence the final overlay design o this project. Considering these factors, a bonded overlay is likely the best option for this project. Milling should be performed to remove the pavement distresses as well as enhance the bond. There appears to be adequate asphalt on both lanes to allow milling 4" (or more depending upon results of investigatory cores) and then placing a bonded concrete overlay which would result in a minor change in profile grade elevation.

Discussions during the site visit revealed that a portion of the northbound lanes have experienced distresses caused by subsurface water. This issue should be corrected with new underdrains and/or complete reconstruction through the limits of the subsurface water distresses.

Figures 10 through 13 show the condition of the existing pavement as photographed on 25FEB2009.

Figure 10 SR-119 Looking South

Figure 11 SR-119 Looking North

Figure 12 Typical Distress (reflective and fatigue cracking)

Figure 13 Fatigue Cracking

#3 SR-119 Everson Road Overpass to Westmoreland County Line

The Everson section of SR-119 consists of a 9" jointed reinforced concrete pavement on a 6" subbase constructed in 1966. Diamond grinding and CPR were performed on both lanes in 1992 and an asphalt overlay was placed on the northbound lanes in 2003. This project is an ideal candidate for an unbonded overlay, for the following reasons:

- The existing asphalt overlay on the northbound lanes can be utilized as a separation layer
- Overhead clearance and lateral transition issues are minimal
- The long slab lengths in the southbound lanes are not conducive to a bonded overlay

A separation layer would need to be placed on the southbound lanes, since they have not been overlaid with asphalt yet. Concrete overlay thickness will be a function of the anticipated traffic, desired pavement life and budget constraints. Michigan's experience with thinner unbonded overlays (4" to 6") is applicable for this project.

Figures 14 through 17 show the condition of the existing pavement as photographed on 25FEB2009.

Figure 14 SR-119 Looking South

Figure 15 Northbound Lane

Figure 16 Typical Distress (reflective cracking) Northbound Lane

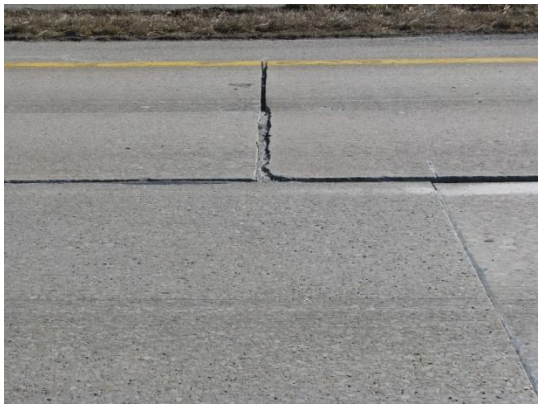

Figure 17 Typical Distress (loss of support and spalling) Southbound Lane

#4 SR-1032 Southpointe Blvd. at I-79

Southpointe is an urban collector road originally constructed in 1994. It is a 7″ plain jointed concrete pavement on an 8″ subbase. The pavement exhibits moderate freeze-thaw distress, possibly related to the use of slag coarse aggregate. The overlay implementation team feels that this project is a candidate for a 4″ **minimum** thickness unbonded overlay. The condition of the roadway and type of distress precludes a bonded overlay. An unbonded overlay performed within the next two years would require very little pre-overlay repair. Delaying an unbonded overlay for more than three years will significantly increase the quantity of pre-overlay repairs required. A 1″ nominal asphalt separation layer will isolate the concrete overlay from the existing pavement. Overlay joints should be constructed on a 6′ x 6′ pattern.

Figures 18 through 21 show the condition of the existing pavement as photographed on 25FEB2009.

Figure 18 Southpointe Looking East

Figure 19 Typical Distress (freeze-thaw deterioration)

Figure 20 Freeze-Thaw Deterioration

Figure 21 Subgrade Support Failure Under Shoulder

#5 Mon-Fayette Expressway Turnpike Route 43

Turnpike Route 43 consists of two existing typical sections. The primary (±2 miles) being an approximate 9" plain jointed concrete pavement with skewed joints at 20' c/c, originally constructed in the late 1980s. The other section is a 9" jointed reinforced concrete pavement on an 11" subbase originally constructed in 1976. Completion of the Mon-Fayette expressway to the south will result in an increase to traffic loads. These pavements also show distress from inadequate air entrainment, more so in the section constructed in the late 1980s. Cores should be taken to confirm this assumption, to identify the type of aggregate used in the concrete mixture and also to evaluate if there is any presence of alkali silica reaction. The overlay implementation team's suggestion is for an approximate 8" thick unbonded overlay with a 1" nominal asphalt separation layer. Shoulders may be constructed of concrete or asphalt. The condition of the existing pavement eliminates a bonded overlay from consideration. Pre-overlay repairs should consist of removing loose material with compressed air and filling large voids with asphalt patching material. Underdrains should be placed along the mainline in the vicinity of ramps and other areas where subsurface drainage is of concern.

Figures 22 through 25 show the condition of the existing pavement as photographed on 25FEB2009.

Figure 22 Turnpike Looking South

Figure 23 Typical Distress (freeze-thaw deterioration)

Figure 24 Freeze-Thaw Deterioration

Figure 25 Freeze-Thaw Deterioration