

EXPERIMENTAL FINAL REPORT

KWIK BOND 1121 POLYESTER POLYMER CONCRETE (PPC) OVERLAY

Location: Interstate 90/Stillwater County/Billings District: Three
Decks: SEP COUNTY ROAD (I00090391+00402),
BERRY CREEK (I00090400+03661),
BERRY CREEK (I00090400+03662)

Project Name: Br Deck Rehab/Repair 11

Project Number: BH STWD (043) - CN 6837000

Experimental Project: MT-13-05

Type of Project: Bridge Deck Rehabilitation

Principal Investigator: Craig Abernathy: Experimental Project Manager (ExPM)

Technical Contact: Jeff Olsen, Bridge Bureau; Billings District

Contractor: Meyers and Sons Construction

Date of Installation: 08/2014

Date of Inspections: 10/2014, 10/2015, 06/2016, 10/2017, 05/2018 & 05/2019

Description

This project is a bridge deck rehabilitation system using an engineered composite polyester polymer concrete (PPC) overlay system that (per manufacturer's information) can rehabilitate ride defects; seal out moisture, oxygen and chloride ions from permeating into the deck; and return traffic in two hours (based on thickness of overlay and environmental conditions) at temperatures down to 40°F.

Experimental Design

The Kwik Bond 1121 Polyester Polymer Concrete (PPC) overlay was applied on three (3) designated bridge decks for the purpose of extending the life of the deck and restoring skid integrity. Overlay thickness was on average measured at 1.25" (3.2 cm). Deck surfaces were prepped by sand and shot blasting. A High Molecular Weight Methacrylate (HMWM) sealer was applied to the deck surface prior to the overlay application.

Evaluation Procedures

Construction Documentation: Will include general information specific to the installation events of the HMWM sealer and PPC overlay.

Post Documentation: Will entail periodic site visits/inspections of PPC overlays for inclusion into the annual and final reports; in addition, documentation will include any maintenance activities associated with the overlays.

The purpose of an experimental features report is to document the phases and events of any given project to provide the reader with an understanding of the general activities required to install or incorporate the research element into an active construction or maintenance project. This report also establishes a baseline for defining performance for any given feature under actual service conditions to determine its relative merits.

Evaluation Schedule

Research will monitor and report on performance for a minimum period of five years annually. This is in accordance with the Department's "Experimental Project Procedures". Delivery of a construction/installation report, interim, annual or semi-annual reports is required as well as a final project report (responsibility of Research). A web page will be dedicated to display all reporting from the project.

2014:	Installation/Construction Report
2015-2018:	Semi-Annual Inspections/Annual Evaluation Reports
2019:	Final Evaluation/Final Report

Project Information

MDT project staff stated the installation of the three PPC overlays followed the manufacturer's guidelines and that no construction issues were noted that may affect future performance. A Kwik Bond representative was present on site.

The PPC overlay began applications at approximately 1:30 AM. The ambient air temperature was 65° F, wind speed at 2-3 mph, relative humidity at 42%, and the deck temperature was approximately 68°F. Project began the week of August 18.

A critical element of this type of deck rehabilitation is the preparation of the surface prior to the PPC application. The contractor employs sandblasting, shot blasting, hand grinding and pressurized air for a clean and debris free deck for the overlay.

The process of paving is to perform one paving pass, relocate the slip form paver to the other prepared deck, perform another pass which allows the previous PPC application to cure (average 3-4 hours), then move back to the original deck and proceed with another pass (lanes are paved first, then shoulders). Repeating this process until the decks receive the full PPC treatment.

The three decks will be monitored for texture wear and pavement condition for a minimum of five years. If the wear documentation does not show rapid deterioration of the PPC, the five-year term may be extended. If the monitoring time frame is protracted, the final report will be issued when the MDT is satisfied that the performances of the structures have been quantified.

Starting at page five (5) of the report represents the general examples of the application practice involved with the Berry Creek eastbound deck and annual site evaluations.

September 2015 Site Inspections

All three structures displayed good texture appearance since installation. No visible vehicle tire wear is apparent to date. No apparent snowplow activity has affected performance of the overlay with exception of the Sep County deck which has areas on the east end travel lane approach of assumed plow abrasion and more pronounced topical scraping of the overlay on the south side deck shoulder (see pages 13 & 14).

This abrasion or scraping of the PPC material is assuming to be undulations of the polymer due to inconsistencies during the paving process (possibly due to the manual screed and floating of the material after paving) which created varying thicknesses susceptible to plow scrape.

Transverse cracks have appeared at deck joints considered to be normal and several cracks have appeared at the transition joints at pavement to deck; all minor to date.

May 2016 Site Inspections

All three structures displayed the same condition as documented in the 2015 site inspection. No apparent distress other than the shoulder abrasion documented in 2014.

The next inspection will take place fall of 2017.

September 2017 Site Inspections

All three structures displayed the same condition as documented in the 2016 site inspection. No apparent distress other than the shoulder abrasion documented in 2014.

Subjectively, Areas of wheel path seem to have more road wear than the surrounding PPC overlay. The hand applied topical sand coat appears to exhibit loss of adhesion.

May 2018 Site Inspections

The Berry Creek and Sep County Road westbound structures are beginning exhibit distress similar to punchouts down to the first mat of rebar; mainly in the travel lane at proximity of the AC pavement and deck transverse joint. Some of the affected areas have previously been patched (see page 20).

In addition, visually; the structures wheel paths are exhibiting wear not seen in past inspections. The Department may want to perform skid testing to determine if skid resistance is within a reasonable parameter (page 24).

May 2019 Site Inspections

As stated in 2018 inspection; the Berry Creek and Sep County Road westbound structures continue to exhibit distress of cracking or spalling down to the first mat of rebar; mainly in the travel lane wheel paths at proximity of the AC pavement and deck edge joint. Some of the affected areas have previously been patched.

The three PPC structures wheel paths are exhibiting a more polished appearance not seen in past inspections. The Department may want to perform skid testing to determine if skid resistance is within a reasonable parameter (page 29).

Berry Creek Structure – East Bound: I-90/Stillwater County; Reference Point 400



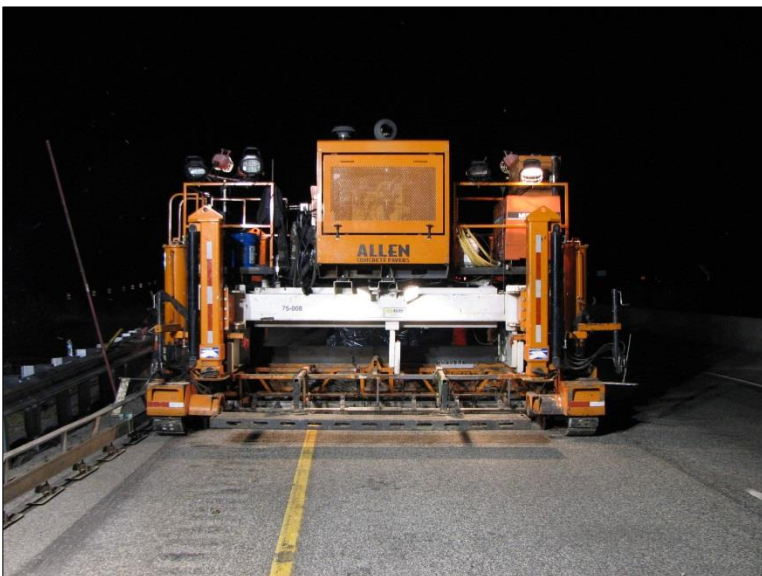
← Although difficult to see in this image, PCCP deck preparations consist of sand and metal shot blasting, hand grinding of pavement markers, air blasting, deck sweeping, and solvent spot cleaning of oil and stains.

Proper deck preparation is a critical element in the PPC process.



← A specialized mobile mixing unit is used for the PPC overlays.

The mobile unit contains the storage bins for the blend of aggregates to be used, the polyester polymer storage tank (unsaturated polyester resin in styrene), and the PPC screw mixing auger.



← The paving unit is an Allen High Profile Two Track Polyester Slip Form specifically modified for PPC paving applications.



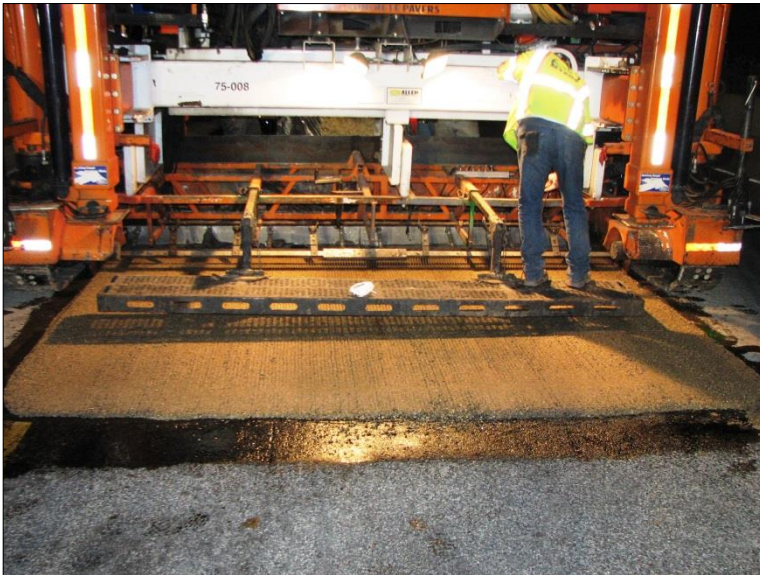
- ↑ During active operation; the aggregates (red arrow), are conveyed to the mixing chute (blue arrow), the styrene is injected into the aggregate blend by a fixed nozzle (white arrow).
- ↓ The styrene infused aggregates are then transported through a mixing auger screw/chute (yellow arrow) to be deposited into the paver hopper.





← Prior to the paving of the overlay, high molecular weight methacrylate (HMWM) is added to the prepared surface as a prime sealing coat.

Paving begins immediately after the HMWM is applied.



← At the beginning of the paving runs.

Note the paver initially tines the PPC as it exits out the rear of the slip form.

Based on a projects requirement, a PPC overlay may vary from 3/4" to 12" in thickness.



← The PPC is screed and floated to the desired density and texture.



← Another image showing the workman applying a float to the PPC.



← Longitudinal tining is reapplied for mechanical texture as one of the last steps in completing the PPC run.

However, prior to tining; a layer of top sand (quartzite) is applied by hand to the surface of the overlay to provide added mechanical skid resistance.



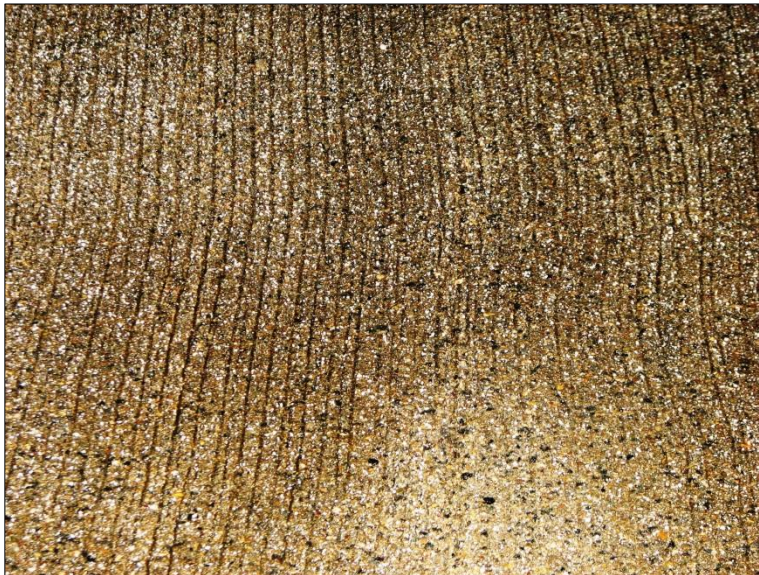
← Close-up of the Kwik Bond top sand.



← Completed PPC run with approach and edges feathered.

The edges were initially feathered for a smooth traffic transition from pavement to deck surface.

The approaches were rebuilt to ensure a jointed connection with the deck overlay and pavement, (see pages 9 & 10).



← Close-up of tined surface with top sand application.



← Additional close-up of aggregate texture with added top sand prior to tining.

The Material Safety Data Sheet (MSDS) lists the types of aggregates as follows: EC Sand, EC Rock, Top Sand, A-3083 Rock, B-70 Fine Sand, B-11 Sand, B-39 Gravel, MLS Friction Aggregate; and Blend 84. All in the chemical family of Silicon Dioxide.

Post Documentation: October 2014



↑ Berry Creek Structure – Westbound I-90: View west.

↓ Berry Creek Structure – Eastbound I-90: View west.





↑ Sep County Rd. structure: Westbound I-90: View west.

← A smooth transition was attained by rebuilding the approaches.



← Sep County Rd. structure: View of cracking along an expansion joint on the south side, east end of the westbound deck.

↓ Close-up of PPC texture in wheel path.



Site Inspection: September 2015



← Sep County Rd.: Westbound deck I-90; view west.



← Surface textures in both lanes appeared to be in good condition after the first year since installation.

Some shearing, assuming plow scrape, of the PPC may be seen at the pavement to deck transition travel lane (Red arrow).



← Additional plow abrasion is apparent on the deck shoulder; predominately on the south side.



← Closer view of the plow scrapes on the PPC travel lane in addition to some localized stress cracking near the joint approach (red arrow).



← Close-up of PPC abrasion by plow passes (south deck shoulder).

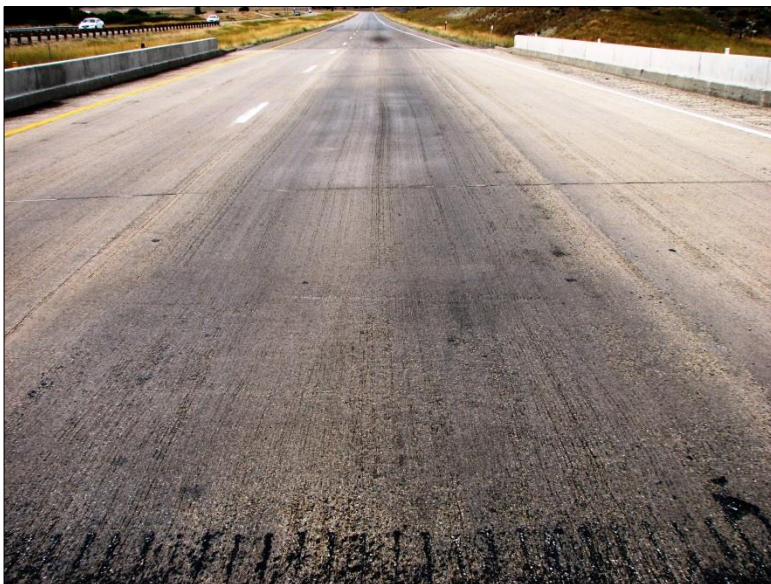
Future inspections will document if this trend continues.



← Berry Creek Structure
Westbound I-90: View west.



← Berry Creek Structure
Eastbound I-90: View west.



← Berry Creek Westbound:
Visually, both structures
surface texture appears coarse
with tining well pronounced as
initially placed in 2014.

No evidence of plow abrasion
on any area of the two decks
as seen on the Sep County
structure.

The AC approaches have been
chipped sealed.

Site Inspection: May 2016: SEP County Road



← Sep County Rd.: Westbound deck I-90; view west.

Slight abrasion of PPC at transition (red arrow).



← Surface textures in both lanes appeared to be in good condition since installation.



← Closer view of PPC texture in the wheel path.



↑ Shoulder abrasion due to snowplow passes as documented in 2015; most likely due to an uneven application of PPC. To date not an indication of deficient performance.

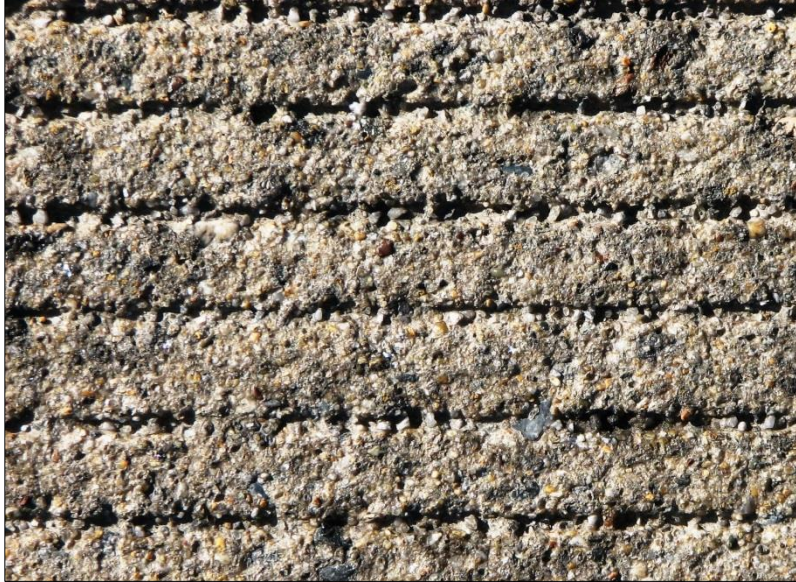
Site Inspection: May 2016: Berry Creek



← Berry Creek Structure
Westbound I-90: View west.



← Surface textures in both lanes
appeared to be in good condition
since installation.



← Closer view of PCC texture in
the wheel path.

Site Inspection: September 2017 – I-90 Structures



← SEP County Rd: Westbound;
View West.



← Berry Creek Rd: Westbound;
View West.



← Berry Creek Rd: Eastbound;
View West

Site Inspection: May 2018; Berry Creek Rd. Structures



↑ East end of Berry Creek Rd. westbound structure (view west); circled area shows section of patched deck and segment of active delamination in the travel lane.

↓ Closer view of the damaged portion of deck at the transition of deck to pavement; the extent of the broken area is down to the top rebar layer and mainly in the wheel paths.





↑ East end of Berry Creek Rd. eastbound structure (view west).

↓ East bound-East end transition joint of deck to pavement; transverse cracking apparent on the PPC which runs along the entire east span.



Site Inspection: May 2018; Sep County Rd. – West Bound Structure



↑ View west – east end of structure; circled area is uncontrolled cracking with a section of previous patch repair in the travel lane. Most of the damage is located in the wheel paths.

← Another view of the PPC overlay damage (view north).



↑ Close-up of damaged deck section.

← Piece of the PPC and underlying PCCP; All sections of damaged deck such as seen here revealed no delamination of the PPC to PCCP layer.

PPC Texture Wear in the Wheel Paths



← ↓ The top and center images are representative of the average (visual) wheel path surface texture on the three PPC structures as seen in 2018.

The lower image is the appearance of the PPC texture (wheel path) as seen in September 2014.



Site Inspection: May 2019; Berry Creek Rd. EB/WB Structures



← Berry Creek
eastbound; view west.



← Berry Creek westbound;
view west.

Note the patch repair at the deck edge predominantly in the travel lane wheel path (red arrows).



↑ Oblique view of deck patching at east end of westbound deck. An area of patch is also on the passing lane right wheel path.

Red arrow denotes continued spalling on right wheel path of travel lane.

Site Inspection: May 2019; Sep County Rd. – West Bound Structure



← Westbound passing lane; view west.



← Westbound travel lane; view west.

Areas of patched spalling, mainly in the wheel path (red arrow).



↑ Additional view of deck patching at east end of westbound deck; continued spalling is apparent.

Supplemental



↑ General representation of the texture difference within and outside the wheel path on all three PPC decks.

The upper half of the image shows some of the initial tining applied during construction in 2014 (see page 9); the lower half of the image is the texture within the wheel paths with a more polished appearance.

Supplemental



↑ Cross section close-up of the aggregate matrix in the fully cured polyester polymer overlay: Thickness represented in this image is approximately 1.25" (3.2cm).

VIDEO: The following is a short clip of the PPC paving process:

http://youtu.be/Evn2_kWx7ZQ

This report and other project information is available at:

<http://www.mdt.mt.gov/research/projects/kwikbond.shtml>

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