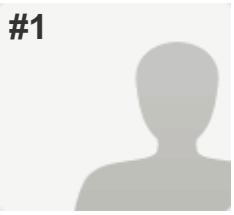

COMPLETE

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Started: Tuesday, April 11, 2017 5:56:20 PM
Last Modified: Tuesday, April 11, 2017 6:01:23 PM
Time Spent: 00:05:03
IP Address: 63.225.17.34

PAGE 1

Q1: State Representative

Name	Val Niculae
Agency	CDOT
State / Province	Colorado
Email	valentino.niculae@state.co.us

Q2: What is the typical mix design for FIBER REINFORCED overlay?

Comments	Haven't see fiber mesh in overlay mixes

Q3: What is the typical mix design for LATEX MODIFIED overlay?

Comments	no experience with

Q4: What is the typical mix design for ULTRA THIN EXOXY overlay?

Respondent skipped this question

Q5: What is the typical mix design for LOW CEMENT (HIGH SLUMP) overlay?

Comments	No Difference from regular Pavement mixes

Q6: What is the typical mix design for POLYESTER CONCRETE overlay?

Comments	no experience with

Q7: What is the typical mix design for POLYMER MODIFIED overlay?

Comments	no experience with

Q8: What is the typical mix design for THIN BONDED POLYMER overlay?

Comments	no experience with

Q9: What is the typical mix design for YOUR DOT SPECIFIC overlay?

Comments	CDOT does not have a specific mix recipe for overlays.

Q10: Any additional comments?

Respondent skipped this question

#2

COMPLETE

Collector: Web Link 1 (Web Link)
Started: Wednesday, April 12, 2017 5:50:41 AM
Last Modified: Wednesday, April 12, 2017 6:02:35 AM
Time Spent: 00:11:53
IP Address: 156.63.133.8

PAGE 1

Q1: State Representative

Name	Dan Miller
Agency	Ohio Department of Transportation
State / Province	Ohio
Email	daniel.miller@dot.ohio.gov

Q2: What is the typical mix design for FIBER REINFORCED overlay?

Cement (pounds per cubic yard)	600
Fly Ash (pounds per cubic yard)	0
Slag (pounds per cubic yard)	0
Silica Fume (pounds per cubic yard)	50
Fine Aggregate (% or pounds per cubic yard)	1410
Coarse Aggregate (% or pounds per cubic yard)	1450
Maximum Coarse Aggregate Size	#8
Target Air Content or range (%)	8 +/-2
Fibers (% or pounds per cubic yard)	1 lb/cy
Comments	W/Cm= 0.40 Slump of 6"

Q3: What is the typical mix design for LATEX MODIFIED overlay?

Cement (pounds per cubic yard)	658
Fly Ash (pounds per cubic yard)	0
Slag (pounds per cubic yard)	0
Silica Fume (pounds per cubic yard)	0
Other (pounds per cubic yard)	0
Fine Aggregate (% or pounds per cubic yard)	1645
Coarse Aggregate (% or pounds per cubic yard)	1315
Maximum Coarse Aggregate Size	#8
Target Air Content or range (%)	7 +/-2
Fibers (% or pounds per cubic yard)	0
% Latex	204 lb
Type of Latex Additive	Styrofan 1186 or Trinseo Modifier A/NA

Q4: What is the typical mix design for ULTRA THIN EXOXY overlay? *Respondent skipped this question*

Q5: What is the typical mix design for LOW CEMENT (HIGH SLUMP) overlay?	*Respondent skipped this question*
Q6: What is the typical mix design for POLYESTER CONCRETE overlay?	*Respondent skipped this question*
Q7: What is the typical mix design for POLYMER MODIFIED overlay?	*Respondent skipped this question*
Q8: What is the typical mix design for THIN BONDED POLYMER overlay?	*Respondent skipped this question*

Q9: What is the typical mix design for YOUR DOT SPECIFIC overlay?

Cement (pounds per cubic yard)	825
Fly Ash (pounds per cubic yard)	0
Slag (pounds per cubic yard)	0
Silica Fume (pounds per cubic yard)	0
Fine Aggregate (% or pounds per cubic yard)	1300
Coarse Aggregate (% or pounds per cubic yard)	1315
Maximum Coarse Aggregate Size	#8
Target Air Content or range (%)	8 +/-2
Fibers (% or pounds per cubic yard)	0
% Polymer Additive	0
Type of Polymer Additive	0
Comments	ODOT SDC Mix. w/c ratio is 0.36

Q10: Any additional comments?

Aggregate weights may differ based on the type of stone (limestone vs. gravel). Deleterious content is limited to 25% of the standard allowable limit based on our table in ODOT CMS Item 703.02.

#3

COMPLETE

Collector: Web Link 1 (Web Link)
Started: Wednesday, April 12, 2017 6:40:36 AM
Last Modified: Wednesday, April 12, 2017 6:57:31 AM
Time Spent: 00:16:54
IP Address: 165.206.209.230

PAGE 1

Q1: State Representative

Name	Todd Hanson
Agency	Iowa DOT
State / Province	Iowa
Email	todd.hanson@dot.iowa.gov

Q2: What is the typical mix design for FIBER REINFORCED overlay?

Respondent skipped this question

Q3: What is the typical mix design for LATEX MODIFIED overlay?

Respondent skipped this question

Q4: What is the typical mix design for ULTRA THIN EXOXY overlay?

Respondent skipped this question

Q5: What is the typical mix design for LOW CEMENT (HIGH SLUMP) overlay?

Cement (pounds per cubic yard)	390
Fly Ash (pounds per cubic yard)	142
Slag (pounds per cubic yard)	177
Fine Aggregate (% or pounds per cubic yard)	1415
Coarse Aggregate (% or pounds per cubic yard)	1436
Maximum Coarse Aggregate Size	1/2"
Target Air Content or range (%)	6.0, Target 6.5% +2/-1
Comments	Mid Range WR required. Mix based on Abs Vol. cement will be lower with lower SpG blended cements

Q6: What is the typical mix design for POLYESTER CONCRETE overlay?

Respondent skipped this question

Q7: What is the typical mix design for POLYMER MODIFIED overlay?

Respondent skipped this question

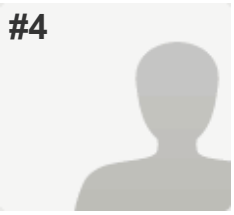
Q8: What is the typical mix design for THIN BONDED POLYMER overlay?

Respondent skipped this question

Q9: What is the typical mix design for YOUR DOT SPECIFIC overlay?

Cement (pounds per cubic yard)	825
Fine Aggregate (% or pounds per cubic yard)	1393
Coarse Aggregate (% or pounds per cubic yard)	1409
Maximum Coarse Aggregate Size	1/2"
Target Air Content or range (%)	6.0, Target 6.5% +2/-1
Comments	Low slump overlay- maximum slump 3/4". Mobile mixer

Q10: Any additional comments? *Respondent skipped this question*



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Last Modified: Thursday, April 13, 2017 8:49:20 AM
Time Spent: 00:12:04
IP Address: 165.201.162.178

PAGE 1

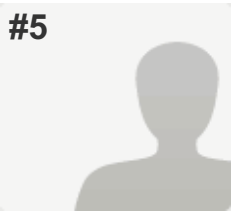
Q1: State Representative

Name	Dave Meggers
Agency	Kansas DOT
State / Province	Kansas
Email	dave.meggers@ks.gov

Q2: What is the typical mix design for FIBER REINFORCED overlay?	*Respondent skipped this question*
Q3: What is the typical mix design for LATEX MODIFIED overlay?	*Respondent skipped this question*
Q4: What is the typical mix design for ULTRA THIN EXOXY overlay?	*Respondent skipped this question*
Q5: What is the typical mix design for LOW CEMENT (HIGH SLUMP) overlay?	*Respondent skipped this question*
Q6: What is the typical mix design for POLYESTER CONCRETE overlay?	*Respondent skipped this question*
Q7: What is the typical mix design for POLYMER MODIFIED overlay?	*Respondent skipped this question*
Q8: What is the typical mix design for THIN BONDED POLYMER overlay?	*Respondent skipped this question*
Q9: What is the typical mix design for YOUR DOT SPECIFIC overlay?	*Respondent skipped this question*

Q10: Any additional comments?

Kansas presently is using very few silica fume concrete overlays, maintenance only.
We have shifted to Multi-Layer polymer overlays and Slurry polymer overlays on new structures and for maintenance.
We have constructed a very few concrete overlays with fibers as we have shifted primarily to polimers.



#5

COMPLETE

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Last Modified: Thursday, April 13, 2017 2:28:38 PM
Time Spent: 00:26:40
IP Address: 164.154.156.59

PAGE 1

Q1: State Representative

Name	Darin Hodges
Agency	South Dakota DOT
State / Province	SD
Email	darin.hodges@state.sd.us

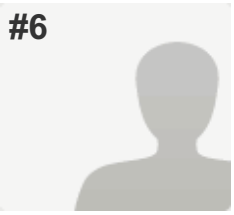
Q2: What is the typical mix design for FIBER REINFORCED overlay?

Cement (pounds per cubic yard)	520
Fly Ash (pounds per cubic yard)	130
Fine Aggregate (% or pounds per cubic yard)	45
Coarse Aggregate (% or pounds per cubic yard)	55
Maximum Coarse Aggregate Size	3/8"
Target Air Content or range (%)	5-7.5
Fibers (% or pounds per cubic yard)	8 lb /yd3
Comments	These are contractor mixes and vary widely.

Q3: What is the typical mix design for LATEX MODIFIED overlay?

Comments	Don't use Latex Modified Overlays

Q4: What is the typical mix design for ULTRA THIN EXOXY overlay?	*Respondent skipped this question*
Q5: What is the typical mix design for LOW CEMENT (HIGH SLUMP) overlay?	*Respondent skipped this question*
Q6: What is the typical mix design for POLYESTER CONCRETE overlay?	*Respondent skipped this question*
Q7: What is the typical mix design for POLYMER MODIFIED overlay?	*Respondent skipped this question*
Q8: What is the typical mix design for THIN BONDED POLYMER overlay?	*Respondent skipped this question*
Q9: What is the typical mix design for YOUR DOT SPECIFIC overlay?	*Respondent skipped this question*
Q10: Any additional comments?	*Respondent skipped this question*



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Last Modified: Friday, April 14, 2017 6:08:51 AM
Time Spent: 19:21:38
IP Address: 204.24.69.109

PAGE 1

Q1: State Representative

Name	John Staton
Agency	Michigan DOT
State / Province	MI
Email	statonj@michigan.gov

Q2: What is the typical mix design for FIBER REINFORCED overlay?

Cement (pounds per cubic yard)	618
Fly Ash (pounds per cubic yard)	N/A
Slag (pounds per cubic yard)	N/A
Silica Fume (pounds per cubic yard)	40
Other (pounds per cubic yard)	N/A
Fine Aggregate (% or pounds per cubic yard)	1273
Coarse Aggregate (% or pounds per cubic yard)	1601
Maximum Coarse Aggregate Size	3/4 inch
Target Air Content or range (%)	6.5 +/- 1.5
Fibers (% or pounds per cubic yard)	2 lb/cyd
% Polymer Additive	N/A
Type of Polymer Additive	N/A

Q3: What is the typical mix design for LATEX MODIFIED overlay?

Cement (pounds per cubic yard)	658
Fly Ash (pounds per cubic yard)	N/A
Slag (pounds per cubic yard)	N/A
Silica Fume (pounds per cubic yard)	N/A
Other (pounds per cubic yard)	N/A
Fine Aggregate (% or pounds per cubic yard)	1490
Coarse Aggregate (% or pounds per cubic yard)	1300
Maximum Coarse Aggregate Size	3/4 inch
Target Air Content or range (%)	4.5 +/- 1.5
Fibers (% or pounds per cubic yard)	N/A
% Latex	206 lb/cyd
Type of Latex Additive	White Latex Styrene Butadiene Modifier

Q4: What is the typical mix design for ULTRA THIN EXOXY overlay?

Cement (pounds per cubic yard)	N/A
Fly Ash (pounds per cubic yard)	N/A
Slag (pounds per cubic yard)	N/A
Silica Fume (pounds per cubic yard)	N/A
Other (pounds per cubic yard)	N/A
Fine Aggregate (% or pounds per cubic yard)	N/A
Coarse Aggregate (% or pounds per cubic yard)	100% Coverage
Maximum Coarse Aggregate Size	3/8 inch
Target Air Content or range (%)	N/A
Fibers (% or pounds per cubic yard)	N/A
% Polymer Additive	N/A
Type of Polymer Additive	N/A
Comments	Paid by Sq Yd, not CYd

Q5: What is the typical mix design for LOW CEMENT (HIGH SLUMP) overlay?

Cement (pounds per cubic yard)	N/A
Fly Ash (pounds per cubic yard)	N/A
Slag (pounds per cubic yard)	N/A
Silica Fume (pounds per cubic yard)	N/A
Other (pounds per cubic yard)	N/A
Fine Aggregate (% or pounds per cubic yard)	N/A
Coarse Aggregate (% or pounds per cubic yard)	N/A
Maximum Coarse Aggregate Size	N/A
Target Air Content or range (%)	N/A
Fibers (% or pounds per cubic yard)	N/A
% Polymer Additive	N/A
Type of Polymer Additive	N/A
Comments	N/A

Q6: What is the typical mix design for POLYESTER CONCRETE overlay?

Cement (pounds per cubic yard)	N/A
Fly Ash (pounds per cubic yard)	N/A
Slag (pounds per cubic yard)	N/A
Silica Fume (pounds per cubic yard)	N/A
Other (pounds per cubic yard)	N/A
Fine Aggregate (% or pounds per cubic yard)	N/A
Coarse Aggregate (% or pounds per cubic yard)	N/A
Maximum Coarse Aggregate Size	N/A
Target Air Content or range (%)	N/A
Fibers (% or pounds per cubic yard)	N/A
% Polymer Additive	N/A
Type of Polymer Additive	N/A
Comments	N/A

Q7: What is the typical mix design for POLYMER MODIFIED overlay?

Cement (pounds per cubic yard)	N/A
Fly Ash (pounds per cubic yard)	N/A
Slag (pounds per cubic yard)	N/A
Silica Fume (pounds per cubic yard)	N/A
Other (pounds per cubic yard)	N/A
Fine Aggregate (% or pounds per cubic yard)	N/A
Coarse Aggregate (% or pounds per cubic yard)	N/A
Maximum Coarse Aggregate Size	N/A
Target Air Content or range (%)	N/A
Fibers (% or pounds per cubic yard)	N/A
% Polymer Additive	N/A
Type of Polymer Additive	N/A
Comments	N/A

Q8: What is the typical mix design for THIN BONDED POLYMER overlay?

Cement (pounds per cubic yard)	N/A
Fly Ash (pounds per cubic yard)	N/A
Slag (pounds per cubic yard)	N/A
Silica Fume (pounds per cubic yard)	N/A
Other (pounds per cubic yard)	N/A
Fine Aggregate (% or pounds per cubic yard)	N/A
Coarse Aggregate (% or pounds per cubic yard)	N/A
Maximum Coarse Aggregate Size	N/A
Target Air Content or range (%)	N/A
Fibers (% or pounds per cubic yard)	N/A
% Polymer Additive	N/A
Type of Polymer Additive	N/A
Comments	N/A

Q9: What is the typical mix design for YOUR DOT SPECIFIC overlay?

Cement (pounds per cubic yard)	658*
Fly Ash (pounds per cubic yard)	N/A
Slag (pounds per cubic yard)	Replace Cement with 25-40% Slag
Silica Fume (pounds per cubic yard)	N/A
Other (pounds per cubic yard)	N/A
Fine Aggregate (% or pounds per cubic yard)	Follow ACI 211
Coarse Aggregate (% or pounds per cubic yard)	Follow ACI 211
Maximum Coarse Aggregate Size	Follow ACI 211
Target Air Content or range (%)	5.5 - 8.0
Fibers (% or pounds per cubic yard)	N/A
% Polymer Additive	N/A
Type of Polymer Additive	N/A
Comments	Deep Concrete Bridge Deck Overlay

Q10: Any additional comments?	*Respondent skipped this question*

#7

COMPLETE

Collector: Web Link 1 (Web Link)
Started: Friday, April 14, 2017 10:14:36 AM
Last Modified: Friday, April 14, 2017 10:42:56 AM
Time Spent: 00:28:19
IP Address: 163.191.102.70

PAGE 1

Q1: State Representative

Name	Steve Gillen
Agency	Illinois Tollway
State / Province	IL
Email	sgillen@getipass.com

Q2: What is the typical mix design for FIBER REINFORCED overlay?

Respondent skipped this question

Q3: What is the typical mix design for LATEX MODIFIED overlay?

Cement (pounds per cubic yard)	658
Fly Ash (pounds per cubic yard)	0
Slag (pounds per cubic yard)	0
Silica Fume (pounds per cubic yard)	0
Other (pounds per cubic yard)	0
Fine Aggregate (% or pounds per cubic yard)	50-58% of total aggregate
Coarse Aggregate (% or pounds per cubic yard)	42-50% of total aggregate
Maximum Coarse Aggregate Size	100% passing 3/4 in. sieve
Target Air Content or range (%)	0-7
Fibers (% or pounds per cubic yard)	0
% Latex	24.5 gal/cy
Type of Latex Additive	styrene butadiene
Comments	maximum of 157 pounds of water in addition to the 24.5 gal/cy of latex

Q4: What is the typical mix design for ULTRA THIN EXOXY overlay?

Cement (pounds per cubic yard)	0
Fly Ash (pounds per cubic yard)	0
Slag (pounds per cubic yard)	0
Silica Fume (pounds per cubic yard)	0
Other (pounds per cubic yard)	0
Fine Aggregate (% or pounds per cubic yard)	100% of total aggregate
Coarse Aggregate (% or pounds per cubic yard)	0
Maximum Coarse Aggregate Size	100% passing the No. 4 sieve
Target Air Content or range (%)	N/A
Fibers (% or pounds per cubic yard)	0
% Polymer Additive	100
Type of Polymer Additive	The epoxy resin base and hardener shall be composed of a two-component, 100% solids, 100% reactive, thermosetting compound with specified properties
Comments	total thickness of the overlay system shall not exceed 3/8 inch.

Q5: What is the typical mix design for LOW CEMENT (HIGH SLUMP) overlay?	*Respondent skipped this question*
Q6: What is the typical mix design for POLYESTER CONCRETE overlay?	*Respondent skipped this question*
Q7: What is the typical mix design for POLYMER MODIFIED overlay?	*Respondent skipped this question*
Q8: What is the typical mix design for THIN BONDED POLYMER overlay?	*Respondent skipped this question*
Q9: What is the typical mix design for YOUR DOT SPECIFIC overlay?	*Respondent skipped this question*
Q10: Any additional comments?	*Respondent skipped this question*

#8

COMPLETE

Collector: Web Link 1 (Web Link)
Started: Monday, April 17, 2017 12:40:15 PM
Last Modified: Monday, April 17, 2017 1:00:08 PM
Time Spent: 00:19:52
IP Address: 63.225.17.34

PAGE 1

Q1: State Representative

Name	Eric Prieve
Agency	Colorado DOT
State / Province	CO
Email	Eric.Prieve@state.co.us

Q2: What is the typical mix design for FIBER REINFORCED overlay?

Cement (pounds per cubic yard)	NA
Comments	NA - We don't specify fiber reinforced overlays

Q3: What is the typical mix design for LATEX MODIFIED overlay?

Cement (pounds per cubic yard)	N/A
Comments	NA - We don't specify latex modified overlays

Q4: What is the typical mix design for ULTRA THIN EXOXY overlay?

Comments	NA - We don't specify ultra thin epoxy overlays

Q5: What is the typical mix design for LOW CEMENT (HIGH SLUMP) overlay?

Comments	NA- We don't specify these

Q6: What is the typical mix design for POLYESTER CONCRETE overlay?

Cement (pounds per cubic yard)	0
Fly Ash (pounds per cubic yard)	0
Slag (pounds per cubic yard)	0
Silica Fume (pounds per cubic yard)	0
Comments	This is a proprietary mix design.

Q7: What is the typical mix design for POLYMER MODIFIED overlay?

Comments	NA- We don't specify these

Q8: What is the typical mix design for THIN BONDED POLYMER overlay?

Comments	NA- We don't specify these

Q9: What is the typical mix design for YOUR DOT SPECIFIC overlay?

Cement (pounds per cubic yard)	700 lbs cementitious
Fly Ash (pounds per cubic yard)	as needed for ASR mitigation. Typically 20% substitution with Class F
Slag (pounds per cubic yard)	not available in Colorado
Silica Fume (pounds per cubic yard)	0
Fine Aggregate (% or pounds per cubic yard)	50
Coarse Aggregate (% or pounds per cubic yard)	50
Maximum Coarse Aggregate Size	3/8"
Target Air Content or range (%)	5-8%
Fibers (% or pounds per cubic yard)	0
% Polymer Additive	0
Type of Polymer Additive	N/A
Comments	This is rarely used, since we are replacing concrete overlays with HMA or polyester to "water proof" the deck

Q10: Any additional comments?

Colorado has a policy of not having bare concrete decks. We are in the process of overlaying existing key bare decks with 1/2" polyester overlays. We have had a long and successful history of applying an asphalt membrane and 3" HMA overlay on bridge decks. Old (50+ year old) bridges that have been demolished with the HMA overlays show minimal corrosion on black bar even when bridge rails and unprotected concrete show significant deterioration from rebar corrosion. CDOT roads and bridges are heavily deiced with MgCl.

The HMA overlay must be maintained. Typically milled & filled every 10 years. If milling hits the asphalt membrane, the contractor must repair the area.

Weekly Report of "Low Slump Concrete"

This is to be used for "Low Slump Concrete" produced by continous mixers or paddle type mixers at the job site. The sections of the form that apply to the particular type of mixer designated. Continuous mixers (concrete-mobiles) control the batching by volumetric propotioning and each mixer requires calibration for the specific aggregates to be used for the project. Paddle type mixers control the batching by weighing the ingrediants prior to mixing.

1. Low Slump Concrete Mix Design 3U17A

Strength	- 5600 psi concrete at 28 days	06002 Ortonville Stone	(Sp.G 2.64) - 1369 pounds
Water	- 270 pounds	17001 Sioux Quartzite	(Sp.G 2.65) - 1374 pounds
Air	- 6.5 percent	52003 New Ulm Quartzite	(Sp.G 2.63) - 1364 pounds
Cement (C	- 836 pounds (Sp.G 3.15)	73006 Marietta Granite	(Sp.G 2.72) - 1411 pounds
FA *	- 1415 pounds, Concrete Sand (Spec 3126)	87002 Granite Falls Granite	(Sp.G 2.67) - 1385 pounds
CA **	- CA, Class A (Spec 3137):>>>>>>>>>>>>>>>>>>>>>>>>>>>	94009 Dresser Trap Rock	(Sp.G 2.97) - 1540 pounds
Slump	- 3/4 in. ± 1/4 in.	94035 RME-Athens	(Sp.G 2.95) - 1530 pounds
Water Redı	- Must be a MnDOT Approved Water Reducer - Use Manufacturer's Recommendations for Dosage Rate		

* Includes assumed 3% moisture

** If a coarse aggregate other than listed is to be used, the concrete mix shall be obtained from the Concrete Engineering Unit.

2. Aggregate Tests

a) A minimum of one gradation of stockpiled aggregates shall be run prior to commencing operations and each time aggregate is delivered to the site

b) Submit one laboratory sample for gradation for both fine and coarse aggregate monthly during operations

3. Moisture Control of Aggregates

The amount of moisture (water) in the mix is controlled by the slump. (The mix produced by the concrete mobile must be allowed to hydrate 4 - 5 minutes in order to measure the true slump). A minimum of one slump test shall be made at the start of each day. Other slump tests will be taken when the consistency of the mix changes due to varying moisture in the aggregates at the job site or whenever the aggregate stockpile is replenished (a minimum of two/day is recommended, see Schedule of Materials Control). Aggregates shall be well drained and protected from the elements to maintain moisture uniformity.

4. Other Tests

See Schedule of Materials Control.

5. Cement Record (Paddle Type Mixer Only)

The cement record shall be maintained in the spaces provided. A positive cement cut-off is required at the end of each week's operations or at the completion of the overlay project. Indicate whether the cement is maintained by pounds or bags.

6. Yield and Batching

a) Continious mixers. Calibration of the equipment will include the determination of the number of cement meter revolutions required to produce 1.0 cy of mix for yield (see Concrete Manual) and batching records. This value is then used to determine the quantity of cencrete produced during the day's pour.

b) Paddle type mixers. Batch sizes will be determined by the capacity of the mixer. The quantity batched will be determined by the volume per batch and the number of batches produced during the day's pour.

The inspector is required to estimate the amount of concrete wasted and to calculate the volume placed during the day. The sy of overlay produced during the day shall also be recorded.

(2356) ULTRATHIN BONDED WEARING COURSE (UTBWC)

Always use SP2005-250.1 (GRADED AGGREGATE FOR BITUMINOUS MIXTURES) or SP2005-250.2 (GRADED AGGREGATE FOR BITUMINOUS MIXTURES) (District 6 version) and 2399 (Pavement Surface Smoothness) Specifications with this write-up.

REVISED 2/8/2013

SP2005-135.1

2356.1 DESCRIPTION

This work is the construction of an ultrathin bonded wearing course on a prepared pavement. An ultrathin bonded wearing course is the application of a polymer modified emulsion membrane followed immediately with an ultrathin wearing course mixture.

2356.2 MATERIAL REQUIREMENTS

A. Bituminous Materials

A.1 Polymer Modified Emulsion Membrane

Provide a polymer modified emulsion membrane meeting the requirements of 3151.2.G

A.2 Asphalt Binder

Use a Performance Graded binder, PG 64-34 that meets Mn/DOT 3151.2.A.

B. Aggregate

Meets MnDOT 3139.4.

B.3 Mineral Filler

Mineral filler shall meet the requirements in AASHTO M 17.

C. Mix Design.

It is the Contractor's responsibility to design the UTBWC mixture that meets the requirements of this specification.

At the optimum binder content the mixture must meet the requirements in Table 2356- 1, "UTBWC Mixture Requirements".

Each design shall include the additional design trial points that bracket the optimum AC content and with at least one point at 0.4 above and below the optimum AC content. Draindown testing and adjusted AFT determinations are required on these trial points.

D. Mix Design Submittal

Submit a proposed job mix formula (JMF) in writing to the Department Bituminous Engineer for review as specified meeting the requirements in Table 3139-9, "UTBWC Aggregate Gradation Broadband" and Table 2356-1, "UTBWC Mixture Requirements" and include the following:

(1) Source, pit ID and description of the materials used.
(2) The proportion and gradation of each material in the JMF.

(3) The composite gradation of the design blend.
(4) Bulk and apparent specific gravities and water absorption (by % weight of dry aggregate). Both coarse and fine aggregate, for each product used in the mixture (including RAP/RAS). Use Mn/DOT Laboratory Manual Method 1204 and 1205. The tolerance allowed between the Contractor's and the Department's specific gravities are G_{sb} (individual) = 0.040 [+4 and -4] and G_{sb} (combined) = 0.020.
(5) Test results and worksheets for all properties required in Tables 2356-1, "UTBWC Mixture Requirements" and Tables 3139-7 to 9.
(6) Testing results and worksheets for the additional design points that bracket the optimum AC point.

Table 2356-1
UTBWC Mixture Requirements

Test	Criteria	Test Reference
Asphalt Content	4.8-6.0	Mn/DOT Laboratory Manual 1853 or 1852
Adj. AFT (Calculated)	10.5 µm minimum.	Mn/DOT Laboratory Manual 1854
Draindown Test	0.10% max	AASHTO T 305
Lottman (TSR)	80% min, 7-8% Voids	Mn/DOT Laboratory Manual 1813

D.1 Job Mix Formula Properties

Base gradation, asphalt binder content and adjusted AFT on the current Department reviewed Mixture Design Report. The JMF limits are the target plus or minus the limits in accordance with table 2356-2, "UTBWC JMF Limits." Use JMF limits as the criteria for acceptance of materials based on individual sample testing. Stop production if the test results vary from the JMF by more than the limits in Table 2356-2, "UTBWC JMF Limits". Identify the cause and document, in detail the corrective action. The JMF may only be adjusted if the revised JMF meets the mixture requirements in Tables 2356-1, "UTBWC Mixture Requirements" and Table 3139-9, "UTBWC Aggregate Gradation Broadbands". Do not resume paving until brought back into specification limits.

Table 2356-2
UTBWC JMF Limits

Gradation	Broad Band Limits
Asphalt Content, %	±0.4*
Adjusted AFT	-0.5*
*Note: The above limits shall not exceed the "Mixture Requirements" in Table 2356-1	

D.1 JMF Adjustments

The Contractor may make a request to the Bituminous or District Materials Engineer for a JMF adjustment if the QC test results indicate a necessary change to the design. A Certified Level II Bituminous QM Mix Designer will review the requested change for the Department. If the request meets the requirements in Table 3139-9, "UTBWC Aggregate Gradation Broadband" and Table 2356-1, "UTBWC Mixture Requirements", a revised Mixture Design Report will be issued.

2356.03 CONSTRUCTION REQUIREMENTS

A. Weather restrictions

The pavement surface temperature and ambient air temperature shall be at least 50 °F [10 °C]. A damp pavement surface is acceptable, if it is free of standing water and favorable weather conditions are expected.

B. Surface Preparation

Complete the following incidental work prior to the paving operations. Remove thermoplastic and tape traffic markings greater than 0.2-in [5-mm] thick. Protect manhole covers, drain, grates catch basins, and other utility structures with plastic or building felt. Clean the pavement surface.

B. Equipment

Use a paver, designed and built for the purpose of applying the ultrathin bonded wearing course. The paving machine shall incorporate a receiving hopper, feed conveyor, a storage tank for polymer modified emulsion membrane, polymer modified emulsion membrane spray bar and a variable width, heated, tamper bar screed. The screed shall have the ability to crown the pavement at the center both positively and negatively and have vertically adjustable extensions to accommodate the desired pavement profile.

C. Paving

Mixture must be produced by a certified plant.

Apply the polymer modified emulsion membrane and the ultrathin bonded wearing course in one pass. Spray the polymer modified emulsion membrane so it is not driven on, immediately prior to the application of the UTBWC. Use a metered mechanical pressure spray bar at a temperature of 120 – 180 °F [50 – 80 °C]. Accurately and continuously monitor the rate of spray and provide a uniform application across the entire pavement width. Use a spray rate in the range of 0.20 gal/yd² $\pm$ 0.07 gal/yd² [0.85 l/m² $\pm$ 0.3 l/m²]. Make adjustments based upon the existing pavement surface conditions and recommendations of the polymer modified emulsion membrane supplier. Apply the UTBWC at a temperature of 290 – 330 °F [143 – 165 °C] as measured in front of the screed. No wheel or other part of the paving machine shall come in contact with the polymer modified emulsion membrane before the UTBWC is applied. Use a heated, combination vibratory-tamping bar screed. Open the new pavement to traffic after the rolling operation is complete and the material has cooled below 158 °F [70 ° C].

D . Thickness

The minimum finished wearing course thickness is 5/8-in [16-mm] with a maximum ½ inch [12.5 mm] vertical edge at the adjacent shoulder pavement edge.

E. Rolling

Roll the wearing course a minimum of two passes, before the material temperature has fallen below 185 °F [85 °C].

Use steel double drum asphalt rollers with a minimum weight of 11 tons [10 tonnes]. Do not allow the roller(s) to remain stationary on the freshly placed UTBWC. Roll in static mode only immediately following the placement of the UTBWC in order to seat the mix.

F. Pavement Smoothness

Conduct paving operations to produce a smooth UTBWC. The UTBWC surface will show no variation greater than 1/8 inch [3 mm] from the edge of a 10 foot [3 m] straightedge laid parallel to or at right angles to the centerline.

Pavement Surface Smoothness 2399 is required to be followed except for the following changes.

Replace section 3.C.2 with the following:

For UltraThin Bonded Wearing Course projects, ALR will be collected only on asphalt pavement laid during this project before the UTBWC. No smoothness will be paid for on the asphalt pavement. Identify ALR using the ProVAL "Smoothness Assurance" analysis, calculating IRI with a continuous short interval of 25 ft [7.62 m] with the 250 mm filter.

Replace the first paragraph in section 3.D.1 with the following:

Evaluate smoothness requirements after the UTBWC is laid using equations and criteria in accordance with the following tables:

(1) Table 2399 4 for bituminous pavements,
(2) Table 2399 6 for percent improvement projects.

No ALR will be measured on the UTBWC.

Replace the second and third paragraphs in section 3.E with the following:

Perform corrective work for ALR on the asphalt pavement before placing the UTBWC. No corrective work is allowed on the UTBWC. Any Mean Roughness Index (MRI) values for the 0.1 mile segments on the UTBWC indicating corrective work will be assessed a deduct of $400 for each 0.1 mile segment.

G. Quality Control

The Contractor is responsible for obtaining all the quality control (QC/QA) sampling and testing as per the Materials Control Schedule.

G Polymer Modified Emulsion Membrane

Verify the application rate of the polymer modified emulsion membrane by dividing the volume of polymer modified emulsion membrane used by the area of paving for that day.

H. Quality Assurance

The Engineer is responsible for all quality assurance (QA) sampling according to Materials Control Schedule (MCS). T h e QA sample is the Department's companion sample to the Contractor's QC sample and tested as required.

H.1 Verification Sampling and Testing

The Department will test at a minimum one (1) verification sample per day to assure compliance of the Contractor's QC program. The Department will decide daily, which QC/QA companion samples are to be submitted and tested as the verification sample. The verification sample can be any one or all of the QC/QA split samples.

In addition the Engineer may obtain additional verification samples at any time and location during production to determine quality levels of the mixture. When additional verification samples are taken, the Department will provide the Contractor a verification companion. The contractor is required to test and use this

verification companion sample as part of the QC program. Use the verification companion sample to replace the next scheduled QC sample.

Compare the verification companion sample to the verification sample for compliance with allowable tolerances in Table 2356-3, "UTBWC Allowable Difference between Contractor and Department Test Results". The Department's verification test results will be available to the Contractor within 2 working days from the time the sample is delivered to the District Laboratory.

If the tolerances between the Contractor's verification companion and the Department's verification sample do not meet the requirements of Table 2356-3, "UTBWC Allowable Difference between Contractor and Department Test Results", the Department will retest the material. If the retests fail to meet tolerances, the Department will substitute the Department's verification test results for the Contractor's results in the QC program and use those results for acceptance. The Department will only substitute the out-of-tolerance parameters.

The Department will test the previously collected QA samples until they meet the tolerances or until the Department has tested all of the remaining samples. After testing the samples, the Department will test QA samples subsequent to the verification sample until tolerances are met.

If the adj. AFT calculation does not meet the tolerance in table 2356-3, equalize the Departments adj. AFT result by increasing the original Department value by 0.5 microns. The increased Department adj. AFT will be the basis for acceptance.

The Department will base acceptance on QC data with substitution of Department test results for those parameters that are out of tolerance. Cease mixture production and placement if reestablished test results do not meet tolerances within 48 h. Resume production and placement only after meeting the tolerances.

Table 2356-3
UTBWC Allowable Differences between Contractor and Department Test Results

Test	Item	Allowable Difference
Asphalt Binder	Chemical Extraction Incinerator Oven	0.4 0.3
Mixture max gravity (Gmm)	Rice Test	0.019
Adj. AFT (Calculated)		1.2
Gradation	**% Passing**	
	3/8 inch (9.5mm)	6%
	No. 4 (4.75mm)	5%
	No. 8 (2.36mm) No.16 (1.18mm) No. 30 (.060mm)	4%
	No. 50 (0.30mm)	3%
	No. 100 (0.150mm)	2%
	No. 200 (0.075mm)	1.2%

I. **Failures**

The Department will base material acceptance on individual test results and those exceeding the JMF limits as failing.

The Department will reduce payment for failing tests in accordance to Table 2356-4, "UTBWC Reduced Payment Schedule." The Department will calculate the quantity of unacceptable material on the tonnage placed from the sample point of the failing test to the sample point when the testing result is back within the JMF. If the failure occurs at the first test after the start of daily production, the Department will include tonnage from the start of production that day with the tonnage subjected to reduced payment.

If an individual failing test for % Asphalt Binder Content, adjusted AFT, or Gradation exceeds the limits in Table 2356-1, "UTBWC Mixture Requirements" or Table 3139-9, "UTBWC Aggregate Gradation Broadband then the mix will be subject to an assessment according to Table 2356-4, "UTBWC Reduced Payment Schedule"

Table 2356-4
UTBWC Reduced Payment Schedule

Item	**Pay Factor ,% ***
Asphalt Content, %	80
Adjusted AFT <10.5- 10.0	75 or ** (as determined by the Engineer)
Adjusted AFT <10.0	R & R**
Gradation	95

* Lowest Pay Factor applies when there are multiple reductions on a single test.
** Remove and replace at no expense to Department

The Department will reduce payment if the mat thickness is less than 5/8 inch [16 mm], or greater than 1 inch [25mm], or the pavement edge is greater than ½ inch [12.5 mm]. Any mixture placed outside of this requirement will be assessed a 50% pay reduction or remove and replaced, as determined by the Engineer, full width, by station.

2356.4 METHOD OF MEASUREMENT

Measure the Ultrathin Bonded Wearing Course by area of pavement surfaced.

2356.5 BASIS OF PAYMENT

Payment for the accepted quantity of Ultrathin Bonded Wearing Course at the Contract unit price of measure will be compensation in full for all costs of furnishing and applying all materials required in this specification. The unit price includes all labor, materials, and equipment necessary to complete the work.

Item No.	Item	Unit
2356.604	Ultrathin Bonded Wearing Course	Square yard [square meter]

SB-13 CHIP SEAL WEARING COURSE (TYPE 1) (Bridge No. XXXX)

SB-13.1 Description of Work

This work consists of preparing deck surface, furnishing and applying a multiple layer epoxy and aggregate wearing course system as shown on the Plans. . The wearing course will provide deck protection and increased skid resistance. The total thickness of the wearing course will be 3/8" minimum.

SB-13.2 Materials

A. General

Furnish materials specifically designed for use over concrete bridge decks. Pre-qualified polymer liquid binders are as follows:

Product Trade Name	Manufacturer or Supplier	Telephone
Mark-163 Flexogrid	PolyCarb, Inc.	(866) 765-9227
PPC-MLS	Kwikbond	(707) 330-6436
Sikadur 22 Lo Mod FS	Sika Corporation	(800) 933-7452
Sikadur 22 Lo-mod	Sika Corporation	(800) 933-7452
E-Bond 526 Lo-Mod	E-Bond Epoxies, Inc.	(954) 566-6555
Propoxy DOT Type III	Unitex	(816) 231-7700
Sure Level Epoxy (J-57)	Dayton Superior	(888) 977-9600
ICO Flexi-Coat	International Coatings	(800) 624-8919
Flexolith	Euclid Chemical Co.	(800) 321-7628
MASTERSEAL 350 (Formerly Trafficguard EP35)	BASF	(800) 433-9517

B. Epoxy Resin

The polymer resin base and hardener shall be composed of two-component, 100% solids, 100% reactive, thermosetting compound with the following properties:

Property	Requirements	Test Method
Gel Time [A]	15 - 45 minutes @ 75° F	ASTM C881
Viscosity [A]	7 - 70 poises	ASTM D2393, Brookfield RVT, Spindle No. 3, 20 rpm
Shore D Hardness [B]	60-75	ASTM D2240
Absorption [B]	1% maximum at 24 hr	ASTM D570
Tensile Elongation [B]	30% - 70% @ 7 days	ASTM D638
Tensile Strength [B]	>2000 psi @ 7 days	ASTM D638
Flexural Strength [B]	>4500 psi @ 7 days	ASTM D790
Chloride Permeability[B]	<100 coulombs @ 28 days	AASHTO T277

[A] Uncured, mixed polymer binder
[B] Cured, mixed polymer binder

C. Aggregates

Furnish natural or synthetic aggregates that have a proven record of performance in applications of this type. Furnish aggregates that are non-polishing, clean, free of surface moisture, fractured or angular in shape; free from silt, clay, asphalt, or other organic materials; and meet the following properties and gradation requirements:

Aggregate Properties:

Property	**Requirement**	**Test Method**
Moisture Content	≤0.2%	ASTM C566
Hardness	≥6.5	Mohs Scale
Fractured Faces	100% with at least 1 fractured face & 80% with at least 2 fractured faces of material retained on No. 16	ASTM 5821

Gradation for roadway deck:

Sieve Size	**% Passing by Weight**
No. 4	100
No. 8	30 – 75
No. 16	0 – 5
No. 30	0 – 1

No Dresser Trap Rock is allowed due to excessive dust. The color of the aggregate will be dark unless noted otherwise.

Gradation for sidewalk:

Sieve Size	**% Passing by Weight**
No. 4	100
No. 8	95-100
No. 16	30-70
No. 30	0-3
No. 100	0-1

The color for sidewalk aggregate will be light unless noted otherwise.

D. Required Properties of Wearing Course System

The required properties of the wearing course system are listed in the table below:

Property	Requirement [A]	Test Method
Minimum Compressive Strength. (psi)	1,000 psi @ 8 hrs 5,000 psi @ 24 hrs	ASTM C 579 Method B, Modified [B]
Thermal Compatibility	No Delaminations	ASTM C 884
Minimum Pull-off Strength	250 psi @ 24 hrs	ASTM 1583

[A] Based on samples cured or aged and tested at 75°F

[B] Plastic inserts that will provide 2-inch by 2-inch cubes shall be placed in the oversized brass molds.

E. Approval of Bridge Deck Epoxy Wearing Course System

A minimum of 20 working days prior to application, submit product data sheets and specifications from the manufacturer, product history/reference projects, and a certified test report to the Engineer for approval of the wearing course system. The engineer may request samples of the epoxy and/or aggregate, prior to application, for the purpose of acceptance testing by the Department.

Kwikbond PPC-MLS is not an epoxy but will be considered an acceptable product alternate in 3/8” thickness. Prefill cracks with an approved methylmethacrylate primer from Kwikbond.

A certified test report consists of a certification by an independent testing laboratory showing compliance with the requirements of this specification. Include the test results with the certification.

Product data sheets and specifications from the manufacturer consists of literature from the manufacturer showing general instructions, application recommendations and methods, product properties, general instructions, or any other applicable information.

SB-13.3 Construction Requirements

A. General

Conduct a pre-installation conference with the manufacturer's representative prior to construction to establish procedures for maintaining optimum working conditions and coordination of work. Furnish the Engineer a copy of the recommended procedures and apply the wearing course system according to the manufacturer’s instructions. The manufacturer's representative familiar with the wearing course system installation procedures, shall inspect all surface preparation prior to placing chip seal wearing course and shall be present at all times during wearing course placement to provide quality assurance that the work is being performed properly.

The requirement for manufacturer’s representative may be waived by the Engineer provided:

(1) The contractor presents evidence they are certified applicators by the epoxy manufacturer for the product being applied.
(2) The specific foreman supervising the epoxy placement produces evidence of three successful epoxy chip seal placements in the last two years with references and contact information for the owner of the referenced placements.
(3) The manufacturer representative must be available for consultation at any time during the epoxy chip seal placement and for evaluating preparation of the concrete prior to placing the epoxy chip seal.

Store resin materials in their original containers in a dry area. Store and handle materials according to the manufacturer's recommendations. Store all aggregates in a dry environment and protect aggregates from contaminants on the job site.

For rehabilitation projects with partial depth bridge removal, contractor shall coordinate final deck profile surface with chip seal wearing course supplier.

B. Deck Preparation

B1. Surface Preparation

Determine an acceptable shotblasting machine operation (size of shot, flow of shot, forward speed, and number of passes) that provides a surface profile meeting CSP 5 according to the International Concrete Repair Institute Technical Guideline No. 03732. Continue adjusting the shotblasting machine and necessary testing until the surface is acceptable to the Engineer or a passing test result is obtained.

Prepare the entire deck using the final accepted adjustments to the shotblasting machine as determined above. Thoroughly blast clean with hand-held equipment any areas inaccessible by the shotblasting equipment. Do not perform surface preparation more than 24 hours prior to the application of the wearing course system.

Take special precautions to control and abate the dust generated by the blasting operation in accordance with MPCA Rule 7011.0150 https://www.revisor.leg.state.mn.us/rules/?id=7011.0150. Submit the proposed plan for dust abatement at least 14 days before the start of this work. Include in the abatement plan, but not necessarily limit to, the following operations and procedures:

(1) Thoroughly sweep the bridge and approach slab(s) prior to blasting. Ensure a power sweeper uses the least amount of water necessary to minimize the dust from the sweeping operation.

(2) Enclose the blast wheel or blasting nozzle(s) in a housing or direct into a housing. Ensure the housing has a negative air emission control system that draws the confined air and dust into an adequate filter collection system. Ensure the capacity of the exhaust system is sufficient to readily relieve the pressure generated within the housing by the blasting equipment. Clean the filter collection system as necessary to ensure proper filtration. Ensure the sides and corners of the housing are flexible at the bottom to the extent that the bottom of the housing is in contact with the deck surface during all blasting operations.

(3) Construct, maintain and operate the housing and/or filter collection system so that avoidable dust emissions are eliminated.

(4) After blasting, hand-sweep the prepared surface or sweep with a "Pickup" type power sweeper equipped with adequate dust storage capacity. Completely remove all minor debris remaining after the sweeping operation by airblasting. Construct the air supply system so that a suitable oil trap is placed in the air supply line between the storage tank and the nozzle.

Prior to full application of wearing course three representative areas shall be tested to verify surface preparation is adequate.

Test in accordance with ASTM C 1583 “Standard Test Method for Tensile Strength of Concrete Surfaces and the Bond Strength or Tensile Strength of Concrete Repair and Overlay Materials by Direct Tension (Pull-Off Method)”. The failure should be in the concrete substrate and not in the chip seal wearing course or the bond of the wearing course to the substrate. The pullout value should not be less than 250 psi with more than 50 percent of the failure area in the concrete at a depth of ¼” or greater. Repair of the test area shall be incidental to chip seal wearing course.

Just prior to wear course placement, clean all dust, debris, and concrete fines from the deck surface including vertical faces of curbs and barrier walls up to a height of 2 inches above the wearing course with compressed air. When using compressed air, the air stream must be free of oil. Any grease, oil, or other foreign matter that rests on or has absorbed into the concrete shall be removed completely. Brooms shall not be used.

Cover the bridge deck drains and bridge expansion joints to prevent materials from adhering and entering.

If required for rehabilitation projects create a transitional area approaching transverse expansion joints and ends of the deck or approach panel using the shot blasting machine or other approved method. Remove 5/16”to 3/8” of concrete adjacent to the joint or end of deck and taper a distance of 3 feet.

Any surface preparation including shotblasting shall be incidental to chip seal wearing course.

The Engineer may consider alternate surface preparation methods per the wear course system manufacturer’s recommendations. The Engineer will approve the final surface profile and deck cleanliness prior to the contractor placing the chip seal wearing course.

All deck preparation equipment will be staged at least 50' from deck so as not to get any windblown dust on the bridge prior to placement.

C. Application of the Wearing Course

Perform the handling and mixing of the epoxy resin and hardening agent in a safe manner to achieve the desired results according to the manufacturer’s instructions. Do not apply the wearing course system if any of the following exists:

(1) Ambient air temperature is below 60°F;
(2) Deck temperature is below 60°F;
(3) Moisture content in the deck exceeds 4.5% when measured by an electronic moisture meter or shows visible moisture after 2 hours when measured in accordance with ASTM D4263.
(4) Rain is forecasted within 8 hours after the estimated completion time;
(5) Materials component temperatures below 50°F.
(6) Epoxy wearing course shall not be placed until all deck concrete has 28 days of cure. On rehabilitation projects, contractor may propose alternative deck patch material to reduce cure time with written approval from epoxy supplier and approval from Engineer. Moisture content tests will be required as part of submittal by contractor.

After the deck has been shotblasted or during the wearing course curing period, only necessary surface preparation and wearing course application equipment will be allowed on the deck.

Begin wearing course placement as soon as possible after surface preparation operations.

The epoxy wearing course shall consist of a two-course application of epoxy and aggregate. Each of the two courses shall consist of a layer of epoxy covered with a layer of aggregate in sufficient quantity to completely cover the epoxy. Apply the epoxy and aggregate a minimum 2" up from deck on vertical surface of rail. Apply the epoxy and aggregate according to the manufacturer's requirements. Apply the wearing course using equipment designed for this purpose. Hand mixing of material is not permitted.

The wearing course manufacturer representative will be at the job site during the entire application unless the conditions under SB-XX.2, "General", are met. The application machine shall feature positive displacement volumetric metering and be capable of storing and mixing the epoxy resins at the proper mix ratio. Disperse the aggregate using a standard chip spreader or equivalent machine that can provide a uniform, consistent coverage of aggregate. The dry aggregate shall be applied in such a manner as to cover the epoxy mixture completely within 5 minutes.

First course applications that do not receive enough aggregate before the epoxy gels shall be removed and replaced. A second course applied with insufficient aggregate may be left in place, but will require additional applications before opening to traffic. These requirements also pertain to the use of Kwikbond product alternates.

After completion of each course, cure the wearing course according to the manufacturer's instructions. Follow the minimum cure times listed under this specification or as prescribed by the manufacturer. Remove the excess aggregate from the surface treatment by sweeping, blowing, or vacuuming without tearing or damaging the surface; the material may be re-used if approved by the Engineer and manufacturer. Apply all courses of the wearing course system before opening the area to traffic. Do not allow traffic on the treated area until directed by the Engineer. Brooming the excess aggregate from any layer of the wearing course shall not begin until the wearing course has cured sufficiently to ensure that the brooming operations will not damage the surface.

In the event Contractors operations damages or mars the wearing course, the Contractor shall remove the damaged areas by saw cutting in rectangular sections and replacing the wearing course in accordance with this specification at no additional cost.

After the first layer of coating has cured to the point where the aggregate cannot be pulled out, apply the second layer. Prior to applying the second layer, broom and blow off the first layer with compressed air to remove all loose excess aggregate.

Prior to opening to traffic, clean expansion joints and joint seals of all debris and epoxy .

No traffic is allowed on lanes between first and second application.

If there are small deck panel areas that cannot freely drain water after second chip seal application, isolated areas of a third layer may be required to achieve positive drainage.

If the Engineer requires additional verification of adequate chip seal bonding to the deck, the contractor shall perform one additional tensile bond strength test per ASTM 1583 similar to pre application test. If there is a failure in bond of wearing coarse to the deck, the contractor shall perform additional test(s) to determine extent of the debonded area. Repair options for debonded areas, include partial and up to total removal of chip seal wearing coarse and reapplication. All testing and repairs are considered incidental.

Take measures to prevent liquid or aggregate entering into lanes of traffic on the bridge. All property claims resulting from liquid or aggregate damage is responsibility of the contractor.

D. Application Rates

Apply the epoxy wearing course in two separate courses in accordance with the manufacturer's instructions, but not less than the following rate of application.

Course	Minimum Epoxy Rate [A] (GAL/100 SF)	Aggregate [B] (LBS/SY)
1	2.5	10+
2	5.0	14+

[A] The minimum total applications rate is 7.5 GAL/100 SF.
[B] Application of aggregate shall be of sufficient quantity to completely cover the epoxy.

E. Minimum Curing Periods

As a minimum, cure the coating as follows:

	Average temperature of deck, epoxy and aggregate components in °F					
Course	**60-64**	**65-69**	**70-74**	**75-79**	**80-84**	**85+**
1	4 hrs.	3 hrs.	2.5 hrs	2 hrs	1.5 hrs.	1 hr.
2 *	6.5 hrs.	5 hrs.	4 hrs.	3 hrs.	3 hrs.	3 hrs.

* Cure course 2 for 8 hours if the air temperature drops below 60° F during the curing period.

F. Acceptance

Acceptance of the materials will be based on the certified test report received during the approval process, a certification of compliance from the manufacturer, and results of any acceptance tests ordered or performed by the Engineer during construction.

G. After curing and 30 days exposure to traffic, sweep loose aggregate and other materials from areas within the limits of the chip seal application area, including all bridge joints and approach panels. Bridge joint cleaning may require hand-operated equipment such as blowers and power washers to thoroughly clean. Any loose material removed from swept and cleaned areas shall become shall become property of the Contractor and must be disposed of as per MnDOT 2104.3C3.

SB-13.4 Method of Measurement

The Department will measure Chip Seal Wearing Course in area by square feet of deck or sidewalk and may include approach panel areas. Where chip seal meets a curb or concrete railing the epoxy wearing course layers excluding aggregate shall be carried 2" up the concrete face, but is not measured.

SB-13.5 Basis of Payment

Payment will be made under Item 2404.618, "CHIP SEAL WEARING COURSE (TYPE 1)" for measured quantities at the contract bid price per square foot. Quantity can include roadway deck area or sidewalks or a combination thereof. Payment is full compensation for preparing the surface including shotblasting; for tensile bond testing; for providing the wearing course; for cleanup; and for sweeping/vacuuming; and disposing of excess materials. No measurement and payment will be made for vertical face areas and these areas shall be considered incidental to the square foot unit prices. Associated mobilization costs shall be considered incidental to the pay item described above.

SB-13 CHIP SEAL WEARING COURSE (TYPE 2) (Bridge No. XXXX)

Description of Work

This work consists of preparing deck surface, furnishing and applying a multiple layer epoxy urethane and aggregate wearing course system as shown on the Plans. . The wearing course will provide deck protection and increased skid resistance. The total thickness of the wearing course will be 3/8" minimum.

SB-13.1 Materials

A. General

Furnish materials specifically designed for use over concrete bridge decks. Pre-qualified polymer liquid binders are as follows:

Product Trade Name	Manufacturer or Supplier	Telephone
Mark-163 Flexogrid	PolyCarb, Inc.	(866) 765-9227
Propoxy DOT Type III	Unitex	(816) 231-7700
PPC-MLS	Kwikbond	(707) 330-6436

B. Crack Pretreatment Resin

Crack treatment shall be composed of a two part epoxy that is flooded on the deck prior to wearing course to enhance bond. Furnish primer or pretreatment compatible with epoxy urethane in accordance with the manufacturer's recommendations and meeting the following requirements:

Property	**Requirements**	**Test Method**
Compressive Strength	Min. 5000 psi	ASTM C109
Tensile Strength	Min 2500 psi	ASTM D638
Tensile Elongation	30% - 70% @ 7 days	ASTM D638
Absorption [A]	1% maximum at 24 hr	ASTM D570
Shore D Hardness	Min. 65-75 at 77º	ASTM D2240
Adhesion to Concrete	100% failure in conc.	ASTM 1583
Viscosity cP	Max. 300	-

[A] Cured, mixed epoxy urethane binder

C. Epoxy Urethane Resin

The epoxy urethane resin base and hardener shall be composed of two-component, 100% solids, 100% reactive, thermosetting compound free of any fillers or solvents with the following properties:

Property	**Requirements**	**Test Method**
Gel Time [B]	15 - 45 minutes @ 75° F	ASTM C881
Viscosity [B]	7 - 70 poises	ASTM D2393, Brookfield RVT, Spindle No. 3, 20 rpm
Shore D Hardness [A]	60-75	ASTM D2240
Absorption [A]	1% maximum at 24 hr	ASTM D570
Tensile Elongation [A]	30% - 70% @ 7 days	ASTM D638
Tensile Strength [A]	>2000 psi @ 7 days	ASTM D638
Flexural Strength [A]	>4500 psi @ 7 days	ASTM D790
Chloride Permeability[A]	<100 coulombs @ 28 days	AASHTO T277
Load Bearing	At 20% strain, retain minimum 85% load bearing tensile strength	ASTM D638

[A] Cured, mixed epoxy urethane binder
[B] Uncured, mixed epoxy urethane binder

D. Aggregates

Furnish natural or synthetic aggregates that have a proven record of performance in applications of this type. Furnish aggregates that are non-polishing, clean, free of surface moisture, fractured or angular in shape; free from silt, clay, asphalt, or other organic materials; and meet the following properties and gradation requirements:

Aggregate Properties:

Property	***Requirement***	***Test Method***
Moisture Content	≤0.2%	ASTM C566
Hardness	≥6.5	Mohs Scale
Fractured Faces	100% with at least 1 fractured face & 80% with at least 2 fractured faces of material retained on No. 16	ASTM 5821

Gradation for roadway deck:

Sieve Size	**% Passing by Weight**
No. 4	100
No. 8	30 – 75
No. 16	0 – 5
No. 30	0 – 1

No Dresser Trap Rock is allowed due to excessive dust. The color of the aggregate will be dark unless noted otherwise.

Gradation for sidewalk:

Sieve Size	**% Passing by Weight**
No. 4	100
No. 8	95-100
No. 16	30-70
No. 30	0-3
No. 100	0-1

The color for sidewalk aggregate will be light unless noted otherwise.

E. Required Properties of Wearing Course System

The required properties of the wearing course system are listed in the table below:

Property	**Requirement** [A]	**Test Method**
Minimum Compressive Strength. (psi)	1,000 psi @ 8 hrs 5,000 psi @ 24 hrs	ASTM C 579 Method B, Modified [B]
Thermal Compatibility	No Delaminations	ASTM C 884
Minimum Pull-off Strength	250 psi @ 24 hrs	ASTM 1583

[A] Based on samples cured or aged and tested at 75°F

[B] Plastic inserts that will provide 2-inch by 2-inch cubes shall be placed in the oversized brass molds.

F. Approval of Bridge Deck Epoxy Urethane Wearing Course System

A minimum of 20 working days prior to application, submit product data sheets and specifications from the manufacturer, product history/reference projects, and a certified test report to the Engineer for approval of the wearing course system. The engineer may request samples of the epoxy urethane and/or aggregate, prior to application, for the purpose of acceptance testing by the Department.

Kwikbond PPC-MLS is not an epoxy-urethane but will be considered an acceptable product alternate in 3/8" thickness. Where used, prime the surface and prefill cracks with an approved methylmethacrylate primer from Kwikbond.

A certified test report consists of a certification by an independent testing laboratory showing compliance with the requirements of this specification. Include the test results with the certification.

Product data sheets and specifications from the manufacturer consists of literature from the manufacturer showing general instructions, application recommendations and methods, product properties, general instructions, or any other applicable information.

SB-13.2 Construction

A. General

Conduct a pre-installation conference with the manufacturer's representative prior to construction to establish procedures for maintaining optimum working conditions and coordination of work. Furnish the Engineer a copy of the recommended procedures and apply the wearing course system according to the manufacturer's instructions. The manufacturer's representative familiar with the wearing course system installation procedures, shall inspect all surface preparation prior to placing chip seal wearing course and shall be present at all times during wearing course placement to provide quality assurance that the work is being performed properly.

The requirement for manufacturer's representative may be waived by the Engineer provided:

1. The contractor presents evidence they are certified applicators by the epoxy manufacturer for the product being applied.
2. The specific foreman supervising the epoxy placement produces evidence of three successful epoxy chip seal placements in the last two years with references and contact information for the owner of the referenced placements.
3. The manufacturer representative must be available for consultation at any time during the epoxy chip seal placement and for evaluating preparation of the concrete prior to placing the epoxy chip seal.

Store resin materials in their original containers in a dry area. Store and handle materials according to the manufacturer's recommendations. Store all aggregates in a dry environment and protect aggregates from contaminants on the job site.

For rehabilitation projects with partial depth bridge removal, contractor shall coordinate final deck profile surface with chip seal wearing course supplier.

B. Deck Preparation

1. Surface Preparation

Determine an acceptable shotblasting machine operation (size of shot, flow of shot, forward speed, and number of passes) that provides a surface profile meeting CSP 5 according to the International Concrete Repair Institute Technical Guideline No. 03732. Continue adjusting the shotblasting machine and necessary testing until the surface is acceptable to the Engineer or a passing test result is obtained.

Prepare the entire deck using the final accepted adjustments to the shotblasting machine as determined above. Thoroughly blast clean with hand-held equipment any areas inaccessible by the shotblasting equipment. Do not perform surface preparation more than 24 hours prior to the application of the wearing course system.

Take special precautions to control and abate the dust generated by the blasting operation in accordance with MPCA Rule 7011.0150 https://www.revisor.leg.state.mn.us/rules/?id=7011.0150. Submit the proposed plan for dust abatement at least 14 days before the start of this work. Include in the abatement plan, but not necessarily limit to, the following operations and procedures:

a. Thoroughly sweep the bridge and approach slab(s) prior to blasting. Ensure a power sweeper uses the least amount of water necessary to minimize the dust from the sweeping operation.

b. Enclose the blast wheel or blasting nozzle(s) in a housing or direct into a housing. Ensure the housing has a negative air emission control system that draws the confined air and dust into an

adequate filter collection system. Ensure the capacity of the exhaust system is sufficient to readily relieve the pressure generated within the housing by the blasting equipment. Clean the filter collection system as necessary to ensure proper filtration. Ensure the sides and corners of the housing are flexible at the bottom to the extent that the bottom of the housing is in contact with the deck surface during all blasting operations.

c. Construct, maintain and operate the housing and/or filter collection system so that avoidable dust emissions are eliminated.

d. After blasting, hand-sweep the prepared surface or sweep with a "Pickup" type power sweeper equipped with adequate dust storage capacity. Completely remove all minor debris remaining after the sweeping operation by airblasting. Construct the air supply system so that a suitable oil trap is placed in the air supply line between the storage tank and the nozzle.

Prior to full application of wearing course three representative areas shall be tested to verify surface preparation is adequate.

Test in accordance with ASTM C 1583 “Standard Test Method for Tensile Strength of Concrete Surfaces and the Bond Strength or Tensile Strength of Concrete Repair and Overlay Materials by Direct Tension (Pull-Off Method)”. The failure should be in the concrete substrate and not in the chip seal wearing course or the bond of the wearing course to the substrate. The pullout value should not be less than 250 psi with more than 50 percent of the failure area in the concrete at a depth of ¼” or greater. Repair of the test area shall be incidental to chip seal wearing course.

Just prior to wear course placement, clean all dust, debris, and concrete fines from the deck surface including vertical faces of curbs and barrier walls up to a height of 2 inches above the wearing course with compressed air. When using compressed air, the air stream must be free of oil. Any grease, oil, or other foreign matter that rests on or has absorbed into the concrete shall be removed completely. Brooms shall not be used.

Cover the bridge deck drains and bridge expansion joints to prevent materials from adhering and entering.

If required for rehabilitation projects create a transitional area approaching transverse expansion joints and ends of the deck or approach panel using the shot blasting machine or other approved method. Remove 5/16”to 3/8” of concrete adjacent to the joint or end of deck and taper a distance of 3 feet.

Any surface preparation including shotblasting shall be incidental to chip seal wearing course.

The Engineer may consider alternate surface preparation methods per the wear course system manufacturer’s recommendations. The Engineer will approve the final surface profile and deck cleanliness prior to the contractor placing the chip seal wearing course.

All deck preparation equipment will be staged at least 50' from deck so as not to get any windblown dust on the bridge prior to placement.

C. Application of the Wearing Course

Perform the handling and mixing of the epoxy urethane resin and hardening agent in a safe manner to achieve the desired results according to the manufacturer’s instructions. Do not apply the wearing course system if any of the following exists:

a. Ambient air temperature is below 60°F;
b. Deck temperature is below 60°F;
c. Moisture content in the deck exceeds 4.5% when measured by an electronic moisture meter or shows visible moisture after 2 hours when measured in accordance with ASTM D4263.
d. Rain is forecasted within 8 hours after the estimated completion time;
e. Materials component temperatures below 50°F.
f. Epoxy urethane wearing course shall not be placed until all deck concrete has 28 days of cure. On rehabilitation projects, contractor may propose alternative deck patch material to reduce cure time with written approval from epoxy supplier and approval from Engineer. Moisture content tests will be required as part of submittal by contractor.

After the deck has been shotblasted or during the wearing course curing period, only necessary surface preparation and wearing course application equipment will be allowed on the deck.

Begin wearing course placement as soon as possible after surface preparation operations.

The epoxy urethane wearing course shall consist of a two-course application of epoxy urethane and aggregate. Each of the two courses shall consist of a layer of epoxy urethane covered with a layer of aggregate in sufficient quantity to completely cover the epoxy urethane. Apply the epoxy urethane and aggregate a minimum 2" up from deck on vertical surface of rail. Apply the epoxy urethane and aggregate according to the manufacturer's requirements. Apply the wearing course using equipment designed for this purpose. Hand mixing of material is not permitted.

The wearing course manufacturer representative will be at the job site during the entire application unless the conditions under SB-XX.2, "General", are met. The application machine shall feature positive displacement volumetric metering and be capable of storing and mixing the epoxy urethane resins at the proper mix ratio. Disperse the aggregate using a standard chip spreader or equivalent machine that can provide a uniform, consistent coverage of aggregate. The dry aggregate shall be applied in such a manner as to cover the epoxy urethane mixture completely within 5 minutes.

First course applications that do not receive enough aggregate before the epoxy urethane gels shall be removed and replaced. A second course applied with insufficient aggregate may be left in place, but will require additional applications before opening to traffic. These requirements also pertain to the use of Kwikbond product alternates.

After completion of each course, cure the wearing course according to the manufacturer's instructions. Follow the minimum cure times listed under this specification or as prescribed by the manufacturer. Remove the excess aggregate from the surface treatment by sweeping, blowing, or vacuuming without tearing or damaging the surface; the material may be re-used if approved by the Engineer and manufacturer. Apply all courses of the wearing course system before opening the area to traffic. Do not allow traffic on the treated area until directed by the Engineer. Brooming the excess aggregate from any layer of the wearing course shall not begin until the wearing course has cured sufficiently to ensure that the brooming operations will not damage the surface.

In the event Contractors operations damages or mars the wearing course, the Contractor shall remove the damaged areas by saw cutting in rectangular sections and replacing the wearing course in accordance with this specification at no additional cost.

After the first layer of coating has cured to the point where the aggregate cannot be pulled out, apply the second layer. Prior to applying the second layer, broom and blow off the first layer with compressed air to remove all loose excess aggregate.

Prior to opening to traffic, clean expansion joints and joint seals of all debris and epoxy urethane.

No traffic is allowed on lanes between first and second application.

If there are small deck panel areas that cannot freely drain water after second chip seal application,

isolated areas of a third layer may be required to achieve positive drainage.

If the Engineer requires additional verification of adequate chip seal bonding to the deck, the contractor shall perform one additional tensile bond strength test per ASTM 1583 similar to pre application test. If there is a failure in bond of wearing coarse to the deck, the contractor shall perform additional test(s) to determine extent of the debonded area. Repair options for debonded areas, include partial and up to total removal of chip seal wearing coarse and reapplication. All testing and repairs are considered incidental.

Take measures to prevent liquid or aggregate entering into lanes of traffic on the bridge. All property claims resulting from liquid or aggregate damage is responsibility of the contractor.

D. Application Rates

Apply the epoxy urethane wearing course in two separate courses in accordance with the manufacturer's instructions, but not less than the following rate of application.

Course	**Minimum Epoxy Urethane Rate [A] (GAL/100 SF)**	**Aggregate [B] (LBS/SY)**
1	2.5	10+
2	5.0	14+

[A] The minimum total applications rate is 7.5 GAL/100 SF.
[B] Application of aggregate shall be of sufficient quantity to completely cover the epoxy urethane.

E. Minimum Curing Periods

As a minimum, cure the coating as follows:

	Average temperature of deck, epoxy urethane and aggregate components in °F					
Course	**60-64**	**65-69**	**70-74**	**75-79**	**80-84**	**85+**
1	4 hrs.	3 hrs.	2.5 hrs	2 hrs	1.5 hrs.	1 hr.
2 *	6.5 hrs.	5 hrs.	4 hrs.	3 hrs.	3 hrs.	3 hrs.

* Cure course 2 for 8 hours if the air temperature drops below 60° F during the curing period.

F. Acceptance

Acceptance of the materials will be based on the certified test report received during the approval process, a certification of compliance from the manufacturer, and results of any acceptance tests ordered or performed by the Engineer during construction.

G. After curing and 30 days exposure to traffic, sweep loose aggregate and other materials from areas within the limits of the chip seal application area, including all bridge joints and approach panels. Bridge joint cleaning may require hand-operated equipment such as blowers and power washers to thoroughly clean. Any loose material removed from swept and cleaned areas shall become shall become property of the Contractor and must be disposed of as per MnDOT 2104.3C3.

SB-13.3 Measurement

The Department will measure Chip Seal Wearing Course in area by square feet of deck or sidewalk and may include approach panel areas. Where chip seal meets a curb or concrete railing the epoxy urethane wearing course layers excluding aggregate shall be carried 2" up the concrete face, but is not measured.

SB-13.4 Payment

A. Chip Seal Wearing Course

Payment will be made under Item 2404.618, "CHIP SEAL WEARING COURSE (TYPE 2)" for measured quantities at the contract bid price per square foot. Quantity can include roadway deck area or sidewalks or a combination thereof.

Payment is full compensation for preparing the surface including shotblasting; for tensile bond testing; for providing the wearing course; for cleanup; and for sweeping/vacuuming; and disposing of excess materials. No measurement and payment will be made for vertical face areas and these areas shall be considered incidental to the square foot unit prices. Associated mobilization costs shall be considered incidental to the pay item described above.

SB-12 PREMIXED POLYMER CONCRETE (PPC) WEARING COURSE (Bridge No. **9601**)

SB-12.1 Description

A. Scope:

This work consists of constructing premixed polymer concrete (PPC) wearing course as shown in the plans and specified in the contract documents. The wearing course must be placed a minimum of 14 days after deck repairs unless alternate patching materials are used. Refer to SB-12.5 for deck repairs.

Place a PPC wearing course on the deck roadway and approach panels of Bridge No. 9601. The minimum PPC wearing course thickness shall be ¾" as shown in the Plans.

B. Definitions:

PPC System - The combination of compatible resins and primers, mixed with aggregates and other specified ingredients and applied as specified, that produces an acceptable PPC pavement wearing course.

System Provider - The polymer concrete supplier experienced in PPC mix design and the application of PPC systems.

C. Public Safety Plan:

Before beginning work, submit for approval, a Public Safety Plan (PSP) for the use of methacrylate resin and premixed polymer concrete. Include in the PSP:

All materials, equipment, and methods to be used.
All potential health and safety risks.
Precautions that will be taken by personnel performing or inspecting the work.

Except for specifically Engineer written authorized, do not perform PPC pavement wearing course work before the Engineer's approval of the PSP.

If the Engineer determines that the measures used by the Contractor are not adequate to provide for public safety associated with use of methacrylate resin and premixed polymer concrete, the Engineer will direct the Contractor to revise his operations and his Public Safety Plan. Such directions will be in writing and will specify the items of work for which the Contractor's Public Safety Plan is deemed inadequate. Do not perform further work on the items specified until the revised Public Safety Plan has been approved.

Within 14 Calendar Days after receiving the original PSP or revised PSP, the Engineer will notify the Contractor, in writing, of the approval or rejection of the original PSP or revised PSP.

D. Pre-placement Conferences:

(1) Supervisory Personnel - Hold a pre-placement conference with all supervisory personnel, subcontractors, and suppliers who are to be involved in the PPC wearing course work and the QCT and the system provider's technical representative (SPTR) at a mutually agreed time approximately two weeks before placing the PPC wearing course including the trial strip. The Engineer, subcontractor, supplier, and all other personnel are required to be at the pre-placement conference. Present and discuss all phases of the PPC wearing course work.

(2) Placement Crew - Hold a second pre-placement conference with the Engineer, the entire PPC pavement overlay crew, the QCT, and the SPTR at the job site one-half hour before the first placement begins to discuss placement duties and procedures. Do not begin PPC wearing course work until this meeting is held.

SB-12.2 Materials

A. Resin Primer:

Furnish a wax-free, high molecular weight methacrylate resin prime coat meeting the following requirements:

High Molecular Weight Methacrylate (HMWM) Resin		
Property	Requirement	Test Method
Viscosity*	25 cps max. (Brookfield RVT with UL adaptor, 50 RPM at 77° F)	ASTM D 2196
Specific Gravity*	0.90, min. at 77 °F	ASTM D 1475
Flash Point*	180° F, min.	ASTM D 3278
Vapor Pressure*	0.039 in. Hg, max. at 77° F	ASTM D 323
Tack-free time	400 minutes, max. at 77° F	California Test 551**
PCC Saturated Surface-Dry Bond Strength	500 psi, min. at 24 hours and 70 ± 2 °F	California Test 551**
* Perform test before adding initiator. ** Copies of California Test 551 are available from the Engineer.		

Provide test results, from an independent testing laboratory, for the first lot of primer manufactured for use on this Project, showing that the primer complies with the requirements of these Specifications. Provide a certificate of compliance from the manufacturer for each subsequent lot of primer, indicating that the primer was manufactured to the same formulation as the first lot.

B. Concrete:

Furnish premixed polymer concrete consisting of polyester resin binder and dry aggregate.

(1) Polyester Resin Binder - Furnish unsaturated isophthalic polyester-styrene co-polymer resin binder meeting the following requirements:

Polyester Resin Binder		
Property	Requirement	Test Method
Viscosity*	75 - 200 cps (RVT, No. 1 Spindle, 20 RPM at 77 °F)	ASTM D 2196
Specific Gravity*	1.05 to 1.10 at 77 °F	ASTM D 1475
Elongation	35% min. Type I at 0.45 in./min. Thickness = 0.25 ± 0.03 inch	ASTM D 638
	Sample Conditioning: 18/25/50 + 5/70	ASTM D 618
Tensile Strength	2,500 psi min. Type I at 0.45 in./min. Thickness = 0.25 ± 0.03 inch	ASTM D 638
	Sample Conditioning: 18/25/50 + 5/70	ASTM D 618
Styrene Content*	40 to 50 % (by weight)	ASTM D 2369
Silane Coupler**	1.0% min. (by weight of polyester styrene resin)	n/a
PCC Saturated Surface-Dry Bond Strength	500 psi, min. at 24 hours and 70 ± 2 °F	California Test 551***
* Perform test before adding initiator. ** An organosilane ester, gammamethacryloxypropyltrimeth-oxysilane. *** Copies of California Test 551 are available from the Engineer.		

Provide test results, from an independent testing laboratory, for the first lot of polyester resin binder manufactured for use on this Project, showing that the binder complies with the requirements of these Specifications. Provide a certificate of compliance from the manufacturer for each subsequent lot of resin binder, indicating that the additional polyester resin binder was manufactured, to the same formulation as the first lot.

Provide a promoter that is compatible with suitable methyl ethyl ketone peroxide.

Initiate and thoroughly blend the polyester resin binder just prior to mixing with aggregate.

(2) Initiator - Provide an initiator system for the methacrylate resin consisting of a metal drier and peroxide. If the initiator is supplied separately from the resin, do not directly mix the metal drier with the peroxide.

Store containers in a manner that prevents leakage or spillage from one material to contact the containers or material of the other.

(3) Accelerators and Inhibitors - Provide accelerators and inhibitors, if required, as recommended by the system provider.

(4) Aggregate - Furnish 3/8" - 0 size aggregate that:

Meets the following combined gradation:

Sieve Size	Percent Passing (by Weight)
3/8"	100
No. 4	62 - 85
No. 8	45 - 67
No. 16	29 - 50
No. 30	16 - 36
No. 50	5 - 20
No. 100	0 - 7
No. 200	0 - 3

- Does not exceed one percent aggregate absorption according to AASHTO T 85.

- The moisture content does not exceed one half of the aggregate absorption at the time of mixing with the polyester resin binder according to AASHTO T 255.

Deliver aggregate to the mixer in containers that maintain the specified moisture content.

(a) Coarse Aggregate - Furnish maximum size No. 4 washed, clean, dry coarse aggregate with the largest size not exceeding one-half the minimum depth of the overlay.

(b) Fine Aggregate - Furnish No. 8 to No. 200 fine aggregate, consisting of natural sand only, with aggregate retained on the No. 8 and No. 4 sieves having a maximum of 45 percent crushed particles with at least one fractured face when tested according to AASHTO TP 61.

(5) Surface Texture Sand - Furnish dry commercial quality blast sand, meeting the absorption and moisture content requirements of the aggregate with

95 percent of the sand passing the No. 8 sieve, and 95 percent of the sand retained on the No. 20 sieve.

C. PPC Mixture Tolerances and Limits:

Provide a uniform, consistent, workable PPC mixture with a polyester resin content, by weight, of 12 ± 1% of the aggregate weight.

D. Acceptance of Premixed Polymer Concrete:

(1) General - Acceptance of PPC will be based on the results of the Contractor's quality control testing as listed below.

(2) Required Properties and Tolerances - Premixed polymer concrete meets the following requirements:

Property	Requirement	Test Method
Compressive Strength for Traffic	2,000 psi, min. before opening to traffic	ASTM C 805
Surface Tolerance	See (d) below	n/a
Bond Strength	250 psi, min.	See (e) below
Set Time	30 to 120 minutes	Visual
Density	See (g) below	ASTM C 138
Modulus of Elasticity at 7 days	1,000 ksi, min. 2,000 ksi, max.	ASTM C 469
Surface Preparation Depth	1/8 inch, min.	ASTM E 965

Perform acceptance testing according to the referenced tests and furnish samples to the Engineer as required. Failing test results may be cause for rejection of the mix with removal and replacement of the affected material at no additional cost to the Department.

(3) Compressive Strength - Within one minute of mixing or at the time of placing the wearing course, cast and cure two sets of three 4 by 8 inch cylinder specimens from each batch of PPC placed on the Project, according to AASHTO T 106. A batch is defined as "per mixer" or "6 cubic yards", whichever is greater. Test one set according to ASTM C 469 to determine modulus of elasticity at 7 days. Retain the second set and submit to the Engineer for verification testing.

Do not allow traffic and equipment on the PPC wearing course until the overlay has reached a minimum compressive strength of 2,000 psi as verified by the rebound number determined according to ASTM C 805.

(4) Surface Tolerance - The finished surface, when tested with a 10 foot straightedge, shall not vary by more than 1/4 inch. Furnish the straightedge and operate it under the direction of the Engineer.

Correct all non-specification surface tolerance with a diamond grinder.

(5) Bond Strength - Perform at least two bond tests daily in the presence of and at locations designated by the Engineer between 24 hours and 48 hours after placing the PPC wearing course. Cut cores from in-place PPC and conduct bond tests on the cores.

The bond tests consists of:

- Coring through the PPC wearing course and approximately 1 inch into the existing concrete.
- Attaching a device to the top of the core.
- Exerting a tensile load to the core sufficient to cause failure or achieve 250 psi, whichever occurs first.

A successful test is the failure of the concrete substrate or bond failure above 250 psi.

After coring and testing, restore the area voided by the cores by blowing with compressed air and filling with PPC.

(6) Set Time - Use an appropriate amount of initiator to achieve the required set time. Accelerators or inhibitors may be required as recommended by the polyester resin binder supplier and as approved by the Engineer.

(7) Density - Determine the unit weight of the PPC mixture according to AASHTO T 121 (ASTM C 138). Submit test results to the Engineer. The correlation factor established through density testing will be used to determine equivalency between weight and volume for purposes of payment. Perform density testing at the rate of one test per batch.

E. Submittals, Samples, and Notifications**:**

Fourteen Calendar Days before the pre-construction conference, provide the following information to the Engineer:

The type of scarifying equipment that will be used for deck preparation.

The method and materials used to contain, collect, and dispose of all concrete debris generated by the scarifying process, including provisions for protecting adjacent traffic from flying debris.

The method and materials used to contain HMWM resin and The PPC mixture within the deck area that will receive the wearing course.

The PPC mix design.

Certification from the System Provider stating that the polyester resin and the primer are approved and are fully compatible with one another.

Provide the following samples to the Engineer before placing the PPC wearing course:

100 pounds of the blended aggregate.

Representative samples from each lot of prepackaged deck repair material selected for use.

Provide the following information:

A Material Safety Data Sheet for each shipment of polyester resin binder and high molecular weight methacrylate resin.

If bulk resin is used, provide written notification to the Engineer 2 Calendar Days before delivery of the bulk resin to the jobsite. Bulk resin is resin that is stored in containers exceeding 55 gallons.

All material delivery receipts upon availability, but no later than one hour after the end of the work shift.

SB-12.3 Equipment

A. General:

Remove all equipment that leaks oil or other contaminants from the jobsite until they are repaired. Before PPC placement, protect the prepared deck or pavement from contaminant spills by covering with clear plastic, overlapped to prevent contaminants from contacting the deck or pavement Do not use equipment until approval is obtained.

B. Surface Preparation Equipment:

(1) Sawing Equipment - Furnish power-driven concrete saws adequate for sawing joints and for surface texture.

(2) Scarifying Equipment - Furnish scarifying equipment consisting of power-operated diamond grinding or micro-milling equipment capable of uniformly removing the existing surface to depths required.

(a) Diamond Grinding - Furnish power-driven self-propelled machines with the cutting head made up of diamond cutting blades.

(b) Micro-milling - Furnish micro-milling equipment according to the following:

1. Cold Plane or Rotomill Grinders - Cold plane or rotomill grinding machines using carbide cutting tools in a rotary drum. Provide equipment with a tooth spacing of not more than 1/4 inch, capable of leaving a smooth, uniform pattern of striations. Limit machines to a gross operational weight of no more than 35 tons and a forward speed to 2.5 feet per minute. Operate at a drum speed of at least 120 RPM.

2. Shot-Blasting - Mono-directional or bi-directional electric-powered shot blast machines with single or multiple blast wheels that cover at least 2.5 feet per pass, and conform to EPA air pollution requirements by containing dust and steel abrasive media. If the equipment is not equipped for simultaneous bi-directional blasting, make separate passes in opposite directions to ensure equal cleaning on all sides of the exposed aggregate.

(3) Air Compressor - Furnish air compressors equipped with functioning oil traps. Ensure air used for blow-down of prepared surfaces is free of oil.

C. Mixing Equipment:

Furnish mechanically operated continuous mixers specifically built or modified for PPC that:

- Employ an auger screw or chute device.
- Is equipped with a positive-displacement pump that is calibrated yearly and is connected to an adjustable catalyst pump.
- Is equipped with a metering device that is calibrated yearly and automatically measures and records the aggregate weight and the corresponding resin weight.
- Has a readout gage, visible to the Engineer at all times, that displays the volumes being recorded.

Record the volumes at no greater than five minute intervals along with the time and date of each recording. Furnish a printout of the recordings to the Engineer at the end of each work shift.

Polyester concrete may be mixed in mechanical mixers of at most 0.3-cubic yard capacity.

D. Finishing Equipment:

Furnish slip-form finishing equipment with an automatic grade control device to strike off the PPC mixture to the established grade and cross section. Fit the finishing equipment with vibrators or other means of consolidating the PPC. Do not place greater than 13' width per wearing course placement. Do not perform adjacent wearing course placements until after the PPC wearing course has reached a minimum compressive strength of 2,000 psi as verified by the rebound number determined according to ASTM C 805.

E. Miscellaneous Equipment:

(1) Hand Tools - Furnish hand tools for placing and finishing the PPC. Use manual type screeds with approved vibrators attached to consolidate and finish smaller areas where it is impractical to use a finishing machine.

(2) Straightedge - Furnish a 10 foot metal straightedge.

(3) Coring Equipment - Furnish core cutting equipment that can cut a core at least 3 inches in diameter.

(4) Bond Testing Equipment - Furnish bond testing equipment that:

- Is compatible with the core tested.
- Can exert a tensile load to the core sufficient to exceed 250 psi.
- Is equipped with a measuring device capable of reading tensile force exerted within 1 percent accuracy.

(5) Diamond Grinders - Furnish power-driven self-propelled machines with the cutting head made up of diamond cutting blades to correct non-specification surface variations only.

SB-12.4 Quality Control

A. Quality Control Personnel:

Provide the following certified technicians:

(1) Certified Aggregate Technician - Duties:

Sample and test on the trial wearing courses to verify gradation, absorption, and crushed particle content.

(2) Quality Control Technician - Duties:

Attend pre-placement meetings.
Be at the PPC placement site when PPC placement is in progress.
Verify that the primer gels, as mixed and applied.
Performs all acceptance testing.
Be responsible for ensuring the PPC is in compliance with Specifications.
Notify the Contractor and the Engineer immediately when the PPC is not in compliance with Specifications.

(3) System Provider's Technical Representative - Duties:

Guide development of the PPC mix design and be present at the trial wearing course placement.
Attend pre-placement meetings.
Be present throughout all mixing to control adjustments to the mix, if any.
Be at the PPC placement site during PPC placement and evaluate each batch delivered and control adjustments to the mix, if any.

SB-12.5 Construction

A. Trial Wearing Course Strip:

Before constructing PPC wearing courses, conduct one or more trial wearing courses on a concrete base approved by the Engineer to determine the initial set time and to demonstrate the effectiveness of deck preparation, mixing, placing, and finishing equipment proposed. Roughen the surface of the trial wearing course strip leaving an exposed aggregate surface texture depth profile of at least 1/8 inch, determined according to ASTM E 965 (standard volumetric test).

Construct trial wearing courses meeting the acceptance criteria of SB-12.2.D, except test the modulus of elasticity at 24 ± 1 hours, at the locations designated by the Engineer. Perform a minimum of two bond tests on areas where PPC wearing course has been placed over deck repairs with similar materials and curing times as is will be used in the remainder of the deck. Construct each trial wearing course 12 feet wide by at least 20 feet long, and at the same thickness as the final PPC wearing course. Construct trial wearing courses when weather conditions are similar to those expected during construction of the PPC wearing course. Use the same equipment, including deck preparation equipment, that will be used for the PPC wearing course.

Do not proceed with PPC wearing course work until the Engineer approves the trial wearing course.

B. Surface Preparation:

(1) General - Remove surface concrete by approved hand methods that cannot be reached by power-driven equipment.

Repair all damage to abutting concrete surfaces or other surfaces that are damaged by Contractor's operations at no additional cost to the Department.

(2) Joints – Seal the construction joint between the PPC wearing course and the concrete approach panel per MnDOT 3725.

(3) Initial Surface Preparation - Perform surface preparation far enough in advance of resurfacing so that all further deck preparation can be satisfactorily completed. Perform deck scarification and Type 3 removals, and patching in accordance with SB-13.2 through SB-13.5. Cure patches a minimum of 14 days prior to PPC wearing course placement. Alternatively, patching may be performed with magnesium phosphate or high-alumina concrete patching material to reduce the cure time to 72 hours. Alternative materials shall be scored when finished to provide roughness to improve PPC adhesion. Patching for Mill and Patch removals to the depth of the top of the bottom bars in the top mat of reinforcement may be made with PPC during the wearing course placement.

(4) Final Surface Preparation - Prepare all surfaces that are to be in contact with the PPC, including vertical contact areas as follows:

- Clean the entire surface by shot-blasting within 24 hours of placing the PPC.
- Sweep the area magnetically to remove metal residue.
- Blow clean the surfaces with compressed air.
- If the prepared surface becomes contaminated by spills, rain, or other contaminant before placing the PPC, prepare the surface again according to this subsection.
- Develop a crack survey map showing locations of all deck cracks after final surface finish and prior to PPC wearing course.

Perform dust abatement measures in accordance with SB-11.1.

C. Prime Coat:

Before applying the prime coat, dry the area by methods approved by the Engineer and blow clean with compressed air to remove accumulated dust and all other loose material. Apply the prime coat only when the surface temperature is at least 50 °F and has been dry the preceding 72 hours. Do not allow the prime coat to leak from the cracks or from other openings of the deck.

Flood the deck surface with the prime coat at rate of 75 to 100 square feet per gallon to allow it to penetrate into the concrete and fill all cracks. Redistribute the applied prime coat in cracks by squeegees or brooms. Only use enough initiated promoted resin that is needed to apply a prime coat. A noticeable increase in viscosity of the prime coat material before it is placed will be cause for rejection. Do not allow traffic on the primed surface.

Allow the prime coat to pond and penetrate into the deck surface a minimum of 15 minutes before placing the PPC. If the primed surface becomes contaminated, or if the prime coat fails, clean the contaminated area by abrasive blasting, and re-prime at no additional cost to the Department.

D. Premixed Polymer Concrete Pavement:

(1) Mixing - Mix PPC on-site. Do not allow packaging to enter the mix.

Use initiators to produce a set time of between 30 and 120 minutes after placement. Use accelerators or inhibitors, if required for the 30 to 120 minute set time, as recommended by the resin supplier.

Initiate and thoroughly blend the polyester resin binder before introduction of aggregate to the binder. Use all bags or other containers of aggregate that are opened at the time of mixing, otherwise discard them.

(2) Placing PPC - Place premixed polymer concrete:

Before it gels or within 15 minutes after the addition of the initiator, whichever is first. Discard the PPC if it is not placed within this time.

During the same work shift the prime coat is applied.

When the surface temperature is 50 °F and rising and not above 90 °F.

E. Roadway Finish:

(1) Abrasive Sand Surface Treatment - After wearing course strike-off and before gelling occurs, uniformly apply an abrasive sand finish to PPC surfaces at a rate of 1.8 pounds per square yard.

(2) Surface Texturing - After application of the surface texturing sand and before gelling occurs, texture the PPC by one of the following methods:

A steel-tined tool with 1/8 inch wide tines that will mark the finished PPC to a depth of 1/8 to 3/16 inch. Randomly space the markings from 1/2 to 1 1/4 inch as approved, and at a 15 degree angle from a line perpendicular to the centerline of roadway.

Correct all non-specification surface texturing, at no additional cost to the Department, according to the following:

Correct texturing after PPC curing and before opening the roadway to traffic.
Cut grooves 1/8 inch wide and 1/8 to 3/16 inch deep.
Unequally space grooves from 1/2 to 1 1/4 inch apart.
Remove saw slurry and laitance from the sawing operation while cutting the grooves.

SB-12.6 Method of Measurement

The Department will measure Premixed Polymer Concrete (PPC) Wearing Course in area by square feet of completed and accepted work.

SB-12.7 Payment

Payment will be made under Item No. 2404.618, "PREMIXED CONCRETE POLYMER CONCRETE (PPC) WEARING COURSE", for measured quantities at the contract bid price per square foot. Payment will be compensation in full for all costs of performing the work as described above and in the Plans, including all other work incidental thereto.

(3151) BITUMINOUS MATERIAL (MSCR)

This is only to be used with SP2016-130.1 (ULTRATHIN BONDED WEARING COURSE (UTBWC) (MSCR)), SP2016-137.1 (PLANT MIXED ASPHALT PAVEMENT (MSCR)), SP2016-138.1 (PLANT MIXED ASPHALT PAVEMENT (LOCAL AGENCY) (MSCR)), SP2016-139.1 (PLANT MIXED ASPHALT PAVEMENT FOR ALTERNATE BID (MSCR)), SP2016-142.1 (STONE MATRIX ASPHALT - SMA (MSCR)), and SP2016-141.2 (PERMEABLE ASPHALT STABILIZED STRESS RELIEF COURSE (PASSRC) AND PERMEABLE ASPHALT STABILIZED BASE (PASB) (MSCR)).

NEW WRITEUP 01/15/16 ◄DO NOT REMOVE THIS. IT NEEDS TO STAY IN FOR THE CONTRACTORS.

SP2016-253.1

MnDOT 3151 is modified as follows:

S-1.1 Replace MnDOT 3151.2.A with the following:

A Asphalt Binder

Only use Performance Graded (PG) Asphalt Binder meeting the requirements of AASHTO M 332, Table 3151-1A, and the Combined State Binder Group Method of Acceptance for Asphalt Binder, available on the Asphalt Products page of the Approved/Qualified Products List.

Table 3151-1A
Multi Stress Creep Recovery (MSCR) Test Requirements

Grade*	Binder Code for 2360 Mix Design	Jnr@3.2kPa, maximum	%R @ 3.2kPa, min.**	Jnr Difference, max***
PG 58S-28	B	4.5	N/A	75 %
PG 58H-28	E	2.0	30 %	75 %
PG 58V-28	H	1.0	55 %	75 %
PG58E-28		0.5	75 %	N/A
PG58S-34		4.5	N/A	75 %
PG58H-34	C	2.0	30 %	75 %
PG58V-34	F	1.0	55 %	75 %
PG58E-34	I	0.5	75 %	N/A
PG49S-34	M	4.5	N/A	75 %
PG52S-34	A	4.5	N/A	75 %
PG64S-22	L	4.5	N/A	75 %

* LTPP Bind temperature for Minnesota is 58°C for the high PG Binder Grade temperature. The bottom three grades are special use binders and are to be tested at the high temperature indicated by the grade (example: PG 49S-34 is tested @ 49C).
** Use in place of Appendix X1 in AASHTO - M332.
*** Jnr Difference is waived for "E" grade binders.

Use asphalt binder supplier recommendations for mixing and compaction temperatures.

• 2353) ULTRATHIN BONDED WEARING COURSE (UTBWC) (MSCR)

Only use this when the District requests it. Always use SP2016-253.1 (BITUMINOUS MATERIAL (MSCR)) with this write-up.

NEW WRITEUP 01/15/16 ◄DO NOT REMOVE THIS. IT NEEDS TO STAY IN FOR THE CONTRACTORS.

SP2016-130.1

MnDOT 2353 is modified with the following:

S-1.2 Replace PG 64-34 with PG 58V-34 in MnDOT 2353.2.A.2.

S-1.3 Asphalt binder meeting AASHTO M332 (MSCR) is required. See Section S-__ (BITUMINOUS MATERIAL (MSCR)) of these Special Provisions.

National Concrete Consortium

Bridge Deck Overlay Mix Designs (Part 2)

Bridge Deck Overlay – Missouri DOT

Low Slump Concrete

505.10.2.1 Coarse aggregate shall be an approved crushed limestone, crushed quartzite, flint chat from the Joplin area or porphyry in accordance with Sec 1005.2, Gradation E, except that the sum of percentages of all deleterious substances shall not exceed one percent and the percentage of deleterious substances shall not exceed the following values:

Item	Percent by Weight
Deleterious Rock	1.0
Shale and Pyrite	0.2
Chert in Limestone	0.5
Other Foreign Material	0.1

505.10.2.2 Gradation D may be used when the plan thickness of the bridge deck overlay is 3 inches or greater.

505.10.2.3 Fine aggregate shall be in accordance with Sec 1005.3 and shall be Class A sand in accordance with Sec 501.

505.10.2.4 Pozzolanic material or Portland pozzolan cements shall not be used.

505.10.3 Concrete Mixture.

505.10.3.1 The contractor shall submit a mix design to Construction and Materials meeting the following properties:

Property	Requirement
Air Content, percent (minimum)	5.0
Slump, inches	1/2 ± 1/2
Percent Fine Aggregate as Percent of Total Aggregate by Absolute Volume	50
Cement Content, lbs./cubic yard	818 to 827

505.10.3.2 The cement content and percent fine aggregate shall not be changed. If total mixing water, including free water in aggregate and liquid admixtures, varies from design mixing water to cause a change in batch volume of more than two percent, a new mix design will be required.

505.10.3.3 A Type A water-reducing admixture will be required.

Latex Modified Concrete

505.20.2.1 Aggregate shall be in accordance with Sec 505.10.2.

505.20.2.2 Pozzolanic material or Portland pozzolan cements shall not be used.

505.20.2.3 Latex admixture shall be kept in a suitable enclosure that will protect the admixture from freezing and from exposure to temperatures in excess of 85 F. Drums of latex admixture to be stored at the work site in direct sunlight shall be completely covered with a suitable insulating blanket material to maintain an enclosed temperature below 85 F.

505.20.3 Concrete Mixture.

505.20.3.1 The contractor shall submit a mix design to Construction and Materials meeting the following requirements:

Property	Requirement
Air Content, percent	0 to 6.5
Slump, inches	9 (max.)
Percent Fine Aggregate as percent of Total Aggregate by Absolute Volume	50 to 55
Cement Content, lbs./cubic yard min.	
Latex Emulsion Admixture, gallons/cubic yard. min.	24.5
Net Water/Cement Ratio, max., lbs.[a] water/lbs. cement	0.40

[a] Net water shall be considered the quantity of mixing water added, plus the non-solid portion of the latex emulsion.

505.20.3.2 Any change in mix design or proportions shall be approved by the engineer.

505.20.3.3 Anti-foam additives, as recommended by the latex emulsion manufacturer, may be required if the concrete mixture entrains air above the specified amount.

505.20.3.4 Air-entraining admixtures shall not be added.

Silica Fume Concrete

505.30.2.1 Silica fume shall be in accordance with Sec 501.

505.30.2.2 Aggregate shall be in accordance with Sec 505.10.2.

505.30.2.3 Pozzolanic material, other than silica fume or Portland pozzolan cements shall not be used.

505.30.2.4 A retarding admixture may be permitted, if recommended by the manufacturer of the silica fume admixture.

505.30.2.5 Approved Type F or G high range water-reducing admixtures will be permitted if specified or recommended by the supplier of the silica fume admixture.

505.30.3 Concrete Mixture.

505.30.3.1 The contractor shall submit a mix design to Construction and Materials with the following properties:

Property	Requirement
Air Content, percent, minimum	5.0
Slump, inches,	3 – 7 1/2
Cement Content, pounds/cubic yard, min	640
Water/Cement Ratio lbs. water/lbs. cementitous materials, max.	0.37
Silica Fume, % replacement of cement	6-8
Percent Fine Aggregate (as percent of total fine and coarse aggregate by absolute volume)	50 – 55
High Range Water Reducer	As required

505.30.3.2 The water content shall include all free moisture in the fine and coarse aggregate, water content of the silica fume admixture and water content of the high range water reducer.

Latex Modified High Early Strength Concrete

505.40.2.1 With approval of the engineer, a Type HE high-early-strength cement, in accordance with ASTM C 1157, may be used. Type III cement will not be permitted.

505.40.2.2 Coarse aggregate shall be an approved crushed limestone, crushed quartzite, flint chat from the Joplin area, or porphyry in accordance with Sec 1005, Gradation E or Gradation F, except the percentage of deleterious substances shall not exceed the following values, and the sum of percentages of all deleterious substances shall not exceed one percent.

Item	Percent by Weight (Mass)
Deleterious Rock	1.0
Shale and Pyrite	0.2
Chert in Limestone	0.5
Other Foreign Material	0.1

505.40.2.3 Fine aggregate shall be in accordance with Sec 1005 and shall be Class A sand in accordance with Sec 501.

505.40.2.4 With approval of the engineer, other gradations of coarse or fine aggregate may be used, however all quality requirements, including a maximum of 2.0 percent passing the No. 200 for fine and coarse aggregate, shall apply and the maximum aggregate size shall not exceed that of Sec 1005, Grade E aggregate.

505.40.2.5 Pozzoloanic material or Portland pozzolan cements shall not be used.

505.40.2.6 Latex admixture shall be kept in suitable enclosures which will protect it from freezing and from exposure to temperatures in excess of 85 F.

505.40.3 Concrete Mixture.

505.40.3.1 The concrete mixture shall meet the following requirements:

Property	Specific Value
Air Content percent	0 to 6.5
Slump, inches	3 to 6
Percent Fine Aggregate as percent of total aggregate by weight	50 to 55
Cement Content, lb/cu yd min.	658
Latex Emulsion Admixture, gal/cu yd	24.5
Net Water-Cement Ratio, max. Lbs.[a] ofwater/lbs. ofcement	0.40

[a]Net water shall be considered the quantity of mixing water added plus the non-solid portion of the latex emulsion.

505.40.3.2 Chloride permeability shall not be greater than 1000 coulombs when tested in accordance with AASHTO T 277. Tests shall be performed on specimens at 28-days. This test shall be performed on each mixture submitted for approval. The tests are to be performed by a qualified commercial laboratory.

505.40.3.3 The mixture shall be designed to develop a minimum 28-day compressive strength of 4,500 psi.

505.40.3.4 Anti-foam additives as recommended by the latex emulsion manufacturer may be required if the concrete mixture entrained air is above the specified amount.

505.40.3.5 Air-entraining admixtures shall not be added.

505.40.3.6 A set control in accordance with the cement manufacturer's recommendation may be considered.

505.40.3.7 Admixtures containing calcium chloride shall not be used.

Epoxy Polymer Concrete Overlay

1039.60.2 Epoxy Resin Material. The infrared spectrum for each component of the epoxy-resin material shall essentially match that of the standard infrared spectrum for the particular component as specified in AASHTO T 237, Sections 4 and 5. The epoxide equivalent for Component A shall not exceed 270. The mixed epoxy shall meet the following requirements:

Epoxy Resin Requirements	
Property	**Specific Value**
Pot life, 75 F, minutes	10 - 55
Tensile strength, 75 F, 7 Days, psi, min.	1500
Tensile elongation, 75 F, percent, min.	20
Water absorption, percent, max.	0.8
Compressive strength, 4 hr., psi, min.	1000
Compressive strength, 48 hr. wet, psi, min.	4000
Ash content, percent, max	0.5
Rotational Viscosity, 75 F, Spindle 3, 60 rpm, Poise	7 - 25
Volatile Content, percent, max.	3.0
Thermal Shear	No shearing, shrinkage, expansion or scaling.

1039.60.3 Aggregate for Epoxy Polymer Concrete Overlay. Aggregate shall be bauxite, crushed porphyry, aluminum oxide, flint chat or other similarly hard, durable, dry aggregates with less than 0.2 percent moisture. Aggregate shall be in accordance with the following gradation:

Aggregate Requirements	
Sieve Size	**% Passing By Weight**
# 4	100
# 20	0-5
# 200	0-1.0

1039.60.5 Test Methods. Tests will be performed in accordance with the following methods:

Test Methods	
Rotational Viscosity	ASTM D 2393 Model LVT Brookfield viscometer
Epoxy equivalent	MoDOT Test Method TM 73
Volatile content[a]	ASTM D 1259, Method B, for mixed system
Filler content	MoDOT Test Method TM 73
Ash content	ASTM D 482
Pot life	AASHTO T 237
Tensile strength	ASTM D 638
Compressive strength	ASTM C 881
Water absorption	ASTM D 570
Thermal Shear	MoDOT Test Method TM 72

[a]Sample cured 4 days at room temperature and weighed on a previously weighed metal foil.

1039.60.6 Manufacturer and Brand Name Approval. Prior to approval and use of this material, the manufacturer shall submit to Construction and Materials a certified test report showing specific test results in accordance with all requirements of this specification. The certified test report shall include the manufacturer's name, brand name of material, lot tested, date of manufacture, ratio of components by volume and system tested. In addition, the manufacturer shall submit to Construction and Materials a sample representing the system for laboratory testing accompanied by a technical data sheet, an MSDS and any special installation instructions relative to the system being submitted. Upon approval of the certified test report and satisfactory results of tests performed on the sample submitted, the brand name and manufacturer will be placed on a qualified list of epoxy resin material for polymer concrete overlay. New certified test results and samples shall be submitted any time the manufacturing process or the material formulation is changed and may be required when random sampling and testing of material offered for use indicates non-conformity with any of the requirements herein specified.

1039.60.7 Product History. The overlay system shall have a proven record of a minimum of two years on similar bridge decks within the United States. A list including the location, the name of the agency involved with the project, and a name and phone number of a contact person with that agency, shall be provided for each location used as evidence of satisfactory use.

Fiber-Reinforced Concrete Overlay

C. Steel Fiber Reinforcement

1.0 Description. At the contractor's option the contractor can use steel fiber reinforcement in lieu of welded wire reinforcement. This work shall consist of constructing a Reinforced Concrete Slab Overlay with Class B-2 concrete and steel fiber reinforcement as alternate reinforcement and in accordance with Sec 501, Sec 703 and the Job Special Provisions.

2.0 Materials.

2.1 Steel fibers shall be made from low carbon steel and nominally be between 1.0-1.5 inches (25-38mm) long and meet the physical property requirements prescribed in ASTM A820. Steel fibers shall have a quantity of at least 2,000 fibers per pound and a fiber aspect ratio of 40 to 60. The steel fibers shall not have any hooks or 90° bends. The steel fibers shall be free from rust, oil and other deleterious materials. Steel fibers shall be transported, stored and applied to the concrete mixture in accordance with the manufacturer's recommendations.

2.1.1 The contractor shall provide initial on-site technical assistance from the supplier of the steel fiber reinforcement. Further technical assistance shall be available at the request of the Engineer.

2.2 Mix Design. The steel fiber dosage rate shall be 45 pounds per cubic yard of concrete or a dosage rate recommended by the steel fiber manufacturer that will provide equivalent or better structural performance to the welded wire reinforcement shown in the plans. The contractor shall provide signed and sealed calculations, by a registered engineer in the state of Missouri, which verifies the proposed steel fiber dosage rate.

501.3.6 Cement Factors. The minimum cement requirements in pounds per cubic yard of concrete for the various classes of sand shall be as follows:

Cement Requirements[a,b]							
Class of Sand	Class A-1 Concrete	Class B Concrete	Class B-1 Concrete	Class B-2 Concrete	Class MB-2 Concrete[g,h]	Pavement Concrete	Seal Concrete
A[c]	600	525	610	705	600	560	660
B[d]	640	565	640	735	620	560	695
C[e]	--	585	660	750	640	560	715
D[f]	--	620	695	790	660	560	735

[a]When used, Type IP, I(PM), IS or I(SM) cement shall be substituted on a pound for pound basis for Type I or Type II cement and adjustments in design mix proportions will be required to correct the volume yield of the mixture.

[b]The contractor may submit an optimized mix design which has a maximum 50 pounds per cubic yard reduction in cement from that shown in the tables. If the contractor chooses this option, the mixture will be subject to review, laboratory testing and approval by the engineer. All other requirements for the cement factor will apply.

[c]Class A sand will include all sand, except manufactured sand, weighing 109 pounds per cubic foot or more.

[d]Class B sand will include all chert, river and Crowley Ridge sand weighing from 106 to 108 pounds, inclusive, per cubic foot or glacial sand weighing 108 pounds or less per cubic foot.

[e]Class C sand will include all chert, river and Crowley Ridge sand weighing from 101 to 105 pounds, inclusive, per cubic foot.

[f]Class D sand will include all sand weighing 100 pounds or less per cubic foot and any manufactured sand that is produced by the process of grinding and pulverizing large particles of aggregate or which contains more than 50 percent of material produced by the reduction of coarser particles. Manufactured sand produced from limestone or dolomite shall not be used in Portland cement concrete for driving surfaces such as bridge decks, pavements and full depth shoulders.

[g]Modified B-2 (MB-2) concrete may be used in-place of Class B-2 Concrete.

[h]Modified B-2 (MB-2) concrete shall use at least one supplementary cementitious material in accordance with this specification. In no case shall MB-2 concrete use less than 15 percent fly ash or GGBFS when used as the individual supplementary cementitious material. In no case shall MB-2 concrete use less than 6 percent metakaolin when used as the individual supplementary cementitious material.

501.5 Consistency. The slump of the concrete shall be within the limits for the respective classes of concrete. The concrete shall be uniform in consistency and shall contain the minimum quantity of water required to produce the designated slump. The slump of concrete mixes will be determined in accordance with AASHTO T 119. The quantity of mixing water in the concrete shall be considered the net quantity after proper allowance has been made for absorption by the aggregate. The slump and mixing water content of the concrete, when placed in the work, shall not exceed the following limits:

Slump and Maximum Water/Cementitious Materials Ratio			
Class of Concrete	Max. Slump, In.	Max. Pounds of Mixing Water Per Pound of Cementitious Materials	
		Air-Entrained	Non-Air-Entrained
A-1	3 1/2	0.46	0.51
B	4	0.51	0.55
B-1	4	0.44	0.53
B-2	3	0.40	----
MB-2	6	0.42	----
Pavement	----	0.50	0.53
Seal	8	----	0.53

501.3.8 Compressive Strength Requirements. Concrete classes shall meet the following compressive strength requirements in pounds per square inch:

Minimum Design Compressive Strength[1]						
Class A-1 Concrete	Class B Concrete	Class B-1 Concrete	Class B-2 Concrete	Class MB-2 Concrete	Pavement Concrete	Seal Concrete
6,000	3,000	4,000	4,000	4,000	4,000	3,000

[1]Minimum compressive strength required unless otherwise specified in the contract documents or approved by the engineer.

Fly Ash (Class C or F): Maximum 25% replacement

Slag: Maximum 30% replacement

Ternary: Maximum 40% replacement

Aggregate Gradation Requirements

1005.2.4 Coarse aggregate for concrete for structures, except as specified in Sec 1005.2.5, may be gravel or crushed stone. Coarse aggregate for Class B, B-1, B-2, MB-2 or Seal concrete shall be in accordance with either Gradation D or E. Coarse aggregate for Class A-1 concrete shall be in accordance with Gradation E.

Gradation D	Percent by Weight
Passing 1-inch sieve	100
Passing 3/4-inch sieve	85-100
Passing 3/8-inch sieve	15-55
Passing No. 4 sieve	0-10

Gradation E	Percent by Weight
Passing 3/4-inch sieve	100
Passing 1/2-inch sieve	70-100
Passing 3/8-inch sieve	30-70
Passing No. 4 sieve	0-20
Passing No. 8 sieve	0-6

Masten, Maria (DOT)

From: Hunter, Brian J <bhunter@ncdot.gov>
Sent: Wednesday, April 12, 2017 7:25 AM
To: Masten, Maria (DOT)
Subject: RE: Part 2 of State Report Survey

Maria,

Below is a copy of our Latex Modified Concrete Specification. Table 1000-5 list the mix design properties. I hope this helps and if you have any additional questions please let me know.

- 1000-7 LATEX MODIFIED CONCRETE

(A) Materials

Refer to Division 10.

Item	Section
Coarse Aggregate, standard size No. 78M	1014-2
Fine Aggregate	1014-1
Portland Cement	1024-1
Type IP Blended Cement	1024-1
Type IS Blended Cement	1024-1
Type IT Blended Cement	1024-1
Water	1024-4

Do not use Type III high early strength cement.

Use a formulated latex admixture that is a non-hazardous, film forming and polymeric emulsion in water and is homogeneous and uniform in composition. Add all stabilizers at the point of manufacture.

Use a latex modifier conforming to Table 1000-4.

TABLE 1000-4
PROPERTIES OF LATEX MODIFIER FOR CONCRETE

Property	Requirement
Polymer Type	Styrene Butadiene: 68 ± 4% Styrene 32 ± 4% Butadiene
Average Polymer Particle Size	1500 to 2500 Angstroms
Emulsion Stabilizers	Anionic and non-ionic surfactants
Percent Solids	46.5% to 49.0%
Weight per gallon at 75°F	8.40 to 8.60 lb

pH	9.5 to 11.0
Shelf Life	2 Years
Color	White

Provide a Type 5 material certification for each load of latex emulsion admixture in accordance with Article 106-3. Test admixture samples to verify compliance with the requirements before use. Allow 7 days for sampling and testing after delivery to the project.

Do not allow the temperature of latex emulsion admixture to fall below 35°F at any time or exceed 85°F after delivery to the project.

For latex emulsion that has been in storage, use a transfer pump and lines to recirculate it before using.

For latex modified concrete, use a workable mixture that meets Table 1000-5.

Measure the slump 4 to 5 minutes after discharge from the mixer.

Submit the latex modified concrete mix design, completed by the latex emulsion manufacturer, to the Engineer for review.

TABLE 1000-5
PROPERTIES OF LATEX MODIFIED CONCRETE

Property	**Requirement**
Cement Content, lb/cy	658 min.
Latex Emulsion Admixture, gal/cy	24.5 min.
Air Content of Plastic Mix, %	3.5 - 6.5
Slump, inches	3 - 6
% Fine Aggregate as percent of total aggregate by weight	50 - 55
7 day Compressive Strength, psi	3,000 min.
Water-Cement Ratio by weight	0.40 max.

(B) Equipment

Before beginning any work, obtain approval for all equipment to be used for deck preparation, mixing, placing, finishing and curing the latex modified concrete.

Use sandblasting equipment capable of removing all clay, salt deposits, oil and grease deposits and all other foreign matter. Provide traps or separators to remove oil and water from the compressed air. Use traps or separators of adequate size and drain them periodically during operations. For proportioning and mixing, use self-contained, mobile and continuously mixing equipment that meets the following requirements:

Use a self-propelled mixer that is capable of carrying sufficient unmixed dry, bulk cement, sand, coarse aggregate, latex modifier and water to produce at least 6 cy of concrete on site.

Use a mixer that is capable of positive measurement of cement introduced into the mix. Use a recording meter that is visible at all times and equipped with a ticket printout to indicate the quantity of cement.

Calibrate the mixers to accurately proportion the specified mix. Before placing latex modified concrete, perform calibration and yield tests under the Engineer's supervision in accordance with the Department's written instructions. Copies of these written instructions are available from the Materials and Tests Unit. Perform the

calibration and yield tests using the material to be used on the project. Recalibrate the mixer after any major maintenance operation on the mixer, anytime the source of materials changes or as directed. Furnish all materials and equipment necessary to perform the calibrations and yield tests.

Use a mixer that controls the flow of water and latex emulsion into the mix. Measure the flow rate of water and the latex emulsion with a calibrated flowmeter coordinated with both the cement and aggregate feeding mechanisms and the mixer. Adjust the flow rate, as necessary, to control the slump and ensure that the water-cement ratios are met. In addition to flowmeters, use mixers with accumulative water and latex meters capable of indicating the number of gallons, to the nearest 0.1 gallon, introduced into the mixer. Filter water and latex with a suitable mesh filter before it flows through the accumulative water and latex meters.

Calibrate the mixer to automatically proportion and blend all components of the indicated composition on a continuous or intermittent basis as the finishing operation requires. Provide a mixer that discharges mixed material through a conventional chute and is capable of spraying water over the placement width as it moves ahead to ensure that the surface to be overlaid is wet before receiving the modified material.

Mount a tachometer on the unit to indicate the drive shaft speed.

Use adequate hand tools for placing and leveling concrete down to approximately the correct level for striking off with the screed.

Use a finishing machine that meets the approval of the Engineer and the requirements of the contract. Use a self-propelled finishing machine capable of forward and reverse movement under positive control. Use a machine with at least 2 finishing devices, one that is a vibrating screed and the other either a vibrating screed, oscillating screed, or one or more rotating cylindrical drums 48" long or less and operating between 1,500 and 2,500 vpm. Make certain the finishing machine can finish the surface to within one foot of the edges of the area being placed. Raise all screeds when the finishing machine is moving backwards over the screeded surface.

Use screeds with a vibration frequency that is variable between 3,000 and 6,000 vpm with positive controls. Use screeds with a metal covered bottom face not less than 4" wide. Provide screeds with positive control of the vertical position.

Use supporting rails for travelling of the finishing machine rigid enough to eliminate deflection from the weight of the machine.

(C) Proportioning and Mixing of Modified Compositions

Meet the following requirements when proportioning and mixing modified materials:

Use mobile continuous mixers that accurately proportion all materials for the specified mixture. Operate the proportioning equipment at the manufacturer's recommended speed verified with the tachometer during calibration and normal operations.

Yield checks and other checks are permitted.

State Laboratory Operations Manager
Materials & Tests Unit
North Carolina Department of Transportation

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From: Masten, Maria (DOT) [mailto:maria.masten@state.mn.us]
Sent: Tuesday, April 11, 2017 6:15 PM
To: Wagner, Denise F [ITRNS] <dfwagner@iastate.edu>; NC2@iastate.edu
Cc: matt.farrar@itd.idaho.gov; Sherrill, Timothy M <tmsherrill@ncdot.gov>; hadly.eisenbeisz@state.sd.us
Subject: Re: Part 2 of State Report Survey

Since everyone uses a limited types of overlays, if you want to email me your mix design specs for the overlays that would work vs. trying to fill out the survey. Either way works great and is appreciated.

Thanks!

Sent from my iPhone

From: Masten, Maria (DOT) [mailto:maria.masten@state.mn.us]
Sent: Tuesday, April 11, 2017 3:49 PM
To: NC2@iastate.edu
Subject: Part 2 of State Report Survey
Importance: High

Thank you to everyone who has completed the survey. After reading through the survey, I realized that as a concrete group, our survey was lacking the good stuff – OVERLAY MIX DESIGNS!

I have created a part 2 of the state report survey – IF AT ALL POSSIBLE PLEASE COMPLETE BY FRIDAY (4/14/17).

https://www.surveymonkey.com/r/Spring_2017_NCC_Part2

One response per state please! THANKS!

Looking forward to seeing everyone in a few weeks!

Maria

Masten, Maria (DOT)

From: Streeter, Donald A. (DOT) <Donald.Streeter@dot.ny.gov>
Sent: Wednesday, April 12, 2017 10:49 AM
To: Masten, Maria (DOT)
Subject: RE: Part 2 of State Report Survey

Maria,
Unless I missed it, the survey was missing option for SF modified concrete so easiest to just attach mix design here.

584-2.03 Manufacture of Microsilica Concrete
A. Proportioning. The initial ingredient proportions except for admixtures are in TABLE 584-2.

TABLE 584-2 MIX CRITERIA - MICROSILICA CONCRETE
Cement Content (lb/cy) 657
Microsilica Content (lb/cy) 61
Sand Percent Total Aggregate (solid volume) 53
Designed Water/Total Cementitious Content 0.37
Desired Air Content (%) 6.5%
Allowable Air Content (%) 5.0 - 8.0
Desired Slump (inches) 4”
Allowable Slump (inches) 2 - 6
Coarse Aggregate 100% passing 1”

Other mixtures are used so infrequently it’s not worth mentioning.

Thanks – Don

Donald Streeter
NYSDOT - Materials Bureau
50 Wolf Rd
Albany, NY 12232

518-457-4593

NEW YORK STATE OF OPPORTUNITY. Department of Transportation

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Maria

SECTION 1042—LATEX MODIFIED MORTAR OR CONCRETE WEARING SURFACE

1042.1 DESCRIPTION—This work is construction of a one course wearing surface of latex modified mortar or concrete on in-service bridge decks. The indicated or specified depth of the wearing surface is the minimum.

1042.2 MATERIAL—

(a) Cement. Type I, IP, IS, or II (MH), Section 701.1.

(b) Fine Aggregate. Type A, Section 703.1.

(c) Coarse Aggregate. Type A, No. 8, Section 703.2.

(d) Water. Section 720.1

(e) Latex Emulsion Admixture. Section 711.3(e)

(f) Latex Modified Mortar or Concrete Mix Design. Use latex modified mortar for depths less than 1 1/4 inches. Use latex modified concrete when the depth is 1 1/4 inches or more.

Provide a concrete technician as specified in Section 704.1(d)2. Provide testing facilities and equipment as specified in Section 704.1(d)3.

The term "latex," as used in this Section, refers to latex modified mortar or concrete, unless otherwise specified. Provide latex conforming to the following requirements:

Latex Modified Mortar or Concrete Mix Design Requirements	Requirements	
	Mortar	Concrete
Cement Content, bags/cu. yd.	8.0	7.0
Latex Emulsion Admixture Modifier, gal/bag of Cement	3.5	3.5
Air Content, % of Plastic Mix (AASHTO T 152)	1 - 7	1 - 7
Water/Cement Ratio, by Weight	0.35 - 0.40	0.30 - 0.40
Slump[(1)], inches (AASHTO T 119)	4 - 6	3 - 7
Percent Fine Aggregate as Percent of Total Aggregate, by Weight	100	60 ± 5
Cement/Fine Aggregate/Coarse[(2)] Aggregate Ratio, by Weight	1:3.25	1:2.5:2.0 to 1:2.9:1.6
5-day Compressive Strength (psi) (PTM Nos. 604 & 611) [(3)]	3,000	3,000
28-day Compressive Strength (psi) (PTM Nos. 604 & 611) [(3)]	3,500	3,500

[(1)] Discharge the sample from the mixer and transport it to a point unaffected by vibration. Deposit the sample on the deck in a suitable container and do not disturb for five minutes. Then, remix the sample and perform the slump test according to AASHTO T 119.

[(2)] Dry basis, Aggregate Specific Gravity = 2.65. The dry weight ratios are approximate and should produce good workability, but due to gradation changes, the ratios may be adjusted within limits by the Representative.

[(3)] Cure specimens according to PTM No. 611, Section 11.1, except strip after the first 48 hours (± 2 hours), and air cure as specified in Section 1042.3(d) Table A.

1. Compatibility Testing During Mix Design. Verify the compatibility of the mix components during mix design and ensure that the mix provides sufficient time of workability to satisfactorily finish and texture the surface. Re-verify compatibility whenever there is a change in mix components. Provide a technical expert from the latex admixture manufacturer for the design process, if directed.

(g) Mix Designs Using Potentially Reactive Aggregates. Section 704.1(g)

1042.3 CONSTRUCTION—

(a) Equipment. Obtain acceptance of all equipment for the deck preparation, mixing, placing, and finishing of the latex wearing surface, before start of wearing-surface work. Include equipment specifications in the QC Plan specified in Section 1042.3(c).

1. Surface Preparation Equipment. Of the following types:

1.a Sandblasting or Water Blasting Equipment. Capable of removing partially loosened chips of concrete and removing rust and corrosion from reinforcement bars. Water blasting equipment must have a minimum rated capacity of 7,5000 pounds per square inch.

1.b Power-Driven Hand Tools. Section 1040.3(c)

2. Proportioning and Mixing Equipment. Provide self-contained, mobile equipment, capable of continuous mixing, with the capacity to deliver a minimum of 6 cubic yards of latex per hour, and subject to the following:

2.a Mixing Equipment. Provide equipment with a metal plate or plates permanently attached in a prominent place, plainly marked with the gross volume of the unit in terms of mixed mortar, operating speed, auger mixing angle, and the weight-calibrated cement constant of the machine, in terms of a revolution counter or other output indicator, all as rated by the manufacturer.

2.b Compartments. Provide separate compartments to carry the necessary ingredients needed for the production of latex modified mortar or concrete. Cover aggregate bins at all times. Provide cement bins free of moisture and contamination at all times. Provide suitable means to carry water and additives on the truck and to incorporate the additives with the mixing water in the mix.

2.c Feed Systems. Provide a unit with a feeder system mounted under the compartment bins to deliver the ingredients to the mixing unit. Provide each bin with an accurately controlled, individual gate to form an orifice for volumetrically measuring the material drawn from each respective bin compartment. Maintain belt feeders and scrapers to prevent leakage of materials onto the deck.

Set the cement bin feeding mechanism to discharge continuously, and at a uniform rate, a given volumetric weight equivalent to cement during the mixing operation. Coordinate the aggregate feeding mechanisms with the cement feeding mechanisms to deliver the required proportions.

2.d Mixing Unit. Provide an auger-type mixing unit, incorporated into the truck's discharge chute or other suitable mixing mechanism, capable of producing latex of uniform consistency and discharging the mix without segregation.

2.e Dials and Measuring Devices. Equip the unit with an accurate revolution counter indicator allowing the reading of the volumetric weight equivalent to cement discharged during the mixing operation. Equip the counter with a ticket printout to record this quantity. Use aggregate dials that allow the setting of required openings for volumetric proportioning.

Equip the unit with a cumulative water meter and a water flow gauge to accurately indicate the discharge rate of water by volume (gallons per minute) entering the mix. Provide an approved device on the mixing unit for the Representative to use to check the rate of flow of the latex modified admixture entering the mix along with the total amount of latex modified admixture contained in the mix. Coordinate the water and additive measuring devices with the cement and aggregate feeding mechanisms. Equip the flow meters with scales appropriate for the type and amount of material being added.

Mount a tachometer on the mixing unit to indicate the drive shaft speed.

Place all required indicating devices in full view and near enough to be accurately read or readjusted by the operator while latex is being produced. Provide the operator with convenient access to all controls.

2.f Calibration. Provide a unit constructed to allow convenient calibration of the gate openings and

meters. Have the calibration conducted by the supplier of the latex in the presence of Representatives, and recalibrate after every 100 cubic yards of production for each unit. Document the calibration of Form CS-4342 and keep with the mobile mixer. Have the supplier of the latex make satisfactory arrangements with the Representative at least 7 calendar days in advance of calibration. Provide platform scales calibrated annually. Calibrate using the maximum water/cement ratio, cement, and aggregates listed on the approved mix design. Verify compatibility of components and mix workability time while performing a yield test at the conclusion of the calibration process, if directed.

Conduct a recalibration in the event of a change in source of aggregates. Conduct additional calibration as directed. Have each approved unit carry a copy of the calibration certificate. In addition to calibration, perform a yield test according to AASHTO T 121, if directed.

An additional check may be made using the following procedure:

With the cement meter set on zero and all controls set for the desired mix, activate the mixer discharging mixed material into a 1/4 cubic yard container (36 inches by 36 inches by 9 inches). When the container is level-struck full, making provision for settling the material into all corners, the cement meter is required to show a discharge of 2 bags of cement for modified mortar (8 bags per cubic yard mix) or 1.75 bags of cement for modified concrete (7 bags per cubic yard mix).

2.g Mixing and Delivery Control. Proportion, measure, and batch cement and aggregates by a volumetric weight equivalent method. In operation, the entire measuring and batching mechanism is required to produce the specified proportions of each ingredient. Establish volume/weight relationships during the calibration of the measuring devices. Provide tolerances in proportioning the various ingredients as follows:

- Cement, weight % 0.0 to +4.0
- Fine Aggregate, weight % ±2.0
- Coarse Aggregate, weight % ±2.0
- Water, weight or volume % ±1.0
- Latex, weight or volume % ±2.0

During mixing, maintain the drive shaft speed as indicated by the tachometer at operating speed ± 50 rpm. Set the auger mixer angle in the range determined by the manufacturer. Do not exceed one-half hour for the interval between the continuous placement of successive batches. Equip the mixer to spray water.

2.h Loading. Charge aggregate bins no more than 6 hours before time of scheduled placement unless otherwise approved by the Representative. Ensure the aggregate is maintained in a uniform wet condition before loading. Determine the amount of free water on the aggregates at the time of loading by performing aggregate moisture tests according to AASHTO T255 and/or ASTM C 70. Adjust mix proportions to account for the amount of available free water. Empty bins and recharge if not utilized within 6 hours or if conditions contribute to variable moisture content of the aggregate. Stock aggregates in a manner that prevents contamination.

Upon arrival at the project site, empty all bins of aggregate that were charged before coming to the current project. Empty the cement bin and latex tank unless use on a previous project can be verified in writing by a Department Representative, or , in the presence of the Representative, obtain a sample of the liquid latex admixture and cement being used in the mixture and deliver the samples to the Representative for testing. The Representative will submit the samples to LTS for testing. Circulate and mix latex tank as recommended by the latex manufacturer.

3. Placing and Finishing Equipment. Provide hand tools for placing and brushing-in freshly mixed latex and for distributing latex overlay to approximately the correct level for striking off with the screed. Use approved hand-operated vibrators and screeds to place and finish small areas of work. Do not use gas-powered vibrators.

Use an approved finishing machine complying with the following requirements for finishing all large areas of work:

- Use a finishing machine that is self-propelled and capable of forward and reverse movement under positive control. Make provision for raising all screeds to clear the screeded surface for

traveling in reverse.

- Use a revolving-drum type finishing machine with one or more rotating roller augers preceded by a 1,500 vpm to 2,500 vpm vibratory pan. Verify frequency with a tachometer.

For small placements, the finishing machine may be of the type designed to finish the overlay with a vibrating screed. Provide variable vibration frequency with positive control between 3,000 vpm and 11,000 vpm. Use screeds with a metal-covered bottom face no less than 4 inches wide. Provide the screeds with positive control of the vertical position. Consolidate latex with a hand-operated vibrator.

Use a suitable portable lightweight or wheeled work bridge behind the finishing operation.

(b) Surface Preparation. Remove unsound concrete and repair as specified in Section 1040.3. Not more than 7 days before the placement of the overlay, scarify the deck surface to a minimum depth of 1/4 inch, as specified in Section 1041.

Not more than 24 hours before placement begins, clean the entire surface by an approved method, including edges of previously placed lanes of latex, to remove any trowel-cut surfaces and promote bond.

Clean the surface thoroughly with a detergent waterblast and rinse, or sandblast and air blast using clean, oil-free compressed air to remove all dust, slurry, blast media, weak or fractured concrete, petroleum stains, leaves, paint, other debris, rust from any exposed bars oil, or other foreign materials detrimental to achieving bond, if necessary. Protect the entired prepared deck surface against contamination by covering with clean full width polyethylene sheeting until the overlay operations are completed. Include cleaning methods in QC Plan, as specified in Section 1042.3(c).

Allow 48 hours of curing to elapse before scarifying or chipping is performed on adjacent concrete within 6 feet of previously placed latex.

(c) Placing and Finishing. Prepare and submit a field operation QC Plan for review and acceptance by the Representative, as outlined on CS-1042. Submit the field operation QC Plan at least 15 days before the proposed start of placing the wearing surface. Do not proceed with latex placement until the QC Plan has been accepted. Include in the plan the method of operations and a sketch describing the equipment and showing complete details of supports for the equipment. Include a list of key personnel and relevant experience.

Raise expansion dams and scuppers as indicated before placing the wearing surface. Provide anchorage for supporting rails for horizontal and vertical stability. Do not treat screed rails with parting compound to facilitate their removal.

Provide all necessary finishing tools, equipment, and manpower at the site of work, and ensure that key personnel are experienced in the placement of latex wearing surfaces.

Adjust screeds to finished grade before placing the wearing surface. For superelevated bridges, adjust screed guides to compensate for the curvature.

Determine the finished grade by raising the existing grade by the amount indicated. Provide a final setting of the screeds such that a smooth riding surface is achieved. Do not lower the screed to compensate for any wear on the existing deck or for over scarifying.

Immediately before placement of the latex, thoroughly wet the clean surface for a period of not less than one hour. Vacuum or blow out all standing water in depressions, holes or areas of concrete removal with clean, oil-free compressed air. Do not allow two cycle (gas/oil) powered equipment on the prepared deck. Maintain prepared deck in a damp, puddle-free condition. Use a fogger/mister to dampen any visible dry spots before the latex placement.

First, brush latex grout on to the damp, prepared surface. When using latex concrete, collect and discard excess aggregate. Do not over-extract grout from the mix to the point that the grout becomes diluted. If directed, apply a second broomed coat of grout to areas where grout is diluted by excessive surface moisture. Immediately remove any material from the deck that is not properly mixed or proportioned, or lacks any component material, and regrout the area.

Ensure that all vertical and horizontal surfaces receive a thorough, even coating and that the rate of progress is limited so that the brushed material does not become dry before it is covered with additional material, as required for the final grade.

Complete all Type 3 deck repairs and Type 2 deck repairs exceeding 2 inches in depth as specified in Section 1040 before placement of the latex overlay. Type 2 deck repairs as specified in Section 1040 less than 2 inches in depth can be placed concurrently with the latex overlay. Fill and consolidate each Type 2 deck repair area less than 2 inches in depth before the advancement of the overlay placement operation.

Place and strike-off the mixture to approximately 1/4 inch above final grade. Use spud vibration at the edges, adjacent to joint bulkheads and expansion dams, in depressions, and in areas of bridge deck repair. Finish to final grade with the approved finishing equipment. Hand-finishing with a float may be required along the edge of the placement or on small areas of repair. Edge-tooling is required at joints, except next to metal expansion dams, curbs, and previously placed lanes. Place latex continuously, and complete the finishing of each area within 15 minutes after the initial brooming. Provide finish with a closed surface, free of pock marks, ridges, tears, and other defects.

When placing latex against latex that has not achieved initial set, but has formed a surface crust or film, remove the surface crust until plastic latex is exposed, place fresh latex against the exposed surface and consolidate both until homogeneous.

Separate screed rails and construction bulkheads from the newly placed material by passing a pointing trowel along their inside face. Do not separate metal expansion dams from the wearing surface. Ensure that this trowel cut is made for the entire depth and length of rails after the mixture has stiffened sufficiently.

Conduct all operations behind the finishing machines or screeds from work bridges suspended above the wearing surface. Provide bridges of rigid construction. Do not allow work bridges to come into contact with the surface of the latex.

Straightedge and edge while the latex is still workable, as specified in Section 501.3(k)3. After the straightedge testing and surface corrections have been completed and before the latex becomes nonplastic, texture the surface as specified for concrete pavements in Section 501.3(k)4. Cure the wearing surface as soon as possible without marking the fresh latex. If mechanical texturing is indicated, wait 5 days after placing latex before applying texturing. After the latex has hardened, test the surface again as specified in Section 501.3(o). Resound the deck if directed.

Provide adequate lighting, as indicated on the field operation QC Plan, for any placement not completed in the daylight. Ensure lighting allows proper placement, testing, and inspection operations of the entire surface area and until curing covers are placed over the surface area.

(d) Curing and Protection. Begin curing as soon as the latex has been placed, finished, and textured, if applicable. Do not use membrane-forming or monomolecular curing compounds:

1. Curing Temperatures and Records of Temperature. Sections 1001.3(p)1, 1001.3(p)2 and as follows: Maintain cure temperatures of 45F or greater throught the wet and dry cure period. Do not count as a curing day, a day on which the curing temperature drops below 45F at any time during that day. If at any time during the curing period, the curing temperature falls below 35F, the Department will consider the work unsatisfactory and it will be rejected. Protect the overlay using methods prescribed in Section 1001.3(p)4 during cool weather and Section 1001.3(p)5 during cold weather.

2. Wet Cure. Promptly cover the surface with a single layer of clean, wet burlap as soon as the surface will support it without deformation. Within 15 minutes of covering with wet burlap, place a layer of white polyethylene film, 4 mil minimum thickness, on the wet burlap and cure the surface as specified in Table A. Secure the edges of the polyethylene film to prevent wind intrusion. Keep the burlap material saturated during the wet cure period. Wet, burlap-backed, white polyethylene sheets may be substituted for the polyethylene film with the approval of the Representative, but do not use them to replace the initial wet burlap.

3. Dry Cure. After wet-curing, remove the curing covers and dry cure for an additional period, as specified in Table A. Maintain the surface of the overlay in a dry condition for the entire dry cure period. Cover the surface with waterproof coverings as required. If the overlay surface becomes wet during the dry period, extend the dry cure period to the equivalent time that the overlay surface was wet.

TABLE A
Curing Times and Application of Live Load

Depth	Wet Cure (hours)	Dry Cure (hours)	Live Load Application Total Cure Time (hours)	Live Load Application Comp. Strength psi
≤2 inches	48	72	120	3,000
>2 inches	48	96	144	3,000

(e) Limitations of Operations. Place the latex during periods where the ambient and substrate deck temperatures are between 45F and 85F. At ambient temperatures above 80F, conduct the overlay placement at night or early morning hours, when directed by the Representative, if in their opinion, a satisfactory placement cannot otherwise be achieved. If the ambient temperature is expected to reach 80F at any time 24 hours before the overlay placement, take any steps necessary, but not limited to the following to mitigate the mix component temperatures that are acceptable to the Representative:

- cover the latex admixture tanker and cement tanker with wet burlap or station the latex admixture tanker and cement tanker in shaded areas;
- condition aggregates with cool water, cover with light-colored tarps and/or stockpile in shaded areas;
- charge the water tank on the mobile mixer with cool water as close to the time of placement as possible, or condition with ice;
- park mobile mixes in shaded areas or cover with wet burlap before the placement.

Place latex at a plastic latex mixture temperature between 50F and 85F. Stop the placement at any time the Represenative determines that a satisfactory surface finish is not being achieved.

Install a bulkhead in case of a major delay in the placement operation resulting in the formation of a surface film. During minor delays, protect the placement from drying with several layers of wet burlap.

Take adequate precautions to protect freshly placed latex from rain. Stop all placement operations when it starts to rain. The Representative may order removal of any material damaged by rainfall.

Do not place latex when the evaporation rate exceeds 0.10 pound per square foot per hour as determined by ACI 305R, Figure 2.1.5. Wind breaks, sunshades, or fogging may be used to reduce evaporation to below the maximum allowable rate.

Discontinue any placement when the Representative determines that flash set of the latex does not provide a suitable placement or finish. Submit redesign and corrective action plan as directed.

(f) Testing and Acceptance.

1. Concrete Field Testing Technician. Section 704.1(d)2.a

2. Testing Facilities and Equipment. Section 704.1(d)3

3. QC and Acceptance Testing.

3.a QC Sampling and Testing of Plastic Latex. Perform testing according to the accepted QC Plan. Include in the QC Plan, testing and sampling frequencies and target points to initiate corrective measures. Furnish a copy of the QC Plan to be maintained in the Department's field office.

Test each 5 cubic yards of latex for plastic air content, temperature, and slump. Continue testing the load until control is established. Do not wait for the completion of the initial test before collecting subsequent samples. Perform slump tests as specified in Section 1042.2(f) and air content tests according to AASHTO T 152. Notify the Inspector when sampling and QC testing are to be performed. The Inspector will witness the sampling and QC testing. Report test results to the Inspector promptly. Coordinate and facilitate changes as needed in a timely manner.

Do not incorporate any latex into the work that does not conform to specification requirements. Immediately separate and remove nonconforming material from the deck surface.

3.b Acceptance Testing. Latex will be accepted on a lot-by-lot basis. Test for plastic air content according to AASHTO T 152; temperature; and compressive strength according to PTM No. 611 and PTM No. 604. Each lot will consist of 20 cubic yards or a day's placement, whichever is less.

The Inspector will select acceptance samples (n=1) according to PTM No. 1. Obtain samples of fresh latex at the point of placement under the direction and supervision of the Inspector and according to PTM No. 601. Acceptance testing of plastic concrete will be performed at a site near the point of placement, as selected by the Inspector. Latex will be tested for yield as directed. Latex not conforming to specification requirements at the point of placement will be rejected.

If the results of testing the plastic latex conform to specification requirements, mold a sufficient number of acceptance cylinders for 5-day compressive strength tests. Compressive strength cylinder molds of 4-inch diameter by 8-inch height may be substituted for cylinder molds of 6-inch diameter by 12-inch height. Perform compressive testing according to PTM No. 604. The Inspector will identify the cylinders as acceptance cylinders. Field cure cylinders as specified in Section 1042.2(f). The compressive strength of the sample will be determined as the average of the compressive strength of two individual cylinders. The lot will be accepted when the 5-day compressive strength meets or exceeds 3,000 pounds per square inch.

(g) Application of Live Loads. After latex placement, do not allow heavy equipment or vehicular traffic on the latex surface until the end of the period specified in Section 1042.3(d), Table A, and until the latex has achieved the minimum strength specified in Section 1042.3(d), Table A.

(h) Defective Work. Sections 105.12 and 1001.3(u), and as follows:

When latex overlays exhibit cracking or surface tears, perform an investigation with the Representative to determine the type of cracking, source of cracking, and extent of cracking. Measure the width, depth, and length of each crack and establish the locations of the ends of each crack with respect to permanent reference points. Coring may be necessary if crack depths cannot be accurately determined using a mechanical probe. If coring is required, obtain two cores at each location, submit one core to an independent laboratory for analysis of the cracks and submit one core to the Representative for analysis of the cracks at the LTS.

If the investigation indicates the type of cracking to be nonstructural cracks (plastic shrinkage, drying shrinkage, temperature related, or surface tears caused by finishing and texturing) that are evidence of defects in materials or workmanship, repair surface cracks and tears greater than 1/4 inch depth and between 0.007 inch and 0.016 inch width at no expense to the Department. Use a high molecular weight methacrylate penetrating crack sealer, a low viscosity epoxy resin, or other suitable material to repair the surface cracks and tears.

Submit for review, a detailed Quality Control and Action Plan that includes, at a minimum, the proposed crack sealing material data sheet from the manufacture and conditions for use, including ambient and substrate temperature and moisture conditions. Do not perform any crack sealing before the Quality Control and Action Plan has been reviewed by the Representative.

Keep cracks clean, covered, and dry until the crack sealing operation is performed to the satisfaction of the Representative.

Unless directed in writing by the District Executive, remove and replace wearing surface deficient in surface tolerance as specified in Section 501.3(o); defective in air content as specified in Section 1042.2(f); defective in compressive strength as specified in Section 1042.3(f)3.b; failing to bond to the substrate; exhibiting nonstructural cracks or tears greater than 1/4 inch depth and greater than 0.016 inch width; or showing surface defects resulting from the effects of rain, improper finish, improper cure, or honeycombing, which, in the Representative's opinion, cannot be repaired.

1042.4 MEASUREMENT AND PAYMENT—Square Yard

As indicated, for the type specified, for the item indicated.

The Department will pay for grade adjustments of expansion dams and scuppers, and scarification, separately.

The Department will pay for repairs to the bridge deck separately under the respective type of concrete bridge deck repair items.

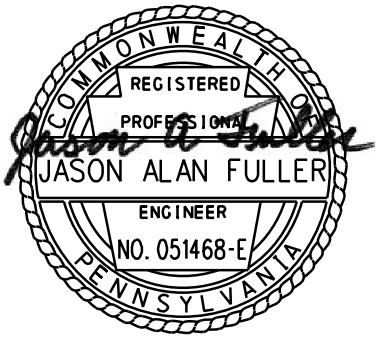
Plenary Walsh Keystone Partners
PROVEN PERFORMANCE. LOCAL PRESENCE.

HDR

Pennsylvania Rapid Bridge Replacement Project

COVER SHEET

Project Specification 9000-7001
¾ inch Polyester Polymer Concrete Overlay



Header

ITEM 9000-7001 ¾ INCH POLYESTER POLYMER CONCRETE (PPC) OVERLAY

Provision Body

ITEM 9000-7001 ¾ INCH POLYESTER POLYMER CONCRETE (PPC) OVERLAY

DESCRIPTION - This work consists of furnishing and placing a ¾ inch thick Polyester Polymer Concrete (PPC) overlay system with a High Molecular Weight Methacrylate (HMWM) resin sealer on concrete surfaces. The surface of the concrete substrate shall be prepared and the PPC overlay system shall be applied in accordance with these specifications in conformity with the lines, grades, thickness, and typical cross-sections shown on the plans or as approved by the Development Entity.

MATERIAL - The polyester concrete shall consist of polyester resin binder and aggregate as specified below. It shall also include a compatible High Molecular Weight Methacrylate sealer that when mixed with other specified ingredients and applied as specified herein, is capable of producing a polyester concrete meeting the requirements of this specification.

Polyester Resin Binder shall have the following properties:

(1) Be an unsaturated isophthalic polyester-styrene co-polymer. The resin content shall be 12% +/- 1% of the weight of the dry aggregate.
(2) Contain at least 1 percent by weight gamma-methacryloxypropyltrimethoxysilane, an organosilane ester silane coupler.
(3) Be used with a promoter that is compatible with suitable methyl ethyl ketone peroxide and cumene hydroperoxide initiators.
(4) Have the values for the material properties as follows :

Accelerators or inhibitor may be required to achieve proper setting time of polyester concrete. Use as recommended by the overlay System Provider. Material components shall be supplied collectively through the system provider. . The System Provider shall demonstrate past experience of component compatibility by demonstrating that the materials provided have been used together successfully on projects of similar size and scope to provide an acceptable outcome.

POLYESTER RESIN BINDER PROPERTIES (Tested each lot sent)

Property	Test Method	Requirement
Viscosity*	ASTM D 2196	75 – 200 cps (RVT No.1 Spindle, 20 RPM at 77 °F)
Specific Gravity*	ASTM D 1475	1.05 to 1.10 at 77 °F
Styrene Content	ASTM D 2369	40-50 percent minimum (by weight of polyester styrene resin)
Silane Coupler	NMR Spectrum	1.0 percent minimum (by weight of polyester styrene resin)
Elongation	ASTM D 638	35 percent, minimum Type I specimen, thickness 0.25 ± 0.03" at Rate = 0.45 inch per minute.
	ASTM D 618	Sample Conditioning: 18/25/50+5/70
Tensile Strength	ASTM D 638	2,500 psi, minimum Type I specimen, thickness 0.25 ± 0.03" at Rate = 0.45 inch per minute.
	ASTM D 618	Sample Conditioning: 18/25/50+5/70
* Test shall be performed before adding initiator.		

High Molecular Weight Methacrylate (HMWM) sealer for the substrate concrete surface shall be a wax-free low odor, high molecular weight methacrylate sealer, and consist of a resin, initiator, and promoter. The sealer shall conform to the following, and all components are to be supplied by the System Provider. All components shall be stored in accordance with the System Provider's recommendations.

Initiator for the methacrylate resin shall consist of a metal drier and peroxide. If supplied separately from the resin, the metal drier shall not be mixed with the peroxide directly; a VIOLENT EXOTHERMIC REACTION will occur. The containers and measuring devices shall not be stored in a manner that allows leakage or spilling to contact the containers or materials of the other.

HIGH MOLECULAR WEIGHT METHACRYLATE RESIN PROPERTIES (Tested yearly)

Property	Test Method	Requirement
Viscosity**	ASTM D 2196	25 cps maximum (Brookfield RVT with UL adapter, 50 RPM at 77 °F)
Volatile Content**	ASTM D 2369	30 percent, maximum
Specific Gravity**	ASTM D 1475	0.90 minimum at 77 °F
Flash Point	ASTM D 3278	180 °F minimum
Vapor Pressure**	ASTM D 323	1.0 mm Hg, maximum at 77 °F
PCC Saturated Surface-Dry Bond Strength (Adhesive)	CalTrans Test 551, part 5	700 psi, minimum at 24 hours and 70 ± 1°F (with polyester concrete at 12% resin content by weight of the dry aggregate), primed surface
**Test shall be performed before initiator is added		

Polyester Concrete Aggregate shall have the following properties:

(1) Have not more than 45 percent crushed particles retained on the No. 8 sieve when tested in accordance with AASHTO Test Method T335.
(2) Provide fine aggregate consisting of natural sand only.
(3) Have a weighted-average aggregate absorption of no more than 1.0 percent when tested under AASHTO Test Methods T84 and T85.
(4) At the time of mixing with resin, have moisture content of not more than one half of the weighted-average aggregate absorption when tested under AASHTO Test Method T255.
(5) Have a Moh's hardness of 7 (minimum).
(6) Comply with the requirements for the aggregate gradation as follows :

AGGREGATE GRADATION (Tested yearly)

Sieve Size	Percent Passing
3/8"	100
No. 4	62-85
No. 8	45-67
No. 16	29-50
No. 30	16-36
No. 50	5-20
No. 100	0-7
No. 200	0-3

Sand for abrasive sand finish shall have the following properties:

(1) Be commercial-quality blast sand.
(2) Have not less than 95 percent pass the No. 8 sieve and not less than 95 percent retained on the No. 20 sieve when tested under AASHTO Test Method T27.
(3) Shall be dry at the time of application.

COMPOSITE SYSTEM PROPERTIES (tested every year) :

Property	Test Method	Requirement
PPC Saturated Surface Dry Bond Strength	CalTrans CT 551	500 psi minimum at 24 hrs. and 70° F (without sealer, at 12% resin content by weight of the dry aggregate, on Saturated Surface Dry Specimen)
Abrasion Resistance	CalTrans CT 550	<2g weight loss (at 12% resin content by weight of the dry aggregate)
Modulus of Elasticity	ASTM C 469	1,000,000 psi to 1,500,000psi (at 12% resin content by weight of the dry aggregate)
Compressive Strength	ASTM C 579	7000 psi
Tensile Strength	ASTM D 638	800 psi
Chloride Permeability	ASTM C 1202	0-200 (max) coulombs

The System Provider will provide a technical representative on site to facilitate the installation of polyester concrete for a minimum of three (3) days per installation crew, per construction season. One of the three days per crew per season will be the first bridge of the season for each crew. A crew shall consist of at least one trained person and a sufficient number of experienced foreman and laborers to complete the work in accordance with these specifications. The technical representative will make recommendations and consultation on surface preparation, polyester concrete application, and polyester concrete cure as needed in conjunction with the Development Entity.

In the event that overlay installation is not completed prior to substantial completion of the bridge, HMWM sealer shall be installed on the deck surface in accordance with System Provider's recommendations to protect the deck from moisture and chloride intrusion until the overlay is installed. System Provider shall provide an onsite technical representative to facilitate installation of HMWM sealer. Prior to opening the bridge to traffic, the fresh HMWM sealer shall be sprinkled with sand at a rate of at least 2.2 lbs. per square yard, broadcast onto the glossy surface immediately after sufficient finishing and before resin gelling occurs. Prior to placing the overlay, the HWMW sealer shall be prepared as described under "Construction" in this specification.

SUBMITTALS

At least 15 days prior to the initial Polyester Overlay Pre-paving Conference each construction season, Contractor to submit the following :

System Provider's material information, recommended installation procedures, and material safety data sheets.

Placement Plan that includes the following:

1) Schedule of overlay work and testing for each bridge
2) Staging plan describing overlay placement sequence including:
   a) Cold joint locations. Cold joints between passes shall be within 6 inches of the stripe lines or centered within a lane.
   b) Sequence of placement
   c) Paving widths
   d) Anticipated paving lengths
   e) Paving directions
   f) Joint locations
3) Description of equipment used for:
   a) Surface preparation including grinding and shot blasting
   b) Applying HMWM sealer resin
   c) Measuring, mixing, placing, and finishing the polyester concrete overlay
   d) Applying surface finish sand
   e) Sketch showing complete details of supports for finishing equipment
4) Method of protecting and finishing around bridge drains
5) Methods of protecting and finishing along parapets
6) Method for controlling, measuring and maintaining overlay thickness and profile.
7) Cure time and method for polyester concrete
8) Storage and handling of HMWM resin and polyester concrete components
9) Procedure for disposal of excess HMWM resin, polyester concrete, and containers
10) Procedure for cleanup of mixing and placement equipment
11) Chain of command in the event of unforeseen circumstances during construction
12) Environmental BMP's required to ensure that the overlay materials do not leave the site (including protective measures at inlets, scuppers, barrier drains, etc.)

Material Certification - The contractor shall submit a certified test report from independent labs for all of the materials associated with the polyester concrete overlay shipped to each bridge. All components shall be packaged and shipped in strong, substantial containers bearing the manufacturers label specifying batch/lot number, brand name, and quantity. If bulk resin is to be used, the contractor shall notify the Development Entity in writing 10 days prior to the delivery of the bulk resin to the job site. Bulk resin is any resin that is stored in containers in excess of 55 gallons

CONSTRUCTION

A pre-paving conference shall be held before the first bridge of each construction season for each placement crew.

No less than five (5) days prior to start of construction of the first bridge for each placement crew, the Contractor shall prepare an offsite pretest PPC overlay patch on a concrete slab measuring a minimum of 10 ft x 6 ft x 4 in. The offsite pretest patches shall be prepared to allow for evaluation of the effectiveness of surface preparation, to determine initial set time and to demonstrate the effectiveness of the mixing, proposed placing and finishing equipment and curing period.

The pretest patches shall be installed at the same thickness and with the same materials, equipment, personnel, timing/sequence of operations and curing period that will be used for the installation of the overlay. The cleaning practice, materials and installation procedure will be approved if one passing test result is obtained from the pretest area when tested at an age of 24 hours or more. Tensile adhesion tests shall not be performed at surface temperatures above 80° F.

Conditions, equipment and personnel used during the construction of the pretest patch shall be the same as those expected and to be used for the construction of the permanent PPC overlay. If the cleaning practice, materials and installation procedure are not acceptable, the Contractor must remove the failed test patches and make the necessary adjustments and retest at no additional cost to the Development Entity until satisfactory test results are obtained.

For newly constructed bridge decks, the deck shall cure a minimum of 28 days, including the 14 day wet cure, and also attain the required design compressive strength prior to the start of surface preparation, which is performed prior to the overlay placement. The surface of concrete substrate shall be prepared for application of the overlay by shotblasting in

order to remove all existing grease, slurry, oils, paint, dirt, striping, cure compound, rust, membrane, laitance, weak surface mortar or any other contaminants that could interfere with the proper adhesion of the overlay system.

The final prepared surface shall adhere to the following requirements:

1) The areas to receive overlay shall be cleaned by shotblasting, or abrasive sandblasting in the event that the shotblaster cannot access areas to be prepared. All contaminants shall be picked up and stored in the vacuum unit and no dust shall be created during the blasting operation that will obstruct the view of motorists in adjacent roadways. The travel speed and / or number of passes of the shotblasting unit shall be adjusted so as to result in all weak or loose surface mortar being removed, aggregates within the concrete being exposed, and open pores in the concrete exposed, as well as a visible change in the concrete color. The prepared surface shall be capable of providing a tensile bond strength greater than or equal to 250 psi or a failure area, at a depth of 1/8 inch or more into the base concrete, greater than 50% of the test area per ASTM C1583. Cleaned surfaces shall not be exposed to vehicular traffic, including construction equipment, unless approved by the Development Entity.
2) If the deck becomes contaminated before placing the overlay, the Contractor shall shotblast or abrasive sandblast the contaminated areas to the satisfaction of the CQAF at no additional cost.
3) Any loose particles shall be removed prior to the overlay placement by magnets and oil free compressed air and vacuuming such that no trapped particles remain. Power washing will not be allowed.
4) The areas to be overlaid shall be blown off with oil-free and moisture-free compressed air just prior to placement of the sealer and shall be completely dry prior to placing sealer.
5) Cleaning methods other than those detailed by specification may be suggested by the overlay System Provider and approved by the CQAF .
6) All steel surfaces that will be in contact with the overlay shall be cleaned in accordance with SSPC-SP No. 10, near-white blast cleaning, except that wet blasting methods shall not be allowed.
7) All equipment for cleaning the existing concrete surface and mixing and applying the overlay system shall be in accordance with the System Provider's recommendations as approved by the CQAF prior to commencement of any work.

EQUIPMENT

A calibrated continuous automated mixer shall be used for all polyester concrete overlay applications and shall:

1) Employ an auger screw/chute device capable of sufficiently mixing catalyzed resin with dry aggregate.
2) Employ a plural component pumping system capable of handling polyester binder resin and catalyst while maintaining proper ratios to achieve set/cure times within the specified limits. Catalyzed resin shall flow through a static mix tube for sufficient duration to completely mix the liquid system.
3) Be equipped with an automatic metering device that measures and records aggregate and resin volumes.
4) Record volumes at least every five minutes, including time and date. Submit recorded volumes at the end of each work shift.
5) Have a visible readout gauge that displays volumes of aggregate and resin being recorded.
6) Produce a satisfactory mix consistently during the entire placement.
7) Mixer calibration shall be performed in accordance with System Provider recommendations and at least every 100 cubic yards.

A portable mechanical mixer of appropriate size for proposed batches, as recommended by the System Provider and approved by the Development Entity, may only be used for patching areas and this use must be approved in advance by the Development Entity.

A minimum of two (2) Class B fire extinguishers with a minimum of five (5) pound capacity, and in good working order, shall be located in close proximity to the mixer unit.

A self-propelled slip-form finishing paving machine, which is modified or specifically built to effectively place the PPC overlay in a manner that meets the objectives and requirements of the project shall be used for polyester concrete overlay applications.

The paving machine shall:

1) Employ a vibrating pan to consolidate and finish the PPC.
2) Be fitted with hydraulically controlled grade automation to establish the finished profile. The automation shall be fitted with substrate grade averaging devices on both sides of the new placement; the device shall average 15 feet in front and behind the automation sensors; or the sensor shall be constructed to work with string-line control. It is acceptable to match grade when placing lanes adjacent to previously placed PPC.
3) Have sufficient engine power and weight to provide adequate vibration of the finishing pan while maintaining consistent forward placement speed.

A vibratory screed riding on preset forms or rails may be used for overlay quantities less than 100 feet in length if approved by the Development Entity. Roller type screeds will not be accepted. A dry run of the paving machine or vibratory screed to verify minimum overlay thickness shall be performed prior to commencing placement of the overlay.

Application methods shown in this specification are typical of general installations and may be modified per the System Provider's recommendations as approved by the Development Entity. The application of the overlay shall not begin until the concrete deck is completely surface dry in accordance with ASTM D4263. The concrete surface temperature shall be between 50° and 100° F and the relative humidity less than 85%. Night work may be required when temperatures cannot be met during the day. Ambient temperature at time of overlay placement shall be 40°F and rising.

The polyester concrete placement operation shall start from the lower elevation and progress towards the higher elevation.

During surface preparation and overlay application, precaution shall be taken to assure that traffic is protected from rebound, dust, and construction activities. Appropriate shielding shall be provided as required and directed by the Development Entity.

During overlay application, the Contractor shall provide suitable coverings (i.e. heavy duty drop cloths) as needed to protect all exposed areas not to receive overlay, such as curbs, sidewalks, parapets, etc. All damage or defacement resulting from this application shall be cleaned and/or repaired to the Development Entity's satisfaction.

HMWM sealer - Immediately before placing sealer, all exposed surfaces shall be completely dry and blown clean with oil-free compressed air. Exposed surfaces shall be protected from precipitation and heavy dew during and after the application of the sealer.

After the exposed surfaces have been prepared and are dry, sealer shall be applied in accordance with the System Provider's recommendations. Sealer shall be placed within 5 minutes of mixing at approximately 90 SF / Gal or the rate recommended by the System Provider.

Sealer shall be applied by flooding and uniformly spread to completely cover surfaces to receive overlay. Care shall be taken to avoid heavy application that results in excess puddling. Excess material shall be removed or distributed to meet the required application rate. Sealer shall be reapplied to any areas that appear dry prior to overlay placement. In the event that previously applied sealer is subjected to rain or heavy dew, all moisture shall be removed, the surface sandblasted and sealer shall be reapplied in accordance with System Provider's recommendations.

Sealer shall not be allowed to leak onto areas that have not received surface preparation.

Polyester Concrete - The prime coat shall be applied a minimum of 15 minutes before placing polyester concrete and polyester concrete shall be placed within 2 hours after the sealer has been applied. The polyester concrete shall be placed prior to gelling or 15 minutes following addition of initiator, whichever occurs first, or as recommended by the System Provider. If polyester concrete is not applied before gelling or within 15 minutes of addition of initiator, prime coat

shall be reapplied at no additional cost to DE.

The resin binder shall be initiated and thoroughly blended just prior to mixing binder with aggregate. The polyester concrete shall be mixed a minimum of 2 minutes prior to placing. Aggregate shall be added and mixed sufficiently when a portable mechanical mixer is used.

Polyester concrete shall have an initial set time of at least 30 minutes and at most 90 minutes. The set time can be determined in the field when the in-place PPC cannot be deformed by pressing with a finger, indicating that the resin binder is no longer in a liquid state. If the initial set does not occur within 30-90 minutes, the material shall be removed and replaced. Accelerators or inhibitors may be required to achieve proper set times and shall be used as recommended by the System Provider.

The surface temperature of the area to receive polyester concrete shall be the same as specified above for the prime coat, a minimum of 50° F and maximum of 100° F, or in accordance with the System Provider's recommendations and approved by the Development Entity.

The overlay shall be consolidated and finished to the required grade and cross-section using PPC placement equipment as defined herein.

Although the paver should yield a finished surface, additional finishing may be necessary. PPC shall be finished as necessary through traditional concrete finishing methods, producing a slight resin bleed indicating complete consolidation of aggregates. PPC patches shall be finished by traditional concrete hand finishing methods.

Resin content shall be as specified as above and to yield a PPC consistency that requires surface applied consolidation and finishing to consolidate the aggregates and yield a slight sheen of bleed resin on top surface, yet does not yield excess bleed resin.

A surface friction sand finish of at least 2.2 lbs. per square yard shall be broadcast onto the glossy surface immediately after sufficient finishing and before resin gelling occurs. To ensure adequate pavement friction, the completed PPC overlay surface shall be free of any smooth or "glassy" areas such as those resulting from insufficient quantities of surface aggregate. Any such surface defects shall be repaired by the Contractor in the manner recommended by the System Provider and approved by the Development Entity at no additional cost.

The overlay shall be textured by spring steel tines. Tining rakes shall produce grooves of approximately 1/8 inch by 1/8 inch spaced at 1 to 1¼ inches apart. Tining grooves shall be neat in appearance and uniform in depth. Tining rakes shall be maintained clean and free from encrusted mortar, polyester resin, sand and polyester concrete to ensure uniform groove thickness.

Tining direction (either transverse or longitudinally) will be directed by the Development Entity. No texture shall be added to overlay surface within strips 12" – 18" wide parallel and adjacent to the parapet. The tining shall not be performed too early whereby the grooves may close up, or too late whereby the grooves are of inadequate depth. Tining that is not approved by the Development Entity shall be corrected with mechanical grooving at Contractor's expense.

Temporary elevation difference between bridge deck and approach roadway will be addressed with a wedge of bituminous material at each end of the deck.

Surface friction sand shall be broadcast prior to tine texturing.

The Contractor shall collect a ticket for each batch provided by each mixer, and ensure that the following information is shown on each ticket:

1) Bridge CJV number
2) PennDOT bridge key number
3) PennDOT Bridge S-xxxxx number
4) PennDOT MPMS number
5) Date and Time
6) Aggregate Weight
7) Polyester Resin Binder Weight
8) Lot/batch number for Polyester Resin Binder and High Molecular Weight Methacrylate

These tickets shall be given to the Development Entity upon completion of each overlay placement.

Curing - The Contractor shall allow the overlay to cure a minimum of four (4) hours at 50° F minimum following final finishing prior to subjecting it to loads or traffic of any nature that may damage the overlay. Cure time depends upon the ambient and deck temperatures as well as initiator / accelerator levels and shall be adjusted in accordance with System Provider recommendations. Overlay shall be protected from moisture for a minimum of four (4) hours after finishing is complete.

The overlay shall be considered cured to a traffic ready state when a minimum reading of 25 on a properly calibrated Schmidt hammer is achieved.

Acceptance Testing - Acceptance of the surface preparation and Polyester Polymer Concrete overlay will be determined by the Development Entity based on vertical axis bond tests. Smoothness quality testing must satisfy the requirements of Publication 408, Section 501.3 (o). Smoothness quality testing shall be performed by the Construction Quality Acceptance Firm (CQAF), assisted by the Contractor.

Overlay Direct Tension Bond Testing – Tensile bond testing shall be performed by an independent testing firm and shall be arranged and paid for by the Contractor.

Vertical axis pull bond tests shall be performed after 24 hours by the Contractor in accordance to ASTM C1583. At a minimum, 1 pull bond test shall be performed on each bridge. Additional testing may be required when material changes to the application process occur, including when installation is interrupted by weather, overlay is placed in phases, after changes in equipment, crew or material/batch, following equipment breakdown, following recalibration or as directed by the Development Entity.

The test result shall be the average of the tests for each structure. Test cores shall be drilled a minimum of 0.25" but no greater than 0.50" below the bond line.

The minimum bond strength of the PPC overlay system on normal weight concrete shall be 250 psi. An acceptable test will demonstrate that the overlay bond strength is sufficient by producing a concrete subsurface failure area greater than 50% of the test surface area. The Contractor shall repair all bond test locations with PPC overlay in accordance with this specification.

Smoothness Quality Testing: The finished transverse and longitudinal surface elevation of the overlay shall be measured using a 10 foot straightedge. Areas to be measured will be as directed by the Development Entity. The Contractor shall furnish an approved 10 foot straightedge, depth gauge, and person to aid the Development Entity in testing the pavement surface.

Installation of PPC Overlay shall be in accordance with Straightedge Testing and Surface Correction for plastic PPC material, (Pub. 408 Conformed, Section 1001.3(k)6.

All cracks, except those that are significant enough to require removal as determined by the Development Entity, shall be thoroughly filled and sealed with HMWM resin. HMWM resin shall be applied to crack of any width until completely filled flush with the surface of the overlay. Immediately following the application of the HMWM resin, the wetted surface shall be coated with sand for abrasive finish.

Correction of defective work shall be in accordance with Sections 105.12 and 1001.3(u), and as follows:

If PPC overlays exhibit cracking or surface tears, perform an investigation with the Representative to determine the type of cracking, source of cracking, and extent of cracking. Measure the width, depth, and length of each crack and establish the locations of the ends of each crack with respect to permanent reference points. Coring may be necessary if crack depths cannot be accurately determined using a mechanical probe. If coring is required, obtain two cores at each location, submit one core to an independent laboratory for analysis of the cracks and submit one core to the Representative for analysis of the cracks.

If the investigation indicates the type of cracking to be nonstructural cracks (plastic shrinkage, drying shrinkage, temperature related, or surface tears caused by finishing and texturing) that are evidence of defects in materials or workmanship, repair visible surface cracks and tears greater than 1/4 inch depth and from 0.007 inch to 0.016 inch width at no expense to the Development Entity. Use a high molecular weight methacrylate penetrating crack sealer, a low viscosity epoxy resin, or other suitable material to repair the surface cracks and tears.

Submit for review, a detailed Quality Control and Action Plan that includes, at a minimum, the proposed crack sealing material data sheet from the manufacture and conditions for use, including ambient and substrate temperature and moisture conditions. Do not perform any crack sealing before the Quality Control and Action Plan has been reviewed by the Representative.

Keep cracks clean, covered, and dry until the crack sealing operation is performed to the satisfaction of the Representative. Unless directed in writing by the Development Entity, remove and replace wearing surface deficient in surface tolerance as specified in Section 501.3(o); defective in air content as specified in Section 1042.2(f); defective in compressive strength as specified in Section 1042.3(f)3.b; failing to bond to the substrate; exhibiting nonstructural cracks or tears greater than 1/4 inch depth and greater than 0.016 inch width; or showing surface defects resulting from the effects of rain, improper finish, improper cure, or honeycombing, which, in the Representative's opinion, cannot be repaired."

The repair materials and finishing methods for surface defects in the overlay shall be in accordance with those used for the installation of the overlay. All surface defects shall be repaired to the satisfaction of the Development Entity before final acceptance of the work will be granted.

MEASUREMENT AND PAYMENT - Square Yard

SPECIAL PROVISION

Project: 69915	Standard / PENNDOT Oversight NHS				Construction
Short Description:	Roosevelt Expy O/Schylkll			Org Code:	0650
County:	Philadelphia	**SR:**	1	**Section:**	RES
District:	06	**Group ID:**	ERP	**Municipality:**	PHILADELPHIA

General

Type: Standard **Addendum:** 0

Detail

Index or Category: Provisional Specification Related **District:** CO

Sequence ID: 10431

Version: A

Provision Name: c10431 ITEM 9019-0001 - EPOXY BASED SURFACE TREATMENT FOR BRIDGE DECKS

Completed: Yes

Associated Items

Item Number	Item Description
9019-0001	EPOXY BASED SURFACE TREATMENT FOR BRIDGE DECKS

Header

ITEM 9019-0001 - EPOXY BASED SURFACE TREATMENT FOR BRIDGE DECKS

Provision Body

I. DESCRIPTION - This work is preparing deck surfaces, furnishing and construction of a multiple layer wearing surface of epoxy resin or epoxy-urethane resin and aggregate on in-service bridge decks.

The indicated or specified depth of the wearing surface is minimum.

II. MATERIAL -

(a) Epoxy Resin. A two-component, (base and hardener), 100% solids, thermosetting, moisture insensitive, flexible, high elongation epoxy resin, from a manufacturer listed in Bulletin 15, and meeting the following physical requirements at 24 +/- 1 C (75 +/- 2 F) when base and hardener are combined:

Viscosity (ASTM D 2393-86, Model RVT Brookfield, Spindle No. 3 at 20 rpm)	10-25 poises
Gel Time (ASTM C 881, para. 11.2 modified, 70 ml sample)	15-45 minutes
Tensile Strength (neat), 7-day (ASTM D 638) (2,500-5,000 psi)	17.2 - 34.4 MPa

Tensile Elongation (neat), 7-day (ASTM D 638)	30-70%
Absorption (neat), 24-hour (ASTM D 570)	1%, Maximum
Compressive Strength (mixed with aggregate), 3 hrs.(1,000 psi, minimum) (ASTM C 109, 50 mm square mortar cube with plastic inserts)	6.9 MPa
Compressive Strength (mixed with aggregate), 24 hrs.(5,000 psi, minimum) (ASTM C 109, 50 mm square mortar cube with plastic inserts)	34.4MPa
Permeability to chloride ion, 28-days (AASHTO T277)	100 coulombs, Maximum
Thermal Compatibility (Mixed with aggregate) (ASTM C 884)	No delamination of overlay or cracks in the concrete
Infrared spectrum (AASHTO T237, para. 4 & 5)	Established for each for each component for each Manufacturer

(b) Epoxy-Urethane Resin. A two-component, (base and hardener), 100% solids, thermosetting, moisture insensitive, flexible, high elongation epoxy-urethane resin, from a Manufacturer listed in Bulletin 15, and meeting the following physical requirements at 24 +/- 1 C when the base and hardener are combined:

Viscosity (ASTM D 2393-86, Model RVT Brookfield, Spindle No. 3 at 20 rpm)	35-70 poises
Gel Time (ASTM C 881, para. 11.2 modified, 70 ml sample)	15-45 minutes
Tensile Strength (neat), 7-day (ASTM D 638) (2,500-5,000 psi)	17.2 - 34.4 MPa
Tensile Elongation (neat), 7-day (ASTM D 638)	30-70%
Absorption (neat), 24-hour (ASTM D 570)	1%, Maximum
Compressive Strength (mixed with aggregate), 3 hrs.(1,000 psi, minimum) (ASTM C 109, 50 mm square mortar cube with plastic inserts)	6.9 MPa
Compressive Strength (mixed with aggregate), 24 hrs.(5,000 psi, minimum) (ASTM C 109, 50 mm square mortar cube with plastic inserts)	34.4MPa
Permeability to chloride ion, 28-days (AASHTO T277)	100 coulombs, Maximum
Thermal Compatibility (Mixed with aggregate) (ASTM C 884)	No delamination of overlay or cracks in the concrete
Infrared spectrum (AASHTO T237, para. 4 & 5)	Established for each for each component for each Manufacturer

(c) Certification.

Certify each lot of epoxy or epoxy-urethane resin as specified in Section 106.03(b)3.

Independent quality assurance sampling and testing may be performed by the Bureau of Construction and Materials and will be used for the purpose of making independent checks on the

certification acceptance procedure as specified in Section 106.03(b)1.

(d) Fine Aggregate. Provide aggregate from an approved source of Type A fine aggregate listed in Bulletin 14 and/or approved by the Bureau of Construction and Materials, and also approved by the epoxy-based concrete overlay Manufacturer. This aggregate consists of angular silica sand, basalt, or other highly siliceous metamorphic or igneous rock having less than 0.2 percent moisture, and free of dirt, clay asphalt and other foreign or organic materials. Provide an aggregate with a minimum Mohs' scale hardness of 7, and meeting the following gradation:

Sieve Size	Percent Passing by Weight
4.75 mm (#4)	100
2.36 mm (#8)	30 - 75
1.18 mm (#16)	0-5
600 m (#30)	0-1

(e) Manufacturer Technical Representative. Have a trained, Manufacturer Technical Representative present during every phase of the application, unless a factory trained, licensed installer, as indicated by written approval from the Manufacturer, applies the epoxy-based concrete overlay. Manufacturer Technical Representative will provide recommendations to the Engineer on approval or disapproval of deck surface preparation, equipment, mixing of components, type and method of application, and finish.

III. CONSTRUCTION -

(a) Delivery and Storage. Order, stock and store the material necessary to perform the entire overlay application prior to any field preparation. Deliver and store all epoxy-resin and epoxy-urethane resin materials in containers, with the manufacturer's name, date of manufacture, batch number, trade name, quantity and mixing ratio printed on the label.

Store and protect the materials from the elements to insure their quality and fitness for the work. Keep the storage space clean and dry, and do not allow the temperature of the storage space to fall below 16 C (60 F) or exceed 38 C (100 F). Avoid contact with flame.

Immediately remove from the work site any material which is rejected because of failure to meet the required tests or that has been damaged.

(b) Equipment. Have all equipment for the deck preparation, mixing and placement of the epoxy-based concrete overlay approved by the Engineer prior to the start of any work.

1. Surface Preparation Equipment. Provide shotblasting equipment capable of removing partially loosened chips of concrete, cleaning the bridge deck surface, roughening the bridge deck surface, and removing rust and/or corrosion from steel expansion joint assemblies or steel-grid decking. Do not use scarifiers, milling machines, or sandblasting in lieu of shotblasting, unless otherwise approved by the Engineer.

Provide a self-propelled vacuum capable of picking up dust and other loose material from the shotblasting operation.

Provide air compressors equipped with an oil/water separator capable of drying all moisture from the bridge deck.

2. Epoxy Resin or Epoxy-Urethane Resin Application Equipment. Of the following types:

2.a Mechanical Application Equipment. Provide mechanical metering, mixing, and distribution equipment that accurately meters and blends the base and hardening components, and uniformly applies the blended epoxy-based resin at the specified rate to the bridge deck in order to cover 100% of the work area. Provide equipment approved by the epoxy-based overlay Manufacturer.

Provide a fine aggregate spreader that uniformly applies the aggregate at the specified rate in order to cover 100% of the expoxy-based resin material.

Provide a self-propelled vacuum truck.

Provide lighting for work performed at night.

2.b Hand Application Equipment. Provide calibrated containers for proper proportioning of the base and hardening components.

Provide a clean, dry, container large enough to blend and mix the proper proportions of base and hardening components.

Provide a powered, paddle-type mixer for blending the base and hardening components.

Provide squeegees, rollers or brooms that are suitable for applying the mixed epoxy-based resin on the bridge deck surface at the specified application rate.

Provide shovels, hand spreaders, and/or other hand tools that are suitable for applying the aggregate at the specified rate.

Provide brooms or air compressors equipped with an oil/water separator to remove excess aggregate after each layer of the overlay has cured.

(c) Surface Preparation. Remove any unsound concrete and repair the areas in accordance with Section 1040, as directed by the Engineer. Do not use patching material containing magnesium phosphate.

Do not apply the epoxy-based concrete overly on hydraulic cement concrete that is less than 28 days of age. Not more than 24 hours before overlay placement begins, clean the surface of the bridge deck by shotblasting and/or other approved methods to expose the coarse aggregate, and to remove any asphaltic material, oils, dirt, rubber, curing compounds, paint carbonation, laitance, weak surface mortar, and other detrimental materials that would interfere with the bond or cure of the overlay. After shotblasting, vacuum the bridge deck surface to remove all dust and other loose material. Brooms are not to be a substitute for the vacuum. Protect the existing expansion dams in a manner acceptable to the engineer during surface preparation.

Use compressed air that is free of oil and water to remove all moisture from the surface of the bridge deck before application of the overlay. Maintain a completely dry surface during the application of the epoxy-based concrete overlay.

Protect the deck against damage, contamination and traffic until the overlay operation is completed. Satisfactorily repair damaged areas prior to placing succeeding construction.

(d) Placing Epoxy-Based Concrete Overlay. Satisfy the Engineer that all necessary equipment, tools, materials, and manpower are on hand at the site of work, and that all workers are familiar with the blending and application of the overlay.

If required by the Engineer, place the overlay on a small test strip not to exceed 9 square meters (100 square feet) off the project site. Use the test strip for equipment calibration and to establish procedures, and techniques for the actual overlay placement on the bridge deck.

Cover exposed areas not to be overlaid with the epoxy-based concrete overlay, such as curbs, sidewalks, railings, parapets, or inlets with suitable coverings.

Premark the bridge deck surface as a guide to obtain the proper application rate when applying the mixed epoxy-based resin by hand.

Combine and mix the base and hardener components as specified by the Manufacturer. Immediately after mixing, apply the mixed epoxy-based resin by a distributor, squeegee, or paint roller, or combinations thereof. Apply the material smoothly, uniformly and continuously over 100 percent of the deck surface. do not allow the mixed epoxy-based resin to puddle or accumulate in holes or depressions in the deck.

Apply the epoxy-based concrete overlay using a minimum of two (2) separate courses at the following application rates:

Course	**Mixed Epoxy-Based Resin Application Rate** **Liters/Sq. Meter (gal./100 sq. ft.)**	**Aggregate Application Rate** **Liters/Sq. Meter (lbs./sq.yd.)**
1	1.0 (2.5) minimum	5.4+
2+	2.0 (5.0) minimum	7.6+

Apply the aggregate at the specified rate, in a uniform manner, such that the aggregate just covers the epoxy base resin. Apply the aggregate within five minutes after application of the mixed epoxy-based resin or as recommended by the Manufacturer.

Repair areas of individual courses identified by the engineer that did not receive a uniform and sufficient application of aggregate before the epoxy based resin is cured. Sandblast areas identified as having insufficient aggregate. Clean sandblasted areas of all loose material. Apply the epoxy-based resin and aggregate to the clean, sandblasted areas in accordance with these specifications.

Remove the excess aggregate from each course after the course has completely cured. Use brooms, vacuums, compressed air free from oil and water, or other approved methods to remove the excess aggregate. Do not remove excess aggregate until vacuuming or brooming can be performed without tearing or damaging the surface.

Protect the existing expansion dams with suitable covers during application of the multilayer epoxy based concrete overlay.

(e) Limitation of Operations. Do not apply the epoxy-based concrete overlay at surface, air, or resin and aggregate component temperatures lower that 16 C (60 F). Do not apply the epoxy-based concrete overlay if the temperature is expected to drop below 13 C (55 F) within 8 hours after application, or the gel time of the mixed epoxy-based resin experienced becomes less than 10 minutes.

Do not allow vehicular traffic on the first course. Do not allow vehicular traffic on any course during the cure period.

Cure each course for the minimum cure period as follows unless longer periods are recommended by the Manufacturer.

Average temperature of deck surface, resin, and aggregate components in C (degree F):

Course	16-18 (60-64)	19-21 (65-69)	22-23 (70-74)	24-26 (75-79)	27-29 (80-84)	30 + (85 +)
1	4 hrs	3 hrs	2.5 hrs	2 hrs	1.5 hrs	1 hr
2+	6.5 hrs	5 hrs	4 hrs	3 hrs	3 hrs	3 hrs

(f) Defective Work. In accordance with Section 105.12 and as follows:

If temperatures fall below 16 C (60 F), the Engineer will require a longer curing period. If, at any time during the curing period, the temperature falls below 10 C (50 F), the work may be considered unsatisfactory and rejected.

Protect freshly applied epoxy-based concrete overlays from sudden or unexpected rain Contractor operations. Stop all application operations when it starts to rain. The Engineer may order removal and replacement of any material damaged by rainfall or Contractor operations that cannot be satisfactorily repaired.

Remove the replace rejected or damaged epoxy-based concrete overlay in rectangular sections by milling or saw cutting to the top of the concrete deck surface. Remove and replace at no additional cost to the Department.

(g) Application of Live Loads. Do not allow vehicular equipment or the traveling public on the epoxy-based concrete overlay before the overlay is cured.

IV. MEASUREMENT AND PAYMENT - Square Meter (Square Yard).

Payment includes surface preparation, furnishing and applying all courses and saw cutting the joints.

Repairs to the bridge deck will be paid separately for type of concrete bridge deck repair indicated.

Project Specific Details

Audit Information

Created By	Created On	Modified By	Modified On
Drew Dallam P.E./PennDOT BP-000119	11/19/2009 11:26:39 AM	Drew Dallam P.E./PennDOT BP-000119	11/23/2009 11:56:56 AM

Table 2

Class[1]	B	A	XX	HP	MC[2]	Z
Minimum Cementitious Content, lb/yd^3	400	400	500	500	500	500
Maximum Cementitious Content, lb/yd^3	700	700	700	700[5]	600	700
Maximum w/cm	0.55	0.45	0.42	0.40	0.40	0.42
Acceptance Criteria						
Consistency Range[3], AASHTO T119 Slump, in.	2-4	2-4	2-4	2-4	2-4	<1
AASHTO T23 Minimum Compressive Strength, psi						
28 days	3000	3000	4000	5000	3500	5000
56 days	----	----	----	----	5000	----
Air Content Range, AASHTO T152, %	5-9	5-9	5-9	5-9	5-9	6-9
Prequalification Criteria						
Chloride permeability, AASHTO T277, coulomb						
28-day standard cure				≤2000	≤3000	
28-day accelerated cure				≤1000	≤1500	
Maximum 28-day drying shrinkage, ASTM C157, %				-0.040	-0.045	
Maximum Adiabatic temperature rise, degree F[4]					75	

Table 2 Footnotes:

1. A single concrete mixture may be used for multiple classifications if performance and prequalification criteria are satisfied.

2. Class MC concrete may have a total supplementary cementitious content of 75 percent by weight of total cementitious material when using either ground-granulated blast-furnace slag meeting the requirements of AASHTO M 302, or combinations of slag and other supplementary cementitious materials. Maximum cement replacement by fly ash or other pozzolan meeting requirements of AASHTO M 295 is 30 percent by weight. Maximum cement replacement by silica fume meeting the requirements of AASHTO M 307 is 7 percent by weight.

3. Slump range measured at the point of discharge. The Contractor shall submit for approval by the Engineer, the target slump range for each element. Slump shall not exceed 4 inches for surfaces sloped greater than 4 percent. If additional workability is desired the Engineer may allow an increase of the maximum specified slump to 6 inches if an AASHTO M 194 Type A - Water Reducing Admixture is used, or an increase of up to 9 inches if an AASHTO M 194 Type F or G - High Range Water Reducing admixture is used.

   AASHTO M 194 Type F or G - High Range Water Reducing Admixture is required when concrete is to be placed by pumping equipment. Admixtures must be used in accordance with manufacturers' recommended dosages.

4. Maximum concrete temperature rise measured in Section 607 mockup trial with cube insulated with curing blankets, or prequalification calorimetry tests.

5. The maximum cementitious content for Class HP may be exceeded for the fabrication of precast/prestressed concrete structures as approved by the Engineer. Class HP concrete shall replace all references to Class X in RIDOT's standard specifications.

b. Design and Approval of Concrete Mixtures. The Contractor shall design the concrete mixtures for each class of concrete specified. The concrete mix components shall be proportioned using the absolute volumes method in accordance with the requirements for each class as specified herein and methods outlined in the American Concrete Institute's "Manual of Concrete Practice," 2000 edition; Standard 211.1, "Recommended Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete"; and Standard 301, "Specifications for Structural Concrete in Buildings - Section 4.2.3.3."

Step 1. Laboratory Testing. At least 60 days prior to production, the Contractor shall submit in writing its concrete mix design on Department forms, and trial batch reports supported by laboratory test data to the Engineer for review.

The trial batch test reports shall include the following information:

(a) Contractor/Testing Laboratory name.

(b) The coarse and fine aggregate gradations and sources.

(c) The fine aggregate finess modulus (FM).

(d) Any other pertinent information (i.e., aggregate specific gravities, unit weights, absorptions, or any other material properties).

(e) Date of mixing.

(f) Mixing equipment and procedures used.

(g) The size of batch in cubic yards.

(h) Weight/volume, type, source/manufacturer of all ingredients used in the mix.

(i) Slump.

b. Bridge Decks with a Modified Structural Concrete Overlay. The initial concrete surface shall be screeded to the true cross section and left without any projections and/or the depressions that could retain water. Mixing, handling, placement finishing and curing of the modified structural concrete shall conform to the applicable requirements of **SECTION 815; LATEX MODIFIED CONCRETE FOR BRIDGE DECK OVERLAYS** and **SECTION 816; CONCRETE BRIDGE DECK OVERLAYS**, of these Specifications. However, pouring may not begin until the concrete bridge deck has obtained the required curing and strength gain set forth below in **Subsection 814.03.10; Application of External Loads.** Transverse grooving is required and it shall conform to the requirements listed under **Subsection 814.03.9, Para. a**, above.

c. Bridge Decks with Bituminous Overlay and Bridge Deck Waterproofing. Bituminous paving shall not begin until the concrete has adequately cured and attained the required strength as listed under **Application of External Loads.** The surface of the concrete bridge deck shall be left without any projections that might puncture, or depressions that could retain water. The surface shall be as smooth as practical in accordance with the recommendations of the manufacturer of the waterproofing membrane. Requirements of waterproofing the bridge deck shall conform with the requirements set forth in **SECTION 813; WATERPROOFING AND DAMPPROOFING,** of these Specifications.

814.03.10 Application of External Loads. No construction work (including placement of sidewalk, curbing, railing, bituminous pavement, concrete overlays, grooving, etc.), shall be allowed on the newly placed bridge deck until concrete has cured for a minimum of 14 days and has attained the minimum required 28-day compressive strength. No heavy equipment or traffic of any description will be permitted on the concrete deck until authorized by the Engineer.

814.04 METHOD OF MEASUREMENT. This work will not be measured separately for payment.

814.05 BASIS OF PAYMENT. No separate payment will be made for this work. Rather, payment will be included with the payment, and at the contract unit price per cubic yard as listed in the Proposal, for "Concrete Superstructure Class HP(AE) Bridge Deck."

SECTION 816

CONCRETE BRIDGE DECK OVERLAYS

816.01 DESCRIPTION. This work consists of placing a Portland cement concrete overlay on a prepared surface of bridge decks, precast concrete butted box beams, deck slabs, deck planks or other specified concrete substrate at the locations indicated on the Plans or as directed by the Engineer, all in accordance with these Specifications.

816.02 MATERIALS. Portland cement concrete shall be Class HP(AE) and shall conform to all applicable requirements of **SECTION 601; PORTLAND CEMENT CONCRETE**, of these Specifications, except as modified herein.

816.03 CONSTRUCTION METHODS.

816.03.1 Existing Bridge Decks.

a. Surface Scarification. The surfaces of existing bridge decks upon which a concrete overlay is to be placed shall be scarified in an approved manner. The scarification method and depth of removal shall be as specified on the Plans.

b. Surface Preparation. The blast-cleaning of an area of the deck shall be performed before the 24-hour water soak period preceding placement of the overlay on the area. The blast-cleaning shall be performed by a method approved by the Engineer. The blast-cleaning method used shall be performed in conformance with all applicable air and water pollution regulations and applicable safety and health regulations. All debris, including dirty water, resulting from the blast-cleaning operations shall be immediately and thoroughly cleaned from the blast-cleaned surfaces and from other areas where debris may have accumulated. All dust and other debris shall be removed by flushing with water, vacuuming, or blowing with oil-free compressed air. The blast-cleaned areas shall be protected, as necessary, against contamination prior to the 24-hour presoaking. Contaminated areas and areas exposed more than 36 hours after cleaning shall be blast-cleaned again, as directed by the Engineer and at no additional expense to the State.

The prepared surface shall then be soaked with clean water for not less than 24 hours prior to the placement of the Class HP(AE) concrete overlay. The surface shall be maintained in a clean, saturated condition by using polyethylene film or other suitable water impermeable clear covers, until ready to receive the overlay. Before the overlay is applied, all standing water shall be blown off with oil-free compressed air.

816.03.2 Precast Concrete Butted Box Beams, Deck Slabs, or Deck Beams. The surfaces of Precast Concrete Butted Box Beams, Deck Slabs or Deck Planks upon which an overlay is to be applied shall be finished with a roughened surface with amplitude of 1/4" minimum by a method noted on the Plans or as approved by the Engineer.

After the placement and curing of the shear key grout and successful post tensioning of the structural elements is complete, and prior to placing the overlay, the entire area of the deck shall be blast-cleaned in accordance with the requirements set forth in **Subsection 816.03.1, Para. b**. Epoxy coated steel and any other appurtenances cast into the surface of the precast elements shall be protected from the effect of the blast medium so that damage to the epoxy coating does not occur. Any damage resulting from the Contractor's failure to adequately protect the steel shall be repaired by the Contractor at no additional cost to the State.

816.03.3 Bonding Grout. When specified in the Plans, a bonding grout shall be applied as follows: After the surface has been cleaned and wetted, and immediately before placing concrete, a thin (approximately 1/8 inch) coating of bonding grout shall be vigorously and thoroughly broomed, brushed or sprayed onto the saturated bridge deck.

Bonding grout shall consist of equal parts, by volume, of approved Portland cement, microsilica (solids part) and mortar sand with sufficient water to form a slurry. The water-to-cementitious ratio by weight of the bonding grout slurry shall not exceed 0.40. The consistency of the slurry shall be such that it can be applied with a stiff synthetic bristle broom or sprayed onto the prepared concrete surface in a thin, even coating that will not run or puddle.

Bonding grout that has dried or become unworkable, as determined by the Engineer, shall not be incorporated in the work. No retempering will be permitted.

Bonding grout shall be broomed with push brooms. At all joints and concrete surfaces around or below reinforcing steel, brooming shall be done with straight brooms. Care shall be exercised to insure that all prepared surface areas receive a thoroughly even coating, and that no excess bonding grout be permitted to collect in pockets. This shall be done to insure the bonding grout is evenly absorbed into the surface. All surfaces to be in contact with new concrete, including the slab, curb, longitudinal and transverse joints, shall be coated with bonding grout.

The rate of bonding grout application shall be limited to that surface area which can be covered with new concrete before the bonding grout begins to dry out. The application of the bonding grout shall not be more than 5 feet from the leading edge of the overlay. The Contractor shall take measures to insure that no drying out of the bonding grout occurs by having sufficient workmen available. In the event drying does occur, as evidenced by a light gray color, the Contractor shall remove the bonding grout by sandblasting, or other means approved by the Engineer. Wetting or spraying the wet or dry bonding grout shall not be allowed.

816.03.4 Limitations of Mixing.

a. Temperature and Weather Conditions. All weather and concrete temperature requirements shall meet the applicable requirements of **Subsection 814.03.3** of these Specifications except as modified below.

b. Cold Weather Concrete. No Class HP(AE) concrete mixtures shall be placed when ambient temperatures are below 45^{O}F. However, the Class HP(AE) concrete may be placed at 45^{O}F when rising temperatures are forecast and if the forecast indicates temperatures over 45^{O}F for a minimum period of 8 hours after the placement has been completed.

If the air temperatures are such that the minimum temperature will not be met, the Contractor may place concrete if the structure is enclosed and external heat is provided in order to meet specified ambient temperature requirement for placement.

At temperatures above 85^{O}F the Engineer may require placements to be made at night or early morning hours, if, in his opinion, a satisfactory surface finish is not being achieved.

c. Inclement Weather. For structures that are not enclosed, all placing operations shall cease when it starts to rain or snow.

816.03.5 Placing and Finishing. Class HP(AE) concrete overlay shall conform to the placement requirements of **Subsection 814.03.6** of these Specifications except as modified herein. Concrete placement shall not proceed until the Engineer is satisfied that all necessary steps have been taken to insure adequate compliance with the Specifications and that completion of the operation can be accomplished within the required scheduled time. It shall be the Contractor's responsibility to allow sufficient time to permit such an inspection by the Engineer.

a. Finishing Machine. The finishing machine shall conform to the applicable requirements of **Subsection 814.03.7** of these Specifications, except as modified in this Section. The finishing machine shall have one or more rotating rollers and augers. Prior to placing the concrete, screed rails shall be accurately set to insure finishing of the concrete surface to the elevations shown on the Plans.

Provisions shall be made for raising the screed to clear the screeded surface for traveling in reverse. The bottom face of the screed shall be a metal surface 4 inches wide. The screeds shall be provided with positive control of the vertical position.

During the dry test run the finishing machine's screed rails are to be set as close to the final grade as possible to eliminate the need for adjusting the finishing machine by hand at any time during the operation.

Bulkheads shall be formed to the required grade and profile prior to placing the modified concrete overlay.

b. Placement and Consolidation. Concrete placement and initial strike-off shall be coordinated so that initial strike-off is never more than 5 feet behind the concrete placement. The direction of placing the concrete shall be as specified on the Plans.

The concrete shall be consolidated by means of an approved high frequency (3000 to 7000 vpm) vibratory pan which shall be applied in a manner to secure maximum consolidation of the concrete.

Spud vibration will be required in deep pockets, edges and adjacent to joint bulkheads and overlays greater than 3 inches thick.

Handheld vibrators shall be equipped with rubber-tipped heads when used to consolidate around epoxy-coated reinforcement.

A construction dam or bulkhead shall be installed in case of a delay in the placement operations exceeding 30 minutes duration. During delays of 30 minutes or less, the placement shall be protected with presoaked wet burlap. If the concrete placement is stopped or delayed for 90 minutes or more, further placement shall be discontinued.

The thickness of the mixture shall be verified by probes in the fresh concrete. Sufficient depth checks shall be made at regular intervals behind the machine(s) prior to commencement of the curing operation along the full width of the span to insure conformity to the overlay thickness specified on the Plans.

Screed rails and/or construction bulkheads shall be separated from the newly placed material by passing a pointed trowel along their inside face. Metal expansion dams shall not be separated from the overlayment. Care shall be exercised to insure that this trowel cut is made for the entire depth and length of rails after the mixture has sufficiently stiffened.

Unsatisfactory performance, particularly with respect to the surface smoothness and profile attained, may be cause for rejection of the equipment.

c. Finishing. The finished surface, before texturing, shall be uniformly smooth, dense and even. Variations in pavement surface in excess of 1/8-inch above, or below the proper finished elevation, or surface irregularities of more than 1/8-inch in 10 feet will not be accepted. The concrete surface shall be checked in accordance with the requirements of **Para. c** of **Subsection 814.03.7** of these Specifications.

Hand finishing with a float may be required along the edge of the pour or on small areas or repair. Edge tooling is required at joints, except next to metal expansion dams, curbs, and previously placed lanes.

816.03.6 Testing. Testing shall be in accordance with the RIDOT Master Schedule for the Preparation of a Project Schedule for Sampling, Testing and Certification of Materials.

All compressive strength cylinders shall be field cured at the job site and under the same conditions as the Class HP(AE) concrete overlay.

816.03.7 Curing Concrete. The curing of Class HP(AE) concrete overlay shall conform to the applicable requirements of **Subsections 814.03.2** and **814.03.8; Contractor's Plan** and **Curing**, respectively, of these Specifications, except as modified below.

No vehicular traffic shall be permitted on the Class HP(AE) concrete surface for a minimum period of fourteen days, or until the minimum specified 28-day design compressive strength is achieved.

816.03.8 Grooving. The final Class HP(AE) concrete deck overlay shall be textured by transverse grooving. Such grooving shall conform to the applicable requirements of **Subsection 814.03.9** of these Specifications.

816.03.9 Defective or Damaged Class HP(AE) Concrete. All defective or damaged HP(AE) concrete identified prior to the final acceptance of the work shall be repaired or replaced at the Contractor's expense. Defects shall include, but not necessarily be limited to, insufficient thickness, cracking, tearing, honeycombing, and damage or other imperfections caused by the Contractor's operations. Repair methods shall be proposed by the Contractor for approval by the Engineer.

816.04 METHOD OF MEASUREMENT. "Concrete Bridge Deck Overlays" will be measured by the number of cubic feet or cubic yards of the concrete actually placed in accordance with the PIans and/or as directed by the Engineer.

816.05 BASIS OF PAYMENT. The accepted quantity of "Concrete Bridge Deck Overlays" will be paid for at the contract unit price per cubic foot or cubic yard as listed in the Proposal. The price so-stated constitutes full and complete compensation for all labor, materials, equipment, surface preparation, bonding grout, grooving, and all other incidentals required to finish the work, complete and accepted by the Engineer.

SECTION 817

REPAIRS TO STRUCTURE CONCRETE MASONRY

817.01 DESCRIPTION. This work consists of making repairs to structure concrete masonry by removing and disposing deteriorated concrete, preparing bonding surfaces of concrete and reinforcing steel, and replacing the deteriorated concrete with approved mortar or concrete to the lines and grades specified and at the locations indicated on the Plans or as directed by the Engineer all in accordance with these Specifications.

6-02.3(2)A1 Contractor Mix Design for Concrete Class 4000D

All Class 4000D concrete shall conform to the following requirements:

1. Aggregate shall use combined gradation in accordance with Section 9-03.1(5) with a nominal maximum aggregate size of 1½ inches.
2. Permeability shall be less than 2,000 coulombs at 56 days in accordance with AASHTO T277.
3. Freeze-thaw durability shall be provided by one of the following methods:
   a. The concrete shall maintain an air content between 4.5 and 7.5 percent.
   b. The concrete shall maintain a minimum air content that achieves a durability factor of 90 percent, minimum, after 300 cycles in accordance with AASHTO T 161, Procedure A. This air content shall not be less than 3.0 percent. Test samples shall be obtained from concrete batches of a minimum of 3.0 cubic yards.
4. Scaling shall have a visual rating less than or equal to 2 after 50 cycles in accordance with ASTM C672.
5. Shrinkage at 28 days shall be less than 0.032 percent in accordance with AASHTO T 160.
6. Modulus of elasticity shall be measured in accordance with ASTM C469.
7. Density shall be measured in accordance with ASTM C138.

6-09 Modified Concrete Overlays

Fine aggregate shall be Class 1. Coarse aggregate shall be AASHTO grading No. 7 or No. 8.

6-09.3(3)C Fly Ash Modified Concrete

Fly ash modified concrete shall be a workable mix, uniform in composition and consistency. Mix proportions per cubic yard shall be as follows:

Portland Cement	611 pounds
Fly Ash	275 pounds
Fine Aggregate	38 percent of total aggregate
Coarse Aggregate	62 percent of total aggregate
Water/Cement Ratio	0.30 maximum
Air (± 1½ percent)	6 percent
Slump	7 inches maximum

6-09.3(3)D Microsilica Modified Concrete

Microsilica modified concrete shall be a workable mix, uniform in composition and consistency. Mix proportions per cubic yard shall be as follows:

Portland Cement	658 pounds
Microsilica Fume	52 pounds
Fine Aggregate	1,515 pounds
Coarse Aggregate	1,515 pounds
Water/Cement Ratio	0.33 maximum

Air (± 1½ percent)	6 percent
Slump	7 inches maximum

6-09.3(3)E Latex Modified Concrete

Latex modified concrete shall be a workable mix, uniform in composition and consistency. Mix proportions per cubic yard shall be as follows:

Portland Cement	1.00 parts by weight
Fine Aggregate	2.40 to 2.75 parts by weight
Coarse Aggregate	1.75 to 2.00 parts by weight
Latex Admixture	3.50-gallons per bag of cement
Water/Cement Ratio	0.33 maximum
Air Content of Plastic Mix	6 percent maximum
Slump	7 inches maximum

Polyester Concrete

The aggregate shall conform to Section 9-03.1(5)B for either 1/2-inch or 3/8-inch maximum nominal aggregate size.

Mixing Components

The polyester resin binder in the polyester modified concrete shall be approximately 12 percent by weight of the dry aggregate. The Contractor shall specify the exact percentage in the mix design Working Drawing submittal.

Masten, Maria (DOT)

From: Hayes, Chad - DOT <chad.hayes@dot.wi.gov>
Sent: Wednesday, April 12, 2017 8:03 AM
To: Masten, Maria (DOT)
Subject: RE: Part 2 of State Report Survey

Because I'm out of the office I'm forwarding you out specs….Thanks.

http://wisconsindot.gov/rdwy/stndspec/ss-05-09.pdf#ss509

http://wisconsindot.gov/Pages/doing-bus/eng-consultants/cnslt-rsrces/rdwy/stndspec.aspx

Chad

From: Masten, Maria (DOT) [mailto:maria.masten@state.mn.us]
Sent: Tuesday, April 11, 2017 5:15 PM
To: Wagner, Denise F [ITRNS] <dfwagner@iastate.edu>; NC2@iastate.edu
Cc: matt.farrar@itd.idaho.gov; tmsherrill@ncdot.gov; hadly.eisenbeisz@state.sd.us
Subject: Re: Part 2 of State Report Survey

Since everyone uses a limited types of overlays, if you want to email me your mix design specs for the overlays that would work vs. trying to fill out the survey. Either way works great and is appreciated.

Thanks!

Sent from my iPhone

From: Masten, Maria (DOT) [mailto:maria.masten@state.mn.us]
Sent: Tuesday, April 11, 2017 3:49 PM
To: NC2@iastate.edu
Subject: Part 2 of State Report Survey
Importance: High

Thank you to everyone who has completed the survey. After reading through the survey, I realized that as a concrete group, our survey was lacking the good stuff – OVERLAY MIX DESIGNS!

I have created a part 2 of the state report survey – IF AT ALL POSSIBLE PLEASE COMPLETE BY FRIDAY (4/14/17).

https://www.surveymonkey.com/r/Spring_2017_NCC_Part2

One response per state please! THANKS!

Looking forward to seeing everyone in a few weeks!

Maria