

# Rehabilitation of Side-by-Side Box Beam Structures



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Houghton County Road Commission

# Houghton County Bridges

- 34 bridges in the county with 20 of them being side-by-side concrete box beams
- 11 of the 20 box beam bridges were built between 1979 and 1988
- Due to their age these 11 bridges have varying degrees of water starting to permeate the HMA wearing surfaces and waterproofing membranes and leak between the box beams
- Needed to start planning projects to replace waterproofing membranes and wearing surfaces before water infiltration damages the box beams

# Sturgeon River Bridge -2015

- 3 span bridge on low volume major collector built in 1979
- Very little maintenance done on the bridge since built
- Guardrail on bridge and approaches were upgraded in 2009
- 10 side-by-side box beams with preformed waterproofing membrane and 2" of HMA
- Deficiencies included cracked HMA wearing surface and waterproofing membrane allowing water to reach the box beams.
- Expansion joint concrete spalled and cracked with tears in rubber gland in multiple locations
- Settlement behind abutments

# Sturgeon River Bridge -2015





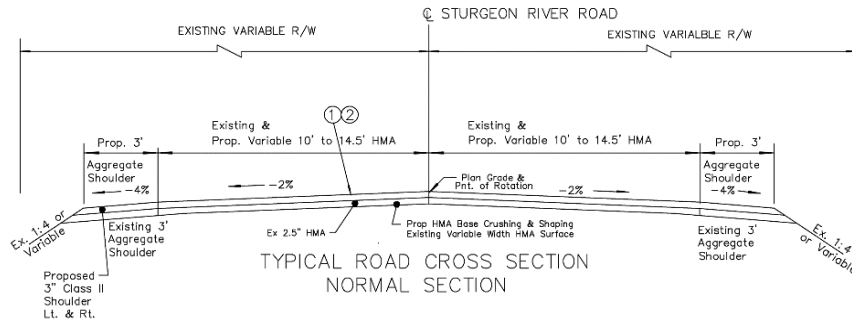
# Sturgeon River Bridge - 2015



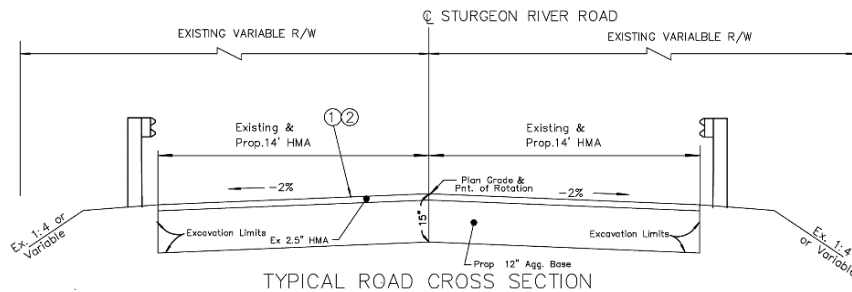
# Sturgeon River Bridge - 2015



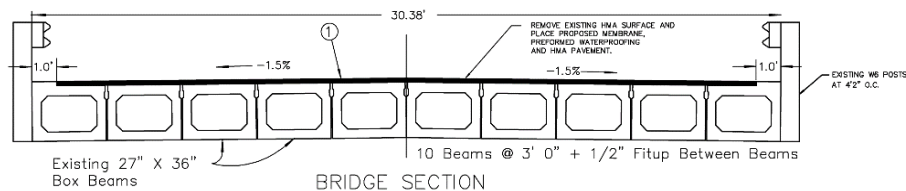
# Sturgeon River Bridge - 2015



Typical to Apply: Sta 9+08 (P.O.B.) to Sta 13+95  
Sta 16+05 to Sta 19+02 (P.O.E.)

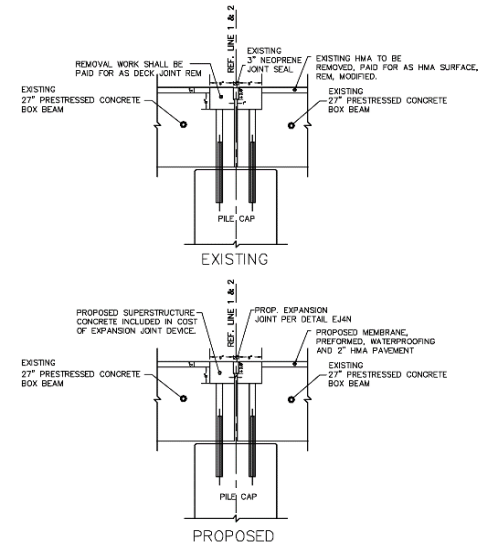


Typical to Apply: Sta 13+95 to Sta 14+10 (Back of Abut. A)  
Sta 15+90 (Back of Abut. B) to Sta 16+05



NO.	ITEM	RATE PER yd <sup>2</sup>	PERF. GRADE	REMARKS
1	HMA, 5E1	¥ 165 - 220 lb	5B-34	MAINLINE TOP COURSE AW = 220 MIN
2	HMA, LVSP	165 lb	5B-34	MAINLINE BASE COURSE
	HMA BOND COAT	0.05-0.1 gal	SS-1h	FOR INFO. ONLY

\* HMA, 5E1 SHALL BE PLACED AT 165 lb/Syd ON THE APPROACHES AND AT 220 lb/Syd ON THE BRIDGE DECK.

BRIDGE DECK  
JOINT REPAIR



# Removing Existing Expansion Joint



# Removing Existing Expansion Joint





# Beam Ends After Existing Expansion Joint Was Removed





# HMA Removal



# Deck With HMA Removed





# Setting New Expansion Joint



# First Half of New Joint Formed





# New Joint Poured



# Joint Covered in Wet Burlap





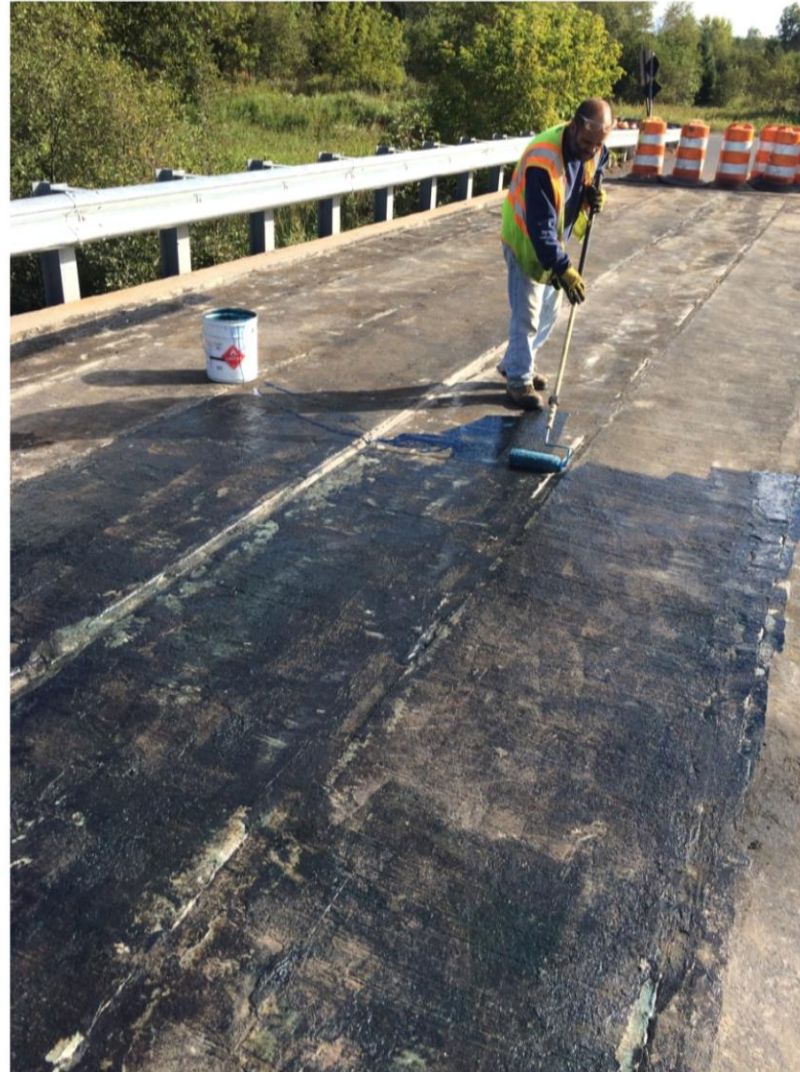
# Entire Joint Covered in Plastic



# Second Half of New Joint Formed



# Applying Primer

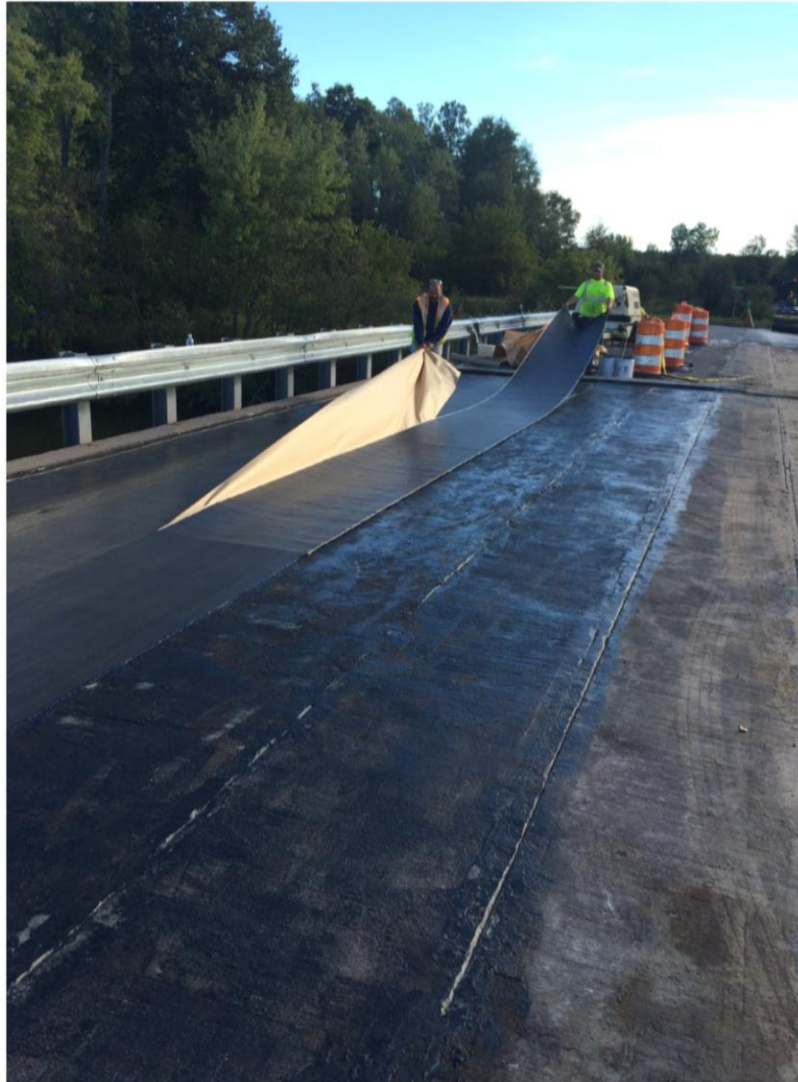




# Placing Membrane



# Placing Membrane



# Applying Primer





# Paving the Deck



# Paving the Deck





# Final Product



# Post Construction Issues



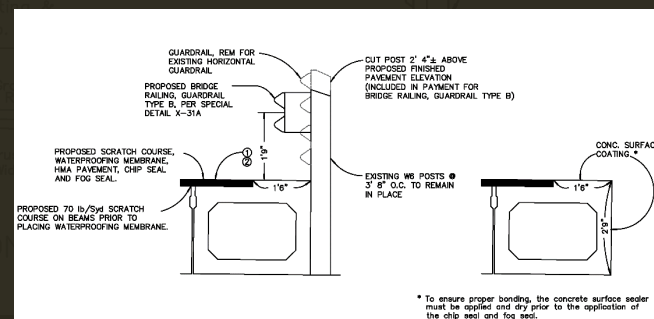
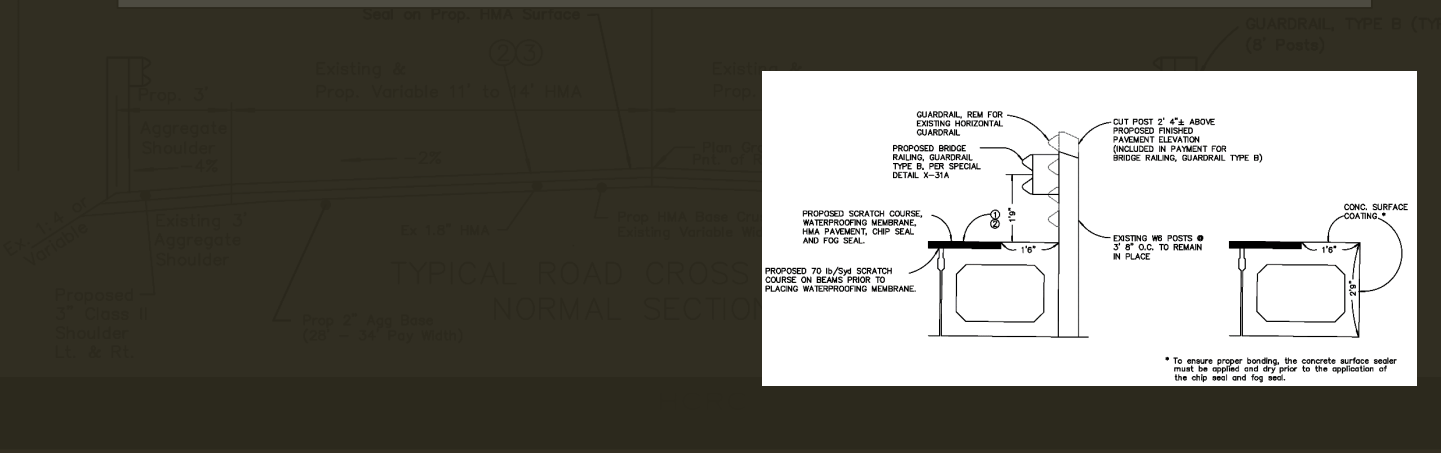
# Summary

- Existing HMA and waterproofing membrane removed by scraping off with skid steer and by hand which was labor intensive and time consuming.
- Deck surface wasn't very smooth and uniform after HMA was removed due to grout between beams which made it hard to get roll out membrane perfectly smooth with no air trapped
- Two piece D.S. Brown SSA2 expansion joint used with A2R gland
- 5,022 sft of Carlisle CCW-711-70 waterproofing membrane (70-mil) @ \$1.95 per sft not applied by a specialty crew
- Approaches paved with 165 #/syd of LVSP (base course) and 165 #/syd of 5E1 (top course)
- Deck paved with 220 #/syd of 5E1
- Crack sealed perimeter of HMA



# South Laird Road Bridge - 2016

- Single span bridge on low volume major collector built in 1983
- Very little maintenance done on the bridge since built
- 10 side-by-side box beams with polyester asphalt hot mix waterproofing membrane and 2" of HMA
- Deficiencies included cracked HMA wearing surface and waterproofing membrane allowing water to reach the box beams.
- Settlement behind abutments
- Bridge railing and approach guardrail was substandard



# Applying Primer





# Placing Membrane



# Chipsealing over HMA



# Summary

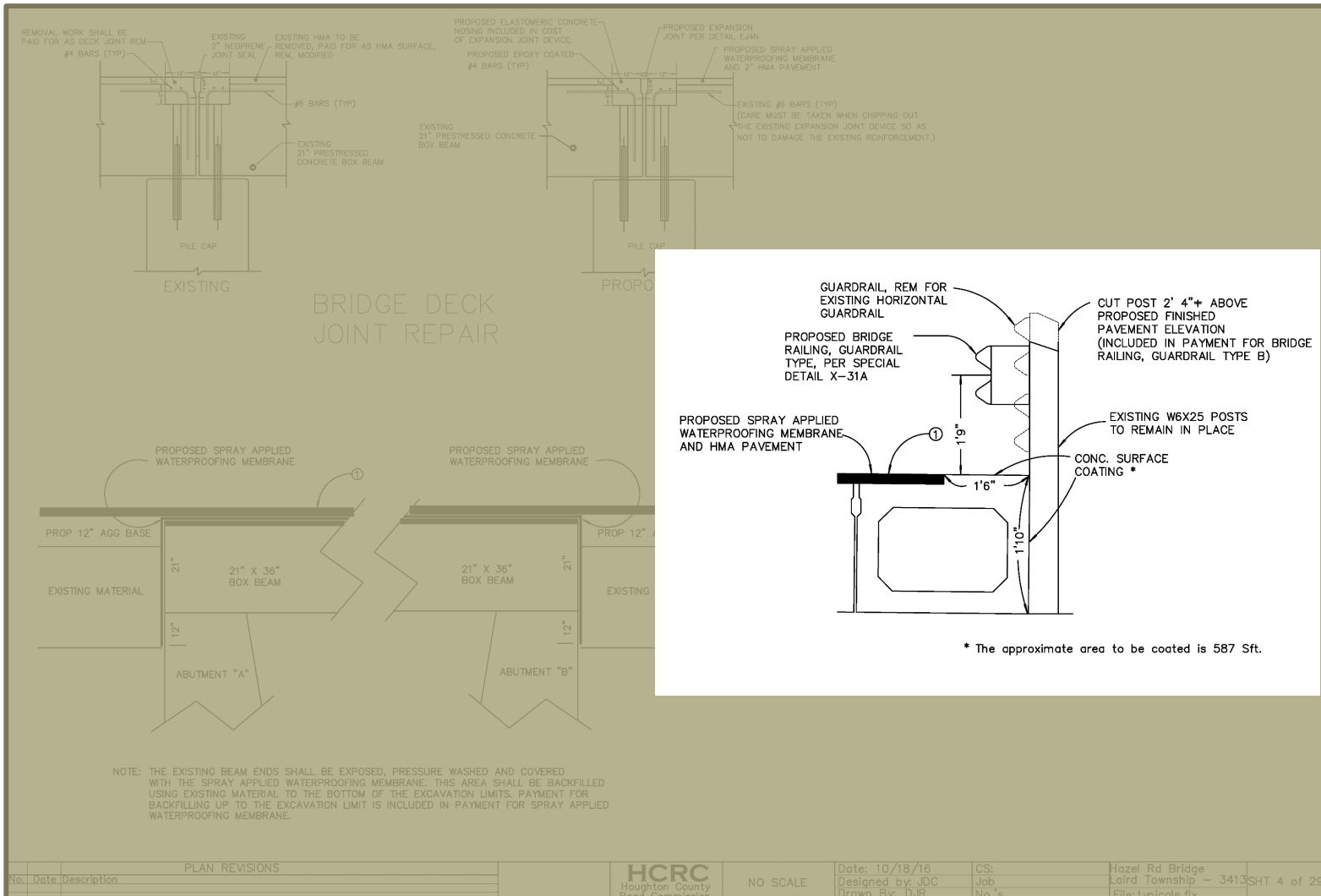
- Existing HMA and waterproofing membrane removed by making 3 passes with a cold mill which was quick and not as labor-intensive as scraping
- Deck surface was smooth and uniform after HMA was removed which made it easier to get roll out membrane perfectly smooth with no air trapped. Using fine tooth mill would make it smoother
- Membrane was not placed by a specialty crew
- 2,190 sft of W.R. Meadows MEL-DEK waterproofing membrane (65-mil) @ \$4.50 per sft
- Approaches paved with 165 #/syd of LVSP (base course), 165 #/syd of 5E1 (top course) and then chip sealed (34CSM) and fog sealed (CSS-1h)
- Deck paved with 220 #/syd of 5E1 then chip sealed and fog sealed
- Bridge railing replaced using SP and Special Detail X-31A
- Good results so far



# Hazel/Horoscope Bridges - 2017

- 3 bridges within 7 miles of each other all needing the same treatment (membrane, expansion joints, HMA, guardrail)
- 2 of the bridges are 2 span and 1 is a single span having been built during the summers of 1984 & 1985
- Very little maintenance done on any of them
- All 3 bridges on gravel low volume major collectors
- Issues with gravel being carried onto the bridges since the paved approaches were so short (50' each side)
- Bridges had  $\frac{3}{4}$ " polyester asphalt hot mix membranes with 2" HMA surface

# Hazel/Horoscope Bridges - 2017



# Horoscope Road Bridge (3415)





# Horoscope Road Bridge (3414)



# Hazel Road Bridge (3413)





# Hazel Road Bridge (3413)





# Proposed Fix

- Began searching for alternatives to roll out membranes in the summer of 2016
- Found other states had used spray applied membranes
- Spoke with product manufacturers/suppliers about my project
- Spoke with MDOT Regional Bridge Engineers about 2 projects that had been done during the summer of 2016
- Decided to use spray applied waterproofing membrane

# Proposed Fix

12DS710(L090)

MICHIGAN  
DEPARTMENT OF TRANSPORTATION

SPECIAL PROVISION  
FOR  
**SPRAY APPLIED WATERPROOFING MEMBRANE**

BRG:JLS

1 of 2

APPR:TES:JAB:07-13-16

**a. Description.** This work consists of providing all labor, equipment and materials necessary to prepare the substrate concrete surfaces and for the application of spray applied waterproofing membrane to be used for coating the entire horizontal surface of the concrete slab, the vertical surface of the concrete slab at the abutments, and a portion of the vertical surface of the barriers, as specified on the bridge plans. Perform this work in accordance with the plans, standard specifications and this special provision.

**b. Materials.** Use materials from one of the following suppliers or approved equal:

1. Stirling Lloyd, Eliminator, 860-666-5008
2. Bridge Preservation, Bridge Deck Membrane, 913-912-3305
3. D.S.Brown, Deckguard Spray Membrane, 419-257-3561
4. Wasser Coatings, Polyflex Bridge Deck System, 216-536-6777

**c. Construction.** Follow the selected manufacturer's recommendations for surface preparation and application, except as modified by this special provision.

1. **Surface Preparation.** Ensure all concrete to be sealed is at least 28 days old. Ensure all surfaces to receive the concrete sealer are dry and free from contamination such as oil, grease, laitance, and curing compounds. Light abrasive blasting followed by oil-free compressed air cleaning is required. Water blasting or wire brushing is prohibited. Conduct moisture testing in accordance with *ASTM D 4263*. Tape a transparent polyethylene sheet (4 mil) to the concrete surface. Seal all edges with tape that will stick to the concrete substrate. Leave the plastic sheet in place for a minimum of 16 hours. There must be no moisture visible on the polyethylene sheet. Alternate methods to detect moisture must be approved by the Engineer.

2. **Application.** Follow the selected manufacturer's recommendations for application procedures and rates. When the spray applied membrane is to be overlaid with a wearing course provide the necessary manufacturer's recommended tack coats and/or aggregate course. Protect from overspray in accordance with subsection 715.03.D.4 of the Standard Specifications for Construction.

3. **Joints and Cracks.** Provide and install manufacturer's recommended joint systems at all joints according to the manufacturer's recommendations. Provide and install manufacturer's recommended joint systems at cracks according to the manufacturer's recommendations.

# Proposed Fix

BRG:JLS

2 of 2

12DS710(L090)

07-13-16

4. Bond Testing. Conduct bond testing in accordance with the manufacturer's recommendations. Perform bond testing a minimum of three times per 5,000 square feet of surface area and as directed by the Engineer. The minimum required tensile bond strength between the primer and the substrate is 150 pounds per square inch.

d. Measurement and Payment. The complete work, as described, will be measured and paid for at the contract unit price using the following pay item:

Pay Item

Pay Unit

Spray Applied Waterproofing Membrane.....Square Yard

Spray Applied Waterproofing Membrane will be measured based on plan quantity. No compensation will be made to the Contractor for surplus materials. Payment includes all costs associated with testing for moisture and bond and protection for overspray. Payment also includes all labor, material, and equipment necessary to furnish and install joint systems, aggregate courses, and tack coats. Payment also includes all labor and equipment necessary to remove and replace the existing material below the excavation limit on the beam ends per the plans.



# HMA Removal



# HMA Removal





# HMA Removal





# Expansion Joint Removal



# Waterproofing Removal





# Grinding Box Beams





# Grinding Box Beams



# Shot Blasting Box Beams





# Sand Blasting Vertical Surfaces





# Cleaned Box Beams



# Cleaned Box Beams





# Cleaned Box Beams





# Preparation for Primer



# Primer

- Wasser Polyflex 111 PU Primer
- Two-component, 100% solids, polyurethane
- Odorless
- Pinhole and bubble free surface
- Excellent adhesion to blasted steel or concrete
- Applied by brush, roll or spray
- Recommended thickness of 8-10 mils
- Dry to touch in 1 hour

# Applying Primer





# Applying Primer



# Testing Primer





# Testing Primer





# First Coat of Waterproofing

- Wasser Polyflex 311 Membrane
- High performance polyurea coating
- Designed for better leveling and high abrasion resistance
- Seamless and flexible
- Impact, tear and abrasion resistant
- Bridges moving cracks up to 1/8"
- Can be placed back in immersion water service in as little as 24 hours
- Recommended thickness of 30-100 mils
- Gel time of 10-15 seconds
- Tack free in 20-30 seconds

# Applying First Coat



# Applying First Coat





# Applying First Coat



# Second Coat of Waterproofing

- Wasser Polyflex 411 ShearCoat with Aggregate
- High performance, slow setting polyurea membrane
- Slower gel time to allow aggregate to be broadcast
- Seamless flexible membrane
- Can accept asphalt overlays within 1 hour
- Recommended thickness of 30-100 mils
- Gel time of 30 seconds
- Tack free in 5 minutes

# Applying Second Coat





# Applying Second Coat



# Preparing For Tack Coat



# Tack Coat

- Wasser Polyflex 511 Tackcoat
- Hot-applied, asphalt based membrane
- High tack finish
- Easy to apply
- Can accept asphalt overlays within one hour



# Applying Tack Coat



# Tack Coat





# Paving Approaches





# Summary

- Existing HMA and waterproofing membrane removed by scraping with fork lift, manually with jack hammers, milled and shot blasted
- Deck surface was smooth and uniform after the shot blasting with some damage from jack hammers
- D.S. Brown SSA2 expansion joint used with A2R gland
- 8,109 sft of Wasser spray applied waterproofing membrane as described @ \$12.22 per sft
- Approaches paved with 165 #/syd of LVSP (base course), 165 #/syd of 5E1 (top course)
- Deck paved with 220 #/syd of 5E1
- Bridge railing replaced using SP and Special Detail X-31A

# Conclusion

- Coldmilling the HMA was quickest, provided smoothest surface and was least invasive to box beams
- If using roll out membrane, would specify that bridge needs to be milled and shot blasted
- May need to work with coating companies to come up with an acceptable moisture reading and modify spec to be able to use a gauge
- Need to add to spec that sounding needs to be done after final coat
- Unsure on life span but happy with spray applied product installation

Any Questions?

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