DAVID EVANS AND ASSOCIATES INC.

Finding the Right Solution for Two Different Bridges

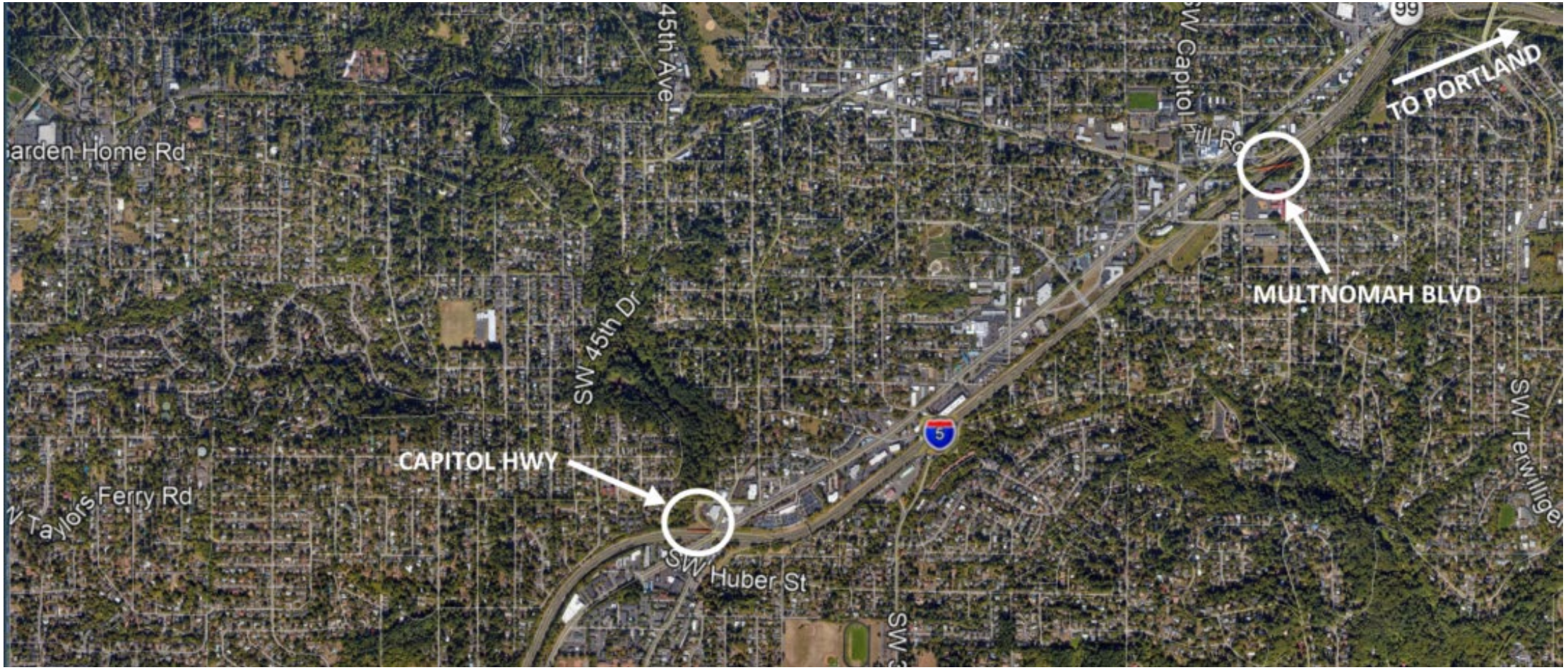
Presented by

Travis Kinney

Overview

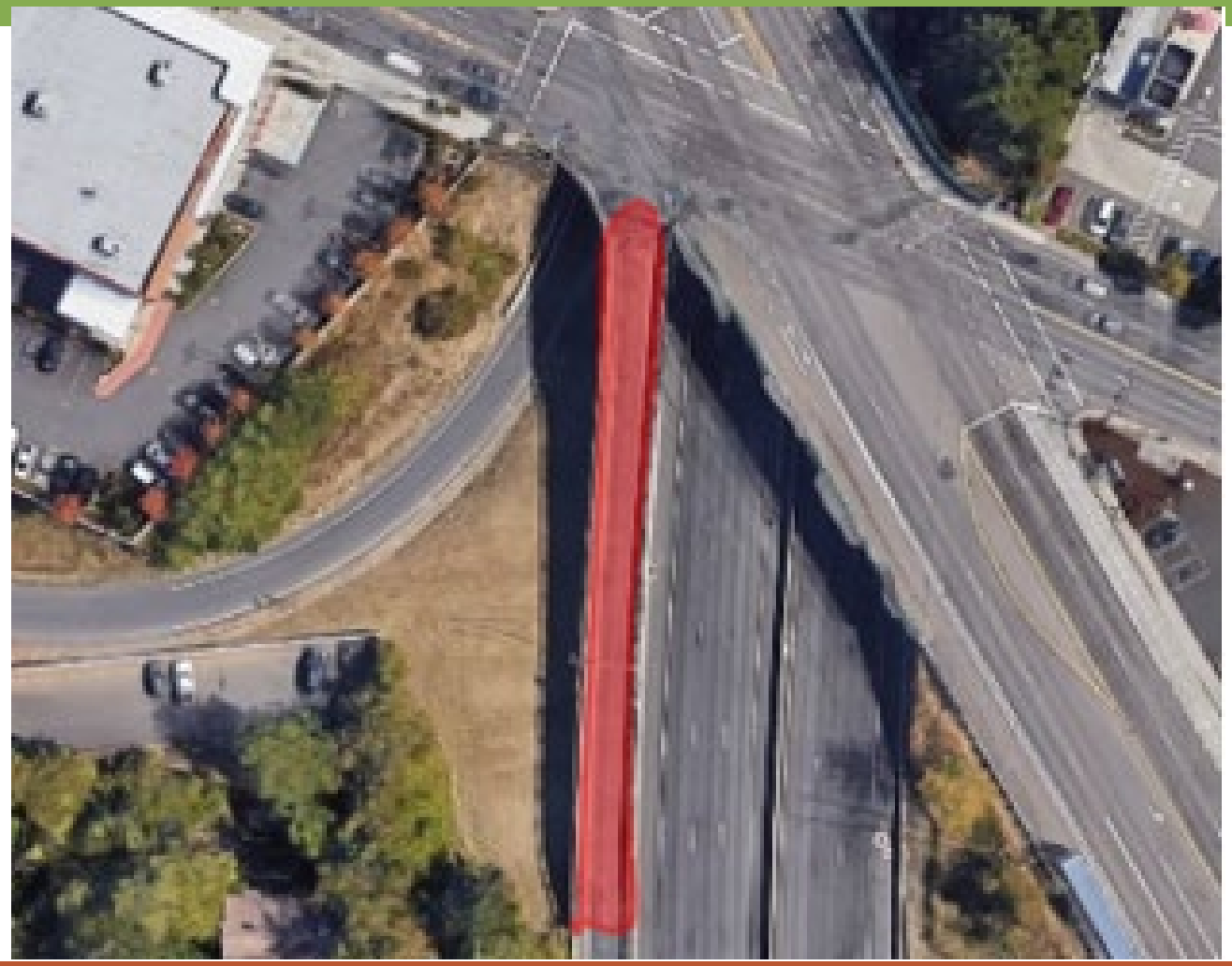
- Bridge Condition and Investigation.
- Deck Rehabilitation Alternatives
- Bridge Rail Retrofit
- Construction Challenges and Lessons Learned

Location Map



Background – Capitol Hwy

- Year of Construction: 1959
- Superstructure: RCDG
- Length: 270 feet
- Roadway Width: 19 feet
- Deck Condition: 5 (Fair)



Deck Condition - Capitol

Element	Structure Unit	Environment	Quantity	Units	CS 1	CS 2	CS 3
16-Re Conc Top Flange	**1**	**3**	**6503**	**(SF)**	**1468**	**2349**	**2686**
1080-Delamination/Spall/Patched Area	1	3	30	(SF)	0	0	30
1090-Exposed Rebar	1	3	204	(SF)	0	200	4
1120-Efflorescence/Rust Staining	1	3	780	(SF)	0	360	420
1130-Cracking (RC and Other)	1	3	4021	(SF)	0	1789	2232

Background – Multnomah Blvd

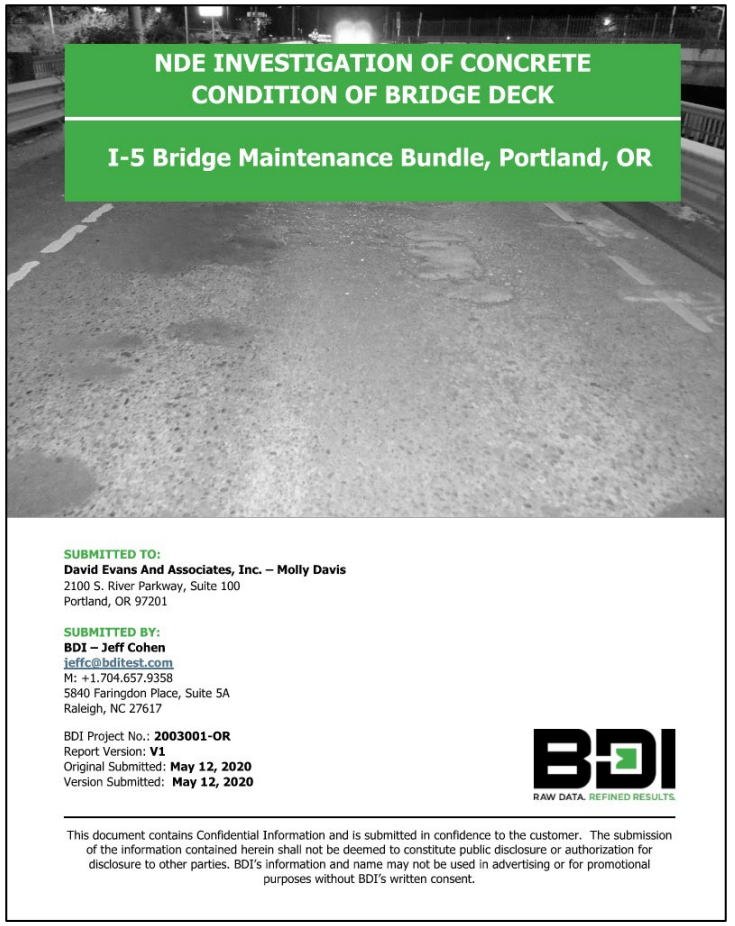
- Year of Construction: 1959
- Superstructure: RCDG and Steel Plate Girders
- Length: 404 feet
- Roadway Width: 30 feet
- Deck Condition: 5 (Fair)

Deck Condition – Multnomah Hwy

Element	Structure Unit	Environment	Quantity	Units	CS 1	CS 2	CS 3	CS 4
12-Re Concrete Deck	**1**	**3**	**9065**	**(SF)**	**4483**	**1533**	**3049**	**0**
1120-Efflorescence/Rust Staining	1	3	520	(SF)	0	493	27	0
1130-Cracking (RC and Other)	1	3	7505	(SF)	4483	0	3022	0
1131-Soffit Cracking (RC, PSC)	1	3	1040	(SF)	0	1040	0	0
521-Conc Prot Coating	1	3	7770	(SF)	7770	0	0	0
16-Re Conc Top Flange	**1**	**3**	**5074**	**(SF)**	**2475**	**820**	**1779**	**0**
1081-Soffit Spalls/Delams/Patches	1	3	2	(SF)	0	1	1	0
1090-Exposed Rebar	1	3	2	(SF)	0	0	2	0
1120-Efflorescence/Rust Staining	1	3	304	(SF)	0	219	85	0
1130-Cracking (RC and Other)	1	3	4166	(SF)	2475	0	1691	0
1131-Soffit Cracking (RC, PSC)	1	3	600	(SF)	0	600	0	0
521-Conc Prot Coating	1	3	4349	(SF)	4349	0	0	0

Deck NDE Testing

- Acoustic Sounding
- Ground Penetrating Radar (GPR)
- Visual Inspection
- Chloride Testing



NDE INVESTIGATION OF CONCRETE CONDITION OF BRIDGE DECK

I-5 Bridge Maintenance Bundle, Portland, OR

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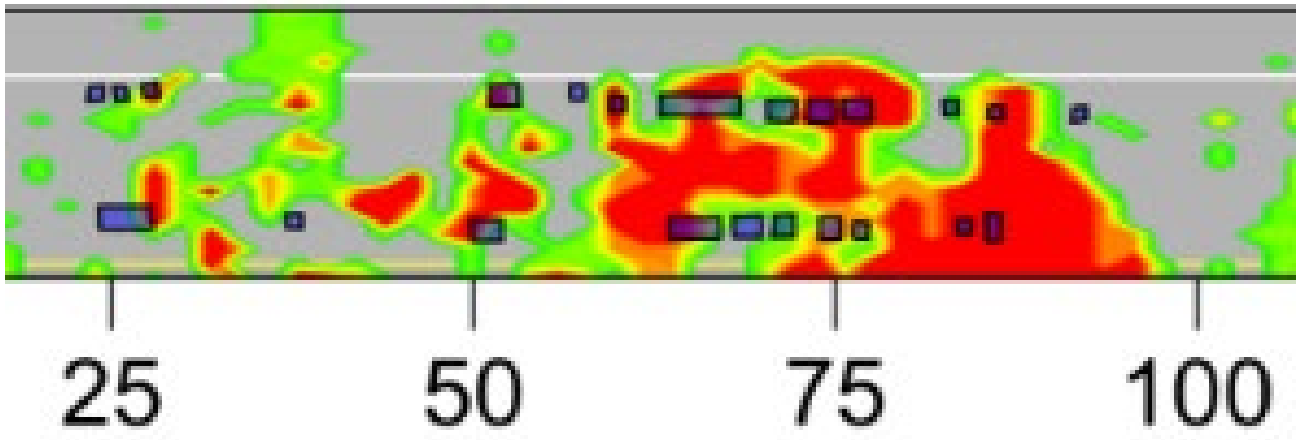
BDI Project No.: **2003001-OR**
Report Version: **V1**
Original Submitted: **May 12, 2020**
Version Submitted: **May 12, 2020**

BDI
RAW DATA. REFINED RESULTS.

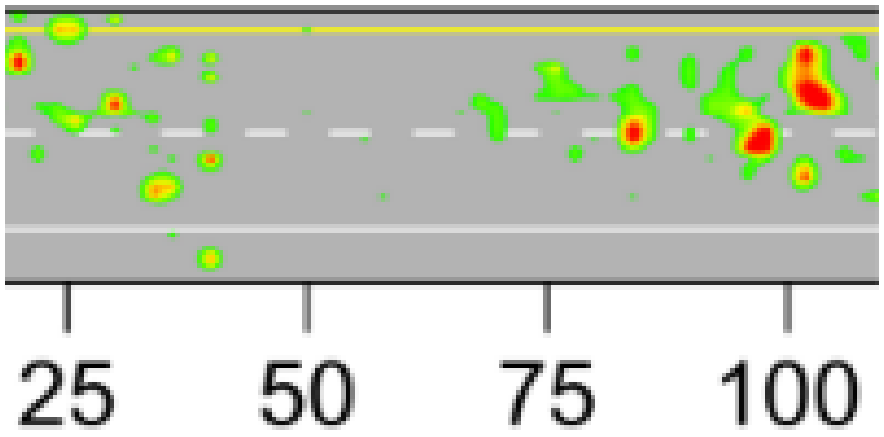
Acoustic Sounding: Capitol

Condition Summary		
Condition	s.f.	%
Severe	243.8	4.7
Poor	347.5	6.7
Fair	1015.8	19.4
Intact	3617.9	69.2



Acoustic Sounding: Multnomah

Condition Summary		
Condition	s.f.	%
Severe	36.5	0.3
Poor	98.4	0.9
Fair	1057.2	9.2
Intact	10293.5	89.6



Chloride Results: Capitol

Table 4. Summary of RCT analysis for Capitol Highway Interchange Bridge Deck

Bridge ID	Test Location	Depth (in)	% Cl- by concrete weight	Cl- (lbs./CY)
08205R	1	1	0.01	0.48
08205R	1	2	0.01	0.51
08205R	1	3	0.01	0.33
08205R	2	1	0.06	2.41
08205R	2	2	0.03	1.12
08205R	2	3	0.02	0.84
08205R	3	1	0.08	3.20
08205R	3	2	0.05	1.98
08205R	3	3	0.02	0.84
08205R	4	1	0.07	2.81
08205R	4	2	0.04	1.65
08205R	4	3	0.01	0.39
08205R	5	1	0.14	5.58
08205R	5	2	0.05	2.14
08205R	5	3	0.02	0.92

Chloride Results: Multnomah

Table 3. Summary of RCT analysis for SW Multnomah Blvd Bridge Deck

Bridge ID	Test Location	Depth (in)	% Cl- by concrete weight	Cl- (lbs./CY)
08437	1	1	0.01	0.49
08437	1	2	0.00	0.18
08437	1	3	0.00	0.02
08437	2	1	0.02	0.97
08437	2	2	0.02	0.80
08437	2	3	0.01	0.24
08437	3	1	0.02	0.73
08437	3	2	0.00	0.19
08437	3	3	0.00	0.02
08437	4	1	0.01	0.60
08437	4	2	0.01	0.29
08437	4	3	0.00	0.11
08437	5	1	0.02	0.76
08437	5	2	0.01	0.27
08437	5	3	0.00	0.11

Deck Condition Summary

Capitol Hwy

- High Chloride Levels
- ~11% of Deck Delaminated
- Significant Deck Cracking

Multnomah

- Acceptable Chloride Levels
- ~1% of Deck Delaminated
- Significant Deck Cracking

Deck Rehabilitation Alternatives

1.9.3.1 Deck Overlays

There are three overlay categories available for use on bridge decks:

- Structural Concrete Overlays, *BDM 1.9.3.1.4*.
- Non-Structural Concrete Overlays – Including Multi-Layer Polymer Concrete Overlay (MPCO) and Premixed Polymer Concrete (PPC), *BDM 1.9.3.1.5*.
- Asphalt Concrete Pavement (ACP), *BDM 1.9.3.1.6*.

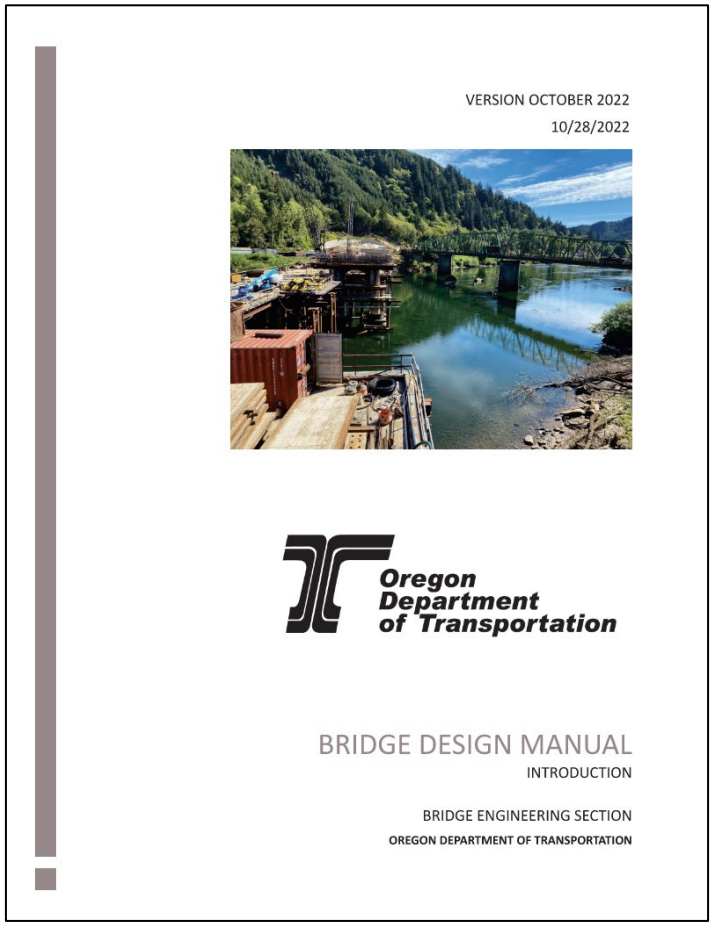


Table 1.9.3.1.2-1 Deck Treatment Warrants Matrix

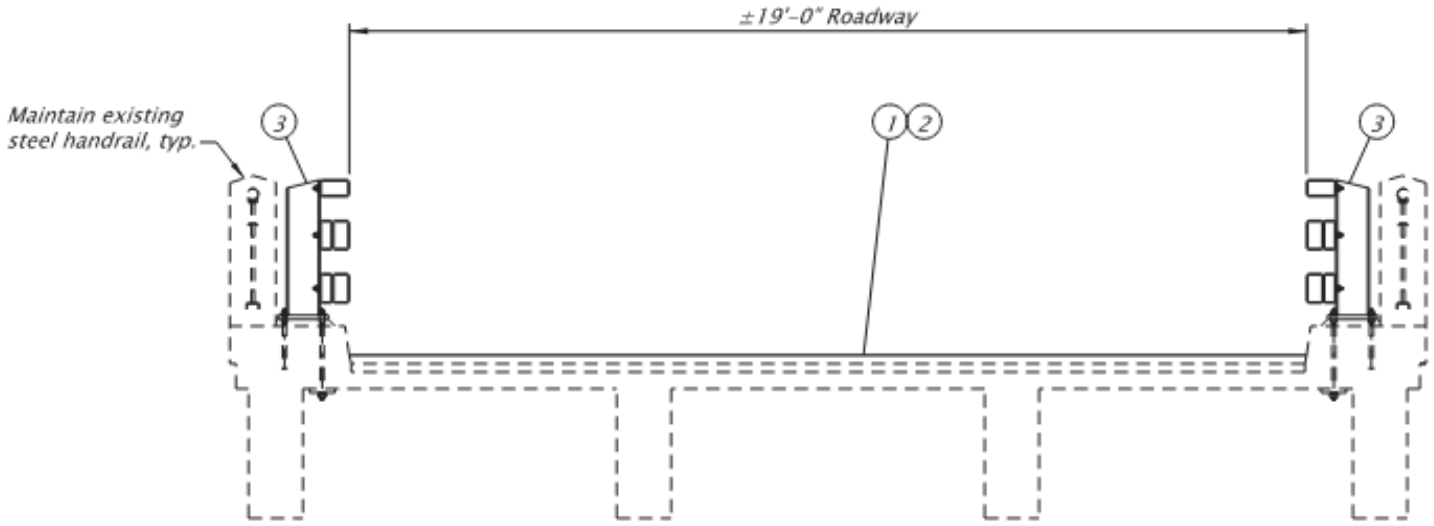
Deck Preservation Action Guidance			MPCO	PPC Overlay	Structural Concrete Overlay (HPC, HESC)	Structural Concrete Inlay (HPC, HESC)	Install New ACP Overlay With Membrane	Remove ACP & Reinstall ACP with Membrane
Primary Factors	1	Inspection Report Item 58 "Deck Condition"	≥ 4	4-6	4-6	-	≥ 4	≥ 4
	2	Elements 12, 13, 15, 16, 38, or 39 defect 1080 "spall/delam/patch" in CS2 or worse	1% ≤ deck area ≤ 5%	1% ≤ deck area ≤ 5%	1% ≤ deck area ≤ 5%	*requires thorough investigation per *BDM 1.9.3.1.1*	-	1% ≤ deck area ≤ 5%
	3	Area identified by delamination survey for class 2 prep (must be less than 2 years old)	deck area ≤ 10% - YES	deck area ≤ 10% - YES	deck area ≤ 15% - YES	*requires thorough investigation per *BDM 1.9.3.1.1*	-	-
	4	Chloride threshold (* chloride data required) (ǂ chloride data suggested)	< 0.04 % by mass of sample at shallowest rebar *	< 0.04 % by mass of sample at shallowest rebar *	< 0.04 % by mass of sample at shallowest rebar *	Remove concrete contaminated beyond 0.04% by mass of sample.*	< 0.04 % by mass of sample at shallowest rebar ǂ	< 0.04 % by mass of sample at shallowest rebar ǂ
	5	Roadway classification	Limited use on Interstates	Any	Any	Any	Acceptable in Region 4	Any

Table 1.9.3.1.2-3 Deck Treatment Material Characteristics Matrix

			MPCO	PPC Overlay	Structural Concrete Overlay (HPC, HESC)	Structural Concrete Inlay (HPC, HESC)	Install New ACP Overlay with Membrane	Remove ACP & Reinstall ACP with Membrane
Secondary Factors	**Material Characteristics**	Minimum thickness (inch)	3/8	¾	≥ 2 minimum	≥ 2 minimum	≥ 2 Varies by membrane type	≥ 2 Varies by membrane type
		Cure time	2-6 hours temperature dependent	2-4 hours temperature dependent	HPC- 7 days HESC- 3 hours	HPC - 7 days HESC - 3 hours	2-6 hours (polymer membrane)	2-6 hours (polymer membrane)
		Minimum closure width	Can be done in single lane phases, placing longitudinal joints on the lane lines.	14 feet for slipform 6 feet for roller screed	16 feet for Deck Finishing Machine 6 feet for roller screed	16 feet for Deck Finishing Machine 6 feet for roller screed	16 feet *can be reduced with extra labor	16 feet *can be reduced with extra labor
		Atmospheric restrictions (degrees F when applicable) Amb. – Ambient temperature Surf. – Surface temperature	visibly dry for ≥ 72 hours 50 ≤ temp ≤ 90 deck temp ≥ dew point+5 No rain	Visibly dry for ≥ 5 days 50 ≤ temp ≤ 90 deck temp ≥ dew point+5 No rain forecasted for 12 hours	40 ≤ Surf. rising ≤ 45 40 ≤ temp ≤ 80	40 ≤ Surf. rising ≤ 45 40 ≤ temp ≤ 80	Varies by membrane type as specified in the specification.	Varies by membrane type as specified in the specification.

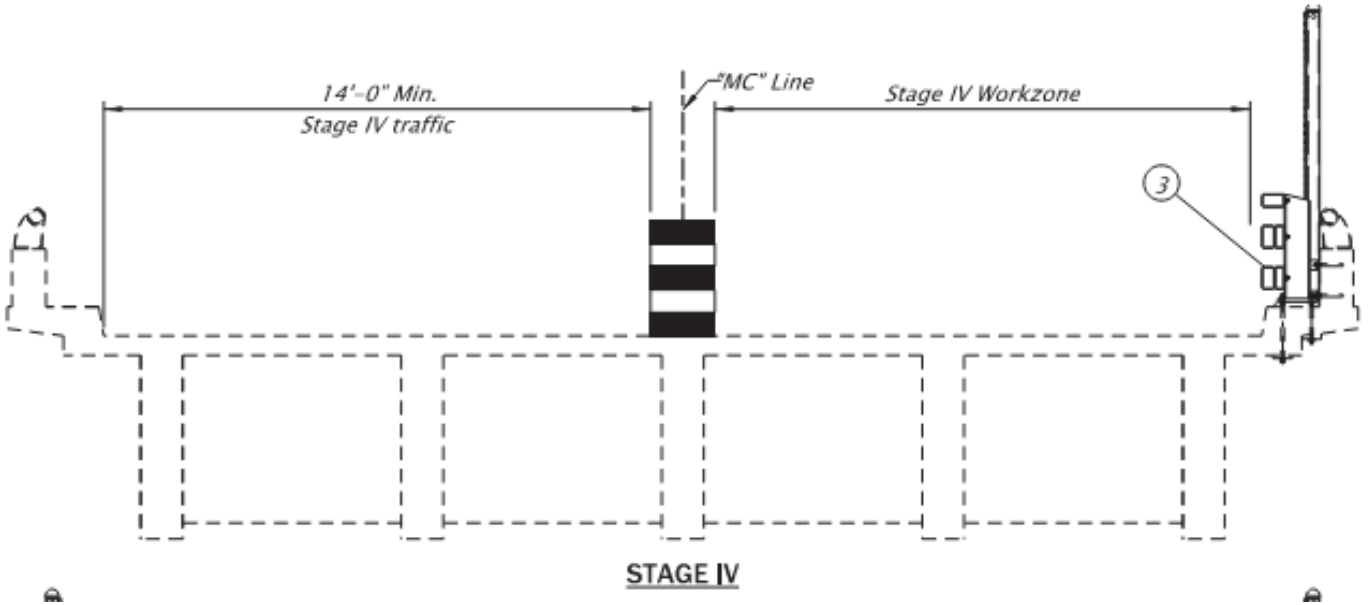
Construction Staging: Capitol

- Narrow Roadway
- High Traffic Volumes
- Plan A
  - Limit closure with High Early Strength Concrete
- Plan B
  - Longer closure with HPC overlay.



Construction Staging: Multnomah

- Staged Construction?
  - 15’ construction, 2’ rail/bidwell, 2’traffic safety devices, 11’ travel lane
- High Traffic Volumes



Deck Recommendations: Capitol

- Preparation: Deep Hydrodemolition

- Overlay: HPC Overlay

Deck Recommendations: Hawthorne

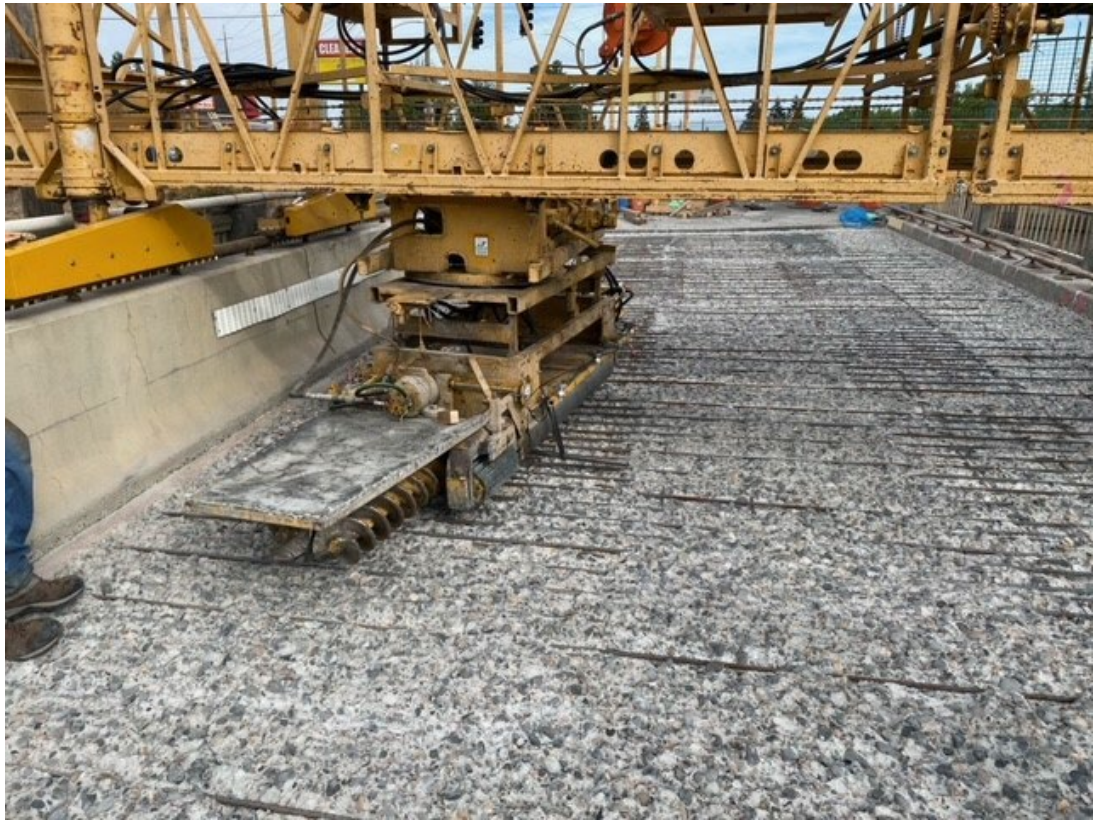
- Preparation: Class II Repairs

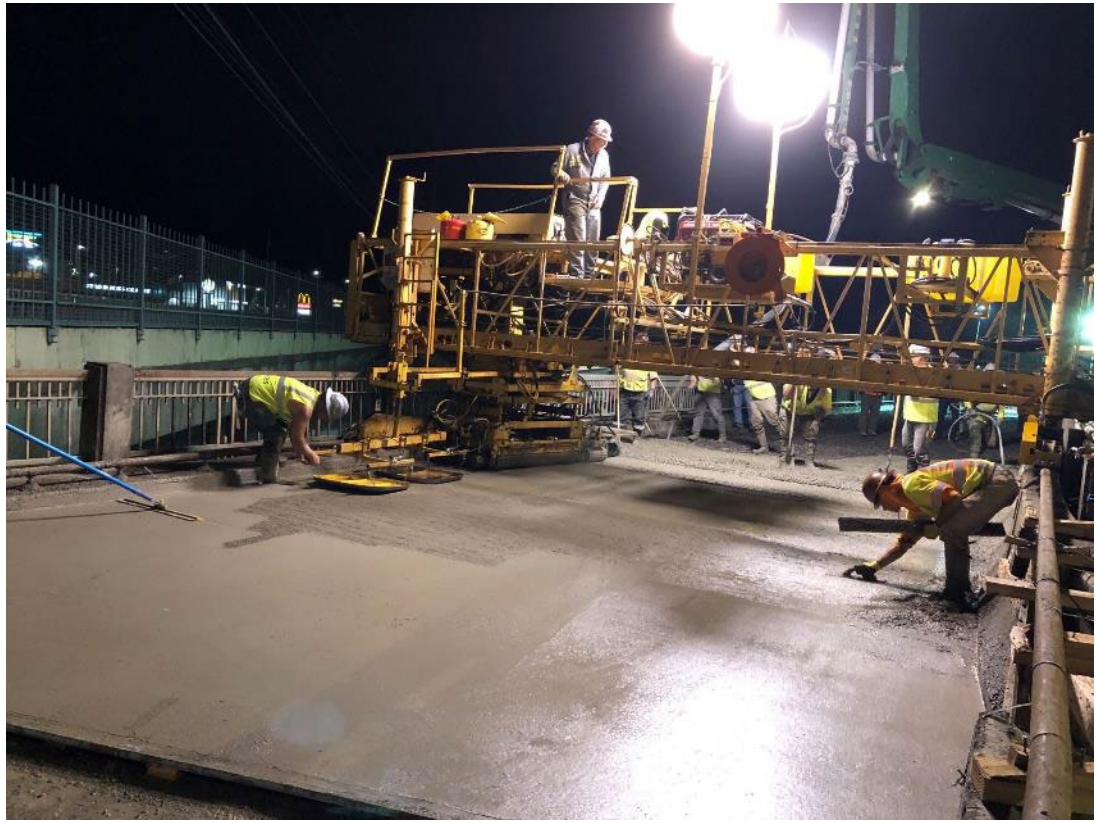
- Overlay: High Early Strength Concrete

Capitol: Hydrodemolition

Capitol: Hydrodemolition

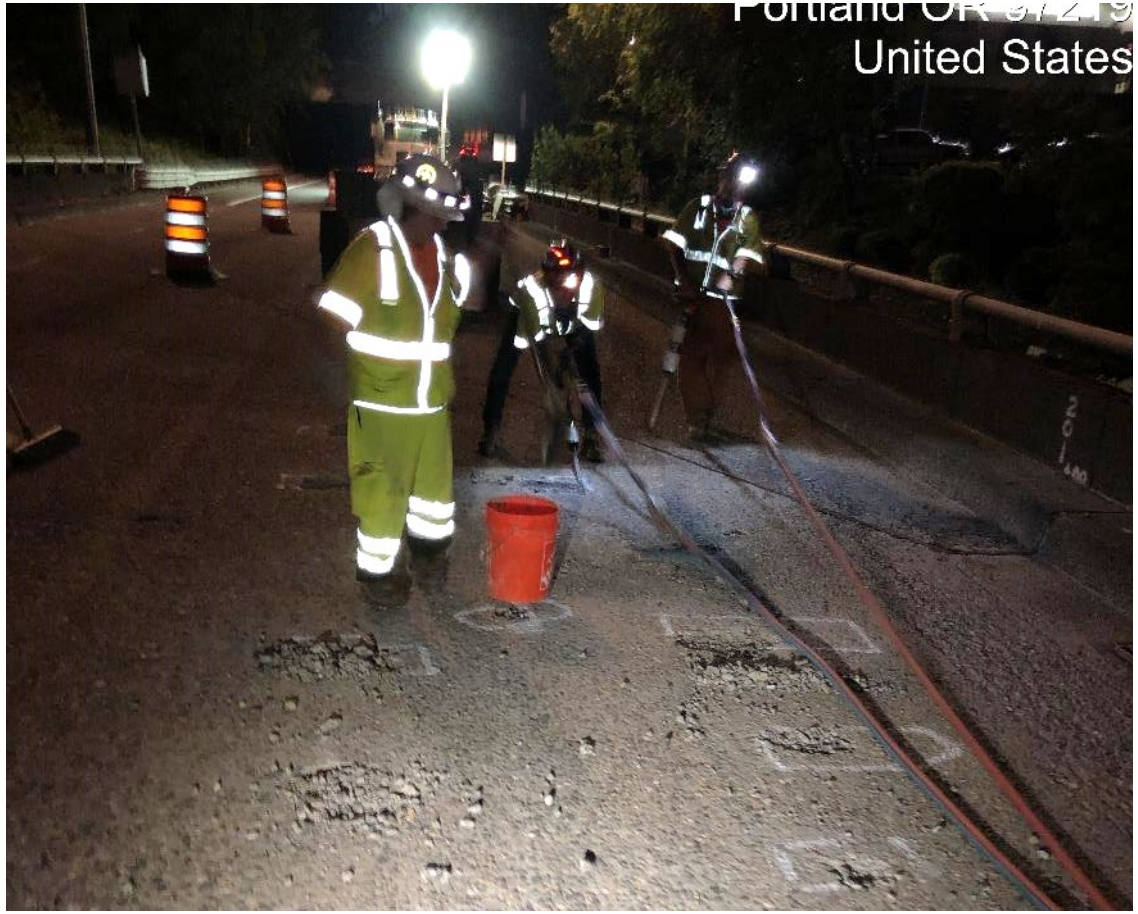
Capitol: Deck Overlay Construction





Capitol: Finished Product

Multnomah: Class II Deck Preparation



Multnomah Deck Prep and Placement


United States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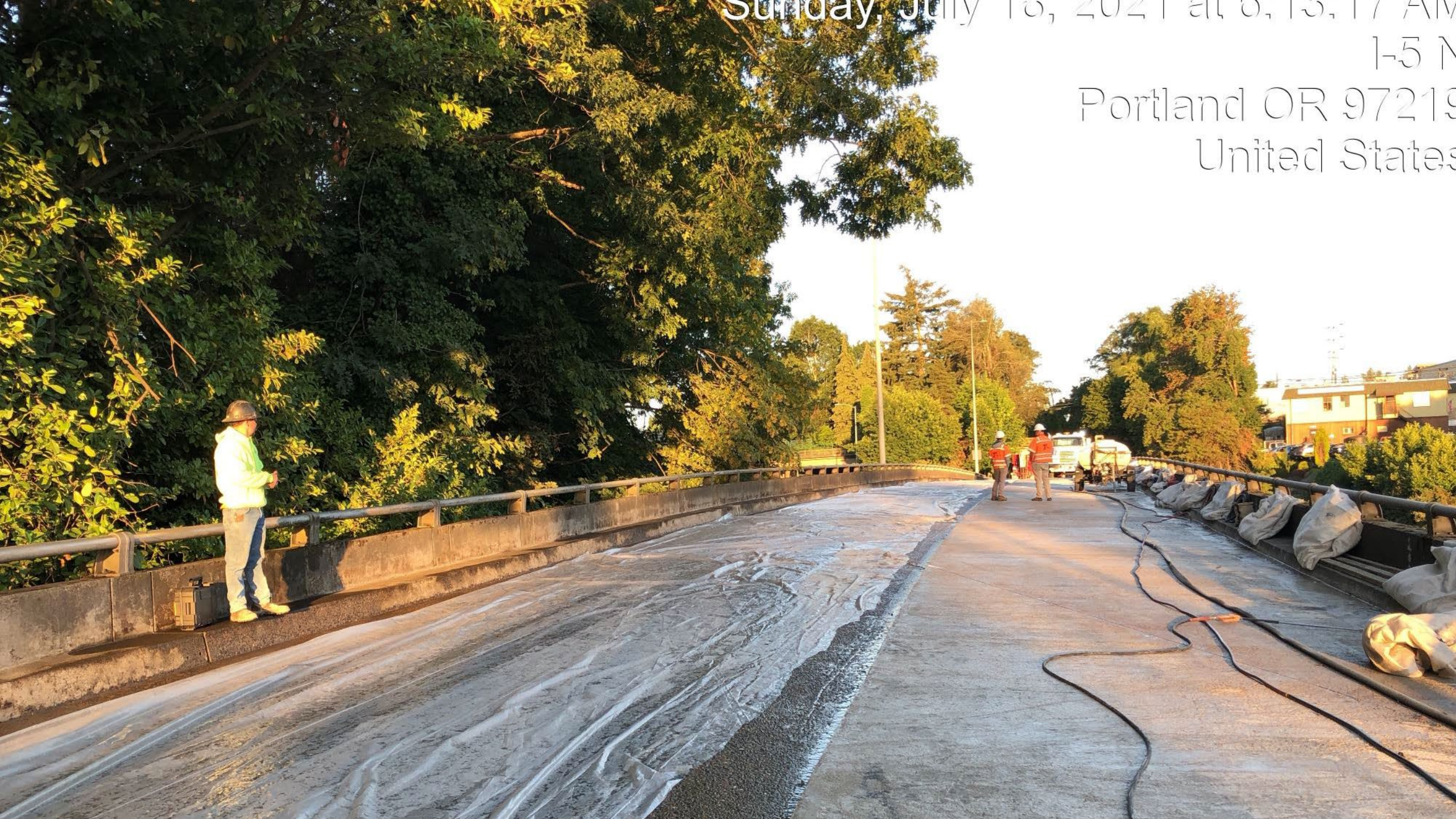
I-5 N
Portland OR 97219
United States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United States

Multnomah: Finished Product

Questions:

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