

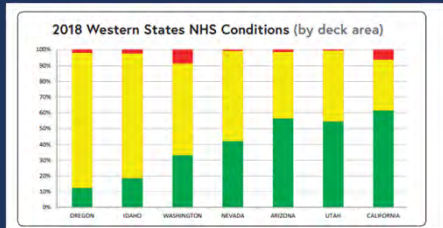
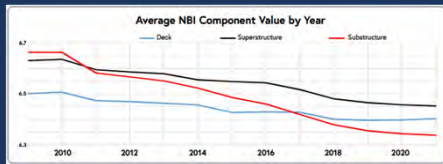
High Early Strength Concrete Overlays: Oregon's Approach

David Dobson, PE
Statewide Structural Materials Engineer
ODOT Structure Services

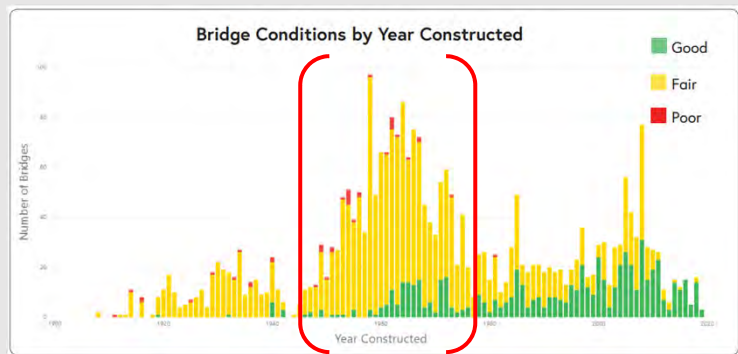
National Concrete Consortium
September 12th - 14th



Aging Infrastructure



ODOT Bridge Condition Report



1950s - 1970s

Large number of structures 50 - 70 years old, in fair condition

National Research - Decks

National Concrete Pavement Technology Center –
Concrete Infrastructure Research Database



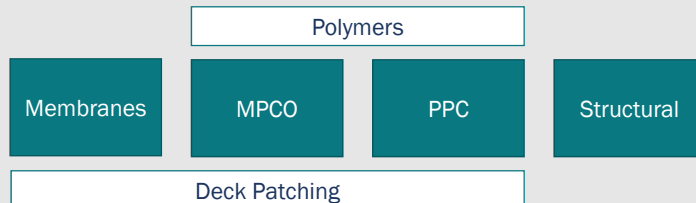
End Date	Title	End Date	Title	End Date	Title
July 2025	Performance Evaluation of Polyester Polymer Concrete Overlays Continuation Proposal—Phase II (TR-772)	October 2022	Investigating Thermal Imaging Technologies and Unmanned Aerial Vehicles to Improve Bridge Inspections	March 2021	Reducing Shrinkage in Concrete Bridge Decks Using Single- and Double-Ring Test Methods
December 2024	Low-Shrinkage Concrete Mixtures for Arkansas	September 2022	Repair or Strengthening of Bridge Decks with Partial-Depth Precast Deck Panels	February 2021	Evaluation of Ultra-High-Performance Concrete for Use in Bridge Connections and Repair
August 2024	Concrete Mix Designs for Partial-Depth Link Slabs and Deck Extension	September 2022	Sustainable nHPC Mixtures for Durable Overlay of Concrete Bridge Decks in Cold Regions: Proof of Concept	December 2020	Service Life Design Guidance For UHPC Link Slabs
May 2024	Real-Time Monitoring of Concrete Strength to Determine Optimal Traffic Opening Time	July 2022	Reducing Shrinkage Cracking in Bridge Decks Using the Single- and Double-Ring Test Methods	December 2020	Deep Learning Models for Bridge Deck Evaluation Using Impact Echo
December 2023	Fiber-Reinforced Concrete Overlays for Bridge Structures	June 2022	Fiber Reinforced Concrete for Bridge Decks and Overlays	December 2020	Bridge Decks: Mitigation of Cracking and Increased Durability—Materials Solution (Phase III)
December 2023	Alternative High Early Strength Concrete (HESC) Structural Overlays	June 2022	Develop an Innovative Self-Healing Concrete Technology for Bridge Deck Life Extension	December 2020	Bridge Decks: Mitigation of Cracking and Increased Durability—Phase III
September 2023	Enhancing the Durability of Bridge Decks by Incorporating Microencapsulated Phase Change Materials (PCMs) in Concrete	May 2022	Field Demonstration of GPR and UAV Technologies for Evaluation of Missouri River Bridge	November 2020	Review of Ultra-High Performance Concrete and Its Application in Bridge Engineering
August 2023	Use of Sand Lightweight Concrete and All Lightweight Concrete to Improve Properties	May 2022	UHPC Thin Bonded Overlay on Deteriorated Bridge Decks	November 2020	International Perspective on UHPC in Bridge Engineering
May 2023	Low-Cement Concrete Mixture for Bridge Decks and Rails	May 2022	Optimal Approach for Addressing Reinforcement Corrosion for Concrete Bridge Decks in Illinois	August 2020	Prototype System for Implementing the Ultrasonic Guided Wave Method on the Field
April 2023	Performance of Cost-Effective Non-Proprietary UHPC in Thin Bonded Bridge Overlay	December 2021	Effects of Concrete Cure Time on Epoxy Overlay and Sealant Performance	August 2020	Effect of Low Shrinkage Mix Designs to Reduce Early Cracking of Bridge Decks
March 2023	Evaluation of Thin Polymer Overlays for Bridge Decks	November 2021	Ultra-High-Performance Concrete (UHPC) Used as a High Friction Surface Treatment (HFST) on Pavements and Bridges	May 2020	Field Performance of Low-Cracking Concretes for the Closure Pours and Overlays of Bridge Decks
February 2023	Investigation and Assessment of Effective Patching Materials for Concrete Bridge Decks	July 2021	Fiber Reinforcement for Latex-Modified Concrete Overlays	April 2020	Optimizing Field Data Collection & Developing Advanced GPR Processing Modules
February 2023	Alternative Supplementary Cementitious Materials in Ultra-High Performance Concrete	June 2021	Evaluation of Chemical Solutions to Concrete Durability Problems	April 2020	Application of Internal Curing to Improve Concrete Bridge Deck Performance
November 2022	SPR-4526: Predictive Analytics for Quantifying the Long-Term Cost of Defects During Bridge Construction	April 2021	Evaluation of Trigger Temperature for Concrete Pavement Growth Based on Joint Movement Data	March 2020	Time-Lapse Infrared Thermography Applied to Concrete Bridge Deck Inspection Surveys

Bridge Deck Maintenance



Material Selection

- Bridge Needs and Service Life
- Project Scope, Budget, and Traffic Control
- Material Limitations



McKenzie River Highway



Photo Credit
Travel Oregon - Left
18590OregonMagazine, Mike Putnam - Center
18590OregonMagazine, Greg Vaughn - Right



2012

40 years old

Fish Hole Bridge
Br No. 13570
Constructed 1972
McKenzie River Hwy
Blue River, OR

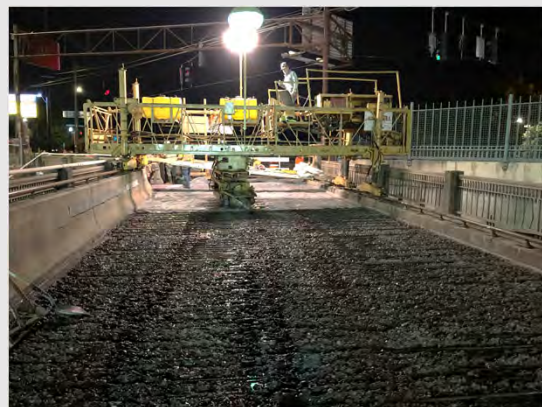






Structural Overlay

- Need a structural overlay solution
- With or without hydrodemolition
- Standard High Performance Concrete – HPC4500 – $\frac{3}{4}$ "
- 7 day wet cure = long closures
- Temp detour bridges and cross-overs are expensive,
 - Narrow bridges, adjacent traffic concerns



HESC Mix Design

- No existing LMC program

Nation's Mini-Mix & CTS Cement

- CSA cement
- 3/4" aggregate
- Macro fibers hand broadcasted into mix
- CTS Low-P admixture, permeability reduction
- Air entrained – but problematic
- <1,000 coulombs permeability
- <0.045% shrinkage

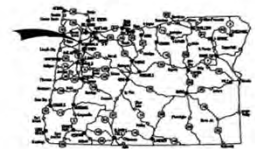


STRUCTURAL CONCRETE MIX DESIGN REVIEW						
Mix Design by: 1	Contractor Mix Design No.:			55/45		
Cement Manufacturer	Source	Type	(Lbs/CY)			
CTS	Rapid Set		658			
SCM Manufacturer	Source	Type				
Slump (Inches)	Coarse Agg Source	GSSD	Abs	DRUW	Coarse Agg Size	
5.5	20-232-3	2.69	2.0%	100.5	3/4" - #4	1623
Air Content (%)						
3.5						
Density (lb/ft ³)	Fine Agg Source	GSSD	Abs	FM	Fine Agg Size	
142.8	20-232-3	2.57	4.0%	2.81	#4 - 0	1265
W/C Ratio						
0.46						
				Water Source	City	280
Admixture Brand/Product:	Type	Dosage				
	Air-Entraining	oz/yd ³				
	WRA, High Range	oz/yd ³				
	Specific Performance	oz/yd ³				
	Retarding	oz/yd ³				
	Fibers	lbs/yd ³				

INDEX OF SHEETS	
SHEET NO.	DESCRIPTION
A01	Title Sheet
A02 - A06	Index Of Sheets Cont. & Std. Draw Nos.
B01 - B19	Detour Route / Traffic Control/TPAR
C01	Bridge Approach Paving Detail
D01 - D02	Bridge Work

STATE OF OREGON
DEPARTMENT OF TRANSPORTATION
PLANS FOR PROPOSED PROJECT

BRIDGE WORK
**OR18: YAMHILL RIVER BRIDGE
OFLOW DECK REHAB**
SALMON RIVER HIGHWAY
YAMHILL COUNTY
APRIL 2020



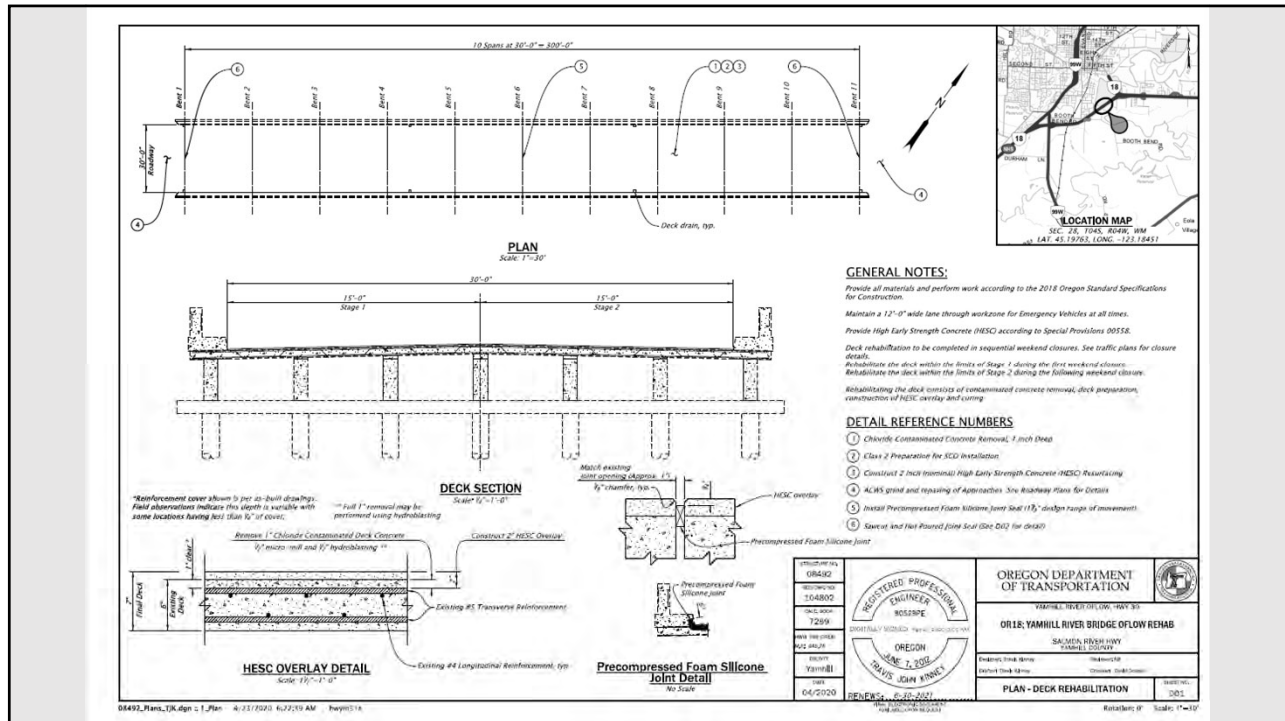
ATTENTION:
Oregon Law Requires You To Follow Rules
Adopted by The Oregon Utility Notification
Center. Those Rules Are Set Forth In
OAR 912-001-0010 Through OAR 912-001-0090.
You May Obtain Copies Of The Rules By Calling
The Center. Use: The Telephone Number For
The Oregon Utility Center Is (503) 232-1987.



T. 7 S., R. 4 W., W.M.



OR18 YAMHILL RIVER BRIDGE OFLOW DECK REHAB SALMON RIVER HWY. NO. 039 YAMHILL COUNTY		
FEDERAL HIGHWAY ADMINISTRATION	PROJECT NUMBER	SHEET NO.
OREGON DIVISION		A01



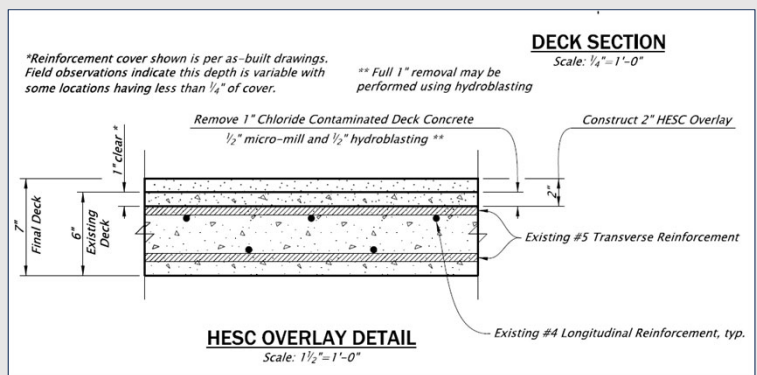
Project Details

Traffic Control

Two weekend full closures
 Single lane work zone

Quantities

1000 sqyd deck area
 56 cuyd HESC





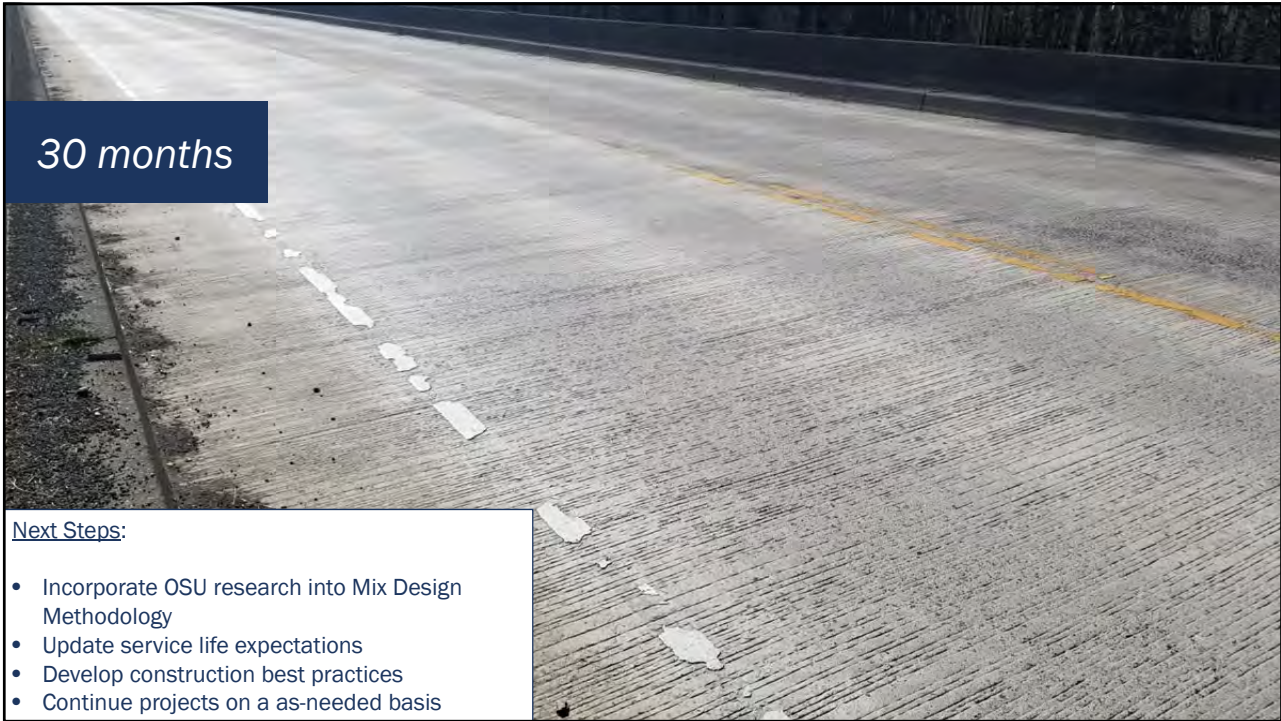






Acceptance Criteria:

- 175 psi bond strength
- 4000 psi compressive strength
- ¼" over 12' straightedge



30 months

Next Steps:

- Incorporate OSU research into Mix Design Methodology
- Update service life expectations
- Develop construction best practices
- Continue projects on a as-needed basis

Discussion

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