

**Federal Highway Administration
Infrastructure Research &
Development**
Presented to the
**Research & Technology Coordinating
Committee**
May, 2019

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Director, Infrastructure Research & Development



Our Staff

- 36 Federal Highway Administration Staff
- 64 Onsite Support Contract Personnel
- 6 Post-Doctoral Fellows

(Plus...)



10 Laboratories



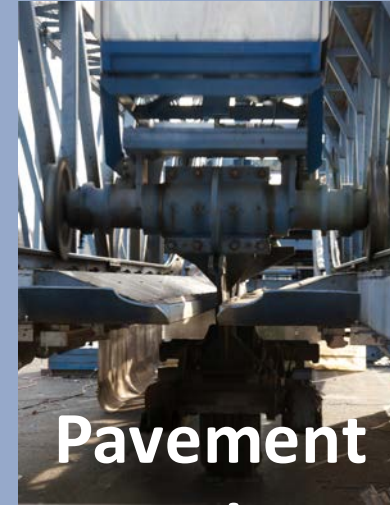
Chemistry



Asphalt



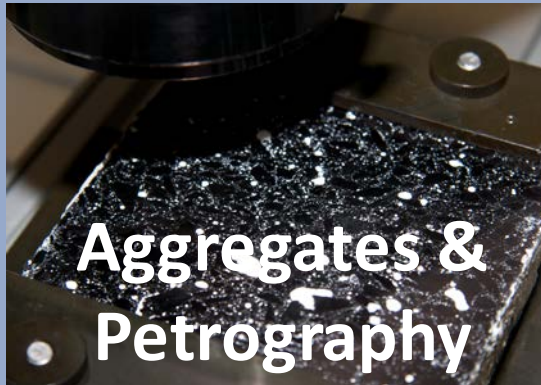
Corrosion



**Pavement
Testing**



Structures



**Aggregates &
Petrography**



Concrete

Geotech



NDE



Hydraulics

All Photos: FHWA



What We Do

- **Research & Development (R&D)**
 - Intramural & Extramural
- **Expert Technical Assistance**
- **Implementation/Deployment Support**



Our Niche

Needs of national importance that cannot or will not be effectively addressed by others.

- Unique expertise/capabilities
- Need for sustained effort
- Nationwide scope
- Urgency
- ...



Strategic Direction

Safety

Infrastructure

Innovation

Accountability



https://www.fhwa.dot.gov/policy/strategicplan/pdfs/FHWA_StrategicPlan_2019-22.pdf

Program Organization

- Construction & Project Management
- Geotechnical
- Hydraulics
- Long Term Infrastructure Performance
- Pavements & Materials
- Structures
- Transportation Performance Management
(including Asset Management & Maintenance)



Relevant US DOT RD&T Topics & Focus Areas

- Automation (Safety Goal)
 - Automated Driving Systems
 - Unmanned Aerial Systems
- **State of Good Repair (Infrastructure Goal)**
 - **Advanced Materials, Designs & Technologies**
 - **Risk-Based Asset Management**
 - **Infrastructure System Resilience**



FOCUS AREA: Automated Driving Systems

Infrastructure Impacts of Autonomous Vehicles

How might AVs impact:

- Current assets?
- Design of new infrastructure?



FOCUS AREA: Unmanned Aerial Systems:

Collection, Analysis and Interpretation of Data Obtained from Unmanned Aerial Systems for Bridges



Focus Area: Advanced Materials, Designs & Technologies

- Bridges
 - Ultra High Performance Concrete
 - Light Weight Concrete
 - Steel Bridge Design
 - Corrosion
 - GRS-IBS
- Pavements
 - Performance Engineered Concrete Mixtures
 - ASR Test Methods
 - Asphalt Materials
 - Performance-Related Specifications
- BIM



Ultra High Performance Concrete

How can we take advantage of UHPC properties to address long-standing bridge engineering challenges?

- Design
- Construction
- Maintenance
- Preservation



Source: FHWA



Lightweight Concrete

Addressed key limitations in specifications to enable use of lightweight concrete to construct lighter, longer, and shallower structures without sacrificing performance.



Steel Bridge Design

Improve design standards to improve efficiency, reduce cost, and fill gaps in existing standards

- Gusset plate design
- Shear stud spacing
- Simplified design for bolted field splice

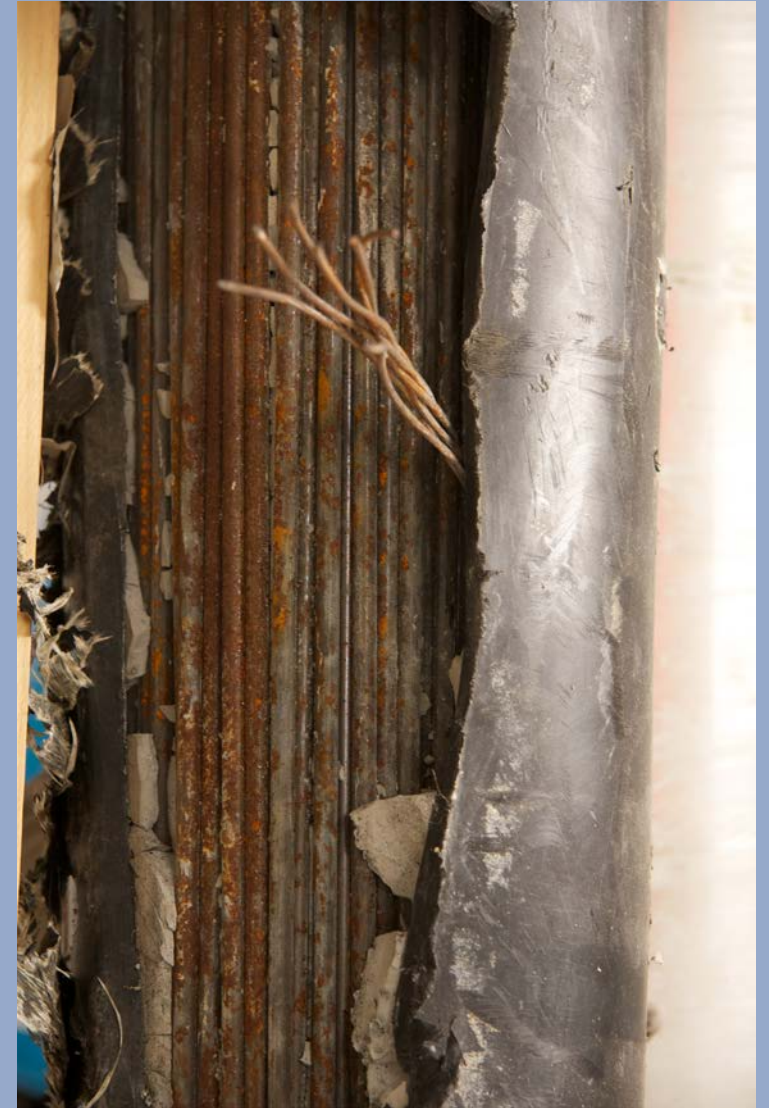


Source: FHWA



Corrosion

- Congressionally-mandated studies
 - Corrosion Prevention & Mitigation Best Practices
 - Worker Certifications
- Stress Corrosion Cracking Potential of Stainless Steel Rebar
- Post-Tensioning



Source: FHWA

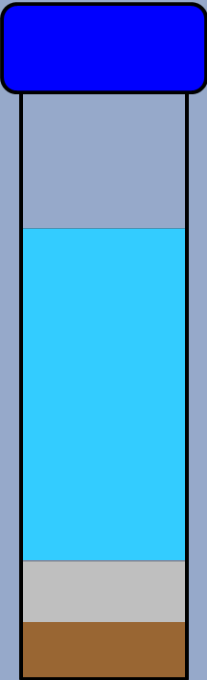


Geosynthetic Reinforced Soil – Integrated Bridge Systems



Performance Engineered Concrete Mixtures

- Rapid ASR Test Method



CONCRETE MIX DESIGN SUMMARY - FLEXURAL STRENGTH CRITERIA

Project number	18.035, Interstate Highway Construction, Inc. (IHC)	Date performed	July 27, 2018
Project name	DEN - Airfield Projects	Report date	August 24, 2018
Lab ID number	F184617	Technician	B. Radovich
Concrete mix design by	Cesare, Inc.	Reviewer	R. Zoetewey
Client mix design ID	2018.07 - 6.75		
Lab batch size (ft³)	7.5		
Description	P-501 -Holcim Mix: 6.75 sack 0.42 w:cm		
Client	Interstate Highway Construction		

Design				Physical Properties		
Material	Source and Type	Specific Gravity	Batch Weights (yd³)	As Tested by Cesare		
				Test	Result	Spec.
Cement (ASTM C1157)	Holcim, Portland - Type I/II LA	3.15	508 lb	Slump (in)	2	1 to 2
Fly ash (ASTM C618)	Boral, Craig - Class F (20%)	2.24	127 lb	Air Content (%)	6.7	4 to 7
Fly ash (ASTM C618)	--	--	0 lb	Mix Temp. (°F)	76	50 to 90
*Coarse aggregate #1 (ASTM C33)	--	--	0 lb	Air Temp. (°F)	78	N/S
*Coarse aggregate #2 (ASTM C33)	Albert Frei & Sons - Pit #6, ASTM Size #67 Coarse Aggregate (63%)	2.79	1893 lb	Unit Weight (pcf)	144.6	N/S
*Intermediate aggregate (ASTM C33)	--		0 lb	Yield, CF/CY	27.0	N/S
*Fine aggregate (ASTM C33)	L.G. Everist - Fort Lupton Pit, Washed Concrete Sand (37%)	2.61	1112 lb	Relative Yield	1.00	0.99 - 1.02
Water	Municipal	1.00	266.5 lb	w/(c+p) Ratio	0.42	≤ 0.45
Air entraining agent (ASTM C260)	Euclid Chemical AEA-92 (0.3oz/100lb cwt)	n/a	3.2 oz	Aggregate Absorptions (%)		
Water reducer (ASTM C494) Type A	Euclid Chemical X15 (1.1oz/100lb cwt)	n/a	19.0 oz	Coarse Aggregate #1		0.0
Target air content (%)	6.0	--	--	Coarse Aggregate #2		0.8
*Aggregate mass determined at SSD condition		Total:	3907 lb	Intermediate Aggregate		0.0
		N/S = Not Specified		Fine Aggregate		0.8
				Combined Absorption (%)		0.80
Flexural Strength Data				1,000		
Date	Test Age	Strength	Average	Spec		

Source: FHWA

Asphalt Materials Research

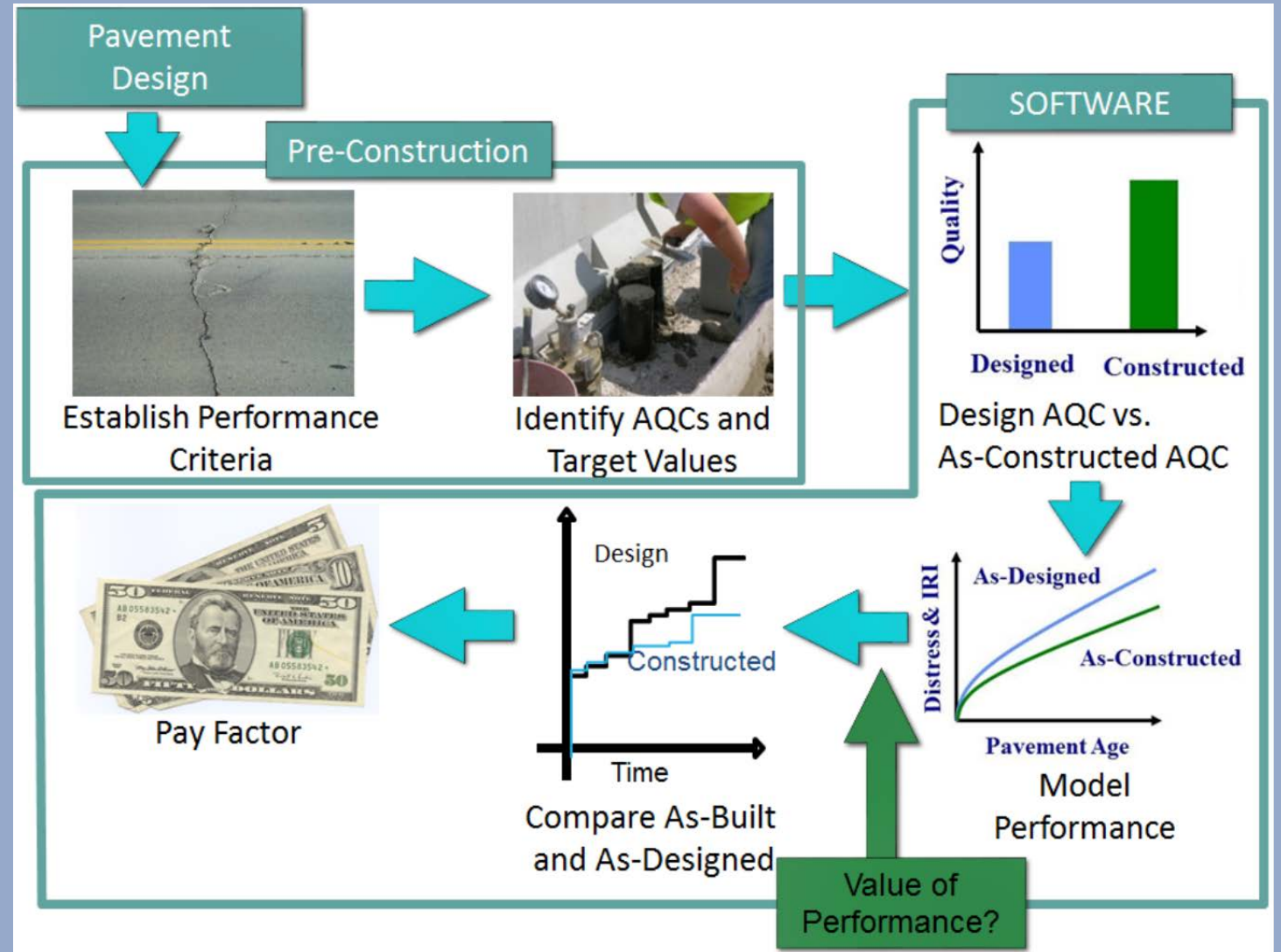
- RAP & RAS
- REOB
- Improved Binder Specification
- Density
- Performance Test



Source: FHWA



Performance-Related Specifications



Building Information Modeling



Source: FHWA

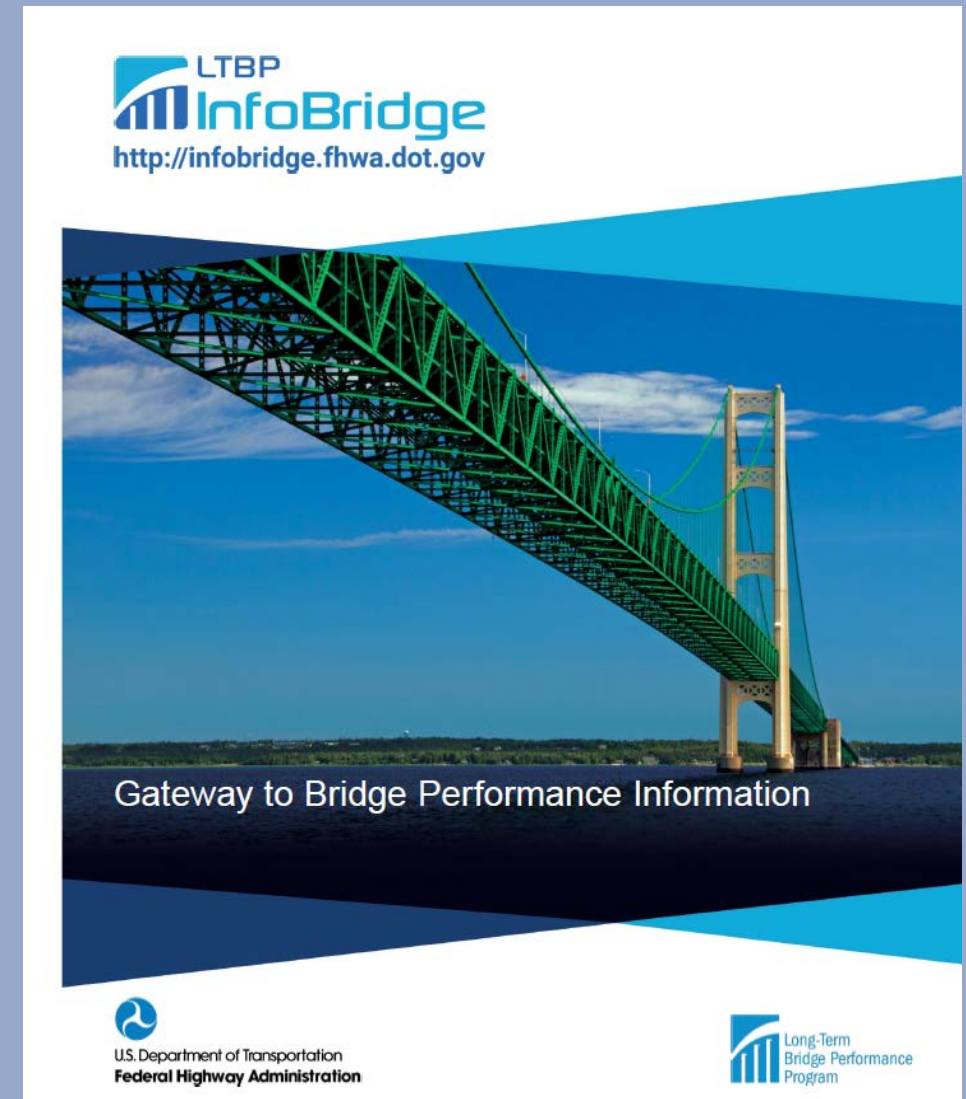
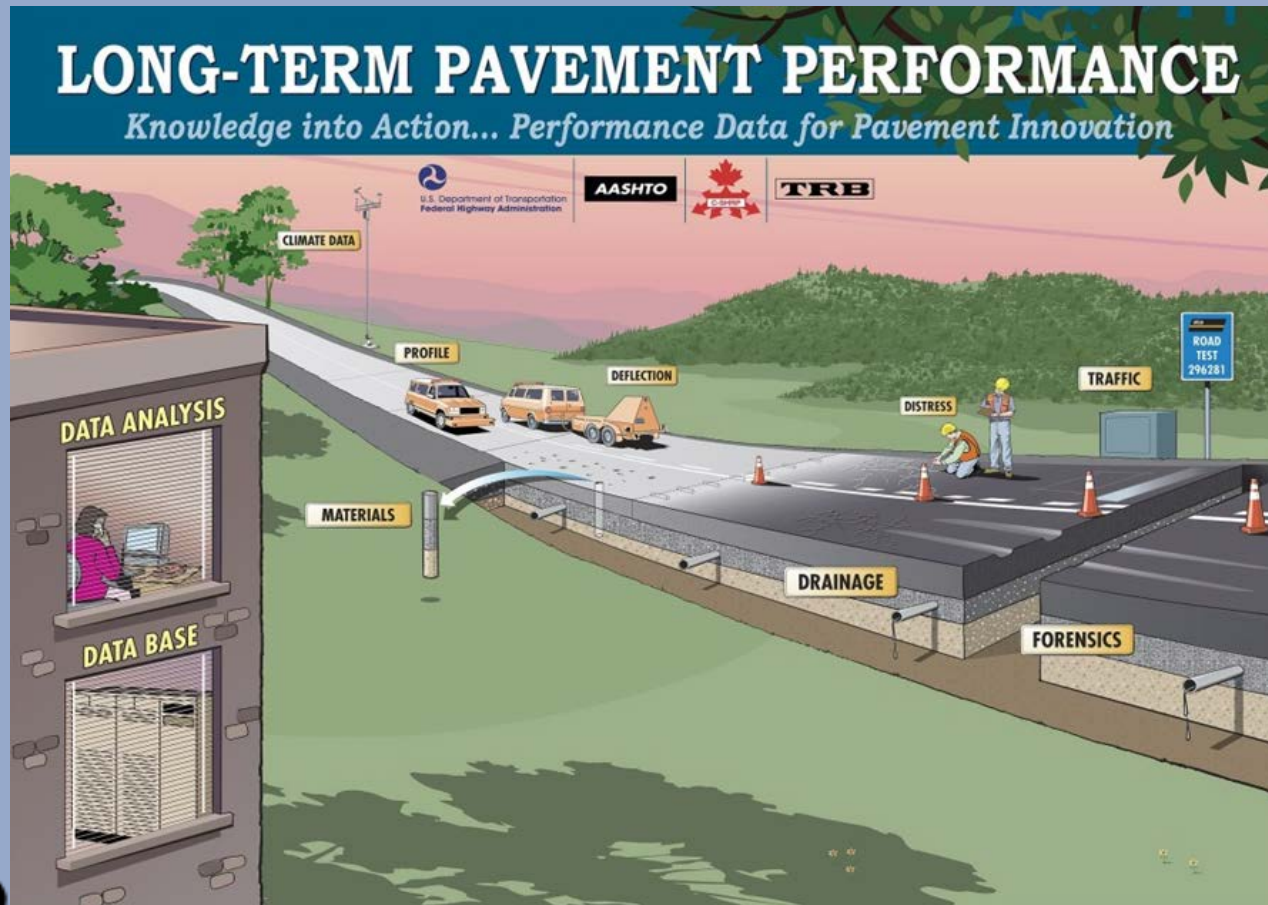


Focus Area: Risk-Based Asset Management

- Long Term Infrastructure Performance
- Geotechnical Performance Measures and Risk Management
- Continuous Friction Measurement
- Next Generation Performance Measures



Long Term Infrastructure Performance



Graphics: FHWA

Geotechnical Performance Measures and Risk Management

- Meaningful measures
- Risk management frameworks
- Quantify asset life-cycle

	Unlikely	Possible	Likely	Almost Certain
Catastrophic				
Major				
Moderate				
Minor				
Insignificant/ Neutral				



Friction Management

- Research (FHWA)
- Deployment (TPF-5(345))

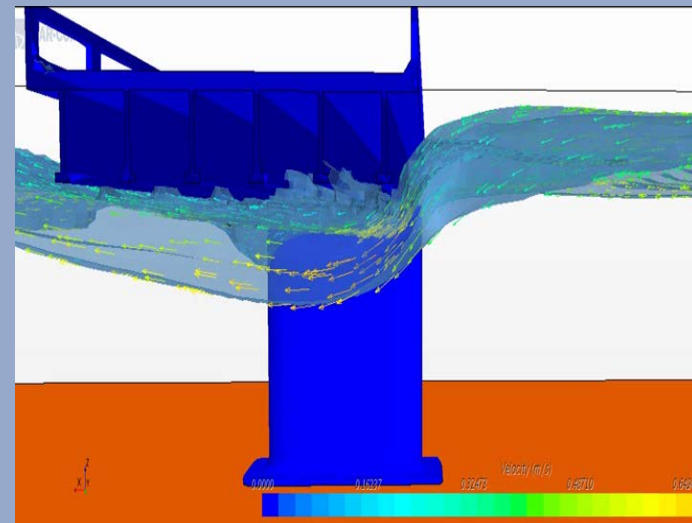
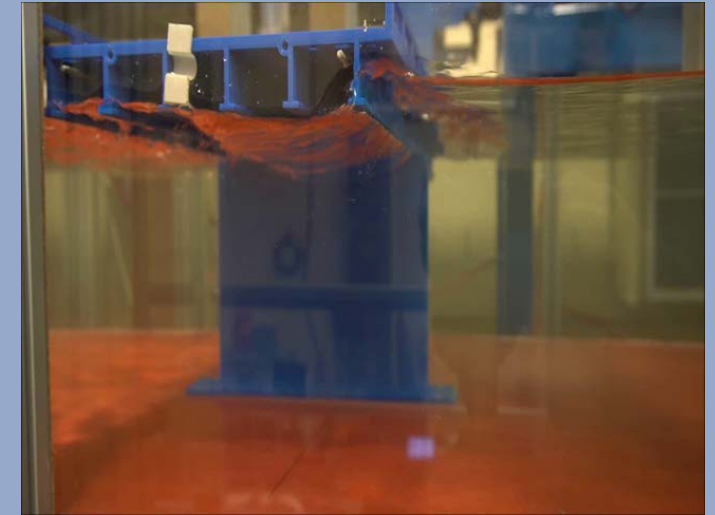


Source: FHWA

Focus Area: Infrastructure System Resilience

Hydraulic Engineering Research

- Modeling
- Scour
- Coastal Engineering
- Culverts
- Drainage
- Hydrology



Source: FHWA



Focus Area: Advanced Inspection Tools

- Hand Held Spectroscopy
- Network Level Pavement Structural Evaluation
- Non-Destructive Evaluation



Hand Held Spectroscopy



Source: FHWA



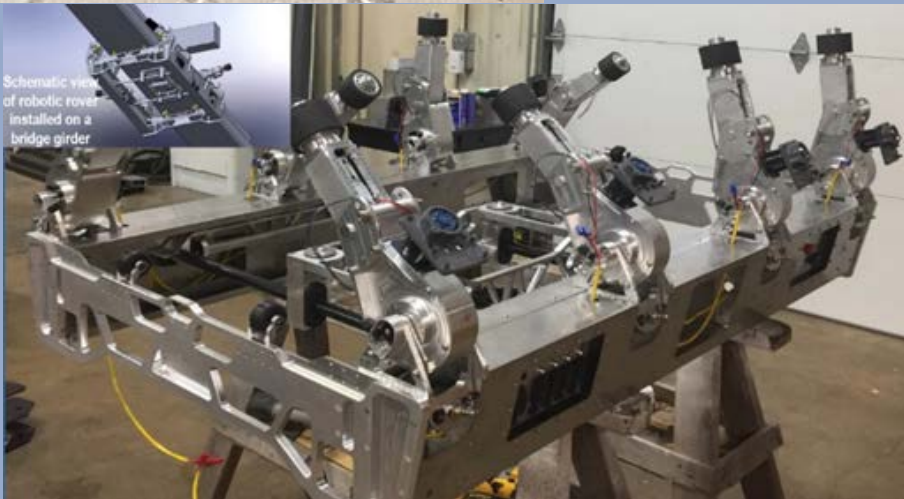
Network Level Structural Evaluation

- FHWA Research
- TPF-5(282) Demonstration
- TPF-5(385) Implementation



Source: FHWA

Non-Destructive Evaluation





FAST

NDE

FHWA Advanced Sensing Technology & Nondestructive Evaluation Laboratory

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Nondestructive Evaluation (NDE) Web Manual

Search Research & Technology

FHWA Home / Programs / Research & Technology

Home

Find Technology

NDE Technologies

Glossary

Acronyms and Abbreviations

Nondestructive Evaluation (NDE) Web Manual, Version 1.0



Motivation

Overview

The Nondestructive Evaluation (NDE) Web Manual was conceived and developed to fill in a critical knowledge gap between the practitioners dealing with bridge performance challenges on a day-to-day basis and the researchers developing and refining NDE technologies serving them. Over the last decade, there has been an explosion of new assessment tools, but their documentation is fragmented (across refereed and non-refereed literature) and not supported by actual performance data for particular technologies and products. The NDE Web Manual's aim is to provide concise and unbiased guidance to help practitioners navigate their way through a complex and changing landscape to identify the technologies that can serve their specific need.

This manual strikes a balance between treating technologies as "black boxes" and simply regurgitating the detailed technical literature that is largely irrelevant for end users. To accomplish this, the Manual provides concise descriptions of each technology, inclusive of (a) the foundational physical principle, (b) performance attributes and limitations, (c) "best-practices" test procedures and protocols, and (d) sample applications and results, among others.

Navigating the NDE web manual

Forensic Investigations

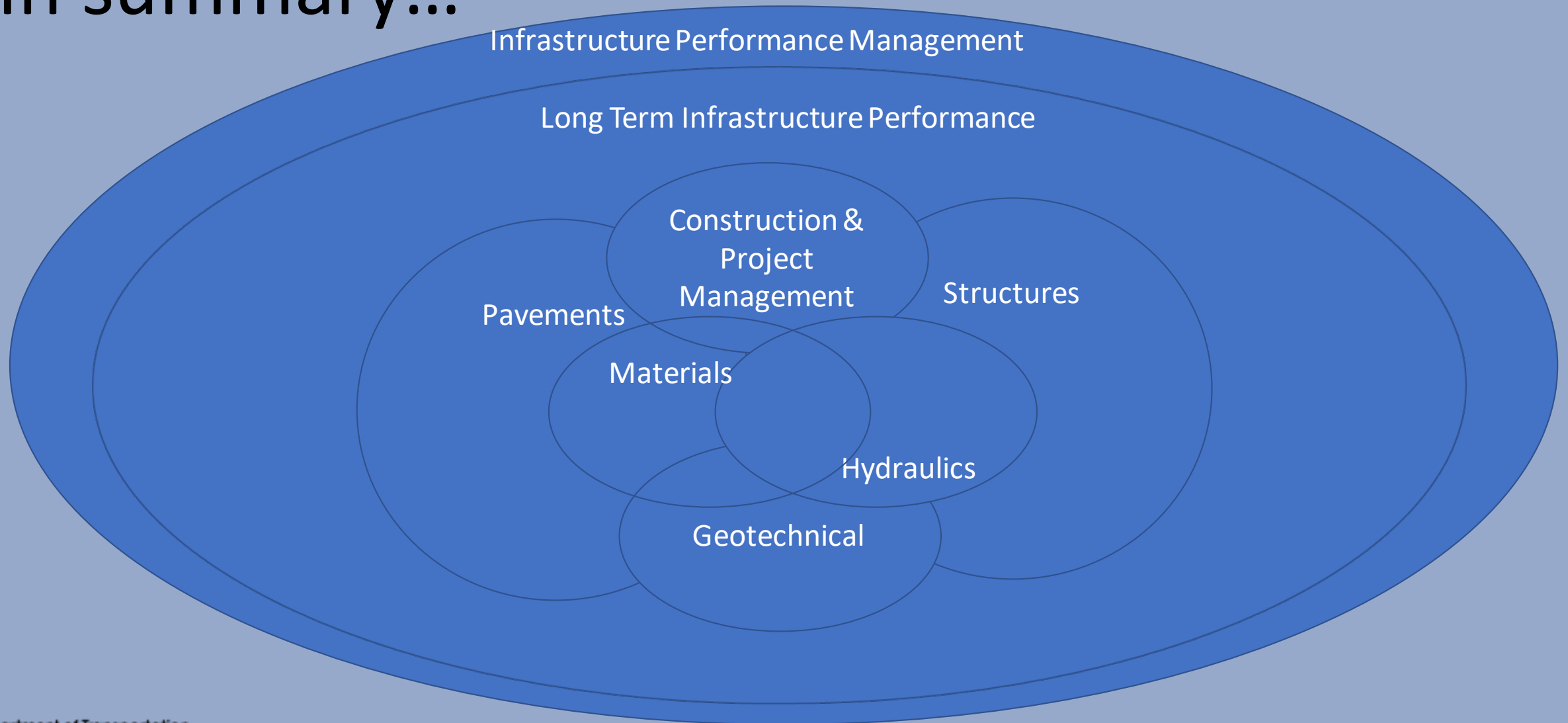
- FIU
- Loreda
- Biloxi
- I-35W
- Fraud
- ...



Source: FHWA



In summary...



Thank you!

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