Federal Highway Administration Infrastructure Research & Development

Presented to the

Research & Technology Coordinating Committee

May, 2019

Cheryl Allen Richter, P.E., Ph.D.

Director, Infrastructure Research & Development

U.S. Department of Transportation
Federal Highway Administration

Our Staff

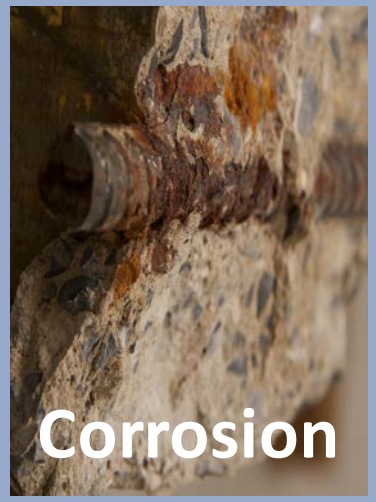
- 36 Federal Highway Administration Staff
- 64 Onsite Support Contract Personnel
- 6 Post-Doctoral Fellows

(Plus…)

10 Laboratories

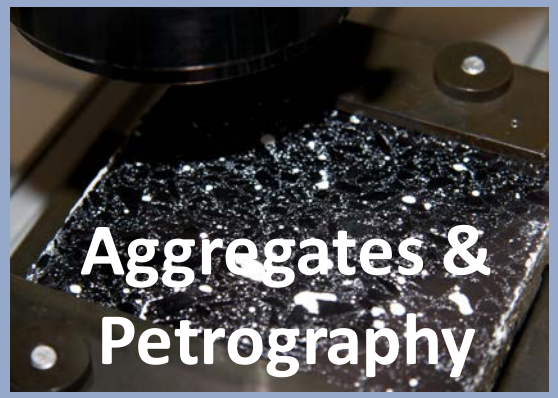

Chemistry


Asphalt


Corrosion


Pavement Testing


Structures


Aggregates & Petrography


Concrete

Geotech


NDE

Hydraulics

All Photos: FHWA

U.S. Department of Transportation
Federal Highway Administration

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

U.S. Department of Transportation
Federal Highway Administration

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

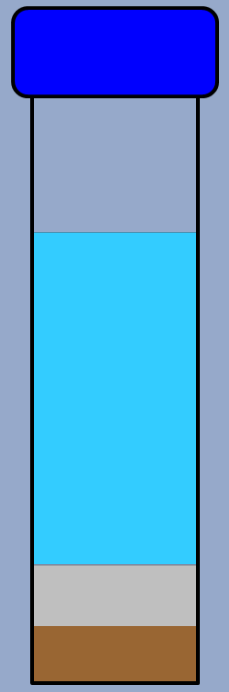
Geosynthetic Reinforced Soil – Integrated Bridge Systems

U.S. Department of Transportation
Federal Highway Administration

Source: FHWA

Performance Engineered Concrete Mixtures

- Rapid ASR Test Method



CONCRETE MIX DESIGN SUMMARY - FLEXURAL STRENGTH CRITERIA

Project number	18.035, Interstate Highway Construction, Inc. (IHC)		
Project name	DEN - Airfield Projects	Date performed	July 27, 2018
Lab ID number	F184617	Report date	August 24, 2018
Concrete mix design by	Cesare, Inc.	Technician	B. Radovich
Client mix design ID	2018.07 - 6.75	Reviewer	R. Zoetewey
Lab batch size (ft^3)	7.5		
Description	P-501 -Holcim Mix: 6.75 sack 0.42 w:cm		
Client	Interstate Highway Construction		

Design					Physical Properties		
					As Tested by Cesare		
Material	Source and Type	Specific Gravity	Batch Weights (yd^3)		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				
Date	Test Age	Strength	Average	Spec.

1,000

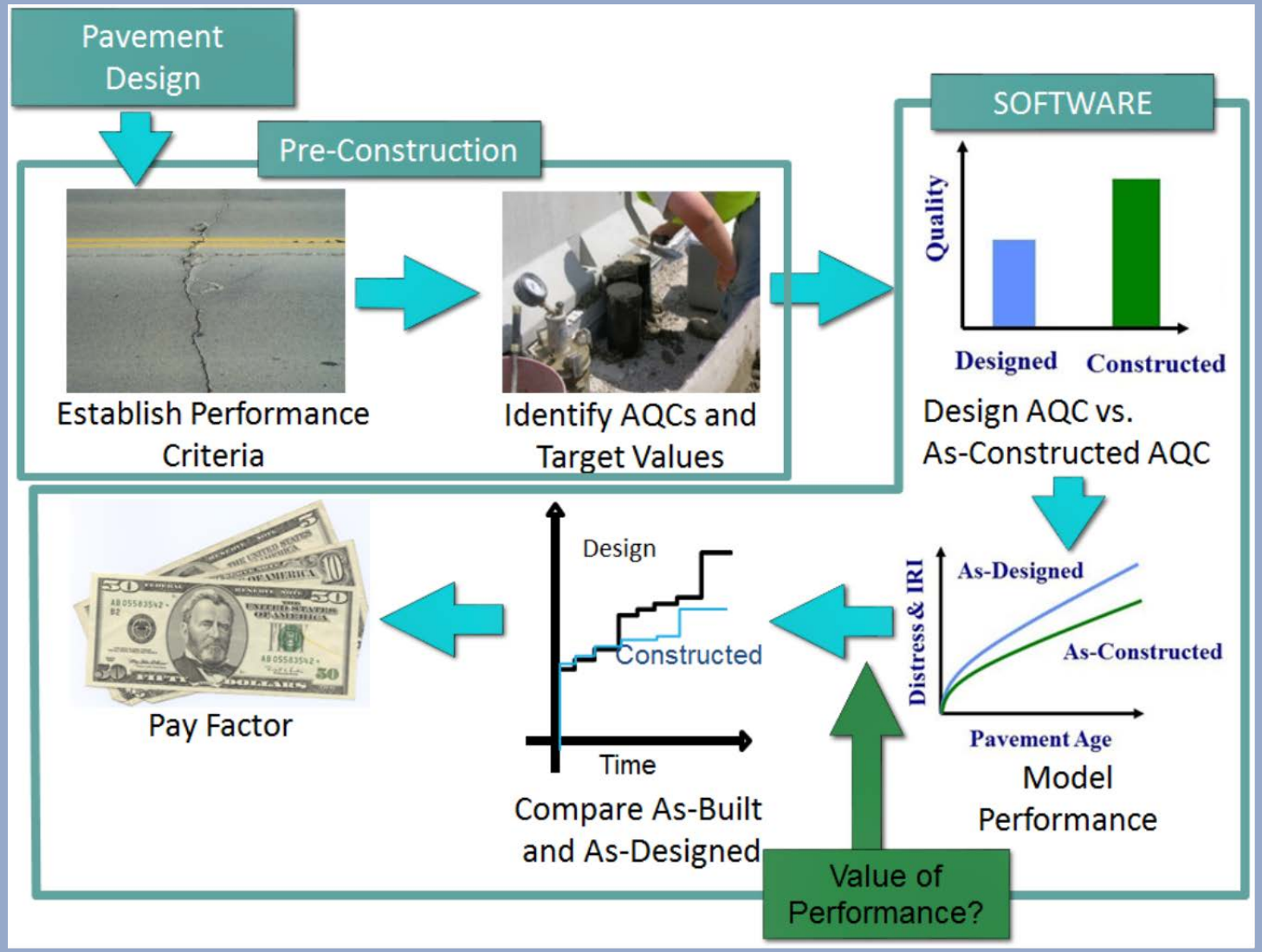
Source: FHWA

Asphalt Materials Research

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

Source: FHWA

Performance-Related Specifications



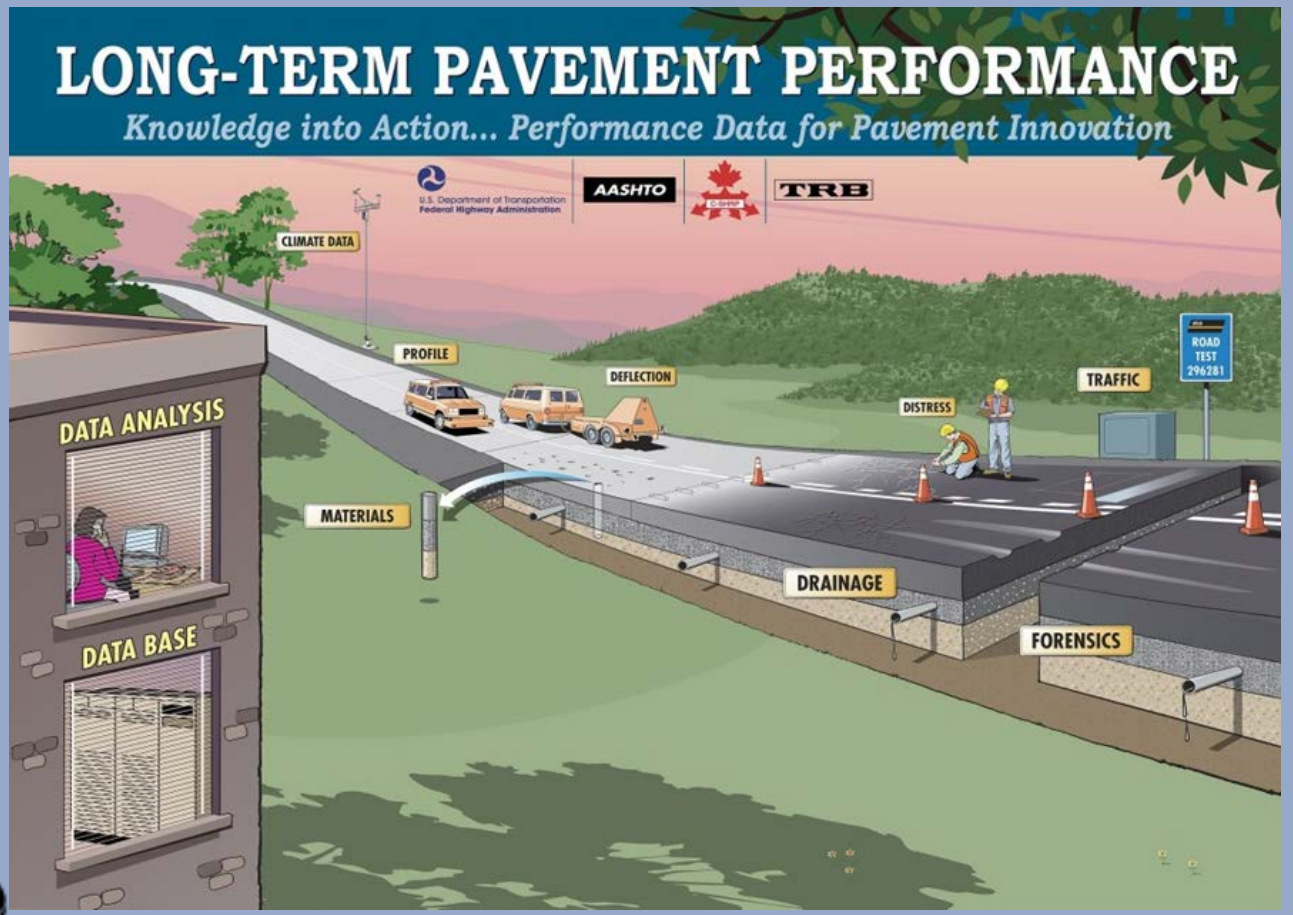
Building Information Modeling

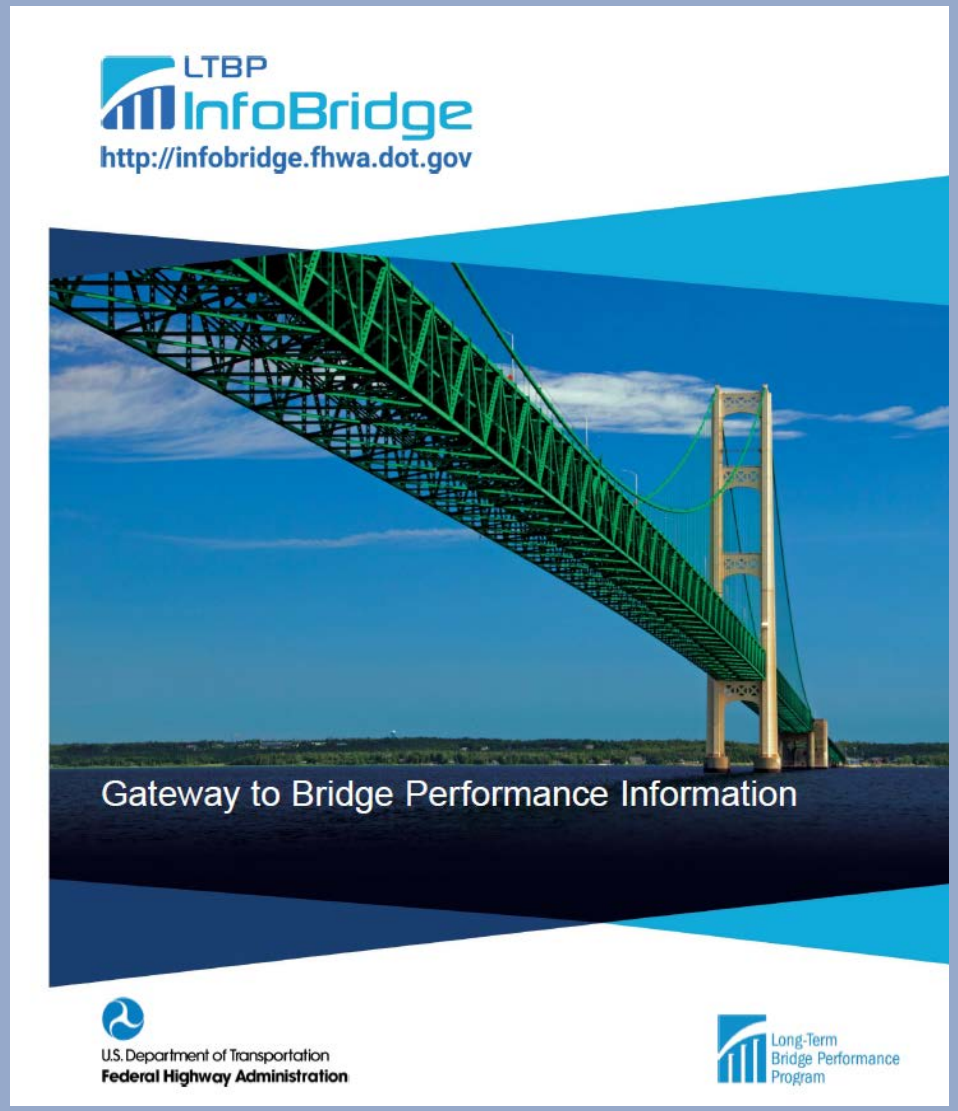
Source: FHWA

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



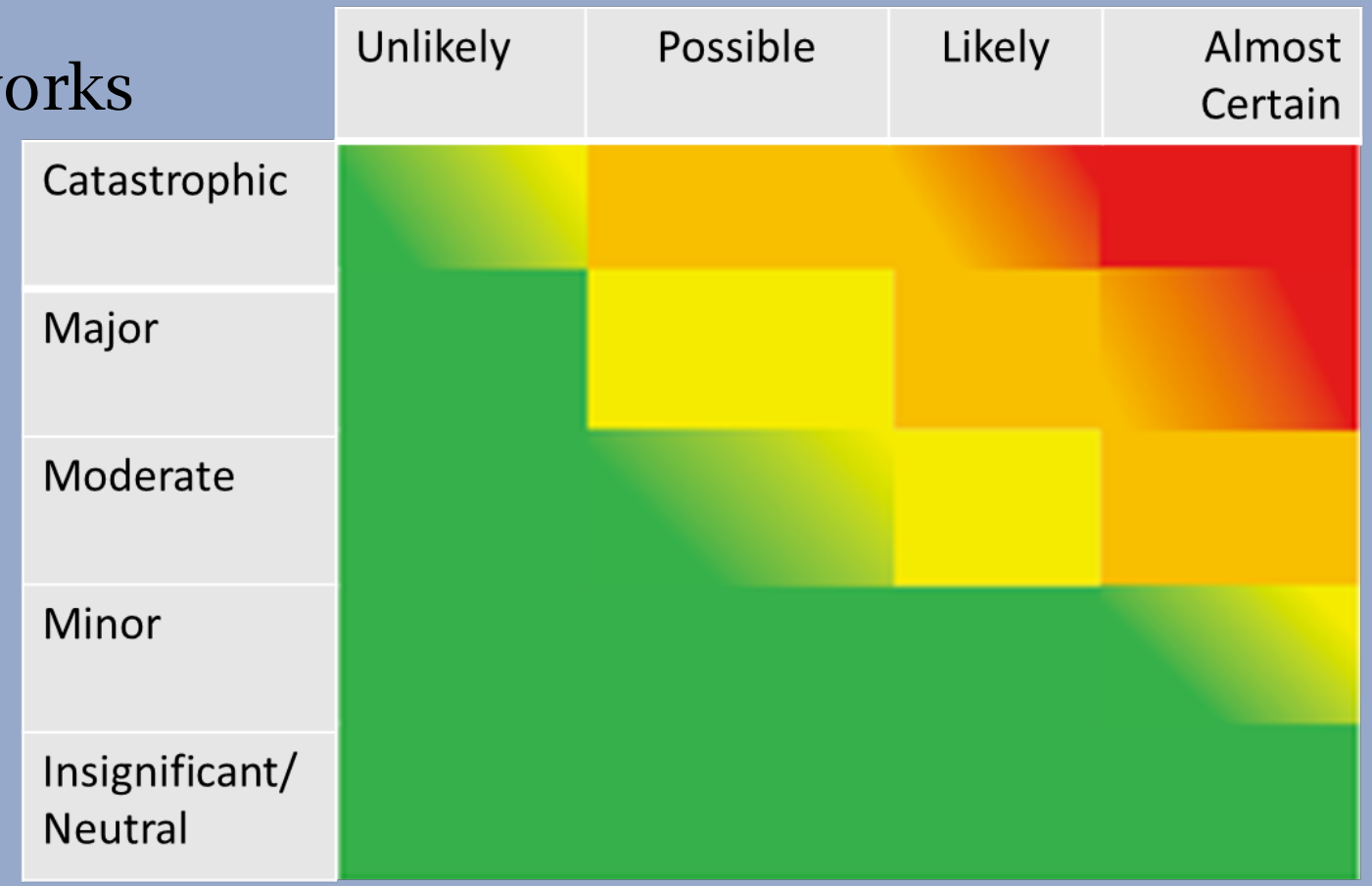


U.S. Department of Transportation
Federal Highway Administration

Graphics: FHWA

Geotechnical Performance Measures and Risk Management

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



Friction Management

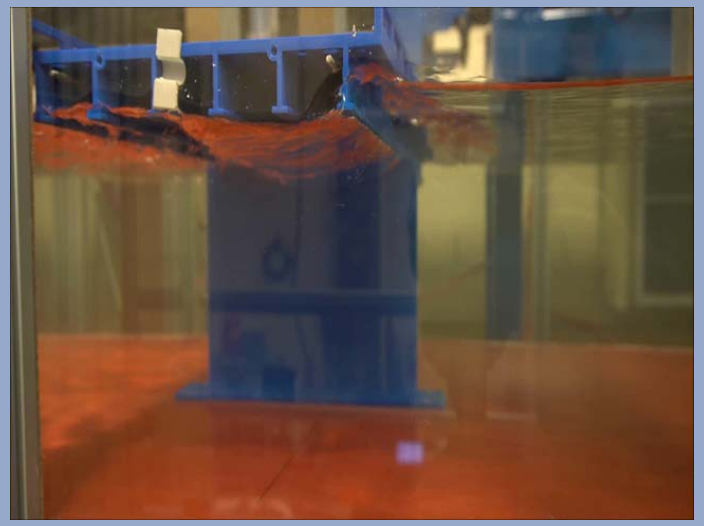
- Research (FHWA)
- Deployment (TPF-5(345))

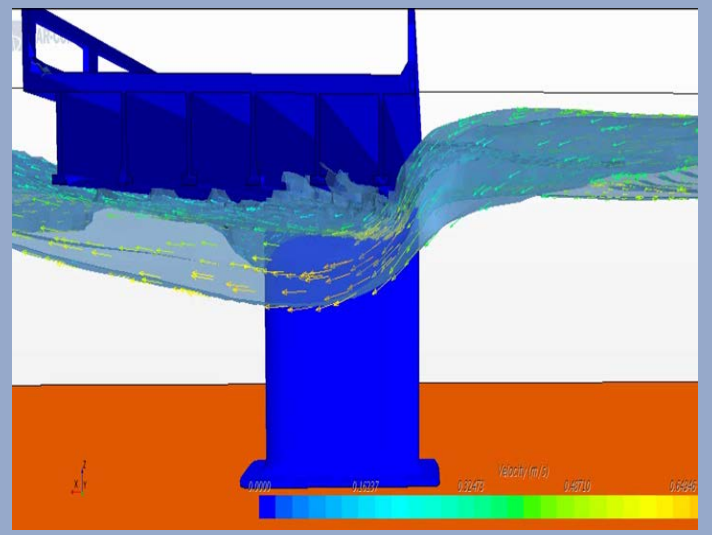
Source: FHWA

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

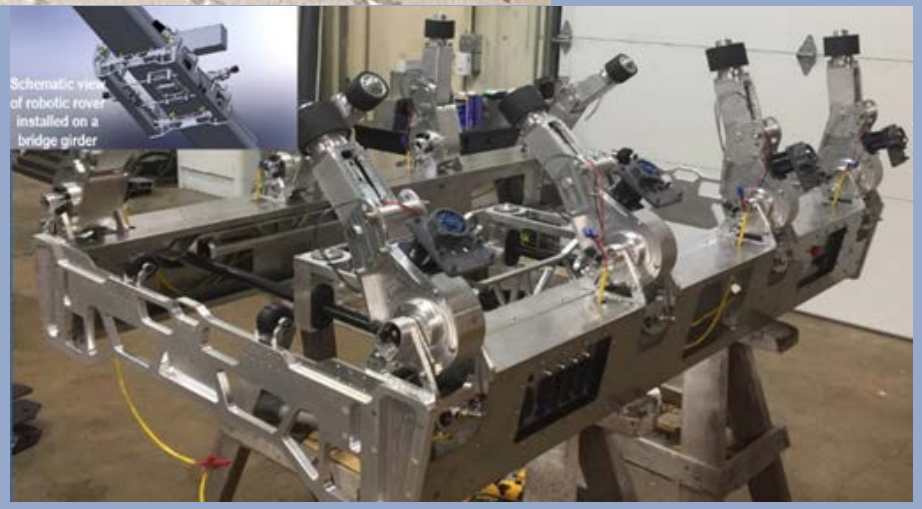
Source: FHWA

Network Level Structural Evaluation

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

Source: FHWA

Non-Destructive Evaluation



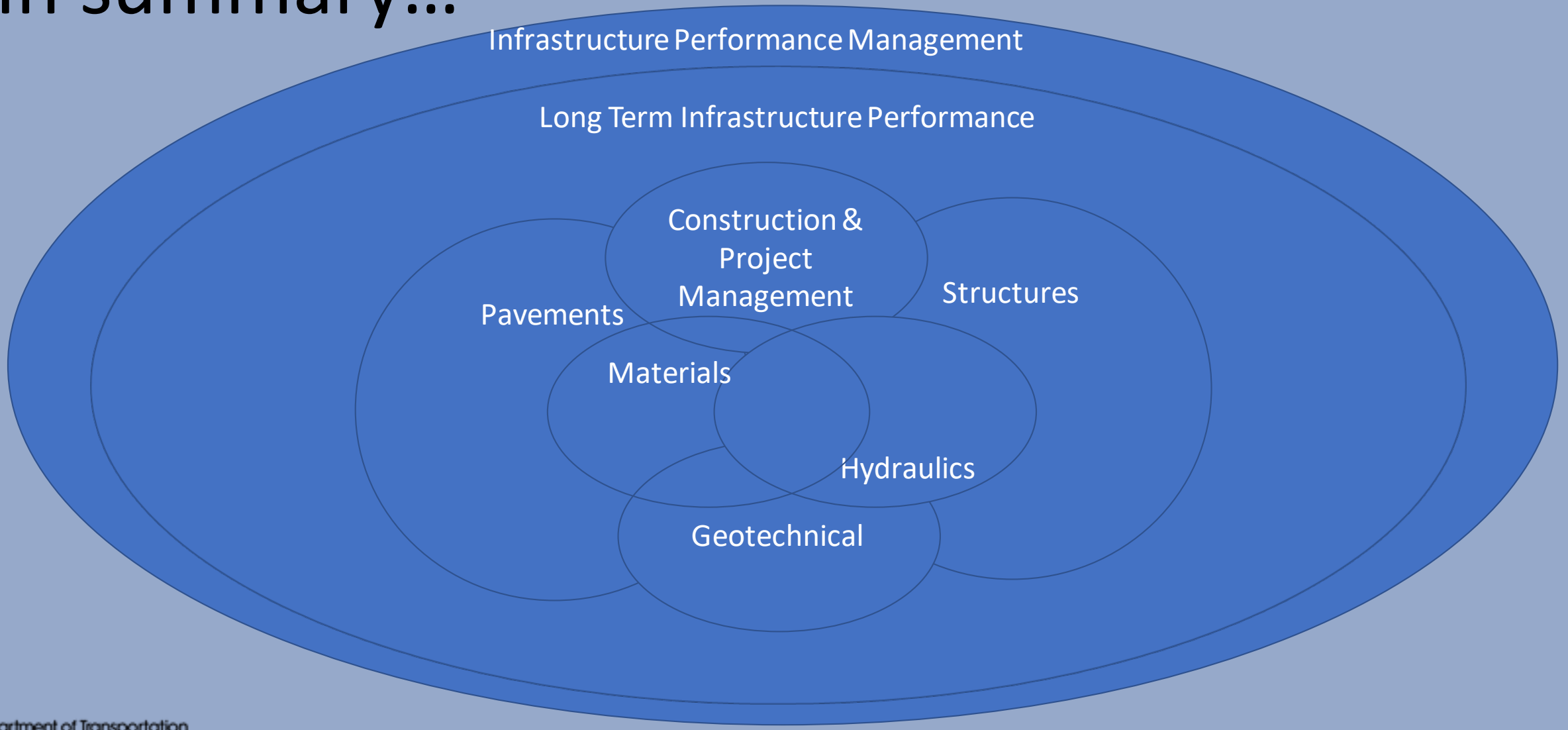
Source: FHWA

Forensic Investigations

- FIU
- Loredo
- Biloxi
- I-35W
- Fraud
- …

Source: FHWA

In summary…


Infrastructure Performance Management
Long Term Infrastructure Performance
Construction & Project Management
Pavements
Structures
Materials
Hydraulics
Geotechnical

Thank you!

Cheryl Allen Richter, P.E., Ph.D.
Director
Office of Infrastructure R&D
202-493-3021
cheryl.richter@dot.gov