Transportation Research: From Theory to Practice

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Outline

- Background
- 18-3P: Flood damaged roadways
- 12-7C: Roller compacted concrete
- 17-6SS: e-Construction
- Summary
- Discussion

Background

- LTRC's role
  - Conduct a comprehensive, high quality, research program
  - Foster innovative solutions to complex transportation problems
  - Benefit DOTD, local entities, consultants, contractors, and traveling public
- Research to practice
  - How long does it take?
- Barriers to implementation?

18-3P: Flooded Roadways

- Best practices for assessing roadway damages caused by flooding
- Contractor
  - Mingjiang Tao and Rajib Mallick
  - Department of Civil and Environmental Engineering
  - Worcester Polytechnic Institute

How to Evaluate Flood Damage?

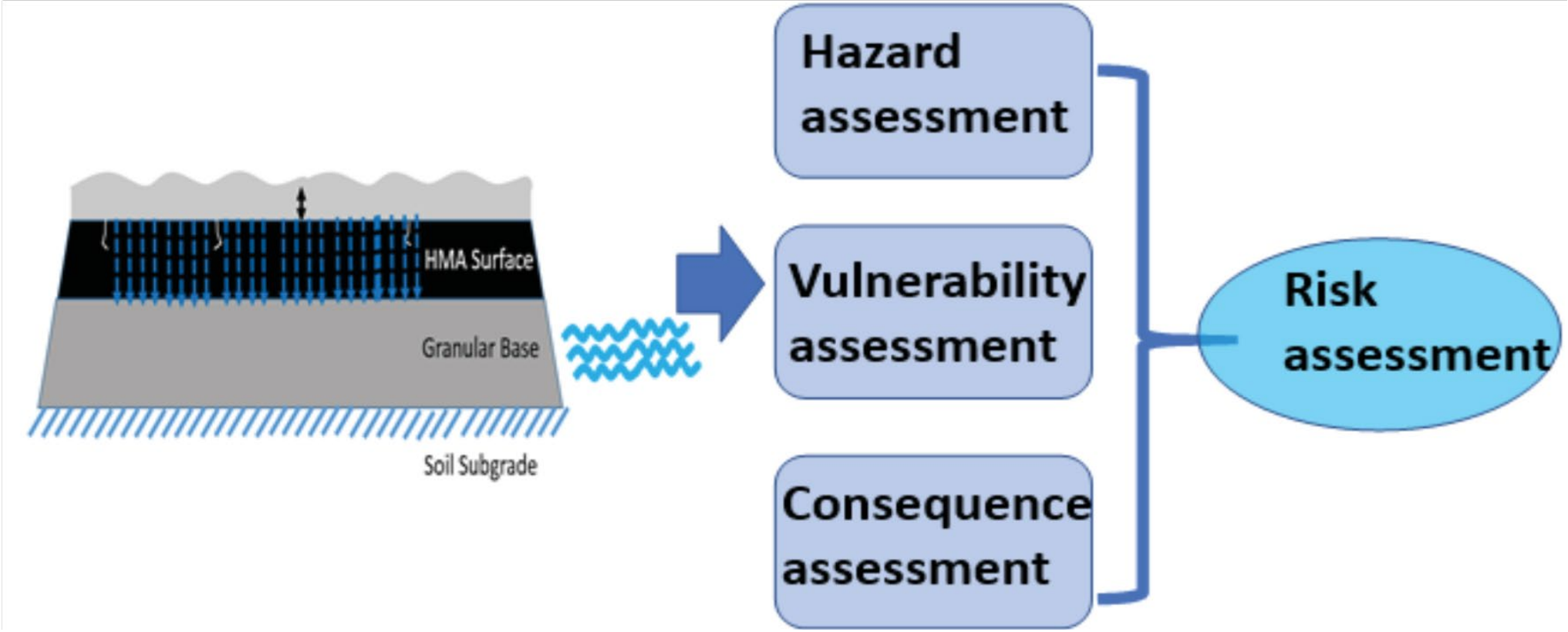
Objectives

- Determine best practices for assessing roadway damages
- Develop multiple levels of roadway damage assessment protocols

Methodology

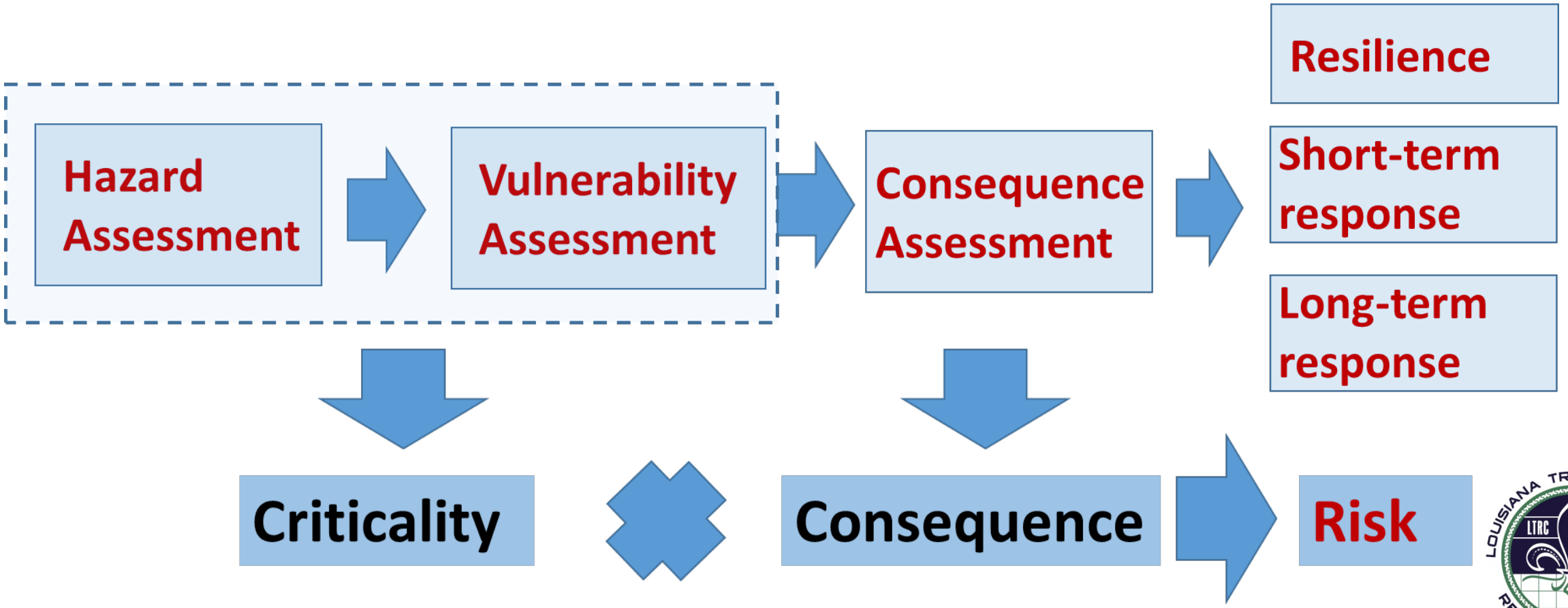
- Literature review
- Questionnaire survey
- Development of engineering protocol levels
  - Topic of todays discussion

Parameters in Engineering Protocol Levels



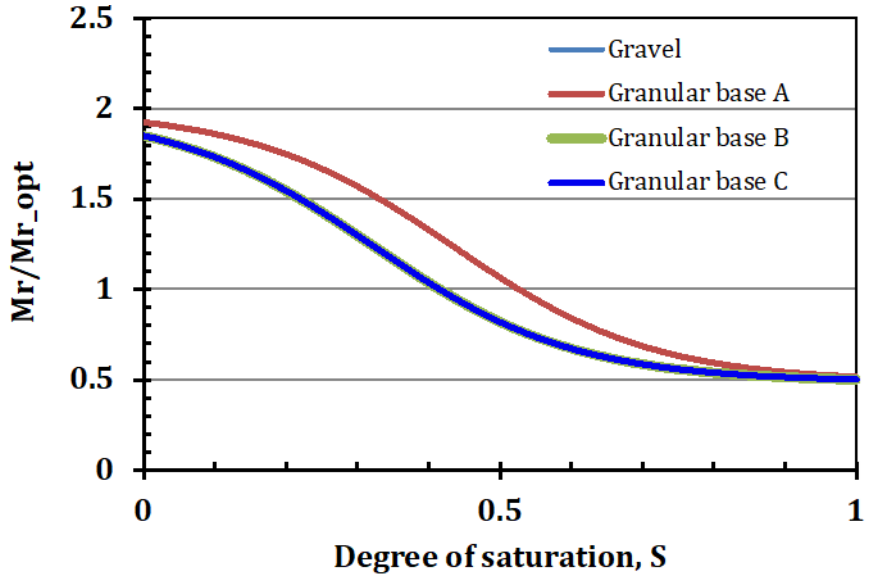
Risk Factor (RF) – A Composite Indicator

$$RF = Hazard\ Factor \times Vulnerability\ Factor \times Consequence\ Factor$$



Damage Mechanisms During Flooding

- Base, subbase, and subgrade lend strength
- Flooding reduces strength by reduction in stiffness
- Erosion
- Deterioration in HMA (reduced adhesion and cohesion)

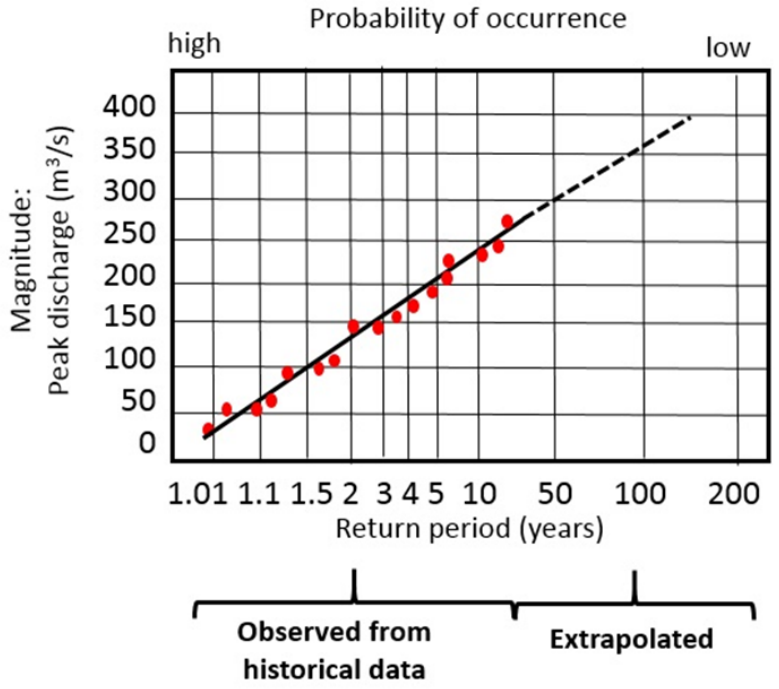


Common Techniques for Structural Assessment

- FWD
- GPR
- DCP
- **Visual Inspection**

Hazard Assessment (Hazard Factor)

- Parameters are unit-less with changeable weighting factors per site conditions
- Detailed procedures and formulas are in the report



Flood characteristics	Hazard factor
100-year flood	5
50-year flood	3
10-year flood	1

Vulnerability Assessment (Vulnerability Factor)

- VF1 (0 or 1): Flooding (1) or no flooding (0)
  - Based upon FEMA flood maps
- VF2 (1-5): Structural loading capacity
  - Based on drainage, subgrade type, and surface layer conditions

$$\boldsymbol{VF = VF_1 \times VF_2}$$

- Detailed formulas and procedures are in the report

Consequence Factor (CF)

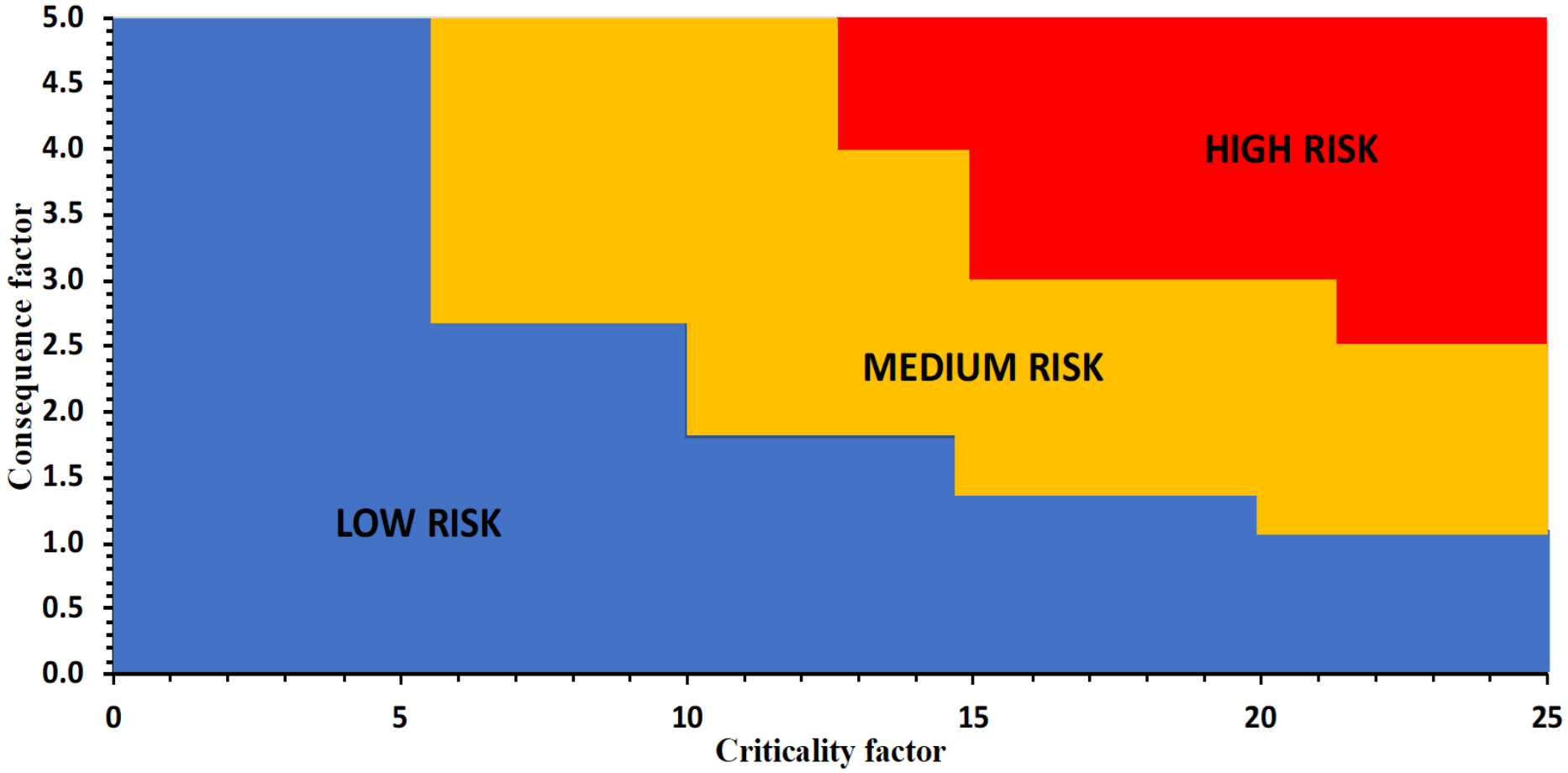
- Weighted sum (w) of the parameters related to replacement / repair cost (RC) and the cost of service restriction to drivers (CD)

$$CF = w_{RC} * RC + w_{CD} * CD$$

Functional class of roadways	replacement/ repair cost
Interstates & Other Arterials	5
Collectors	3
Local roads	1

Traffic volume (AADT)	cost of service restriction to drivers
>3,000	5
400-3,000	3
<400	1

Risk Assessment



12-7P: Roller Compacted Concrete

- Results from LTRC's Accelerated Loading Facility
- Contractor
  - Zhong Wu and Tyson Rupnow
  - LTRC and LSU

Background and Methodology

- Need exists for a low volume roadway solution for heavy trucks, agriculture equipment, and shale gas / oil exploration
- Several successful projects around the US
  - 10" RCC near Aiken, SC
  - 7" and 8" RCC in Northern Arkansas

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Objectives

- Determine structural performance with failure mechanism(s) and load carrying capacity of **thin RCC** surface pavements
- Determine the applicability of using **thin RCC** pavement structures (with cement treated or stabilized base) as a design option for low and high volume pavement design in Louisiana

Constructed Sections

8 " RCC
12 "Cement Treated Base
Existing Subgrade

Section 1

6 " RCC
12 "Cement Treated Base
Existing Subgrade

Section 2

4"RCC
12 "Cement Treated Base
Existing Subgrade

Section 3

8 " RCC
8.5" Soil Cement Base
10" Cement Treated Subgrade
Existing Subgrade

Section 4

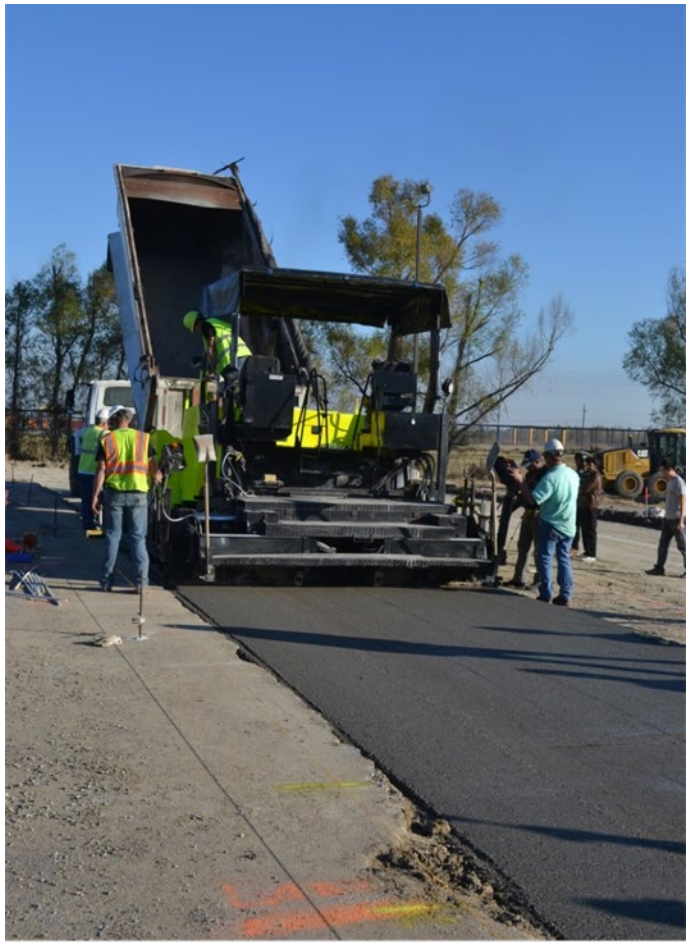
6 " RCC
8.5" Soil Cement Base
10" Cement Treated Subgrade
Existing Subgrade

Section 5

4"RCC
8.5 "Soil Cement Base
10" Cement Treated Subgrade
Existing Subgrade

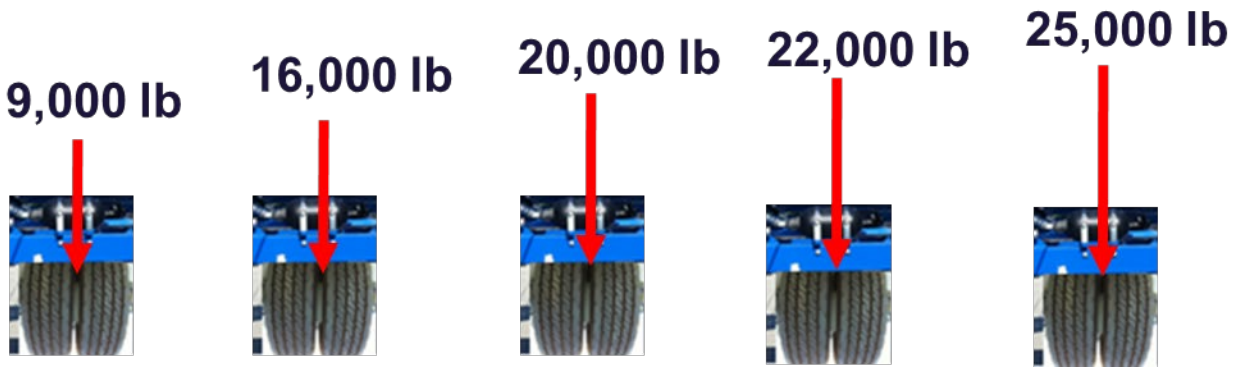
Section 6

Pictures



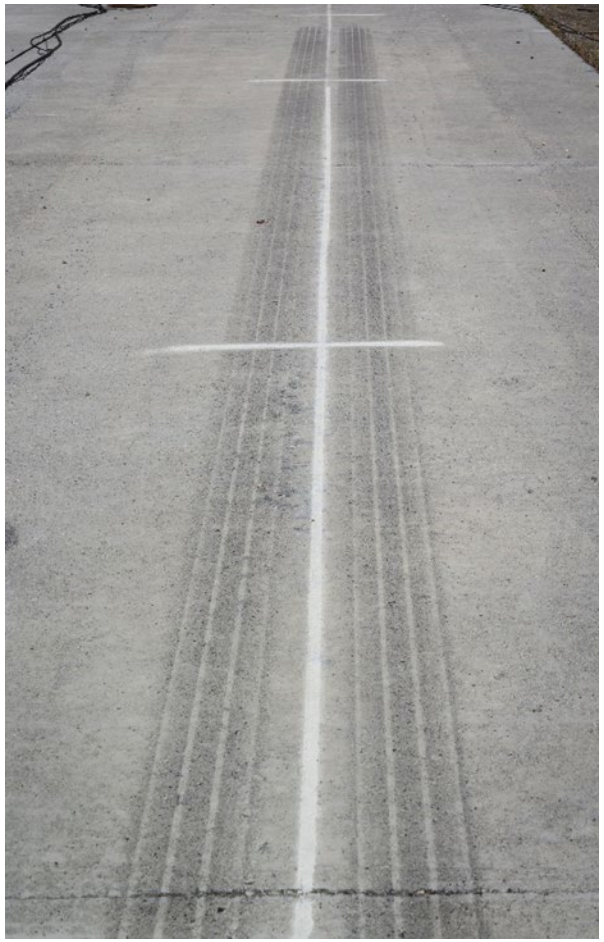
Accelerated Loading Testing

- 78,000 passes for each load level
  - ~1 week per level



Distress Observed (8+8.5RCC) – Section 4

- Approximately after 392,500 load repetition (11.28 million equivalent ESALs), no significant damage was observed
- Due to the high load repetitions received on section 6+8.5RCC to fatigue failure, the test was discontinued



Distress Observed (6+8.5RCC) – Section 5

- Visual Distresses
- Longitudinal cracks were observed along the wheel path and at the edge of the tire print
- Pumping action was observed through cracks and joints
- 87.4 million ESALs to failure
- ***1.9 million ESALs predicted***

Distress Observed (4+8.5RCC) – Section 6

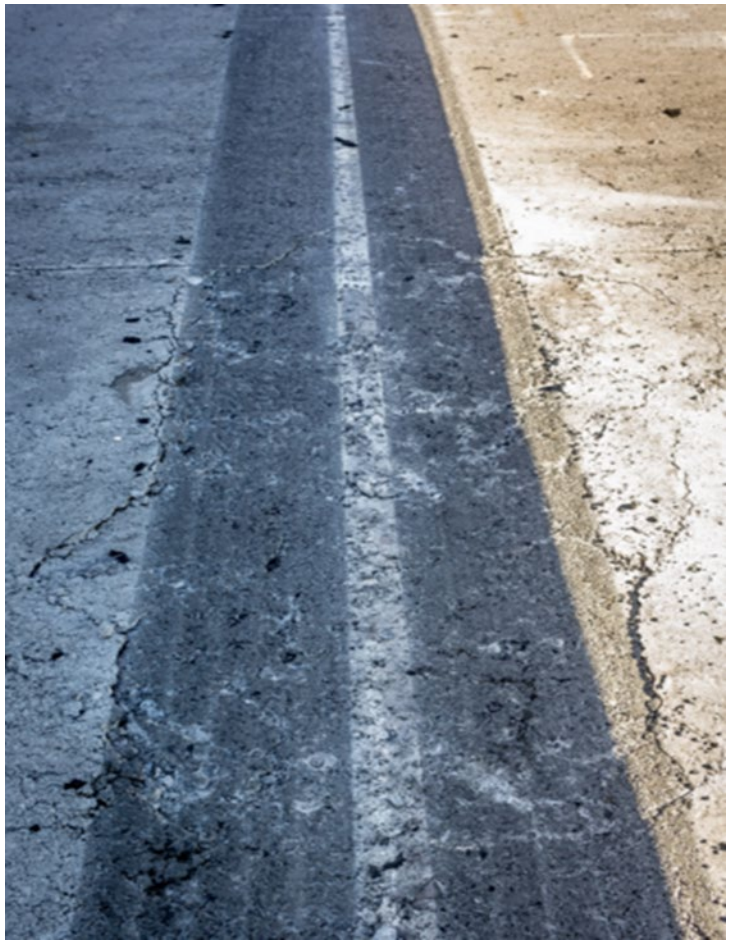
- Visual Distresses
- Longitudinal cracks were observed along the wheel path and at the middle of the tire print
- Pumping action was observed through the cracks and joints
- 19.2 million ESALs to failure
- ***0.7 million ESALs predicted***

Distress Observed (4+12RCC) – Section 3

- Due to relatively weaker support, an early longitudinal crack was observed after 55,000 passes under 9 loading
- About 3 million ESALs to failure
- ***Predicted 0.7 million ESALs to failure***

Distress Observed (6+12RCC) – Section 2

- Longitudinal cracks
- Pumping and Local failure
- About 19 million ESALs to failure
- ***Predicted 1.9 million***



Construction Cost Analysis

- 13-ft wide , 1 mile length
  - RCC = $198,082
  - HMA = $311,169
- Typical 2-lane, 10 mile long project
  - 5-in RCC vs. 7-in HMA
  - Total cost savings up to $2,261,740

Implementation

- The ATLaS30 loading results generally indicate that
  - a thin-RCC over soil cement pavement structure has a superior load carrying performance
  - Recommendation to select and build several field RCC test sections on those Louisiana highways where the pavements are often encountered by heavy truck loading
    - To validate the APT performance and provide further implementation guidelines
  - ***Will not test the 8-inch sections to failure!***
- **LCG paving three sections this weekend!**

17-6SS: E-Construction Inspection Technology

- Current project delivery
  - Resource intensive
  - Valuable information
  - Heavily paper based
- Future project delivery
  - Leverage existing technologies
  - Accumulated project intelligence = asset intelligence

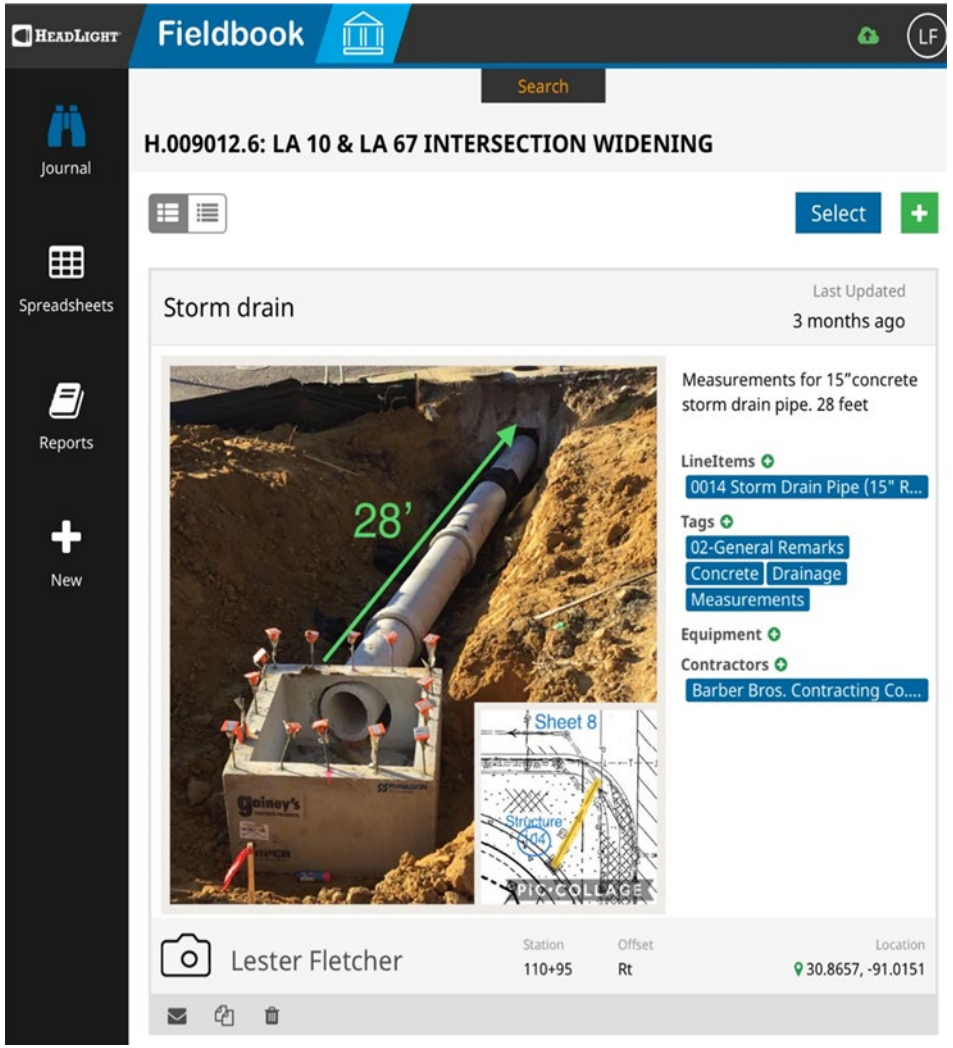
Background

- Move Louisiana forward
- More timely submission of DWRs
- Potential to lower claims
- All lead to
  - Reduced risk
  - Accelerated delivery
  - Increased accountability
  - Increased efficiency

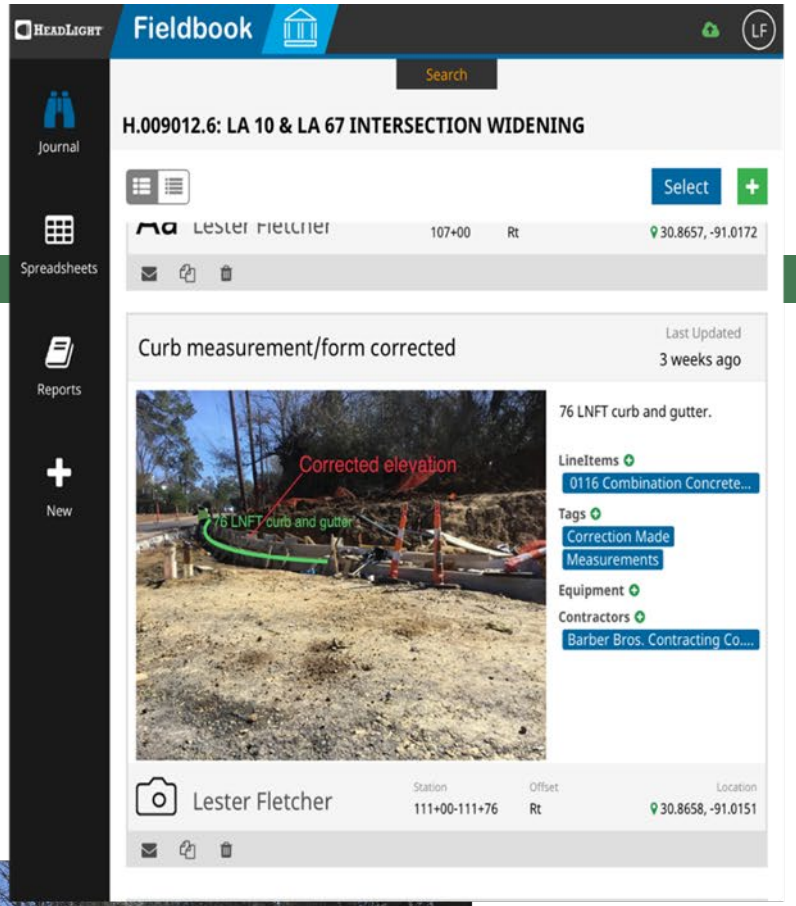
Equipment

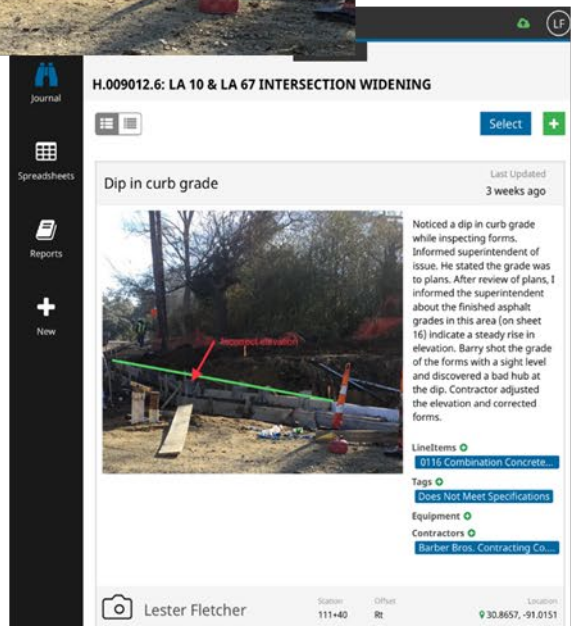

HEADLIGHT
FIELDBOOK
PAVIA.ADMIN
Search
Westlake Ave N
Journal
08/07/2017 Looking North
Palmer Engineering
Josh Weiland
Weather Observation

Observations

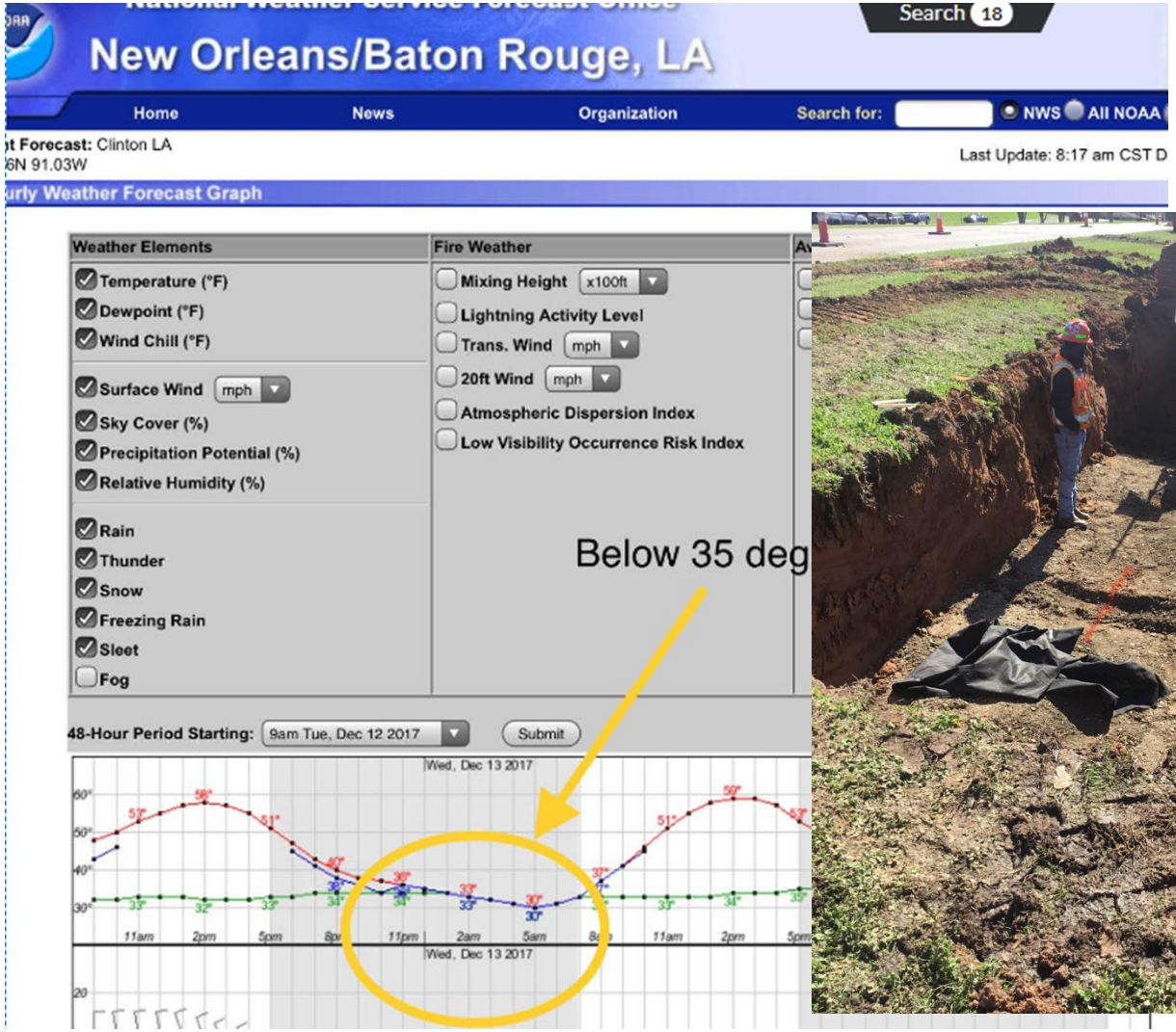


Observations





Documentation



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Initial Findings

- Reduced claims
- Future assent management
- Training opportunities
- More complete documentation
- 1.25 more hours of work in the field
- Increased dialogue between Department and Contractors
- Accountability

Summary

- Final reports
  - http://www.ltrc.lsu.edu/pubs_final_reports.html
- Technical Summaries
  - http://www.ltrc.lsu.edu/pubs_final_reports.html
- Project Capsules
  - http://www.ltrc.lsu.edu/pubs_projectcapsules.html

Summary

- ALWAYS looking for subject matter experts to serve on Project Review Committees (PRC's)
  - Review scope of work, research team qualifications, and review deliverables
- ALWAYS looking for potential implementation avenues for completed research products
  - LCG has been a GREAT ally in this arena in the past decade


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