

Project Overview Report

1. UTC Identifying Number

DTRT13-G-UTC28

2. Center Identifying Number

CAIT-UTC-NC45

3. Project Title

COLLABORATIVE PROPOSAL: The Connection between State of Good Repair and Resilience: Measures for Pavements and Bridges

4. Principal Investigator & Contact Information

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7. Project Description

Resilience: “The ability to prepare and plan for, absorb, recover from, and more successfully adapt to adverse events” Disaster Resilience: A National Imperative While there are many definitions of resilience and almost as many measures of resilience, operationalizing the concept to be useful in decision making is particularly challenging. These challenges include:

- The diverse hazards that impact transportation infrastructure including climate change, particularly sea level rise, extreme weather events (wind, storm surge, flooding, erosion and deposition), land subsidence, seismic events, and tornadoes, as well as exposure to biological and technological hazards, and terrorist activities.
- The changes that occur over time as well as from location to location.
- The different perspectives including the owner, the operating agency, and the user (both passenger and freight)
- The interdependencies with other infrastructure systems such as electricity, communications, water and wastewater, as well as network connectivity.

To address these challenges we are proposing to connect the concepts of resilience and performance measures related to decision making related to pavements and bridges. The proposed research builds on work in three areas. First, the proposed research builds on the growing body of literature to connect the concepts of resilience and performance measures related to state of good repair to meet the needs of state DOTs. Second, recent work on integrating risk into the decision making process and asset management provides access to appropriate tools (see for example, <http://www.fhwa.dot.gov/asset/pubs.cfm?thisarea=risk> and <http://www.ops.fhwa.dot.gov/publications/fhwahop15025/fhwahop15025.pdf>). Third, familiarity with the widely available data on State of Good Repair related data for pavements and bridges will provide a base from which to test the applicability of the concepts including their effectiveness in capturing the concept of resilience and changes over time, and the relevance to the needs of state agencies.

The research approach will begin with a critical review of the literature on resilience measures in the context of its relevance to pavement related decisions and the use of State of Good Repair related

measures to connect to resilience performance measures. Related measures such as robustness, and vulnerability will also be considered as alternatives. The critical review requires an understanding of the appropriate criteria and attributes that can be used to benchmark different measures and tools both in the literature and practice.

This will be followed by a critical assessment of the tools available and the tools needed to assess resilience as a measure to support state of good repair. Drawing on these reviews and assessment, the project will then propose measures of resilience and assess these measures for states to understand: 1) Does existing data related to State of Good Repair adequately support the concept of resilience? 2) Do the measures of resilience support risk based pavement/ asset management? This will be accomplished through meetings with relevant stakeholders. As needed the measures may be revised and reassessed.

Case studies applying the resilience measures will be developed. We anticipate conducting three to five case studies. Case studies will include a section of pavement in Delaware subject to frequent flooding compared with the local network that in general is subject to degradation over time, the role of the resilience measures in the closure of the I-495 bridge in Delaware, and a hypothetical event causing closure of an interstate. The results illustrate the application of resilience at different spatial and temporal scales - a segment subject to specific flooding events, a network with progressive degradation, and a sudden onset event on a critical link. For example, the concepts of robustness, redundancy, resourcefulness and rapidity (Bruneau, and Reinhorn, 2007) may be more applicable at the project level, where functionality over time (Bocchini and Frangopol, 2012) may be appropriate at the network level. The case study results provide insights into the impacts of different strategies for ensuring the functioning of the pavements prior to, during and immediately following an event.

Drawing on these results we will develop an outline for a guide for selecting resilience measures for use by state DOTs. The results of the project will be assembled into a report documenting the process, outcomes and recommendations.

8. Implementation of Research Outcomes (or why not implemented)

This research is most likely to inform policy and decision making. One of the most important avenues for dissemination will be a paper submitted to the Transportation Research Board Annual Meeting. The focus of the paper will be on translating the concept of pavement resilience to potential measures and insights that can be gained from the perspective of an MPO and DOT. We will work with our clients at DelDOT and NJDOT to explore these ideas and present them in a form of value to DOTs.

9. Impacts/Benefits of Implementation (actual, not anticipated)

TBD

10. Dates and Budget

Start Date: 9/1/2016

End Date: 6/30/2018

UTC (CAIT) Dollars: \$151,684

Cost Sharing: \$131,715

Total Dollars: \$283,399

11. Keywords

Resilience, State of Good Repair, Performance Measures, Asset Management, Risk Assessment

12. Web Links (Reports and Project Website)

<https://cait.rutgers.edu/cait/research/collaborative-proposalthe-connection-between-state-good-repair-and-resilience-measures>