RESEARCH
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TECHNOLOGY TRANSFER PROGRAM

Best Practices for Assessing Roadway Damages Caused by Flooding

JUST THE FACTS:

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POINTS OF INTEREST:

Problem Addressed / Objective of Research / Methodology Used Implementation Potential

PROBLEM

The United States has witnessed numerous natural disasters in recent years that resulted in the inundation of thousands of roadway lane-miles. Assessment of flooded pavements is a challenge that transportation agencies will likely face more often as climatologists predict that the changing climate will produce more frequent and extreme events.

Damage to pavement structures that are not visibly eroded or washed out during a flooding event is neither well understood nor easy to identify. Quite often, flooding results in deterioration or weakening of underlying pavement layers that are not visible on the surface.

Some guidance is available for distinguishing between roadway damage that warrants temporary versus permanent repairs when assessing flooded roadways, but it is primarily based on visual inspection rather than tied to any pavement performance properties.

The importance of obtaining reliable information regarding flood-induced damage in pavements is evident. Identifying the best practice for assessing flood-induced damages to roadways can help agencies to better prepare, conduct more effective assessments, and allocate resources for post-flooding investigative actions.

OBJECTIVE

The major objective of this research is to identify best practices for assessing roadway damages caused by flooding and to develop a rational and risk-based multi-level roadway damage assessment protocol.

METHODOLOGY

A comprehensive literature review and national survey will be conducted to develop a hierarchical level of flood-induced damage evaluation, considering flood and roadway characteristics, as well as associated repair/mitigation costs.

Some roadways are more vulnerable than others to the effects of flooding due to hydraulic conditions, pavement structure, material type, drainage, and surface permeability. The consequence of flood-induced roadway damage depends on traffic volume, roadway class, and costs of repair/traffic delay. It is thus logical to use roadway damage evaluation methods that are commensurate with the degree of flood hazard (probability and magnitude), roadway vulnerability, and consequence of damage.

For this study, a composite risk factor will be determined and used to rank the relative risk associated with flooding on various roadways. This risk factor will guide decision

makers when selecting the appropriate level of engineering evaluation for roadways that may sustain damage during a flood (see Figure 1).

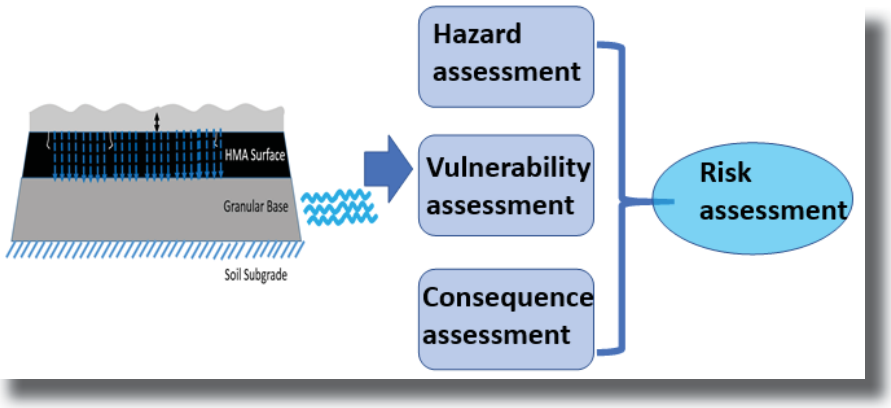

Figure 1
Schematics of a hierarchical evaluation protocol of flood-induced damage to pavement

The hazard, vulnerability, and consequence factors are qualitative or quantitative indicators. Decision matrices, developed based on expert judgment, will be used to derive scores for each factor. Using calculated risk factors, a pavement post-flood risk assessment can be performed.

Based on risk factors, four levels of engineering evaluation are proposed. Level 4 is the least robust engineering assessment for roadways with lowest risk factors, while Level 1 is the most robust assessment for highest risk factors. Accordingly, Levels 3 and 2 are recommended for roadways with intermediate risk factors.

Level 4: *Inferring damage based on previous engineering studies*

Level 3: *Field reconnaissance (visual inspection-data recording-checking)*

Level 2: *Non-destructive testing, field reconnaissance (visual inspection-data recording-checking)*

Level 1: *Hydraulic and pavement performance analyses, non-destructive testing, field reconnaissance (visual inspection-data recording-checking)*

This hierarchy of damage assessment protocols allows for risk-based allocation of resources based on engineering principles and methods.

IMPLEMENTATION POTENTIAL

Prioritizing maintenance/repair of roadways that may be or have been damaged due to flooding, based on assessment of hazard, vulnerability, and consequence, allows for better allocation of limited resources. The methodology developed during this study will establish a framework for ranking these roadways.