TIDC Transportation Infrastructure Durability Center AT THE UNIVERSITY OF MAINE

Scour and Debris Induced Vulnerability Analysis for Riverine Bridge Structures

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Abstract

In flood events or severe storms bridges face heightened risk due to hydraulic forces, landslides and local scour. Especially due to the removal of soil causing erosion around the bridge piers. The danger escalates more when large woody debris from the upstream due to the fallen trees accumulates at the bridge pier and intensifying the impact forces. The accelerating water flow which further aggravates the scour increase the challenges more. Addressing the challenges of predicting bridge vulnerability, especially with the limitation of real data on debris accumulation and past bridge failures this study mainly advocates for a physics-based fragility assessment. The case study is conducted for a bridge in Vermont under the influence of hurricane with the return period of 100 year. Following which the most debris prone area with the highest accumulation of debris size are evaluated. To calculate the scour around the bridge pier Hydraulic Engineering Circular-18 (HEC-18) is used to compare the depth of the foundation for the representative bridge model. In the next step for a range of varying water velocity and flow rate, the effects are evaluated over the different depth of foundation to analyze the effect of debris size using risk sensitivity analysis. The risk analysis result show when the flow rate remains constant and foundation depth decreases, for the debris incorporated water the probability for failure increases more rapidly. The debris size with 25m and 20m causes total failure at a very lower water velocity compared to other debris size range between 5-15m. The proposed fragility models will be used to forecast bridge damages and aid decision-makers and engineers in deciding which bridges should be closed in advance of a storm.

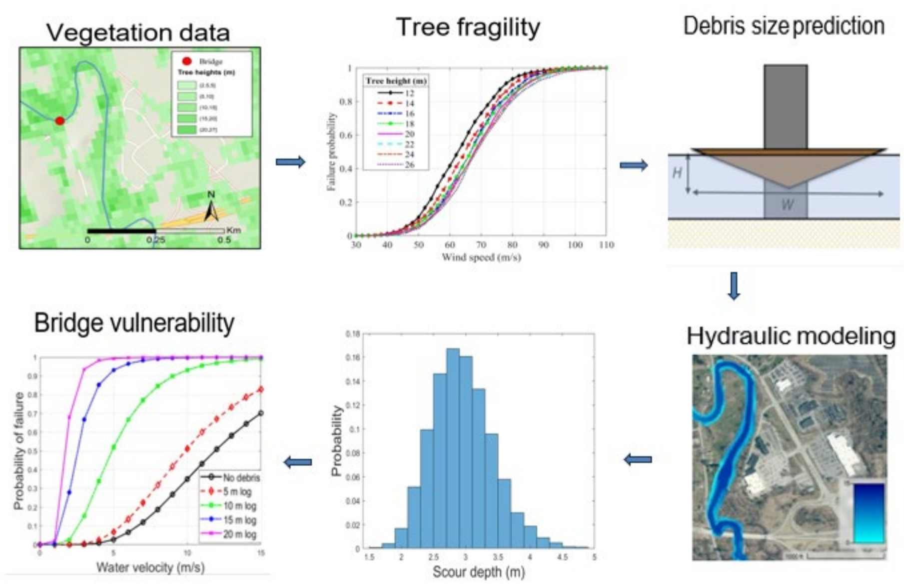

Figure 1. Flowchart of bridge risk analysis framework

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