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Original Research Paper

# Force-based and displacement-based reliability assessment approaches for highway bridges under multiple hazard actions

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ABSTRACT

The strength limit state of American Association of State Highway and Transportation Officials (AASHTO) Load and Resistance Factor Design (LRFD) Bridge Design Specifications is developed based on the failure probabilities of the combination of non-extreme loads. The proposed design limit state equation (DLSE) has been fully calibrated for dead load and live load by using the reliability-based approach. On the other hand, most of DLSEs in other limit states, including the extreme events I and II, have not been developed and calibrated though taking certain probability-based concepts into account. This paper presents an assessment procedure of highway bridge reliabilities under the limit state of extreme event I, i. e., the combination of dead load, live load and earthquake load. A force-based approach and a displacement-based approach are proposed and implemented on a set of nine simplified bridge models. Results show that the displacement-based approach comes up with more convergent and accurate reliabilities for selected models, which can be applied to other hazards.



## 1. Introduction

Designing bridges to resist extreme hazard loads has been a major concern of American Association of State Highway and Transportation Officials (AASHTO) and the bridge engineering community for decades. In recent decades, a considerable amount of efforts were devoted to earthquake and wind effects and also extended to other hazards, such as scour, storm surge, vessel and vehicular collisions, etc. (Huang et al., 2014;

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