# BRIDGE APPLICATION OF LOAD & RESISTANCE FACTOR RATING

# USING SITE SPECIFIC DATA

by

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## ABSTRACT

Highways play a significant role in the nation's economy. Bridges are a very important part of the highway system. As transportation needs increase and the bridges continue to age and deteriorate, while maintenance and repair operations are deferred due to limited budgets, more and more bridges are classified as structural deficient. This makes accurate condition assessment very important for bridge engineers to effectively manage their bridge inventory. Although the newly emerging AASHTO load & resistance factor rating (LRFR) method for bridges can lead to consistent and uniform safety, its factors are derived from conservative traffic and multiple presence assumptions, and not based on site-specific information. This research proposes a live load probabilistic model based on site-specific data, which allows the elimination of a substantial portion of live load effect modeling uncertainty. Random occurrence rate of peak loads, Bayesian updating of measurement uncertainties and modeling errors are considered. Gumbel distribution is found to fit the projected maximum live load very well. Sensitivity studies show the projected maximum live load is not sensitive to the threshold strain above which events are recorded, as long as the threshold is sufficiently high. The proposed live load model is used to derive reliability-based rating equations – both for one specific bridge as well as for an inventory of bridges. Sensitivity studies of resistance, dead load and live load on the rating factor (RF) are conducted. The relationship between reliability index and RF is then investigated. The proposed rating method can easily take into account the effect of deterioration. The proposed methodology is illustrated using two slab-on-

steel girder bridges on I-95. Site-specific bridge response data (peak live load strain) are collected using an In-Service Bridge Monitoring System developed at the Center for Innovative Bridge Engineering at the University of Delaware. The results are compared to the RFs from traditional methods.