



Consequence-based Management of Railroad Bridge Networks

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ABSTRACT

To increase overall profitability, add capacity to rail operations to meet projected needs, and comply with new federal regulations on bridge safety, North American railroads are exploring means and methods to improve the management of their bridge networks. Current maintenance, repair, and replacement (MRR) decisions are informed by bridge inspections and ratings. Inspection and rating practices recommend observing the response of bridges under revenue traffic. However, an objective relationship between bridge responses, bridge service state condition, and the associated impact to railroad operations has yet to be established. Moreover, measuring responses while trains are on the bridge can be quite challenging, and sometimes may not be possible. As a result, current MRR decisions are in general conservative, prioritizing decisions to overcome the uncertainty of consequences of inaction. If the consequences of MRR decisions could be better determined, then the railroads could more effectively allocate their limited resources. This paper develops an approach for consequence-based management of bridge networks, adopted from the field of seismic risk assessment, for making MRR decisions on a network-wide basis. Critical to the framework is the ability to assess bridge service condition. The proposed framework employs fragility curves to this end, relating service condition limit-states to bridge displacement under revenue service traffic. The expenses associated with these service conditions can be used to estimate the total costs of a given MRR policy. In this way, MRR decisions can be prioritized, minimizing the total expected cost to railroad operations. Additionally, measured bridge data can be used to update periodically the fragilities to have more accurate estimates of the bridge condition. This framework provides a consistent approach for intelligent management of railroad bridges, and more specifically, for the prioritization of railroad bridge MRR decisions. Using this framework the rail owner can identify the most efficient use of a limited budget while maintaining safe railroad operations.

KEYWORDS: *bridge maintenance, railroad bridges, monitoring, fragility, assessment, decision making*