ABSTRACT

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Title: A Benchmark for Evaluating Performance in Visual Inspection of Steel Bridge Members and Strategies for Improvement
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Visual inspection is the primary means of ensuring the safety and functionality of in-service bridges in the United States and owners spend considerable resources on such inspections. While the Federal Highway Administration (FHWA) and many state departments of transportation have guidelines related to inspector qualification, training, and certification, an inspector's actual capability to identify defects in the field under these guidelines is unknown. This research aimed to address the knowledge gap surrounding visual inspection performance for steel bridges in order to support future advances in inspection and design procedures. Focusing primarily on fatigue crack detection, this research also considered the ability of inspectors to accurately and consistently estimate section loss in steel bridge members.

Inspection performance was evaluated through a series of simulated bridge inspections performed in representative in-situ conditions. First, this research describes the results from 30 hands-on, visual inspections performed on full size bridge specimens with known fatigue cracks. Probability of Detection (POD) curves were fit to the inspection results and the 50% and 90% detection rate crack lengths were determined. The variability in performance was large, and only a small amount of the variance could be explained by individual characteristics or environmental conditions. Based on the results, recommendations for improved training methods, inspection procedures, and equipment were developed.

Long term, managing agencies may eschew traditional hands-on inspection methods in favor of emerging technologies imagined to provide improved results and fewer logistical challenges. This research investigated the potential for unmanned aircraft system (UAS) assistance during visual inspection. Using the same specimens as in the hands-on inspections, four UAS-assisted field inspections and 19 UAS-assisted desk inspections were performed. A direct comparison was made

between performance in the hands-on and UAS-assisted inspections, as well as between performance in the two types of UAS-assisted inspections. Again, significant variability was present in the results suggesting that human factors continue to have a substantial influence on inspection performance, regardless of inspection method.

Finally, to expand the findings from the crack detection inspections, the lower chord from a deck truss was used to investigate variability in the inspection of severely corroded steel tension members. Five inspectors performed a hands-on inspection of the specimen and four engineers calculated the load rating for the same specimen. Significant variability was observed in how inspectors recorded thickness measurements during the inspections and engineers interpreted the inspection reports and applied the code requirements.