ABSTRACT

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Title: Evaluation of Fatigue Life in Built-up Steel Members Subjected to Crevice Corrosion

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Corrosion is a particularly deleterious phenomenon occurring in steel bridge structures and often attributed as having the single greatest impact on a structure's ability to continue to safely serve its intended purpose. Accordingly, engineering assessments of aging steel structures often require quantifying corrosion induced damage which can ultimately result in a reevaluation of the structure's capacity. These evaluations often attempt to consider many interdependent limit states such as strength, fatigue, redundancy, and extent of damage/degradation to assess the structure's fitness. Unfortunately, there is little research and codified guidance on how to address the effects of corrosion.

Crevice corrosion (i.e., pack-out) is a type of corrosion occurring in steel built-up members on the internal surfaces between fastened parts which is often not directly observable at the beginning of the corrosion process. The telltale indications include, rust stains emerging from between surfaces or corrosion product deposition and buildup where the surfaces meet at an exterior edge. In extreme cases, through thickness section-loss with the associated buildup of corrosion product may pry apart the surfaces, plastically deforming one or both of the parts in contact.

To address the lack of guidance with respect to the effects on fatigue life, the project consisted of three primary phases of work; experimental laboratory testing, in-situ monitoring, and numerical analyses. The experimental work subjected four specimens, with crevice corrosion to loading cycles in excess of a 95% probability of developing fatigue cracks, to no effect. In-situ monitoring was conducted, measuring stresses in crevice corroded elements with real traffic loads. The numerical study explored additional geometries, assessing the fatigue behavior attributable to crevice corrosion.

The culmination of those efforts has resulted in a proposed simplified analysis approach. A method utilizing dimensional parameters to characterize the extent of corrosion damage, in

order to amplify the net-section stress to an effective net-section stress, for fatigue evaluations utilizing the currently available methods.