# ABSTRACT

Primary causes of structural deficiencies in steel girder bridges include deterioration due to corrosion. Corrosion at steel girder ends is often caused by deicing salts mixed with water that leak through expansion joints, accelerating deterioration in the girder ends. This leads to a loss of cross-sectional area, reducing structural resistance to shear and bearing. This dissertation investigates the impact of corrosion on the structural capacity of steel girders, with a focus on improving inspection and assessment procedures.

Large-scale experiments were conducted on steel girders with three types of end configurations: unstiffened ends, ends with full-depth bearing stiffeners, and ends with partial-depth transverse connection plates. These experiments provided critical insights into failure modes, deformation characteristics, and strength degradation in shear and web local crippling capacities due to corrosion-induced section loss. The findings highlighted the sensitivity of different failure modes to strength reduction, influenced by the length, height, and extent of the section loss, with significant differences observed across the various girder end configurations.

Finite element models were developed and benchmarked against experimental results to capture failure modes, load-bearing capacity, and force-displacement behavior. Parametric analysis was conducted using these benchmarked models to understand the impact of different corrosion parameters on the strength of corroded steel girders. Reduction factors for practical residual strength estimation were developed from regression analysis of the parametric study results.

Photogrammetry was employed to reconstruct 3D models of steel girders with section loss. Thickness measurements from the 3D models were validated against ultrasonic thickness gauge results. Finite element models utilizing the thickness measurements from these 3D point cloud models were developed to estimate the strength of the steel girder, and these estimates were validated against experimental results.

In conclusion, this research advances the understanding of the impact of corrosion on the strength of steel girders and contributes to the advancement of inspection and assessment procedures for corroded steel girders.

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