Research Project Summary

In-Service Structural Evaluation of Overhead Box Beam Sign Structures

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Start-End Dates:
06/01/2022 – 11/30/2024

Abstract
Caltrans maintains thousands of Box-Beam Overhead Sign Structures along its right of way. These structures have a history of problems with corrosion damage, especially at the connections of the ribbed sheet steel vertical diaphragms. The objective of this project is to quantify the relationship between the corrosion of sign structures and the corresponding strength loss and to develop a mapping between these quantities. The project uses a variety of methodologies, including numerical simulations with detailed Finite Element (FE) models including model updating using optimization algorithms; experimental simulations with full scale testing of sign structures; field testing of sign structures with vibration data collection and system identification; and vision-based AI methods to detect corroded locations from images. These simulations are conducted on actual sign structures in California: one in Northern California near the city of Davis, and another one in Southern California near Seacliff, Ventura. The Seacliff sign structure was removed from its location because of aging and brought to the PEER structural laboratory for testing. In the final phase of the study, tests that will be conducted on the corroded sign structure and an identical corrosion-free structure, along with the corresponding post-test simulations, will be employed to establish the relationship between several corrosion indices and strength loss.

Deliverables
The results of this project will be presented in a Caltrans report, PEER report, MS thesis, various journal and conference publications, and presentations at the PEER annual meeting and other technical conferences and workshops. In addition, there will be a fully developed and validated FE model of the sign structure that will facilitate conducting additional simulations and will serve as a reference for the monitoring and inspection for other sign structures.

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Research Impact

Caltrans Structures Maintenance and Investigation (SM&I) Division performs field inspections on approximately 16,000 overhead signs. Due to constraints on time, resources, equipment, and traffic, the inspections have not been able to perform detailed assessment on the corrosion issues. The findings of the project and the established mapping between corrosion and strength loss are expected to inform guidelines on how to interpret these inspections for assessing the strength loss and the remaining strength of sign structures. This will increase the efficiency and effectiveness of asset management, and facilitate important decision making, such as prioritizing the structures to be replaced, repaired, or retrofitted.

Project Images
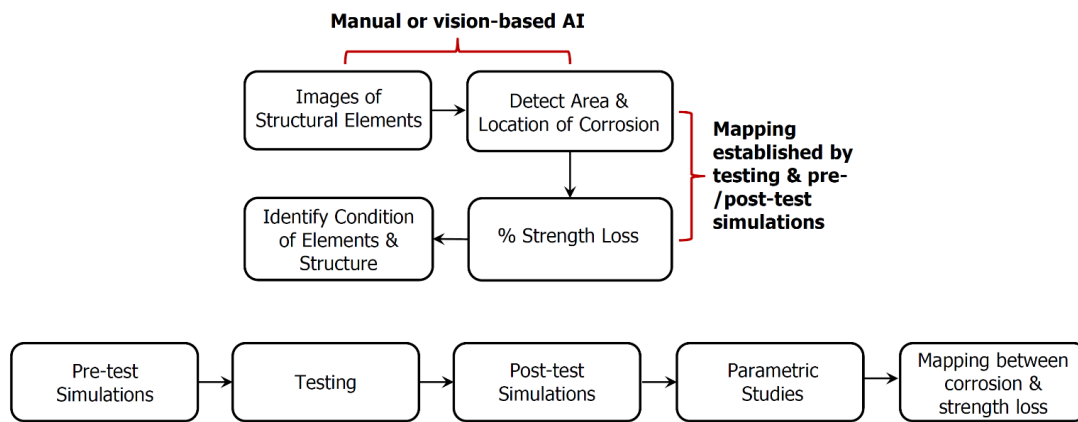
Workflow of establishing the mapping between corrosion and strength loss and use of this mapping in the sign structure condition assessment framework
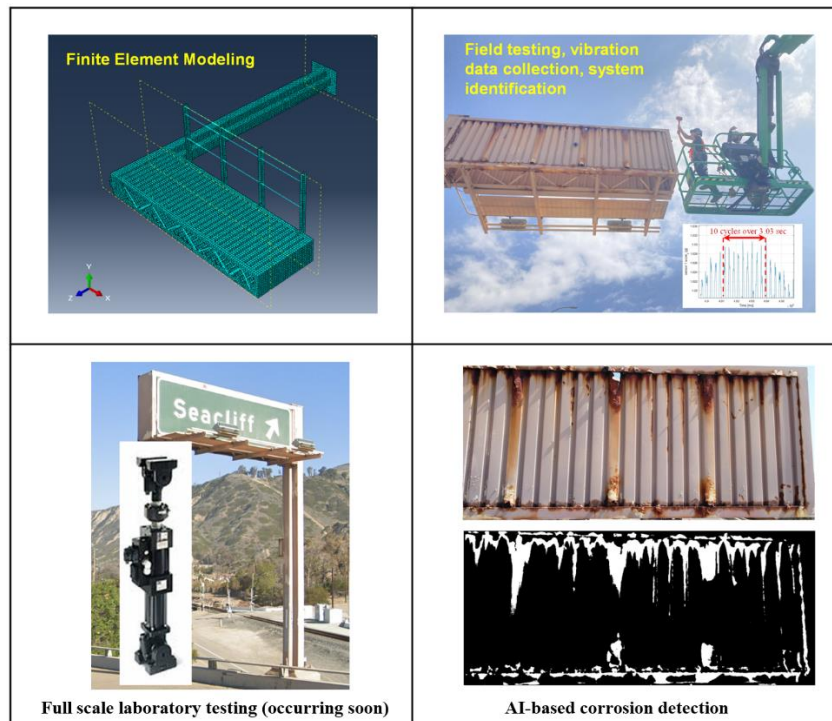
Methodologies developed for achieving the project objectives