Texas A&M Transportation Institute

PROJECT SUMMARY

Texas Department of Transportation

0-7040: EVALUATION OF CORROSION PREVENTION AND MITIGATION APPROACHES USED ON TEXAS BRIDGES

Background

Corroded steel members cause significant risk to the durability of steel and reinforced concrete bridges in Texas. Prevalent corrosion prevention and mitigation strategies that are employed on state bridges include (a) corrosion-resistant materials such as weathering steel and painted steel elements for steel girders, and (b) epoxy-coated rebar (ECR) and high-performance concrete (HPC) for reinforced concrete decks. The Texas Department of Transportation spends millions of dollars for repair and maintenance of steel and concrete bridges every year; thus, a comprehensive study is essential to evaluate the corrosion resistance of these structures across the state.

What the Researchers Did

The researchers created and validated a Texas corrosion risk assessment map (Figure 1) based on corrosion modeling in which Region 1 corresponds to a low risk of corrosion and Region 6 corresponds to a high risk of corrosion. To assess corrosion prevention and mitigation techniques applied on steel and concrete bridges, over 100 bridges were inspected in depth throughout the state. This inspection included conducting visual inspection and nondestructive evaluation as well as taking concrete cores of these structures. In addition, concrete, steel, paint, and rust samples were collected from the inspected structures for the purpose of conducting further studies and detailed laboratory examinations. A metric was developed to rank the current corrosion and prevention mitigation methods employed on Texas bridges. The researchers developed a decision tool for effective corrosion prevention and mitigation in different regions in Texas and, finally, developed a tool to project the service life of weathering steel bridges.

What They Found

Researchers found the following:

- Weathering steel produces a protective patina in low to moderate corrosive environments. In regions with higher corrosion risks, the patina of weathering steel might be inactive or active (Figure 2).
- A properly maintained Paint System III (consisting of an inorganic zinc primer and epoxy coatings) is preferred over weathering steel in regions with high risk of corrosion. An example of the failure of a paint system is shown in Figure 3.
- A combination of black rebar and concrete with the use of a concrete surface treatment shows reasonable corrosion resistance in low corrosive regions.
- In highly corrosive environments, a combination of ECR with additional mitigation methods such as high-performance concrete (HPC) proved an effective approach to decreasing corrosion activities in reinforced concrete.

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- ECR is recommended in the bottom layer of concrete decks for bridge overhangs.
- The quality of the epoxy layer of ECR varies. Better quality control for ECR is recommended.

What This Means

Proper design of corrosion prevention and mitigation strategies for the particular corrosive environment can ensure the long-term durability and service life of bridges, as well as reduce risks associated with corrosion failures of bridge components. It can further save the state millions of dollars on repair and maintenance of these structures.

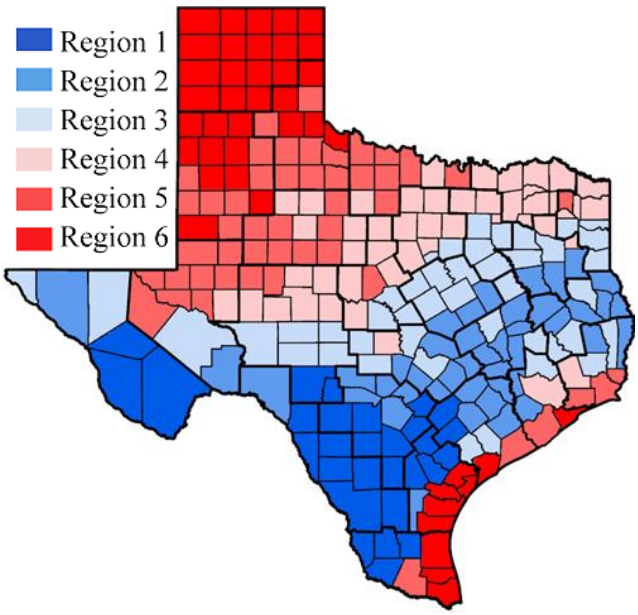

Figure 1. Texas Corrosion Risk Assessment Map.

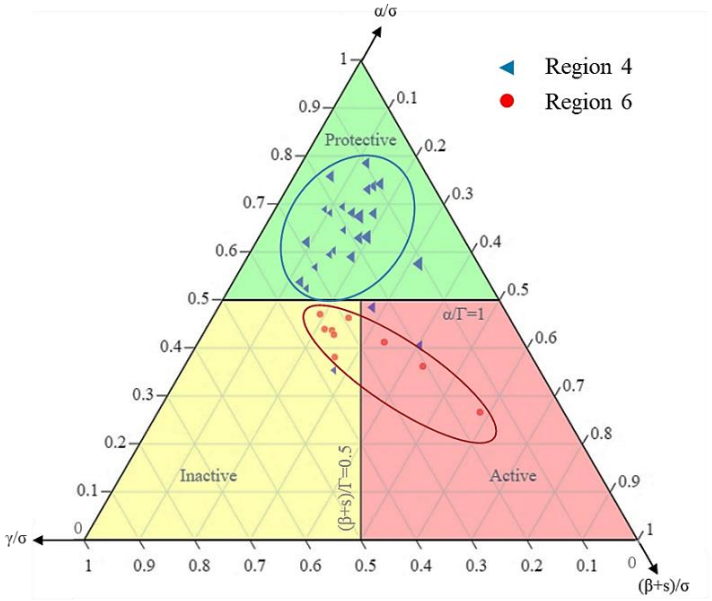

Figure 2. Condition of Protective Patina.

Figure 3. Corrosion on Painted Steel Girder.

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