Research Brief

Wisconsin Highway Research Program
Project 0092-24-02
July 2025

Investigation of MSE Wall Corrosion in Wisconsin

Objectives

- Assess steel reinforcement condition of MSE wall
- Evaluate electrochemical and geotechnical properties of the backfill material
- Determine the remaining life service of the MSE wall
- Evaluate WisDOT's design and maintenance practices relative to corrosion of buried steel
- Provide recommendations to enhance long-term durability and safety of MSE walls

Benefits

- Improve design and maintenance practices for MSE walls
- Provide recommendations to enhance long-term durability and safety of MSE walls

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Background

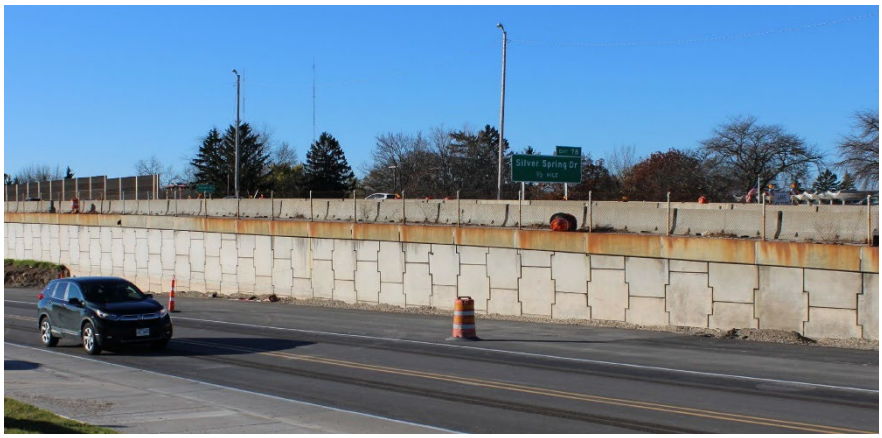
Mechanically Stabilized Earth (MSE) walls play a crucial role in transportation infrastructure due to their cost-effectiveness, ability to tolerate deformations, and higher resistance to seismic loading than rigid concrete wall structures, among other advantages. These walls typically consist of metallic or geosynthetic reinforcing layers that provide tensile strength to the backfill and facing elements. While MSE walls are intended for long-term performance, the durability of their steel reinforcements is a key factor influencing their service life. When embedded in soil, steel reinforcements are susceptible to corrosion due to electrochemical interactions with the surrounding backfill.

As part of a highway widening project, WisDOT planned to remove an MSE wall along I-43 in Glendale, Milwaukee County, in 2024. The MSE wall, built in 1992, was reinforced with galvanized steel strips.

Methodology

Geocomp was contracted by WisDOT and performed a field investigation and analysis of this MSE wall. Geocomp investigated five 10 feet by 15 feet excavation sections (1 through 5) along the MSE wall by carefully deconstructing its components. The wall height decreased, and distance from the bridge increased, from Section 1 to 4. Section 5 was a shallow trench between Sections 1 and 2.

Their testing included field soil resistivity, gradation, moisture content, pH, Atterberg limits, Proctor, direct sheer, chloride content, sulfate content, galvanized coating and steel thickness and corrosion loss measurements.



MSE Wall along I-43 in Glendale, Milwaukee County constructed in 1992

"This research showed salt use and pavement condition are key factors that were not were not previously used to determine the condition of wall elements. This new information will allow the department to add crucial information to the department's toolbox for designing and maintaining the MSE wall inventory and allow us to develop better risk matrices to manage that inventory." –

Steve Doocy, WisDOT

Results

The study's findings emphasize the critical impact of pavement distress and salt intrusion on the deterioration of MSE wall reinforcements. Overall, the data show that corrosion loss decreases with increasing depth of the reinforcing straps. The results show significant corrosion in metal straps at shallow depths, while minimal to no corrosion was observed beyond a depth of 10 feet. Additionally, metal straps in sections closer to the bridge, where the wall is taller, show higher corrosion levels. Field investigations revealed that moisture and salt intrusion through pavement cracks and joints likely altered the backfill electrochemical properties over time, creating a highly corrosive environment.

Geocomp excavations uncovered elevated chloride levels in the reinforced backfill and significant corrosion loss, as indicated by pitting corrosion loss as high as 90% of the strip's cross-sectional area in some locations. The excessive corrosion loss of metal strips extended to a depth of up to 13 feet from the top of the MSE wall. Deterministic stability analyses indicated that, had the MSE wall remained in service, an internal failure was highly probable within 10 to 15 years.

Recommendations for Implementation

Geocomp made several recommendations for design and construction practices to reduce corrosion including:

- Use non-aggressive fills in the reinforced zone, use galvanized coated reinforcements, and design the reinforcements with a sacrificial thickness
- Design the pavement cross slopes to force and manage the surface water to flow away from the reinforced zones
- Ensure uniform compaction of the backfill around the MSE wall to minimize differential settlement in fill
- Use impervious membranes and drainage systems to mitigate the intrusion of de-icing salts and chemicals into the backfill
- Design a dedicated drainage system for the bridge and its approach slab to prevent water infiltration into the backfill
- In the absence of other design modifications, the upper rows of reinforcement straps are more exposed to excessive corrosion. Increasing the sacrificial thickness of these upper rows could extend the service life
- Regularly maintain pavement surfaces and drainage structures to prevent salt and moisture intrusion
- Give special attention to pavement directly above the reinforced zone, ensuring cracks and joints are routinely sealed

Interested in finding out more?
Final report is available at:
WisDOT Research website

This brief summarizes Project 0092-24-02
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