NEBRASKA
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DEPARTMENT OF TRANSPORTATION

RESEARCH SUMMARY

Where concrete barriers and metal guardrails meet, AGTs provide important safety features in the event of a crash.

New Guardrail Transition Designs Incorporate Existing Infrastructure To Save Time And Money

An overlay applied to the surface of a bridge is a cost-effective strategy that the Nebraska Department of Transportation (NDOT) commonly uses to extend the bridge's service life. However, a typical overlay can raise the height of the road by a few inches, which, depending on the age and design of the bridge, can affect the transition points between the guardrail and concrete barrier. To avoid modifying or replacing the concrete structures and minimize costs, NDOT developed a retrofit attachment design that will allow the agency to continue to use the existing guardrail infrastructure while ensuring it meets current federal safety requirements.

THE CHALLENGE

Across the United States, bridge surfaces are exposed to a variety of weather conditions that can make them susceptible to cracking and deterioration over time. To repair the damage and increase the service life of its aging bridge decks, NDOT often applies an asphalt overlay on the existing bridge surface. While this strategy offers a cost-effective alternative to more expensive and time-consuming rehabilitation options, an overlay can raise the bridge surface height by 2 to 3 inches. This action essentially lowers the height of the guardrails and concrete barriers adjacent to the bridge that have been designed and installed according to exacting federal safety standards.

"Thanks to this project, NDOT will save time and money on its bridge repairs, and the standardized construction process will allow workers to get the job done faster and in a safer manner."

— Emilie Hudon, Nebraska DOT

In the event of a crash, approach guardrail transitions, or AGTs, provide important structural integrity where the concrete and metal guardrail structures meet. Like other transportation safety hardware, these connection points have been designed and developed over time through rigorous crash testing and serve a critical role in reducing impact severity and maximizing safety.

However, AGTs are typically designed to be compatible with 34-inch-tall guardrails. When a 3-inch overlay is added to the bridge's surface, it effectively makes the guardrails only 31 inches high. As a result, the connection hardware may not align properly or perform effectively in a crash.

To ensure that Nebraska's existing guardrail systems can continue to meet critical safety requirements without the need for replacement or significant alteration after an overlay has been applied, NDOT sought to develop retrofit AGT designs that incorporate existing hardware.

THE RESEARCH

The project began with a review of 10 bridge rail configurations commonly used in Nebraska. The research team evaluated each of these to identify any safety concerns with the connection hardware and crash safety performance, and then replicated each configuration in a digital model to design retrofit options. Design solutions were developed for six bridge guardrail structures. Each design was subjected to simulated crash tests to ensure it performed as expected and would make the 31-inch guardrails compliant with federal safety standards.

THE RESULTS

NDOT is already implementing the knowledge gained through this research and realizing substantial time and cost savings. Before this project, NDOT had to completely remove and reconstruct its concrete bridge barriers when an asphalt overlay was placed on the bridge. Now, the new connections can be installed on the existing infrastructure without any significant modifications.

THE BENEFITS FOR NEBRASKA

Without the need to replace or modify its existing guardrails or barriers every time an overlay is placed on a bridge, NDOT can expect to save more than $500,000 per year. Additionally, the standardized process for retrofitting AGTs can be completed quickly at each bridge site, increasing safety for NDOT's construction workers and reducing travel disruptions to the public.

This research project was so successful that it was honored with a prestigious 2025 High Value Research Award from the American Association of State Highway and Transportation Officials. Details of the research were also presented at the Transportation Research Board's Annual Meeting in January, where thousands of transportation professionals from around the world gathered to learn and share their innovative approaches to everyday challenges.

ABOUT THIS PROJECT

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