Installing partially grouted revetment underneath bridges can be a cost-effective strategy to prevent scour.

RESEARCH SOLUTIONS

Evaluating partially grouted revetment to prevent bridge scour

A primary cause of bridge failure is bridge scour, which occurs when fast-moving water erodes the foundations of bridges. Countermeasures to prevent or protect bridge foundations from erosion are often costly, especially for local agencies that are already operating on limited budgets. Partially grouted revetment, also known as partially grouted riprap, is a relatively new and affordable alternative to treating bridge scour. To better understand the cost-effectiveness of this option, researchers compared the performance and cost of existing scour countermeasures, including partially grouted revetment.

THE NEED

Bridge scour causes 60 percent of bridge failures in the United States. In Iowa, many low-volume bridges are susceptible to scour or the condition of their foundations is unknown. Mitigating scour and maintaining bridge integrity often require expensive countermeasures, which can be challenging for many local agencies faced with competing demands on resources.

Partially grouted revetment is a low-cost alternative to address bridge scour. This countermeasure places rock, stone, or recycled concrete on a subsoil-compatible filter layer and then fills approximately 50 percent of the space between sediment pieces with a portland cement-based grout material. Partial grouting is effective because it adheres the sediment into one structure but allows for flexibility to conform to the subsurface. This research project monitored pilot installations of partially grouted revetment to provide Iowa DOT

(continued)

"Partially grouted revetment offers county engineers an affordable and effective countermeasure for bridge scour."

— **BRIAN KEIERLEBER,**
Buchanan County Engineer

and county engineers with valuable information about the effectiveness, appropriate use, and proper installation of this countermeasure.

RESEARCH APPROACH

This project's goals were to document and analyze the performance and cost of existing scour countermeasures, install and analyze the performance of partially grouted revetment pilot projects, and develop best practices for implementing scour countermeasures.

A literature review identified and analyzed scour countermeasures, including conventional riprap, fully grouted riprap, partially grouted riprap, articulating concrete block systems, concrete armor units, gabion mattresses, and grout-filled mattresses.

A survey of county engineers in Iowa and other states gathered information about the use and effectiveness of countermeasures they have employed. The survey results identified countermeasures for further analysis.

Partially grouted revetment was installed at four pilot project sites in Buchanan, Madison, Wayne, and Woodbury counties. Installations of the countermeasure varied to determine the best design, placement, and installation methods. Evaluations of the sites occurred after approximately five years of service.

WHAT IOWA LEARNED

Overall, partially grouted revetment is the preferred countermeasure when considering both cost and performance. Results of the pilot projects indicated satisfactory performance. While loose sediment is currently the most widely used countermeasure because of its low cost, partially grouted revetment offers an increase in performance, which outweighs its higher cost.

The pilot installations of partially grouted revetment offered valuable lessons for future use and installations. Recommendations and best practices from this effort include using a hose smaller than 4 inches in diameter when placing grout, controlling the flow of the grout to ensure efficient placement, mixing the grout to the appropriate consistency so that it settles well between the sediment, installing the countermeasure before bridge deck placement when used in new construction, and avoiding placing the partially grouted revetment in water.

PUTTING IT TO WORK

Low cost and effective performance make partially grouted revetment a preferred countermeasure for bridge scour. This study produced recommendations and best practices for future installations. Disseminating these recommendations and best practices to local agencies will provide county engineers with an affordable and effective countermeasure for bridge scour.

ABOUT THIS PROJECT

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