Research Project Name: Optimizing SEAHIVE® solutions to mitigate bridge scour (TXST)

Improving the Durability and Extending the Life of Transportation Infrastructure

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Federal: $81,841 Match: $42,026 (TXST)

Project Start Date: 01/01/2026 **Project End Date**: 12/31/2026

Project Description: Bridge scour remains the top cause for bridge failure in the US. When scour is observed during bridge inspections, a plan of action must be established to ensure the safety of the traveling public. Bridge failure is obviously costly, however, scour mitigation and monitoring are additional costs for the life cycle of the structure. Scour is additionally challenging to predict and unforeseen changes in the hydraulic load (both in direction and in magnitude from extreme events) can further exacerbate bridge scour. This research is the next phase of TXSTs effort to implement SEAHIVE® elements for scour mitigation. SEAHIVE® is an engineered protection system composed of concrete hexagonal prisms. Perforations on the side faces of the elements provide passage for water flow, dissipating the energy within the system while also adding structural complexity to improve its potential for habitat creation. SEAHIVE® is under research and development at the University of Miami (UM) for wave energy dissipation. TXST conducted experimental and computational studies on a horizontally stacked three-unit SEAHIVE® system. A three-unit system placed three pile diameters in front of a monopile reduced the scour magnitude by 70.2% and volume by 94.1%. The configuration also reduced tangential velocity by one-third and vertical velocity by 80%, effectively weakening vortex strength and minimizing local scour. A limitation of the first phase is the SEAHIVE® system was continuous in that it extended edge-to-edge across the TXST flume and in the computational model.

The objective of this research is to expand the analysis to more realistically simulate field-scale challenges and to establish baseline design parameters towards testing a prototype system in the O.H. Hinsdale Wave Research Laboratory at Oregon State University (OSU). The calibrated coupled hydrodynamic-morphodynamic model in Open FOAM will be used for further analysis to include studying the effects of: soil density, flow height, velocity, and SEAHIVE® length to pier diameter ratios. Additionally, in this phase we will analyze vertical SEAHIVE® systems, including a SEAHIVE® skirt around the monopile and a SEAHIVE® wall. Such data are needed more fully understand the practical boundaries of SEAHIVE® as an effective green-gray scour counter measure and design the prototype scale experiments in the OSU flume.

US DOT Priorities: *Section left blank until USDOT's new priorities and RD&T strategic goals are available in Spring 2026.*

Outputs: The results of this research will be used to guide a prototype project. This prototype may be evaluated in the OSU O.H. Hinsdale Wave Research Laboratory, allowing for a larger model test. We will seek partnerships with our DOTs (Florida and Texas) to identify partnership opportunities for a prototype on a scour critical bridge that can be instrumented to evaluate the

full-scale efficacy. We will also engage state and local bridge owners to explain the market and potential benefit of this technology concurrently with the research project.

Outcomes/Impacts: Bridge scour is the number one cause of bridge failure. The outcome/impact of mitigating or eliminating bridge scour using SEAHIVE® elements is enhanced bridge durability. Numerous drivers have perished due to bridge scour when the bridge failed while in use. The use of SEAHIVE® elements to mitigate bridge scour would also result in significant cost savings by reducing unnecessary foundation depths due to predicted scour, removing the need for rapid scour stabilization, and/or bridge repairs following structural deficiency ratings.

Final Research Report: URL to final Report will be provided upon completion.