Research Project Name: Novel surge barriers for coastal protection (TAMU)

Improving the Durability and Extending the Life of Transportation Infrastructure

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Project Partners: N/A

Research Project Funding:
Federal: $60,000 Match: $30,000 (TAMU)

Project Start Date: 01/01/2026 **Project End Date**: 05/31/2027

Project Description: Surge barriers are large hydraulic structures designed to protect infrastructure from coastal storm surges and high tides. Preventing surges from moving into bays and estuaries minimizes the need for other expensive elements of a flood control system, such as levees and floodwalls. Surge barriers can provide cost-effective protection critical transportation infrastructure, such as ports, roads, and bridges. Conventional surge barriers comprise a fixed structure with movable vertically or horizontally opening gates that can be closed during extreme storms and tidal events. Disadvantages of fixed barriers include high cost, sensitivity to waste and silt, potential debris blockage, and constraints to marine traffic. Temporary surge barriers can avoid these disadvantages. This research evaluates three novel temporary barrier concepts: flexible membrane barriers, sinkable floating barriers, and shade curtain barriers. Flexible membrane barriers are self-deploying and permanently located on shore. Buried when not deployed, they rise with rising water due to their buoyancy. Sinkable floating barriers rest on the seabed when not deployed and, when needed, are raised to the surface by pumping air into a tube. Shade curtains are fabric barriers attached to an existing bridge. When not deployed, it is secured to the underside of the bridge deck. In advance of a surge, the fabric curtain is lowered using a sinker-cable system to provide a vertical barrier extending from the bridge deck to the seabed. Hydraulic loads are transmitted from the barrier to the bridge and its foundations, which must be capable of resisting the added loads. This project addresses three key issues related to temporary surge barrier deployment: site conditions for which temporary surge barriers are appropriate, hydraulic loading on the barriers, and structural/geotechnical design considerations for the barriers.

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

Outputs: Outputs from three research phases are planned for the concepts described above. Phase 1 will screen out design configurations that, even if technically feasible, would be unacceptable based on non-technical considerations. This research will be based on literature reviews and interviews with coastal protection authorities. Phase 2 will quantify the hydraulic loads on the barriers. These estimates will be guided by existing storm surge risk maps for the Texas coast. Wave forces are in addition to the hydrostatic loads imposed by water level rise; they will be estimated from basic principles of wave mechanics supplemented by previous wave tank studies specifically directed toward these types of barriers. Phase 3 will quantify load demand on structural and geotechnical systems. The first two concepts, flexible membrane and sinkable floating barriers, transmit loads directly to the seabed via cables. In these cases, the

problem is mainly geotechnical, requiring the identification of a suitable anchor type and size to resist the hydraulic loads. The third barrier concept, the shade curtain, transmits hydraulic loads through the bridge structure to the foundation, usually piles or piers. Technical evaluation of this concept will include estimates of added load demand on the bridge deck, piers, and foundation elements. The need and extent to which the bridge structure and foundations require reinforcement will be the major question to be addressed in the evaluation of this surge barrier concept.

Outcomes/Impacts: The output from Phase 1 will be a design guidance report for identifying when temporary surge barriers are appropriate. The Phase 2 output will provide recommendations for estimating hydraulic loads on surge barriers. Output from Phase 3 will provide design guidance for sizing the anchors needed for the flexible membrane and sinkable floating barrier options. The Phase 3 output will also provide guidance on determining whether the existing bridge foundations can resist the added hydraulic loads imposed by a shade curtain. It is anticipated that the development of the design guidance for temporary surge barriers will involve developing novel solutions for the details of their design and deployment. Depending on the innovation, such solutions can be published for dissemination in the public domain, or they can be put on a path to a patent and commercialization. With numerous publications on geotechnical design and four patents, the PI has successful experience with both approaches. Experience with temporary surge barriers is limited and the shade barrier has not proceeded beyond the conceptual stage. Thus, this research can spur major changes to the practice. Protecting transportation infrastructure from coastal storm surge can be a costly undertaking involving reinforcing existing infrastructure, relocation, or constructing expensive fixed barriers. Surge barriers can provide a unique solution to a problem as cost-effective alternatives.

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