Research Project Name: Coastal and river bridge scour mitigation using hybrid solutions (TAMU)

Improving the Durability and Extending the Life of Transportation Infrastructure:

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Federal: $120,000 Match: $60,000 (TAMU)

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Project Description: Bridge piers, foundations, and abutments in coastal areas or across rivers often face heightened risk of detrimental scour development under wave and/or current loading. Along our coastlines bridges are part of essential evacuation routes, saving lives ahead of predicted storm impacts with life-threatening consequences if compromised. Further inland, many bridges across creeks and rivers that are part of rural transportation systems and low-volume road networks afford equally important transportation connections. When disaster strikes and these structures are compromised – as was painfully demonstrated in the recent Central Texas flash flood disaster – entire communities are cut-off from relief help or means to recover quickly.

In most instances, bridge failure is initiated through hydraulically-induced scour formation and growth at the interface of the structural components and the surrounding sediment. If scour issues can be predicted and mitigated early, catastrophic failure can be avoided. The problem is that traditional mitigation techniques are costly or, in the case of rural bridges, may not even be included in the design. Here, we plan to test low-cost hybrid mitigation techniques that can help reduce scour impact to bridges caused by wave or current impact by using bio-cementation (such as Microbially-Induced Calcium Carbonate Precipitation - MICP) and/or geosynthetics in combination with the in-situ sediment.

Proposed Research: We plan the following tasks to address the efficacy of these solutions to reduce scour:
Task 1: Assess existing technological options for coastal and riverine bridge scour protection. This will be done via an in-depth literature review on scour protection with the goal of identifying various options, their advantages and limitations.
Task 2: Conduct physical model wave flume scour tests with wave and/or current loading for different low-cost, hybrid scour protection combinations including MICP and geosynthetics in tandem with the in-situ sediments.
Task 3: Develop scour prediction equations based on the conducted physical model tests that can be used to assess the efficacy of the hybrid solutions for use in coastal and riverine bridge systems.

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

Outputs: The findings of this study will be described in detail in journal and conference publications at the Transportation Research Board annual meeting. In addition, a workshop for interested federal, state, and local organizations involved in designing coastal and riverine bridge scour protection (e.g., TxDOT, USACE, TX General Land Office, Local MPOs, etc.) will be held on our campus to transfer the knowledge on applicable technology directly to responsible design agencies for implementation.
Outcomes/Impacts: The data collected as a part of this project will aid in evaluating the feasibility of a low-cost "hybrid" approach – bio-cementation in combination with geosynthetics – to mitigate scour in bridges on the coastline as well as on inland low-volume roads. Low-cost, hybrid bridge scour protection options can help prevent failure of critical transportation infrastructure. In that sense, the durability and service life of existing inland infrastructure is improved. The proposed research benefits local communities by: (i) maintaining critical transportation network connections (inland) and evacuation routes (coastal) and (ii) providing additional means to prevent complete bridge washouts and bridge failures during flood events.
Final Research Report: URL to final Report will be provided upon completion.