Project Requirements Form USDOT
CREATE UTC Contract Number 69A3552348330
Center Lead: Texas State University; Texas State University

Research Project Name: Cracking-resistant Concrete for Durable Coastal Structures (TXST)
Improving the Durability and Extending the Life of Transportation Infrastructure
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Project Partners: Texas Department of Transportation; Oregon State University
Research Project Funding: Federal: $134,318 Match: $87,100 (TxDOT/TXST)
Project Start Date: 09/01/2024 **Project End Date**: 02/28/2026
Project Description: This research project aims to develop a crack-resistant and durable fiber reinforced concrete for coastal structures. The primary objective is to investigate the synergetic utilization of internal curing (IC) materials and recycled steel fibers (RSF) obtained from scrap tires. There have been continuous efforts to utilize IC agents to mitigate shrinkage and associated cracking in concrete for bridge decks. However, studies on using IC materials to control cracks and improve structural performance in concrete pavements are limited. Although lightweight aggregates (LWA) and superabsorbent polymers (SAP) have been used as IC agents, their inclusion can lead to a reduction in the mechanical properties of concrete. The reduced mechanical properties of internally cured concrete can be alleviated by incorporating RSF, which are abundant in the United States. Integrating IC materials with RSF can potentially provide resistance to crack opening and propagation, thereby enhancing the durability of concrete. Furthermore, adding RSF to internally cured concrete could potentially replace (partially or completely) the conventional steel reinforcement in pavement structures.
US DOT Priorities: The project will result in transformational recommendations for how to design and build cracking-resistant coastal concrete structures (e.g., concrete pavements) through a combined use of internal curing agents and recycled steel fibers. Internal curing reduces concrete shrinkage, which can lower the stress level in restrained concrete and potentially reduce the risk of cracking. Additionally, the use of fibers improves concrete toughness (i.e., makes concrete harder to crack) and controls crack width. A combined use of the two techniques will markedly increase concrete cracking resistance. Cracking of concrete is a leading contributor to various concrete durability issues (e.g., steel corrosion) that reduce the life of transportation infrastructure.
Outputs: This research project explores the potential combination of IC agents and RSF to develop cracking-resistant concrete for durable coastal structures. The project is expected to design fiber-reinforced concrete combining IC materials and RSF to mitigate the shrinkage and associated cracking, thereby enhancing the service life of the pavement infrastructures. By the end of the project, detailed guidelines and recommendations on materials selection (types and optimal dosage of internal curing agent and optimal dosage of recycled steel fiber) and mixture design modifications will be proposed. In addition, comprehensive guidelines and recommendations on how concrete materials properties are modified and the implications to coastal concrete structure designs (e.g., concrete pavements) will be proposed. The research

team has an active TxDOT project (0-7172) titled "Developing a Performance-Based Concrete Overlay Mix Design for Improved Resistance to Early-Age Cracking and Increased Durability". The TxDOT project will complement this UTC project and provide a joint effort to develop cracking resistance concrete.
Outcomes/Impacts: The utilization of RSF from scrap tires can potentially replace (partially or completely) the conventional steel reinforcement in continuously reinforced concrete pavement (CRCP) structures. By utilizing recycled steel fibers, which are abundant in the United States, the concrete industry could potentially save millions of tons of manufactured steel fibers (MSF) as well as rebar reinforcement typically used for CRCP applications. This approach promotes sustainable construction practices by reducing the environmental impacts environmental impacts associated with the manufacturing of MSF and rebar. Additionally, RSF is much cheaper, costing only about 10% of the price of MSF and half that of rebar, thereby offering a cost-effective solution.
Final Research Report: URL to final Report will be provided upon completion.