Research Project Name: Analyzing Pre- and Post-Coastal Hazard Pavement Conditions to Optimize Response Strategies for Coastal Infrastructure Durability (TXST)

Improving the Durability and Extending the Life of Transportation Infrastructure

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Project Description: Texas' coastal region stretches over 367 miles along the Gulf of Mexico which is a significant ecological and economic zone encompassing beaches, marshes, estuaries, and barrier islands. This area supports a vibrant tourism industry, international trade, commercial fishing, and energy production, with major ports such as Houston, Corpus Christi, and Galveston playing vital roles. However, Texas' coastline faces increasing risks from natural hazards, necessitating efficient and effective infrastructure response strategies to mitigate impacts and ensure rapid recovery. This research aims to investigate the effects of coastal hazards on pavement conditions and to use network analysis for optimizing pavement infrastructure response, maintenance decisions, and treatment allocation to support coastal communities. The study focuses on Houston which is a key urban center exposed to frequent coastal hazards. Hurricane Harvey was selected as a case study for in-depth analysis.

Initially, the research team will conduct a comprehensive literature review of existing studies focusing on methods used for evaluating pavement conditions before and after coastal hazards. This review aims to identify best practices and effective methodologies for enhancing pavement durability and performance. Following this, the team will analyze historical pavement condition data from Houston before Hurricane Harvey, focusing on different pavement types (ACP, CRCP, JCP) and utilizing statistical models to understand data variability and characteristics. Subsequently, the team will analyze pavement conditions in Houston following Hurricane Harvey. This analysis will involve comparing pre- and post-Harvey data to assess the impact on pavement performance. Statistical methods will be applied to evaluate distress distribution and severity of pavements. Additionally, the research will evaluate the effectiveness of pavement condition analysis models for better maintenance prioritization post-coastal hazards. This step aims to understand how maintenance strategies evolve post-disaster and to enhance decision-making for maintenance planning. The final phase of the research focuses on developing tailored strategies for improving infrastructure durability. This involves reviewing existing strategies including customizing them for Texas' coastal context and assessing their effectiveness through scenario analysis. The expected outcome of this research is to provide valuable insights into pre- and post-coastal hazard pavement conditions in Houston. By leveraging network analysis models, the study aims to inform maintenance decisions that prioritize efficient response measures. The findings will contribute to developing strategies that enhance durability for coastal pavement infrastructure.

US DOT Priorities: The project aligns closely with Priority Area D by directly addressing the goal of enhancing durability to natural disasters, specifically coastal hazards, by assessing the impact of these events on pavement conditions in Houston's coastal areas. Understanding how coastal hazards affect infrastructure, such as pavements, aligns with the priority of preparing transportation systems to withstand and recover from disasters. The project also aligns with multiple USDOT strategic goals. The research aims to optimize infrastructure durability by evaluating changes in pavement conditions pre- and post-coastal hazards. By utilizing network analysis to inform maintenance decisions and treatment allocation, the project supports the USDOT's strategic goal of ensuring robust and durable infrastructure systems. The project will use data-driven analyses to inform maintenance decisions and ensure resources are allocated effectively. Using the automated data collection equipment and conducting comprehensive pavement condition assessments, the project aligns with the USDOT's goal of fostering innovation and employing data-driven approaches to improve decision-making in transportation infrastructure management.

Outputs: Overall, this research will comprehensively assess pre- and post-coastal hazard pavement conditions in Houston using Statistical data analysis models, data processing methods, and advanced pavement condition analysis models, such as outlier reduction, normality check, bootstrapping normalization, probability density function, cumulative distribution function, etc. Through network pavement condition analysis, the study seeks to offer valuable insights for informed pavement maintenance decisions during natural hazards. The study aims to contribute strategies prioritizing appropriate response measures, quicker responses, and increased durability for Houston's coastal infrastructure, benefiting communities facing recurring coastal hazards.

Outcomes/Impacts: The project involves the application of advanced pavement condition analysis models in pavement evaluation, specifically tailored to the environmental characteristics of coastal areas. This aligns with the US DOT Strategic Goal to promote innovation in transportation to improve safety, mobility, and economic competitiveness.

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