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

Research Project Name: Soil Innovations for Enhanced Coastal Infrastructure Durability: Durable Soil Stabilization with Computational Insights (OSU)
Improving the Durability and Extending the Life of Transportation Infrastructure
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Project Partners:
Research Project Funding: Federal: $100,000 Match: $50,000 (OSU)
Project Start Date: 09/15/2024 **Project End Date:** 09/14/2025
Project Description: Problematic soils, such as soils that shrink and swell, weak clays, and silts, are commonly found in coastal areas of the United States. Constructing infrastructure including ports, roads, railways, and pipelines in places with challenging soil conditions can lead to significant damage and early failure during its operational lifespan. The rising sea level has worsened this scenario through more frequent intense storms and storm surges. Hence, ensuring the optimal functioning of coastal structures is crucial for the protection of our coastlines and the communities residing in these areas. The frequent infiltration of saltwater into the stabilized soil material can rapidly degrade its qualities. Restricting the entry of salt-rich water into the stabilized soil material and forming durable products that enhance strength (such as low Calcium C-S-H) will boost the long-term performance. Therefore, there is a need to optimize the current approach for chemical stabilization for the coastal environments, e.g., salt-rich, dynamic pH, moisture fluctuations, and temperature changes. This study will focus on two main objectives: firstly, improving the chemical composition of the stabilizer to encourage the development of strong strength-enhancing compounds (such as low calcium C-S-H) in coastal environments, and secondly, enhancing the density of compacted stabilized soil to reduce the infiltration of moisture and dissolved salts by using the soil modification properties of the stabilizers.
US DOT Priorities: This project aligns with the Priority Area and Strategic Goals of the USDOT by seeking to develop technology to enhance the durability of weak soils around coastal region and making the coastal infrastructure more resilient. The U.S. coast is the site of over 129 million residents and generates $10 trillion in products and services annually. It is essential that coastal infrastructure be both resilient and reliable in the presence of extreme weather events such as hurricanes, sea level rise, and high tide flooding to guarantee the safety of coastal communities and to ensure that they have equitable access to fundamental necessities, including food and medical care. This is also crucial for the safe operation of military bases, airports, power plants, oil refining facilities, and other infrastructure that have been constructed in the vicinity of the coast. The project aligns with USDOT's goals by contributing to the safety and modernization of the transportation infrastructure, addressing the urgent need for resilience in the face of climate change and its effects on coastal regions. **Outputs:** This research project aims to develop pragmatic stabilizers using locally available materials for enhanced durability in coastal environmental conditions. The proposed research will focus on two key components: (1) optimizing the chemical composition of the stabilizer to

maximize the precipitation of durable strength-enhancing products (e.g., low calcium C-S-H) in coastal environment, and (2) achieving high density (reduced potential for moisture and dissolved salt intrusion) of the compacted stabilized soil by leveraging the soil modification properties of the stabilizers. The study's findings will offer suggestions for the selection of stabilizers and the building procedure to be used by local authorities and departments of transportation (DOTs). The study findings will be disseminated through publication in peer-reviewed journals and presentation at national and international conferences, ensuring broad exposure to a professional audience. If the results of the study are promising, field trials in collaboration with Dr. Xijun Shi at Texas State will also be carried out to assess efficacy of this technique for coastal infrastructures resiliency on a large scale.

Outcomes/Impacts: This study will develop pragmatic stabilizers that are more durable in coastal environments using locally available materials. Coastal regions are highly susceptible to challenging climatic conditions, such as flooding, rising sea levels, an increase in the frequency and intensity of storms, high humidity, erosion of coastlines, salinity, and fluctuations in temperature. These factors can significantly impact the durability and effectiveness of traditional construction materials. This study will develop durable stabilizers suitable for indigenous soil supplied from the local area and specifically designed for these areas can provide a more sustainable, cost-effective, and robust solution to infrastructure challenges in these locations. By utilizing indigenous materials that possess inherent resistance to moisture and salinity, the structural stability of transportation infrastructure will greatly improve. Using local resources reduces the costs of shipping and obtaining raw materials from faraway locations. Maintenance is also more economically efficient, as repairs can make use of easily accessible local resources. In addition, the use of indigenous resources promotes economic growth by generating employment opportunities and decreasing reliance on costly imports, resulting in lower project expenses.

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