MarTREC UTC Project Information Form
USDOT Tier 1 University Transportation Center
Agency ID or Contract Number 69A3551747130

Project Title: Bio-Inspired Stabilization of Levee Slope on Expansive Yazoo Clay at the Maritime and Multimodal Transportation Infrastructure in Mississippi
Project Abstract (Brief Description): The existence of Yazoo clay in Mississippi frequently causes distress in Levee and highway embankment slopes, which are an integral component of maritime and multimodal transportation infrastructure. Each year, fixing the slope failure requires significant maintenance budget of the Mississippi Department of Transportation (MDOT) and the US Army Corps of Engineers. The Vetiver grass, which provides root depth up to 10 ft., has been utilized to repair slope failures in many Asian countries and can be an excellent and cost-effective bio-engineered solution to repair shallow slides on the expansive soil in the US. However, the use of Vetiver as a biotechnical solution to stabilize slides on expansive soil is minimal in the US, due to a lack of understanding of the performance. The current proposal is focused to investigate the effect of the vetiver grassroots to stabilize levee slopes at the maritime and multimodal transportation infrastructures at Mississippi. A levee section in U.S. Army Engineer Research and Development Center (ERDC) will be selected as a reference test section. Soil samples from the test section and highway embankment in the Jackson area will be collected. A test box will be built in the lab in JSU, where vetiver grass will be grown. Once grown, vetiver grass and vetiver rooted soil samples will be tested in the laboratory to determine the shear strength properties. A 50 ft. wide section at the test section in ERDC facilities will be prepared to grow Vetiver grass. Another 50 ft. the wide section will be selected as a control section. Both sections will be instrumented using moisture sensors to monitor the moisture movement at field conditions. The test section will be monitored periodically to investigate moisture movement, growth of the vetiver grass and evaluate the performance of the reinforced test section. Extensive numerical analysis using the finite element method will be conducted to evaluate the performance of the vetiver reinforced levee slope. Moreover, the performance of the vetiver reinforced levee slope under different intensity and duration of rainfall will be evaluated using numerical analysis. The laboratory test results, field monitoring, and numerical analysis results will be combined to evaluate the performance of the vetiver reinforced slope on Yazoo clay. The study will help to improve the bio-inspired slope repair technique which will help to mitigate the recurring shallow slopes failures in expansive soil which is common in many miles of maritime and multimodal transportation infrastructure such as levees and highway embankment in Mississippi.
Describe Implementation of Research Outcomes (or why not implemented) - Place any photos here *To be determined upon conclusion of the project*: The major outcome of this project is a. The effectiveness of the slope repair system using deep rooted grass, and b. The performance of the vetiver grass reinforced slope in field scale and c. Understanding the behavior of the vetiver reinforced levee slopes subjected to different rainfall intensity. The waterway levees are major components of the Maritime and Multimodal Transportation system. The findings of the research, which include laboratory investigation, field scale monitoring and extensive advanced finite element analysis of vetiver reinforced levee slope will improvise understanding of the Bio-Inspired Slope repair technique using Vetiver Grass. According to Federal Highway Administration (FHWA), expansive soils are a very significant problem in many parts of the United States and are responsible for the application of premature maintenance and rehabilitation activities on many miles of roadway each year. The findings from this study will help the levee owners and transportation officials in decision making to consider the Bio-Inspired landslides repair technique using Vetiver Grass. Moreover, this study will be open for future studies by any federal, state or local

governmental agencies as well as for industry practitioners. The raw data files will also be available upon request for future research and implementation.
Impacts/Benefits of Implementation (actual, not anticipated) *To be determined upon conclusion of the project:* Vetiver grass has significant potential and great promise to bio-engineered slope repair in the levees and highway embankment of maritime and multimodal transportation infrastructures, specially build by marginal expansive clay. The current study will investigate the effect of the vetiver grassroots to stabilize levee slopes in the maritime and multimodal transportation infrastructures at Mississippi. The shallow slope failure in the high plastic clay soil is recurring. The Vetiver grass, which provides root depth up to 10-12 ft. can be an excellent and cost-effective bio-engineered solution to repair shallow slides on the expansive soil. The outcome from this study will create a baseline to stabilize shallow landslides in Maritime and Multimodal Transportation Infrastructure, which will enhance resiliency and potentially cut down the cost of the recurring landslide repair.
Web Links: martrec.uark.edu
Budget (Funding) Amounts & Source(s) (US DOT +Match(s) =Total Costs): $115,000 (USDOT) + $57,500 (Matching funds) = $172,500 (Total Cost)
Project Start and End Dates: March 15, 2020, to September 30, 2023 Complete
Principal Investigator(s) and Contact Information: Sadik Khan, Ph.D., P.E, Assistant Professor, Department of Civil and Environmental Engineering, Jackson State University, 1400 J. R. Lynch Street, Jackson, MS, 39217, email: J00797693@jsums.edu, phone: 601-979-6373, https://orcid.org/0000-0002-0150-6105
Principal Investigator Institution (University): Jackson State University