MarTREC
Maritime Transportation Research & Education Center

USDOT Tier 1 University Transportation Center

Agency ID or Contract Number: DTRT13-G-UTC50

MarTREC USDOT Project Request Form UTC

Project Title: Rapid and non-destructive assessment of levees for strength and liquefaction resistance
Project Abstract (Brief Description): In 2013, the American Society of Civil Engineers (ASCE) gave the levee system in the United States an overall rating of D-. This rating is based in part on information from the National Levee Database (NLD) which is comprised of approximately 14,700 miles of levees operated by the U.S. Army Corps of Engineers (USACE). These levees are more than 55 years old on average and were originally designed to protect farmland from flooding; however, due to urban sprawl and changes in land use, over 14 million people now live or work behind these structures. Unfortunately, only 8% of these levees are found to be in acceptable condition, while about 69% are minimally acceptable, and 22% are rated as unacceptable. In the coming decades, continued deterioration, urban development, and an increase in extreme weather events will test these structures to and beyond their capacity, leading to a significant increase in risk. To prevent failures in these structures, ASCE estimates more than $100 billion is needed to repair and rehabilitate the levee system. However, only a small portion of that money is currently allocated by the federal government. Therefore, the available money must to be used to repair the most critical levees first. Typically, levees are evaluated based on a simple visual inspection program to identify critical or weak spots in the levee system. This method can detect surface distress or erosion failures (post failure), but it cannot identify defects that exist within the inner core or foundation soil. Thus, local defects may be missed that could lead to a failure during an extreme event. To detect these local defects before failures occur, the visual inspections need to be combined with rapid, non-destructive geophysical testing that can detect these local defects so the limited repair funds can be used in the most effective manner. The goal of this research is to develop a rapid, non-destructive geophysical testing program and probabilistic framework that can be used to proactively evaluate levees. A series of geophysical field trials will be conducted to determine the most accurate and efficient methods and the best parameters for detecting various features or defects within levees. The results from the most effective methods along with traditional visual and geotechnical data will be used to build a probabilistic framework used to rapidly and cost effectively evaluate the condition of levee systems and identify the most critical areas of the levee system in need of repair. This will allow levee owners to use the limited funds available to repair the most critical parts of the levee first.
Describe Implementation of Research Outcomes (or why not implemented): The main objective of this study is to develop an approach to rapidly and non-destructively gather the data needed to detect internal defects, quantitatively assess the overall condition of levees, and determine the most critical levee sections. Since the start date of the project on January 1, 2015, the project team has been performing tasks 1 and 2, as defined in the project proposal. A comprehensive literature review is currently being conducted to determine the main levee failure mechanisms, the corresponding defects associated with these failures, and the non-destructive geophysical methods that

have been used to evaluate levee conditions or detect defects in the levee or foundation soil. A portion of this literature and data gathering process is being conducted through collaborations with United States Army Corps of Engineers (USACE) to obtain additional information regarding previous trials and potential use of equipment currently unavailable to the PIs. The goal of this task is to identify geophysical techniques which are able to detect all of the possible defects. The research team is also working with USACE as a part of task 2 to identify levees that are suitable for the pilot study and those which could benefit from non-destructive testing during the main study. The levees will be chosen based on the availability of data from traditional geotechnical tests including CPT and SPT/borings so that results from the geophysical tests can be compared and/or calibrated against the more traditional geotechnical tests used in design. After selection of the testing sections, the team will coordinate the geophysical field testing and develop a testing schedule.
Impacts/Benefits of Implementation (actual, not anticipated) *To be determined upon conclusion of the project:*
Web Links: martrec.uark.edu
Budget (Funding) Amounts & Source(s) (US DOT +Match(s) =Total Costs): $109,469 MarTREC + $128,670 U of A Start Up Funds = $238,139
Project Start and End Dates: 01/01/15-12/31/16
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Principal Investigator Institution (University): University of Arkansas