Transportation Consortium of South Central States

Performance of Drilled Shaft under Combination of Complicated Loads under Hurricane Event

Key Points

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18GTTSA02

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Funds Requested to UTC:
$50,000

Funding Source(s):
Tran-SET
University of Texas at San Antonio

Total Project Cost:
$100,000

Brief Project Description

As many studies have manifested that drilled shafts behave significantly differently under combined loads, this study focuses on investigating the lateral response of a drilled shaft that is subjected to a combination of vertical and lateral loads. Specially, this study assesses the condition that the vertical load is applied prior to the lateral load. This scenario occurs to a drilled shaft supporting a bridge subjected to hurricane loads. Large-scale testing and numerical simulation will be performed to assess the effect of load ratio, drilled shaft head fixity, and cyclic loading on the lateral response of a drilled shaft built in stiff clay when vertical load is present. Based on the data, the effect will be quantified in terms of lateral deflections under different conditions. Utilizing these results, existing p-y curves will be modified to assist the analysis and design of drilled shafts that are subjected to combined vertical and lateral loads. This project will provide urgently needed information to address the safety and sustainability of the critical infrastructures of Region 6, as drilled shafts are widely used to support bridges, and retaining walls.

Problem Statement

Drilled shafts have gradually become one of the most commonly used deep foundation to support various transportation infrastructures, such as bridges, retaining walls, mast arm sign, and wind walls. The annual constructed onshore drilled shafts exceed one million lineal feet in the US and is approximately 6 million lineal feet worldwide. A large portion of the built drilled shafts are designed to sustain significant lateral loads, induced by wind pressure, water flow, earth pressure, ground excitation, etc. However, drilled shafts as a bridge foundation are often subjected to combined lateral and vertical loads.

Despite studies consistently showing the critical joint effect of vertical and lateral loads on a drilled shaft, current practice considers vertical and lateral loads independently in the design, which is a safety concern in case of extreme events such as hurricanes. It is critically important to improve the resilience of the transportation infrastructure as the states in Region 6 are frequently struck by Category 4 and 5 hurricanes.

Objectives

Given the missing information to permit a rational analysis and design that account for the interaction between vertical and lateral loads, this study shall focus on assessing how a vertically loaded drilled shaft performs when a sudden, high magnitude lateral load is applied. This scenario represents the drilled shafts supporting bridges when subjected to hurricane loads. The ultimate objective of this project is to quantify the effect of vertical loads on the lateral response of a drilled shaft during a hurricane event to allow a rational design and analysis of bridge foundation under hurricane events.

Intended Implementation of Research

The objective of this study is in alignment with the practice of local, state, and federal transportation authorities, and the study can be extended to embrace many drilled shaft configurations that will be investigated in this study. The overarching goal of the study will be developing an inclusive design guideline in the long run, which can be easily used in design. Therefore, this topic has potential for future development and implementation from state DOTs in Region 6. In addition, this topic is of interest of drilled shaft contractors. The researchers will proactively reach out to the potential sponsors to disseminate the results and explore the mutual ground to advance the study further.

Also, two graduate students will be supported through this project as well as one undergraduate during the summer months.

Anticipated Impacts/Benefits of Implementation

This study will provide urgently needed information to address the safety and sustainability of the critical infrastructures of Region 6, as drilled shafts are widely used to support bridges and retaining walls. It will provide an approach to design a drilled shaft considering the interaction between vertical and lateral loads. Specifically, modification factors will be suggested, which can be applied to existing, commonly used p-y curves to assist in the analysis and design of drilled shafts across Region 6 and the US.

Weblinks:

http://transet.lsu.edu/research/research-in-progress/

https://rip.trb.org/View/1505474