



Experimental Investigation for Effects of Mini-piles on the Structural Response of Raft Foundations

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Abstract

Mini-piles made their debut as a cost-effective way to stabilize the historical structures. Recently, mini-piles have increased in popularity all over the world and are being used for bridges, buildings, slope stability, antenna towers, and residential construction. This paper presents the preparing, executing, data acquisition, and result presentation for an experimental work concerns with five scale-down mini-piled raft foundation models. All models were prepared to study the effectiveness of the mini-piled raft foundation in reducing the settlement and the bending moments. Five tests have been achieved. The reference first test includes a raft foundation with 15mm thickness. Second, third, and fourth tests are mini-piled raft foundations with five mini-piles and with thicknesses of 15 mm, 10 mm, and 8mm respectively. Finally, the fifth test dealt with a single mini-pile 178mm in length and 6mm in diameter. It has been adopted to investigate the reference behavior of the single mini-pile. When they were used, the piles have 42 mm center to center distances. A scale-down factor of 1/45, a sandy soil with ϕ of 40°, and relative density of 60% have been considered in all tests. Test results indicated a 45% decrease in settlement for 15mm mini-piled raft foundation comparing with the reference 15mm raft foundation. Moreover, there is no significant difference in settlement between 15mm mini-piled raft foundation comparing with the 10mm and 8mm thick mini-piled raft foundations. Regarding to the bending moments, they decrease at the mid and edge of the 15mm mini-piled raft foundation comparing to those of the reference raft foundation. It has also been noted that the moments are inversely proportional to the thickness of the piled raft foundations. With respect to the mini-piles, it has been found that most of the pile axial loads are transferred to the underneath soil through friction and this friction increases as the raft thickness decreases.

Keywords: Mini-Pile; Raft Foundation; Sandy Soil; Settlement; Bending Moment; Friction.

1. Introduction

A mini-pile is a drilled pile with a diameter equivalent to or less than 300 mm and lengths up to 30 m. It is having a small diameter to length ratio so that it is slender in nature, most of the load is transferred to the soil by friction FHWA (2005) [1]. Mini-piles construct in Europe at the beginning to retrofit the historic and the sensitive structures that had damage during World War II. As the development of geomechanics, a need for mini-piles was increased. Mini-pile technology is predicted to begin in Italy during the 1950 by Fernando Lizzi, and it was seen in the United States in the 1980 Bruce (1997) [2].

Since then, much collaboration and research has been done in the area of mini-pile design and construction. Today, mini-piles are effectively utilized in various scenarios including building underpinning, excavation stabilization, and

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