Ultimate Shaft Resistance of Tension Pile in Gypseous Soils

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ABSTRACT

Deep foundation such as piles adopt in case of weak soil or when type of soil in the site not capable to resists the external loadings from superstructure or collapsible soil. Types of external loads that the pile can sustain such as compression, tension or lateral load reflects on the design of pile and on the real behavior of soil-structure interaction. Many piles designed to resists compression loads only but in specific places such piles subjected to tension load due to lateral external loads such as wind or earthquake loadings. Another place that the piles subjected to tensile load is in case of the piles distributed under the towers, in this case not only sustain loads but also make the towers more stable.

Many researchers investigated the behavior of piles embedded in sand or clay and subjected to axial and lateral loads, but little studies concerned on the behavior of pile in collapsible soils such as gypseous soil. This type of soil has capable to support the external load from superstructure in case of dry condition due to the existence of gypsum which strengthens the soil structure. Many problems appear when water flows through its particles due to the dissolution of gypsum inside the soil skeleton. This dissolution leads to form cavities in the soil structure and this causes many problems such as settlement, tilting, etc. for the structures.

The present study concerned on the behavior of shaft resistance of tension pile in gypseous soils in both dry and soaking conditions to examine the effect of presence of water in the gypseous soil on the ultimate shaft resistance of pile. Many parameters are taken into account such as amount

of gypsum content (30%, 46%, and 66%), the slenderness ratio of pile L/D (10, 15, 20, and 25), pile type (steel solid pile with circular and square cross sections, steel pipe piles with open and closed ends, H-pile, timber pile, and concrete pile), pile diameter (1cm, 1.5cm, and 2cm). Also the pile shape (circular, square, and rectangular) and effect of time (2hr, 4hr, 1day and 7day after installation of pile). The test results reveals and showed that the shaft resistance of pile increases with the increase of gypsum content. When the gypsum content increases from 30% to 46%, the increase in the shaft resistance about 18%, and when the gypsum content increases from 46% to 66%, the shaft resistance increased about 35%, at the dry condition. In the soaking case, the shaft resistance of pile in gypseous soil with 66% gypsum content is found to be greater than that of others soils of 46% and 30% by about, 40% and 77% respectively. The increase in the slenderness ratio of the pile (L/D) from 20 to 25 leads to increase in the ultimate shaft resistance of pile about 70% and 84% in dry and soaking conditions respectively. The shaft resistance of steel solid pile with circular section was more than that of other types of pile. The increase of pile diameter from 1.5cm to 2cm in dry case leads to the decrease in the ultimate shaft resistance reaches 25%. While in the soaking case, when the pile diameter increases from 1.5cm to 2cm, the increase in the shaft resistance reaches 71%. In addition, the results shows that the ultimate shaft resistance of pile with rectangular section is more than that for piles with square and circular sections about 39% and 63% respectively in a dry condition, and about 29% and 39% respectively in soaking condition. The increase of time between the installation of pile and its test leads to decrease in the pile shaft resistance in both dry and soaking cases. When time increases from 2hr to 4hr, the decreases in the resistance reaches 39% in a dry case, and 51% in a soaking case.