

## Lateral Capacity of Helical-Pile Groups Subjected to Bearing Combined Loads

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**Abstract :** Helical piles have earned considerable attention as an effective deep foundation alternative due to their rapid installation process and their dual purpose in compression and tension. These piles find common uses as foundations for structures like solar panels, wind turbines, offshore platforms, and some kinds of retaining walls. These structures usually transfer different combinations of loads to their helical-pile foundations in the form of axial and lateral loads. Extensive research has been conducted to investigate and understand the behavior of these piles under the influence of either axial or lateral loads. However, the impacts of loading patterns that may act on the helical piles as combinations of axial compression and lateral loads still need more efforts of research work. This paper presents the results of an experimental (Lab tests) and numerical (PLAXIS-3D) study performed on vertical helical-pile groups under the action of combined loads as axial compression (bearing loads), acting successively with lateral (horizontal) loads. The study aims to clarify the effects of key factors, like helix location and direction of lateral load, on the lateral capacity of helical-pile groups and, consequently, on group efficiency. Besides the variation of helix location and lateral load direction, three patterns of successive bearing combined loads were considered, in which the axial vertical compression load was either zero, V1 or V2, whereas the lateral horizontal loads were varied under each vertical compression load. The study concluded that the lateral capacity of the helical-pile group is significantly affected by helix location within the length of the pile shaft. The optimal lateral performance is achieved with helices at a depth ratio of  $H/L = 0.4$ . Furthermore, groups of rectangular plan distribution exhibit greater lateral capacity if subjected to lateral horizontal load in the direction of its long axis. Additionally, the research emphasizes that the presence of vertical compression loading can enhance the lateral capacity of the group. This enhancement depends on the value of the vertical compression load, lateral load direction, and helix location, which highlights the complex interaction effect of these factors on the efficiency of helical-pile groups.

**Keywords :** helical piles, experimental, numerical, lateral loading, group efficiency

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