

矩形壁樁極限載重試驗案例分析與探討

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摘 要

近年來國內採用連續壁單元作為承載上部結構垂直載重基礎，以替代大口徑場鑄圓樁之案例已日漸普遍，然矩形壁樁與傳統圓樁之斷面形狀及施工方式均不同，且目前可供參考達極限破壞載重之試驗案例不多，故壁樁之承載及變形行為宜進一步深入探討。本文彙整新北市華中橋西側重劃區內6組壁樁之下壓載重試驗結果，首先分析各試驗壁樁於不同地層之 $t-z$ 曲線及樁底卵礫石層之 $q-w$ 曲線，並比較有、無施作樁底灌漿壁樁間樁頭荷重-位移($Q\sim S$)曲線及 $q-w$ 曲線之差異；繼則評估繪製本案例各土層之代表性 $t-z$ 及 $q-w$ 曲線，據以提出其簡化線性勁度模式，用來計算不同尺寸壁樁之樁頭荷重-位移曲線(即性能曲線)；然後建議樁頭之等值雙直線基樁垂直承載勁度(K_v)，供樁筏複合基礎之土壤-結構互制分析使用。本案例研究結果顯示，採用 $t-z$ 及 $q-w$ 曲線法可合理模擬矩形壁樁之荷重-位移行為與其性能表現；且本文所採用之分析方法與歸納評估之簡化線性模式，可應用於其他地區試樁作類似之分析，以擷取合理適用之分析模型。

關鍵字：壁樁、極限載重試驗、樁底灌漿、 $t-z$ 曲線、 $q-w$ 曲線、樁勁度。

Case Study for Ultimate Load Test of Walled-type Pile

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Abstract

The units of diaphragm wall, also called as walled-type piles or rectangular piles, were designed as foundations to support the vertical loadings of superstructures common recently in Taiwan. However, the cross-sections and construction methods of walled-type piles were rather different from those of conventional larger-diameter circular bored piles and the available test results of walled-type piles loaded to ultimate failure were still few, thus the bearing behaviors of walled-type piles should be investigated. Results of six compressive load tests of walled-type piles, which fully instrumented and installed in New Taipei City, are studied in this paper. First the characteristics of $t-z$ curves of various alluvial soils and $q-w$ curves of gravel layer are evaluated, and the differences of load-deflection ($Q\sim S$) curves and $q-w$ curves for piles with or without base grouting are discussed. Then the representative nonlinear $t-z$ curves and $q-w$ curves for various soil strata are summarized; in addition, the simplified linear models for representative $t-z$ curves and $q-w$ curves together with the corresponding parameters of stiffness and strength are proposed. Accordingly the load-deflection curves, which designated as the "performance curves", for walled-type piles with various cross-section and lengths are simulated. Besides, the bilinear models for load-deflection curves as well as the corresponding equivalent stiffness are suggested for the analysis of soil-structure interaction of pile-raft foundation. Results of this case study indicates that the simulation method employing the $t-z$ and $q-w$ curves can be used to estimate the bearing behavior of walled-type piles very well; the simplified linear models and analysis methods proposed are suggested to be utilized in interpreting the results of pile load tests conducted in the other sites, thus the applicable analysis models can be established.

Key Words : walled-type pile, ultimate pile load test, base-grouting, $t-z$ curve, $q-w$ curve, pile stiffness.