路塹橋墩深基礎開挖與PLAXIS 3D模擬分析

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摘　要

國道1號五股至楊梅段拓寬之新建工程，其中泰山林口路段，因為上邊坡側為高速公路不適開挖，所以在下邊坡處進行橋墩基礎開挖，使用三種不同的開挖擋土工法，分別為型鋼襯板擋土工法、土釘逐階降挖擋土工法與竹削井式擋土工法。

本文針對土釘逐階降挖擋土工法與竹削井式擋土工法，蒐集傾度管監測數據，彙整後繪製不同開挖階段之傾度管側向變位及側向變位速率圖形，搭配高速公路裂縫位置，進而研判邊坡潛在滑動面的位置，最後依據傾度管的變位、開挖壁面的穩定性、高速公路裂縫與滑動面的產生以及工期長短，以決定較佳開挖擋土工法。然後，以非線性有限元素法軟體PLAXIS 3D，模擬土釘逐階降挖擋土工法之每一階開挖過程，以數值回饋分析結果與現地傾度管變位比對，驗證地盤力學參數的適用性，最後，以PLAXIS 3D使用相同的土壤與材料參數，模擬竹削井式擋土工法的開挖過程，擋土壁位移分析結果與傾度管的變位也吻合，驗證竹削井式擋土工法開挖過程邊坡穩定的優越性。

關鍵字：高架橋、竹削井式擋土工法、掛網噴漿、土釘、PLAXIS 3D。

Vertical Shaft Construction and PLAXIS 3D Simulation

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Abstract

A new viaduct was constructed to relieve the congesting traffic flow on National Expressway No. 1,from Wugu to Yangmei. Three difference excavation methods were used to install the bridge pier foundation along the slope of embankment for National Expressway, such as braced cut with soldier beam retaining wall, open rectangular excavation with shotcrete wall and soil nail retaining system, and vertical round shaft excavation with shotcrete wall and horizontal beams.

Monitoring results of inclinometers located near the bridge pier foundations during foundation excavation were used to investigate the soil movement of upslope after each stage of excavation. In addition, the possibility of potential sliding failure was also analyzed due to the appearance of several parallel tensile cracks on the expressway pavement. The advantage and disadvantage of these excavation methods are evaluated based on the monitoring results and construction records. Then a nonlinear 3-dimensional finite element software, PLAXIS 3D, are used to verify the soil engineering properties so that the calculated and measured inclinometer deflections are well matched. Finally this finite element method with the same calibrated material parameters is used to simulate vertical round shaft excavation with shotcrete wall and horizontal beams. The calculated deflection of inclinometer matched very well to the measurement on the site. The monitoring results and numerical results also demonstrate the superiority of vertical round shaft excavation over the other two excavation methods in this formation of clayey gravel with cobble.

Key Words： viaduct, vertical round shaft excavation , shotcrete, soil nail, PLAXIS 3D.