

## 以等值單列直根模型進行含根邊坡穩定性之量化評估

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**摘 要** 本研究對不同植物根系拉拔試驗之土~根互制行為進行模擬分析。由現地根系拉拔試驗之結果與數值模擬成果之比對，本文所提二維有限差分數值模式及計算程序之有效性可獲得確認。承接上述根系拉拔數值模擬運算程序及技巧，可再針對全尺寸刺竹植生邊坡進行定量穩定性分析，並藉此建立含根邊坡之數值分析模式。由分析結果可知，在相同等值單位根系面積比( $A_r/A_s$ )之條件下，根系越長，邊坡穩定性提升之效應越明顯，且隨邊坡角度漸增之條件下，邊坡之穩定相對安全係數值（相對於不含根之邊坡穩定安全係數）提高之程度愈大，根系對邊坡之加勁更為明顯。本研究同時在根系達到特定極限拉拔強度或極限拉拔力之條件下，求取根徑  $d$  及根長  $L$  在各種組合情況下之等植根系面積比( $A_r/A_s$ )及其所需之單根總支數  $n_r$ ，並建立資料庫( $d$ 、 $L$ 、 $A_r/A_s$ 、 $n_r$ )以利爾後進行含根土壤力學行為數值模擬時，根系參數轉換之所需。  
**關鍵詞**：根系拉拔試驗，植生邊坡穩定分析，根系加勁土壤。

## Quantitative Evaluation on the Stability of Vegetated Slope Using the Equivalent Single Taproot Model

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**ABSTRACT** This study performs a simulation on the interactive behaviors between the soil-root system in pull-out test employing two-dimensional Finite Difference Method (FDM). Through the comparisons of the ultimate pull-out resistance of soil-root system from in-situ tests with those from numerical results, the validity of the proposed FDM numerical model and calculation scheme can be verified. The analyses also indicate the pull-out resistance of soil-root system can be greatly mobilized to a certain extent with small values of root diameter and root length at the initial pull-out stage. Eventually, the proposed computation techniques were incorporated into the quantitative analyses of a full-scale slope vegetated with thorny bamboo. It can be found that the stability of vegetated slope is significantly promoted as the root lengths increase. Meanwhile, the relative safety factor displays that the effect of the reinforcement of root system on slope stability is tending evident as the slope angle increases. For a specific root diameter  $d$ , root length  $L$  and ultimate pull-out strength  $\tau_{peak}$ (or pull-out resistance  $P_{act}$ ) it is possible to calculate the corresponding area ratio( $A_r/A_s$ ) and the number of single root  $n_r$  in equivalent root system.

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