不連續面先天異向性及應力異向性對岩石邊坡孔隙水壓分布之影響

報告者：劉佳怡
指導教授：董家鈞 老師
報告日期：2022/09/30

摘要

岩石邊坡受岩體中的不連續面影響，其所形成之複雜網絡往往是地下水之重要通道，因此不連續面之幾何，包含位態、內寬等會影響岩石邊坡之滲透特性。根據前人研究發現不連續面位態分布會使岩體滲透係數產生先天異向性，同時應力會影響不連續面之內寬，亦將導致滲透係數產生應力引致異向性。本研究利用 FLAC3D 建立邊坡模型，利用擬連續體模式(continuum approach)分別考慮不連續面先天異向性以及岩體不連續面內寬隨正向應力改變之應力引致異向性計算等值滲透係數張量(equivalent permeability tensor)，將計算結果輸入模型，透過滲流分析得到穩態孔隙水壓於邊坡模型之分佈情形。

研究結果顯示，滲透係數異向性隨不連續面分佈異向性增加而增加，在施加均向應力且最大滲透係數主軸平行於坡面的情況下，比較不連續面位態均向分佈以及不連續面位態非均向分佈，其孔隙水壓最大相對差異值約 44%。此外，考慮非均向應力引致之異向性，由於距地表越深其應力值越大造成內寬閉合量越大，其滲透係數主軸值隨深度增加而減小，因此引致滲透係數異向性。本研究討論不連續面先天異向性及應力引致之異向性，未來預計分析其孔隙水壓分布對邊坡穩定性之影響。

The effects of inherent distribution of discontinuities and stress-induced anisotropy on pore water pressure distribution of rock slopes

Presenter：Chia-Yi Liu
Advisor：Prof. Jia-Jyun Dong
Date：2022/09/30

Abstract

The complex of fracture networks are major flow paths in rock slope. Therefore, the geometry of the discontinuities including orientation and aperture of discontinuities will affect the distribution of pore water pressure in rock slope. According to previous study, it indicated that the orientation of discontinuities in rock mass would lead to the inherent anisotropy for permeability. In addition to the inherent distribution of discontinuities, the stress would make the aperture changing, leading to the stress-induced anisotropy. This research used FLAC3D to construct the slope model with simple geometry. First, considered the inherent distribution of discontinuities and stress-induced anisotropy to calculate the equivalent permeability tensor respectively by continuum approach. Secondly, the results could input to the model and then established steady-state pore water pressure by fluid-flow analysis.

As a results, the anisotropy ratio of permeability increased with the increase of the anisotropic distribution of discontinuities. When the maximum principal axis of permeability paralleled slope surface, the maximum relative variation equal to 44%. Besides, when considered the stress field of the slope, the value of permeability decreased with the increase of the depth. Due to the aperture closed by larger value of normal stress, therefore the stress field lead to the stress-induced anisotropy. In summary, the inherent distribution of discontinuities and stress-induced anisotropy would lead to the anisotropic permeability. Furthermore, the influence of pore water pressure distribution on slope stability needs to be discussed.