

以分離元素法分析卵礫石邊坡破壞

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摘 要 2008 年 9 月 15 日辛樂克颱風來襲造成邊坡崩塌，造成近 5 萬 m³ 的崩塌災害，此邊坡由河階地卵礫石組成。本文利用分離元素程式 PFC2D 模擬卵礫石之力學行為，接著利用分離建模來模擬卵礫石邊坡破壞。本研究採用分離元素建模來模擬雙軸試驗以建立宏觀與微觀參數的關係式；其中宏觀參數為強度、彈性模數、柏松比；微觀參數為正向勁度、切向勁度與正向勁度比、顆粒間的鍵結，卵礫石層的宏觀參數由現地調查測得，透過複迴歸分析建立宏觀與微觀參數的關係式。本研究預期卵礫石邊坡破壞是因為礫石間的膠結弱化而不是地下水位上升所引起，基質強度會促進礫石間的膠結程度，礫石間含水量上升會弱化基質強度而降低膠結。

關鍵詞：分離元素法、卵礫石、邊坡。

Discrete Element Modeling on the Collapse of a Gravel Slope

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ABSTRACT In September 15, 2008, a road slope collapsed during the attack of typhoon Sinlaku. The collapse debris of approximately 50 thousand cubic meters buried vehicles resulting in 7 people died and 7 people injured. The slope is composed of gravel deposits of a river terrace, including soils, gravels, and cobbles. This study first uses discrete element program PFC2D to simulate the mechanical behavior of gravel deposits. Then, the discrete model is used to simulate the failure of the gravel slope.

In this study, the discrete element models are adopted to simulate biaxial tests to establish the relationships between macro and micro parameters. Macro parameters are strength parameter, elastic modulus, and Poisson ratio, while micro parameters are normal stiffness, ratio of shear to normal stiffness, and bond between particles. The macro parameters of various gravel deposits are estimated with field investigation. Through multiple regression, the relationships of macro and micro parameters are established.

The cause of the gravel slope failure is expected to be the weakening of the cementation between gravels rather than the rise of groundwater table. The strength of matrix contributes to the cementation between gravels. The increase of water content in gravel deposits weakens the matrix and in turn decreases the cementation between gravels, i.e. weakening of the whole gravel deposit. Finally, the slope model shows failure as the bond between particles is progressively reduced from the shallow to the depth.

Key Words: Discrete element method, gravel deposit, slope.

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