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裂縫滲透引致淺層崩塌之臨界降雨條件分析

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摘　　要　本文建立一概念模式以描述裂縫滲透造成淺層崩塌之臨界降雨條件。邊坡崩塌係由總雨量及臨界降雨強度來控制。當降雨強度高於臨界降雨強度時，土體裂縫才會累積水深進而產生淺層崩塌；而當跨過此一門檻值後，土體崩壞之所需之累積降雨量隨降雨強度之增高而遞減。本模式可反應坡面裂縫之地文條件改變對臨界降雨條件之效應，並可重現前人建立之臨界降雨條件。較大規模之裂縫崩塌產生於高強度降雨之峰值附近，且隨著降雨強度增高，裂縫崩塌所需之降雨延時急速遞減。 本模式有助於評估地震對坡地災害降雨警戒值之影響，並可供坡地管理及坡地災害預警之參考。

關鍵詞：裂縫、淺層崩塌、入滲、臨界條件、降雨。

Threshold Conditions of Rainfall-induced Shallow Landslides with Cracks

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ABSTRACT　A conceptual model is proposed in this study to describe the threshold conditions of rainfall-induced shallow landslides with cracks. Landslides occur only when the rainfall intensity exceeds the threshold value, which depends on the characteristics of cracks. The total rainfall needed to trigger the landslide decreases with increasing rainfall intensity. This model fits well previous regression curves for debris flows. Moreover, the effects of cracks on the threshold conditions can be evaluated in the present model. The rainfall intensity required for landslides to occur increases when cracks get deeper. although the rainfall duration becomes shorter. Consequently, the scenarios of large shallow landslides occur around the peaks of rainfalls.

Key Words: cracks, shallow landslides, seepage, threshold conditions, rainfall.

一、前　　言

在土石流之源頭山坡面常有因地震、潛變(creep)、崩塌或摺皺風化等引起之地表裂縫(如圖一所示)。依現場勘查，當裂縫之深度超過 30 公分時，一般之草根植物便無法發揮其固土作用。降雨時坡面逕流更會順著裂縫下滲土體，造成坡面的不穩定度提高，進而引發崩塌及土石流等災情。在日本阪神大地震(1995)發生後，平松等人(1999)現地踏勘兵庫縣六甲山之 13 處山坡裂縫特性，歸納出裂縫長 1.5- 22m (平均值 10m)、寬 5-100 cm (平均值 35 cm)、 深 20-80 cm (平均值 50 cm)。 大部份裂縫之長向與坡面等高線平行，而含裂縫之飽和土體之整體滲透係數約爲無裂縫飽和土體的五倍。當坡面呈凹谷形時，裂縫滲透產生坡面破壞之可能性較平面或凸曲面形之坡面爲高。 九二一集集大地震(1999)導致台灣中部山區

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