

落石碰撞反彈性質之研究—以台灣東北部瑞芳地區之石英安山岩及砂岩為例

The Bouncing Study of Rockfall—Two Cases Study of Dacite and Sandstone in Kuifan Area,  
Northeastern Taiwan

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摘要

落石在山區是經常發生的地質災害之一，本文是以落石碰撞反彈的性質為主題，利用台灣東北部瑞芳兩個地區所發生的石英安山岩及砂岩落石事件作為案例之探討。以瞭解落石掉落時的真正性質。

由落石碰撞反彈試驗結果顯示，石英安山岩之法線方向折減係數之平均值介於 0.3-0.51 之間，切線方向折減係數之平均值則介於 0.35-1.13 之間。砂岩之法線方向折減係數之平均值介於 0.25-0.56 之間，切線方向折減係數之平均值則介於 0.38-1.29 之間。

探討落石大小與形狀、岩性、掉落高度及碰撞入射角等各項因素與折減係數的關係發現：(1) 落石大小與法線折減係數值並無明顯的關係存在；(2) 岩性的差異對折減係數值的影響並不明顯；(3) 掉落高度與折減係數的關係並不明顯；(4) 圓度及球度與法線方向折減係數呈現正相關，且在碰撞入射角在 90°時相關性最高。而圓度及球度與切線方向折減係數的相關性則較低；(5) 不同的入射角對法線方向折減係數影響不大，切線方向折減係數在入射角為 30°及 45°時亦無明顯的差異，但隨著入射角變大到 60°及 75°時，切線方向折減係數則會明顯的變大。另外，若分析法線方向折減係數與切線方向折減係數之關係，發現此兩者似乎呈現互相消長的關係，尤其是圓度值較佳時，這種關係越明顯。在兩個不同地區之案例探討時以電腦程式 (CRSP) 分析落石運動的軌跡，並配合現場調查的結果，可有效的模擬落石發生時之狀況，掌握落石在坡面上碰撞點的位置，並可進一步求得落石在運動過程中的速度與具有的能量，此結果應可提供防治落石災害之重要參考依據。

**關鍵詞：**落石、折減係數、石英安山岩、砂岩、圓度、球度

## **Abstract**

This study of debris flow is focused on the engineering geology characteristics at gully No.1 and No.3 which along the west side of Hoshe river, Nantou during typhoon Herb attacked on the end of July, 1996.

The study methods of this thesis include geomorphological features, geological condition, geometrical characteristics and slope stability analysis. The geomorphological features were comprehended by using the judgement of aerial photographs and the information of in-situ reconnaissance. The topography difference was compared by overlapping the contour map before and after geohazard. The geological survey includes the orientation measurements of outcrops and discontinuities. The investigated results demonstrated that the failure types are combined of landslide and the collapse of the riverbed deposit. The syncline structures pass through the gully No.1 and No.3, landform the hollow landform. The hollow landform is easy to converge the runoff and rock fragments during heavy rainy.

The stability analysis displayed the results of rock and deposited geometrical on both sides of gully. In general, the safety factor is greater than 1 and the condition of rock slope and deposited geometrical are in stable condition. When the safety factor is smaller than 1, the rock slope and deposited geometrical are in unstable condition. Therefore, heavy precipitation could trigger the occurrence of debris flow which mixed the deposited geomaterial from both side of gully.

**Key words:** Debris Flow, Hollow, Syncline Axis, Discontinuity, Slope Stability, Aerial Photographs