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南投縣出水溪土石流之工程地質特性研究

The Engineering Geological Characteristics of Debris Flow in the Tsushui River of Nantou Area

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摘要

本論文利用地貌分析、地質調查、地質材料試驗及穩定性分析，探討南投神木村出水溪土石流之工程地質特性。地貌分析是利用 6 個不同年度之航照圖，配合地形剖面分析與野外調查及比對，以瞭解民國 69 年至民國 88 年間土石流發生前後之地形、地貌的改變，並藉由 GPS 儀器瞭解溝谷中部分區域土石堆積的地形變化狀況。在現場調查工作中，量測不連續面之位態分佈，亦採集溝谷堆積及溝谷兩側岩坡之地質材料，一併進行自然物理性質及力學性質試驗，以探討本研究區溝谷內堆積之材料及溝谷兩側岩坡材料的工程地質特性及穩定性狀況。

研究結果顯示：由於受到褶皺構造的影響，在溝谷沿線兩側岩坡之不連續面相當發達，其中層面位態的分布爲介於 N10°E　50°E，向南傾 30°　80°，不連續面與坡面在溝谷兩側形成各種潛在性順向坡及楔型坡破壞模式，爲河床上土石主要來源。本研究區發生部源頭處有一大型崩塌窪地，大量土石堆積在窪地上及沿線河道上。從民國 85 年賀伯颱風後所估計之流失土石方量可發現，其中 53%來自發生部，37%來自流動部。在破壞型態上，將近 73%爲河床堆積物破壞所提供，其餘爲溝谷兩側邊坡破壞所提供。因此，本研究區所發生的土石流災害，在破壞類型上屬於溝谷堆積物崩塌型。

從地質材料的試驗結果顯示，溝谷中堆積材料之含量以 5 公分以上之岩塊爲主，其含量爲 68%左右，細顆粒小於 200 號篩部份，則分布在 10%左右，堆積材料之摩擦角介於 37.2°　42.3°之間。至於溝谷兩側岩坡不連續面材料之摩擦角則分佈在 27.4°　47.1°之間，其中砂岩之剪力強度較頁岩爲高。從現地坡體穩定性分析結果顯示，溝谷中堆積地質材料與溝谷兩側具有潛在破壞性之坡體，在飽和狀態下其安全係數均小於 1，屬於不穩定狀態。因此，溝谷堆積材料及溝谷兩側之岩坡可能在高降雨強度下先後發生破壞，進而形成土石流。

關鍵詞：土石流、航照判釋、不連續面

Abstract

The thesis is to investigate the engineering geological characteristics of debris flow in the Tsushui river of Nantou Area. The study methods include geomorphological features and changes, geological condition, geomaterial characteristics and slope stability analysis. The geomorphological features were comprehended by using the judgement of aerial photographs and the information of field investigation. The topography difference was compared by overlapping the counter map before and after geohazard. And we also employ the GPS instrument to monitor the variation of the valley during last 2 years. The mechanical tests of geomaterials included physical property tests and shear strength tests. The samples are collected from fragments and rocks which located on both sides of valley in order to understand the geological characteristics and the stability of geomaterials.

The study results showed that stratums were subjected to fold structure, thus rock discontinuities developed very well on both sides of valley. The strikes of beddings range from N10°E to N50°E, and dip from 30°S to 80°S. The discontinuities and slope surfaces were formed by various models of dip slope and wedge slope, and may be the origin of deposited geomaterials. From the aerial photography, we can see that the original of the river was a deposited hollow and lots of geomaterials were deposited on the riverbed. The debris that flowed away in the valley of Tsushui river was around 53% of this deposition came from source area and 37% from the flow area. Besides, nearly 73% of failure geomaterials are provided by riverbed deposits. Consequently, the failure types of deposited geomaterials were mainly the collapse of valley.

The experimental results show that the major contents of deposited material are gravel particles comprising arround 68% of the material. The fine particles are less than 10% of the total. The friction angle of deposited material ranges from 37.2° to 42.3°. The friction angle of sandstone ranges from 28.4° to 47.1°. The friction angle of shale ranges from 29.3° to 32.9°.

Analysis of slope stability on the channel reveals that the deposited geomaterials and rock slope on both sides of valley is unstable when saturated. Thus heavy precipitation may trigger the occurrence of debris flow.

Key words: debris flow, aerial photography, discontinuties