

南投九九峰卵礫石之排列及其形狀對坡度的影響

The Relationship between the Slope Grade and Gravel Orientation and Shape in 99Peaks of the Nantou Area

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摘要

由更新世頭料山層火炎山相礫石層組成之南投九九峰，在 921 地後，產生了大量的山崩，導致岩層裸露。過去研究指出，礫石的形狀、大小、含量、排列方向等等皆會影響礫石層的性質；因此，本文研究動機即探討礫石的形狀與排列方向對礫石層坡度的影響；另外，本文也對地震後九九峰地區的地貌與材料之自然物理性質作一調查。

由現場調查的結果顯示，本研究區域坡度的分布為介於 50°至 85°之間，其中 60°至 70°的邊坡，佔了全區 50%以上。坡體的傾向並無規律性，各方向都有分佈；而礫石的傾向全都集中在 80°至 220°之間，有超過 50%以上則集中在 120°至 160°之間，而上述兩者傾向的傾向夾角為介於 28°至 139°之間。本研究區域礫石的形狀包括了碟狀、球狀、板狀以及柱狀等 4 種分布，碟狀礫石的含量為介於 24%至 58%之間；球狀礫石的含量為介於 13%至 58%之間，兩者含量佔了全區 65%。

至於本研究區材料性質方面，礫石岩性主要為石英砂岩所組成，少部分為變質砂岩，礫石顆粒的分布約佔 85%，基質中砂顆粒成分約佔 14%，其餘為細顆粒的組成。基質的液性限度為 26，塑性限度為 15，塑性指數 11，比重為 2.52。經過貫入試驗結果顯示，介於礫石間之基質材料其強度為介於 100~250kg/cm² 之間，已達弱岩的分類標準，基質中小於 200 號篩以下的礦物有石英、高嶺土、伊萊石以及膨潤土。礫石乾單位重 2.56kg/cm³，吸水率 1.14，第一循環耐久消散指數 99，第二循環耐久消散指數 98.6，顯示本研究區域的礫石抗風化能力佳。

在礫石形狀與排列對坡度的影響探討方面，結果發現當坡體礫石排列傾向與坡面傾向一致時，亦即傾向夾角越小時，坡度有下降的趨勢。在礫石形狀與坡度的關係方面，當碟狀礫石、板狀礫石、柱狀礫石含量增多時、坡度有增加的趨勢，但相關係並不明顯；當球狀礫石含量越多時，坡度則有相當明顯下降的趨勢，兩者的關係是四種礫石中最明顯的，相關係數可達到-0.74。

關鍵詞：卵礫石、卵礫石層、傾向夾角、卵礫石形狀

Abstract

The 99 peaks of the Nantou area is comprised of the gravel formation of Pleistocene. During the Chi-Chi Earthquake, there were lots of landslides in the area. Lots of former study indicate that the difference of the shape, size, proportion and orientation of the gravels make the properties of the gravel material change. The major point of this study is to comprehend the relationship between the slope grade and the orientation and shape.

The results of in-situ investigation show that the slope ranges 50° to 85° and 60° to 70° with more than 50%. The dip direction of the slopes is random and that of gravel is between 80° ~ 220° . The intersected angle of dip direction of the slopes and the gravels ranges 28° to 139° . Four gravel shapes distributed in the study area which include disk, equant, bladed and roller. Disk and equant shape comprise more than 65%.

The distribution of the gravel particles in the matrix is 85% and sand particle is 14% of the matrix in the study area. The soil classification was poorly-graded gravel (GP) according to the Unified Soil Classification System. The liquid limit of the matrix is 26%, plastic limit is 15% and the specific gravity of the matrix is 2.52. The strength of the matrix ranges from 100 to 250 kg/cm². The mineral of the matrix includes quartz, kaolinite, illite and smectite. The dry unit weight of the gravel particles in the study area is 2.56 kg/cm³ and water-absorptivity is 1.14%. Slake durability index (Id₂) is 98.6 which shows the ability against weathering of the gravels is good.

The gravel orientation effects the distribution of the slope grade. Linear regression analysis shows that when the dip direction of the gravels orientations and slope surfaces are uniform, the slope grade appears to decrease with a correlation coefficient of 0.69. The difference in content percentage of various gravel shapes will affect slope grade.

Linear regression analysis shows that when the gravel proportion of disk, bladed and roller shapes increase, the slope grade will increase. And as the equant shape proportion of the gravel increase, the slope grade will decrease. The relationship between the content of the equant shape gravel and the slope grade is more obvious than that of the other shapes.

Key words: gravel, gravel formation, intersected angle of dip directions, shape of the gravels