



An investigation on the effect of particle shape on the shear strength of rockfill materials using the results of large triaxial tests

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Abstract

Advantages in using rockfill materials, especially economical aspects, capability to absorb seismic energy in rockfill dams, providing high safety factor and compatibility with different site conditions, have caused great interest in these materials. In this study, the experimental test results of large-scale triaxial test on basalt and dolomite rockfill samples were used to investigate the effect of angularity of particles on shear behavior of rockfill materials. In order to isolate the effect of angularity on the rockfill behavior, the particle size distribution and other sample specifications were kept constant. Comparing the behavior of rockfill materials with round and angular shaped particles indicates that, under the same confining pressure, despite common belief materials with round shaped particles have greater angle of friction and dilation. The effect of particle breakage in rounded rockfill materials is not clear and compared with angular samples it is very negligible. For both types of basalt materials, after maximum deviatoric stress, the ratio of peak to residual strength decreases with confining pressure.

Keywords: Rockfills, Particle shape, Triaxial test, Point load test, stress-strain behavior.

1. INTRODUCTION

Rockfill dams are increasingly used because of their inherent flexibility, capacity to absorb large seismic energy, and adaptability to various foundation conditions. The use of modern earth and rock moving equipment and locally available materials make such dams economical as well. Rockfill materials consist primarily of angular to subangular particles obtained by blasting parent rock or rounded/sub-surrounded particles collected from river beds. The maximum size of rockfill materials is very large and may exceed over 1 m in certain cases.

During the past decades, great efforts have been made to study the shear behavior of rockfill materials [1-3], due to its importance to both safe and economic design of embankments and dams. Such investigation was usually carried out in large-scale triaxial testing apparatus, which have revealed that rockfills exhibit a non-linear stress-strain relationship, stress-dependence of stiffness and a non-linear strength envelope, as well as intense shearing contraction and dilatancy. Particle shape is one of the most important factors influencing rockfill behavior and variation of constitutive parameters such as angle of friction and dilation. Material angularity affected particle breakage of rockfill materials and it has made the behavior pattern of these materials unpredictable using well-known criteria in granular soils.

This paper deals with the results of large triaxial and point load tests on rounded and angular rockfill materials made of basalt and dolomite. The focus of this study has been made on the effect of particle shape on the stress-strain and volume change behaviors, constitutive parameters and breakage factor of rockfill materials. The article is organized in the following sections. Section 2 appropriate to background of researches in behavior of rockfill materials field. Then in Section 3, the details of materials and testing program are presented. Results of laboratory tests are given in section 4. Analysis of stress-strain and volume change behavior and effects of particles angularity on the shear strength behaviors of materials are discussed in sections 5 and 6 respectively. In the last section explains the Summary and Conclusions are propounded.

2. REVIEW

As mentioned, rockfill materials contain particles of large size, and direct testing of the prototype materials would require equipment of formidable dimensions. Various methods such as the scalping technique, parallel