

## 粗粒含量对砾类土直剪过程中强度与变形特性影响的离散元模拟研究

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## DEM SIMULATION ON EFFECT OF COARSE GRAVEL CONTENT TO DIRECT SHEAR STRENGTH AND DEFORMATION CHARACTERISTICS OF COARSE-GRAINED SOIL

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**摘要** 粗粒含量对砾类土的工程力学特性具有重要的影响。本文对4组不同粗粒含量的强风化玄武岩砾类土进行了大型直剪试验,并获取相关的强度与变形参数,基于离散单元法颗粒流理论,采用粒间作用为平行黏结模型的圆球模拟土颗粒,建立了4种不同粗粒含量砾类土直剪的离散元模拟的计算模型,并进一步校正了颗粒单元细观参数,模拟了不同粗粒含量砾类土100kPa垂直压力时的应力应变关系、垂直变形以及剪切带上的土颗粒运动与颗粒间作用力传递的影响特性,分析了粗粒含量对砾类土宏观及细观力学性质的影响机理。结果表明:砾类土表现出的粗粒含量越大强度越高的本质是由于随粗粒含量增加时,土颗粒间平均刚度增加及颗粒间的咬合作用使得摩擦系数增加,采用平行黏结模型能较好的拟合峰值前剪应力-剪位移曲线,但是峰后曲线段尤其对软化现象的适应性不是十分理想;垂直位移-剪位移模拟值与试验值存在一定的偏差;随着粗粒含量的增加,最大剪应力时粗颗粒对力链的控制表现得愈明显,相应的剪切带厚度约为剪切盒高度的1/3~1/5,并随粗粒含量增加而增大。

**关键词:** 大型直剪 粗粒含量 PFC<sup>2D</sup> 砾类土

**Abstract:** Mechanical behaves of coarse grained soil is greatly influenced by the content of coarse gravels. The shear characteristics of four groups of strong weathered basalt coarse grained soils are investigated under different coarse gravel contents on large-scale direct shear apparatus to obtain the strength and deformation parameters in this paper. Based on the theory of discrete element method (DEM), four direct shear samples under vertical pressure of 100kPa are carried out using the parallel bond model (PBM) with multiplicity coarse gravel content. The parameters are calibrated. Then we simulate the relationship among shear stress, shear deformation and vertical deformation. The simulation also simultaneously analyzes the particle movement and force in order to settle the mechanism for the fact that coarse content affects shearing properties. Results show that the inherence for shear strength increasing with the increase of coarse gravel content at the same vertical stress is due to the increase of particle stiffness and the increase of friction coefficient. The peak of stress-strain curve can be well simulated by the PBM. But the soften segment cannot be well fitted. Simulation of shear-vertical displacement curve does not fit perfectly to the testing value. The effects of coarse particles on the peak force chains were significantly evident than those of fine particles during the shearing process. It is considered that the vortex area is the thickness of shear band, approximately 1/3-1/5 of the height of shear box.

**Key words:** Large-scale direct shear Content of coarse gravel PFC<sup>2D</sup> Coarse grained soils

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