

土与结构相互作用的可视化剪切试验装置研制及应用

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DEVELOPMENT OF SHEAR TEST DEVICE WITH INTERFACE VISUALIZATION FOR SOIL-STRUCTURE INTERACTION AND ITS APPLICATION

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摘要

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摘要 土与结构的相互作用是岩土工程中普遍存在的力学问题, 在已有大型直剪试验系统平台上, 设计局部可透视的刚性剪切盒和数据采集分析系统, 研制相应的设备。在接触面力学参数可靠获取的基础上, 通过高清数码摄像实时采集剪切试验过程中接触面剪切带的数字图像, 利用GeoPIV分析获得剪切带土砾的变形和剪切带的厚度, 实现土与结构接触面直剪试验剪切带变形的可视化与量化。以三峡库区堆积体滑坡工程为背景, 开展不同含水率条件下土石混合物与混凝土接触的剪切试验, 得到接触面抗剪强度参数的变化规律和剪切过程中土砾颗粒运移特征, 定量分析土砾颗粒在剪切过程中的位移变化规律, 获得试验条件下接触面剪切带厚度为17~23 mm, 试验结果表明上剪切盒中的土砾剪切过程中发生显著的位移, 其相对下剪切盒的水平位移小于上下剪切盒的相对位移, 呈现非线性的变化趋势, 并给出土砾实际位移与剪应力的关系。该研究成果可为土与结构相互作用的可视化剪切试验、接触面力学特性和本构模型分析提供重要支撑。

关键词: [土力学](#) [接触面](#) [剪切试验](#) [可视化](#) [数字图像](#) [剪切带](#)

Abstract: The interaction between soil and structure is a significant mechanical problem with widespread in geotechnical engineering. This paper introduces the development of shear testing device with interface visualization for soil-structure interaction and its application. On the basis of an existing large-scale direct shear test system, the locally perspective rigid shear boxes and data acquisition and analysis system are designed, and relevant devices are developed. Besides the obtainment of mechanical parameters of soil-structure interface, during the process of shear tests, a series of images of the shear band on the interface are captured by digital camera in real time; the thickness of the shear band and the deformation of the soil particles and gravels at the shear band are obtained by images analysis using GeoPIV software. Based on real geological condition of an accumulative landslide in the Three Gorges reservoir area, a series of shear tests of soil-concrete interface are conducted under different water contents. The change law of shear strength parameters and the characteristics of particles movement are obtained during shear tests; the displacement and its change rules of soil particles and gravels are quantitatively analyzed. The testing results indicate that the thickness of the shear band under the circumstance described in this paper is 17 - 23 mm; there is obvious deformation of soil and gravels in the upper shear box; the horizontal displacement of soil and gravels is less than the relative displacement of shear boxes. The relationship between shear stress and real displacement of soil and gravels is given as well. The research results will not only contribute to shear test of soil-structure interaction, but also provide vital supports for the study of mechanical behavior and constitutive model of interface between soil and structure.

Keywords: [soil mechanics](#) [interface](#) [shear test](#) [visualization](#) [digital images](#) [shear band](#)

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