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黑方台灌溉渗透型黄土滑坡的运动学模拟研究

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KINEMATIC SIMULATION OF IRRIGATION-INDUCED LOESS LANDSLIDE IN HEIFANGTAI

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摘要 研究滑坡的运动学特征对于认识和减缓滑坡灾害风险具有重要的意义。以甘肃省永靖县黑方台焦家崖头灌溉渗透型黄土滑坡为研究对象,在工程地质测绘和实验测试的基础上,根据滑坡表现出的各种迹象,基于有限差分法滑坡运动模型对滑坡运动的全过程进行了模拟,并分析了滑坡的速度场。模拟结果表明:滑坡的速度可分为启动加速,高速波动和碰撞减速3个阶段,全程平均滑速为8.6m·s^{-1},表现为高速滑动特征,具有较大的危害性。不同计算方法得出的滑坡速度不尽相同,其中数值模拟的剪出口速度比美国土木工程师协会推荐法结果大1.2m·s^{-1},比变分法计算速度小2m·s^{-1} 左右,与潘家铮算法的下限值较接近。本次模拟工作对于潜在的灌溉型黄土滑坡的致灾范围和滑速预测具有一定参考意义。

关键词: 黑方台 黄土滑坡 有限差分法 运动学模拟

Abstract: This paper aims to study the kinematic features of landslides to assess and mitigate landslide risks. It takes Jiaojiayatou irrigation-induced loess landslide in Heifangtai, Yongjin, Gansu Province as the research object. It is based on engineering geological mapping and soil tests, as well as landslide features analysis. It simulates the whole moving process of the landslide and analyzes the velocity field using the finite-difference-method-based kinematic model. The simulation results show that the velocity field of the landslide can be divided into three stages: the initial acceleration stage, the high-speeding fluctuation stage and the collision deceleration stage. The average velocity in the whole process is about 8.6m·s^{-1},which represents a high-speed moving feature and can cause dangerous results. The velocity at the shear opening from the numerical simulation is 1.2m·s^{-1} higher than that calculated using the ASCE recommended method, 2m·s^{-1} lower than that calculated using the variational method, and close to the lower limit calculated using Pan Jiazheng Method. This study is helpful to the prediction of sliding velocity and influencing area of potential irrigation-induced loess landslides.

Key words: Heifangtai Loess landslide Finite difference method Kinematic simulation

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