Postprint: Study on Landslide Disaster Mechanisms in the Meizhou Region

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Abstract

Due to its unique geological environment and climatic conditions, Meizhou has become one of the cities most severely affected by geological hazards in Guangdong Province. The number of geological hazard potential points in Meizhou accounts for over 24% of the total in Guangdong Province. This study takes the slope at the entrance road of Baishishan as the research object, investigating the sliding dynamics characteristics and collapse patterns of fine sand, Baishishan slope soil samples, and fine aggregates under different slope gradients, and establishes a sliding velocity prediction model to provide quantitative basis for slope protection design. Based on indoor simulation experiments, slopes of 50° and 60° were set up to measure sliding distance, time, and collapse coverage area, and to calculate sliding velocity; combined with a multiple linear regression model, the interactive effects of slope gradient, material type, and sliding distance were analyzed, and the model applicability was verified through field survey data. Experimental results indicate that under 60° slope, the sliding velocity of fine sand increased by 12.5% compared with 50°, and the collapse area expanded by 23.6%; the multiple regression model achieved a coefficient of determination (R2=0.89) and root mean square error (RMSE=0.04 m/s); field crack angles (55°-75°) were consistent with the high collapse risk interval (>60°) from experiments. Slope angle and material shear strength are the main controlling factors for instability, the model demonstrates high prediction accuracy, and it is recommended that slopes above 60° adopt cohesive soil improvement or lattice reinforcement measures.

Full Text

A Study on Landslide Disaster Mechanisms in the Meizhou Region

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Abstract

Due to its unique geological environment and climatic conditions, Meizhou is one of the cities most severely affected by geological disasters in Guangdong Province, with the number of geological hazard sites accounting for over 24% of the provincial total. This study investigates the sliding dynamics characteristics and collapse patterns of fine sand, Baishishan slope soil samples, and fine aggregates under different slope gradients, using the Baishishan entrance road slope as a case study. A sliding velocity prediction model was established to provide quantitative support for slope protection design. Based on laboratory simulation experiments conducted at slope angles of 50° and 60°, we measured sliding distance, duration, and collapse coverage area to calculate sliding velocities. A multiple linear regression model was employed to analyze the interactive effects of slope angle, material type, and sliding distance, with model applicability verified through field investigation data.

Experimental results demonstrate that at a 60° slope, fine sand sliding velocity increased by 12.5% compared to that at 50°, while collapse area expanded by 23.6%. The multiple regression model achieved a coefficient of determination (R^2 = 0.89) and root mean square error (RMSE = 0.04 m/s). Field-observed crack angles (55°-75°) aligned with the high collapse risk interval (>60°) identified in experiments. Slope angle and material shear strength represent the primary controlling factors of instability. The model exhibits high prediction accuracy, and we recommend that slopes steeper than 60° be treated with cohesive soil improvement or lattice reinforcement measures.

Keywords: geological hazards; sliding dynamics; multiple regression model; shear strength and stiffness

Note: Figure translations are in progress. See original paper for figures.