Braking effect (velocity-strengthening) of Kaolinite under intermediate slip velocities

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Abstract

In rock mechanics, friction resists the sliding blocks from displacement. Also, velocity plays the role of controlling this frictional strength. Numerous studies focus on the frictional resistance of the interfaces decreasing while the sliding rates increase. Velocity-strengthening friction has been less noticed, despite its importance for various aspects of frictional phenomena such as the propagation speed of interfacial rupture fronts and the amount of stored energy released by them. This study aims to understand the mechanisms of velocity-strengthening under intermediate slip velocity (10^{-7}m/s to 10^{-2} m/s) and its application to the landslide warning threshold. The apparent friction coefficient of wet kaolinite clay was measured under normal stress of 1 MPa. Experiments were conducted with continuously variable intermediate velocity on a sample via low to high-velocity rotary shear apparatus. According to the previous studies, most samples show a similar velocity-strengthening under the intermediate shear velocity. The selected stochastic parameters is height water table above failure surface (h_w), which are modeled using a sinusoidal function. The geometric parameters, such as height of slope, angle of slope relative to horizontal, unit weight, and the slice of width, are regarded as constant parameters. The approach of displacement-based method: Newmark (1965) and applying the formula velocity-dependent friction coefficient (μ) of (Ferri et al., 2011) over time intervals are utilized in this study to conduct an analysis of h_w and μ relation and to determine the stability of infinite slopes with parallel seepage. The preliminary analysis revealed that the friction coefficient has the greatest influence on the safety factor of infinite slopes. In the future, additional scenarios and stochastic parameters will be examined to improve the estimation of velocity-strengthening in the slope stability uncertainty.