The impact of a weak horizon on kinematics and internal deformation of a failure mass using discrete element method

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Abstract
Weak horizons within slopes may induce and/or accelerate failure of slopes. In this study, we focus on the effect of orientation, location and dimension of a weak horizon on the mode and kinematics of downslope movement of a failure mass using discrete element method. Two kinds of cases with weak horizons were studied, one unstable homogeneous slope with low shear strength ($c = 50$ kPa, $\mu = 0.57$) and two stable homogeneous slopes with high shear strength ($c = 60$ kPa, $\mu = 0.57$ or $c = 50$ kPa, $\mu = 0.7$). In the three sets of slope models, there was a weak horizon with a finite thickness embedded within the slope. In each set of slope models, two different thicknesses and locations for the weak horizons were considered to systematically investigate the effect of these parameters on the mass movement. In addition, the dip of the weak horizon was changed where in some models, it was parallel to the slope and in others it was dipping either steeper or gentler than the slope. We analyzed both kinematics and internal deformation of the failure mass in all models and conclude that the presence and geometry (i.e., thickness, location and dip) of a weak horizon changes the mode and kinematics of mass movement and governs the location of the failure surface.