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A Numerical Study of Rockslide-Structure Interactions in a Dip Slope Disaster by 3D Discrete Element Modeling

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The past decade has witnessed increasing case studies on the application of 3D discrete element modeling to assess potential rockslide disasters. The assessment is usually based only on the influence area related to kinematic process and final deposition by the simulation. Currently, the hazard of the rockslide-structure interaction is not well defined, and only a few studies have quantality this behavior with a parametric analysis. A dip slope disaster case history on 18 August 1997 in Taiwan was simulated in this study using discrete element method (DEM). The landslide intensely damaged a five-floor building complex of the Lincoln community and caused 28 death. This study first gathered historical aerial images, geology maps of 1:50,000 scale, post-disaster investigation reports, and in-situ photos to clarify the geological and geometry conditions of the dip slope and its spatial relationship to the Lincoln community. Most importantly, a 3D geomechanical model was developed for the numerical study. With the advantage of DEM analysis on large deformation problems, the entire impact process of the dip slope failure was simulated, starting from rock mass sliding to collision and breaking during movement, impacting on the structural buildings and progressive failure of the structures. The simulated results agree well with the field observation after the incident in 1997. The parametric results show that the configuration of the geological discontinuity dominates the magnitude of the potential sliding block, and the rockslide-structure interactions are affected by the relative location between rock slope and buildings and the strengths of rock mass and structure elements. Overall, the 3D DEM-based simulation provides qualitative information on the impact process of the rockslide and the damage states of the building complex. This validated numerical approach can be a valuable tool for assessing the building vulnerability to rockslide with scenario study.