



## Analysis of Cliff Retreat and Rockfall Talus Deposition Patterns through Geomorphologic Analysis, Physical Modeling and Numerical Simulation

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During storms or earthquakes, Rockfall is a frequent mishap in mountain areas. Reviewing the histories of rockfall disasters in Taiwan, as the cluster of rockfall consists of simultaneous movements, it might cause serious disasters, which had occurred in Central Cross-Island highway, Nanyali, Maijin road of Jilong City, Taidong Zhiben river, and the landslide-blocked lake of Longquan river. Such disasters have threatened the safety of life and need to be concerned.

Whereas, this research study the relationship of talus deposits development induced by various cliff retreat types in Hungtsaiping rockfall area. In the present paper, we analyzed the geomorphologic changes of cliffs and talus deposits based on the findings from the topographic maps and interpreting aerial photos. The physical modeling was then carried out which was helpful to understand the relationship of cliff retreat and talus deposition patterns. The results of physical modeling were compared with those produced by numerical simulation (Application of discrete element method by PFC3D 3.0 program) so that the correctness of the numerical simulation could be justified. Subsequently, calibrated numerical methods adopted in the small-scale model were used to simulate the full-scale model. The simulation results should be as close to reality as much as possible. Finally, the shape function of talus deposition topographic patterns and the cluster of rockfall influence area for various cliff retreat types.

Furthermore, the shape function reflects the deposits characteristic of main factors (the factor includes the slope angle of movement area, the fall height, rockfall amount, the joints spacing, the mean roughness height of deposition area, cliff retreat type) through the full-scale model simulation and physical modeling tests. The shape function are helpful for rockfall hazard zonation and developing reasonable and scientifically sound guidelines while giving land use assessment and protection engineering sited in rockfall area.

Keywords: rockfall disaster, cliff retreat, talus deposits, geomorphologic analysis, physical modeling, numerical simulation, shape function