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Landslide monitoring using TDR and related numeral stability analysis in Mountain Ali, Taiwan

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Woo-Wan-Chai in Mountain Ali is the one of the most dangerous provincial road in Taiwan especially during typhoon events. In the past decades, experts have conducted drilling, experimenting, and manual monitoring in field to investigate shallow and deep-seated sliding surfaces in Woo-Wan-Chai. However, automatically disaster prevention monitoring is now required and widely implemented. Among all of the automatic technologies, Time Domain Reflectometry (TDR) is featured with low-cost, easy-installation, and multi-function in landslide monitoring. TDR can offer spatially and temporally continuous displacement monitoring along the coaxial cable which was grouted in the borehole up to 100 m depth in this case. Meanwhile, the corresponding TDR cloud platform was proposed to periodically examine the sliding depth and rate of the shear deformation as an early warning system. It is aimed to reduce losses from the sliding in Woo-Wan-Chai in the future. In addition to the enhancement using TDR monitoring, the geological profiles with related soil/rock properties, and previous monitoring data, such as underground water depth during typhoon Morakot, were collected carefully to support the landslide stability analysis. The numerical scenarios indicated the critical slide depth at 30 m will be triggered by high underground water and also saturated soil, and this is further verified by the shear deformation monitoring results of the manual inclinometers.