Slope Stability and Rockfall Hazard Analysis along Karimbala Road, Liquiça Municipality, Timor-Leste

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ABSTRACT

Timor-Leste has a rough topography and a complex geology contributing to the occurrence of many slope stability problems, which are aggravated by recent road construction activities aiming to improve the old roads. Many cuts, sometimes with a considerable height are a frequent cause of several failures that require a detailed study. The study area where the research on Slope Stability Analysis (SSA) was done, is in Maubara, in the Municipality of Liquiça, along the Karimbala road, which links the Liquiça and the Bobonaro Municipalities. It was verified that slope failures have occurred systematically throughout the years, the most recent ones occurred in January 2018. The general objectives of this research were to study the slope stability problems and to compute the Factor of Safety (FoS). For the characterization of the slope material and its geomechanical classification, the slope was mapped to define the outcropping materials, the discontinuities were characterized, and the strength of the rock was evaluated using the Schmidt hammer. Based on the data collected in the field, the RMR and the SMR geotechnical classifications were applied to the slope. The evaluation of the stability conditions was also done using the Rocscience software (SLIDE, ROCFALL and ROCTOPPLE) suitable for each individual slope failure. The Rockfall Hazard Rating System (RHRS) classification guidelines to rate each occurrence was also used. The types of failures identified were rockfall, toppling, debris fall, plane failure and wedge failure. Rockfalls and debris fall are frequent on all slopes from Slope 1 to Slope 5, in contrast to the wedge failure, which only occurs in Slope 2 and Slope 6. The main causes of slope instability are the geological discontinuities with unfavourable orientation, the surface weathering and the intense rainfall which add weight and induce high water pressure in the slopes. The FoS values computed lower than 1.5, are considered as insufficient for a long-term stability. The RHRS results computed are greater than 300. Therefore, it can be concluded that Slope 1 to Slope 5 are vulnerable to additional slope failures. Mitigation must be urgently implemented to reduce damages in the road and drivers. It is highly recommended to develop proper technical design of the slopes considering a FoS suitable for long-term stability, using improvement techniques adjusted to the local conditions such as: reduction of slope height (reduction of overburden stress), reduction of slope angle (reduction of overburden stress), drainage improvement (reduction of pore water pressure), reinforcement of slope (increase of shearing resistance of slip surface). In a few slopes presenting unstable conditions a few improvement stability procedures were simulated, to evaluate the best procedure to be used.

Keyword: Slope stability analysis (SSA), Factor of Safety (FoS), rockscience software, geotechnical classifications, mitigation