Instituto do Petróleo e Geologia – Instituto Público
(IPG)

4th IPG International Geosciences Conference on
Timor-Leste Geological Data and Information for Economic Diversification and Development
Dili 23-26 October 2018

Note Taker's Document

Date: 26/10/2018 Time: 14:40 Conference Day: 4

Venue: CCD Conference Speaker: **Oktoviano Viegas Tilman de Jesus (IPG)**

Presentation Title/Topic: **Slope Stability and Rockfall Hazard Analysis along Karimbala Road, Liquiça Municipality, Timor-Leste**

Presentation Notes	Q&A
Slope Stability and Rockfall Hazard Analysis along Karimbala Road, Liquiça Municipality, Timor-Leste • Introduction Timor-Leste is a small and mountainous island country, located between Indonesia and Australia, it has the population of about 1.5 million. Timor-Leste in general, consists of different types of Geological condition (Geological structures), which made some areas prone to geological hazards, such as; landslide, flooding and coastal erosion. Generally, the study area is affected by frequent slope failures, causing difficulties and great danger to the drivers using the road. The slope failures occurring in this area consists of Rockfall, Plane Failure, Wedge Failure, Rock Topple. In analyzing the Slope Stability and Rock Toppling it is required to compute for the Factor of Safety (FoS) using SLIDE and ROCTOPPLE program. Where, the recommended Factor of Safety (FoS) for permanent slope is 1.50 (Samarawickrama, Amarasinghe and Bandara, 2014).	**N/A:**

Note Taker's Name:
_____OV_____

In analyzing the Rockfall it is used the Rockfall Hazard Rating system (RHRS) classification Table and using the ROCFALL program for Rockfall hazard stability analysis. • Objectives of the Study - The main objective of this work is to Perform the Slope Stability Analysis (SSA) and Rockfall Hazard Rating System (RHRS) for five selected road slopes in the study area. - Analyze the other probable causes the landslide/slope failure (Geology and Geomorphology, Hydrogeology, Seismicity/Earthquake events). - Study/analyze and propose stabilization (hard measures) on the road slope failures. • Location of the study area Located in the NW part of Timor-Leste, along the Karimbala Road, Administrative post of Maubara, Liquiça Municipality. ~1.5 hrs. drive from Dili (Capital of Timor-Leste) to the study area. • Methodology Desk Study/Preparation →Field Work and Data Collection→Solution, Mitigation and Recommendation • Geology and Geomorphology The Local Geology of the study area belongs to the Formation of Aileu Phyllite, schist, amphibolites, slate, metasandstone, shale, few volcanic rocks. (Audley Charles, 1968). Geomophology of the sstudy area lies in a Moderate Topography • Hydrogeology The study area is a part of localized aquifer (high fracture). The lithologies are impermeable towards the water, it has low porosity and low permeability.	

Note Taker's Name:
_____OV_____

The study area is controlled by the geological structures and discontinuities, including: Faults, folds and fractures influencing the water infiltration. • Seismicity The seismic activity occurrences nearby to the study area are ranging from 3.2-5.9 in its Magnitude and 0-88.1km in Depth. The PGA value used in this study is 28 gal or 0.28m/s^2. • GIS Analysis for General Landslide/Slope Failure Susceptibility Zonation Study Area lies in a Moderate to High Susceptibility Zone • Results and Discussion Using Rock Mass Rating System Classification, Slope Mass Rating Classification and Rockfall Hazard Rating System Classification. Results shows all slopes have poor quality based on the RMR, SMR and RHRS. Slope Materials Determination: Silty Gravel and Clayey Gravel For Slope 1 the FoS for Dry/Natural Condition, Saturated Condition, and Additional Seismic Load Condition are 1.637, 1.185 and 0.666 respectively. After slope stabilization using Wiremesh and Bioengineering and Rockfill the FoS become 1.518. Areas also prone to the Rockfall, after analysis for the stabilization using ROCFALL program, where installing the 2m barrier protection at the bottom of the slope. The slope is said to be in a safe condition. For Slope 2 the FoS for Dry/Natural Condition, Saturated Condition, and Additional Seismic Load Condition are 1.486, 1.153 and 0.706 respectively. After slope stabilization using Wiremesh and Rockbolts and Rockfill the FoS become 2.190. Areas also prone to the Rockfall,	

Note Taker's Name:
_____OV_____

after analysis for the stabilization using ROCFALL program, where installing the 2m barrier protection at the bottom of the slope. The slope is said to be in a safe condition. For Slope 3 the FoS for Dry/Natural Condition, Saturated Condition, and Additional Seismic Load Condition are 1.204, 0.776 and 0.441 respectively. After slope stabilization using Wiremesh and Rockbolts and Rockfill the FoS become 1.588. Areas also prone to the Rockfall, after analysis for the stabilization using ROCFALL program, where installing the 2m barrier protection at the bottom of the slope. The slope is said to be in a safe condition For Slope 4 the FoS for Dry/Natural Condition, Saturated Condition, and Additional Seismic Load Condition are 1.603, 1.214 and 0.736 respectively. After slope stabilization using Wiremesh and Rockbolts and Rockfill the FoS become 1.875. Areas also prone to the Rockfall, after analysis for the stabilization using ROCFALL program, where installing the 2m barrier protection at the bottom of the slope. The slope is said to be in a safe condition. For Slope 5 the FoS for Dry/Natural Condition, Saturated Condition, and Additional Seismic Load Condition are 1.107, 0.842 and 0.514 respectively. After slope stabilization using Wiremesh and Rockbolts and Rockfill the FoS become 1.522. Areas also prone to the Rockfall, after analysis for the stabilization using ROCFALL program, where installing the 2m barrier protection at the bottom of the slope. The slope is said to be in a safe condition. • Conclusion The main causes for the occurrence of instability situations is the geological structures condition: Random and unfavorable orientation of discontinuities	

Note Taker's Name:
_____OV_____

Presence of water on slopes. The slope failure occurs throughout the years in the study area, the most recent one was in January 2018, where the types of failures were: Rockfall, Rock Topple and Soil Slide The results of the RHRS classification correspond to this situation, which requires the adoption of rapid stabilization measures. • Recommendation To mitigate future slope failures in the post failure vulnerable areas, attempts were made to achieve a minimum Factor of Safety (FoS) of 1.5 by employing different types of improvement techniques such as: Drainage improvement (reduction of pore water pressure). To minimize the failure from the joints, discontinuities and fractures it is recommended to use the Wire Mesh and Rockbolts method. It is considered that the use of rockfill is a good solution, well suited to Timor-Leste because it can benefit from the abundant rock outcrops and does not need high skilled techniques or procedures. The Toppled rock mass generally sustains large strain in its inside, therefore it is recommended to remove the unstable part of rocks and construction of retaining wall at the toe of the slope (rockfall barrier/protection with the 2m in its height). For Soil Materials Improvement of securing using plant materials, by using the Bio-organic/ (Bio-engineering) Method. Rerouting is a possible alternative.	

Note Taker's Name:
_____OV_____

If the slope failure would continue for long time the maintenance cost may increase. Detail engineering study and design of the road slopes before project implementation must be performed. A detail drilling and core sampling to have suitable subsurface data information for future detail study is highly recommended. This research work could serves as the starting results of study for future recommendation to the Ministry of Public Works of Timor-Leste on having the Factor of Safety (FoS) standardization for slope design, which must be greater than 1.5 for any road slope design along the Geological Condition of Aileu Formation. (Oktoviano, 2018)	

Note Taker's Name:
_____OV_____