

## **Relict Structures and Cut Slope Failures in Highly to Completely Weathered Rocks Along Jalan Tg. Siang, Kota Tinggi, Johor**

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A new road to Tg. Siang was completed in late 1998 as a by-pass to Tg. Balau and Tg. Siang from the main Kota Tinggi road. The by-pass transverses a gently undulating terrain of metasedimentary rocks of the Mersing Group (Permo-Carboniferous), consist of interbedded phyllite, slate and quartzite with minor intercalation of metavolcanics. The regional structural strike is in the NW-NNW direction and is dominated by dextral transpressional shear zones, intervened by zones of multiply deformed, tight to isoclinal folds. A slope failure survey conducted in September 1999, followed by geological mapping in April 2000, found that the number of slope failures increased from 10 to 18 cases. All the failures involve slopes cut in zones of highly-completely weathered rocks (grade IV-V) and residual soils (grade VI). The presence of relict structures has been identified as the main geological factor in controlling the failures, in addition to water and slope materials. Most of the slope cut failures in highly weathered rock (engineering soils) took place in the form of undercutting-induced failures. Instabilities of the slopes were initiated by ravelling of the loose materials, rill and gully erosions, which was subsequently followed by earth falls, shallow slips, earth wedges and/or slumping. The failure planes are largely controlled and defined by relict structures (e.g. relict joints, foliations, bedding and/or shear zones). Results of this study highlight the importance of geological input, especially on the nature and orientation of relict structures in slope engineering. Cut slopes in highly-completely weathered rocks should not be oversimplified and treated as homogeneous soil slopes. Instead, they should be treated as discontinuity-controlled soil or weak rock mass in order to successfully implement safe and economic design. It is always a good practice for the slopes to be mapped by engineering geologists with sound structural background or vice-versa, structural geologists with some knowledge of engineering geology. The structural mapping should be carried out during the site investigation stage to choose the most suitable alignment, and during construction to check the results and interpretation made in the earlier pre-construction stage.

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