

## Engineering geology of the Ipoh-Gopeng segment of the North-South Highway

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The Ipoh-Gopeng segment of the North-South Highway traverses terrain representing Kinta Geology, i.e. with rock formations comprising limestone, schists, quartzite and granite. Superficial deposits include various residual soils, alluvium, colluvium, mine tailings and slimes.

The construction of the highway in the Ipoh-Gopeng area is very much dictated by the type and nature of the deposits (soils and rocks) traversed by the highway. This paper presents examples of engineering geological works along the highway illustrating the influence of geology on engineering works.

For example, initial mapping of certain section of the highway alignment revealed the extensive occurrence of colluvial deposits, which are rather weak materials. As such, the elevation of the highway alignment was shifted to a higher level to avoid as much as possible these colluvial deposits.

The soft slimes and mine tailings left over from previous tin mining activities were removed or transferred to other ponds away from the alignment wherever possible. Those not removed or transferred elsewhere were subject to soil stabilisation measures such as preloading with pre-fabricated vertical drains to accelerate consolidation of the soft soils.

Cut slopes in residual soils of granite and schists do not present much problems, except that at the base of some of the slopes which were designed and constructed to be at steeper angles, some soil stabilisation works were required such as guniting, soil nailings, soil anchors, etc. An unexpected occurrence of weathered pegmatitic dykes and veins at the base of one of the schist cut slopes did caused some problems to the guniting works carried out at one location.

Cut slopes in granite at the southernmost section of this part of the highway did cause some major concerns and problems during the construction stage. By virtue of the ubiquitous occurrence of several joint sets in the granite and half a dozen or more faults dissecting the granite mass, a number of rock slope failures occurred during the construction stage. Numerous stabilisation measures were adopted, such as installing rock dowels and removal of a major section of the rock slope.

A major overhang at the limestone cliff at Simpang Pulai which was located very close to the highway alignment was similarly "stabilised" by major blasting and removal to yield a benched rock slope. The blasting of steep or overhanging limestone cliffs, however, is not without its associated hazards such as the triggering of rockfalls. The resulting benched slopes, however, are more acceptable since they pose less risk to the highway.

In conclusion, this case study clearly demonstrates the influence of geology (soils & rocks) on construction works.