

## Engineering Geological Characterisation of Sedimentary Rocks at Parit to Kuala Kangsar, Perak, Malaysia

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The Parit to Kuala Kangsar area is a part of Kati Formation that consists of alternating layers of sandstone, siltstone and mudstone. The presence of sedimentary structures such as graded bedding, lamination and slumping causes these heterogeneous rocks to undergo non-uniform weathering. Field observations at the outcrop along the road A164 (N04°32', E100°56') show that the sedimentary rocks are moderately to highly weathered. Besides that, different parts of the rocks within the same outcrop exhibit different rock properties. Furthermore, the weathering grades of the rocks are difficult to identify applying the widely accepted International Association of Engineering Geology (IAEG) weathering classification, (IAEG,1981) which appears to be more suitable for igneous rock. Therefore engineering geological characterization of sedimentary rock needs to be determined to classify the weathering grade systematically by applying qualitative and quantitative techniques. In this research, the physical properties and mechanical strength of rock such as porosity, dry density, point load strength index (Is(50)) and slake durability index are determined based on the recommendation of ISRM and ASTM. Initial laboratory results based on lithology are shown in Table 1 with a

preliminary weathering grade classification. Moderately weathered sandstone has the mean porosity of 11.4 %, mean dry density of 2.40 g/cm<sup>3</sup>, mean point load strength index of 0.53 MPa and mean slake durability index of 68.0 %. For highly weathered sandstone, the mean porosity is 19.1 %, mean dry density is 2.22 g/cm<sup>3</sup>, mean point load strength index is 0.15 MPa and slake durability index is 32.6 %. The completely weathered sandstone is classified as well graded sandy soil with an estimate of shear strength more than 0.45 MPa based on the pocket penetrometer test. Moderately weathered mudstone has the average porosity of 36.0 %, mean dry density of 1.77 g/cm<sup>3</sup>, mean point load strength index of 0.28 MPa and mean slake durability index of 12.5 % while highly weathered mudstone has average porosity of 39.7 %, mean dry density of 1.62 g/cm<sup>3</sup>, mean point load strength index of 0.10 MPa and mean slake durability index of 1.6 %. Apart from the sandstone and mudstone, there is also present of weathered sandstone that had undergone recementation with higher rock strength. Recemented sandstone has the average porosity of 4.5 %, dry density of 2.54 g/cm<sup>3</sup>, point load strength index of 2.30 MPa and slake durability index of 98.2 %.

Table 1. Summary of laboratory test results based on lithology.

Rock Type	Weathering State	Mean Porosity (%)	Mean Dry density (g/cm <sup>3</sup> )	Mean Point Load Strength Index (Is(50)) (MPa)	Mean Slake Durability Index, Id2 (%)
Sandstone	Moderately weathered	11.4	2.40	0.53	68.0
	Highly weathered	19.1	2.22	0.15	32.6
Mudstone	Moderately weathered	36.0	1.77	0.28	12.5
	Highly weathered	39.7	1.62	0.10	1.6
Recemented Sandstone	Moderately cemented	4.5	2.54	2.30	98.2