Performance of Some Rock Index Tests in Older Alluvium as Midpoint between the Soil and Rock

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Abstract: The variable properties of older alluvium under different weather condition led several problems during excavation and piling. Older alluvium is semi cemented sedimentary rock and easily to break during wet season, however harder while dry. Specimen from Desa Tebrau in Johor was tested to obtain it strength. Irregular samples were used due to the difficulties in preparing cylindrical samples at laboratory. Rock index tests such as point load test and Schmidt (rebound) hammer test were tested. However there were zero values during the tests in wet and dry conditions. In addition, the slake durability test was not available due to samples were slake readily in water for less than ten minutes. Therefore, older alluvium deposits required different tests to obtain their strength, such as procedure adopted in soil laboratory test or conducted in situ. Moreover, the sampling and testing of the older alluvium need to carry out at deeper layer which in the confined environment, thus to be actual site condition.

Keywords: Older Alluvium; Moisture Content; Point Load Test; Schmidt Hammer; Slake Durability Test.

1. Introduction

At general alluvium is loose unconsolidated soil or sediments, eroded deposited and reshaped by water at non-marine environment at aged of Holocene. Meanwhile, the older alluvium is semi consolidated sediments at aged of Pleistocene (between 0.01 and 1.8 million years). Table 1 shows comparison between the older alluvium and alluvium at Desa Tebrau in south Johor state. [1]. Figure 1 showed the older alluvium exposed the study area. The boundary between weathered granite and older alluvium was exposed at study area as shown in (Figure 2).

Table 1: Comparison between the older alluvium and alluvium at Johor [1].

Name	*Older Alluvium*	*Alluvium*
Age	Pleistocene	Holocene
Description and components	Semi–consolidated Gravel, sand and clay Boulder beds	Unconsolidated Gravel, sand and clay
Origin	Fluviatile and shallow-marine	Fluviatile and shallow-marine

The problem of older alluvium occurred when working in dry condition (such as piling or excavation works). It characteristics changed due to the weather.

Fig. 1: Photograph showing older alluvium found at Desa Tebrau, Johor.

According to Edy Tonnizam *et. al* [2] the shear strength (τ) of older alluvium decreased with increasing moisture content as shown in Figure 3. The tested the samples were taken from the surface of the older alluvium outcrop due to the excavation problem. However, Badee [3] mentioned that the direct shear on regular sample of older alluvium, required careful in-situ the samples preparation, to ensure the samples were undisturbed. Therefore a series of rock index tests at different moisture contents were studied. The results will use as an evidence to classify the older alluvium.

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The rock index tests such as rebound hammer test and point load strength (I_s) were studied. In addition, the slake durability index (SDI) was adopted to review empirically rock strength. The hypothesis of this study was the moisture contents affected the properties. Generally, the water acting as lubrication agent caused soften the bonds and interact with mineral surfaces, consequently decrease frictional shearing resistance and the water pressure decreased the stability of the weakness planes [3].

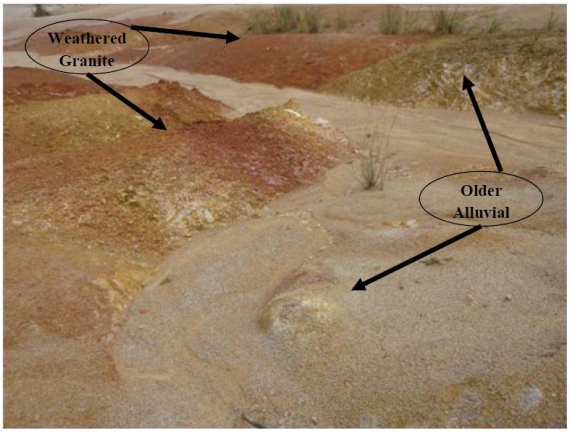

Fig. 2: The boundary between the older alluvium and weathered granite.

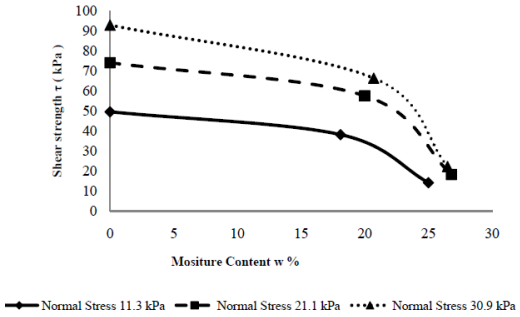

Fig. 3: Comparison reduction of shear strength with moisture content at different applied normal stress of 11.3, 21.1 and 30.9 kPa [2].

2. Methodology

The index (indirect) tests were conducted to obtain the engineering properties of the rocks with minimum cost. In this study, three types of indirect tests were chosen; (1) Schmidt hammer test SHT, (2) slake durability test SDT and (3) point-load test PLT. The Schmidt hammer test was applied at field as well as at laboratory, while the point-load test and slake durability test were only adopted at laboratory. The test began with Schmidt hammer test on the field (figure 4). However, the tests at wet condition for the point-load test and slake durability test were ignored because the results from the Schmidt hammer which indicated (it was zero) the weakness and unreality of the samples on wet condition for the those tests. The standards which used were, ASTM5873 [4] for Schmidt hammer test, ASTM D5731 [5] for point-load test, ASTM D 4644 [6] for slake durability test. In another side, the samples taken from the surface as mentioned previously in introduction.

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3. Results and Discussion

The results from Schmidt (rebound) hammer RH, point-load test PLT and slake durability test SDT were shown in Table 2. It is appear no values (zero) can be recorded during the tests. The samples were destroyed before or while tested. The samples had not enough strength to stand or resist to the applied force.

The cylindrical shape for point-load test was started to prepare, however the samples were destroyed during preparation as shown in Figure 5. Therefore, irregular samples were used. However, irregular samples were also failed before any values were recorded on the point load test (it can be accounted as zero value) (Figure 6). Schmidt hammer test carried out at irregular samples in dry condition and at laboratory (Figure 7). Meanwhile for the slake durability test, it was found that samples were fully slake in water after submerged for less than 10 minutes as shown in Figures 8 and 9. Thus, the results indicated that the older alluvium can be classified as a weak rock.

Table 2 Summary of the index tests conducted in the laboratory.

Test Name	Sample Shape	Sample Condition	Considered results	Sample reaction
RH	Irregular	Wet & Dry	Zero	Destroyed before the apparatus recorded anything
PLT	Irregular	Dry	Zero	Cracked & destroyed before the apparatus recorded anything
SDT	Irregular	Wet & Dry	Zero	Destroyed after submerged less than 10 minutes

RH = Schmidt (rebound) hammer test. PLT = Point-load test. SDT = Slake durability test

Fig. 4: Measured surface hardness of older alluvium by Schmidt (rebound) hammer.

Fig. 5 The dry sample was disturbed partially during use coring apparatus to prepare it for the direct shear test.

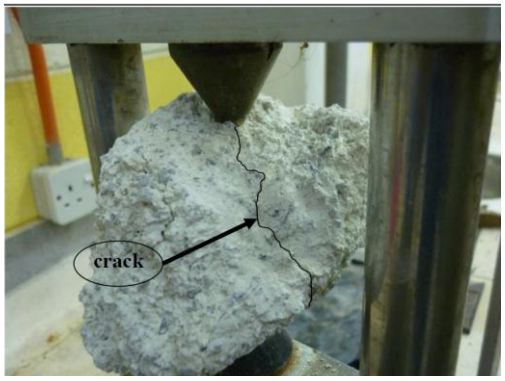

Fig. 6: The sample was cracked than destroyed before the point-load test recorded any value (zero).

Fig. 7 The sample was destroyed during implementation the Schmidt (rebound) hammer test at laboratory.

Fig. 8 Submerging the sample into water.

Fig. 9 The samples fully destroyed after submerged in water for less ten minutes.

Table 3 Suitability, sample shape and sample condition for the geotechnical tests.

Test Name	Sample Shape	Sample Condition	Suitability
Schmidt (rebound) hammer	Irregular & Regular	Wet	0
Schmidt (rebound) hammer	Irregular & Regular	Dry	0
Point-load test	Irregular & Regular	Wet	0**
Point-load test	Irregular & Regular	Dry	0**
Slake durability test	Irregular	Wet	0
Slake durability test	Irregular	Dry	0
Moisture content	Irregular & Regular	Wet & Dry	1
Wet sieve analysis	-	Wet & Dry	1

0 = Unsuitable.

1 = Suitable (directly following the conventional standard).

** The apparatus which used was manually and it had low sensitive at reading.

4. General Review for All Tests

Table 3 shows the suitability, sample shape and sample condition for the geotechnical tests which carried out on the older alluvium. It is clear that the geotechnical tests which usually applied for rock such as Schmidt hammer test, point-load test and slake durability tests were not suitable for the older alluvium sample (which taken from the surface of deposits). The samples unable to prepare and were failed without indicates any values It seems that the samples taken from the surface of older alluvium changed it properties. Thus, it should not carried the rock test on the surface samples of older alluvium by using portable apparatus, however, it should be adopted more sensitive apparatus such as Universal Test Machine, UTM [7]. Badee [3] was experienced conducts the direct shear on the alluvium required carefully sample preparation to keep the samples undisturbed.

5. Conclusion

In general the older alluvium has different behaviour at different level of moisture content [3]. The older alluvium have high strength at the dry condition but unable to conduct the rock index tests due to the insensitive apparatus. The older alluvium was too fragile and broken while cylindrical samples preparation. For Schmidt hammer, no results recorded at all condition (dry and wet conditions) as well as the point load test. It can conclude that the samples of older alluvium which sampling in unconfined condition is considered as soil. To obtain the older alluvium engineering properties, therefore need to use sensitive apparatus such as universal test machine as well as to obtain samples from deeper alluvium layer.

6. Recommendations and Suggestions

From these results, the unconfined older alluvium should be considered as a soil. In addition, any strength tests should be implemented by using sensitive apparatus such as Universal Test Machine. Moreover, the engineering properties tests should be conducted in situ where in the confined condition The old sediment was likely behaved like a rock in the confined condition, indicates by the difficulties during the excavation and piling activities. In another side, due to the previous results which indicate presence of 38% fine material within the older alluvium components, consequently, conducting the standard penetration test (SPT) is not represented an actual behaviour of the older alluvium when the moisture contents were changed [3].

7. References

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