THE CORRELATIONS AND SOIL PROPERTIES ANALYSIS OF TEMERLOH, PAHANG

Muzamir bin Hasan[1], Amizatulhani binti Abdullah[2], Aminaton binti Marto[3]

[1,2] Faculty of Civil Engineering & Earth Resources,
Universiti Malaysia Pahang, Jalan Tun Razak,
26300 Gambang, Kuantan, Pahang.

[3]Faculty of Civil Engineering,
Universiti Teknologi Malaysia,
81310 Skudai, Johor

Email: [1]muzamir@ump.edu.my,
[2]amizatulhani@ump.edu.my, [3]aminaton@utm.my

ABSTRACT

The characteristics of silty clay soil are different compared to other soils due to their low strength and high compressibility. It is also difficult to get an undisturbed sample for this type of soil for laboratory testing. Hence, the correlation between basic properties and clay/silt content or between basic properties itself will be useful to engineers especially for preliminary design purposes.An attempt was made to correlate the Atterberg limits itself and Atterberg limits with clay/silt content. In general, the correlations show that the liquid limit and plasticity index increase with the moisture content. The plasticity index also tends to increase with liquid limit. From the correlation between the liquid limit with the clay/silt content, it is found out that the liquid limit increases with the increase of clay/silt content, probably due to the clay particles tend to pull or absorb water to the surface of soil particle, making the liquid limit to be much higher. The results give an alternative for engineers to use the basic soil properties to predict the strength of soil. One can also determine the shear strength of the soil at certain depth below ground level. This will allows a quick and economic design for construction on silty clay

KEYWORDS*: Radial Basis Function, gender, entry qualification, student performance, intelligence approach.*

1.0 INTRODUCTION

The emergence of development in construction industry has minimized the preferred site of geotechnical quality for construction although

these sites are known to reduce technical problems and thus the cost associated with their construction. By that, socio-economic and political considerations have forced the use of sites of lower quality and in particular, of sites covered by compressible soils. In developed country such as Malaysia, the chances to have a good quality construction sites become rarer and it seems like it is necessary to choose sites that include compressible soils, especially for industrial structure and transportation projects. Therefore, the tasks to do constructions on these compressible soils have become a challenge for geotechnical engineers all over the world.

Soils with characteristics of low strength and compressible exist all over the world. One of the most significant problem arises because of its characteristics is its difficulties in supporting loads on such foundation. The problem arises with low strength is that leads to difficulties in guaranteeing the stability of the embankment. On the other hand, this type of soil also associated with high compressibility which leads to large settlements and deformations of the structure.

2.0 BACKGROUND

The construction on soft cohesive soil is increasing lately because there are not too many suitable sites for construction of infrastructures and other development. The problems that related to this type of soil are stability and settlement. By that, the understanding and knowledge of engineering characteristics of soft clay soil are critical and should be concentrated by people that related in this field. The selection of construction method on this formation is restricted by costs, duration of completion, and benefits.

The development in South East Asia had been so rapid that the importance of studies in soft clay soil is very important. However, the studies that been done concentrated on major cities, such as Bangkok, Kuala Lumpur, Jakarta, Singapore, and many more. Because of that, the coastal area in Pahang are chosen for this study to develop correlations that hopefully will be use by the engineers for preliminary design purposes as well as increasing database on engineering characteristics of soil properties in future. All Pahang's district area involved in this research were Bentong, Bera, Kuala Lipis, Maran, Kuantan, Raub, Rompin, Jerantut, Temerloh, Pekan and Kuala Lipis's high population residential area known as Cameron Highlands. Data are taken with some helps from Public Work Department (JKR) Malaysia.

3.0 OBJECTIVES

The objectives of the study can be shortlisted as follows:-

a) To determine the engineering properties and design parameters for soil in Pahang State.

b) To produce correlations between engineering characteristics and basic properties of soil for design purposes.

c) To produce correlations between engineering characteristics and basic properties with depth of soil for design purposes.

d) To contribute to Pahang soil analysis development.

4.0 SCOPE

This study was conducted specifically in Pahang. The map of Pahang is shown in Figure 1. The samples data were taken at several construction project sites in Pahang State at every of its district area. The samples data are taken from construction project sites which chosen based on the SI report given by JKR Malaysia. This paper presented the results for Temerloh district.

FIGURE 1
The Map of Pahang (http://www.asiatour.com/malaysia/e-07paha/em-pah10.htm, 2010)

5.0 IMPORTANCE OF STUDY

To overcome the problem encountered in soft soil, knowledge and deep understanding about the engineering characteristics of the soft soil are very important. The data that had been obtained are analyzed and hopefully will become a part of soft soil database in Malaysia. This is because there are lack of studies in soft soil properties and engineering characteristics in Malaysia. The result from this study can be referred by engineers as useful guidance for them to apply in construction on soft soil. Whereby, the correlation that been produced can be used as preliminary design for structure on soft soil.

6.0 LITERATURE REVIEW

There are only limited correlations on soil characteristics available to date, in particular for soft soil. The generated correlations in the studies are correlation between plasticity index with liquid limit, liquid limit with clay/silt content, natural moisture content with clay/silt content, natural moisture content with liquid limit and natural moisture content with plasticity index.

6.1 Correlation between Plasticity Index and Liquid Limit

(Hussein, 1995) has generated the correlation between plasticity index and liquid limit with the equation as follows:

$$I_p = 0.7(w_L - 6) \quad (1)$$

(Abdullah *et.al*., 1987) also generated a correlation between plasticity index and liquid limit. The equation of the correlation is:

$$I_p = 0.64(w_L - 8.8) \quad (2)$$

(Saiful, 2004) has generated another correlation between plasticity index and liquid limit with the equation as follows:

$$I_p = 0.77(w_L - 10) \quad (3)$$

where,

I_p = plasticity index
w_L = liquid limit

Liquid limit and plasticity index obtained by (Saiful, 2004) is 31% to 142% and 17% to 101% respectively. While the liquid limit and plastic limit obtained by (Hussein, 1987) is 40% to 125% and 10% to 40% respectively.

6.2 Correlation between Natural Moisture Content and Clay/Silt Content

(Saiful, 2004) has generated the upper and lower limit between natural moisture content and clay content with the equations as follows:

$$\text{Upper limit: } w = 1.93\ (\%\text{clay}) + 53 \tag{4}$$

$$\text{Lower limit: } w = 0.43\ (\%\text{clay}) + 11 \tag{5}$$

where,

w = natural moisture content

Natural moisture content obtained by (Saiful, 2004) and (Ting *et.al*., 1977) is 18% to 139% and 20% to 140% respectively.

6.3 Correlation between Liquid Limit Moisture Content and Clay Content

(Saiful, 2004) has generated the upper and lower limit between liquid limit and clay content with the equations as follows:

$$\text{Upper limit: } w_L = 1.92\ (\%\text{clay}) + 56 \tag{6}$$

$$\text{Lower limit: } w_L = 0.39\ (\%\text{clay}) + 24 \tag{7}$$

where,

w_L = liquid limit

7.0 RESULTS AND DISCUSSIONS

From the results, some correlations were generated. The correlations are liquid limit and plasticity index with natural moisture content, plasticity index with liquid limit, natural moisture content with clay/

silt content and liquid limit with clay/silt. Table 1 and Table 2 shows the generated correlations and correlations with upper and lower limit, respectively.

TABLE 1
Simplified Correlations Produced

No.	Correlations	Equations	R^2
1	Liquid limit (%) & natural moisture content (%)	$w_L = 1.9391(w) + 13.34$	0.4518
2	Plasticity index (%) & natural moisture content (%)	$I_p = 1.2915(w) - 1.744$	0.7698
3	Plasticity index (%) & liquid limit (%)	$I_p = 0.4384(w_L) + 1.5301$	0.6822

TABLE 2
Correlation with upper and lower limit equation

No.	Correlations	Equations	R^2
1	Liquid limit (%) & natural moisture content (%)	$w_L = 1.9391(w) + 13.34$	0.4518
2	Plasticity index (%) & natural moisture content (%)	$I_p = 1.2915(w) - 1.744$	0.7698
3	Plasticity index (%) & liquid limit (%)	$I_p = 0.4384(w_L) + 1.5301$	0.6822

7.1 Moisture Content

The moisture content with depth for three locations in Temerloh is shown in Figure 2. The percentage of moisture content in Temerloh generally is high from 1.5m to 9.5m depth. But then it decreases from 11m to 20m depth. The percentage of moisture content in this area is in the range of 13% to 25%.

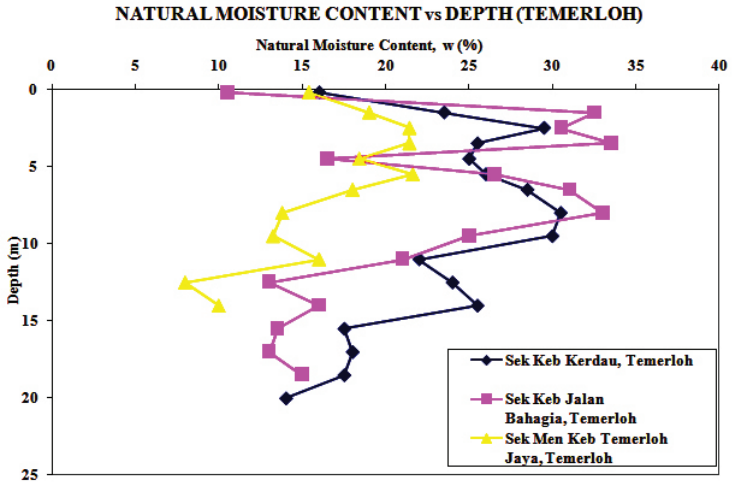

FIGURE 2
Natural Moisture Content with Depth

7.2 Plasticity

The percentage of liquid limit in this area is roughly decreases from 3.5m to 20m depth. The range for the percentage of liquid limit for this site is from 20.3% to 71%.

The percentage of plastic limit in this area is also decreases from 1.5m to 20m depth though sometimes the percentage appears to be inconsistent. The range for the percentage of plastic limit for this site is from 24% to 37%.

The percentage of plasticity index in the area had showed some inconsistency. The percentage is increases at the beginning from 0.2m to 3.5m depth. But then start to be inconsistent where it increases and decreases often but the percentage getting smaller with depth.

Figure 3 show the correlation between liquid limit with natural moisture content. It shows that liquid limit increases with the increase of moisture content. The same trend also appear in correlation between plasticy index with liquid limit (as shown in Figure 4) and correlation between plasticity index and natural moisture content (as shown in Figure 5), where plasticity index increases with the increase of liquid limit. While plasticity index increases with the increase of natural moiture content.

The plasticity is controlled by fine particles (clay and silt) and in particular, the plasticity of the soil is strongly influenced by clay content. Natural moisture contents are increases with clay content. Plasticity index are also increases with the increases of natural moisture content and liquid limit. Liquid limit and natural moisture content are also increase to one other. For liquid limit and clay content, the value had showed unsimilarity.

The plasticity is controlled by fine particles (clay and silt) and in particular, the plasticity of the soil is strongly influenced by clay content. Liquid limit increases with the increase of clay content. Clay particles tend to pull or adsorb water to soil surface particle, making the liquid limit to be much higher.

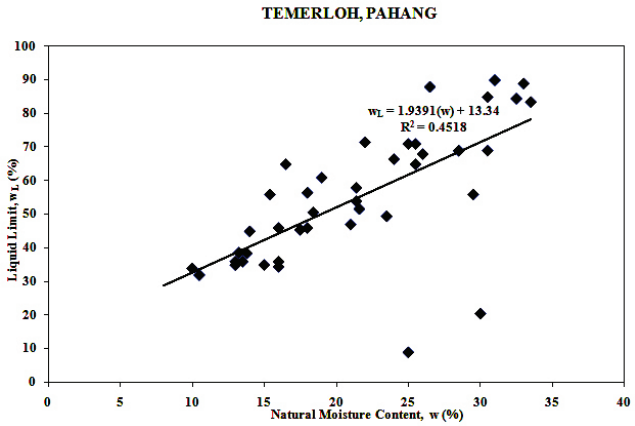

FIGURE 3
Correlations between Liquid Limit and Natural Moisture Content

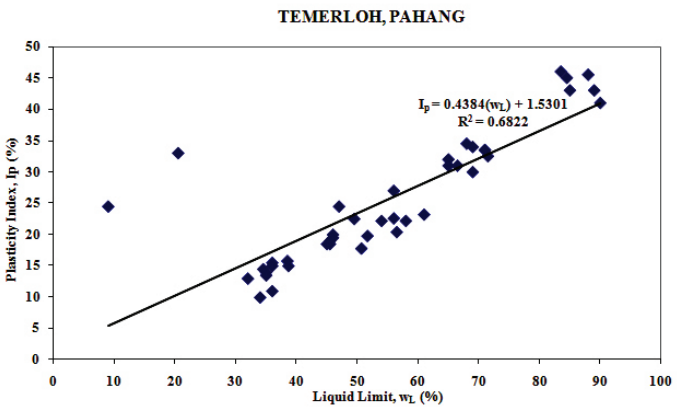

FIGURE 4
Correlations between Plasticity Index and Liquid Limit

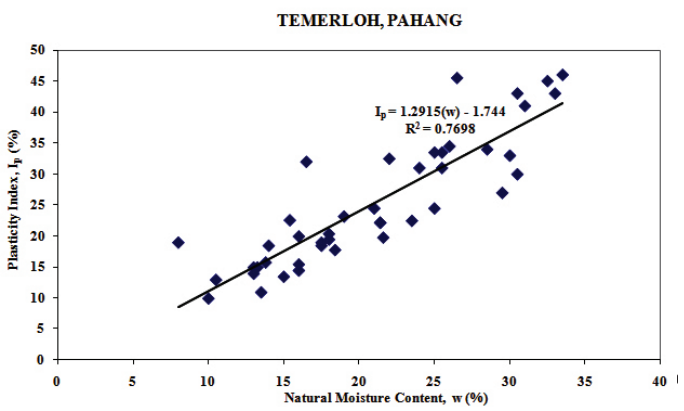

FIGURE 5
Correlations between Plasticity Index and Natural Moisture Content

7.3 Correlation with Upper and Lower Limit equation

Natural Moisture Content and Clay/Silt Content has generated the upper and lower limit correlation as follows:

Upper Limit: $w = - 0.07(\%\ clay/silt) + 40$ (8)

Lower Limit: $w = 0.04(\%\ clay/silt) + 5.5$ (9)

where,

w = natural moisture content

Figure 6 illustrates the correlation between natural moisture content and clay/silt content.

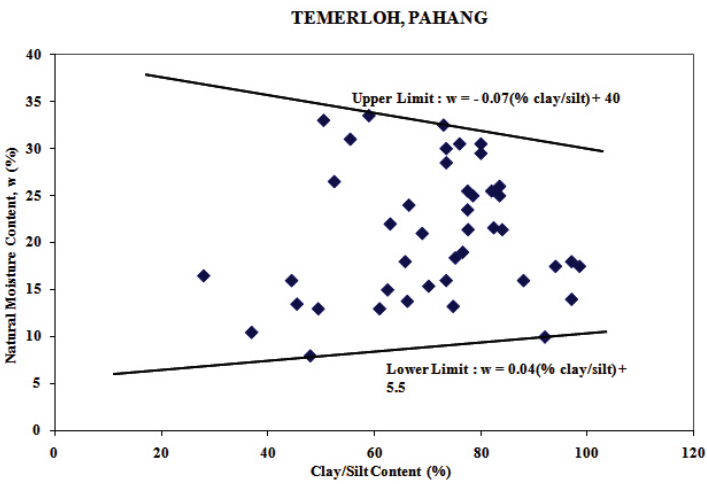

FIGURE 6
Correlations between Natural Moisture Content and Clay/Silt Content

Figure 7 shows the correlations between liquid limit and clay/silt content. The upper and lower limit for correlations between liquid limit and clay/silt content :

Upper Limit: $w_L = 0.23(\%\ clay/silt) + 105$ (10)

Lower Limit: $w_L = 0.44(\%\ clay/silt) + 3$ (11)

where,

w_L = liquid limit

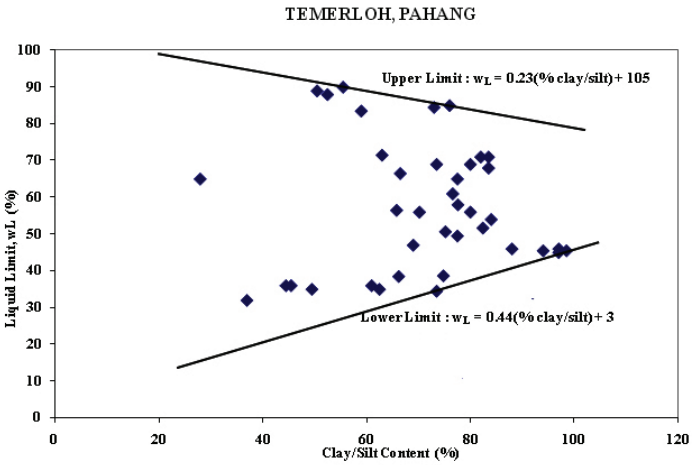

FIGURE 7
Correlations between Liquid Limit and Clay/Silt Content

8.0 CONCLUSIONS

Several conclusions can be drawn from the study as follows:

a) The correlation developed shows that the clay content influences the liquid limit.

b) The liquid limit plasticity index with moisture content show that all the parameters increase with the increase of moisture content.

c) The correlation developed show that plasticity index are proportional with liquid limit.

d) The liquid limit is not increase with clay/silt content.

e) Natural moisture content with clay/silt content had produced a proportional increases in this area.

f) The plasticity index is also increases with natural moisture content.

g) The correlation had showed that soil content for every district

area are largely dominated by clay follow by sand and lastly gravel.

h) Percentage of moisture content in Temerloh is high from 1.5m to 9.5m depth. But then it is getting decreases from 11m to 20m depth. The percentage of moisture content in this area is in 13% to 25% range.

i) The percentage of liquid limit in this area is roughly decreases from 3.5m to 20m depth. The range for the percentage of liquid limit for this site is from 20.3% to 71%.

j) The percentage of plastic limit in this area is also decreases from 1.5m to 20m depth though sometimes the percentage appears to be inconsistent. The range for the percentage of plastic limit for this site is from 24% to 37%.

k) The percentage of plasticity index in the area had showed some inconsistency. The percentage is increases at the beginning from16.7% at 0.2m to 33.9% at 3.5m depth. But then start to be inconsistent where it increases and decreases often but the percentage getting smaller with depth.

l) The correlation of undrained shear strength with moisture content shows that the undrained shear strength decreases with the increase of moisture content.

m) The correlations from undrained shear strength with liquid limit, plastic limit, and plasticity index show that undrained shear strength decreases with the increase of liquid limit, plastic limit, and plasticity index.

n) Liquid limit increases with the increase of clay content. Clay particles tend to pull or absorb water to the surface of soil particles, making the liquid limit to be much higher.

10.0 ACKNOWLEDGEMENT

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