Shear Strength Relationship for Very Soft Clayey Soils

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Abstract: In this study, correlations between strength and other soil properties for soft soils were investigated. Based on literature review, over 100 data were collected from different sources for the analyses. The soil strength varied from (0.3 to 25) kPa. New strength relationships were developed for the very soft soil in terms of moisture content and liquid limit.

1- Introduction

Different correlations to predict the undrained shear strength (Su) of soft soil have been reported in the literature. The undrained shear strength of soil varied from (0.3 to 25) kPa. The shear strength has been correlated to soil properties such as plastic limit (W_p), liquid limit (W_L), and moisture content.

2- Objectives

The objective of this study was to re-evaluate some of the correlation equations in the literature and check their effectiveness of predicting shear strength of soft soil. In addition, new correlations for shear strength in soft soil were introduced combining test results of laboratory miniature vane shear test with high moisture contents and data from the literature.

3- Methods and Materials

In this study shear strength were measured using the modified vane shear device.

Table 1. Selected Strength Relationships for Soft Soils

Equation	Reference	Remarks
$Su = 551.22e^{-0.0521w/c}$	Micic et al.(2001)	• Remoulded marine clay. • Dark gray silty clay with very low strength. • Su about (1kPa) of water content (110%-120%). • LL=66% • pH=7.6. • Composition: illite & kaolinite.
$\log\tau = \log\tau_{LL} + \frac{2}{\log w_L / log w_p} * log\frac{w_L}{w}$	Binu & Padma(2003)	• 55 test samples. • LL ranges (33.8-82) %. • Not valid for high LL (210-460) % as tested. • Good for the soil that has strength (1.7, 170) kPa at LL & PL respectively.
Remarks	Limited ranges of liquid limit were considered less than liquid limit of real soft soil. Also, no high moisture contents applicable.	

Where: Su= undrained shear strength, w/c=soil moisture content, τ= shear stress, τ_{LL}=shear stress at liquid limit, w_L= liquid limit, w_P=plastic limit, w= natural water content, LL=liquid limit, PL=plastic limit.

4-Results: Two relationships are proposed based on the moisture content and liquid limit of the soft soil:

Model 1: Total of 92 data collected from the literature was used to develop this strength relationship. The strength of the soil varies from (1 to 10) kPa.

$$Su = -6.0 * \ln(W/C\,\%) + 15, \quad when\ "W/C < 300\%\ \&\ LL < 500\%" \ldots\ldots\ldots\ldots\ldots\ldots (1)$$

Model 2: Drilling muds with varying percentage of bentonite was used in this study. The clay content varied from (2 to 10) %.

$$Su = 14.369 * e^{\left(-0.004*\frac{W}{C}\%\right)} + 1/(e^{\left(\frac{W}{C}\%-LL\%\right)}), when\ "W/C > 300\%\ \&\ LL > 500\% \ldots (2)$$

(R^2 = 0.9053)

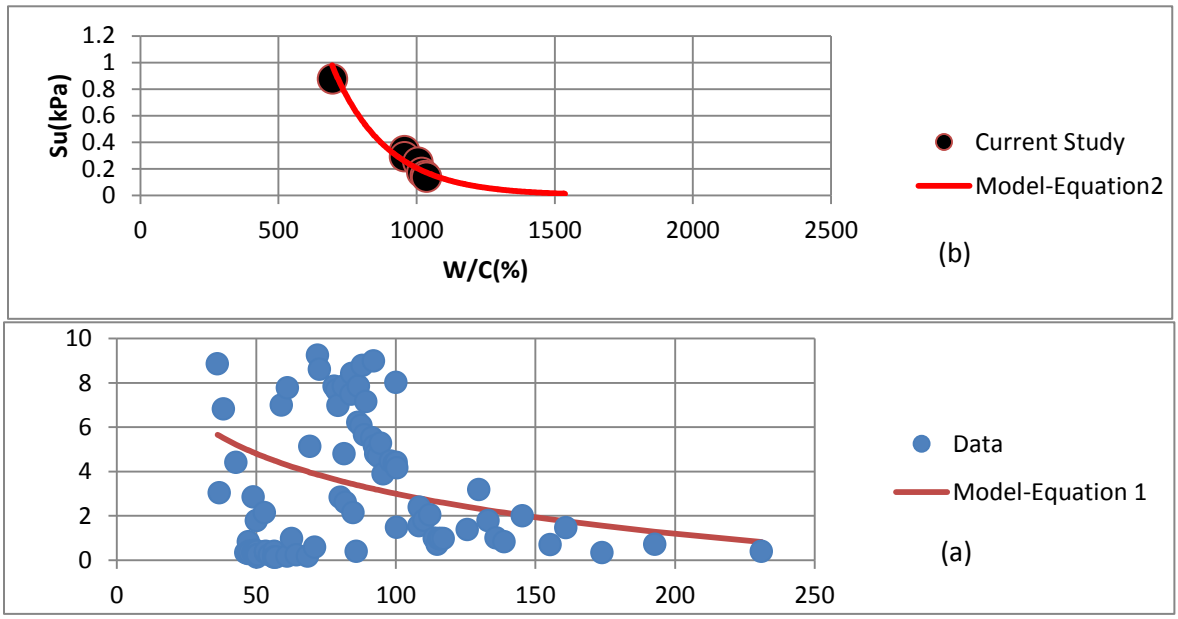

Figure 1.Variation of Shear Strength with Moisture Contents (a) 0<Su<10 and (b) 0<Su<1.

5- Conclusions

Several strength relationships have been reported in the literature. Based on limited test results, a strength model has been developed for very soft soil drilling muds with shear strength of less than 1 kPa.

6- Acknowledgements

This study was supported by the Center for Innovative Grouting Materials and Technology (CIGMAT), University of Houston, Houston, Texas.

7- References

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