Nghiên cứu cường độ chống cắt không thoát nước của đất sét mềm khu dân cư Lò Vôi, phường 1, thành phố Tuy Hòa, tỉnh Phú Yên bằng thí nghiệm nén một trục nở hông và thí nghiệm cắt phẳng

TÓM TẮT

Sức kháng cắt không thoát nước của đất sét yếu là thông số quan trọng để thiết kế nền đắp, móng nông và móng cọc. Các phương pháp tiêu chuẩn để xác định sức kháng cắt không thoát nước Sức kháng cắt không thoát nước của đất được phân loại rộng rãi là nén trong phòng thí nghiệm (ví dụ, nén không giới hạn, nén ba trục không cố kết/không thoát nước (UU), nén ba trục cố kết không thoát nước (CU), cắt đơn giản và cánh quạt trong phòng thí nghiệm) và các quy trình tại hiện trường (ví dụ: thử nghiệm xuyên hình nón (CPT)/thử nghiệm xuyên qua thanh chữ T/quả bóng và thử nghiệm cánh quạt). Nghiên cứu này sử dụng mẫu đất sét yếu nguyên dạng có đường kính 90 mm thu được bằng máy khoan địa chất tại khu dân cư Lò Vôi, phường 1, thành phố Tuy Hòa, tỉnh Phú Yên. Các thử nghiệm trong phòng thí nghiệm bao gồm thí nghiệm nén một trục nở hông và thí nghiệm cắt trực tiếp. Các giá trị cường độ cắt không thoát nước (Su) từ thí nghiệm nén một trục nở hông được so sánh với các giá trị ứng suất cắt (τ) từ thí nghiệm cắt phẳng.

Keywords: *đất sét yếu, sức kháng cắt không thoát nước, thí nghiệm nén một trục nở hông, thí nghiệm cắt trực tiếp.*

Research of undrained shear strength of soft clay in the Lo Voi residential area, Ward one, Tuy Hoa City, Phu Yen province by unconfined compressive strength and direct simple shear test

ABSTRACT

The undrained shear strength of soft clays is a key parameter for the design of embankments, shallow foundations, and pile foundations. The standard methods to determine the undrained shear strength of soils are broadly classified as laboratory (e.g., unconfined compression, unconsolidated/undrained (UU) triaxial compression, consolidated undrained (CU) triaxial compression, simple shear, and laboratory vane) and in situ procedures (e.g., cone penetration test (CPT)/T-bar/ball penetration test and vane test). This study employed intact clay samples with a diameter 90 mm obtained using geological drilling machine in the Lo Voi residential area, Ward 1, Tuy Hoa City, Phu Yen province. Laboratory tests include the unconfined compressive strength of cohesive soil and direct simple shear tests. The values of undrained shear strength (S_u) from the unconfined compressive strength test were compared with the values of shear stress (τ) from the simple shear test.

Keywords: *soft clays, undrained shear strength, unconfined compressive strength, direct simple shear tests.*

1. INTRODUCTION

In recent years, the Central Coast region has been considered one of the regions with a relatively strong tourism economic development rate, especially Phu Yen province where dense population, political, economic, and cultural centers gather. Therefore, localities are making efforts to renovate and upgrade transport infrastructure, connecting road systems, railways, airways, houses, offices, apartments... However, the geological characteristics of this area are quite complex and quite new. In this geological area, there is almost a young sedimentary soft layer, this layer is widely and deeply distributed along the coastal route extending to Binh Dinh province. This greatly affects work such as geological surveys, underground design, and underground construction methods. Most geological engineers of laboratories in the region encounter many difficulties in conducting sampling and laboratory testing to determine physical and mechanical criteria, deformation characteristics and shear strength of soft clays.

The Lo Voi area is located in north Phu Yen province as illustrated in **Figure 1**. This paper presents a full geotechnical characterization, and engineering properties of the soft site in the Lo Voi residential area, Ward 1, Tuy Hoa City, Phu Yen province.

The scope of the topographic survey in the expected survey area is as follows: The North borders vacant land and current residential status. The South borders Tran Quang Khai Street and Ong Chu Bridge. The East borders Nguyen Tat Thanh Street and the West borders Chua River.

Figure 1: Map of the Lo Voi residential area, Ward 1, Tuy Hoa City, Phu Yen province

2. METHODOLOGY

2.1. Unconfined compressive test (ASTM D2166)

This test method covers the determination of the unconfined compressive strength of cohesive soil in the undisturbed, remolded, or compacted condition, using strain-controlled application of the axial load.[6]

In this test method, unconfined compressive strength (q_u) is taken as the maximum load attained per unit area or the load per unit area at 15 % axial strain, whichever is secured first during the performance of a test. Shear strength (s_u)—for unconfined compressive strength test specimens, the shear strength is calculated to be 1⁄2 of the compressive stress at failure.[6]

$$S_u = \frac{q_u}{2}$$

Where s_u is Shear strength and q_u is the compressive stress at failure.

In this study, the compression device used the Triplex II advanced as Figure 2.

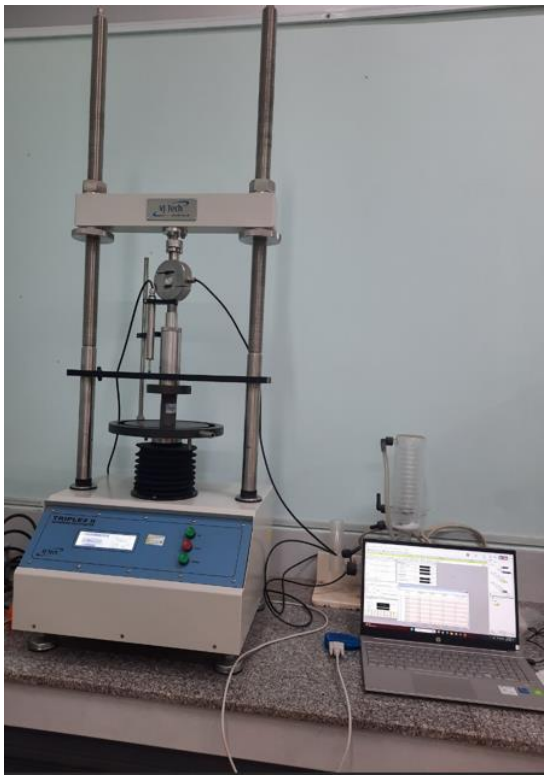

Figure 2. The Tripex II advanced

2.2. The direct simple shear test

The direct simple shear test which is an experiment in geotechnical engineering determines the shear strength of clays. In this test, the shear strength is evaluated using the Mohr-Coulomb failure criteria as

$$s = c + \delta tan\varphi$$

Where c is cohesion and ϕ is the angle of friction of the soil.[1]

The shear device uses a two-speed soil shearing machine which is made in China as illustrated in **Figure 3.**

Figure 3. The two-speed soil shearing machine

2.3. Test Specimens [2]

Testing was conducted on six reconstituted clay specimens with high plasticity. Onsoy clay samples were retrieved from a depth of 2–6 m in a test pit in the Lo Voi residential area, Ward 1, Tuy Hoa City, Phu Yen province. The samples in the unconfined compressive test were 48 mm in diameter and 70 mm in height. The samples in the direct simple shear test were 60 mm in diameter and 20 mm in height.[6] The characterizations of the soft clay samples are listed in Table 1 and the results of geotechnical characterization are plotted **in Table 1 and Table 2.**

Table 1: The Specifications of the specimens

Sample	**Deep** (m)	**Described test sample**	**Test**	**Diameter** (cm)	**Height** (cm)
1	1.8-2	Soft, gray, sandy lean clay, low plasticity.	Unconfined compressive test (ASTM D2166)	48	76
2	3.8-4	Soft, gray, lean clay, high plasticity, Pasty state.	Unconfined compressive test (ASTM D2166)	48	76
3	5.8-6	Soft, gray, lean clay, high plasticity, Pasty state.	Unconfined compressive test (ASTM D2166)	48	76
4	1.8-2	Soft, gray, sandy lean clay, low plasticity.	Direct simple shear test (TCVN 8868:2011)	60	20
5	3.8-4	Soft, gray, lean clay, high plasticity, Pasty state.	Direct simple shear test (TCVN 8868:2011)	60	20
6	5.8-6	Soft, gray, lean clay, high plasticity, Pasty state.	Direct simple shear test (TCVN 8868:2011)	60	20

Table 2: Geotechnical characterization of soft clays in the Lo Voi residential area, Ward 1, Tuy Hoa City, Phu Yen province

Simple	Deep m	γ kN/m^3	γ_d kN/m^3	w %	w_L %	w_P %	I_P	I_L	e_0
1	1.8-2	16.09	9.81	63.98	60.6	28.5	32.1	1.11	1.696
2	3.8-4	16.1	9.6	68	54.3	33.6	20.7	1.67	1.828
3	5.8-6	17.2	11.1	54.63	55.1	34.1	21	0.98	1.445

3. RESULTS AND DISCUSSION

The samples in the direct shear test had an unequal distribution of stress over the shear surface. The stress is greater at the edges than at the center. This type of stress distribution results in progressive failure. The failure plane predetermined by the shear box of the testing equipment as shown in Figure 4

In this Unconfined compressive test, axial stress on the specimen is gradually increased until the specimen fails. The shear stress is distributed over the specimens. The failure plane appeared with a random tilt angle from the center to the outer edge of the specimen as shown in Figure 5.

This means, pure shear only exists at the center of the specimen.

The values of undrained shear strength of soft clays in the Lo Voi residential area, Ward 1, Tuy Hoa City, Phu Yen province from the unconfined compressive test are smaller than the direct simple shear test. The value difference ranges from 1.19% to 1.2% as shown in Figure 4.

The shear strength of soft clays increases gradually with depth in the same soil layer as shown in Figure 5.

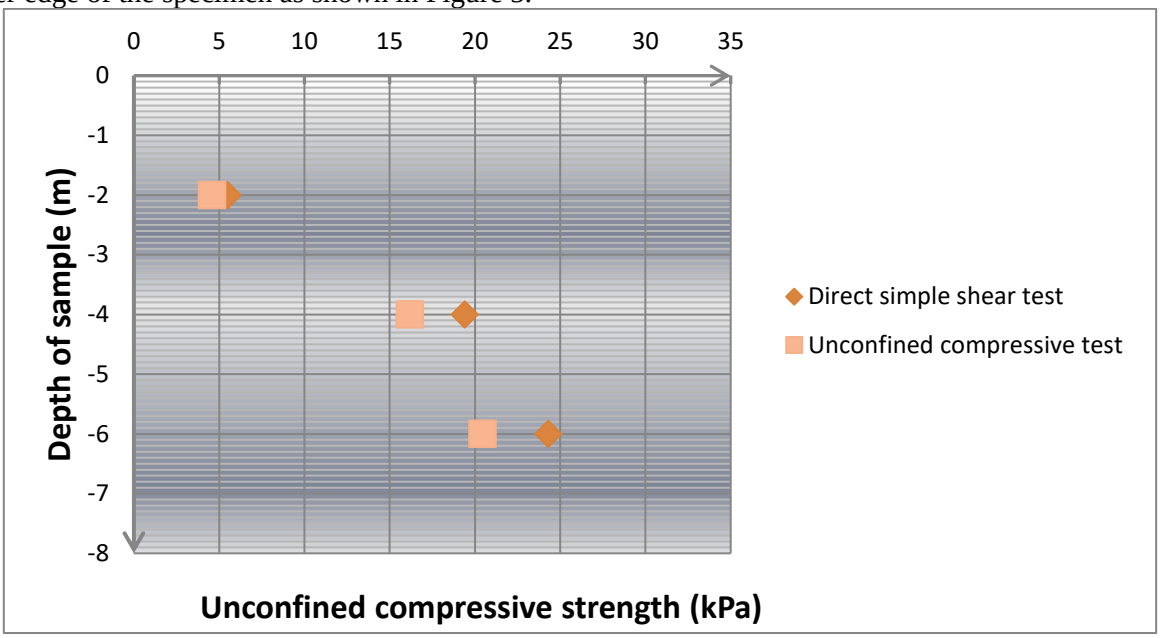

Figure 4. The values of undrained shear strength of soft clays in Lo Voi residential area, ward 1, Tuy Hoa city, Phu Yen province from unconfined compressive test and direct simple test.

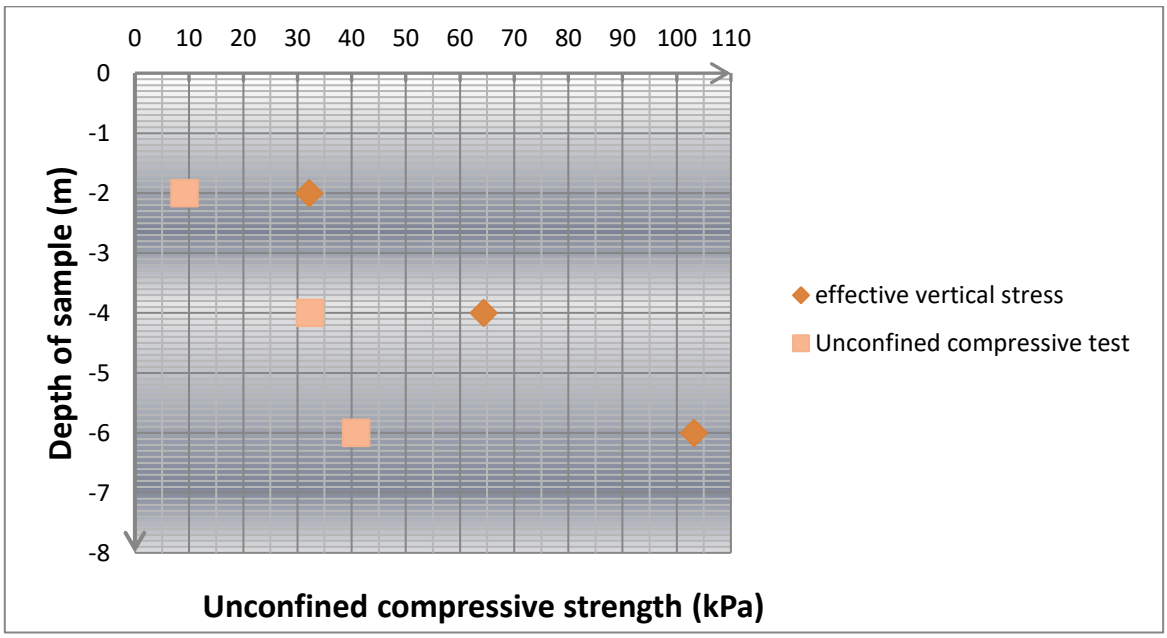

Figure 5. The values of undrained shear strength of soft clays in Lo Voi residential area, ward 1, Tuy Hoa city, Phu Yen province from unconfined compressive test and effective vertical stress of soil.

4. CONCLUSIONS

Designers should use the unconfined compression test instead of the direct simple shear test to determine the undrained shear strength of soft clays. The value of the unconfined compression strength q_u of very soft clays and soft clays with similar characteristics as in the study ranges from 1 kN/m^2 to 48 kN/m^2.[1]

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