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Shear strength characteristics of Jerash expansive soil

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Abstract

The results of the direct shear test on Jerash expansive soil show the effect of the initial water content on the cohesion (c) and on the angel of internal friction (Ø) [shear strength parameters].it show that, as the initial water increase, the cohesion (c) of Jerash expansive soil also increase up to the shrinkage limit, after that increase of water even small amount, decrease the cohesion of the soil.

On the other hand, the results of direct shear test show also that as the water content increase, the angle of internal friction (Ø)remain unchanged up to shrinkage limit , any increase of water cause a large decrease on the angle of internal friction of Jerash expansive soil.

Introduction

Swelling pressure was define as the vertical pressure exerted by a swelling soil against a confining surcharge when moisture is a available in soil

The swelling and shrinkage is the most serious challenge which civil engineer faces because of the potential danger of unpredictable upward movement structure was founded on these soils.

Study the behavior of expansive soil and investigate the factors affecting the swelling potential help the civil engineer to deal and solve problems associated with expansive soils.

In this study the results of expansive of the swelling pressure and the factors affecting the swelling pressure of the soil, the study includes the effects of time, effect of initial moisture content and initial dry densities on the swelling pressure of Jerash expansive soils. The physical properties of Jerash expansive soil was given in table 1

Color	Light yellow
Specific gravity	2.7%
Percentage of clay	71%
Liquid limit (LL)	72%
Plastic limit (PL)	27%
Shrinkage limit	15%

In this study , constant volume method was used to determine the swelling pressure because it was found as the most suited method by many researchers (Arova-1987)

In this method , consolidometer apparatus was used to determine swelling pressure .

Apparatus , consisted of a cylindrical ring of 60 mm in diameter having cross sectional area as $28.27 cm^2$.

The height of the ring used was 20 mm and the volume of specimen was 56.54 cm^3.

The specimens were prepared at different densities from remolded soils by static compaction by means of a compression machine in perfectly dry state in the swelling pressure moulid.

The specimen was mounted on the consoled meter with top and bottom porous stones.

A perforated pressure pad was also placed over the top of the porous stone. The lever arm of the equipment was balanced in such a way that no load is applied on the sample.

The dial gangs is set and the initial reading recorded. The dial gauge was set to zero.

Swelling pressure reading were taken after 1,5,10,15,20,25,30,45,60,90,120,160,180 minutes and recorded for different initial dry density at zero initial water content as show in figure 1.

Figure 1: show the swelling results at different initial dry densities at constant initial water content (w=0%)

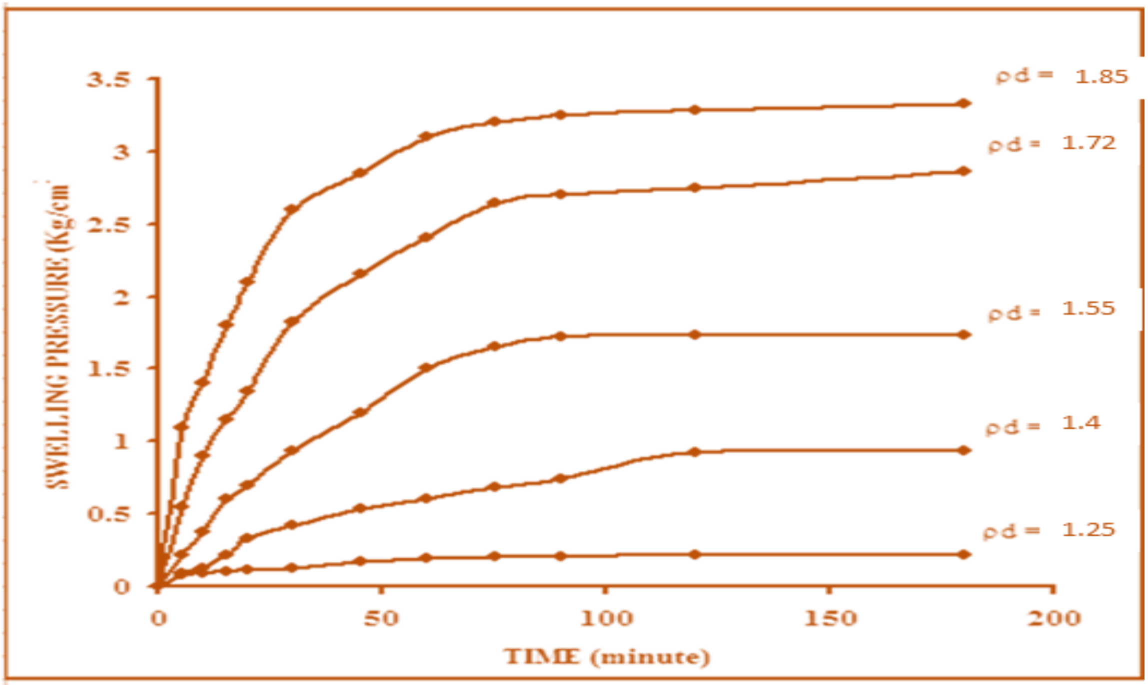

Table2 show the swelling results at different initial dry densities at constant initial water content
(w=0%)

Initial dry density (gm/cm^3)	**Swelling pressure (kg/cm^2)**
1.85	3.1
1.72	2.65
1.55	1.65
1.4	0.83
1.25	0.25

also the swelling pressure reading were taken after 1,5,10,15, 20,25, 30,45 ,60,90,120,160,180 minutes and recorded for different initial water content at constant initial dry density $\rho d=1.72gm/cm^2$.

Table 3 show the results of swelling pressure at different initial water content for constant dry density $\rho d=1.72gm/cm^2$

Initial water content W%	**Swelling pressure Kg/cm²**
W_i=0%	2.65
W_i=5%	2.5
W_i=10%	2.40
W_i=15%	1.35
W_i=20%	0.90
W_i=30%	0.15

Figure 2: show the results of swelling pressure at different initial water content for constant dry density ρd=1.72gm/cm^2

Analysis and discussion

In this study, constant volume method was used to determine the swelling pressure of the expansive soil at different initial compacted dry densities. For this study, five different dry densities were selected. The specimens were prepared at these densities from remolded soils by static compaction. The effect of varying dry density on swelling pressure for constant moisture content was shown in fig3.

Figure 3: Swelling results at different initial dry densities at constant initial water content (w=0%)

The same method (constant volume method) was used to study the effect of initial moisture content on the swelling pressure at constant dry density. Six values of different initial moisture contents were used. The effect of varying initial moisture content on swelling pressure for constant dry density is show in figure 4

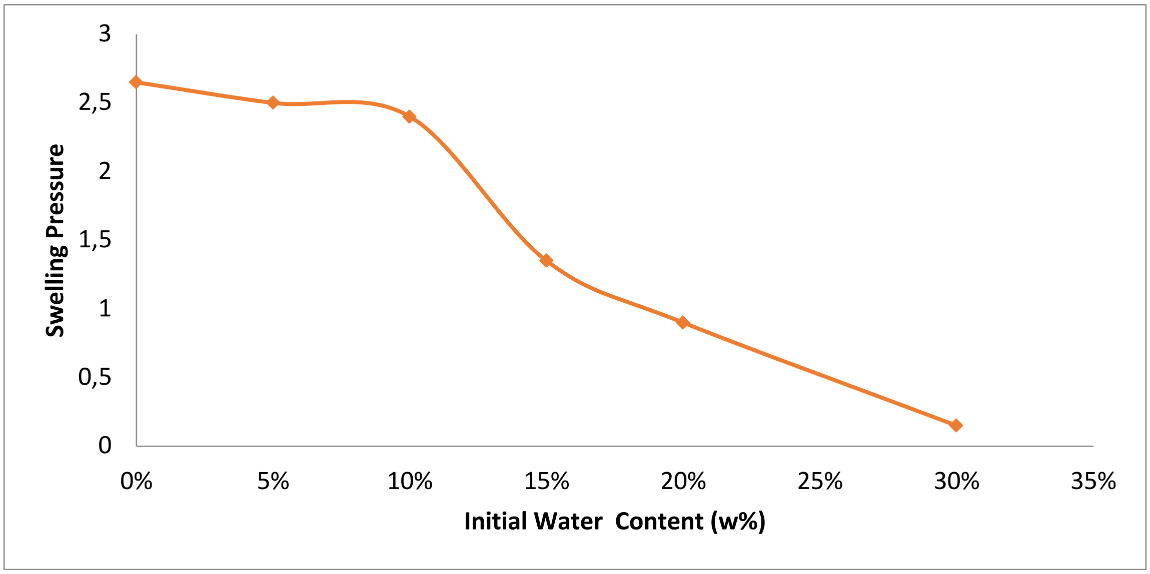

Figure 4 :swelling pressure at different initial water content for constant dry density ρd=1.72gm/cm^2

The work presents the result of experiments of the swelling pressure and the factors affecting the swelling pressure of the soils. The study includes the effects of time, effect of initial moisture contents and effect of initial dry densities on the swelling pressure of the remolded expansive soils. Using constant volume method at different dry densities and different initial water content.

This study show that as the initial density increase from (1.25gm/cm^3

To 1.85 gm/cm^3), the swelling pressure increase rapidly from (0.25kg/cm^2 to 3.1kg/cm^2).

The effect of varying initial moisture content on swelling pressure for constant dry density is show that the decrease of the swelling pressure is not high till the moisture content reached the shrinkage limit that is , as the initial water increase from (w_i =0% to w_i=10%), swelling pressure decrease only from (2.65kg/cm^2 to 2.40 kg/cm^2) after that the swelling pressure decrease very rapidly to 0.90 kg/cm^2 as the initial moisture content become (20%) and to (0.15 kg/cm^2)at initial moisture content 30%.

Fig 1 shows the swelling pressure versus time relationship of dry densities at zero initial moisture content. These curves are nonlinear throughout.

Initial stage, the curves are hyperbolic which become asymptotically in a later stage.

Conclusions

Base on the experimental results. The following conclusion can be drawn.

1) The relationship between initial dry densities and the swelling pressure of the expansive soils was studied. If found that as the initial dry density decrease, swelling pressure also decrease and may approaches zero, which may be used this result to eliminate the effect of swelling pressure by compacted the expansive soil to low density .
2) Also this study show that as initial water content increase beyond the shrinkage limit , swelling pressure of the expansive soil decrease and maybe approaches zero at initial water content equal to (30%) or more. Again, this expansive soil even with high swelling potential may have not swelling pressure if its initial water content equal to 30% or more.

Reference

[1] Raddy N.G., Tahasildar J. nad Rao B.H.,"Evaluating the influence of additives on swelling characteristics of expansive soil " , Int . J. geosynth .& ground Eng., 1(7).2015,1-13.

[2] Muthyalu P. V. and Prasada G.V.R, "Study on Performance of Chemically Stabilized Expansive Soil ", International Journal of Advances in Engineering & Technology , IJAET,Vol. 2,2012, pp139-148.

[3] Sambre Tejashri Ramesh ; Prof.Naik U. P. " Stabilization of Expansive Soil "International Journal of Engineering and Innovative Technology (IJET) Volume 5, Issue 12 ,June 2016

[4] Katti D. and Shanmugasundaram V ., " Effect of Controlled Swelling Saturated

Expansive Soil", Canadian Geotechnical Journal . Vol.38,2001,PP 175-182.

[5] Thomas M. Petry and Dallas N. Little, " Review of Stabilization of Clays and Expansive Soils in Pavements and Lightly Loaded Structures –History, Practice , and Future " J. Mater . Cive.Eng ,. 14 (6).2002.447-460.

[6] Kerrane, J.P. (2011) What Are Expansive Soils. Benson & Associates PC, Golden.

[7] Rosenbalm, D.C. (2013) Volume Change Behavior of Expansive soils Due to Wetting and Drying Cycles, Arizona. PhD Thesis, Arizona State University, Phoenix.

[8] Erol, A.O. and Dhowian, A. (1990) Swell Behavior of Arid Climate Shale from Saudi Arabia. Journal of Engineering Geology, 23, 243-254.

[9] Mitchell, J.K. and Raad, L. (1973) Control of Volume Changes in Expansive Earth Materials. Proceedings of the Workshop on Expansive Clay and Shales in Highway Design and Construction, 2, 200-219.

10. Mahmoud, R. T., Abdull, A. I., & Khazaa, A. S. (2020). Behavior of Timber Beams Strengthened by Jute Fibers. Journal of Advanced Sciences and Engineering Technologies, 3(1), 1-20.

[11] .Embaby, A.A., Abu Halawa, A. and Ramadan, M. (2017) An Experimental Study to Mitigate Swelling Pressure of Expansive Tabuk Shale, Saudi Arabia. In Press.
characteristics of expansive soil treated with jute fiber reinforcement. International Journal of Geomechanics, 17(11), 04017101.
[13] Zhai, J. Y., & Cai, X. Y. (2018). Strength characteristics and slope stability of expansive soil from Pingdingshan, China. Advances in Materials Science and Engineering, 2018.
[14] Jain, A., Choudhary, A. K., & Jha, J. N. (2020). Influence of Rice Husk Ash on the Swelling and Strength Characteristics of Expansive Soil. Geotechnical and Geological Engineering, 38(2), 2293-2302.
[15] Dai, Zhangjun, Jianhua Guo, Hongming Luo, Jian Li, and Shanxiong Chen. "Strength characteristics and slope stability analysis of expansive soil with filled fissures." Applied Sciences 10, no. 13 (2020): 4616.
[16] . Elsharief A. M. and Moustafa, S. E., (2012) "Physico- Chemical Properties of Expansive Soils from Sudan and Their Effects on Intrinsic Swelling and Shrinkage" Fulfilment for the Degree of Master of Science in Structural Engineering at the University of Khartoum

12.S Wang, Y. X., Guo, P. P., Ren, W. X., Yuan, B. X., Yuan, H. P., Zhao, Y. L., ... & Cao, P. (2017). Laboratory investigation on strength

Proceedings Annual Conference of Postgraduate Studies And Scientific Research, Friendship Hall, Khartoum, Vol.1 pp. 188-224.
[17] Gobena, J. A., & Suppiah, S. Strength Characteristics Of Tropical Expansive Soil–A Review.
[18] Elsharief A. M. (1987) "A Laboratory and Field Investigation of Swelling Potential and Performance of Short Piles in Expansive Soils", A Thesis Submitted in Partial Fulfillment for the Degree of Master of Science in Civil Engineering at the University of Khartoum.
[19] Dang, L. C., & Khabbaz, H. (2019). Shear Strength Behaviour of Bagasse Fibre Reinforced Expansive Soil. IACGE 2018. doi:10.1061/9780784482049.038
[20] .Sofyan M. A., (2013) "Some Laboratory Study of Factors Controlling Swelling Potential", A Thesis Submitted in Partial