

# CIVIL ENGINEERING DIMENSION

Journal of Civil Engineering Science and Application

Dimensi Teknik Sipil

Jurnal Keilmuan dan Penerapan Teknik Sipil

Volume 12 Number 1

March 2010

**An Appraisal of Project Procurement Methods in the Nigerian Construction Industry**

Babatunde, S.O., Opawole, A., Ujaddughe, I.C.

**Owner and Contractor Perceptions Toward Factors Causing Delays in Structural and Finishing Works**

Andi, A., Lalitan, D., Loanata, V.R.

**Sidoarjo Mud: A Potential Cement Replacement Material**

Nuruddin, M.F., Bayuaji, R., Masilamani, M.B., Biyanto, T.R.

**Compressive Strength of Volcanic Ash/Ordinary Portland Cement Laterized Concrete**

Olawuyi, B.J. and Olusola, K.O.

**Study on Reactivity of Circulating Fluidized Bed Combustion Fly Askes in the Presence of Water**

Salain, I.M.A.K.

**Building Blocks Incorporating Waste Materials Bound with Bitumen**

Thanaya, I.N.A.

**Effect of Steel Fibers on the Behavior of Over-Reinforced Beams Subjected to Pure Torsion**

Gunneswara Rao, T.D., Rama Seshu, D., and Warnitchai, P.

**Development of Special Hazard Map for Indonesia with a Return Period of 2500 Years using Probabilistic Method**

Asrurifak, M., Irsyam, M., Budiono, B., Triyoso, W., and Hendriyawan

**Discussion on: Behavior of Expansive Clay of Ngawi Region (East Java) Under Water Content Variation**

Muntohar, A.S.

Acredited by DGHE No. 110/DIKTI/Kep/2009

PETRA CHRISTIAN UNIVERSITY - SURABAYA, INDONESIA

Civil Engineering Dimension	Vol.12	No. 1	Page 1-64	Surabaya March 2010	ISSN 1410-9530 (Print) ISSN 1979-570X (Online)
-----------------------------	--------	-------	-----------	------------------------	---

Discussion on: paper by Sudjianto, A. T., et al, Civil Engineering Dimension Vol 11, No 2, September 2009, pp. 100-105

## Behavior of Expansive Clay of Ngawi Region (East Java) Under Water Content Variation

Muntohar, A.S.<sup>1)</sup>

The authors have prepared a significant investigation in swelling behavior of expansive clay. The lateral swelling potential obtained from modified oedometer test was especially interesting. Discussant used the term of swelling potential to represent both strain and swelling pressure. The effect of three different initial water contents, which is 20%, 25%, and 30%, on swelling potential has been studied. The specimens were prepared at similar densities. The lateral swelling potential has been measured from the installed strain gauges. However, installation of the strain gauges and procedure of the test were not clearly informed. Two discussions will be presented as follows.

### Vertical Swelling Potential

It is interesting to observe swelling characteristics as presented in Figure 3. The curve can be divided into three phases that is initial, primary, and secondary swelling [1]. There is a significant difference in the swelling mechanism at initial phases which the authors have overlooked. At the initial moist content of 20% the soil swelled rapidly, whereas at the higher moist content the swelling rate was much slower. The initial swelling was about 9%, 2.5%, and 2% for specimen prepared with 20%, 25%, and 30% of initial moisture content. For this case, it seems that the initial swelling was less influenced by initial moisture content. According to the data presented in Table 4, the swelling was greatly affected by the degree of saturation. The degree of saturation for the specimens prepared at 25% and 30% moisture content was more or less similar. However, there was a great difference, about 4.8%, on the degree of saturation of the specimens prepared at 20% and 25% moisture content. Even the difference of moisture content was 5%, those resulted in significant difference of the degree of saturation. Hence, it can be noted that the initial swelling was major affected by degree of saturation, while the initial moisture content controlled the ultimate swelling.

The author also correlated the vertical swelling with initial moisture content as presented in Figure 4.

The correlation was perfectly in linear relationship as obtained also by Al-Shamrani and Al-Mhaidib [2]. However, it is not clear why the authors stated the null moisture content at 24% instead of 37% as the discussant have extrapolated from the same linear relationship (Figure 10). This value is quite far from the plastic limit which is approximately 30%. This is true since swelling will not occur at water content greater than the plastic limit. In discussant point of view, principally, the swelling percentage is maximum if the soil is initially at the shrinkage limit and decreases with increasing water content. Once the field water content is above the plastic limit, the swelling is negligibly small. As montmorillonite is the main mineral in the soil, swelling will also depend on exchangeable cations or cation exchange capacity and the soil fabric [3].

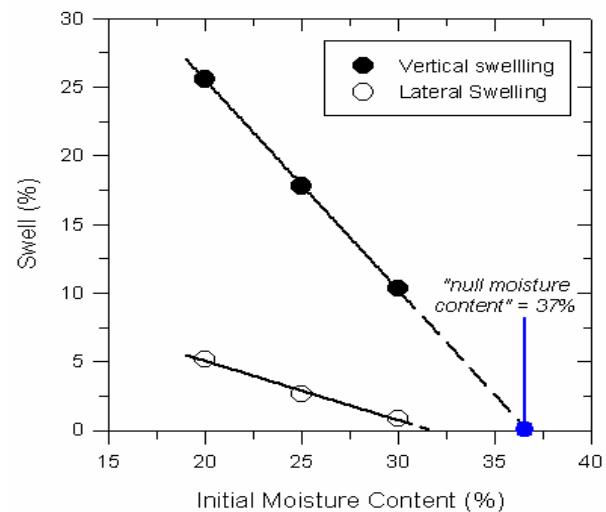


Figure 10 Extrapolating of the swelling and initial moisture content relationship.

### Swelling Pressure

The authors had not clearly defined the swelling pressure presented in Table 6 and Figure 8 whether it was vertical swelling pressure or lateral swelling pressure. It is not clear how to relate the findings of swelling pressure measurement with the plotted test result in Figure 8. It seems that Figure 8 is related with Table 4 which is for the determination vertical swelling pressure.

<sup>1)</sup> Department of Civil Engineering, Universitas Muhammadiyah Yogyakarta, Indoensia.  
Email: muntohar@umy.ac.id

Back to the osmotic pressure theory of double layer, vertical swelling pressure was strongly dependent on the mid-plane potential which is a function of soil properties (specific surface and cation exchange capacity), water electrolyte properties (cation concentration, dielectric constant, valence of cation), and the distance between the platelets (which could be obtained either from void ratio or dry density) [3,4]. Referring to the definition of swelling pressure, the vertical swelling pressure of those specimens were predicted by extrapolating from Figure 8 except for specimen with initial moisture content of 30%. Therefore, the last conclusion of the paper remains dubious. Some researchers concluded that although the swelling decrease with an increase of the initial water content, the swelling pressure was independent of initial water content but strongly dependent on the initial dry density and vertical pressure [5, 6].

## References

- 1 Muntohar, A.S., Swelling and Compressibility Characteristics of the Soil–Bentonite Mixtures, *Civil Engineering Dimension*, Vol. 5 No. 2, 2003, pp. 93-98.
- 2 Al-Shamrani, M.A. and Al-Mhaidib, Vertical Swelling of expansive Soils Under Fully and Partially Lateral Restraint Conditions, *Proceeding 1<sup>st</sup> Asian Conference on Unsaturated Soils UNSAT-Asia 2000*, in Rahardjo, H., Toll, D.G., and Leong, E.C., (eds.), 2000, pp. 627-632.
- 3 Komine, H. and Ogata, N., Predicting Swelling Characteristics of Bentonites, *Journal of Geotechnical and Geoenvironmental Engineering*, Vol. 130, No. 8, 2004, pp. 818–829.
- 4 Sridharan, A., Rao, A.S., and Sivapullaiah, P.V., Swelling Pressure of Clays, *Geotechnical Testing Journal*, GTJODJ, Vol. 9, No. 1, 1986, pp. 24-33.
- 5 Chen, F.H., *Foundation on Expansive Soil, Development in Geotechnical Engineering 12*, Elsevier Scientific Publishing Company, New York, USA, 1983.
- 6 Basma, A.A., Al-Hamoud, A.S., and Malkawi, A.H., Laboratory assessment of swelling pressure of expansive soils, *Applied Clays Science*, Vol. 9, 1995, pp. 355–368.

Sponsored by



## Editorial Board

- Chief Editor : Prof. Dr. Benjamin Lumantarna, M.Eng.
- Editor : Ir. J.I. Suwono, M.Eng. (Geotechnical Engineering)  
Ir. Gogot Setyo Budi, M.Sc., Ph.D. (Geotechnical Engineering)  
Ir. Gideon Hadi Kusuma, M.Eng. (Structural Engineering & Material)  
Ir. Harry Patmadjaja, M.T. (Construction Management & Transportation)  
Ir. Ruslan Djajadi, M.Eng. (Water Resources Development)  
Ir. Herry Pintardi Chandra, SE., MM., MT. (Construction Management)
- International Reviewer : Dr. Andreas Nataatmadja, MIEAust, M.ASCE  
(Senior Lecturer, School of Civil Engineering, Queensland University of Technology, Australia)  
Dr. Dario Rosidi, G.E.  
(Principal Technologist, CH2M HILL Corporation 155 Grand Avenue, Suite 1000 Oakland, CA 94612, USA)  
Dr. J. Andy Soesilo, REM  
(Adjunct Professor, Center for Environmental Studies, Arizona State University, Arizona, USA)  
Dr. Jeff Budiman  
(Associate Professor, Department of Civil and Architectural Engineering, Illinois Institute of Technology, Illinois, USA)  
Dr. David Ardit  
(Professor, Department of Civil and Architectural Engineering, Illinois Institute of Technology, Illinois, USA)  
Dr. Priyan Mendis  
(Associate Professor, Department of Civil and Environmental Engineering, Faculty of Engineering, University of Melbourne)  
Dr. Worsak Kanok-Nukulchai  
(Professor, School of Engineering and Technology, Asian Institute of Technology, Bangkok, Thailand)  
Dr. Stephen Olu Ogunlana  
(Professor, School of the Built Environment, Heriot-Watt University, United Kingdom)  
Dr. Ir. Dradjat Hoedajanto, IP-U  
(Indonesian Society of Civil and Structural Engineers)  
Dr. Ir. Iswandi Imran, IP-U  
(Indonesian Society of Civil and Structural Engineers)  
Dr. Ir. Muslinang Moestopo  
(Indonesian Society of Civil and Structural Engineers)

Administrative Assistant: Sumarno

Editor and Administration Address:

Institute of Research and Community Outreach  
Petra Christian University  
Jl. Siwalankerto 121-131, Surabaya 60236 – Indonesia  
Phone: 62-31-8494830/8439040, ext. 3139, 3147. Fax: 62-31-8436418, 8492562  
E-mail: dimensi-sipil@petra.ac.id  
Home page: <http://puslit2.petra.ac.id/ejournal>  
Also available at: <http://infotrac.galegroup.com>.