IMPROVEMENT OF SECONDARY CONSOLIDATION CHARACTERISTICS OF PEATY CLAY BY PRECONSOLIDATION

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Master of Engineering (Honours)

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Thesis submitted in partial fulfilment of the requirements for the degree of Master of Engineering in Foundation Engineering and Earth Retaining Systems

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DECLARATION

I declare that this is my own work and this thesis does not incorporate without acknowledgement any material previously submitted for a Degree or Diploma in any other University or institute of higher learning and to the best of our knowledge and belief it does not contain any material previously published or written by another person except where the acknowledgement is made in the text.

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R.M.S. Fernando

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……………………………………… Date: March 16, 2017

Prof. S.A.S. Kulathilaka

(Supervisor)

ABSTRACT

Special consideration should be given to secondary consolidation settlements during service in the construction of high road embankments in lands underlain by thick layers of soft peaty clay. Usually a preload design will be done to ensure that the peaty clay will remain in an over consolidated state during the operation of the road. Peaty clays are known for high secondary consolidation settlements. As such, possible secondary consolidation settlement during service life is also a major concern. The coefficient of secondary consolidation (C_α) is expected to reduce with increasing over consolidation ratio (OCR) achieved during preloading. At the stage of surcharge removal, the settlement during operation has to be estimated. In a preload design the practically achievable over-consolidation ratios (OCRs) are in the range of 1.1 to 1.2. Effectiveness of such OCR values in keeping the long term in service secondary consolidation settlements within acceptable limits was studied in this research. Oedometer tests were carried out simulating the process of loading-unloading-reloading on remoulded samples. Effects of prolonged loading on the coefficient of secondary consolidation was also assessed. Further tests were done on undisturbed samples obtained from preloaded peaty clay layers in two different projects. Results illustrate that the level of reduction of C_α is related to the achieved OCR.

Keywords: Peaty clay, compressibility, secondary consolidation.

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Postgraduate research projects in Foundation and Earth Retaining Systems of Civil Engineering curriculum are very useful and beneficial for students who are about to face industry as engineers or follow higher studies. This module itself encourages students to improve the ability of self-studying which is much needed in becoming an all-round engineer. In addition to that, it improves problem solving, analytical and communication skills.

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Abbreviations

DS – Disturbed Sample

OCR – Over Consolidation Ratio

UDS – Undisturbed Sample

Notations

ε_v% – Vertical strain

$\Delta\sigma$ – Stress increment

$\Delta\delta$ – Variation in settlement

σ' – Effective stress

σ'_p – insitu preconsolidation presure

σ'_v – effective vertical stress

σ'_{vf} – final effective vertical stress

σ'_{vs} – maximum effective vertical stress reached before removal of surcharge

γ_w – Unit weight of water

C_α – Coefficient of secondary consolidation

C_α' – Secondary consolidation coefficient in reloading increments

C_α'/C_α – Reduction of secondary consolidation coefficient

C_α'' – Post surcharge secant secondary compression index defined from t_l

C_c – Compression index

C_v – Coefficient of consolidation

E_u – Undrained Young's modulus

e – Void ratio

H – Height of the soil layer

k – Permeability

m_v – Coefficient of volume compressibility

p_c – Pre-consolidation pressure

R'_s – Effective surcharge ratio – $(\sigma'_{vs}/ \sigma'_{vf})$ -1

T – Time for reappearance of secondary compression after the period of rebounce

t_l – Post surcharge time at which secondary compression reappears

t_p – Duration of primary consolidation

t_{pr} – Time required to complete primary rebound after removal of surcharge

Annexures