# INVESTIGATION OF RELATIONSHIPS BETWEEN THE CBR SWELL AND OTHER SOIL PARAMETERS USED IN ROAD CONSTRUCTION IN IDENTIFICATION OF EXPANSIVE SOIL

Koralage Dona Indu Uthpala Kannangara
(168330F)

Degree of Master in Engineering

Department of Civil Engineering

University of Moratuwa
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Koralage Dona Indu Uthpala Kannangara
(168330F)

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## DECLARATION OF THE CANDIDATE AND SUPERVISOR

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# ABSTRACT

With the rapid growth in the construction industry in Sri Lanka, presently there is a shortage of natural resources, especially soils. Therefore, finding good quality soil that conforms to the construction specification is challenging.

Expansive soils are one of the major problematic materials in the road construction industry. Clay minerals within expansive soils are subjected to significant volume changes when their environmental conditions are altered from dry to wet. Therefore, prolonged periods of drying and wetting cycles in the expansive soil can result in surface movements and distress in the road pavement which may lead to safety issues for road users and high maintenance costs to the road authorities.

There are various measures used to predict the swell behaviour of soils in the road construction industry. Some of the measures which regularly used are CBR swell, shrink-swell Index, soil suction, plasticity index, weighted plasticity index, swelling pressure, linear shrinkage, clay content and cation exchange capacity. Even though some of the measures used are complex, CBR swell test is one of the simplest ways of predicting the swell behaviour of soil.

As Sri Lanka is a tropical country, four days of soaked CBR is carried out as a part of the requirement of pavement design guidelines. CBR swell test is also conducted as a part of the CBR test. Therefore CBR swell data are readily available. But there is no published information on relationships between CBR swell with soil parameters for Sri Lankan conditions. Therefore, it is expected that the relevance of current specifications on quantitative estimation of soil swell using CBR swell parameter to be in this research. With that concern, the objectives of the study are to understand the nature of expansive soils and their properties, to identify the parameters of expansive soil behaviour used by engineers in road construction and then identify and quantify relationships that may exist in CBR swell with relevant soil parameters.

Particle size distribution, LL, PI, PL, Soil classification, Modified compaction, CBR and CBR swell data were collected on 61 numbers soil samples and a database was prepared. Then linear regression analysis and multiple regression analysis were carried out considering PI, LL, MDD, CBR and percentage passing in the 75μm test sieve as variables in order to obtain correlations to CBR swell.

Depending on the analysis, the variation of CBR swell is higher for soil types CH, CL, MH and SM and also, these soil types have shown higher CBR swell values over the other soil types. The lower CBR swell range for each soil type is less than 0.5 which is independent of whether the soil is fine-grained soil or coarse-grained soil. As per the analysis, the results from linear regression analysis, logarithmic regression analysis and multiple regression analysis, a relationship between CBR Swell and other soil parameters cannot be established. The soils which could be identified as expansive soil based on the WPI value, were not given evidence to be identified as expansive soils based on their CBR swell.

The reliability of the relationships between CBR swell with soil parameters is greatly influenced by the accuracy of the CBR swell test, especially the use of correct filter paper between soil and perforated base plate of CBR mould. Hence, use of inappropriate filter paper may lead to the

migration of fine particles into the soaking tank which will result in low CBR swell measurements.

Therefore, it is suggested to consider CBR swell along with other swell parameters and/ or verify the results with a direct swell parameter for future studies related to expansive soil and obtaining correlations for soil swell.

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| | |
|---|---|
| CBR | California Bearing Ratio |
| LL | Liquid Limit |
| MDD | Maximum Dry Density |
| OMC | Optimum Moisture Content |
| PL | Plastic Limit |
| PI | Plasticity Index |
| RDA | Road Development Authority |
| SSCM | Standard Specification for Construction and Maintenance |
| WPI | Weighted Plasticity Index |