UNIVERSITI TEKNOLOGI MARA

STRESS-STRAIN PREDICTION IN GRANITIC RESIDUAL SOIL BY EFFECTIVE STRESS AND SHEAR STRENGTH INTERACTION MODEL

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ABSTRACT

This study focused on the prediction of soil stress-strain response under any arbitrary confining effective pressure. The stress-strain curves showed a higher peak strength as effective confining pressure increases. Therefore, there is a need for an effective method to predict the stress-strain response at any arbitrary effective confining pressure in order to carried out the soil volume change or settlement modelling. This is because the soil stress-strain behaviour governs the way the soil response to stress and influence the development of the mobilised shear strength envelopes. Thence, in soil volume change or settlement modelling, the most important property and the primary governing factor is the soil stress-strain response. Therefore, there is a need for accurate prediction of the stress-strain response at any specific value of effective stress. A method called Rotational Multiple Yield Surface Framework has been introduced for the prediction of the soil stress-strain response for saturated and unsaturated conditions. This is the concept of effective stress and shear strength interaction which is an extended concept of effective stress introduced by Terzaghi in 1936. The mobilised shear strength envelopes of the soil are derived from a minimum of three (3) stress-strain curves at three (3) different confining pressures. The limitation of the method is that it can only predict up to the minimum axial strain at failure and thus it cannot predict the stress-strain curve for the higher confining pressures. Then, in this study an improvised method has been introduced to overcome this limitation. The method is called Normalised Strain Rotational Multiple Yield Surface Framework. The test soil is granitic residual soil grade V taken from Kuala Kubu Baru and four (4) consolidated drained triaxial tests have been conducted at effective confining pressures of 50, 100, 200 and 300 kPa for saturated specimens and similar test at suction of 50, 100, 150, 200 and 250 kPa has been conducted for unsaturated specimens and the curve surface envelope of the soil has been determined to encompass the shear strength at saturated and unsaturated conditions. In addition, the effect of soaking in the degradation of soil shear strength of the test soil has also been investigated and essentially the strength reduce with the period of the soaking. Then the development of the mobilished shear strength envelop has been derived from the stress-strain curves. The determination of mobilished shear strength envelopes are the soil inherent property and it can be applied to predict the stress-strain response at any arbitrary effective confining pressure and at any value of suctions. The prediction of the stress-strain response using Normalised Strain Method is proved to improve the accuracy compared to the former Rotational Multiple Yield Surface Framework.

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CHAPTER ONE
INTRODUCTION

1.1 Introduction

This chapter explains the background of this research, objectives and significance of study related to geotechnical engineering. This research was conducted to introduce and show the normalised strain method which is used as a tool to improvise the established method of Rotational Multiple Yield Surface Framework. In order to predict settlement of a foundation, there are many methods that may vary between empirical and semi-empirical methods such as prediction settlement by Steinbrenner (1934), Terzaghi (1943), Janbu et al. (1956) and Bowles (1988) where prediction was based on stiffness of modulus of elasticity and Poisson's ratio. Upon that, there is another method known as Rotational Multiple Yield Surface Framework that make use of the developed mobilised shear strength relationship with the anisotropic compressions in the prediction of the soil stress-strain behavior. (Md Noor and Anderson, 2006).

The relationship between the mobilised shear strength and the isotropic compression is the inherent property of the soil. It is being derived from the soil stress-strain behaviour obtained from conducting the consolidated drained triaxial test. (Saffari, 2016, Md Jais, 2018). However difficulties of this Rotational Multiple Yield Surface Framework are that the axial strain at failure is not the same for stress-strain curves of different effective stress. Essentially the axial strain at failure increases with increasing of effective stress. In order to resolve the problem an improvised Rotational Multiple Yield Surface Framework is introduced and the method is called normalised strain method where a factor is applied to the stress-strain curves so that a normalised stress-strain curves is achieved where the axial strain at failure is unique. However at the end of the method when the actual axial strain is required they are reverted by multiplying them with an inverse factor.

Besides that this research was also conducted to determine the shear strength envelope using Rotational Multiple Yield Surface Framework for granitic residual soil grade V taken from Kuala Kubu Baharu, Selangor for saturated and partially saturated conditions. Rotational Multiple Yield Surface Framework truly follows the true shear