UNIVERSITI TEKNOLOGI MARA

SHEAR BAND THEORY-BASED REINFORCEMENT MECHANISM OF GEOSYNTHETICS

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AUTHOR'S DECLARATION

I declare that the work in this thesis was carried out in accordance with the regulations of Universiti Teknologi MARA. It is original and is the result of my own work, unless otherwise indicated or acknowledged as referenced work. This thesis has not been submitted to any other academic institution or non-academic institution for any degree or qualification.

I, hereby, acknowledge that I have been supplied with the Academic Rules and Regulations for Post Graduate, Universiti Teknologi MARA, regulating the conduct of my study and research.

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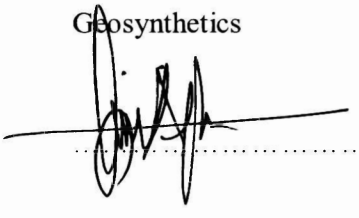
Signature of Student	:	
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ABSTRACT

Geosynthetic is one of reinforcement materials which is widely used in earth retaining structures. Previous researchers have carried out many studies on the soil-geosynthetic interaction. However, research on shear band is limited because of its presence in micro scales which also makes it difficult to be determined and predicted. This research is a new contribution for Malaysia's engineering practice. There is no such research has been conducted in our country, on the local soil. In this study, three types of silica sand were used. The coarse sand (D_{50}=1.357mm), medium sand (D_{50}=0.571 mm) and fine sand (D_{50}=0.286mm). Pullout test were conducted for different governing parameters such as porosity, density, mean size and normal pressure at 100kPa, 150kPa and 200kPa. There are two types of geosynthetics which were used as reinforcement. They are biaxial geogrids and woven geotextiles. The conventional machine used is Pull out box test where size of box is 700mm (length) X 550mm (height) X 400mm (width). The simulations of Pullout Tests were made and calibrated with the experimental study. Using Discrete Element Method (DEM), it was found that the shear bands existed in soil structure during movement of geosynthetics. Shear bands were predicted equivalent with sheared zone at the reinforced region. The higher thickness value was recorded by the simulation of sand-geotextile interaction in coarse sand at 200kPa. The shear band is 232mm width and has a pore space at the tail of the geotextile. Meanwhile, the lower thickness value was stated by the simulation of geotextile-pullout in fine sand at 100kPa whereby the band is just 88mm width. Comparatively, the percentage different is 62.07% for the wider to small shear band thickness. It can be concluded that, the higher pullout force, the thicker shear band produced.

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CHAPTER ONE
INTRODUCTION

1.1 INTRODUCTION

Reinforced soil structure is used to hold back earth and maintain a difference in the elevation and structure of the ground (Yun, 2006). There are many methods used to reinforce the soil structure. Among the well-known methods are soil nailing, shotcrete lining and retaining wall. However, the different methods comprise of different material used to restraint the soil structure. The soil nailing for instance,uses a steel rod as the main material and anchoraged beneath the slopes. Meanwhile, the shotcrete lining uses the combination of the concrete and steel mesh to withstand the slope surface and underground spaces. For geosynthetics, it is widely used for earth retaining structures such as in steep slope and retaining wall.

The conventional methods applied in designation of the steep slope and retaining wall using geosynthetics are based on the failure modes of soil structure itself. The failures consist of two main factors which are external and internal stabilities (Pinto, 2003 and Yun, 2006). The external stabilities are sliding, overturning and bearing capacity. Obviously the failures of the external stabilities are related to major damage or collapse of the earth retaining structures. Meanwhile, the internal stabilities are considered as failure of geosynthetics and pullout. The internal failure occurs silently without showing any destructive signs and can be considered as a minor damage. However, this failure is actually a trigger factor that leads to the failure of external stabilities. The internal stability of the geosynthetic-reinforced soil is classified for two common failure mode which is rupture due to tensile over stressing in the high-stress condition and pullout failures. Pullout failure occurs whenever the slippage of soil-geosynthetics interaction in the low-stress condition within the interface region (Alfaro and Pathak, 2005).

The interaction is related to the reinforcement mechanism of geosynthetics which had reduced friction and interlocking effect with soil particles. The effect of the reduced friction and interlocking caused the movement of geosynthetics usually in tensile direction. The mobilized geosynthetics may influence on the straining localization