THE EFFECTIVENESS OF GABION TYPE RETAINING WALL MADE OF TIRE BUFFER TO MITIGATE SLOPE FAILURE

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I hereby declare that the work in this thesis is based on my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously or concurrently submitted for any other degree at Universiti Malaysia Pahang or any other institutions.

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ABSTRAK

Tembok penahan adalah salah satu cara untuk mencegah kegagalan cerun. Terdapat banyak jenis dinding penahan yang telah digunakan. Salah satunya adalah dinding penahan jenis gabion. Dinding gabion terbukti sebagai struktur yang berkesan untuk memastikan kestabilan cerun. Dalam kajian ini, dinding gabion dibuat daripada campuran kerikil dan cebisan tayar untuk mengkaji potensi kegunaannya. Objektif utama kajian ini adalah menggantikan kerikil di dinding gabion dengan cebisan tayar. Analisis kajian ini telah menggunakan sudut cerun yang berbeza-beza iaitu 30 º, 45 º dan 60 º untuk mencari sudut kritikal akibat kesan pemendakan. Kajian ini juga menganalisis keberkesanan rawatan cerun menggunakan dinding gabion menggantikan dengan pelbagai bahagian 0%, 20%, 50%, 80% dan 100% dari segi jumlah cebisan tayar. Model simulator cerun dalam skala 1:20 telah dibina dan dinding gabion digunakan untuk mengekalkan model cerun yang terdiri daripada pasir dengan sudut kritikal 60°. Keamatan hujan sederhana (13mm / jam) tertakluk pada bacaan cerun dan transduser telah merekodkan pergerakan dinding gabion. Hasilnya menunjukkan bahawa pergerakan antara dinding gabion dengan 20% cebisan tayar dan 100% kerikil mempunyai perbezaan yang besar untuk menahan cerun. Oleh itu, cebisan tayar tidak berkesan untuk digunakan sebagai bahan alternatif untuk kerikil dalam pembinaan tembok gabion kerana perbezaan pergerakan cerun yang besar. Oleh itu, kajian lanjut perlu dibina untuk mengkaji potensi penampan tayar yang akan digunakan di dinding gabion pada masa akan datang.

ABSTRACT

Retaining wall is one of the way to prevent slope failure. There are many type of retaining wall that have been used. One of them is gabion type retaining wall. Gabion wall is proven as an effective structure to ensure slope stability. In this study, the gabion wall was made from mixture of gravel and tire buffer to study the potential of its usage. The main objective of this study is to replace the gravel in gabion wall with tire buffer. This study used various slope angles which was 30º, 45º and 60º to find the critical angle due effect of precipitation. This study also analyse the effectiveness of slope treatment using gabion wall replace with various proportion of 0%, 20%, 50%, 80% and 100% of tires buffer in term of volume. Slope simulator model in scale 1:20 have been constructed and gabion wall were used to sustain the slope model consist of sand with 60º of critical angle. Moderate rain intensity (13mm/hour) was subjected on the slope and transducer reading that recording the displacement of gabion wall was taken. The result shows that the displacement between of gabion wall with 20% of tire buffer and 100% gravel has a huge difference in resisting slope. Therefore tire buffer is not effective to use as alternative material for gravel in constructing of gabion wall due the large difference of displacement. Therefore, further study need to be constructed to studies the potential of the tire buffer to be utilize in gabion wall in future.

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LIST OF SYMBOLS

c	Cohesion
G_s	Specific gravity
kN	Kilo Newton
kPa	Kilo Pascal
mm	Millimetre
mm/h	Millimetre per hour
µm	Micrometre
w_{opt}	Optimum moisture content
γ	Unit weight
γ_{max}	Maximum unit weight
ρ_d	Dry density
R^2	Correlation cohesion
%	Percent
°	Degree
φ	Angle of friction

LIST OF ABBREVIATIONS

ASTM	American Society for Testing and Materials
LL	Liquid Limit
PL	Plastic Limit

CHAPTER 1

INTRODUCTION

1.1 Background Study

Slope failure always happen anywhere in this world. It is a major natural hazards occurring both globally and locally. The slope failure or also being referred as mass wasting, is the downslope movement of the rock debris and the response of soil to the gravitational force or stresses (Hughes, 2003). It is a phenomenon that a slope is collapse due to the weakened self-retainability of the earth with the influence or causes by the rainfall or an earthquake. Because of this disaster, number of people had die due to fail to make an escape when it happened especially near the residential area. The rate of fatalities cause by the slope failure also increases upon time. The destruction causes by the slope failure or landslide had cause economic losses and also affect and damage the environmental. The major types of the slope failure are classified as the type of downslope movement which are falls, slides and flows. Natural forces such as wind, water and snow will change the topography of the earth thus will creating the unstable slopes.

To prevent the landslide to happen again in the future, mitigation measures had been made to the place that have high possibility of slope failure especially at the hillside and other high ground places. Slope stability is based on the interplay between two types of forces which are driving forces and resisting forces. The driving forces will promote the downslope movement of the material while the resisting forces is the deter movement of the slope. When the driving forces overcome the resisting forces, the slope will become unstable. The main driving force in most land movement is gravity and for the main resisting force is the shear strength of the material itself. Slope stability can act as the resistance of any inclined surface, as the wall of an open pit or cut, to failure by sliding or collapsing. Any ground surface that stands at the angle to the horizontal is known as

unrestrained slope and can be of natural origin or man-made. As the ground surface is not horizontal, there will always be the tangential component of gravity that tends to move down the slope-forming material. If the tangential component of gravity is very large, and the internal shear strength of the slope is low, the slope failure might happen.

Retaining wall is one of the mitigation measure in slope stability to overcome and prevent the slope failure. The retaining wall is the structure that holds or retains the soil behind it and capable of resisting most types of stress, particularly tension and shear. It will provides a comprehensive reinforcement throughout the structure. There are several types of retaining wall such as gabion wall. Gabion wall already proven its effectiveness as it already being used as retaining wall to ensure slope stability. The gabion is a cage like box that were filled with rocks, concrete and sometimes sand and soil that were used in civil engineering, road building, landscaping, slope and also for military applications. The size of the gabion wall can be change according to the predetermined size or according the requirement needed for the gabion. The size of the gabion in Malaysia already set its size by Jabatan Kerja Raya Malaysia which is 1m×1m×1m and usually used for slope stability (Penyenggaraan & Persekutuan, 2016).

Gabion wall are relatively easy to construct as it only need to build the level reinforced footing. Gabion's cages were then stack together on the footing. Those cages were being reinforced and fill with stones or aggregates. The gabion wall also has long service life as the material to build the cage which are galvanized wire and PVC coating wire that are durable materials against rusting.

1.2 Problem Statement

The transportation technology in this world is improving from time by time. There are several types of transportation nowadays, no matter whether in the ground or in the air. All of this transportation has the main objective which is to reduce the human effort or work to transport something to other places. Most of the transportation especially the vehicles on the ground that exist right now using the tire as the mechanism to smoother the travel of the transport. With the increasing of the vehicles right now, it will contribute

to the increasing number of waste tires as the used tire cannot been reuse for the purpose of the vehicles.

The estimate number of vehicles in Malaysia in 2017 is about 28,181,203 unit vehicles. With the increasing number of vehicles every year, the total number of waste tire will increase. There were about 15,000 tonne/year of waste tire that would increase every year (Ehsan, 2011). So in 2019, the prediction of waste tyre in peninsular Malaysia will exceeded 350,000 tonne over the year. Usually, waste tires will being dump at the landfill and only some of it will be retreaded to become the reuse tire. If the landfill is full with the waste tire, the disease will arise and will endanger the health of the people surrounding. If the waste tire being burn, it will produces black smoke and will give the negative impact to the environment. So, the proper controlled of the waste tire should be necessary to avoid the bad thing happened in the future.

On the other hand, gravel is extremely important as a foundation material for all of the industries with a number of application can be made using the gravel. Gravel is one of the non-renewable natural resources and its being used for more than 20 billion tons a year (Peduzzi, 2014). The extreme excavation of the gravel or aggregates will affect the biodiversity at that place as the quarries requires the removal of virtually all natural vegetation, top soil and also the subsoil to the aggregate underneath. It will also lead to the loss of the existing wildlife animal at that place as their habitats were destroyed. The excavation of the aggregates will affect the environment as the ecosystem will be affected by the noise, pollution, dust and also the contaminated water (Winfield and Taylor, 2005). Therefore, the dependency of the aggregates should be reduce to maintain the natural wildlife and also preserving the nature.

1.3 Objectives

The main aim of this research is to study the effectiveness of gabion type retaining wall made of tire buffer to mitigate slope failure. To achieve the aim, several specific objectives have been identified as following:

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