# GREEN STABILIZATION SYSTEM FOR RESIDUAL SOIL SLOPE IN TROPICS

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Prof.,

**LAPORAN KEMAJUAN PENYELIDIKAN :**

***GREEN STABILIZATION SYSTEM FOR RESIDUAL SOIL SLOPE IN TROPICS***

Merujuk kepada perkara di atas, bersama-sama ini disertakan naskah Laporan Kemajuan Penyelidikan bertajuk 'Green Stabilization System For Residual Soil Slope in Tropics' oleh kumpulan penyelidik dari RIF MyGERMEC, Institut for Infrastructure Engineering and Sustainable Management, Fakulti Kejuruteraan Awam.

Sekian, terima kasih.

Yang benar,

**PROF. IR. DR. ZAINAB MOHAMED**

Ketua Projek

# 4. Report

## 4.1 Executive Summary

Green stabilization system is a technique of slope stabilization using biotechnical system in order to prevent slope failure**.** Failure of residual soil slope is normally shallow type in nature but has significant effect to the slope long term global stability. Over decades, many philosophies and technological approaches worldwide (Diti, 1999) has been adopted and applied to range of slope topography and climate conditions but to date none able to prove to be the absolute solution to mitigate the hazard. In Malaysia environment, the two common techniques used, either by vegetative cover or by using structure component, however failed to mitigate slope failure hence need for improvement is crucial. The biological technique has recently being revisited by few researchers (Elliott, 1998) due to depletion of construction materials, escalating of material cost price and failure of some engineered slopes. The mechanical stabilization technique such as retaining wall is applied to slope that has high probability of deep slope failure however the challenge is on optimum cost-benefit technique. Meanwhile, for shallow slope failure, the surface vegetative cover failed to stabilize the slope as it is not a load bearing structure. This study is going to explore and introduce a green stabilization system that innovate a special type of vegetation root system that able to enhance and create a natural earth reinforced root system within the residual soil slope to overcome the potential shallow slope failure induce by external factors. Some preliminary trial was carried out by practisetioner (Alfred, 2006) to introduce the potential of using legume crop as an agent that enrich residual soil hence encourage the growth of vegetation root system that strengthen the reinforcing matrix to the residual soil mass. The main objectives of this study are to derive analysis of chemical composition for ferum soil and to determine interaction between ferum soil and plant root system. The expected outcome of this study is that an engineered root system able to create a natural root-reinforced-soil mass should be able to stabilize and overcome potential shallow slope failure and even to the extent of using the technique to reinstate failed residual soil slope by unskillful labor at minimum cost. A full scale insitu lab will be prepared to model a ferum soil slope subjected to natural tropical climate. The stability and performance of the ferum soil slopes shall be determine and the interaction between ferum slopes and plants root system shall be derived. The slope parametric study will be carried out by using Slope/W software to validate the efficiency of root matrix. The agricultural science approach will be used to enhance the capacity and sustainability of the root system to stabilize the slope in aggressive environment.

## 4.2 Enhanced Executive Summary

Green stabilization system is a technique using bioengineering method in order to prevent slope failure. The bioengineering method has been applied mostly by few researchers due to cost effective benefit (Elliott, 1998). Over the years, the number of engineered slopes failures increases especially during monsoon season in Malaysia. In general, vegetative mainly influences the slope stabilization by hydrological effect and mechanical effects of root system which act as root reinforcement to the soil (Tsukamoto, 1990; Chok *et al*., 2004; Wendi, 2006; Joanne and John, 2006; Faisal and Normaniza, 2007; Bibalani and Majnounian, 2008; Bujang and Sina, 2010; Ali *et a*l., 2012). However, Ali *et al.* (2012) revealed that the mechanical effect contributes to strength is much greater than the influence by hydrology effect.

Sivaprasad and Sulochana (2001) acknowledged that there are two types of microorganisms which are important for soil-root growth such as bacteria and fungi**.** The colonization of fungi were found able to increase plant growth hormones, plant roots, crop yield and nutrient uptake elements (Davis *et al.,* 1978; Trevor *et al.,* 1979; Hable, 2000; Sivaprasad and Sulochana, 2001; Muchovej, 2001; Ulrich *et al.*,2002; Sally *et al*., 2003; Heinemeyer and Fitter, 2004; Ghazi *et al.,* 2004; Semra, 2004; Karoolina *et al.,* 2004; Turjaman *et al*., 2006; Veronica *et al.,* 2006; Tanja *et al*., 2008; Jose *et al.,* 2009; Tiby, 2009; Mahmood and Rizvi, 2010; Ashwani *et al.*, 2010; Xian *et al.,* 2010; Ortas, 2010; Irfan *et al.,* 2010; Ming *et al.,* 2011; Arafat and He, 2011; Janardan *et al.,* 2011).

This study is to review on the possibility of further exploring the vegetation soil-root matrix system that was once used as bioengineering technique. The engineered soil-root matrix behaves as soil-reinforcement mechanism in grasses method of slope stabilization. It is believes these bioengineering technique is more acclimatize to accommodate Malaysian monsoon for sustainability of slope. Besides that, this study is also going to investigate the effect of microorganism toward root-soil growth of residual soil for slope stabilization. A physical model shall be constructed with residual soil, grasses, and specific microorganisms. The main objectives of this research study are to determine characteristics of residual soil, soil-root matrix and root bacteria, to characterize bacteria that promote soil- root matrix growth and water uptake capacity, to formulate bacteria-root-soil mixture that promote root growth, to characterize soil-root matrix characteristics and strength and to determine effective soil-root matrix reinforcement for slope sustainability in wet environment. The expected outcome of this study is improvement of soil-root growth of grasses with respect to specific microorganisms for slope stabilization.