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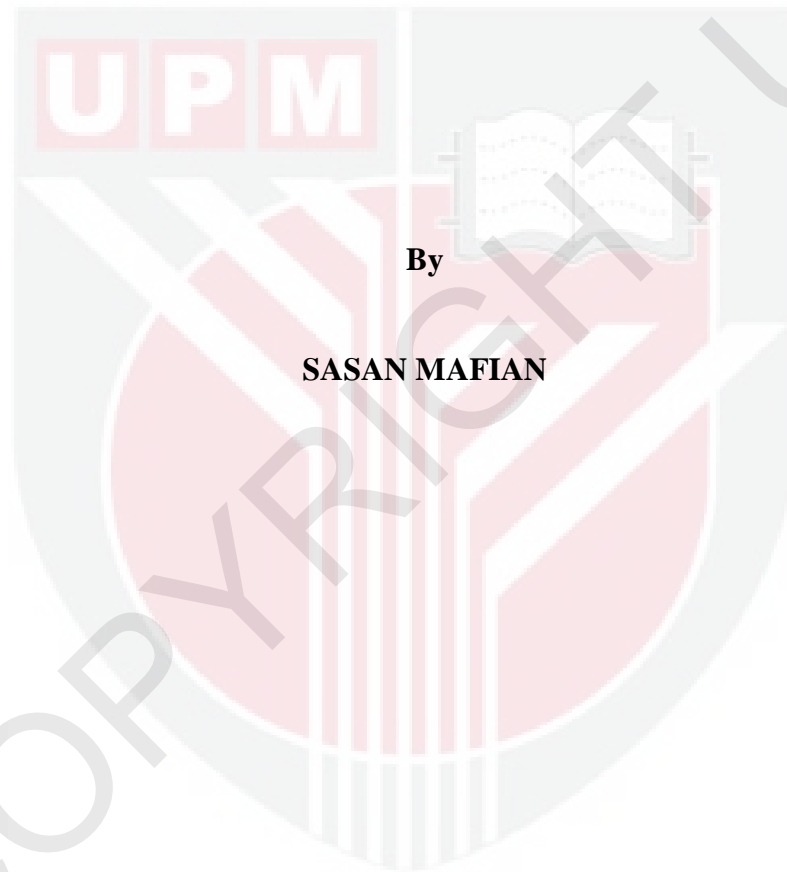
***SPECIES SCREENING AND EVALUATION OF LIVE POLE TECHNIQUE  
FOR SLOPE STABILIZATION IN TROPICAL ENVIRONMENT***

**SASAN MAFIAN**

**FK 2010 74**

**SPECIES SCREENING AND EVALUATION OF LIVE POLE TECHNIQUE**

**FOR SLOPE STABILIZATION IN TROPICAL ENVIRONMENT**



**By**

**SASAN MAFIAN**

**Thesis Submitted to the School of Graduate Studies, Universiti Putra Malaysia,  
in Fulfilment of the Requirements for the Degree of Master of Science**

**September 2010**

To:

*My mother who was all my life,*

*My wife who is all my love, and*

*My sons who are all my hopes*



Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfilment of the requirement for the degree of Master of Science

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**September 2010**

**Chairman: Professor Bujang Kim Huat, PhD**

**Faculty : Engineering**

The occurrence of landslides and slope failures is common in tropical regions, particularly during the monsoon seasons. Significant numbers of slope failures in these areas have been reported on residual soil slope. Among all categories of landslide, *shallow slope failures* are widespread and cause costly maintenance problem. More than two-third of slope movements are shallow sliding with less than 1.5m depth. Earth slope could be stabilized using reinforcement techniques and one of these techniques which seems to be appropriate for the shallow slope failures is using *Live Pole*.

Vegetation plays both important and well recognized roles in improving the stability of the slopes as they can provide immediate shear strength enhancement and modify saturated soil water regime (mechanical and hydrological effects). However, the lack

of proper analytic laboratory and field data for assessing and modelling the effects of live pole reinforcements in soil slope stabilities became the main objectives of this research.

After reviewing related literature, the branches of eleven trees/shrubs were selected and tested for root and stem growth in containers filled with a control media consisting of well graded sand (SW) and 10 % organic matters for eight weeks and under shade-house conditions for two selected species, namely *Dillenia suffruticosa* (Ds) and *Hibiscus tiliaceus* (Ht) which were finally selected based on their root growth, diameter of root, length of root, survival rate, etc. The live poles from these two selected tree species were planted for 12 months at three slopes with five different soil types and growing/dieback rates of their plantation were investigated.

In order to determine the mechanical characteristics of the stem and roots of these selected species, tests such as bending, shear and tension were conducted. These were followed by thirty-three large shear box tests on the roots and soil matrix of the live poles to determine their shear strength parameters. The results were then used in PLAXIS<sup>®</sup> to analyze the stability of the planted trial slopes. The observation revealed that the safety of the slopes was significantly increased by reinforcing the effects of the live poles which is due to the higher stress concentration around the live poles. The effects of the selected live poles on the soil suction and the influence of two types of fertilizers on the growth of the live pole species were considered in the final stages of this research.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia  
sebagai memenuhi keperluan untuk ijazah Sarjana Sains

**IMBASAN DAN PENILAIAN SPESIS TEKNIK PANCANG HIDUP UNTUK  
KESTABILAN CERUN DI KAWASAN TROPIKA**

Oleh

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Kejadian tanah runtuh dan kegagalan tanah cerun adalah sesuatu yang biasa berlaku di negara-negara tropika khususnya ketika musim monsoon. Sejumlah laporan berkaitan dengan kejadian ini sering kedengaran di kawasan-kawasan yang bertanah cerun. Daripada semua kategori tanah runtuh yang disenaraikan, *shallow slope failure* adalah kategori yang paling kerap berlaku serta melibatkan kos penyelenggaraan yang tinggi dan kerja-kerja pembaikan tanah yang banyak. Lebih daripada 2/3 pergerakan cerun adalah di dalam kategori *shallow sliding* dengan kedalaman kurang daripada 1.5m. Cerun tanah boleh distabilkan dengan menggunakan teknik-teknik peneguhan dan salah satu daripada teknik-teknik yang didapati amat berkesan untuk menangani kategori *shallow slope* ini ialah teknik *Live Pole*.

Tumbuh-tumbuhan memainkan peranan yang penting dalam proses penstabilan tanah cerun dengan meningkatkan kekuatan ricih sedia ada dan memodifikasi regim air di dalam tanah tepu (mekanikal dan kesan hidrologi). Walaubagaimanapun, kekurangan analisis makmal dan data-data yang sesuai untuk penilaian dan pemodelan kesan teknik *Live Pole* untuk menguatkan kestabilan tanah adalah pencetus kepada objektif utama kajian ini.

Selepas menyemak kesusasteraan berkaitan, ranting-ranting sebelas pokok / semak dipilih dan diuji untuk pertumbuhan akar dan batang di dalam bekas yang di isi dengan media kawalan yang terdiri daripada pasir bergradasi baik dan 10 % perkara-perkara organik yang lain selama lapan minggu dan di bawah tempat yang teduh bagi dua spesies terpilih, yakni *Dillenia suffruticosa* (Ds) dan *Hibiscus tiliaceus* (Ht) yang mana ia dipilih berdasarkan pertumbuhan akar mereka, garis pusat akar, panjang akar, kadar kemandirian, dan sebagainya. *Live Pole* daripada kedua-dua spesies pokok terpilih ini telah ditanam untuk 12 bulan pada tiga lereng-lereng dengan lima jenis-jenis tanah berbeza dan kadar pertumbuhan akan dinilai.

Dengan tujuan menentukan ciri-ciri mekanikal batang dan akar bagi spesies yang terpilih, ujian yang dilakukan seperti membengkok, ricih dan ketegangan telah dijalankan. Ini telah diikuti oleh tiga puluh tiga kotak ricih besar menguji pada akar dan matriks tanah *Live Pole* itu bagi menentukan parameter kekuatan ricih mereka.

Keputusan-keputusan itu kemudiannya digunakan dalam PLAXIS® untuk analisa kestabilan dan di tanam di cerun untuk pemerhatian. Pemerhatian itu mendedahkan yang keselamatan cerun-cerun itu bertambah dengan nyata sekali dengan mengukuhkan kesan-kesan *Live Pole* yang disebabkan oleh tegasan yang lebih tinggi sekitar *Live Pole* itu. Kesan-kesan *Live Pole* terpilih pada sedutan tanah dan

pengaruh kedua-dua jenis baja pada pertumbuhan *Live Pole* spesies adalah dianggap sebagai peringkat terakhir di dalam penyelidikan ini.





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I certify that a Thesis Examination Committee has met on **04/09/2009** to conduct the final examination of **Sasan Mafian** on his Master thesis entitled “**Tropical Live Pole Bioengineered Slope Stabilization**” in accordance with the University and University Colleges Act 1971 and the Constitution of the Universiti Putra Malaysia [P.U. (A) 106] 15 March 1998. The Committee recommends that the student be awarded the Master of Science degree.



This thesis was submitted to the Senate of Universiti Putra Malaysia and has been accepted as fulfilment of the requirement for the degree of Master of Science. Members of the Supervisory Committee were as follows:

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Date: 25 Nov. 2010

## DECLARATION

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



**SASAN MAFIAN**

Date: September 2010

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