

Abstract of thesis entitled

**“Native Shrubs and Trees as an Integrated Element
in Local Slope Upgrading”**

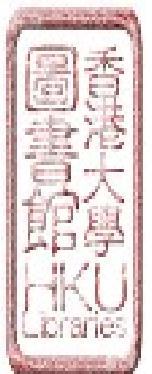
Submitted by

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Hilly topography and frequent rainstorms result in many slope failures in Hong Kong which is a major hazard receiving much public attention. Various mitigation schemes have been implemented over the last few decades to increase the safety margins of urban cut and fill slopes. The urge to build a sustainable green society has made the conventional solution of using hard sprayed concrete cover inadequate. Greening of urban slopes using live self-generated vegetation with minimal maintenance cost thus became a favorable option and is worth to further explore in a more systematic manner. It is believed that live vegetation can upgrade a slope through hydrological and mechanical contributions.

Both field and laboratory studies were undertaken in this study which covered the mechanical and hydrological aspects of vegetation. Four native species, including shrubs, *Rhodomyrtus tomentosa* and *Melastoma sanguineum*, and small trees, *Schefflera heptaphylla* and *Reevesia thyrsoidea*, were studied. About 1,000 seedlings were planted and monitored for three years. Natural individuals of the selected native species and an exotic tree, *Leucaena leucocephala*, were sampled randomly for comparison. Their growth performance, root distribution and mechanical functions were compared between establishment time and types,



species, plant forms and tree origins, by laboratory (tensile and direct shear tests) and field (uprooting and direct shear tests) tests. Finally, slope stability analysis was conducted on bare slopes and slopes vegetated using the selected native species.

After a three-year establishment period, the growth rate of the studied species has not yet leveled off. The average maximum rooting depth (RD) of the three-year old trees exceeded 1 m. The planted samples had larger root systems than the natural ones in terms of most root attributes. The growth potential of these four species on typical man-made slopes in Hong Kong was highlighted.

The anchorage ability of the plants was investigated by uprooting test. Correlation between the peak pull-out resistance (P_{\max}) and plant parameters gives a first-hand estimation of P_{\max} . Above-ground dry weight was the key indicator of P_{\max} for both plant forms of the native species while trees could also be well predicted by basal diameter. However, root shapes had no significant impact on P_{\max} .

In laboratory direct shear test, reinforced samples had higher peak shear strength (Δs) at longer displacement. Root directions and root area ratio (RAR) had significant influence on Δs . Significant power relationship was found between root diameter and Δs . From field tests, no significant Δs was found between plant forms and establishment types, which indicates similar magnitude of reinforcement by the planted shrubs and naturally grown trees.

Using the Wu Model, the maximum root cohesion (c_r) of the studied species was found within the top 0.4 m soil depth. The increase in the factor of safety (FOS) is remarkable in shallow soil depth determined by RD. In sunny days, the effect of suction induced by plants is reduced. With the typical approach of slope stability analysis, an unsafe slope can be turned to marginally safe by mature trees with similar reinforcement effects as shrubs in the same height class.

