Information Note 08/2022 **November 2022**

Soil Bioengineering Measures for Natural Terrain Landslide Scars

Key Messages: Soil bioengineering measures offer a potentially effective, low-cost, sustainable, and environmentally acceptable means to repair natural terrain landslide scars.

Introduction

The Government is committed to maintaining the highest standard of slope safety, while at the same time strives to ensure that the appearance of the respective slopes would not be visually intrusive. The current Government policy is to preserve existing vegetation and to use vegetation as a slope surface cover on both new and upgraded slopes as far as possible (Information Note 1/2022 & GEO Publication No. 1/2011).

Repair works to natural terrain landslide scars are generally not warranted because of the high cost and adverse effect on the environment associated with the inaccessibility of most of the scars. In situations where the long-term repair of natural terrain landslide scars are called for, soil bioengineering measures offer a low-cost, less heat- and light- reflective, potentially effective, largely maintenance-free, sustainable, and environmentally acceptable alternative to conventional slope works.

Definitions

Soil bioengineering is defined as "the use of living vegetation, either alone or in conjunction with non-living plant material and civil engineering structures, to improve slope stability and/or reduce erosion" (Morgan & Rickson, 1995). Soil bioengineering measures provide additional mechanical support to soil, present barriers to earth movement, function as hydraulic drains, and act as hydraulic pumps or wicks.

Different Soil Bioengineering Techniques

Available soil bioengineering measures comprise direct measures, which are applied to sites requiring repair or stabilisation, and indirect measures, which are applied to areas adjacent to deteriorated sites.

Direct measures include two distinct components, namely, ‘living’ (i.e. the planting of living plants) and ‘structural’ or ‘non-living’ (e.g. timber cribwalls and bender fences). In practice, the two components are commonly combined (e.g. live cribwalls), see Table 1 and Figure 1. Following installation of live plants such as stems and branches, the active growth of roots and stems form the major structural components of the soil bioengineering system. Subsequent invasion by surrounding plants reinforces the system. With rooting depths typically ranging from 200mm to 1200mm for most natural hillside applications, these direct measures can be expected to reinforce the soil to depths of up to about one metre, in contrast to the shallow soil binding depths offered by the more commonly used greening methods such as hydroseeding or conventional planting.

Indirect measures include the planting of live barriers. These are belts of hardy species (trees and bamboo) that are strategically planted to restrict the passage of landslide debris.

The Use of Soil Bioengineering Measures in Hong Kong

Until 2003, the remedial use of vegetation in eroded areas of natural terrain in Hong Kong was largely restricted to direct planting. Direct planting was mostly carried out in Country Parks, and close to new towns.

In April 2003, the GEO of CEDD began a pilot project to assess the suitability of soil bioengineering measures for minimising the deterioration of natural slopes in areas of natural terrain affected by recent, shallow landsliding and related gully erosion. The project had two main objectives, i) to identify measures that are capable of reinforcing the soil mass, and thereby increase the resistance of the slope to further erosion, and ii) to identify means of accelerating the natural re-vegetation of deteriorating slopes, which in turn would enhance the local ecosystems. The findings and recommendations based on the field trials carried out on several natural terrain slopes across Hong Kong are presented in GEO Report No. 227 (July 2008). Field trials on selected man-made slopes have been conducted and reported under the Landslip Preventive Measures Programme.

In late 2019, the GEO commenced another pilot project to investigate the potential application of broadcasting seeding by unmanned aerial vehicle (UAV) as a means to facilitate re-vegetation of landslide scars on remote hillsides.

The Limitations of Soil Bioengineering Measures

An important aspect of soil bioengineering is the selection of suitable plant species and species combinations. Species should be selected in consultation with specialists, following on-site vegetation surveys. Native species, mainly shrubs, are preferable, because they blend in with the existing vegetation cover, and they are adapted to the local climate, soil conditions and moisture. Consideration should also be given to the ability of the plants to promote natural colonisation by the surrounding plant community, with the ultimate goal of producing a diverse and sustainable native or semi-native plant cover.

Soil bioengineering measures should not be used for emergency slope repairs, but could be considered as a long-term replacement for temporary works such as shotcreting. They are not suitable where the landslide scars are in bedrock as there is no soil as a rooting medium for plants. Steep slopes (over about 35°) may present problems, because they generally require the provision of safety measures along the access routes and in the working areas. Also, sites in some areas rapidly re-colonise naturally, without intervention, so bioengineering techniques would be unwarranted at these locations, primarily because initial vegetation clearance would be required.

References

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Table 1 – Types of Soil Bioengineering Measures and Recommended Plants Species

Soil Bioengineering Measures	Plant Form	Recommended Plants Species
Living Approach		
Direct Planting	Rooted Plants	*Acaia confuse, Cratoxylum cochinchinensis, Duranta erecta, Gordonia axillaris, Lophostemon confertus, Melastoma candidum, Machilus checkiangensis, Melastoma sanquineum, Phyllanthus emblica, Rhodomyrtus tomentosa, Sterculia lancealate, Schefflera octophylla, Schima superba*
Combined Living and Non-living Approach		
Live Stakes	Live Branch Cuttings	*Ficus microcarpa, Salix babylonica*
Live Fascines		*Ficus microcarpa, Gardenia jasminoides*
Pole Drains		*Ficus microcarpa, Gardenia jasminoides*
Brushlayers		*Gardenia jasminoides, Melastoma candidum*
Branchpacking		*Gardenia jasminoides, Melastoma candidum*
Live Gully Repairs		*Gardenia jasminoides, Melastoma candidum*
Hedgelayers	Rooted Plants	*Duranta erecta, Gardenia jasminoides, Melastoma candidum, Melastoma sanguineum, Phyllanthus emblica, Raphiolepis indica*
Live Cribwalls		*Gardenia jasminoides, Melastoma sanquineum, Phyllanthus emblica, Rhodomyrtus tomentosa*
Bender Fences		*Acaia confuse, Cratoxylum cochinchinensis, Duranta erecta, Gordonia axillaris, Lophostemon confertus, Melastoma candidum, Machilus checkiangensis, Melastoma sanquineum, Phyllanthus emblica, Rhodomyrtus tomentosa, Sterculia lancealate, Schefflera octophylla, Schima superba*

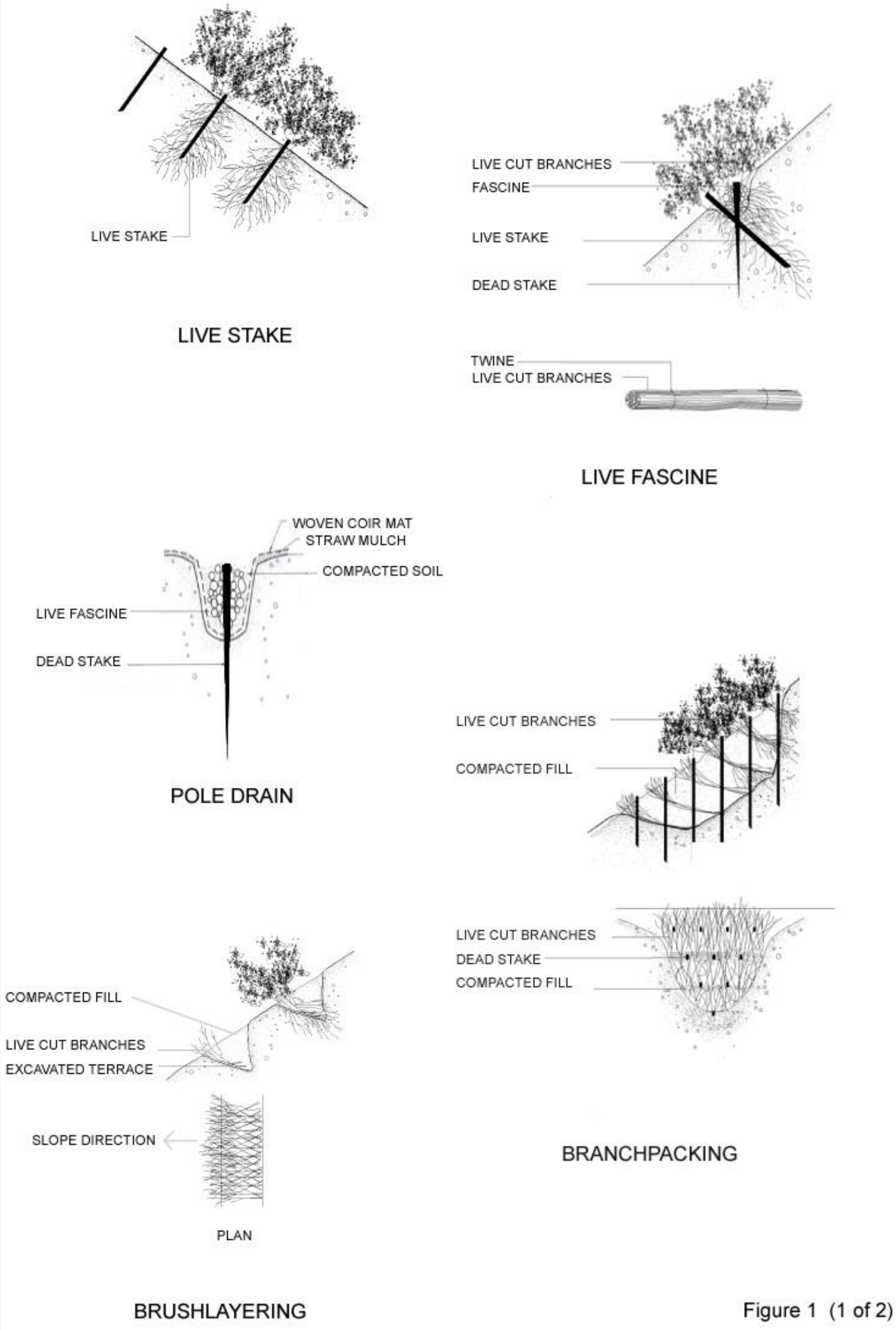

Figure 1 (1 of 2)

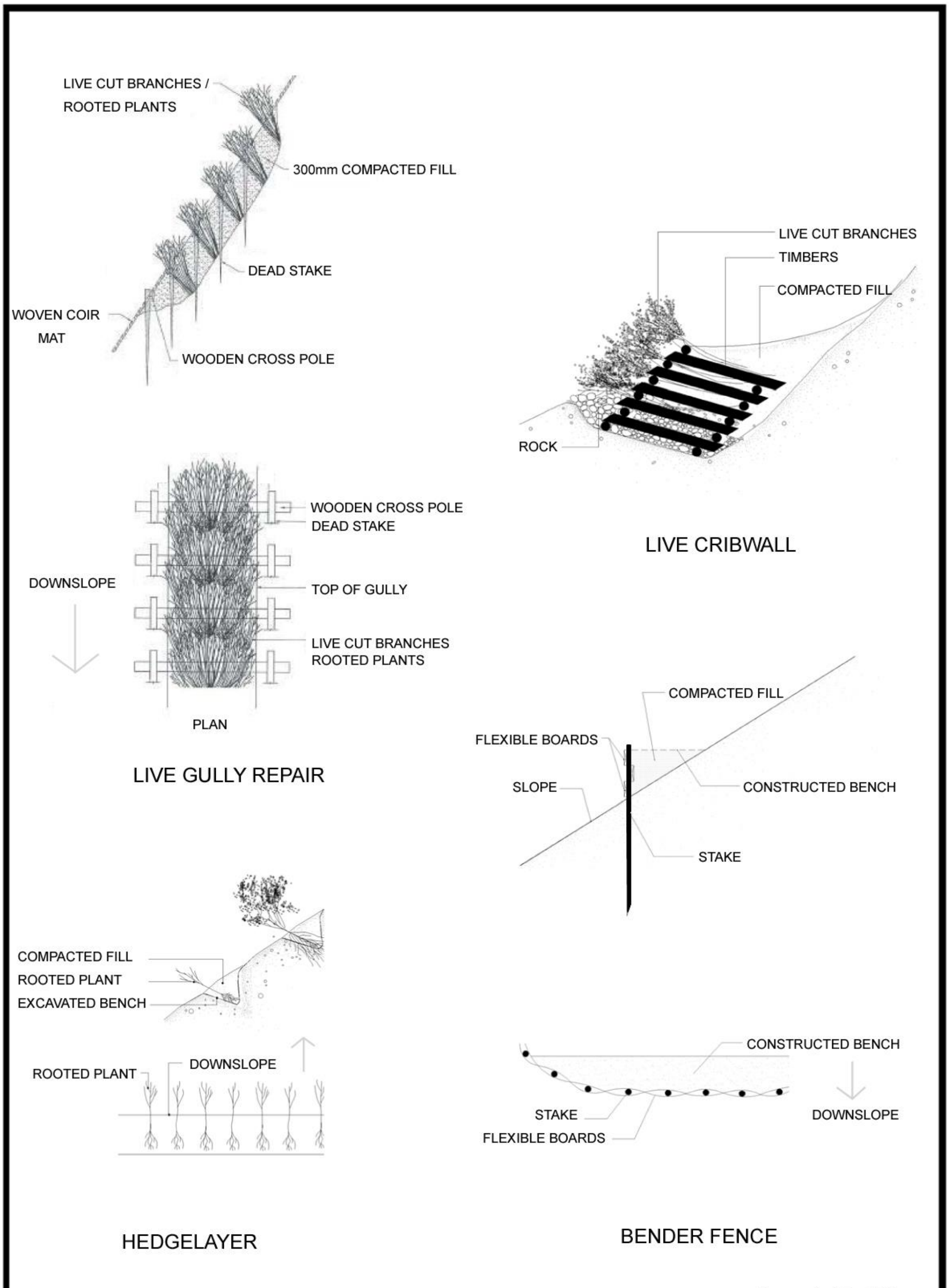

Figure 1 (2 of 2)