LIST OF TABLES

Table 1 - Summary of Slope Type and Treatment included in the Local Slope Review

Slope Treatment[Note 2] (on slope or part of slope)		Slope Type and Dominant Material (S,R or M)[Notes 1 and 3]																			Totals
		Cut Slope (137)			Fill Slope (14)			Cut/Fill Slope (7)			Cut/ Retaining Wall (7)			Fill/ Retaining Wall (8)			Cut/Fill/ Retaining Wall (2)			Retaining Wall (20)	
		S	R	M	S	R	M	S	R	M	S	R	M	S	R	M	S	R	M	N/A	
Soft Treatment	Hydroseeding with Grass Seed	5	-	5	4	-	-	-	-	-	2	-	-	1	-	-	-	-	-	-	17
	Hydroseeding with Grass and Tree/Shrub Seed	6	-	8	2	-	-	4	-	-	2	-	-	1	-	-	-	-	-	-	23
	Grass Hydroseeding with Pit Planting of Seedling Sized Trees and Shrubs	4	-	12	2	-	1	1	-	1	2	-	-	3	-	-	1	-	-	-	27
	Ornamental Tree, Climber, Groundcover Planting	1	-	-	1	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	3
	Self-seeded Groundcover	6	4	7	3	-	-	1	-	-	1	-	1	1	-	-	-	-	-	-	24
	Trees (Plantations)	-	-	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4
	Synthetic Erosion Control Mats with Hydroseeding/Planting	4	-	7	2	-	-	1	-	1	-	-	-	2	-	-	-	-	1	-	18
	Biodegradable Erosion Control Mats with Hydroseeding/Planting	1	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	2
	Soil Nailing with a Vegetation Cover	3	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	7
Hard Treatment	Sprayed Concrete (untreated)	19	11	37	2	1	-	1	-	1	-	-	1	2	-	-	-	-	-	-	75
	Sprayed Concrete with Colour Pigment	8	1	12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	21
	Chunam	1	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3
	Slope Surface Cladding	10	2	3	2	-	-	2	-	-	1	-	-	1	-	-	-	-	-	-	21
	Soil Nailing with Hard Cover	5	-	4	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	10
	Gabions	1	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2
	Crib Walls	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	1	-	-	1	3
	Wall Facing and Finishes	-	-	5	2	-	-	1	-	-	4	-	1	6	-	-	1	-	1	20	41
	Rock Buttresses	-	10	18	-	-	-	-	-	1	-	-	-	-	-	-	-	-	1	-	30
Mixed Treatment	Grillages	1	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3
	Grasscrete	1	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2
	"Creat" Toyo-Mulching	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	2
	General Toyo-Mulching	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	2
	Strip Toyo-Mulching	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	1
	"ON" Method	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
	Geogrid Reinforced Slope with Vegetative Cover	-	-	-	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4
	Reinforced Fill Structure with Facing Panels	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	1
	Berm Planters	3	2	8	-	-	-	1	-	-	-	-	-	2	-	-	-	-	-	1	17
	Toe Planters	11	8	12	2	-	-	-	-	-	-	-	-	1	-	-	-	-	-	8	42
	Hanging Planters	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	2
	Surface Pit Planters	1	-	2	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4
	Vegetation on Rock Cut Slopes	-	4	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	7
	Vegetation on Rock Fill	-	-	-	-	-	1	-	-	1	-	-	-	-	-	-	-	-	-	-	2
	Existing Mature Trees on Slopes and Walls	4	1	12	1	-	-	-	-	-	-	-	-	1	-	-	-	-	-	4	23
Other Treatment	Rock Protection Wire Mesh	-	1	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5
	Rock Exposure	-	19	26	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	46
	Rock Bolts	-	2	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	8
	Street Trees	-	2	2	-	-	-	-	-	1	1	-	-	-	-	-	-	-	-	1	7
	Tree Rings	6	-	15	3	-	-	1	-	-	-	-	1	1	-	-	-	-	-	-	27

Notes: (1) Dominant slope material is given as S:soil, R:rock, or M:mixed, a combination of rock and soil.
(2) On most of the slopes visited more than one slope treatment was found on the slope.
(3) Number in bracket with slope type refers to the total number of slopes visited for that particular slope type.

Table 2 - Assessment of Likely Visual Importance of Slope

Number of Viewers	Sensitivity of Receiver		
	High	Medium	Low
Very Many	Very High	High	Moderate
Many	High	Moderate	Low
Few	Moderate	Low	Very Low

Notes: (1) The likely visual importance of a slope given in this table is for guidance only.
(2) For examples of Number of Viewers and Sensitivity of Receiver see Tables 3 and 4 respectively.

Table 3 - Typical Examples of Slopes Viewed in Each Number of Viewers Category

Example	Number of Viewers		
	Very Many	Many	Few
(1) Slope in existing urban or urban fringe area, which is viewed from surrounding by high rise commercial/residential buildings, or a well trafficked major transport corridor.	✓		
(2) Slope in existing urban fringe or rural area, which is viewed from a few high-rise, or several low-rise residential buildings, or alongside a well trafficked local transport corridor.		✓	
(3) Slope in existing rural / industrial area, which is viewed from a few low rise residential / industrial buildings, or alongside a less well used local transport corridor			✓

Note: These examples are for guidance only.

Table 4 - Typical Examples of Slopes Viewed in Each Sensitivity of Receiver Category

Example	Sensitivity of Receiver		
	High	Medium	Low
(1) Residential occupiers.	✓		
(2) Users of open spaces, recreational and other outdoor community facilities (e.g. cemeteries).	✓	✓	
(3) People occupied in the course of their work		✓	✓
(4) Road, rail, sea travellers (both drivers and passengers) and pedestrians		✓	✓

Notes: (1) These examples are for guidance only.
(2) Directness of view, distance of view, and period of view (also frequency e.g. slope seen as part of a daily journey) as well as the context of the view, will all affect the sensitivity of the viewer.

Table 5 - Evaluation of Soft Slope Treatments (Sheet 1 of 8)

Treatment Name	Description	Typical Slope Application in Hong Kong	Capital Cost	Ease of Construction	Ease of Maintenance	Cost of Maintenance	Longevity	Geotechnical Advantages and Limitations	Landscape and Aesthetic Advantages and Limitations	Recommended Use
Hydroseeding with grass seed	Sprayed mixed grass seed, macerated paper and fertilizers in a water suspension	Establishment of vegetation on soil slopes	•	•	•	•	•	Advantages: – possibly reduces surface water infiltration into slope – reduces surface soil erosion – no limitation on angle of slope provided adequate stable soil surface is available Limitations: – does allow some infiltration of surface water – does not include deep or tap-rooted species which would benefit slope stability – at steeper slope angles needs to be protected against possible soil erosion	Advantages: – green, so visually pleasing – semi natural appearance – incomplete cover on mixed soil rock slopes reflects natural vegetation pattern – with irrigation can be undertaken throughout the year Limitations: – grasses are not the local climax vegetation, and will become out-competed by other plants – needs to be protected during establishment period of about 4 to 8 weeks – needs water supply to become established – needs cutting if it is intended to be used as an ornamental grass sward	Recommended for: – immediate vegetation cover, for surface erosion control but not on steep slopes – use with tree planting, as an understorey layer – shallow soil bodies where digging of pits for direct planting is not possible – slopes where soil has been protected with surface erosion control matting

Table 5 - Evaluation of Soft Slope Treatments (Sheet 2 of 8)

Treatment Name	Description	Typical Slope Application in Hong Kong	Capital Cost	Ease of Construction	Ease of Maintenance	Cost of Maintenance	Longevity	Geotechnical Advantages and Limitations	Landscape and Aesthetic Advantages and Limitations	Recommended Use
Hydroseeding with grass and tree/shrub seeds	Sprayed mixed grass, tree and shrub seeds, macerated paper and fertilizers in a water suspension	Establishment of vegetation on soil slopes	•	•	•	•	•	Advantages: – possibly reduces surface water infiltration into slope – reduces surface soil erosion – includes deeper rooting plant which benefit slope stability Limitations: – does allow some infiltration of surface water – action of leaf drip and stem flow may be more erosive on soil than direct rainfall – on steep slopes greater risk of shallow instability from uprooting of trees	Advantages: – visually pleasing – semi natural appearance Limitations: – use of exotic plant species – difficult to control overcrowding of trees – grass can not be cut in the first two years – very poor bio-diversity – needs to be protected during establishment of trees of about 12 weeks – difficulty in establishing groundcover beneath tree canopy	Recommended for use on soil slopes only where – direct tree planting is not possible due to shallowness of soil cover, – inaccessibility for pit planting

Table 5 - Evaluation of Soft Slope Treatments (Sheet 3 of 8)

Treatment Name	Description	Typical Slope Application in Hong Kong	Capital Cost	Ease of Construction	Ease of Maintenance	Cost of Maintenance	Longevity	Geotechnical Advantages and Limitations	Landscape and Aesthetic Advantages and Limitations	Recommended Use
Grass hydroseeding with pit planting of seedling sized trees and shrubs	Sprayed mixed grass seed, macerated paper and fertilizers in water suspension with follow-up planting of shrub/tree seedlings (whips)	Establishment of vegetation on soil slopes	•	•	•	•	•	Advantages: – possibly reduces surface water infiltration into slope – reduces surface soil erosion – includes deeper rooting plants which benefit slope stability Limitations: – does allow some infiltration of surface water – action of leaf drip and stem flow may be more erosive on soil than direct rainfall	Advantages: – visually pleasing – good natural appearance – greater control of overall appearance – high degree of bio-diversity – faster establishment and greater success rate of trees/shrubs than hydroseeded method Limitations: – requires landscape specialist supervision of planting – generally uses foreign tree/shrub species – needs to be protected during establishment of grass of about 6 weeks – difficulty in establishing groundcover beneath tree canopy – more expensive than hydroseeding with tree/shrub seeds	Recommended for any soil slope

Table 5 - Evaluation of Soft Slope Treatments (Sheet 4 of 8)

Treatment Name	Description	Typical Slope Application in Hong Kong	Capital Cost	Ease of Construction	Ease of Maintenance	Cost of Maintenance	Longevity	Geotechnical Advantages and Limitations	Landscape and Aesthetic Advantages and Limitations	Recommended Use
Ornamental tree, climber, groundcover planting	Planting of plant specimens in planter beds	Establishment of vegetation in planter beds	• •	•	•	• • •	• • •	Advantages: – possibly reduces surface water infiltration into slope – may include deeper rooting plants which benefit slope stability Limitations: – does allow some infiltration of surface water	Advantages: – visually pleasing – natural appearance can be achieved – high degree of bio-diversity possible – can simulate local climax vegetation Limitations: – requires continuous maintenance if intended to be ornamental – labour intensive – requires specialist landscape supervision	Recommended for any planter

Table 5 - Evaluation of Soft Slope Treatments (Sheet 5 of 8)

Treatment Name	Description	Typical Slope Application in Hong Kong	Capital Cost	Ease of Construction	Ease of Maintenance	Cost of Maintenance	Longevity	Geotechnical Advantages and Limitations	Landscape and Aesthetic Advantages and Limitations	Recommended Use
Turfing	Pre-grown sward Usually of grasses with roots and a thin layer of soil	Establishment of vegetation on soil slopes	•	•	•	•	•	Advantages: – possibly reduces surface water infiltration into slope – reduces surface soil erosion by providing instant establishment of cover Limitations: – does allow some infiltration of surface water – does not include deep or tap-rooted species – limited to slopes less than 15°	Advantages: – visually pleasing – approximate natural appearance – instant establishment of cover Limitations: – single species dominance – strictly ornamental appearance – will revert to wild grass if not continuously maintained – very expensive compared to grass hydroseeding – time consuming and difficult to establish	Recommended only for shallow slopes where a high quality visual effect is required instantly.

Table 5 - Evaluation of Soft Slope Treatments (Sheet 6 of 8)

Treatment Name	Description	Typical Slope Application in Hong Kong	Capital Cost	Ease of Construction	Ease of Maintenance	Cost of Maintenance	Longevity	Geotechnical Advantages and Limitations	Landscape and Aesthetic Advantages and Limitations	Recommended Use
Hydrosprigg-ing	Sprayed seeds and chopped sections of rhizome of herbaceous planting, macerated paper and fertilizers in a water suspension	Not typically used in Hong Kong. Establishment of vegetation on soil slopes	•	•	•	•	•	Advantages: – possibly reduces surface water infiltration into slope – reduces surface soil erosion – includes deeper rooting plant which benefit slope stability Limitations: – does allow some infiltration of surface water – action of leaf drip and stem flow may be more erosive on soil than direct rainfall – on steep slopes greater risk of shallow instability from uprooting of trees	Advantages: – visually pleasing – semi natural appearance – rapid establishment of vegetation cover Limitations: – single species dominance – tendency towards an ornamental effect – grasses are not the local climax vegetation – very limited on range (throw) of spray gun	Recommended for: – immediate vegetation cover, for surface erosion control – use with tree planting, as an understorey layer – shallow soil bodies where digging of pits for direct planting is not possible – slopes where soil has been protected with surface erosion control matting

Table 5 - Evaluation of Soft Slope Treatments (Sheet 7 of 8)

Treatment Name	Description	Typical Slope Application in Hong Kong	Capital Cost	Ease of Construction	Ease of Maintenance	Cost of Maintenance	Longevity	Geotechnical Advantages and Limitations	Landscape and Aesthetic Advantages and Limitations	Recommended Use
Vetiver grass (*Vetiveria zizanoides*)	A fast growing grass that has a dense and deep root system capable of penetrating several metres into the soil	Not typically used in Hong Kong. Used on soil slopes up to about 60°	•	•	•	•	•	Advantages: – reduces soil erosion – binding of upper soil layer by root system – has been successfully grown on slope gradients up to 60° Limitations: – deep rooting and need for frequent irrigation would need to be addressed in engineering	Advantages: – semi natural appearance – can be established on nutrient-poor soils – tolerant to extreme climatic variation (rainfall, drought and temperature) Limitations: – foreign plant species – needs to be grown in conjunction with other species – contour planting may appear unnatural – limited local experience – shade intolerant – labour intensive during planting and establishment – contour planting considered 'troublesome' by contractors – slow root development – not yet commercially available in Hong Kong – variable results in establishing plants successfully at different sites in Hong Kong	Requires further assessment in local conditions
				•	•	•	•			
				•	•	(?)	•			

Table 5 - Evaluation of Soft Slope Treatments (Sheet 8 of 8)

Legend:

Capital Cost (HK$ per m²) (Note 3)	Ease of Construction	Ease of Maintenance	Cost of Maintenance (HK$ per m²) (Note 2)	Longevity (years)
<500	Readily available local skill, machinery and materials	None	Minimal to 50	<5
500 to 1000	Readily available either local skill/machinery, skill/material or machinery/material	Maintenance is not essential	50 to 150	5 to 50
1000 to 5000	Readily available either local skill, machinery or materials	Maintenance is essential for continued performance	>150	50 to 120
>5000	Local skill, machinery and materials not readily available			

Notes:
(1) Product is covered by patents and the local agent should be contacted.
(2) Based on estimated maintenance cost over 5 year period (GEO, 1999b) and costs provided by suppliers/agents.
(3) Capital cost is an estimate of the total cost of installing the product based on information provided by suppliers/agents. See Appendix E for details of cost.
(4) Details given above may change over time and the suppliers/agents should be contacted for current details.

Table 6 - Evaluation of Hard Slope Treatments (Sheet 1 of 9)

Treatment Name	Description	Typical Slope Application in Hong Kong	Capital Cost	Ease of Construction	Ease of Maintenance	Cost of Maintenance	Longevity	Geotechnical Advantages and Limitations	Landscape and Aesthetic Advantages and Limitations	Recommended Use
Sprayed concrete (untreated)	Sprayed concrete mix, either wet or dry, with or without fibre reinforcement	Prevention of water infiltration and minor spalling on generally rock and steep soil cut slopes	•	•	•	•	• • (?)	Advantages: – prevents surface water infiltration into slope – prevents soil erosion Limitations: – root action causes cracking and deformation	Advantages: – clean – easy to apply – no breeding opportunity for pests Limitations: – visually oppressive – does not integrate with the natural surroundings – high albido (reflectance) – does not encourage bio-diversity	Recommended use on soil and rock slopes of very low visual importance
Sprayed concrete with colour pigment	Sprayed concrete mix, either wet or dry, with or without fibre reinforcement and with pigment added with spray or applied afterwards	Prevention of water infiltration and minor spalling on generally rock and steep soil cut slopes	•	•	•	•	• • (?)	As above	Advantages: – pigment can be used to blend slope into surroundings – pigment can be used for artistic impression Limitations: – pigment may fade with time – inappropriate use of colour may be visually oppressive – does not encourage bio-diversity	Recommended use on soil and rock slopes of low or very low visual importance

Table 6 - Evaluation of Hard Slope Treatments (Sheet 2 of 9)

Treatment Name	Description	Typical Slope Application in Hong Kong	Capital Cost	Ease of Construction	Ease of Maintenance	Cost of Maintenance	Longevity	Geotechnical Advantages and Limitations	Landscape and Aesthetic Advantages and Limitations	Recommended Use
Chunam	Mix of soil and cement applied by hand to slope surface	Used on all slope types to provide a surface covering	•	•	•	•	•	Advantages: – prevents surface water infiltration into slope – prevents surface soil erosion Limitations: – none	Advantages: – as for sprayed concrete (untreated) Limitations: – as for sprayed concrete (untreated)	Recommended use on soil and rock slopes of low or very low visual importance
Slope surface cladding	Generally masonry stone work set in mortar	Used on all slope types to provide a surface covering	•	•	•	•	•	Advantages: – prevents surface water infiltration into slope – prevents surface soil erosion Limitations: – none	Advantages: – on rock slopes can be effectively integrated with the composition of the rock – can be used to break up the uniformity of a slope Limitations: – albido effects	Recommended use on all slopes with a moderate visual importance or less but can be used as part of a landscape design on slopes of very high visual importance

Table 6 - Evaluation of Hard Slope Treatments (Sheet 3 of 9)

Treatment Name	Description	Typical Slope Application in Hong Kong	Capital Cost	Ease of Construction	Ease of Maintenance	Cost of Maintenance	Longevity	Geotechnical Advantages and Limitations	Landscape and Aesthetic Advantages and Limitations	Recommended Use
Soil nailing with hard cover	Galvanized steel bar grouted in pre-drilled hole in slope with an anchor head at the slope face. Slope is then covered in sprayed concrete	Used on steep soil slopes up to about 70°	•	•	•	•	•	Advantages: – reduces surface water infiltration into slope – reduces surface soil erosion – soil nailing with a hard cover can be used on slopes up to about 70°, depending on design Limitations: – none	Advantages: – as for sprayed concrete (untreated) Limitations: – as for sprayed concrete (untreated)	Recommended use on soil and rock slopes of low or very low visual importance

Table 6 - Evaluation of Hard Slope Treatments (Sheet 4 of 9)

Treatment Name	Description	Typical Slope Application in Hong Kong	Capital Cost	Ease of Construction	Ease of Maintenance	Cost of Maintenance	Longevity	Geotechnical Advantages and Limitations	Landscape and Aesthetic Advantages and Limitations	Recommended Use
Gabion	Rhombic wire mesh boxes filled with rock	Used to form near vertical wall or for facing of a slope	• to • •	•	•	•	• • to • • •	Advantages: – face can be constructed near vertical – reduces soil erosion – reduces land-take when compared to fill slope – can be used as a skin wall over existing slope/wall Limitations: – PVC coated wire may suffer abrasion and subsequent corrosion leading to instability	Advantages: – can be partly vegetated using soil bags in basket or cuttings planted through basket – a variety of plants can be planted – mix of rock and vegetation can be visually appealing – rock infill may be layered giving greater visual appeal Limitations: – baskets are usually not vegetated – difficulties in retaining water in baskets with possible withering of vegetation – mesh may remain visible – mesh may deform and bulge over time giving appearance of instability	Recommended for general use on low to medium height slopes where visual importance is moderate or less

Table 6 - Evaluation of Hard Slope Treatments (Sheet 5 of 9)

Treatment Name	Description	Typical Slope Application in Hong Kong	Capital Cost	Ease of Construction	Ease of Maintenance	Cost of Maintenance	Longevity	Geotechnical Advantages and Limitations	Landscape and Aesthetic Advantages and Limitations	Recommended Use
Crib wall (concrete construction)	Gravity retaining wall system constructed from pre-cast concrete with stone infill	Used to form near vertical walls	• • • (?)	• •	•	•	• • •	Advantages: – face can be constructed with near vertical face – reduces land-take when compared to fill slope – can be used as a skin wall over existing slope/wall Limitations: – none	Advantages: – visually interesting pattern – planters can be created on the face Limitations: – difficulties in retaining water in planters	Recommended for low height slopes where visual importance is moderate or less
Crib wall (timber construction)	Gravity retaining wall system constructed from timber with stone infill	Not yet used in Hong Kong. Used to form near vertical walls up to about 7 m	• • • (?)	• •	•	•	• •	Advantages: – face can be constructed with near vertical face – reduces land-take when compared to fill slope – can be used as a skin wall over existing slope/wall Limitations: – needs to be ordered from abroad – relatively expensive – design life is about 50 years	Advantages: – visually interesting pattern – planters can be created on the face – timber provides additional visual interest Limitations: – difficulties in retaining water in planters	Further assessment in Hong Kong conditions is required

Table 6 - Evaluation of Hard Slope Treatments (Sheet 6 of 9)

Treatment Name	Description	Typical Slope Application in Hong Kong	Capital Cost	Ease of Construction	Ease of Maintenance	Cost of Maintenance	Longevity	Geotechnical Advantages and Limitations	Landscape and Aesthetic Advantages and Limitations	Recommended Use
Wall facing and finishes	Variety of materials and patterns used to face retaining structures	N/A	Varies					In most cases has no effect on the engineering performance of the wall	Advantages: – can be very pleasing visually Limitations: – can be expensive	Retaining walls in areas of high visibility or country parks
Rock protection wire mesh	PVC coated galvanized twisted rhombic wire mesh	Wire mesh draped over rock slope for use as support for climbers. Not typically used for this purpose in Hong Kong	•	•	•	•	• • (?)	Advantages: – can also be used to control spalling of small rock pieces – relatively cheap and simple Limitations: – obscures slope surface from visual inspection – design life is limited due to corrosion of mesh – possible root action effects if creepers spread to rock face	Advantages: – visually interesting when used with rock slopes – approximate natural appearance Limitations: – may require some time for the affect to become established – may require particular horticultural maintenance	Recommended use on rock slopes

Table 6 - Evaluation of Hard Slope Treatments (Sheet 7 of 9)

Treatment Name	Description	Typical Slope Application in Hong Kong	Capital Cost	Ease of Construction	Ease of Maintenance	Cost of Maintenance	Longevity	Geotechnical Advantages and Limitations	Landscape and Aesthetic Advantages and Limitations	Recommended Use
Rock buttress	Concrete block cast in situ on to the rock face to provide lateral support	Commonly used on most rock slopes	• • (?)	•	•	•	• • •	Advantages: – provides localised lateral support for rock slope – can be used on any inclination of slope and formed to the desired shape in situ Limitations: – none	Advantages: – if appropriately finished can be effectively visually integrated into the slope Limitations: – introduces unnatural form and texture to the rock face	Recommend that buttresses are given an architectural finish to complement their surroundings

Table 6 - Evaluation of Hard Slope Treatments (Sheet 8 of 9)

Treatment Name	Description	Typical Slope Application in Hong Kong	Capital Cost	Ease of Construction	Ease of Maintenance	Cost of Maintenance	Longevity	Geotechnical Advantages and Limitations	Landscape and Aesthetic Advantages and Limitations	Recommended Use
Reinforced fill wall	Comprises concrete facing panels, reinforcing strips and selected backfill	Not commonly used in Hong Kong. Used to form near vertical to vertical walls	• • • (?)	• • to • • •	•	•	• • •	Advantages: – can tolerate higher differential settlements and tight curves better than conventional reinforced concrete retaining structures – permit construction on weaker materials Limitations: – land-intake required may exceed that required by other structures – corrosion of steel reinforcing elements will occur	Advantages: – visually pleasing – a variety of facings and wall geometry can be used Limitations: – can be expensive	Recommended for low to medium height slopes but where part of a landscape design can be used in areas of very high visual importance

Table 6 - Evaluation of Hard Slope Treatments (Sheet 9 of 9)

Legend:

Capital Cost (HK$ per m^2) (Note 2)	Ease of Construction	Ease of Maintenance	Cost of Maintenance (HK$ per m^1) (Note 1)	Longevity (years)
• <500	• Readily available local skill, machinery and materials	• None	• Minimal to 50	• <5
• 500 to 1000	• Readily available either local skill/machinery, skill/material or machinery/material	• Maintenance is not essential	• 50 to 150	• 5 to 50
• 1000 to 5000	• Readily available either local skill, machinery or materials	• Maintenance is essential for continued performance	• >150	• 50 to 120
• >5000	• Local skill, machinery and materials not readily available			

Notes:
(1) Based on estimated maintenance cost over 5 year period (GEO, 1999b) and costs provided by suppliers/agents.
(2) Capital cost is an estimate of the total cost of installing the product based on information provided by suppliers/agents. See Appendix E for details of cost.
(3) Details given above may change over time and the suppliers/agents should be contacted for current details.

Table 7 - Evaluation of Mixed Slope Treatments (Sheet 1 of 19)

Treatment Name	Description	Typical Slope Application in Hong Kong	Capital Cost	Ease of Construction	Ease of Maintenance	Cost of Maintenance	Longevity	Geotechnical Advantages and Limitations	Landscape and Aesthetic Advantages and Limitations	Recommended Use
Synthetic erosion control mats with hydroseeding /planting	3-dimensional polymer mat laid over seeded slope or sprayed with hydroseed/ planting	Prevention of soil erosion on vegetated slopes up to about 80°. Mats have been in use for some 15 years in HK.	•	•	•	•	• • to • • •	Advantages: – reduces surface water infiltration into slope – reduces surface soil erosion – protection of slope during vegetation establishment Limitations: – does allow some infiltration of surface water – depending on product; longevity ranges from 20 years to 200 years – laying needs to be carefully supervised to prevent erosion beneath mat	Advantages: – allows full range of planting – visually acceptable once plants have established Limitations: – laying needs to be carefully supervised to ensure mat is in contact with soil to allow germination of plants	Recommended for use on soil slopes

Table 7 - Evaluation of Mixed Slope Treatments (Sheet 2 of 19)

Treatment Name	Description	Typical Slope Application in Hong Kong	Capital Cost	Ease of Construction	Ease of Maintenance	Cost of Maintenance	Longevity	Geotechnical Advantages and Limitations	Landscape and Aesthetic Advantages and Limitations	Recommended Use
Biodegradable erosion control mat with hydroseeding/ planting	Biodegradable woven geotextile made from organic jute or coconut fibre laid over seeded slope or sprayed with hydroseed/ planted	Prevention of soil erosion on vegetated slopes up to about 45°	•	•	•	•	•	Advantages: – reduces surface water infiltration into slope – reduces surface soil erosion Limitations: – does allow some infiltration of surface water – applicable for short-term erosion control only – depending on product, longevity ranges from about 2 years to 10 years	Advantages: – allows full range of planting – visually acceptable when first laid Limitations: – restriction on plant size that can be used with it – some inhibition of grass seed germination due to lack of contact with soil or reduced light levels below matting	Recommended for use on soil slopes that are not prone to long-term soil erosion

Table 7 - Evaluation of Mixed Slope Treatments (Sheet 3 of 19)

Treatment Name	Description	Typical Slope Application in Hong Kong	Capital Cost	Ease of Construction	Ease of Maintenance	Cost of Maintenance	Longevity	Geotechnical Advantages and Limitations	Landscape and Aesthetic Advantages and Limitations	Recommended Use
Soil nailing with vegetation cover	Galvanized steel bar grouted in pre-drilled hole in slope with an anchor head at the slope face. Slope can be planted or hydroseeded	Commonly used on steep soil slopes up to about 60°	•	•	•	•	•	Advantages: – possibly reduces surface water infiltration into slope – reduces surface soil erosion – soil nailing with a vegetative cover can be used on slopes up to about 60° Limitations: – does allow some infiltration of surface water – at steeper slope angles needs to be protected against possible soil erosion by matting	Advantages: – allows a full range of hydroseeding or planting to be used Limitations: – localised plant establishment can be difficult over soil nail head	Recommended for any steep soil slope

Table 7 - Evaluation of Mixed Slope Treatments (Sheet 4 of 19)

Treatment Name	Description	Typical Slope Application in Hong Kong	Capital Cost	Ease of Construction	Ease of Maintenance	Cost of Maintenance	Longevity	Geotechnical Advantages and Limitations	Landscape and Aesthetic Advantages and Limitations	Recommended Use
Grillages	Regular arrangement of connected reinforced beams constructed on the slope surface. Slope can be planted or hydroseeded	Not commonly used in Hong Kong. Can possibly be used on steep soil slopes up to about 70°	• •	•	•	• •	• • •	Advantages: – possibly reduces surface water infiltration into slope – reduces surface soil erosion – soil nailing with a vegetative cover can possibly be used on slopes up to about 70° if nailed to slope Limitations: – does allow some infiltration of surface water – at steeper slope angles needs to be protected against possible soil erosion by matting – slope angle limited by the nail design – no past geotechnical performance data for slopes in Hong Kong	Advantages: – allows a full range of hydroseeding or planting to be used Limitations: – access difficulties for horticultural maintenance at steep slope angles	Recommended for any steep soil slope

Table 7 - Evaluation of Mixed Slope Treatments (Sheet 5 of 19)

Treatment Name	Description	Typical Slope Application in Hong Kong	Capital Cost	Ease of Construction	Ease of Maintenance	Cost of Maintenance	Longevity	Geotechnical Advantages and Limitations	Landscape and Aesthetic Advantages and Limitations	Recommended Use
Grasscrete (note 1)	Cast in situ reinforced concrete layer with voids for planting grass	Generally used for river channels but has been used on slopes. Has been used for heavy vehicular access road on hillsides. e.g. Hong Kong Electric on Lamma Island	• •	• •	•	• •	• •	Advantages: – reduces surface water infiltration – prevents soil erosion – can be used on slopes that experience concentrated surface water flow – relief of hydrostatic pressure by surface venting Limitations: – little past geotechnical performance data for slopes in Hong Kong but has been used in the Lam Tsuen River Training Scheme with no major damage	Advantages: – visually pleasing – semi natural appearance – provides a good greening effect together with surface protection – even profile allows grasscutting – can be inset in panels in shotcrete Limitations: – vegetation may die back – concrete surfacing may remain visible	Recommended for use on soil slopes but performance on steep slopes over 45^{o} needs to be tested in Hong Kong

Table 7 - Evaluation of Mixed Slope Treatments (Sheet 6 of 19)

Treatment Name	Description	Typical Slope Application in Hong Kong	Capital Cost	Ease of Construction	Ease of Maintenance	Cost of Maintenance	Longevity	Geotechnical Advantages and Limitations	Landscape and Aesthetic Advantages and Limitations	Recommended Use
Creat Toyo-Mulching (note 1)	Sprayed grass seed mix, binding agent, fertilizer and water holding agent onto plastic coated rhombic wire mesh within an anchored sprayed concrete ("Creat") grillage	Recently (1998) introduced to Hong Kong. Establishment of vegetation on steep rock or sprayed concrete slopes and landslide scars up to about 85°	•	•	•	•	•	Advantages: – reduces surface water infiltration – reduces soil erosion – can be used on steep slopes up to about 85° – can be applied onto hard slope surfacing – can be used on landslide scars Limitations: – does allow some infiltration of surface water – does not include deep or tap-rooted species which would enhance slope stability – little past geotechnical performance data for Hong Kong – watering essential for first month	Advantages: – visually pleasing – approximate natural appearance Limitations: – vegetation turns brown in dry seasons – vegetation may die back after about 5 years – Creat grillage may remain visible – vegetation only guaranteed for 5 years	Has been in use in Japan (15 years) and Taiwan (10 years). Further review and assessment is recommended in Hong Kong conditions.
			•		•		•			

Table 7 - Evaluation of Mixed Slope Treatments (Sheet 7 of 19)

Treatment Name	Description	Typical Slope Application in Hong Kong	Capital Cost	Ease of Construction	Ease of Maintenance	Cost of Maintenance	Longevity	Geotechnical Advantages and Limitations	Landscape and Aesthetic Advantages and Limitations	Recommended Use
General Toyo-Mulching (note 1)	Sprayed grass seed mix, binding agent, fertilizer and water holding agent onto plastic coated galvanized rhombic wire mesh	Recently introduced to Hong Kong. Establishment of vegetation on steep soil slopes up to about 65°	•	•	• •	•	• •	Advantages: – reduces surface water infiltration – reduces soil erosion – can be used on steep slopes up to about 65° Limitations: – does allow some infiltration of surface water – does not include deep or tap-root species which would enhance slope stability – little past geotechnical performance data for Hong Kong – must be watered for first month	Advantages: – visually pleasing – semi natural appearance Limitations: – vegetation may die back after about 5 years – requires high level of maintenance – vegetation only guaranteed for 5 years	Has been in use in Japan (25 years) and Taiwan (10 years). Further review and assessment is recommended in Hong Kong conditions.

Table 7 - Evaluation of Mixed Slope Treatments (Sheet 8 of 19)

Treatment Name	Description	Typical Slope Application in Hong Kong	Capital Cost	Ease of Construction	Ease of Maintenance	Cost of Maintenance	Longevity	Geotechnical Advantages and Limitations	Landscape and Aesthetic Advantages and Limitations	Recommended Use
Strip Toyo-Mulching (note 1)	Sprayed grass seed mix, binding agent, fertilizer and water holding agent onto plastic coated galvanized rhombic wire mesh with additional fertilizer bags	Recently (1998) introduced to Hong Kong. Establishment of vegetation on steep rock or sprayed concrete slopes up to 70° and soil slopes up to about 85°	•	•	• •	•	• •	Advantages: – reduces surface water infiltration – reduces soil erosion – can be used on steep soil slopes up to about 85° – can be applied onto hard slope surfacing up to 70° Limitations: – does allow some infiltration of surface water – does not include deep or tap-rooted species – little past geotechnical performance data for Hong Kong – watering necessary for first month	Advantages: – visually pleasing – semi natural appearance Limitations: – vegetation may die back after about 5 years – requires high level of maintenance – vegetation only guaranteed for 5 years – vegetation turns brown in dry season	Has been in use in Japan (25 years) and Taiwan (10 years). Further review and assessment is recommended in Hong Kong conditions.

Table 7 - Evaluation of Mixed Slope Treatments (Sheet 9 of 19)

Treatment Name	Description	Typical Slope Application in Hong Kong	Capital Cost	Ease of Construction	Ease of Maintenance	Cost of Maintenance	Longevity	Geotechnical Advantages and Limitations	Landscape and Aesthetic Advantages and Limitations	Recommended Use
'ON' Method (note 1)	Sprayed grass seed mix, fertilizer, resin and soil mix with Portland cement laid onto wire mesh	Establishment of vegetation on steep slopes of soil, rock and onto sprayed concrete	• •	•	•	• •	•	Advantages: – reduces surface water infiltration – reduces soil erosion – can be used on steep slopes up to about 60° Limitations: – does allow some infiltration of surface water – does not include deep or tap-rooted species – little past geotechnical performance data for Hong Kong	Advantages: – visually pleasing – approximate natural appearance – can be used to green rock surfaces Limitations: – single species dominance – grasses are not local climax vegetation – needs high levels of maintenance – long-term establishment of vegetation questionable	Though available in Hong Kong since the 1980s, it has been used only a few times. Further review and assessment is recommended in Hong Kong conditions.

Table 7 - Evaluation of Mixed Slope Treatments (Sheet 10 of 19)

Treatment Name	Description	Typical Slope Application in Hong Kong	Capital Cost	Ease of Construction	Ease of Maintenance	Cost of Maintenance	Longevity	Geotechnical Advantages and Limitations	Landscape and Aesthetic Advantages and Limitations	Recommended Use
Geogrid reinforced slope with vegetative cover	High-strength synthetic polymer geogrid	Not commonly used in Hong Kong. Used to form near vertical green wall (up to about 75°)	•	•	•	•	•	Advantages: – face can be constructed near vertical – reduces soil erosion – reduces land-take when compared to fill slope – can be used as a skin wall over existing slope/wall Limitations: – stability assessment for each slope must be undertaken	Advantages: – visually pleasing – a variety of plants can be planted – good natural appearance Limitations: – difficulties in retaining water in fill with possible vegetation die back – geogrid may remain visible	Has considerable potential for slopes that require green wall
			•	•		•	•			
							•			

Table 7 - Evaluation of Mixed Slope Treatments (Sheet 11 of 19)

Treatment Name	Description	Typical Slope Application in Hong Kong	Capital Cost	Ease of Construction	Ease of Maintenance	Cost of Maintenance	Longevity	Geotechnical Advantages and Limitations	Landscape and Aesthetic Advantages and Limitations	Recommended Use
Reinforced fill structure with facing panels	High-strength reinforcement with concrete panels (reinforced with hot-dip galvanized high adherence steel strip, facing panels stepped-back to form planters)	Not commonly used in Hong Kong. When panels are stepped-back can form near vertical wall e.g. Route 3, Tsing Yi, HK	•	•	•	•	•	Advantages: – face can be constructed near vertical – reduces soil erosion – reduces land-take when compared to fill slope – can be used as a skin wall over existing slope/wall Limitations: – requirement for watering of plants is disliked by engineers	Advantages: – visually pleasing – a variety of facing, geometry and plants can be used – can provide a visually pleasing combination of architectural and vegetation finishes Limitations: – difficulties in retaining water in fill with possible vegetation die back	Recommended for medium to high height slopes but where part of a landscape design can be used in areas of very high visual importance. Tsing Yi wall is 40m total height.
			•	•		•	•			
						(?)	•			

Table 7 - Evaluation of Mixed Slope Treatments (Sheet 12 of 19)

Treatment Name	Description	Typical Slope Application in Hong Kong	Capital Cost	Ease of Construction	Ease of Maintenance	Cost of Maintenance	Longevity	Geotechnical Advantages and Limitations	Landscape and Aesthetic Advantages and Limitations	Recommended Use
Berm planters	Longitudinal walled planters less than 1 m deep by up to about 3 m wide	Used on berms for both soil and rock cut slopes	•	•	•	•	•	Advantages: – none Limitations: – can impair access for slope inspection and maintenance – potential leaks from irrigation systems – root action causes cracking and deformation	Advantages: – can provide the only opportunity for planting on a slope – can be visually appealing when used on rock slopes Limitations: – because of harsh conditions only a limited number of plants are suitable – straight line planting appears artificial – may require sometime for the affect to become established – difficult for horticultural maintenance – die back of plants due to lack of water retention in planter	Recommended use on soil and rock slopes

Table 7 - Evaluation of Mixed Slope Treatments (Sheet 13 of 19)

Treatment Name	Description	Typical Slope Application in Hong Kong	Capital Cost	Ease of Construction	Ease of Maintenance	Cost of Maintenance	Longevity	Geotechnical Advantages and Limitations	Landscape and Aesthetic Advantages and Limitations	Recommended Use
Toe planters	Either continuous longitudinal or isolated walled planters	Where space permits, can be used at the toe of most slopes	• • (?)	•	•	• • (?)	• • •	Advantages: – none Limitations: – may impair access to toe of slope for inspection and maintenance – root action causes cracking and deformation	Advantages: – can provide the only opportunity for planting on a slope – can be used to plant trees to effectively screen lower slope Limitations: – may require sometime for the effect to become established – die back of plants due to lack of water retention in planter	Recommended use on all slopes

Table 7 - Evaluation of Mixed Slope Treatments (Sheet 14 of 19)

Treatment Name	Description	Typical Slope Application in Hong Kong	Capital Cost	Ease of Construction	Ease of Maintenance	Cost of Maintenance	Longevity	Geotechnical Advantages and Limitations	Landscape and Aesthetic Advantages and Limitations	Recommended Use
Hanging planters	Soil filled trough generally placed at mid-height on face of retaining wall	Usually used on particularly tall walls	•	•	•	•	•	Advantages: – none Limitations: – minor infiltration of water – root action causes cracking and deformation	Advantages: – can provide the only opportunity for planting on a wall Limitations: – may require sometime for the effect to become established – only suitable for small plants and climbers – die back of plants due to lack of water in pit planter	Recommended use on all tall walls

Table 7 - Evaluation of Mixed Slope Treatments (Sheet 15 of 19)

Treatment Name	Description	Typical Slope Application in Hong Kong	Capital Cost	Ease of Construction	Ease of Maintenance	Cost of Maintenance	Longevity	Geotechnical Advantages and Limitations	Landscape and Aesthetic Advantages and Limitations	Recommended Use
Surface pit planters	Generally isolated circular pit planters with a small concrete upstand within a slope surface having a hard cover	Used on slopes that have a hard cover (e.g. sprayed concrete, chunam)	•	•	•	•	• • •	Advantages: – none Limitations: – minor infiltration of water – root action causes cracking and deformation	Advantages: – can provide the only opportunity for planting on a slope Limitations: – may require some time for the effect to become established – only suitable for small plants and climbers – die back of plants due to lack of water in pit planter	Recommended use on all slopes with hard covering

Table 7 - Evaluation of Mixed Slope Treatments (Sheet 16 of 19)

Treatment Name	Description	Typical Slope Application in Hong Kong	Capital Cost	Ease of Construction	Ease of Maintenance	Cost of Maintenance	Longevity	Geotechnical Advantages and Limitations	Landscape and Aesthetic Advantages and Limitations	Recommended Use
Vegetation on rock cut slopes	Planting or hydroseeding of plants on rock cut slope	Not typically used on rock cut slopes in Hong Kong.	• (?)	• (?)	•	•	• • •	Advantages: – none Limitations: – requires the creation of a rough rock face which may require more stabilisation – potential of uprooting of trees on steep slopes – potential root action loosening rock	Advantages: – visually pleasing – good natural appearance Limitations: – may require some time for the effect to become established – rock face only suitable for small to medium plants and climbers – die back of plants due to wash-out of soil and lack of water on slope	Recommended for use on rock slopes with high visual importance

Table 7 - Evaluation of Mixed Slope Treatments (Sheet 17 of 19)

Treatment Name	Description	Typical Slope Application in Hong Kong	Capital Cost	Ease of Construction	Ease of Maintenance	Cost of Maintenance	Longevity	Geotechnical Advantages and Limitations	Landscape and Aesthetic Advantages and Limitations	Recommended Use
Vegetation on rock fill	Planting or hydroseeding of plants on rock fill	Used with an upper soil planting layer above rock fill.	• (?)	• (?)	•	•	• • •	Advantages: – none Limitations: – difficulty of retaining soil on rock fill – geotextile membrane above rock will help to retain soil but will create a possible plane of instability – distress may be masked	Advantages: – visually pleasing – good natural appearance – natural appearance can be achieved Limitations: – may require some time for the effect to become established – die back of plants due to wash-out of soil and lack of water on slope	Recommended for use on rock fills with high visual importance but geotechnical limitations must be borne in mind.
Street Trees	Trees planted in pits adjacent to the toe of the slope to screen the slope	Occasionally used where space permits instead of a toe planter	•	•	•	•	• •	Advantages: – none Limitations: – none	Advantages: – provides a screening of the slope Limitations: – may require some time for the effect to become established	Recommended for slopes where landscaping of the slope is not possible.

Table 7 - Evaluation of Mixed Slope Treatments (Sheet 18 of 19)

Treatment Name	Description	Typical Slope Application in Hong Kong	Capital Cost	Ease of Construction	Ease of Maintenance	Cost of Maintenance	Longevity	Geotechnical Advantages and Limitations	Landscape and Aesthetic Advantages and Limitations	Recommended Use
Tree rings	Concrete ring generally formed of sprayed concrete to retain existing mature trees on hard surfaced slopes	Used on all slopes with hard surfacing up to slope angles approaching vertical	•	•	•	•	• • •	Advantages: – none Limitations: – continued growth of tree roots can cause surface cover to deteriorate	Advantages: – retention of mature trees as possibly the only greening effect on a slope Limitations: – few isolated tree rings have a limited effect on reducing the visual impact	Recommended for all hard surfaced slopes with existing mature trees

Table 7 - Evaluation of Mixed Slope Treatments (Sheet 19 of 19)

Legend:

Capital Cost (HK$ per m^2) (Note 3)	Ease of Construction	Ease of Maintenance	Cost of Maintenance (HK$ per m^2) (Note 2)	Longevity (years)
• <500	• Readily available local skill, machinery and materials	• None	• Minimal to 50	• <5
• 500 to 1000	• Readily available either local skill/machinery, skill/material or machinery/material	• Maintenance is not essential	• 50 to 150	• 5 to 50
• 1000 to 5000	• Readily available either local skill, machinery or materials	• Maintenance is essential for continued performance	• >150	• 50 to 120
• >5000	• Local skill, machinery and materials not readily available			

Notes:
(1) Product is covered by patents and the local agent should be contacted.
(2) Based on estimated maintenance cost over 5 year period (GEO, 1999b) and costs provided by suppliers/agents.
(3) Capital cost is an estimate based on information provided by suppliers/agents.

Table 8 - Effects of Site Characteristics

Requirement	Characteristic	Effect
Soil	Physical composition	– the degree of structural support that can be derived – water holding capacity – availability of oxygen (soil air pockets) and ability of plants to take up oxygen through their roots
	Chemical composition	– nutrient availability
	pH and salinity	– nutrient up take
Light	Sunlight	– light requirements for photosynthesis
Air	Wind	– the rate at which plants lose water through their leaves (evapo-transpiration)
	Exposure	– the rate at which plants lose water through their leaves (evapo-transpiration)
	Quality	– maintains healthy plant. Degeneration of plant health due to the effects of airborne particulate and chemical pollution

Table 9 - Typical Maintenance Operations during 12-month Establishment Period

Maintenance Operation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
General Inspection including check for insect, virus and fungal attack	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Litter collection	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Weeding			✓	✓	✓	✓	✓	✓	✓	✓		
Replacement planting				✓	✓	✓	✓					
Pruning			✓					✓				
Grass cutting				✓					✓			
Fertilising				✓								
Aeration / Mulching				✓								
Staking & tying				✓								

Legend:

✓ timing of operation

Table 10 - Long Term Maintenance of Grass/Groundcover Vegetation

Maintenance Operation	Frequency
General Inspection	once a year
Inspection for fungal/viral attacks and pest infestations, and treatment as necessary	as required
Repair after fire damage	as required
Clearance of litter	as required
Grass cutting/groundcover trimming and removal of arisings	twice a year
Clearance of drainage channels	once a year

Table 11 - Long Term Maintenance of Native Woodland Vegetation

Maintenance Operation	Frequency
General Inspection	once a year
Clearance of litter	once a year
Grass cutting/groundcover trimming and removal of arisings	twice a year until year five
Clearance of drainage channels	once a year
Inspection for fungal/viral attacks and pest infestations, and treatment as necessary	as required
Replacement of plants after typhoon/fire damage	as required
Thinning of exotic species (timing to be adjusted to suit specific site conditions)	50% in Year 5 50% in Year 10

Table 12 - Capital Cost and Tentative Maximum Slope Angle for Selected Vegetative Treatments

Range of Estimated Capital Cost (HK$ per m^2) (note 5)	Vegetative Technique (note 6)	Tentative Maximum Slope Angle (degrees)
<500	Turfing	15
	Hydroseeding	45
	Planting	45
	Hydroseeding with biodegradable ECM (note 8)	45
	Hydroseeding with synthetic ECM (note 8)	55
	Vetiver (note 2)	60
	Rock-Grass System (notes 1, 2)	70
	General Toyo-Mulching (notes 1, 2)	70
	Strip Toyo-Mulching (notes 1, 2)	85
500 to 1000	Grassguard (notes 1, 2)	45
	Grasscrete (notes 1, 4)	45
	'ON' Method (notes 1, 2)	60
	Green Terramesh (notes 1, 2)	70
	Grillage (note 3)	70
	Soil Panel (notes 2, 3)	70
	Geogrid reinforced slope (notes 7)	80
	"Creat" Toyo-Mulching (notes 1, 2)	85
> 1000	Textomur for Nailing (notes 2, 3)	70

Notes:
(1) Based on manufacturer's recommendation.
(2) Technique not yet used or seldom used in Hong Kong.
(3) Used in combination with soil nails with assumed maximum slope angle of 70°.
(4) According to manufacturer, product can be used at steeper angle with minor modifications.
(5) Capital cost is the estimated cost of installation as supplied by the product manufacturers in 1999.
(6) For details of application refer to manufacturer's guide.
(7) Used to construct a reinforced fill block on the face/toe of slope.
(8) ECM: erosion control mat.

Table 13 - Record of Trials

Subject	Trial of :	Location	Parties (Client / Organiser)	Date	Notes
Native tree species establishment	• different species • plant spacing • soil materials	SENT Landfill	Green Valley Landfill Ltd / Urbis Limited & Baptist University	1997 – on going	Information not published
Native tree species establishment	• different species • soil ameliorates	Shek O Quarry	Shek O Quarry Ltd / ACLA, Urbis Limited, Golden Ace	1991 – on going	Information not published
Native species establishment	• different species • planting technique	various	Highways Department	on going	Information not published
Proprietary products and techniques	• ON Method • grasscrete • various erosion control mats • coloured sprayed concrete with creepers	various, Lion Rock Reservoir	LPM Branch GEO	1990 – 1999	Reported in ' Use of Vegetation as surface protection on slopes' (January 1999)
Proprietary products and techniques	• Vetiver Grass		Jockey Club Research & Information Centre for Landslip Prevention and Land Development		
Native species establishment	• factors affecting establishment of survival of four native species	various	HKU	1992 – 1994	"The Ecology of Fire in HK", PhD Thesis (1994)
Native species establishment	• early survival of ten native tree species on hillsides	various	HKU	1991 – 1993	"Forest Succession in HK", PhD Thesis (1993)
Native species establishment	• propagation of native tree and shrub species	KFBG	Kadoorie Farm & Botanic Garden	1998 – 2000	Not reported

Note: General Requirements of all trials

- Development of trial hypothesis/methodology/monitoring regime.
- Identification of potential trial sites.
- Detailed design and contract documentation of physical works.
- Monitoring and reporting.

LIST OF FIGURES

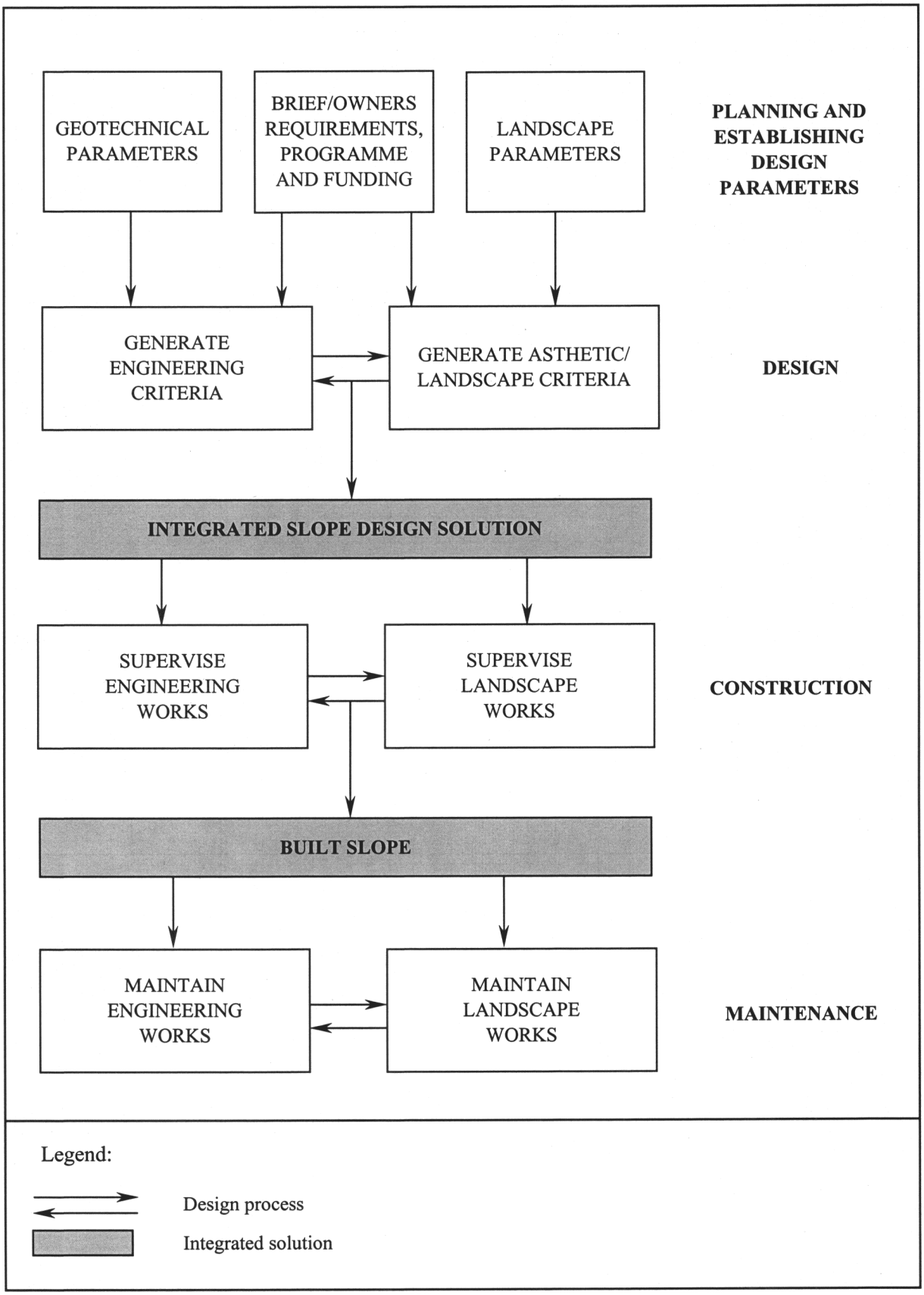
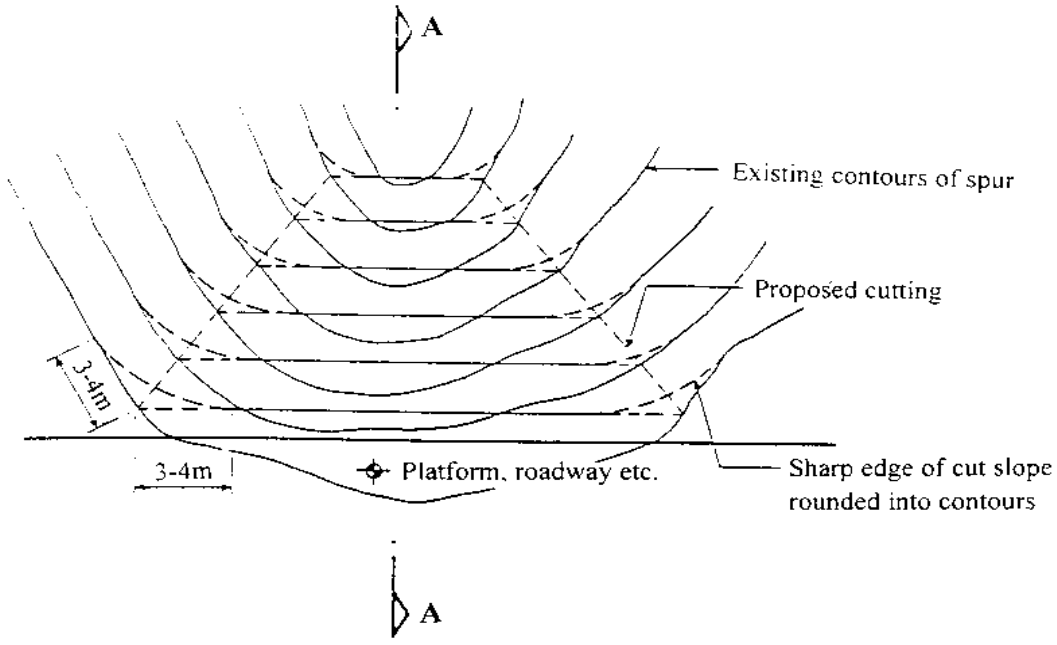
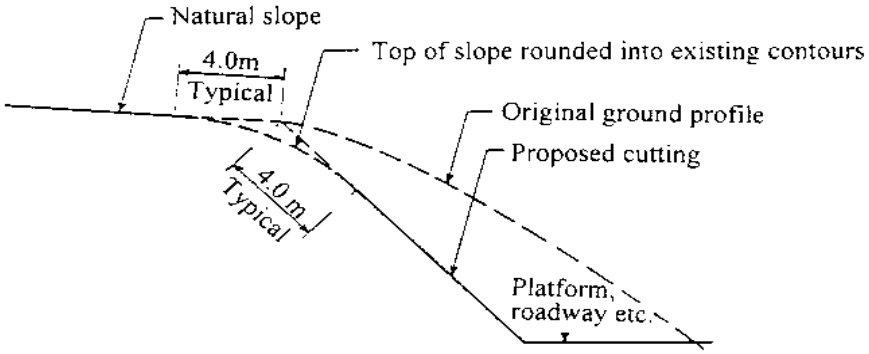


Figure 1 - Integration of Geotechnical and Landscape Design into the Slope Design, Construction and Maintenance Process



Plan



Section A - A

Figure 2 - Typical Details for Rolling and Stepping Back a Cut Slope (CED, 1994)

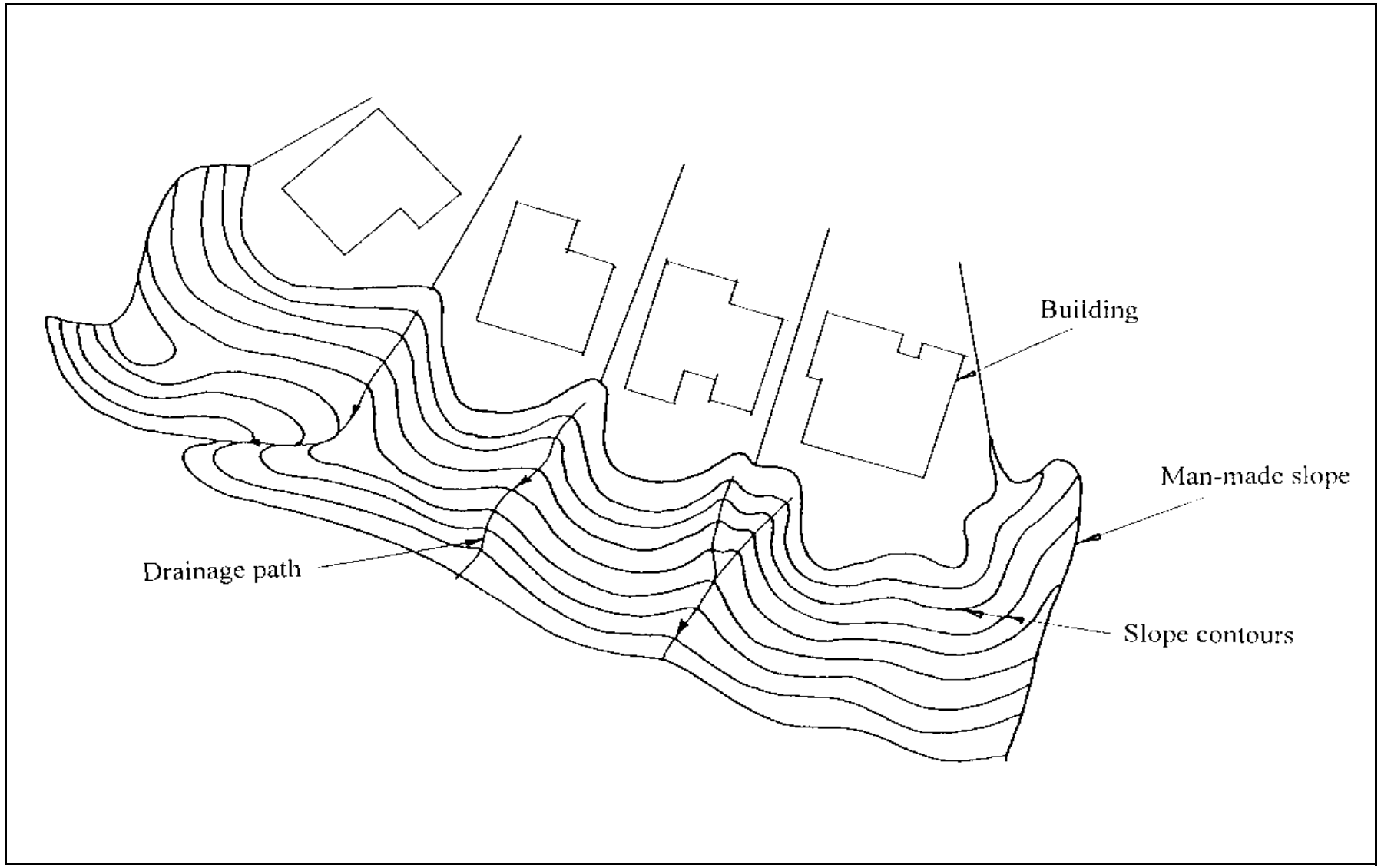


Figure 3 - Landform Slope Geometry Configuration (based on Shor & Gray (1995))

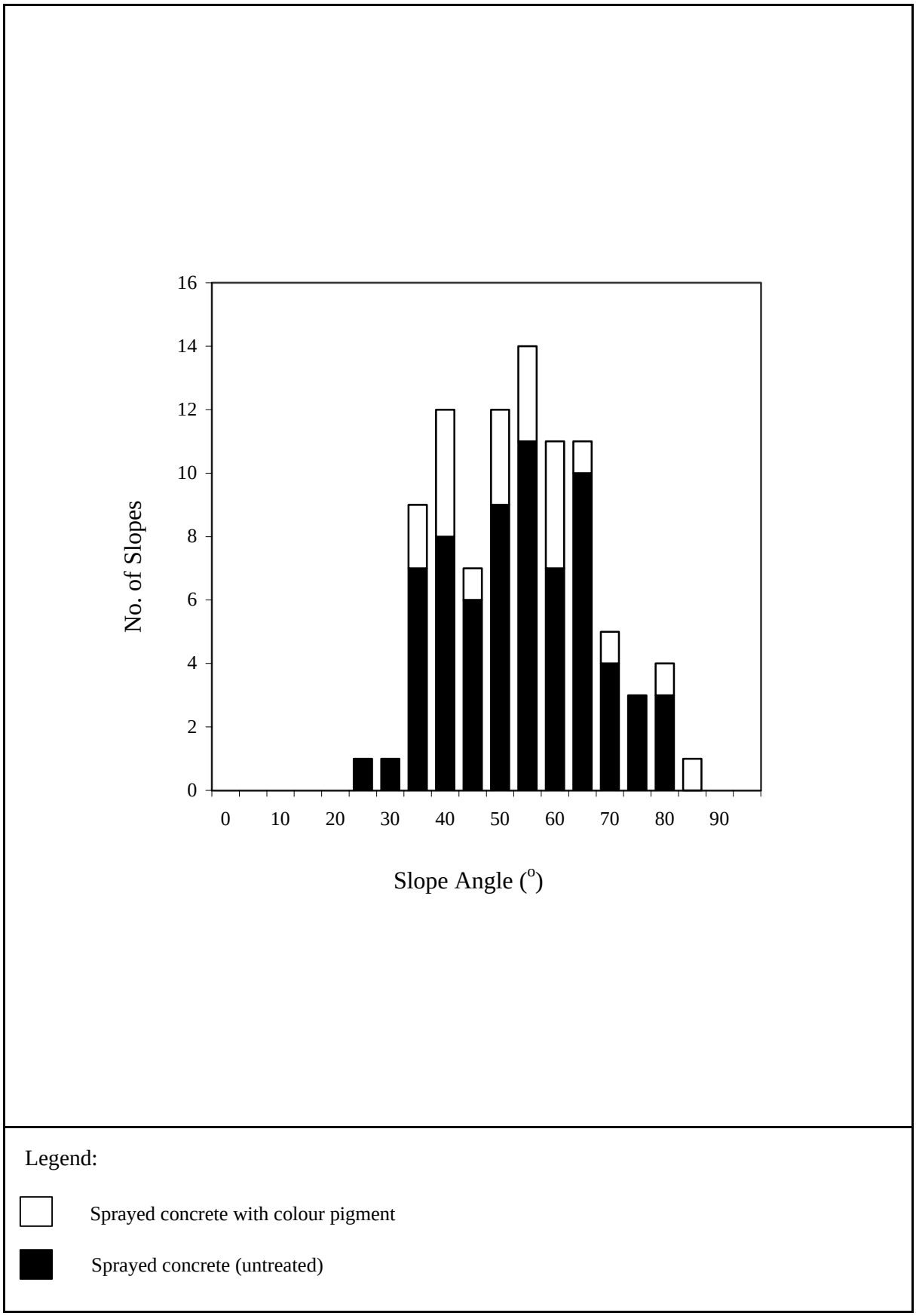
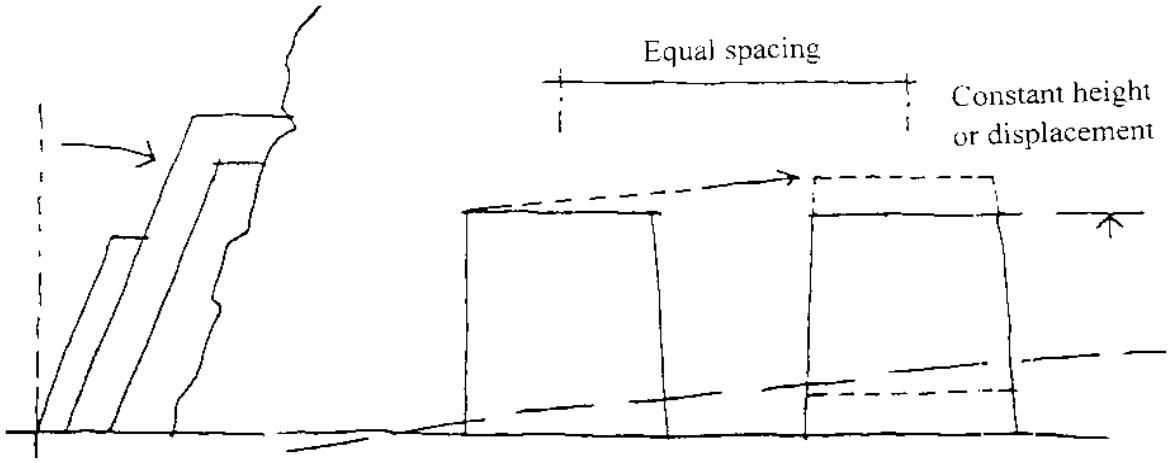


Figure 4 - Histogram of Slopes with Sprayed Concrete Covering against Slope Angle

Key objectives - to make buttresses look part of a considered, co-ordinated family of elements, and to minimise their visual impact by reducing contrast with surrounding elements.



- consistent height, width, spacing
- even displacement with an inclined base level
- inclined in section rather than vertical to give a more relaxed appearance
- very high buttress features to be stepped to give them an appropriate scale and proportion
- for individual buttresses proportion of height to width at (3 to 1) or (3 to2)
- design to be co-ordinated with toe planters

- surface finish to match surrounding rock/landscape e.g. (1) coloured/painted finish, (2) masonry facing
- consider bevelled corners/edges for 'softer' appearance
- no fines concrete has more texture/darker tone which can be visually appealing
- single large buttress preferred to many small ones
- mid-slope buttresses (not in contact with ground level) will appear unstable and should be avoided

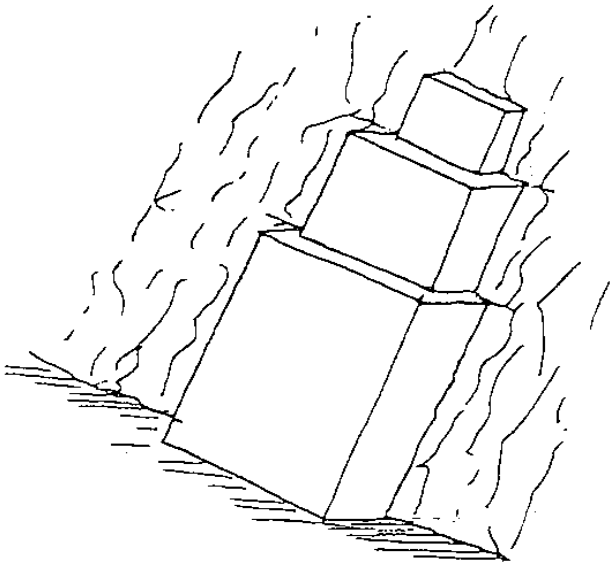


Figure 5 - Treatment of Buttresses