NATURE BASED LANDSLIDE MITIGATION IN FOREST RESERVES

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Soil bioengineering is one of the main techniques used to stabilize unstable slopes incorporating the use of vegetation along with or without the engineering structures. This study identifies the effect of *Bambusa vulgaris* (Bamboo) in stabilizing critical slopes in two stages.

In the first stage, the slope is stabilized by bamboo stems by anchoring the soil while the tensile strength, shear strength, pullout resistance, diameter of the stem, and anchorage length are key parameters in achieving the required factor of safety (FoS).

In the second stage, the slope is stabilized by bamboo roots due to an increase in the cohesion of the soil. Root properties such as the tensile strength of the roots and root area ratio are the key factors in the second stage.

In the initial stage, the stem will act as an anchor and with time, bamboo bud starts to grow and soil cohesion will increase. This situation will lead to a stable slope. As time passes, the strength gained from bamboo stems becomes weak and soil cohesion is increased by bamboo roots in stabilizing a slope.

A parametric analysis was done to obtain the (FoS) for different slope angles of 30°,45°,60° and 75°, with internal friction angles of 15°,20°,25°,30° and 35°, and cohesion of 0,5,10,15,20 and 25 kPa while the slope heights for 5 m and 10 m using Bishop's Limit Equilibrium Analysis in GeoStudio Slope/W. The water table is a critical factor when considering slope stabilization. The stability of a slope decreases with the increase of the water table due to the increment of pore water pressure inside the soil. Therefore, in this analysis, a higher water table was used for a conservative analysis.

Finally, critical and safe slope angles were obtained for each combination of geotechnical parameters, where the critical slope angle is the maximum slope angle that can marginally withstand when the FoS is 1. The safe slope angle is the maximum slope angle that can safely withstand under specified geotechnical parameters when the FoS is 1.2.

Keywords: Slope stability, Bamboo, Cohesion, Critical slope angle, Safe slope angle

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To reduce the landslide risk in forest reserves using vegetation as a nature based method

Bambusa Vulgaris (Bamboo) was selected as vegetation

- High vegetative propagation ability
- Rapid growing ability
- High flexibility
- High tensile strength of bamboo stem

Stage 1 – Stabilize the slope using bamboo anchors

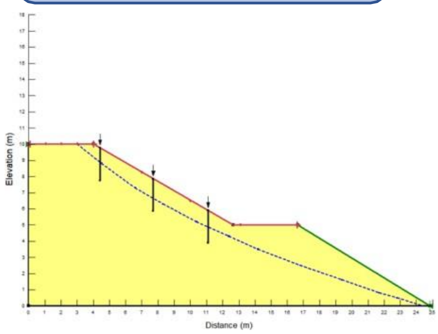

Figure 1 - Idealized model

H = 10 m (Safe) - Stage 1		Friction Angle				
		ϕ=15°	ϕ=20°	ϕ=25°	ϕ=30°	ϕ=35°
Cohesion (kPa)	5	30	30	30	36	42
	10	30	30	36	43	49
	15	30	36	43	50	56
	20	40	48	53	58	75
	25	75	75	75	75	75

Table 1 - Variation of safe slope angles for stage 1 for selected geotechnical parameters

Stage 2 – Stabilize the slope using bamboo roots

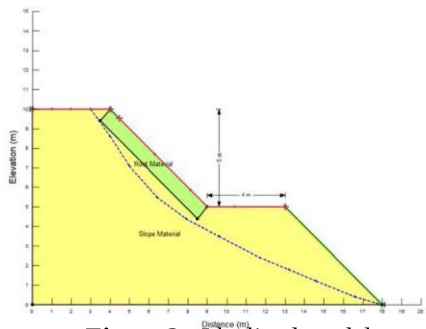

Figure 2 - Idealized model

H = 10 m (Safe) - Stage 2		Friction Angle				
		ϕ=15°	ϕ=20°	ϕ=25°	ϕ=30°	ϕ=35°
Cohesion (kPa)	5	30	30	30	37	43
	10	30	30	37	45	52
	15	30	38	46	53	59
	20	38	48	56	64	75
	25	55	75	75	75	75

Table 2 - Variation of safe slope angles for stage 2 for selected geotechnical parameters

Since, both stages are combined together, minimum angles from stage 1 and stage 2 have been taken to plot the final graph