VETIVER SYSTEM TECHNOLOGY FOR INFRASTRUCTURE STABILISATION

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INTRODUCTION

• The Vetiver System (VS) is was first developed by the World Bank for soil and water conservation and now being used in over 100 countries for various applications.

• R&D conducted in several countries showed that vetiver grass is tolerant to the most adverse soil and climatic conditions, such as drought and flood.

• Due to the above features VS has been used successfully for soil erosion and sediment conservation and, infrastructure in Australia, Africa, Asia, North and South America and southern Europe.
SPECIAL MORPHOLOGICAL AND PHYSIOLOGICAL FEATURES OF VETIVER GRASS

Stiff and erect stems up to 2m tall and over 2.5m with flower head. It flowers but setting no seeds.
Forming a thick hedge when planted in row which can spread and slow down runoff water
DEEP, EXTENSIVE AND PENETRATING ROOT SYSTEM

China: One year old with 3.3m deep root system

Vietnam: Agriculture & Forestry University, Saigon
Soil stabilization mechanism by vetiver grass

Vetiver hedgerows

Vetiver roots

Slipping zone on slopes usually 0~2 m depths
These roots are strong enough to stop the slide and the concrete path is cracked.
Options for Slope Protection:

1. Hard structures
2. Combination of hard and soft bioengineering including geofabrics
3. Bioengineering alone including geofabrics on erodible soil
Asep Sunandar and Nanny Kusminingrum of the Indonesian Institute of Road Engineering (IRE) conducted a series of experiments with slopes ranging from 30° to 80°.

Soil Type: Silty Clay Loam, Stability Index: Unstable, 3 Month Old, West Java

Soil Type: Dusty Clay, Stability Index: Unstable, 3 Month Old, West Java
Soil Type: Clay Loam, Stability Index: Stable, 4 Month Old, Nagreg West Java

Slope 80°, Age: 4 months
Before trimming

Slope 80°, Age: 4 months
After trimming
Indonesian Institute of Road Engineering (IRE)
Trial comparing 3 Vetiver planting densities, Bahia grass and bare slope at Nagreg West Java
Bahia grass

Vetiver

Vetiver planted at 3 densities
Very steep, 80° slope on highly erodible red volcanic soil
CONCLUSION

- Vetiver system can be used effectively to control surface erosion and shallow failure of road batter

- Vetiver system can be used effectively at slope between $30^\circ - 60^\circ$

- Vetiver system could be applied by road authorities to cope with erosion and shallow failure of road slope

- At road slope $>60^\circ$, vetiver technology is not recommended to be applied solely (must combined with geotextiles and/or mechanical methods)
Based on the above technical data, vetiver system has been used very effectively in stabilising extreme and highly erodible slopes around the world.

The following photos show successful applications of VS on extreme slopes:

- Without Geofabrics and
- With Geofabrics
Without Geofabrics: BRAZIL Road Batters
Without Geofabrics: CHINA Zhejiang Province

National Highway 330 on slope area of 10 600m² to prevent landslides
Without Geofabrics
COLOMBIA
Construction site
Without Geofabrics
COLOMBIA
Construction site

Hydromulch
Vetiver
Without Geofabrics: INDONESIA East Java

Before: Slope length: 300m, height: 14m

1 month: Regular trimming

2.5 months: 4 months

Regular trimmings after 4 months
Without Geofabrics: INDIA Assam, Doria Bridge

PC S Bhattacharyya
For this project the Chinese imported 1 million plants by Jumbo jet to the Congo.
Without Geofabrics: Dam wall Protection

Australia

South Africa

China
Without Geofabrics: Highway batters

THAILAND Central Highlands

PC S Sanguankaeo
MADAGASCAR: RIO TINTO Erosion control on access road to Ilminite sand mines

Sand dunes
Sand dunes
One year later
Without Geofabrics: VENEZUELA Road Batters
Without Geofabrics: VIETNAM Ho Chi Minh Highway

The best trial, where the first, the President. It is lucky because stable, though still having pr
Ho Chi Minh Highway – Central Vietnam
Highly erodible sandy soil with gradient up to 50o at some sections.
Vetiver planting
Six months after planting
With Geofabrics: BRAZIL Road Batters
With Geofabrics: GUATEMALA

Batters on 72º slope with geofabrics
With Geofabrics: GUINEA (West Africa): Road Batters

Still stable after 8 years
On 60°-70° vertical slope using Green TerraMesh walls at Selembao Kinshasa.
With Soil Nails: COLOMBIA: Medellin

Ten months after planting
Some Instruments Used on these Extreme Slopes

This Australian “Hole puncher” is mounted on a backhoe to make holes for vetiver planting on the steep wall.
Ladder, Portable Drill and Strong Hands in GUINEA (West Africa)
CONCLUSION

- Vetiver System Technology (VST) can be used effectively to control surface erosion and shallow failure of road batter at slope between $30^\circ - 60^\circ$.

- At road slope $>60^\circ$, VST is not recommended to be applied solely (must combined with geotextiles and/or mechanical methods).

- To achieve successful application, VST has to be implemented correctly and professionally.

- The layout design varies with slope gradient, cut or fill slope, soil types, rainfall of a particular site.

- From this information, the VST specialist will decide on whether the site needs geofrfrabrics, hydromulching and other measures.

- *Failure of VST is most likely due to incorrect and unprofessional implementation.*
REFERENCES

Mining Rehabilitation
- **Roley Noffke**: Mine and associated rehabilitation projects in Africa and Indian Ocean Islands
  