

*Engineered Solution Provider in Geosynthetics*



**GARWARE-WALL ROPES LTD.**

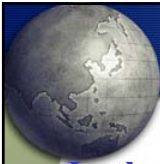
**GEOSYNTHETICS DIVISION**

## **CIVIL ENGINEERING APPLICATIONS OF GEOTEXTILES AND GEOSYNTHETICS**

By

**M. Venkataraman**

**20<sup>th</sup> March 2009**



## **NEW CHALLENGES**



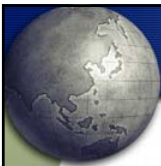
**In the recent years, while providing a solution, the  
Engineer has to face increased challenges like**

- **Various site constraints like space, alignments etc.**
- **Tight time schedules**
- **Ensure max. usage of local resources (Material & Manpower), hence Cost effective!!**
- **Least environment impact**
- **Long term performance & higher Cost benefit ratio over a larger period of time (Least maintenance cost)**



## SOLUTION !!!

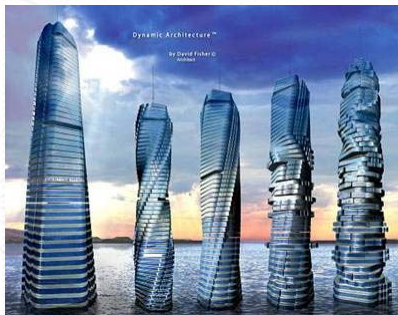
USE OF PROPER **GEOSYNTHETIC MATERIALS**  
OFFERS THE POSSIBILITY TO SOLVE OR  
DRASTICALLY REDUCE THE PROBLEMS



## GEOSYNTHETICS


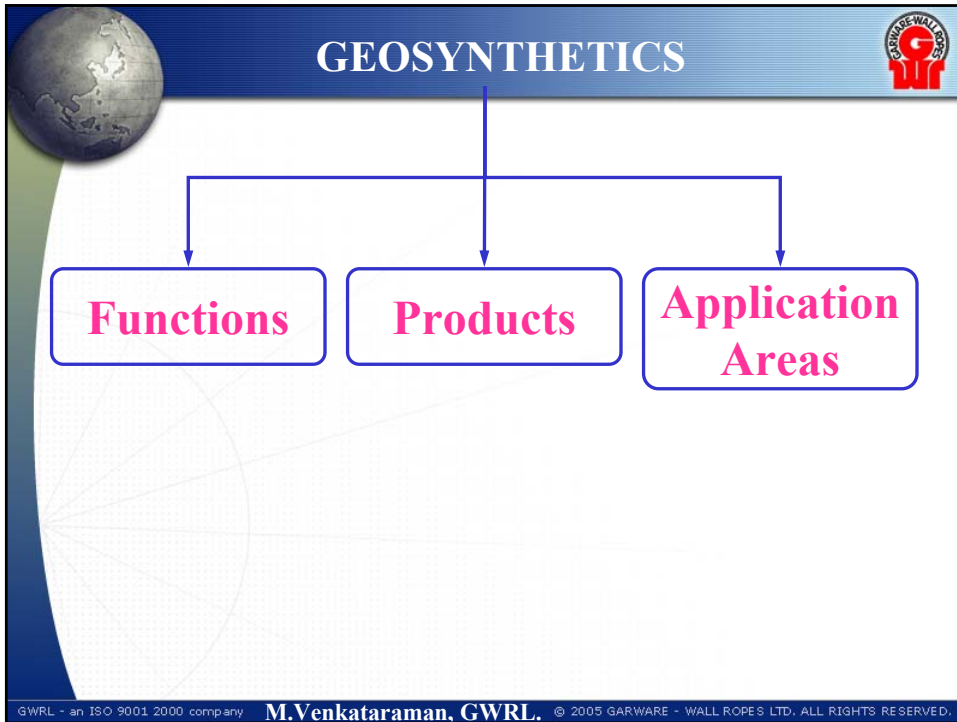


### CONCRETE & STEEL




### GEOSYNTHETICS






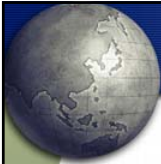
## FUNCTIONS OF GEOSYNTHETICS



- **Separation**
- **Filtration**
- **Reinforcement**
- **Drainage**
- **Containment**



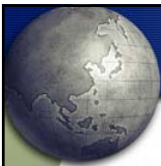
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# Geosynthetic Products



- **Polymer Rope & Steel Gabions and Mattresses**
- **Polymer Rope Boulder Nets**
- **Steel Wire Rope Boulder Nets**
- **Woven Multifilament Geotextiles**
- **Prefabricated Vertical Drains**
- **Geomat (Mulchmat)**
- **Anco Drain**



# Geosynthetic Products



- **Geogrids**
- **Nonwoven Geotextiles**
- **HDPE Geomembranes**
- **Geosynthetic Clay Liners**
- **Geonets**
- **Geocomposites**





# Geosynthetic Products



## Gabions

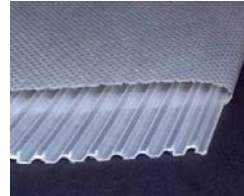
Steel Wire



Polymer Rope



PVD



GARMAT



Boulder Net



Anco Drain



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# Geosynthetic Products



## Geogrids

(Uniaxial & Biaxial)



## Geotextiles

Nonwoven



Woven



Geonet



Geosynthetic  
Clay Liners

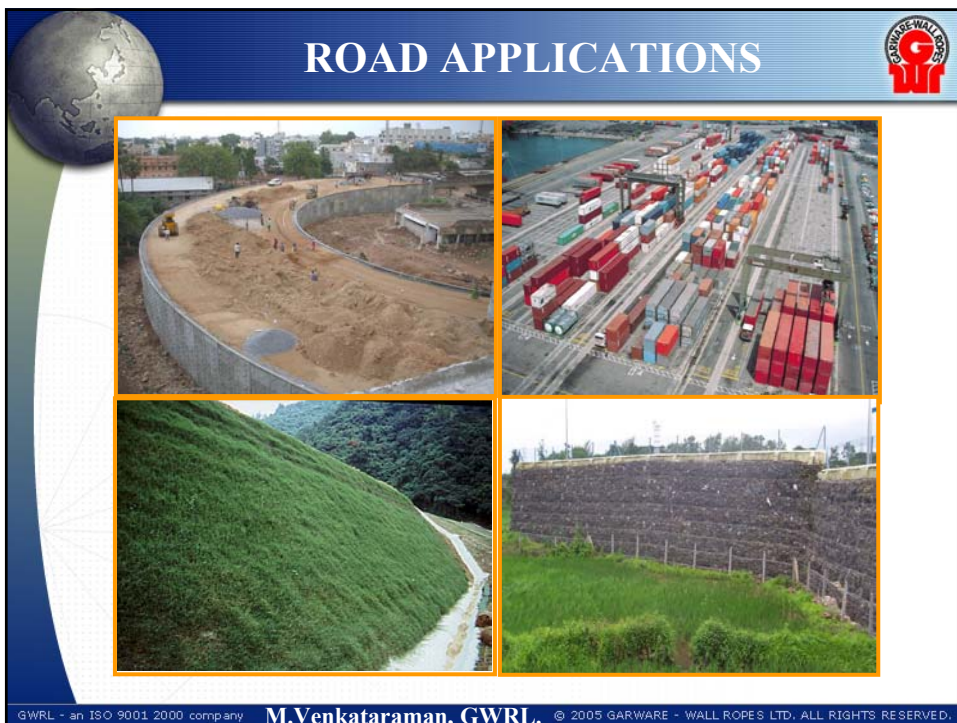
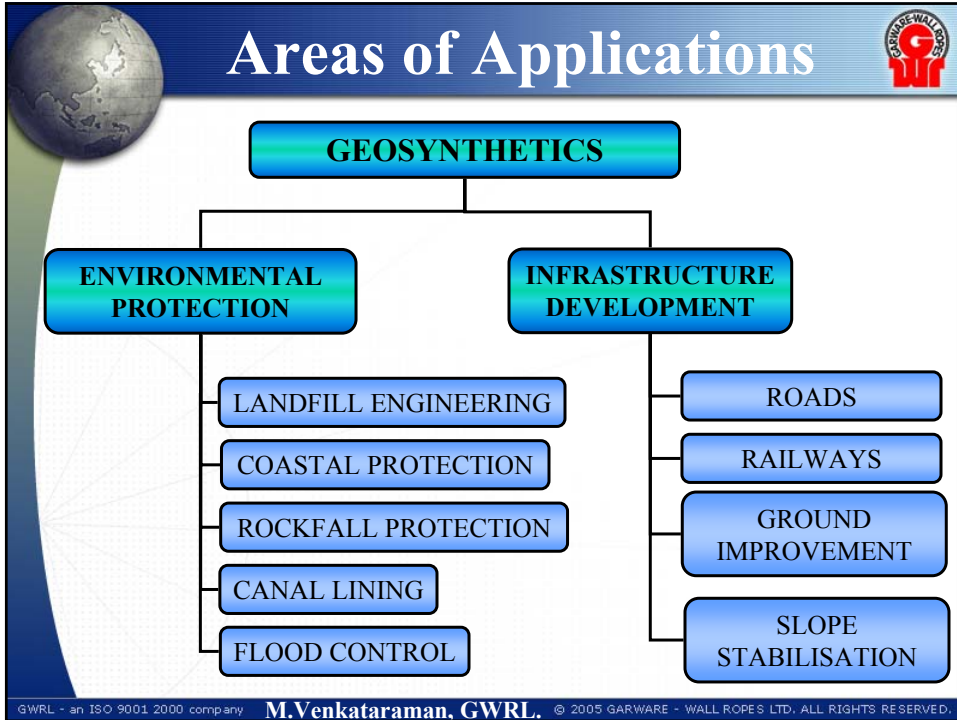


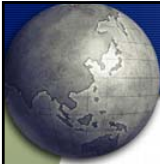
Geomembranes



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## ROAD APPLICATIONS



### REINFORCED SOIL WALLS (RSW)



## REINFORCED SOIL WALL SYSTEMS

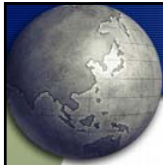


### With Steel strip reinforcement

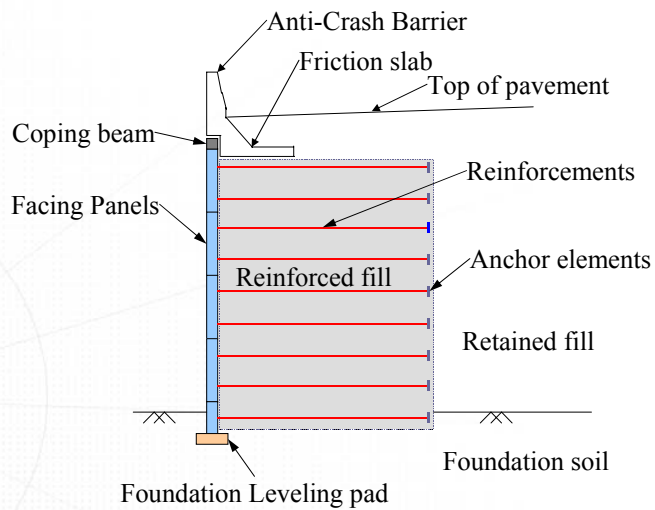
- Inextensible system
- Galvanised metallic strips with galvanised metallic anchors elements
- Discrete panels.

### With Geogrid Reinforcement

- Extensible system
- Geogrid
- Discrete panels / Full Height panels / segmental blocks



# Steel Strip Reinforcements



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## TYPES OF FACING



### Discrete Panels



### Full Height Panel



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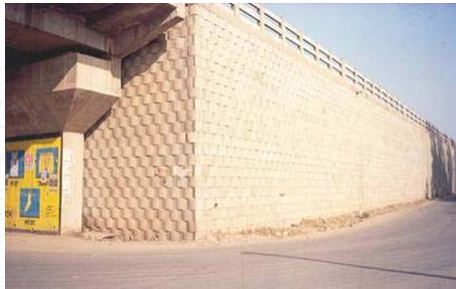
## TYPES OF FACING



**Wrap Around**



**Vegetative face**

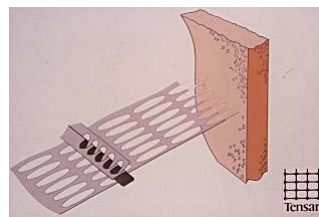


**Segmental Blocks**

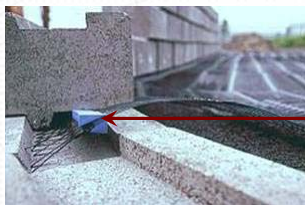
## RSW WITH GEOGRIDS



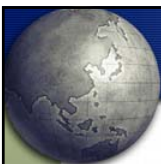
**Segmental Blocks**



**Bodkin Joint**



**Connectors**



## ADVANTAGES OF RSW



- Occupies very Less space (Right-of-Way)
- Less site preparation and minimum excavation
- Simple and rapid construction
- Flexible to withstand diff. Settlements
- Better Seismic resistance
- Minimal maintenance during service life
- Cost effective



## ERECTION OF PANELS & ANCHORS





## SOIL FILLING & COMPACTION



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## Case Histories



With precast panels

Hyderabad



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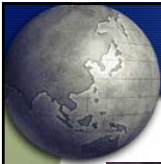


## PRECAST PANEL FACING



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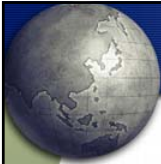
## RSW –Segmental Block Facing



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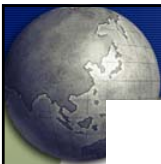




## RSW – FULL HEIGHT PANEL



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## RSW – FULL HEIGHT PANEL



### CSEB - Korba



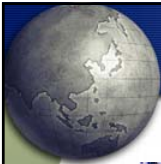
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## FULL HEIGHT PANEL – ADVANTAGES

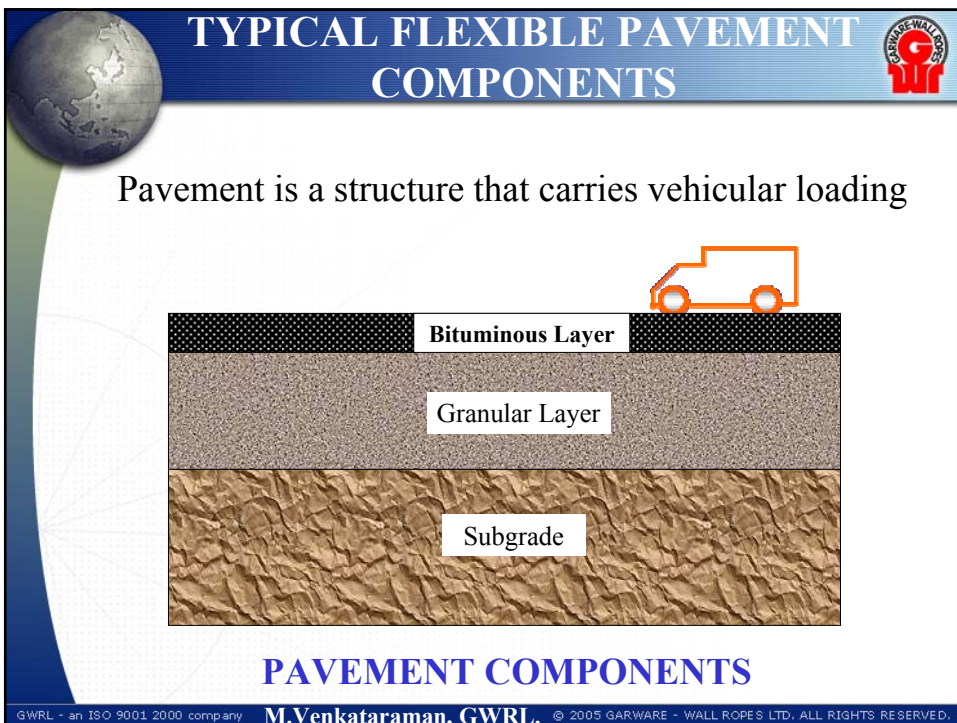


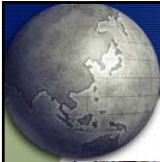
- Faster installation allowing faster construction
- Perfect alignment –
  - Less number of vertical joints hence possibility of less errors and defects
  - Easier to maintain the alignment of a full height panel than a segmental block or discrete panels
- Machinery will be required for limited period saving on the construction costs.
- Compaction movement are minimal with full height panels.



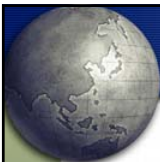
## RSW WITH GABION FACIA KPCL - BELLARY







...but we come across weak sub-soil !

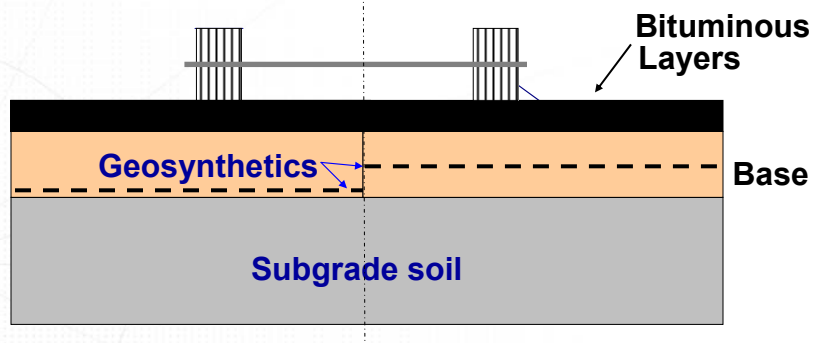


## STABILIZATION

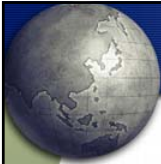


### 1. Subgrade Improvement

### 2. Base Reinforcement







## SUB-BASE APPLICATIONS



Before Reinforcement

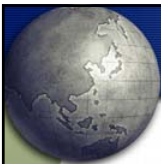


After Tensar Reinforcement

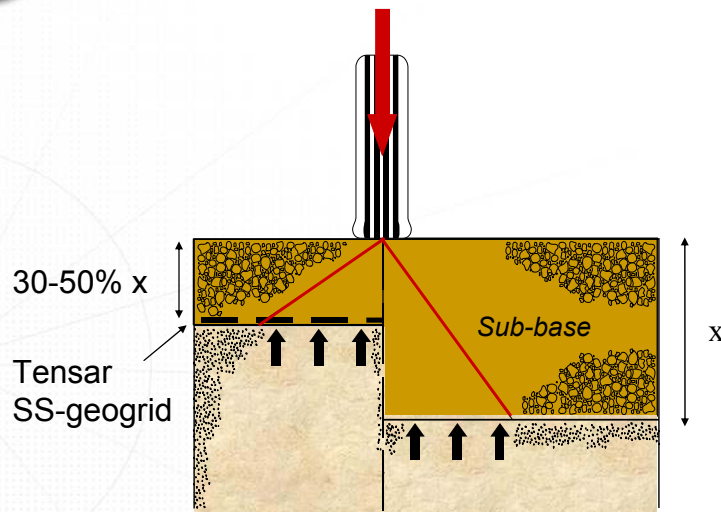
### Improvement of Bearing Capacity

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### 3. Reduction in Granular Layer Thickness :

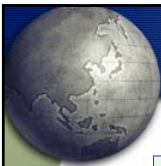
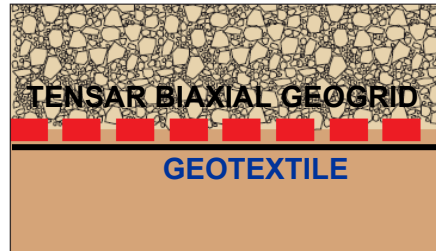
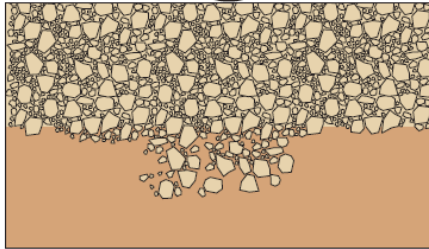


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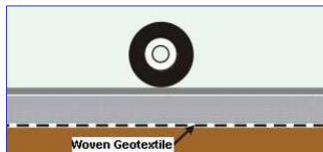
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#### 4. Prevention of Aggregate Penetration & Mud Pumping



#### WOVEN GEOTEXTILE IN ROADS

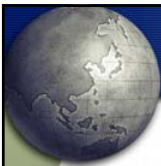




## RIVER / SHORE PROTECTION WORKS

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## RIVER / SHORE PROTECTION – PRODUCTS



- Steel Gabions
- Polymer Rope Gabions
- High Strength Woven Geotextile
- Geotextile bags
- Geotextile tubes



GWRL - an ISO 9001:2000 company

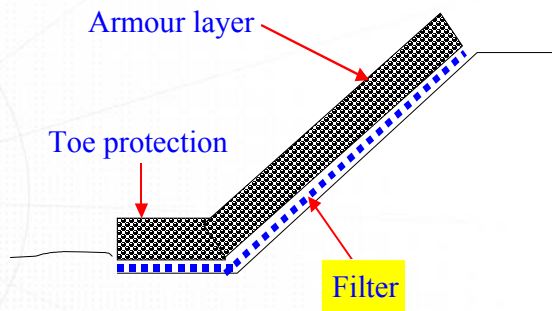
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## RIVER / SHORE PROTECTION – FUNCTIONS



1. Shore Protection
2. Beach nourishment
3. Bank Protection
4. River Beautification



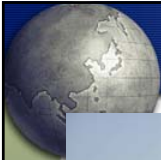
## ADVANTAGES



### CONVENTIONAL VS. GEOSYNTHETICS

Masonry & Concrete Structures	Geosynthetics Structures
Rigid nature	Flexible nature
Non porous (Pore pressure builds up)	Porous (Pore pressures are dissipated immediately)
Materials brought from far away	Locally available material
Costlier	Economical and easier installation
	Technically efficient





## SMC - BARIMATHA



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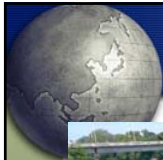


## SMC - RANDER



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## PCMC – MULA RIVER



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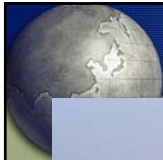
## ANTI EROSION SEA BUND MORBHAGWA, GUJARAT



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## NARMADA RIVER - MADHI



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## SEA WALL – THERONDA, ALIBAUG



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## SEA WALL



Swaminarayan Temple in Gujarat, India.



**Present Condition**

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## TEESTA DIVERSION CHANNEL



A very cost effective alternative to rip rap stones in concrete ribs, by using Geotextile bags filled with local soil as fill in Gabion Mattress.

Entire 760m lining (approx. 75,000 Sq.m) completed in 42 Days!!!

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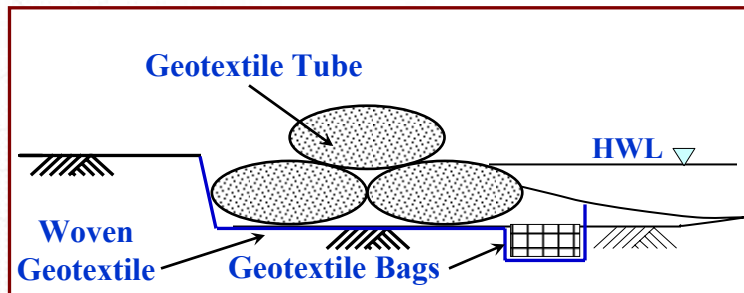
# SHANKARPUR TO HALDA, WEST BENGAL



## PROBLEM

- Severe erosion due to Waves , 1m high
- Vertical Cuts, 4 m deep
- Damage to public property along the coastal line

## SOLUTION



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# SHANKARPUR TO HALDA, WEST BENGAL



INSTALLATION – GEOTEXTILE TUBE

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## SHANKARPUR TO HALDA, WEST BENGAL



## SUBMERGED GEOTEXTILE TUBE DYKE



### HALDIA DOCK YARD, WEST BENGAL

#### PROBLEM

- Silting of Navigation Channel
- Frequent Dredging


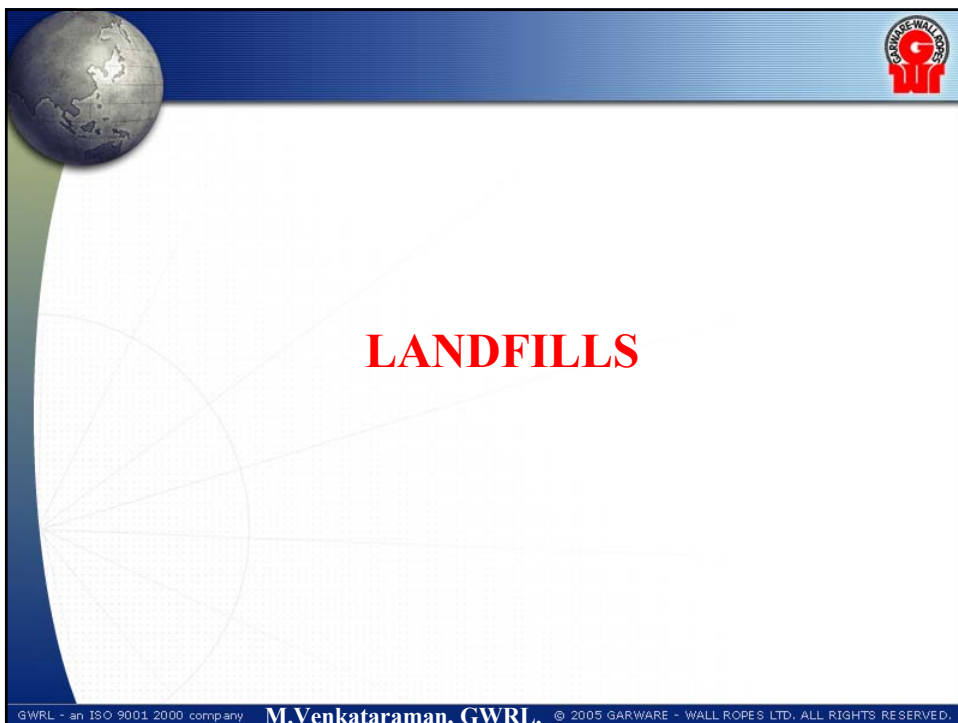
#### SOLUTION

**Submerged Dyke**



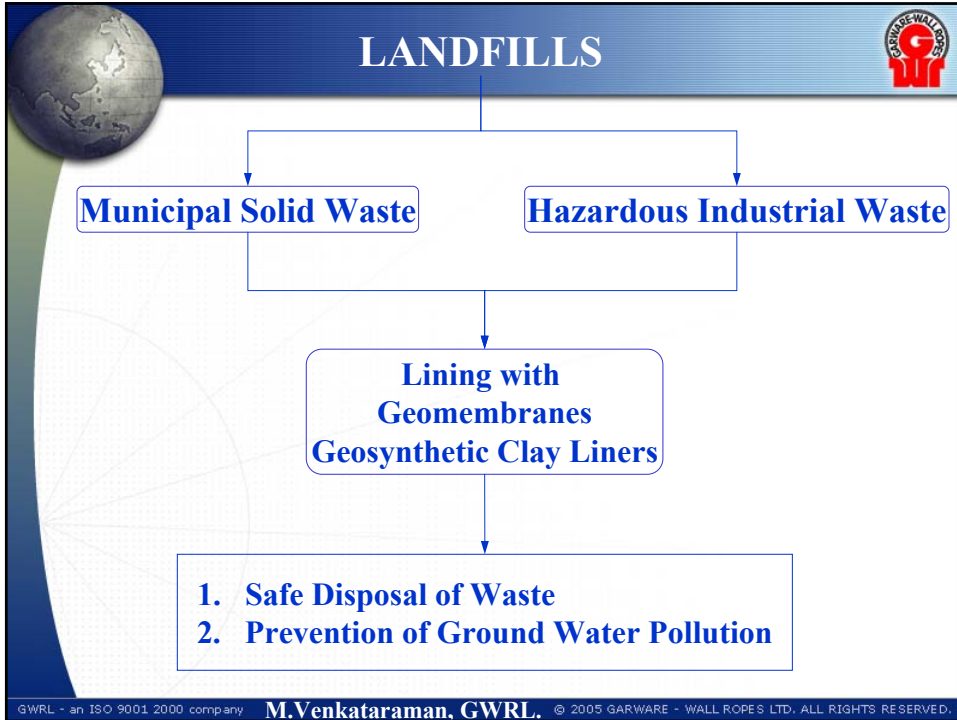
**GEOTEXTILE**  
**FILLING**  
**TRIAL GEOTEXTILE TUBE**

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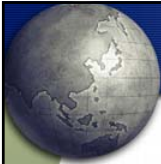


**LANDFILLS**

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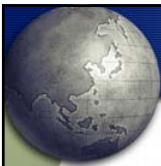
## HZL VIZAG



### ALL LAYERS VIEW

Non-woven geotextile (Bottom layer) Geomembrane(1<sup>st</sup> layer),  
Geonet, Geomembrane(2<sup>nd</sup> layer), Non-woven geotextile(Top  
layer)

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## HZL VIZAG

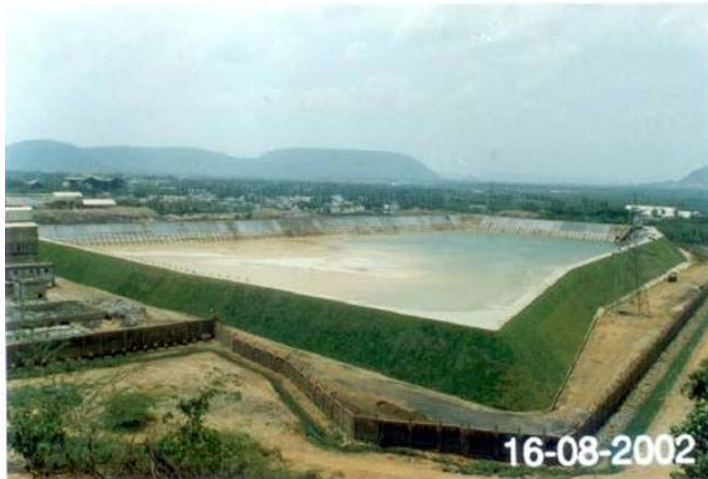


Woven geotextile laid on pond bottom.

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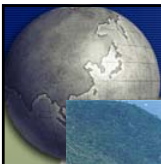


## HZL VIZAG



**Jarosite Pond – Completed & commissioned.**

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## HZL UDAIPUR



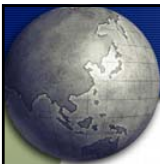
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## ARSENIC TANK LINING - GOA



**Lining with wall boundaries**



## WATER RESOURCES MANAGEMENT

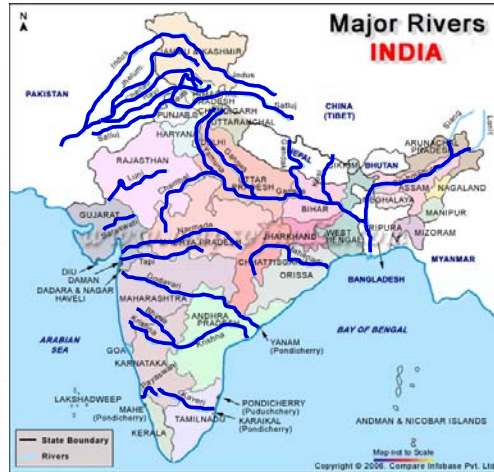


## INDIAN SCENARIO IN CANAL LINING USING GEOSYNTHETICS

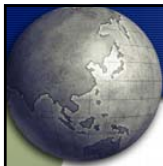


- Interlinking of Rivers
- Investments in irrigation programmes

-Store and distribute the water for cultivation  
-Increase Agriculture by irrigating uncultivable areas



(Download:[www.mapsofindia.com](http://www.mapsofindia.com))



## CANAL LINING - ADVANTAGES



- ✓ Effective barrier
- ✓ Highly flexible to withstand stresses :
  - Any differential settlement,
  - Thermal stresses and
  - High hydraulic pressures, etc.
- ✓ Installation is simple and easier
- ✓ Improves canal hydraulics
- ✓ Reduces water logging and salining





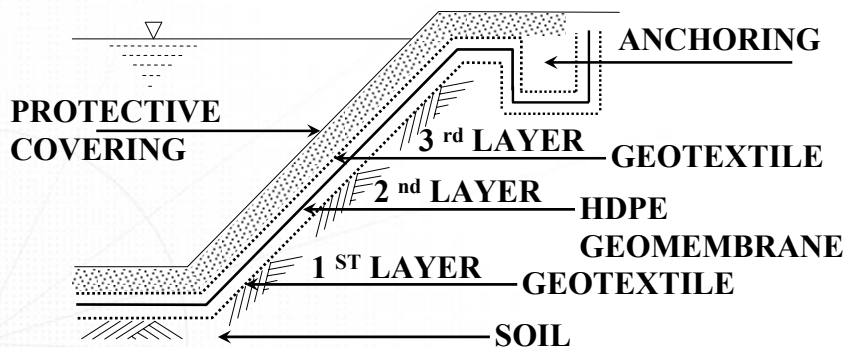
## CANAL LINING - ADVANTAGES



- ✓ No weed growth
- ✓ Other benefits:
  - Prevention of canal erosion
  - No Piping
  - Low maintenance and easy cleaning



## METHOD OF LINING THE CANAL USING THE GEOMEMBRANES



TYPICAL CROSS-SECTION OF CANAL LINING



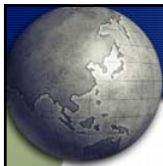
## METHOD OF LINING THE CANAL USING THE GEOMEMBRANES



**Nonwoven Geotextile**

**Concrete**

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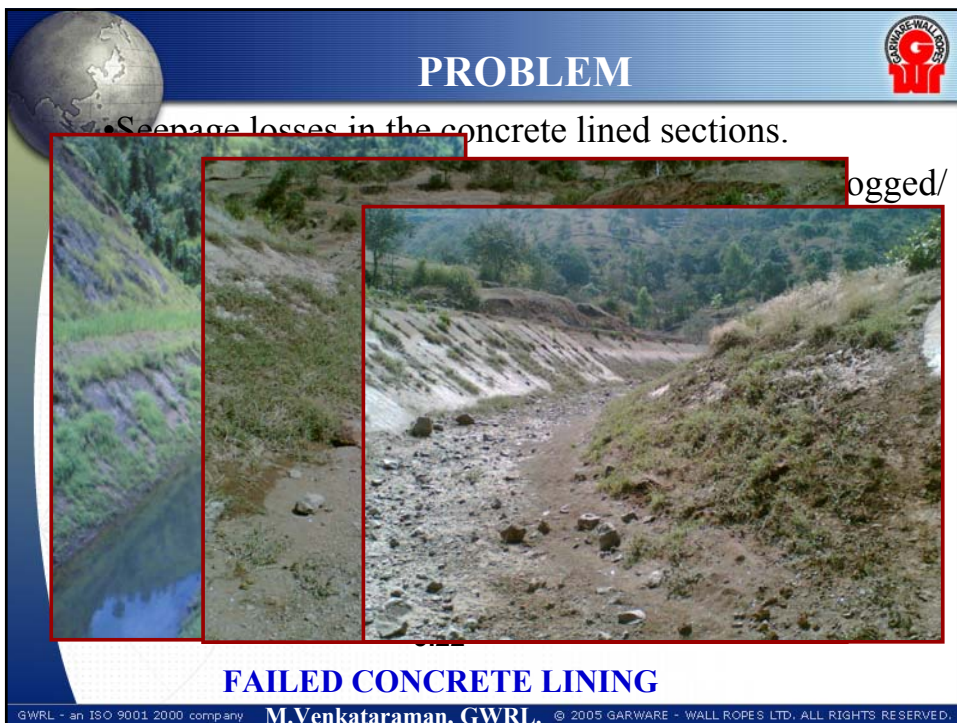
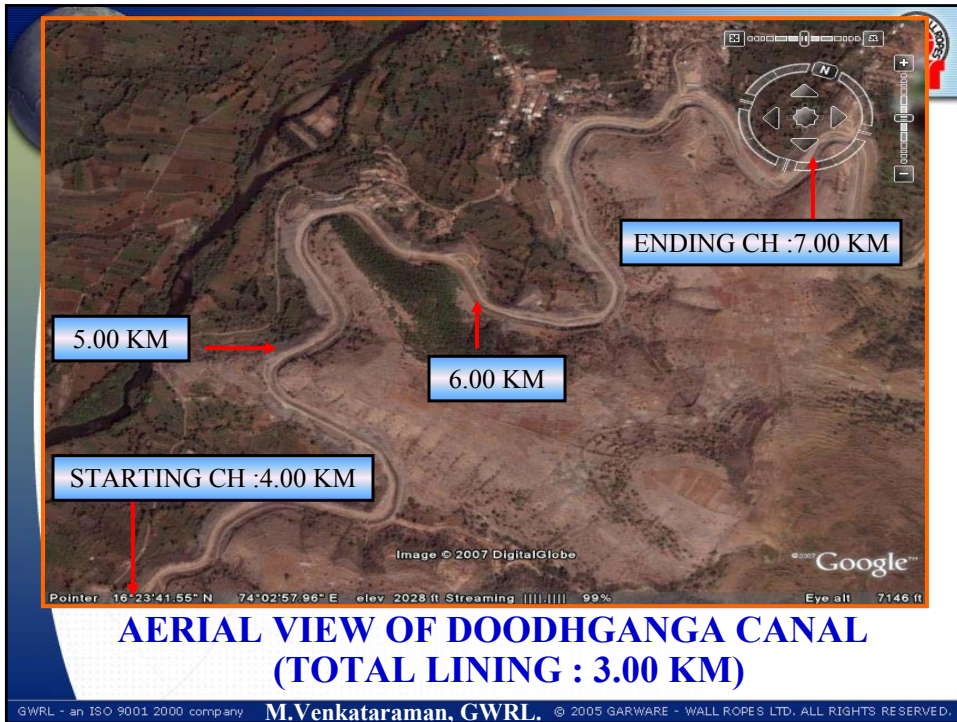
## CASE HISTORIES ON CANAL LINING IN INDIA



### **1.DOODHGANGA CANAL PROJECT, KOLHAPUR, MAHARASHTRA, INDIA**

- Flows from the Dhoodhganga Dam in Solankar near Kolhapur
- Total length of Doodhganga Right Bank Canal = 24 km.
- Stretch lined earlier with concrete = 11 km  
Unlined portion = 13 km

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## PROBLEM



### WATER LOGGING IN ADJACENT AREAS



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## SOLUTION

- Repairing of existing concrete
- Lining of the Canal :
  - NonWoven Geotextile, 250 gsm (1<sup>st</sup> Layer)
  - HDPE Geomembrane, 1mm Thk. (2<sup>nd</sup> Layer)
  - NonWoven Geotextile, 250 gsm (3<sup>rd</sup> Layer)
  - Concrete Cover, 75 mm (M10 Grade)
- Consumption of Geomembrane = 66,000 SQ.M
- Nonwoven Geotextile = 1,32,000 SQ.M

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12-12-2006

**LINED CANAL** **CANAL FLOWING FULL**

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# RAJGHAT CANAL

**Dhatia, Madhya Pradesh**



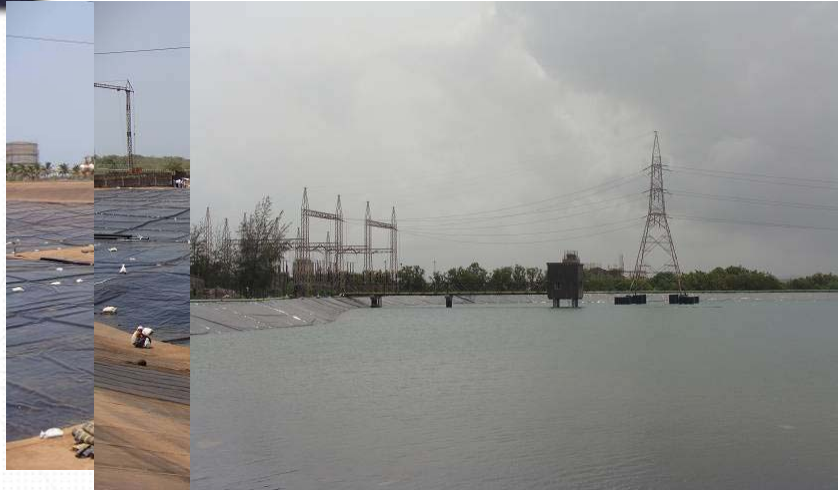
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## RESERVOIR LINING



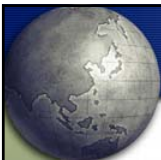
**Finolex Industry**



**Cost saving Rs.2 lakh/day**

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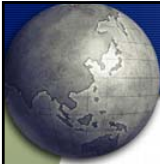
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## GROUND IMPROVEMENT

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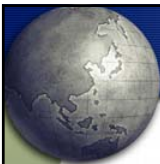
## PREFABRICATED VERTICAL DRAINS



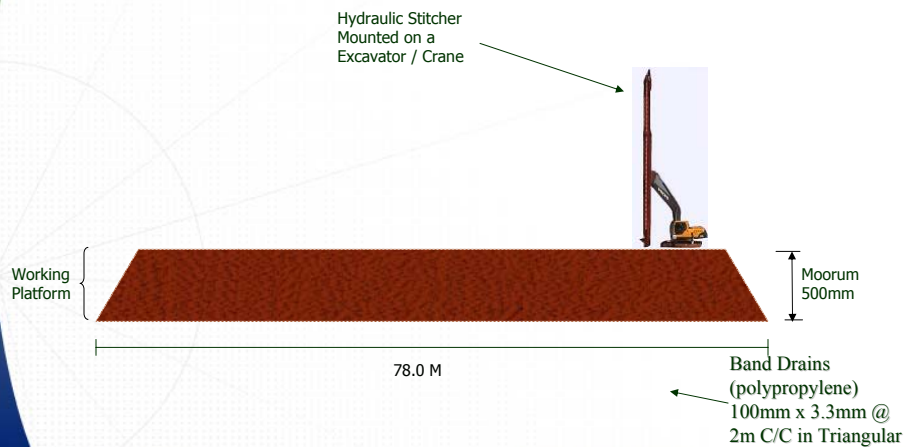
**For ground improvement of soft clay soils**

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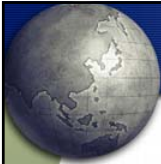
## INSTALLATION OF PVDS



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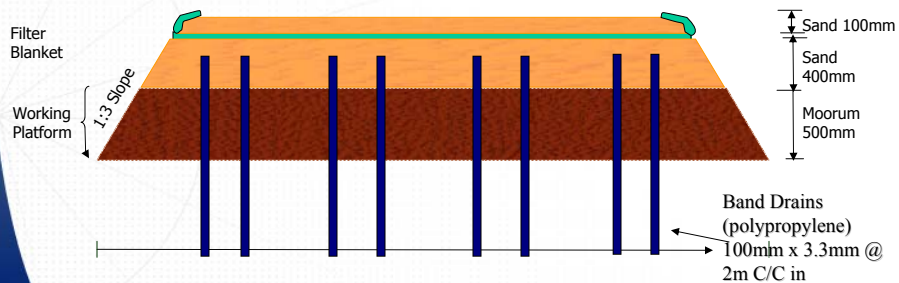




## PVD AT VIZAG AIRPORT



Using  
Geotextile  
and PVD's

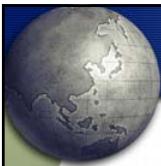


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Triangular Fashion RESERVED.



## WOVEN GEOTEXTILE



Vizag Airport



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# Erosion Control



Geomat

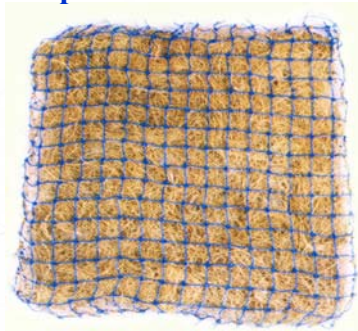
Micro-reinforced Vegetation



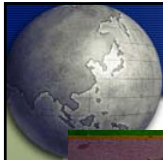
## Garmat<sup>TM</sup> (Mulch Mat)



**Garmat system consists coir fiber mulch mat sandwiched between polymer rope nets**



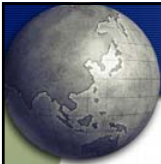
- Promotes growth of vegetation
- The synthetic nets enhance the effectiveness of vegetation
- The net intertwines with the roots



## PRE CULTIVATED VEGETATION



**GARMAT™**

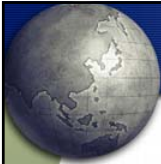


## GARMAT™



- Soil slope protection
- Erosion Control

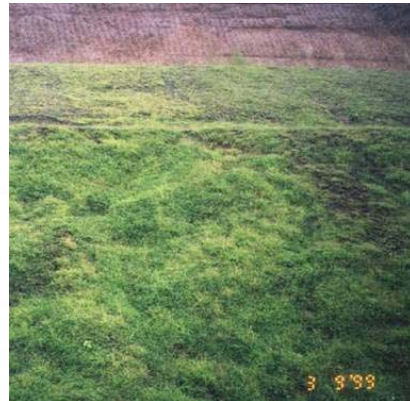




## EROSION CONTROL USING GARMAT™

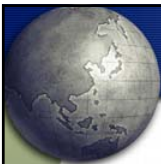


**Before**



**After**

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## EROSION CONTROL USING GARMAT™



**Hindustan Zinc Ltd. - Vishakhapatnam**

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## EROSION CONTROL USING GARMAT™



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## CONCLUSIONS



### Geosynthetics - Attractive – Why?

- Offer simple and easy solutions to many of complex problems
- More developments in products & usage
- Highly flexible
- Covers almost all Civil Engg. Applications
- Heretofore impossible design and applications are made possible
- Highly eco-friendly solution

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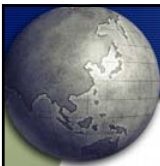
## GEOSYNTHETICS



**YESTERDAY :ATTRACTIVE**

**TODAY :INEVITABLE**

**TOMORROW :MANDATORY ?**

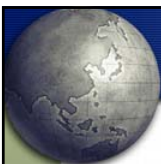


## Lessons



*“It is unwise to pay too much, but it worse to pay too little. When you pay too much, you loose a little money-that is all. When you pay too little, you sometimes loose every thing because the thing you bought is incapable of doing the function it was bought to do”.*





# Thank you



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