CRRI EXPERIENCES ON USE OF GEOTEXTILES IN ROAD WORKS

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Geosynthetics

- **Geosynthetics in civil engineering**
  - Geotextiles – Woven and Non woven
  - Geogrids – Flexible and Rigid
  - Geonets
  - Geoties
  - Geomembranes
  - Band drains
- **Polymer based – Polypropylene, Polyester, PVC, Polyamide, Polyethylene**

Geotextile Usage

- About 7 billion square m of geotextiles estimated to have been used world wide last year – China using about 50 per cent of this quantity
- About 5 to 10 million square m of geosynthetics used in India last year, worth $ 20 million
- Huge potential for usage of geosynthetics in on-going road development projects

Geosynthetic Usage – Potential Areas

- Black Cotton Soil Areas – Geotextile application
- Coastal and Delta Regions – Band drains
- Hilly Terrain – Erosion control with the use of Geotextiles – Synthetic and Natural
- Reinforced soil structures using polymeric geosynthetics

Pioneering Studies on Usage of Geotextiles by CRRI

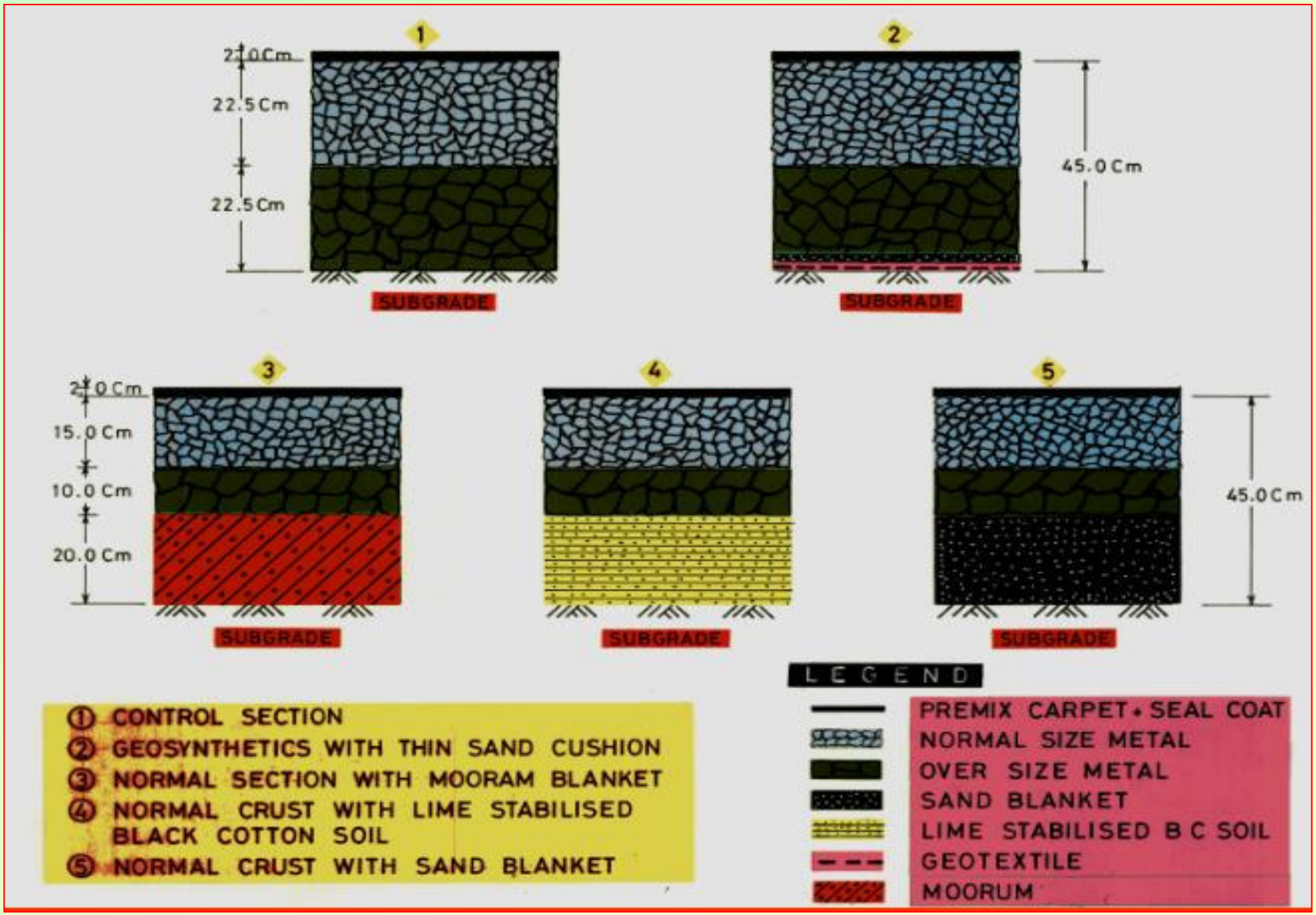
- **Objective of Study: To study relative efficacy of geotextile as compared to use of conventional techniques for BC soils**

- **Location of Sites: Ten roads in Gujarat and Maharashtra each 4-6 Km**

Typical test specifications

- **Control section**
- **Geotextile with thin sand cushion**
- **Normal section with moorum blanket**
- **Normal section with lime stabilised BC soil**
- **Normal section with sand blanket**

TYPICAL TEST SECTIONS INCORPORATED FOR FIELD TRIALS

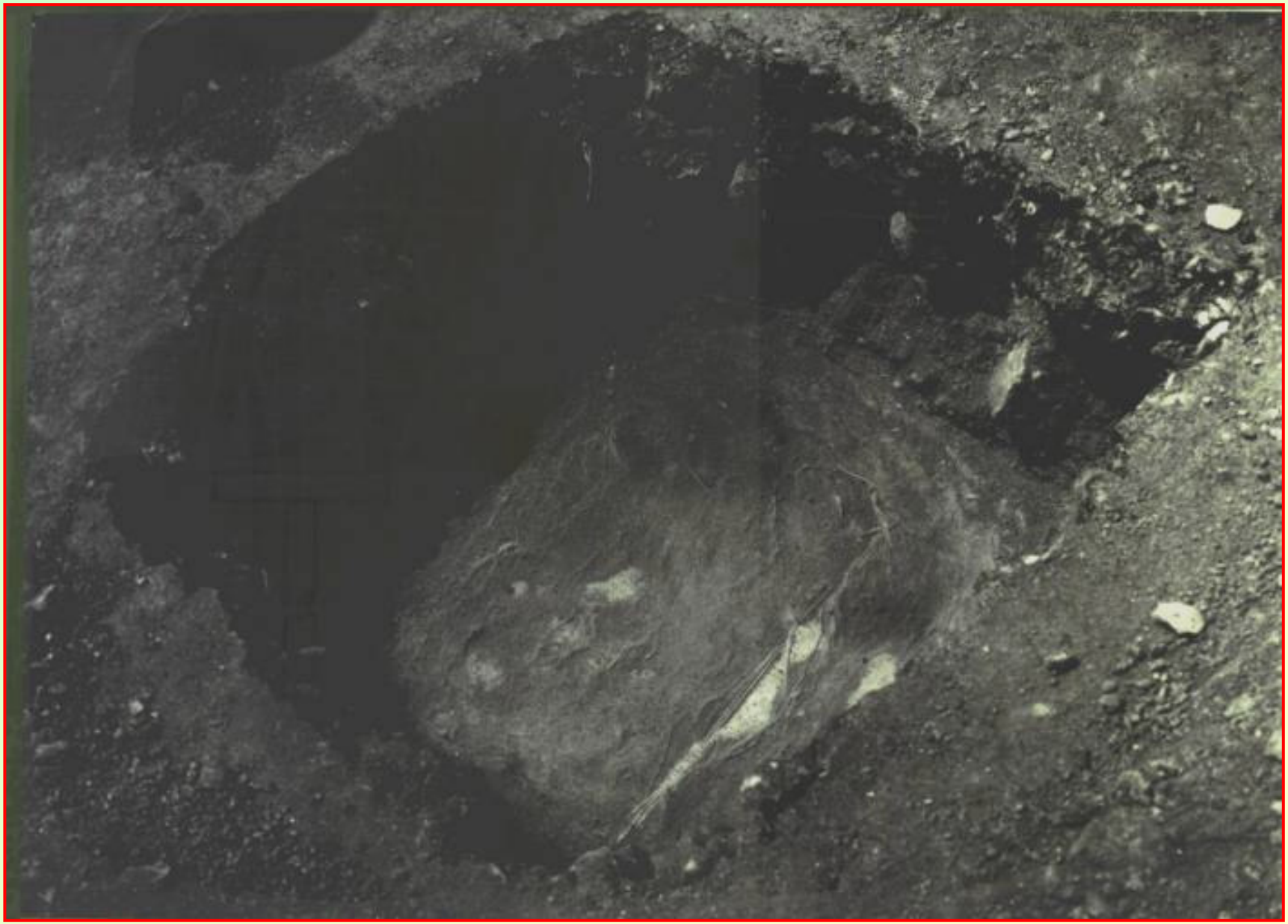


LAYING OF GEOTEXTILE ON SOFT SUBGRADE

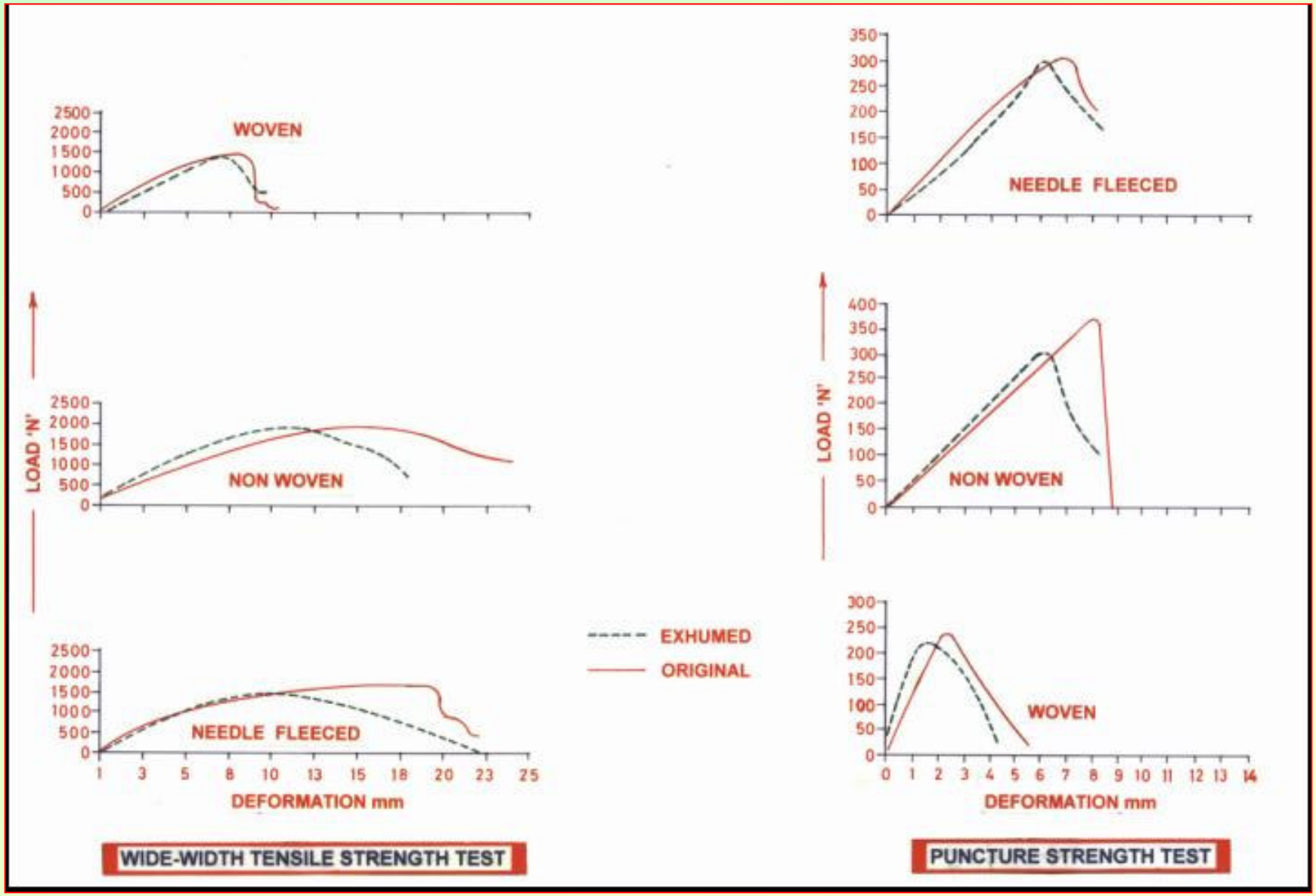
Pavement Performance Evaluation (3 Yrs)

S.N	Test Specification	Rut depth(mm)	Deflection(mm)	Distress (%)
1	Control Section	6 – 18	1.6 – 2.5	12 – 15
2	Section with Geotextile	6 – 9	1.5 – 2.0	1.0 – 6.0
3	Section with Moorum	8 – 14	1.7 – 3.5	3.0 – 8.0
4	Section with lime stabilised BC Soil	7 – 20	2.5 – 3.8	5 – 17.0
5	Section with sand blanket	4 – 14	1.7 – 2.2	1.0 – 5.0

CONDITIONS OF GEOTEXTILE AFTER THREE YEARS



STRENGTH LOSS AFTER THREE YEARS SERVICE



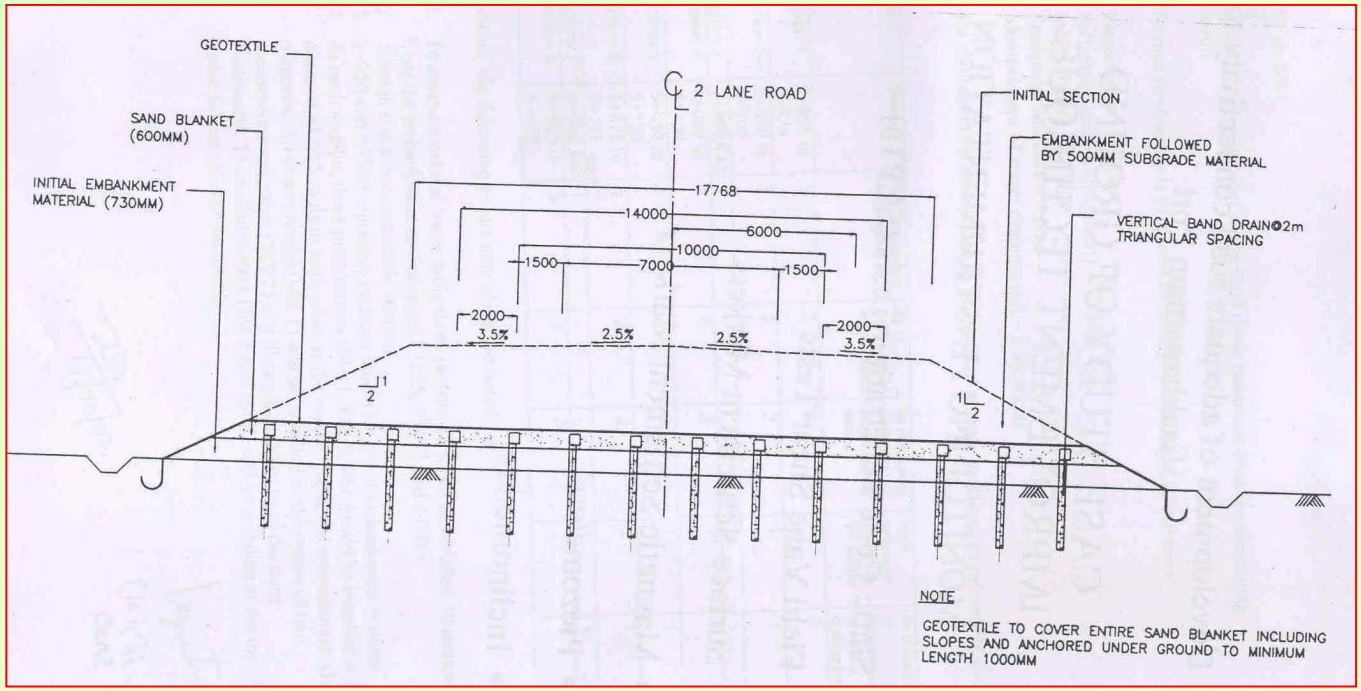
Outcome of Study

- Geotextiles are an effective substitute for conventional sand blanket course

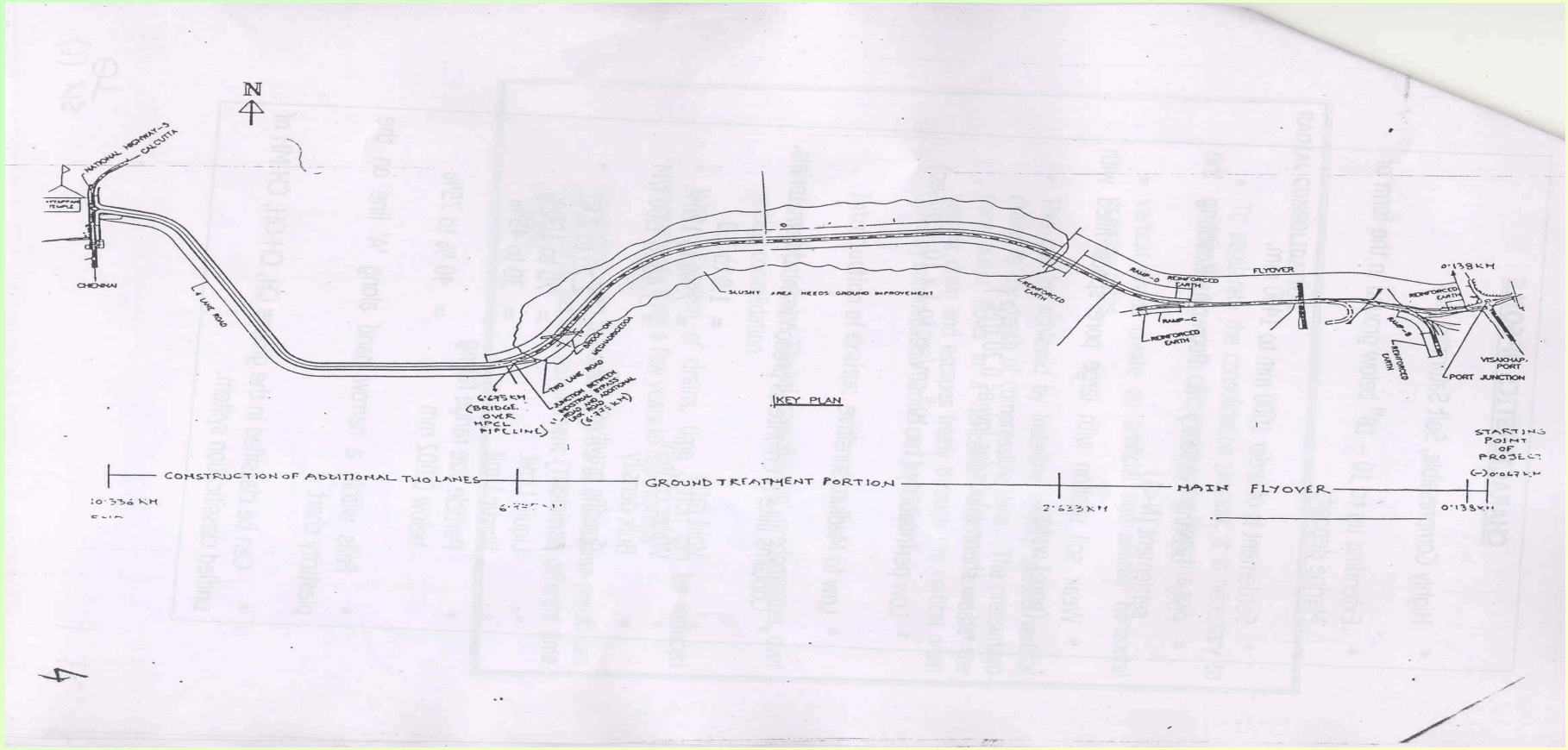
- It's use is very cost effective when good quality subbase materials are not available within economic lead and CBR of subgrade is low i.e. less than 3

Ground Improvement Using Geosynthetic Band Drains

- Project – Visakhapatnam Port Connectivity Road
- Distinguishing feature – Ground improvement using band drains for a length of 4 km
- Spacing of band drains – 1.15 m centre to centre and waiting period – 350 days



LOCATION OF EMBANKMENT



Installation of band drains

Stitcher for installing band drains

Close up view of mandrel for installing band drain

Band Drains After Installation

FAILURE OF AN EMBANKMENT

After Completion

Agro Based geotextile

- 100 per cent biodegradable
- Can be adopted for
  - Erosion Control
  - Vertical drains for consolidation of clays
  - Horizontal drains for stabilisation of slopes
  - Subsurface drains
- Jute and Coir based geotextile

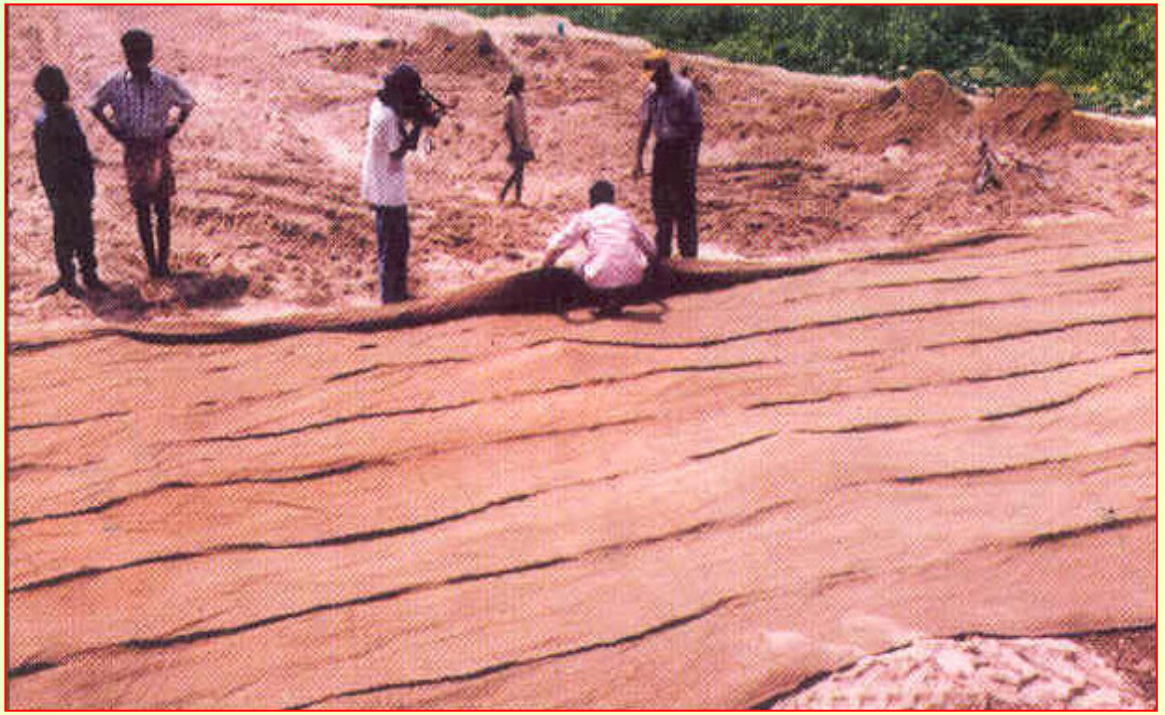
Jute Geotextiles as Reinforcement - Kakinada

- The topsoil up to a depth of 2m from the ground level – silty sand and clay mixture
- Soil below this depth – Plastic clay
- Natural moisture content – 70 to 85%
- Bulk density – 1.3 to 1.45 g/cc.
- Undrained shear strength - 4.6 – 6.0 kN/sq. m.
- Compression index (C_c) – 0.15 to 0.29

Properties of Woven Jute Geotextiles used at Kakinada Port

S. No.	Property	Test value
1.	Thickness	5mm
2.	Weight	750gsm
3.	Tensile strength	15 kN/m
4.	Elongation	10%
5.	Puncture resistance	350 N
6.	Overlap length	300 mm
7.	Type of fabric	Woven

Kakinada Port – Use of JGT



Use of Coir Based Geotextile for Road Construction at Kerala

Use of Jute Geotextiles for Improving Performance of PMGSY Roads

- **Objective – To study the use of jute geotextile in the road pavement**
  - **As a drainage layer**
  - **As a separator**
  - **Capillary cut-off**
  - **Shoulder improvement**
  - **Side slope erosion protection**
- **Pilot project taken up in 10 roads across five states under varying soil/ climatic conditions by CRRI & JMDC**

Laying of bitumen treated jute geotextile in West Bengal

Jute Geotextile

PMGSY Road in Assam

Use of Geotextile as Separator in NHDP Work

(Four-laning work on NH-6, Dankuni to Kolaghat, Km 17 to 72, West Bengal)

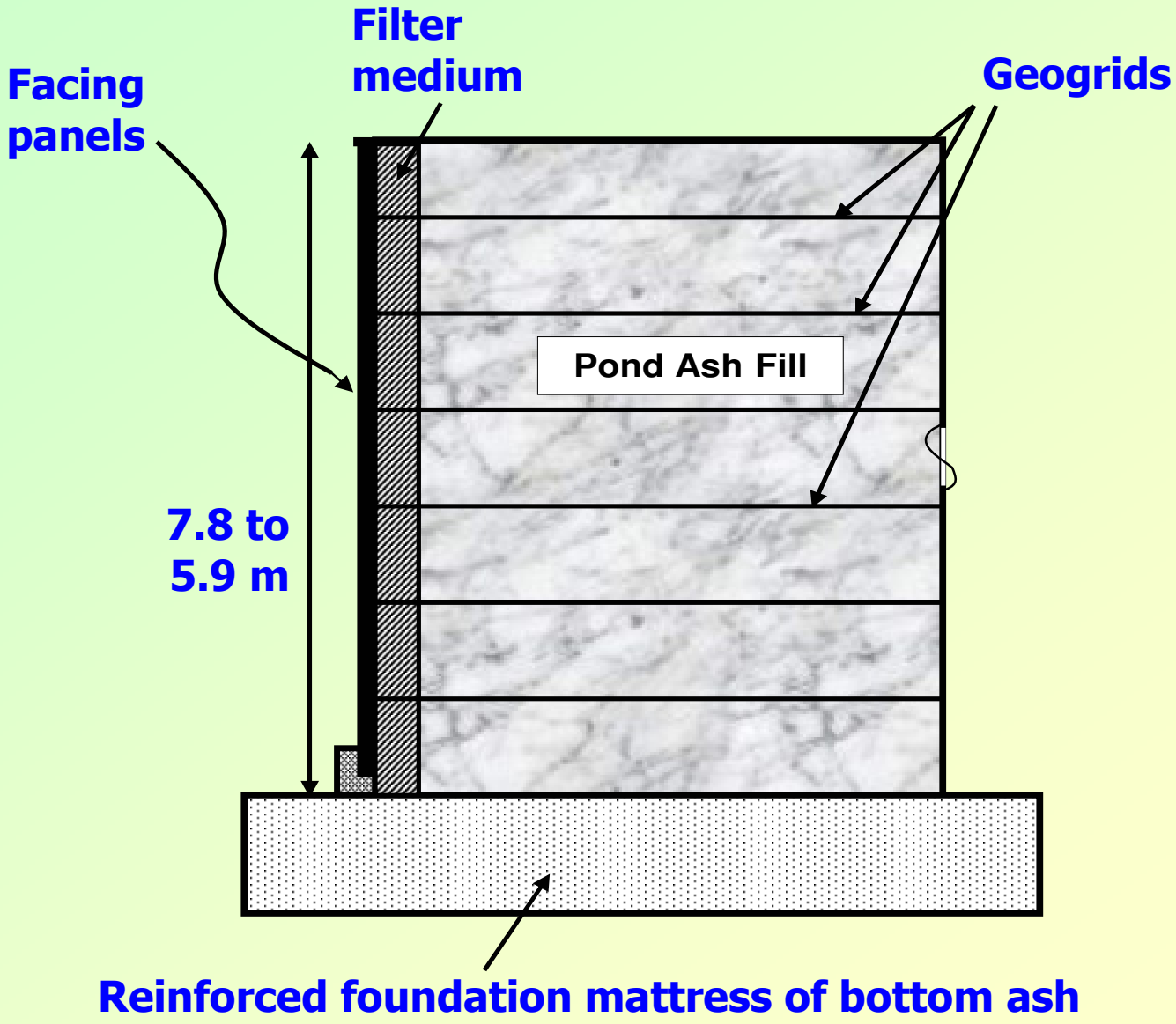
Use of Geosynthetics in Black Topped Pavement

Use of Geosynthetics in Concrete Pavement

Reinforced Soil Embankment Using Geogrids – Okhla Flyover

- First geogrid reinforced fly ash approach embankment constructed in the country
- Length of embankment – 59 m
- Height varied from 5.9 to 7.8 m
- Ash utilised – 2,700 cubic metre
- Opened to traffic in 1996
- Performance has been very good

Okhla flyover approach embankment

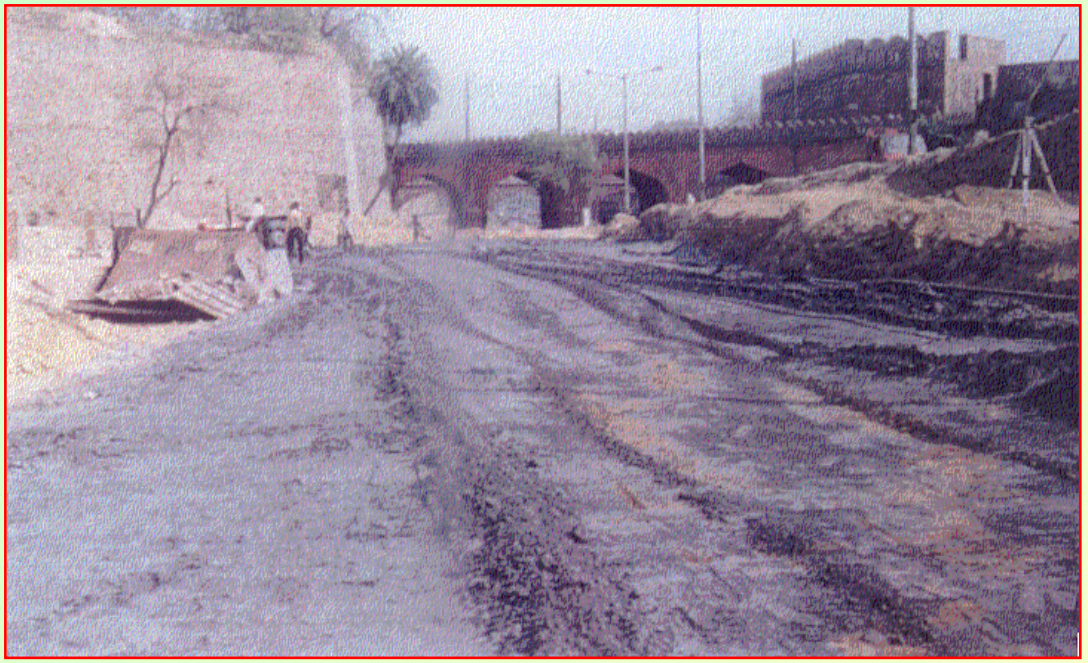


Erection of facing panels

Okhla flyover approach embankment

Laying of Geogrids

Hanuman Setu flyover approach embankment



- Geogrid reinforced fly ash approach embankment
- Length of embankment – 138.4 m
- Height varied from 3.42 m to 1.0 m
- Opened to traffic in 1997

Reinforced Soil Embankment at Sarita Vihar Flyover

- Length of embankment - 90m
- Max height - 5.25 m
- Embankment opened to traffic in Feb 2001
- Polymeric friction ties used for reinforcement

Laying of friction ties

Sarita Vihar Flyover Reinforced Approach Embankment

Arrangement of friction ties before laying pond ash

Pitfalls – Failure of Reinforced Embankment

RE Wall Failure at Delhi

Construction of Retaining Wall in front of RE Wall

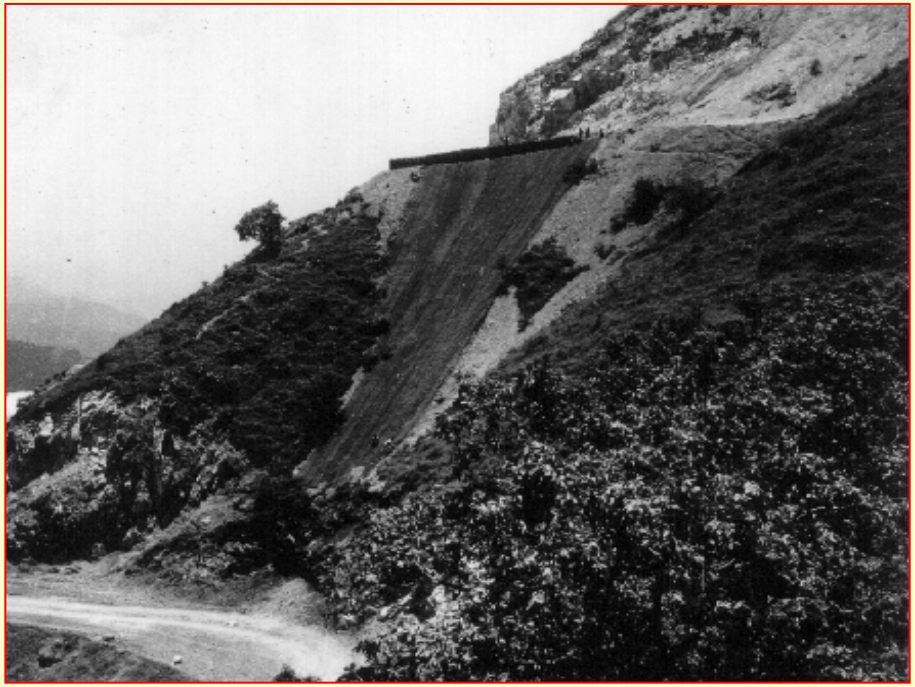
Collapse of RE Wall

Erosion Control & Landslide Mitigation

- Loss of excessive material from the surface of natural or manmade slope by the action of wind or water
- Woven jute geogrid with square grids used
- Mass of geogrid – 750 gsm

Erosion control on Steep slope - Lambidhar, Mussoorie

Slope at Mussoorie protected with Geogrid



Stabilisation of Natural Slope - Kaliasur

Erosion Control of Slopes

Use of jute geotextile for erosion control

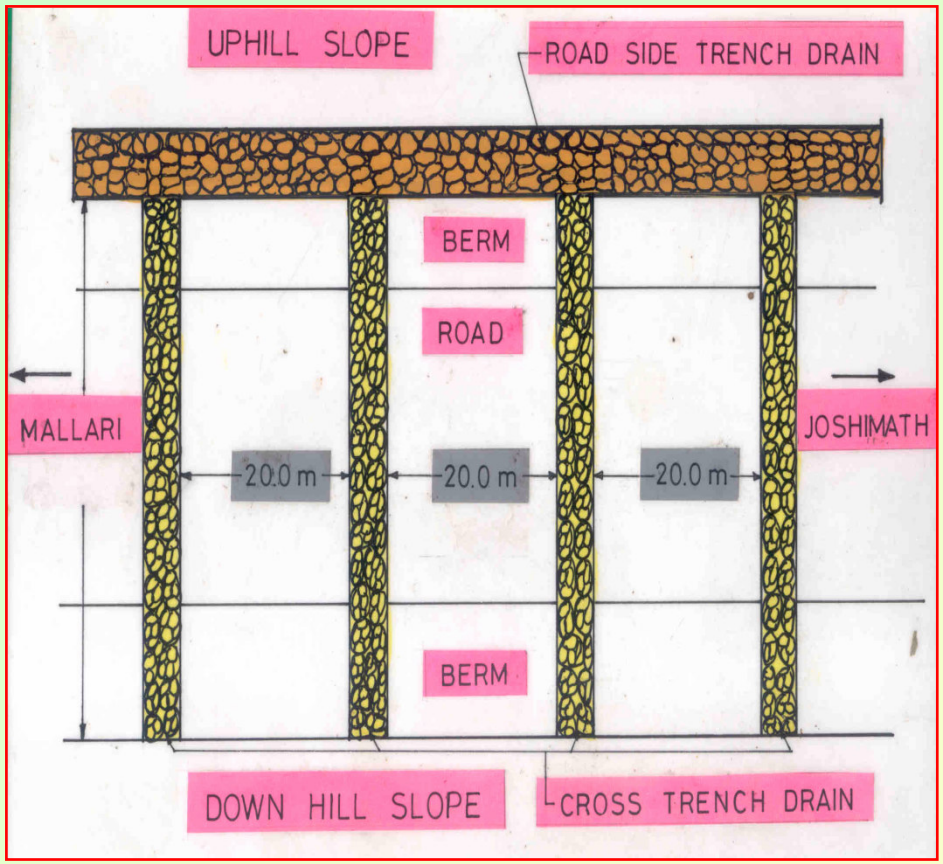
Erosion Control of Road Embankment at Rann of Kutch

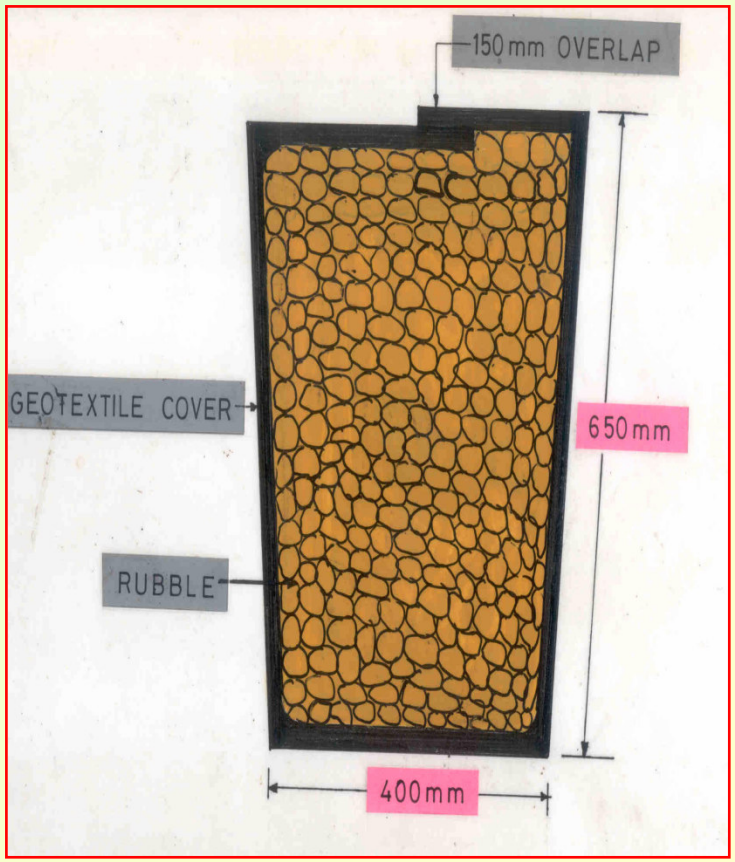
- Embankment height 1.5 – 2.0 m
- Soil predominently silty having high salt content
- Erosion due to surface runoff as well as wave action of water flooding on both sides of alignment
- Use of non-woven geotextiles to contain erosion of side slopes
- Failure of geotextile layer due to improper anchoring

Bhuj Area- Damage to Slopes

Use of Geotextile for Erosion Control

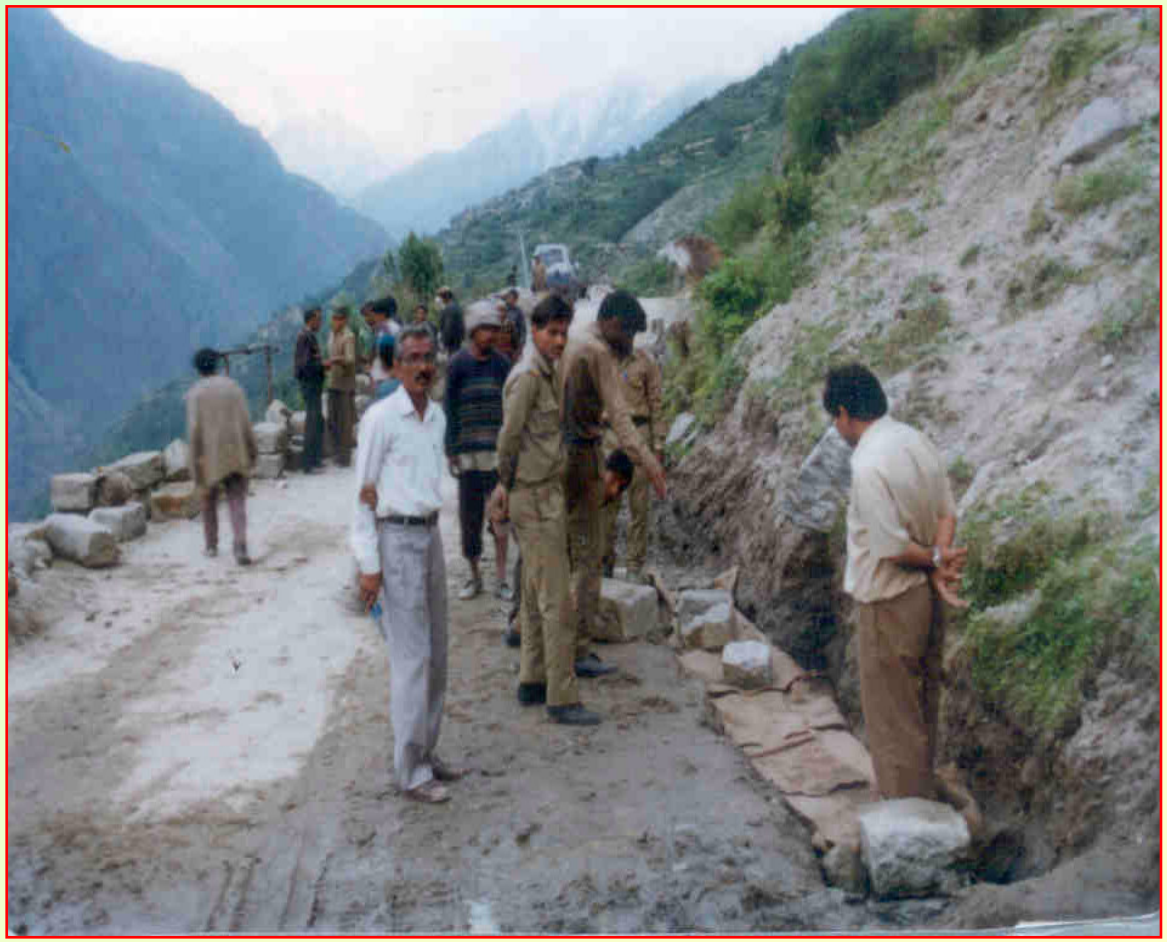
Use of Jute geotextile in trench drains on Joshimath-Mallari Road, NH-58





Use of Jute Geotextile in Trench Drains

Jute geotextile laid in position



A view of completed drain

Mere usage of Geosynthetics will not ensure good performance

Proper selection of Geosynthetics, correct design and quality assurance are essential

Path Ahead

- Use of Geosynthetics in road works to be win-win situation
- Popularising the technology through demonstration projects
- Evolving IS codes and guidelines for usage
- Establishing country wide Geosynthetic testing facilities
- Making available good quality geotextile at competitive price
- Incentives to indigenous manufacturers


THANK YOU