OVERVIEW OF GEOSYNTHETICS

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What are Geosynthetics

The generic term to all synthetic and natural materials used in geotechnical and man-made applications.

The use of geosynthetics materials has two main objectives:

- to do the job better
- to do it more economically

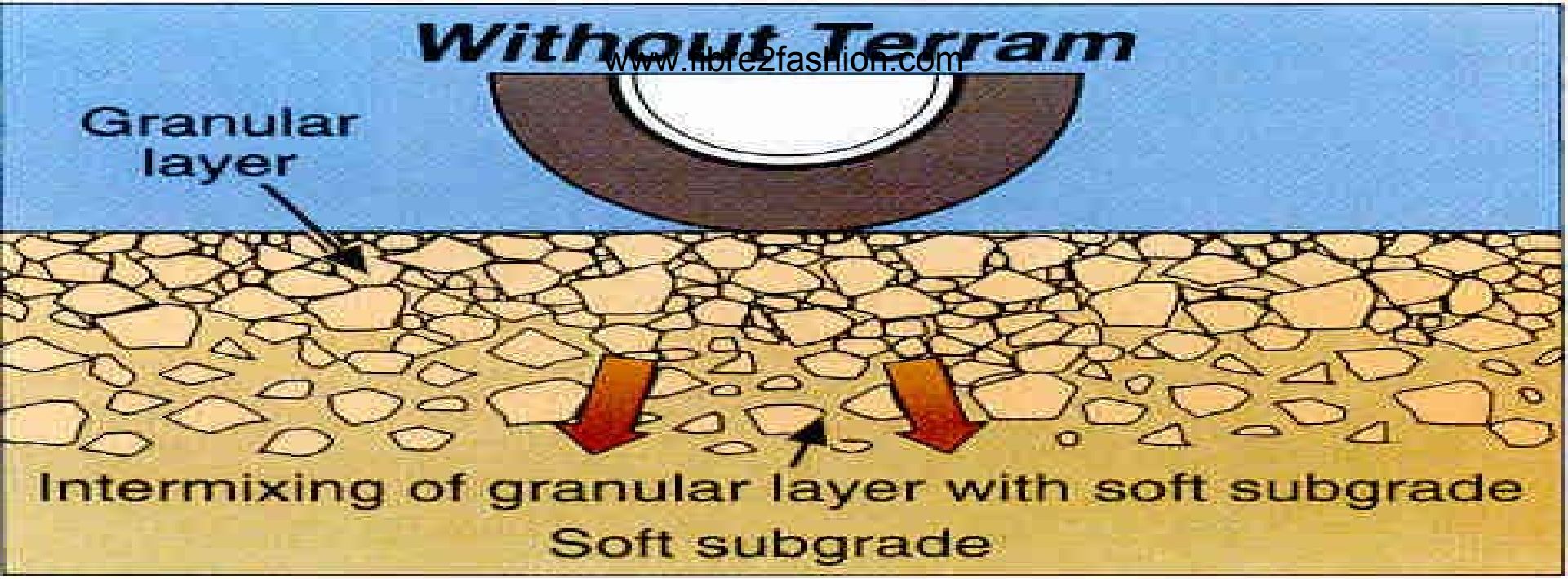
Why Textiles

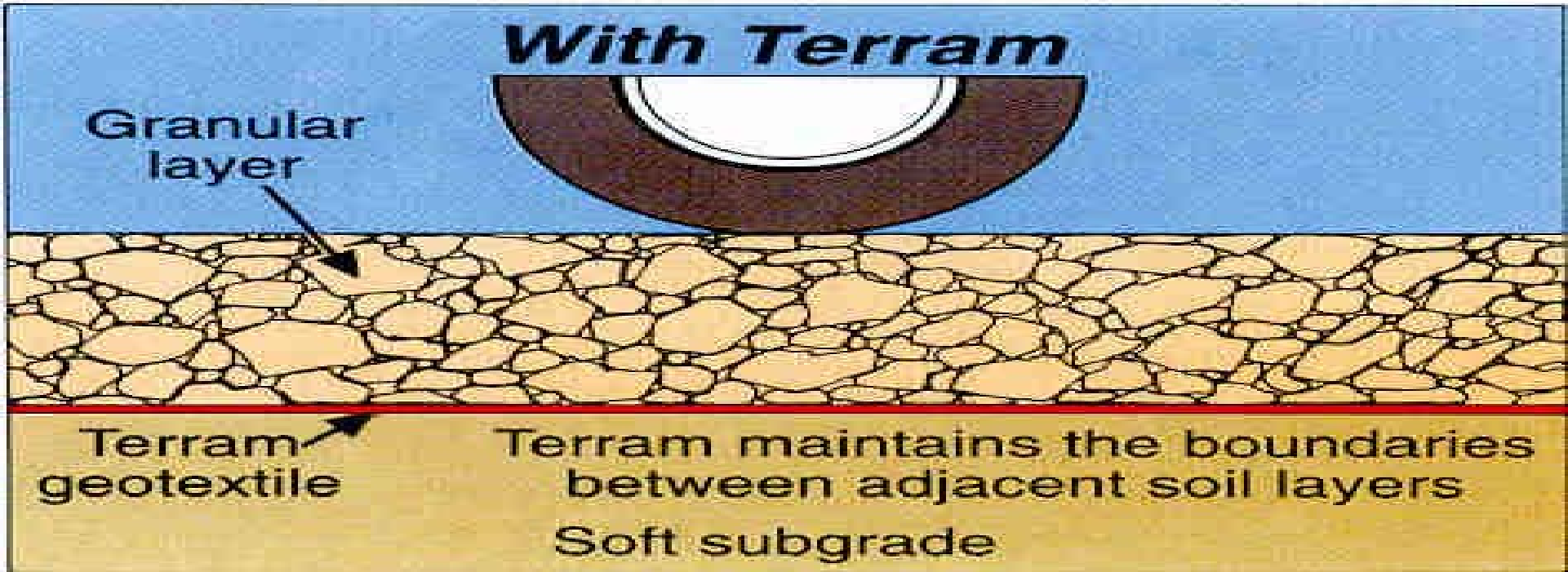
- Textiles perform the function :separation, filtration, drainage, reinforcement.
- Textiles are more reliable than soil.
- Textiles can be engineered as per functional requirements.
- Easy for transportation
- Can be laid during inclimate weather.
- Cost effective

Families of Geosynthetics

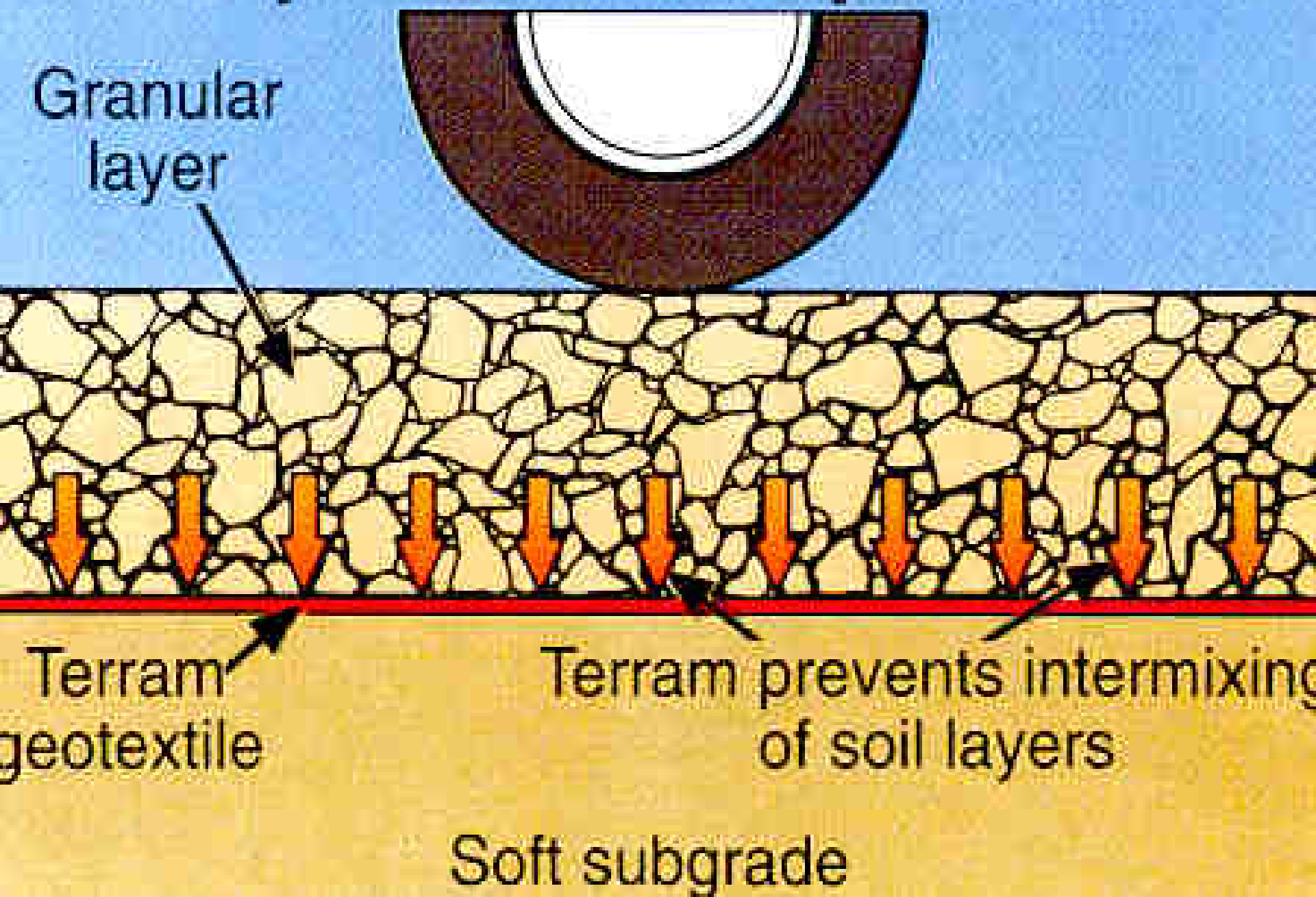
- Geotextiles
- Geogrids
- Geotubes
- Geonets
- Geomembrane
- Geosynthetic clay liner
- Geofoams
- Geocell
- Geocomposites

Geotextiles

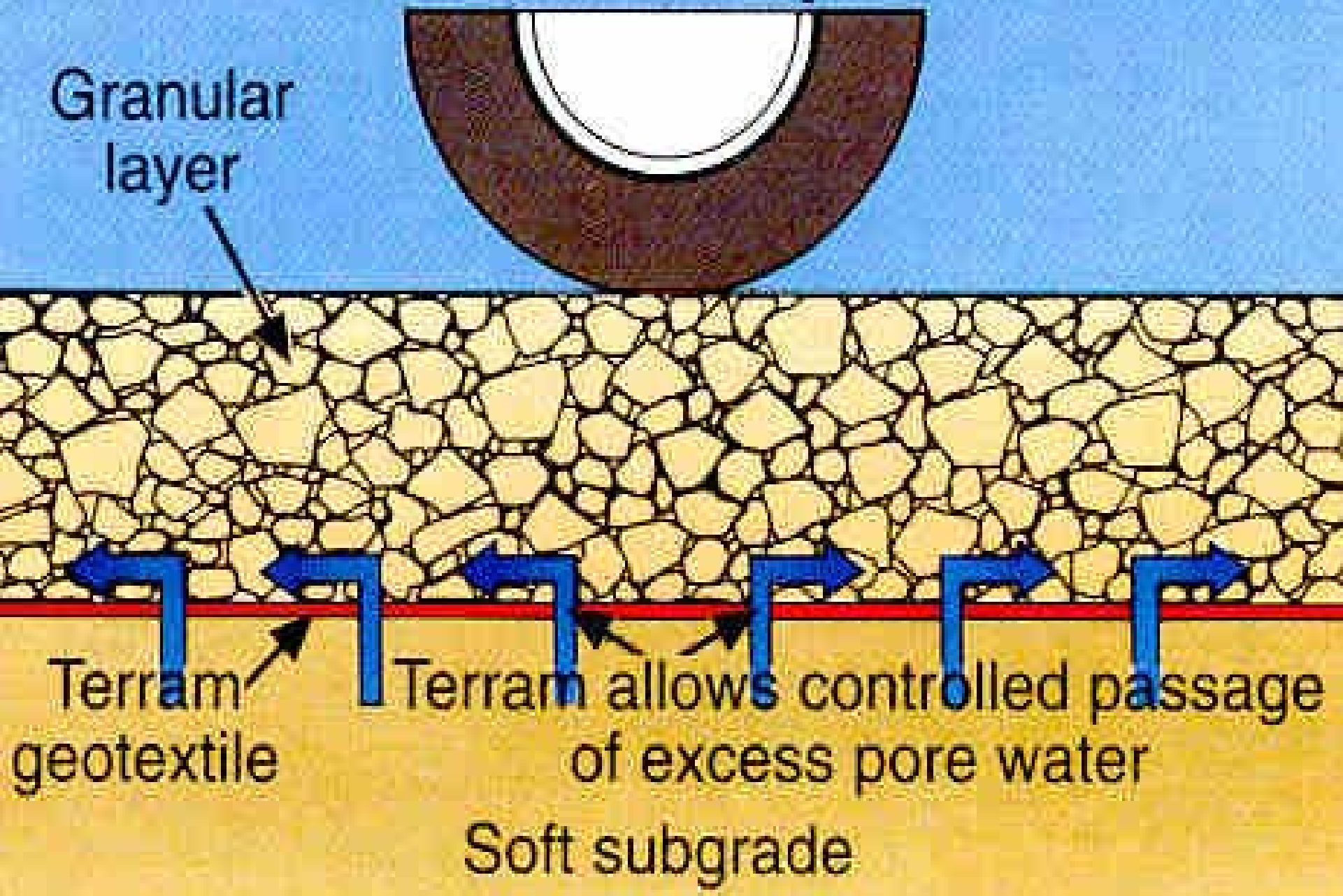




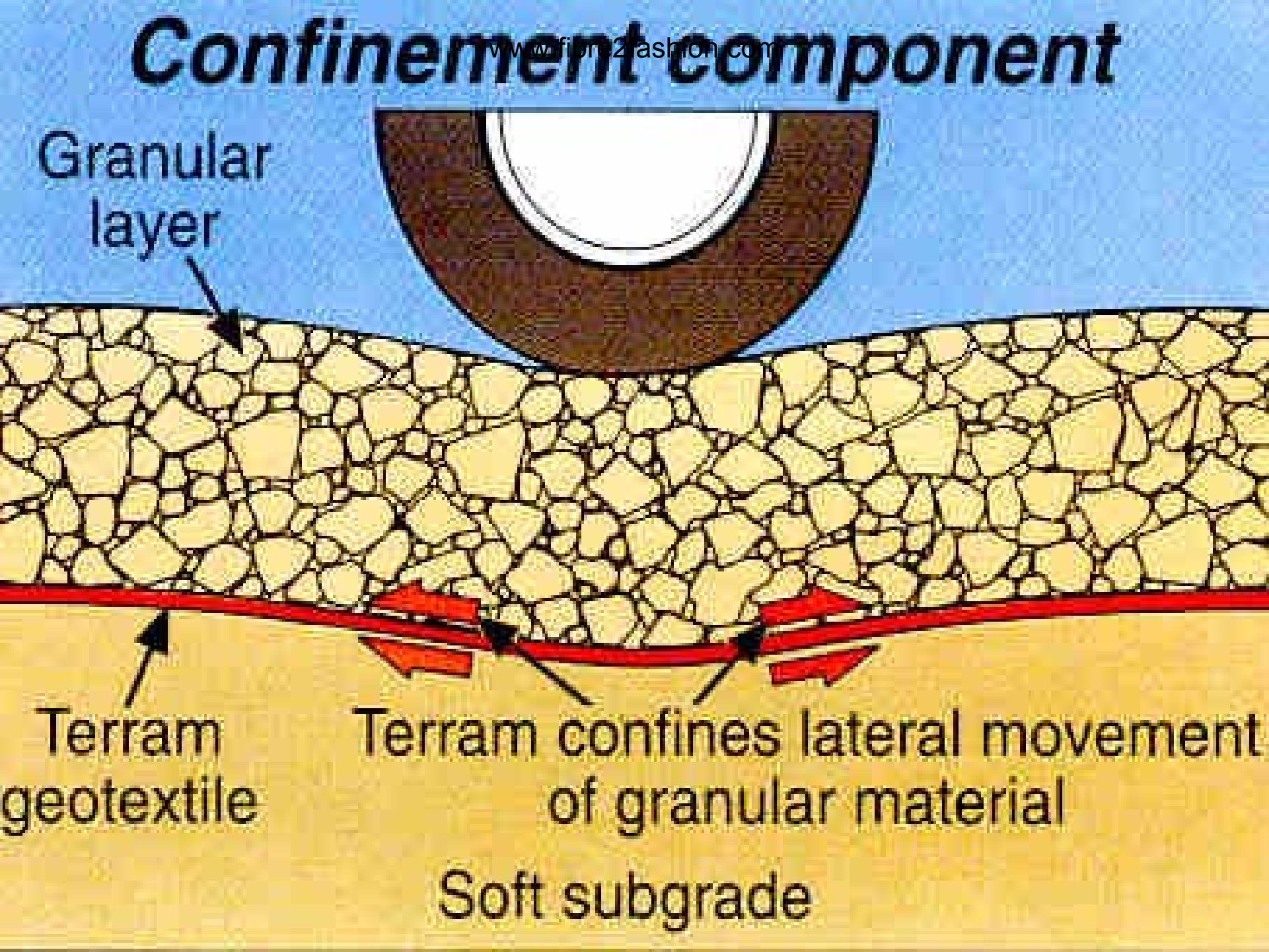
Separation component

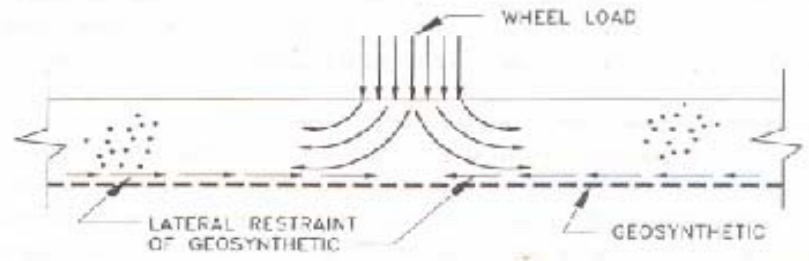


Filtration component

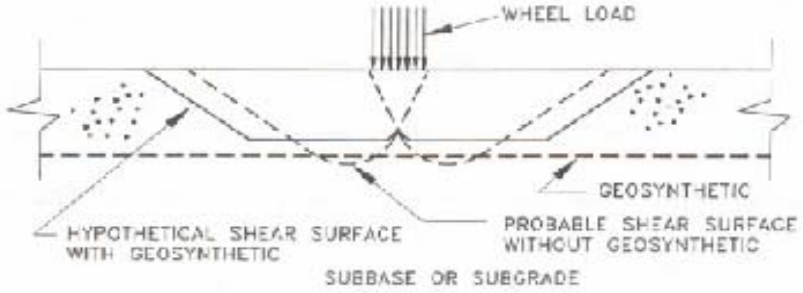


Confinement component

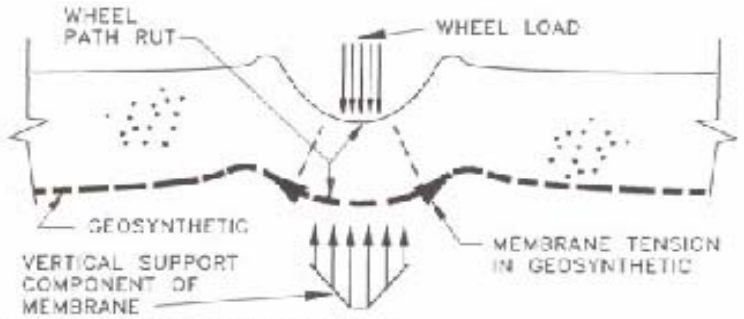




(a) LATERAL RESTRAINT



(b) BEARING CAPACITY INCREASE



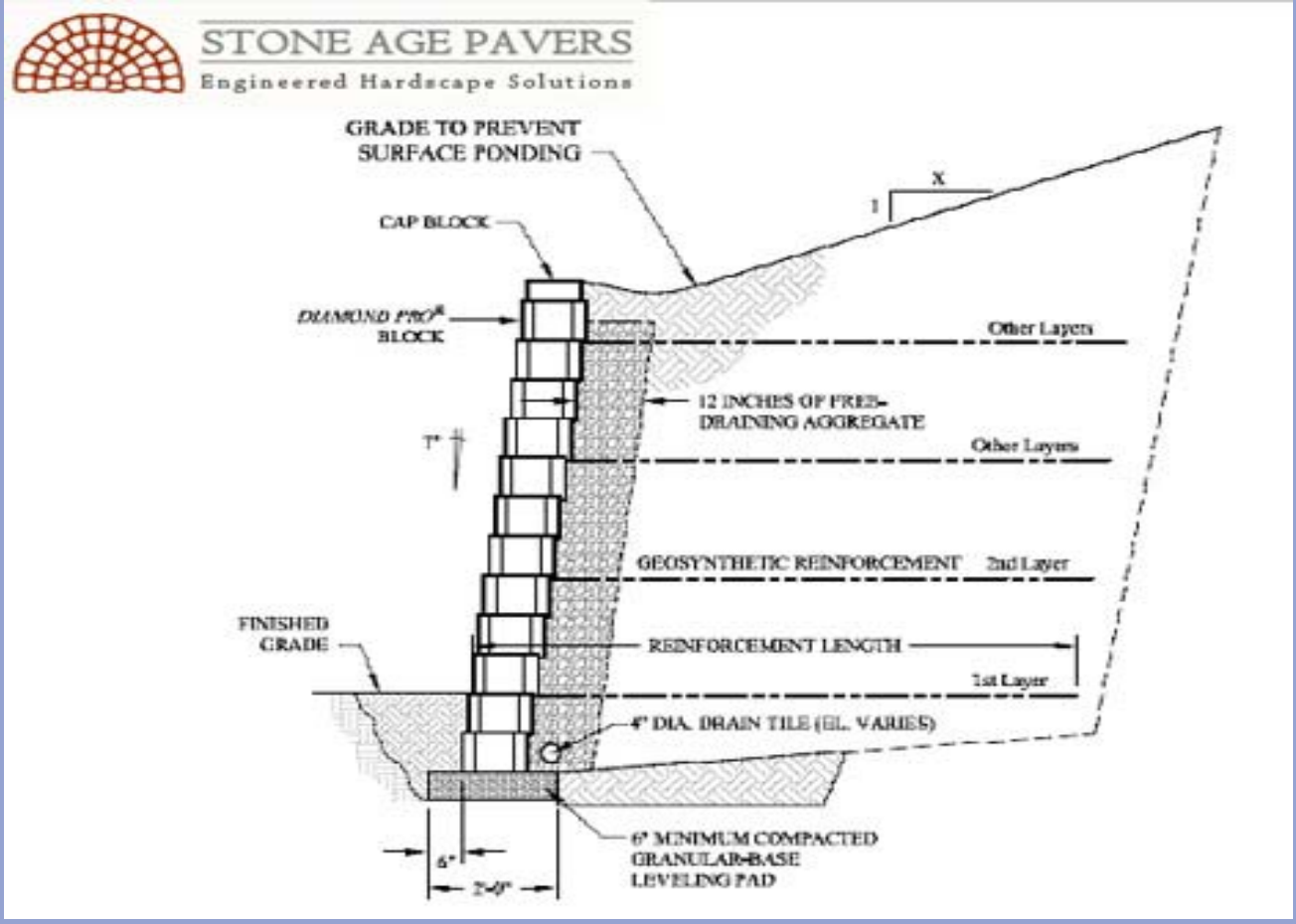
(c) MEMBRANE TENSION SUPPORT

Figure 5-2 *Possible reinforcement functions provided by geosynthetics in roadways: (a) lateral restraint, (b) bearing capacity increase, and (c) membrane tension support (after Haliburton, et al., 1981)*

Retaining Walls

Installation of geogrids

Cross section of a RE Wall



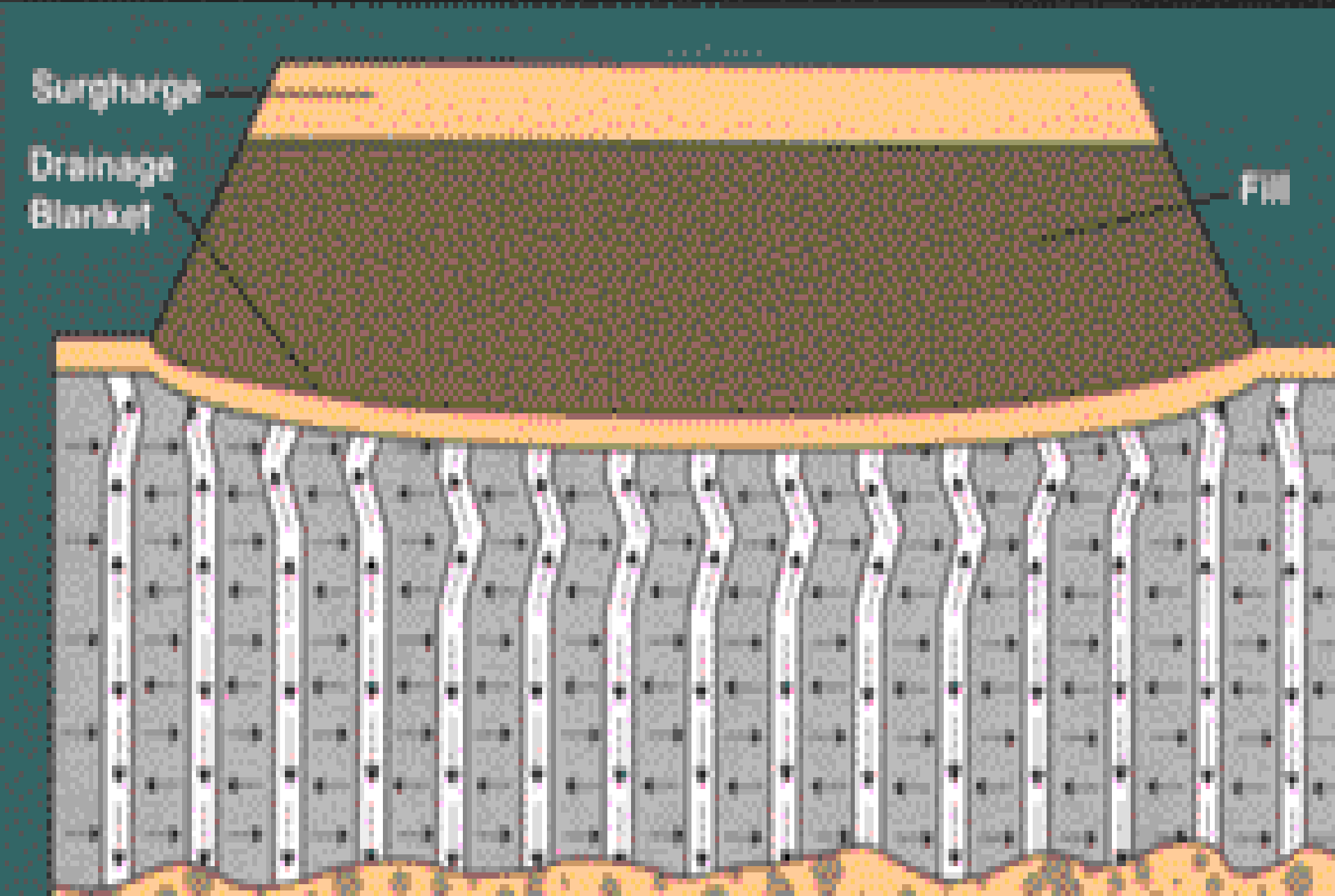
Geomembrane

Geocell

Geofoam

Geofoam

WITH VERTICAL DRAINS



Growth of Geotextiles

Year	Volume, ‘000 tonnes	Value, US $ mln
1995	196	565
2000	255	740
2005	319	922
2010	413	1203

Market of geosynthetics in India

Type	Value, Rs cr
Woven geotextiles	85
Nonwoven geotextiles	67
Geogrids and others	35
Geomembrane/Geocomposites(PVDs)	54
Agricultural geotextiles	31
Total	272

Case Study I: Embankment Construction on Soft Soil for National Highway

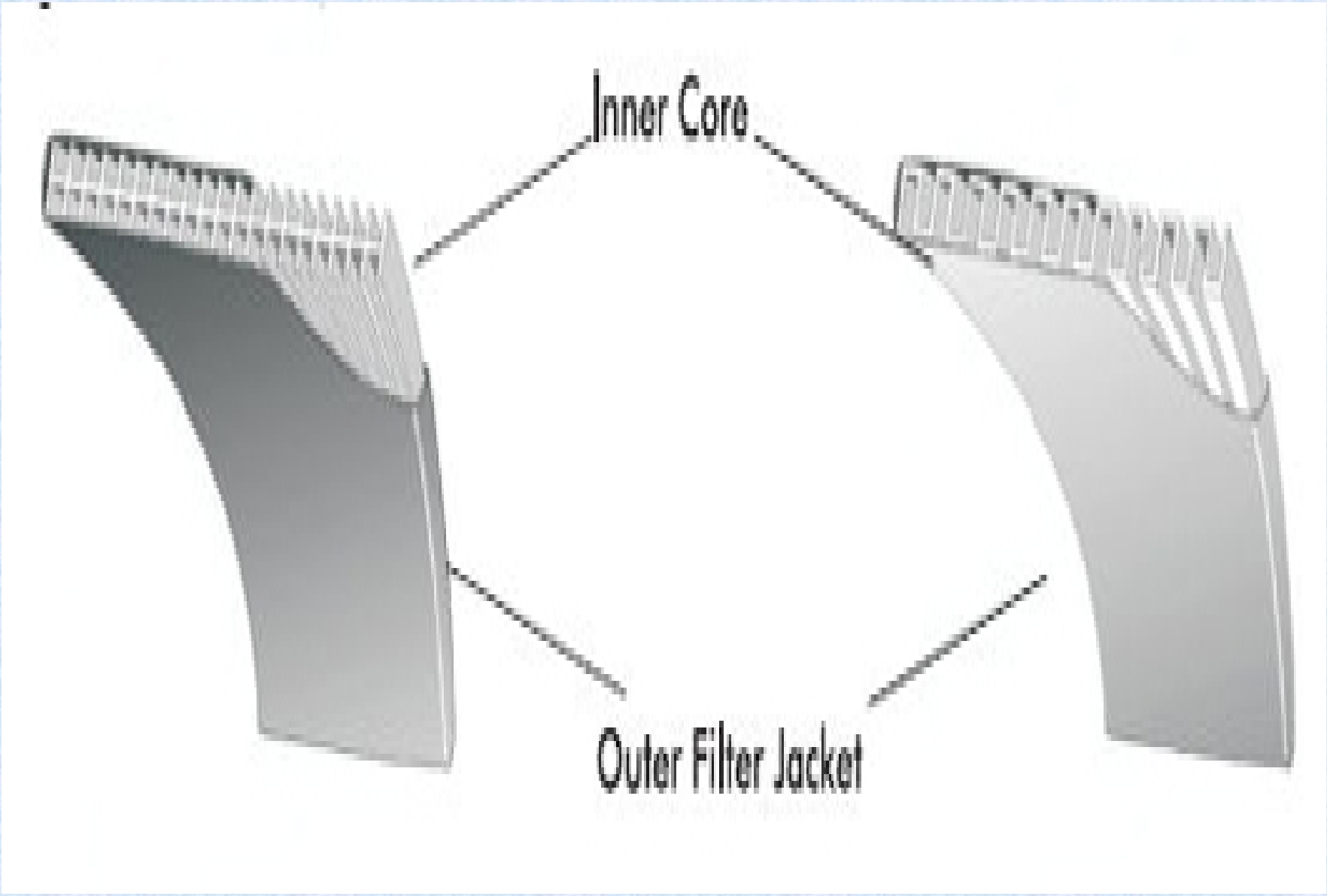
- Problem:
- Embankment upto 6 m high to be constructed on soft soil.
- 3 km of 6 km road have very soft soil upto 9 m depth.
- Removal and disposal of semi-liquid may pose major environment problem

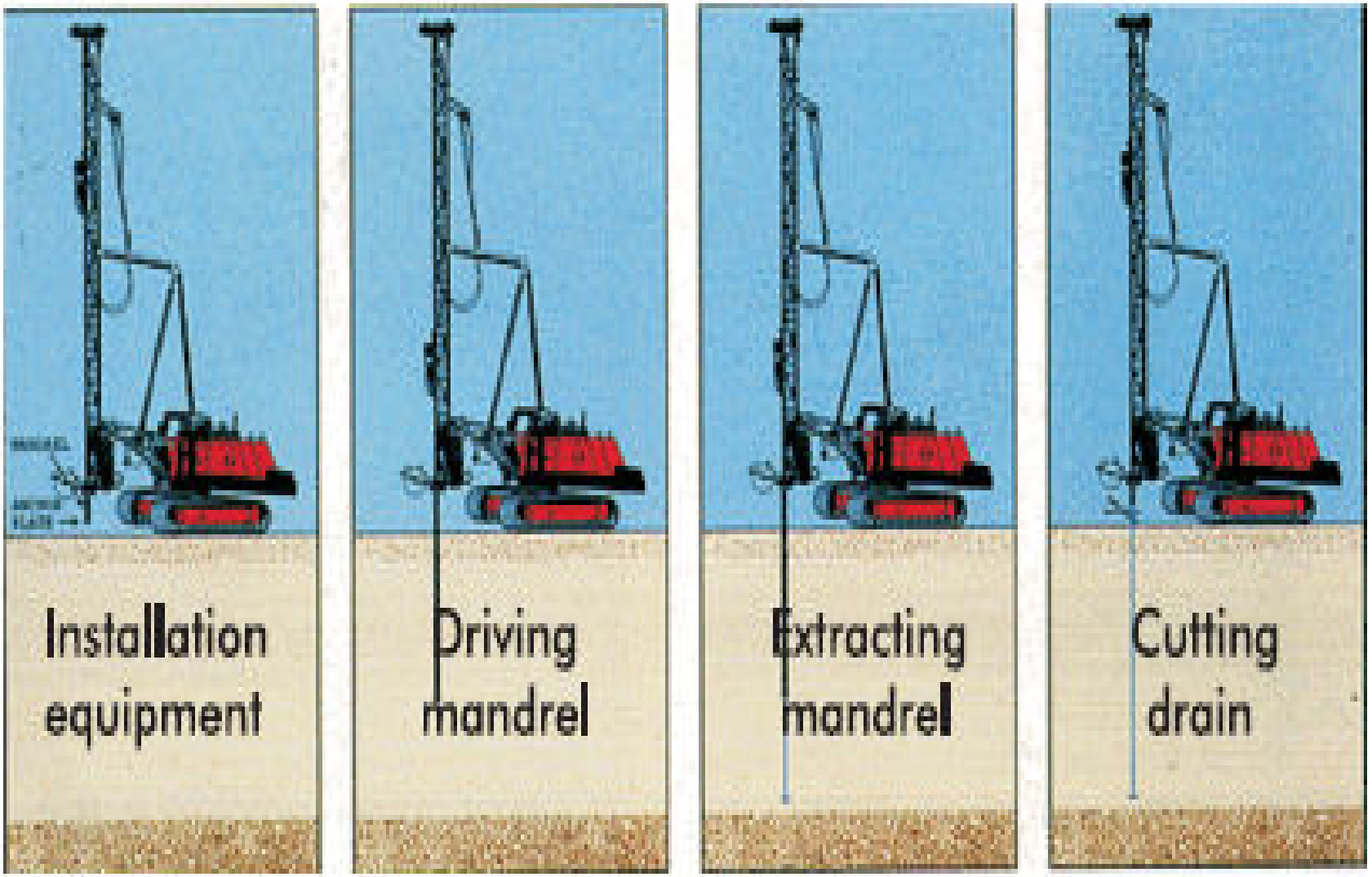
Sub –soil Condition

- Clay in saturated condition with very low shear strength
- Liquid limt above 100-%
- Plastic limit : 40-42%
- Density: 1.5-1.6 g/cc
- Coeff. of consolidation: 1.0-1.25 m^2/year

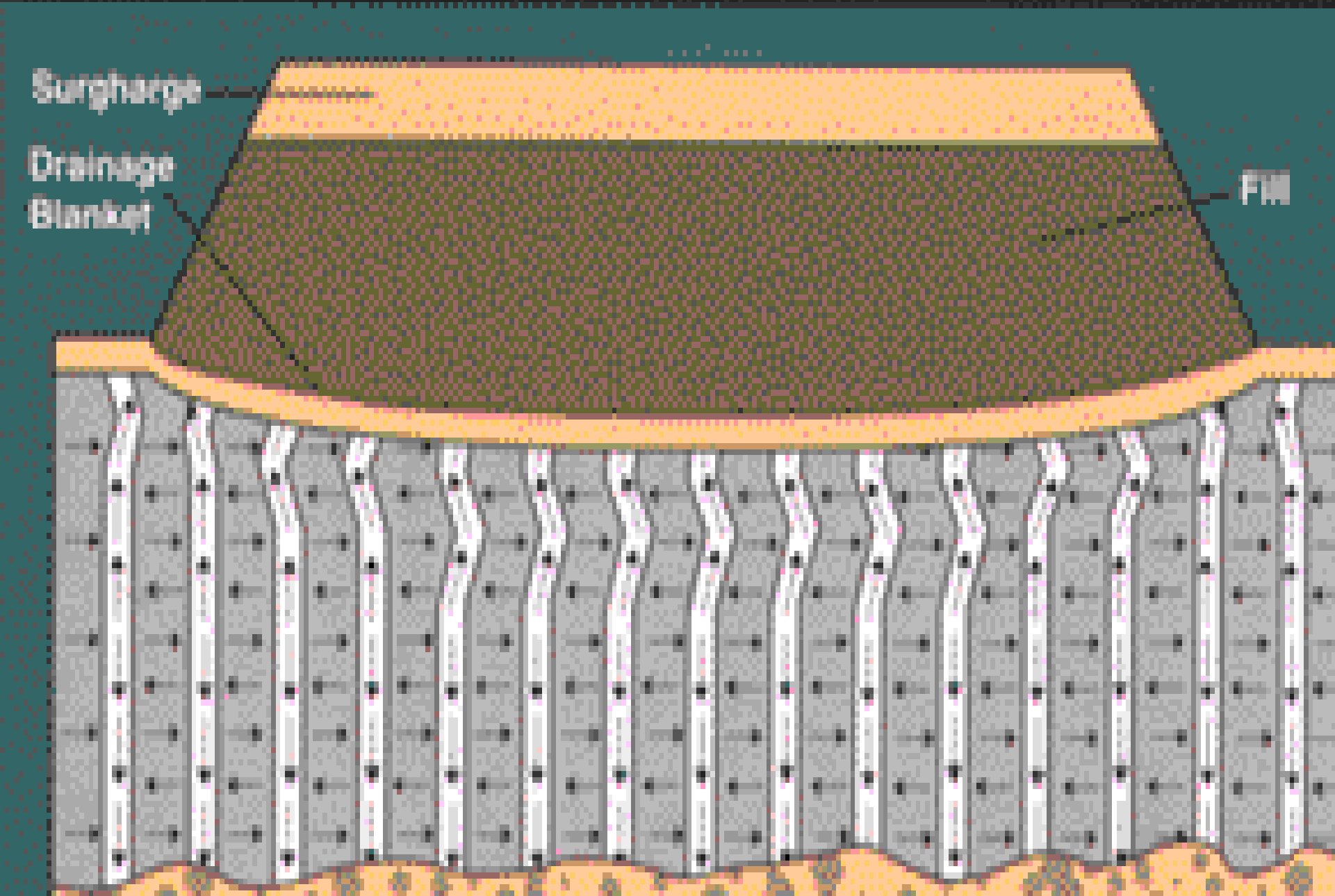
Solution to Problem

- Install PVDs and stage loading of the embnankment fill to accelerate consolidation process.
- Use a suitable geotextile basal reinforcement considered necessary for stability during embankment construction.
- Geotextiles act as a separator between the embankment fill and drainage filter blanket.


Inner Core
Outer Filter Jacket


Installation equipment
Driving mandrel
Extracting mandrel
Cutting drain

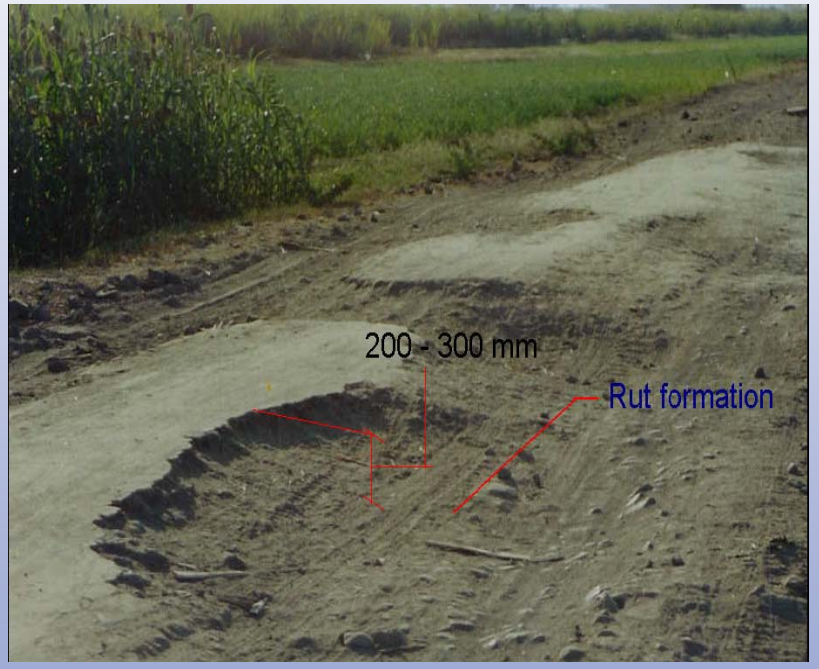
WITH VERTICAL DRAINS



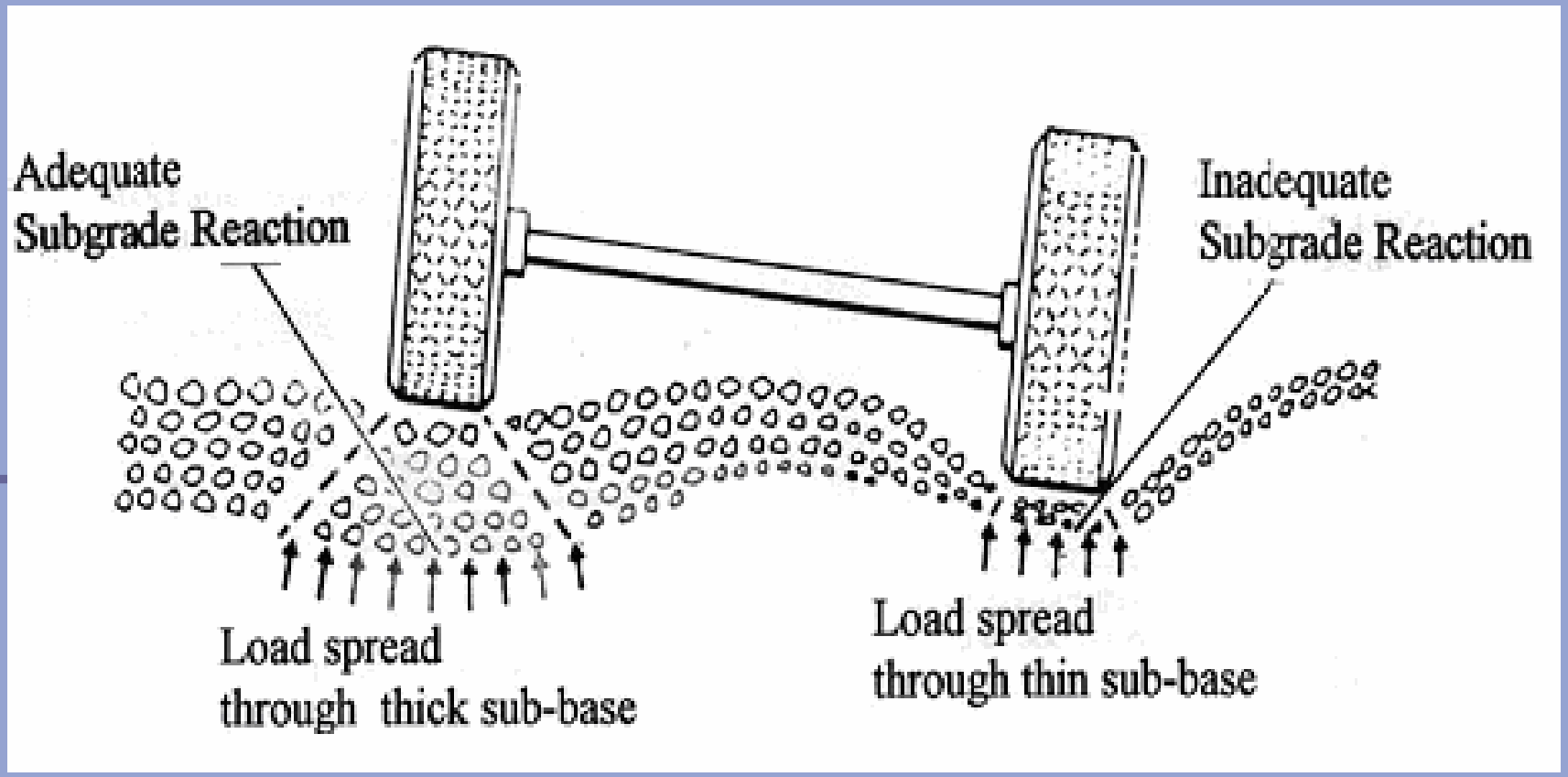
Case Study No II on State Highways

Problem:

- Rut depths of 200 -300 mm were observed.
- Every year new road is constructed.
- A non-uniformity in load spreading phenomena occurs.



Load Spreading Phenomenon of Sub-base on Sub Grade



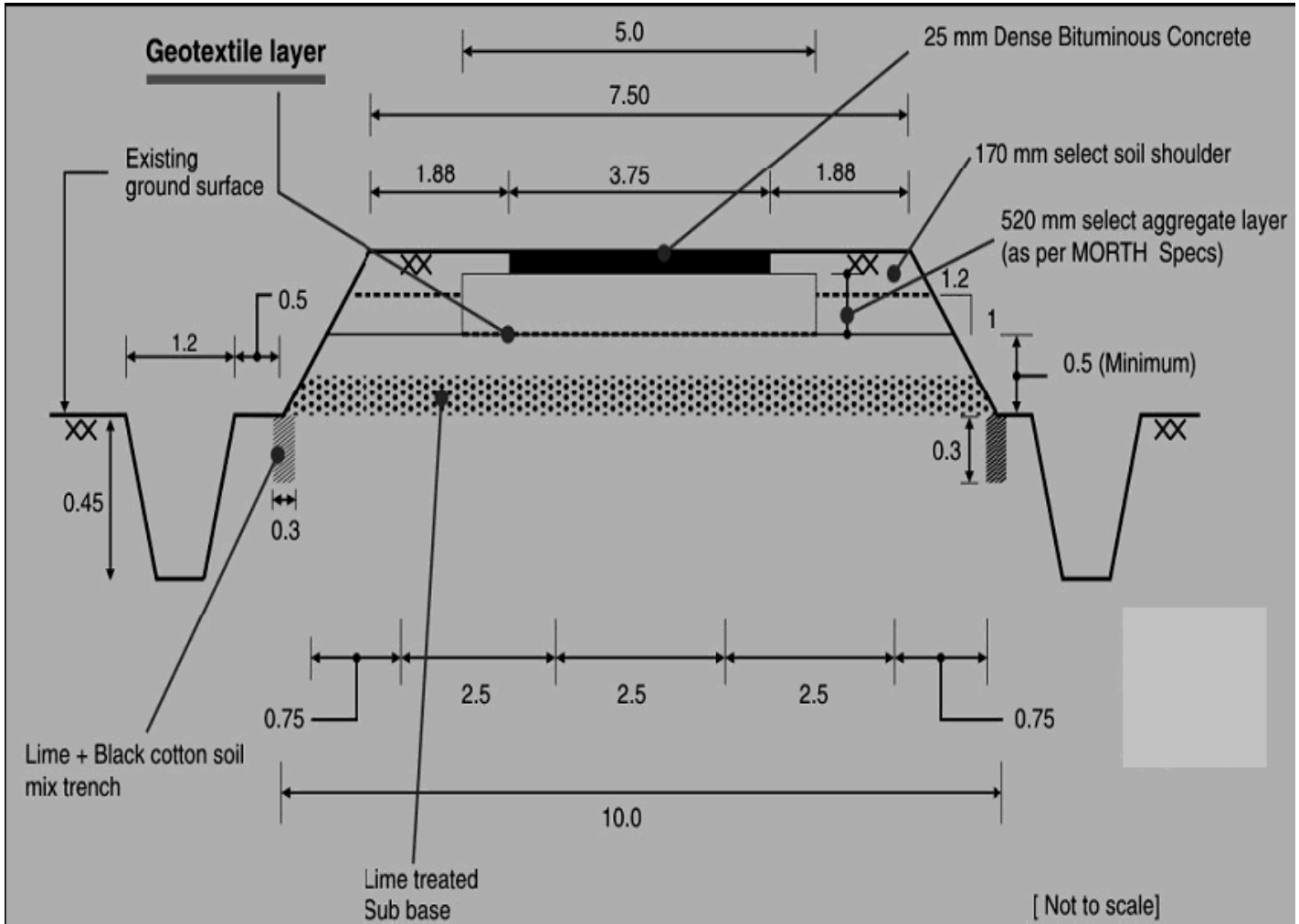
Properties of Soil

- Black cotton soil
- Clay (<0.002mm) ; 62%
- CBR (%)

  unsoaked 7.8%

  soaked 1.8
- Undrained cohesion : 52.5 kN/m^2
- Free Swell (%) 93

Cross-section of Geotextile Reinforced Road



Status of Road in Sept, 2003

Status of Road in Sept, 2004

Status of Road in Sept 2005

Case Study III:

Erosion control Measures

For the Bhagirathi river

Prachin Mayapur at Nabadwip in the district of Nadia,

West Bengal

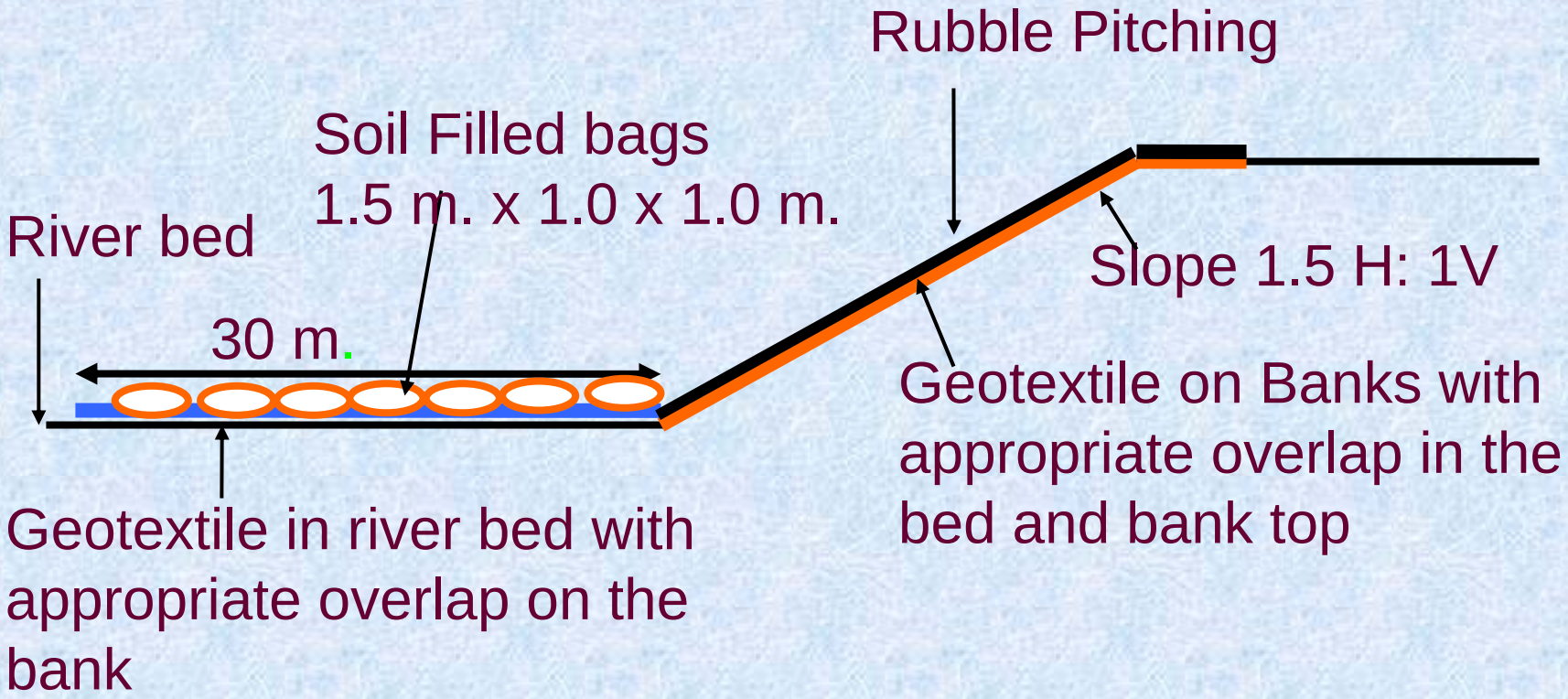
Photographs of Bhagirathi river Before Geotextile Installation

Photographs of Bhagirathi river Before Geotextile Installation

Solutions to Problem

- Analyzing the site conditions,
- Collection of samples from the sections of river
- Testing of soil samples for its grain size distribution
- Design and recommendations given by Dr S.Y.Mhaiskar of Sardar Patel College of Engineering

Proposed cross section for Erosion Control



Specification of Geotextile recommended

Parameters		KP-70
Mass per unit area (g/m2)		240
Tensile strength, kN/m (D-4595)	warp weft	60 45
% Elongation at break (IS-1969)	warp weft	37 22
Grab Tensile strength, (N) (ASTM D-4632)	warp weft	2000 1400
Trapezoidal Tearing Strength, N (ASTM D-4533)	warp weft	800 500
Water permeability, (D-4491) At 5cm water head	lits/m2/sec	8
Index Puncture Resistance, (N) (ASTM D-4833)		600
Apparent Opening Size (mm) (D-4751)		$\leq$75 microns

Photographs of Geotextile Installation

Photographs of River after Geotextile Installation

NAIP Project on Rubber Dam

To Develop Suitable Fabric Substrate for Flexible Rubber Dams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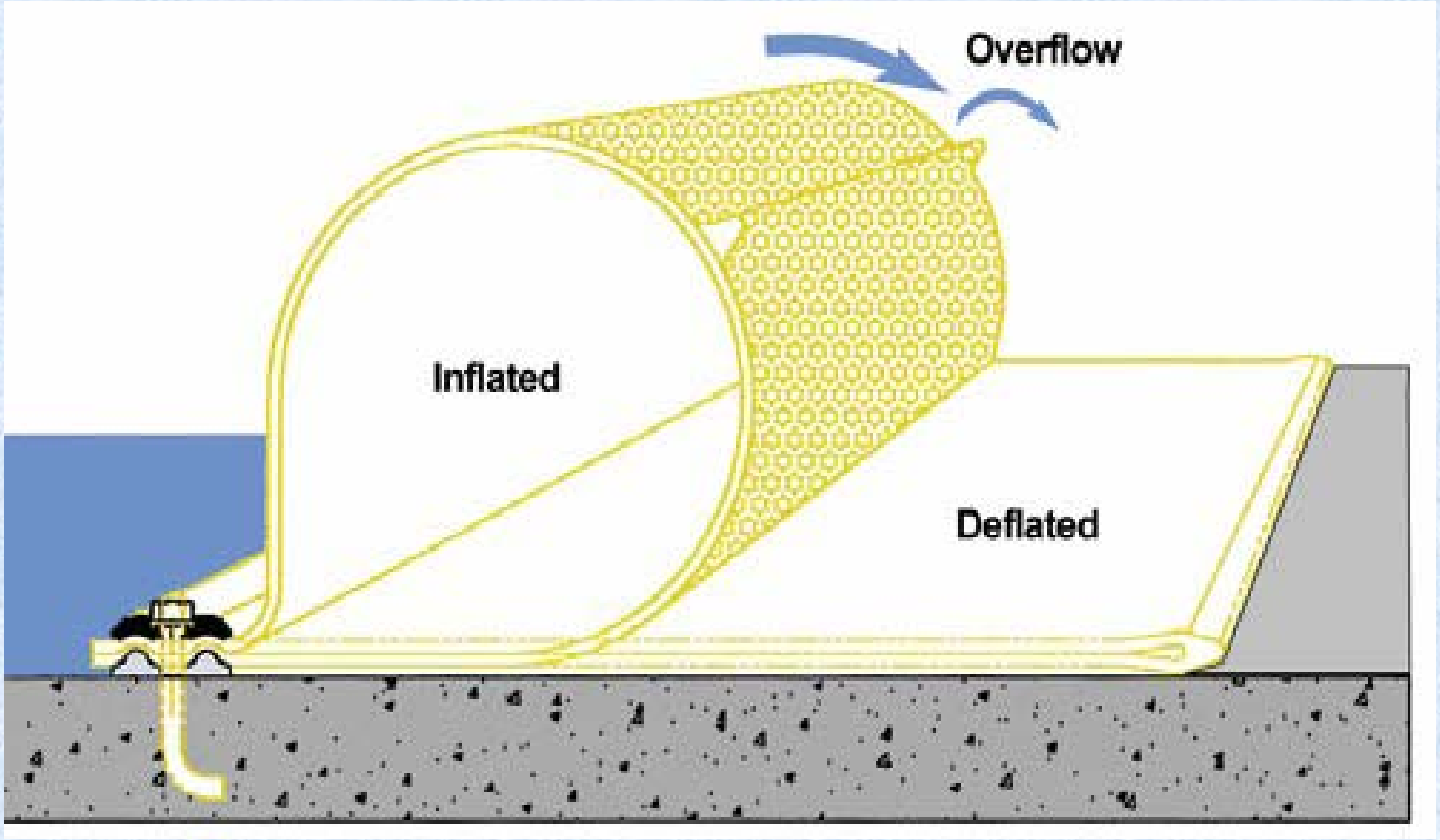
RUBBER DAM STRUCTURE

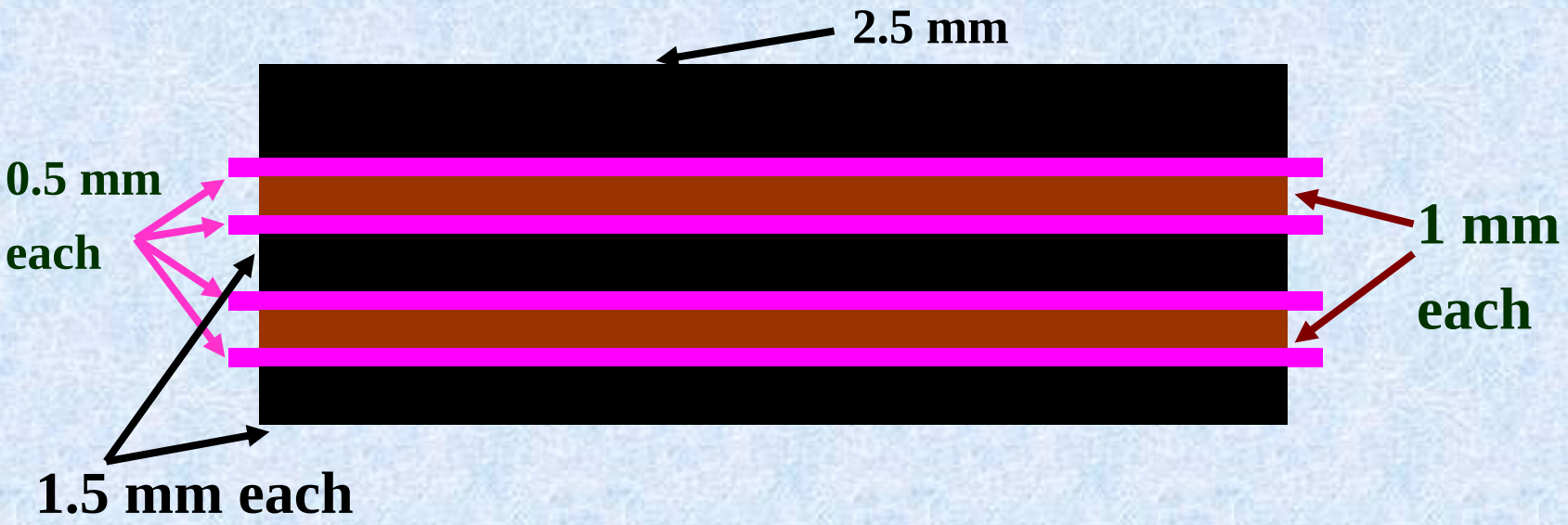
A Rubber Dam consists of four parts

- **A rubberized fabric dam body**
- **A concrete foundation**
- **A control room housing (inflation & deflation mechanisms)**
- **An inlet / outlet piping system**

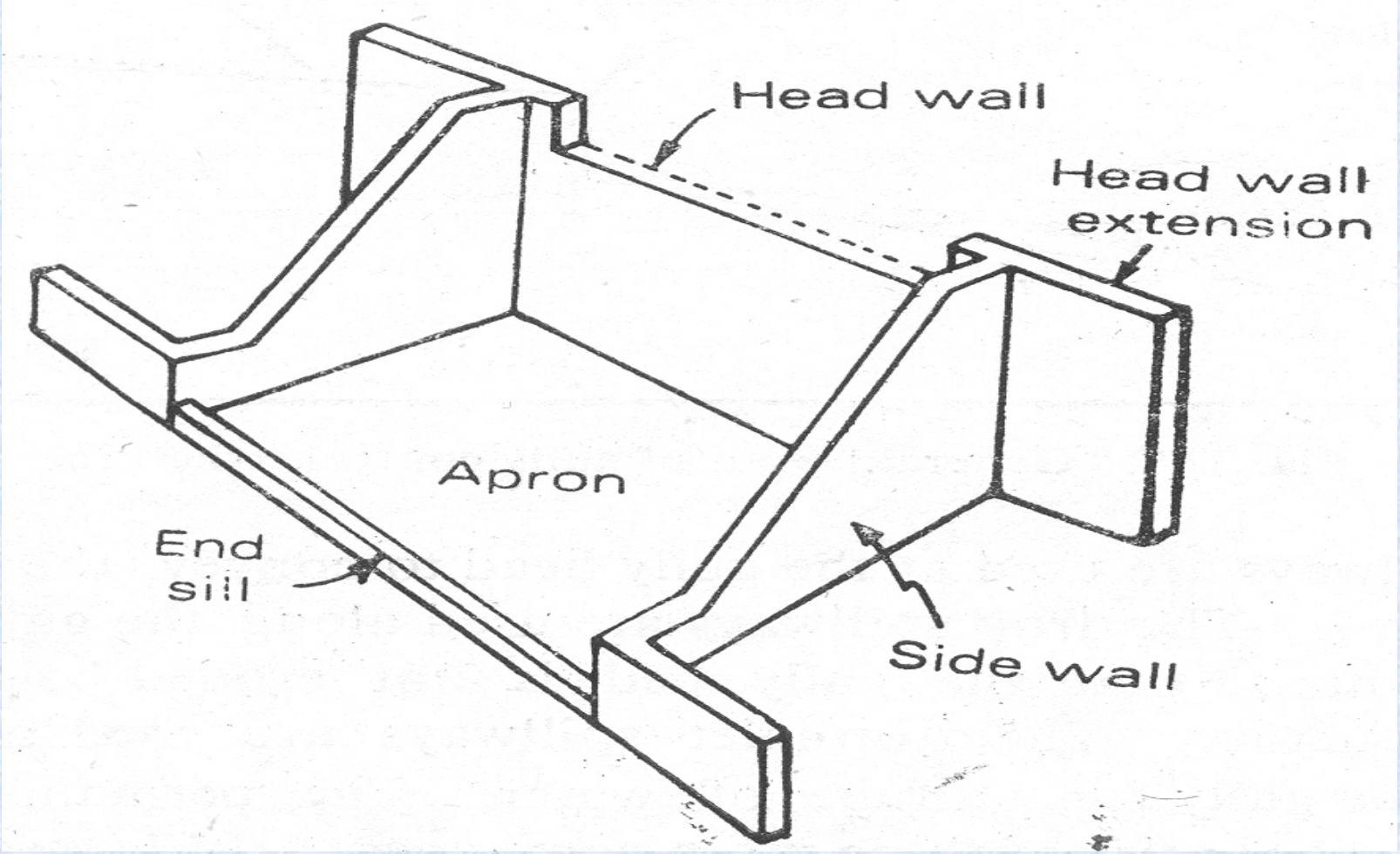
RUBBERIZED FABRIC DAM BODY



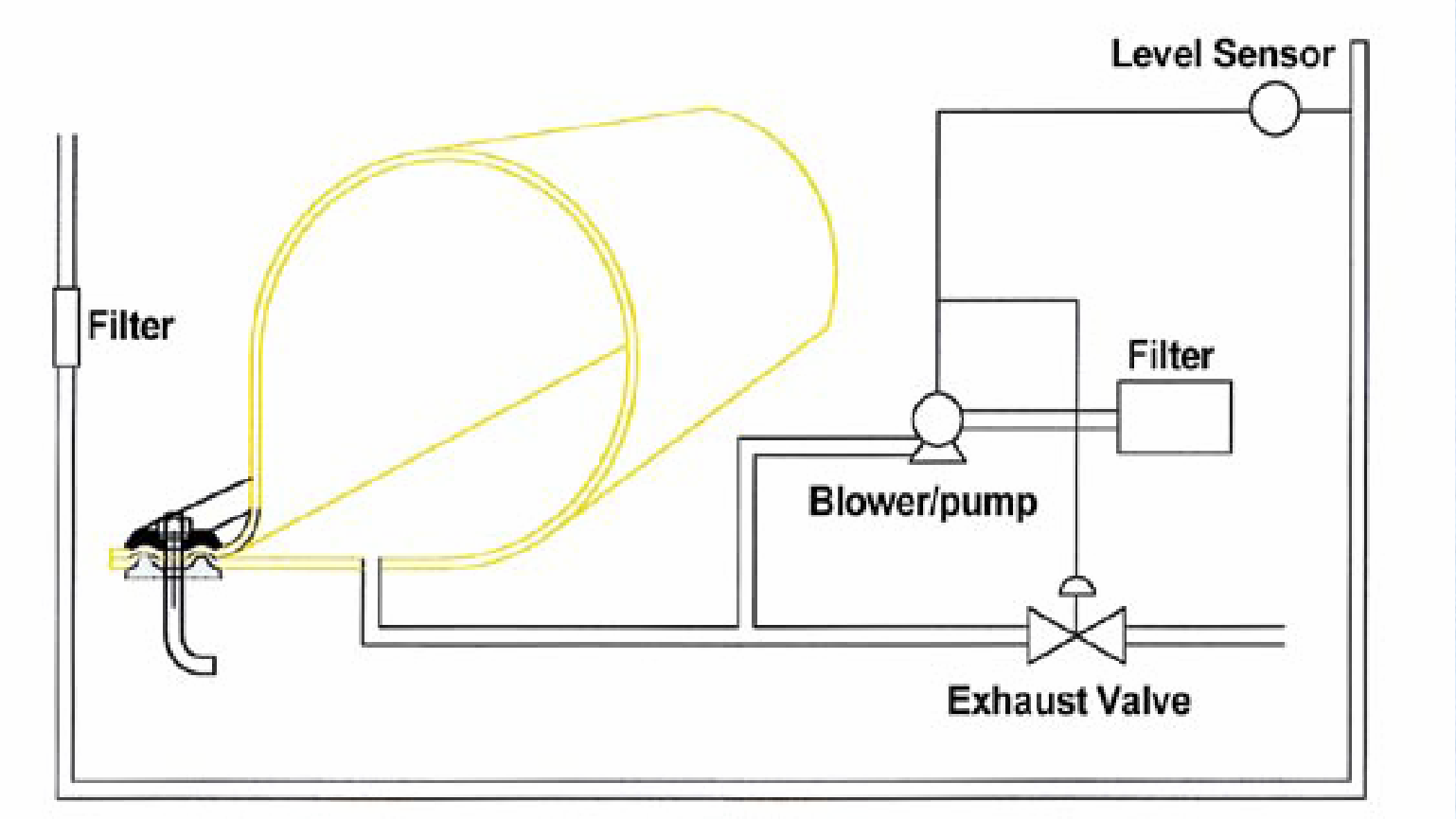
TENTATIVE LAYOUT OF COMPOSITE MATERIAL



CONCRETE FOUNDATION



INFLATION & DEFLATION MECHANISM



ADVANTAGES OF RUBBER DAM

- Short construction period
- Easy maintenance and repair
- Long span and adaptable to different slopes
- Low project life cycle cost
- Earthquake resistant
- Adaptable to adverse condition
- Environmental friendly

Conclusion

- Geosynthetics meet variety of civil engineering functional requirements.
- Their applications are increasing continuously.
- In Indian Scenario, engineers still lack the confidence of using geosynthetics.

THANK YOU