GEOSYNTHETICS AND REINFORCED SOIL STRUCTURES

Different Types of Geosynthetics and Their Applications

K. Rajagopal, Professor
Department of Civil Engineering
IIT Madras, Chennai
e-mail: gopalkr@iitm.ac.in

RECAP OF PREVIOUS LECTURE

- Introduction
- Historical background
- Early applications
- Functions of geosynthetics
- Types of geosynthetics

OUTLINE OF 2nd LECTURE

- TYPES of geosynthetics

  - - - - CONTINUED

- TYPICAL APPLICATIONS

TYPES OF GEOSYNTHETICS

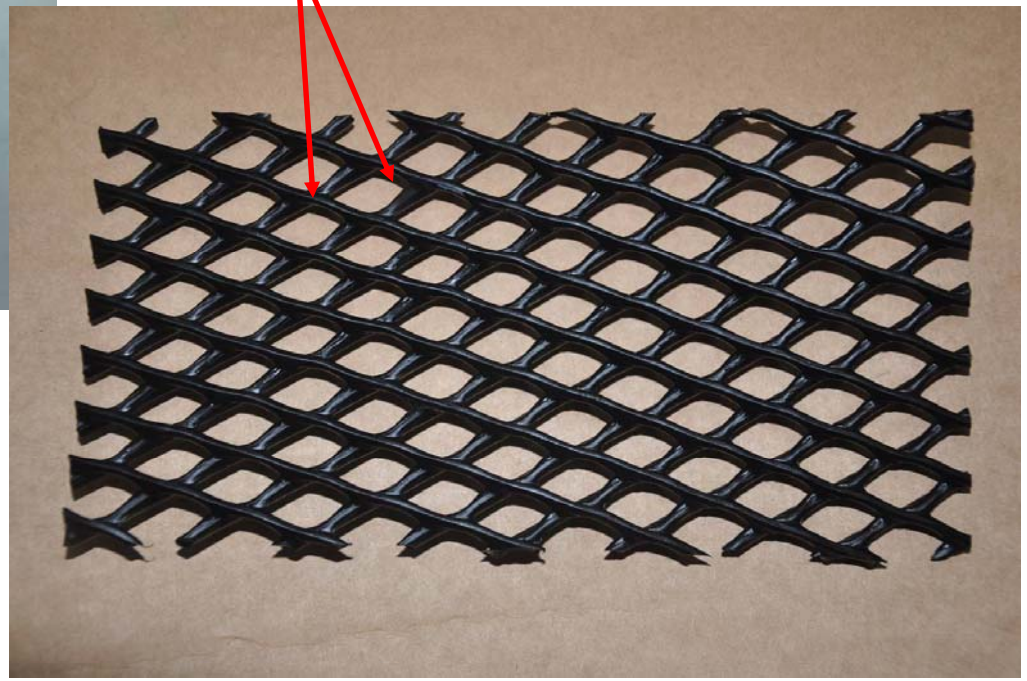
- Geotextiles
- Geogrids
- Geonets
- Geomembranes
- Pre-fabricated vertical drains (PVD)
- Geosynthetic Clay Liner (GCL)
- Geocells (3-d confinement)
- Geocomposites & Geo-others

GEONETS

- Geonets are also planar products
- Consists of ribs in two directions
- Apertures are of diamond shape
- Ribs in the two directions are at different planes
- Thickness of geonets is larger than that of geogrids
- Geonets are also referred to as geospacers

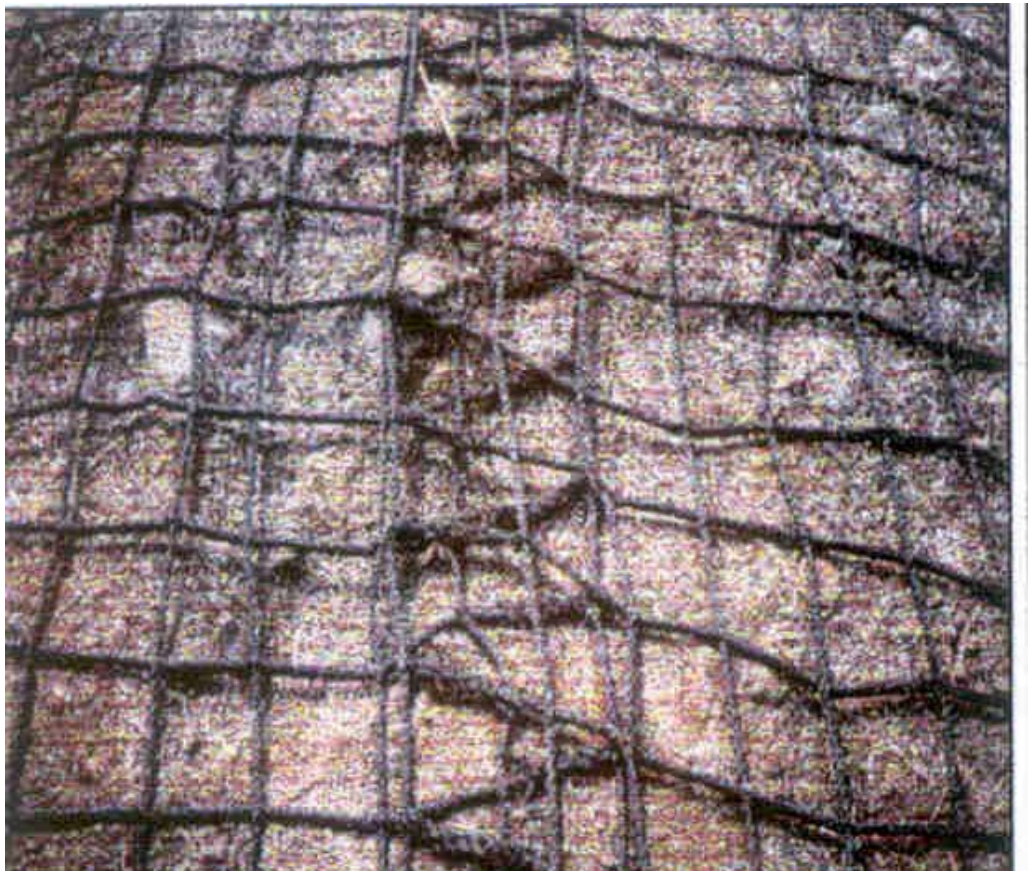
TYPICAL GEONETS

Ribs at two horizontal planes

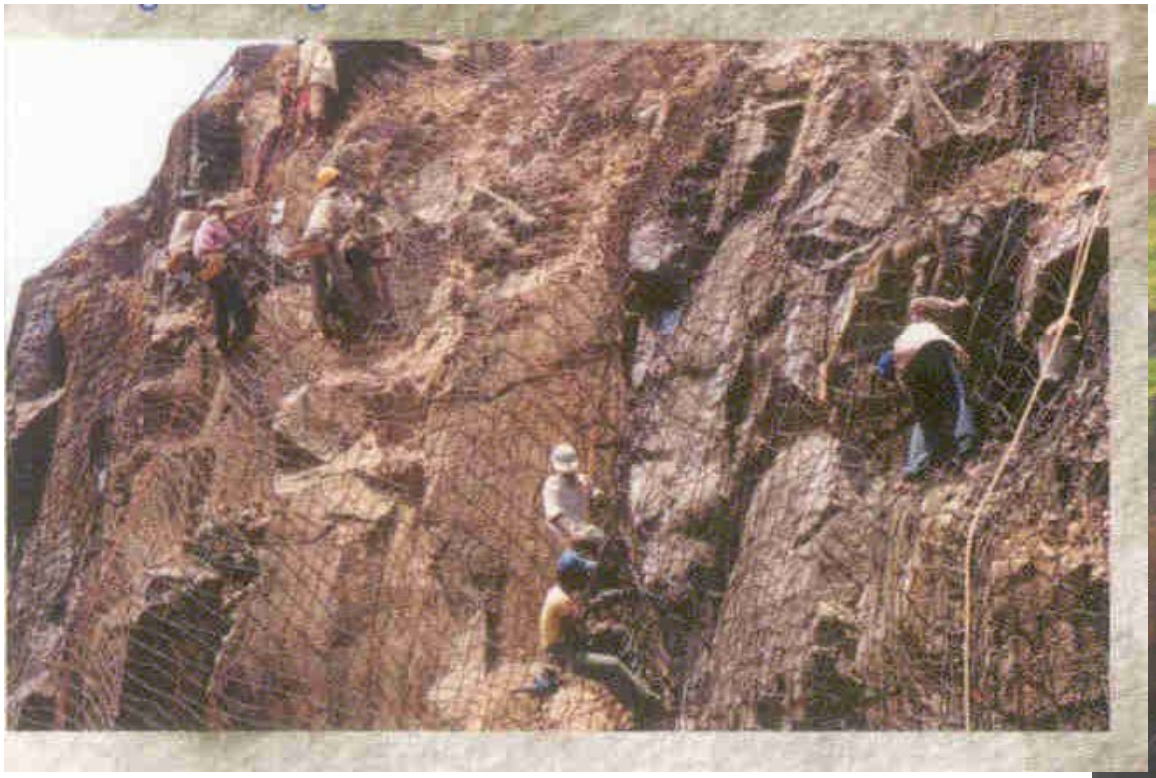


GEONET APPLICATIONS

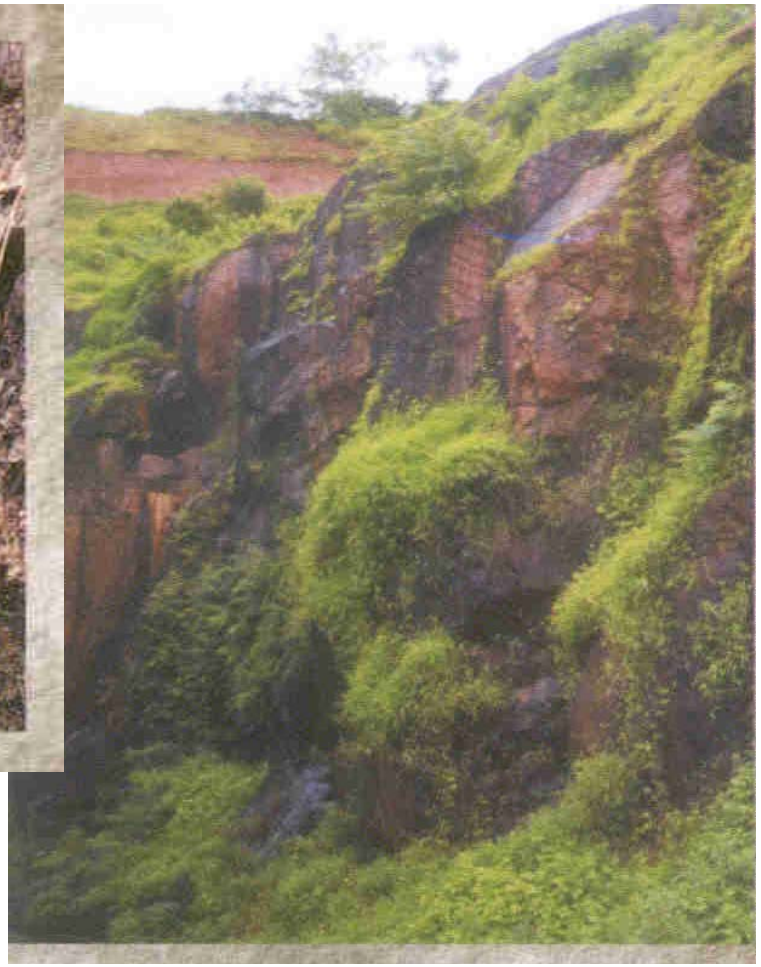
- Erosion control – ribs act as small check dams to slow down the surface runoff – decreases erosion potential of water
- Drainage layers – water flows along the geonet because of large thickness



Boulder net laid on Konkan railway line in Western ghats – functions as guide for loose boulders and vegetation support



Laying of boulder net



Vegetation growth after two seasons

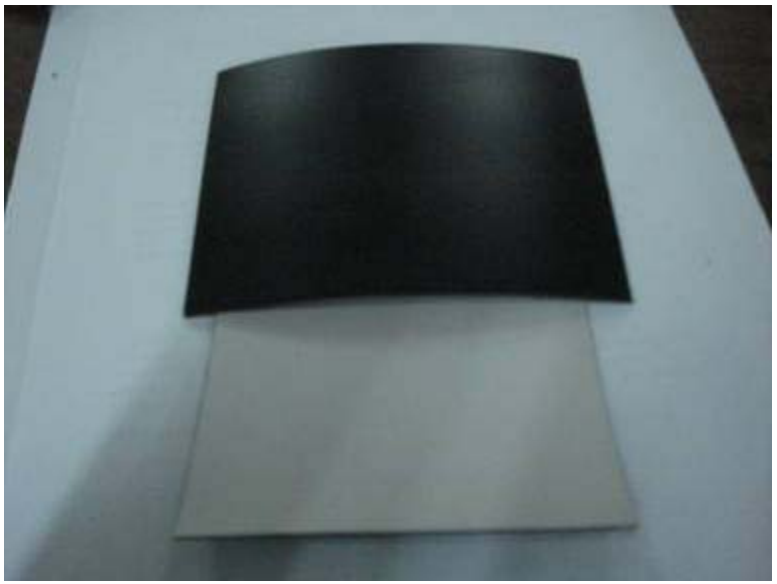
Courtesy: M/s Garware Wall Ropes Ltd., Pune

Anchor trench at the top of the slope, 1m deep, 0.5m wide, filled with soil

GEOMEMBRANES

- Thick impervious plastic sheets
- Thickness .5 mm to 3 mm approximately
- To contain liquids and gases

Rough surface texture



Smooth – double sided membrane

APPLICATIONS OF GEOMEMBRANES

- Landfill lining
- Canal lining
- Tunnel lining

Geomembrane in a landfill

Canal lining using geomembranes

Concrete lining of surface

geomembrane

Anchor trench

Tunnel lining for moisture protection

Pre-fabricated vertical drains to accelerate the pre-consolidation of soft clay soils

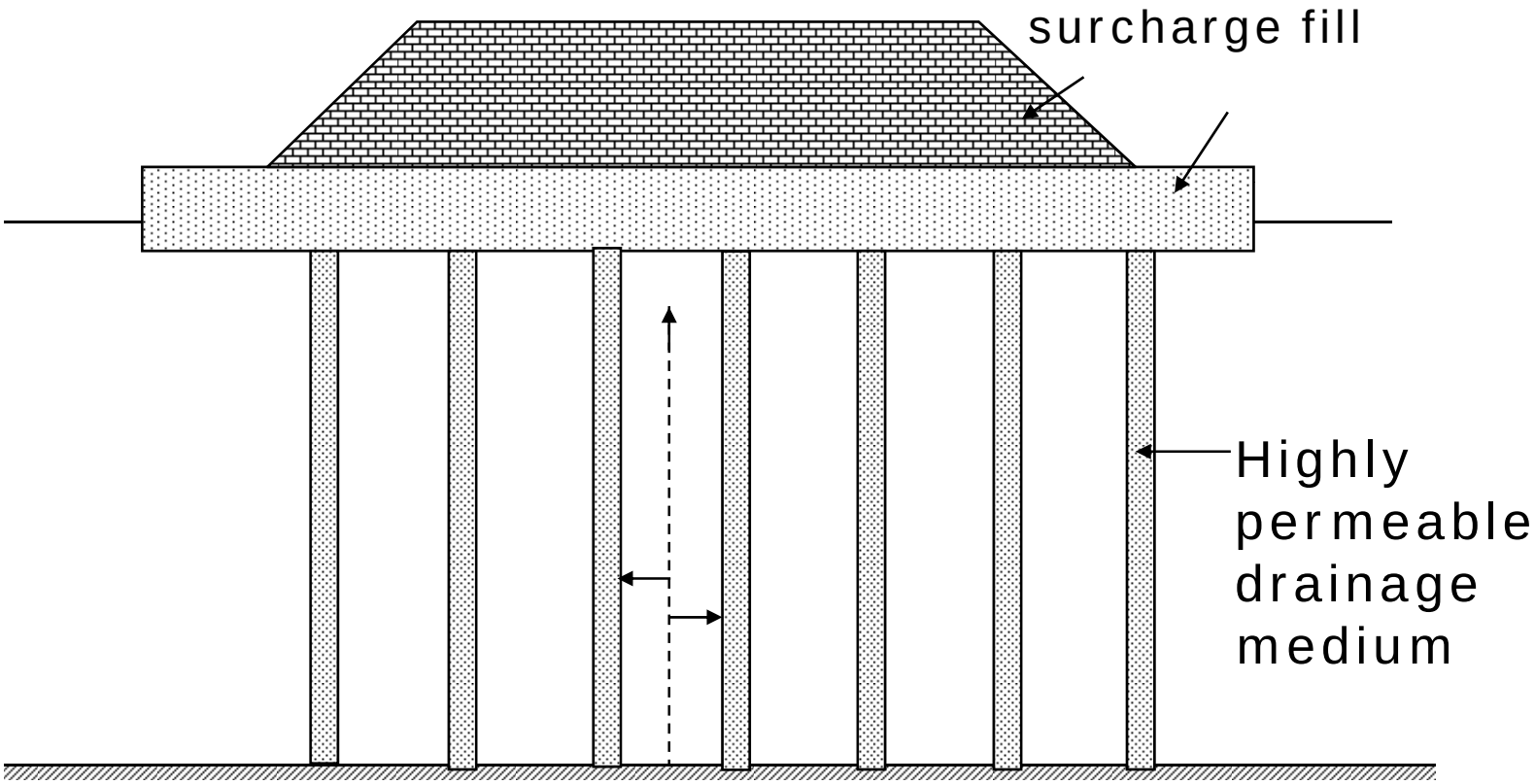
$$T_v = \frac{c_v t}{d^2}$$

$$T_v \Rightarrow f(U\%)$$

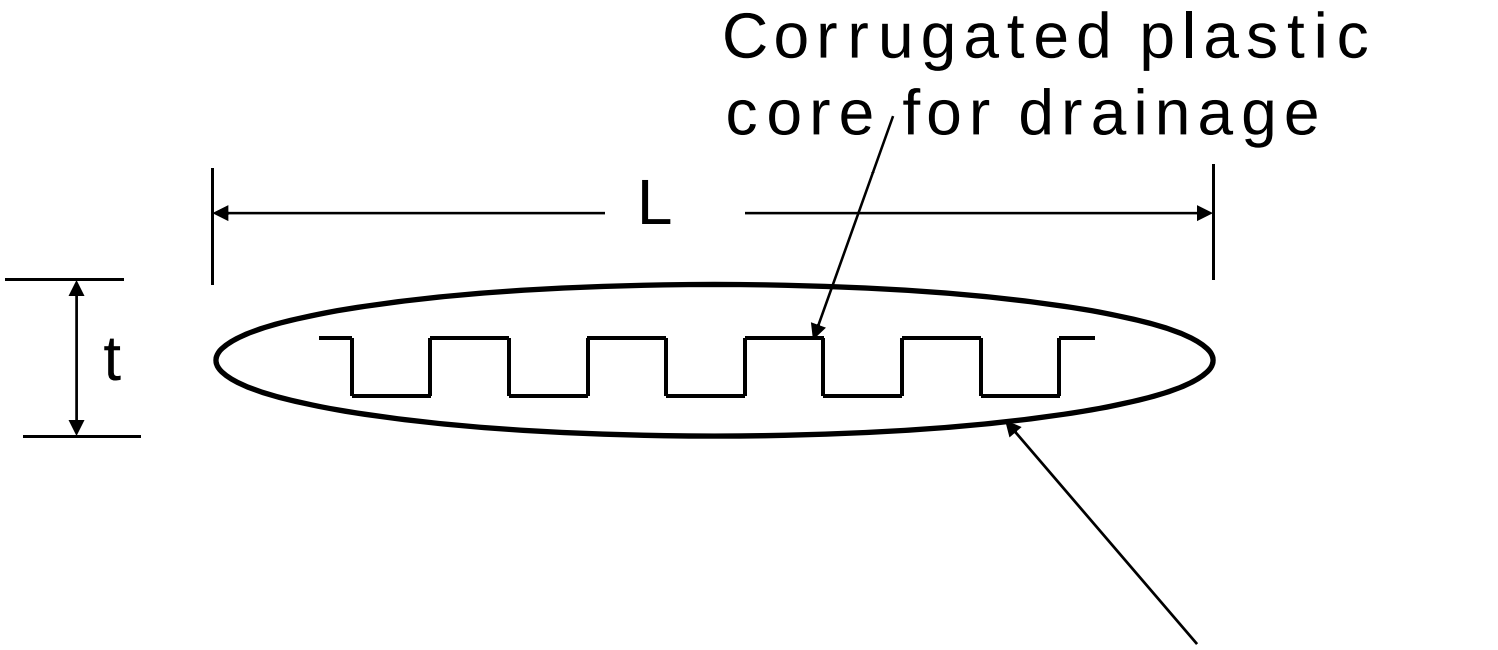
$$t = \frac{T_v d^2}{c_v}$$

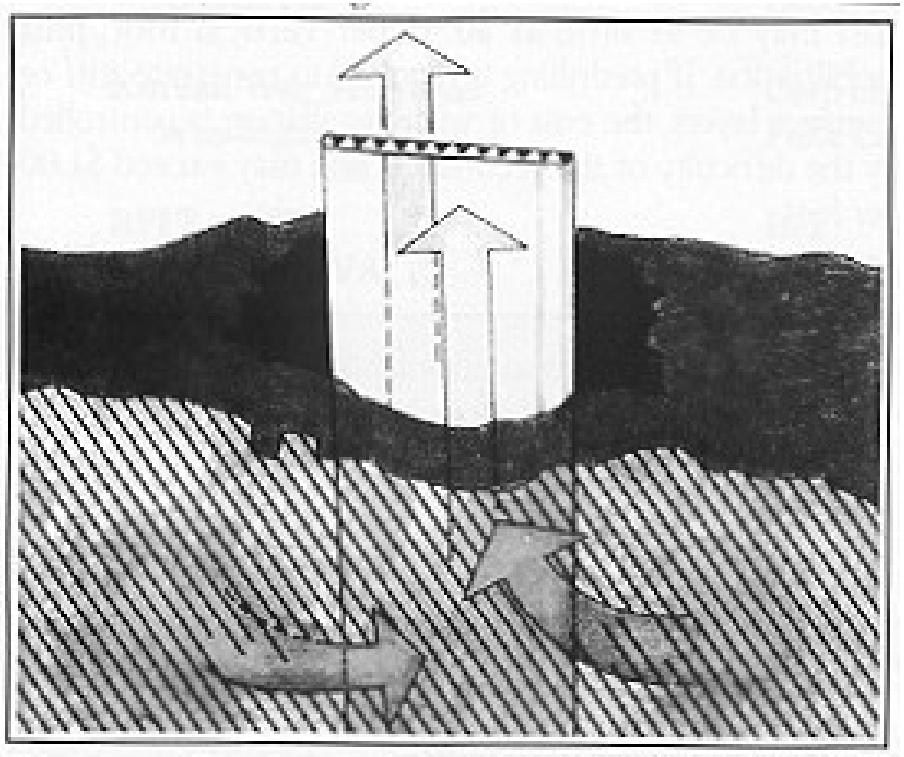
T_v = time factor
t = time
c_v = coefficient of consolidation
d = drainage path length
U% = degree of consolidation

Reducing the flow path length to accelerate rate of consolidation

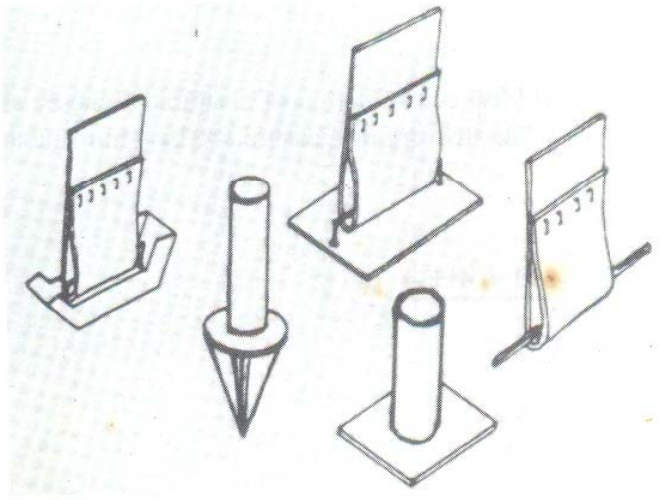


PVDs for pre-consolidation





Pore water flows laterally to the wick drains and is carried through the core



Connection arrangements for wick drain installation

Installation of PVDs at a construction site – notice the connection of PVD with the anchor plate

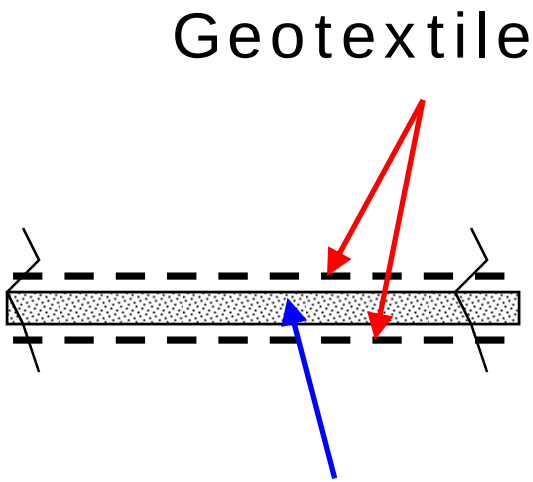
PVD being pushed into the ground

General view after installation of PVD’s at a site

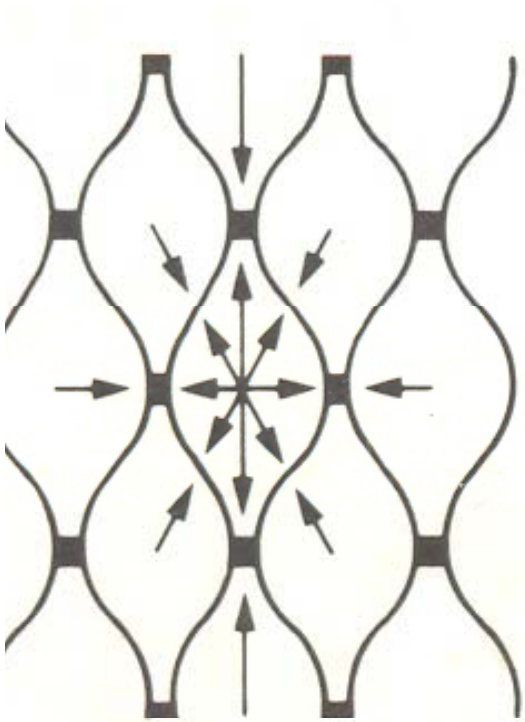
Geosynthetic Clay Liners

- Consist of a core of bentonite clay sandwiched between layers of thick non-woven geotextile
- Applied below and above geomembrane layers in landfills
- Self-repair mechanism
- Bentonite expands when flid leaks through punctured geomembrane – closes the gap

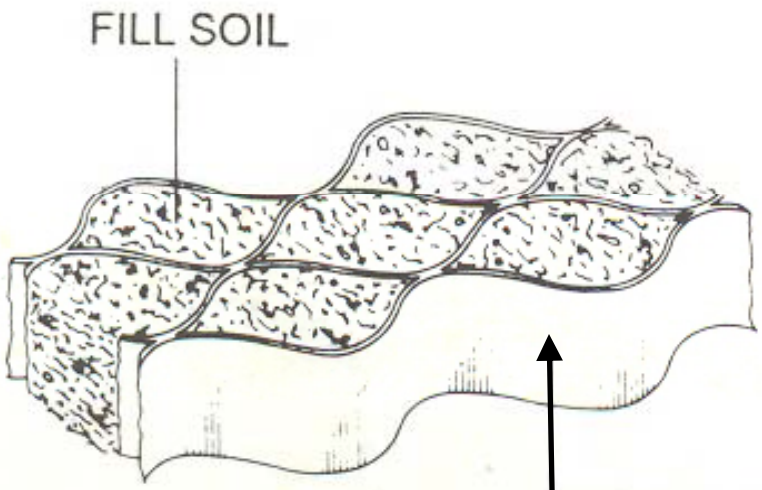
Geosynthetic Clay Liner



GEOCELL – 3d confinement product



Plan view showing the mechanism of confinement



Iso-metric view of a geocell layer

Photograph of an expanded geocell

Advantages

- Easy to transport
- Any fill material can be used
- All round confinement to soil
- Semi-rigid layer (very stiff support)
- Spreads loads over a large area
- Excellent support even under cyclic loads.

APPLICATIONS

- Erosion control
- Steep slopes and retaining walls
- Sub-base support
    - **Road bases**
    - **Railway tracks**
    - **Container yards**

Use of geocells for construction of unpaved road Factory

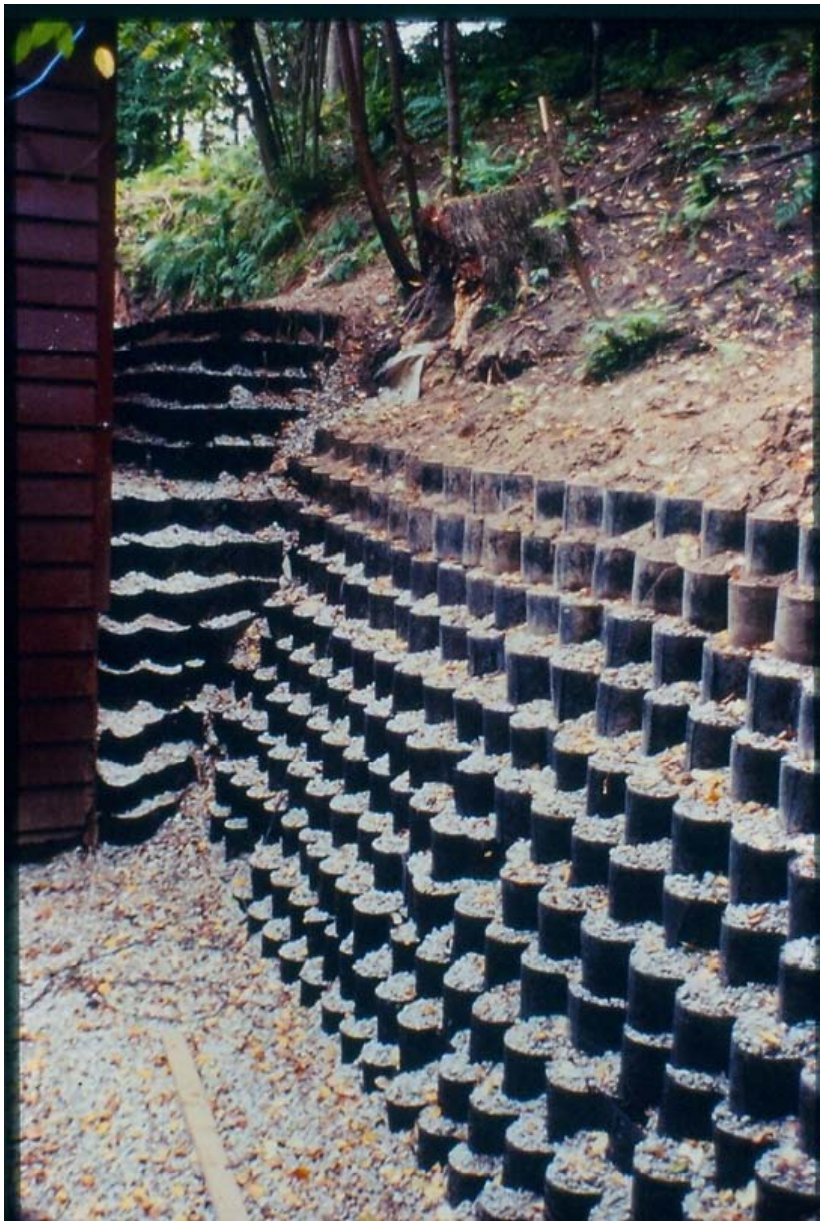
Preparation of ground

Stapling to join different geocells

Stretching of the geocell layer

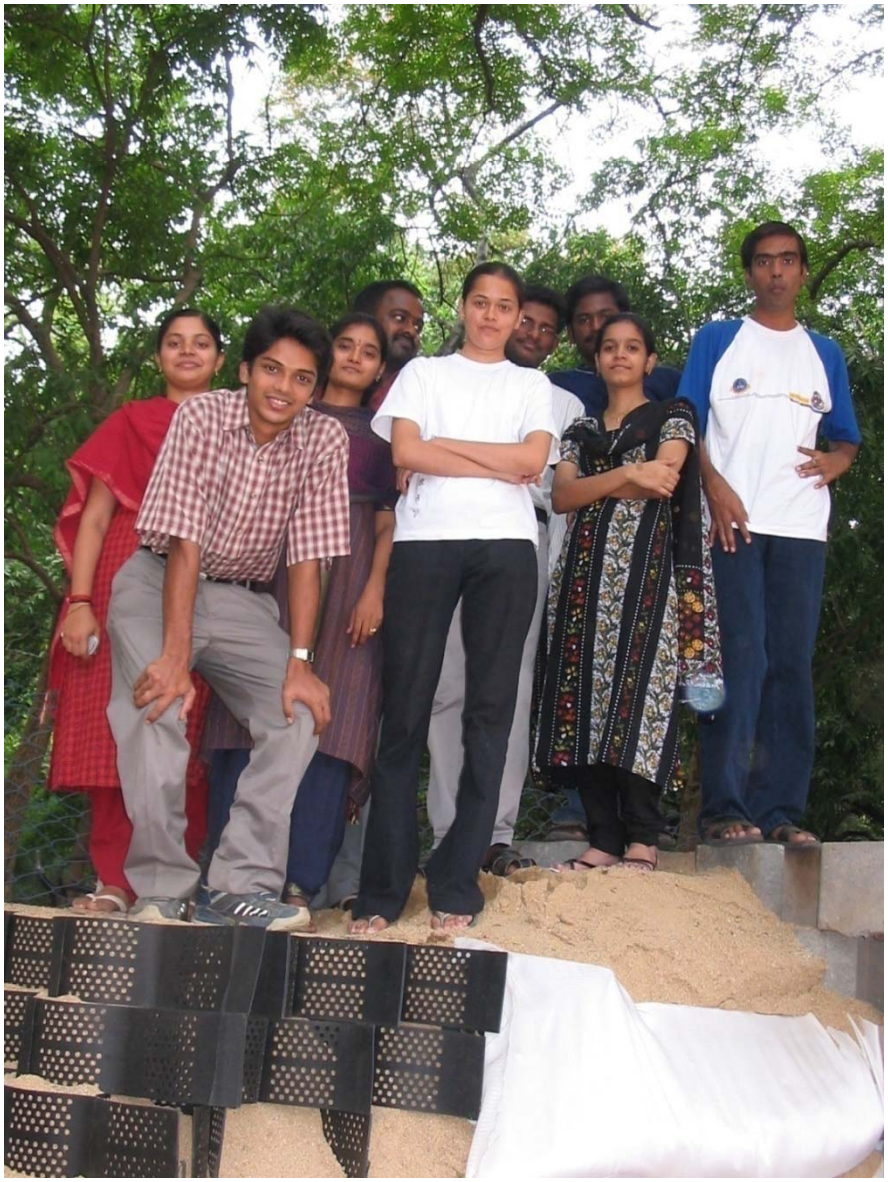
Stone aggregate filled in geocell pockets

Compaction by a 10 tonne roller



Geocells used for construction of a steep slope

Vegetation taking root through geocell pockets



IITM students standing on a geocell supported soil

Typical Container yard – heavy loads, usually constructed on soft marine clays near the shore

Typical mud wave formation in container yards due to heavy loads and extremely soft subgrade soil

Geotextile separator being laid on the ground surface at a container yard

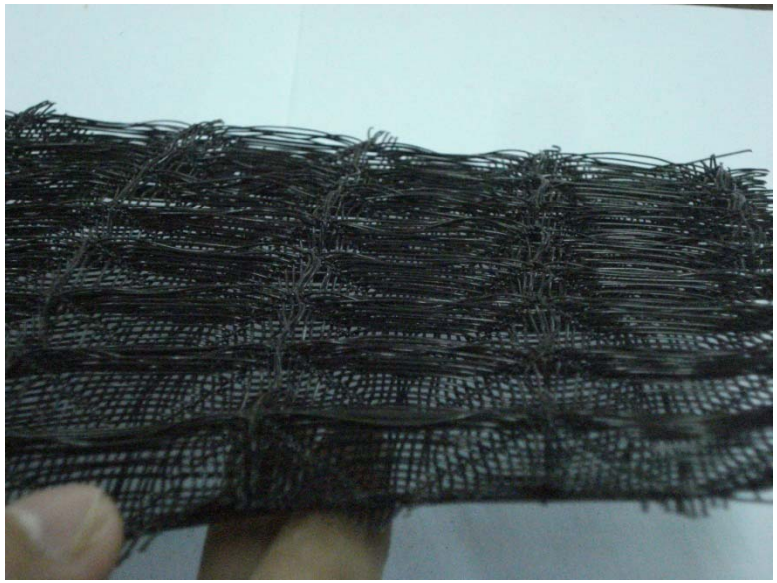
Geocell layer laid on the geotextile separator and filled with stone aggregate

Container yard 3 years after geocell treatment

Some more pictures of the same yard

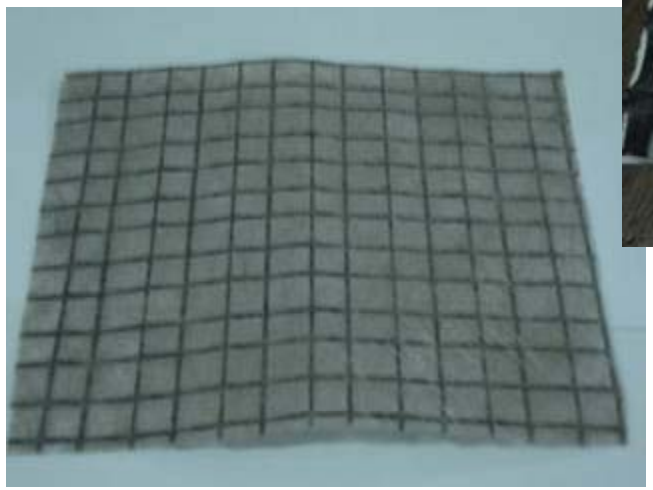
Perfectly level surface – minor damage in paver blocks

Polymeric erosion control mats



Geocomposites

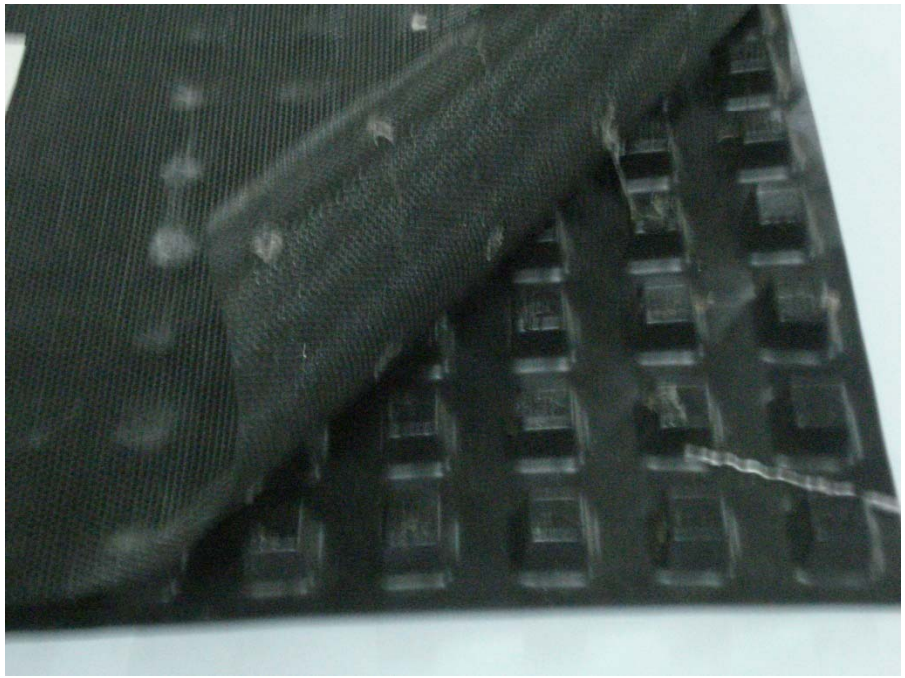
- Combination of two different types of geosynthetics to take advantage of each



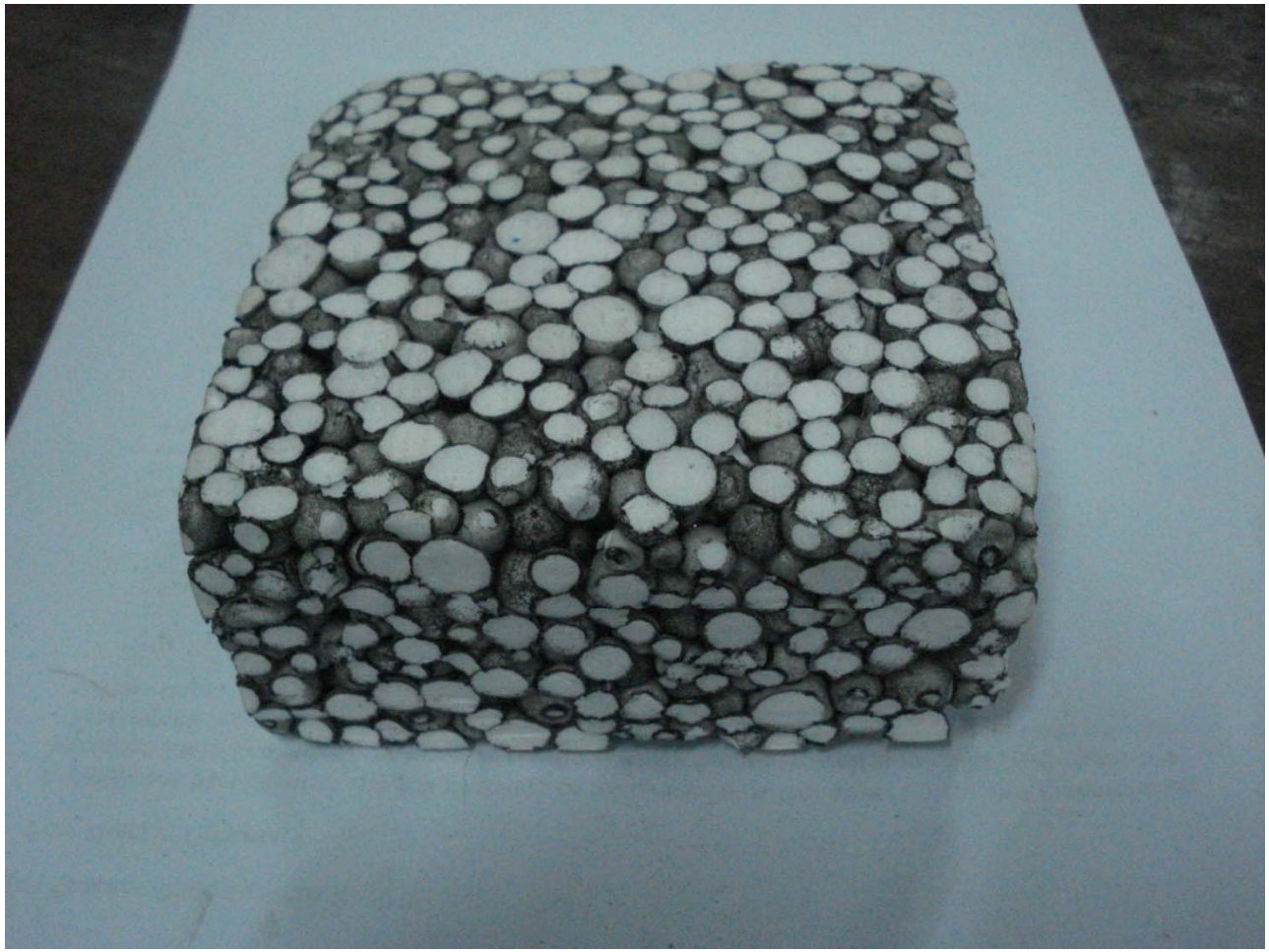
Geo-others

- Geodrains
- Lightweight fills
- Geopipes
- Geotextile bags & soil encapsulation
- Gabions
- Geosynthetic Encased Stone Columns
- Many others – left to the imagination of engineers

Drainage boards for use in Retaining Walls



Light-weight fill cum drainage medium



Thick medium made of polystyrene beads

Gabions filled with stones

Gabions filled with sand bags

SAND FILLED GEOBAGS

PLACEMENT OF GEOBAGS

TYING OF ROPE GABIONS

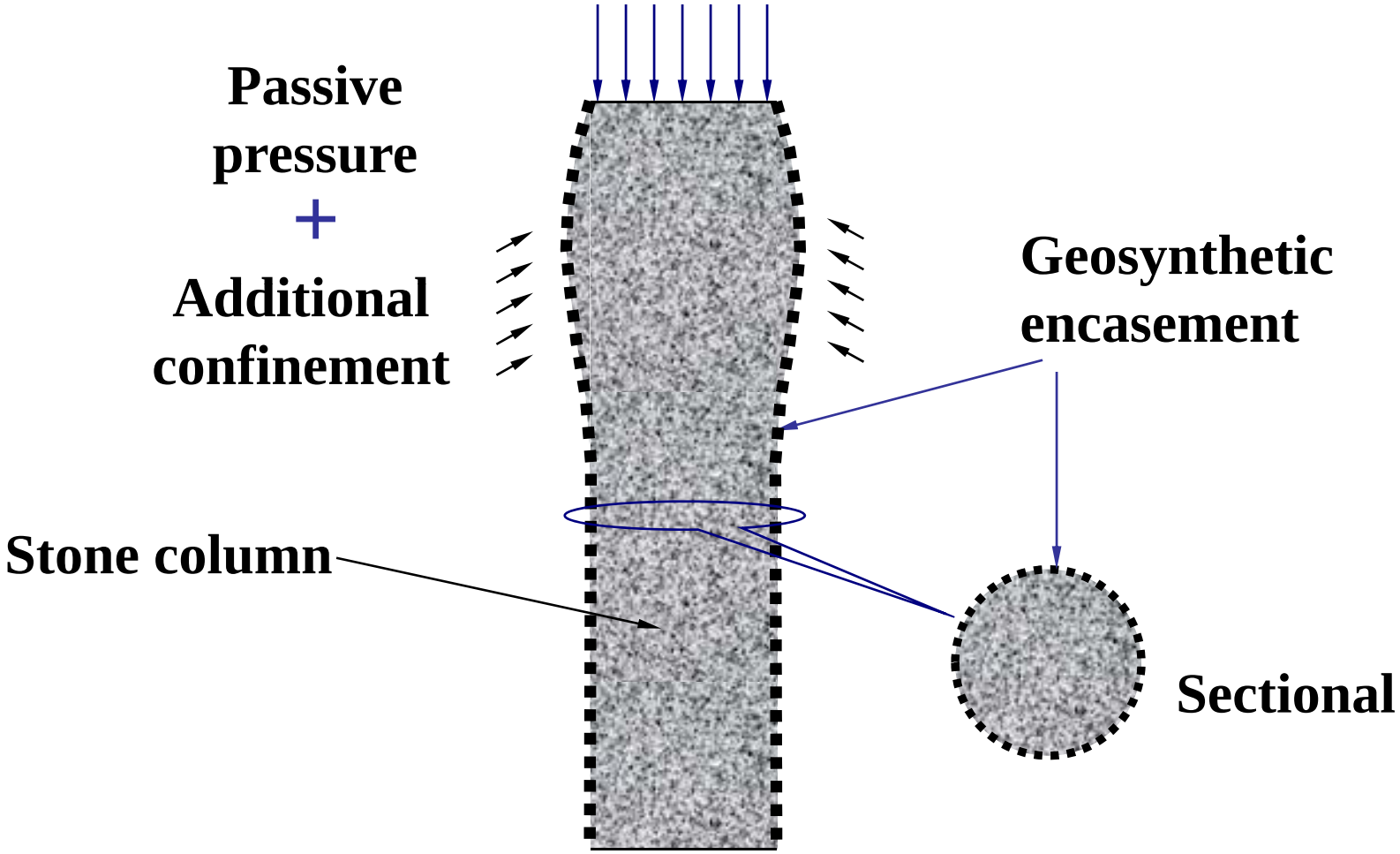
FINAL VIEW

Light-weight drainage medium

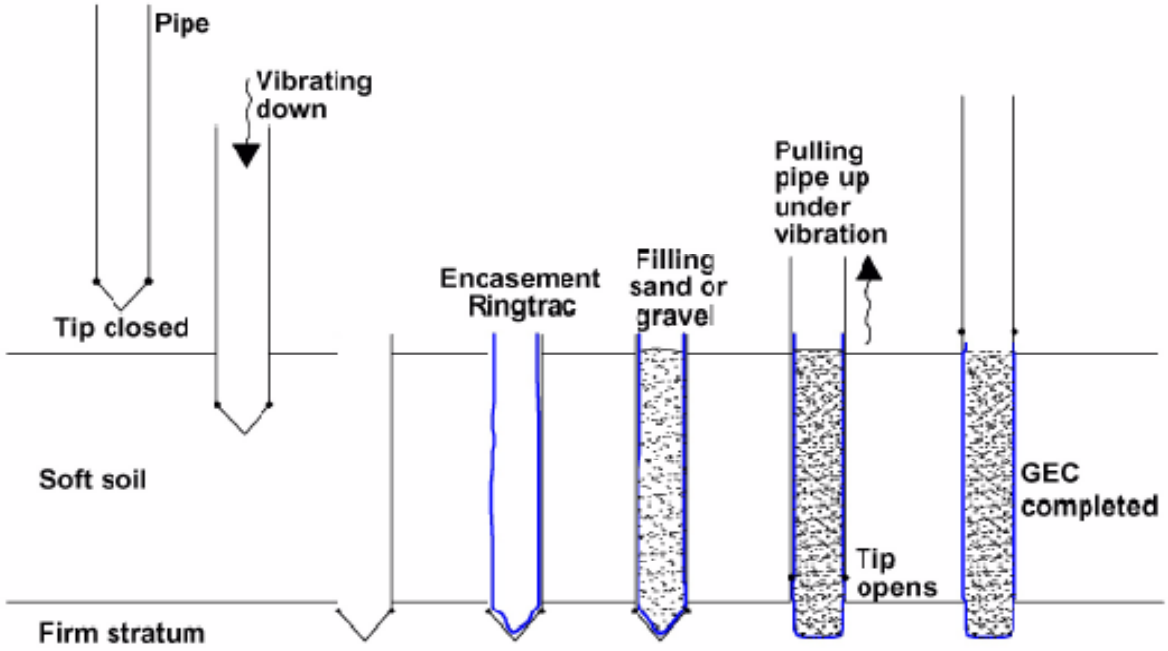
Made of used rubber tyres and other industrial wastes

Encased Stone Column

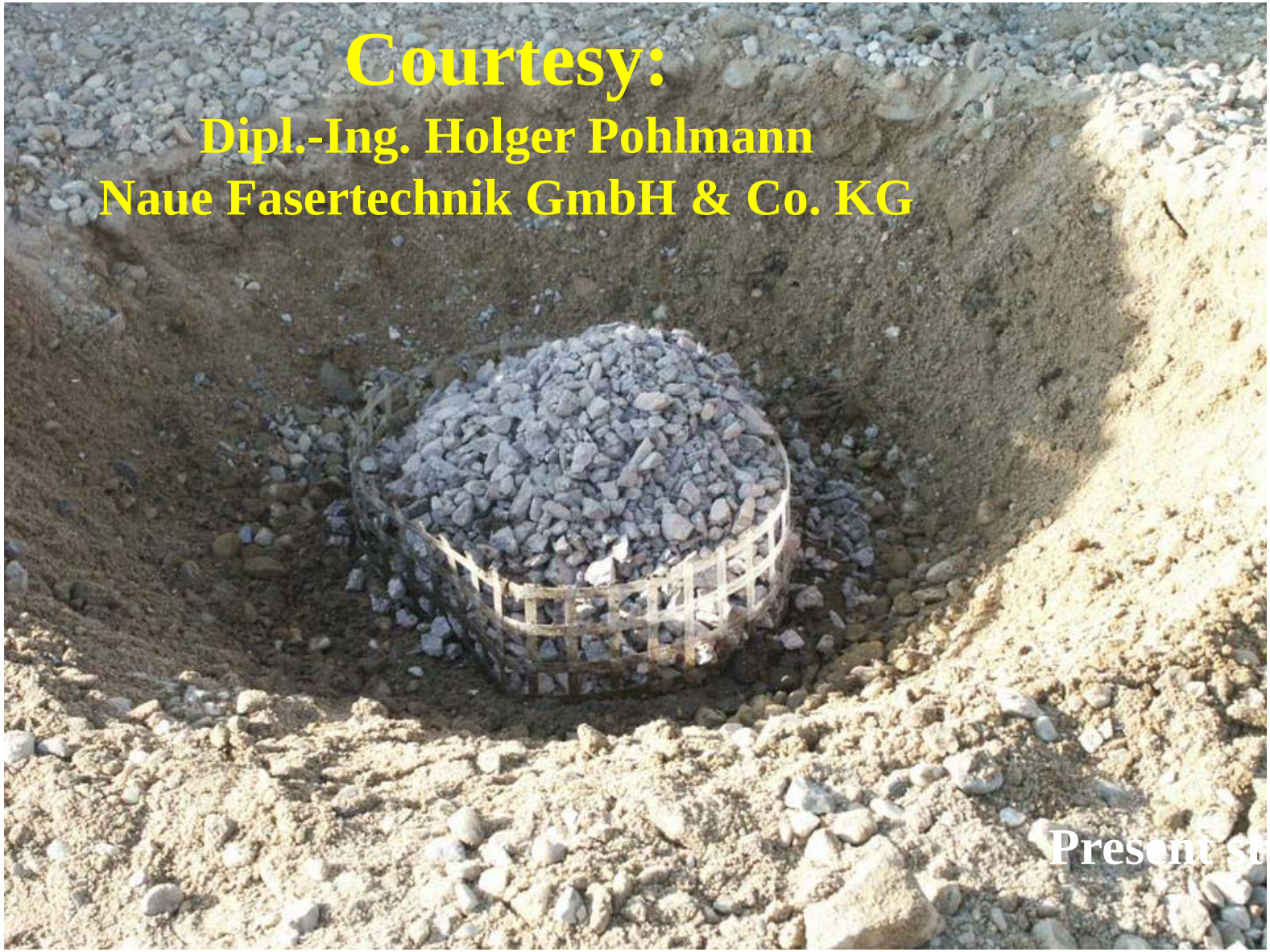
Bearing capacity enhanced by



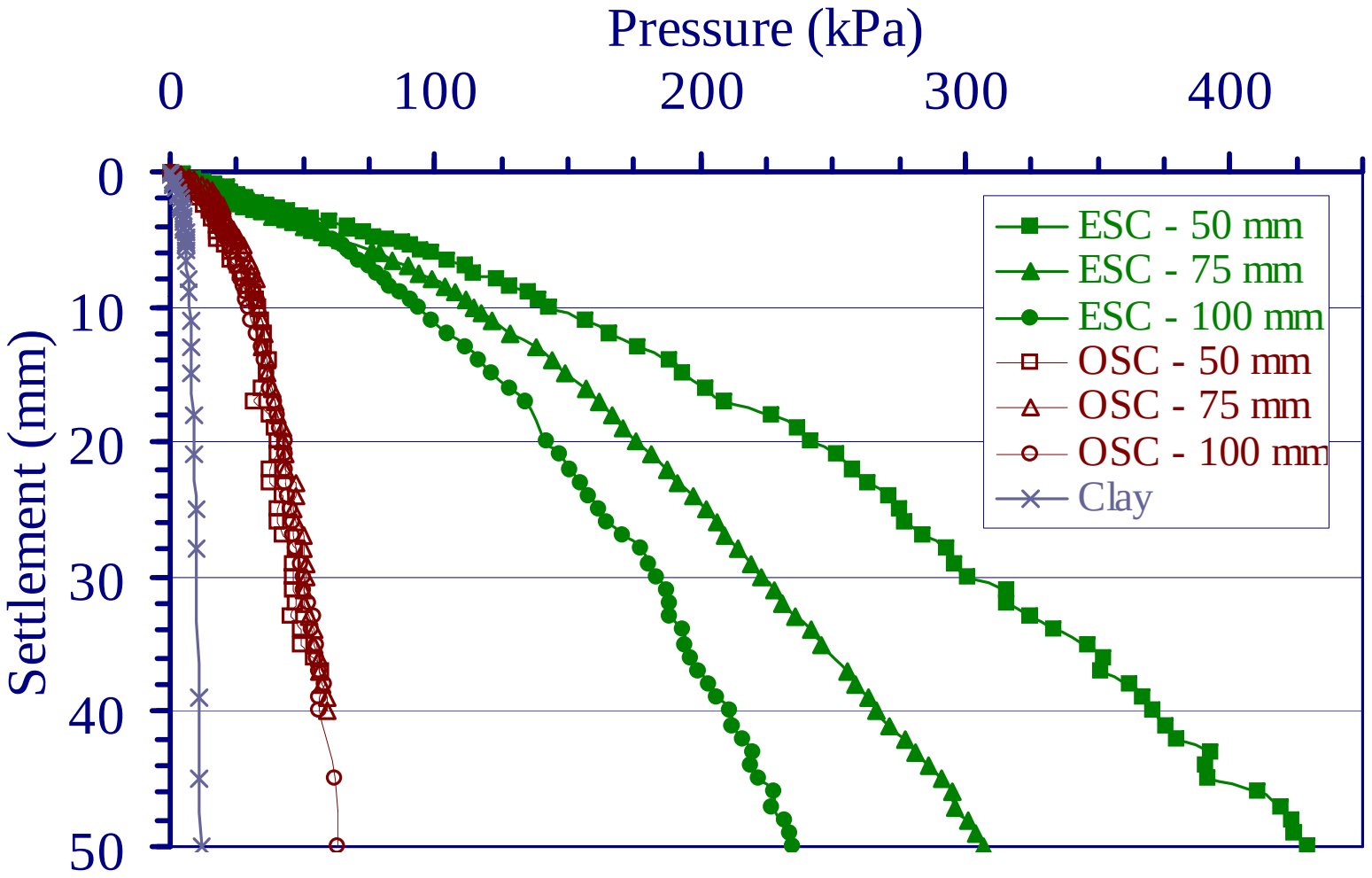
Construction of Encased Stone Column



Alexiew *et al.* (2005)


Courtesy:
Dipl.-Ing. Holger Pohlmann
Naue Fasertechnik GmbH & Co. KG

Load settlement curve for stone columns encased in non-woven geotextile



Latest Trends

- Vacuum consolidation
- Encased stone columns
- Electro Kinetic geosynthetics

Questions
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