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Innovative Geosynthetics application to reduce use of natural resources in Ash Dyke of thermal power plants


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PRESENTATION OUTLINE

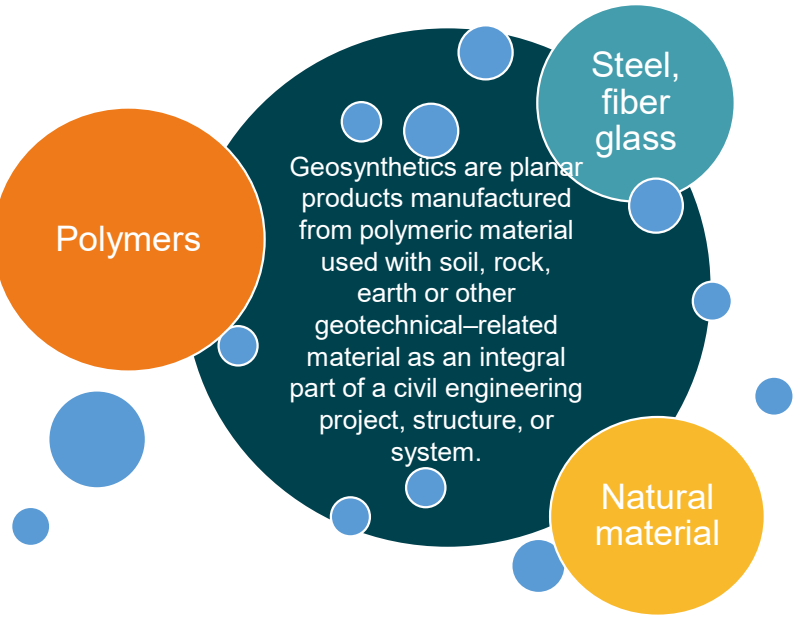
A) Geosynthetics

B) Application of Geosynthetics in Ash Dyke areas

C) Innovative application of Geosynthetics in Ash Dyke areas

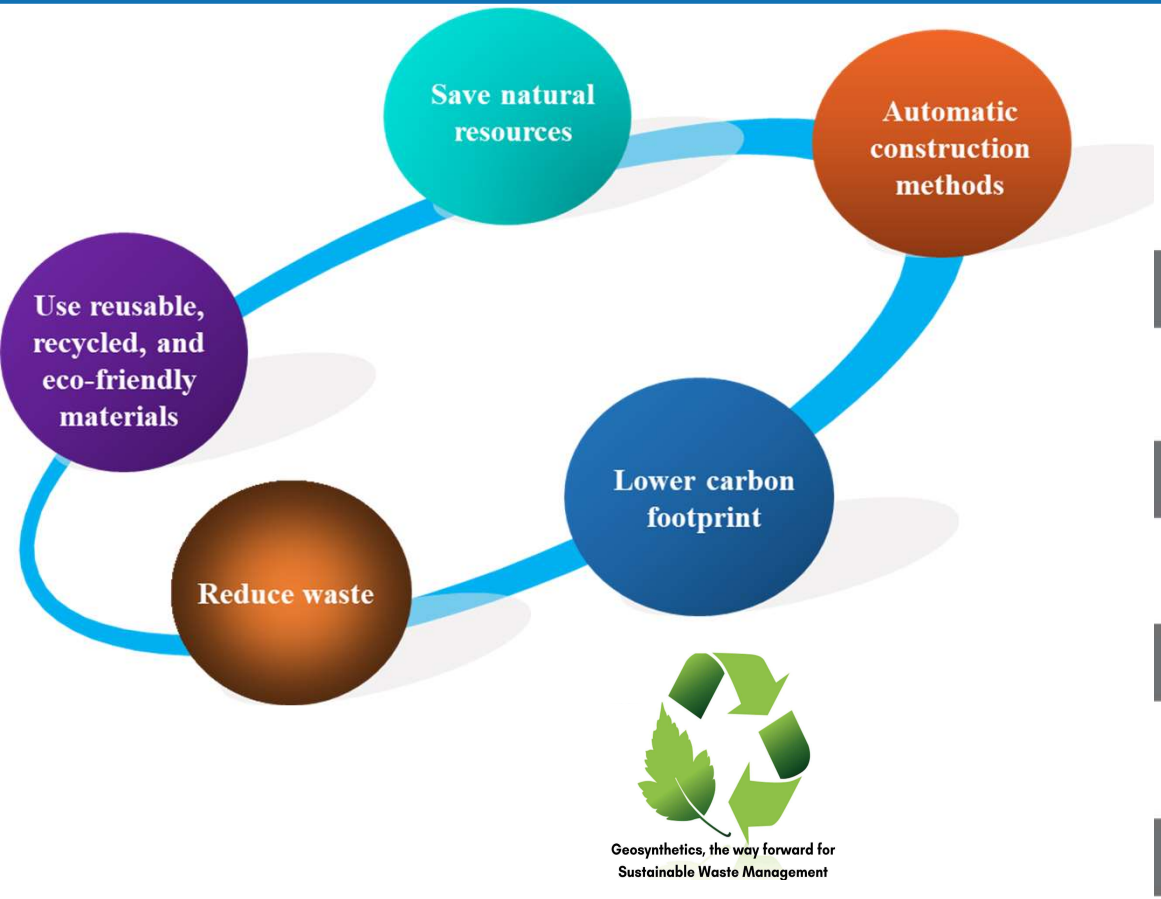
D) Conclusion

1) Geosynthetics



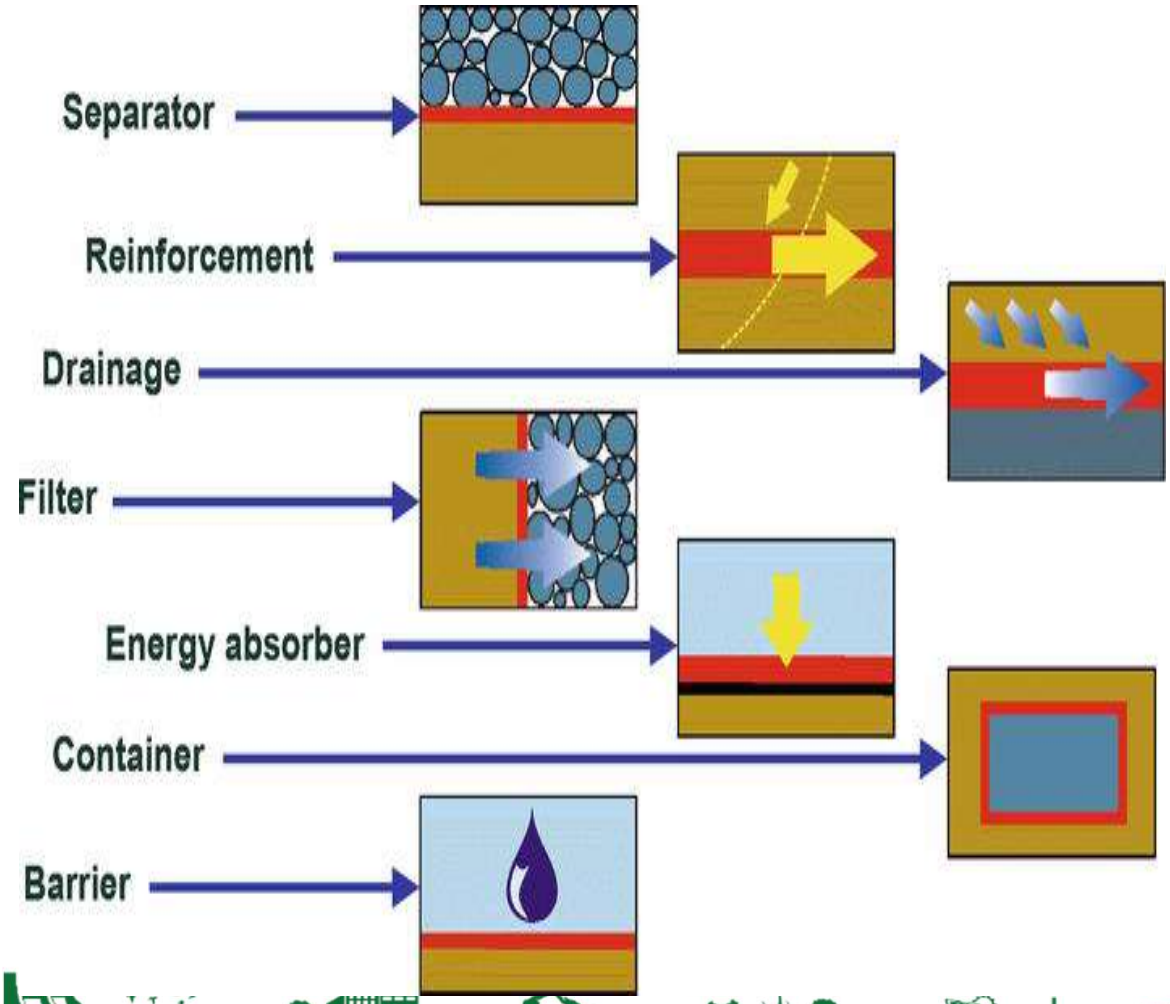
- Geosynthetics are polymeric inert material manufactured from natural or synthetic substances.
  - With Natural Fibres
  - With recycled product from textile industry
  - With recycled product from shoe industry, tyre industry
- Is a modern construction material like cement and steel.
- Have become essential engineering materials in a wide range of civil engineering applications, e.g. geotechnical, geo-environmental, hydraulics, transportation.
- Is a subset of much larger recent development in civil engineering materials, which are planar products manufactured from polymeric synthetic/ natural materials.
- Worldwide annual consumption of geosynthetics close is to 4.7 billion m2, with the value exceeding one billion USD.

Relation of Geosynthetics with Sustainability



Challenges	Performance
Safety Reduction of risk	• **Elimination** of failure through the reduction of risk • **Dedicated** and responsible geosynthetic design • **Reduced** vehicular traffic
Sustainability Environmental responsibility	• Better stakeholder **relations** • **Decreased** carbon footprint • Beneficial **re-use** of mine residuals
Time Product to market	• **Fast and practical** installation • **Reduced** construction delays • **Reduction** of implementation stages
Economics Decreasing all-in costs	• Increased heap leach **recovery** • **Reduction** of construction time • **Optimisation** of footprint utilisation

2) Functional types of Geosynthetics

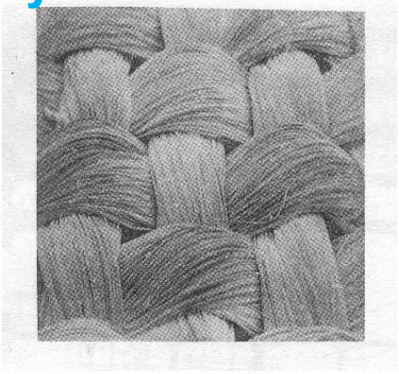


Based on functional applications, Geosynthetics are of following types:

- **Reinforcement Functions:** Woven geotextile, Geogrids, Geo-strips, Geo-cells.
- **Filtration function:** Non-woven geotextile
- **Drainage function:** Geo-composites
- **Slope Protection:** Geocells, Jute geotextiles, Coir-geotextiles, Geo-bags
- **Separator function:** Geo-textiles.

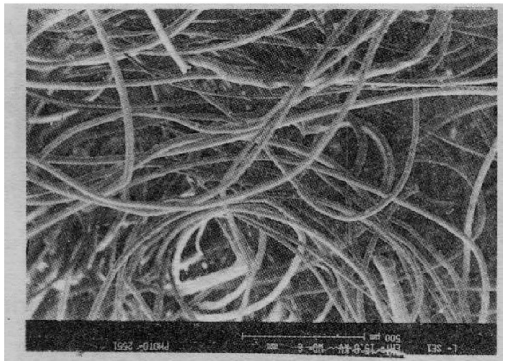
General types of Geotextiles

Synthetic Geotextiles: Woven/Nonwoven



Woven geotextile

Non-woven Geotextile



Natural Geotextiles: Woven/Nonwoven

Woven JGT
(IS 14715)

Nonwoven JGT
(IS 17070 :2018)

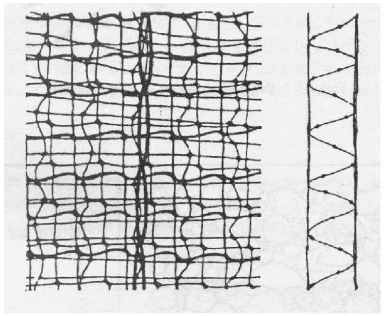
Nonwoven Coir GT

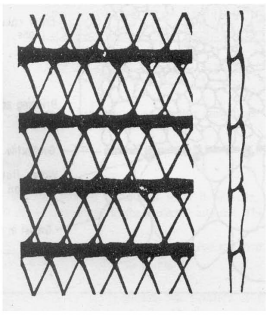
General types of Geogrids, Geonets, Geostrips

Uniaxial - Biaxial

Biaxial Geogrid

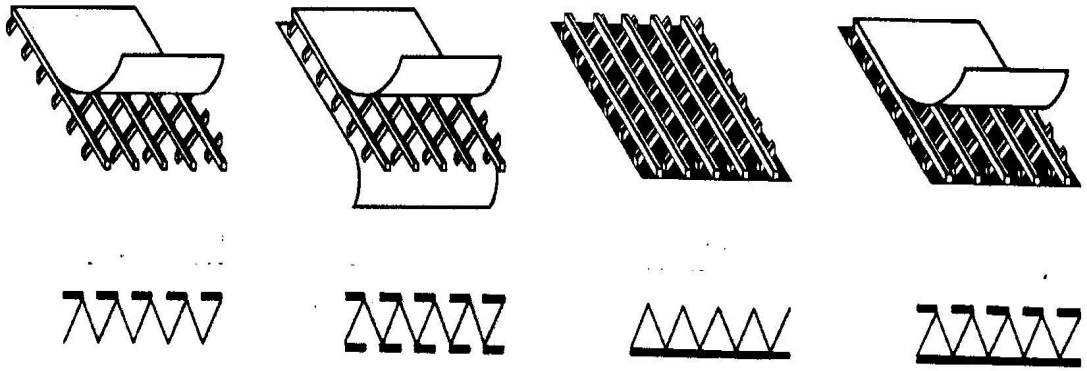
Geogrid rolls



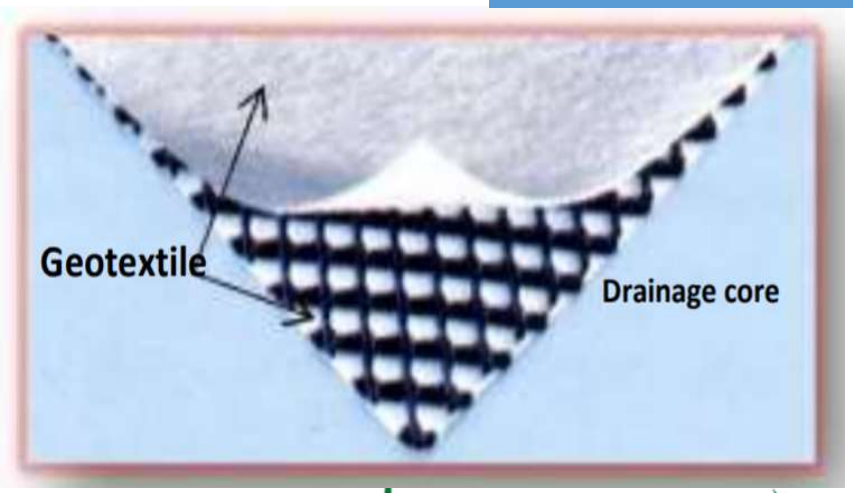


Geonet

General types of Geocomposites



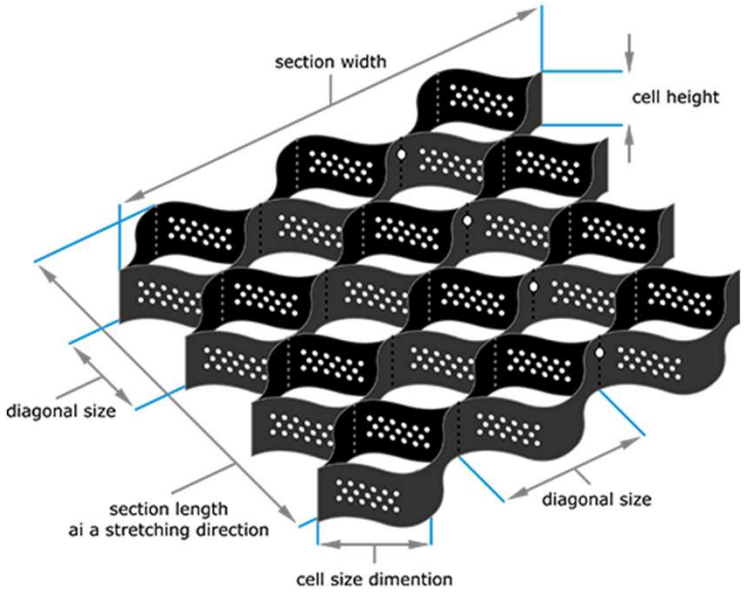
Various types of Geo composites



Synthetic Geocomposites

Natural Coir Geocomposites

General types of Geocells

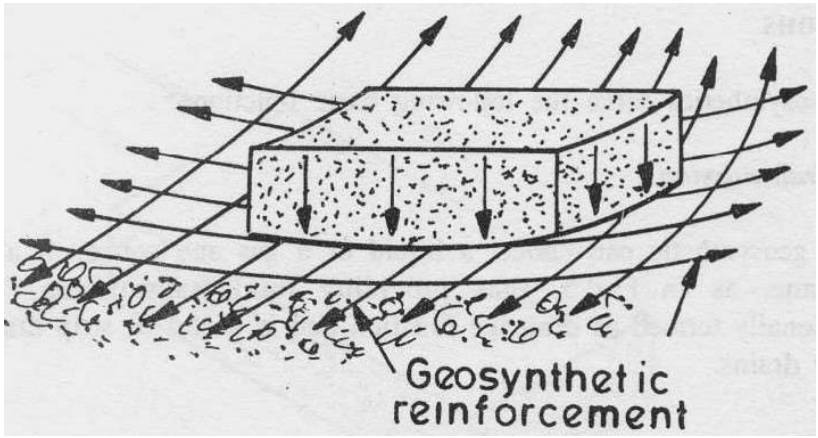


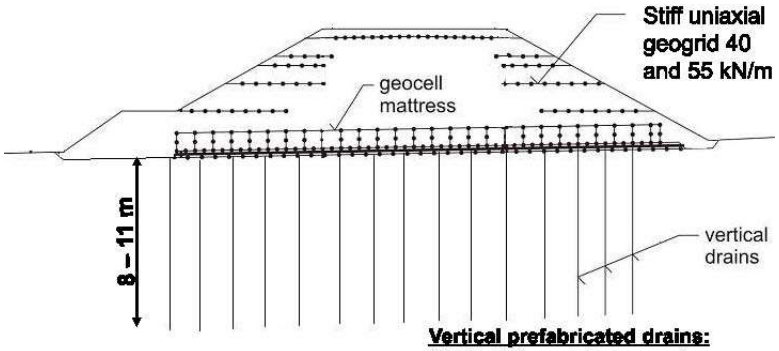
Synthetic Geocell

Natural Coir Geocell

B) Application of Geosynthetics in Ash Dyke areas

Reinforcement application

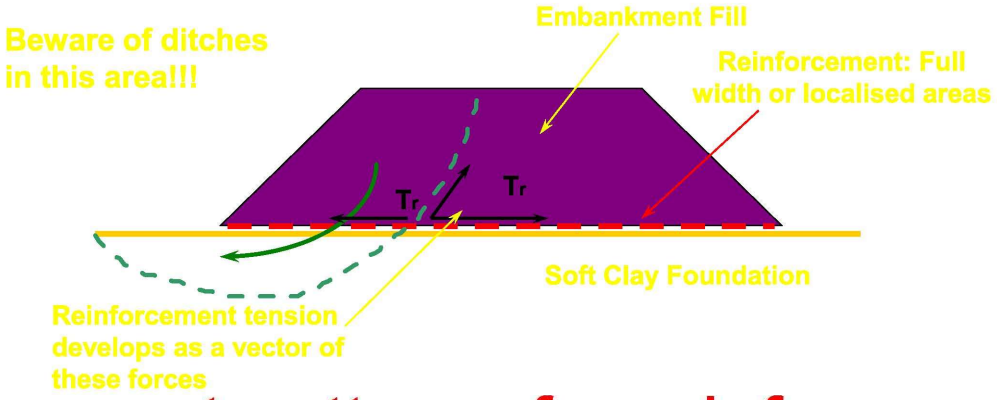




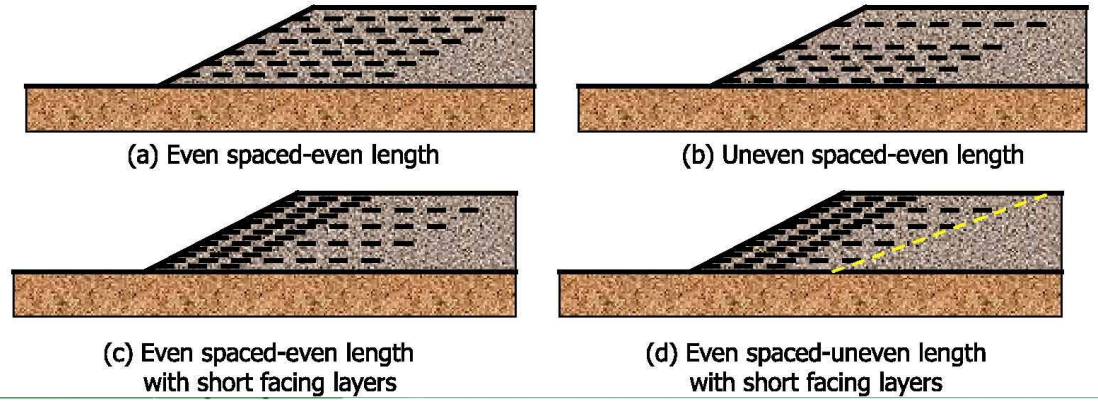
Geocell mattrace :
Uniaxial stiff geogrid 80 kN/m
Biaxial geogrid 30 kN/m

Vertical prefabricated drains:
Width 100mm, Thickness 3 mm
PP filter, Tensile strength 2.2kN
Discharge capacity buckled
50.10^{-4} m^3/s

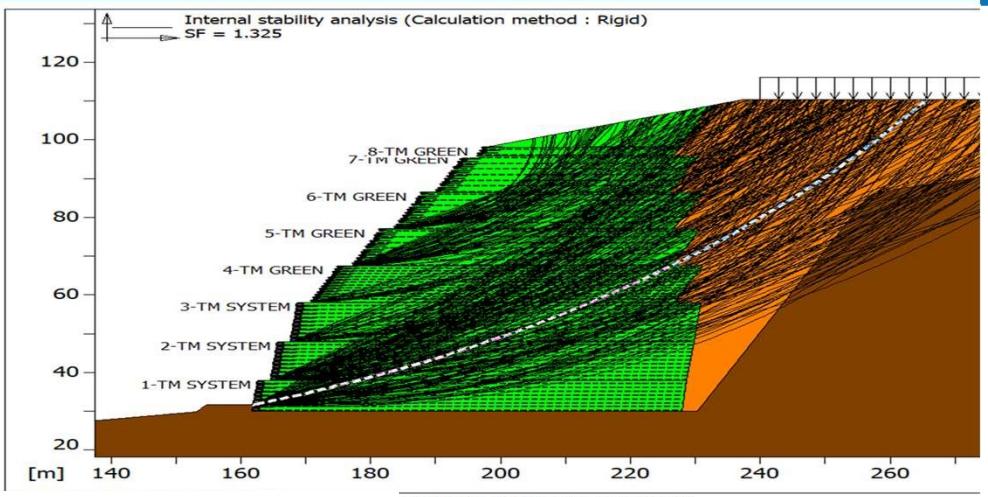
Embankment over Soft clay



Placement patterns for reinforcement



Reinforced Soil embankment



Geogrid reinforced

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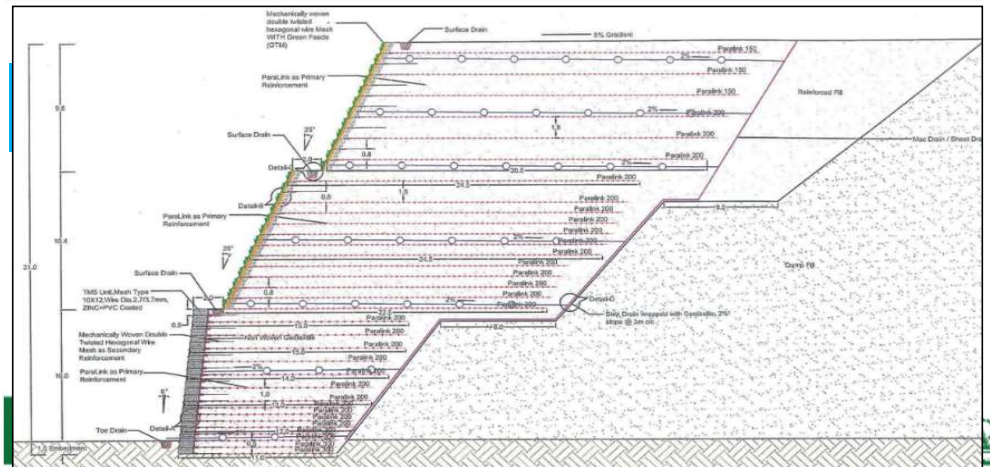
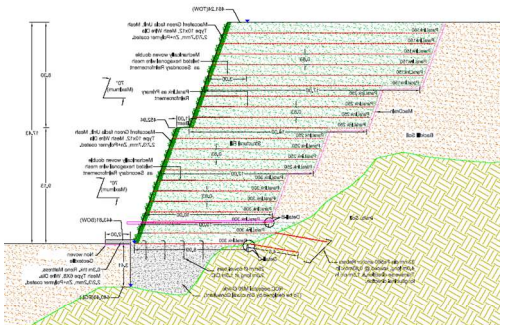
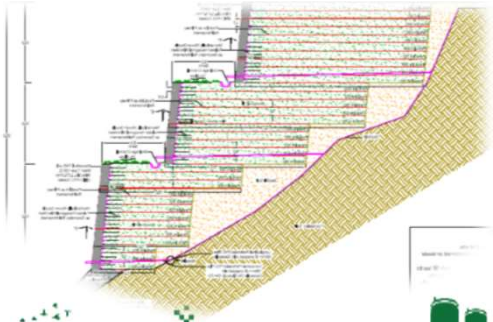


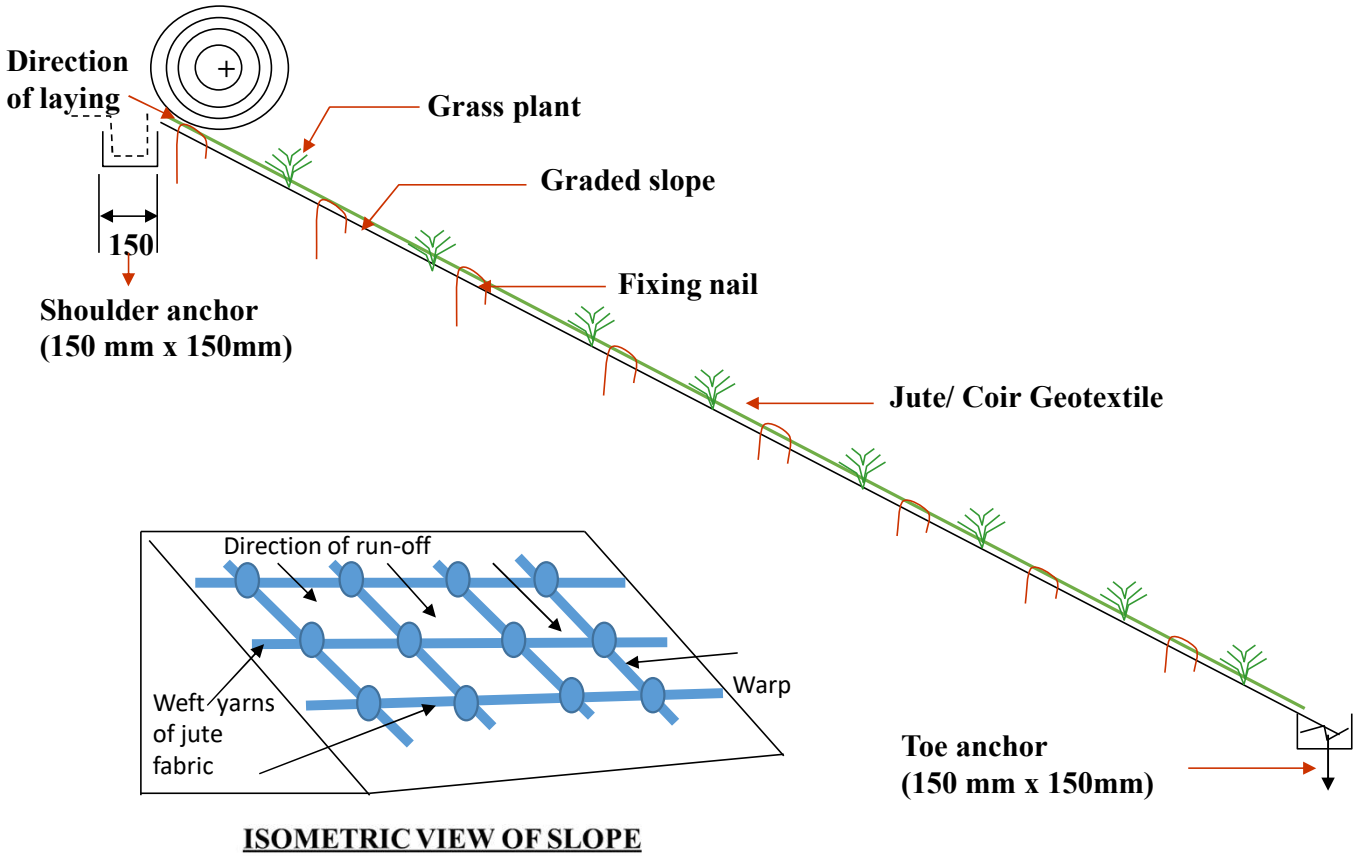
- Geogrids allow a great flexibility, strength and an energy absorption capacity, making them suitable for super high walls (above 10 m) in seismic areas.
- A very high (74m) and challenging MSE retaining structure was built in Sikkim, India.
- The executed wall in this case recently withstood an earthquake with a 6.9 magnitude without visible damage.

Reinforced Soil embankment





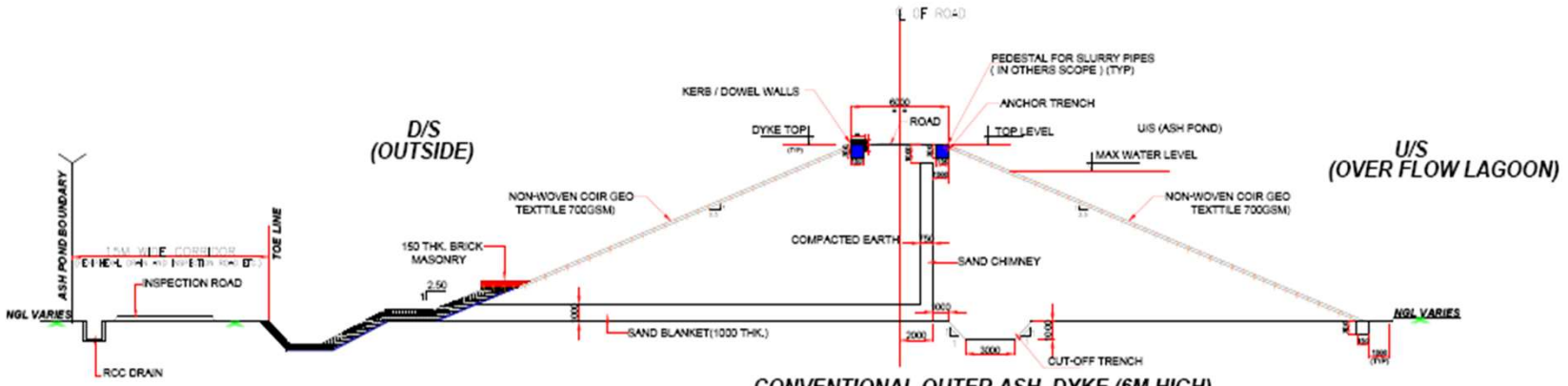
Slope Protections



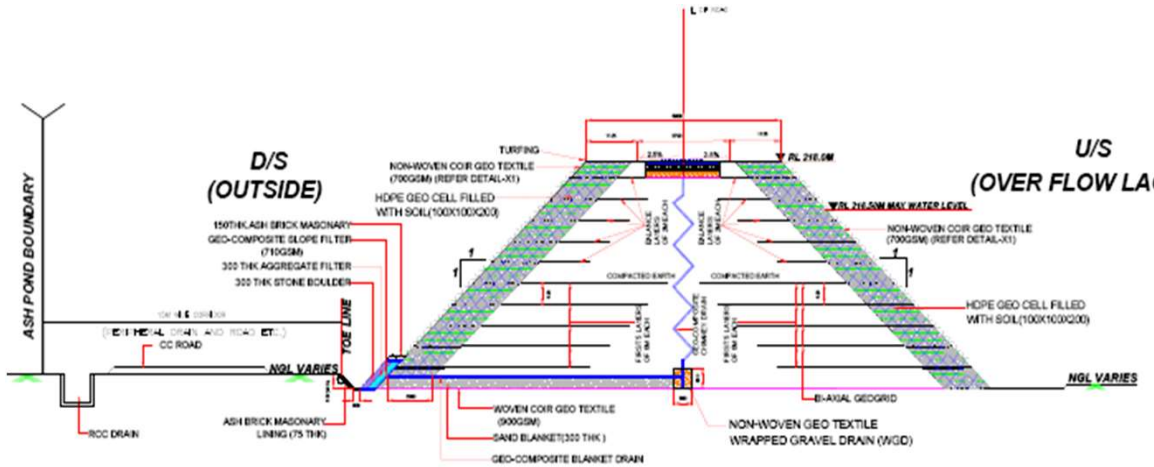
ISOMETRIC VIEW OF SLOPE

C) Innovativce application of Geosynthetics in Ash Dyke areas

1) Optimized Ash dyke section in reinforced Ash Dyke



CONVENTIONAL OUTER ASH DYKE (6M HIGH)



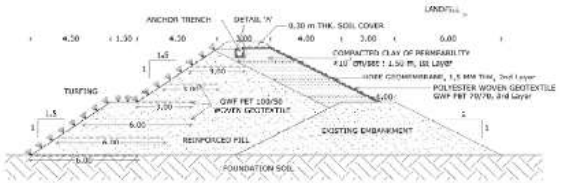
GEOSYNTHETIC OUTER ASH DYKE (6M HIGH)

Cost analysis for proposed Reinforcement application

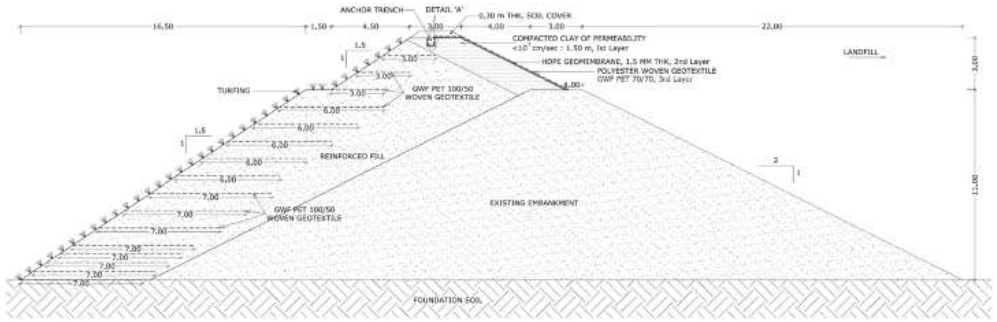
Comparison for 10m high Starter Dyke of 10km length in 400 acres of 2x800MW:

- Cost of borrow earth:300/ cum
- Cost of Geogrid:200/Sqm
- X-section area:
  - Conventional=322 sqm; Reinforced:160 sqm
- Saving in X-section area: 162 sqm
- Saved earthwork volume per km:1,62,000 cum
- Saved earthwork cost: 4.86 Cr/Km
- Additional Geogrid area:94000 sqm
- Additional Geogrid cost:1.88 Cr/km
- Cost saving per km: (4.86-1.88)/4.86=61.31%
- Total saving in earth work in entire 10Km length: approx.30 Cr

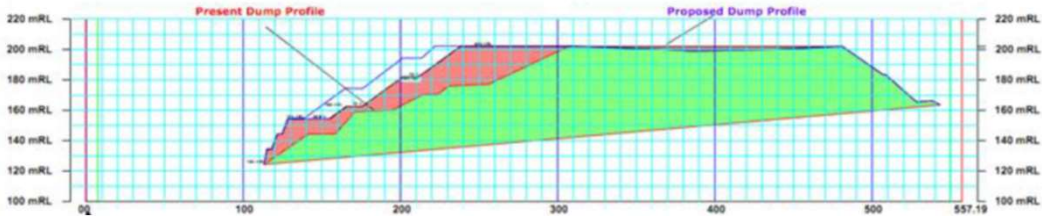
Optimized Raising Ash dyke section(reinforced)

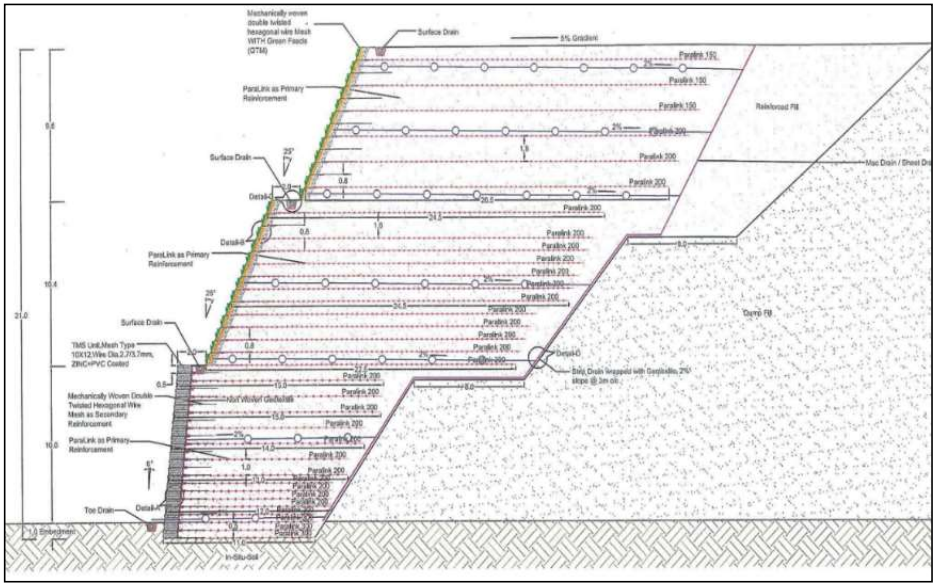


Typical cross-section of 6.0 m high reinforced embankment

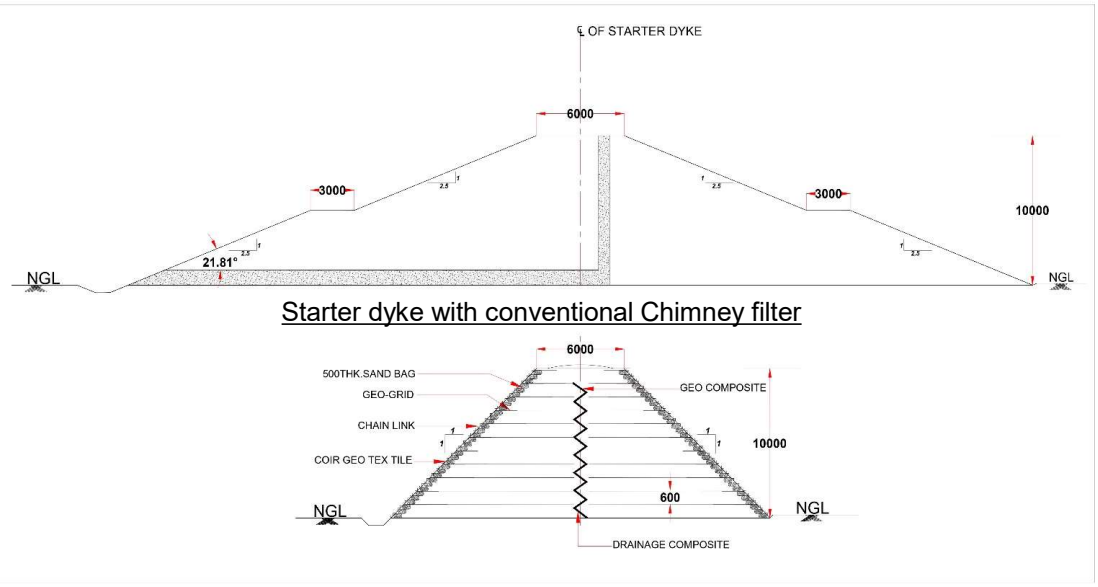


Typical cross-section of 14.0 m high reinforced embankment





2) Drainage geo-composite in Chimney filter



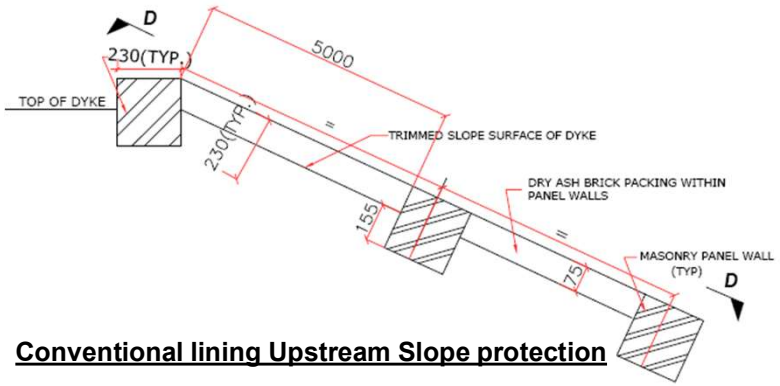
Starter dyke with conventional Chimney filter

Reinforced Starter dyke with drainage geo-composite

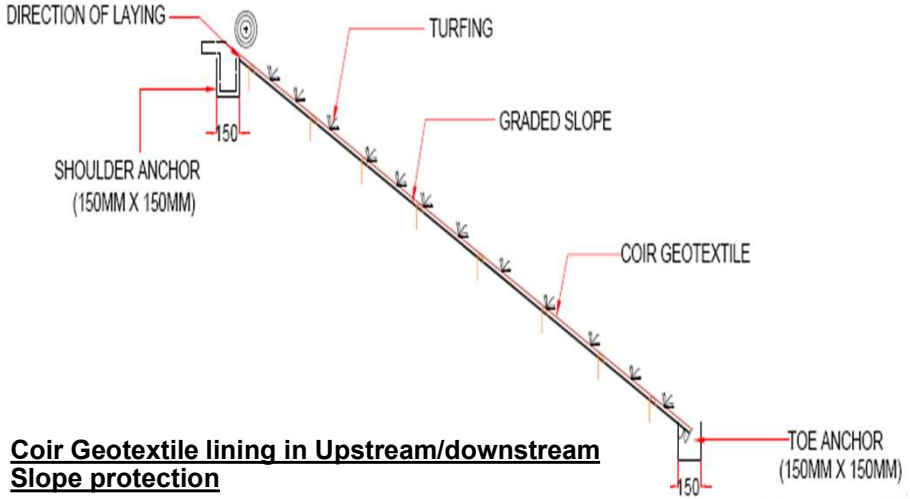
Comparison for 10m high Starter Dyke of 10km length in 400 acres of 2x800MW:

- **Cost of Sand filter:2000/ cum**
- **Cost of drainage geo-composite:400/Sqm**
- **Qty of sand filter per km:6750cum**
- **Qty of geo-composite per km: 12726 sqm**
- **Cost of sand filter per km: 1.35 Cr**
- **Cost of geo-composite per km: 0.51 Cr**
- **Cost saving per km: (1.35-0.51)/1.35=62%**
- **Total saving in sand filter in entire 10Km length: approx.8.4 Cr**
- **Breakeven cost of sand: 634 per Cum**

3) Upstream/ downstream slope protection with coir-geotextil



Conventional lining Upstream Slope protection



Coir Geotextile lining in Upstream/downstream Slope protection

Comparison for 10m high Starter Dyke of 10km length in 400 acres of 2x800MW:

- **Cost of brick lining:535/ sqm**
- **Cost of coir-geotextile lining:125/Sqm**
- **Upstream lining area per km: 30 sqm**
- **Cost of brick lining per km:5.35 lac**
- **Cost of Coir Geotextile lining per km: 1.25 lac**
- **Cost saving per km: (5.35-1.25)/5.35=76.63%**
- **Saving in slope protection in entire 10Km length: approx.0.4 Cr.**
- **Breakeven cost of sand: 187 per Sqm**

CONCLUSION

- Conventional Starter Ash dykes requires very high quantity of natural resources which are often difficult to procure due to long leads.
- Furthermore, there are restrictions on quarrying, and in some cases, even ban on exploitation of sands. At many projects, these are not available in close vicinity and is to be borrowed from far-off sources making it unviable from both time and cost considerations.
- Geosynthetics are modern construction material like cement and steel and have become essential engineering materials in wide range of civil engineering applications.
- Considering the benefits of Geosynthetics, when land is at a premium and natural resources are scarce, it is prudent to have Geosynthetic dyke with a narrow footprint rather than a conventional dyke with wide footprint.
- Unlike the conventional Ash dyke, Geosynthetic dyke is slim, occupying a reduced land footprint, with steep side-slopes resulting reduced use of natural resources, enhanced ash storage area, reduced construction time and compared to a conventional ash dyke, its economical too.

Migratory Birds at NTPC Dadri

Thank You

NTPC Ramagundam

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