



STRATA

Innovative Geotechnical Solutions

**3rd NATIONAL CONCLAVE ON STANDARDS FOR TECHNICAL
TEXTILES**

TEST STANDARDS FOR GEOCELLS

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Geocells (StrataWeb[®])

- Cellular confinement system - Strong but very light-weight
- Specially textured HDPE strips to improve friction between infill and cell walls
- Brought to site in collapsed form and expanded, then filled with non-plastic soil
- Strips are ultra-sonic welded, with staggered welding
- Cell walls perforated for drainage



Geocells



Efficient Transportation and handling



Expanded geocell panels



Benefits of Geocells

COST



- Transportation Costs – Lightweight and easy to handle
- Land Use – Minimize the use of expensive land
- Basic Equipment – No special equipment or materials required

AESTHETICS



- Colour Customizations – Black, Green, etc.
- Vegetated – Can be filled with topsoil and planted which adds aesthetic value and absorbs water

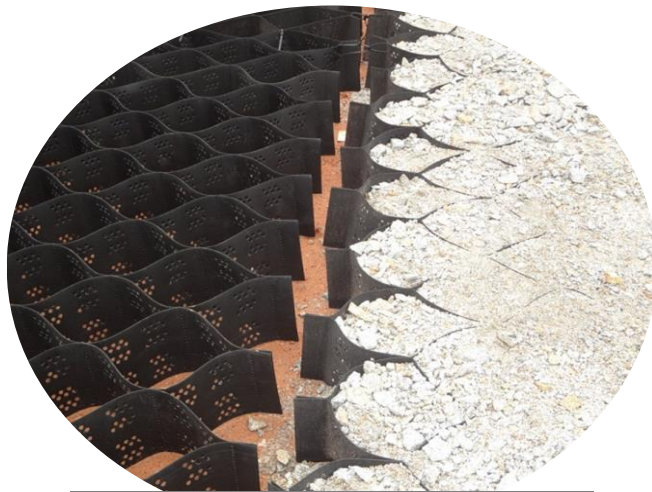
ENVIRONMENT FRIENDLY



- Limited Infill – Reduces strain on carbon footprint
- Carbon Emissions – Reduces emissions due to lower transportation

Geocell Applications

Geocells can be used in **four** main applications.



Ground Protection
(Basal Reinforcement & Load



Slope Erosion



Reinforced Soil Walls

Load Carrying

Load-carrying systems
for flexible paved and
unpaved pavements,
and rigid pavements
Example shown:
National Highway 44
from Assam to Tripura



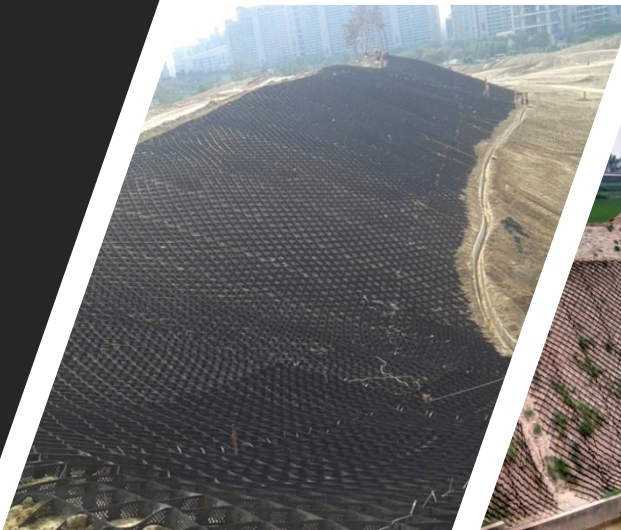
Basal Reinforcement

Basal Reinforcement for earth embankments and reinforced soil structure systems, and for static loads in yards, foundations, etc.



Slope Erosion Protection

Erosion protection systems
for slopes of embankment,
canals, reservoirs and landfill
containment slopes with
concrete or vegetated soil in-
fill



Gravity Retaining Walls

- Gravity retaining structure elements and fascia for reinforced soil systems



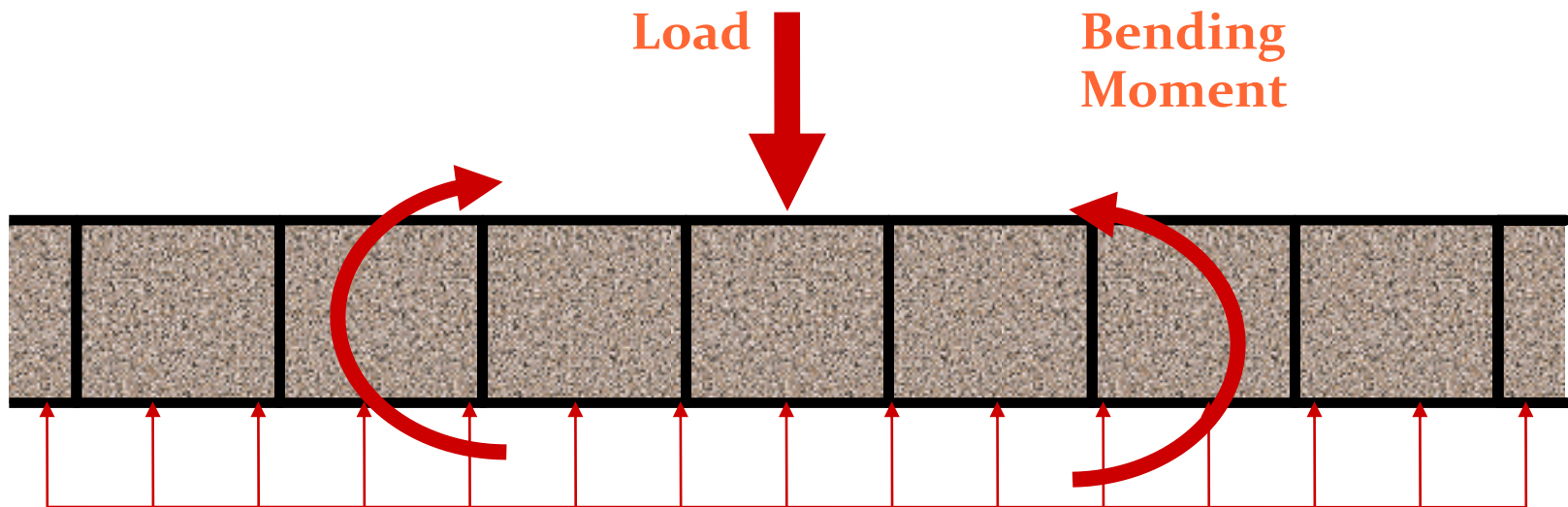


Geocell Mechanism: How Geocells Work



Geocell Mechanism: Load Carrying - Pavements

Point Load and Bending moments developed

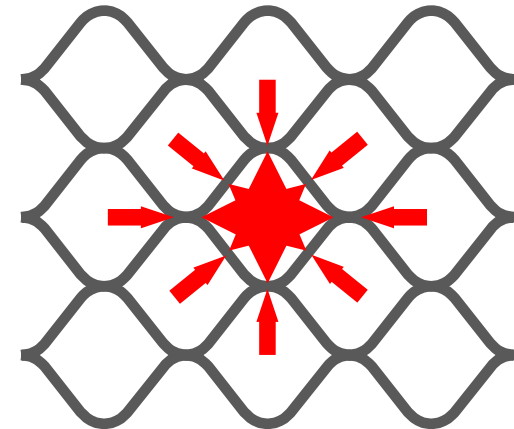
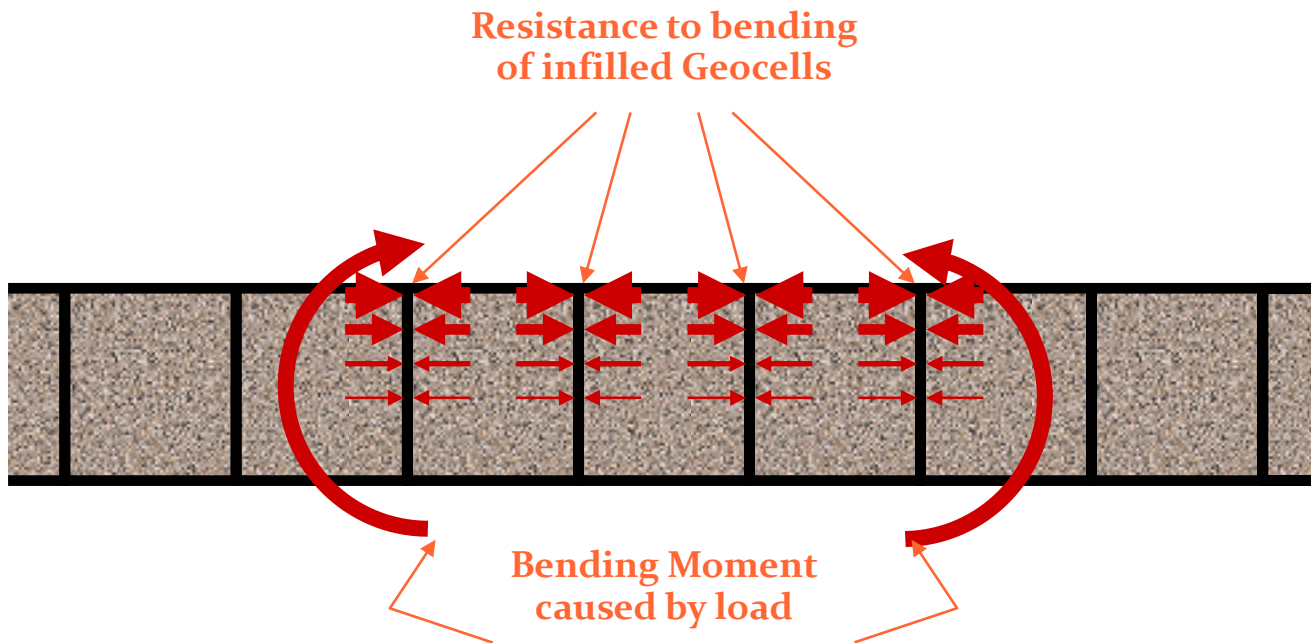


Geocell Mechanism: Load Carrying - Pavements

Those moments are resisted by the compacted infill

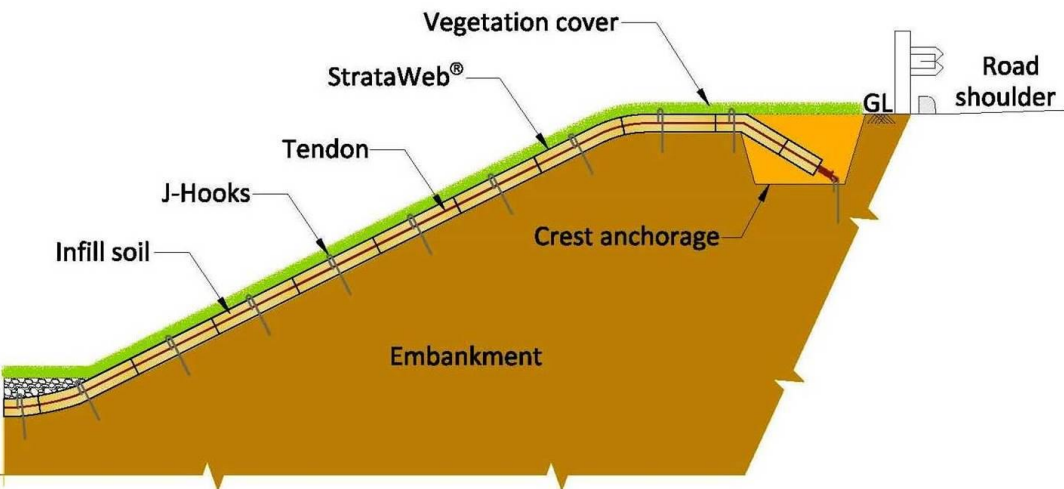
Infill provides the strength to the system

The support provided by surrounding cells also contributes to the ability of the system to rapidly distribute loads



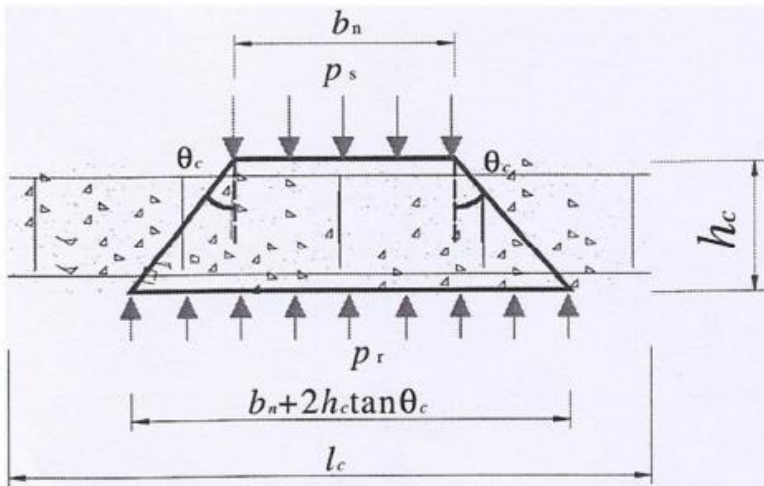
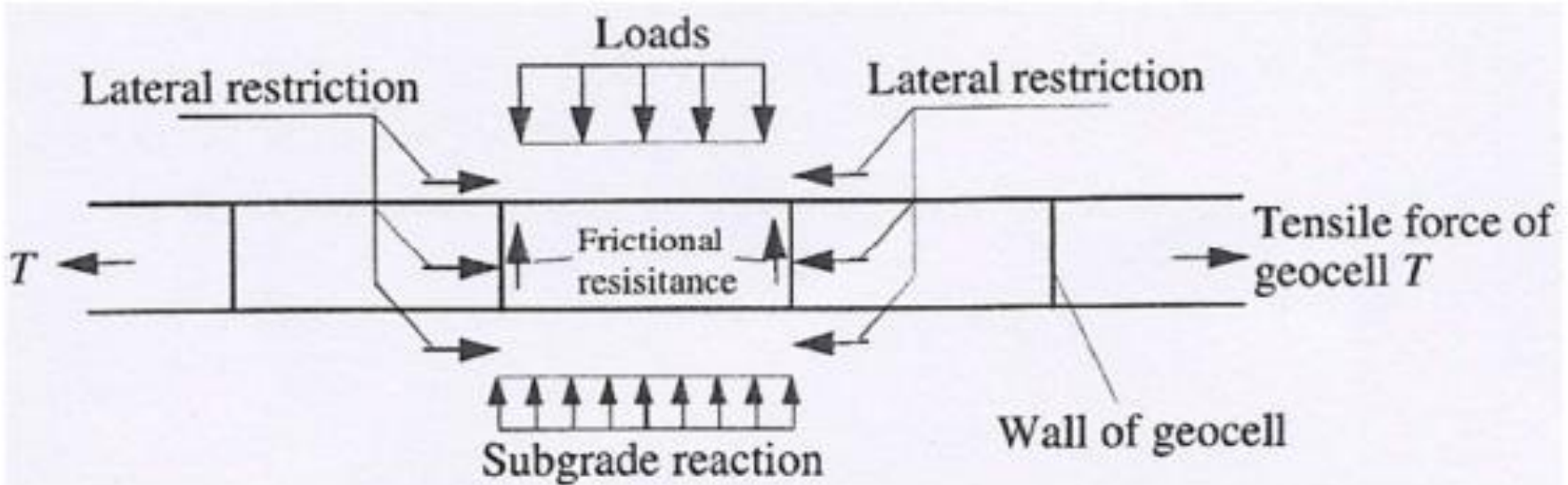
Geocell Mechanism: Erosion Protection

- ◆ Sliding Forces
 - ◆ Weight of soil
- ◆ Resisting Forces
 - ◆ Through crest anchorage, J-hooks, toe protection, tendons.



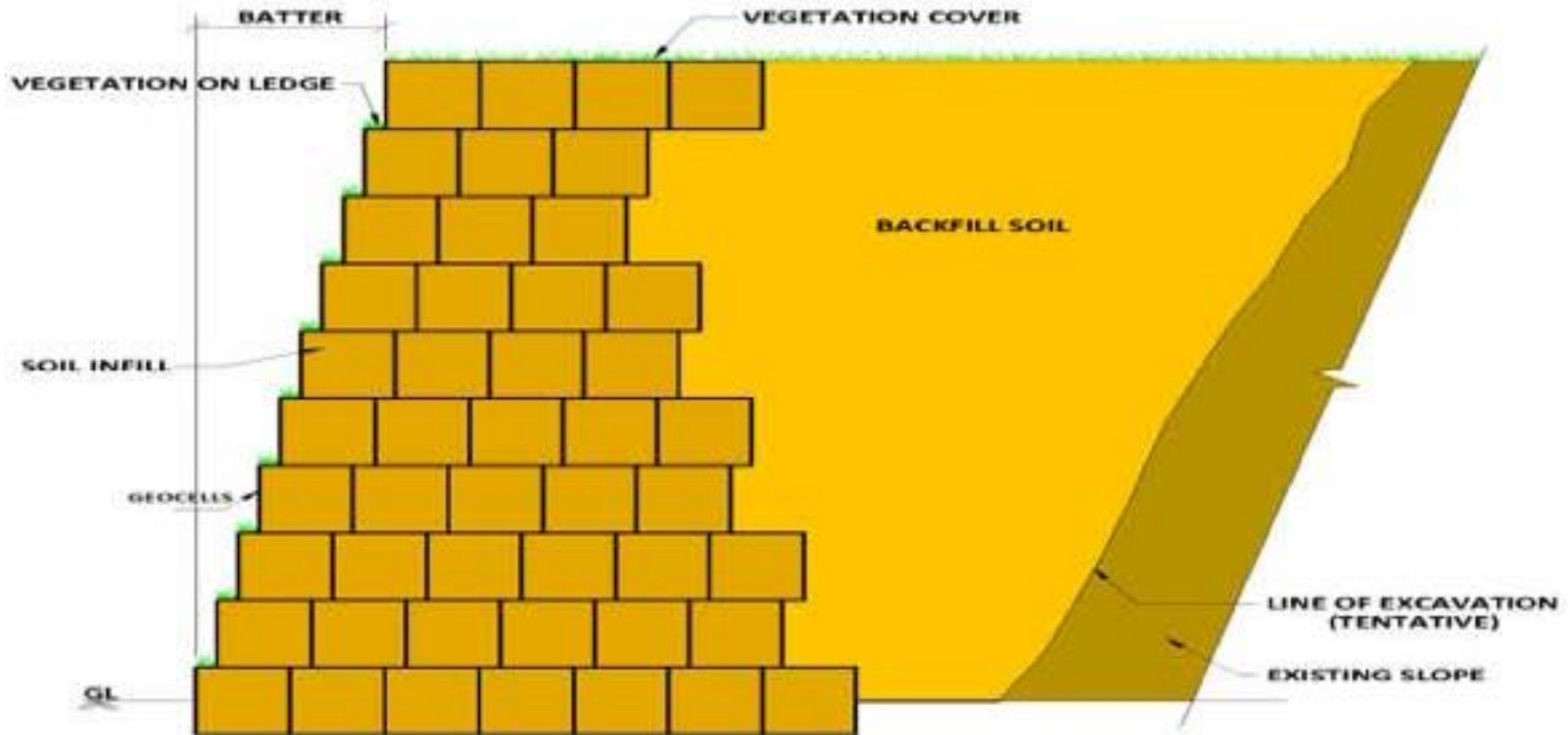


Geocell Mechanism: Basal Reinforcement STRATA



- ❖ Lateral pressures are generated within the vertically stressed cells
- ❖ Vertical stresses are partly taken up by cell wall friction
- ❖ Lateral pressures are correspondingly generated in the adjoining cells as reactions
- ❖ More friction is generated in these adjoining cells
- ❖ This manifests as Vertical Stress Dispersion over the base of the Geocell Mat

Geocell Mechanism: Gravity Structures



- Governing Forces: Lateral soil pressures, Gravitational forces
- These manifest as: Internal and external sliding forces, Overturning forces



Mandatory Tests for All Applications



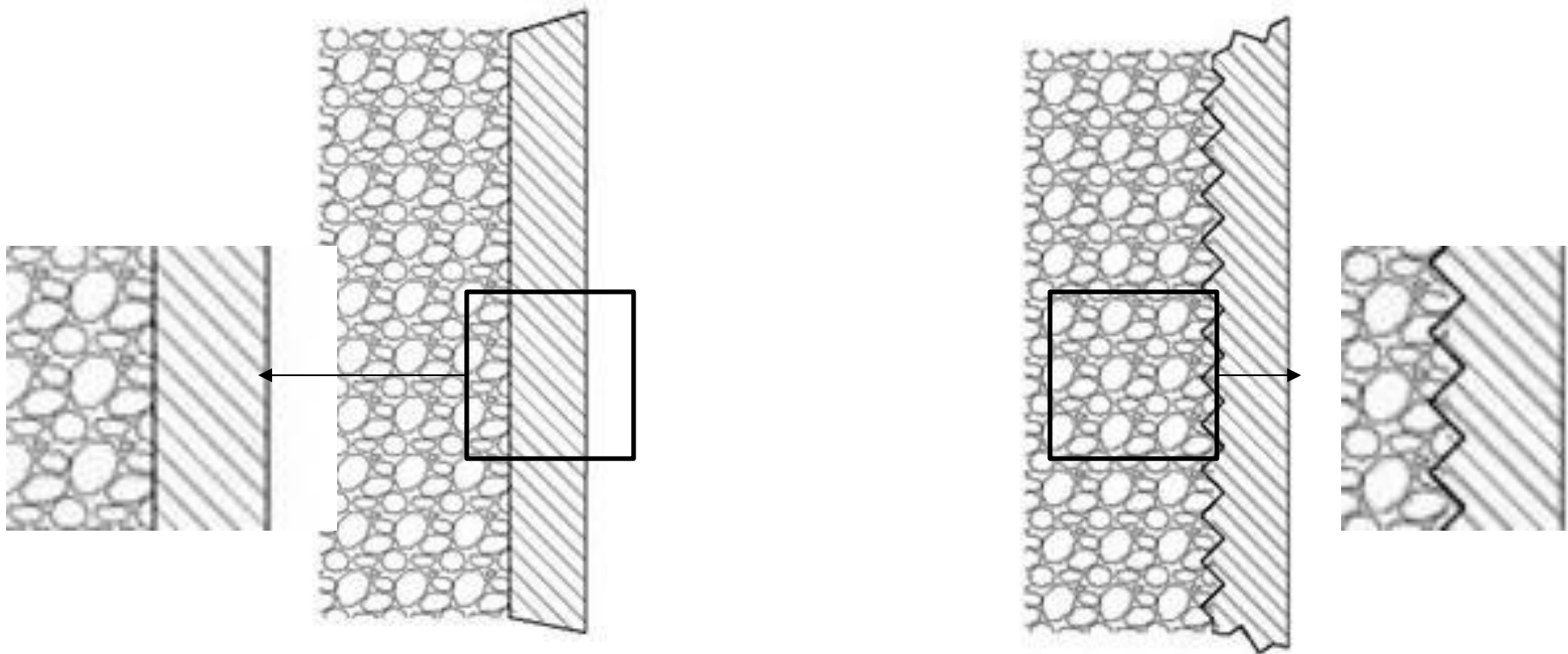
No International Test Standards



Available International Test Standards

Property	Method	Value (Norm)
Wall Thickness (Nominal – 10%)	GRI-GS 14	1.52mm
Density (Minimum average)	ASTM D 1505 / D 792	0.940g/cc
Environmental Stress Crack resistance	ASTM D 1693	>5,000 hrs
Carbon Black Content	ASTM D 1603	Min. 2%
Tensile Properties (Minimum average)	ASTM D 6693 Type IV	
Yield strength		155N
Break strength		330N
Yield elongation		12%
Break elongation		100%

Material and Texture

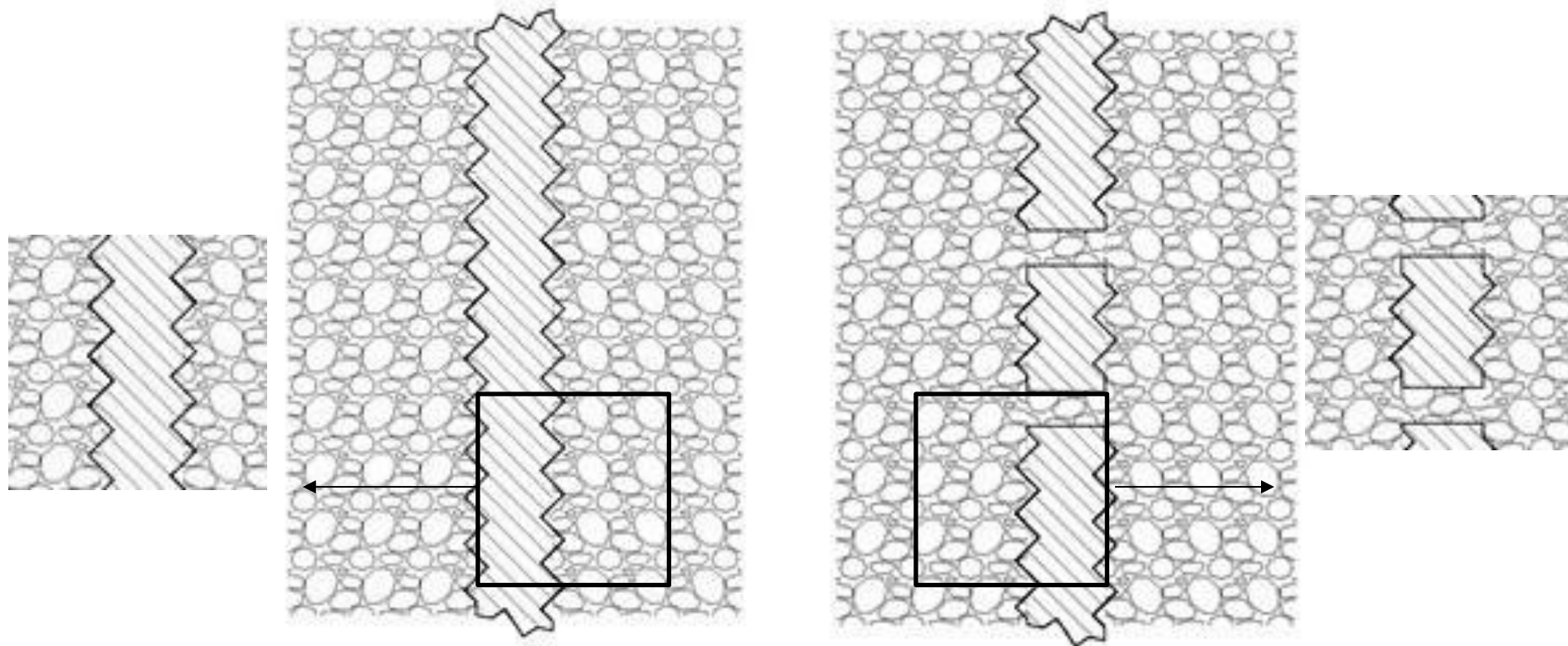


Smooth cell wall

Textured cell wall

- ◆ Material: Virgin HDPE material with no more than 25% rework.
- ◆ Texture: Rhomboidal indentation with a surface density of 22-32 per cm².

Perforation



Non perforated cell wall

Perforated cell wall

- Perforations: Horizontal rows of maximum 10mm diameter holes; Perforation area should be less than 12% of the cell surface area



Tests for Load Carrying and Pavements



Available International Test Standards

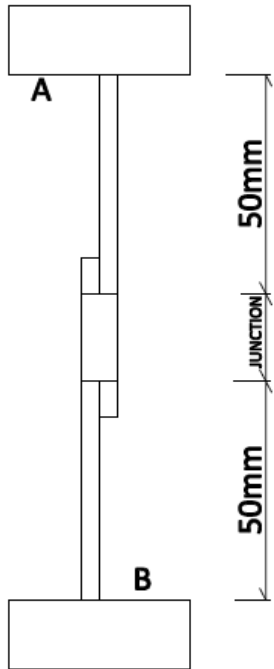
Property	Method	Value (Norm)
Oxidative Induction Time (Minimum average) a) Standard OIT or a) High Pressure OIT	ASTM D 3895 ASTM D 5885	100 min 400 min
Oven aging at 85°C a) Standard OIT (minimum average) % retained after 90days or a) High Pressure OIT (minimum average) % retained after 90 days	ASTM D 5721 ASTM D 3895 ASTM D 5885	55% 80%

Available International Test Standards

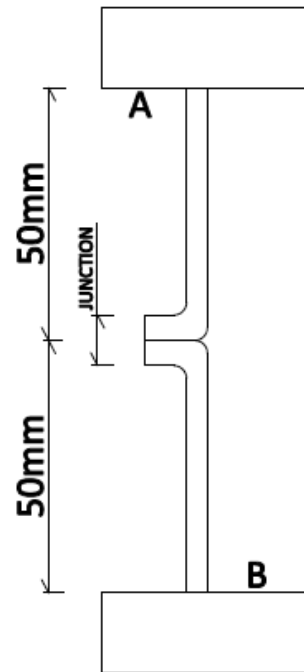
Property	Method	Value (Norm)
Seam Efficiency (Min. average)	GRI-GS 13	100%
Direct Shear Friction Angle (See Note 1)	ASTM D 5321	30°
Seam peel strength (Method A) (See Note 2)	EN ISO 13426	1420 N for (100mm depth)
Seam peel strength (Method B) (See Note 2)	EN ISO 13426	1420 N for (100mm depth)

- ◆ This test must be conducted on the actual geocell strip along with its perforations against well graded sand or the actual infill material
- ◆ Seam peel strength tests (Method A and Method B) are explained in the following figures

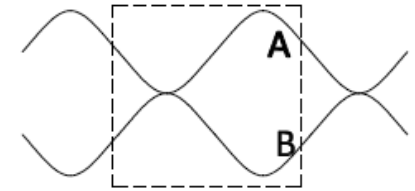
Seam Peel Strength (Note 2)



Tensile Shear Test (Method A)



Peeling Test (Method B)





Tests for Slope Erosion Protection

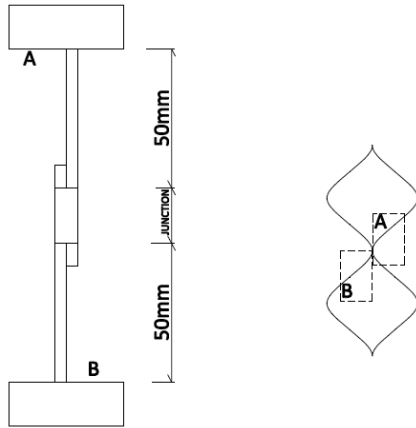


Available international test standards

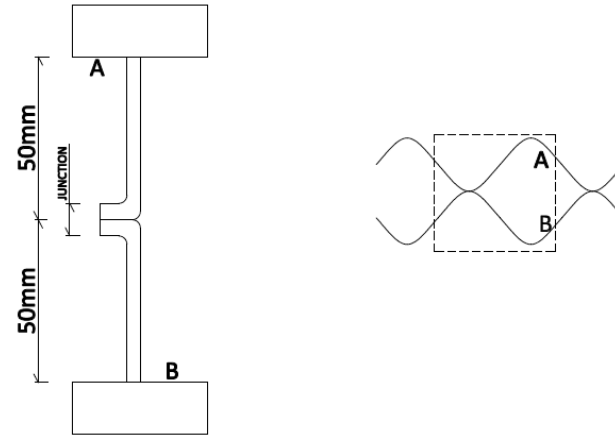
Property	Method	Value (Norm)
Seam peel strength (Method A) (See Note 1)	EN ISO 13426	1420 N for (100mm depth)
Seam peel strength (Method B) (See Note 1)	EN ISO 13426	1420 N for (100mm depth)
Seam peel strength (Method C) (See Note 1)	EN ISO 13426	1420 N for (100mm depth)
Seam peel strength (Method D) (See Note 1)	EN ISO 13426	1420 N for (100mm depth)
Tear Resistance	ASTM D 1004	-
Puncture resistance	ASTM D 4833	-

- ◆ Seam peel strength tests (Method A to Method D) are explained in the following figures

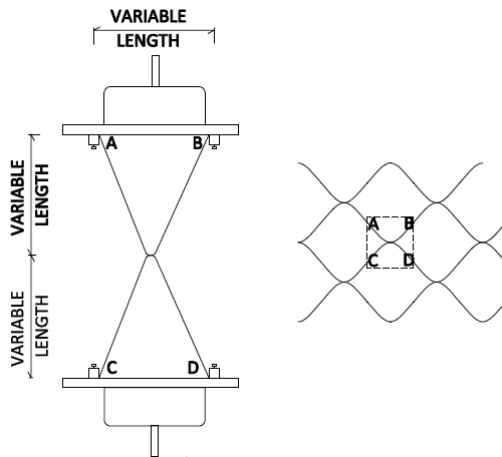
Seam Peel Strength (Note 1)



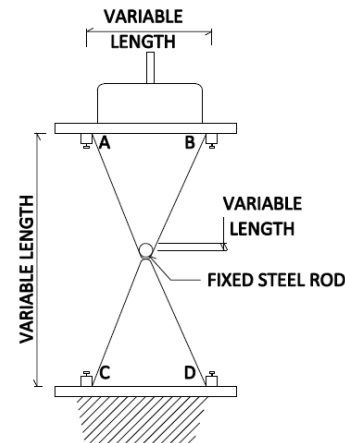
Tensile Shear Test (Method A)



Peeling Test (Method B)



Splitting Test (Method C)



Local Overstressing Test (Method D)

Illustration of above methods

- ❖ Method B
 - ❖ Applicable for both slopes as well as load spread applications.

- ❖ Methods C and Method D
 - ❖ Essentially apply to slopes.
 - ❖ Instantaneous slippage of tendons during placement of the geocells on a slope that could result in the Splitting (Method C).
 - ❖ The Overstressing test (Method D) simulates a situation where the geocell locally supported by a spike driven into the ground.

- ❖ Method A
 - ❖ Due to careless handling at site and may not replicate any sustained engineered situation

Tests for gravity retaining structures



Available International Test Standards

Property	Method	Value (Norm)
Oxidative Induction Time (Minimum average)		
a) Standard OIT	ASTM D 3895	100 min
or		
a) High Pressure OIT	ASTM D 5885	400 min
Oven aging at 85°C		
a) Standard OIT (minimum average)	ASTM D 5721	
% retained after 90days	ASTM D 3895	55%
or		
a) High Pressure OIT (minimum average)		
% retained after 90days	ASTM D 5885	80%

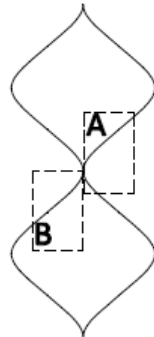
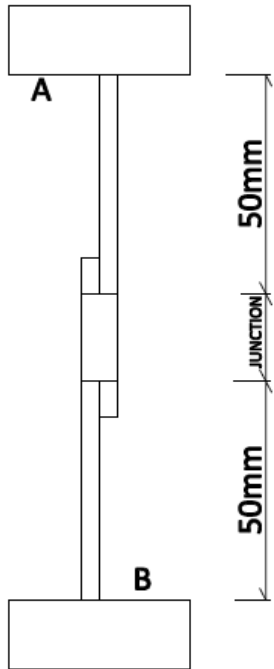


Available International Test Standards

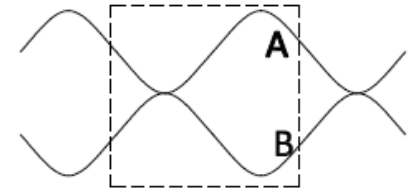
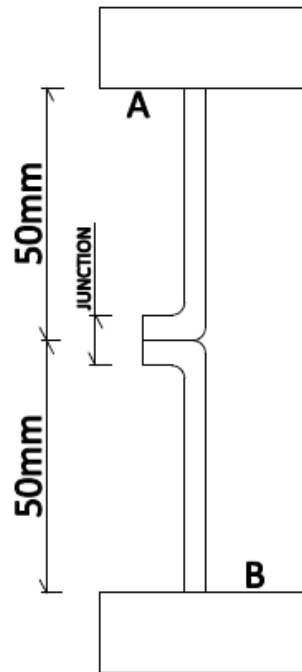
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- ◆ Note 1.: This test must be conducted on the actual geocell strip along with its perforations against well graded sand or the actual infill material
- ◆ Note 2.: Seam peel strength tests (Method A and Method B) are explained in the following figures

Seam Peel Strength (Note 2)



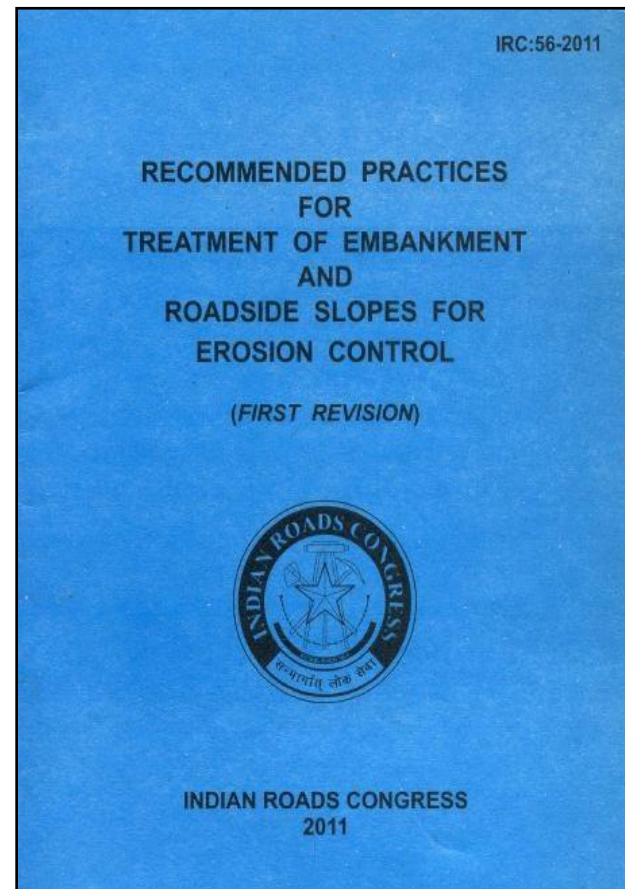
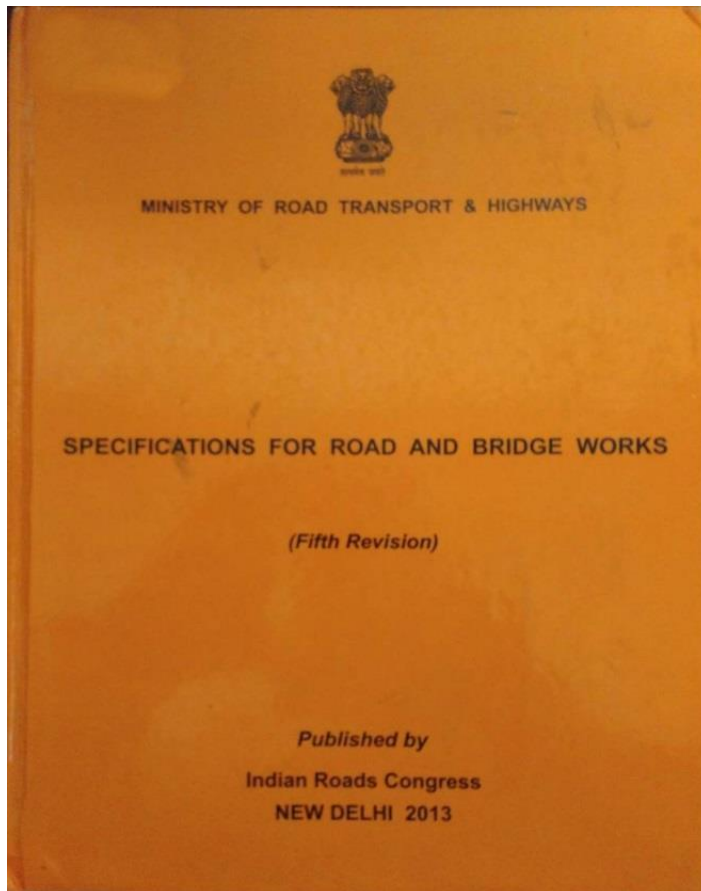
Tensile Shear Test (Method A)



Peeling Test (Method B)

Conclusion

- ◆ BIS should bring out test procedures for various applications of geocells



Thank You



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