International Geosynthetics Society

GEOSYNTHETICS IN EMBANKMENT: Applications & Benefits



Basal Reinforcement

Embankment on soft soils, embankment on piles and over areas prone to subsidence are the applications for which geosynthetics reinforcement provide effective solutions. Reinforcement used at the base, enhance the resistance of embankments and avoid failure through excessive deformation or shear in the subsoil.

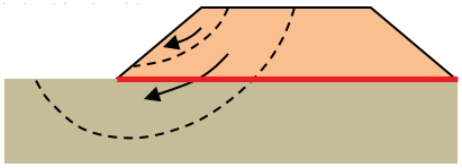
Embankment on Soft Soils

The shearing resistance of a soft soil depends on the type and size of particles and the water content, It governs the bearing capacity of the foundation and the maximal load that can be applied without failure. Thus, the stability of the structure is linked to the weight, the height of the embankment and the bearing capacity, related to the soil consolidation. It may be solved using various soil improvement techniques from dynamic compaction up to deep foundation. Generally applied in combination with these methods e.g. vertical drainage, geosynthetic reinforcements installed at the base, enhance the stability of the embankment, avoiding deep circle failure through the soft soil.

Embankment on soft soil: vertical drain and basal reinforcement

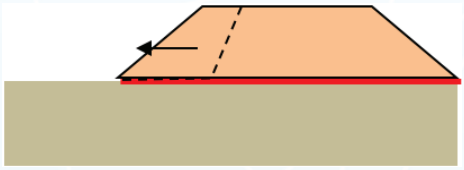
Settlement cannot be prevented but becomes more uniform below the embankment with reinforcement. Also, the consolidation process is improved, reducing the time needed to reach the final settlement and avoiding a step by step construction: the full height of the embankment can be reached immediately with geosynthetics reinforcement.

To design the geosynthetic reinforcement, local, rotational, global stability against slip circle failure shall be verified.

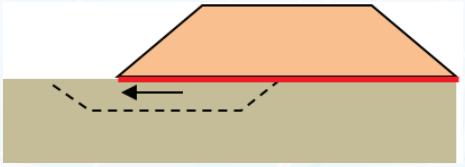


Local and rotational stability

As well subgrade extrusion and lateral thrust of the embankment may have a major effect and shall be studied.



Lateral sliding

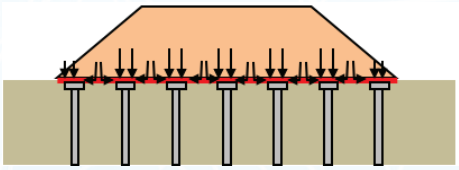


Foundation extrusion

Example of geosynthetics reinforcing embankment on soft soil

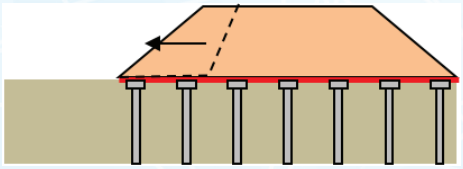
Embankment on Piles

The technique of piling enables embankments to be constructed to an unrestricted height at any construction rate (assuming the fill is suitably stable) with subsequent controlled post-construction settlements. A wide range of pile types may be used beneath embankments, including driven or cast in situ concrete piles, etc.
Basal reinforcement spanning across the pile caps are used to transfer the embankment loading onto the piles. The reinforcement permits the spacing of the piles to be increased.



Vertical loads transferred to the pile cap

The tensile strength of the reinforcement counteracts the horizontal thrust of the embankment fill. The need for raking piles along the extremities of the foundation can thus be eliminated.



Lateral sliding over piles

The use of reinforcement thereby maximizes the economic benefit of piled embankment foundations.

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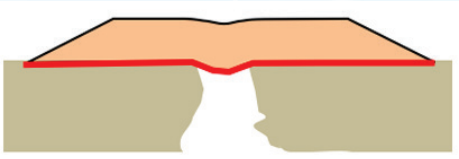
Reinforcement over piles with high strength wovens

Embankment on voids

Subsidence normally results from the collapse of a void below the ground surface. Subterranean voids can arise from natural processes (e.g. soil erosion in karstic areas) or from man-made processes (e.g. ground water pumping or underground mining). The consequence of subsidence occurring beneath structures can range from a loss of serviceability to total collapse.

Geosynthetics installed at the base of the embankment prevent brutal failure of the structure and disastrous effect (ultimate limit state), but also limit the amount of surface deformation caused by subsidence (serviceability limit state).

A void developing beneath a reinforced embankment may be repaired by filling the void with grout in which case the reinforcement should act temporarily. This is the case when the settlement is visible at the surface and may continue to develop.



Temporary reinforcement with surface deformation before repair

If the void cannot be seen at the surface, particularly when the deformation criteria at the surface is very severe and leads to thick structure, the reinforcement should be permanent and specified to act for the design life of the structure.

Permanent reinforcement for railways embankment

The general design procedure for determining the characteristics needed by the reinforcement includes:

A. Determination of the maximum acceptable surface deformation limits for the pavement or embankment

B. Determination of a suitable design value for the void diameter

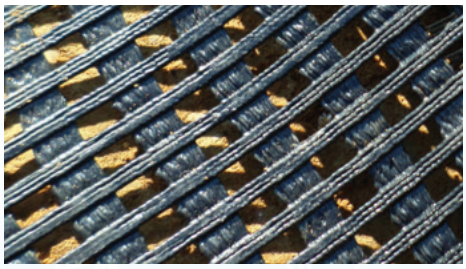
C. Determination of the maximum allowable strain in the reinforcement such that the criterion in a.) is satisfied

D. Determination of the tensile properties of the reinforcement needed for the design

Geosynthetics in Basal Reinforcement

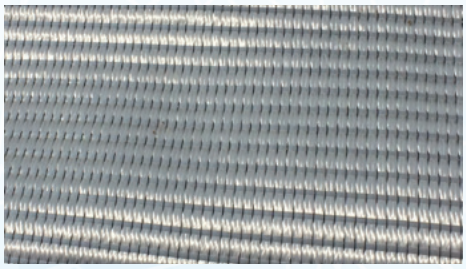
GSY used to reinforced the base of the embankment are either geogrids or grids, wovens or composites or mattresses, generally made of high strength yarns of polyester (PET), polypropylene (PP) or poly-vinyl-alcohol (PVA).

Compared to other applications where the needed strength is generally limited to 200 kN/m (eg retaining walls), basal reinforcement may require very high strength from 100 kN/m up to 3000 kN/m.



Example of high strength grid

Easy to install in wide area, high strength geosynthetics offer environmental friendly and economical, by using less natural resources.



Example of High strength PET woven

About the IGS

The International Geosynthetics Society (IGS) is a non-profit organization dedicated to the scientific and engineering development of geotextiles, geomembranes, related products and associated technologies. The IGS promotes the dissemination of technical information on geosynthetics and their appropriate uses through a newsletter (IGS News), two official journals (Geosynthetics International and Geotextiles and Geomembranes), conferences and technical seminars, dedicated task forces, over 40 National Chapters, special publications, and multiple other communications and outreach methods.

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