



## Geosynthetics in Embankments on Soft Soils

Prepared by J. Otani and E.M. Palmeira

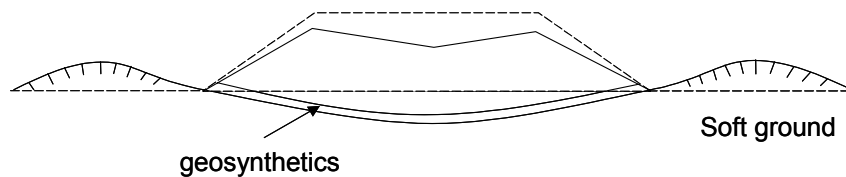
The construction of embankments on soft soils can be a challenging task. In this context, the use of geosynthetics to improve embankment stability is one of the most effective and well-tried forms of the soil reinforcement technique.



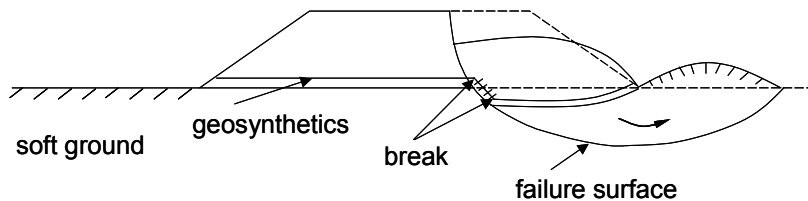
Typical unreinforced embankment failure and uses of geosynthetics as reinforcement.

In such problems, geosynthetics can be effectively used to

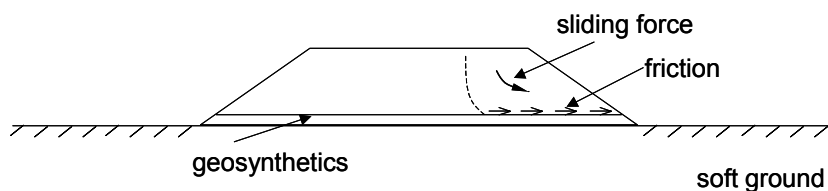
- 1) Reduce soft soils displacements due to low bearing capacity of soft soils;



- 2) Prevent overall failure of the embankment and soft foundation soil; and



- 3) Prevent sliding failure along the geosynthetics surface.



The stability level of a reinforced embankment on soft soil can be evaluated by the definition of safety factors ( $F_s$ ):

- For overall stability

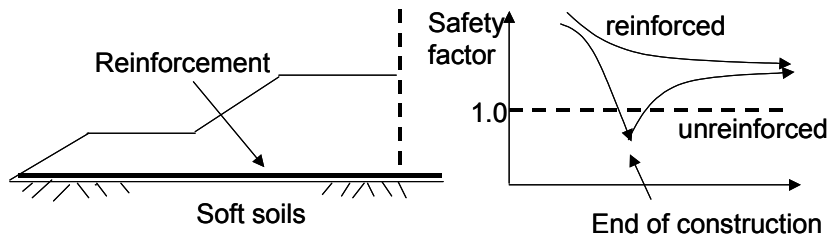
$$F_s = \frac{M_R + \Delta M_R}{M_D} \geq \text{typically } 1.2 \sim 1.3$$

where  $M_D$ : soil driving moment  
 $M_R$ : soil resisting moment  
 $\Delta M_R$ : geosynthetic moment contribution against failure

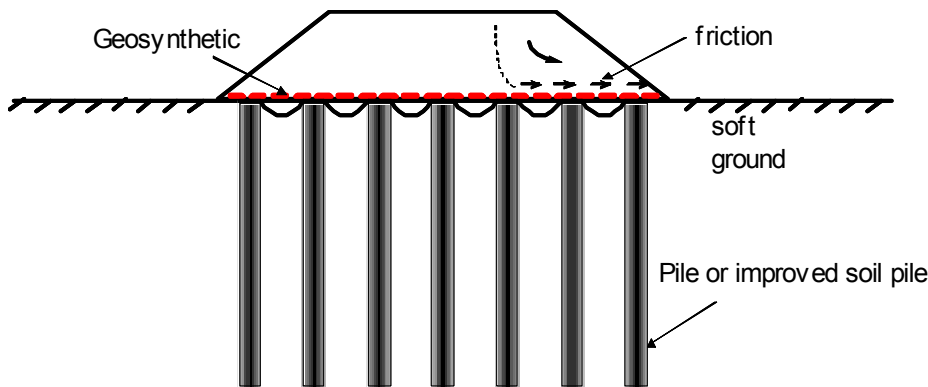
- For stability against sliding failure  $F_s = \frac{P_R}{P_A} \geq \text{typically } 1.5$

$P_A$ : active thrust from the fill (from active earth pressures)  
 $P_R$ : friction force along the fill-reinforcement interface

The efficiency of geosynthetics as reinforcements of embankments on soft soils can be visualized by the following figures.



In case of limited reinforcement effect, the so called “basal reinforced piled embankment” can be used. Prefabricated piles or improved soil piles can be employed.



Basal reinforced piled embankment

If draining materials are used, geosynthetics can be properly specified to contribute to the acceleration of settlements due to soft soil consolidation.

### 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 through a newsletter (IGS News) and through its two official journals (Geosynthetics International - [www.geosynthetics-international.com](http://www.geosynthetics-international.com) and Geotextiles and Geomembranes - [www.elsevier.com/locate/geotexmem](http://www.elsevier.com/locate/geotexmem)). Additional information on the IGS and its activities can be obtained at [www.geosyntheticsociety.org](http://www.geosyntheticsociety.org) or contacting the IGS Secretariat at [IGSsec@aol.com](mailto:IGSsec@aol.com)

**Disclaimer:** The information presented in this document has been reviewed by the Education Committee of the International Geosynthetics Society and is believed to fairly represent the current state of practice. However, the International Geosynthetics Society does not accept any liability arising in any way from use of the information presented. Reproduction of this material is permitted if the source is clearly stated.