NPTEL Course

REINFORCED SOIL PRINCIPLES AND MECHANISMS

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Introduction

An externally stabilised system such as cantilever retaining wall uses an external structural wall against which stabilising forces are mobilised. An internally stabilised system such as reinforced earth involves reinforcements installed within and extending beyond the potential failure mass.
a) Cantilever  

b) Gravity Element  

c) Braced

EXTERNALLY STABILIZED SYSTEMS

d) Tied-Back  

e) Reinforced Soil  

f) Soil Nailing

EXTERNALLY STABILIZED  

INTERNAFLY STABILIZED SYSTEMS
Introduction

- Soil reinforcement is a construction technique that depends on friction between soil and reinforcing element leading to tensile force mobilization.
Reinforcement introduces pseudo-confining pressure
Failure occurs either due to tension or pull out of reinforcement
Components

• The reinforcing elements (strip, grid or sheet, fabricated from metals or geosynthetics)

• Facing units to prevent the soil from erosion (Pre-cast concrete panels, metal sheets and plates, gabions, welded wire mesh, shotcrete, wrapped sheets of geosynthetics)

• Backfill materials (local soils, specified soils, marginal materials)
Technical Benefits

• Reduce the forces in the soil, which cause failure
• Shearing resistance of soils does not dominate design
• Efficient use of materials (shear resistance of soil with tensile capacity of the reinforcement)
• Inherent flexibility and tolerance to deformation
• Improved overall performance of the structure
Economic Benefits

- Cost savings relative to alternative designs
- Use of locally available and poor quality soils
- Land acquisition can be kept to a minimum
- Less construction time on projects
Mechanisms

Unreinforced Slope

Reinforced Slope

Failure surface
Persisting force = $P_v \tan \phi'$
Shearing resistance:
From soil alone: $P_V \tan \phi$
Reduction in shear force: $P_R \sin \theta$
Increase in force resisting shear: $P_R \cos \theta \tan \phi$

Shearing resistance:
$P_{resisting} = P_V \tan \phi + P_R (\sin \theta + \cos \theta \tan \phi)$
Principal tensile strain $\theta_c$ 

$$\theta_{crt} = (90 - \phi')$$

Increase in strength $(\sin \theta + \cos \theta \tan \phi')$
a) Geotextile response

b) Strain compatibility diagram
a) Concertina Method

b) Telescope Method
Profile View

c) Sliding Method