# REINFORCED EARTH STRUCTURES

**(Professional Elective-2)**

**I Semester**

| Course Code: 19CE2153 | L | P | C |
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**Prerequisites:** Geotechnical Engineering

**Course Outcomes:**

At the end of the course, the student will be able to:

CO1 Illustrate the principles and mechanisms of reinforced soil

CO2 Evaluate applications of reinforced soil.

CO3 Illustrate the issues of stability and construction of RE Wall.

CO4 Analyse the durability of reinforcing materials

CO5 Illustrate the application of reinforced soil in Civil Engineering

## UNIT-I: (10 Lectures)

## BASIC COMPONENTS AND MECHANISMS

Historical background, principles, concepts and mechanisms of reinforced earth. Materials used in reinforced earth structures, fill materials, reinforcing materials –metal strips, geotextile, geogrids, geocomposites and geojute, natural fibers, facing elements.

**Learning outcomes**:

1. Explain various reinforcing materials (L2)
2. Illustrate the principles and concepts of Reinforced Earth (L4)
3. Compare various reinforcing materials (L4)

## UNIT- II (10 Lectures)

## STRENGTH CHARACTERISTICS

Schlosser & Long's approach, rupture and sliding failures, sigma & tau models, sliding shear test, pull out test.

**Learning outcomes:**

1. Illustrate Concept of rupture and sliding failures (L4)
2. Discuss tests like Sliding Shear and Pull Out (L2)
3. Compare various models (L4)

**UNIT III : (10 Lectures)**

**STABILITY ANALYSIS AND CONSTRUCTION**

External stability-sliding, overturning, tilting/ bearing, slip failures. Static earth pressure analysis.

Internal stability-tension failure, wedge/ pullout failure (static case only).

Construction steps of an RE Wall, drainage above, behind and beneath the structure, wall drainage.

**Learning outcomes:**

1. Discuss the Construction steps of a Reinforced Earth Wall(L2)
2. Illustrate the issues related to External and Internal Stability (L4)
3. Compare External and Internal Stability (L4)

**UNIT- IV (10 Lectures)**

**DURABILITY OF REINFORCEMENT MATERIALS**

Electrochemical corrosion, bacterial corrosion, effects of UV light, oxidation, hydrolysis, humidity, polyester structure, temperature and externally applied loads. Resistivity, redox potential, water content, pH. Physical damage.

**Learning outcomes:**

1. Discuss about various factors effecting durability(L2)
2. Discuss the concept of resistivity, redox potential (L2)
3. Illustrate the concept of corrosion in view of durability (L4)

**UNIT- V : (10 Lectures)**

**SOIL NAILING AND FIBRE-REINFORCED SOIL**

Concept of soil nailing, methods of nailing, advantages of nailing, limitations of the system, comparison of soil nailing with reinforced soil, texsol, plysol.

Types of fibres-synthetic, natural, plant roots. Direction of placement.

**Learning outcomes:**

1. Discuss about various types of fibres (L2)
2. Compare soil nailing with other mechanisms (L4)
3. Illustrate the methods of soil nailing (L4)

**Text Books :**

1. Sivakumar Babu, G.L., *An Introduction to Soil Reinforcement and Geosynthetics*, 1st Edition, Orient Blackswan, 2005.

2. Swami Saran, *Reinforced Soil and its Engineering Applications*, 1st Edition, IK International (P) Ltd., 2006.

**References:**

1. Alan McGown, Khen Yeo, K. Z. Andrawes (Eds.), Performance of Reinforced Soil Structures: Proc. Intl. Reinforced Soil Conf., September 10-12, 1990, Thomas Telford.

2. Jones, Colin J F P., *Earth Reinforcement and Soil Structures*, 3rd Ed., Thomas Telford, 1996

3. Koerner, R.M., *Design with Geosynthetics*, 5th Edition, Pearson Prentice Hall, 2005.

4. Mandal, J.N., Reinforced Soil and Geo-textiles, Proc. IGC-1988, Oxford and IBH Publishing Company Private Ltd., 1988.

5. Sanjay Kumar Shukla, Erol Guler (Eds.), Advances in reinforced soil structures, Proc. 1st GeoMEast, Springer Intl. Publg. AG, 2018.

**Codes:**

1. BS 8006 –I : 2010, Code of Practice for strengthened/reinforced soils and other fills, 2010. British Standards

2. BS 8006 – 2 : 2011, Code of Practice for strengthened/reinforced soils. Soil nail design, 2011. British Standards

3. Federal Highway Administration, Design and Construction of Mechanically Stabilized Earth Walls and Reinforced Soil Slopes, Volumes 1 & 2, Publication No. FHWA-NHI-10-024, 2009.