

## GROUND IMPROVEMENT TECHNIQUES

### Course Learning Objectives

The objective of this course is:

- To make the student appreciate the need for different ground improvement methods adopted for improving the properties of remolded and in-situ soils by adopting different techniques such as in situ densification and dewatering methods.
- To make the student understand how the reinforced earth technology and soil nailing can obviate the problems posed by the conventional retaining walls.
- To enable the students to know how geo textiles and geo synthetics can be used to improve the engineering performance of soils.
- To make the student learn the concepts, purpose and effects of grouting.

### Course Outcomes:

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

- Understand the principles of various ground improvement techniques Prefer suitable ground improvement techniques based on the Soil conditions and Local available Materials
- Understand the principles and suitability of various stabilization techniques Select suitable stabilization techniques based on the Soil conditions and local Available materials Understand the Principles of dewatering techniques and to apply suitable
- Dewatering technique in the field depending on the requirement Understand the grouting technology and its applications by selecting the suitable

### SYLLABUS

#### UNIT I

**Introduction** – Need for Engineering Ground – Classifications of Ground Modification Techniques – Suitability, Feasibility and Desirability. Densification of cohesionless soils – Deep Compaction – Vibroflotation – Vibro Composer method - Blasting – Densification at Ground. - Vibrocompaction - Heavy Tamping

#### UNIT II

**Improvement of Cohesive soils** – Preloading - Soil Replacement – Radial Consolidation – Vertical and Radial Consolidation - Vertical Drains – Sand Drains – Effect of Smear – Sandwicks – Band drains – Dynamic Compaction.

#### UNIT III

**Stabilization**- Mechanical Stabilization, Lime Stabilization, Cement Stabilization, Bitumen Stabilization, Thermal Stabilization, Chemical Stabilization and Stabilization with Different Admixtures

#### **UNIT IV**

**Dewatering:** - Dewatering methods – open sumps and ditches – gravity flow wells – Vacuum dewatering – Electro – kinetic dewatering – Electrosmosis  
**Grouting:** Overview of grouting - Suspension grouts – Solution grouts – Emulsion grouts- Categories of grouting – Grouting Techniques – ascending stage, descending stage and stage grouting – Grouting Plant - Grout control - Grouting applications – Dams, Tunnels, Shafts and drifts, excavations.

#### **UNIT V**

**Stone Columns** – Methods of installation of Stone Columns – Load shared by stone columns and the stabilized ground – uses of stone columns Lime columns and granular trenches – Installation – In situ ground reinforcement – ground anchors – types – Components and applications – uplift capability- Stability of foundation trenches and surrounding structures through soil Nailing, tie backs.

#### **TEXT BOOKS**

1. 'Ground Improvement Techniques' by Purushotham Raj, Laxmi Publications, New Delhi.
2. 'Ground Improvement Techniques' by Nihar Ranjan Patro, Vikas Publishing House (P) Limited, New Delhi.
3. An introduction to Soil Reinforcement and Geo synthetics' by G.L.Siva Kumar Babu, Universities Press

#### **REFERENCES**

1. Construction and Geotechnical Methods in Foundation Engineering By R.M. Koerner, McGraw – Hill Book Co.
2. Current Practices in Geotechnical Engineering Vol.1, Alam Singh and Joshi, International Book Traders, Delhi, & Geo- Environ Academia.
3. Foundation Analysis and Design (1V Ed.) By J.E. Bowles, McGraw – Hill Book Co.,
4. Ground Improvement – Edited by M.P. Moseley, Blackie Academic & Professional.
5. Soil for Road Engineers, H.M.S.O, London.
6. Ground Improvement Techniques by Bergadoetal.