Ground Improvement Techniques – Classification, Case Studies and Trends

(30 August -09 September, 2016)

Department of Civil Engineering, NIT WARANGAL

1. Overview

Ground improvement is one of the basic requirements of many civil engineering construction projects. Improving the ground permits construction on problematic soils by changing their characteristics and strength. With the introduction of Japanese high speed railways (Shinkansen) in India, ground improvement will play a significant role in the construction and infrastructure development in India.

This course focuses on the principles of various ground improvement techniques developed in Japan, Asia and the rest of the world. The course will encompass the understanding of the problems facing geotechnical researchers and engineers working in the field of ground improvement, and will also cover the recent advances in the techniques available to them. The course contents consist of three parts. Part I focuses on the approaches for ground improvement geosystem dividing each techniques in to various groups and mechanics involved in each techniques. Part II describes many case histories from Japan and other Asian countries based on the tutors' experiences of working in various ground improvement projects and their implementation. Part III focuses on the new applications and trend of the ground improvement geosystem including recycling, geo-environmental consideration and preservation of the world cultural heritage.

This course targets the beginners and the intermediate level practitioners who are dealing with geotechnical construction projects or who have interest in the development and application of ground improvement techniques. Engineers and researchers will find it helpful in developing, advancing and applying the techniques in the field.

In this course, ground improvement techniques, their theoretical background, methods adopted in a particular situation and accomplishment of the projects will be described in an easily understandable way. This course helps students, researchers and engineers to understand what is ground improvement, principles of the improvement methods considering the geological and geotechnical background, how they are executed in the site, basis of selection of a particular ground improvement technique in a project, and the cost-performance of such methods, etc.

The course will be delivered by expert who had many years of practical and consulting experiences as well as experiences on research, development and, execution of ground improvement projects in Japan and other Asian countries.

2. Objectives

The primary objectives of the course are as follows:

i) Explain the mechanics of ground improvement technique and mechanism involved including the important factors that will help engineers in judging and adopting a particular technique in the fields.
ii) Describe many case histories from Japan and other countries of the world. Numerous case studies will help to understand how the new and improved methods have actually been applied over a wide variety of ground conditions.
iii) Contribute to a better understanding of various existing ground improvement techniques, which will be described in a concise and easily understandable ways.
iv) Help students, engineers, researchers and practitioners gaining a firsthand experiences of ground improvement techniques through many case studies along with some example calculations

Suggested Lecture Schedule

Date	Day	Time	L/T/P	Topic
30/08/2016 Approaches for Ground Improvement	Tue	08.30 to 09.30		**Registration and Inauguration**
		09:30 to 10.30	L1	Concept of ground improvement, Mechanism for increasing soil strength through ground improvement
		10:45 to 11:45	L2	Types of modern ground improvement technique, Feasibility and applicability of ground improvement techniques
		14:00 to 15:00	L3	Ground improvement without admixtures in non-cohesive soils
31/08/2016	Wed	09:30 to 10.30	L4	Ground improvement without admixtures in cohesive soils
		10:45 to 11:45	L5	Ground improvement with admixtures or inclusion: Soil-cement,
		14:00 to 15:00	L6	Ground improvement with admixtures or inclusion: dynamic consolidation,
		15:00 to 16:00	P1	Problem solving session with examples
01/09/2016	Thr	09:30 to 10.30	L7	Ground improvement with grouting type admixtures: Grouting, jetting and mixing, dynamic grouting, multi-point grouting.
		10:45 to 11:45	L8	Ground improvement by earth reinforcement: geosyntheics, soil nailing and root piling
		14:00 to 15:00	L9	Ground improvement by earth reinforcement: rock bolting, anchoring.
02/09/2016	Fri	09:30 to 10.30	L10	Other ground improvement techniques: Freezing, blasting, electro-osmosis.
		10:45 to 11:45	L11	Ancient ground improvement techniques, Pratice adopted in Ancient India, Practice exported from India to other Asian nations in the construction of temples
		14:00 to 15:00	P2	Problem solving session with examples
03/09/2016 Case Histories of Ground Improvement Techniques	Sat	09:30 to 10.30	L12	Case history (No. 1) of ground improvement technique: Soil-cement
		10:45 to 11:45	L13	Case history (No. 2) of ground improvement technique: Preloading and dewatering

05/09/2016	Mon	09:30 to 10.30	L14	Case history (No. 3) of ground improvement technique: Sand compaction pile
		10:45 to 11:45	L15	Case history (No. 4) of ground improvement technique: Grouting
		14:00 to 15:00	L16	Case history (No. 5) of ground improvement technique: Jetting and mixing
06/09/2016	Tue	09:30 to 10.30	L17	Case history (No. 6) of ground improvement technique: Geo-synthetics
		10:45 to 11:45	L18	Case history (No. 7) of ground improvement technique: Soil nailing and root piling
		14:00 to 15:00	P3	Problem solving session with examples
07/09/2016 Recent Applications and Trends of Ground Improvement Techniques	Wed	09:30 to 10.30	L19	Geo-environmental aspects of ground improvement, treatment of wastes
		10:45 to 11:45	L20	Utilization of industrial by-products in ground improvement
		14:00 to 15:00	L21	Novel ground improvement techniques against natural disaster such as earthquakes and tsunami
08/09/2016	Thr	09:30 to 10.30	L22	Ground improvement techniques used for cultural heritage preservation across Asia
		10:45 to 11:45	L23	Local technology aided low cost ground improvement techniques
		14:00 to 15:00	L24	Review of the course and free discussion
09/09/2016	Fri	09:30 to 10.30	P4	Examination for students
		10:45 to 11:45	P5	
		14:00 to 15:00	P6	

Modules	▪ **Approches for Ground Improvement** ▪ Case Histories of Ground Improvement Techniques ▪ Recent Applications and Trends of Ground Improvement Techniques
You Should Attend If…	▪ you are a faculty member/research scientist in Civil Engineering interested in soil mechanics, foundation engineering and ground improvement methods. ▪ you are a professional civil engineer interested in geotechnical engineering, methods adopted in field for ground improvement and different case histories around the world. ▪ you are a student of civil engineering interested in learning the different methods of ground improvement and when and where to apply a certain method.
Fees	The participation fees for taking the course is as follows: **Participants from abroad : For students - US $100; for faculty/scientists – US$500** **Industry/ Research Organizations: Rs.10,000/-** **Faculty: Rs. 4,000/-** **Students & Research Scholars:** **Without award of Grade: Rs. 1,000/-** **With award of Grade: Rs. 2,000/-** The above fee includes all instructional materials, computer use for tutorials, free internet facility, working lunch, tea & snacks. The participants from industry / research organisations will be provided with twin sharing accommodation on payment basis (subject to the availability). Participants from the academic institutions will be provided with twin sharing accommodation either in Visitors Block or in Student Hostels. (Accommodation and boarding charges will be Rs. 4000/- for ten days @ Rs. 400/- per day)

The Faculty

	Hemanta Hazarika, Professor in the Department of Civil Engineering, Kyushu University, Fukuoka, Japan. His research interests include soil-structure interaction, stability of soil- structures during earthquakes and tsunami, ground improvement, application of recycled waste and lightweight materials in constructions, stability of cut slopes, and landslides and protection against them.
	**Dr. V. Ramana Murthy** is an Associate Professor of Civil Engineering at NIT Warangal. His research interests are Ground Improvement, Expansive soils and waste material utilization.
	**Dr. G. Kalyan Kumar** is an Assistant Professor of Civil Engineering at NIT, Warangal. His research interests are Soil Dynamics, Seismic hazard, Seismic microzonation, Disaster Management and Subsurface Investigation.
	**Dr. Rakesh J. Pillai** is an Assistant Professor of Civil Engineering at NIT, Warangal. His research interests are Soft clay engineering, Cyclic behavior of clays, Constitutive modeling and Tunneling.