

**Geotechnical properties of soil and its implication on the
foundation design of park enclave, Chak Shehzad, Islamabad**



BY

**Faisal Mushtaq
Saqib Pervez**

**Department of Earth and Environmental Sciences,
Bahria University, Islamabad**

2012

**GEOTECHNICAL PROPERTIES OF SOIL AND ITS
IMPLICATION ON THE FOUNDATION DESIGN OF PARK
ENCLAVE, CHAK SHEHZAD,
ISLAMABAD**



A thesis submitted to Bahria University, Islamabad in partial fulfillment of the requirement for the degree of BS in Geology.

**FAISAL MUSHTAQ
SAQIB PERVEZ**

**Department of Earth and Environmental Sciences,
Bahria University, Islamabad**

2012

ABSTRACT

Islamabad, the capital city of Pakistan is a planned city constructed since 1960 at the foot of the Margalla Hills just north of the old city of Rawalpindi. Expert engineering is required for construction purposes because of increasing population of both Islamabad and Rawalpindi. This has resulted in ever-increasing demands of shelter for residence and other purposes.

The present research focuses on the geo-technical investigations outcome carried out by Earth Services, Islamabad in Chak Shahzad, Islamabad. The test samples were collected from different locations. Field and laboratory tests were performed on selected samples in the geo-technical laboratory to evaluate their geotechnical properties and their results have been compiled.

The standard penetration test data reveals that N-values vary to minimum of 16 at shallow depths to a maximum of 52 at greater depth. Geo-technical laboratory analyses for the representative soil samples have also been discussed. Grain size analysis data exhibit that gravel ranges from 0% to 30 %, sand ranges from 60 to 70%, and silt 10 to 15%. The natural moisture content varies from 3.54% to 16.67%. The soil consistency data reveals that liquid limit for studied samples varies 28% to 44%, plastic limit is in between 17% to 33% and the plasticity index is from 3% to 17%. Specific gravity for soil samples is 2.68 g/cc.

Geotechnical properties of soil samples reveals that these soil can prove as a reliable foundation base and their behavior under imposed load (buildings and roads) in Park Enclave is safe and chances for collapse or subsidence are minimum.

ACKNOWLEDGMENTS

We want to thank number of people without whom this work might not have been completed, and to whom we are greatly indebted.

To our respected supervisor Mr. Abdul Jabbar, Lecturer NICE, National University of Sciences and Technology (NUST), Islamabad and co-supervisor Mr. Hummad Ghani, Lecturer Earth & Environmental Sciences, Bahria University, Islamabad, under whose practical and professional guidance, this work has been completed.

To Mr. Maqsood Hussain, Lab Technician & Mr. Ahmed Jamal, Lab Assistant, NICE, NUST, Islamabad, for their help and guidance during our laboratory work. We are also thankful to Earth Services, Islamabad for their corporation in completing this work.

To our Parents, who continue to teach and develop our qualities and have been the source of encouragement throughout our life. We are also grateful to our teachers and friends who supported us in our work. Their continuous help and prayers during this research work may not be left unmentioned in this regard.

CONTENTS

	Page
Abstract	i
Acknowledgments	ii
Contents	iii
Figures	v
Tables	vi
Graphs	vii

CHAPTER 1 INTRODUCTION

1.1	General Statement	01
1.2	Location and Accessibility	01
1.3	Physiography	01
1.4	Climate	02
1.5	Hydrology	04
1.6	Historic Earthquakes near Islamabad	04
1.7	What does the future holds for Pakistan?	04
1.8	Aims and Objectives	06
1.9	Methodolgy	07

CHAPTER 2 TECTONICS & GEOLOGY OF PAKISTAN

2.1	General Geology of Pakistan	08
2.2	The Kohat-Potwar Fold-Belt	09
2.3	Tectonic Setting of Potwar Plateau	10
2.4	Geology of Islamabad/Rawalpindi Area	11
2.4.1	Stratigraphy	11
2.4.1.1	Surghar Group	12
2.4.1.1.1	Samana Suk Formation	12
2.4.1.1.2	Chichali Formation	12
2.4.1.1.3	Lumshiwai Formation	12
2.4.1.2	Rawalpindi Group	14
2.4.1.2.1	Murree Formation	14
2.4.1.2.2	Kamlial Formation	14
2.4.1.3	Surficial Units	14
2.4.1.3.1	Lei Conglomerate	14
2.4.1.3.2	Terrace alluvium	15
2.4.2	Geologic Structure	15
2.4.2.1	Hazara Fault Zone	16

2.4.2.2	Piedmont Fold Belt	16
2.4.2.3	Soan Syncline	17

CHAPTER 3
ENGINEERING GEOLOGY

3.1	Methodology	18
3.2	Geo-Technical Properties	19
3.2.1	Field Testing	19
3.2.1.1	Standard Penetration Test (SPT)	19
3.2.2	Laboratory Testing	20
3.2.2.1	Moisture content	20
3.2.2.2	Sieve Analysis	25
3.2.2.3	Hydrometer Analysis	26
3.2.2.4	Atterberg Limits	29
3.2.2.5	Specific Gravity	32
3.2.2.6	Proctor Test	34

CHAPTER 4
RESULTS AND DISCUSSIONS

4.1	Site Introduction	37
4.2	Earthquake Potentials	37
4.3	Groundwater	37
4.4	Standard Penetration Test	38
4.5	Sieve Analysis	38
4.6	Specific Gravity	39
4.7	Atterberg Limits	39
4.8	Proctor Tests	40
4.9	Moisture Content	41

CHAPTER 5
CONCLUSIONS & RECOMMENDATIONS

5.1	Foundation Design	42
5.2	Construction Precautions	42

References	43
Appendix	46

Figures

	Page
Figure 1.1. Location Map Showing Islamabad Study Area (Box) and Selected Regional Features	02
Figure 1.2. Pakistan Earthquake Zone Map	05
Figure 1.3. Large Historical Earthquakes near Islamabad	07
Figure 2.1. Geological and Structural Map of the Potwar Basin	09
Figure 2.2. General Geology and division of Salt Range	10
Figure 3.1. Satellite Image Showing Sample Locations from Park Enclave, Islamabad	18
Figure 3.2. Oven Used For Moisture Content Determination in Soil Samples	22
Figure 3.3. Speedy Moisture Instrumentation	23
Figure 3.4. Sieve Analysis Instrumentation	26
Figure 3.5. Hydrometer Test Instrumentation	28
Figure 3.6. (A) Liquid Limit Test Instrumentation. (B) Soil Sample in Liquid Limit Device	30
Figure 3.7. Threads for Plastic Limit Estimation	31
Figure 3.8. Atterberg Limits	32
Figure 3.9. Specific Gravity Test Instrumentation	33
Figure 3.10. Proctor Test Instrumentation	35
Figure 3.11. (A) Mold Filled With Soil Sample. (B) Excursion of Sample for Moisture Content Determination	35

Tables

	Page
Table 1.1. Average Temperature & Heavy Rainfalls at Islamabad	03
Table 1.2. Major Damaging Earthquakes in the 20'Th Century	06
Table 2.1. Generalized Stratigraphic Section of Islamabad-Rawalpindi Study Area	13
Table 3.1. Standard SPT Values and Their Relative Densities	20
Table 3.2. Oven Drying Test Values	22
Table 3.3. Speedy Moisture Test Values	24
Table 3.4. Result of Grain Size Distribution	26
Table 3.5. Hydrometer Test Values	28
Table 3.6. Liquid Limit Test Values	31
Table 3.7. Standard Values for Plasticity Index	31
Table 3.8. Standard Ranges of Specific Gravity for Soils	32
Table 3.9. Specific Gravity Test Results	33
Table 3.10. Density Calculations	36
Table 3.11. Moisture Content	36

Graphs

	Page
Graph 3.1. Moisture Content Graph	24
Graph 4.1. Sieve Analysis Result Graph for Five Samples	38
Graph 4.2. Specific Gravity Result Graph for Five Samples	39
Graph 4.3. Modified Proctor Test Result Graph	40
Graph 4.4. Moisture Content Result Graph for Five Samples	41