

SITE INVESTIGATION

by  
Machlouzaridou Theophania

Project Report  
Submitted to  
the Department of Civil Engineering  
of the Higher Technical Institute  
Nicosia Cyprus  
in partial fulfillment of the requirements  
for the diploma of  
TECHNICIAN ENGINEER

in

CIVIL ENGINEERING

June 1990

HIGHER TECHNICAL INSTITUTE	PROJECT NO 1589
----------------------------------	--------------------

## SUMMARY

This project is mainly intended to analyse the objectives of Site Investigation, in conjunction with the main methods used for S.I for the Construction of buildings, and also to give special emphasis on methods used nowadays in Cyprus.

Chapter 1, states initially what information should be obtained in the Course of a Site Investigation. Secondly, the various Boring and Drilling methods used for actual S.I are described in order the general suitability of the site to be assessed. Finally, the geophysical methods are analysed with emphasis on electrical resistivity, seismic and magnetic methods and also foundation properties of various types of soils are stated.

Chapter 2, describes the unsuitable soil and rock conditions for foundation design, and the methods applied to overcome these conditions.

Chapter 3, deals with the methods used for sampling. Information is given for disturbed and undisturbed samples and finally both the laboratory and in-situ methods of soil testing are described.

In chapter 4, the methods to be applied in any design, and the correct way of planning the work are mentioned. This

is to enable an adequate and economical design to be prepared, giving emphasis to the design of dams and foundations.

Chapter 5, deals with the present day practice of Site Investigation in Cyprus for building construction.

CONTENTS

Page

SUMMARY

INTRODUCTION TO SITE INVESTIGATION ..... 1

CHAPTER 1: TO ASSESS THE GENERAL SUITABILITY OF SITE  
FOR THE PROPOSED WORKS.

1.1	Information required from a site investigation	5
1.2	Methods of investigation .....	7
1.2.1	Exploration in soils .....	7
	Examination in - situ .....	7
1.2.1.1	Trial pits .....	7
1.2.1.2	Shafts and headings .....	8
1.2.1.3	T.V and borehole cameras .....	8
	Boring and drilling .....	9
1.2.1.4	Percussion boring .....	9
1.2.1.5	Mechanical augers .....	13
	(1) Short flight augers .....	13
	(2) Continuous flight augers .....	13
	(3) Bucket augers .....	14
1.2.1.6	Hand and portable augers .....	15
1.2.1.7	Wash boring .....	16
1.2.1.8	Rotary drilling .....	17
	(1) Open - hole drilling .....	17
	(2) Core drilling .....	18
1.2.2	Exploration in rocks	20

1.2.2.1	Test pits .....	20
1.2.2.2	Drilled shafts .....	20
1.2.2.3	Rotary core drilling .....	21
1.2.3	Water level observations .....	21
1.2.4	Excavation for works over water .....	22
1.3	Geophysical methods .....	24
1.3.1	Generally .....	24
1.3.2	Electrical resistivity method .....	25
1.3.3	Seismic refraction method .....	28
1.3.4	Magnetic method .....	29
1.4	Discussion of investigation results in relation to construction design .....	31

CHAPTER 2: TO FORSEE AND PROVIDE AGAINST DIFFICULTIES  
THAT MAY ARISE DURING CONSTRUCTION AND COMPLETION  
OF THE PROJECT DUE TO GROUND AND OTHER LOCAL  
CONDITIONS.

2.1	Foundation properties of soils and rocks ....	34
2.1.1	Properties of soil types .....	34
2.1.1.1	Non - cohesive soils .....	34
2.1.1.2	Cohesive soils .....	35
2.1.2	Properties of rock types .....	36
2.1.2.1	Weathering .....	36
2.1.2.2	Faulting .....	37
2.1.2.3	Jointing .....	37

2.2	Methods to overcome unsuitable ground conditions .....	38
2.2.1	Excavation support .....	38
2.2.1.1	Timbering .....	38
2.2.1.2	Shoring .....	38
2.2.1.3	Anchoring .....	39
2.2.2	Ground water control .....	42
2.2.2.1	Sheet piling .....	42
2.2.2.2	Diaphragm walls .....	42
2.2.2.3	Thin - grouted membrane .....	43
2.2.3	Temporary water removed .....	47
2.2.3.1	Pumping from sumps .....	47
2.2.3.2	Well pointing .....	47
2.2.4	Methods to prevent settlement .....	50
2.2.4.1	Strip foundations .....	50
2.2.4.2	Raft foundations .....	50
2.2.5	Pile foundations .....	53
2.2.5.1	Timber piles .....	53
2.2.5.2	Concrete piles .....	53
2.2.5.3	Steel piles .....	55

### CHAPTER 3: SAMPLING AND TESTING

3.1	Sampling .....	59
3.1.1	General .....	59
3.2	Types of samplers .....	60
3.2.1	Open - drive samplers .....	60

3.2.2	Thin - walled samplers .....	61
3.2.3	Split - barrel sampler .....	61
3.2.4	Stationary piston sampler .....	62
3.2.5	Continous sampler .....	64
3.2.6	Compressed our sampler .....	64
3.3	Testing .....	65
3.3.1	General .....	65
3.3.2	In - situ testing .....	67
3.3.2.1	Shear Vane test .....	67
3.3.2.2	Plate bearing test .....	68
3.3.2.3	Standard penetration test .....	70
3.3.2.4	Static - cone penetration test .....	72
3.3.3	Laboratory testing .....	74
3.3.3.1	The Atterberg Limit test .....	74
3.3.3.2	Particle size distribution test .....	75
3.3.3.3	Direct shear test (shear box test) .....	77
3.3.3.4	Triaxial compression test .....	78
3.3.3.5	Unconfined compression test .....	83
3.3.3.6	Consolidation test .....	83
3.4	Exploration report .....	87

CHAPTER 4: TO ENABLE AN ADEQUATE AND ECONOMICAL DESIGN  
TO BE PREPARED

4.1	General .....	91
4.1.1	Design of dams .....	91
4.1.2	Design of foundations .....	93

## CHAPTER 5: PRESENT DAY PRACTICE IN CYPRUS

5.1	Preliminary site investigation .....	96
5.2	Exploration report .....	97
5.2.1	Boring and drilling .....	97
5.3	Sampling .....	98
5.4	Testing .....	98
5.4.1	In - situ testing .....	98
5.4.2	Laboratory testing .....	99
5.5	Site investigation report .....	100
1.	Scope of investigation .....	101
2.	General description of the proposed structure for which the exploration has been conducted .	101
3.	Geological conditions of site .....	101
4.	Drainage facilities at the site .....	102
5.	Details of boring .....	102
6.	Description of subsoil conditions as determined from the soil and rock samples collected .....	102
7.	Ground water table as observed from the borehole .....	103
8.	Details of foundation recommendations and alternatives .....	103
9.	Anticipated construction problems .....	104
10.	Limitations of the investigation .....	104

### CONCLUSIONS