

MAINTENANCE OF RETAINING STRUCTURE DUE TO SOIL FAILURE

**SITI ZUBAIDAH HASHIM
2005631927**

**BUILDING SURVEYING DEPARTMENT
FACULTY OF ARCHITECTURE, PLANNING AND SURVEYING
UNIVERSITI TEKNOLOGY MARA
SHAH ALAM, SELANGOR DARUL EHSAN**

APRIL 2007

	CONTENTS	PAGE
ACJKNOWLEDGEMENT		
TABLE OF CONTENTS		
LIST OF CHART		
LIST OF TABLE		
LIST OF PHOTOGRAPHS		
LIST OF APPENDIX		
1.0 INTRODUCTION		1
1.1 PREFACE		1
1.2 DEFINITION OF TOPIC		3
1.2.1 Maintenance		3
1.2.2 Retaining structure		3
1.2.3 Soil failure		4
1.3 STATEMENT OF ISSUE		8
1.4 AIM		9
1.5 OBJECTIVE OF STUDY		9
1.6 METHODOLOGY		10
1.6.1 Collection of data		10
1.7 AREA OF STUDY		11
2.0 MAINTENANCE OF RETAINING STRUCTURE		12
2.1 PREFACE		12
2.2 MAINTENANCE		14
2.2.1 Access		14
2.2.2 Slope performance observation		14
2.3 THE FOR MAINTENANCE		16
2.4 FACTOR INFLUENCING THE DECISION TO CARRY OUT MAINTENANCE		17
2.4.1 Instrument		17
2.4.1.1 Inclinometer		18
2.4.1.2 Piezometer		21
2.4.1.2.1 Observation well		21
2.4.1.2.2 Open standpipe piezometer		23
2.4.1.2.3 Pneumatic piezometer		24
2.4.1.2.4 Vibrating wire piezometer...		25

2.4.2 DRAINAGE	26
2.4.2.1 Surface drainage	26
2.4.2.2 Subsurface drainage	27
2.4.2.3 Adjacent utilities	27
2.5 THE CAUSES OF MAINTENANCE WORK	28
2.5.1 Rationale	28
2.5.2 Loading	28
2.5.3 Water pressure	28
2.5.4 Wall materials	29
2.5.5 Monitoring	29
2.6 CHECKLIST OF SLOPE MAINTENANCE	30
2.7 INSPECTION	33
2.7.1 Type 1 inspection	34
2.7.2 Type 2 inspection	34
2.7.3 Type 3 inspection	34
2.7.4 Frequency and purpose types inspection	35
2.8 RETAINING STRUCTURE	36
2.8.1 THE FACTORS SHOULD BE CONSIDER IN DESIGN	38
2.8.1.1 Nature and characteristic	38
2.8.1.2 Height of water table	38
2.8.1.3 Types of wall	38
2.8.1.4 Material to be used	38
2.9 SLOPE FAILURE	39
2.9.1 FACTORS CONTRIBUTING TO SLOPE FAILURE	39
2.9.1.1 Factors causes increase in shear stress	
2.10 CAUSES OF SLOPE FAILURE	42
2.10.1 ROCK SLOPE FAILURE	42
2.10.1.1 Types of rock failure	43
2.10.1.1.1 Plane failure	43
2.10.1.1.2 Wedge failure	44
2.10.1.1.3 Toppling failure	45
2.10.2 Soil slope failure	47
2.10.2.1 Slump	47
2.10.2.2 Earth flow	48
2.10.2.3 Creep	49
2.11 TYPES OF RETAINING WALLS	50
2.11.1 CANTILEVER RETAINING WALL	51
2.11.2 DRIVEN PILES	52
2.11.3 DRILLED SHAFT WALLS	53
2.11.4 TIEBACK WALLS	55

3.0 SLOPE STABILIZATION	56
3.1 PREFACE	56
3.2 SELECTION OF SLOPE STABILIZATION METHODS	58
3.3 FACTORS SELECTION OF METHODS OF STABILIZATION	59
3.3.1 THE PURPOSE OF STABILIZING THE SLOPE	59
3.3.2 TIME IS AVAILABLE	59
3.3.3 THE ACCESSIBLE IN THE SITE	59
3.3.4 COST OF REPAIR	60
3.4 TYPES OF STABILIZATION METHODS	60
3.4.1 DRAINAGE	60
3.4.2 RETAINING STRUCTURE	62
4.0 CASE STUDY	64
4.1 PREFACE	64
4.2 CASE STUDY 1	66
4.2.1 PROJECT OVERVIEW	66
4.2.2 LOCATION OF SLOPE FAILURE	67
4.2.3 SITE GEOLOGY	68
4.2.4 BOREHOLE LOCATION	70
4.2.5 THE RESTRICTION	72
4.2.6 OPTION OF METHODS	73
4.2.7 THE METHODS FOR THIS PROJECT	74
4.2.8 RECOMMENDED MEASURES	74
4.2.9 CROSS SECTION	75
4.2.10 SURVEY PLAN	75
4.2.11 RECOMMENDED MEASURE	76
4.2.11.1 Soil nailing	76
4.2.11.2 Reinforced fill below roadway	76
4.2.11.3 Bottom slope erosion protection	77
4.2.11.4 Drainage works	78
4.2.11.5 Maintenance work	79
4.2.11.6 Stages of construction	80
...	
4.3 CASE STUDY 2	84
4.3.1 PROJECT OVERVIEW	84
4.3.2 SITE DESCRIPTION	85
4.3.3 SLOPE STABILITY PROBLEM	86
4.3.4 OPTION OF METHODS	87
4.3.5 ANALYSIS	88
4.3.6 TYPICAL CROSS SECTION	89
4.3.7 SLOPE STABILITY SOLUTIONS	90
4.3.7.1 SCALING	90
4.3.7.2 ROCK BOLTING AND ANCHORING	90
4.3.7.3 GROUND NETTING AND ROCK FALL FENCE	91

4.3.7.4 DRAINAGE WORKS	92
4.3.7.5 BIOMET AND VEGETATION	92
4.3.8 SUMMARY	93
4.3.9 STAGE OF CONSTRUCTION	94
4.4 CASE STUDY 3	98
4.4.1 PROJECT OVERVIEW	98
4.4.2 SLOPE PROPERTY	99
4.4.3 SURVEY PLAN	100
4.4.4 SLOPE PROTECTION	102
4.4.4.1 Propose temporary slope	102
4.4.4.2 Erosion protection	103
4.4.4.3 Slope protection	103
4.4.4.4 Stage of construction	104
4.4.4.5 Summary	110
5.0 ANALYSIS AND FINDINGS	111
5.1 PREFACE	111
5.2 DATA COLLECTION	112
5.3 FORMAT OF QUESTIONNAIRE	113
5.3.1 PART A	114
5.3.2 PART B	115
5.3.3 PART C	115
5.3.4 PART D	115
5.3.5 PART E	116
5.4 DATA ANALYSIS METHODOLOGY	117
5.5 QUANTITATIVE ANALYSIS	118
5.5.1 BACKGROUND OF RESPONDENTS	119
5.5.2 FINDINGS	124
6.0 CONCLUSION AND RECOMMENDATION	138
6.1 PREFACE	139
6.2 FINDINGS	139
6.2.1 OBJECTIVE OF STUDY	139
6.2.1.1 First objective	139
6.2.1.2 Second objective	140
6.2.1.3 Third objective	140
6.3 CONCLUSION	141
6.4 RECOMMENDATIONS	143