

**IMPROVEMENT OF SECONDARY CONSOLIDATION  
CHARACTERISTICS OF PEATY CLAY BY  
PRECONSOLIDATION**

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**Master of Engineering (Honours)**

Department of Civil Engineering

University of Moratuwa

Sri Lanka

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Thesis submitted in partial fulfilment of the requirements for the degree of Master  
of Engineering in Foundation Engineering and Earth Retaining Systems

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## DECLARATION

I declare that this is my own work and this thesis does not incorporate without acknowledgement any material previously submitted for a Degree or Diploma in any other University or institute of higher learning and to the best of our knowledge and belief it does not contain any material previously published or written by another person except where the acknowledgement is made in the text.

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Date: March 16, 2017

R.M.S. Fernando

“The undersigned hereby certify that he has read and recommended the thesis for the acceptance in partial fulfillment of the requirements for the Master of Engineering”

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Date: March 16, 2017

Prof. S.A.S. Kulathilaka

(Supervisor)

## ABSTRACT

Special consideration should be given to secondary consolidation settlements during service in the construction of high road embankments in lands underlain by thick layers of soft peaty clay. Usually a preload design will be done to ensure that the peaty clay will remain in an over consolidated state during the operation of the road. Peaty clays are known for high secondary consolidation settlements. As such, possible secondary consolidation settlement during service life is also a major concern. The coefficient of secondary consolidation ( $C_\alpha$ ) is expected to reduce with increasing over consolidation ratio (OCR) achieved during preloading. At the stage of surcharge removal, the settlement during operation has to be estimated. In a preload design the practically achievable over-consolidation ratios (OCRs) are in the range of 1.1 to 1.2. Effectiveness of such OCR values in keeping the long term in service secondary consolidation settlements within acceptable limits was studied in this research. Oedometer tests were carried out simulating the process of loading-unloading-reloading on remoulded samples. Effects of prolonged loading on the coefficient of secondary consolidation was also assessed. Further tests were done on undisturbed samples obtained from preloaded peaty clay layers in two different projects. Results illustrate that the level of reduction of  $C_\alpha$  is related to the achieved OCR.

Keywords: Peaty clay, compressibility, secondary consolidation.

## ACKNOWLEDGEMENTS

Postgraduate research projects in Foundation and Earth Retaining Systems of Civil Engineering curriculum are very useful and beneficial for students who are about to face industry as engineers or follow higher studies. This module itself encourages students to improve the ability of self-studying which is much needed in becoming an all-round engineer. In addition to that, it improves problem solving, analytical and communication skills.

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## Table of Contents

DECLARATION .....	i
ABSTRACT .....	ii
ACKNOWLEDGEMENTS .....	iii
Table of Contents.....	iv
List of Figures.....	vi
List of Tables .....	xi
List of abbreviations and notations .....	xiv
Annexures.....	xvi
1.0 Introduction.....	1
1.1 General.....	1
1.2 Objectives.....	2
1.3 Methodology.....	2
1.4 Structure of the thesis.....	3
2.0 Literature Survey.....	4
2.1 Introduction .....	4
2.2 The history of consolidation theories.....	13
2.2.1 Primary Consolidation .....	13
2.2.2 Secondary Consolidation.....	14
2.3 Soil parameters which influence consolidation.....	19
2.3.1 Primary Consolidation .....	19
2.3.1.1 Permeability $k$ .....	19
2.3.1.2 Coefficient of Volume Compressibility $m_v$ .....	20
2.3.1.3 Compression Index $C_c$ .....	20
2.3.1.4 Coefficient of Consolidation $C_v$ .....	20
2.3.2 Secondary Consolidation.....	20
2.3.2.1 Secondary Consolidation Coefficient $C_\alpha$ .....	20
2.4 Reduction of secondary consolidation by surcharging .....	24
3.0 Simulated tests on remoulded peaty clay .....	25
3.1 Background.....	25
3.2 Methodology.....	27
3.3 Simulated Tests on Remoulded Peaty Clay .....	27
3.4 One day tests Conducted.....	28



3.4.1	Reduction of $C_{\alpha}$ with OCR for one day duration tests.....	40
3.4.2	Conformity with the $C_{\alpha}/C_c$ Concept.....	41
3.5	Three day tests Conducted .....	43
3.5.1	Reduction of $C_{\alpha}$ with OCR for three day duration tests .....	77
3.5.2	Conformity with the $C_{\alpha}/C_c$ Concept.....	79
4.0	Consolidation tests on undisturbed samples of preloaded Peaty Clay .....	84
4.1	Tests on Peaty clay treated by preloading from CKE Project.....	84
4.1.1	Variation of $C_{\alpha'}/C_{\alpha}$ with OCR .....	95
4.1.2	Conformity with $C_{\alpha}/C_c$ Concept .....	96
4.2	Tests on undisturbed samples of Preloaded Peaty clay from Fish Market Project.....	100
4.2.1	Variation of $C_{\alpha'}/C_{\alpha}$ with OCR.....	103
4.2.2	Conformity with $C_{\alpha}/C_c$ Concept.....	103
5.0	Effects of Sustained loading.....	105
5.1	Effects of Sustained loading on secondary consolidation .....	105
5.2	Unloading Behavior of peaty clay subjected to sustained loading .....	117
6.0	Summary and Conclusions .....	121
	References .....	125

## List of Figures

Figure 2.1 – Variation of void ratio with time.....	4
Figure 2.2 – Spring Analogy.....	5
Figure 2.3 – Compressibility and shear strength of a clay exhibiting delayed consolidation (after Bjerrum et al 1967).....	16
Figure 2.4 – Definition of Instant and Delayed compression compared with ‘primary’ and ‘secondary’ compression (after B’jerrum et al 1967).....	17
Figure 2.5 – Instant compression behavior resulting from secondary compression aging (after B’jerrum et al 1967).....	18
Figure 2.6 – Typical settlement Vs log (time) plots (From tests done at University of Moratuwa).....	21
Figure 2.7 – Variation of $C_\alpha$ with time and influence of pre-consolidation pressure (After Mesri et al. 1997).....	22
Figure 2.8 – Variation of $C_\alpha$ Vs $C_c$ of a sample from Middleton peat (after Mesri et al. 1997).....	23
Figure 2.9 – $C_\alpha$ changes with OCR (after Walker et al. 1969).....	24
Figure 3.1– Load Vs void ratio (e) – (NBRO-Test A).....	29
Figure 3.2 – Void ratio Vs log (time) – Loading Increment – (NBRO-Test A).....	30
Figure 3.3 – Void ratio Vs log (time) – Reloading Increment – (NBRO-Test A).....	30
Figure 3.4 – Variation of $C_\alpha$ with stress level in loading and reloading increment.....	31
Figure 3.5 – Reduction of $C_\alpha$ with OCR – (NBRO-Test A).....	32
Figure 3.6 – Load Vs void ratio (e) – (NBRO-Test B).....	33
Figure 3.7 – Void ratio Vs log (time) – Loading Increment – (NBRO-Test B).....	34
Figure 3.8 – Void ratio Vs log (time) – Reloading Increment – (NBRO-Test B).....	34
Figure 3.9 – Variation of $C_\alpha$ with stress level in loading and reloading increment – (NBRO-Test B).....	35
Figure 3.10 – Reduction of $C_\alpha$ with OCR – (NBRO-Test B).....	36
Figure 3.11 – Load Vs void ratio (e) – (NBRO-Test J).....	37
Figure 3.12 – Void ratio Vs log (time) – Loading Increment – (NBRO-Test J).....	37
Figure 3.13 – Void ratio Vs log (time) – Reloading Increment – (NBRO-Test J).....	37
Figure 3.14 – Variation of $C_\alpha$ with stress level in loading and reloading increment – (NBRO-Test J).....	38
Figure 3.15 – Reduction of $C_\alpha$ with OCR – (NBRO-Test J).....	39

Figure 3.16 – Reduction of $C_\alpha$ with OCR for all one day tests.....	40
Figure 3.17 – Load Vs void ratio (e) – (NBRO-Test A-1).....	45
Figure 3.18 – Void ratio Vs log (time) – Loading Increment – (NBRO-Test A-1).....	46
Figure 3.19 – Void ratio Vs log (time) – Reloading Increment – (NBRO-Test A-1).....	46
Figure 3.20 – Variation of $C_\alpha$ with stress level in loading and reloading increment – (NBRO-Test A-1).....	47
Figure 3.21 – Reduction of $C_\alpha$ with OCR – (NBRO-Test A-1).....	48
Figure 3.22 – Load Vs void ratio (e) – (NBRO-Test C).....	49
Figure 3.23 – Void ratio Vs log (time) – Loading Increment – (NBRO-Test C).....	50
Figure 3.24 – Void ratio Vs log (time) – Reloading Increment – (NBRO-Test C).....	50
Figure 3.25 – Variation of $C_\alpha$ with stress level in loading and reloading increment – (NBRO-Test C).....	51
Figure 3.26 – Reduction of $C_\alpha$ with OCR – (NBRO-Test C).....	52
Figure 3.27 – Load Vs void ratio (e) – (NBRO-Test D).....	53
Figure 3.28 – Void ratio Vs log (time) – Loading Increment – (NBRO-Test D).....	53
Figure 3.29 – Void ratio Vs log (time) – Reloading Increment – (NBRO-Test D).....	53
Figure 3.30 – Variation of $C_\alpha$ with stress level in loading and reloading increment – (NBRO-Test D).....	54
Figure 3.31 – Reduction of $C_\alpha$ with OCR – (NBRO-Test D).....	55
Figure 3.32 – Load Vs void ratio (e) – (NBRO-Test E).....	56
Figure 3.33 – Void ratio Vs log (time) – Loading Increment – (NBRO-Test E).....	57
Figure 3.34 – Void ratio Vs log (time) – Reloading Increment – (NBRO-Test E).....	57
Figure 3.35 – Variation of $C_\alpha$ with stress level in loading and reloading increment – (NBRO-Test E).....	58
Figure 3.36 – Reduction of $C_\alpha$ with OCR – (NBRO-Test E).....	59
Figure 3.37 – Load Vs void ratio (e) – (UOM-Test A).....	60
Figure 3.38 – Void ratio Vs log (time) – Loading Increment – (UOM-Test A).....	60
Figure 3.39 – Void ratio Vs log (time) – Reloading Increment – (UOM-Test A).....	60
Figure 3.40 – Variation of $C_\alpha$ with stress level in loading and reloading increment – (UOM-Test A).....	61
Figure 3.41 – Reduction of $C_\alpha$ with OCR – (UOM-Test A).....	62
Figure 3.42 – Load Vs void ratio (e) – (UOM-Test B).....	63

Figure 3.43 – Void ratio Vs log (time) – Loading Increment – (UOM-Test B).....	64
Figure 3.44 – Void ratio Vs log (time) – Reloading Increment – (UOM-Test B).....	64
Figure 3.45 – Variation of $C_{\alpha}$ with stress level in loading and reloading increment – (UOM-Test B).....	65
Figure 3.46 – Reduction of $C_{\alpha}$ with OCR – (UOM-Test B).....	66
Figure 3.47 – Load Vs void ratio (e) – (UOM-Test C).....	67
Figure 3.48 – Void ratio Vs log (time) – Loading Increment – (UOM-Test C).....	67
Figure 3.49 – Void ratio Vs log (time) – Reloading Increment – (UOM-Test C).....	67
Figure 3.50 – Variation of $C_{\alpha}$ with stress level in loading and reloading increment – (UOM-Test C).....	68
Figure 3.51 – Reduction of $C_{\alpha}$ with OCR – (UOM-Test C).....	69
Figure 3.52 – Load Vs void ratio (e) – (UOM-Test D).....	70
Figure 3.53 – Void ratio Vs log (time) – Loading Increment – (UOM-Test D).....	71
Figure 3.54 – Void ratio Vs log (time) – Reloading Increment– (UOM-Test D).....	71
Figure 3.55 – Variation of $C_{\alpha}$ with stress level in loading and reloading increment– (UOM-Test D).....	72
Figure 3.56 – Reduction of $C_{\alpha}$ with OCR – (UOM-Test D).....	73
Figure 3.57 – Load Vs void ratio (e) – (UOM-Test 02).....	74
Figure 3.58 – Void ratio Vs log (time) – Loading Increment – (UOM-Test 02).....	74
Figure 3.59 – Void ratio Vs log (time) – Reloading Increment– (UOM-Test 02).....	74
Figure 3.60 – Variation of $C_{\alpha}$ with stress level in loading and reloading increment – (UOM-Test 02).....	75
Figure 3.61 – Reduction of $C_{\alpha}$ with OCR – (UOM-Test 02).....	76
Figure 3.62(a) – Reduction of $C_{\alpha}$ with OCR for all tests.....	77
Figure 3.62(b) – Reduction of $C_{\alpha}$ with OCR for all tests (eliminating the samples with high OCR & erroneous results).....	77
Figure 3.62(c) – Reduction of $C_{\alpha}$ with OCR for all tests (eliminating the samples with high OCR, high reduction of $C_{\alpha}$ & erroneous results).....	78
Figure 4.1 – Load Vs voids ratio (e) – BH 1 (14.25m-15.00m).....	85
Figure 4.2 – Load Vs voids ratio (e) – BH 2 (12.00m-12.75m).....	85
Figure 4.3 – Load Vs Voids ratio (e) – BH 2 (14.25m-15.00m).....	86
Figure 4.4 – Load Vs voids ratio (e) – BH 4 (12.00m-12.75m).....	86

Figure 4.5 – Load Vs voids ratio (e) – BH 4 (15.00m-15.75m).....	87
Figure 4.6 – Load Vs voids ratio (e) – BH 5 (13.50m-14.25m).....	87
Figure 4.7 – Load Vs voids ratio (e) – BH 5 (14.50m-15.25m).....	88
Figure 4.8 – Load Vs voids ratio (e) – BH 6 (9.50m-10.25m).....	88
Figure 4.9 – Load Vs voids ratio (e) – BH 8 (7.00m-7.75m).....	89
Figure 4.10 – Load Vs voids ratio (e) – BH 10 (12.50m-13.25m).....	89
Figure 4.11 – Load Vs voids ratio (e) – BH 10 (13.50m-14.25m).....	90
Figure 4.12 – $C_{\alpha}$ Vs Stress level – BH 1 (14.25m-15.00m).....	90
Figure 4.13 – $C_{\alpha}$ Vs Stress level – BH 2 (12.00m-12.75m).....	91
Figure 4.14 – $C_{\alpha}$ Vs Stress level – BH 2 (14.25m-15.00m).....	91
Figure 4.15 – $C_{\alpha}$ Vs Stress level – BH 4 (12.00m-12.75m).....	92
Figure 4.16 – $C_{\alpha}$ Vs Stress level – BH 4 (15.00m-15.75m).....	92
Figure 4.17 – $C_{\alpha}$ Vs Stress level – BH 5 (13.50m-14.25m).....	93
Figure 4.18 – $C_{\alpha}$ Vs Stress level – BH 5 (14.50m-15.25m).....	93
Figure 4.19 – $C_{\alpha}$ Vs Stress level – BH 6 (9.50m-10.25m).....	94
Figure 4.20 – $C_{\alpha}$ Vs Stress level – BH 8 (7.00m-7.75m).....	94
Figure 4.21 – $C_{\alpha}$ Vs Stress level – BH 10 (12.50m-13.25m).....	95
Figure 4.22 – $C_{\alpha}$ Vs Stress level – BH 10 (13.50m-14.25m).....	95
Figure 4.23 – Variation of $C_{\alpha'}/C_{\alpha}$ with OCR for UD samples from CKE project.....	96
Figure 4.24 – Load Vs voids ratio (e) – BH 3 (7.50m-8.00m).....	101
Figure 4.25 – Load Vs voids ratio (e) – BH 6 (3.00m-3.50m).....	101
Figure 4.26 – $C_{\alpha}$ Vs Stress level – BH 3 (7.50m-8.00m).....	102
Figure 4.27 – $C_{\alpha}$ Vs Stress level – BH 6 (3.00m-3.50m).....	102
Figure 4.28 – Variation of $C_{\alpha'}/C_{\alpha}$ with OCR for different peat samples.....	103
Figure 5.1 – Secondary compression of Middleton peat predicted by $C_{\alpha}/C_c$ concept of compressibility (after Mesri et al 1997).....	105
Figure 5.2 – Compression behaviour of Middleton Peat for pressure increment after secondary compression ageing (after Mesri et al 1997).....	106
Figure 5.3(a) – Load increment (0-5kN/m <sup>2</sup> ).....	108
Figure 5.3(b) – Load Increment (5-10kN/m <sup>2</sup> ).....	108
Figure 5.3(c) – Load increment (10-20kN/m <sup>2</sup> ).....	108
Figure 5.3(d) – Load increment (20-40kN/m <sup>2</sup> ).....	108

Figure 5.4(a) – Load increment (0-5 kN/m <sup>2</sup> ).....	109
Figure 5.4(b) – Load increment (5-10 kN/m <sup>2</sup> ).....	109
Figure 5.4(c) – Load increment (10-20 kN/m <sup>2</sup> ).....	109
Figure 5.4(d) – Load increment (20-40 kN/m <sup>2</sup> ).....	109
Figure 5.4(e) – Load increment (40-80 kN/m <sup>2</sup> ).....	109
Figure 5.5(a) – Load increment (0-5kN/m <sup>2</sup> ).....	110
Figure 5.5(b) – Load increment (5-10kN/m <sup>2</sup> ).....	110
Figure 5.5(c) – Load increment (10-20kN/m <sup>2</sup> ).....	110
Figure 5.5(d) – Load increment (20-40kN/m <sup>2</sup> ).....	110
Figure 5.5(e) – Load increment (40-80kN/m <sup>2</sup> ).....	110
Figure 5.5(f) – Load increment (80-160kN/m <sup>2</sup> ).....	110
Figure 5.6(a) – Load increment (0-5 kN/m <sup>2</sup> ).....	111
Figure 5.6(b) – Load increment (5-10 kN/m <sup>2</sup> ).....	111
Figure 5.6(c) – Load increment (10-20 kN/m <sup>2</sup> ).....	111
Figure 5.6(d) – Load increment (20-40 kN/m <sup>2</sup> ).....	111
Figure 5.6(e) – Load increment (40-80 kN/m <sup>2</sup> ).....	111
Figure 5.6(f) – Load increment (80-160 kN/m <sup>2</sup> ).....	111
Figure 5.6(g) – Load increment (160-320 kN/m <sup>2</sup> ).....	111
Figure 5.7 – Load Vs void ratio (e) – (NBRO-Test F).....	113
Figure 5.8 – Load Vs void ratio (e) – (NBRO-Test G).....	114
Figure 5.9 – Load Vs void ratio (e) – (NBRO-Test H).....	114
Figure 5.10 – Load Vs void ratio (e) – (NBRO-Test I).....	115
Figure 5.11 – Load Vs void ratio (e) – (combined graph).....	115
Figure 5.12 – Load Vs void ratio (e) – (Ageing Curves).....	116
Figure 5.13 – Elapsed time for reappearance of secondary compression as function of effective surcharge ratio (After Mesri et al 1997) for Middleton peat.....	117
Figure 5.14 – Post surcharge secondary compression index for different surcharge (After Mesri et al 1997).....	118
Figure 5.15 – Void ratio Vs log (time) with unloading from 101 kN/m <sup>2</sup> to 93kN/m <sup>2</sup> .....	119
Figure 5.16 – Void ratio Vs log (time) with unloading from 231.5kN/m <sup>2</sup> to 203kN/m <sup>2</sup> ...	119
Figure 5.17 – Void ratio Vs log (time) with unloading from 292.32kN/m <sup>2</sup> to 243.6 kN/m <sup>2</sup> .....	120

## List of Tables

Table 2.1 – Degrees of humification.....	9
Table 2.2 – Classification of peat.....	10
Table 2.3 – Typical values for the permeability of different soil type.....	19
Table 2.4 – Some typical values of $C_{\alpha}/C_c$ for different peat type.....	23
Table 2.5 – Some typical values of $C_{\alpha}/C_c$ for various type of soil deposit.....	24
Table 3.1 – Loading increments of the tests.....	28
Table 3.2 – Load Vs void ratio – (NBRO-Test A).....	29
Table 3.3 – Variation of $C_{\alpha}$ loading and reloading increment – (NBRO-Test A).....	31
Table 3.4 – OCR Vs $C_{\alpha}'/C_{\alpha}$ – (NBRO-Test A).....	32
Table 3.5 – Load Vs void ratio – (NBRO-Test B).....	33
Table 3.6 – Variation of $C_{\alpha}$ loading and reloading increment – (NBRO-Test B).....	34
Table 3.7 – OCR Vs $C_{\alpha}'/C_{\alpha}$ – (NBRO-Test B).....	35
Table 3.8 – Load Vs void ratio – (NBRO-Test J).....	36
Table 3.9 – Variation of $C_{\alpha}$ loading and reloading increment – (NBRO-Test J).....	38
Table 3.10 – OCR Vs $C_{\alpha}'/C_{\alpha}$ – (NBRO-Test J).....	39
Table 3.11 – $C_{\alpha}/C_c$ and $C_{\alpha}'/C_r$ values for different loading – (NBRO-Test A).....	41
Table 3.12 – $C_{\alpha}/C_c$ and $C_{\alpha}'/C_r$ values for different loading – (NBRO-Test B).....	41
Table 3.13 – $C_{\alpha}/C_c$ and $C_{\alpha}'/C_r$ values for different loading – (NBRO-Test J).....	42
Table 3.14 – Loading increments of the tests.....	43
Table 3.15 – Load Vs void ratio – (NBRO-Test A-1).....	45
Table 3.16 – Variation of $C_{\alpha}$ loading and reloading increment – (NBRO-Test A-1).....	47
Table 3.17 – OCR Vs $C_{\alpha}'/C_{\alpha}$ – (NBRO-Test A-1).....	48
Table 3.18 – Load Vs void ratio – (NBRO-Test C).....	49
Table 3.19 – Variation of $C_{\alpha}$ loading and reloading increment – (NBRO-Test C).....	50
Table 3.20 – OCR Vs $C_{\alpha}'/C_{\alpha}$ – (NBRO-Test C).....	51

Table 3.21 – Load Vs void ratio – (NBRO-Test D).....	52
Table 3.22 – Variation of $C_{\alpha}$ loading and reloading increment – (NBRO-Test D).....	54
Table 3.23 – OCR Vs $C_{\alpha}'/C_{\alpha}$ – (NBRO-Test D).....	55
Table 3.24 – Load Vs void ratio – (NBRO-Test E).....	56
Table 3.25 – Variation of $C_{\alpha}$ loading and reloading increment – (NBRO-Test E).....	57
Table 3.26 – OCR Vs $C_{\alpha}'/C_{\alpha}$ – (NBRO-Test E).....	58
Table 3.27 – Load Vs void ratio – (UOM-Test A).....	59
Table 3.28 – Variation of $C_{\alpha}$ loading and reloading increment – (UOM-Test A).....	61
Table 3.29 – OCR Vs $C_{\alpha}'/C_{\alpha}$ – (UOM-Test A).....	62
Table 3.30 – Load Vs void ratio – (UOM-Test B).....	63
Table 3.31 – Variation of $C_{\alpha}$ loading and reloading increment – (UOM-Test B).....	64
Table 3.32 – OCR Vs $C_{\alpha}'/C_{\alpha}$ – (UOM-Test B).....	65
Table 3.33 – Load Vs void ratio – (UOM-Test C).....	66
Table 3.34 – Variation of $C_{\alpha}$ loading and reloading increment – (UOM-Test C).....	68
Table 3.35 – OCR Vs $C_{\alpha}'/C_{\alpha}$ .....	69
Table 3.36 – Load Vs void ratio – (UOM-Test D).....	70
Table 3.37 – Variation of $C_{\alpha}$ loading and reloading increment – (UOM-Test D).....	71
Table 3.38 – OCR Vs $C_{\alpha}'/C_{\alpha}$ – (UOM-Test D).....	72
Table 3.39 – Load Vs void ratio – (UOM-Test 02).....	73
Table 3.40 – Variation of $C_{\alpha}$ loading and reloading increment – (UOM-Test 02).....	75
Table 3.41 – OCR Vs $C_{\alpha}'/C_{\alpha}$ – (UOM-Test 02).....	76
Table 3.42 – $C_{\alpha}/C_c$ and $C_{\alpha}'/C_r$ values for different loading – (NBRO-Test A-1).....	79
Table 3.43 – $C_{\alpha}/C_c$ and $C_{\alpha}'/C_r$ values for different loading – (NBRO-Test C).....	79
Table 3.44 – $C_{\alpha}/C_c$ and $C_{\alpha}'/C_r$ values for different loading – (NBRO-Test D).....	80
Table 3.45 – $C_{\alpha}/C_c$ and $C_{\alpha}'/C_r$ values for different loading – (NBRO-Test E).....	80



Table 3.46 – $C_{\alpha}/C_c$ and $C_{\alpha}'/C_r$ values for different loading – (UOM-Test A).....	81
Table 3.47 – $C_{\alpha}/C_c$ and $C_{\alpha}'/C_r$ values for different loading – (UOM-Test B).....	81
Table 3.48 – $C_{\alpha}/C_c$ and $C_{\alpha}'/C_r$ values for different loading – (UOM-Test C).....	81
Table 3.49 – $C_{\alpha}/C_c$ and $C_{\alpha}'/C_r$ values for different loading – (UOM-Test D).....	82
Table 3.50 – $C_{\alpha}/C_c$ and $C_{\alpha}'/C_r$ values for different loading – (UOM-Test 02).....	82
Table 4.1 – Details of tested samples.....	84
Table 4.2 – $C_{\alpha}/C_c$ and values for different loading – BH 1 (14.25m-15.00m).....	97
Table 4.3 – $C_{\alpha}/C_c$ and values for different loading – BH 2 (12.50m-12.75m).....	97
Table 4.4 – $C_{\alpha}/C_c$ and values for different loading – BH 2 (14.25m-15.00m).....	97
Table 4.5 – $C_{\alpha}/C_c$ and values for different loading – BH 4 (12.00m-12.75m).....	97
Table 4.6 – $C_{\alpha}/C_c$ and values for different loading – BH 4 (15.00m-15.75m).....	98
Table 4.7 – $C_{\alpha}/C_c$ and values for different loading – BH 5 (13.50m-14.25m).....	98
Table 4.8 – $C_{\alpha}/C_c$ and values for different loading – BH 5 (14.50m-15.25m).....	98
Table 4.9 – $C_{\alpha}/C_c$ and values for different loading – BH 6 (9.50m-10.25m).....	98
Table 4.10 – $C_{\alpha}/C_c$ and values for different loading – BH 6 (10.25m-11.00m).....	99
Table 4.11 – $C_{\alpha}/C_c$ and values for different loading – BH 8 (7.00m-7.75m).....	99
Table 4.12 – $C_{\alpha}/C_c$ and values for different loading – BH 10 (12.50m-13.25m).....	99
Table 4.13 – $C_{\alpha}/C_c$ and values for different loading – BH 10 (13.50m-14.25m).....	99
Table 4.14 – Details of tested samples.....	100
Table 4.15 – $C_{\alpha}/C_c$ and values for different loading – BH 3 (7.50m-8.00m).....	104
Table 4.16 – $C_{\alpha}/C_c$ and values for different loading – BH 6 (3.00m-3.50m).....	104
Table 5.1 – Loading arrangement of each test.....	107
Table 5.2 – $C_{\alpha}$ variation for each load increments.....	112

## List of abbreviations and notations

### Abbreviations

DS – Disturbed Sample

OCR – Over Consolidation Ratio

UDS – Undisturbed Sample

### Notations

$\varepsilon_v\%$  – Vertical strain

$\Delta\sigma$  – Stress increment

$\Delta\delta$  – Variation in settlement

$\sigma'$  – Effective stress

$\sigma'_p$  – insitu preconsolidation pressure

$\sigma'_v$  – effective vertical stress

$\sigma'_{vf}$  – final effective vertical stress

$\sigma'_{vs}$  – maximum effective vertical stress reached before removal of surcharge

$\gamma_w$  – Unit weight of water

$C_\alpha$  – Coefficient of secondary consolidation

$C_\alpha'$  – Secondary consolidation coefficient in reloading increments

$C_\alpha'/C_\alpha$  – Reduction of secondary consolidation coefficient

$C_\alpha''$  – Post surcharge secant secondary compression index defined from  $t_1$

$C_c$  – Compression index

$C_v$  – Coefficient of consolidation

$E_u$  – Undrained Young's modulus

$e$  – Void ratio

$H$  – Height of the soil layer

$k$  – Permeability

$m_v$  – Coefficient of volume compressibility

$p_c$  – Pre-consolidation pressure

$R'_s$  – Effective surcharge ratio –  $(\sigma'_{vs}/\sigma'_{vf}) - 1$

T – Time for reappearance of secondary compression after the period of rebound

$t_l$  – Post surcharge time at which secondary compression reappears

$t_p$  – Duration of primary consolidation

$t_{pr}$  – Time required to complete primary rebound after removal of surcharge

**Annexures**

Annexure 1 – Details of Laboratory Test Results.....128

Annexure 2 –  $\epsilon$  Vs  $\log(\text{time})$  graphs.....129