

TABLE OF CONTENTS

INTRODUCTION.....	1
GEOLOGY.....	1
RESIDUAL SOIL FORMATION AND THE WEATHERING PROFILE.....	2
ENGINEERING CLASSIFICATION.....	4
ENGINEERING PROPERTIES.....	5
Permeability.....	5
Compressibility.....	6
Shear Strength.....	6
Dynamic Properties.....	6
GEOTECHNICAL INVESTIGATION, SAMPLING, AND TESTING.....	7
Sampling Methods.....	7
In-situ Testing.....	8
Laboratory Testing.....	10
EXCAVATIBILITY.....	11
DESIGN CONSIDERATIONS.....	13
Settlement of Shallow Foundations.....	13
Methods to estimate settlement.....	14
Conclusions regarding reliability of methods.....	16
Drilled Shafts.....	17
Design methods.....	18
Conclusions regarding design methods for drilled shafts.....	20
Other aspects of drilled shaft behavior.....	20
Excavation and construction.....	20
REFERENCES.....	22
APPENDIX A: PRESSUREMETER TEST INTERPRETATION.....	A-1
Description of test.....	A-1
Interpretation of test results.....	A-2
Example calculation.....	A-4
APPENDIX B: SETTLEMENT PREDICTIONS.....	B-1
Schmertmann strain influence methodology.....	B-1
Values of soil modulus.....	B-2
Bias and Reliability.....	B-3
Spreadsheet for Schmertmann’s strain influence method.....	B-6
Example calculation.....	B-7

Modified Meyerhof SPT methodology.....	B-16
Bias and Reliability.....	B-16
Example calculation.....	B-17
Peck, Hanson, and Thornburn SPT methodology.....	B-19
Bias and Reliability.....	B-20
Example calculation.....	B-20
One-dimensional consolidation methodology.....	B-21
Bias and Reliability.....	B-21
Menard PMT methodology.....	B-22
Bias and Reliability.....	B-22

APPENDIX C: HYBRID α - β METHODOLOGY FOR DRILLED SHAFT

DESIGN.....	C-1
Background.....	C-1
Axial Capacity.....	C-1
Load Transfer.....	C-3
Settlement.....	C-4
Example calculation.....	C-5

APPENDIX D: DRILLED SHAFT CASE HISTORIES..... D-1

Case #1: Museum of Nature and Science, Raleigh, NC.....	D-1
Case #2: ADSC/ASCE Test Site, Atlanta, GA.....	D-9
Case #3: Georgia Tech Campus, Atlanta, GA.....	D-25
Case #4: Coweta County, GA.....	D-45
Case #5: Virginia Center, Vienna, VA.....	D-53
Case #6: Buncombe County, NC.....	D-58
Case #7: Springfield Interchange, Fairfax County, VA.....	D-68

LIST OF FIGURES

Figure 1	Piedmont physiographic province (from Mayne, 1997).....	2
Figure 2	Weathering profiles (from Sowers, 1994).....	2
Figure 3	Example of Denison sampler (from Terzaghi et al., 1996).....	8

Appendix A

Figure A-1	Schematic of a pressuremeter test in a borehole (from Gambin and Rousseau, 1988)...	A-1
Figure A-2	Example pressuremeter test results (from Baguelin et al., 1978).....	A-2
Figure A-3	Pressure vs. log volume plot for extrapolation of limit pressure at NCSU research site (from Wilson, 1988).....	A-3
Figure A-4	Pressuremeter test results from NCSU research site (from Wilson, 1988).....	A-5

Appendix B

Figure B-1	Strain influence factor diagram (from Schmertmann et al., 1978).....	B-2
Figure B-2	Pressuremeter modulus (E_{PMT}) vs. SPT N-values (from Martin, 1987).....	B-3
Figure B-3	Reliability of Schmertmann strain influence method with PMT test data.....	B-5
Figure B-4	Reliability of Schmertmann strain influence method with E_{PMT} - SPT N-value correlation test data.....	B-5
Figure B-5	Reliability of Schmertmann strain influence method with E_{PMT} - SPT N-value correlation test data, corrected per Martin.....	B-6
Figure B-6	Site exploration summary and soil modulus profile (after Law Engineering, 1986).....	B-8
Figure B-7 (a)	Settlement spreadsheet example – soil modulus based on CPT – input data.....	B-10
Figure B-7 (b)	Settlement spreadsheet example – soil modulus based on CPT – axisymmetrical condition.....	B-11
Figure B-7 (c)	Settlement spreadsheet example – soil modulus based on CPT – plane strain condition.....	B-12
Figure B-8 (a)	Settlement spreadsheet example – soil modulus based on SPT – input data.....	B-13
Figure B-8 (b)	Settlement spreadsheet example – soil modulus based on SPT – axisymmetrical condition.....	B-14
Figure B-8 (c)	Settlement spreadsheet example – soil modulus based on SPT – plane strain condition.....	B-15
Figure B-9	Reliability of Modified Meyerhof SPT method.....	B-17
Figure B-10	Subsurface profile at one-million gallon on-ground storage tank in Atlanta, GA (from Barksdale et al., 1986).....	B-18
Figure B-11	Chart correlating settlement, bearing capacity, footing width, and SPT N-value (from Peck et al., 1953).....	B-19
Figure B-12	Reliability of Peck, Hanson, and Thornburn SPT method.....	B-20
Figure B-13	Reliability of One-dimensional consolidation method.....	B-22
Figure B-14	Reliability of Menard PMT method (using equations by Baguelin et al., 1978).....	B-23

Appendix C

Figure C-1	Example of a Gibson profile (from Mayne and Harris, 1993).....	C-3
------------	--	-----

Appendix D

Figure D-1	Test shaft schematic at the Museum of Nature and Science (from Loadtest, 2000)....	D-1
Figure D-2	Subsurface profile for the Museum of Nature and Science (from Loadtest, 2000).....	D-2
Figure D-3	Load-displacement curve for the Museum of Nature and Science (from Loadtest, 2000).....	D-3
Figure D-4	Schematic of test shafts at the ADSC/ASCE test site (from Mayne and Harris, 1993)	D-9
Figure D-5	Subsurface profile at the ADSC/ASCE test site (after Mayne and Harris, 1993).....	D-11
Figure D-6	Load-displacement curve for shaft C-1 at the ADSC/ASCE test site (from Mayne and Harris, 1993).....	D-12

Figure D-7	Load distribution for shaft C-1 at the ADSC/ASCE test site (from Mayne and Harris, 1993).....	D-12
Figure D-8	Components of shaft capacity for shaft C-1 at the ADSC/ASCE test site (from Mayne and Harris, 1993).....	D-13
Figure D-9	Load-displacement curve for shaft C-2 at the ADSC/ASCE test site (from Mayne and Harris, 1993).....	D-13
Figure D-10	Load distribution for shaft C-2 at the ADSC/ASCE test site (from Mayne and Harris, 1993).....	D-14
Figure D-11	Components of shaft capacity for shaft C-2 at the ADSC/ASCE test site (from Mayne and Harris, 1993).....	D-14
Figure D-12	SPT N-value profile from the Georgia Tech test site (from Watson, 1970).....	D-26
Figure D-13	Load-displacement curve for shaft 1 at the Georgia Tech test site (from Watson, 1970).....	D-27
Figure D-14	Load transfer for shaft 1 at the Georgia Tech test site (from Watson, 1970).....	D-27
Figure D-15	Load-displacement curve for shaft 2 at the Georgia Tech test site (from Watson, 1970).....	D-28
Figure D-16	Load transfer for shaft 2 at the Georgia Tech test site (from Watson, 1970).....	D-28
Figure D-17	Load-displacement curve for shaft 3 at the Georgia Tech test site (from Watson, 1970).....	D-29
Figure D-18	Load transfer for shaft 3 at the Georgia Tech test site (from Watson, 1970).....	D-29
Figure D-19	Load-displacement curve for shaft 4 at the Georgia Tech test site (from Watson, 1970).....	D-30
Figure D-20	Load transfer for shaft 4 at the Georgia Tech test site (from Watson, 1970).....	D-30
Figure D-21	Load-displacement curve for shaft 5 at the Georgia Tech test site (from Watson, 1970).....	D-31
Figure D-22	Load-displacement curve for shaft 6 at the Georgia Tech test site (from Watson, 1970).....	D-31
Figure D-23	Schematic of test shaft and subsurface profile at the Coweta County test site (from O'Neill, et al., 1996).....	D-46
Figure D-24	Load-displacement curve for the test shaft at the Coweta County test site (from O'Neill, et al., 1996).....	D-47
Figure D-25	Load transfer for test shaft at the Coweta County test site (from O'Neill et. al., 1996).....	D-47
Figure D-26	Schematic of test shaft at Virginia Center (from Winter et al., 1989).....	D-53
Figure D-27	In-situ test results at Virginia Center (from Winter et al., 1989).....	D-54
Figure D-28	Load-displacement curve for the test shaft at Virginia Center (from Winter et al., 1989).....	D-54
Figure D-29	Schematic of test shaft at the Buncombe County test site (from Loadtest, 2000).....	D-58
Figure D-30	Subsurface profile at the Buncombe County test site (from Loadtest, 2000).....	D-59
Figure D-31	Bottom of Osterberg cell load-displacement curve for test shaft at the Buncombe County test site (from Loadtest, 2000).....	D-61
Figure D-32	Top of Osterberg cell load-displacement curve for test shaft at the Buncombe County test site (from Loadtest, 2000).....	D-62
Figure D-33	Schematic of test shaft at Springfield Interchange (from Law Engineering, 1998).....	D-69
Figure D-34	Soil profile at test shaft at Springfield Interchange (from Law Engineering, 1998)....	D-70
Figure D-35	Load-displacement curve for test shaft at Springfield Interchange (from Law Engineering, 1998).....	D-71

LIST OF TABLES

Table 1	Classification systems of weathering profiles (from Wilson and Martin, 1996).....	3
Table 2	Void ratio through the weathering profile (from Sowers and Richardson, 1983).....	4
Table 3	Permeability through the weathering profile (from Sowers and Richardson, 1983).....	5
Table 4	Excavation techniques based on in-situ testing (from White and Richardson, 1987)....	12
Table 5	Other sources of information for geotechnical design subjects in the Piedmont region	13
Table 6	Coefficient of variation and bias of several settlement estimation methods.....	17
Table 7	Comparison of drilled shaft case histories in the Piedmont region.....	19

Appendix A

Table A-1	Values of V_C according to pressuremeter probe type (from Gambin and Rousseau, 1988).....	A-3
Table A-2	Range of E_{PMT} and p_l for several soil types (from Gambin and Rousseau, 1988).....	A-5

Appendix B

Table B-1	Pressuremeter modulus (E_{PMT}) and N -values for trendline #3 (after Martin, 1987).....	B-4
Table B-2	Example problem information for input into spreadsheet.....	B-9
Table B-3	Comparison of measured and calculated settlements using Schmertmann's strain influence method for an office building in Tyson's Corner, VA.....	B-9
Table B-4	Width correction factor, C_B (from Duncan and Buchignani, 1976).....	B-16
Table B-5	Time rate factor, C_t (from Duncan and Buchignani, 1976).....	B-16
Table B-6	Comparison of measured and calculated settlements using modified Meyerhof SPT method for a one million gallon on-ground storage tank in Atlanta, GA.....	B-19
Table B-7	Comparison of measured and calculated settlements using Peck, Hanson, and Thornburn SPT method for a one million gallon on-ground storage tank in Atlanta, GA.....	B-21

Appendix D

Table D-1	Summary of average N -values at each test shaft location at the ADSC/ASCE test site.....	D-10
Table D-2	Failure loads, distribution of load, and settlement of test shafts at the Georgia Tech test site (after Watson, 1970).....	D-26