

---

# Contents

---

<b>Foreword</b> . . . . .	xi
<b>Symbols and Notations</b> . . . . .	xv
<b>Introduction</b> . . . . .	xxvii
<b>Chapter 1. Measuring Water Content and Density</b> . . . . .	1
1.1. Sample collection method . . . . .	1
1.1.1. Measuring water content using the frying pan method . . . . .	1
1.1.2. Measuring water content using the oven-dry method . . . . .	1
1.1.3. Measuring dry density using a membrane densitometer . . . . .	2
1.1.4. Measuring dry density using the excavation method . . . . .	4
1.2. Method without sample collection . . . . .	4
<b>Chapter 2. Soil and Rock Sampling Methods</b> . . . . .	7
2.1. Sampling classes and nomenclature . . . . .	7
2.2. Sampling techniques . . . . .	8
2.2.1. Manual samples . . . . .	9
2.2.2. Core drilling . . . . .	12
2.2.3. Semi-destructive drills . . . . .	19
2.2.4. Destructive drills . . . . .	23
2.3. The procedures . . . . .	23
2.3.1. Sample collection methods . . . . .	24
2.3.2. The choice of sampling technique . . . . .	25
2.3.3. Labeling samples . . . . .	30
2.3.4. Transporting the samples . . . . .	32
2.3.5. Storage before testing of class 1 and 3 samples . . . . .	32
2.3.6. Competence of the providers . . . . .	32

2.3.7. Checking: controls . . . . .	33
2.3.8. Sampling written record . . . . .	34
2.4. The drilling section . . . . .	35
2.5. The rock-quality designation (RQD) . . . . .	37
<b>Chapter 3. Measuring the Total Pressuring, the Interstitial Pressure and the Groundwater Table Rating . . . . .</b>	<b>39</b>
3.1. Measuring the total pressure within the soil. . . . .	39
3.1.1. Measurement principles . . . . .	39
3.1.2. Mode of action of the sensors. . . . .	39
3.1.3. Deformation measuring systems . . . . .	40
3.1.4. Soil-sensor interaction . . . . .	41
3.1.5. Other measuring errors. . . . .	44
3.1.6. Examples of total pressure sensors. . . . .	50
3.2. Measuring the interstitial pressure and the level of the water table . . . . .	50
3.2.1. Open-tubed piezometer . . . . .	51
3.2.2. Closed-tube piezometer . . . . .	52
<b>Chapter 4. Measuring Movement, Settling and Force . . . . .</b>	<b>55</b>
4.1. Measuring movement . . . . .	55
4.1.1. Topography . . . . .	55
4.1.2. Measuring distance directly . . . . .	61
4.1.3. The inclinometry technique . . . . .	63
4.2. Measuring the settlement. . . . .	67
4.2.1. Plate settling gauge . . . . .	68
4.2.2. Hydraulic settling gauge. . . . .	69
4.2.3. Magnetic settling gauge . . . . .	70
4.3. Force transducers . . . . .	71
<b>Chapter 5. Static Loading Tests . . . . .</b>	<b>73</b>
5.1. Plate loading test. . . . .	73
5.1.1. Low-pressure loading test. . . . .	73
5.1.2. High-pressure loading test. . . . .	80
5.2. Static pile-loading test . . . . .	83
5.2.1. Test principle . . . . .	83
5.2.2. Practical realization of the test . . . . .	86
5.2.3. Loading cycles . . . . .	94
5.2.4. Pile-test interpretation . . . . .	98
5.3. In conclusion: pile-loading tests. . . . .	103

---

<b>Chapter 6. Tests by Flat Dilatometer (DMT)</b> . . . . .	105
6.1. Principle of the test . . . . .	106
6.2. Modus operandi . . . . .	107
6.3. Interpretation . . . . .	109
<b>Chapter 7. Penetrometer Test (CPT, CPTU, SPT, DCPT) and Variants</b> . . . . .	113
7.1. Static penetrometer (or cone penetrometer test, CPT) . . . . .	114
7.1.1. Principle of the test . . . . .	114
7.1.2. Measurement methods . . . . .	118
7.1.3. Interpretation . . . . .	119
7.1.4. Use of the static penetrometer to calculate foundations . . . . .	120
7.1.5. Types of static penetrometer . . . . .	122
7.2. The piezocone (CPTU) . . . . .	127
7.2.1. Principle of the test . . . . .	127
7.2.2. Modus operandi . . . . .	128
7.2.3. Interpretation . . . . .	132
7.2.4. Exploitation of the test . . . . .	134
7.3. Standard penetration test (SPT) . . . . .	135
7.3.1. Principle of the test . . . . .	136
7.3.2. Modus operandi . . . . .	137
7.3.3. Interpretation of SPT . . . . .	141
7.4. The dynamic penetrometer (DCPT) . . . . .	146
7.4.1. Principle of the test . . . . .	148
7.4.2. Modus operandi . . . . .	148
7.4.3. Interpretation . . . . .	154
7.4.4. Use of dynamic penetration in the calculation of the foundation . . . . .	154
7.4.5. Comparison between the results of the static and dynamic penetrometers . . . . .	155
<b>Chapter 8. Direct Shear Tests In Situ</b> . . . . .	157
8.1. Direct shear box test. . . . .	157
8.2. The vane test (VST) . . . . .	159
8.2.1. Principle of the test . . . . .	159
8.2.2. Practical realization of the test . . . . .	161
8.2.3. Interpretation: determining the undrained cohesion. . . . .	163
8.2.4. Exploitation complement of the vane test. . . . .	167
8.3. The Philipponnat <i>phicomètre</i> . . . . .	169
8.3.1. Principle of the test . . . . .	169

---

8.3.2. Practical realization of the test . . . . .	171
8.3.3. Interpretation . . . . .	172
8.3.4. Advantages and disadvantages of the phicometric test . . . . .	174
<b>Chapter 9. Pressuremeter Tests (PMT, SBP) and Variants . . . . .</b>	<b>175</b>
9.1. Ménard pressuremeter test (PMT) . . . . .	176
9.1.1. Principle of the test . . . . .	176
9.1.2. Execution of the test . . . . .	177
9.1.3. Normalized interpretation of the standard and cyclical tests . . . . .	190
9.2. Self-drilling pressuremeter test (SBP) . . . . .	193
9.2.1. Principle of the test . . . . .	193
9.2.2. Execution of the test . . . . .	197
9.2.3. Evaluation of the tests . . . . .	198
9.3. The dilatometer . . . . .	198
9.3.1. Description. . . . .	198
9.3.2. Interpretation of the results . . . . .	201
9.4. The “Géomécamètre” . . . . .	203
9.4.1. Principle of the test . . . . .	203
9.4.2. Modus operandi . . . . .	205
9.4.3. Interpretation . . . . .	206
9.5. Theoretical interpretation of the pressuremeter test . . . . .	207
9.5.1. Cohesive soil: the Baguelin et al. (1972) interpretation . . . . .	207
9.5.2. Cohesive soil: Monnet and Chemaâ (1995) interpretation . . . . .	214
9.5.3. Granular soil: the Monnet and Khlif (1994) and Monnet (2012) interpretations . . . . .	226
<b>Chapter 10. Water Tests in Soils . . . . .</b>	<b>243</b>
10.1. Punctual water tests . . . . .	244
10.1.1. Infiltrometer test. . . . .	244
10.1.2. Lefranc permeability test. . . . .	249
10.1.3. Permeability test in borehole current section . . . . .	259
10.1.4. Lugeon permeability test. . . . .	266
10.2. Pumping or transmission tests . . . . .	275
10.2.1. Principle of the test . . . . .	275
10.2.2. Execution of the test . . . . .	276
10.2.3. Interpretation. . . . .	286
<b>Chapter 11. Characterization of Sites and Soils by In Situ Tests . . . . .</b>	<b>291</b>
11.1. Characterization of sites. . . . .	291

11.1.1. Analysis by drilling parameter recording . . . . .	291
11.1.2. Cluster analysis . . . . .	299
11.2. Characterization of soils . . . . .	303
11.2.1. Identification of the soils. . . . .	303
11.2.2. Physical and mechanical parameters . . . . .	305
11.2.3. Correlations and relations between the characteristics measured in the laboratory . . . . .	306
11.2.4. Correlations involving in situ tests . . . . .	313
11.2.5. Relations involving in situ tests . . . . .	333
<b>Bibliography</b> . . . . .	345
<b>Index</b> . . . . .	359