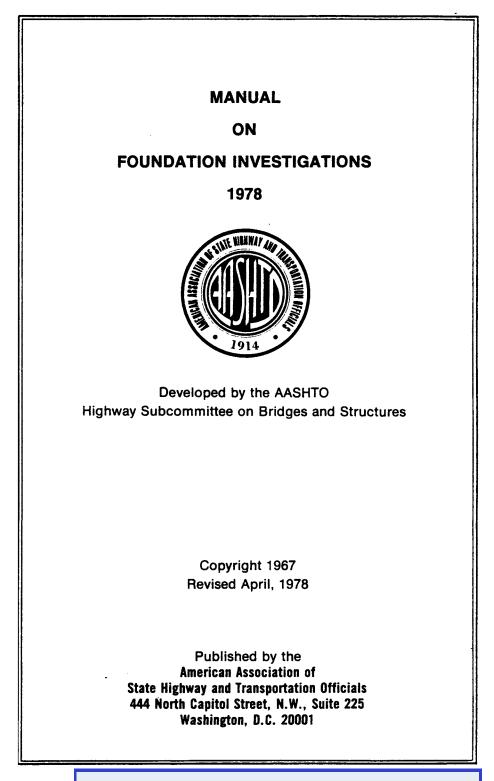
NOTE: THESE MATERIALS ARE OUT OF PRINT, AND MAY NOT REPRESENT CURRENT AASHTO POLICIES.



HIGHWAY SUB-COMMITTEE ON BRIDGES AND STRUCTURES 1978

Sidney L. Poleynard, Louisiana, Chairman Lester A. Herr, FIIWA, Secretary Frank D. Sears, FIIWA, Assistant Secretary

Alabama Alaska Arizona Arkansas California Colorado Connecticut Delaware **District** of Columbia Florida Georgia Hawaii Idaho Illinois Indiana lowa Kansas Kentucky Louisiana Maine Maryland Massachusetts Michigan Minnesota Mississippi Missouri Montana Nebraska Nevada New Hampshire New Jersey New Mexico New York North Carolina North Dakota Ohio Oklahoma Oregon **Pennsylvania** Puerto Rico Rhode Island South Carolina South Dakota Tennessee Texas USDOT Utah Vermont Virginia Washington West Virginia Wisconsin Wyoming **New Brunswick** Ontario

Charles Cook Don Halsted Martin Toney *Veral Pinkerton Robert Cassano Paul Chuvarsky, Jr. J. F. Cavanaugh (Milton O. Johnson) Robert C. McDowell Harry Moy Thomas Alberdi, Jr. John T. Kratzer Clarence R. Yamamoto Robert B. Jarvis Carl E. Thunman, Jr. E. Wayne Walters **Charles Pestotnik** Earle E. Wilkinson (Glen M. Koontz) Charles G. Cook (R. K. Captio) David S. Huval (Sidney L. Poleynard) Theodore Karasopoulos Earle S. Freedman (Hugh G. Downs) John J. Aherne, Jr. Adrianus VanKampen Keith V. Benthin Bennie D. Verell W. Dale Carney Howard E. Stratton James R. Holmes Hugh Brinson Edward T. Swierz Warren J. Sunderland Herman Tachau Edward V. Hourigan (Robert N. Kamp) Landis M. Temple Stan Haas *Robert B. Pfeifer (Fred H. Ray) Veldo M. Goins *Walter J. Hart Bernard F. Kotalik Jose J. Muniz (Samuel Laboy) *Richard B. Kalunian John R. Coleman (E. S. Coffey) *Kenneth C. Wilson Henry Derthick (Robert C. Odle) Wayne Henneberger W. Jack Wilkes **Ray Behling** Wendell M. Smith Fred C. Sutherland (J. N. McCabe, Jr.) Charles S. Gloyd Harry H. Stephens (Robert C. Smith) William A. Kline Charles H. Wilson James Fraser P. Csagoly

*Member: Subcommittee on Substructures and Retaining Walls

THE BODY

PART I - INTRODUCTION

Page

GENERAL	1
PURPOSE OF MANUAL	1
LIMITATIONS	. 1
CONTENTS	1

PART II - RECONNAISSANCE

OFFICE RECONNAISSANCE	2
Study of Existing Structures	2
Study of Preliminary Plans	2
Consultation With Others	2
Review of Other Information	2
Topographic Maps	2
Geologic Maps	3
Agricultural Maps	4
Remote Sensing	4
Well-Drilling Logs	5
Formulation of Boring Plan	5
FIELD RECONNAISSANCE	6
Items to Observe	7
Location of Bents and Piers	7
Surface Soils	. 7
Gullies, Excavations, Slopes, or Stream Banks	
Surface and Subsurface Water	7.
Study of Existing Structures	8
Topography and Vegetation	8
Information Required by the Drill Crew	8
Verification of Boring Plan	8
Type of Equipment Needed	8
Reference Points and Bench Marks	о 9
	-
Permission of Property Owners	9
Utilities	9
General Notes	10
Geophysical Survey	10
Field Reconnaissance Report	10, 11

PART III - FOUNDATION EXPLORATION

GENERAL	12
Permission of Property Owners	12
Locations of Roads, Structures, and Utilities	13

GENERAL (Continued)	Page
Special Equipment	13
Layout — Surveying Vertical Control	· 13 14
Tolerance in Hole Location	14
SUBSURFACE EXPLORATION PLAN	14
METHOD OF DRILLING	16
Rotary Drilling	16
Auger Drilling	17
Wash-Boring	17
Drilling by Continuous Sampling	17 18
Special Methods	18
- SAMPLING	19
Split-Barrel Sampling	19
Push Barrel or Thin-Walled Tube Sampling	20
Wet Barrel or Double Wall Sampling	20
Dry Barrel or Single Wall Sampling	21
Wash Sampling	21 21
Sample Protection and Transportation	21
FIELD TESTS.	22
Dynamic Field Tests	22
Standard Penetration Test	22
Cone Penetrometer Test	23
Driven Probe Test	24 24
Driven Casing Test Static Penetrometer Test	24 24
In-Place Vane Shear Test	25
Other Field Tests	25
FIELD BORING LOG	25
Duties of the Logger	26
Field Identification and Classification of Soils and Rocks	27
Field Tests	28 28
Equipment and Supplies.	28 28
Format of Field Boring Log	28
Logging Procedures.	28
Groundwater Table	30
SITE CLEAN-UP	30
OPEN PIT AND TRENCH EXCAVATION	31
Open Test Pits	31
Test Trenches	31
EXAMPLE FORM	32
Typical Field Boring Log	32

PART IV - LABORATORY TESTS

FART IV - LABORATORT TESTS	Page
GENERAL	33
GRAIN SIZE, SHAPE, AND GRADATION	33
SPECIFIC GRAVITY	35
ATTERBERG LIMITS	35
CONSOLIDATION	35
TRIAXIAL SHEAR	36
DIRECT SHEAR	36
UNCONFINED COMPRESSION	36
MOISTURE CONTENT AND IN-PLACE DENSITY	36
CLASSIFICATION	37

PART V - COMPILING INFORMATION

GENERAL	38
FINISHED BORING LOG	38
PLOTTING SOIL PROFILES.	39
ARRANGEMENT OF TEST DATA	40
CRITICAL STUDY AND IMPLICATIONS	40
FINAL WRITTEN REPORT	41
Type of Support	41
Pile Support	41
Footing Foundation Support	42
Approach Fill Considerations	42
Construction Considerations	42
EXAMPLES	43-46
Typical Finished Boring Log	43
Boring Log Legend	44
Soil Profile	45
Test Results	46

THE APPENDIX

APPENDIX A - GEOLOGY

Page

GENERAL	A-1
BEDROCK	A-1
Origin of Rocks	A-1
Igneous Rocks	A-1
Sedimentary Rocks	A-2
Metamorphic Rocks	A-4
COMMON TYPES OF ROCK	A-5
Classification	A-5
Minerals	A-5
Hardness	A- 5
Minimum Equipment for Identification	A-6
Steps in Identification of Rock	A-6
STRUCTURAL TYPES ENCOUNTERED IN ROCK	A-7
Terms	· A-7
Types of Folds	A- 8
Illustration of Types of Folds	A-10
Joints and Bedding Planes	A-8
WEATHERING.	A-9
Rain	A-9
Frost	A-11
Wind	A-11
Insolation	A-11
TABLE OF 32 COMMON ROCKS	A-13
TABLE OF 20 COMMON MINERALS	A-19

APPENDIX B - SOILS

GENERAL	B-1
FORMATION OF SOILS	B-1
Geologic Cycle	B-1
Weathering	B-2
Mechanical	B-2
Mechanical Abrasion	• B-2
Temperature Changes	B-2
Other Agents	B-3
Chemical	B-3
Products of Weathering	B-3
Transported Soils	B-4
Water-Deposited Soils (Alluvial and Marine Deposits)	B-4

iv

THE APPENDICES

FORMATION OF SOILS (Continued)	Page
Wind-Deposited Soils (Aeolian Deposits)	B-5
Volcanic Ash-Pumice	B-6
Ice-Deposited Soils (Glacial Deposits)	B-6
Gravity-Deposited Soils (Colluvial Deposits)	B-7
Residual Soils	B-7
SOIL PROPERTIES	B-8
Physical Properties	B-8
Voids	B-8
Soil Moisture	B-8
Specific Gravity	B-9
Unit Weight	B-9
Relationships	B-10
Relative Density	B-11
Grain Size	B-11
Soil Particle Sizes (Chart)	B-13
Grain Size Distribution Curves (Plot)	B-14
Grading Chart (Photos)	B-15
Grain Sizes (Photos)	B-16
Grain Shape	B-17
Roundness Chart (Photos)	B-19
Plasticity	B-17
Engineering Characteristics	B-18
Strength	B-18
Mohr Diagram (Plot)	B-22
Compressibility	B-21
Pressure – Void Ratio Curve (Plot)	B-24
Pressure – Void Ratio Curve (Plot – Log Scale)	B-25
SOIL CLASSIFICATION	B-26
Unified Soil Classification System	B-26
Coarse-Grained Soils	B-27
Less Than 5% Pass the No. 200 Sieve	B-27
GW Group	B-27
SW Group	B-28
GP Group	B-28
SP Group	B-28
More Than 12% Pass the No. 200 Sieve	B-28
GM Group	B-29
GC Group	B-29
SM Group	B-29
SC Group	B-29
Borderline (Between 5% and 12%)	B-29
Fine-Grained Soils	B-30
ML Group	B-30
MH Group	B-30
CL Group	B-30
CH Group	B-30
Borderline	B-31

THE APPENDICES

SOIL CLASSIFICATION (Continued)	Page
Highly Organic Soils	B-31
OL Group	B-31
OH Group	B-31
Field Identification	B-31
Coarse-Grained Soils	B-31
Fine-Grained Soils	B-32
Highly Organic Soils	B-32
Dual Classifications	B-32
TABLES AND CHARTS	
Description of Moisture Content	B-32
Unified Soil Classification Chart	B-34
Laboratory Identification Procedure (FOLD-OUT)	B-33
MANUAL TESTS FOR FIELD IDENTIFICATION	B-35
Silt and Clay Characteristics	B-36
Soil Percentage Triangles	B-37
POSSIBLE ABBREVIATIONS	B-38
GLOSSARY	B-39

APPENDIX C - TESTING

SECTION ON FIELD TESTS	C-1
Consistency and Density Testing By Penetrometer	C-1
Standard Penetration Test (AASHTO T 206)	C-1
Apparatus	C-1
Procedure	C-1
Discussion	C-2
Sources of Error	C-2
Cone Penetrometer Test	C-2
Apparatus	C-2
Procedure	C-2
Discussion	C -3
Driven Probe Test (Probe Point Penetrometer Test)	C-3
Apparatus	C-3
Procedure	C-4
Friction Penetrometer	C-4
Nomograph	C-5
Static Cone Penetrometer Test	C-4
Soil Shear Tests	C-6
In-Place Vane Shear Test	C-6
Apparatus	C-6
Procedure	C-6
Field Calculations	C-6
Shear Vane Assembly (Drawing)	C-11
Load Plate Test	C-7

THE APPENDICES

APPENDIX C - TESTING (Continued)	Page
SECTION ON LABORATORY TESTING	C-7
PHOTOGRAPHS OF FIELD TEST EQUIPMENT C.	-12-13

APPENDIX D - DRILLING

GENERAL	D-1
DRILLING METHODS	D-1
Rotary Drilling	D-1
Table of Bentonite Proportions	D-2
Rock Coring	D-3
Wash-Boring	D-3
Continuous Sampling Method	D-4
Auger Drilling	D-4
Percussion Drilling	D-5
DRILLING EQUIPMENT	D-5
Drilling Units	D-5
Rotary Drilling Equipment	D-6
Drill Rods	D-6
Casing	D-7
Drill Bits	D-7
Drilling Accessories	D-8
Diamond Core Drilling Equipment	D-8
Table of Drill Rods, Casing and Coring Bits	D-9
Table of Diamond Sizes	D-10
Table of Total Carat Weight	D-11
Table of Matrix Hardness	D-12
Wash-Boring Equipment	D-12
Auger Drilling Equipment	D-12
Table of Popular Size Augers	D-13
Table of Auger Heads	D-13
Table of Hollow-Stem Auger Sizes	D-14
Diamond Size Comparison Chart	D-15
Casing Bit and Shell Diameters (Table)	D-16
Set Bit and Shell Diameters (Table)	D-17
Photographs of Equipment D-	18-19

APPENDIX E - SAMPLING

GENERAL	E-1
CLASSIFICATION OF SOIL SAMPLES	E-1
Disturbed Samples	E-1
Undisturbed Samples	E-1

APPENDIX E - SAMPLING (Continued)	Page
FREQUENCY OF SAMPLING	E-2
ROCK BORINGS	E-2
DETAILED METHODS OF SECURING SAMPLES	E-2
Split-Barrel Sampling	E-2
Push Barrel or Thin-Walled Tube Sampling	E-3
Shelby Tube Sampling	E-3
Stationary Piston Type Sampling	E-5
Wet Barrel or Double Wall Tube Sampling	E-6
Dry Barrel or Single Wall Tube Sampling	E-7
Retractable Plug Sampling	E-7
Rock Core Borings	E-8
PRESERVING SAMPLES	. E-8
Split-Barrel Samples	E-9
Push Barrel or Thin-Walled Tube Samples	E-9
Wet Barrel or Double Wall Tube Samples	E-10
Retractable Plug Samples	E-10
Rock Cores	E-10
PHOTOGRAPHS OF EQUIPMENT	E-11

APPENDIX F - GEOPHYSICAL EXPLORATION

GEOPHYSICAL EXPLORATION	F-1
Geophysical Investigation	F-1
Seismic Methods	
Seismic Problems and Limitations	F-5
Resistivity Methods	· F-6
Resistivity Problems and Limitations	F-6

BIBLIOGRAPHY	BIB-1

viii