

STP 599

SOIL SPECIMEN PREPARATION

for Laboratory Testing



AMERICAN SOCIETY FOR TESTING AND MATERIALS

SOIL SPECIMEN PREPARATION FOR LABORATORY TESTING

A symposium
presented at the
Seventy-eighth Annual Meeting
AMERICAN SOCIETY FOR
TESTING AND MATERIALS
Montreal, Canada, 22-27 June 1975

ASTM SPECIAL TECHNICAL PUBLICATION 599
D. A. Sangrey, symposium co-chairman
R. J. Mitchell, symposium co-chairman

List Price \$35.00
04-599000-38



AMERICAN SOCIETY FOR TESTING AND MATERIALS
1916 Race Street, Philadelphia, Pa. 19103

© BY AMERICAN SOCIETY FOR TESTING AND MATERIALS 1976
Library of Congress Catalog Card Number; 76-704

NOTE

The society is not responsible, as a body,
for the statements and opinions
advanced in this publication.

Foreword

The symposium on Soil Specimen Preparation for Laboratory Testing was presented at the Seventy-eighth Annual Meeting of the American Society for Testing and Materials held in Montreal, Canada, 22-27 June 1975. Committee D-18 on Soil and Rock for Engineering Purposes sponsored the symposium. D. A. Sangrey, Cornell University, and R. J. Mitchell, Queen's University of Kingston, presided as symposium co-chairmen.

Related ASTM Publications

Performance Monitoring for Geotechnical Construction, STP 584 (1975),
\$14.00, 04-584000-38

Field Testing and Instrumentation of Rock, STP 554 (1974), \$18.75,
04-554000-38

Analytical Methods Developed for Application to Lunar Sample Analysis,
STP 539 (1973), \$15.00, 04-539000-38

A Note of Appreciation to Reviewers

This publication is made possible by the authors and, also, the unheralded efforts of the reviewers. This body of technical experts whose dedication, sacrifice of time and effort, and collective wisdom in reviewing the papers must be acknowledged. The quality level of ASTM publications is a direct function of their respected opinions. On behalf of ASTM we acknowledge with appreciation their contribution.

ASTM Committee on Publications

Editorial Staff

Jane B. Wheeler, *Managing Editor*

Helen M. Hoersch, *Associate Editor*

Charlotte E. DeFranco, *Senior Assistant Editor*

Ellen J. McGlinchey, *Assistant Editor*

Contents

Introduction

Effect of Water Saturation History on the Strength of Low-Porosity Rocks—G. BALLIVY, B. LADANYI, AND D. E. GILL	4
Testing Equipment	5
Rock Types	7
Specimen Preparation	8
Testing Procedures	11
Experimental Results	12
Conclusions	19
Four Factors Influencing Observed Rock Properties— P. G. CHAMBERLAIN, E. M. VAN EECKHOUT, AND E. R. PODNIEKS	21
Discussion of Critical Factors	22
Summary	34
Trimming Device for Obtaining Direct Shear Specimens from Samples of Stiff Fissured Clay Shale—G. N. DURHAM	37
Residual Shear Test Procedures	38
Waterways Experiment Station Residual Shear Testing	38
WES Direct Shear Trimming Device	39
Specimen Preparation	40
Discussion	42
Effects of Specimen Type on the Residual Strength of Clays and Clay Shales—F. C. TOWNSEND AND P. A. GILBERT	43
Previous Investigations	44
Materials and Equipment	45
Specimen Preparation	47
Test Results and Analyses	49
Conclusions	63
Effects of Storage and Extrusion on Sample Properties— ARA ARMAN AND K. L. MCMANIS	66
Literature Survey	67
Sampling and Field Testing	68
Laboratory Tests and Results	69
Selection of Representative Specimens	80
General Conclusions	85

Transportation, Preparation, and Storage of Frozen Soil Samples for Laboratory Testing—T. H. W. BAKER	88
Factors Affecting Laboratory Tests on Frozen Soils	89
Frozen Soil Samples	89
Machining and Preparation of Specimens for Testing	97
Rough Cutting Methods	98
Finishing Methods	98
Storage and Protection During Laboratory Testing	104
Conclusions	111
Temperature-Controlled Humid Storage Room— MICHAEL BOZOZUK	113
Design	115
Closed Flow Conditioning System	119
Handling and Preparation of Samples for Storage	122
Effect of Storage Time on Test Results	122
Summary	125
Effect of Storage and Reconsolidation on the Properties of Champlain Clays—P. LA ROCHELLE, J. SARRAILH, AND F. A. TAVENAS	126
Characteristics of the Cemented Clays	128
Water Migration Following Sampling	130
Influence of Reconsolidation	137
Influence of Storage Time	140
Conclusion	144
Pore Water Extraction and the Effect of Sample Storage on the Pore Water Chemistry of Leda Clay—J. K. TORRANCE	147
Soil Material	149
Storage Procedures	149
Pore Water Extraction	150
Results and Discussions	151
Conclusions and Recommendations	155
Variation in Atterberg Limits of Soils Due to Hydration History and Specimen Preparation—D. A. SANGREY, D. K. NOONAN, AND G. S. WEBB	158
Test Program	160
Conclusions	167
Effect of Specimen Preparation Method on Grain Arrangement and Compressibility in Sand—ARSHUD MAHMOOD, J. K. MITCHELL, AND ULF LINDBLOM	169
Soil Fabric	170
One-Dimensional Compressibility	171

Experimental Investigation	171
Fabric Results	178
Compression Test Results	180
Conclusions	190
A Technique for the Preparation of Specimens of Loose	
Layered Silts—V. A. NACCI AND R. A. D'ANDREA	193
Soil Description	195
Specimen Preparation	195
Typical Testing Procedure and Result	198
Conclusions	200
Shrinkage of Soil Specimens During Preparation for	
Porosimetry Tests—T. F. ZIMMIE AND L. J. ALMALEH	202
Equipment	204
Experimental Work	211
Conclusions	214
Compaction and Preparation of Soil Specimens for	
Oedometer Testing—A. R. BOOTH	216
Choice of Compaction Method	217
Construction of Mold	218
Method of Compaction	219
Adjustment of the Degree of Saturation	221
Comparison of Specimens	223
Effect on Results	224
Conclusions	225
Laboratory Preparation of Specimens for Simulating Field	
Moisture Conditions of Partially Saturated Soils—T. Y. CHU AND S. N. CHEN	229
Review of Current Methods for Pretesting Treatment	230
Development of Equipment and Procedures for Pretesting Treatment	232
Test Results and Discussion	236
General Conclusion	243
Scalping and Replacement Effects on the Compaction	
Characteristics of Earth-Rock Mixtures—R. T. DONAGHE AND F. C. TOWNSEND	248
Procedure	249
Test Results and Discussion	257
Conclusions	274
Study of Irregular Compaction Curves—P. Y. LEE	278
Laboratory Investigation	281

Discussion of Test Results	282
Conclusions	287
Importance of Specimen Preparation in Microscopy—	
J. E. GILLOTT	289
Microscopic Methods	291
Specimen Preparation for Fabric Analysis	293
Specimen Preparation for Analysis of Particle Size and Shape	299
Ion Bombardment	300
Replication, Shadowing, and Coating	302
Discussion	304
Conclusions	305
Use of Ultrasonic Energy for Disaggregation of Soil	
Samples—A. I. JOHNSON AND R. P. MOSTON	308
Ultrasonic Equipment	308
Testing Methods	311
Summary	312
Soil Drying by Microwave Oven—P. V. LADE AND	
H. NEJADI-BABADAI	320
Heating with Microwaves	321
Effects of Heating Clay Mineral Systems	322
Preliminary Investigations	323
Determination of Water Content	324
Effects of Microwave Heating on Soil Characteristics	330
Summary and Conclusions	333
Discussion	335

