



GEOTECHNICAL MANUAL

Wisconsin Department of Transportation

TABLE OF CONTENTS

Chapter 1: General

Section 1-1 Manual Development

Chapter 2: Geology of Wisconsin

Section 2-1 General

Section 2-2 Bedrock Geology

- 2-2.1.....Bedrock Formations
 - 2-2.1.1 Igneous Bedrock
 - 2-2.1.2 Sedimentary Bedrock
 - 2-2.1.3 Metamorphic Bedrock
- 2-2.2.....Geologic History
 - 2-2.2.1 Wisconsin Geologic Time
 - 2-2.2.2 Bedrock Distribution and Age
- 2-2.3.....Karst

Section 2-3 Glacial Geology

- 2-3.1.....Terms and Definitions
- 2-3.2.....Glacial History
- 2-3.3.....Glacial Landforms and Formations

Section 2-4 Post-Glacial Geology

- 2-4.1.....Alluvial Deposits
- 2-4.2.....Colluvium and Talus
- 2-4.3.....Organic Soils
- 2-4.4.....Residuum

Chapter 3: Wisconsin Soil Development and Distribution

Section 3-1 General

Section 3-2 Terms and Definitions

- 3-2.1.....Soil
- 3-2.2.....Soil Components
- 3-2.3.....Soil Properties

Section 3-3 Soil Classification Systems

- 3-3.1.....AASHTO Classification System
- 3-3.2.....Unified Classification System
- 3-3.3.....USDA Classification System

Section 3-4 Soil Development

Section 3-5 Major Soils Groups

- 3-5.1.....Glacio-fluvial Soils
- 3-5.2.....Glacial Till Soils
- 3-5.3.....Lacustrine Soils
- 3-5.4.....Alluvial Soils
- 3-5.5.....Aeolian Soils
- 3-5.6.....Residual Soils

[3-5.7](#).....Organic Soils

Section 3-6 Pedology

[3-6.1](#).....General

[3-6.2](#).....Application

Section 3-7 Soil Maps and Soils Data

Chapter 4: Organic Soils

Section 4-1 General

Section 4-2 Types and Descriptions

[4-2.1](#).....Peat

[4-2.1.1](#) Sedimentary Peat

[4-2.1.2](#) Fibrous Peat

[4-2.1.3](#) Woody Peat

[4-2.2](#).....Marl

[4-2.3](#).....Organic Silt, Sand, or Clay

[4-2.4](#).....Buried Organic Material

Section 4-3 Formation Influences

[4-3.1](#).....Topography

[4-3.2](#).....Groundwater Levels

[4-3.3](#).....Climate

[4-3.4](#).....Geographic Location

[4-3.5](#).....Plant Species

Section 4-4 Treatment Alternatives

[4-4.1](#).....Avoidance

[4-4.2](#).....Excavation and Replacement

[4-4.3](#).....Partial Excavation and Displacement

[4-4.4](#).....Lightweight Fill Materials

[4-4.5](#).....Geosynthetic Supported Embankments

[4-4.6](#).....Surcharging

[4-4.7](#).....Combination Treatments

Chapter 5: Roadway Investigations

Section 5-1 General

[5-1.1](#).....Level 1 Investigation

[5-1.2](#).....Level 2 Investigation

[5-1.3](#).....Level 3 Investigation

Section 5-2 Level 1 Investigations and Reports

[5-2.1](#).....Overlay Resurfacing Projects

[5-2.2](#).....Pavement Removal and Replacement Projects

[5-2.3](#).....Projects with Safety Improvement Earthwork

[5-2.4](#).....Projects with Major Earthwork

[5-2.5](#).....Resources

Section 5-3 Level 2 Investigations and Reports

[5-3.1](#).....Deliverable Information

[5-3.1.1](#) Soil Types and Textures

[5-3.1.2](#) Recommended Grade Line Position

[5-3.1.3](#) Frost Susceptible Materials

[5-3.1.4](#) Topsoil depths

[5-3.1.5](#) Earth Cuts

[5-3.1.6](#) Select Materials

[5-3.1.7](#) Excavation Below Subgrade

- [5-3.1.8](#) Expansion/Shrinkage Factors
- [5-3.1.9](#) Organic Soils
- [5-3.1.10](#) Bedrock Excavations
- [5-3.1.11](#) Pavement Design Factors
- [5-3.1.12](#) Level of Investigation

Section 5-4 Level 3 Investigations and Reports

- [5-4.1](#) Geophysical Investigative Methods
 - [5-4.1.1](#) Seismic Methods: (Seismic Refraction and Vibration Monitoring)
 - [5-4.1.2](#) Ground Penetrating Radar: (GPR)
 - [5-4.1.3](#) Electrical Resistivity: (ER)
 - [5-4.1.4](#) Falling Weight Deflectometer (FWD)
- [5-4.2](#) Slope Stability
 - [5-4.2.1](#) Constructed Embankments
 - [5-4.2.2](#) Cut Earth Slopes
 - [5-4.2.3](#) Analyses and Alternatives
- [5-4.3](#) Consolidation
 - [5-4.3.1](#) Analyses
 - [5-4.3.2](#) Treatment Alternatives
- [5-4.4](#) Bedrock Slopes
 - [5-4.4.1](#) Potential Issues
 - [5-4.4.2](#) Analyses
- [5-4.5](#) Organic Deposits
- [5-4.6](#) Industrial Waste Usage
 - [5-4.6.1](#) Potential Applications
 - [5-4.6.2](#) Considerations

Chapter 6: Pavements

Section 6-1 General

Section 6-2 Flexible Pavements

- [6-2.1](#) Keyser's Group Index
- [6-2.2](#) Design Group Index
- [6-2.3](#) Frost Index

Section 6-3 Rigid Pavements

Chapter 7: Structures

Section 7-1 General

Section 7-2 Foundation Types

- [7-2.1](#) Shallow Foundations
- [7-2.2](#) Deep Foundations
 - [7-2.2.1](#) Piles
 - [7-2.2.2](#) Drilled Shafts
 - [7-2.2.3](#) Micropiles and Augercast Piles

Section 7-3 Foundation Analyses and Design

- [7-3.1](#) Shallow Foundations
 - [7-3.1.1](#) Minimum Embedment
 - [7-3.1.2](#) Scour
 - [7-3.1.3](#) Settlement
 - [7-3.1.4](#) Bearing Resistance
 - [7-3.1.5](#) Stability
- [7-3.2](#) Piles
 - [7-3.2.1](#) Selection of Pile Type
 - [7-3.2.2](#) Static Analyses
 - [7-3.2.3](#) Other Design Considerations

- [7-3.3](#).....Drilled Shafts
- [7-3.4](#).....Micropiles and Augercast Piles

Section 7-4 Subsurface Investigations – All Structures

- [7-4.1](#).....Review of Proposed Plans
- [7-4.2](#).....Review of Existing Subsurface Information
- [7-4.3](#).....Field Investigation
 - [7-4.3.1](#) Exploration Depths
 - [7-4.3.3](#) Bedrock Investigation
- [7-4.4](#).....Bore Logs
- [7-4.5](#).....Laboratory Testing

Section 7-5 Bridges

- [7-5.1](#).....Subsurface Investigations
- [7-5.2](#).....Analyses and Recommendations
- [7-5.3](#).....Site Investigation Report

Section 7-6 Retaining Walls

- [7-6.1](#).....Typical Wall Types
- [7-6.2](#).....Subsurface Investigations
- [7-6.3](#).....Analyses and Recommendations
- [7-6.4](#).....Site Investigation Report

Section 7-7 Box Culvert, Rigid Frame and Plate Arches

- [7-7.1](#).....Subsurface Investigation
- [7-7.2](#).....Analyses and Recommendations
- [7-7.3](#).....Site Investigation Report

Section 7-8 Ancillary Structures

- [7-8.1](#).....Subsurface Investigation
- [7-8.2](#).....Analyses and Recommendations
- [7-8.3](#).....Site Investigation Report
- [7-4.3.2](#).... Soil Descriptions

Chapter 8: Appendix

Section 8-1 Soil Test Descriptions

- [8-1.1](#).....Test Descriptions

Section 8-2 NRCS Soil Information

- [8-2.1](#).....NRCS Engineering Properties