Chapter 1 - Introduction

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1.1 General

At the direction of ODOT's Chief Engineer, the *ODOT Geotechnical Design Manual (GDM)* establishes standard policies and procedures regarding geotechnical work performed for ODOT (DES 05-02). The manual covers geotechnical investigations, analysis, design, and reporting for earthwork and structures for highways. The purpose of the GDM is to establish investigation and design standards, furnish information for an optimum design, which will minimize over-conservatism, as well as to minimize under-design and the resulting failures commonly and mistakenly attributed to unforeseen conditions. All State of Oregon projects are required to meet the design standards in the GDM.

Specific changes in the 2023 edition of the GDM are quite significant. Since the establishment of the GDM circa 2006 there have been significant policy, standards, quality control and required documentation changes within ODOT for the geotechnical profession. In an effort to improve quality of project delivery, statewide consistency, and quality control, this edition captures some of these changes by; reordering the Chapters in order of project delivery, emphasizing quality control and quality assurance in Chapter 2, and providing instructions for special efforts to advance the practice of the Geotechnical disciplines.

For the first time since the publishing of the Soil and Rock Classification Manual, there are significant changes. With the publishing of this new version of the Soil and Rock Classification Manual, any projects in development that have not completed the DAP phase will use the current Soil and Rock Classification Manual. The 1987 Soil and Rock Classification Manual will only be available for completion of existing projects that have completed the DAP phase and existing construction projects. The current version of the Soil and Rock Classification and Logging is now Chapter 5 of the GDM. All Geotechnical Reporting Documents thereafter will use the most current version of the GDM. Chapter 5 of the GDM replaces the 1987 Soil and Rock Classification Manual.

An effort is currently underway to combine both geotechnical and structural seismic design criteria in a stand-alone manual. The current Seismic Design, Chapter 13, will be sunset upon the publishing on the *Seismic and Tsunami Design Criteria Manual*, all projects without DAP acceptance will use the Seismic and Tsunami Design Criteria Manual.

Foundation design for bridges, signs, signals, luminaires, sound walls, and buildings have been combined into one chapter titled Foundation Design. Similarly, the previously titled chapters Construction Recommendations and Report have been merged with Geotechnical Reporting and Documentation for a more efficient and succinct manual.

Table 1-1, of this chapter, provides a crosswalk between GDM 2022 and the previously published manual as well as the Technical Resource and contact information. The Technical Resources listed in this table should be the first point of contact for project questions, design deviation requests, and any suggestions for manual changes.

Finally, a subsection titled Special Geotechnical Procedures has been added to Chapter 1 to emphasize recent changes and efforts in geotechnical programs.

1.2 Overview

Even the most rigorous geotechnical investigation will reveal only a small percentage of the subsurface materials beneath a project. Further, it would be impractical to provide a rigid set of specifications for all possible cases. Therefore, this manual will not address all subsurface problems and leaves many areas where individual geologic and engineering professional judgment must be used. It is intended that the procedures discussed in this manual will establish a reasonable and uniform set of standards, policies and procedures while maintaining sufficient flexibility to permit the application of engineering analysis to the solution of geotechnical problems.

This manual references publications, presents specific engineering design, construction, or laboratory testing procedures. Each chapter contains a listing of associated references for the subject area of the chapter. Among the commonly referenced materials are the publications of the American Association of State Highway Transportation Officials (AASHTO), the Federal Highway Administration (FHWA), and the American Society for Testing and Materials (ASTM).

The ODOT Geotechnical Engineering and Engineering Geology Section is responsible for the publication and modification of this manual. Any comments or questions about the *ODOT Geotechnical Design Manual* should be directed to the Technical Resource professional listed in Table 1-1.

1.3 Manual Revisions, Project Specific Geotechnical Standards Deviation

1.3.1 Manual Revision Procedure

The GDM is continually updated by headquarters' staff to clarify ODOT geotechnical practices and to include new practices and information as they come into broad usage. Revisions and submittals from all users of the GDM, both internal (ODOT) and external (Consultants and others), are encouraged. Users of the GDM should follow the instructions for defining the problem and put it in writing as complete as possible and email to either the Technical Resource found in Table 1-1 or to the State Geotechnical Engineer for consideration and follow up. Use the following procedure when submitting suggested manual revisions to the Technical Resource.

1. **<u>Define the problem</u>**

   Discuss the suggestion or revision of the GDM with others that have a stake in the outcome. If it is agreed that the item should be proposed, develop a written proposal. Changes to design policy, design practice, or procedures can have wide-ranging effects – including preparation of contract documents for ODOT. Proposed changes to design standards should be consistent with AASHTO and FHWA design procedures.

2. **Put it in writing**

   Research and develop a written proposal using the three general subject headings:

   - Problem Statement.
   - Analysis/ Research Data.
   - Proposal.

   Check the finished product by reviewing the following guiding comments:

   - The existing problem is clearly stated.
   - Research and analysis of the problem and potential solution are thorough and understandable.
   - The proposed solution is well thought out, is supported by facts, and solves the problem. Has the impact on other areas been considered? Have the details been coordinated with other units or organizations that may be affected?
   - No questions remain that need to be answered before implementation.

3. **Submittal, Review and Approval**

   Submit proposed manual revisions to the Technical Resource in Table 1-1. After reviewing the written proposal for technical validity, completeness, and business applicability, the technical resource Geotechnical Engineering and Engineering Geology Section will either:

   - Accept, without further review, manual corrections for inclusion in the GDM, or
   - Distribute proposed manual revisions to internal (ODOT) stakeholders for review and comments.

   After receiving review comments from internal stakeholders, the Geotechnical Engineering and Engineering Geology Section will do one of the following:

   - Accept proposed revisions and incorporate them into the next upcoming version of the GDM, or
   - Return submittal to the originator with comments and recommendations for revision and resubmittal.

   Regardless of whether or not a proposal is accepted, the Geotechnical Engineering and Engineering Geology Section will reply in writing to the person making the submittal.

4. **Implementation of Approved Revision**

   Proposals will be incorporated electronically into the GDM on the ODOT web page as soon as practical.

1.3.2 Deviation from Geotechnical Standards

All State of Oregon projects are required to meet ODOT design standards. Design deviation requests will be submitted for all STIP projects which do not meet standards and have a Design

Acceptance Package milestone date after **July 1, 2018**. A request for a deviation from design standards is appropriate when the request benefits the project and is supported by rational engineering principles. Deviations to design standards should be discussed early in the design process with the assigned Technical Resource (Table 1-1).

For geotechnical design deviations, the proposal is prepared by the Professional of Record (POR) using the Geotechnical Design Deviation Request Form (Design Deviation Request). The Design Deviation Request should be used to document the applicable geotechnical design standard(s) from which deviation is being requested. Furthermore, it should also provide a justification for the need and proposed solution for the deviation. It should also include the risks, hazards, consequences and effects of the deviation. The POR should coordinate with the project team when developing the request. A draft of the deviation request should be submitted to the applicable Technical Resource (Table 1-1) for review by the senior Headquarters staff, and recommendation made to the State Geotechnical Engineer. All Design Deviation Requests will be reviewed by Sr. Geologist (GES), Sr. Geotechnical Engineer (GES or BES), and Technical Resource for recommendation to the Delegated Authority for approval. Subsequent discussions and negotiations concerning the deviation will generally be conducted between the Technical Resource and the Professional of Record. The final Design Deviation Request is filed in ProjectWise with concurrence signatures from the Tech Center Manager and notice provided to the Technical Resource that the document is available for approval.

The Design Deviation Request is available at the following link: Design Deviation Request.

Table 1-1 Technical Resources

Pre-2022	Chapter	Title	Technical Resource
1	1	Introduction	Susan Ortiz
23	2	Quality Control & Quality Assurance	Susan Ortiz
2	3	Project Geotechnical Planning	Curran Mohney
3	4	Field Investigation	Curran Mohney
Separate	5	Soil and Rock Classification and Logging	Curran Mohney
5	6	Engineering Properties of Soil and Rock	Susan Ortiz
7	7	Slope Stability Analysis	Susan Ortiz
20	8	Material Sources Report	Curtis Ehlers
9	9	Embankments – Analysis and Design	Susan Ortiz
10	10	Soil Cuts – Analysis and Design	Susan Ortiz
12	11	Rock Cuts – Analysis, Design and Mitigation	Curran Mohney
13	12	Landslide Investigation and Mitigation	Curran Mohney

Pre-2022	Chapter	Title	Technical Resource
6	13	Seismic Design	Susan Ortiz
	14	Ground Improvement	Susan Ortiz
14	15	Geosynthetic Design	Sophie Brown
15	16	Retaining Structures	Sophie Brown
8, and 16	17	Foundation Design	Susan Ortiz
17	18	Culverts and Trenchless Technology Design	Sophie Brown
18	19	Construction Recommendations and Reporting	Susan Ortiz
21	20	Geotechnical Reporting and Documentation	Susan Ortiz

1.4 ODOT Geotechnical Organization

The functions of geotechnical design in ODOT are generally managed and performed within the five Region offices. Tech Centers within each region are staffed with Geotechnical Engineers, and Engineering Geologists. The geotechnical design, construction, and maintenance support may be performed in-house or contracted out to specialty consultants. The ODOT Technical Services Geotechnical Engineering and Engineering Geology Section sets standards, procedures, and policy, provides design assistance and review, organizes training, initiates section goals for geotechnical work, ensures workload is staffed with competent PORs, process improvement, research, implement state-of-the-art practice and standard-of-practice standards.

1.5 Special Geotechnical Procedures

Long-term efforts such as Geotechnical Asset Management and research require consistency and specificity. In an effort to maintain momentum for these programs, which ultimately improve project efficiency, explicit actions are required. As such, the special geotechnical efforts section of the GDM is reserved to emphasize new or on-going efforts.

1.5.1 Geologic and Geotechnical Data

Inarguably the most vital component of a geologic interpretation and geotechnical design is the subsurface exploration, and in-situ testing. Regardless of the extent of exploration and testing, more data is always useful. As such, legacy data is useful to improve overall understanding of the geologic setting, engineering properties, and maintenance repairs. Further, access and consistency of the raw electronic data facilitates ease of use. Ideally, all data retrieved for a project is filed and stored in ProjectWise. Examples of data include but not limited to:

exploration logs, Cone Penetration Test (CPT) files, Direct Simple Shear, Cyclic Direct Simple Shear, suspension logging, and geophysical data. This data is stored in ProjectWise in their raw useable electronic format such as *.gnt for borehole log, etc.

Agency goals with respect to geotechnical information asset management includes single-source access to all geologic and geotechnical data produced by and for the agency in a geospatial database. This will be achieved in a measured process starting with newly-collected data and eventually expand to include all of the data collected by the agency that still exists in various formats. To this end, explorations are required to be labeled with unique alphanumeric codes to facilitate their incorporation into a database. Exploration naming standards are set forth in Chapter 5.

1.5.2 Cyclic Direct Simple Shear Testing (CDSS)

Studies of Willamette Silt in Western Oregon were initiated in the mid-1990's and continue in an effort to determine the cyclic response of these unique soils which underlie the majority of Oregon's population. To better understand these soils specific sampling, and testing criteria is required to bolster the existing dataset of Willamette Silt data. If an ODOT STIP project can justify the cost of testing (~$20k) with an overall savings in project costs, then CDSS testing should be completed. Until recently, CDSS testing availability for ODOT projects was limited to resources outside the Country. Currently, there are several consulting firms and two Universities in Oregon that are able to perform this testing.

Paired mud rotary borings and CPT soundings are required for site investigations where CDSS testing will be used. Undisturbed sampling, storage, and transport to the laboratory require careful handling as these transitional soils are subject to easy disturbance.

Testing protocol requires the following tests to be performed for each sample: index tests, soil classification with particle size distribution, constant rate-of-strain consolidation test where $\sigma'_{vo} = \sigma'_{vc}$, a minimum of four constant-volume, monotonic direct simple shear tests over a range of OCRs from 1 to 8, and a minimum of four constant-volume, stress-controlled, Cyclic Direct Simple Shear (CDSS) tests. All test results in the raw data form, in excel format, are stored in ProjectWise with the associated project. Geotechnical Reporting Documents will include the laboratory test results, procedures, interpretation and application for each project.

If you have questions regarding the testing protocol requirements, data storage, interpretation, reporting requirements or application do not hesitate to contact the Seismic Design Technical Resource (Table 1-1).