

# Geotechnical & Paving Design Guide

- **Introduction**

The Appendix "A" defines the scope of A&E services. The Unified Facilities Criteria (UFC) 1-300-09N ("Design Procedures"), 1-300-10N (Electronic Design Deliverables) and 3-200-10N ("Design: General Civil / Geotechnical / Landscape Requirements") provide guidance for the design and presentation of the required services. This Geotechnical and Paving Design Guide further defines the geotechnical and paving services identified in the Appendix "A" and identifies our technical and submittal requirements for geotechnical and paving engineers doing design work.

- **Resources**

The branch maintains record files pertaining to the geotechnical aspects of previously constructed projects. Architecture and engineering firms preparing fees, Requests for Proposals (RFP), or designs are encouraged to use this resource to research existing conditions or past design approaches for facilities, structures, or pavements. Viewing or discussion of the files' contents is possible by contacting members of the branch. For design build contractors, any geotechnical or pavement information that is available is attached to the design-build RFP.

- **Geotechnical & Paving Design Requirements**

- **Registered Geotechnical Engineers**

The geotechnical engineers participating in the design shall be registered professional engineers and shall be familiar with the geological conditions, geotechnical design approaches, and construction materials used in the location in which they are performing work.

- **Design Criteria**

The use of the Naval Facilities Engineering Command's design manual series on soil mechanics and foundations (NAVFAC DM-7.1, 7.2 and 7.3) or the UFC-3-220 geotechnical series is recommended. The NAVFAC design manuals and the UFC series can be obtained from the Whole Building Design Guide (WBDG) website (<http://www.wbdg.org>). However, other published geotechnical texts may also be used in lieu of the NAVFAC design manuals.

The pavement for airfields shall be designed in accordance with the UFC-3-260 series. The pavement for roads, streets, parking, and open storage shall be designed using the Army Corps of Engineers TM-5-822 series.

- **Pre-Design Services**

- **Field Investigation**

- **General**

The A/E shall obtain all site and building data and investigate existing site conditions, utilities, and facilities as necessary to properly integrate the design of the project with the existing conditions. The field investigation shall include complete and accurate site investigation, noting any features or conditions that would influence the design, including topography, groundwater, climatic or tidal action, availability of utility and drainage systems, etc. Applicable existing as-built record drawings and subsurface information from the Geotechnical & Paving Branch record files, when available, will be furnished for information. However, the A/E shall be responsible for field verification of the as-built drawings and other site features that may influence the design of the project.

All site investigations shall be coordinated with the cognizant Public Works Department. The exact location of the geotechnical excavation, whether by drilling or digging, shall be approved by the appropriate authorities, be it the local utility service or by a company hired by the geotechnical engineering firm to 'scope' utilities. During the execution of the field investigation work, the A/E shall be responsible for obtaining necessary permits, and comply with applicable laws, codes, and regulations, including OSHA regulations. The A/E shall be responsible for all damages to persons and property that occur as a result of the A/E's negligence. The A/E shall take proper safety precautions to protect both the public and private interests from physical hazards and unsafe conditions. Upon completion of field investigation, the A/E shall return the property to its original condition.

- **Geotechnical Investigation**

A literature review of the existing borings, pile driving records, physiographic data and geologic maps should be accomplished early in the subsurface investigation program.

- **Subsurface Exploration**

Subsurface investigation and evaluations (including soil borings, test pits, ground penetrating radar surveys, seismic refraction surveys, and electrical resistivity testing) shall be in accordance with ASTM.

- **Soil Borings**

The soil borings and standard penetration tests shall be made in accordance with ASTM D 1586. The ASTM D 1586 procedure shall be modified to make continuous standard penetration and sampling tests for the initial 12 feet of the boring. If drilling techniques are used that prevent the measurement of the water table, install at least two piezometers per drilling site to more accurately measure the depth to the water table. Piezometers are required for storm water pond investigations. Piezometers are not required if there is good evidence that the water table is not within the depth of the borings or zone of influence for the foundation or structure. The driller shall visually classify all soils in accordance with ASTM D 2488. If evidence is discovered indicating soil or groundwater contamination, this should be reported immediately to the project manager or the Geotechnical and Paving Branch. If soft cohesive materials are discovered in the near surface soils, they should be sampled with a thin wall tube for laboratory

testing. Undisturbed sampling shall be performed at the discretion of the Geotechnical Engineer responsible for performing the investigation.

- **Laboratory**

The minimum laboratory testing shall include grouping like samples and conducting a sieve analysis and Atterberg Limits on one sample from the group. The field logs shall be updated in accordance with ASTM D 2487. Other testing could include moisture contents, California Bearing Ratio, unconfined compressive strength, consolidation testing, triaxial testing, and potential volume change in accordance with FHA No. 595 in suspected expansive clay areas. Some environmental testing of soils may be required just to identify contaminated (predominantly petroleum) soils; however, if major contamination is suspected, the situation will be sent to the Environmental Division for definition.

- **Other Field Testing**

Projects may require a variety of other testing from percolation tests for septic systems to seismic refraction surveys. In areas of near surface rock, seismic refraction surveys or ground penetrating radar may be required to determine the depth of rock or competent material. Soil resistivity by the Weener 4-pin method should be used when designing underground structures like piping.

- **Geotechnical Report**

**General Report**

Provide a report describing the physiographic and geologic features of the site. Describe the general situation as to topography, ground cover, and any other features that may influence the design. Describe the investigation program, drilling techniques/procedures used. Discuss the soil stratigraphy, materials, and groundwater conditions at the site. The report shall specifically address the groundwater levels expected to be encountered in construction under normal conditions, and any site specific factors (such as tidal action, climate, seasonal flooding or droughts, etc.) that may influence the groundwater levels. Include copies of pertinent U.S. Geological Survey Maps used. The boring logs and laboratory testing results shall be provided on compact disc (CD) in an AUTOCAD compatible format (either .DXF or .DWG) with text size conforming to the Professional Services Guide. An Adobe Acrobat (PDF) version of the geotechnical report shall be included on the CD and two printed copies of the report shall also be submitted.

**Boring Logs**

Show a scaled location plan with the borings located with offsets to existing features. The boring logs shall be in accordance with ASTM D 1586. The laboratory data shall be summarized in tables.

**Foundation and Site Preparation Recommendations**

Discuss the facility under design and make recommendations for the foundation type. Describe and specify the improvements that are required for shallow foundations, such as compaction, removal and replacement, surcharging, wick drains, etc. Describe the soil bearing capacity, pile capacity, pile length, pile type and special instructions such as jetting, pre-drilling and testing required. If

required by the A/E of record, state the pavement design parameters and the pavement design. If the pavement design is to be completed by others, provide design parameters determined from subsurface investigation. If multiple structures are being designed, address structures on an individual basis. Discuss the site preparation and susceptibility to rain and construction equipment.

- **Design Services**

- **Basis of Design**

The Basis of Design shall include a paragraph briefly describing the geotechnical investigation program, the recommendations for the site preparation, and the recommendations for the building foundation and/or pavement design.

It is preferred that the geotechnical report be included in the Basis of Design as an appendix. However, the schedule may preclude the completion of the field investigation prior to the submittal of the Basis of Design. If this is the case, describe the assumed basis of design for the foundations and pavement and submit the geotechnical report as soon as possible.

- **Calculations**

- **General Requirements**

Generally the geotechnical report will contain the calculations relating to foundation and pavements. However, if the pavement calculations are done by a different consultant, they may appear here or in the civil engineering package.

- **Geotechnical and Paving Requirements**

The geotechnical calculations normally appear in the geotechnical report; however, they may be in a separate package if another consultant other than the geotechnical consultant prepares the calculations for foundations or pavement. The calculations should indicate the loadings, capacities, the safety factors, and the text from which the calculations were based for the foundation and pavements. Graphs and formulae shall be clearly indicated along with the derivation of curve slopes and data derived from the laboratory testing.

- **Drawings**

A typical presentation of the borings on drawings is shown in attachment. It includes the logs as they appear in the Geotechnical Report, a summary table of the laboratory testing, notes concerning the drilling, logs, and testing, and any site preparation notes or details. Surcharging details with settlement plates should be shown here.

- **Design Submittals**

- **35% Design Development Submittal**

- **Basis of Design**

Include the Geotechnical Report as an appendix if available. It is encouraged to have this report at this submittal to obtain any review comments at the earliest possible date.

- **Drawings**

Boring log drawings are encouraged, but not required, at this submittal.

- **Calculations**

Submit geotechnical foundation and pavement design calculations if not included in the Geotechnical Report.

- **100% Pre-final Submittal**

- **Basis of Design**

The Geotechnical Report, if modified during the 35% review, shall be re-submitted as an appendix to the Basis of Design, otherwise do not submit.

- **Drawings**

The boring log drawing(s) shall be complete. Drawings depicting any special site preparation details should be included.

- **Calculations**

Submit any calculations not submitted or that were modified during the 35% submittal. Otherwise, do not submit.

- **Final Submittal**

- **Final Basis of Design**

The Geotechnical Report, if modified during the 100% review, shall be re-submitted as an appendix to the Basis of Design, otherwise do not submit.

- **Drawings**

All geotechnical drawing(s) shall be complete and signed.

- **Calculations**

Submit any calculations not submitted or that were modified during the 100% submittal. Otherwise, do not submit.

- **Overseas Requirements**

- **Geotechnical Report**

The Geotechnical Report shall be translated into English.

- **Drawings**

The boring logs shall be shown in two languages, English and the country of bidding and construction.