

**ADOPTION OF AN AMENDMENT TO
THE PUBLIC FACILITIES MANUAL
OF THE COUNTY OF FAIRFAX, VIRGINIA**

At a regular meeting of the Board of Supervisors of Fairfax County, Virginia, held in the Board Auditorium of the Government Center at Fairfax, Virginia, on Tuesday, November 1, 2016, the Board after having first given notice of its intention so to do, in the manner prescribed by law, adopted an amendment to the Public Facilities Manual of the County of Fairfax, Virginia, said amendment so adopted being in the words and figures following, to-wit:

**BE IT ORDAINED BY THE BOARD OF SUPERVISORS OF FAIRFAX
COUNTY, VIRGINIA:**

Amend the Public Facilities Manual, Chapter 4 (Geotechnical Guidelines), as follows:

Amend § 4-0300 (Geotechnical Report), 4-0303 (General Guidelines), by revising Subsection 4-0303.7 (Laboratory Testing), where insertions are underlined and deletions are shown as strikeouts, to read as follows:

4-0303.7 Laboratory Testing. The nature and extent of laboratory testing deemed necessary is dependent upon the characteristics of the soil and the anticipated geotechnical problems requiring analysis.

4-0303.7A On granular soils, gradation tests on representative samples and water content determinations often are adequate.

4-0303.7B Testing of cohesive soils samples may include, but are not limited to, determination of water content, dry density and unconfined compressive strength.

4-0303.7C In stiff, fissured clays such as the Cretaceous Marumscos, ~~and/or “Marumscos~~ complexes, and soils previously mapped as marine clays,” the results of unconfined compression tests alone cannot be used to assess the structural property of the soil *in-situ*. Atterberg limits and hydrometer analysis tests aid in classification and ~~also in predicting certain~~ in the prediction of physical properties.

4-0303.7D Consolidation tests should be performed on samples from relatively soft clayey soils (i.e., those mapped as Dulles, Elbert, Jackland, Kelly, Haymarket, Hattontown, Orange and their complexes) ~~which~~ that may underlie the foundations. Expansive pressure of the soft clayey soils should also be determined for foundation design.

4-0303.7E For the stiff fissured clays and deltaic clays ~~which that~~ have undergone relatively large strains in the past, the important properties for predicting long-term slope behavior are the residual effective friction angle and the residual cohesion intercept (the absolute minimum strength of clay material). Any cohesion of the fissured and deltaic clays should be ignored in the evaluation of the long-term stability of a slope. These shear strength parameters should be determined by appropriate laboratory tests (drained direct shear tests using sufficient stress reversals to obtain large strains as discussed in the COE laboratory testing procedure EM 1110-2-1906).

4-0303.7E(1) Many reversals are required to reach residual strengths, but must never be less than three reversals at any particular normal stress. The strain rate(s) selected to shear the samples must be based on either the consolidation data at the first normal stress or experience with similar soils. The strain rate used during each reversal may be varied (i.e., a slightly higher rate than specified in EM 1110-2-1906), but the rate during the last reversal at each normal stress shall not exceed 1.44 inches per day. The geotechnical engineer shall be aware of unintended buildup of pore water pressure during testing and shall lower the strain rates accordingly. To obtain the strength envelope for the sample, the direct shear test must be repeated at two other normal stresses.

4-0303.7E(2) Some references suggest using a pre-split sample (Ref. Engineering Properties of Clay Shales Report No. 1, by W. Haley and B. N. MacIver). Shearing an intact, stiff to hard in-situ specimen may overestimate the results (see U.S. Geological Survey Professional Paper 1344: Relationship Between Geology and Engineering Characteristics of Soils and Weathered Rocks of Fairfax County and Vicinity, Virginia [1986]). Shearing such a specimen could also pose practical difficulties with some lab equipment (see EM 1110-2-1906); the test results from such samples should only be used with extreme caution. Only an intact reconstituted sample or a pre-split in-situ sample must be selected for the testing. The geotechnical report shall identify the type of sample and the strain rates used in the testing.

4-0303.7E(3) For less complex situations subject to approval of the Director, the required shear strength parameters may be estimated by comparison of other index properties (particularly the Atterberg limits and grain-size sieve analysis) with those of similar soils for which test results are reported in the published literature and on the basis of past experience. Correlations may be based on either U.S. Geological Survey Bulletin 1556: Engineering Geology and Design of Slopes for Cretaceous Potomac Deposits in Fairfax County, Virginia, and Vicinity (1984) or

“Empirical Correlations - Drained Shear Strength for Slope Stability Analyses” by Stark & Hussain (ASCE Journal of Geotechnical and Geoenvironmental Engineering [2013]). Documentation shall be furnished when shear strength parameters are based on results other than laboratory tests. Such documentation must set forth the reasoning by which the parameters were determined estimated. The residual friction angle shall be limited to a maximum of 12° when obtained through correlations, however, the Director may allow an angle greater than 12° when shear testing data from an adjoining site suggest that such an angle may be acceptable.

Amend § 4-0300 (Geotechnical Report), 4-0303 (General Guidelines), by revising Subsection 4-0303.8 (Engineering Analysis and Recommendations), where insertions are underlined and deletions are shown as strikeouts, to read as follows:

4-0303.8 Engineering Analysis and Recommendations

4-0303.8A The report of the soil studies shall include sufficient analytical foundation and slope stability studies to allow a reviewer to follow the logic and assumptions on which the analysis was based and conclusions reached. Recommendations and advice concerning pavement design, foundation design, earthwork, site grading, drainage, slope stabilization and construction procedures must be included in the report. The report shall include a complete record of the field and laboratory findings, information concerning structures to be built (types and elevations of basements), the conclusions reached from the study and the recommendations for use by the designer and the owner. Probable total and differential settlement of foundations, special basement problems and retaining wall design must be discussed and recommendations set forth.

4-0303.8B Where Marumsco soils, ~~and/or~~ “Marumsco complexes, and soils previously mapped as marine clays” are found, an engineering analysis of the short- and long-term stability of the existing and planned slopes must be made including performed. The analyses shall include a careful evaluation of potential adverse effects on ~~nearby~~ adjoining properties. The stability ~~analysis~~ analyses shall be ~~made by acceptable~~ performed using methods of analysis acceptable to the Director. The long-term stability of ~~Marumseo slopes containing these soils and/or “marine clays”~~ shall be based on performed using the “residual” shear strength parameters for the Marumseo soils and/or “marine clays.” as well as a conservative representation of the long-term groundwater conditions. Perched groundwater is common over these soils during wet seasons and must always be modeled in the long-term stability analysis as being at least 1 foot above the top of the formation. A model without perched groundwater may be allowed if the Director decides either that the model would result in unreasonable flooding or an extended-time set of groundwater level readings demonstrates that the assumed perched water level is unreasonable. For long-term stability, a minimum Factor of Safety (FS) of 1.25 is required when supported with sufficient field and laboratory characterization of the slope’s soils. Otherwise, a minimum FS of 1.5 is required.

4-0303.8C In areas that are susceptible to high water table conditions (permanent, perched and/or seasonal), the engineer shall ~~provide~~ recommend sub-pavement drainage design; and other measures to assure dry basements, ~~and to preclude wet yards, etc.~~

4-0303.8D Design criteria for retaining walls or structures shall be ~~given~~ provided. A preliminary global stability analysis for walls over 8 feet tall shall be performed to determine

whether structural or earthwork measures are needed in order to achieve a sufficient factor of safety against slope failure as defined in § 4-0303.8B.

4-0303.8E The report shall include a discussion on the problems ~~of~~ associated with expansive soils as defined in § 4-0501.3. Expansive cClay soils containing montmorillonite, which generally have a high expansion potential, have been found in ~~a wide variety of various~~ locations in southern Fairfax County, ~~and could~~ Expansive properties may also exist in the areas of other problem soils types mapped in the central and northern parts of the County. It is suggested that the design recommendations be based on expansive properties of the clay unless it is shown other-wise by X-ray ~~defraction~~ diffraction studies or other appropriate laboratory tests.

Amend § 4-0400 (Construction Plans) by revising 4-0402 (Footing and Drainage Design), where insertions are underlined and deletions are shown as strikeouts, to read as follows:

4-0402 Footing and Drainage Design

4-0402.1 Where Cretaceous Age deltaic clays occur, roof drains shall be required and the downspouts from these drains shall be piped to a storm drainage system. However, the requirement may be waived or modified by the Director where soil conditions warrant.

4-0402.2 Foundations ~~footings~~ of structures must be placed at depths that will minimize the possibility of heaving or shrinkage differential settlement due to desiccation of underlying ~~clays~~ expansive soils. The emplacement depth shall be based on the soil characteristics of the site. Consideration must be given to stratification of underlying materials, natural moisture content, gradation of backfill soils, site grading and adjacent vegetation. Consideration should also be given to special cases of potential volume change of ~~clays~~ expansive soils underlying footings embedded in thin layers of natural or artificially compacted granular soils. ~~Exterior F~~foundations in Marumsco soils, ~~and/or~~ “ Marumsco complexes, other soils previously mapped as marine clays”, and expansive soils (i.e., those mapped as Dulles, Elbert, Jackland, Kelly, Haymarket, Hattontown, Orange and their complexes) should be at least 4 feet ~~deep~~ below the nearest finished exterior grade, or to the bottom of the expansive soil stratum, whichever occurs first. Where the Director has determined that the geotechnical study has proven the demonstrated that ~~a 4-foot vertical buffer is feet to be~~ insufficient, the proper buffer depth must be recommended by the geotechnical engineer. ~~Foundations in areas of expansive clays developed in residual soils can usually be emplaced on firm underlying weathered rock materials.~~

4-0402.3 Surface and subsurface drainage shall be planned to minimize the amount of water entering Marumsco soils, ~~and/or~~ “ Marumsco complexes, and other soils previously mapped as marine clays.”

4-0402.4 Perimeter drains shall be provided around all basement areas.

4-0402.5 Floor slabs that will be designed to be ground-supported shall not directly bear on expansive soils, even when the floor slab is at the basement level, to minimize the possibility of heaving or shrinkage settlement. Slabs underlain by Marumsco soils, Marumsco complexes, other soils previously mapped as marine clays, and expansive soils (e.g., Dulles, Elbert, etc.) shall bear on a vertical buffer of at least 2 feet of non-expansive soils, or below the bottom of the

expansive soil stratum, whichever occurs first. Where the geotechnical study has demonstrated that a 2-foot vertical buffer is insufficient to reasonably reduce the impact of shrink-swell cycles of the expansive soil, the proper depth of the buffer shall be a part of the geotechnical engineer's recommendation.

This amendment shall become effective on November 2, 2016 at 12:01 a.m.

GIVEN under my hand this 1st day of November, 2016.

CATHERINE A. CHIANESE
Clerk to the Board of Supervisors