

**GEOTECHNICAL REQUIREMENTS  
METROPLACE AT DUNN LORING  
PARCELS C, D2 AND E  
PST Project No. 463-95057**

**SUBSOIL CONDITIONS**

Approximately one inch to 6 inches of topsoil was encountered at fourteen (14) test borings locations and 2 feet to 11.5 feet of man-made fill was encountered at three (3) of the twenty-seven (27) test boring locations (test borings TB-1B, TB-4 and B-5). The topsoil and/or the man-made fill are underlain by two (2) virgin soil strata, which are essentially the result of the in-place weathering of the underlying parent rock (metaceous schists). The man-made fill and the two virgin soil strata are briefly described hereunder:

**STRATUM I - MAN-MADE FILL**

As stated above, approximately 2 feet to 11.5 feet of man-made fill was encountered at test borings TB-1B, TB-4 and B-5. The fill generally consists of brown, red brown and yellow brown, silty clay and medium to highly plastic silty clay with trace of sand, organics and gravel, and medium to highly plastic clayey gravel (USCS Designations: ML, CL, CH, GC). Varying percentages of mica was encountered within the fill. The upper 4 inches to 5 inches of the fill at test borings TB-1B and TB-4 were classified as topsoil. The Standard Penetration Test (SPT) "N" values within the fill varied significantly from 4 blows per foot (bpf) to 19 bpf. Because of the nature of the encountered fill and the significant variance in its strength characteristics, the fill was classified as uncontrolled.

**STRATUM II**

Stratum II was encountered at twenty-five (25) of the twenty-seven (27) test boring locations underlying the man-made fill or the topsoil, and extended to depths ranging from 2 feet to 13.5 feet below the existing surface grade. This stratum generally consists of brown, yellow brown and red brown, micaceous silty, silty clay and medium to high plasticity silty clay with trace to little sand, and micaceous sandy silt (USCS Designations: ML, CL, and CH). Traces of organics were observed at localized areas within this stratum.

The stratum generally was medium stiff to very stiff with the SPT "N" values ranging from 5 bpf to 27 bpf. However, localized soft areas were encountered in the upper layers of this stratum with "N" values ranging from 3 bpf to 4 bpf. In addition, an N value of 50 blows for 2 inches of penetration was recorded in test boring TB-1, possibly due to encountering a boulder. Rehearsal was encountered at 5.2 feet below the existing surface grade at test boring TB-1 and it was offset approximately 25 feet to the east of its original location and redfilled.

**STRATUM III - SAPROLITE OR SHAIST**

Stratum III was encountered at all twenty-seven (27) test boring locations underlying Stratum I or II, and extended to the depths explored. This stratum generally consists of brown, yellow brown, red brown, and light gray micaceous silt with little sand, sandy silt and silty sand (USCS Designations: ML, SM), with varying percentages of quartz fragments at different elevations. The stratum generally was stiff/loose to hard/very dense with the SPT "N" values ranging from 9 bpf to 73 bpf. However, very dense layers with "N" values of 50 blows for 4 inches of penetration and 2 inches of penetration were recorded in test boring B-11.

**GROUNDWATER CONDITIONS**

All the test borings were found dry during, at completion and 24 hours after completion of the drilling operations.

**SITE PREPARATION AND EARTHWORK (BUILDING PADS, STREETS AND PARKING AREAS)**

The following requirements shall govern the earthwork that may be involved to attain the planned grades within the footprint areas of building pads, streets and parking areas.

- Areas to support the building pads and pavements shall be stripped of trees and vegetation, topsoil and organics. The depth of this excavation is expected to be approximately 25 mm (1 inch) to 150 mm (6 inches), and may differ at the other unretrofit areas on the site.
- Additional undercut shall be anticipated in areas where or moderately to highly plastic soils are encountered near the existing surface grades; to remove tree mats of mature trees, or to remove existing fills.
- Following the stripping and excavation of all unsuitable materials, grading operations may proceed. Prior to fill placement, the site shall be observed by a geotechnical engineer for proper stripping and preparation for receiving the fill.
- The subgrades exposed after stripping shall be proofrolled in the presence of the geotechnical engineer or his representative with at least two (2) passes of a loaded dump truck with a minimum axle load of 10 tons to identify any soft/loose pockets. Any observed loose/soft pockets shall be excavated to suitable-bearing subgrade and replaced with fill satisfying the controlled fill requirements detailed later.

The excavations for underground garages shall be made with adequate side slopes to allow for their stability on short-term basis. However, if soft and saturated soils are encountered, adequate protective measures such as bracing or shoring shall be taken to safeguard the work crew. Additionally, we anticipate that sheeting and shoring will be required for the areas closer to Park Tower Drive along the northwestern garage wall of Building No. 1.

Fill placement within the building pads shall extend laterally beyond the building limits a minimum distance of 5 feet or depth of fill, whichever is greater. The building pads shall be prepared to an elevation 200 mm (8 inches) below the floor slab-on-grade. The footings shall be excavated after the building areas have been properly prepared.

Material satisfactory for controlled fill shall include clean soil or bankrun sand and gravel (GW, GM, and SM), but exclude highly plastic clays (MH, CH).

CL and ML materials may be used subject to the following limitations:

Maximum Dry Density (PCF)	≥105
Liquid Limit (%)	≤40
Plasticity Index	≤20

GC and SC material is suitable for use in engineered fill provided that the liquid limit and plasticity index of the finer fraction of the material satisfy the above requirements. The fill materials shall be free from topsoil, organics and rock fragments having a major dimension greater than 3 inches.

The on-site soils of Strata I and II, except layers of moderately to highly plastic soils (LL > 40 and PI > 20), are suitable for use in controlled structural fills, subject to moisture adjustments. The material to be backfilled against the below-grade walls shall, however, be limited to the saprolite soils of Stratum II classified as ML, SM or more granular with LL ≤ 40 and PI ≤ 15.

Fill placement shall be in maximum 200-mm (8-inch) thick, loose, horizontal lifts compacted uniformly with the proper equipment.

Fill required to support the footings, slab-on-grade and pavement areas shall be compacted to at least ninety-five percent (95%) of the maximum dry density as established by ASTM D-698 test method.

The VTM-1 method shall govern the compaction for the streets, roadways and other paved areas to be handed over to VDOT for future maintenance.

The requirements for the degree of compaction shall conform to the current VDOT Specifications and the current Fairfax County Public Facilities Manual, as indicated below:

Aggregate Subbase/Base Course	90 to 100 percent*
Subgrade	100 percent
The entire thickness of fill up to 6 inches below the subgrade elevations	95 percent

\*As per Section 309.05 of the current VDOT Road and Bridge Specifications.

The moisture content of the subgrade soils shall be maintained within plus or minus two (±2) percentage points of the optimum moisture content.

The earthwork shall be performed under the supervision of and to the satisfaction of a geotechnical engineer.

**FOUNDATIONS**

**SHALLOW FOUNDATIONS**

Shallow foundations (continuous and spread footings) are considered adequate for the support of the proposed building. The footings shall be supported on the undisturbed virgin soils of Strata I and/or II, or on controlled structural fill. When the embedment depth of footing subgrade is less than 4 feet below the adjacent exterior finished grade, the footings can not be supported on moderately to highly plastic soils (LL > 40 and PI > 20). In such a case, these soils have to be excavated to a minimum of 4 feet below the lowest adjacent exterior finished grade and replaced with approved controlled fill. Alternatively, the footings can be lowered to a minimum of four (4) feet below the lowest adjacent exterior finished grade and supported on these soils.

Continuous footings that are partially located in fill and partially in undisturbed soil formation, shall be designed as grade beams 5 feet on either side of the transition. The column footings, in similar circumstances, shall be extended into the underlying virgin soils.

The footings may be sized and designed on the basis of allowable bearing pressures indicated below, subject to the observations and approval of soil conditions at the bottom of footing excavations for suitable soil bearing by a geotechnical engineer.

SOIL CONDITIONS AT SUBGRADE	ALLOWABLE BEARING PRESSURE (PSF)	MINIMUM WIDTH OF FOOTINGS (INCHES)
Controlled Structural Fill		
Isolated Footings	2,500	30
Continuous Footings	2,500	16
Virgin Undisturbed Soils (Strata I and II)		
Isolated Footings	3,000	30
Continuous Footings	3,000	16

**DEPTH OF FOOTINGS**

The embedment depth of all footings shall be governed by the minimum depth requirements for protection against frost heave in accordance with the BOCA National Building Code. The depth of frost in Northern Virginia is approximately 24 to 30 inches. The footings shall be embedded at least 30 inches below the lowest adjacent exterior finished grade.

**DESIGN PARAMETERS FOR BELOW-GRADE WALLS AND RETAINING WALLS**

Several retaining walls are proposed on Parcel C at the following locations:

- Along the western half of the south side of Building 4
- At the northeastern corner of Building No. 4
- At the southwestern corner of Building No. 3
- Between the northeastern and southeastern corners of Buildings No. 3 and No. 4, respectively.

In addition, the perimeter walls for the buildings/underground parking structures shall be designed as retaining walls. At this time, we do not have information regarding the type of retaining walls. The maximum toe pressure for below-grade walls shall not exceed the maximum allowable pressure for virgin soils or controlled structural fill presented in "Shallow Foundations". The walls shall be backfilled with the soils of Stratum II classified as ML, SM or more granular soils, with maximum liquid limit and plasticity index of 40 and 15, respectively. Clayey soils such as CL, CH, GC and SC shall not be used to backfill below-grade walls and retaining walls.

The walls shall be designed by the project structural engineer based on the parameters presented in the table below:

PARAMETER	SANDY SILT ML	SILT SAND OR SAND SM, SW, SP	NO. 57 STONE
Internal Friction Angle (degrees)	28	32	38
Moist Unit Weight (pcf)	125	130	140
Equivalent Fluid Pressure Active Condition (pcf)	60	45	35

The above design requirements assume that sufficient drainage measures are incorporated into the design for retaining walls as well as below-grade walls. Drainage measures for the below-grade walls are presented in "Damp Proofing/Water Proofing". Detailed drainage measures for the retaining walls can be provided upon request once information is available regarding their type and design details.

Surcharge loads from the proposed buildings, parking areas and construction equipment shall be taken into account when designing the walls.

The wall backfill that will support the pavement areas shall be compacted to at least ninety-five percent (95%) of the maximum dry density as established by ASTM D-698 test method. The wall backfill in non-structural areas shall be compacted to at least 85 percent (85%) of the maximum dry density. The material shall be placed in maximum 8-inch thick, loose, horizontal lifts compacted uniformly with small vibratory rollers. Heavy equipment shall not be allowed to operate in the vicinity of the walls (minimum 5 feet lateral distance from the walls) to avoid causing any damage to the walls.

The concrete to be used in the below-grade walls will have a minimum 28-day strength of 3,000 pounds per square inch (psi), or as designed by the project structural engineer. Four (4) cylinders shall be fabricated for each concrete pour to monitor the quality of concrete for the walls. More detailed requirements regarding the construction of the retaining walls can be provided, if necessary, once detailed information regarding their design is available.

The design of the below-grade and retaining walls satisfying the above requirements shall be submitted to the Fairfax County Plan Review Division for their approval, prior to actual construction.

**DESIGN OF UNDERGROUND STORMWATER MANAGEMENT VAULT**

The structural design of the underground stormwater management vaults (box culverts) shall be provided by a specialty contractor in accordance with AASHTO and ASTM standards. The design will be based on HS-20 and AL-1 (AASHTO 3.7.6). The design of the vaults shall be verified by the designer based upon the existing local conditions of the site and the soil parameters provided above.

The maximum pressure below the underground vault shall not exceed the maximum allowable pressure for virgin soils or controlled structural fill presented in "Shallow Foundations". The vaults shall be backfilled with the soils of Stratum II classified as ML and SM with maximum liquid limit and plasticity index of 40 and 15, respectively.

**DAMP PROOFING/WATER PROOFING**

The following requirements shall govern the effective damp proofing/water proofing of the below-grade structures (underground garages) and installation of perimeter drainage. The drains shall discharge into a sump at an appropriate location or be tied into the stormwater drainage system. The location and outfalls from the perimeter drains shall be shown on the plan.

Exterior faces of all below-grade walls located in A and/or B soils shall be coated with a heavy coating of bituminous material and covered with 6-mil thick plastic sheet. Alternatively, the exterior face(s) of the wall shall be treated with DECC-20 - a penetrating concrete sealer, a product of Dean Enterprises, Inc. and approved by Fairfax County as a water proofing agent or an equivalent product.

Bleeder pipes (50 mm (2 inches) in diameter) shall be installed in the upper half of the exterior wall footings.

Approximately 450 mm (18 inches) of VDOT No. 57 stone shall be placed along the outer perimeter of the footings and at the bleeder pipes to provide lateral drainage to the inlet point of bleeder pipes. The gravel filter shall be completely wrapped with a non-woven geotextile fabric (EGS #70 Sewe, Gradient Kanto 2 or less) to minimize the potential for migration of fines into the filter.

The subgrade of the floor slab shall be shaped to uniformly slope towards the interior underfoot the drain, tied into a sump with a heavy-duty electric pump. The tile drains shall have at least 50 mm (2 inches) of gravel bedding. The water shall be pumped into the stormwater structures at appropriate elevations or shall be discharged into the drainage swales.

The walls shall be backfilled with specific non-expansive material for which they have been designed. Plastic soils, classified as CL, CH, MH, SC and GC, as per the Unified Soil Classification System, shall not be used as backfill.

Five-grained soils, excluding plastic silts and clays (MH and CH soils), shall be placed in the top 300 mm to 450 mm (12 to 18 inches) in the grass areas, as a "cap" to reduce infiltration of surface run-off into the backfill. Furthermore, the "cap" shall be graded to slope away from the houses.

Yard slopes within the first 3 m (10 feet) of the building shall be a minimum of five percent (5%) to minimize the potential for ponding and to reduce seepage of water in the backfill.

The area around the building shall be graded with slopes no flatter than three percent (3%) to reduce the potential for wet yards.

The roof drains must discharge beyond the limits of excavations for below-grade walls.

**FLOOR AND GARAGE SLABS**

The following requirements shall govern the placement of the floor and garage slabs-on-grade.

Floor and garage slab excavations shall be proofrolled and prepared as described under "Site Preparation and Earthwork".

Moderately to highly plastic soils (LL > 40 and PI > 20), if encountered at and below the subgrade elevations of the slab-on-grade, shall be excavated to a minimum depth of 600 mm (2 feet) and replaced with approved fill material.

A fire-straining granular blanket of crushed stone or gravel shall be placed under the slab for lateral drainage and as a capillary barrier. The thickness of this blanket shall be at least 100 mm (4 inches).

A 6-mil thick impermeable plastic membrane (vapor barrier) shall be placed directly under the concrete slab and over the granular material.

The entire slab area shall be reinforced with a welded wire fabric.

The column points and perimeter walls shall be isolated from the slab to minimize the possibility of the slab cracking due to relative displacement.

Adequate control joints shall be provided with adequate shear reinforcement.

The slab shall be designed on the basis of modulus of subgrade reaction "k" of not more than 150 psf/inch.

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GEOTECHNICAL REQUIREMENTS - PARCELS C1, D2 & E

**METROPLACE AT DUNN LORING  
PARCEL C1**

PROVIDENCE DISTRICT  
FAIRFAX COUNTY, VIRGINIA

DESIGN SCALE AS SHOWN

SHEET 23 OF 35

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