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Geotechnical Engineering • Materials Testing • Environmental Engineering

GEOTECHNICAL INVESTIGATION
BLACK MOUNTAIN RANCH

Prepared for:

Longford Homes of NM, Inc.

Project No.: 03-1-267

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V & A

TABLE OF CONTENTS

V & A

TABLE OF CONTENTS

1.0 INTRODUCTION

This report presents the results of our geotechnical investigation for the proposed Black Mountain Ranch project.

The investigation was performed to determine site subsurface conditions; and, based upon the conditions observed in the test holes, to develop geotechnical recommendations for:

Foundation Design;
Slabs-on-Grade;
Lateral Earth Pressures;
Site Grading; and
Earthwork Construction.

The conclusions and recommendations presented are based on information provided to us regarding the proposed development, on subsurface conditions disclosed by the test holes, on laboratory testing, and upon the local standards of our profession at the time this report was prepared.

This investigation was not performed to determine the presence of potentially hazardous waste or radon gas. Determination of the presence of potentially hazardous materials was beyond the scope of this investigation and requires the use of exploration techniques and analytic testing which were not appropriate for this

investigation. If desired, Vinyard & Associates, Inc. will perform an environmental audit of the site.

2.0 PROPOSED CONSTRUCTION

Based upon information obtained from personnel with Longford Homes of New Mexico, Inc., we anticipate the site will be developed with a single-family residential subdivision. The proposed buildings will be constructed utilizing conventional wood-frame construction. The ground floor will be a conventional concrete slab-on-grade. No basements or below grade structures are anticipated. The maximum column and bearing wall loads (dead plus live) are not anticipated to exceed ten kips and two kips per linear foot, respectively. If structure loads or configuration differ from those indicated in this report, this office should be notified.

Final site grading plans were not available during preparation of this report. We anticipate that significant cut/fill earthwork will be required to develop the site.

3.0 SITE CONDITIONS

The site is bound to the south, east, and west by vacant land. The site is bound to the north by Paradise Boulevard.

The site topography is uneven with a slight overall slope to the east. Numerous ridges and outcrops of basalt are scattered throughout the site. Vegetation on-site consists of grasses, occasional scrub trees, brush, and occasional cacti. There is a slight amount of trash and debris scattered across the site.

4.0 SITE SUBSURFACE CONDITIONS

To explore the site subsurface conditions, sixty test holes were drilled at the approximate locations shown on the Site Plan, Figure 1. As shown on the Logs of Test Holes, Figures 2 through 61, the test holes encountered a variable depth of soil over basalt rock. The soils are composed of fine to medium grained silty sands. The sands are loose to medium dense and slightly moist.

Flowing groundwater was not encountered in the test holes to a depth of fourteen feet, the maximum depth of exploration. However, groundwater conditions may change with time due to precipitation, variations in groundwater level, seepage from ponding areas, or leaking utilities. During periods of heavy precipitation groundwater may temporarily perch atop the basalt surface.

The soils encountered in the test holes exhibit a limited consolidation potential under the anticipated structural loads. Significant consolidation (collapse) occurs when site soils increase in moisture content. Refer to Figures 63 through 90.

Existing fill was encountered in the vicinity of Test Hole 38. The existing fill encountered consists of silty sand. This fill is not suitable for structure or pavement support. The existing fill appears suitable for re-use as structural fill provided all deleterious materials are removed.

The test holes allow observation of a very small portion of the soils below the site. Significant variations in subsurface conditions may occur across the site which were not disclosed by the test holes.

5.0 LABORATORY TESTING

A laboratory testing program was performed on samples obtained during the field investigation which appeared representative of the soils encountered in the test holes. The laboratory testing program was structured to determine the physical properties of the soils encountered in the test holes necessary for development of geotechnical recommendations.

The laboratory testing program included:

- Moisture Content;
- Dry Density;
- Sieve Analysis;
- Atterberg Limits; and
- Consolidation/Collapse.

Moisture Content and Dry Density tests were performed to evaluate the in-place soil density and moisture content. Test results help to evaluate settlement potential. Test results indicate the soils encountered in the test holes are loose to medium dense with an average dry density of approximately 104 pcf. Natural moisture content averaged approximately three percent. Test results are presented on the Logs of Test Holes, Figures 2 through 61, and are summarized on Table 1.

Sieve Analysis and Atterberg Limits tests were performed to confirm field soil classifications and to provide information on general physical soil properties. Test results are presented on Table 1.

Consolidation/Collapse tests were performed to evaluate structure settlement and to determine the effect of water on site soils. The tests indicate the tested soils are slightly compressible under anticipated loads. Significant additional settlement occurred when the tested soils increased in moisture content. Test results are presented on Figures 63 through 90.

6.0 FOUNDATIONS

If the recommendations presented in this report are implemented particularly those regarding site grading and drainage, the proposed structures may be supported on either conventional spread and strip footings or monolithic slabs with turned down edges. To provide isolation from the basalt rock, foundations should bear on a minimum of one foot of engineered fill. Engineered fill should extend a minimum

of three feet laterally beyond the edge of all footings. Foundations may be designed for an allowable bearing pressure of 1500 pounds per square foot. This value may be increased by one-third for short-term loads due to wind and earthquakes. If it is not feasible to implement the site grading, drainage, and landscaping recommendations presented herein, an alternate foundation system may be required. This office should be contacted for additional recommendations.

The base of exterior footings should be embedded a minimum of eighteen inches below lowest adjacent grade. The base of interior footings should be embedded a minimum of twelve inches below finish pad grade. Spread and strip footings should be a minimum of twenty-four and eighteen inches wide, respectively. Turned down edges should be a minimum of twelve inches wide. However, local building codes may require greater dimensions.

Lateral foundation loads will be resisted by a combination of passive soil pressure against the sides of footings and friction along the base. A passive soil resistance of 300 pounds per cubic foot may be utilized for design. Frictional resistance may be determined by multiplying foundation dead load by a coefficient of friction of 0.40.

Prior to fill placement and following footing excavation, the natural soils should be scarified to a depth of eight inches and moistened to a near optimum moisture content (±3%). The exposed soils should then be compacted to a minimum of 95% of maximum density as determined by ASTM D-1557 with a minimum of

twenty passes of a minimum twenty-ton vibratory compactor. However, it is not necessary to scarify, moisture condition, or compact competent basalt. If vibratory compaction will endanger existing structures, a fully loaded scraper may be utilized. All fill below structures should be placed and compacted as detailed in the attached Appendix. Prior to pouring concrete footing excavations should be cleaned of any slough, loose soil, or debris. Footing excavations should be compacted as detailed in the attached Appendix.

Foundations designed and constructed as described herein are not anticipated to settle more than one inch. The majority of this settlement should occur during construction. Differential settlement between adjacent column footings should not exceed one-half of the above value. The above settlement estimates are based on the assumption the site soils will not be allowed to increase in moisture content and that the site grading, drainage, earthwork, and landscaping recommendations presented in this report will be fully implemented.

The site soils are collapsible if allowed to increase in moisture content. If the soils supporting footings are allowed to increase in moisture content, additional settlement of 1/8 inch per foot of wetted soil could occur.

Foundations should be designed and constructed to tolerate the above settlement. Foundations should be designed by a qualified structural engineer.

To reduce the affect of settlement on the structure, we suggest that all stucco be fiberglass reinforced. Periodic control joints should be utilized in the stucco particularly at window and door corners. Periodic control joints should also be utilized in masonry walls.

7.0 CONCRETE SLABS-ON-GRADE

Concrete slabs-on-grade may be utilized. Slabs should bear on a minimum of two feet of structural fill. Conventional slabs should be isolated from all foundations, stem walls, and utility lines. Monolithic slabs should be isolated from all utilities. Frequent joints should be scored or cut in slabs to control the location of cracks.

Thickened slabs may be utilized to support interior partitions. Thickened slabs should be a minimum of twelve inches in width and should be designed to exert a maximum earth pressure of 500 pounds per square foot. Wall loads on thickened slabs should not exceed 800 pounds per linear foot. The thickness and reinforcement should be determined by a qualified structural engineer.

Slabs should be adequately reinforced. Reinforcement should be placed in the middle of the slab. Slab reinforcement should be turned down into turned down edges.

If moisture-sensitive floor covering is utilized, the flooring manufacturer should be contacted to determine the necessity of a vapor barrier. The moisture barrier may consist of a 6-mil polyethylene film or equivalent. The barrier may be overlain with one or two inches of clean sand to provide a working surface and reduce shrinkage cracking.

To provide isolation from the basalt, the rock and existing soil should be overexcavated as necessary to allow a minimum of two feet of structural fill below slabs. Prior to placing slabs or structural fill, the natural soils should be stripped of vegetation, scarified to a depth of eight inches, and moistened to a near optimum (±3%) moisture content. The exposed soils should then be compacted to a minimum of 95% of maximum density as determined by ASTM D-1557 with a minimum of twenty passes of a minimum twenty-ton vibratory compactor. However, it is not necessary to scarify, moisture condition, or compact competent basalt. If vibratory compaction will endanger existing structures, a fully loaded scraper may be utilized. All fill below slabs should be placed and compacted as detailed in the attached Appendix.

8.0 RETAINING WALLS

Retaining walls constructed in conjunction with this project are not anticipated to exceed four feet in height. If higher walls or unusual loading conditions such as sloping backfill, slopes below retaining wall footings or

surcharges are anticipated, this office should be contacted for supplemental recommendations.

Foundations for retaining walls may be designed for a maximum toe bearing pressure of 1500 pounds per square foot. Retaining wall footings should be embedded a minimum of eighteen inches below lowest adjacent grade. Prior to placing footings, the exposed soils should be scarified to a depth of eight inches, moisture conditioned to a near optimum (±3%) moisture content, and compacted to a minimum of 95% of maximum density as determined by ASTM D-1557.

We recommend that the following equivalent fluid pressures be utilized for design of retaining walls:

Loading Condition	Equivalent Fluid Pressure*
Active Earth Pressure	32 pcf
Passive Earth Pressure	
Undisturbed Natural Soils	300 pcf
Structural Fill	400 pcf
Earth Pressure at Rest	60 pcf

* Does not include a factor of safety or hydrostatic pressure.

The above earth pressures do not include a factor of safety or hydrostatic pressure. If retaining walls are restrained against rotation (corners of basements, upper floors, etc.) the earth pressure at rest should be utilized for design.

Lateral retaining wall loads will be resisted by passive earth pressure at the toe and friction along the base of the wall. A coefficient of friction between soil and concrete of 0.4 may be used for design.

Backfill adjacent to retaining walls should be placed and compacted as detailed in the attached Appendix. Backfill adjacent to walls should be compacted with relatively light, hand-operated equipment to prevent overstressing the wall and excessive lateral deflections.

To prevent staining of concrete, the back of retaining walls should be waterproofed prior to backfilling. Weep holes should be constructed near the base of exterior walls. Perimeter drains may be necessary around interior walls.

9.0 EARTHWORK

9.1 General

The recommendations presented in this report are based upon the assumption that site earthwork will be performed as recommended in this report and the attached Appendix. Presented below is a summary of the site earthwork recommendations. Detailed earthwork procedures are presented in the attached Appendix.

9.2 Clearing and Grubbing

Prior to placing structural fill, all borrow and fill areas should be stripped of vegetation and deleterious materials. All strippings should be hauled off-site or utilized in landscaped areas. The existing fill on-site to the best of our knowledge was not placed under the observation of a geotechnical engineer and therefore is not suitable for structure support. The existing fill appears suitable for re-use as structural fill provided all deleterious material is removed.

All existing utilities, leach fields, and disturbed soil should be removed from below the proposed structures. The resulting excavations should be backfilled with compacted fill as detailed in the attached Appendix.

9.3 Excavation

We anticipate that on-site soils can be excavated with conventional earthwork equipment. Frequent cobbles or boulders may be encountered during excavation. Cobbles and boulders should be disposed of off-site or utilized for landscaping. Cobbles and boulders should not be placed within structural fills.

Excavation of the basalt will require the use of a hoe ram or a trencher equipped with carbide teeth. Blasting may be appropriate for larger excavations well away from existing structures. Vibration monitoring of existing structures should be performed if blasting is used.

9.4 Natural Ground Preparation

Prior to placing structural fill and subsequent to final grading in cut areas, the exposed soils should be scarified to a depth of eight inches and moisture conditioned to a near optimum (±3%) moisture content. The exposed soils should then be compacted to a minimum of 95% of maximum density as determined by ASTM D-1557 with a minimum of twenty passes of a minimum twenty-ton vibratory compactor. However, it is not necessary to scarify, moisture condition, or compact competent basalt. If vibratory compaction poses a threat to nearby structures, static compaction should be utilized.

9.5 Fill Placement and Compaction

Structural fill should be placed in horizontal lifts a maximum of eight inches in loose thickness, moisture conditioned to a near optimum moisture content, and mechanically compacted. Fill below footings and slabs should be compacted to a minimum of 95% of maximum dry density as determined by ASTM D-1557. On-site native soils appear suitable for re-use as engineered fill.

9.6 Observation and Testing

Placement and compaction of structural fill should be observed and tested by a qualified geotechnical engineer or his representative. The purpose of the observation and testing is to confirm that the recommendations presented herein are

followed and to provide supplemental recommendations, if subsurface conditions differ from those anticipated.

Foundation excavations should be observed by a qualified geotechnical engineer, or his representative, prior to placement of reinforcement or concrete. The purpose of the observation is to determine if the exposed soils are similar to those anticipated.

10.0 SITE GRADING AND DRAINAGE

The site soils are slightly to moderately collapsible if allowed to increase in moisture content. To reduce the risk of structure settlement the site should be graded to rapidly drain away from structures. We suggest a minimum four percent gradient within at least the first ten feet away from structures in areas not protected by sidewalks and pavement. Splash blocks should be utilized below down spouts and canales.

If ponding areas are required, they should be located as far away from structures as possible, a minimum of ten feet. If this criteria cannot be met, this office should be contacted for supplemental recommendations.

Roof gutters and downspouts should be utilized. Roof gutters should discharge to the front of the structures. Water should run off rapidly.

11.0 LANDSCAPING

Landscaping adjacent to structures should be designed and constructed to minimize the potential for wetting of soils supporting the proposed facilities. If soils supporting the proposed facilities are allowed to increase in moisture content, significant localized settlement could occur.

Trees and shrubs within five feet of structures should be hand watered or watered using controlled drip irrigation. If drip irrigation is used, emitters should discharge no more than one gallon per hour. If grass must be planted within five feet of structures, watering should be carefully controlled to prevent overwatering. Grassed areas adjacent to structures should be sloped so that excess irrigation water will run off promptly. Sprinkler lines and drip irrigation mains should be located a minimum of five feet away from foundations.

Mowing strips, planters and sidewalks should not "dam" water adjacent to structures. If necessary, mowing strips should be perforated to allow water to flow away from structures.

All interior planters should be closed bottom and watertight.

12.0 UTILITIES

The site soils are collapsible if allowed to increase in moisture content. If post-construction water or sewer line leaks occur, localized settlement may result. Following installation, all water and sewer lines should be pressure checked for leaks. Any leaks found should be repaired.

Backfill in utility line trenches below slabs, driveways, and pavement should be compacted to a minimum of 90% of maximum density as determined by ASTM D-1557. Utility trenches should be as narrow as can be properly compacted. To reduce the possibility of breaking utility lines with compaction equipment, heavy compactors should not be utilized.

Utility trenches may not be compacted to the same degree as the remainder of the building pad. Therefore, wall footings and thickened slabs should not be placed longitudinally over utility lines. Additionally, column footings should not be placed over utility trenches.

Water may temporarily perch atop the basalt surface. Additionally, water from landscape irrigation may flow atop the bedrock surface for some distance before infiltrating into the soil and through rock fractures. Water could accumulate in below-slab duct work; therefore, we discourage the use of below-slab ducts.

13.0 TRENCHES AND EXCAVATIONS

All trenches greater than four feet in depth must be sloped, shored or braced, or otherwise supported according to OSHA Construction and Safety Standards. Material excavated from the trench or spoil must be placed a minimum of two feet from the edge of the excavation. The spoil should be retained in an effective manner such that no loose material can fall into the excavation.

Temporary construction excavations less than eight feet deep should be sloped no steeper than 1½:1 (horizontal:vertical). If deeper excavations are required, this office should be contacted for supplemental recommendations. Limited raveling of slopes will occur particularly as the exposed soils dry out. Heavy equipment and material stockpiles should be located a minimum of five feet from the top of slope.

14.0 CLOSURE

The recommendations presented in this report are based upon the subsurface conditions disclosed by the test holes. Soil and groundwater conditions may vary between test holes and with time.

This report reflects our interpretation of the site subsurface conditions. We strongly recommend that prior to bidding all contractors perform their own subsurface investigation to form their own opinion of the site soil, rock, and

groundwater conditions. Should contractors elect to use this report for construction, bidding or estimating purposes, they do so at their own risk.

In a southwest climate it is particularly important to protect the soils supporting the proposed structure from an increase in moisture content. If soils supporting the structure increase in moisture content due to any cause such as poor site drainage, ponding areas, or leaking utility lines, significant structural settlement and distress may occur.

If conditions are encountered during construction which differ from those presented herein, this office should be contacted for supplemental recommendations. The staff of **Vinyard & Associates, Inc.** is available for supplemental consultation as necessary.

This office would be pleased to review site grading and drainage plans to evaluate conformance with the recommendations presented herein. All site earthwork should be observed by a qualified geotechnical engineer or his representative. **Vinyard & Associates, Inc.** would be pleased to provide these services.

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