REPORT OF GEOTECHNICAL EXPLORATION
LOTS 3 AND 4 HEIDE HEIGHTS
110TH AND COTTONWOOD PLAZA
OMAHA, NEBRASKA
NOVEMBER 8, 2016
TD2 FILE NO. 2016-203

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EXECUTIVE SUMMARY

The site is the existing Maple Ridge Apartments at 110th and Cottonwood Plaza in Omaha Nebraska. The legal description for this project is Lots 3 and 4 Heide Heights. We understand that this project will include the construction of a new apartment building and a multi-stall garage building (M and N) respectively, and a replacement building for the fire damaged Building H, located at 11117 and 11123 Cottonwood Plaza. We anticipate that the apartment buildings will be three-stories in height with a slab-on-grade main level floor. No basement or below grade areas are expected. The buildings will be wood framed with engineered wood trusses supporting wood roof decking.

To investigate the site soil conditions, five (5) soil borings were advanced. Soils encountered included natural Peoria loess overlying Loveland loess. The soils anticipated to be encountered at bearing level include the natural Peoria loess. No soil improvement or pre-loaded is expected for the site.

For the purpose of the settlement analysis, foundation loads of up to 4 to 5 kips per foot for continuous wall loads and individual columns of up to 75 kips were preliminarily provided for the new structure. Cuts and fills are expected to be minor (4') for the two apartment buildings and garage. Settlements are expected to be within the tolerable range for the building construction.

Free ground water was not encountered during or after the drilling operations in any of the borings. It should be noted that groundwater levels may fluctuate seasonally and yearly from the readings noted on the boring logs. The expected depth to free water is below the depth of anticipated shallow utility and foundation excavations; therefore, free ground water is not expected to impact the proposed construction.

Floor slab and pavement subgrades should be prepared such that a subgrade of structural fill is used to support the slab or pavement. Some overexcavation may be necessary to compact the full depth of the required subgrade in cut areas.

This executive summary is not intended to relate all geotechnical findings and conclusions provided in this report. The entire report should be read and consulted by the project design professionals for application to the project as described herein.

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1.0 INTRODUCTION

This Report summarizes subsoil exploration work, laboratory findings, and geotechnical engineering conclusions and recommendations by Thompson, Dreessen & Dorner, Inc. (TD2) for the above referenced project. This work was based on our written agreement with Mr. Robert Rush of Sterling Management as the project owner. This investigation was made to evaluate geotechnical properties of the soils at the site of the proposed commercial buildings. The report presents the results of the boring and testing program and discusses special precautions for the design and construction of the project as it relates to geotechnical issues.

2.0 PROJECT DESCRIPTION

The site is the existing Maple Ridge Apartments at 110th and Cottonwood Plaza in Omaha Nebraska. The legal description for this site is Lots 3 and 4 Heide Heights. We understand that this project will include the construction of a new apartment building and a multi-stall garage, buildings (M and N) respectively, and a replacement building for the fire damaged Building H, located at 11117 and 11123 Cottonwood Plaza. We anticipate that the apartment buildings will be three-stories in height with a slab-on-grade main level floor. The garage building will be a single story with a slab-on-grade floor. No basement or below grade areas are expected. The buildings will be wood framed with engineered wood trusses supporting wood roof decking.

3.0 EXPLORATION RESULTS

3.1. Field Work

A total of five (5) test borings, numbered B-1 through B-5 were advanced as part of this exploration across the site to investigate soil conditions. The boring locations are shown on the Boring Location Plan included in the Appendix of this Report. The boring locations were determined in the field by taping or estimating distances from landmarks shown on the preliminary building plan and available site GIS photographs. Survey methods were not included to locate or determine ground surface elevations at the boring locations. Ground surface elevations at the borings were interpreted from the completed topographic survey of the site.

Borings B-1 and B-2 were advanced in the proposed garage building footprint. Borings B-3 and B-4 were advanced in the proposed apartment building footprint. Boring B-5 was advanced near the existing apartment building with fire damage. Borings B-1 and B-2 were advanced to a depth of 30 feet below grade surface. Boring B-3 was advanced to a depth of 20 feet bgs. Boring B-4 was advanced to a depth of 25 feet bgs, and Boring B-5 was advanced to a depth of 35 feet bgs. The borings were made with continuous flight augers and required no drill hole stabilization techniques such as drilling fluid or hollow stem augers.

Samples were recovered every 2.5 feet in the top 10 feet of boring and every 5 feet thereafter. Field boring logs were prepared as drilling progressed. More details of the field work can be found in Section 6.1 of this Report.

3.2. Laboratory Test Program

Selected samples were tested in the laboratory to define pertinent geotechnical properties necessary for the analysis. Laboratory tests included moisture content, density determination, unconfined compressive strength, and visual classification of the soil under the Unified Soil Classification System (USCS). A complete table of laboratory test results is included in the Appendix. Each test was performed in general conformance with current ASTM procedures. More details of the laboratory testing program can be found in section 6.2 of this Report.

Based on the results of the testing program, the field boring logs were reviewed and supplemented as presented in the Appendix. These final logs represent our interpretation of the in-place soil conditions.

3.3. Site Conditions

This site lies within the loessial hills of eastern Nebraska. The typical soil profile in this region consists of various ages of loess materials overlying glacial deposits. The Peoria and Loveland loess materials are derived from wind borne sediments developed from the historic floodplain of the Missouri River following the last regional glaciation. The Peoria loess materials are generally silt sized particles that are cemented together with clays and various calcium based compounds. The Loveland loess materials are generally silt and clay sized particles and were derived from a different source than the Peoria loess. The loess deposits generally overly and conform to the eroded Kansan till surface. The Kansan till is a heterogeneous mixture of clay, silt, gravel and sand. The till material was deposited under the advancing and retreating glacial front of the last regional glaciation. The borings at the site encountered natural Peoria loess overlying Loveland loess.

The USDA Web Soil Survey of Douglas County identifies natural surface soils at the site are mapped as Urban land-Udarents complex, 0 to 16 percent slopes (9711). This mapping indicated that the near surface soils have been obscured through man's activity and fill placement.

The 1975 Douglas County Soil Survey identifies natural surface soils at the site are mapped as Marshall silty clay loam, 3 to 7 percent slopes (MaC), Marshall silty clay loam, 3 to 7 percent slopes, eroded (MaC2), and Monona and Ida silty loams, 11 to 17 percent slopes, eroded (MsE2). This mapping indicated that the near surface soils formed in loessial materials.

The current site is generally sloped downhill from east to west. There is 13 feet of relief across the Building N footprint, and about 3 feet of relief across the Building M footprint. The existing Building H footprint is generally level.

3.4. Subsurface Conditions

The subsurface conditions encountered in the borings have been used to infer the general soil conditions at the site. We assume the soil conditions between borings are fairly represented by the borings. However, variations between borings may become apparent during construction. During construction, if conditions are encountered other than that described below and as shown on the boring logs, it is important that we be informed to evaluate the exposed conditions with respect to their effect on our recommendations.

The following is a brief review of the various layers of soil encountered in the borings. All depths given are relative to the ground surface at the time of drilling. The Appendix contains the detailed boring logs. The current ground surface at the site is generally weed and grass covered except for some areas of existing pavement or buildings. There was a general topsoil thickness of about 4 inches encountered in each of the borings.

Peoria Loess was encountered underlying the topsoil in Borings B-1 through B-5. Boring B-3 was terminated in the Peoria loess. The Peoria loess was described as brown to light brown to gray to grayish brown, slightly moist to wet, and firm to hard. Visual classification of this material type generally suggested Lean Clay (CL) according to the Unified Soil Classification System (USCS). Laboratory analysis of the recovered loess samples yielded moisture contents from 12.5% to 33.0%, dry unit weights from 76.3 to 101.0 pcf, and unconfined compressive strengths of 0.29 to 2.54 tons per square foot.

Loveland Loess was encountered underlying the Peoria loess in Borings B-1, B-2, B-4, and B-5. These borings were terminated in the Loveland loess. The Loveland loess was described as reddish brown to brown, moist to very moist, and firm to hard. Visual classification of this material type generally suggested Lean Clay (CL) according to the Unified Soil Classification System (USCS). Laboratory analysis of the loess samples yielded moisture contents from 22.2% to 25.9% and dry unit weights from 93.7 to 101.4 pcf, and unconfined compressive strengths from 1.42 to 1.85 tsf.

3.5. Groundwater Data

Free water was not encountered during or after the drilling operations in any of the borings. It should be noted that groundwater levels may fluctuate seasonally and yearly from the readings noted on the boring logs. Factors affecting groundwater levels can include precipitation, flow direction, nearby pumping, and temperature changes.

The expected depth to free water is well below the depth of anticipated shallow utility and foundation excavations; therefore, free ground water is not expected to impact the proposed construction.

4.0 ENGINEERING RECOMMENDATIONS

4.1. Discussion

The following analyses, conclusions, and recommendations are based on our field investigation, laboratory test results, engineering analysis, and experience. The engineering recommendations made in this Report are based on our understanding of the project as discussed in the preceding paragraphs. The following sections provide a brief discussion of the geotechnical aspects of the site followed by project specific recommendations and conclusions.

4.2. Site Preparation

Prior to on-site earthwork, topsoil, including the root crown and other trees, shrubs, organic materials and debris should be stripped, cleared, and grubbed. Because topsoil was specifically identified in the borings, the upper most soil crust along with the root crown should be removed prior to grading operations. Topsoil should be stockpiled for distribution after construction completion. Removal of trees and shrubs should include the removal of the root ball. We recommend that the upper 3" to 5" of topsoil be removed with the grass stubble and root crown. A greater excavation depth may be required below any trees or shrubs. The geotechnical engineer should be consulted during stripping and reserves the right to adjust the depth of stripping based on observations at the time of construction. The strippings can be stockpiled for placement in green spaces following construction or can be removed completely from the site.

Some of the ground surface at the site is covered by pavements or the existing building footprints. Demolition of the existing Building H, located at 11117 and 11123 Cottonwood Plaza and all portions of the sidewalk will be necessary prior to construction. Additionally, any site service utilities that will not be reused by the proposed construction should be properly abandoned and removed.

Removal of the existing structures should include the removal of all existing foundations and slabs. Excavations should be made wide enough to allow access for the contractor's compaction equipment. All excavations made during demolition must be refilled with structural fill according to the requirements of this report. It should be noted that any demolition fills that are not properly compacted will require overexcavtion and replacement with properly compacted structural fill prior to foundation construction.

The borings did not encounter debris or buried former structure features. Therefore, these features are not expected to be present. If these conditions are encountered during construction, the typical geotechnical recommendation is to provide localized overexcavation and replacement with structural fill. Should such conditions be encountered, the geotechnical engineer should be notified to evaluate the conditions and provide specific recommendations. Burial of any demolition debris or other debris-like materials is strictly prohibited.

The existing site pavements, where not reused for the new construction, should be completely removed from the proposed building footprints. The existing parking lot pavement may be temporarily left partially in place while demolition and construction progresses, as a convenience to the contractor.

During the demolition phase, the geotechnical engineer should be provided an opportunity to perform compaction testing of the fill placed to refill onsite excavations and to observe encountered conditions. Through this testing and observation, the material can be documented as meeting project requirements and thus comply with the recommendations of the report. If testing is not performed as part of the demolition phase, then additional on-site sampling and testing will need to be performed in areas where the proposed construction overlaps the demolished construction to verify that the soil conditions are suitable for the recommendations made in this report. If that testing does not meet the requirements of this report, then additional over-excavation and recompaction may be needed to remediate the encountered conditions.

Based on present site topography, minor cuts and fills (<4') will be necessary in order to create a level building pad for the proposed building and garage. The minor fill placement is not expected to result in significant surface subsidence. Therefore, the settlement under the completed structure is expected to be due to the new construction itself and not a new fill load. No construction delay or surcharge is anticipated to be needed to allow settlement to occur under minor fills. Additional settlement discussion is found in Section 4.7 of this Report. All site fill should be considered Structural Fill and compacted to the requirements in Section 4.3 of this report.

Shallow foundations are suitable for support of the proposed structure when bearing on the existing Peoria loess at the site. No surcharge of the existing site is necessary to pre-compress the site soils. The encountered loess materials in boring B-1 indicate properties of a collapse susceptible soil. Of the six (6) recovered and tested Peoria loess samples in this boring, three (3) samples indicated an in-place dry unit weight of less than 83 pounds per cubic foot. Five of the Peoria loess samples indicated moisture contents from below to well below optimum moisture. Low density and low moisture content are characteristics of collapsible soils. Collapse is the sudden consolidation (settlement) upon increasing moisture contents to at or near the saturation moisture content. Boring B-1 was advanced in the proposed garage footprint, however, significant loads are not expected at this location. It is expected that the risk for collapse at this location can be accepted due to the non-critical nature of the garage building. Therefore, soil improvement to remediate the collapse potential is not expected to impact construction at this particular building location. The remaining borings did not indicate properties of a collapse susceptible soil, or of a swell-susceptible material; therefore, soil improvement methods to remediate the soils are not expected to be necessary. However, subgrades for floor slabs and pavements must be prepared to support the slab or pavement. Recommendations for shallow foundations are provided in Section 4.6, Foundation Analysis, of this Report.

The new floor slab is anticipated to carry light to moderate loads in the building and garage areas. A compacted structural fill subgrade should be prepared to support the garage floor slab. This is needed in cut or fill areas. Some overexcavation may be needed to properly prepare a compacted subgrade in cut areas. Subgrade compaction requirements for the floor slab are provided in Section 4.9 of this Report.

Site pavements are expected to be able to be supported directly on a prepared soil subgrade. Light to moderate truck traffic is expected at the site. Therefore properly prepared pavement subgrades will be important to the life of pavement. Subgrades for pavements are recommended to be prepared using Section 4.10, Pavement Subgrades, of this Report.

4.3. Earthwork

The on-site excavations are expected to encounter a range of moisture contents in the materials excavated. In general, the vast majority of the on-site low plastic soils are expected to be suitable for reuse as structural fill or backfill following moisture conditioning and processing. Most of the on-site soils are expected to require blending or mixing to maintain moisture contents at optimum or above. Processing should include reducing maximum particle size to less than 1 ½ inches. Soil types that are potentially swell susceptible should be excluded from use as on-site structural fill borrow but may be used as surcharge material.

Imported fill may be required for use as backfill or as a blending material or replacement material. Imported fill should exhibit a liquid limit less than 43 and a plasticity index less than 23, be free of organics, debris, particles larger than 1½" and other deleterious materials. Compaction of all fill placed is necessary to minimize post-construction compression (settlements) of the fill

For the purposes of estimating earthwork quantities, 1 cubic yard of compacted structural fill can be expected to require 1.30 cubic yards of on-site excavation.

Compaction requirements for cohesive fills should be referenced to the ASTM D1557 (Modified Proctor) test method. The expected on-site borrow will be cohesive, Lean Clay materials. Therefore, compaction is expected to be best accomplished by a sheep's foot type compactor because of its kneading effect during compaction. Moisture conditioning of the fill soil, prior to compaction, helps make the compactive effort more effective and efficient.

Structural fill should be compacted to an in-place dry unit weight at least 90 percent of the maximum dry unit weight at a water content at the time of compaction to within -0 and +5 percent of the optimum water content.

Backfill for shallow utilities should be compacted to an in-place dry unit weight at least 85 percent of the maximum dry unit weight at a water content at the time of compaction to within -2 and +6 percent of the optimum water content. Backfill placed with a zone of subgrade preparation should be compacted to the requirements of the subgrade for the full depth of the backfill.

All fill should be placed in thin, horizontal lifts, and moisture conditioned prior to compaction. Loose lift thickness should be adjusted depending on the contractor's construction equipment but should generally not exceed 8 inches. Fill placed to create an embankment slope should be compacted in horizontal layers, with compactive effort extending to the slope face. In many cases, overbuilding the slope may be needed to facilitate slope face compaction prior to cutting to the required shape. When fill is placed adjacent to an existing embankment slope, the existing slope should be stepped or benched to allow the placement of horizontal layers to eliminate a shear plane. Steps or benches should be no greater than 4 feet in height.

The soils found at this site are typical of the area. Past experience indicates that corrosion potential of buried metallic pipes in these soils is moderate, therefore, it is recommended that polyethylene wrap is provided for ductile iron piping. Sulfate corrosion potential of Portland cement is minimal, and Type I Portland cement is suitable for use. All concrete used for this project should be air-entrained to reduce damage from frost action.

4.4. Excavations

Vertical cuts and excavations may stand for short periods of time, but should not be considered stable in any case. All excavations should be sloped back, shored, benched, or shielded for protection of workers. All workers should use adequate safety precautions. Trenching and excavation activities should conform to federal and local regulations as a minimum.

The soils encountered in the test borings generally classify as Type B according to OSHA's Construction Standards for Excavations. In general, the maximum allowable slope for shallow excavations in a Type B soil is 1H:1V, although other provisions and restrictions may apply. If different soil types are encountered, the maximum allowable slope may be different. All excavation work should be completed in accordance with OSHA standards by competent personnel on site. Where safe back-slopes cannot be provided, bracing or shoring designed by competent professionals should be installed.

Surface water seepage may cause excavations to be less stable. Therefore, the amount of open trenches exposed should be kept to a minimum. Backfill should be placed as soon as possible after structural strength requirements are met after installation. Parallel excavations should be avoided because an unstable column of soil can form between the excavations especially the excavations that are close and if one of the excavations is backed filled before the other.

Groundwater seepage into open shallow utility and foundation excavations is not a concern based on the observed water levels in the borings.

4.5. Seismic Conditions

Seismic design conditions for this project should utilize a Site Class of "D" according to 2006 International Building Code. The IBC Site Class determination is based on the top 100 feet of soil and rock profile. Although the borings performed at the site are much shallower than 100', generalized information of the site subsurface conditions suggest this Site Class. The structural engineer should perform the seismic design, using the recommended Site Class.

4.6. Foundation Analysis

In light of the subsurface conditions revealed by the boring and testing program, this site appears suitable for use of a shallow spread foundation system. The selection of an allowable soil bearing pressure for shallow foundation elements must fulfill two requirements. First, the load must be sufficiently less than the ultimate bearing capacity of the foundation to insure stability. Second, the differential settlement must not exceed an amount which will produce adverse behavior of the superstructure.

In order to meet the previous criteria, we have explored both the bearing capacity and the load settlement characteristics of the site soils assuming typical wall loads of 4 to 5 kips per foot and column loads of up to 75 kips. The bearing capacity is based on a factor of safety of 3 against the full dead load plus normal live load. The allowable bearing pressure is expressed in terms of the net pressure transferred to the soil.

A net allowable soil bearing pressure of 1,500 pounds per square foot may be used to size both continuous wall footings and isolated spread column footings in areas where natural soils or new structural fill are at bearing level. In no case should footings be smaller than local code sizes. Exterior footings and footings in unheated areas should be founded at a minimum depth of 3.5 feet below surrounding grade to provide frost protection. Isolated interior footings in heated areas may be founded such that the floor slab subgrade preparation does not disturb bearing soils. All footings should be reinforced with steel reinforcement. Structural stoops should be provided at all entrances.

Due to the clayey nature of the encountered site soils, trench-formed foundations may be considered. This type of footing has the advantage of quicker construction, it eliminates the need to backfill the foundation, and it distributes stresses much more evenly to the soil. Trench formed footing excavations should be made with a smooth edge bucket excavator to reduce bearing surface disturbance. Care should be exercised to avoid overexcavating below the grade required by the plans.

Trenched "grade beam" type footings are acceptable for exterior walls. "Grade beam" footings should be reinforced with top and bottom reinforcement. "Grade beam" footings should be designed to be capable of spanning 10 feet under applied loads. "Grade beam" footings supporting load bearing walls should have a minimum width of 16 inches. For this purpose, a trench footing is defined as any footing with a thickness at least two times its width.

Lateral loads acting against the footings can be resisted by friction against the footing bearing surface using normal dead loads and an allowable friction coefficient of 0.23. Alternatively, lateral resistance can be developed by assigning an allowable adhesion of 400 psf to the net contact area. Additional lateral resistance can be developed by assigning an allowable passive resistance to the portions of the footings or grade beams more than 1.5 feet below the slab subgrade. The allowable passive resistance can be approximated by an equivalent fluid weight of 160 pcf. Passive resistance should only be used with trench formed footings or formed footings that have been backfilled to the requirements of structural fill.

4.7. Settlement Analysis

For the purpose of our settlement analysis it was assumed that new foundation loads of up to 4 to 5 kips per foot for continuous wall loads and individual columns of up to 75 kips are expected for the new structure. A maximum total settlement of 1 inch and a differential settlement of ½ to ¾ inch are generally considered acceptable for this type of construction and were used in our analysis.

Based on the analysis of footings bearing on existing site soils, and the estimation of minor cuts and fills, total settlements are expected to be less than 1 inch at the foundations for Building M, the apartment building. Differential settlements are expected to be less than ¾ inch across 30 feet. Additional analysis may be necessary if more significant loads or fill heights are used.

Based on the analysis of footings bearing on existing site soils, and the estimation of minor cuts and fills, total settlements are expected to be less than 1 inch at the foundations for Building N, the garage building. Differential settlements are expected to be less than ¾ inch across 30 feet. Additional analysis may be necessary if more significant loads or fill heights are used.

Based on the analysis of footings bearing on existing site soils, and the estimation of minor cuts and fills, total settlements are expected to be less than 1 inch at the foundations for Building H, the existing building. Differential settlements are expected to be less than ¾ inch across 30 feet. Additional analysis may be necessary if more significant loads or fill heights are used.

The encountered soil properties exhibit a low swell potential. Swell occurs with increasing moisture content and can be followed by shrinkage with decreasing moisture content. Differential settlements are associated with swell and shrinkage. The low potential for swell should not be a factor for foundation construction.

Some loess materials are collapse susceptible. Collapse is the sudden consolidation (settlement) upon increasing moisture contents to at or near the saturation moisture content. Potentially collapsible soils generally exhibit properties such as a low dry unit weight or moisture content well below optimum. Potentially collapsible soil was encountered in boring B-1 only. However, as B-1 is within a garage footprint, it is expected that the risk for collapse at this location can be accepted due to the non-critical nature of the structure use. Therefore, soil improvement to remediate the collapse potential is not expected to impact construction at this particular building location. The probability of collapse is considered low as interpreted from the recovered samples of the other borings at the site.

In any case, care should be exercised during construction so as not to leave foundation trenches open for more time than necessary. If foundation excavations become saturated due to precipitation, or dry out excessively, the excavation should be evaluated by the geotechnical engineer prior to use to determine suitability and corrective action.

The soils at the site are frost susceptible. As such, foundations in unheated areas should be founded at a frost free depth. Structural stoops should be provided at all entrances. Overhead door slab entrances may consider a thickened edge where the exterior slab abuts the interior slab of the structure. The effective drainage of surface features and reduction of infiltration of water adjacent to pavements and structure foundations can aid in reducing frost heave.

Reliably predicted settlement estimates cannot be made for extraneous causes of settlement such as poor backfill or fill compaction, saturating of subsoils through excessive irrigation, precipitation, or broken piping. Therefore, this report provides recommendations for the proper compaction of fill and backfill and surface drainage to reduce potential extraneous settlement.

4.8. Floor Slab Subgrades

The Site Preparation Section of this report recommended that the floor slab for the buildings and garage be placed on a compacted soil subgrade composed of structural fill. To provide uniform support for floor slabs, the subgrade should be composed of 12 inches of structural fill. The structural fill requirements of the subgrade may include moisture contents from 0 to +5 of optimum. Some overexcavation may be necessary to compact the full depth of the required subgrade in cut areas.

The compaction for the subgrade is expected to occur early in the construction process. The completed subgrade is expected to be subjected to disturbances from under slab utility construction, precipitation, construction traffic, or freezing conditions prior to slab pavement placement. Therefore, the subgrade should be reworked and compacted immediately prior to concrete placement. The disturbances should be repaired by scarification and recompaction. Extensive disturbances should be repaired by overexcavation and recompaction.

Provided the above subgrade compaction requirements are followed and applied, a subgrade modulus of 100 pounds per cubic inch can be used for design of the floor slab.

A granular base course may be used under the slab, but is not required in light of geotechnical conditions. If a granular base course is used beneath the floor slab, this layer should be at least 4 inches thick, free-draining, well-graded, and compacted by vibration prior to pouring the floor slab. The use of fine sand or mason's sand is discouraged from use as a leveling course as it is extremely difficult to maintain a compacted state in the sand under typical construction traffic.

A vapor barrier should be considered if floor coverings could be damaged by moisture vapor intrusion through the floor slab. If a vapor barrier is used with the granular cushion, the vapor barrier should be placed between the concrete slab and the granular cushion. The vapor barrier should be at least 10 mil in thickness. The use of a vapor barrier will affect the curing of the slab, and as such, proper finishing, jointing, and curing techniques should be implemented, as well as implementing an appropriate water-cement ratio.

Significant floor loads are not anticipated for use in the structure so a significant amount of structural reinforcement not expected to be needed. A specific floor slab thickness and reinforcing design should be prepared by a structural engineer. Interior non-load bearing partitions may be supported directly by the floor slab when the load does not exceed 600 pounds per lineal foot and the slab is at least a minimum of 4 inches thick.

The slab should be designed with consideration to isolation joints at columns, expansion joints at exterior walls, and construction and control joints as needed. A moveable joint should be provided between the floor slab and structural members to accommodate some differential movement. All control joints should be made to a depth of ¼ of the slab thickness as a minimum, unless special provisions for a joint-less floor are included in the design. Longitudinal construction joints should utilize keyed construction to provide a load transfer mechanism. Expansion joints should be made full depth and be sealed with a flexible sealant and re-sealed periodically as needed.

4.9. Pavement Subgrades

Pavement performance is directly affected by the degree of compaction, uniformity, and stability of the subgrade. This is particularly important where heavy truck traffic is anticipated. It is recommended the subgrade under pavements be prepared to a depth of 12 inches. Subgrade thickness may require some over excavation. Subgrades are recommended to be compacted to the requirements of structural fill, however, the subgrade materials should be placed at a moisture content from 0% to +5%. The subgrade materials should be moisture conditioned prior to compaction. The subgrade should extend beyond the pavement edge by at least 1 foot, or up to 3 feet if slip formed paved, to provide edge support.

The final subgrade should be proof rolled immediately prior to placement of the concrete or asphalt to detect any localized areas of instability. Proof rolling may be accomplished by using a twin axle, dual wheel dump truck, which is partially loaded. Proof rolling should be performed in the presence of the geotechnical engineer. Unstable areas should be reworked to provide a uniform subgrade. Subgrade materials disturbed by precipitation or construction traffic should be repaired by scarification and recompaction. Significantly disturbed areas should be overexcavated and replaced with structural fill.

It should be noted that the above subgrade compaction requirements are minimum recommended values. More stringent requirements based on a specific pavement design should supersede these recommendations.

Provided the above subgrade recommendations are applied, a subgrade modulus, k, of 110 pounds per cubic inch or a CBR value of 4 may be used for structural design of Portland cement concrete or asphaltic concrete pavements.

Surface drainage around the pavement is also important to long term performance. Curbs should be backfilled as soon as possible after construction of the pavement. Backfill should be compacted and should be sloped to prevent water from ponding and infiltrating under the pavement. All pavement joints should be caulked and any cracks should be promptly sealed to prevent moisture intrusion into the subgrade.

4.10. Pavement Thickness

The pavement thickness design used assumed traffic loading, the recommended subgrade preparation methods, ACI 330, and our local experience. Portland cement concrete (PCC) construction is anticipated for use in the parking lot, drive lanes, entrances, and trash pad areas of the site. The pavement thickness used the recommended subgrade preparation methods. A minimum thickness of PCC concrete of 6 inches should be used in all parking and drive lane areas. Where no more than about 5 trucks per week could pass, such as entrances, drive lanes, truck docks, or trash pads, the thickness should be increased to a minimum of 8 inches.

The concrete used must have a minimum 28-day compressive strength of 4,000 psi and from 5.5% to 7.5% air-entrainment and meet City of Omaha specifications (Section 501). The pavement must be properly jointed, and curbs backfilled as soon as structural strength requirements are met. PCC pavements should utilize transverse joint spacing not exceeding about 12 to 15 feet, and made to a depth of at least ¼ of the slab depth. Tie bars should be used for longitudinal joints. Longitudinal construction joints should utilize keyed construction to provide a load transfer mechanism. Dowel bars should be considered where new pavements abut existing pavements to allow for improved load transfer.

4.11. Surface Drainage and Landscaping

The success of the shallow foundation system and slab on grade floor system is contingent upon keeping the subgrade soils at more or less constant moisture content, and by not allowing surface drainage a path to the subsurface. Positive surface drainage away from structure must be maintained at all times. Typical sources of water that could cause water content gains in the subgrade soils include infiltration of surface water, irrigation water, and utility line leaks. Utilities within the building footprint should be verified as leak-tight prior to service.

The final grade of the foundation backfill and any overlying pavements should have a positive slope away from foundation walls on all sides. A minimum slope of 1 inch per foot for the first 5 to 10 feet is recommended. However, the slope may be decreased if the ground surface adjacent to foundations is covered with concrete slabs or asphalt pavements. Pavements and exterior slabs that abut structures should be carefully sealed against moisture intrusion at the joint. Exterior pavement and slabs should be sloped to promote drainage. A minimum slope of 2 percent is recommended for other landscaped areas of the site.

No final graded slopes should be made steeper than 3H:1V due to erosion and maintainability concerns. If steeper slopes are proposed, additional slope stability analyses and design measures will be required. The natural occurring site soils are considered highly erodible. Erosion protection and controls should be installed for all exposed slopes of 5H:1V or steeper. Redistribution of topsoil and final seeding are recommended for all exposed surfaces. If sufficient topsoil is not available on-site, additional offsite topsoil should be borrowed. The topsoil not only provides a zone for the vegetative cover to initialize roots but also provide a buffer between the vegetative cover and the mineral soils.

Landscaped areas should be designed and built such that irrigation and other surface water will be collected and carried away from foundation elements. Irrigation within ten feet of the foundation should be carefully controlled and minimized. All downspouts and faucets should discharge onto splash blocks that extend at least 3 feet from the building line. Splash blocks should slope away from the foundation walls. The roof drains should be directed to exterior daylight outlets, exterior storm sewer system or to interior sumps for subsequent pump discharge. Exterior daylight outlets should be discharged onto splash blocks or pavements that are not as susceptible as soil to erosion. Connections to the storm sewer system should be made such that at full flow conditions, backup into the drain system does not occur.

During construction, temporary grades should be established to prevent runoff from entering excavations. Backfill should be placed as soon as possible after structural strength requirements are met and installed. The length of open trench should not exceed 300 feet to minimize potential runoff from entering the trench.

5.0 PLAN REVIEW AND CONSTRUCTION OBSERVATION

Since a project of this nature requires many soil-related judgments and decisions, we recommend that TD2 be retained as part of the construction team. The geotechnical engineer should be provided the opportunity for general review of the final design and specifications in order that earthwork and foundation recommendations may be properly interpreted and implemented in the design and specifications.

Implementation of the site preparation and design recommendations presented in this report requires evaluation of the soil conditions encountered during construction. Therefore, we recommend that the geotechnical engineer be retained to inspect all fill placement and footing trench excavations.

We also recommend that a limited number of compaction tests be performed to document the degree of compaction obtained in backfill and structural fill. In general terms, grading compaction tests should be made once per lift per 10,000 square feet. Subgrade compaction test should be made once per lift per 1,000 square feet.

6.0 EXPLORATION PROCEDURES

6.1. Soil Sampling

The test borings were made with a CME 45-B drill rig equipped with 4" continuous flight augers to advance the borings. Relatively undisturbed samples of cohesive soils were obtained with thin-walled tube samplers in accordance with ASTM D 1587. Cohesionless soils were sampled using a split barrel sampler while performing the Standard Penetration Test (SPT) in conformance with ASTM D1586. As the samples were obtained in the field, they were visually and manually classified by the drill crew chief in general accordance with ASTM D-2488.

Logs of the borings, indicating the depth and identification of the various strata, water level information, and pertinent information regarding the method of maintaining and advancing the drill holes are included in the Appendix. Recovered samples of cohesive material were tested in the field using a hand penetrometer to estimate the unconfined compressive strength and to aid in describing the consistency of the recovered sample.

The field boring logs were supplemented with the laboratory test results for the preparation of the final boring logs. The final boring logs present the interpreted soil profile at each boring location.

6.2. Laboratory Testing

Recovered samples were extruded in the field, sealed in plastic, labeled, and protected for transportation to the laboratory for further testing and verification of field classification according to ASTM D4220. A chart illustrating the soil classification procedure is included in the Appendix. Select samples were evaluated in the laboratory and summarized on a Summary of Soil Testing Results report included in the appendix. Laboratory tests included moisture content (ASTM D2216), density determination (ASTM D2937), unconfined compressive strength (ASTM D2166), and classification by Unified Soil Classification System (ASTM D2487). All tests were conducted in substantial conformance with ASTM requirements. Laboratory results are reported on the Summary of Soils Tests Results report included in the appendix.

7.0 STANDARD OF CARE

This report was prepared under the supervision of a professional registered engineer. This Report has been prepared for the exclusive use of our client and their agents for application to the proposed project as described. The recommendations contained in this Report represent our professional opinions. These opinions were arrived at in accordance with currently-accepted engineering procedures at this time and location. Other than this, no warranty, either expressed or implied, is intended. Additive conclusions or recommendations made from these data by others are their responsibility.

In the event that any changes in the nature, design, or location of the structure are planned, the conclusions and recommendations contained in this report shall not be considered valid unless the changes are reviewed and conclusions of this report modified or verified in writing. Because of special mechanical or structural details, it is sometimes necessary to deviate from our recommendations. These problems can usually be reconciled by a brief conference between us and the designing architects and engineers.

If any soil conditions become notably different during construction, from those described here, TD2 should be notified immediately. This geotechnical engineering report does not relate any findings, conclusions, or recommendations about the potential for hazardous materials existing at the site or in the subsurface. If potential hazardous materials are believed to exist at the site, a geo-environmental investigation should be performed.

Respectfully submitted,
THOMPSON, DREESSEN & DORNER, INC.

Prepared by,

Alexandra Berney, E.I.
Engineer Intern

Reviewed by,

Kurtis L. Rohn, P.E.
Geotechnical Engineer

KLR/tjp
Enclosures

APPENDIX

N

0' 50' 100'

TD2 engineering & surveying

Job Number: 2016-203

thompson, dreessen & dorner, inc.
10836 Old Mill Rd
Omaha, NE 68154
p.402.330.8860 www.td2co.com

Date: 10-19-16
Drawn By: ARB
Reviewed By: KLR
Revision Date: ..

Lots 3 and 4 Heide Heights
110th and Cottonwood Plaza, Omaha, NE

Boring Location Plan

THOMPSON, DRESSEN & DORNER, INC.
CONSULTING ENGINEERS & LAND SURVEYORS

GEOTECHNICAL ENGINEERING DIVISION

PROJECT:	Lots 3 and 4 Heide Heights
LOCATION:	110th and Cottonwood Plaza, Omaha, NE
CLIENT:	Sterling Management
JOB No. :	2016-203
DATE:	10/14/16

BORING LOG

BORING No. : B- 1

WEATHER CONDITIONS	BORING LOCATION	SURFACE ELEV.	ELEVATION DATUM	DRILLER	LOGGER
Cloudy 52°	See Boring Location Plan			T. Eggert	A. Cannia

GROUNDWATER LEVEL OBSERVATIONS: WHILE DRILLING	END OF DRILLING	24 HOURS AFTER DRILLING	HOURS	TYPE OF SURFACE / DRILLING METHOD	SPT HAMMER / BIT USED	DRILL RIG / TOTAL DEPTH
				Weeds	NA	CME-45
NE	NE	HBED		4" Continuous Flight Augers	Fish	30.0 feet

DEPTH FT	SAMPLE No. & Type	Pene-trometer Strength (tsf)	% REC	COLOR	MOIST	CONS	USCS	GEOLOGICAL DESCRIPTION	MC (%)	DRY DENSITY (pcf)	q_u	SOIL CLASS
0								4" Topsoil				
				Brown	Moist	Stiff	CL	Peoria Loess, Lean Clay, Low Plasticity, Root Holes, Root Hairs				
	U-1	2.5	100						16.1	76.3	0.62	
				Light Brown	Slightly Moist	Very Stiff		Rust Stains, Silty				
5	U-2	3.25	100						12.5	85.8	0.67	
	U-3	4.0	100						12.6	82.8	1.58	
10	U-4	3.75	100						13.9	85.5	1.06	
15	U-5	3.0	100						12.5	80.7		
						Hard						
20	U-6	>4.5	100						13.5	86.5		
				Reddish Brown	Moist	Hard	CL	Loveland Loess, Lean Clay, Low Plasticity, Mealy, Common Rust Stains				
25	U-7	>4.5	100						19.8	96.7		
						Very Stiff						
30	U-8	3.0	100					Bottom of boring @ 30'	23.7	100.2		

THOMPSON, DREESSEN & DORNER, INC.
CONSULTING ENGINEERS & LAND SURVEYORS

GEOTECHNICAL ENGINEERING DIVISION

PROJECT:	Lots 3 and 4 Heide Heights
LOCATION:	110th and Cottonwood Plaza, Omaha, NE
CLIENT:	Sterling Management
JOB No. :	2016-203
DATE:	10/13/16

BORING LOG

BORING No. : B- 2

WEATHER CONDITIONS	BORING LOCATION	SURFACE ELEV.	ELEVATION DATUM	DRILLER	LOGGER
Sunny 56°	See Boring Location Plan			T. Eggert	A. Cannia

GROUNDWATER LEVEL OBSERVATIONS: WHILE DRILLING	END OF DRILLING	24 HOURS AFTER DRILLING	- HOURS	TYPE OF SURFACE	SPT HAMMER	DRILL RIG
				Grass	NA	CME-45
				DRILLING METHOD	**BIT USED**	**TOTAL DEPTH**
NE	NE	HBED		4" Continuous Flight Augers	Fish	30.0 feet

DEPTH FT	SAMPLE No. & Type	Penetrometer Strength (tsf)	% REC	COLOR	MOIST	CONS	USCS	GEOLOGICAL DESCRIPTION	GRAPHICAL LOG	MC (%)	DRY DENSITY (pcf)	q_u	SOIL CLASS	DEPTH FT
								4" Topsoil						
				Brown	Very Moist	Firm	CL	Peoria Loess, Lean Clay, Low Plasticity, Root Hairs						
	U-1	1.0	100							30.0	94.9	0.54		
	U-2	1.0	100					Slightly Blocky		31.0	93.6	0.62		
5														5
	U-3	2.5	80			Stiff				27.0	94.2	1.90		
	U-4	1.75	100			Firm		Layered, Root Holes, Rust Stains, Silty		26.2	93.6	1.07		
10														10
	U-5	2.5	100			Stiff				25.8	92.6			
15														15
	U-6	1.5	100			Firm				30.3	88.8			
20														20
				Reddish Brown	Moist	Stiff	CL	Loveland Loess, Lean Clay, Low Plasticity, Mealy, Root Holes, Rust Stains						
	U-7	2.5	100							23.9	99.3			
25														25
	U-8	3.25	100			Very Stiff				23.0	101.4			
30								Bottom of boring @ 30'						30

THOMPSON, DREESSEN & DORNER, INC.
CONSULTING ENGINEERS & LAND SURVEYORS

GEOTECHNICAL ENGINEERING DIVISION

PROJECT:	Lots 3 and 4 Heide Heights
LOCATION:	110th and Cottonwood Plaza, Omaha, NE
CLIENT:	Sterling Management
JOB No. :	2016-203
DATE:	10/13/16

BORING LOG

BORING No. : B- 3

WEATHER CONDITIONS	BORING LOCATION	SURFACE ELEV.	ELEVATION DATUM	DRILLER	LOGGER
Sunny 53°	See Boring Location Plan			T. Eggert	A. Cannia

GROUNDWATER LEVEL OBSERVATIONS: WHILE DRILLING	END OF DRILLING	24 HOURS AFTER DRILLING	HOURS	TYPE OF SURFACE / DRILLING METHOD	SPT HAMMER / BIT USED	DRILL RIG / TOTAL DEPTH
				Grass	NA	CME-45
NE	NE	HBED		4" Continuous Flight Augers	Fish	20.0 feet

SAMPLE DATA / DESCRIPTION OF SOIL / LABORATORY RESULTS

DEPTH FT	SAMPLE No. & Type	Penetrometer Strength (tsf)	% REC	COLOR	MOIST.	CONS	USCS	GEOLOGICAL DESCRIPTION	MC (%)	DRY DENSITY (pcf)	q_u	SOIL CLASS
0								4" Topsoil				
				Brown	Wet	Firm	CL	Peoria Loess, Lean Clay, Low Plasticity, Slightly Blocky				
	U-1	0.75	100						33.0	91.6	0.29	
5	U-2	1.75	80		Very Moist				30.3	92.1	0.75	
	U-3	4.25	80			Hard			24.2	98.1	2.42	
10	U-4	>4.5	100	Gray	Moist				19.2	101.0	2.54	
15	U-5	3.75	80	Brown		Very Stiff		Layered, Rust Stains, Silty	22.8	97.1		
20	U-6	2.25	90		Very Moist	Stiff			26.3	95.6		
								Bottom of boring @ 20'				
25												
30												

THOMPSON, DREESSEN & DORNER, INC.
CONSULTING ENGINEERS & LAND SURVEYORS

GEOTECHNICAL ENGINEERING DIVISION

PROJECT:	Lots 3 and 4 Heide Heights
LOCATION:	110th and Cottonwood Plaza, Omaha, NE
CLIENT:	Sterling Management
JOB No. :	2016-203
DATE:	10/13/16

BORING LOG

BORING No. : B- 4

WEATHER CONDITIONS	BORING LOCATION	SURFACE ELEV.	ELEVATION DATUM	DRILLER	LOGGER
Sunny 53°	See Boring Location Plan			T. Eggert	A. Cannia

GROUNDWATER LEVEL OBSERVATIONS: WHILE DRILLING	END OF DRILLING	24 HOURS AFTER DRILLING	- HOURS	TYPE OF SURFACE / DRILLING METHOD	SPT HAMMER / BIT USED	DRILL RIG / TOTAL DEPTH
				Grass	NA	CME-45
NE	NE	HBED		4" Continuous Flight Augers	Fish	25.0 feet

DEPTH FT	SAMPLE No. & Type	Penetrometer Strength (tsf)	% REC	COLOR	MOIST	CONS	USCS	GEOLOGICAL DESCRIPTION	GRAPHICAL LOG	MC (%)	DRY DENSITY (pcf)	q_u	SOIL CLASS	DEPTH FT
								4" Topsoil						
				Brown	Very Moist	Firm	CL	Peoria Loess, Lean Clay, Low Plasticity, Blocky						
	U-1	1.5	90							25.3	98.0	0.80		
						Very Stiff								
5	U-2	2.25	90							25.5	93.0	0.79		5
					Moist	Very Stiff		Layered, Root Holes, Calcium Deposits, Rust Stains						
	U-3	3.5	90							20.2	96.7	1.43		
				Grayish Brown	Very Moist	Stiff								
10	U-4	2.25	100							25.7	94.7	1.37		10
				Brown										
15	U-5	2.5	100							26.0	93.4			15
20	U-6	2.75	100							25.6	93.3			20
				Reddish Brown	Very Moist	Firm	CL	Loveland Loess, Lean Clay, Low Plasticity, Mealy, Root Holes, Common Rust Stains						
25	U-7	1.75	100							25.9	93.7			25
								Bottom of boring @ 25'						
30														30

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CONSULTING ENGINEERS & LAND SURVEYORS

GEOTECHNICAL ENGINEERING DIVISION

PROJECT:	Lots 3 and 4 Heide Heights
LOCATION:	110th and Cottonwood Plaza, Omaha, NE
CLIENT:	Sterling Management
JOB No. :	2016-203
DATE:	10/17/16

BORING LOG

BORING No. : B- 5

WEATHER CONDITIONS	BORING LOCATION	SURFACE ELEV.	ELEVATION DATUM	DRILLER	LOGGER
Sunny 84°	See Boring Location Plan			T. Eggert	A. Cannia

GROUNDWATER LEVEL OBSERVATIONS				TYPE OF SURFACE	SPT HAMMER	DRILL RIG
WHILE DRILLING	END OF DRILLING	24 HOURS AFTER DRILLING	- HOURS	Grass	NA	CME-45
				DRILLING METHOD	BIT USED	TOTAL DEPTH
NE	NE	HBED		4" Continuous Flight Augers	Fish	35.0 feet

SAMPLE DATA				DESCRIPTION OF SOIL						LABORATORY RESULTS				
DEPTH FT	SAMPLE No. & Type	Penetrometer Strength (tsf)	% REC	COLOR	MOIST	CONS	USCS	GEOLOGICAL DESCRIPTION	GRAPHICAL LOG	MC (%)	DRY DENSITY (pcf)	q_u (tsf)	SOIL CLASS	DEPTH FT
								4" Topsoil						
				Light Brown	Moist	Stiff	CL	Peoria Loess, Lean Clay, Low Plasticity, Layered, Root Holes, Rust Stains, Silty						
	U-1	2.0	100							18.9	76.5	0.38		
5	U-2	3.5	100			Very Stiff				16.9	81.0	1.13		5
	U-3	3.25	100							20.5	84.3	0.80		
10	U-4	2.5	100			Stiff		Gray Mottles		22.2	89.3	1.12		10
15	U-5	3.25	100	Grayish Brown	Very Moist	Very Stiff		Large Calcium Nodules		25.2	92.0			15
20	U-6	3.25	100	Brown	Moist					23.3	93.2			20
25	U-7	2.0	100		Very Moist	Stiff				25.9	94.6			25
				Reddish Brown	Moist	Very Stiff	CL	Loveland Loess, Lean Clay, Low Plasticity, Mealy, Root Holes, Common Rust Stains						
30	U-8	4.0	100							22.2	99.6			30

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GEOTECHNICAL ENGINEERING DIVISION

PROJECT:	Lots 3 and 4 Heide Heights
LOCATION:	110th and Cottonwood Plaza, Omaha, NE
CLIENT:	Sterling Management
JOB No. :	2016-203
DATE:	10/17/16

BORING LOG

BORING No. : B- 5 cont'd

WEATHER CONDITIONS	BORING LOCATION	SURFACE ELEV.	ELEVATION DATUM	DRILLER	LOGGER
Sunny 84°	See Boring Location Plan			T. Eggert	A. Cannia

GROUNDWATER LEVEL OBSERVATIONS				TYPE OF SURFACE	SPT HAMMER	DRILL RIG
WHILE DRILLING	END OF DRILLING	24 HOURS AFTER DRILLING	- HOURS	Grass	NA	CME-45
				DRILLING METHOD	BIT USED	TOTAL DEPTH
NE	NE	HBED		4" Continuous Flight Augers	Fish	35.0 feet

DEPTH FT	SAMPLE No. & Type	Pene-trometer Strength (tsf)	% REC	COLOR	MOIST	CONS	USCS	GEOLOGICAL DESCRIPTION	GRAPHICAL LOG	MC (%)	DRY DENSITY (pcf)	q_u (tsf)	SOIL CLASS	DEPTH FT
				Reddish Brown	Moist	Very Stiff	CL	Loveland Loess						
35	U-9	2.75	100	Brown		Stiff		Slightly Silty		22.8	98.6	1.42		35
								Bottom of boring @ 35'						
40														40
45														45
50														50
55														55
60														60

SOIL BORING LOGS

Water Level Observations: Water level observations were made under the conditions noted in the open, uncased bore holes. Fluctuations in the water levels may occur with time, precipitation, and other factors.

Samples: Samples types are identified by letter and by consecutive number within a boring:

- U Thin-walled tube sample 3-inch diameter, unless otherwise noted.
- S Split spoon sample, 2-inch OD unless otherwise noted.
- A Auger disturbed sample obtained from auger cuttings.
- CC Continuous core sample from Macro Core® sampler.

N-Blows per Foot: Resistance as measured while performing the Standard Penetration Test. The number indicates blows for the last 12 inches of penetration of the split spoon sampler. Multiple numbers indicate blows per 6 inches of penetration or blows per length driven.

Penetrometer Strength: The hand penetrometer resistance in tons per square foot determined in the field for the recovered sample.

Recovery: Recovery is shown as a ratio of inches of sample recovered to inches of sample attempted.

Physical Description: The description includes; color, moisture condition, consistency, and Unified Soil Classification System description. The USCS description is either interpreted or determined as noted. Includes other pertinent comments from field observations.

Geologic Description: A brief geologic interpretation and observations of the recovered samples and/or exposed cuttings.

Graphical Log: The symbols suggest the observed variations in the geologic formations or soils layers showing similar attributes. The soil boring log Geologic Description contains detailed descriptions. A symbol legend follows the soil boring logs.

Laboratory Results: Brief summary of selected laboratory results. A separate Summary of Soil Testing Results provides more complete information.

Limitations: The profiles indicated on the logs are an idealized description of the subsurface soil materials based on the observations of the recovered samples. The boundary lines shown represent approximate boundaries between material types and the actual changes may be gradual.

CLASSIFICATION OF SOILS FOR ENGINEERING PURPOSES

(Based on Unified Soil Classification System) ASTM: D 2487

Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests[A]				oil Classification	
				Group Symbol	Group Name[B]
Coarse-Grained Soils More than 50% retained on No. 200 sieve	Gravels More than 50% of coarse fraction retained on No. 4 sieve	Clean Gravels Less than 5% fines[C]	$Cu \geq 4$ and $1 \leq Cc \leq 3$[E]	GW	Well-graded gravel[F]
			$Cu < 4$ and/or $1 > Cc > 3$[E]	GP	Poorly graded gravel[F]
		Gravels with Fines More than 12% fines[C]	Fines classify as ML of MH	GM	Silty gravel[F, G, H]
			Fines classify as CL or CH	GC	Clayey gravel[F, G, H]
	Sands50% or more of coarse fraction passes No. 4 sieve	Clean Sands Less than 5% fines[D]	$Cu \geq 6$ and $1 \leq Cc \leq 3$[E]	SW	Well-graded sand
			$Cu < 6$ and/or $1 > Cc > 3$[E]	SP	Poorly graded sand[I]
		Sands with Fines More than 12% fines[D]	Fines classify as ML or MH	SM	Silty sand[G, H, I]
			Fines classify as CL or CH	SC	Clayey sand[G, H, I]
Fine-Grained Soils50% or more passes the No. 200 sieve	Silts and Clays Liquid limit less than 50	Inorganic	PI > 7 and plots on or above "A" line[J]	CL	Lean clay[K, L, M]
			PI < 4 or plots below "A" line[J]	ML	Silt[K, L, M]
		Organic	Liquid limit -- oven dried / Liquid limit -- not dried < 0.75	OL	Organic clay[K, L, M, N] Organic silt[K, L, M, O]
	Silts and Clays Liquid limit 50 or more	Inorganic	PI plots on or above "A" line	CH	Fat clay[K, L, M]
			PI plots below "A" line	MH	Elastic silt[K, L, M]
		Organic	Liquid limit -- oven dried / Liquid limit -- not dried < 0.75	OH	Organic clay[K, L, M, P] Organic silt[K, L, M, Q]
Highly organic soils		Primarily organic matter, dark in color, and organic odor		PT	Peat

[A] Based on the material passing the 3-in. (75-mm) sieve.

[B] If field sample contained cobbles or boulders, or both, add "with cobbles or boulders, or both" to the group name.

[C] Gravels with 5 to 12% fines require dual symbols:
- GW-GM well-graded gravel with silt
- GW-GC well-graded gravel with clay
- GP-GM poorly graded gravel with silt
- GP-GC poorly graded gravel with clay

[D] Sands with 5 to 12% fines require dual symbols:
- SW-SM well-graded sand with silt
- SW-SC well-graded sand with clay
- SP-SM poorly graded sand with silt
- SP-SC poorly graded sand with clay

[E] $Cu = D_{60}/D_{10}$ $\quad Cc = \frac{(D_{30})^2}{D_{10} \times D_{60}}$

[F] If soil contains > 15% sand, add "with sand" to group name

[G] If fines classify as CL-ML, use dual symbol GC-GM, or SC-SM.

[H] If fines are organic, add "with organic fines" to group name.

[I] If soil contains > 15% gravel, add "with gravel" to group name

[J] If Atterberg limits plot in shaded area, soil is a CL-ML, silty clay.

[K] If soil contains 15 to 29% plus No. 200, add "with sand" or "with gravel", whichever is predominant.

[L] If soil contains ≥ 30% plus No. 200, predominantly sand, add "sandy" to group name.

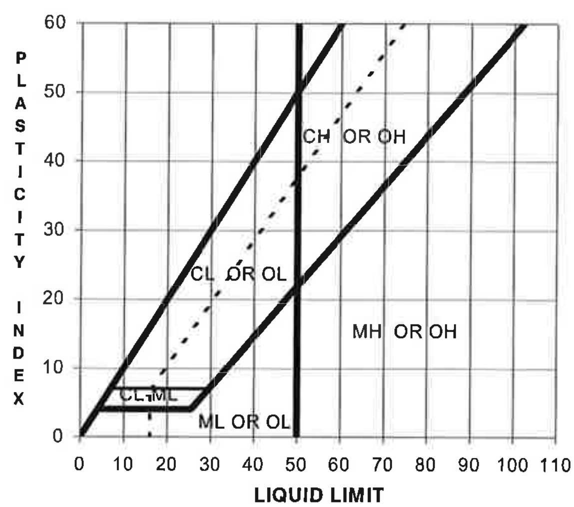
[M] If soil contains ≥ 30% plus No. 200, predominantly gravel, add "gravelly" to group name.

[N] PI ≥ 4 and plots on or above "A" line.

[O] PI < 4 or plots below "A" line.

[P] PI plots on or above "A" line.

[Q] PI plots below "A" line.



THOMPSON, DREESSEN & DORNER, INC.
CONSULTING ENGINEERS & LAND SURVEYORS

TD2 engineering & surveying

GEOTECHNICAL ENGINEERING DIVISION

SUMMARY OF SOIL TEST RESULTS

PROJECT: Lots 3 and 4 Heide Heights
CLIENT: Sterling Management
LOCATION: 110th and Cottonwood Plaza
Omaha, Nebraska

TD2 JOB NO: 2016-203
DATE: 10/19/16

BORING No.	SAMPLE NO.	SAMPLE DEPTH (ft.)	SAMPLE DIAM. (in.)	SAMPLE LENGTH (in.)	MOISTURE CONTENT (%)	DENSITY WET (pcf)	DENSITY DRY (pcf)	VOID RATIO (e)	SAT. (%)	UNCONFINED COMPRESSION qu (tsf)	UNCONFINED COMPRESSION STRAIN (%)	SOIL CLASSIFICATION ATTERBERG LIMITS LL	PL	PI	GROUP SYMBOL	PASSING #200 (%)	REMARKS
B-1	U-1	1-2.5	2.83	5.84	16.1	88.6	76.3	1.192	36	0.62	2.1						
	U-2	3.5-5	2.84	5.84	12.5	96.6	85.8	0.948	35	0.67	2.1						
	U-3	7-8.5	2.88	5.89	12.6	93.2	82.8	1.021	33	1.58	2.5						
	U-4	8.5-10	2.87	5.86	13.9	97.4	85.5	0.956	39	1.06	2.1						
	U-5	13.5-15	2.87	5.91	12.5	90.7	80.7	1.073	31								
	U-6	18.5-20	2.87	5.89	13.5	98.2	86.5	0.933	39								
	U-7	23.5-25	2.85	5.33	19.7	115.7	96.7	0.730	72								
	U-8	28.5-30	2.84	5.89	23.7	123.9	100.2	0.670	95								
B-2	U-1	1-2.5	2.86	5.87	30.0	123.4	94.9	0.762	100	0.54	17.0						
	U-2	3.5-5	2.89	5.89	31.0	122.6	93.6	0.786	100	0.62	14.4						
	U-3	7-8.5	2.88	5.88	27.0	119.7	94.2	0.775	94	1.90	11.9						
	U-4	8.5-10	2.87	5.90	26.2	118.1	93.6	0.787	89	1.07	7.3						
	U-5	13.5-15	2.89	5.89	25.8	116.5	92.6	0.806	86								
	U-6	18.5-20	2.88	5.90	30.3	115.7	88.8	0.884	92								
	U-7	23.5-25	2.88	5.89	23.9	123.0	99.3	0.684	93								
	U-8	28.5-30	2.87	5.90	23.0	124.8	101.4	0.649	95								
B-3	U-1	1-2.5	2.88	5.88	33.0	121.9	91.6	0.826	100	0.29	11.1						
	U-2	3.5-5	2.89	5.90	30.3	120.0	92.1	0.816	99	0.75	17.0						
	U-3	7-8.5	2.86	5.90	24.2	121.8	98.1	0.704	92	2.42	9.3						
	U-4	8.5-10	2.88	5.90	19.2	120.4	101.0	0.656	78	2.54	4.4						
	U-5	13.5-15	2.87	5.90	22.8	119.2	97.1	0.723	85								
	U-6	18.5-20	2.85	4.71	26.3	120.7	95.6	0.750	94								
B-4	U-1	1-2.5	2.87	5.80	25.3	122.8	98.0	0.707	96	0.80	6.0						
	U-2	3.5-5	2.86	5.83	25.5	116.7	93.0	0.799	86	0.79	12.0						
	U-3	7-8.5	2.88	5.89	20.2	116.2	96.7	0.730	74	1.43	3.9						
	U-4	8.5-10	2.88	5.90	25.7	119.1	94.7	0.766	90	1.37	6.8						
	U-5	13.5-15	2.88	5.92	26.0	117.7	93.4	0.790	88								
	U-6	18.5-20	2.89	5.89	25.6	117.2	93.3	0.792	87								
	U-7	23.5-25	2.88	5.89	25.9	117.9	93.7	0.786	88								

THOMPSON, DREESSEN & DORNER, INC.
CONSULTING ENGINEERS & LAND SURVEYORS

GEOTECHNICAL ENGINEERING DIVISION

SUMMARY OF SOIL TEST RESULTS

PROJECT: Lots 3 and 4 Heide Heights

CLIENT: Sterling Management

LOCATION: 110th and Cottonwood Plaza
Omaha, Nebraska

TD2 JOB NO: 2016-203

DATE: 10/19/16

BORING No.	SAMPLE NO.	SAMPLE DEPTH (ft.)	SAMPLE DIAM. (in.)	SAMPLE LENGTH (in.)	MOISTURE CONTENT (%)	DENSITY WET (pcf)	DENSITY DRY (pcf)	VOID RATIO (e)	SAT (%)	UNCONFINED COMPRESSION qu (tsf)	UNCONFINED COMPRESSION STRAIN (%)	SOIL CLASSIFICATION ATTERBERG LIMITS LL	PL	PI	GROUP SYMBOL	PASSING #200 (%)	REMARKS
B-5	U-1	1-2.5	2.83	5.88	18.9	90.9	76.5	1.187	43	0.38	2.1						
	U-2	3.5-5	2.85	5.90	16.9	94.7	81.0	1.065	43	1.13	1.7						
	U-3	7-8.5	2.84	5.88	20.5	101.5	84.3	0.985	56	0.80	1.7						
	U-4	8.5-10	2.87	5.89	22.2	109.0	89.3	0.873	68	1.12	3.0						
	U-5	13.5-15	2.88	4.33	25.2	115.1	92.0	0.818	82								
	U-6	18.5-20	2.88	4.43	23.2	114.9	93.2	0.794	78								
	U-7	23.5-25	2.84	5.89	25.9	119.2	94.6	0.768	91	1.24	5.9						
	U-8	28.5-30	2.87	5.90	22.2	121.6	99.6	0.679	87	1.85	3.1						
	U-9	33.5-35	2.87	5.90	22.7	121.1	98.6	0.696	88	1.42	4.2						