GEOTECHNICAL REPORT
NEW MANUFACTURING CENTER
TOPEKA, KANSAS

PROJECT NO. 14085051
MAY 13, 2008

Prepared for:

GREATER TOPEKA CHAMBER OF COMMERCE
Topeka, Kansas

Prepared by:

Terracon
Topeka, Kansas

Terracon

May 13, 2008

Terracon
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Attention: Ms. Kathy Moellenberndt
Vice President - Director

RE: Preliminary Geotechnical Report
New Manufacturing Center
Topeka, Kansas
Terracon No. 14085051

Dear Ms. Moellenberndt:

Terracon Consultants, Inc. (Terracon) has completed the subsurface exploration and geotechnical engineering evaluation of the Manufacturing Center site. These services were performed in general accordance with our proposal dated April 17, 2008. This report presents the results of the subsurface exploration and provides preliminary geotechnical recommendations regarding site development and foundation design for the proposed manufacturing center.

We appreciate the opportunity to be of service to the Greater Topeka Chamber of Commerce. If you have any questions regarding this report, or if we may be of further service to you, please contact us.

Sincerely,
Terracon

STEPHEN BRIAN PRETSCH LICENSED 16602 KANSAS PROFESSIONAL ENGINEER

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Enclosures

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PRELIMINARY GEOTECHNICAL REPORT
NEW MANUFACTURING CENTER
TOPEKA, KANSAS

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INTRODUCTION

Subsurface exploration at the proposed manufacturing center site has been completed. Borings B-101 to B-112 were drilled within the eastern part of the subject track to supplement data Terracon obtained at Borings B-1 to B-17, which were previously performed on the western portion of the subject tract for the Greater Topeka Chamber of Commerce. Logs of all twenty-nine (29) borings and boring location diagram are included in Appendix A of this report. The purpose of this report is to describe the subsurface conditions encountered at the borings and provide preliminary geotechnical recommendations regarding the design of the proposed development.

PROJECT INFORMATION

A new manufacturing center is planned on an approximate 100 acre site located east of US 75 Highway, northeast of the terminus of Wenger Drive in Topeka, Kansas. We understand the building will be one story above grade with no basement level. As the proposed development is still in preliminary design phases, the size and position of the manufacturing facility on the subject track has not been established. Only limited structural loading information was available at the time of this report. In our analysis, we considered maximum column loads of 160 kips and maximum wall loads in the range of 6 to 8 kips per linear foot. Grading plans were not available at the time of this report. Based on the current topography of the site and our understanding of the proposed development, we considered up to approximately 15 feet of cut and/or fill might be required at the site to achieve design grades, with cuts occurring primarily on the north side of the property and fills on the south. The project also includes associated parking areas and drives for both light and heavy traffic. Design traffic information was provided by the Greater Topeka Chamber of Commerce.

SUBSURFACE EXPLORATION AND LABORATORY TESTING PROCEDURES

Subsurface Exploration

The locations of borings were established in the field by Terracon. The boring locations established during the earlier exploration (B-1 through B-17) were measured with a cloth tape from survey markers established by Cook, Flat, and Strobel Engineers. A hand held GPS unit was used to locate Borings B-101 through B-112.

The borings were drilled with a truck-mounted, rotary drill rig using continuous flight augers to advance the boreholes. Representative samples were obtained using thin-walled tube and split-barrel sampling procedures. In the thin-walled tube sampling procedure, a thin-walled, seamless steel tube with a sharp cutting edge is pushed hydraulically into the ground to obtain relatively undisturbed samples of cohesive or moderately cohesive soils. In the split-barrel sampling procedure, a standard 2-inch O.D. split-barrel sampling spoon is driven into the ground with a 140-pound hammer falling a distance of 30 inches. The number of blows required to advance the sampling spoon the last 12 inches of a normal 18-inch penetration is recorded as the standard penetration resistance value (N). These "N" values are indicated on the boring logs at the depths of occurrence. The samples were tagged for identification, sealed to reduce moisture loss and returned to the laboratory for testing and classification.

Field logs of each boring were prepared by the drill crew. These logs included visual classifications of the materials encountered during drilling as well as the driller's interpretation of the subsurface conditions between samples. The final boring logs included with this report represent our interpretation of the subsurface conditions at each boring based on date from field logs, observation of the samples, and evaluation of laboratory tests.

Laboratory Testing

Water content tests were performed on all samples. Dry density tests and unconfined compression tests were performed on selected thin-walled tube samples. Atterberg limits tests were performed on selected samples. The results of all tests are presented on the respective boring logs.

The samples were classified in the laboratory based on visual observation, texture and plasticity. The descriptions of the soils indicated on the boring logs are in general accordance with the Unified Soil Classification System and the General Notes in Appendix B. The rock samples were classified from disturbed samples. Petrographic analysis may reveal other rock types. The rock descriptions are in accordance with the enclosed Sedimentary Rock Classification General Notes.

SUBSURFACE CONDITIONS

Specific conditions encountered at each boring location are indicated on the individual boring logs. The stratification lines shown on the boring logs represent approximate boundaries between soil and rock types; in-situ, the transitions may vary or be more gradual.

Borings B-1 through B-17

An approximate 3 to 4 inch thick root zone was encountered at the surface of most of the borings. Materials that may be fill, identified on the boring logs as possible fill, were encountered at Borings B-1, B-4, B-10, B-15, and B-17. The possible fill materials, which extended to depths ranging from approximately 2½ to 3 feet, consisted of fat clays. Native clays of variable plasticity and with varying amounts of sand were encountered below the root zone and possible fill materials at all boring locations. The native clays were generally of stiff to hard consistency and extended to depths ranging from approximately 7 to 17½ feet. The cohesive soils were underlain by sands of varying gradation and with varying silt and clay contents at Borings B-2 through B-8 and B-12 through B-16. The native sands extended to depths ranging from approximately 8½ to 17½ feet and were medium dense.

Bedrock was encountered below the clays and sands at all boring locations at depths ranging from approximately 8 feet to 17½ feet. We were able to drill into the bedrock 0 to 2 feet before auger refusal occurred. By our definition, auger refusal occurs when our auger fitted with a carbide, finger tooth bit can not penetrate materials more than a few inches in one minute. Borings B-2 and B-10 were advanced 10 to 12 feet into the rock by core drilling. Observations of the cores revealed alternating layers of siltstone, limestone, shale and coal.

Borings B-101 through B-112

An approximate 4 inch thick root zone was encountered at the surface of most of the borings. Materials that may be fill, identified on the boring logs as possible fill, were encountered at Boring B-12. The possible fill materials, which extended to a depth of approximately 3 feet, consisted of fat clays with varying amounts of gravel. Native clays of variable plasticity and with varying amounts of sand were encountered below the root zone and possible fill materials at all boring locations. The native clays were generally of medium stiff to hard consistency and extended to depths ranging from approximately 6½ to 13 feet. The cohesive soils were underlain by sands of varying gradation at Borings B-101 through B-105 and B-109. The native sands extended to depths ranging from approximately 10 to 16 feet at Borings B-104, B-105, and B-109 and to termination depths of Borings B-101 through B-103 at depths ranging from approximately 12½ to 17½ feet. The native sands were medium dense. Native clays were encountered below the sands at Borings B-109 and extended to the termination depth of this boring, 20 feet.

Bedrock was encountered below the clays and sands at all boring locations with the exception of Boring B-109 at depths ranging from approximately 6½ feet to 17½ feet. We were able to drill into the bedrock 0 to 8½ feet before auger refusal occurred. By our definition, auger refusal occurs when our auger fitted with a carbide, finger tooth bit can not penetrate materials more than a few inches in one minute. Observations of the disturbed auger cuttings revealed alternating layers of sandstone, limestone, and shale.

Water Level Observations

The borings were monitored while drilling and after completion for the presence and level of water. Water seepage was observed on December 5, 2007 during drilling at Borings B-1, B-5, B-7, B-15, and B-16 at depths ranging from about 8½ feet to 14 feet. Upon completion of these borings, a free static water surface was observed at depths ranging from about 8½ feet to 16 feet. Water was not observed at the remainder of the borings drilled in December 2007 and water was not noted while drilling on April 15 and 16, 2008 or during the short time following drilling before the boreholes were backfilled. Because a longer period of time may be necessary for water levels to stabilize in boreholes, long term observations in piezometers or observation wells would be required for a more accurate indication of the groundwater conditions.

Fluctuations of the groundwater level can occur due to seasonal variations in the amount of rainfall, runoff and other factors not evident at the time the borings were performed. Therefore, groundwater levels during construction or at other times may be higher or lower than the levels indicted on the boring logs. The possibility of groundwater level fluctuations should be considered when developing the design and construction plans for the project.

ANALYSES AND PRELIMINARY RECOMMENDATIONS

Geotechnical Considerations

Materials that could be fill were encountered at Borings B-1, B-4, B-10, B-15, B-17 and B-112 to depths ranging from 2½ to 3 feet. Existing fill could be present below unexplored areas of the site. We do not recommend footings or floor slabs be supported on or above existing fill materials that have not been placed with strict moisture and density control. We recommend existing fill, if encountered within the planned building areas, be removed and replaced with properly compacted structural fill.

Based on the anticipated site grading, bedrock may be encountered at or above the base of anticipated shallow foundations toward the north end of the site. It is also possible that bedrock may be present at or above planned building floor subgrade levels in some areas. It is likely that jackhammers and rock splitters, in addition to excavation equipment with ripping attachments, will be required to excavate hard shale, limestone, siltstone or sandstone. Bedrock will likely not be encountered at shallow depths toward the south side of the site where fills are expected to develop planned grades. Settlement of foundations that bear on bedrock and foundations that bear on native soils/engineered fill will be different. Recommendations to help reduce differential settlement can be provided once development plans are available.

Expansive clay soils are present at the site. This report provides recommendations to help mitigate the effects of shrinkage and expansion when expansive materials are encountered. However, even if these procedures are followed, some subgrade volume change, accompanied by movement of structures should be anticipated where expansive soils are present below or around the site improvements. The severity of movement and resulting cracking and other cosmetic damage such as uneven floor slabs will probably increase if expansive soils become excessively wetter or drier. Eliminating the risk of movement and cosmetic distress may not be feasible, but it may be possible to further reduce the risk of movement if more of the expansive materials are removed below sensitive structures. The recommendations presented in this report are based on our understanding of the owner's risk tolerance related to expansive soils. We would be pleased to discuss other construction alternatives with you upon request.

Preliminary geotechnical recommendations are based on the data obtained from the field and laboratory testing programs. Our recommendations are presented in the following paragraphs.

Site Preparation and Fill Placement

At the on-set of site grading activity, all existing vegetation, topsoil and other loose, soft or otherwise unsuitable material should be removed from the areas to be improved as well as any areas that will be filled. In our opinion, any existing fill present at the site should be removed.

The lean to fat and fat clay soils encountered at the site exhibit high plasticity, and have a high potential for volume change (shrink/swell) with variations in moisture content. To reduce the potential for subgrade volume change, we recommend that a low volume change (LVC) zone be provided below all grade-supported concrete slabs where expansive soils are encountered. By our definition, low volume change materials should consist of low plasticity cohesive soils (liquid limit less than 45 and plasticity index less than 20) or well-graded granular materials. If the LVC layer is constructed prior to foundation construction, the LVC fill should extend at least 5 feet laterally beyond the exterior sides of the building. The moisture content of the clay soils encountered to a depth of 24 inches below the LVC zone should be evaluated by Terracon. If relatively dry clay soils are encountered, the desiccated clay should be removed, moisture conditioned, and placed as engineered fill as recommended below.

After the site has been stripped, existing fill has been removed (if encountered), and the building area has been undercut where necessary to accommodate the LVC zone, but prior to placement of fill, the subgrade should be proofrolled. Terracon personnel should observe the subgrades as they are proofrolled. Proofrolling aids in providing a firm base for compaction of fill and delineating soft or disturbed areas that may exist below subgrade level. Unsuitable areas observed at this time should be improved by compaction or by undercutting and placement of suitable compacted fill. Proofrolling may be accomplished with a fully loaded, tandem-axle dump truck or other equipment providing an equivalent subgrade loading. A minimum gross weight of 20 tons is recommended for the proofrolling equipment. Following proofrolling and removal of soft soils, the exposed subgrades should be scarified to a depth of 6 inches, moisture conditioned and compacted as recommended for engineered fill.

Engineered fill should consist of materials approved by Terracon that are free of organic matter and debris. Fill should be placed in maximum loose lifts of 9 inches and each lift should be compacted to at least 95 percent of the material's maximum standard Proctor dry density. The moisture content of cohesive (clay) fill should be within the range of 0 to +4 percent of the optimum moisture content value determined by the standard Proctor test at the time of placement and compaction. To reduce the potential for future subgrade swell, the moisture contents of clay fills must be maintained within the recommended range until the floor slabs are constructed. Granular fills should be placed at workable moisture contents.

Settlement Due to Site Fills

It has been our experience that fills that are compacted to at least 95 percent of the material's standard Proctor maximum density will experience some internal consolidation/compression. In addition, depending on the thickness of the fill, the load imposed can cause consolidation of the lower native soils. Where relatively thick fills are placed over thick compressible native deposits, total settlements due to the fill alone could exceed 1 inch. Terracon can evaluate potential settlement when grading plans are available.

Spread Footing Foundations

Spread footing foundations perform more predictably when supported on similar materials. Preliminary recommendations for spread footing foundations that derive their support from bedrock and soils are provided below. The potential for differential settlement should be evaluated if consideration is given towards designing foundations that are supported by both rock and soil materials.

Rock Bearing Footings: Spread footing foundations that bear uniformly on the underlying bedrock could be designed for a maximum allowable net bearing pressure in the range of 8,000 to 10,000 pounds per square foot. The net pressure refers to the pressure that may be transmitted to the bearing materials at footing base level in excess of the minimum surrounding overburden pressure. Where deep excavations are required to expose suitable bedrock materials, the excavations could be backfilled with a lean concrete to design bearing elevations. We estimate that foundations that extend to sound bedrock materials and are constructed as recommended above should experience settlements less than ½ inch. Differential settlements should also be less than ½ inch.

Soil Bearing Footings: Spread footing foundations that bear uniformly on stiff native soils, medium dense sands and/or engineered fill could be designed for a maximum allowable net bearing pressure in the range of 2,000 to 2,500 pounds per square foot. Estimates for total and differential settlement on footings supported on native soils or engineered fill can be provided once grading plans are made available.

General Information: Perimeter footings and footings beneath unheated areas should extend at least 3 feet below the lowest adjacent finished grade for frost protection and to provide foundation support below the level of seasonal moisture variations in the soil. Isolated footings should have a minimum width of 30 inches, and continuous formed footings should have a minimum width of 18 inches.

Concrete should be placed soon after excavating to minimize disturbance of the bearing materials. Should the materials at bearing level become excessively dry, disturbed or saturated, the affected material should be removed prior to placing concrete. We recommend that Terracon be retained to observe and test the foundation bearing materials. If unsuitable bearing materials are encountered in footing excavations, the excavations should be deepened to suitable materials. The footings could bear directly on these materials at the lower level or on lean concrete backfill placed in the excavations.

Drilled Pier Foundations

Drilled pier foundations that extend through the existing fill and or native soils and extend at least 24 inches into hard bedrock may be proportioned using an allowable end bearing pressure of 20 kips per square foot. To be considered a drilled pier, the foundation must have a minimum length to diameter ratio of 3.

Conventional drilling equipment should be able to penetrate the native soils and shale bedrock. Coring may be required to advance the pier excavations to sound limestone and siltstone. Temporary steel casing will likely be required to advance the pier excavations as groundwater is likely. The bottom of the pier excavations should be cleaned of water and loose material before placing concrete. Drilled piers for this project should have a minimum diameter of 30 inches to facilitate cleaning and observation of the bearing materials. Temporary steel casing should be installed if personnel will enter the excavation to clean and/or observe the bearing surface.

Drilled pier excavations should be observed by a representative of Terracon to evaluate the suitability of the bearing material. Should isolated areas of unsuitable material be encountered at planned depths, it will be necessary to deepen the drilled piers to suitable bearing material. The base of all drilled pier excavations should be free of water and loose material prior to placement of concrete.

For drilled pier foundations designed and constructed as recommended above, total settlements should be less than ½ inch and differential settlements should also be less than ½ inch.

Uplift resistance can be provided by that portion of the drilled pier that extends into sound bedrock. An allowable uplift resistance value of 2,000 psf can be used for hard shale, limestone, and siltstone. The following equation may be used to compute the allowable uplift capacity provided by a rock socket.

$$Q_{up} = 2.0A_sL$$

where:

Q_{up} is the allowable uplift capacity, in kips
A_s is the gross surface area of the pier, in square feet per 1-foot length
L is the length of the rock socket in suitable bedrock strata in feet

The uplift capacity per pier should be reduced if piers are spaced closer than 3 diameters (clear distance). Terracon should be contacted to evaluate the reductions on an individual basis once final plans are developed.

Slab Subgrades

Building floor slabs should be supported on a layer of low volume change (LVC) material. The thickness of LVC layers is a function of the thickness and plasticity of the underlying strata and their potential for moisture variation, composition of the LVC material, floor loading conditions and the sensitivity of the floor systems to post construction floor movement. LVC thickness typically ranges from 18 to 36 inches. Materials acceptable for use as low volume change material should consist of either cohesive soils having a liquid limit less than 45 and a plasticity index less than 20 or approved granular materials.

The low volume change material should be placed and compacted in accordance with the recommendations in the "Site Preparation and Fill Placement" section of this report. Upon completion of grading operations in the building areas, care should be taken to maintain the recommended subgrade moisture content and density until the slabs are constructed. Completed subgrades that have become desiccated, saturated, frozen, or disturbed by construction activity should be reconditioned to meet the recommendations of this report prior to placement of the granular leveling course and construction of the slabs.

A free-draining, compacted granular leveling course should be placed below the floor slabs to provide uniform slab support. The layer of free-draining granular material should be at least 4 inches thick and can be considered part of the low volume change zone. If there is concern about moisture vapor transmission through the concrete slab, a vapor barrier should be used.

The on site clays are not the ideal material for support of heavily loaded floor slabs. To improve subgrade support capacity, we recommend granular materials or Class C fly ash or lime stabilized clay soils be used to develop floor slab subgrades. More detailed recommendations can be provided once building loads and final grades are provided.

Lateral Earth Pressures

Reinforced concrete walls with unbalanced backfill (such as loading dock walls) should be designed for at- rest lateral earth pressures at least equal to those indicated in the following table. Earth pressures will be influenced by structural design of the wall, location of groundwater, conditions of wall restraint, construction methods, backfill compaction procedures and the strength of the materials being restrained. Active and at-rest earth pressure conditions are shown. The active earth pressure condition requires wall movement to mobilize the earth pressure and is commonly used for design of free-standing, cantilever-type retaining walls that are not attached to other structures. The "at-rest" condition assumes no wall rotation and is commonly used for design of dock walls that are attached to other structures. The recommended lateral earth pressure parameters do not include a factor of safety and are based on adequate drainage of the wall backfill being provided.

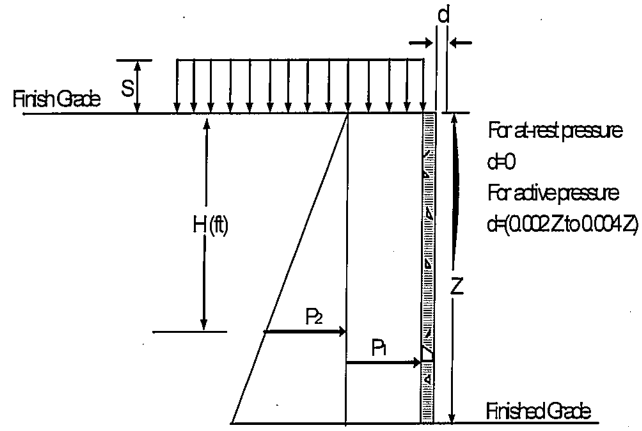

TABLE 1.0 Earth Pressure Coefficients

EARTH PRESSURE CONDITION	COEFFICIENT FOR BACKFILL TYPE	EQUIVALENT FLUID WEIGHT (pcf)	SURCHARGE PRESSURE, P_1 (psf)	EARTH PRESSURE, P_2 (psf)
Active (K_a)	Granular – 0.33	40	(0.33)S	(40)H
	Cohesive – 0.4	50	(0.4)S	(50)H
At-Rest (K_o)	Granular – 0.5	65	(0.5)S	(65)H
	Cohesive – 0.55	70	(0.55)S	(70)H
Passive (K_p)	Granular – 3.0	330	-	-
	Cohesive – 2.6	260	-	-

Conditions applicable to the above recommendations include:

- For active earth pressure, wall must rotate about base, with top lateral movements 0.002 Z to 0.004 Z, where Z is wall height
- Wall must "move" horizontally to mobilize passive resistance
- Uniform surcharge, where S is surcharge pressure, in psf

- In-situ soil backfill unit weight of 125 pcf maximum
- Cohesive backfill soils are low plasticity (LL ≤ 45, PI ≤ 23)
- Horizontal backfill, compacted to at least 95 percent of standard Proctor dry density
- Loading from nearby foundations, floor slabs, or other structures not included
- Heavy equipment and other concentrated load components not included
- No safety factor included

Backfill placed against structures should consist of low plasticity cohesive soils (e.g., lean clays or sandy lean clays) or granular materials (e.g., crushed stone or sand). For the granular values to be valid, the granular backfill must extend out from the base of the wall at an angle of at least 45 degrees for the active and at-rest cases and at least 60 degrees for the passive case. To calculate the resistance to sliding, an ultimate coefficient of friction of 0.35 may be used where the footing bears on stiff consistency, native clay soils or on controlled engineered fill. An appropriate safety factor should be applied to the friction coefficient.

To reduce the potential for hydrostatic loading on below-grade walls, and/or seepage into below grade areas we recommend that drains be installed. The drain lines should be located at or near foundation level, sloped to provide positive gravity drainage to a suitable downgradient outlet or to a storm sewer connection, and should be surrounded by free-draining granular material encapsulated with suitable filter fabric. At least a 2-foot wide section of free-draining granular fill should be used for backfill above the drain line and adjacent to the wall. The drainage section should extend vertically from the base of the wall to within 2 feet of final grade. The granular backfill should be capped with compacted cohesive fill to minimize infiltration of surface water into the drain system.

A prefabricated drainage structure may be used above a perimeter drain line as an alternative to free-draining granular fill. Prefabricated drainage structure is a plastic drainage core or mesh which is covered with filter fabric to prevent soil intrusion, and is fastened to the wall prior to placing backfill.

Site Seismicity

The subsurface profiles encountered at the site are generally consistent with the description given for Site Class "C" according to the 2003 International Building Code, Table 1615.1.1.

Pavement Subgrade Preparation and Fill Compaction

Possible fill was encountered at the site and existing fill may be encountered in unexplored areas of the site. Existing fill should be removed to full depth. In our opinion, because pavements typically endure movements due to subgrade frost action and moisture variations, an LVC layer is not necessary below pavements. Subgrade preparation and fill placement in paved areas should