AMERICAN ENGINEERING TESTING, INC.

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• ENVIRONMENTAL
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• MATERIALS
• FORENSICS

April 24, 2007

Cossetta's Restaurant and Market
211 7th Street West
St. Paul, Minnesota 55102

Attn: Mr. Dave Cossetta

Re: Geotechnical Exploration/Review
Proposed Cossetta's Restaurant Addition and Parking Ramp
211 7th Street West/212 Smith Avenue
St. Paul, Minnesota
AET Project No. 05-03034

Dear Mr. Cossetta:

We have completed a subsurface exploration and geotechnical engineering review for the referenced project. This report documents the results of our exploration/review and provides our opinions and recommendations to aid you and your design team in planning and construction of the project. We are submitting three copies of this report to you and two copies to Mr. John Seppanen of ESG Architects; this report is the instrument of services defined in our proposal.

We have enjoyed working with you on this phase of the project. If you have questions regarding this report or if we can be of further assistance, please contact us.

Sincerely,

American Engineering Testing, Inc.

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GEOTECHNICAL EXPLORATION/REVIEW
PROPOSED COSSETTA'S RESTAURANT ADDITION
AND PARKING RAMP
ST. PAUL, MINNESOTA
AET PROJECT NO. 05-03034

SUMMARY

Purpose

Cossetta's is planning an addition to its restaurant at 211 7th Street West, as well as a new parking ramp at 212 Smith Avenue in St. Paul, Minnesota. The purpose of our services on this project is to explore subsurface conditions and provide geotechnical engineering recommendations to assist you and the project team in planning, design, and construction of this addition.

Scope

We drilled eight Standard Penetration test (SPT) borings and diamond cored the bedrock at six locations to explore the subsurface conditions on these sites and prepared this geotechnical engineering report. We also drilled six SPT borings in the area of the proposed restaurant addition in 2006. The boring logs from our 2006 field exploration are attached.

Findings

In each boring, we found a surficial layer of fill or possible fill extending to the top of bedrock, at depths of about 2' to 17' below grade. The fill in each boring overlies bedrock or possible bedrock. The bedrock that we encountered in our borings consisted of limestone of the Platteville Formation overlying shale of the Glenwood Formation and sandstone of the St. Peter Formation. We did not encounter groundwater in any of our borings during or after drilling.

Recommendations

These recommendations are in a condensed form for your convenience. It is important that you read our entire report for a more comprehensive explanation of our recommendations.

- Excavations for the basement of the addition, the below grade level for the parking ramp and the connecting pedestrian tunnel, as well as excavations for new underground utilities on these sites will require bedrock excavation.

- We recommend constructing all of the footings for both the restaurant addition and the parking ramp on limestone or sandstone bedrock to reduce the potential for differential settlement between footings bearing on bedrock and footings bearing on soil.

- We recommend that the footings not bear in the Glenwood Shale. We also recommend excavating the Glenwood Shale from under the lower level parking slab.

INTRODUCTION

You have authorized American Engineering Testing, Inc. (AET) to conduct a subsurface exploration and provide geotechnical engineering recommendations for this project by accepting our proposal dated February 9, 2007. This report presents the field information we obtained at the site and our engineering recommendations.

To protect you, AET, and the public, we authorize use of opinions and recommendations in this report only by you and your project team for this specific project. Contact us if other uses are intended. Even though this report is not intended to provide sufficient information to accurately determine quantities and locations of particular materials, we recommend that your potential contractors be advised of the report availability.

Scope of Services

Our scope of services for this project, as outlined in our proposal, was limited to the following elements:

- Drill and sample eight Standard Penetration test (SPT) borings in the proposed parking ramp, each to the depth of auger and/or split-barrel refusal, and then diamond core the bedrock at five of the eight SPT boring locations, each to a termination depth of about 20' below grade. One of the diamond coring locations was omitted due to the presence of overhead electric lines and difficult access conditions at the time of our field exploration.

- Diamond core the Platteville Limestone (and possibly the Glenwood Shale) at three of the SPT boring locations that we previously drilled in the area of the proposed restaurant addition, each to a termination depth of about 15' below grade. We did not diamond core one of the planned locations because we encountered overburden soils that extended below the planned depth of the basement floor elevation.

- Perform visual/manual classification of the soil and rock samples.

- Prepare a written report including the logs of the test borings and our geotechnical recommendations for the building foundations, site grading underground utility construction, and pavement subgrade preparation and design.

  The scope of our work is intended for geotechnical purposes only. This scope is not intended to explore for the presence or extent of chemical contamination at the site.

PROJECT INFORMATION

Cossetta's is planning an addition to its restaurant at 211 7th Street West in St. Paul, Minnesota. As part of this project, a new parking ramp will be constructed on a vacant lot north of the restaurant building (at 212 Smith Avenue). This parking ramp will replace the surface parking that currently occupies the area of the proposed addition.

The existing restaurant building is a three-story structure with a basement. The addition will be built off the southwest and northwest sides of the building, covering a footprint of about 11,500 square feet. The addition will extend to the lot lines on the southwest and southeast sides (i.e., zero lot line clearance). You indicated that a building formerly occupied the area of the proposed addition. This building was razed several years ago and there is no documentation of removal of the foundations or underground utilities for the old building.

Based on information provided by ESG Architects, the first floor elevation of the existing building is at elevation 85.58 feet St. Paul City Datum (SPCD), and the finished floor elevation of the basement is at elevation 74.91 feet SPCD. There will be a basement under the addition, with a finished floor elevation at about 73.5 feet SPCD. The addition will have one above grade level, with the first floor matching the elevation of the existing first floor.

The site of the proposed parking ramp is currently vacant; however, a building previously occupied this site. The new ramp will have one level of parking below grade and two above grade levels; the ramp will be unheated. The parking ramp will extend to the lot lines on all four

sides of the lot (i.e., zero lot line clearance). There are existing buildings on the lots adjacent to the proposed parking ramp and these buildings extend to the lot lines.

The parking ramp design is still preliminary, and you are considering two options for the below grade parking level. One option would include a below grade level under the entire ramp footprint; the second option includes a below grade level only under the east approximately one-third of the ramp footprint. Based on preliminary design information provided by ESG Architects, the lower level of parking will be at about elevation 78.8 feet SPCD. The existing grades on the parking ramp site range from about 90 to 94 feet SPCD. Future plans also include construction of up to two levels of commercial space above the upper parking deck.

There is an alley that separates the parking ramp lot from the existing restaurant building. A tunnel will be constructed to provide access from the lower level of the new parking ramp to the lower level of the west side of the new restaurant addition. The lower level finished floor elevation of the addition is planned at about 73.5 feet SPCD. Therefore, the tunnel floor will slope down from the parking ramp to the restaurant addition.

Project Assumptions

Our foundation design assumptions include a minimum safety factor of 3 with respect to the ultimate rock bearing capacity. We assume that the structures will be able to tolerate up to 1" of total settlement and up to ½" of differential settlement over a horizontal distance of 30'. We assume that the connection between the addition and the existing building will be designed to accommodate up to 1" of differential movement.

The presented project information represents our understanding of the proposed construction. This information is an integral part of our engineering review. It is important that you contact us if there are changes from that described so that we can evaluate whether modifications to our recommendations are appropriate.

SITE CONDITIONS

Surface Observations

At the time of our field exploration, the site of the proposed parking ramp was a vacant gravel-surfaced lot. The topography was relatively flat to gently sloping; we found about 4' of elevation difference among our eight borings on the parking ramp site. The site of the proposed addition was a relatively flat bituminous paved parking lot adjacent to the existing restaurant building.

At the time of our 2006 field exploration for the proposed restaurant addition, we observed an open hole in the bituminous parking lot about 20' southwest of the main entrance to the building. The hole was about 6" in diameter. We lowered a tape measure down the open hole and measured a depth of about 17' below grade. We returned to the site the following day and lowered a video camera down the hole. Based on the images that we observed from the video camera, the hole in the bituminous appeared to have developed over an old manhole that was open at the top. To temporarily cover the old manhole, a metal plate was placed over the top of the manhole and a bituminous patch was placed at the surface.

Geology

Based on a surficial geology map published by the Minnesota Geological Survey, the naturally-occurring surficial soils in the area of this site consist of sand and gravel of the Langdon Terrace of the West Campus Formation.

Based on the bedrock map published by the Minnesota Geological Survey, the upper bedrock in the area of the site is the Upper Ordovician Platteville and Glenwood Formations, consisting of limestone and shale. The bedrock surface is shown at approximately elevation 750 feet National Geodetic Vertical Datum (NGVD) in the area of this site, which corresponds to a depth of less than 10' to about 30' below the ground surface.

The Platteville Formation consists of five members: the Carimona, the Magnolia, the Hidden Falls, the Mifflin, and the Pecatonica. The Carimona, Magnolia, and Hidden Falls members are

often eroded in this area of St. Paul, leaving only the Mifflin and Pecatonica members. When it is present, the entire thickness of the Mifflin member is typically around 12' to 13' thick, and the Pecatonica member is usually about 1' to 2' thick in this area of St. Paul. In this area, the Glenwood Shale is typically about 3' to 4' thick, and the St. Peter Sandstone is on the order of about 150' thick.

Tunnels are known to exist in the St. Peter Sandstone in portions of downtown St. Paul. The main tunnels are generally located in the street rights-of-way. However, drifts were excavated into the building sites to allow the utilities to be hooked up to buildings. Although tunnel invert elevations vary, the majority of the tunnels are located within the upper 25' to 30' of the sandstone sequence. We strongly recommend that a detailed historical search of old underground utilities, sewers and tunnels, and mapping of old underground utilities and tunnels be completed in the area of the new parking ramp and restaurant addition prior to construction.

Soils

The logs of the test borings are included in the Appendix. The logs contain information concerning soil/bedrock layering, soil/bedrock classification, geologic description and moisture; the relative density or consistency of the soils are also noted, based on the Standard Penetration resistance (N-value, "blows per foot").

> The boring logs only indicate the subsurface conditions at the sampled locations. Variations often occur between and beyond the borings.

In each boring, we found a surficial layer of fill or possible fill consisting of a mixture of brown, dark brown, gray and black sand, silt, and clay extending to depths of about 2' to 17' below grade. The fill generally overlies bedrock or possible bedrock.

Bedrock

Below the fill in each boring, we encountered possible bedrock at depths of about 2' to 17' below grade, corresponding to elevations ranging from 66.7 to 89.9 feet SPCD. The following table

presents the estimated bedrock surface elevations, either weathered or sound rock. Please note that the bedrock surface elevation varies significantly across the site and may be deeper or shallower between borings than found at the borings. Further, there may be crevasses or ridges in the bedrock surface that are not evident at the ground surface.

TABLE A – ESTIMATED BEDROCK ELEVATIONS

Boring Number	Surface Elevation, feet SPCD	Total Depth Drilled, feet	Estimated Top of Bedrock, feet (Elevation, feet SPCD)
2006 Borings			
1	86.3	3.0	2.0 (84.3)
2	86.3	7.6	7.0 (79.3)
3	85.2	1.5	1.5 (83.7)
4	83.7	7.6	7.0 (76.7)
5	*(boring not drilled due to underground utility conflicts)*		
6	84.4	11.1	11.1 (73.3) (1)
7	83.6	1.5	1.0 (82.6)
2007 Borings			
1A	86.3	15.2	2.0 (84.3)
3A	85.2	15.2	1.5 (83.7)
4A	83.7	17.5	17.0 (66.7) (1)
8	93.8	20.3	5.5 (88.3)
9	95.0	8.5	8.5 (86.5)
10	94.0	20.8	5.0 (89.0)
11	93.1	20.4	6.0 (87.1)
12	91.4	4.0	2.0 (89.4)
13	92.9	5.8	4.0 (88.9)
14	94.3	6.4	5.0 (89.3)
15	92.4	20.2	2.5 (89.9)

Notes:
(1) = Boring could be in area of a former building on this site hat had a basement level and was later filled in.

In the borings that we did not diamond core, it is possible that some of the auger refusal that we encountered could have occurred on debris in the fill or on old foundations or slabs that were left in place from past structures. In the borings where we encountered auger refusal at depths less than about 3', we offset and re-drilled the borehole several times to assess the cause of auger refusal. In these borings, the deepest penetration depth is noted on the logs.

In order to verify bedrock and its condition, we diamond cored the bedrock at six locations. The upper bedrock that we encountered in our borings consisted of light gray to gray limestone of the Platteville Formation. On this site, only the Mifflin and Pecatonica members of the Platteville Formation were present in our borings. The bottom of the Platteville Limestone ranged from about 7' to 17' below grade, corresponding to elevations ranging from about 77 to 78 feet SPCD. Underlying the Platteville Limestone, we found gray shale of the Glenwood Formation extending to depths of about 11' to 20.5' below grade, corresponding to elevations ranging from about 73 to 74 feet SPCD. Underlying the shale in each of the borings that we diamond cored, we encountered light gray and light brown sandstone of the St. Peter Formation.

Core recoveries varied from 22% to 100%, with lower recoveries in the upper, more highly fractured Platteville Formation and in the underlying St. Peter Sandstone where sandstone can be eroded and washed out by the action of drilling water. The Rock Quality Designation (RQD) in the limestone ranged from 26% to 70%.

Based on the conditions that we found in our borings, we anticipate that bedrock would be encountered in excavations for foundations and underground utilities for this project. We cannot assess from our borings whether the bedrock can be excavated by ripping with bulldozers or by using a large backhoe with ripping teeth. In order to define the excavatability/rippability of this rock, we strongly recommend a supplementary exploration by means of test pits, using a large backhoe. We strongly recommend that this test pit exploration be carried out with mandatory attendance by all excavators who will bid the project.

draining soils. The presence of relatively shallow bedrock below the fill can also greatly impede the vertical migration of water infiltrating through the fill.

Limestone

In our opinion, the limestone of the Platteville Formation has a high strength and a low compressibility potential under the anticipated loads. The upper few feet of limestone is weathered at some of our borings locations and has a lower strength and higher compressibility than the underlying competent limestone. The Mifflin Member of the Platteville Formation can be very difficult to excavate. The limestone is generally judged to be slow draining; however, fractured and weathered zones within the limestone can allow rapid transmission of groundwater. The non-weathered portion of the limestone is not judged to be significantly frost susceptible. However, in our opinion, the weathered limestone would be considered moderately to highly frost susceptible.

Shale

In our opinion, the Glenwood Shale has a relatively high strength and a relatively low compressibility potential under the anticipated loads. However, the Glenwood Shale can undergo volume changes with changes in water content and due to elevated temperatures. When the water content in the shale increases, the shale can swell; the forces generated in swelling could lift light structures, possibly damaging foundations and floor slabs. Swelling of the shale has been a problem on some sites in the downtown St. Paul area. Swelling of the shale is generally more severe when the overburden soils and limestone are removed. Additionally, crystal formation within the shale has been observed in areas where temperatures and humidity levels are higher-than-normal. If the new structure will have equipment generating heat (e.g., high temperature boilers), please contact us for additional recommendations. The shale is judged to be slow draining and is at least moderately frost susceptible.

Sandstone

In our opinion, the St. Peter Sandstone has a high strength and a low compressibility potential under the anticipated loads. The sandstone is moderate to slow draining. The upper portion of the sandstone is generally slower draining due to its higher shale content and higher degree of cementation.

Approach Discussion

The depth to the top of bedrock varies significantly across the site, and it could be deeper or shallower than what we found in our borings. If the bedrock is deeper than what we found in our borings, the top of bedrock could be below the planned bottom of footings for the new parking ramp and addition. We recommend constructing all of the footings on bedrock to reduce the potential for differential settlement between footings bearing on bedrock and footings bearing on soil. In areas where the top of bedrock is lower than the anticipated bottom of footing elevation, the bottom of footing elevations and the heights of column piers and walls would vary with the elevation of bedrock. Strip footings would have to be stepped deeper to follow the bedrock, supported on horizontal benches at varying elevations.

Depending on the depth of bedrock, it is possible that the existing fill could extend deeper than the lower parking ramp slabs. If you choose to incur the risk of excessive total and differential floor slab settlement, then the existing fill soils could be left in place below the slabs. Where the existing fill is left in place under the slab, it should be surface-compacted with heavy towed or self-propelled vibratory roller, applying at least eight passes. If you cannot tolerate the risk of excessive floor slab settlement, then soil correction should be carried out under the entire footprint of the parking ramp where existing fill is encountered.

However, if the existing fill is left below the parking ramp slabs, the frost susceptibility of these soils must be considered. The existing silty and clayey fill soils on this site are judged to be moderately to highly frost susceptible. If a rigid pavement (i.e., a concrete slab-on-grade) is used for the lowest level of the unheated parking ramp, we recommend excavation of silty or clayey fill soils to a depth of at least 4' below the bottom of slab (or the top of competent bedrock), and replacement with non-frost-susceptible (NFS) granular soil. The purpose of this is to reduce the potential for the characteristic heave that can occur when silty or clayey soils freeze each winter. This heaving can raise the overlying slabs, possibly damaging the slabs. As an alternative to excavating and replacing the frost susceptible soils, you could consider placing a horizontal layer

feet SPCD for the below grade parking level, the bottom of footings would likely fall within the Glenwood Shale and the lower level floor slab would be within about 2' of the top of the Glenwood Shale. The Glenwood Shale can undergo swelling upon increases in water content, therefore we recommend that the spread footings be lowered to bear in the St. Peter Sandstone below the shale, and that the Glenwood Shale be removed from below the lowest level floor slab of the parking ramp. For portions of the ramp without a lower level, the footings could bear in the competent limestone above the shale, and the shale would not have to be removed from under the floor slab.

Depending on the depth of bedrock, it is possible that the existing fill could extend below the basement floor slab of the addition and below the street level parking ramp slab. If you choose to incur the risk of excessive total and differential floor slab settlement, then the existing fill soils could be left in place under the slabs. Where the existing fill is left in place under the slab, it should be surface-compacted with heavy towed or self-propelled vibratory roller, applying at least eight passes. If you cannot tolerate the risk of excessive floor slab settlement, then soil correction should be carried out under the entire footprint of the parking ramp where existing fill is encountered. However, if the existing fill is left below the parking ramp slabs, the frost susceptibility of these soils must be considered. Refer to the FROST ACTION subsection later in this report for additional recommendations.

Bedrock Excavation

Excavations for the basement in the addition and the below grade level in the parking ramp will extend into the bedrock. The bedrock excavation will likely extend through the entire section of Platteville Limestone. The Mifflin Member of the Platteville Formation is a very dense limestone (with compressive strengths as high as 15,000 pounds per square inch) with widely spaced natural fractures. Excavation of the Platteville Formation typically requires hard rock excavation techniques such as line drilling and chipping with hammers. The Glenwood Shale has a lower compressive strength than the Platteville limestone, but excavation will still require hard rock excavation techniques.

The St. Peter Sandstone is generally weakly cemented, and all though it has a high strength when confined, the sandstone is easily erodible when unconfined and exposed to groundwater seepage. Footings for the parking ramp and the addition will likely bear in the St. Peter Sandstone. Depending on the depth of excavation into the sandstone, and the groundwater conditions at the time of construction, excavation support could be required to stabilize the exposed sandstone. This could include soil nails or rock bolts with wire mesh and a grouted face. The need for stabilization of the sandstone will have to be evaluated at the time of construction and the Contractor must include an appropriate budget for such protection.

Excavation Retention Systems

If the contractor elects to use an open cut for the basement excavations, the sideslopes in the overburden soils must be laid back at a safe angle to meet OSHA requirements. In our opinion, the predominantly granular fill soils, or interbedded granular and cohesive fill soils encountered on this site would be preliminarily classified as "Type C," and the slopes would be limited to no steeper than 1.5 horizontal:1 vertical (1.5H:1V). However, soil discontinuities or layering observed in the excavation sideslopes, such as silt or sand seams or shrinkage cracks, may necessitate slopes shallower than 1.5H:1V. The final decision on the OSHA soil types and safe slopes must be made by the contractor's "competent person," and cannot be defined in this report.

An unbraced excavation will likely not be possible along the existing streets and alleys (depending on the depth of overburden soils above the bedrock), and a temporary earth retention system could be required to provide a safe excavation. If a temporary earth retention system is chosen for some portions of the basement excavation, common methods for this type of construction in this area are driven or drilled soldier piles and wood lagging, or braced steel sheet piles. The toes of the piles must be installed deep enough to provide lateral retention at the base. This will likely require pre-drilling into the bedrock. The responsibility for the design of an open cut or a temporary retention system lies with the contractor.

The bedrock will typically stand at near-vertical angles; however, the final decision on safe bedrock slopes must be made by the contractor's "competent person," and cannot be defined in this report. Because the Platteville Limestone is fractured, the intersection of near vertical fractures with horizontal discontinuities such as bedding planes can cause blocks of rock to fall into the excavation. Rock anchors (or rock bolts) and/or shotcreting will likely be required to stabilize the exposed vertical rock face and provide a safe excavation. This type of stabilization would also likely be required adjacent to existing structures to reduce the potential for excessive settlement of the existing buildings during excavation of the below grade levels. This will have to be evaluated at the time of construction and the Contractor must include an appropriate budget for such protection.

Filling/Compaction

After removing the shale in the lower level floor slab of the parking ramp, new compacted granular fill could be placed up to the planned subgrade elevation. Granular fill could also be used to reestablish the planned floor slab subgrade elevation in the addition if over-excavation of the bedrock occurs under the floor slab. Granular fill placed under the lower level slab of the unheated parking ramp should be non-frost susceptible, as described in the FROST ACTION section of this report. For fill below the addition slab, we recommend using an imported granular soil with less than 20% passing the No. 200 sieve no gravel larger than 3", such as Mn/DOT 3149.2B1. If the Contractor proposes a different type of fill, a sample should be submitted to our laboratory for testing and review by a Geotechnical Engineer.

Fill placed below the addition and parking ramp slabs should be placed in thin lifts and compacted to at least 95% of the maximum Standard Proctor dry density (ASTM: D 698). The fill should be placed in lifts thin enough to attain the specified compaction level throughout the entire lift thickness. This normally requires that fill be placed in loose lifts less than 8" thick.

Please refer to the standard data sheet at the end of this report entitled "Excavation and Refilling for Structural Support" for general information regarding excavation and fill placement for

foundation support. This standard sheet also addresses excavation and fill placement during cold weather.

Foundation Recommendations

After the site preparation described above, the addition and parking ramp can be supported on conventional spread footing foundations bearing directly on competent limestone or sandstone bedrock; the footings should not bear in the Glenwood Shale. Depending on the foundation elevations, removal of weathered and/or highly fractured limestone could be required to reach competent limestone. Additionally, over-excavation of bedrock could be required to extend the footings through the Glenwood Shale. Details of our foundation recommendations are given below.

Restaurant Addition

The lower level floor slab of the restaurant addition is planned at about elevation 73.5 feet SPCD. At this elevation, we anticipate that the footings would bear on the St. Peter Sandstone. Based on the conditions found in our borings, it is our opinion that footings bearing directly on the St. Peter Sandstone could be proportioned for a maximum net allowable bearing capacity of up to 50 tons per square foot (tsf). The factor of safety with respect to bearing capacity for this design would exceed 3. Based on this design, we estimate that total post-construction building settlement would not exceed 1", with differential settlement less than ½" over a horizontal distance of 30'.

The settlement of the existing building has probably already fully occurred. Thus, even acceptable settlement of the addition, commonly taken as 1" or less, would be differential from the existing building. We recommend that connections between the addition and the existing building be designed to accommodate this relative movement.

Parking Ramp

Based on a planned finished floor elevation of about 79 feet SPCD for the below grade parking level, the lowest parking slab would be slightly above the contact between the Platteville Formation and the Glenwood Shale and the bottom of footings would likely fall within the

If tunnels exist in the area of the proposed footings, those footings would have to be lowered to bear within the sandstone at a depth that would allow for a 1 horizontal to 1 vertical (1:1) slope between the outside edge of the footing and the bottom outside edge of the tunnel invert. As an alternative to lower the spread footings, caissons (drilled piers) could be extended into the sandstone to provide the same 1:1 separation between the outside edge of the foundation and the tunnel invert

Building Floor Slabs

We recommend importing a 100% crushed concrete or crushed limestone Class 5 aggregate for the floor slab base in the lower level of the parking ramp. The purpose of the Class 5 crushed aggregate base below the parking ramp slab is to provide a firmer base and to allow the contractor to place a flatter slab; the Class 5 would also help the slab performance under traffic at joints in the slab. The minimum thickness of the Class 5 should be 6". The Class 5 aggregate base should be compacted to at least 98% of the maximum Standard Proctor dry density, or to meet the criteria for Mn/DOT dynamic cone penetrometer (DCP) tests. Refer to the BUILDING GRADING section of this report for additional recommendations on excavation and filling in floor slab areas.

For relative ease of compaction in confined spaces, we recommend that imported granular soils with less than 20% passing the No. 200 sieve (such as Mn/DOT 3149.2B1) be used as interior backfill around the new foundations and in underslab utility trenches inside the addition and parking ramp. Cohesive or semi-cohesive soil, or cobbles/ boulders should not be used for this backfill.

The backfill should be placed in thin lifts, with each lift mechanically compacted using manually-operated vibratory or impact equipment, to at least 95% of the maximum Standard Proctor dry density. The fill should be placed in lifts thin enough to attain the specified compaction level throughout the entire lift thickness. This normally requires that fill be placed in

loose lifts less than 8" thick. We recommend not using heavy towed or self-propelled compactors within 4' of newly constructed foundation walls; such equipment can damage the new walls.

Based on a subgrade prepared with this type of backfill, and after general site grading, the floor slabs can be cast on-grade. For slabs cast on new compacted granular fill, we recommend using a modulus of subgrade reaction (k) of 220 pounds per cubic inch (pci) for design of the slabs. For slabs cast on Class 5 material, we recommend using a modulus of subgrade reaction of 260 pci. If the existing fill is to be left in place under the slabs, a modulus of 150 pci should be used.

We recommend placing a vapor retarder under the floor slab of the addition. The purpose of a vapor retarder is to reduce the potential for upward migration of water vapor from the soil into and through the concrete slab. Water vapor migrating upward through the slab can damage floor coverings, coatings, or sealers placed on the slab, or materials/packages stored on the slab, and contribute to excess humidity and possible microbial growth in a building. For additional recommendations on moisture and vapor protection of floor slabs, please refer to the standard sheet at the end of this report entitled "Floor Slab Moisture/Vapor Protection."

Frost Action

Unheated structures (such as the parking ramp) with slabs cast on subgrade soils consisting of primarily of silt or clay can experience slab heaving and cracking each winter when the soils freeze. To reduce the risk of slab heaving and cracking, we recommend excavation and replacement of silty or clayey soils to a depth of at least 4' below the bottom of slab, and replacement with non-frost-susceptible (NFS) granular soil. The NFS sand should be a sand or sand and gravel mix having less than 5% passing the No. 200 sieve and less than 40% passing the No. 40 sieve. The NFS sand should be placed in thin lifts and compacted to at least 95% of the maximum Standard Proctor dry density. We recommend placing drainpipes at the base of the NFS granular fill, connected to the site storm sewers to remove infiltrating water.

As an alternative to excavating the frost susceptible soils and replacing them with NFS fill, you could consider placing a horizontal layer of high quality insulation beneath the slab. The