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Bid Bulletin #01

PROJECT: St. Paulinus Catholic Church – New Parish Hall

DATE: 4/15/2014

This Bid Bulletin includes items 1-1 through 1-5. Each item shall be fully incorporated into the Bidding/Contract Documents and have the same force and effect as though originally included. Bidders shall acknowledge receipt of this Bid Bulletin on the bid form.

Item 1-1 Door hardware for Doors 001-008 shall be Hardware Set 4.

Item 1-2 Sheet A120, Room Finish Schedule, Room 116 ceilings shall be ACP-2 per specification 095113. All other ceilings noted as ACT shall be ACP-1 per specification 095113.

Item 1-3 New Fire Sprinkler System shall be included for the New Addition Only.

Item 1-4 Attached is the Geotechnical Report prepared by Olsson Associates.

Item 1-5 Specification Section 04 2000 – Unit Masonry shall be added to the project specification. See Attached.

End of Bid Bulletin #01

REPORT OF GEOTECHNICAL EXPLORATION

ST. PAULINUS CHURCH ADDITION
NEAR THE INTERSECTION OF
POPLAR STREET & 5TH STREET
SYRACUSE, NEBRASKA

PREPARED FOR
CLARK ARCHITECTURAL COLLABORATIVE^3

PREPARED BY
OLSSON ASSOCIATES

MAY 13, 2013

OLSSON PROJECT NO: 013-0419

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OLSSON ASSOCIATES

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A. PROJECT UNDERSTANDING

A.1. GEOTECHNICAL SCOPE

This report presents the results of the geotechnical subsurface exploration performed for the proposed St. Paulinus Church addition and associated pavement areas. The proposed development is located southeast of the intersection of Poplar Street & 5th Street in Syracuse, Nebraska.

The purpose of this exploration was to evaluate the subsurface conditions and provide recommendations regarding the design of foundations, floor slabs, and pavement for the proposed St. Paulinus Church addition and pavement areas. We have completed the following scope of services for this project:

- Performed a site reconnaissance and reviewed geologic subsurface conditions.
- Drilled four soil test borings to depths ranging from 20 to 25 feet in the proposed building addition area.
- Drilled three soil test borings to a depth of 10 feet in the proposed pavement areas.
- Performed laboratory tests on selected soils samples obtained during drilling operations.
- Conducted a geotechnical engineering evaluation using information obtained from our observations, soil test borings and laboratory tests, and information available regarding the proposed construction.
- Preparation of this Report of Geotechnical Exploration presenting the soil test borings, laboratory test results, and a summary of our engineering evaluations and recommendations.

The scope of this exploration did not include any environmental assessment for the presence of wetlands and/or hazardous or toxic materials in the soil or groundwater on or near the site. Any statements in this report regarding odors, discoloration, or suspicious conditions are strictly for the information of our client.

A.2. SITE LOCATION AND DESCRIPTION

The proposed St. Paulinus Church addition and pavement areas are planned on a lot located southeast of the intersection of Poplar Street and 5th Street in Syracuse, Nebraska. At the time of our field exploration, the site consisted of grass vegetation, concrete pavement, and asphalt pavement that was accessible with a truck mounted drill rig. Based on historical photos, three houses were depicted in the area of the proposed addition. Two of these homes were demolished sometime between the years of 1993 and 1999. The third home is planned to be demolished as part of this project. The approximate location of the proposed addition, pavement areas, previous houses, and existing house are depicted on the Boring Location Plan included in *Appendix A*.

A.3. PROJECT INFORMATION

The proposed construction will consist of the building addition located on the south side of the existing St. Paulinus Church and its associated pavement areas. The proposed single-story building addition is anticipated to be approximately 9,500 square feet. It was assumed that no portion of the building would have a basement. The location of the proposed building addition and pavement areas are depicted on the Boring Location Map included in *Appendix A*.

The finished floor elevation (FFE) for the proposed addition was provided by ***Olsson*** to be approximately 1113.5. According to the topographic map, the existing site grades across the proposed addition range from a low elevation of 1108 to a high elevation of 1114. Based on the finished floor elevation, grading operations within the proposed building addition are anticipated to include a maximum structural fill depth of 5.5 feet with minimal excavation (less than one feet) will be required to achieve the design grades within the proposed building addition.

Structural design loads were not provided; however, based on our experience with similar structures, maximum column and continuous wall loads for the proposed buildings are not anticipated to exceed approximately 100 kips and 3.0 kips per lineal foot, respectively.

Traffic loads on the proposed parking lot and driveway pavements were assumed to consist of cars, pickup trucks, garage trucks, and delivery trucks. Since the traffic volumes were not provided, the frequency of each vehicle driving on the proposed pavement areas were assumed to be similar to the traffic loads utilized in similar developments.

B. Exploratory and Test Procedures

B.1. Field Exploration

The field exploration program consisted of performing seven soil test borings at the locations depicted on the Boring Location Plan presented in *Appendix A*. The ground surface elevations at the boring locations were interpreted from the topographic map provided by ***Olsson***. The surface elevations at the boring locations were rounded to the nearest half-foot and are presented on the boring logs.

The soil test borings were extended to depths ranging of 10 to 25 feet below the existing ground surface with a truck-mounted drill rig using hollow stem augers. Soil samples were obtained at selected intervals in the soil test borings. Soils samples designated as "U" samples on the boring logs were obtained in using Thin-Walled Tube Sampling techniques. Soil samples designated as "SS" samples were obtained during Penetration Test using a Split-Spoon Barrel sampler. Recovered samples were sealed in containers, labeled, and protected for transportation to the laboratory for testing.

B.2. Laboratory Testing

Descriptions of the soils encountered in the soil test borings were prepared using Visual-Manual Procedures for Descriptions and Identification of Soils. Laboratory tests were also performed to evaluate the engineering properties for the recovered soil samples. Moisture content tests and density determinations were used to determining the existing moisture/density condition of the soils. Unconfined compression tests were used to help define the stress-strain characteristics and related shear strength of the cohesive soils. Two Atterberg limits tests were conducted to aid in the classification of the soils under the Unified Classification System and to indicate the shrink/swell potential of the soils. A consolidation test and a swell/consolidation test were conducted to determine the swell potential and the potential settlement of the proposed structures. A summary of the laboratory test results is presented in *Appendix C*.

C. SUBSURFACE CONDITIONS

C.1. AREA GEOLOGY

The site lies in the Hillslopes region of Nebraska at the interface of the Morrill-Malmo and the Wymore silty clay loam soils. The Morrill-Malmo soils are known to be moderately well drained, have a moderately low to moderately high permeability with slopes ranging from 2 to 5 percent. The Wymore silty clay loam soils are known to be well drained, have a moderately high permeability with slopes ranging from 3 to 9 percent. The majority of the site was most recently utilized as grass vegetation and concrete pavement.

C.2. TEST BORINGS AND LABORATORY SUMMARY

The generalized subsurface profile for this site, in descending order, generally consisted of grass vegetation, concrete pavement and asphalt pavement overlying fill, Loveland formation and weathered glacial till soils. Specific soil descriptions are noted in more detail on the Soil Test Boring Logs in *Appendix* B.

Developed Zone

A developed zone with approximately 2 inches of topsoil was encountered in soil test borings B-3 and B-5 through B-7, which consisted of varying amounts of organics and roots. Organic material is typically considered unsuitable for structural support or for use as structural fill due to its high organic content. It should be noted that the developed zone encountered in the soil test borings is to be stripped and stockpiled outside of the construction area prior to the placement of structural fill.

Concrete

Concrete, approximately 4 to 5 inches thick, was encountered in soil test borings B-1 and B-2 at the time of drilling operations. It should be noted that the concrete encountered in the soil test borings is to be removed outside of the construction area prior to the placement of structural fill.

Asphalt

Asphalt, approximately 3 inches thick, was encountered in soil test boring B-4 at the time of drilling operations. It should be noted that the asphalt encountered in the soil test borings is to be removed outside of the construction area prior to the placement of structural fill.

Fill

Existing fill was encountered in each of the soil test borings and extended to depths ranging from 3.0 to 5.0 feet below the existing ground surface. Soil identified as existing fill were generally firm to very stiff, strong brown to dark brown, moist to very moist, mostly lean clay and fat clay with trace fine sand. Laboratory tests on recovered samples from this stratum depicted a moisture content ranging from 16.1 to 34.5 percent, dry densities ranging from 86.8 to 103.9 pounds per cubic foot (pcf), and unconfined compressive strength values ranging from 0.7 to 2.8 tons per square foot (tsf). Atterberg limits test performed on the existing fill indicated a liquid limit ranging from 34 to 63 with a plastic index ranging from 15 to 37. The unconfined compressive strength values indicated a firm to very stiff consistency for the existing fill soils.

Loveland Formation

Loveland formation was encountered in soil test borings B-1 through B-4 and extended to depths ranging from 7.5 to 10.0 feet below the existing ground surface. Soils identified as Loveland formation were generally firm to very stiff, light greyish brown to strong brown, moist, mostly lean clay with trace fine sand. Laboratory tests on recovered samples from this stratum depicted a moisture content ranging from 16.7 to 21.7, dry densities ranging from 101.9 to 104.6 pcf, and unconfined compressive strength values ranging from 1.1 to 1.7 tsf. The unconfined compressive strength values indicated a stiff consistency for the Loveland formation soils.

Weathered Glacial Till (Cohesive)

Cohesive weathered glacial till was encountered in each of the soil test borings and extended to depths ranging from 9.0 feet below the existing ground surface to the base of the soil test boring. Soils identified as cohesive weathered glacial till were generally firm to very stiff, light brown to light grey, moist to very moist, mostly silty lean clay with trace fine sand. Laboratory tests on recovered samples from this stratum depicted a moisture content ranging from 14.0 to 29.9, dry densities ranging from 84.6 to 103.3 pcf, and an unconfined compressive strength value of 2.1 tsf. A P-200 test performed on a sample of the cohesive weathered glacial till indicated 93.4 percent of the material passed through the #200 sieve. Standard penetration resistance “N” values obtained in this stratum ranged from 18 to 31 blows per foot (bpf). The unconfined compressive strength values and the standard penetration resistance “N” values indicated a very stiff to hard consistency for the weathered glacial till soils.

Weathered Glacial Till (Cohesionless)

Cohesionless weathered glacial till was encountered in soil test borings B-1, B-2 and B-7 and extended to depths ranging from 15.0 feet below the existing ground surface to the base of the soil test boring. Soils identified as cohesionless weathered glacial till were generally medium dense, light grey to yellowish brown, dry to moist, mostly fine sand with little silt. Laboratory tests on recovered samples from this stratum depicted a moisture content ranging from 3.0 to 8.2 percent with 17.7 percent of the material passing through the #200 sieve. A standard penetration resistance "N" value obtained in the cohesionless weathered glacial till resulted in 16 bpf. The standard penetration resistance "N" values indicated a medium dense relative density for the cohesionless weathered glacial till material.

C.3. GROUNDWATER SUMMARY

Groundwater was not entered in the soil test borings at the time of drilling operations. The dates, conditions and depths of the groundwater table are noted in more detail on the Soil Test Boring Logs in *Appendix B*. Groundwater levels will fluctuate depending on seasonal variations of precipitation and other factors that may occur and higher elevations at some time in the future. ***Section D.6.*** of this report will address any site drainage concerns with water elevations in this region.

D. Site Preparation

D.1. Demolition of the Existing Structures/Utility Relocation

Initial site preparation for the redevelopment area should commence with the demolition/relocation of the existing utilities, pavement areas, and the existing structures within the proposed redevelopment area. Demolition should include removal of any at grade slabs, gravel and concrete associated with the building, driveways, sidewalks, and utilities. All broken concrete and other debris from the demolition operations should be removed from the site and disposed of in accordance with applicable regulations. All disturbed soils should be undercut prior to placement of structural fill. All utility lines and driveways should be relocated to areas outside of the proposed construction area. Excavations created by removal of the existing lines should be cut wide enough to allow for use of construction equipment to recompact the structural fill. In addition, the base of the excavation should be thoroughly evaluated by an ***Olsson*** geotechnical engineer or engineering technician prior to the placement of structural fill. All fill should be placed in accordance with the recommendations presented in the *Structural Fill* section of this report.

D.2. Site Preparation – Building Area

In all new fill and excavation areas, vegetation, topsoil (typically 2 inches thick), roots, concrete (typically 4 to 5 inches thick), asphalt (typically 3 inches thick) and other deleterious materials deemed unsuitable by the full-time field observer shall be removed from the proposed construction area, and replaced with controlled fill. Site clearing, grubbing, and stripping will need to be performed only during dry weather conditions. Operations of heavy equipment on the site during wet conditions could result in excessive rutting and mixing of organic debris with the underlying soils.

Based on the laboratory test results and site observations made during drilling operations, the existing fill soils were found to be variable in density and moisture content and will not be suitable for support of the building addition area. Therefore, we recommend overexcavating the proposed building addition areas to the base of the fill material. During our field exploration, the existing fill was encountered at depths ranging from 3.0 to 5.0 feet below the existing ground surface. The actual existing fill depths should be verified by a representative of ***Olsson*** during grading operations. By overexcavating the proposed building addition area to the base of the fill material, the future addition will be supported on a uniform, compacted subgrade consisting of structural fill. This uniform subgrade will significantly reduce the potential settlement and differential settlement of the building and pavement.

Excavations for the building addition should be extended horizontally 5 feet beyond the perimeter of the buildings outer edge. The sides of the excavation should be sloped at a 1(H):1(V) to permit controlled earth fill to be placed against the sides of the excavations to the specified degree of compaction as stated in ***Section D.4*** of this report. Backfill placed on sloped areas shall be "benched" horizontally a minimum of five feet into the side of the slope, so that the lifts of backfill are placed and compacted in as nearly a horizontal plane as possible. Lifts of backfill material shall be placed and compacted in such a fashion to allow overlying lifts to interlock with the underlying soils to reduce consolidation potential along the slope interface. In addition to the fill placement along the slopes, the base of the excavation should be at least wide enough to allow for compaction equipment to be utilized. A representative from ***Olsson*** should observe the excavation operations to document conformance to the above recommendations. Please refer to the soil test boring logs in *Appendix B* for use in estimating the existing fill excavation volume. Actual existing fill removal volume should be based upon field observations made during the excavation process.

At the base of excavation operations, we recommend the top 12.0 inches of the exposed subgrade soils be scarified and recompacted to 98 percent of the maximum dry density at a moisture content ranging from -1 to +3 percent. Unstable and unsuitable soils, which cannot be adequately densified in-place, should be removed under the direction of the ***Olsson*** representative. The contractor shall be responsible for maintaining a working platform at the base of all excavations and should keep the construction traffic on the exposed subgrade soils to a minimum. Unstable and unsuitable soils, which are revealed during the compaction process and which cannot be adequately densified in-place, should be removed under the direction of the ***Olsson*** representative. It may be necessary to perform selective removal of soft, wet soils and/or stabilize existing soft soils in-place. If required, the methods of stabilization will typically include the use of crushed stone and/or a geosynthetic fabric or grid installed over the soft soils. The identification of areas that may require undercutting and/or stabilization would be based on the actual conditions at the time of construction, and will depend on the location and extent of the soft area.

Care should be taken not to disturb soils beneath the existing building foundations. It is recommended that, where possible, excavations below existing footings not extend below an imaginary plane extending out and down from the outside edge of the existing footings at a slope of approximately 2H:1V. Even with these criteria, excavation that extended below the level of existing foundations should be backfilled the same day they are excavated. Where this is impractical, shoring or underpinning of existing foundations may be required.

The Atterberg limits test results on the existing fill soils indicated a liquid limit ranging from 34 to 62 with a plasticity index ranging from 15 to 36. Based upon the results of the Atterberg limits test, it appears that the fill soils are variable and that portions will not be acceptable for reuse within two (2) feet of the base of the floor slab or granular cushion. Some of the excavated material may be suitable for reuse as structural fill if approved by an on-site representative of ***Olsson*** through Atterberg limits testing during construction. It is recommended that all structural fill have a liquid limit less than 45 and a plasticity index less than 25 within 2 feet of the base of the floor slab or granular cushion. Structural fill soils that are placed at depths greater than 2 feet from the base of the floor slab or granular cushion should have a liquid limit less than 60 with a plasticity index less than 40. The suitability of the structural fill soils should be determined by an on-site representation of ***Olsson*** through Atterberg limits testing completed during construction.

Type 'C' flyash could be used to treat the on-site soils within the building addition area within 2 feet of the base of the floor slab or granular cushion. The on-site soils should be thoroughly mixed with at least 14 percent (by dry unit weight) Type 'C' flyash and compacted to the recommendations in ***Section D.4.*** The flyash should be incorporated into in each lift with high speed rotary pulverization equipment.

D.3 Site Preparation – Pavement Areas

In all new fill and excavation areas, vegetation, topsoil (typically 2 inches thick), roots, concrete (typically 4 to 5 inches thick), asphalt (typically 3 inches thick) and other deleterious materials deemed unsuitable by the full-time field observer shall be removed from the proposed construction area, and replaced with controlled fill. Site clearing, grubbing, and stripping will need to be performed only during dry weather conditions. Operations of heavy equipment on the site during wet conditions could result in excessive rutting and mixing of organic debris with the underlying soils.

Based on the laboratory test results and site observations made during drilling operations, the existing fill soils were found to be variable in density and moisture content and will not be suitable for support of the pavement areas. Therefore, we recommend overexcavating the proposed pavement areas to the base of the fill material. During our field exploration, the existing fill was encountered at depths ranging from 3.0 to 5.0 feet below the existing ground surface. The actual existing fill depths should be verified by a representative of ***Olsson*** during grading operations. By overexcavating the proposed pavement areas to the base of the fill material, the future pavement will be supported on a uniform, compacted subgrade consisting of structural fill. This uniform subgrade will significantly reduce the potential settlement and differential settlement of the building and pavement.

Excavations for the building addition should be extended horizontally 5 feet beyond the perimeter of the buildings outer edge. The sides of the excavation should be sloped at a 1(H):1(V) to permit controlled earth fill to be placed against the sides of the excavations to the specified degree of compaction as stated in ***Section D.4.*** of this report. Backfill placed on sloped areas shall be "benched" horizontally a minimum of five feet into the side of the slope, so that the lifts of backfill are placed and compacted in as nearly a horizontal plane as possible. Lifts of backfill material shall be placed and compacted in such a fashion to allow overlying lifts to interlock with the underlying soils to reduce consolidation potential along the slope interface. In addition to the fill placement along the slopes, the base of the excavation should be at least wide enough to allow for compaction equipment to be utilized. A representative from ***Olsson*** should observe the excavation operations to document conformance to the above recommendations. Please refer to the soil test boring logs in *Appendix B* for use in estimating the existing fill excavation volume. Actual existing fill removal volume should be based upon field observations made during the excavation process.

At the base of excavation operations, we recommend the top 12.0 inches of the exposed subgrade soils be scarified and recompacted to 98 percent of the maximum dry density at a moisture content ranging from -1 to +3 percent. Unstable and unsuitable soils, which cannot be adequately densified in-place, should be removed under the direction of the ***Olsson*** representative. The contractor shall be responsible for maintaining a working platform at the base of all excavations and should keep the construction traffic on the exposed subgrade soils to a minimum. Unstable and unsuitable soils, which are revealed during the compaction process and which cannot be adequately densified in-place, should be removed under the direction of the ***Olsson*** representative. It may be necessary to perform selective removal of soft, wet soils and/or stabilize existing soft soils in-place. If required, the methods of stabilization will typically include the use of crushed stone and/or a geosynthetic fabric or grid installed over the soft soils. The identification of areas that may require undercutting and/or stabilization would be based on the actual conditions at the time of construction, and will depend on the location and extent of the soft area.

Care should be taken not to disturb soils beneath the existing building foundations. It is recommended that, were possible, excavations below existing footings not extend below an imaginary plane extending out and down from the outside edge of existing footings at a slope of approximately 2H:1V. Even with these criteria, excavation that extended below the level of existing foundations should be backfilled the same day they are excavated. Where this is impractical, shoring or underpinning of existing foundations may be required.

The Atterberg limits test results on the existing fill soils indicated a liquid limit ranging from 34 to 62 with a plasticity index ranging from 15 to 36. Based upon the results of the Atterberg limits test, it appears that the fill soils are variable and that portions will not be acceptable for reuse within 12 inches of the base of the pavement. Some of the excavated material may be suitable for reuse as structural fill if approved by an on-site representative of ***Olsson*** through Atterberg limits testing during construction. It is recommended that all structural fill have a liquid limit less than 45 and a plasticity index less than 25 within 12 inches of the base of the pavement. Structural fill soils that are placed at depths greater than 12 inches from the base of the pavement should have a liquid limit less than 60 with a plasticity index less than 40. The suitability of the structural fill soils should be determined by an on-site representation of ***Olsson*** through Atterberg limits testing completed during construction.

Type 'C' flyash could be used to treat the on-site soils within the building addition area within 12 inches of the base of the pavement. The on-site soils should be thoroughly mixed with at least 14 percent (by dry unit weight) Type 'C' flyash and compacted to the recommendations in ***Section D.4***. The flyash should be incorporated into each lift with high speed rotary pulverization equipment.

D.4. Structural Fill

During construction, we recommend that all fill materials placed in the building addition area have a liquid limit of less than 45 and a plasticity index less than 35 within 3 feet from the base of the floor slab or granular cushion. Structural fill soils within the pavement areas should have a liquid limit of less than 45 and a plasticity index less than 35 within 12 inches from the base of the pavement. Structural fill soils that are placed at depths greater than 3 feet from the base of the floor slab or granular cushion should have a liquid limit less than 60 with a plasticity index less than 40. Structural fill soils that are placed in the proposed pavement areas should have a liquid limit less than 60 with a plastic index less than 40.

In addition to the plasticity characteristics, the fill soils should also be relatively free of organic materials (less than about two hundredths by weight), other deleterious material and should not contain particle sizes larger than three inches. Imported fill material should be tested prior to placement at the site to verify it complies with the criteria stated in this section of the report. Samples of the proposed imported structural fill should be submitted at least three days prior to placement so the necessary laboratory tests can be performed.

Suitable fill material should be placed in thin lifts (lift thickness depends on type of compaction equipment, but in general, lifts of 8 inches loose measurement are recommended). The soil should be compacted by heavy compaction equipment such as a Caterpillar 815 sheepsfoot roller. Within small excavations, such as in utility trenches (less than 24 inches in width), around manholes or behind retaining walls, we recommend the use of "wacker packers", "Rammax" compactors, or vibrating plate compactors to achieve the specified compaction. Loose lift thickness of 4 inches are recommended in small area fills.

We recommend that structural fill and backfill be compacted in accordance with the criteria stated in Table 1. A qualified field representative should periodically observe fill placement operations and perform field density tests concurrently to indicate if the specified compaction is being achieved.

TABLE 1

STRUCTURAL FILL PLACEMENT GUIDELINES

Areas of Fill Placement	Compaction Recommendation (ASTM D698-Standard Proctor)	Moisture Content (Percent of Optimum)
Granular Cushion Beneath Floor Slab (If used)	98%	As necessary to obtain density
Floor Slab/Soil Subgrade – 3' below the base of the granular cushion (if used) or Floor Slab	98%	-1 to +3 percent
Structural fill placed below the Floor Slab Subgrade and within 5 feet of the perimeter of the building pad	98%	-2 to +3 percent
Pavement Soil Subgrade – 1' below the base of the pavement	98%	-1 to +3 percent
Structural fill placed below the base of the Pavement Soil Subgrade	98%	-2 to +3 percent
Utility Trenches - Within building and pavement areas	98%	-1 to +3 percent
Beneath Landscaped/Grass Areas	92%	As necessary to obtain density

The moisture content of suitable borrow soils should generally be between the specified ranges in Table 1. More stringent moisture limits may be necessary with certain soils. Adjustment of moisture content may be necessary to allow compaction in accordance with project specifications. Dependent on the percentage of fines, the clean free-draining aggregates utilized in the granular cushion beneath the floor slab could alternatively be consolidated by means of a vibratory compactor to at least 70% "relative density", as determined in accordance with ASTM D 4253 (Standard Test Methods for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table) and D 4254 (Standard Test Methods for Minimum Index Density and Unit Weight of Soils and Calculations of Relative Density).

D.5. CONSTRUCTION EQUIPMENT MOBILITY

Some of the soils encountered at this site may be highly susceptible to softening under the action of construction equipment traffic in combination with wet weather. Mitigation of equipment mobility problems and management of soft surficial soils will be greatly dependent on the severity of the problem, the season in which construction is performed and prevailing weather conditions.

Some general guidelines for reducing equipment mobility problems and dealing with soft, wet, surficial soils are as follows:

- Optimize surface water drainage at the site.
- Whenever possible, wait for dry weather conditions to prevail, and do not operate construction equipment on the site during wet conditions. Rutting the surface will only aggravate the problem.
- Use construction equipment that is well suited for the intended job under the site conditions. Heavy rubber-tired equipment typically requires better site conditions than light, track-mounted equipment, especially on granular and less cohesive soil conditions.
- Implement a construction schedule that realistically allows for rain days. Pressure to perform earthwork under a tight schedule is frequently counterproductive.

Ultimately, it may be necessary to take steps to aggressively improve construction mobility if construction must proceed under unfavorable conditions. Methods for addressing equipment mobility problems may range from removing several feet of soft wet soils, to utilizing crushed stone materials and/or appropriate stabilization fabrics. Other methods include cement modification of soils, lime stabilization, etc. The optimal approach should be determined by a representative of the geotechnical engineer at the time of construction.

Any additional disturbance below the proposed subgrade elevation should be the responsibility of the general contractor to stabilize by means which are in accordance with the project specifications and this report. Any site or soil conditions which are a result of adverse weather conditions and which may require additional measures to improve construction mobility and site conditions should be the responsibility of the general contractor. The contractor should not allow water to collect near the surface of foundation or floor slab areas, either during or after construction. Site grading should be designed to provide rapid and efficient drainage of water away from the building and pavement areas at all times during construction.

D.6. Drainage and Groundwater Considerations

At the time of drilling operations, groundwater was not encountered in soil test borings and it is not anticipated to affect construction activities. It should be noted that variations in groundwater elevations could be expected based on seasonal changes in rainfall, temperature, snow melt, runoff, localized irrigation demand, or other factors that may differ from those at the time of the drilling operations.

In general, water should not be allowed to collect near the surface of the foundation or floor slab areas of the structures during or after construction. Since soils generally tend to soften when exposed to free water, provisions should be made to remove seepage water from excavations, should it occur. In addition, undercut or excavated areas should be sloped toward one corner to facilitate the collection and removal of rainwater or surface runoff.

The site should also be graded to avoid water flows, concentrations, or pools behind grade retaining walls. If swales are designed at the top of the walls, proper line and slope should be considered to avoid any moisture infiltration behind the walls. Special attention to sources of storm water from building roofs, gutter downspouts, and paved areas draining to one point is needed.

Additionally, in order to minimize concerns related to improper drainage away from the building foundation that tend to soften subgrade soils that are exposed to water, we provide the following general recommendations:

- Site grading should provide for efficient drainage of rainfall away from building areas, with a minimum slope of 2% for pavement areas and 5% for grass or landscaped areas.
- Roof run-off should be collected and transferred directly to the storm sewer system, if possible, or to a location well away from the building. Conventional downspout drainage leading to splash blocks, though not as desirable, may be used.
- Install clay plugs in each utility trench for utility line penetrations entering the building pad. The compacted clay plug should extend a minimum distance of five feet out from the building exterior.
- External hose connections should incorporate splash blocks to prevent localized accidental flooding of foundation soils. External hose connections should have cutoff valves inside the building to prevent accidental or unauthorized use of external hose connections.

- Building maintenance personnel should be informed of the potential problems associated with watering in close proximity to the building. Excessive watering of shrubs or lawns near buildings should be avoided. Placement of deep-rooted or water-intensive shrubs near buildings also should be avoided.

D.7. TEMPORARY SLOPES AND EXCAVATIONS

The owner and the contractor should make themselves aware of and become familiar with applicable local, state, and federal safety regulations, including current OSHA excavation and trench safety standards. Construction site safety generally is the sole responsibility of the contractor. The contractor shall also be solely responsible for the means, methods, techniques, sequences, and operations of construction operations. ***Olsson*** is providing the following information solely as a service to our client. Under no circumstances should ***Olsson's*** provision of the following information be construed to mean that we are assuming responsibility for construction site safety or the contractor's activities, as such responsibility is not implied and should not be inferred.

The contractor should be aware that slope height, slope inclination, and excavation depths (including utility trench excavations) should in no case exceed those specified in local, state, or federal safety regulations; e.g., *OSHA Health and Safety Standards for Excavations, 29 CFR Part 19266,* or successor regulations. Such regulations are strictly enforced and, if not followed, the owner, the contractor, or earthwork or utility subcontractors could be liable for substantial penalties.

For this site, the overburden soil encountered in our exploratory borings generally consisted of firm to very stiff lean clay to fat clay. We anticipate that OSHA will classify the cohesive soils as type B. OSHA recommends a maximum slope inclination of 1(H):1(V) for type B soils.

Note: Soils encountered in the construction excavations may vary significantly across the site. Our preliminary soil classifications are based solely on the materials encountered in the widely spaced boring locations. The contractor should verify that similar conditions exist throughout the proposed area of excavation. If different subsurface conditions are encountered at the time of construction, ***Olsson*** recommends that they be contacted immediately to evaluate the conditions encountered. If any excavations, including utility trenches, are extended to depths of more than 20 feet, OSHA requires that the side slopes of such excavations be designed by a professional engineer registered in the state where construction is occurring.
As an alternative to temporary slopes, vertical excavations can be temporarily shored. The contractor or the specialty subcontractor should be responsible for the design of the temporary shoring in accordance with applicable regulatory requirements.

E. BUILDING AND STRUCTURES

E.1. SHALLOW FOUNDATION DESIGN

Based on the results of the soil test borings, laboratory testing and our engineering evaluation, it is our opinion that the subsurface conditions are suitable for supporting the proposed building addition on a conventional shallow foundation system. Assuming the recommendations in ***Section D*** of this report are followed and that the finish floor elevation for the proposed building addition is 1113.5, the interior and exterior foundations will be supported on structural fill and Peoria loess material. Based on the above soil properties and assuming the recommendations above are followed, we recommend that the foundations be designed for a maximum net allowable soil bearing pressure of 2,500 psf.

The net allowable bearing pressure refers to the bearing pressure at foundation level in excess of the surrounding overburden pressure. Footings should have minimum dimensions in accordance with local building codes. Exterior footings and footings in unheated areas should bear at a minimum depth of 3½ feet below the lowest adjacent final ground surface. It is recommended that interior footings in heated areas bear at a depth as shallow as possible below the lowest adjacent final ground surface. The analyses for interior and exterior footings utilized bearing depths of 2 and 3½ feet, respectively, below the finished floor elevation.

Provided the recommendations contained in this report are followed, total post-construction settlements are anticipated to be less than 1 inch with differential settlements anticipated to be less than 0.5 inches for the building addition. Differential settlements between the existing building and proposed addition are anticipated to be 1 inch or less. To reduce effects of differential settlement, a floating floor slab independent from the wall and column loads with expansion joints will be critical in minimizing the potential cracking that can occur along and around the proposed foundation system. Floor slab control joints should be used to reduce damage due to shrinkage cracks.

It is possible that some soils at the site will have an allowable soil bearing pressure less than the recommended design value. Therefore, foundation bearing surfaces should be performed by an ***Olsson*** representative during footing construction to aid in the identification of such soils. After foundation subgrades have been observed and documented and any required remedial measures are performed, concrete should be placed as quickly as possible to avoid exposure of the foundation subsoils to wetting, drying or freezing. If soils in the areas of foundation support are subjected to such conditions, the footings should be reevaluated.

E.2. Floor Slab Subgrade Preparation

The soil subgrade in the areas of concrete slab-on-grade support is often disturbed during foundation and superstructure construction. Additionally, floor slab areas are often disturbed by construction equipment traffic between the time of initial grading and final construction. To prepare the floor slab subgrade, the top 12 inches of the subgrade in the building area should be scarified and re-compacted to a minimum of 98 percent of the maximum dry density as determined by the standard Proctor test (ASTM D698-91). The moisture content should also be controlled between optimum and +3 percent of the materials optimum. The final subgrade should be proofrolled and evaluated by a field representative immediately prior to placement of the concrete to detect any localized areas of instability. If required, the methods of stabilization will typically include the use of crushed stone and/or a geosynthetic fabric or grid installed over the soft soils. The identification of areas that may require undercutting and/or stabilization should be based on the actual conditions at the time of construction, and will depend on the location and extent of the soft area. In regards to the moisture levels of the subgrade, additional water application may be necessary to maintain moisture levels above optimum. It is imperative that the subgrade soil be at or above the optimum level prior to the placement of the aggregate base (if used) and concrete floor slab.

To reduce the potential for moisture leaching from the concrete after placement, it is also recommended that enough water be added to nearly saturate the granular cushion. The granular cushion should be compacted to a minimum of 70 percent of the materials relative density. Laboratory maximum and minimum index density for the relative density tests should be performed in accordance with ASTM D4253 and D4254. If these recommendations are implemented, a subgrade modulus of at least 125 psi/in for the floor slab design is acceptable.

E.3. Lateral Earth Pressures

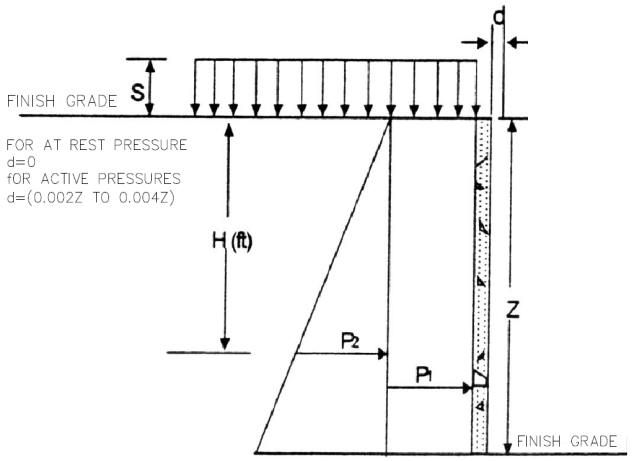
The following soil parameters are provided for use in designing grade retaining walls and/or foundation walls subject to lateral earth pressures. The parameters are based on the understanding that retained soils will be similar in composition to the on-site soils encountered during this investigation.

Walls which are rigidly restrained at the top and are essentially unable to deflect or rotate should be designed for "at rest" earth pressure conditions. Walls that are unrestrained at the top and are free to deflect or rotate slightly may be designed for "active" earth pressure conditions. The "passive" earth pressure condition should be used to evaluate the resistance of soil to lateral loads. Table 2 presents recommended values of earth pressure coefficients based on our experience with soils in the area. Equivalent fluid densities are frequently used for the calculation of lateral earth pressures for the "at-rest" and "active" conditions and are therefore provided in Table 2. The equivalent fluid densities in Table 2 do not include the effects of surcharge loading (P_1).

TABLE 2

EARTH PRESSURE PARAMETERS

LEGEND OF SYMBOLS	
Z	WALL HEIGHT (ft)
H	DEPTH BELOW SURFACE (ft)
d	WALL DISPLACEMENT (ft)
S	SURCHARGE LOAD (psf)
P_1	SURCHARGE PRESSURE (psf)
P_2	EARTH LOAD (psf)
K	COEFFICIENT OF EARTH PRESSURE
G	EQUIVALENT FLUID DENSITY (psf)



PRESSURE CALCULATIONS	
SURCHARGE PRESSURE	P_1 (psf) = K x S (psf)
EARTH PRESSURE	P_2 (psf) = G (pcf) x H (ft)

BACKFILL TYPE		FRICTION ANGLE	TOTAL SOIL DENSITY
COHESIVE -	Lean Clay (CL)	26°	120 pcf
GRANULAR* -	Less than 10% Fines (SP, GP)	32°	120 pcf

EARTH PRESSURE COEFFICIENT (K)			EQUIVALENT FLUID DENSITY (G)	
			DRAINED CONDITION	UNDRAINED CONDITION
AT REST (K_0)	Cohesive	- 0.56	68 pcf	95 pcf
	Granular*	- 0.47	56 pcf	
ACTIVE (K_a)	Cohesive	- 0.39	47 pcf	85 pcf
	Granular*	- 0.31	37 pcf	
PASSIVE (K_p)	Cohesive	- 2.00	240 pcf	170 pcf
	Granular*	- 3.00	360 pcf	

* If granular backfill is utilized, it is recommended the granular backfill be permanently drained

These design recommendations are based on the following assumptions:

- 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.
- Drained conditions assume a permanent drainage system behind the retaining wall that will allow no development of hydrostatic pressure.
- Horizontal backfill.
- The upper 40 inches do not contribute resistance against horizontal movement if the soil is subject to frost action and seasonal volume change.
- Onsite backfill soils having a bulk unit weight of 120 pcf.
- Backfill soils placed within the height of the retaining wall consisting of selected lean clay should be tested to verify the lean clays exhibit low plasticity and can achieve a minimum friction angle of 26 degrees.
- Imported granular backfill soils having a minimum angle of internal friction of 32 degrees.
- Uniform surcharge, where S is surcharge pressure, in psf.
- Heavy equipment and other concentrated load components not included.
- No safety factor is included.

Backfill soils placed within a lateral distance from the face of the wall to seven tenths of the wall height could consist of selected lean clay exhibiting an Atterberg liquid limit of less than 40. For granular soils, the granular backfill must extend out from the base of the wall at an angle of 45 and 60 degrees from the vertical wall for the active and passive cases, respectively. To calculate the resistance to sliding on native soil and crushed angular limestone, an ultimate coefficient of friction value of 0.3 and 0.45 should be used, respectively, where the footing bears on suitable approved bearing soil. A factor of safety of at least 1.5 to 2 should be applied.

F. PAVEMENTS

F.1. PAVEMENT SUBGRADE PREPARATION

Based on our experience and the laboratory test results, the pavement subgrade soils at this site can be adequately prepared by field conditioning and compaction. It is important that the subgrade support be relatively uniform, with no abrupt changes in the degree of support. Non-uniform pavement support can result from the transition at cut and fill areas, varying soil moisture contents, varying soil types, and where utility backfill has been placed in areas to be paved. Improper subgrade preparation such as inadequate vegetation removal, proofrolling, and compaction can also result in non-uniform subgrade support.

To prepare the subgrade, the top 12 inches of the lean clay subgrade should be compacted to a minimum of 98 percent of the maximum dry density as determined by ASTM D698-91, Standard Proctor Moisture-Density Relationship at a moisture content between optimum to +3 percent of optimum.

The final subgrade should be proofrolled immediately prior to placement of the concrete or asphalt to detect any localized areas of instability. Unstable areas should be reworked to provide a uniform subgrade. For a subgrade prepared in this manner, we estimate a California Bearing Ratio (CBR) value of 3.0 (assumed) and a modulus of subgrade reaction of 212.3 pci.

F.2. PAVEMENT DESIGN

Pavement design is influenced by the anticipated traffic loads and volumes, site subgrade conditions, pavement materials, traffic study and the desired design life. The recommended pavement thickness is based on our experiences with the alternate pavement types and equivalent pavement sections based on recognized structural coefficients. It is important to note that changes in traffic conditions that exceed the assumptions of this report can have a significant impact on the design life of the pavement.

The recommended design requires that the site be properly prepared in accordance with ***Section F.1.*** of this report and that site drainage be provided to minimize the future wetting of the pavement subgrade. A pavement design life of 20 years is used. AASHTO pavement design procedures were used to estimate the required pavement thickness.

The following parameters were adopted for the thickness design:

- Subgrade: 12" subgrade compacted to at least 98% of ASTM D-698, at a moisture content between optimum and +3 percent of optimum
- CBR value: 3.0 (Assumed)
- Working stress (PCC) 600 psi

The Standard-Duty and Heavy-Duty pavement recommendations are based on a design life of 20 years, terminal serviceability = 2.5, reliability = 85%, initial serviceability = 4.4, drainage coefficient = .95, and standard deviation = 0.45 for flexible pavements and 0.35 for rigid pavements.

For each pavement section we have provided a total design ESAL's and how the total ESAL's correlate to the daily traffic count for passenger cars and truck delivery traffic. The pavement section chosen should be based off of expected traffic counts. For design purposes, the anticipated traffic on the proposed pavement areas was assumed to consist of automobiles, buses, delivery trucks, and occasional garbage trucks. If the traffic counts described with the pavement section are not sufficient for the proposed roadways please contact the geotechnical engineer.

Based on the above design parameters, we recommend the following **minimum** pavement design thickness.

General Pavement Cross Section:

Asphalt Pavement (Standard Duty: 29,780 ESAL)

Correlates to 400 - passenger cars, 1 – delivery truck per day

Depth (in)	Material Designation	Material Specification
1.5		Surface Course: NDOR Section 1028, Asphaltic Concrete, Type SPR
4.5		Base Course: NDOR Section 1028, Asphaltic Concrete, Type SPR
12.0		Subgrade: NDOR Section 302, Subgrade Preparation

Asphalt Pavement (Heavy Duty: 56,035 ESAL)

Correlates to 400 - passenger cars, 2 – delivery trucks, and 1 – garbage truck per day

Depth (in)	Material Designation	Material Specification
2.0		Surface Course: NDOR Section 1028, Asphaltic Concrete, Type SPR
6.0		Base Course: NDOR Section 1028, Asphaltic Concrete, Type SPR
12.0		Subgrade: NDOR Section 302, Subgrade Preparation

Concrete Pavement (Standard Duty: 29,618 ESAL)

Correlates to 400 - passenger cars, 1 – delivery truck per day

Depth (in)	Material Designation	Material Specification
5.0		Concrete: NDOR Section 1002, Portland Cement Concrete
12.0		Subgrade: NDOR Section 302, Subgrade Preparation

Concrete Pavement (Heavy Duty: 68,397 ESAL)

Correlates to 400 - passenger cars, 2 – delivery trucks, and 1 – garbage truck per day

Depth (in)	Material Designation	Material Specification
7.0		Concrete: NDOR Section 1002, Portland Cement Concrete
12.0		Subgrade: NDOR Section 302, Subgrade Preparation

Because parking lot areas are subjected to slow-moving and static load conditions, a PG64-28 asphalt cement is recommended for the surface and base course. This grade of asphalt cement produces an asphaltic concrete that is less susceptible to rutting and creep caused by slow-moving or static loads during warm periods. Minimum surface course thickness of 1.5 inches in light duty areas and 2.0 inches in heavy duty areas are recommended for asphaltic cement concrete pavement sections. Surface drainage around the pavement and proper maintenance are also important for 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 infiltration under the pavement. All pavement joints should be caulked and any cracks should be quickly patched or sealed to prevent moisture from reaching and softening the subgrade.

G. LIMITATIONS

G.1. REPORT LIMITATIONS

The conclusions and recommendations presented in this report are based on the information available regarding the proposed construction, the results obtained from our soil test borings and sampling procedures, the results of the laboratory testing program, and our experience with similar projects. The soil test borings represent a very small statistical sampling of subsurface soils and it is possible that conditions may be encountered during construction that are substantially different from those indicated by the soil test borings. In these instances, adjustments to design and construction may be necessary.

This geotechnical report is based on the site plan and information provided to ***Olsson*** and our understanding of the project as noted in this report. Changes in the location or design of new structures could significantly affect the conclusions and recommendations presented in this geotechnical report. ***Olsson*** should be contacted in the event of such changes to determine if the recommendations of this report remain appropriate for the revised site design.

Soil stratification, as shown on the Boring Logs, represent soil conditions at the boring locations; however, variations may occur between or around the boring locations. The lines of demarcation represent the approximate boundary between soil types but the transition may be more gradual.

This report was prepared by an Engineer Intern and reviewed by a Professional Engineer registered in the State of Nebraska with the firm ***Olsson Associates (Olsson)***. The conclusions and recommendations contained herein are based on generally accepted, professional, geotechnical engineering practice at the time of this report within this geographic area. No other warranty is expressed or implied. This report has been prepared for the exclusive use of the ***Clark Architectural Collaborative***[3] with specific application to the proposed project.

****

We trust that this report will assist you in the design and construction of the proposed project. ***OLSSON*** appreciates the opportunity to provide our services on this project and looks forward to working with you during construction and on future projects. Should you have any questions, please do not hesitate to contact us.

Respectfully submitted,
Olsson Associates

Prepared by:

Steve Jensen, E.I.
Assistant Engineer

Reviewed by:

Andrew M. Phillips, P.E.
Geotechnical Engineer

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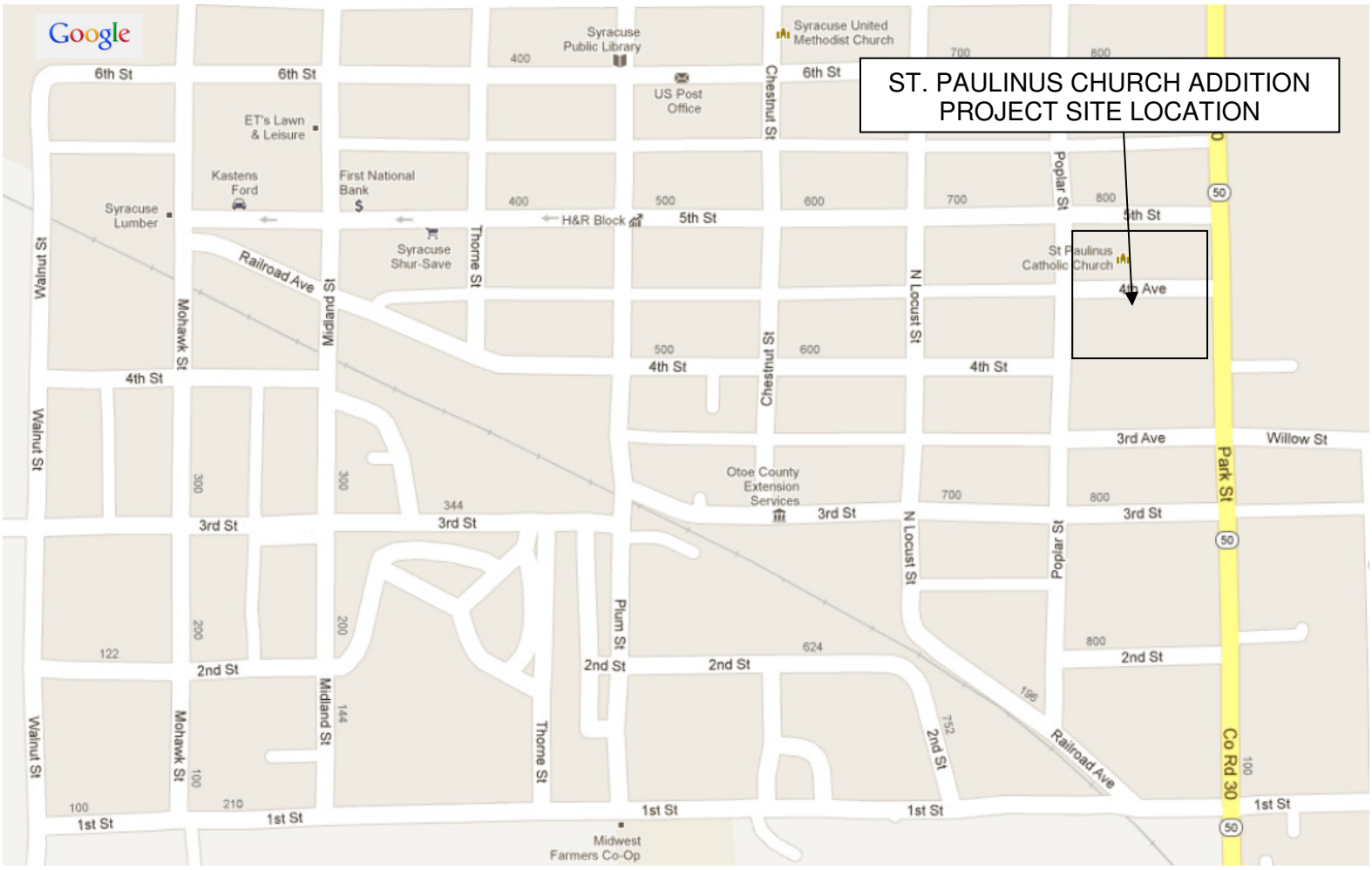
APPENDIX A

Site Location Plan
Boring Location Map



N

SITE LOCATION PLAN
ST. PAULINUS CHURCH ADDITION
SYRACUSE, NEBRASKA
OA PROJECT NO. 013-0419

F:\Projects\013-0419_GTECH\DWG\Boring Location Map\BLMAP.dwg
DATE: 4/10/2013 USER: sjensen

LEGEND

SOIL BORING LOCATION

0 25 50 100

SCALE IN FEET

PROJECT: 013-0419

DRAWN BY: SVJ | REVISIONS: XXX

DATE: 4/10/13

BORING LOCATION MAP

SYRACUSE, NEBRASKA

OLSSON ASSOCIATES

1111 Lincoln Mall, Suite 111
P.O. Box 84608
Lincoln, NE 68501-4608

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APPENDIX B

Symbols & Nomenclature
Boring Logs

SYMBOLS AND NOMENCLATURE

DRILLING NOTES

DRILLING AND SAMPLING SYMBOLS

SS:	Split-Spoon Sample (1.375" ID, 2.0" OD)	HSA:	Hollow Stem Auger	NE:	Not Encountered
U:	Thin-Walled Tube Sample (3.0" OD)	CFA:	Continuous Flight Auger	NP:	Not Performed
CS:	Continuous Sample	HA:	Hand Auger	NA:	Not Applicable
BS:	Bulk Sample	CPT:	Cone Penetration Test	% Rec:	Percent of Recovery
MC:	Modified California Sampler	WB:	Wash Bore	WD:	While Drilling
GB:	Grab Sample	FT:	Fish Tail Bit	IAD:	Immediately After Drilling
SPT:	Standard Penetration Test Blows per 6.0"	RB:	Rock Bit	AD:	After Drilling
				CI:	Cave-In

DRILLING PROCEDURES

Soil samples designated as "U" samples on the boring logs were obtained in using Thin-Walled Tube Sampling techniques. Soil samples designated as "SS" samples were obtained during Penetration Test using a Split-Spoon Barrel sampler. The standard penetration resistance 'N' value is the number of blows of a 140 pound hammer falling 30 inches to drive the Split-Spoon sampler one foot. Soil samples designated as "MC" were obtained in using Thick-Walled, Ring-Lined, Split-Barrel Drive sampling techniques. Recovered samples were sealed in containers, labeled, and protected for transportation to the laboratory for testing.

WATER LEVEL MEASUREMENTS

Water levels indicated on the boring logs are levels measured in the borings at the times indicated. In relatively high permeable materials, the indicated levels may reflect the location of groundwater. In low permeability soils, the accurate determination of groundwater levels is not possible with only short-term observations.

SOIL PROPERTIES & DESCRIPTIONS

Descriptions of the soils encountered in the soil test borings were prepared using Visual-Manual Procedures for Descriptions and Identification of Soils.

PARTICLE SIZE

Boulders	12 in. +	Coarse Sand	4.75mm-2.0mm	Silt	0.075mm-0.005mm
Cobbles	12 in.-3 in.	Medium Sand	2.0mm-0.425mm	Clay	<0.005mm
Gravel	3 in.-4.75mm	Fine Sand	0.425mm-0.075mm		

COHESIVE SOILS

Consistency	Unconfined Compressive Strength (Qu) (tsf)
Very Soft	<0.25
Soft	0.25 – 0.5
Firm	0.5 – 1.0
Stiff	1.0 – 2.0
Very Stiff	2.0 – 4.0
Hard	> 4.0

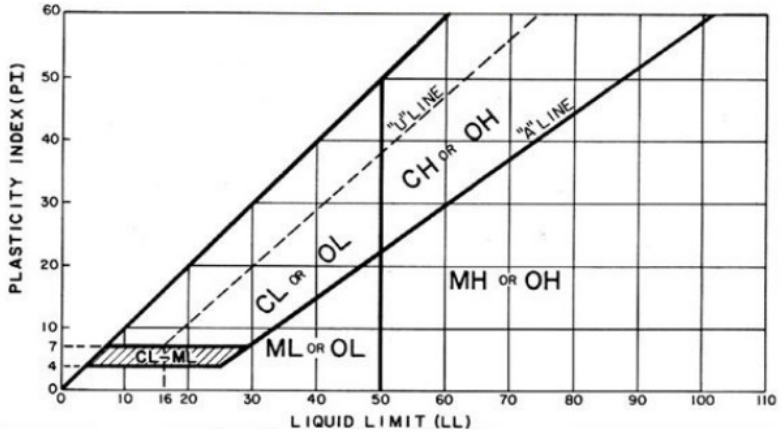
COHESIONLESS SOILS

Relative Density	'N' Value
Very Loose	0 – 3
Loose	4 – 9
Medium Dense	10 – 29
Dense	30 – 49
Very Dense	≥ 50

COMPONENT %

Description	Percent (%)
Trace	<5
Few	5 - 10
Little	15 - 25
Some	30 - 45
Mostly	50 - 100

PLASTICITY CHART



ROCK QUALITY DESIGNATION (RQD)

Description	RQD (%)
Very Poor	0 – 25
Poor	25 – 50
Fair	50 – 75
Good	75 – 90
Excellent	90 – 100

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BORHOLE REPORT NO. B-1

Sheet 1 of 1

PROJECT NAME	CLIENT
St Paulinus Church Addition	Clark Architectural Collaborative
PROJECT NUMBER	**LOCATION**
013-0419	Syracuse, Nebraska

Shelby Tube

ELEVATION (ft)	MATERIAL DESCRIPTION	GRAPHIC LOG	DEPTH (ft)	SAMPLE TYPE NUMBER	CLASSIFICATION (USCS)	BLOWS/6" N-VALUE RQD	UNC. STR. (tsf)	MOISTURE (%)	DRY DENSITY (pcf)	LL/PI (%)	ADDITIONAL DATA/ REMARKS
1110	**APPROX. SURFACE ELEV. (ft):** 1110		0								
	CONCRETE 0.3'										
	FILL										
	Lean clay (CL) *Firm, dark brown mottled with light brown, moist, mostly lean clay, trace fine sand*			U 1	CL			22.0	97.9	34/15	
	3.0'										
	LOVELAND FORMATION										
1105	*Lean clay (CL)* *Stiff, strong reddish brown, moist, mostly lean clay, trace fine sand*		5	U 2			1.7	21.7	101.9		
	8.0'										
	WEATHERED GLACIAL TILL										
1100	*Silty lean clay (CL/ML)* *Very stiff, light grey, moist, mostly silty lean clay, trace fine sand*		10	U 3			2.1	21.2	103.3		
	Silty lean clay (CL/ML) *Very stiff, light grey, moist, mostly silty lean clay, trace fine sand, iron*										
	14.5'			U 4							
1095	15.0'		15								
	Poorly graded sand (SP) *Medium dense, yellowish brown, moist, mostly fine sand*										
	Silty lean clay (CL/ML) *Very stiff, light grey, moist, mostly silty lean clay, few fine sand, iron*			U 5							
1090	20.0'		20								
	BASE OF BORING AT 20.0 FEET										

WATER LEVEL OBSERVATIONS	
WD	Not Encountered
IAD	Not Encoutered
AD	Not Performed

OLSSON ASSOCIATES
1111 LINCOLN MALL, SUITE 111
LINCOLN, NEBRASKA 68508

STARTED	2/14/13	FINISHED	2/14/13
DRILL CO.	OLSSON	DRILL RIG	CME 45
DRILLER	DAL	LOGGED BY	CMM
METHOD	CONTINUOUS FLIGHT AUGER		

BORHOLE REPORT NO. B-2

Sheet 1 of 2

PROJECT NAME	CLIENT
St Paulinus Church Addition	Clark Architectural Collaborative
PROJECT NUMBER	**LOCATION**
013-0419	Syracuse, Nebraska

Shelby Tube ▮ Split Spoon ⊠

ELEVATION (ft)	MATERIAL DESCRIPTION	GRAPHIC LOG	DEPTH (ft)	SAMPLE TYPE NUMBER	CLASSIFICATION (USCS)	BLOWS/6" N-VALUE RQD	UNC. STR. (tsf)	MOISTURE (%)	DRY DENSITY (pcf)	LL/PI (%)	ADDITIONAL DATA/ REMARKS
	APPROX. SURFACE ELEV. (ft): 1113.1		0								
	CONCRETE 0.4'										
	FILL										
	Lean clay (CL) *Firm, light brown mottled with dark brown, moist, mostly lean clay, trace fine sand*			U 1			0.7	24.1	95.7		
1110	3.0'										
	Lean clay (CL) *Firm, strong brown, very moist, mostly lean clay, trace fine sand* 5.0'		5	U 2				34.5	86.8		
	LOVELAND FORMATION										
	Lean clay (CL) *Stiff, reddish brown, moist, mostly lean clay, trace fine sand*			U 3				20.8	102.6		
1105											
	Lean clay (CL) *Firm, strong brown, moist, mostly lean clay, trace fine sand* 10.0'		10	U 4							
	WEATHERED GLACIAL TILL										
1100											
	Silty lean clay (CL/ML) *Firm, light greyish brown, moist, mostly silty lean clay, trace fine sand, iron*		15	U 5							
	16.0'										
1095											
	Silty lean clay (CL/ML) *Firm, light greyish brown, very moist, mostly silty lean clay, trace fine sand, iron*		20	U 6				29.9	94.2		
	CONTINUED NEXT PAGE										

WATER LEVEL OBSERVATIONS	
WD	▽ Not Encountered
IAD	▼ Not Encoutered
AD	▼ Not Performed

OLSSON ASSOCIATES
1111 LINCOLN MALL, SUITE 111
LINCOLN, NEBRASKA 68508

STARTED	2/14/13	FINISHED	2/14/13
DRILL CO.	OLSSON	DRILL RIG	CME 45
DRILLER	DAL	LOGGED BY	CMM
METHOD	CONTINUOUS FLIGHT AUGER		

OLSSON ASSOCIATES

BORHOLE REPORT NO. B-2

PROJECT NAME	CLIENT
St Paulinus Church Addition	Clark Architectural Collaborative
PROJECT NUMBER	**LOCATION**
013-0419	Syracuse, Nebraska

Shelby Tube Split Spoon

ELEVATION (ft)	MATERIAL DESCRIPTION	GRAPHIC LOG	DEPTH (ft)	SAMPLE TYPE NUMBER	CLASSIFICATION (USCS)	BLOWS/6" N-VALUE RQD	UNC. STR. (tsf)	MOISTURE (%)	DRY DENSITY (pcf)	LL/PI (%)	ADDITIONAL DATA/ REMARKS
			20								
	WEATHERED GLACIAL TILL										
	Silty lean clay (CL/ML) *Firm, light greyish brown, very moist, mostly silty lean clay, trace fine sand, iron*										
1090											
	24.0'			U 7							
	Poorly graded sand (SP) *Medium dense, light grey, moist, mostly fine sand*		25	SS 8		6-9-10 N=19					
	26.0'										

BASE OF BORING AT 26.0 FEET

WATER LEVEL OBSERVATIONS	
WD	Not Encountered
IAD	Not Encoutered
AD	Not Performed

OLSSON ASSOCIATES
1111 LINCOLN MALL, SUITE 111
LINCOLN, NEBRASKA 68508

STARTED	2/14/13	FINISHED	2/14/13
DRILL CO.	OLSSON	DRILL RIG	CME 45
DRILLER	DAL	LOGGED BY	CMM
METHOD	CONTINUOUS FLIGHT AUGER		

OLSSON ASSOCIATES

BORHOLE REPORT NO. B-3

Sheet 1 of 1

PROJECT NAME	CLIENT
St Paulinus Church Addition	Clark Architectural Collaborative
PROJECT NUMBER	**LOCATION**
013-0419	Syracuse, Nebraska

Shelby Tube ▪ Split Spoon

APPROX. SURFACE ELEV. (ft): 1111.9

ELEVATION (ft)	MATERIAL DESCRIPTION	GRAPHIC LOG	DEPTH (ft)	SAMPLE TYPE NUMBER	CLASSIFICATION (USCS)	BLOWS/6" N-VALUE RQD	UNC. STR. (tsf)	MOISTURE (%)	DRY DENSITY (pcf)	LL/PI (%)	ADDITIONAL DATA/ REMARKS
	DEVELOPED ZONE *0.1'*		0								
	FILL										
1110	*Fat clay (CH)* *Stiff, dark brown, very moist, mostly fat clay, trace fine sand*			U 1	CH			27.5	94.3	63/37	
	3.0'										
	LOVELAND FORMATION										
	Lean clay (CL) *Stiff, strong brown, moist, mostly lean clay, trace fine sand*		5	U 2							
	6.0'										
1105	*Lean clay (CL)* *Stiff, strong brown, moist, mostly lean clay, trace fine sand*			U 3			1.1	17.4	104.6		
	9.0'										
	WEATHERED GLACIAL TILL		10	U 4							
	Silty lean clay (CL/ML) *Very stiff, light brown, moist, mostly silty lean clay, trace fine sand, iron*										
1100											
	14.5'			U 5				3.0			
	Silty sand (SM) *Medium dense, light grey, dry, mostly fine sand, little silt*		15								
1095											
	Silty sand (SM) *Medium dense, light grey, dry, mostly fine sand, little silt*			SS 6		6-7-9 N=16		8.2			P-200 = 17.7%
	20.0'		20								
	BASE OF BORING AT 20.0 FEET										

WATER LEVEL OBSERVATIONS	
WD	▽ Not Encountered
IAD	▼ Not Encoutered
AD	▼ Not Performed

OLSSON ASSOCIATES
1111 LINCOLN MALL, SUITE 111
LINCOLN, NEBRASKA 68508

STARTED	2/14/13	FINISHED	2/14/13
DRILL CO.	OLSSON	DRILL RIG	CME 45
DRILLER	DAL	LOGGED BY	CMM
METHOD	CONTINUOUS FLIGHT AUGER		

OLSSON ASSOCIATES

BORHOLE REPORT NO. B-4

Sheet 1 of 2

PROJECT NAME	CLIENT
St Paulinus Church Addition	Clark Architectural Collaborative
PROJECT NUMBER	**LOCATION**
013-0419	Syracuse, Nebraska

Shelby Tube ▮ Split Spoon ⊠

APPROX. SURFACE ELEV. (ft): 1112.8

ELEVATION (ft)	MATERIAL DESCRIPTION	GRAPHIC LOG	DEPTH (ft)	SAMPLE TYPE NUMBER	CLASSIFICATION (USCS)	BLOWS/6" N-VALUE RQD	UNC. STR. (tsf)	MOISTURE (%)	DRY DENSITY (pcf)	LL/PI (%)	ADDITIONAL DATA/ REMARKS
	ASPHALT 0.2'		0								
	FILL										
	Lean to fat clay (CL/CH) *Firm, dark brown mottled with light brown, moist, mostly lean to fat clay, trace fine sand*			U 1							
1110											
	Lean to fat clay (CL/CH) *Firm, dark brown mottled with light brown, moist, mostly lean to fat clay, trace fine sand, some brick* 5.0'		5	U 2				21.8			
	LOVELAND FORMATION										
	Lean clay (CL) *Very stiff, strong reddish brown, moist, mostly lean clay, trace fine sand* 7.5'			U 3				16.7	104.5		
1105	***WEATHERED GLACIAL TILL***										
	Silty lean clay (CL/ML) *Firm, light brownish grey, dry to moist, mostly silty lean clay, few fine sand*		10	U 4				14.0	99.4		
1100											
	14.0'			U 5							
	Silt (ML) *Very stiff, light grey, moist, mostly silt, trace fine sand*		15								
1095											
	Silt (ML) *Very stiff, light grey, moist, mostly silt, trace fine sand*		20	SS 6		6-8-10 N=18		22.3			P-200 = 93.4%
	CONTINUED NEXT PAGE										

WATER LEVEL OBSERVATIONS	
WD	▽ Not Encountered
IAD	▼ Not Encoutered
AD	▼ Not Performed

OLSSON ASSOCIATES
1111 LINCOLN MALL, SUITE 111
LINCOLN, NEBRASKA 68508

STARTED	2/14/13	FINISHED	2/14/13
DRILL CO.	OLSSON	DRILL RIG	CME 45
DRILLER	DAL	LOGGED BY	CMM
METHOD	CONTINUOUS FLIGHT AUGER		

OLSSON ASSOCIATES	BORHOLE REPORT NO. B-4	Sheet 2 of 2

PROJECT NAME	CLIENT
St Paulinus Church Addition	Clark Architectural Collaborative
PROJECT NUMBER	**LOCATION**
013-0419	Syracuse, Nebraska

Shelby Tube ☒ Split Spoon

ELEVATION (ft)	MATERIAL DESCRIPTION	GRAPHIC LOG	DEPTH (ft)	SAMPLE TYPE NUMBER	CLASSIFICATION (USCS)	BLOWS/6" N-VALUE RQD	UNC. STR. (tsf)	MOISTURE (%)	DRY DENSITY (pcf)	LL/PI (%)	ADDITIONAL DATA/ REMARKS
	WEATHERED GLACIAL TILL		20								
1090											
	Silt (ML) *Hard, light grey, moist, mostly silt, trace fine sand* ***25.0'***		25	SS 7		10-14-17 N=31					

BASE OF BORING AT 25.0 FEET

WATER LEVEL OBSERVATIONS	
WD	▽ Not Encountered
IAD	▼ Not Encoutered
AD	▼ Not Performed

OLSSON ASSOCIATES
1111 LINCOLN MALL, SUITE 111
LINCOLN, NEBRASKA 68508

STARTED	2/14/13	FINISHED	2/14/13
DRILL CO.	OLSSON	DRILL RIG	CME 45
DRILLER	DAL	LOGGED BY	CMM
METHOD	CONTINUOUS FLIGHT AUGER		

OLSSON ASSOCIATES

BORHOLE REPORT NO. B-5

Sheet 1 of 1

PROJECT NAME: **St Paulinus Church Addition**

CLIENT: **Clark Architectural Collaborative**

PROJECT NUMBER: **013-0419**

LOCATION: **Syracuse, Nebraska**

Shelby Tube

ELEVATION (ft)	MATERIAL DESCRIPTION	GRAPHIC LOG	DEPTH (ft)	SAMPLE TYPE NUMBER	CLASSIFICATION (USCS)	BLOWS/6" N-VALUE RQD	UNC. STR. (tsf)	MOISTURE (%)	DRY DENSITY (pcf)	LL/PI (%)	ADDITIONAL DATA/ REMARKS
	APPROX. SURFACE ELEV. (ft): 1117.8		0								
	DEVELOPED ZONE 0.1'										
	FILL										
	Fat clay (CH) *Stiff, dark brown, moist, mostly fat clay, trace fine sand*			U 1			1.6	20.8	91.8		
1115	3.0'										
	WEATHERED GLACIAL TILL										
	Lean clay (CL) *Very stiff, light greyish brown, moist, mostly lean clay, trace fine sand*		5	U 2							
1110											
	Lean clay (CL) *Firm, light greyish brown, very moist, mostly lean clay, trace fine sand*		10	U 3				28.5	92.3		
	10.0'										
	BASE OF BORING AT 10.0 FEET										

WATER LEVEL OBSERVATIONS	
WD	Not Encountered
IAD	Not Encoutered
AD	Not Performed

OLSSON ASSOCIATES
1111 LINCOLN MALL, SUITE 111
LINCOLN, NEBRASKA 68508

STARTED	2/14/13	FINISHED	2/14/13
DRILL CO.	OLSSON	DRILL RIG	CME 45
DRILLER	DAL	LOGGED BY	CMM
METHOD	CONTINUOUS FLIGHT AUGER		

BORHOLE REPORT NO. B-6

Sheet 1 of 1

PROJECT NAME: St Paulinus Church Addition	CLIENT: Clark Architectural Collaborative
PROJECT NUMBER: 013-0419	LOCATION: Syracuse, Nebraska

Shelby Tube

ELEVATION (ft)	MATERIAL DESCRIPTION	GRAPHIC LOG	DEPTH (ft)	SAMPLE TYPE NUMBER	CLASSIFICATION (USCS)	BLOWS/6" N-VALUE RQD	UNC. STR. (tsf)	MOISTURE (%)	DRY DENSITY (pcf)	LL/PI (%)	ADDITIONAL DATA/ REMARKS
	APPROX. SURFACE ELEV. (ft): 1116.4		0								
	DEVELOPED ZONE 0.1'										
	FILL										
1115	*Fat clay (CH)* *Very stiff, dark brown mottled with light grey, dry to moist, mostly fat clay, trace fine sand*			U 1				16.1			
	3.0'										
	WEATHERED GLACIAL TILL										
	Silty lean clay (CL/ML) *Stiff, light brown, moist, mostly silty lean clay, trace fine sand*		5	U 2				16.3	84.6		
1110											
	Silty lean clay (CL/ML) *Stiff, light brown mottled with light grey, moist, mostly silty lean clay, trace fine sand*			U 3							
	10.0'		10								

BASE OF BORING AT 10.0 FEET

WATER LEVEL OBSERVATIONS	
WD	Not Encountered
IAD	Not Encoutered
AD	Not Performed

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LINCOLN, NEBRASKA 68508

STARTED	2/14/13	FINISHED	2/14/13
DRILL CO.	OLSSON	DRILL RIG	CME 45
DRILLER	DAL	LOGGED BY	CMM
METHOD	CONTINUOUS FLIGHT AUGER		

OLSSON ASSOCIATES

BORHOLE REPORT NO. B-7

Sheet 1 of 1

PROJECT NAME	CLIENT
St Paulinus Church Addition	Clark Architectural Collaborative
PROJECT NUMBER	**LOCATION**
013-0419	Syracuse, Nebraska

Shelby Tube

APPROX. SURFACE ELEV. (ft): 1107.7

ELEVATION (ft)	MATERIAL DESCRIPTION	GRAPHIC LOG	DEPTH (ft)	SAMPLE TYPE NUMBER	CLASSIFICATION (USCS)	BLOWS/6" N-VALUE RQD	UNC. STR. (tsf)	MOISTURE (%)	DRY DENSITY (pcf)	LL/PI (%)	ADDITIONAL DATA/ REMARKS
	DEVELOPED ZONE *0.1'*		0								
	FILL										
1105	*Fat clay (CH)* *Very stiff, light brown, moist, mostly fat clay, trace fine sand, trace brick*			U 1			2.8	20.2	103.9		
	3.0'										
	WEATHERED GLACIAL TILL										
	Silty lean clay (CL/ML) *Very stiff, light reddish brown, dry to moist, mostly lean clay, trace fine sand*		5	U 2				12.0	93.6		
1100											
	9.0'										
	Silty sand (SM) *Medium dense, light grey, moist, mostly fine sand, few silt* *10.0'*		10	U 3							
	BASE OF BORING AT 10.0 FEET										

WATER LEVEL OBSERVATIONS	
WD	Not Encountered
IAD	Not Encoutered
AD	Not Performed

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LINCOLN, NEBRASKA 68508

STARTED	2/14/13	FINISHED	2/14/13
DRILL CO.	OLSSON	DRILL RIG	CME 45
DRILLER	DAL	LOGGED BY	CMM
METHOD	CONTINUOUS FLIGHT AUGER		

APPENDIX C
Summary of Laboratory Test Results

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LINCOLN, NEBRASKA 68508

SUMMARY OF LABORATORY RESULTS

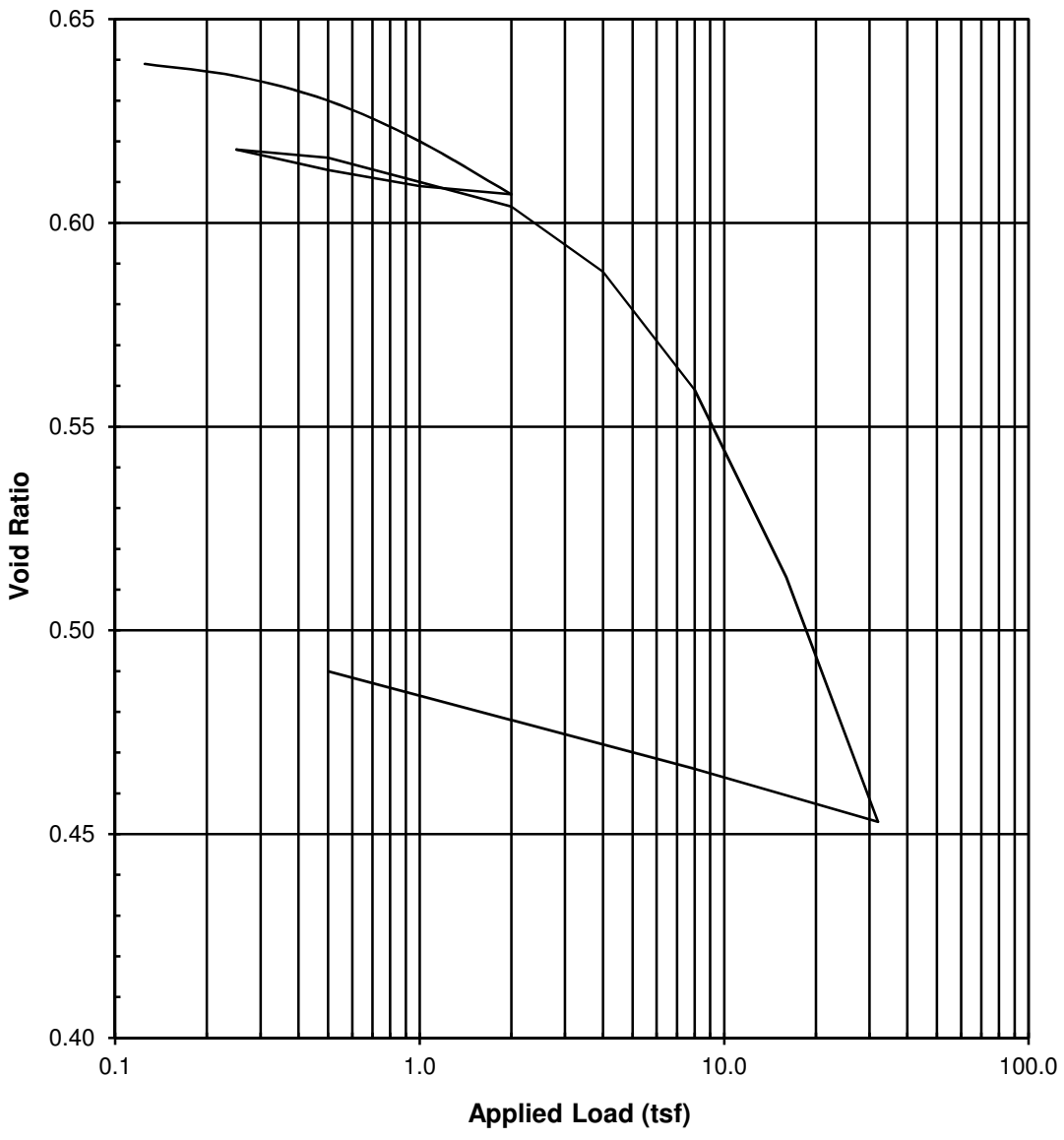
PROJECT NAME St Paulinus Church Addition
PROJECT NUMBER 013-0419
CLIENT Clark Architectural Collaborative
PROJECT LOCATION Syracuse, Nebraska

BORING NUMBER	SAMPLE I.D.	SAMPLE DEPTH (ft)	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	VOID RATIO	SATURATION (%)	UNCONFINED STRENGTH (tsf)	STRAIN (%)	ATTERBERG LIMITS			P-200	USCS CLASS.
									LIQUID LIMIT	PLASTIC LIMIT	PLASTIC INDEX		
B-1	U-1	1.0 - 2.5'	22.0	97.9	0.722	82.3			34	19	15		CL
B-1	U-2	3.5 - 5.0'	21.7	101.9	0.654	89.4	1.7	5.4					
B-1	U-3	8.5 - 10.0'	21.2	103.3	0.632	90.5	2.1	4.9					
B-2	U-1	1.0 - 2.5'	24.1	95.7	0.761	85.4	0.7	6.8					
B-2	U-2	3.5 - 5.0'	34.5	86.8	0.942	98.9							
B-2	U-3	6.0 - 7.5'	20.8	102.6	0.643	87.3							
B-2	U-6	18.5 - 20.0'	29.9	94.2	0.789	100.0							
B-3	U-1	1.0 - 2.5'	27.5	94.3	0.787	94.3			63	26	37		CH
B-3	U-3	6.0 - 7.5'	17.4	104.6	0.611	76.8	1.1	4.1					
B-3	U-5	13.5 - 15.0'	3.0										
B-3	SS-6	18.5 - 20.0'	8.2									17.7	
B-4	U-2	3.5 - 5.0'	21.8										
B-4	U-3	6.0 - 7.5'	16.7	104.5	0.613	73.6							
B-4	U-4	8.5 - 10.0'	14.0	99.4	0.696	54.3							
B-4	SS-6	18.5 - 20.0'	22.3									93.4	
B-5	U-1	1.0 - 2.5'	20.8	91.8	0.837	67.1	1.6	1.9					
B-5	U-3	8.5 - 10.0'	28.5	92.3	0.826	93.1							
B-6	U-1	1.0 - 2.5'	16.1										
B-6	U-2	3.5 - 5.0'	16.3	84.6	0.992	44.3							
B-7	U-1	1.0 - 2.5'	20.2	103.9	0.622	87.6	2.8	6.9					
B-7	U-2	3.5 - 5.0'	12.0	93.6	0.801	40.5							

CONSOLIDATION TEST

Drill Hole No.	B-2	Sample No.	U-3				
Sample Description	Loveland Formation: Reddish brown, Lean clay (CL)						
Initial Water Content	20.8%	Dry Unit Weight (pcf)	102.61	Initial Saturation	87.3%		
Final Water Content	18.4%	Specific Gravity	2.7	X	Assumed		
Liquid Limit	N/A	Plastic Limit	N/A	Plasticity Index	N/A		
Classification	CL						

St. Paulina's Church Addition

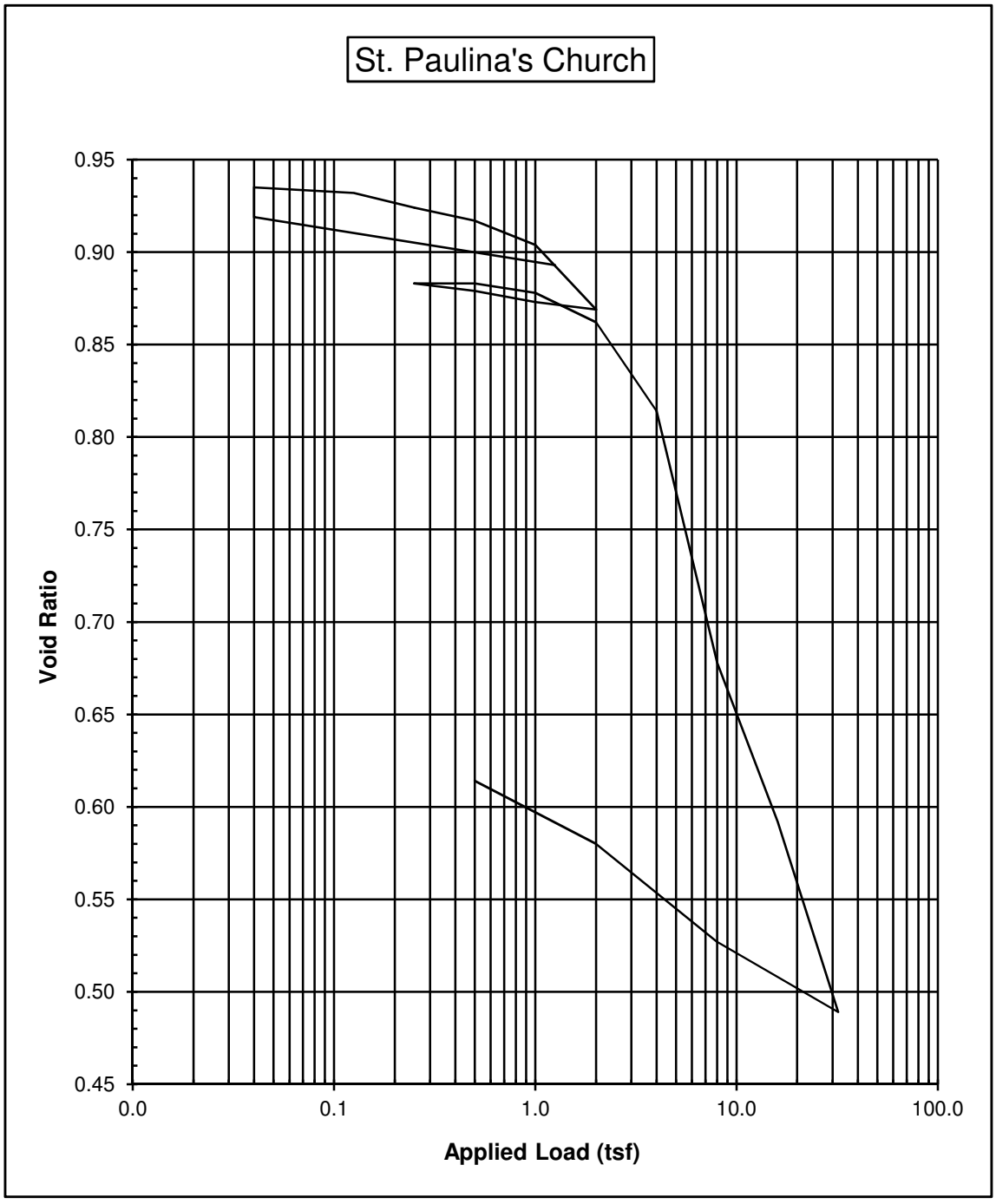


OLSSON ASSOCIATES

Project	St Paulina's Church Addition		
Location	Syracuse, Nebraska		
Job No.	013-0419	Date:	03/04/13

SWELL/CONSOLIDATION TEST

Drill Hole No.	B-3	Sample No.	U-1 (1-2.5')		
Sample Description	Fill: Dark brown, Fat clay (CH)				
Initial Water Content	31.3%	Dry Unit Weight (pcf)	86.73	Initial Saturation	89.7%
Final Water Content	23.7%	Specific Gravity	2.7	X Assumed	
Liquid Limit	62	Plastic Limit	26	Plasticity Index	36
Classification	CH				



OLSSON ASSOCIATES

Project	St Paulina's Church		
Location	Syracuse, Nebraska		
Job No.	013-0419	Date:	03/04/13

APPENDIX D
PAVEMENT DESIGN

WinPAS

Pavement Thickness Design According to

1993 AASHTO Guide for Design of Pavements Structures

American Concrete Pavement Association

Rigid Design Inputs

Agency:
Company: Olsson Associates
Contractor:
Project Description: St. Pualinus Church Addition
Location: Syracuse, Nebraska

Rigid Pavement Design/Evaluation

PCC Thickness	4.00	**inches**	**Load Transfer, J**	3.60	
Design ESALs	29,618		**Mod. Subgrade Reaction, k**	212	**psi/in**
Reliability	85.00	**percent**	**Drainage Coefficient, Cd**	0.95	
Overall Deviation	0.35		**Initial Serviceability**	4.40	
Modulus of Rupture	600	**psi**	**Terminal Serviceability**	2.50	
Modulus of Elasticity	4,100,000	**psi**			

Modulus of Subgrade Reaction (k-value) Determination

Resilient Modulus of the Subgrade	4,118.2	**psi**
Resilient Modulus of the Subbase	0.0	**psi**
Subbase Thickness	0.00	**inches**
Depth to Rigid Foundation	0.00	**feet**
Loss of Support Value (0,1,2,3)	0.0	

Modulus of Subgrade Reaction	212.30	**psi/in**

WinPAS

Pavement Thickness Design According to

1993 AASHTO Guide for Design of Pavements Structures

American Concrete Pavement Association

Flexible Design Inputs

Agency:
Company: Olsson Associates
Contractor:
roject Description: St. Pualinus Church Addition
Location: Syracuse, Nebraska

Flexible Pavement Design/Evaluation

Structural Number	2.33		**Soil Resilient Modulus**	4,118.20	**psi**
Design ESALs	29,780		**Initial Serviceability**	4.40	
Reliability	85.00	**percent**	**Terminal Serviceability**	2.50	
Overall Deviation	0.45				

Layer Pavement Design/Evaluation

Layer Material	Layer Coefficient	Drainage Coefficient	Layer Thickness	Layer SN
Asphalt Cement Concrete	0.44	0.95	1.50	0.63
Asphalt Cement Concrete	0.40	0.95	4.50	1.71
	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00
			ΣSN	2.34

WinPAS

Pavement Thickness Design According to

1993 AASHTO Guide for Design of Pavements Structures

American Concrete Pavement Association

Rigid Design Inputs

Agency:
Company: Olsson Associates
Contractor:
Project Description: St. Pualinus Church Addition - Heavy Duty
Location: Syracuse, Nebraska

Rigid Pavement Design/Evaluation

PCC Thickness	4.34	**inches**	**Load Transfer, J**	3.60	
Design ESALs	68,397		**Mod. Subgrade Reaction, k**	212	**psi/in**
Reliability	85.00	**percent**	**Drainage Coefficient, Cd**	0.95	
Overall Deviation	0.35		**Initial Serviceability**	4.40	
Modulus of Rupture	600	**psi**	**Terminal Serviceability**	2.50	
Modulus of Elasticity	4,100,000	**psi**			

Modulus of Subgrade Reaction (k-value) Determination

Resilient Modulus of the Subgrade	4,118.2	**psi**
Resilient Modulus of the Subbase	0.0	**psi**
Subbase Thickness	0.00	**inches**
Depth to Rigid Foundation	0.00	**feet**
Loss of Support Value (0,1,2,3)	0.0	

Modulus of Subgrade Reaction	212.30	**psi/in**

WinPAS

Pavement Thickness Design According to

1993 AASHTO Guide for Design of Pavements Structures

American Concrete Pavement Association

Flexible Design Inputs

Agency:
Company: Olsson Associates
Contractor:
roject Description: St. Pualinus Church Addition - Heavy Duty
Location: Syracuse, Nebraska

Flexible Pavement Design/Evaluation

Structural Number	2.58		**Soil Resilient Modulus**	4,118.20	**psi**
Design ESALs	56,035		**Initial Serviceability**	4.40	
Reliability	85.00	**percent**	**Terminal Serviceability**	2.50	
Overall Deviation	0.45				

Layer Pavement Design/Evaluation

Layer Material	Layer Coefficient	Drainage Coefficient	Layer Thickness	Layer SN
Asphalt Cement Concrete	0.44	0.95	2.00	0.84
Asphalt Cement Concrete	0.40	0.95	5.00	1.90
	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00
			ΣSN	2.74

SECTION 042000 - UNIT MASONRY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Concrete masonry units.
2. Decorative concrete masonry units.
3. Stone units.
4. Mortar and grout.
5. Masonry-joint reinforcement.
6. Ties and anchors.
7. Embedded flashing.
8. Miscellaneous masonry accessories.

B. Products Installed but not Furnished under This Section:

1. Cast-stone trim in unit masonry.
2. Steel lintels in unit masonry.

C. Related Requirements:

1. Section 033000 "Cast-in-Place Concrete" for installing dovetail slots for masonry anchors.
2. Section 076200 "Sheet Metal Flashing and Trim" for exposed sheet metal flashing and for furnishing manufactured reglets installed in masonry joints.

1.3 DEFINITIONS

A. CMU(s): Concrete masonry unit(s).

B. Reinforced Masonry: Masonry containing reinforcing steel in grouted cells.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For the following:

1. Masonry Units: Show sizes, profiles, coursing, and locations of special shapes.
2. Stone Units: Show sizes, profiles, and locations of each stone units required.
3. Fabricated Flashing: Detail corner units, end-dam units, and other special applications.

C. Samples for Initial Selection:

1. Decorative CMUs, in the form of full-scale units.
2. Stone units.
3. Colored mortar.
4. Weep holes/cavity vents.

1.6 INFORMATIONAL SUBMITTALS

A. List of Materials Used in Constructing Mockups: List generic product names together with manufacturers, manufacturers' product names, model numbers, lot numbers, batch numbers, source of supply, and other information as required to identify materials used. Include mix proportions for mortar and grout and source of aggregates.

1. Submittal is for information only. Receipt of list does not constitute approval of deviations from the Contract Documents unless such deviations are specifically brought to the attention of Architect and approved in writing.

B. Qualification Data: For testing agency.

C. Material Certificates: For each type and size of the following:

1. Masonry units.

a. Include data on material properties material test reports substantiating compliance with requirements.

2. Integral water repellant used in CMUs.
3. Cementitious materials. Include name of manufacturer, brand name, and type.
4. Mortar admixtures.
5. Preblended, dry mortar mixes. Include description of type and proportions of ingredients.
6. Grout mixes. Include description of type and proportions of ingredients.
7. Joint reinforcement.
8. Anchors, ties, and metal accessories.

D. Mix Designs: For each type of mortar. Include description of type and proportions of ingredients.

1. Include test reports for mortar mixes required to comply with property specification. Test according to ASTM C 109/C 109M for compressive strength, ASTM C 1506 for water retention, and ASTM C 91/C 91M for air content.

2. Include test reports, according to ASTM C 1019, for grout mixes required to comply with compressive strength requirement.

E. Cold-Weather and Hot-Weather Procedures: Detailed description of methods, materials, and equipment to be used to comply with requirements.

1.7 QUALITY ASSURANCE

A. Testing Agency Qualifications: Qualified according to ASTM C 1093 for testing indicated.

B. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.

1. Build mockups for each type of exposed unit masonry construction typical exterior wall in sizes approximately 48 inches (1200 mm) long by 48 inches (1200 mm) high by full thickness, including face and backup wythes and accessories.

    a. Include a sealant-filled joint at least 16 inches (400 mm) long in exterior wall mockup.
    b. Include lower corner of window opening, framed with stone sill, at upper corner of exterior wall mockup. Make opening approximately 12 inches (300 mm) wide by 16 inches (400 mm) high.
    c. Include through-wall flashing installed for a 24-inch (600-mm) length in corner of exterior wall mockup approximately 16 inches (400 mm) down from top of mockup, with a 12-inch (300-mm) length of flashing left exposed to view (omit masonry above half of flashing).
    d. Include wood studs, sheathing, sheathing joint-and-penetration treatment air barrier, veneer anchors, flashing, cavity drainage material, and weep holes in exterior masonry-veneer wall mockup.

2. Where masonry is to match existing, erect mockups adjacent and parallel to existing surface.
3. Clean one-half of exposed faces of mockups with masonry cleaner as indicated.
4. Protect accepted mockups from the elements with weather-resistant membrane.
5. Approval of mockups is for color, texture, and blending of masonry units; relationship of mortar and sealant colors to masonry unit colors; tooling of joints; and aesthetic qualities of workmanship.

    a. Approval of mockups is also for other material and construction qualities specifically approved by Architect in writing.
    b. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Store masonry units on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied. If units become wet, do not install until they are dry.

B. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.

C. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.

D. Deliver preblended, dry mortar mix in moisture-resistant containers. Store preblended, dry mortar mix in delivery containers on elevated platforms in a dry location or in covered weatherproof dispensing silos.

E. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

1.9 FIELD CONDITIONS

A. Protection of Masonry: During construction, cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress.

1. Extend cover a minimum of 24 inches (600 mm) down both sides of walls, and hold cover securely in place.
2. Where one wythe of multiwythe masonry walls is completed in advance of other wythes, secure cover a minimum of 24 inches (600 mm) down face next to unconstructed wythe, and hold cover in place.

B. Do not apply uniform floor or roof loads for at least 12 hours and concentrated loads for at least three days after building masonry walls or columns.

C. Stain Prevention: Prevent grout, mortar, and soil from staining the face of masonry to be left exposed or painted. Immediately remove grout, mortar, and soil that come in contact with such masonry.

1. Protect base of walls from rain-splashed mud and from mortar splatter by spreading coverings on ground and over wall surface.
2. Protect sills, ledges, and projections from mortar droppings.
3. Protect surfaces of window and door frames, as well as similar products with painted and integral finishes, from mortar droppings.
4. Turn scaffold boards near the wall on edge at the end of each day to prevent rain from splashing mortar and dirt onto completed masonry.

D. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in TMS 602/ACI 530.1/ASCE 6.

1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F (4 deg C) and higher and will remain so until masonry has dried, but not less than seven days after completing cleaning.

E. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in TMS 602/ACI 530.1/ASCE 6.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations for Masonry Units: Obtain exposed masonry units of a uniform texture and color, or a uniform blend within the ranges accepted for these characteristics, from single source from single manufacturer for each product required.

B. Source Limitations for Mortar Materials: Obtain mortar ingredients of a uniform quality, including color for exposed masonry, from single manufacturer for each cementitious component and from single source or producer for each aggregate.

2.2 PERFORMANCE REQUIREMENTS

2.3 UNIT MASONRY, GENERAL

A. Masonry Standard: Comply with TMS 602/ACI 530.1/ASCE 6, except as modified by requirements in the Contract Documents.

B. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to contain chips, cracks, or other defects exceeding limits stated. Do not use units where such defects are exposed in the completed Work.

2.4 CONCRETE MASONRY UNITS

A. Shapes: Provide shapes indicated and as follows, with exposed surfaces matching exposed faces of adjacent units unless otherwise indicated.

1. Provide special shapes for lintels, corners, jambs, sashes, movement joints, headers, bonding, and other special conditions.
2. Provide square-edged units for outside corners unless otherwise indicated.

B. Integral Water Repellent: Provide units made with integral water repellent for exposed units.

1. Integral Water Repellent: Liquid polymeric, integral water-repellent admixture that does not reduce flexural bond strength. Units made with integral water repellent, when tested according to ASTM E 514/E 514M as a wall assembly made with mortar containing integral water-repellent manufacturer's mortar additive, with test period extended to 24 hours, shall show no visible water or leaks on the back of test specimen.

a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1) ACM Chemistries.

2) BASF Construction Chemicals - Building Systems.

C. CMUs: ASTM C 90.

1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 1900 psi (13.1 MPa).
2. Density Classification: Normal weight.
3. Size (Width): Manufactured to dimensions 3/8 inch (10 mm) less than nominal dimensions.

D. Decorative CMUs: ASTM C 90.

1. Products: Subject to compliance with requirements, provide the following or pre-approved substitution:

   a. Gauge Brothers decorative concrete masonry units.

2. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 1900 psi (13.1 MPa).
3. Density Classification: Normal weight.
4. Size (Width): Manufactured to dimensions specified in "CMUs" Paragraph.
5. Pattern and Texture:

   a. Standard pattern, ground-face finish. Match Architect's samples.
   b. Standard pattern, split-face finish. Match Architect's samples.

6. Colors: Match Architect's samples.

2.5 STONE UNITS

A. Limestone: ASTM C 568/C 568M, Match existing Density.

B. Finish: Rock face (pitched face).

1. Finish for Jamb Returns.

C. Provide stone units accurately shaped, with exposed faces dressed true, and with beds and joints at right angles to faces.

1. For limestone, comply with recommendations in ILI's "Indiana Limestone Handbook."
2. For marble, comply with recommendations in MIA's "Dimensional Stone - Design Manual VII."

2.6 MORTAR AND GROUT MATERIALS

A. Portland Cement: ASTM C 150/C 150M, Type I or II, except Type III may be used for cold-weather construction. Provide natural color or white cement as required to produce mortar color indicated.

1. Alkali content shall not be more than 0.1 percent when tested according to ASTM C 114.

B. Hydrated Lime: ASTM C 207, Type S.

C. Portland Cement-Lime Mix: Packaged blend of portland cement and hydrated lime containing no other ingredients.

D. Colored Cement Products: Packaged blend made from portland cement and hydrated lime and mortar pigments, all complying with specified requirements, and containing no other ingredients.

1. Colored Portland Cement-Lime Mix:

a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1) Essroc.
2) Holcim (US) Inc.
3) Lafarge North America Inc.

2. Formulate blend as required to produce color indicated or, if not indicated, as selected from manufacturer's standard colors.
3. Pigments shall not exceed 10 percent of portland cement by weight.

E. Aggregate for Mortar: ASTM C 144.

1. For mortar that is exposed to view, use washed aggregate consisting of natural sand or crushed stone.
2. For joints less than 1/4 inch (6 mm) thick, use aggregate graded with 100 percent passing the No. 16 (1.18-mm) sieve.
3. White-Mortar Aggregates: Natural white sand or crushed white stone.
4. Colored-Mortar Aggregates: Natural sand or crushed stone of color necessary to produce required mortar color.
5. Pointing Mortar by Type: ASTM C 270, Proportion Specification, Type N unless otherwise indicated; with cementitious material limited to portland cement and lime. Add mortar pigments to produce mortar colors required.

F. Aggregate for Grout: ASTM C 404.

G. Cold-Weather Admixture: Nonchloride, noncorrosive, accelerating admixture complying with ASTM C 494/C 494M, Type C, and recommended by manufacturer for use in masonry mortar of composition indicated.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. BASF Construction Chemicals - Building Systems.
b. Euclid Chemical Company (The); an RPM company.

H. Water-Repellent Admixture: Liquid water-repellent mortar admixture intended for use with CMUs containing integral water repellent from same manufacturer.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

   a. ACM Chemistries.
   b. BASF Aktiengesellschaft.
   c. Euclid Chemical Company (The); an RPM company.

I. Water: Potable.

2.7 REINFORCEMENT

A. Masonry-Joint Reinforcement for Veneers Anchored with Seismic Masonry-Veneer Anchors: Single 0.187-inch- (4.76-mm-) diameter, hot-dip galvanized carbon-steel continuous wire.

2.8 TIES AND ANCHORS

A. General: Ties and anchors shall extend at least 1-1/2 inches (38 mm) into veneer but with at least a 5/8-inch (16-mm) cover on outside face.

B. Materials: Provide ties and anchors specified in this article that are made from materials that comply with the following unless otherwise indicated:

1. Hot-Dip Galvanized, Carbon-Steel Wire: ASTM A 82/A 82M, with ASTM A 153/A 153M, Class B-2 coating.
2. Galvanized-Steel Sheet: ASTM A 653/A 653M, Commercial Steel, G60 (Z180) zinc coating.
3. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.

C. Adjustable Anchors for Connecting to Concrete: Provide anchors that allow vertical or horizontal adjustment but resist tension and compression forces perpendicular to plane of wall.

1. Connector Section: Dovetail tabs for inserting into dovetail slots in concrete and attached to tie section; formed from 0.060-inch- (1.52-mm-) thick steel sheet, galvanized after fabrication.

2. Tie Section: Triangular-shaped wire tie made from 0.187-inch- (4.76-mm-) diameter, wire. Mill-galvanized wire may be used at interior walls unless otherwise indicated.

D. Adjustable Masonry-Veneer Anchors:

1. General: Provide anchors that allow vertical adjustment but resist a 100-lbf (445-N) load in both tension and compression perpendicular to plane of wall without deforming or developing play in excess of 1/16 inch (1.5 mm).
2. Fabricate sheet metal anchor sections and other sheet metal parts from 0.105-inch- (2.66-mm-) thick steel sheet, galvanized after fabrication.
3. Fabricate wire ties from 0.187-inch- (4.76-mm-) diameter, hot-dip galvanized-steel wire unless otherwise indicated.

4. Seismic Masonry-Veneer Anchors: Connector section and rib-stiffened, sheet metal anchor section with screw holes top and bottom, with projecting tabs having slotted holes for inserting vertical leg of connector section. Connector section consists of a wire tie pintle with down-turned leg designed to fit in anchor section slot and with integral tabs designed to engage continuous wire.

    a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

        1) Dur-O-Wal; a Hohmann & Barnard company.
        2) Hohmann & Barnard, Inc.
        3) Heckmann Building Products.

5. Polymer-Coated, Steel Drill Screws for Wood Studs: ASTM C 954 except manufactured with hex washer head and neoprene or EPDM washer, No. 10 (4.83-mm) diameter by length required to penetrate wood stud 1.5 inches (37mm), and with organic polymer coating with salt-spray resistance to red rust of more than 800 hours according to ASTM B 117.

2.9 EMBEDDED FLASHING MATERIALS

A. Flexible Flashing: Use one of the following unless otherwise indicated:

1. Rubberized-Asphalt Flashing: Composite flashing product consisting of a pliable, adhesive rubberized-asphalt compound, bonded to a high-density, cross-laminated polyethylene film to produce an overall thickness of not less than 0.030 inch (0.76 mm).

    a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

        1) Advanced Building Products Inc.
        2) Carlisle Coatings & Waterproofing Inc.
        3) Fiberweb, Clark Hammerbeam Corp.
        4) Grace Construction Products; W.R. Grace & Co. -- Conn.
        5) Heckmann Building Products, Inc.
        6) Hohmann & Barnard, Inc.
        7) Polyguard Products, Inc.
        8) W.R. Meadows, Inc.

    b. Accessories: Provide preformed corners, end dams, other special shapes, and seaming materials produced by flashing manufacturer.

2. Butyl Rubber Flashing: Composite, self-adhesive, flashing product consisting of a pliable, butyl rubber compound, bonded to a high-density polyethylene film, aluminum foil, or spunbonded polyolefin to produce an overall thickness of not less than 0.030 inch (0.76 mm).

    a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1) DuPont Building Innovations: E. I. du Pont de Nemours and Company.
2) Grace Construction Products; W.R. Grace & Co. -- Conn.
3) Protecto Wrap Company.

b. Accessories: Provide preformed corners, end dams, other special shapes, and seaming materials produced by flashing manufacturer.

B. Adhesives, Primers, and Seam Tapes for Flashings: Flashing manufacturer's standard products or products recommended by flashing manufacturer for bonding flashing sheets to each other and to substrates.

C. Termination Bars for Flexible Flashing: Stainless-steel sheet 0.019 inch by 1-1/2 inches (0.48 mm by 38 mm) with a 3/8 inch (10-mm) sealant flange at top.

2.10 MISCELLANEOUS MASONRY ACCESSORIES

A. Control/Expansion Joints: Premolded filler strips complying with ASTM D 1056, Grade 2A1; compressible up to 35 percent; of width and thickness indicated; formulated from neoprene urethane or PVC.

B. Bond-Breaker Strips: Asphalt-saturated felt complying with ASTM D 226/D 226M, Type I (No. 15 asphalt felt).

C. Weep/Cavity Vent Products: Use the following unless otherwise indicated:

1. Cellular Plastic Weep/Vent: One-piece, flexible extrusion made from UV-resistant polypropylene copolymer, full height and width of head joint and depth 1/8 inch (3 mm) less than depth of outer wythe, in color selected from manufacturer's standard.

a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1) Advanced Building Products Inc.
2) Heckmann Building Products, Inc.
3) Hohmann & Barnard, Inc.

D. Cavity Drainage Material: Free-draining mesh, made from polymer strands that will not degrade within the wall cavity.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Advanced Building Products Inc.
b. CavClear/Archovations, Inc.
c. Heckmann Building Products, Inc.
d. Hohmann & Barnard, Inc.
e. Mortar Net USA, Ltd.

2. Configuration: Provide one of the following:

a. Strips, full depth of cavity and 10 inches (250 mm) high, with dovetail-shaped notches 7 inches (175 mm) deep or with a dimpled surface each designed to catch mortar droppings and prevent weep holes from clogging with mortar.

2.11 MASONRY CLEANERS

A. Proprietary Acidic Cleaner: Manufacturer's standard-strength cleaner designed for removing mortar/grout stains, efflorescence, and other new construction stains from new masonry without discoloring or damaging masonry surfaces. Use product expressly approved for intended use by cleaner manufacturer and manufacturer of masonry units being cleaned.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Diedrich Technologies, Inc.; a division of Sandell Construction Solutions.
b. EaCo Chem, Inc.

2.12 MORTAR AND GROUT MIXES

A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures unless otherwise indicated.

1. Do not use calcium chloride in mortar or grout.
2. Use portland cement-lime mortar unless otherwise indicated.
3. Add cold-weather admixture (if used) at same rate for all mortar that will be exposed to view, regardless of weather conditions, to ensure that mortar color is consistent.

B. Preblended, Dry Mortar Mix: Furnish dry mortar ingredients in form of a preblended mix. Measure quantities by weight to ensure accurate proportions, and thoroughly blend ingredients before delivering to Project site.

C. Mortar for Unit Masonry: Comply with ASTM C 270, Proportion Specification. Provide the following types of mortar for applications stated unless another type is indicated or needed to provide required compressive strength of masonry.

1. For masonry below grade or in contact with earth, use Type S.
2. For exterior, above-grade, load-bearing and nonload-bearing walls and parapet walls; for interior load-bearing walls; for interior nonload-bearing partitions; and for other applications where another type is not indicated, use Type N.

D. Pigmented Mortar: Use colored cement product or select and proportion pigments with other ingredients to produce color required. Do not add pigments to colored cement products.

1. Pigments shall not exceed 10 percent of portland cement by weight.
2. Mix to match Architect's sample.
3. Application: Use pigmented mortar for exposed mortar joints with the following units:

a. Decorative CMUs.

b. Stone units.
c. Cast-stone trim units.

E. Colored-Aggregate Mortar: Produce required mortar color by using colored aggregates and natural color or white cement as necessary to produce required mortar color.

1. Mix to match Architect's sample.
2. Application: Use colored-aggregate mortar for exposed mortar joints with the following units:

a. Decorative CMUs.
b. Stone units.
c. Cast-stone trim units.

F. Grout for Unit Masonry: Comply with ASTM C 476.

1. Use grout of type indicated or, if not otherwise indicated, of type (fine or coarse) that will comply with TMS 602/ACI 530.1/ASCE 6 for dimensions of grout spaces and pour height.
2. Proportion grout in accordance with ASTM C 476, paragraph 4.2.2 for specified 28-day compressive strength indicated, but not less than 2000 psi (14 MPa).
3. Provide grout with a slump of 8 to 11 inches (200 to 280 mm) as measured according to ASTM C 143/C 143M.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

1. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
2. Verify that foundations are within tolerances specified.
3. Verify that reinforcing dowels are properly placed.
4. Verify that substrates are free of substances that impair mortar bond.

B. Before installation, examine rough-in and built-in construction for piping systems to verify actual locations of piping connections.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. Thickness: Build cavity and composite walls and other masonry construction to full thickness shown. Build single-wythe walls to actual widths of masonry units, using units of widths indicated.

B. Build chases and recesses to accommodate items specified in this and other Sections.

C. Leave openings for equipment to be installed before completing masonry. After installing equipment, complete masonry to match construction immediately adjacent to opening.

D. Use full-size units without cutting if possible. If cutting is required to provide a continuous pattern or to fit adjoining construction, cut units with motor-driven saws; provide clean, sharp, unchipped edges. Allow units to dry before laying unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.

E. Select and arrange units for exposed unit masonry to produce a uniform blend of colors and textures. Mix units from several pallets or cubes as they are placed.

F. Matching Existing Masonry: Match coursing, bonding, color, and texture of existing masonry.

3.3 TOLERANCES

A. Dimensions and Locations of Elements:

1. For dimensions in cross section or elevation, do not vary by more than plus 1/2 inch (12 mm) or minus 1/4 inch (6 mm).
2. For location of elements in plan, do not vary from that indicated by more than plus or minus 1/2 inch (12 mm).
3. For location of elements in elevation, do not vary from that indicated by more than plus or minus 1/4 inch (6 mm) in a story height or 1/2 inch (12 mm) total.

B. Lines and Levels:

1. For bed joints and top surfaces of bearing walls, do not vary from level by more than 1/4 inch in 10 feet (6 mm in 3 m), or 1/2-inch (12-mm) maximum.
2. For conspicuous horizontal lines, such as lintels, sills, parapets, and reveals, do not vary from level by more than 1/8 inch in 10 feet (3 mm in 3 m), 1/4 inch in 20 feet (6 mm in 6 m), or 1/2-inch (12-mm) maximum.
3. For vertical lines and surfaces, do not vary from plumb by more than 1/4 inch in 10 feet (6 mm in 3 m), 3/8 inch in 20 feet (9 mm in 6 m), or 1/2-inch (12-mm) maximum.
4. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/8 inch in 10 feet (3 mm in 3 m), 1/4 inch in 20 feet (6 mm in 6 m), or 1/2-inch (12-mm) maximum.
5. For lines and surfaces, do not vary from straight by more than 1/4 inch in 10 feet (6 mm in 3 m), 3/8 inch in 20 feet (9 mm in 6 m), or 1/2-inch (12-mm) maximum.
6. For vertical alignment of exposed head joints, do not vary from plumb by more than 1/4 inch in 10 feet ((6 mm in 3 m),) or 1/2-inch (12-mm) maximum.

C. Joints:

1. For bed joints, do not vary from thickness indicated by more than plus or minus 1/8 inch (3 mm), with a maximum thickness limited to 1/2 inch (12 mm).
2. For exposed bed joints, do not vary from bed-joint thickness of adjacent courses by more than 1/8 inch (3 mm).
3. For head and collar joints, do not vary from thickness indicated by more than plus 3/8 inch (9 mm) or minus 1/4 inch (6 mm).

4. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/8 inch (3 mm).
5. For exposed bed joints and head joints of stacked bond, do not vary from a straight line by more than 1/16 inch (1.5 mm) from one masonry unit to the next.

3.4 LAYING MASONRY WALLS

A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.

B. Bond Pattern for Exposed Masonry: Unless otherwise indicated, lay exposed masonry in running bond; do not use units with less-than-nominal 4-inch (100-mm) horizontal face dimensions at corners or jambs.

C. Lay concealed masonry with all units in a wythe in running bond or bonded by lapping not less than 2 inches (50 mm). Bond and interlock each course of each wythe at corners. Do not use units with less-than-nominal 4-inch (100-mm) horizontal face dimensions at corners or jambs.

D. Stopping and Resuming Work: Stop work by stepping back units in each course from those in course below; do not tooth. When resuming work, clean masonry surfaces that are to receive mortar, remove loose masonry units and mortar, and wet brick if required before laying fresh masonry.

E. Built-in Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry around built-in items.

F. Spot grout steel frames set in masonry with mortar unless otherwise indicated. Fill void with mineral wool insulation.

G. Where built-in items are to be embedded in cores of hollow masonry units, place a layer of metal lath, wire mesh, or plastic mesh in the joint below, and rod mortar or grout into core.

H. Fill cores in hollow CMUs with grout 24 inches (600 mm) under bearing plates, beams, lintels, posts, and similar items unless otherwise indicated.

3.5 MORTAR BEDDING AND JOINTING

A. Lay CMUs as follows:

1. Bed face shells in mortar and make head joints of depth equal to bed joints.
2. Bed webs in mortar in all courses of piers, columns, and pilasters.
3. Bed webs in mortar in grouted masonry, including starting course on footings.
4. Fully bed entire units, including areas under cells, at starting course on footings where cells are not grouted.
5. Fully bed units and fill cells with mortar at anchors and ties as needed to fully embed anchors and ties in mortar.

B. Lay solid masonry units with completely filled bed and head joints; butter ends with sufficient mortar to fill head joints and shove into place. Do not deeply furrow bed joints or slush head joints.

C. Set stone and cast-stone trim units in full bed of mortar with full vertical joints. Fill dowel, anchor, and similar holes.

1. Clean soiled surfaces with fiber brush and soap powder and rinse thoroughly with clear water.
2. Allow cleaned surfaces to dry before setting.
3. Where indicated, rake out mortar joints for pointing with sealant.

D. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness unless otherwise indicated.

3.6 ANCHORED MASONRY VENEERS

A. Anchor masonry veneers to wall framing and concrete backup with seismic masonry-veneer anchors to comply with the following requirements:

1. Fasten screw-attached and anchors through sheathing to wall framing and to concrete backup with metal fasteners of type indicated. Use two fasteners unless anchor design only uses one fastener.
2. Embed tie sections connector sections and continuous wire in masonry joints.
3. Locate anchor sections to allow maximum vertical differential movement of ties up and down.
4. Space anchors as indicated, but not more than 16 inches (406 mm) o.c. vertically and horizontally, with not less than one anchor for each 1.76 sq. ft. (0.15 sq. m) of wall area. Install additional anchors within 12 inches (305 mm) of openings and at intervals, not exceeding 24 inches (600 mm), around perimeter.

B. Provide not less than 2 inches (50 mm) of airspace between back of masonry veneer and face of sheathing.

1. Keep airspace clean of mortar droppings and other materials during construction. Bevel beds away from airspace, to minimize mortar protrusions into airspace. Do not attempt to trowel or remove mortar fins protruding into airspace.

3.7 MASONRY-JOINT REINFORCEMENT

A. General: Install entire length of longitudinal side rods in mortar with a minimum cover of 5/8 inch (16 mm) on exterior side of walls, 1/2 inch (13 mm) elsewhere. Lap reinforcement a minimum of 6 inches (150 mm).

1. Space reinforcement not more than 16 inches (406 mm) o.c.
2. Provide reinforcement not more than 8 inches (203 mm) above and below wall openings and extending 12 inches (305 mm) beyond openings in addition to continuous reinforcement.

B. Interrupt joint reinforcement at control and expansion joints unless otherwise indicated.

C. Provide continuity at wall intersections by using prefabricated T-shaped units.

D. Provide continuity at corners by using prefabricated L-shaped units.

3.8 ANCHORING MASONRY TO CONCRETE

A. Anchor masonry to concrete, where masonry abuts or faces concrete, to comply with the following:

1. Provide an open space not less than 2 inches (50 mm) wide between masonry and concrete unless otherwise indicated. Keep open space free of mortar and other rigid materials.
2. Anchor masonry with anchors embedded in masonry joints and attached to structure.
3. Space anchors16 inches (406 mm) o.c. vertically and horizontally.

3.9 CONTROL AND EXPANSION JOINTS

A. General: Install control- and expansion-joint materials in unit masonry as masonry progresses. Do not allow materials to span control and expansion joints without provision to allow for in-plane wall or partition movement.

B. Form control joints in concrete masonry as follows:

1. Install preformed compressible filler between masonry units. Keep head joints free and clear of mortar for application of sealant.

C. Form expansion joints in brick as follows:

1. Build in compressible joint fillers where indicated.
2. Form open joint full depth of brick wythe and of width indicated, but not less than 3/8 inch (10 mm) for installation of sealant and backer rod specified in Section 079200 "Joint Sealants."

3.10 LINTELS

A. Install galvanized steel lintels where indicated.

B. Provide minimum bearing of 8 inches (200 mm) at each jamb unless otherwise indicated.

C. Precast / Cast Stone lintels are also inditaced on the plans and shall be designed by a resistered professional engineer in the State of Nebraska with their calculations being submitted for review.

3.11 FLASHING, WEEP HOLES, AND CAVITY VENTS

A. General: Install embedded flashing and weep holes in masonry at shelf angles, lintels, ledges, other obstructions to downward flow of water in wall, and where indicated. Install cavity vents at shelf angles, ledges, and other obstructions to upward flow of air in cavities, and where indicated.

B. Install flashing as follows unless otherwise indicated:

1. Prepare masonry surfaces so they are smooth and free from projections that could puncture flashing. Where flashing is within mortar joint, place through-wall flashing on sloping bed of mortar and cover with mortar. Before covering with mortar, seal penetrations in flashing with adhesive, sealant, or tape as recommended by flashing manufacturer.
2. At masonry-veneer walls, extend flashing through veneer, across airspace behind veneer, and up face of sheathing at least 8 inches (200 mm); with upper edge tucked under air barrier, lapping at least 4 inches (100 mm).
3. At lintels and shelf angles, extend flashing a minimum of 6 inches (150 mm) into masonry at each end. At heads and sills, extend flashing 6 inches (150 mm) at ends and turn up not less than 2 inches (50 mm) to form end dams.
4. Cut flexible flashing off flush with face of wall after masonry wall construction is completed.

C. Install reglets and nailers for flashing and other related construction where they are shown to be built into masonry.

D. Install weep holes in exterior wythes and veneers in head joints of first course of masonry immediately above embedded flashing.

1. Use specified weep/cavity vent products to form weep holes.
2. Space weep holes 32 inches (800 mm) o.c. unless otherwise indicated.

E. Place cavity drainage material in airspace behind veneers to comply with configuration requirements for cavity drainage material in "Miscellaneous Masonry Accessories" Article.

F. Install cavity vents in head joints in exterior wythes at spacing indicated. Use specified weep/cavity vent products to form cavity vents.

1. Close cavities off vertically and horizontally with blocking in manner indicated. Install through-wall flashing and weep holes above horizontal blocking.

3.12 REPAIRING, POINTING, AND CLEANING

A. Remove and replace masonry units that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Install new units to match adjoining units; install in fresh mortar, pointed to eliminate evidence of replacement.

B. Pointing: During the tooling of joints, enlarge voids and holes, except weep holes, and completely fill with mortar. Point up joints, including corners, openings, and adjacent

construction, to provide a neat, uniform appearance. Prepare joints for sealant application, where indicated.

C. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.

D. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:

1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
2. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes. Obtain Architect's approval of sample cleaning before proceeding with cleaning of masonry.
3. Protect adjacent stone and nonmasonry surfaces from contact with cleaner by covering them with liquid strippable masking agent or polyethylene film and waterproof masking tape.
4. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing surfaces thoroughly with clear water.
5. Clean masonry with a proprietary acidic cleaner applied according to manufacturer's written instructions.
6. Clean stone trim to comply with stone supplier's written instructions.
7. Clean limestone units to comply with recommendations in ILI's "Indiana Limestone Handbook."

3.13 MASONRY WASTE DISPOSAL

A. Salvageable Materials: Unless otherwise indicated, excess masonry materials are Contractor's property. At completion of unit masonry work, remove from Project site.

B. Waste Disposal as Fill Material: Dispose of clean masonry waste, including excess or soil-contaminated sand, waste mortar, and broken masonry units, by crushing and mixing with fill material as fill is placed.

1. Crush masonry waste to less than 4 inches (100 mm) in each dimension.
2. Mix masonry waste with at least two parts of specified fill material for each part of masonry waste. Fill material is specified in Section 312000 "Earth Moving."
3. Do not dispose of masonry waste as fill within 18 inches (450 mm) of finished grade.

C. Masonry Waste Recycling: Return broken CMUs not used as fill to manufacturer for recycling.

D. Excess Masonry Waste: Remove excess clean masonry waste that cannot be used as fill, as described above or recycled, and other masonry waste, and legally dispose of off Owner's property.

END OF SECTION 042000