SECTION 02200

REVISED EXCAVATION AND/OR FILL

1. GENERAL

All work included under this heading shall be subject to the General Conditions of the entire operation. This Contractor is required to refer especially thereto.

2. WORK INCLUDED

2.1 This Contractor shall furnish all labor and materials to complete all excavation and/or fill as required by the drawings and/or herein specified, including the following:

2.1.1 Protection against damage of all walls, walks, streets, buildings, adjacent to or on the premises

2.1.2 General excavations in or adjacent to the building to grades, lines, and levels as indicated for foundations, footings, floor slabs, column footings, grade beams, etc., as required.

2.1.3 Excavation and/or fill to subgrades indicated for new exterior sidewalks.

2.1.4 Filling and backfilling for all work herein as required to bring work to finished grades including furnishing of any extra material as required.

A. Where excavation is made below depth required for footings, foundations or any bearing work, fill to required grade with concrete.

B. Provide free draining granular fill under all floor slabs on grade with a FA-A or MA-1 gradation or approved equal.

2.1.5 Pipe and conduits to remain on the site shall be supported and protected.

2.1.6 Water shall be diverted and/or pumped out of all areas requiring fill.

2.1.7 Provide all required shoring, bracing, planking, and cribbing as required and provide removal of same.

2.1.8 Removal of old footings, foundations, pipe lines, etc., which interfere with the progress of the work and are located at all new footing locations.

2.1.9 Strip topsoil from all areas of the building, sidewalks, drives and parking surfaces. Stockpile on the site verify location with Architect.

2.1.10 Provide 6" topsoil over all fill areas indicated to be grass areas. Fine grade with rake, removing stones and debris.

2.1.11 Contractor to provide laboratory tests for compaction of fill and backfill at his expense.

2.1.12 Contractor to provide hook-up and protect temporary utilities during construction.

3. GENERAL EXCAVATION

3.1 All Excavations shall be made to the proper depth in accordance with requirements of O.S.H.A. with proper allowance made for fill, floor slabs, forms, centers, and sheath piling. Bottoms of piers and footings shall be clean, clear of loose material, approximately level and lower sections true to size. Trench bottoms shall be evenly pitched as required.

3.2 Excavations greater than five feet in depth shall have sloped embankments and/or shoring for protection from cave-ins in accordance with current O.S.H.A. requirements.

3.3 All footing shall be carried to the depth below the finished grade indicated on the drawings.

3.4 Work that is excavated to a greater extent than required and which is within the bearing area of the footings shall be filled with concrete.

3.5 When such occurs in pipe trenches, provide brick or concrete piers as required to support pipes at required elevations.

3.6 Soils may vary somewhat in consistency both vertically and horizontally and "soft spots" may occur between boring locations. All excavations for footings shall be left open and protected from disintegration and inclement weather until inspected by the Architect prior to placement of concrete.

3.7 This Contractor shall notify the Architect before proceeding with the work when any unusual or questionable soil condition is encountered during construction.

3.8 Additional Exploratory operations: Additional test borings or other exploratory operations may be performed by the Contractor, at the Contractor's option; however, no additional payment will be authorized for such additional operations.

4. SITE PREPARATION

4.1 Adjacent structures and foundations must not be undermined while performing excavations. Adjacent foundations and structures must be protected (where applicable) while performing excavations and soil improvement programs. Roof drains and storm water drainage from adjacent structures and surrounding area should also be directed away from the proposed construction area.

4.2 Existing utilities within the proposed building area must be relocated to avoid passing beneath the new structure. We recommend abandoned utility pipes that cannot be removed be plugged with grout to reduce the potential for future collapse or moisture migration into the Subgrade soils. Excavations resulting from utility removal must be replaced with engineered structural fill.

4.3 In preparing the site for construction, surface vegetation and topsoil containing a significant percentage of organic matter should be removed from the areas beneath structures and any other areas that are to be paved, cut or receive fill. The removal depth for this site is expected to be about 6 inches. However, the removal depth should be monitored during stripping and adjusted as required. This material should either be removed from the site or stockpiled for later use in landscaping of unpaved or non-structural areas.

4.4 After removal of the topsoil, the Subgrade in fill areas should be proof rolled with a loaded tandem axle dump truck or equivalent (loaded water truck, loaded concrete mixer or motor grader). Any soft or unsuitable areas should be compacted or removed and replaced with stable fill material similar in composition to the surrounding soils. If necessary, clean materials such as crushed concrete or crushed gravel may be used to stabilize areas where wet soil or water is present. Further, in areas to accept fill, the top 9 inches of the ground surface should be scarified, moisture conditioned and re-compacted to eliminate a plane of weakness along the contact surface.

5. GENERAL STRUCTURAL FILL

5.1 General structural fill should consist of granular material or low plasticity cohesive material with a liquid limit (LL) less than 50 and plasticity index (PI) less than 25 and be free from organic matter or debris. Granular fill should have a maximum particle size of 2 inches and meet KDOT freeze/thaw durability and magnesium sulfate soundness requirements.

5.2 The on-site lean clay soils with a LL less than 50 and a PI less than 25 will be suitable for reuse as structural fill. On-site clay soils with a LL greater than 50 and a PI greater than 25 may be used as general structural fill after chemical stabilization as described in section 5 of this spec.

6. LOW VOLUME CHANGE MATERIAL (LVC)

6.1 Low volume change (LVC) material as specified for use below foundations and floor slabs must consist of material with a liquid limit (LL) less than 40 and plasticity index (PI) between 10 and 20. LVC material could be a granular material but must have sufficient cohesion to form a compactable, uniform and stable Subgrade. Silty gravel (KDOT AB-3) is an acceptable LVC material. Granular material exhibiting a PI less than 10 may be used within confined areas such as within foundation stem walls. The on-site lean clay soils may be considered LVC material as defined in this section.

7. CHEMICAL STABILIZATION OF SOIL

7.1 Chemical stabilization may be achieved b y amending the soil with: 4 to 6 percent lime, 14 to 16 percent class “C” fly ash or 6 to 8 percent cement kiln dust.

7.2 Lime stabilization

7.2.1 To establish index properties, we recommend performing a laboratory standard Proctor Moisture-Density Relationship (ASTM D698, “Laboratory Compaction Characteristics of Soil Using Standard Effort”) using a sample of the proposed lime-soil mixture. The sample should comprise of field-amended soil collected during mixing.

7.2.2 Lime may be applied as a slurry or powder. Initial mixing should be performed to reduce soil clods to a nominal size of one inch or less. The moisture content at the time of incorporation should be controlled to a minimum of 8 percent above the optimum moisture content as determined by ASTM D698. The lime should be incorporated into the soil and the supplemented soil should be allowed to “age” between 48 and 96 hours prior to final mixing and compaction. The soil-lime mixture should be protected from drying during the aging period by sealing the surface with a pneumatic tire or steel drum roller. The surface may require periodic moisture additions to prevent drying.

7.2.3 Final mixing should be performed until the material is one-inch or less in nominal size. The moisture should be adjusted to between optimum and 3 percent above optimum in preparation for final compaction in accordance with Section 6 of this spec (engineered structural fill).

7.2.4 Lime mixing should not be performed at ambient air temperatures below 41 degrees Fahrenheit.

7.3 Fly Ash Stabilization

7.3.1 To establish index properties, we recommend performing a laboratory standard Proctor Moisture-Density Relationship (ASTM D698, "Laboratory Compaction Characteristics of Soil Using Standard Effort") using a sample of the proposed fly ash-soil mixture. The sample should comprise of field-amended soil collected during manipulation.

7.3.2 Prior to the introduction of fly ash, the soil material should be thoroughly pulverized to reduce clods to ½" or less. During the pulverization process, we recommend that water be added to reach a moisture content at or above the optimum moisture content as determined by ASTM D698 for the proposed fly ash-soil mixture. The fly ash should remain dry and be protected from external sources of moisture during transportation and storage. Fly ash material that is introduced to moisture prior to incorporation with the soil must be discarded.

7.3.3 The fly ash and soil should be thoroughly mixed within ½ hour after introduction. The moisture content should be field-tested immediately following mixing and adjusted as needed to maintain a range between optimum and 3 percent above optimum. The fly ash-soil mixture should not be allowed to air dry. If the moisture content is determined to be in excess of 3 percent of optimum, additional fly ash should be applied to achieve the specified moisture content. Compaction of the fly ash supplemented soil should be competed within 2 hours after incorporation. Additional compaction after 2 hours may cause degradation of the soil strength. The fly ash-soil mixture should be compacted as noted in Section 6 of this spec (engineered structural fill).

7.3.4 Fly ash mixing should not be performed at ambient air temperatures below 50 degrees Fahrenheit.

7.4 Cement Kiln Dust

5.4.1 Cement kiln dust can also be used as a soil stabilization agent and should be incorporated into the soils using the procedures outlined for lime stabilization in accordance with the previous section. However, the cement kiln dust-soil mixture does not require re-mixing as specified for the lime stabilization.

7.5 General

7.5.1 Lime, fly ash or cement kiln dust stabilized soil that will be utilized as pavement subgrade should not be allowed to freeze prior to floor slab or pavement placement. The subgrade should be covered with a minimum of 4 inches of asphalt prior to being subjected to freezing conditions. If paving does not immediately follow soil stabilization, the supplemented soil should be kept moist and trafficking minimized for a curing period of approximately 5 to 7 days following compaction. An asphalt prime coat should be applied over the stabilized material surface as an alternative to periodic moisture additions to maintain acceptable moisture throughout curing.

8. COMPACTION OF ENGINEERED STRUCTURAL FILLS

8.1 Cohesive fill materials should be placed in loose lifts not to exceed 9 inches and be compacted to a minimum of 95 percent of the maximum dry unit weight obtained from ASTM D698. Moisture content at the time of compaction should be controlled to between optimum and 3 percent above the optimum moisture content.

8.2 Cohesionless fill materials (the percent passing the No. 200 sieve is less than 10 percent and the moisture-density curve indicates only slight sensitivity to changing moisture content), should be compacted to 75 percent relative density (ASTM D4253, "Maximum Index Density and Unity Weight of Soils Using a Vibratory Table" and ASTM D4254, "Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density"). Cohesionless materials should be placed at a moisture content that will achieve the desired densities. Water flooding is not an acceptable compaction method. Flooding cohesionless soils will negatively impact on-site clay soils.

8.3 Please note that relative density and standard Proctor tests measure different parameters and are not interchangeable.

9. UTILITY TRENCH BACKFILL

9.1 Utility trench backfill material should meet the requirements of general structural fill as defined in Section 3 of this spec. Where utility trenches pass beneath structures or flatwork, utility backfill should meet the requirements of LVC material as defined in Section 4 of this spec.

9.2 Backfill soils in utility trenches must be placed in lifts of 6 inches or less in loose thickness, moisture conditioned to between optimum and 3 percent above, and be compacted to a minimum of 95 percent of the standard Proctor maximum dry unit weight as determined by ASTM D698.

9.3 Controlled low strength material (CLSM) or flowable fill may also be used for utility backfills. CLSM with a maximum compressive strength less than 300 pounds per square inch (psi) can be readily excavated with a backhoe. The intent for the CLSM is to provide a backfill that can be placed in a single life, without personnel entering the excavation and without the need for compaction equipment.

9.4 Where used beneath flatwork or structures, CLSM should be terminated on foot below the structure or at the pavement subgrade elevation. To provide uniform support beneath flatwork and structures, the fill placed over the CLSM should be of similar composition as the surrounding bearing materials and be constructed as moisture-conditioned and compacted engineered structural fill in accordance with Section 6 of this spec.

10. FLOOR SLABS

10.1 In general, floor slabs will bear on engineered structural fill. However, even moderately plastic soils present a risk of causing slab movement. The Owner must be willing to accept some amount of movement of the slab-on-grade floor. Recommendations to help reduce the risk of movement of a slab supported by plastic clay soils are presented below.

10.2 To provide uniform support for floor slabs and reduce the potential for subgrade volume change, we recommend all floor slabs bear on a minimum of 12 inches of LVC material as defined in this spec. The placement and compaction of the LVC material should conform to the recommendations in Section 6 of this spec. Depending on final grades, some over-excavation of the plastic fat clay soils may be required to develop the 12-inch layer of LVC material.

10.3 By constructing a 12-inch layer of low plasticity, low volume change material immediately beneath the floor slab and closely controlling the moisture and density of the scarified soil and new fill materials, it is our opinion that the potential for detrimental floor slab movement will be reduced. However, because of the remaining thickness of the moderately plastic soils, the potential for future movement will still exist. A greater thickness of low plasticity fill beneath the floor slab may further reduce potential slab movement.

10.4 We also recommend the moisture content of the subgrade be checked prior to placement of a sand base or concrete floor slab. If a significant time period passes or if the moisture of the subgrade changes between site preparation and construction of the floor slab, we recommend the subgrade be scarified, moisture conditioned and re-compacted according to Section 6 of this spec.

10.5 We recommend a 4-inch granular cushion (such as ASTM D 448 No. 10 material) be placed beneath the floor slab in addition to the low plasticity, low volume change material. This layer should be free-draining, well-graded and compacted by vibration prior to placing the floor slab. This granular cushion should be moist, but not saturated, at the time of concrete placement.

10.5.1 **Table 5.4-1: ASTM D448 No. 10**

Sieve Size/No.	Percent Finer
3/8”	100
No. 4	85-100
No. 100	10-30

10.6 We recommend the floor-covering manufacturer be consulted regarding the use of a vapor retarder beneath floor slabs. If a vapor retarder is recommended by the floor-covering manufacturer, it should conform to the manufacturer’s specifications to maintain the product warranty.

10.7 The floor slab should be independent of any and all structural members and components. We recommend designing the floor slabs as a system free to move independently of columns and exterior walls without damaging the remainder of the building. If the floor slabs are fixed to structural members, the Owner must be willing to accept an increased potential for slab cracking. Areas adjacent to shallow foundations present the greatest potential for cracking of a fixed slab.

11. SURFACE DRAINAGE AND LANDSCAPING

11.1 The success of the shallow foundation system and slab-on-grade floor system is contingent upon keeping the moisture content of subgrade soils as constant as possible and not allowing surface drainage to have a path to the subsurface soils. Positive surface drainage away from structures must be maintained at all times. Landscaped areas should be designed and constructed such that irrigation and other surface water will be collected and carried away from foundation elements.

11.2 During construction, temporary grades should be established to prevent runoff from entering excavations or footing trenches. Backfill should be placed as soon as concrete structural strength requirements are met and should be graded to drain away from the building.

11.3 The final grade of the foundation backfill and any overlying pavements should have a positive slope away from foundation walls on all sides. We typically recommend a minimum slope of one inch per foot for the first 5 to 10 feet for uncovered surfaces. However, the slope may be decreased if the ground surface adjacent to foundations is covered with concrete slabs or asphalt pavements. For other areas of the site, we recommend a minimum slope of two percent. Pavements and exterior slabs that abut structures should be carefully sealed against moisture intrusion at the joint. All downspouts and faucets should discharge onto splash blocks that extend at least three feet from the building line or be tied into the storm drain system. Splash blocks should slope away from the foundation walls.

11.4 The placement of vegetation and plantings next to the foundation should be minimized. Where landscaping is required, we recommend considering plants and vegetation that require minimal irrigation. Irrigation within ten feet of the foundation should be carefully controlled and minimized.

12. CONSTRUCTION CONSIDERATIONS

12.1 If construction of the project is to be performed during periods of freezing temperatures, steps should be taken to prevent the soils under floor slabs, footings, or pavements from freezing. In no case should the fill materials, floor slabs, foundations, pavements, or other exterior flat work be placed on frozen or partially frozen materials. Frozen materials should be removed and replaced with a suitable material as described in earlier sections of this report.

12.2 Care should be exercised during excavation of new footings to avoid undermining the existing footings. Shoring, bracing, underpinning or other methods of maintaining foundation integrity may be required. Total settlement of the addition should be considered as differential settlement when designing architectural and structural connections between the addition and the existing structure.

12.3 Construction performed during periods of high precipitation may result in saturated unstable soils, and caving or sloughing of excavations. Control of soil moisture will be necessary for successful soil compaction, and to maintain soil-bearing capacity.

13. CONSTRUCTION OBSERVATION AND QUALITY CONTROL

13.1 The general contractor shall retain the services of a qualified geotechnical engineer to review those portions of the plans and specifications that pertain to foundations and earthwork to evaluate consistency with this spec.

13.2 Site grading, including proof rolling, replacement or re-compaction of material, and placement of fill and backfill, should be observed by a qualified geotechnical technician under the direction of a registered professional engineer. The technician should perform density tests and make any other observations necessary to assure that the requirements of the specifications are being achieved.

13.3 The geotechnical engineer of record shall also be the one to perform construction observation. Field observation services are essential and a continuation of the design process.

END OF SECTION 02200