PART II – TECHNICAL SPECIFICATIONS

DIVISION IV, *Structures*

CITY OF ABILENE

ITEM 400

EXCAVATION AND BACKFILL FOR STRUCTURES

400.1 DESCRIPTION.

This Item shall govern for the excavation bedding, backfill and/or Portland Cement Stabilized Backfill required for the construction of all structures. This Item shall also govern for any necessary sloping, pumping or bailing, for drainage, and for all sheeting and bracing of excavation walls up to five feet in depth. Excavation greater than five (5) feet in depth shall be protected as specified in TxDOT Item 402, "Trench Excavation Protection" or TxDOT Item 403, " Temporary Special Shoring". Unless otherwise provided, the work included herein shall provide for the removal of old structures or portions thereof (abutments, wingwalls, piers, house foundations; old sewers, sewer appurtenances, etc.), trees and all other obstructions to the proposed construction, the blocking of the ends of abandoned sewers cut and left in place, and the protection of existing utilities. Also governed by this Item are the cutting and restoration of pavement and base courses, the construction and removal of any required cofferdams, the hauling and disposition of surplus materials and the bridging of trenches and other provisions for maintenance of traffic or access.

400.2 EXCAVATION.

(1) General. Excavation shall conform to the lines and grades shown on the Plans or as directed by the Engineer.

When trench and/or negative projecting conditions for concrete pipe culverts are required by design, an excavation diagram will be shown on the Plans. These limits of excavation shall not be exceeded.

(a) Disposal of Excavation. All materials from excavation operations not required for backfilling and that are considered satisfactory, may be placed in embankment in accordance with Item 132, "Embankment". All excess material or material not satisfactory for use in Embankment will become the property of the Contractor. All surplus material shall be removed from the work site promptly following the completion of the portion of the structure involved and disposed of in a manner satisfactory to the Engineer and by permit from the City.

Whenever excavation is made for installing structures across private property or beyond the limits of the embankment, the top soil removed in the excavation shall be kept separate and replaced, as nearly as feasible.

(b) Excavation in Streets. Where structures are installed in streets, highways or other paved areas, the work shall include the cutting of pavement and base to neat lines and the restoration of pavement structure after structural excavation and backfill are completed. The type and thickness of replacement materials shall be as shown on the Plans. Any work done or any damage to base and/or pavement incurred outside the limits shown on the Plans or authorized by the Engineer, will not be measured for payment, but shall be restored at the Contractor's expense. Maintenance and control of traffic shall be in accordance with the approved traffic control plan and Manual on Uniform Traffic Control Devices.

(c) Protection of Utilities. The **Contractor** shall conduct his work with a minimum disturbance of existing utilities and it shall be his responsibility to coordinate all work in or near the utilities with the utility owners. The Contractor shall inform utility owners sufficiently in advance of his operations to enable them to identify and locate, reroute, provide temporary detours, or to make other adjustments to utility lines in order that work may proceed with a minimum of delay. The Contractor shall cooperate with all utility owners concerned for any utility adjustments necessary.

Particular care shall be exercised to avoid the cutting or damaging of underground utility lines that are to remain in place. Such lines if damaged shall be restored promptly. When active sanitary sewer lines are cut during excavation operations temporary flumes shall be provided across the excavation, while open, and the lines shall be restored when the backfilling has progressed to the original bedding lines of the cut sewer.

(d) Removing Old or Abandoned Structures. When old or abandoned structures or foundations are encountered in the excavation, such obstructions shall be removed for the full width of the excavation and to a depth of one (1) foot below the bottom of the excavation. When old inlets or manholes are encountered and no plan provision is made for adjustment or connection to the new structures, such manholes and inlets shall be removed completely to a depth one (1) foot below the bottom of the excavation. In each instance, the bottom of the excavation shall be restored to grade by backfilling and compacting by the methods provided hereinafter for backfill. Where the excavation cuts through abandoned sewers, these sewers shall be removed as required to clear the new structure and plugged in a manner approved by the Engineer.

(e) Dewatering of Excavation Area. Structures shall not be constructed or laid in the presence of water unless approved by the Engineer. Setting of precast members, placement of concrete, or pipe placing operations shall be performed on a dry firm bed. This shall be accomplished by removal of water from the surface of the bed by bailing, pumping, wellpoint installation, deep wells, drench drains, or any other method approved by the Engineer.

For foundations placed in the presence of water, when approved by the Engineer, pumping or bailing from the interior of any foundation enclosure shall be done in a manner which precludes the possibility of movement of water through or alongside any concrete being placed. No pumping or bailing will be permitted during the placing of structural concrete or for a period of at least 36 hours thereafter, unless from a suitable sump separated from the concrete work. Pumping or bailing during placement of seal concrete shall be only to the extent necessary to maintain a static head of water within the cofferdam. Pumping or bailing to dewater a sealed cofferdam shall not be started until the seal has aged at least 36 hours.

In the event that the excavation cannot be dewatered to the point where the subgrade is free of mud, or it is difficult to keep the reinforcing steel clean in cast-in-place structures, a special material shall be used in the bottom of the excavation. Such special material shall be a minimum depth of three inches and shall consist of a lean concrete mixture (not less than three (3) sacks of cement per cubic yard), or other material approved by the Engineer.

(2) Bridge Foundations and Retaining Walls. To determine the adequacy of a proposed foundation, the Engineer may require the Contractor to make soundings or take cores to determine the character of the subgrade materials. The maximum depth of soundings or cores will not exceed five (5) feet below the proposed footing grade.

Care shall be taken not to disturb the material below the bottom of footing grade. Backfilling in a foundation to compensate #5 excavation which has extended below grade will not be permitted. Such areas below grade shall be filled with concrete at the time the footing is placed. The additional concrete involved shall be at the Contractor's expense.

Unless otherwise required herein or on the Plans, rock or other hard foundation material shall be free from all loose material, clean, and cut to a firm surface which may be level, stepped, or serrated, as

directed by the Engineer. All seams shall be cleaned out and filled with concrete at the time the footing is placed.

When the material encountered at footing grade of a retaining wall, bridge bent or pier is found to be partially of rock or incompressible material and partially of a compressible material, the foundation shall not be placed until the Engineer has inspected the footing and authorized necessary changes to provide a uniform bearing condition.

(3) Culverts. For all single and multiple box culverts, pipe culverts, pipe arch culverts, long span structural plate structures, box sewers, and pipe sewers where the soil encountered at established footing grade is an unstable or incompressible material, the following procedure shall be used unless other methods are called for on the Plans:

Unstable material shall be removed to a depth not to exceed two (2) feet below the footing of the structure unless additional depth is authorized by the Engineer. All soil removed shall be replaced with stable material in uniform layers not to exceed eight (8) inches in depth (loose measurement). Each layer shall have sufficient moisture to be compacted by rolling or tamping as required to provide a stable foundation for the structure.

When it is not feasible to construct a stable footing as outlined above, the Contractor shall use special materials, such as flexible base, cement stabilized base, cement stabilized backfill or other material, as directed by the Engineer. This work will be paid for as provided in Article 400.8. Special material used, or additional excavation made, for the Contractor's convenience to expedite the work, will be at the Contractor's expense.

When the material encountered at the footing grade of a structure is found to be rock, partially rock or other incompressible material, the incompressible material shall be removed to a depth of six (6) inches below the footing grade and backfilled with a compressible material approved by the Engineer and compacted in accordance with Section 400.5.

(4) Trench. Unless otherwise shown on the Plans, all sewer pipe structures shall be constructed in an open cut with vertical sides to a point one (1) foot above the pipe. When site conditions or the Plans do not prohibit the sloping of the cut, the excavation one (1) foot above the pipe may be stepped and/or the sides laid back to a stable slope. Required vertical sides shall be sheeted and braced when necessary to maintain the required vertical excavation throughout the construction period.

For all pipe sewers to be constructed in fill above natural ground, the embankment shall first be constructed to an elevation not less than one (1) foot above the top of the pipe, after which excavation for the pipe shall be made as noted above.

Unstable or incompressible material shall be removed in accordance with Section 400.2(3). For unstable trench conditions requiring outside forms, seals, sheeting and bracing, or where ground water is encountered, any additional excavation and backfill required shall be done at the Contractor's expense for trenches up to five (5) feet in depth.

400.3 COFFERDAMS.

The term cofferdam designates any temporary or removable structure constructed to hold the surrounding earth, water, or both out of the excavation, whether the structure is formed of soil, timber, steel, concrete, or a combination of these. The “cofferdam” shall also include the use of pumping wells or well points used for the same purpose. The cost of cofferdams shall be included in the price bid for excavation except where temporary special shoring is shown on the Plans to provide excavation protection.

For sheet pile or other types of cofferdams, which require internal bracing, the Contractor shall submit details and design calculations bearing the seal of a Registered Professional Engineer for review. The

maximum stresses shall not exceed 125 percent of the working allowable stresses used by the City Engineering Department for the design of structures. The interior dimensions of cofferdams shall provide sufficient clearance for the construction, inspection (inside and outside), and removal of any required forms and to permit pumping outside the forms. In general, sheet pile cofferdams shall extend well below the bottom of the footings and any concrete seal and shall be well braced and as watertight as practicable.

When the Engineer judges it to be impractical to de-water a cofferdam and a concrete seal is to be placed around piling driven therein, the excavation shall be deep enough to allow for swell of the material during pile driving operations. After driving the piling, all swelling material shall be removed to the bottom of the seal grade. Where it is possible to de-water the cofferdam without placing a seal, the foundation material shall be removed to exact footing grades after piling are driven. Backfilling a foundation to compensate for excavation, which has been extended below grade, will not be permitted. Such areas below grade shall be filled with concrete at the time the seals or footings are placed. The additional concrete quantities necessary to compensate for excavation below grade shall be at the Contractor's expense.

Unless otherwise provided, the Contractor shall remove cofferdams after the completion of the substructure without disturbing or damaging the structure.

400.4 Shaping and Bedding.

For precast pipe and box sections, the excavation shall be undercut a minimum depth sufficient to accommodate the class of bedding indicated on the Plans and conforming to the bedding requirement of this Item. Where cement stabilized backfill is indicated on the Plans, the excavation shall be undercut a minimum of four (4) inches and backfilled with stabilized material to support the pipe at the required grade.

Three classes of bedding for trench or embankment conditions are shown in Figures 1, 2, and 3. Bedding shall be in accordance with Class C bedding unless otherwise shown on the Plans. The Engineer may require the use of a template to secure reasonably accurate shaping of the foundation material.

400.5 BACKFILL.

(1) General. As soon as practical, all portions of the excavation not occupied by the permanent structure shall be backfilled. Backfill material may be obtained from excavation or from other sources. Backfill material shall be free from stones of such size as to interfere with compaction; free from large lumps which will not break down readily under compaction; and free from frozen lumps, wood, or other extraneous material.

Backfill which will not support any portion of the completed roadbed or embankment shall be placed in layers not more than ten (10) inches in depth (loose measurement). Backfill which will support any portion of the roadbed or embankment shall be placed in uniform layers not to exceed eight inches in depth (loose measurement). Each layer of backfill shall be compacted to a density comparable with the adjacent undisturbed soil or as shown on the Plans.

Each layer of backfill material, if dry, shall be wetted uniformly to the moisture content required to obtain a density comparable with the adjacent undisturbed soil or as shown on the Plans and shall be compacted to that density by means of mechanical tamps or rammers. The use of rolling equipment of the type generally used in compacting embankments will be permitted on portions which are accessible to such equipment.

When tamping equipment is furnished which, when proven to the satisfaction of the Engineer, will adequately compact the backfill material to the density required, the eight (8) inch and ten (10) inch lifts (loose measurement) specified above may be increased to lifts not to exceed 12 inches.

Cohesionless materials, such as sand, may be used for general backfilling purposes. Compaction of cohesionless materials shall be done with vibratory equipment, water ponding or a combination thereof.

(2) Bridge Foundations, Retaining Walls, and Culverts. No backfill shall be placed against any structure until the concrete has reached the minimum flexural strength required in Item 421, "Portland Cement Concrete".

The material used for backfilling shall be free of any appreciable amount of gravel or stone particles more than four inches in greatest dimension and shall be of a gradation that permits thorough compaction. The use of rock or gravel mixed with soil will be permitted, provided the percentage of fines is sufficient to fill all voids and insure a uniform and thoroughly compacted mass of proper density.

When the excavation has been made through a hard material resistant to erosion, the Engineer may require the backfill around piers and in front of abutments and wings to be of stone or lean concrete. Unless otherwise provided, such backfill will be measured and paid for as extra work in accordance with Part I, General Provisions – Division I, General Requirements and Covenants.

Embankment which is too close to a structure to permit compaction by the use of the blading and rolling equipment used on adjoining sections of embankment, shall be placed and compacted in accordance with Section 400.5(1). Mechanical tamps or rammers shall be required when the structure being backfilled could sustain damage from other compacting operations.

Care shall be taken to prevent any wedging action of backfill against the structure, and the slopes bounding the excavation shall be stepped or serrated to prevent such action. Backfill placed around piers shall be deposited uniformly.

(3) Pipe. After the bedding and pipes have been installed as required, the selected backfill materials shall be brought to proper moisture condition, placed along both sides of the pipe equally, in uniform layers not exceeding eight (8) inches in depth (loose measurement), and each lift thoroughly

compacted mechanically. Special care shall be taken to secure thorough compaction of the materials placed under the haunches of the pipe and to prevent damage or displacement of the pipe. Filling and/or backfilling shall be continued in this manner to the elevation of the top of the pipe. Backfill above the top of the pipe shall be placed and compacted in accordance with Subarticle 400.5(1). During construction, protection of the pipe shall be in accordance with the pertinent pipe item. Pipe damaged by the Contractor during construction shall be replaced at the Contractor's expense or repaired to the satisfaction of the Engineer.

The Engineer may reject any material containing more than 20 percent by weight of material retained on a three (3) inch sieve, or material excavated in such a manner as to produce large lumps not easily broken down or which cannot be spread in loose layers. In general, material excavated by means of a trenching machine will meet the requirements above, provided large stones are not present.

Where sewers extend beyond the toe of slope of the embankment and the depth of cover provided by backfill to the original ground level is less than the minimum required by the specifications for the type of pipe involved, additional material shall be placed and compacted, as herein specified for backfill outside the limits of the roadbed, until this minimum cover has been provided.

400.6 CEMENT STABILIZED BACKFILL.

When shown on the Plans, the excavation shall be backfilled to the elevations shown with cement stabilized backfill. Unless otherwise shown on the Plans, cement stabilized backfill shall contain aggregate, water and a minimum of seven (7) percent Portland Cement based on the dry weight of the aggregate, in accordance with Test Method Tex-120-E. Aggregate shall be as shown on the Plans or as approved by the Engineer.

Cement stabilized backfill below the top of sewers, manholes, inlets, or other structures shall be placed equally along all sides of the structure so as to prevent strain on or displacement of the structure. Cement stabilized backfill shall be placed in a manner that will completely fill all voids in the trench. Should compaction be required to fill all voids, hand operated tampers may be used.

400.7 MEASUREMENT.

Excavation and backfill will be measured by the cubic yard. Cutting and restoring of pavement will be measured by the square yard.

This is a Plans quantity measurement Item and the quantity to be paid for will be that quantity shown in the proposal and on the “Estimate and Quantity” sheet of the contract Plans, except as may be modified by General Conditions of Contract Documents. If no adjustment of quantities is required, additional measurements or calculations will not be required.

Unless otherwise shown on the Plans, structural excavation for pipe headwalls, inlets, manholes, culvert widening (extensions) 15 feet or less in length, bridge abutments, retaining walls and side road and private entrance pipe culverts will not be measured but shall be considered subsidiary to the various bid items.

For culvert widening (extensive) greater than 15 feet, quantities for structural excavation will be shown on the Plans.

Structural excavation will be measured by the cubic yard computed by the method of average end areas using the following limits to establish templates for measurement:

(1) For all excavation requiring measurement, except that required for the barrels of pipe culverts; for structural plate structures no material outside of vertical planes one (1) foot beyond the edges of the footings and parallel thereto will be included, unless otherwise shown on the Plans. When the Plans

provide the Contractor the option of cast-in-place or precast boxes, measurement will be based on the cast-in-place option.

(2) For pipes 42 inches or less in nominal or equivalent diameter, no material outside of vertical planes one foot beyond the horizontal projection of the outside surfaces of the pipe and parallel thereto will be included. For pipes more than 42 inches in nominal or equivalent diameter, no material outside of vertical planes located two (2) feet beyond the horizontal projection of the outside surfaces of the pipe and parallel thereto will be included. Excavation for pipes shall be measured between the extreme ends of the completed structure, including any end appurtenances, as shown on the Plans and from centerline to centerline of inlets, manholes, etc., therein. When excavation for appurtenances is measured for payment, the limits of excavation for the pipes shall not overlap those of the appurtenances.

(3) For structural plate structures no material outside of vertical planes three (3) feet beyond the horizontal projection of the outside surfaces of the structure(s) and parallel thereto will be included. When the quality of the existing soil or embankment is less than that of the proposed backfill material, the excavation shall be extended for measurement to vertical planes located at one-half of the span beyond the horizontal projection of the outside surfaces of the structure(s) and parallel thereto.

(4) If a cofferdam is used, the limitations of Section 400.7(1) shall apply just as if no cofferdam were used. Excavation quantities for foundations shown on the Plans and in the proposal where cofferdams are required shall be considered as final quantities and no further measurement will be made.

(5) Where excavation, in addition to that allowed for the footings, is required for other portions of the structure, such as for the cap, cross strut, or tie beam of a pier or bent or for the superstructure, measurement for such additional excavation will be limited laterally by vertical planes one (1) foot beyond the face of the member and parallel thereto and vertically to a depth of one (1) foot below the bottom of such member.

(6) No measurement will be made of any excavation necessary for placing forms or falsework except as allowed by the above conditions.

(7) At all structure sites except at culverts and trench excavations, the measurement of structural excavation will include only material below or outside the limits of the completed road or channel excavation.

Trench excavation in fill above natural ground, as specified in Section 400.2(4), will be measured for payment. Quantities will include that area as specified in Section 400.7(2) plus one (1) foot above the top of the pipe, regardless of the height of fill previously made.

(8) Excavation required for shaping the slopes of header banks which were built by prior contract and upon which riprap is to be placed will be measured as “Structural Excavation, (Riprap)”.

(9) For all culverts, except for side road and private entrance culverts, all excavation within the limits of the structure and below or outside the limits of the completed roadway excavation, will be measured as culvert excavation. Where the overall normal width of the culvert is 12 feet or less, measurement will be as “Structural Excavation, culvert, Small”. Where the overall normal width of the culvert exceeds 12 feet, measurement will be as “Structural Excavation, Culvert, Large”.

(10) Where excavation diagrams are shown on the Plans, they shall take precedence over these provisions.

(11) Measurement will not include materials removed below footing grades to compensate for anticipated swelling due to pile driving, nor will it include material required to be removed due to swelling beyond the specified limits during pile driving operations.

(12) Measurement will not include additional volume caused by slips, slides, cave-ins, sitting, or fill material resulting from the action of the elements or the Contractor's operation.

(13) Where rock or other incompressible or unstable material is undercut to provide a suitable foundation for pipe or box sections, such material below grade, which is directed by the Engineer to be removed, will be measured for payment.

(14) No allowance will be made for any variance from plan quantity incurred by an alternate bid.

(15) Additional measurement will be made of the volume of excavation involved in the lowering or raising of the elevation of a footing, foundation, or structure unit, when such grade change is authorized by the Engineer.

(16) Cement stabilized backfill will be measured in accordance with the backfill diagram shown on the Plans. The quantity of "Cement Stabilized Backfill" shown on the Plans shall be considered as final quantities and no further measurement will be required. Changes in alignment or grade as authorized by the Engineer will be measured for payment.

(17) The work to be done in the cutting and restoring of pavement will be measured in accordance with the dimensions shown on the Plans. The excavation below the pavement and/or base shall be measured as structural excavation of the pertinent type.

400.8 Payment.

The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Structural Excavation", "Structural Excavation (Bridge)", "Structural Excavation (Culvert, Small)", "Structural Excavation (Culvert, Large)", "Structural Excavation (Trench)", "Structural Excavation (Riprap)", "Cement Stabilized Backfill" and "Cutting and Restoring Pavement".

Payment for removal and replacement of unstable or incompressible material below the footing grades of culverts as provided for in Section 400.2.(3) will be made as follows:

When the Plans specify or when the Engineer directs the use of special materials such as flexible base, cement stabilized base, cement stabilized backfill or other special material, payment for excavation below the footing grades shall be made at the unit price bid for "Structural Excavation" of the pertinent type. Payment for furnishing, hauling, placing and compacting the flexible base, cement stabilized base, cement stabilized backfill or other special materials will be made at the unit price bid for these items in the contract or in accordance with General Requirements and Covenants, in cases where the required material is not a bid item.

Where special materials are not required or specified, payment for the removal and replacement of unstable and/or incompressible material will be made at a price equal to 200 percent of the unit price bid per cubic yard for "Structural Excavation" of the pertinent type. This price shall be full compensation for removing the unstable or incompressible material, furnishing, hauling, placing and compacting suitable replacement material and for all labor, equipment, tools, and incidentals necessary to complete the work.

If no direct method of payment is provided in the contract for culvert excavation and no special materials are required or specified, the removal and replacement of unstable or incompressible material, when such work is authorized by the Engineer, will be measured and paid for at fifteen dollars ($15.00) per cubic yard.

Should the Engineer deem it necessary to lower a bridge foundation to an elevation below the grade shown on the Plans, such over excavation below plan will be paid for as "Structural Excavation" at an adjusted unit price as defined herein. Payment will be made at a unit price equal to 115 percent of the

contract unit price bid for all over excavation where the revised footing grade does not vary from plan grade by more than five feet.

Payment will be made at a unit price of 125 percent of the contract unit price bid for all over excavation where the revised grade varies from plan grade by more than five (5) feet but not in excess of ten (10) feet. In cases where the revised footing grade varies from plan grade by more than ten (10) feet, a supplemental agreement shall be prepared to establish a unit price with which to make payment for the over excavation.

No direct payment will be made for backfilling ground structures. Payment for the backfilling and compacting of areas which were removed as structural excavation shall be included in the unit price bid for "Structural Excavation".

Unless otherwise shown on the Plans, structural excavation, which has been completed to the satisfaction of the Engineer, but not backfilled, a partial payment of 50 percent of the price bid, will be made. The remaining amount will be paid upon the satisfactory completion of the backfilling.

This price shall be full compensation for all excavation, bedding, and backfill including placing, sprinkling and compaction of material; all soundings; cleaning and filling seams; constructing all cofferdams; all de-watering; and for furnishing all materials, hauling, labor, equipment, tools, sheeting and/or bracing of excavations up to and including five feet in depth, pumps, drills, explosives, disposition of surplus material, cutting pavement and base to neat lines; and for incidentals necessary to complete the work, except that protection methods for excavations greater than five feet in depth shall be measured and paid for as required under Item 402, "Trench Excavation Protection" or Item 403, "Temporary Special Shoring".