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DIVISION VI

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SECTION 601

GENERAL CONSTRUCTION REQUIREMENTS FOR STORM SEWERS

601.01 DESCRIPTION: This section shall apply to the construction of all storm sewers and all storm sewer appurtenances incidental to the construction of pavement.

601.04 CONSTRUCTION METHODS, ORDER OF CONSTRUCTION, GENERAL: The construction of all sewers shall begin at the outlet or the low point in the line. Storm sewers construction shall progress sufficiently ahead of pavement construction to facilitate drainage of storm water off the roadway in times of inclement weather. Sewer pipe in roadways shall be constructed ahead of subgrade preparation.

When the construction involves the building of main or submain sewers having one or more laterals or tributaries, the construction of tributary lines will not be started until the main or submain sewers have been completed to the point where the tributary or lateral discharge into it. Sewer appurtenances shall be constructed as soon as the sewer which they serve is constructed to their location.

(A) Connections to Other Sewers or to Appurtenances: The connecting of sewers or sewer appurtenances to other sewers or to sewer appurtenances shall be made in accordance with the plans or under the direction of the Engineer. The work shall be done in a workmanlike manner in such a way as not to damage any of the structures involved. No sewer shall project beyond the inside wall line of other sewers or of sewer appurtenances.

(B) Sewer Grades: The grade line shown on the plans is the elevation of the invert or flow line of the sewer. The grade line shall be established in the trench by the use of batter boards set at grade stakes not farther than 25 feet apart. Not less than 3 batter boards shall be maintained in correct position continuously during the construction of the sewer. Batter boards shall be of good, straight, sound material, fastened to substantial stakes or uprights. Batter boards 10 feet or less in length shall not be smaller than 1 x 4's, and when longer than 10 feet shall not be smaller than 1 x 6's or 2 x 4's. Stakes shall not be smaller than 2 x 4's. Steel stakes with suitable clamps may be used when approved by the Engineer. A suitable fine cord or wire, approved by the Engineer, shall be stretched tightly between batter boards over the exact center line of the sewer. A graduated pole or rod shall be provided for measuring from the cord stretched between batter boards to the bottom of the trench while the trench is being prepared and to the sewer invert while the sewer is being placed. When the distance from the cord between batter boards to the invert of the sewer exceeds 10 feet, a line shall be set in the bottom of the trench for aligning the pipe and establishing the grade.

At the option of the contractor the laser beam method may be used to establish grade and alignment of pipe.

SECTION 602

MANHOLES, DROP OR CURB INLETS, AND JUNCTION BOXES

602.01 DESCRIPTION: This work shall consist of the construction of manholes, drop or curb inlets, including special curbs, junction boxes or similar structures in accordance with the plans and these specifications and in reasonably close conformity with the lines, grades and elevations shown on the plans or established by the Engineer.

602.02 MATERIAL, GENERAL: Materials shall meet the requirements specified in Section 700 - Materials.

Junction boxes, inlets, and manholes of approved design may be constructed with precast concrete units.

Concrete brick or precast concrete units shall not be used in the construction or rebuilding of sanitary sewer manholes.

(A) **Portland Cement Mortar:** The mortar for use with brick masonry shall be composed of one part Portland cement, and two parts mortar sand by volume, mixed with sufficient water to form a plastic consistency. The use of hydrated lime not to exceed 10 percent by volume of the amount of cement will be permitted, but when used shall be added to the cement first and in proportioning the mortar will be considered as cement.

(B) **Accessories:** Accessories, such as bolts, rivets, spacers, small I-beams, channels, and plates used for assembling or supporting frames, gratings, or covers shall be of first quality standard commercial material free from defects which may affect their value for the service intended.

602.04 CONSTRUCTION METHODS:

(A) **Concrete:** In the construction of concrete bottoms for manholes and inlets, the concrete shall be rounded to the dimensions and shape, the surface shall be troweled and retroweled until a uniform, smooth and impervious "hard fanned" finish is obtained.

(B) **Clay Brick or Concrete Brick:** Brick masonry in circular or curved walls which have a radius of less than two (2) feet shall have every fifth course stretchers, and the remainder, headers, and the thickness of joints shall not exceed 1/4 inch vertical on the inside face, or 3/8 inch horizontal. Brick masonry in straight walls and in walls where the radius of curvature is two (2) feet or greater, shall have every fifth course headers, and the remainder, stretchers, and all joints shall have a thickness not exceeding 3/8 inch.

Vertical joints in adjacent courses shall be broken approximately half the length or width of the brick, as the case may be.

All brick shall be laid in a full bed of mortar and all joints shall be shoved joints, completely filled with mortar. Buttered joints will not be permitted. The joints on the inside face or exposed face of the masonry shall be rubbed full and cut as the brick work is built up. The masonry shall be built up in level courses, reasonably true to line, grade and dimension. Bats shall be used only when necessary to close joints, or around irregular openings. All brick shall be thoroughly wet down immediately before being placed. All work shall be completed and finished in a careful, workmanlike manner. Old brick masonry shall be thoroughly cleaned and wetted before joining new masonry thereto. Where a

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mortar coating is required, it shall have the minimum thickness shown on the plans, shall be applied while the brick masonry is clean and damp and shall be troweled and retroweled until a uniform smooth and impervious surface is obtained.

When precast manholes are used, all joints and the base shall be properly sealed to prevent the passage of water.

(C) Pipe Connections: Inlet and outlet pipe shall be of the size indicated on the plans or as required by the Engineer. The end of the pipe shall be flush with the inside of the wall and shall be tightly sealed in the wall with mortar throughout the circumference of the pipe. The mortar shall be pressed in and troweled off flush with the face of the wall.

(D) Reinforcing Steel: All reinforcing steel shall be placed as shown on the plans or as directed by the Engineer.

(E) Castings, Gratings, and Drop Inlet Gratings and Special Framers: All casting, gratings or special frames or supports, shall be accurately and rigidly assembled and carefully placed as shown on the plans. The frames of all manhole frames and covers, and inlet frames and gratings, shall be bedded in a substantial layer of mortar, shall have a full bearing, and shall be set to the exact grade required. Unless otherwise shown on the plans, the top of such castings shall be flush with the surrounding surface. Cast iron steps shall be accurately spaced as shown on the plans and securely embedded in the wall to the depth required, care being taken that all space about the legs of the steps is filled with mortar so that the steps will not work loose.

(F) Excavation and Backfill: Excavation shall be made to the required depth, and the base upon which the manhole, inlet, or junction box is to be set shall be compacted to a firm, even surface. All soft and unsuitable material shall be removed and replaced with suitable material which shall be thoroughly compacted.

602.05 METHOD OF MEASUREMENT: The accepted items of this Section will be measured for payment in the following manner:

(A) Manholes, that do not exceed 5 feet in depth, as measured from the bottom of the frame cover casting to the flow line of the outlet lead shall be measured for payment as "Manhole" and shall include the walls and the concrete bottom.

(B) Manholes, exceeding 5 feet in depth will be measured as set out above, and the depth in excess of 5 feet will be measured by the vertical foot of wall and classified for payment as "Additional Depth in Manholes."

(C) Frames and covers for manholes shall be measured by each "Manhole Frame and Cover" complete, installed and accepted.

(D) Inlets will be measured by the cubic foot of wall constructed based on an 8-inch thick wall. Deduction will not be made for openings made by pipes 18 inches or less in diameter. Deduction will be made for all openings caused by pipes exceeding 18 inches in diameter, computed on the nominal inside diameter of the pipe. Concrete used in the base will be measured for payment by the cubic yard of concrete.

(E) Frames and grates for inlets will be measured by each "Inlet Frame Grate" complete in place and accepted. Unless otherwise specified on the plans, frames shall be cast iron and grates cast steel.

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(F) Junction Boxes will be measured by the cubic foot of wall measured as defined above for inlets.

(G) Cast Iron Curb Inlets will be measured by each, complete in place.

(H) Excavation and backfill will not be measured for payment but the cost of same will be included in the unit price or prices bid for the various pay items.

Reinforcing steel will be included as part of the cost of the structure complete and will not be measured as a pay item.

602.06 BASIS OF PAYMENT: Accepted quantities measured as provided above, will be paid for at the contract unit price for:

Manhole-----	EA.
Additional Depth in Manhole-----	VERT. FT.
Manhole Frame and Cover-----	EA.
Inlet-----	CU. FT.
Inlet Frame and Grate-----	EA.
Junction Boxes-----	CU. FT.
Cast Iron Curb Inlets-----	EA.

which shall be full compensation for furnishing all materials, equipment, labor and incidentals to complete the work as specified.

SECTION 603

STRUCTURAL CONCRETE

603.01 DESCRIPTION: This work shall consist of constructing concrete culverts, headwalls, retaining walls and incidental construction in accordance with these specifications and in reasonably close conformity with the lines, grades and dimensions as shown on the plans or established by the Engineer.

603.02 MATERIALS:

(A) Materials shall meet the requirements specified in Section 735.

(B) Tests: Tests of concrete and concrete material shall be made in accordance with applicable AASHTO standards and as directed by the Engineer.

603.04 CONSTRUCTION METHODS:

(A) Forms: Forms shall be so designed and constructed that they will hold reasonably true to lines and grades as shown on the plans and may be removed without injuring the concrete.

The material to be used in the forms for exposed surface shall be sized and dressed lumber, masonite, plywood or equal, or metal in which all bolt and rivet heads are countersunk, so that in any case a plain, smooth surface is obtained. Undressed lumber may be used for backing or other unexposed surfaces.

The forms shall be built reasonably true to line and grade and braced in a substantial and unyielding manner. They shall be mortar tight. All corners, except at tops of footings or bases, shall be chamfered. Chamfer or moulding strips shall be finished lumber, cut with true edges, and shall not be warped, cracked or frayed. No two pieces of chamfer strips of unequal width shall be used in the same chamfer line. Chamfer shall be held true to line and kept securely nailed to forms while placing concrete.

Form lumber for all curbs on bridges and culverts shall have a nominal thickness of two (2) inches or more. Studding on all forms shall be spaced so that no bulge or deflection is apparent between the studs.

Form lumber which is to be used a second time, shall be free from bulge or warp and shall be thoroughly cleaned. The forms shall be inspected immediately preceding the placing of concrete; and any bulging, warping or offset in adjacent boards shall be remedied.

All dimensions shall be carefully checked, by the Contractor, after the forms are erected and before any concrete is placed. The Contractor will be held responsible for the accuracy of all construction. The interior surfaces of the forms shall be adequately oiled or greased to insure the non-adhesion of mortar.

Forms for faces of wingwalls and curbs shall be removed within 24 hours after the concrete is placed, unless otherwise specified by the Engineer.

Forms carrying the slab shall be left in place at least 7 days for spans of less than 8 feet; 8 foot and 10 foot spans at least 10 days. For clear spans in excess of 10 feet, forms supporting the slab shall be left in place one additional day for each foot of clear span in excess of 10 feet. If required by weather conditions, the Engineer may increase this length of time at his discretion. Traveling steel form systems will be considered. The proposed

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traveling form method and details shall be submitted to the Engineer for approval. When the use of High-Early-Strength Concrete is approved by the Engineer in top slab, Section 504 shall govern.

(B) Handling, Placing and Vibrating Concrete:

1. General: In preparation for the placing of concrete, all sawdust, chips, and other debris shall be removed from the interior of forms.

Struts, stays and braces, serving temporarily to hold the forms in correct shape and alignment, pending the placing of concrete at their locations, shall be removed when the concrete placing has reached an elevation rendering their service unnecessary. All temporary wood members shall be removed from the forms and not buried in the concrete.

Concrete shall be placed so as to avoid segregation of the materials and the displacement of the reinforcement. The Engineer may order the discontinuance of any type of conveyance or method of placing, if the concrete is not being satisfactorily placed.

Open troughs and chutes shall be mortar tight. Where steep slopes are required, the chutes shall be equipped with baffles or be in short lengths that change the direction of movement.

All chutes, troughs and pipes shall be kept clean and free from coatings of hardened concrete by thoroughly flushing with water after each run; water used for flushing shall be discharged clear of the structure.

When placing operations would involve dropping the concrete more than 5 feet, it shall be deposited through approved sheet metal chutes, pipes, or flexible tubing. As far as practicable, the pipes shall maintain an even flow of concrete during the placing and their lower ends shall be kept level with the newly placed concrete. After the initial set of the concrete, the forms shall not be jarred and no strain shall be placed on the ends of reinforcing bars which project.

Concrete during and immediately after depositing, shall be thoroughly consolidated by mechanical vibration. Vibrators shall be of a type and design approved by the Engineer.

The Contractor shall provide a sufficient number of vibrators to properly consolidate each batch of concrete immediately after it is placed in the forms.

Vibrators shall be manipulated so as to thoroughly work the concrete around the reinforcement and imbedded fixtures and into the corners and angles of the forms. The vibration shall be of sufficient duration and intensity to thoroughly compact the concrete, but shall not be continued so as to cause segregation.

Application of vibrators shall be at points uniformly spaced and not farther apart than twice the radius over which the vibration is visibly effective.

Vibration shall not be applied directly or through the reinforcement to sections or layers of concrete which have hardened to the degree that the concrete ceases to be plastic under vibration. It shall not be used to make concrete flow in the forms.

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Vibration shall be supplemented by such spading as is necessary to insure smooth surfaces and dense concrete, along form surfaces and in corners and locations impossible to reach with the vibrators.

Concrete shall be placed in horizontal layers no more than 12 inches thick except as hereinafter provided. When less than a complete layer is placed in one operation, it shall be terminated in a vertical bulkhead. Each layer shall be placed and compacted before the preceding batch has taken initial set. Each layer shall be compacted, so as to avoid the formation of a construction joint with a preceding layer, before it has taken initial set.

When the placing of concrete is temporarily discontinued, the concrete after becoming firm enough to retain its form, shall be cleaned of laitance and other objectionable material to a sufficient depth to expose sound concrete. To avoid visible joints as far as possible upon exposed faces, the top surface of the concrete adjacent to the forms shall be smoothed with a trowel. Where a "feather edge" might be produced at a construction joint, as in the sloped top surface of a wingwall, inset form work shall be used to produce a blocked out portion in the preceding layer which shall produce an edge thickness not less than 6 inches in the succeeding layer. Work shall not be discontinued within 18 inches of the top of any face, unless provision has been made for a coping less than 18 inches thick, in which case, if permitted by the Engineer, the construction joint may be made at the underside of the coping.

No concrete shall be deposited in water or on unstable subgrade.

2. Reinforced Concrete Boxes: In general, the base slab or footings of box culverts shall be placed and allowed to set before the remainder of the culvert is constructed. Provisions shall be made for bonding the sidewalls to the culvert base, by means of raised longitudinal keys so constructed as to prevent the percolation of water through the construction joint.

Before concrete is placed in the sidewalls, the culvert footing shall be thoroughly cleaned and the surface carefully chipped and roughened in accordance with the method of bonding construction joints as specified herein.

In the construction of box culverts 4 feet or less in height, the sidewalls and top slab may be constructed as a monolith. When this method of construction is used, any necessary construction joints shall be vertical and at right angles to the axis of the culvert.

In the construction of box culverts more than 4 feet in height, the concrete in the walls shall be placed and allowed to set before the top slab is placed. Appropriate keys shall be left in the sidewalls for anchoring the cover slab.

3. Pumping: Placement of concrete by pumping will be permitted provided the equipment is so arranged that vibrations will not damage freshly placed concrete.

Where concrete is conveyed and placed by mechanically applied pressure, the equipment shall be suitable in kind and adequate in capacity for the work. Aluminum pipe shall not be used. The operation of the pump shall be such that a continuous stream of concrete without air pockets is delivered.

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(C) Joints: Whenever the work of placing concrete is delayed until the concrete shall have taken its initial set, the point of stopping shall be deemed a construction joint. So far as possible, the location of construction joints shall be planned in advance and the placing of concrete carried continuously from joint to joint. These joints shall be perpendicular to the principal lines of stress.

Where dowels, reinforcing bars, or other adequate methods are not shown on the plans, keys shall be made by placing water-soaked beveled timbers of a size shown on the details, or as directed by the Engineer. The key material shall be removed when the concrete has set. In resuming work the surface of the concrete previously placed shall be thoroughly cleaned of laitance, or other soft material with stiff wire brushes, and if deemed necessary by the Engineer, shall be roughened by a steel tool.

Construction joints shall be made only where located on the plans or shown in the placing schedule, unless otherwise approved by the Engineer. Shear keys or continuous reinforcement shall be used to transmit shear or bond the two sections together.

In order to maintain the proper alignment of the different parts of the work, they shall be provided with keys at approximately 1/3 of the area of the cross sections of the wall or with the equivalent thereof in dowels.

(D) Curing: All concrete shall be cured as provided in these specifications for the various parts of structures.

The side forms on all piers, abutments, retaining walls, wingwalls, and reinforced concrete boxes may be left in place for at least three (3) days or if removed before the 3 days have elapsed, the surfaces shall be cured for the remaining part of the 3 day period by one of the methods specified herein. Surfaces that require a concrete surface finish shall be shrouded with wet burlap or wet mats from the time the forms are removed until the 3 day curing period has elapsed.

1. Curing for at least 3 days with an approved polyethylene burlap.
2. Cured for at least 3 days with 3 layers of wet burlap.
3. Cured for at least 3 days with wetted cotton mats.
4. Cured with an approved membrane curing compound (red).

The curing compound shall be applied under pressure, by means of a spray nozzle, in such a manner as to cover the entire exposed surface thoroughly and completely with a uniform film. Sufficient pressure shall be applied to the spray machine to force the compound to leave the nozzle as a fine mist. The application of curing compound shall be close to the finishing at all times and all finished concrete shall be sprayed immediately after the superficial water, if any, has subsided.

Formed surfaces shall be coated with the curing compound as soon as practicable after removal of the forms.

The curing compound shall be applied on concrete for sidewalks, curbs and floors as soon as possible after finishing. On surfaces requiring a surface finish or surfaces poured against forms, the curing materials which adversely affect the bond on surface finish shall not be applied.

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If hair checking develops before the curing compound can be applied, the procedure set forth above shall be modified in that initial curing with wet burlap shall be performed as specified for the particular type of work under construction.

If discontinuities, or pinholes, or abrasions in the membrane exist, a second coat shall be applied to the affected areas. Walking on the cured surface will not be permitted for 24 hours after application. If any abrasions occur within 24 hours, they shall be corrected by the use of additional compound.

Rate of Application: The sealing compound shall not be applied at a coverage rate lighter than specified below:

Steel trowel finish-----225 sq. ft. per gallon
Rough float finish-----200 sq. ft. per gallon

Whenever the atmospheric temperature is 100 degrees F. or more, the Engineer may require an additional coat at a rate of approximately 270 square feet per gallon; if he deems the additional material essential to obtain adequate water retention. When required, the second coat shall be applied 30 minutes after the first.

When the desired results are not obtained by this method, the membrane method shall be discontinued and the curing shall be by other methods specified in the specifications.

(E) Removal of Forms: In order to make possible the obtaining of satisfactory surface finish, forms on vertical surfaces which do not carry loads and which require a special concrete surface finish shall be removed as soon as practicable.

Forms for vertical walls on columns, piers, abutments, and retaining walls requiring a concrete surface finish, shall be removed in warm weather within 24 hours after the concrete is placed and in the cool weather within 48 hours, at least as soon as they may be removed without damaging the concrete.

As soon as the forms are removed, all rough places, holes, and porous spots shall be filled, and all bolts, wires or other appliances used to hold the forms and which pass through the concrete shall be cut off flush with the surface. For all finished surfaces, all wires shall be cut off 1/4 inch below the surface and the depression filled with cement mortar at once. This shall be left rough for several hours and then rubbed smooth with the surface.

Honeycomb shall be repaired as soon as the forms are taken off by removing any aggregate that is loose or that is not thoroughly bonded to concrete mass, washing the surface with clean water, using a wire brush to remove any loose particles, and applying a thin coating of neat cement mortar. Patched areas shall be dressed flush with the surrounding area.

Small cavities shall be neatly pointed up with cement mortar of the same mix as used in the body of the work, immediately after removing forms. Care shall be taken to remove any thin surfaces or edges and expose the whole cavity before pointing up.

(F) Defective Work: Any defective work discovered after the forms have been stripped shall be removed immediately and replaced. If the surface of the concrete is bulged, uneven, or shows excess honeycombing or settlement, which cannot be repaired satisfactorily, the entire section shall be removed and replaced. No additional compensation will be allowed for this work.

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(G) Drainage and Weep Holes: Drainage openings and weep holes shall be constructed in the manner and where indicated on the plans or directed by the Engineer.

(H) Placing Pipes and Conduits: Pipes and conduits for utility service lines which are to be encased in the concrete shall be placed by the Contractor during construction. Such pipes and conduits will be delivered to the Contractor, unless otherwise stated, at the site of the structure by the City or by others for whose use they are intended.

(I) Placing Anchors, Bolts, Grillages, etc.: The Contractor shall place all anchors, bolts, grillages, etc., securely and accurately in the locations shown on the plans or as otherwise required.

(J) Water Proofing: Reinforced retaining walls, abutments, earth filled arches, etc., shall be waterproofed whenever shown on the plans or directed by the Engineer.

(K) Finishing: Unless otherwise specified on the plans a special finish conforming to the following method shall be applied. Before the surface finish is applied the surface shall be inspected by the Engineer to assure compliance with Subsection 603.04(E). The finish coat shall be uniformly textured and colored in a manner approved by the Engineer.

The special finish shall meet the requirements of Section 735. The intent of this specification is to attain a durable finish reasonably uniform in appearance as to texture and color. The color to be somewhat lighter than the natural color of concrete unless otherwise specified on the plans.

Before the surface finish is applied the surface shall be thoroughly washed with clean water applied with a jet spray. The application of the surface finish shall be applied with an approved plaster type spray gun or by the brush and float method, as recommended by the manufacturer. No application is to be made when the atmospheric temperature is 40 degrees F. or below or when the temperature is expected to drop to freezing within 12 hours.

Curing shall be done in the same manner as required for curing concrete. Application of the special surface finish shall not be started until all other work which might mar or deface the surface finish has been completed.

Application: At the time of application of spray finish, concrete surfaces shall be free of moisture as determined by both sight and touch, and in a condition consistent with the manufacturer's recommendations.

Surfaces which are not to be covered by spray finish shall be protected by paper, cloth, or other means from spatter of the sprayed material. Any concrete areas which are not intended to be covered by the spray finish and which are stained or spattered by the spray shall be cleaned by wire brushing, sandblasting, or other methods satisfactory to the Engineer.

The spray finish shall be applied at a rate of 45 ± 5 sq ft per gallon with heavy duty spray equipment (4:1 ratio or larger) capable of maintaining a constant pressure as necessary for proper application.

The completed finish shall be tightly bonded to the structure, and present a uniform appearance and texture. If necessary, additional coats shall be applied to produce the desired surface texture and uniformity. Upon failure to adhere positively to the structure without chipping or cracking, or to attain the

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desired surface appearance, coatings shall be removed entirely from the structure and the surface shall be refinished to the satisfaction of the Engineer at no additional cost.

A carborundum finish may be substituted with approval of the Engineer.

603.05 METHOD OF MEASUREMENT: The quantities which constitute the completed and accepted structure will be measured for payment according to the plans and specifications for the several pay items as provided in the proposal, which shall include full compensation for all materials, falsework, labor, equipment, and incidentals necessary to complete the work as specified. Excavation and backfill will not be measured for payment and the cost of this work shall be included in the bid price for the appropriate structure.

SECTION 604

STORM SEWERS

604.01 DESCRIPTION: The work shall include the construction, complete, of present precast circular storm sewers as specified herein and in conformity with the lines, grades, dimensions and design shown on the plans.

604.02 MATERIALS: All materials shall conform to the requirements of plans or provided in the proposal or Special Provisions. Bedding shall be as shown on the plans.

604.03 EQUIPMENT: Construction equipment shall be as approved by the Engineer.

604.04 CONSTRUCTION METHODS:

(A) Excavation: The width of trench excavation at the ground line for sewers shall conform to the requirements of the following table:

<u>SIZE OF PIPE</u> <u>Internal Diameter</u>	<u>MAXIMUM WIDTH OF TRENCH AT GROUND LINE</u>	
	<u>Where No Sheeting Or Shoring is Used</u>	<u>Where Sheeting and Shoring is Used</u>
12" and smaller	24"	36"
15" to 21" incl.	Inside diameter + 12"	Inside diameter + 24"
24" to 30" incl.	Inside diameter + 18"	Inside diameter + 30"
33" to 54" incl.	Outside diameter + 18"	Outside diameter + 30"
60" and larger	Outside diameter + 24"	Outside diameter + 36"

Where only a small amount of sheeting and shoring is required, which in the opinion of the Engineer will not unduly interfere with the work, the maximum trench width shall be the same as where no sheeting and shoring is required. Bell holes or recesses for bells of the pipe shall be excavated at every joint and shall be of sufficient size and depth to relieve the bell of all load, permitting the barrel to be firmly bedded throughout its length and to provide ample space for forming the joint. Filling and ramming earth or other material beneath the pipe to raise it to grade will not be permitted. Where a complete cradle or refill is shown on the plans or provided in the Special Provisions, it shall be placed in conformity with the plans and specifications, and shall consist of 2000 psi concrete having a slump of from 5 to 7 inches.

(B) Backfill, General: All trenches and excavations shall be backfilled in a reasonable time after the pipes are installed therein, unless other protection of the pipe is directed by the Engineer. The backfill material shall be approved by the Engineer. Backfill material containing stones or rock exceeding 6 inches shall not be used adjacent to or until the fill over the top of the pipe exceeds 1 foot. Great care shall be used to obtain thorough compaction under the haunches and along the sides to the top of the pipe.

The backfilling shall be placed in loose layers not exceeding 6 inches in depth under and around the pipe and not exceeding 8 inches over the pipe. Successive layers shall be added and wetted and thoroughly compacted by hand and pneumatic tampers to a density approved by the Engineer, until the trench is completely filled and brought to the elevation as directed. Backfilling shall be done in such a manner as to avoid injuring top or side pressure on the pipe. Any pipe so damaged shall be removed and replaced at the Contractor's expense.

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(C) Backfill (In Roadways): All provisions shall apply to backfill in roadways with the following exceptions:

1. The backfill material shall be select borrow compacted to a density of 95% Standard Density. In the event the material as excavated is of classification other than select borrow, it shall be removed from the site and disposed of as directed by the Engineer. After compaction the backfill area shall be shaped to conform to the plans or as directed by the Engineer.
2. No stones or rocks greater than 3 inches in diameter will be allowed in any portion of the backfill.
3. The backfill material shall be placed in lifts not to exceed 8 inches loose, moistened and compacted to a density of 95% Standard Proctor.
4. In lieu of select borrow material clean river sand may be used for backfill as required by the Engineer. Jetting or flooding the trench with water will not be allowed.

(D) Laying Pipe Sewers: No sewer shall be laid unless the foundation is in a condition satisfactory to the Engineer. The laying of pipe in a wet trench shall be done only when and as approved by the Engineer. The spigot end of the pipe shall be laid in the direction of the flow. No bucking in or laying pipe downgrade will be permitted. Pipe shall not be dropped to the bottom of the trench but shall be lowered in a careful manner approved by the Engineer.

The inside of the barrel shall be cleared when the pipes are lowered into the trench.

(E) Sewer Pipe Joints, General: Joints in a pipe sewer shall be formed in a careful, thorough and workmanlike manner. The spigots and the inside of the bells shall be cleaned at the time the joint is made. Spigots shall be centered in the bells so as to form a concentric joint with no offset on the interior surface of the pipe line. The spigot of the pipe shall be butted tightly against the shoulder of the bell. All superfluous joint material shall be completely removed from the inside of the pipe. On sewers 12 inches in diameter and smaller, a suitable drag or swab shall be kept in the pipe line and pulled forward past each joint immediately after its completion, unless otherwise permitted by the Engineer.

Joints shall be made with oakum and mortar, cold applied mastic type, rubber gaskets or plastic joint material in accordance with the appropriate specifications for the type of pipe being used. Flexible conduit shall be joined by coupling bands.

604.05 METHOD OF MEASUREMENT: Pipe sewers shall be measured along the centerline of the sewer actually laid.

End sections will be measured by the number of units of each size installed. On sewer 12 inches or less in diameter, no deductions will be made for standard manholes. Deductions will be made for special structures, unless otherwise shown on the plan. On sewers larger than 12 inches in diameter, deductions will be made for all manholes and for all structures. Sewers which extend only through the wall of the structures will be measured to the actual end of the pipe except as provided above for measuring 12 inches or less in diameter through standard manholes.

SECTION 604 - STORM SEWERS

Earth backfill, sheeting, and shoring will not be measured for payment.

Joint filler for pipe will not be measured for payment and the cost will be included in other bid items.

Trench excavation will be measured by the cubic yard calculated on theoretical basis of the volume of material defined as follows:

The depth of the trench will be the average depth measured from the design flowline to the finished subgrade elevation in cut areas or from the height specified on the plans above the design flowline grade in fill areas within the roadway construction lines or from the natural ground line outside the roadway construction lines. The length will be that measured for the Pipe Conduit. The width will be measured inside the vertical neat lines of the trench defined in 604.04(A). The removal and disposal of unsatisfactory backfill material and the replacement with satisfactory material will not be measured for payment.

Bedding material and foundation construction will not be measured for payment and the cost shall be included in the unit bid for storm sewer pipe. Concrete headwalls will be measured for payment in accordance with Section 603.

604.06 BASIS OF PAYMENT: Accepted quantities, measured as provided above, will be paid for at the contract unit price for:

Pipe Conduit-----L.F.
End Sections-----EA.
Trench Excavation-----CU. YD.

which shall be full compensation for furnishing all materials, equipment, labor and incidentals to complete the work as specified.

SECTION 605

ADJUSTMENT TO EXISTING STRUCTURES

605.01 DESCRIPTION: The item shall consist of the necessary adjustment, alteration or resetting to the required grade and alignment of existing structures, equipment or appurtenances which are not to be removed or abandoned and which are not the property of a private company, firm or corporation required to move their own property.

605.04 CONSTRUCTION METHODS, GENERAL: The materials and workmanship necessary in raising, lowering or otherwise adjusting or resetting existing structures shall conform to the requirements of the owner's standard specifications for the class of work involved, unless otherwise provided for in the specifications. Whole bricks, salvaged in good condition from structures, may be used in rebuilding such structures provided the bricks are cleaned satisfactory to the Engineer. Existing structures shall be rebuilt accurately to correct grade and alignment and such work shall be completed in advance of the construction of new work abutting, when required by the Engineer.

(A) Water Lines, Valves, Meters, Fire Hydrants, etc.: The Contractor shall make complete arrangements with the City Water Department for lowering or relocating of all water lines and resetting of water valves and meters, and fire hydrants; and where the Contractor himself is to perform the actual work such work shall conform strictly to the requirements of the City.

(B) Electric Traffic Signals: The Contractor shall make proper arrangements with the Traffic Control Department of the City for the moving and resetting of any electric traffic signals, conduits, cables, etc. Where the Contractor is to perform the actual work, such work shall conform strictly to the requirements of the City.

(C) Manholes: Where the tops of manholes are to be lowered to a new grade, the walls shall be removed and rebuilt to an elevation far enough below the new grade so that the maximum batter of the walls does not exceed 4 inches per foot. Where manholes are to be built up a distance of 1 foot or less to a new grade, the walls may be carried up vertically and 1 new standard step shall be set. Where the walls are to be built up a distance exceeding 1 foot, the existing walls shall first be removed to the bottom of the batter section of the walls or to such elevation that the inside diameter of the manhole is not less than 3 feet 6 inches. The manhole shall then be rebuilt in conformity with the size and shape of requirements for new manholes.

(D) Parking Meters: Where parking meters are to be moved in areas where the sidewalk is to be removed and replaced, the concrete shall be carefully removed from around the base of the meter post and the parking meter then transported by the Contractor to a storage point designated by the Traffic Control Department.

Where parking meters are to be moved in areas where the existing sidewalk is to be left in place, the parking meter post shall be cut at a distance above the sidewalk to be designated by the Engineer and the meter then transported to a storage point to be designated by the Traffic Control Department. All parking meters will be reinstalled by the City and the cost of such installation will not be included in this contract. The Contractor shall make provisions for the reinstallation of the meters as directed by the Engineer.

SECTION 605 - ADJUSTMENT TO EXISTING STRUCTURES

605.05 METHOD OF MEASUREMENT: Where payment is to be made on the unit price basis, vertical measurements of structures raised or lowered to grade will include only the actual net distance the structure is raised or lowered and will not include sections of wall removed and rebuilt.

605.06 BASIS OF PAYMENT: Payment will be made at the contract price, or the unit price, or lump sum price basis, as the case may be, for the adjustment of the particular class of structure involved. Such price or prices shall be compensation in full for all labor, materials, tools, equipment and incidentals necessary to complete the work in accordance with the plans and these specifications.

SECTION 607

REMOVAL OF PAVING, SIDEWALKS, DRIVEWAYS, CURBS, ETC.

607.01 DESCRIPTION: This item shall consist of the removal of existing paving, sidewalks, driveways, curbs, or items of similar nature, composed of concrete, asphalt, brick, or any other material, and the disposal of same all in accordance with these specifications and as shown on the plan, or as directed by the Engineer. For purpose of classification, all gutter, whether combined or separate from curb, shall be considered as paving.

607.04 CONSTRUCTION METHODS, GENERAL: In removal of any paving, sidewalks, driveways, curbs, gutters, etc., care shall be taken to leave a straight, smooth edge by sawing perpendicular to the surface of the portion left in place, at the location given by the Engineer. Any breakage outside the lines given by the Engineer shall be replaced by the Contractor at his expense.

(A) **Disposal of Materials Removed:** All materials designated by the Engineer as salvageable, including broken concrete bricks, manhole frames and grates, catch basin frames and grates, and all sewer and culvert pipe, shall be hauled and stored as directed by the Engineer. Gravel and macadam surfacing shall, as nearly as practicable, be removed separately from dirt or other materials, and where desired for use on other streets or alleys, shall be disposed of at sites designated by the Engineer. The disposal of all excavated material other than specified above shall be the responsibility of the Contractor and at sites approved by the Engineer.

607.05 METHOD OF MEASUREMENT: The various items of this section when classified for payment as contract pay items, will be measured by the unit designated on the plans or as set out in the proposal.

607.06 BASIS OF PAYMENT: The various items of this section when classified for payment will be measured as provided above and paid for at the contract unit price for:

Removal of Concrete Pavement-----	SQ. YD.
Removal of Asphalt Pavement-----	SQ. YD.
Removal of Concrete Sidewalks-----	SQ. YD.
Removal of Concrete Curb-----	L.F.
Removal of Driveway-----	SQ. YD.
Sawing Pavement-----	L.F.

and such payment shall be full compensation for all materials, equipment, tools, labor and incidentals necessary for completing the removal and disposal of the item specified.

SECTION 608

INCIDENTAL PAVING REPAIR AND REPLACEMENT

608.01 DESCRIPTION: This item shall consist of:

- (A) The repair and replacement of paving cuts required for sewer or other ditch construction including the construction of edges or portions for adjacent pavement.
- (B) The repair and replacement of base failures in pavement including the reconstruction of edges of adjacent slab.
- (C) Preparation of pavement for resurfacing.

608.02 MATERIALS: All materials shall conform to the requirements of Section 700 for the type and class of materials involved.

608.04 CONSTRUCTION METHODS:

- (A) The repair and replacement of paving cut required for sewer or other ditch construction shall be in accordance with the standard drawing for this item of work.
- (B) The repair and replacement of base failures in pavement shall be accomplished by removing the slab over and around the area of the failure as directed by the Engineer, or indicated on the plans.

When soft or spongy foundation material is encountered it shall be removed to the depth indicated by the Engineer, and replaced with select borrow. The backfill material shall be moistened and compacted in lifts not to exceed 6 inches to a density of 95% Standard Density.

When the subgrade repair is of sufficient area to justify the use of a roller, in the opinion of the Engineer, the subgrade shall be rolled with an approved type power roller weighing, not less than 3 and more than 5 tons. Areas inaccessible to the roller shall be tamped with a mechanical tamper approved by the Engineer.

(C) The existing pavement shall be prepared for resurfacing as follows: Hard surface type pavements shall be thoroughly cleaned of all dirt, dust or other loose, inert materials prior to the placing of resurfacing material, by sweeping with approved brooms and flushing with water, using an approved hose and nozzle. The hose shall be of sufficient length to reach the entire width and length of the area to be cleaned. The cleaning shall be continued until the surface is in a condition satisfactory to the Engineer. Care shall be taken and the necessary arrangements made to prevent the water used in flushing the pavement from coming in contact with, or interfering with, any new work already in place or being placed.

Where the existing paving is of two-course construction, and the surface course is removed, the area from which the surface course was removed shall be thoroughly cleaned of all particles of old surface course and, if directed by the Engineer, the area shall be flushed and broomed prior to resurfacing as indicated in the preceding paragraph.

SECTION 608 - INCIDENTAL PAVING REPAIR AND REPLACEMENT

608.05 METHOD OF MEASUREMENT:

(A) The repair and replacement of paving cuts for sewer ditch or other ditch construction, will be measured by the square yard for the standard trench width specified in Subsection 604.04(A) or as shown on the plans.

(B) The repair and replacement of base failures in pavement including the reconstruction of edges of adjacent slab will consist of the items measured as follows: Paving removal will be measured as provided in Section 607 of these specifications. Unsatisfactory subgrade materials removed and disposed of will not be measured for payment. Select borrow used to replace unsatisfactory subgrade materials will be measured as provided in Section 401. Pavement repair and replacement will be measured as provided in (A) above. All other items of work necessary for the satisfactory completion of base replacement and repair shall be considered incidental.

(C) Preparation of pavement for resurfacing will not be measured for payment and the cost of this item shall be included in the bid price of some other item on the proposal.

608.06 BASIS OF PAYMENT: Accepted quantities measured as provided above, will be paid for at the contract unit price for:

Pavement Repair and Replacement-----SQ. YD.

which shall be full compensation for furnishing all materials, equipment, labor and incidentals to complete the work as specified.

SECTION 609

SIDEWALK AND DRIVEWAY CONSTRUCTION

609.01 DESCRIPTION: This item shall consist of the construction of driveways or the replacement, repair, relating to grade, and extensions of sidewalks and driveways incidental to other construction work. Driveways shall be constructed in conformity with the standard drawings of the City for driveway construction.

609.02 MATERIALS: All materials for the construction of concrete sidewalks and driveways shall conform to the requirements of Portland Cement Concrete, Section 701. Concrete shall have a slump of not more than 3 inches.

609.04 CONSTRUCTION METHODS:

(A) Excavation: Excavation shall be made to the required depth below the finished surface in accordance with the grades given by the Engineer for the new work. All soft and yielding or other unsuitable material shall be removed and replaced with suitable material and the subgrade shall be compacted thoroughly and finished to a firm, smooth surface. Where filling is required, the material shall be compacted thoroughly in layers not exceeding 8 inches in depth, measured loose.

(B) Sand Cushion: Sand cushion, when required, shall be constructed in accordance with Section 409.

(C) Forms: Forms shall be of 2 inch surfaced plank having a flat surface on top and of a depth equal to the required thickness of the concrete. They shall be securely staked, braced and held firmly to the required line and grade. All forms shall be cleaned thoroughly and wetted before concrete is placed against them. Forms shall be removed within 18 to 24 hours after the concrete is placed.

(D) Placing Concrete: Concrete shall be placed and spread uniformly to the required depth with as little handling as possible, and shall be spaded next to the forms to prevent voids and honeycombed surfaces. The concrete shall be compacted so as to produce a uniformly dense concrete and permit proper finishing. Excess water, laitance or other inert material shall be floated from the surface. Concrete sidewalks and driveways shall have the finished thicknesses designated, but in no instance shall concrete sidewalks be less than 4 inches, or concrete driveways be less than 6 inches in thickness.

(E) Joints:

1. Sidewalks: Transverse contraction joints, tooled or sawed, shall be placed on intervals equal to the width of the sidewalk, unless otherwise shown on the plans, and constructed in accordance with Subsection 504.04(Q). Expansion joints shall be placed as shown on the plans or as directed by the Engineer.

2. Driveways: Joints shall be of the type specified and at locations shown on the plans or standard drawings and constructed in accordance with Subsection 504.04(Q).

609.05 METHOD OF MEASUREMENT: Concrete sidewalks will be measured in square feet of the depth specified. Concrete driveways will be measured in square yards of the specified depth. Measurement of driveways adjacent to new curb shall be from the back of said curb.

SECTION 609 - SIDEWALK AND DRIVEWAY CONSTRUCTION

609.06 METHOD OF PAYMENT: Accepted quantities, measured as provided above, will be paid for at the contract unit price for:

Portland Cement Concrete Sidewalk-----SQ. FT.

Portland Cement Concrete Driveway-----SQ. FT.

which shall be full compensation for all excavation, joint construction and material, fine grading, sand cushion, if required, furnishing all materials, equipment, labor and incidentals to complete the work as specified.

SECTION 650

CONCRETE CURBS AND GUTTERS

650.01 DESCRIPTION: This item shall consist of the construction of concrete curbs and gutters, either separate or in combination, for pavements and roadways in accordance with these specifications and in conformity with the lines, grades, and cross sections shown on the plans. The mixture of the Portland Cement Concrete shall conform to the strength requirements specified in Section 701. Integral Concrete Curb shall be constructed as specified in Section 504.

650.02 MATERIALS: All materials shall conform to the requirements of Section 700.

650.03 EQUIPMENT: A self-propelled curb machine may be used when approved by the Engineer. The curb machine shall be capable of extruding a uniformly textured material to the shape and density specified and placing it in reasonably close conformity to the established line and grade.

650.04 CONSTRUCTION METHODS:

(A) **Excavation:** Excavation shall be made to the required depth below the finished surface in accordance with the cross section shown on the plans. All soft yielding or other unsuitable material shall be removed and replaced with suitable material and the subgrade shall be compacted thoroughly and finished to a firm, smooth surface.

(B) **Forms:** The forms shall be of wood or metal, straight and free from warp, and of sufficient strength to resist springing during the process of depositing and tamping the concrete. Straight forms, if of wood, shall be of two (2) inch surface plank, and, if of metal shall be of approved section and shall have a flat surface on top. Curb forms shall be placed on a firm solid subgrade. Forms for use on radii may be of flexible material, approved by the Engineer. The forms shall be of a depth equal to the depth of the curbing or gutter, and so designed as to permit secure fastening together in the correct position. They shall be securely staked, braced, held firmly to the required line and grade, using approved spreaders and clamps, and shall be sufficiently tight to prevent the leakage of mortar. All forms shall be cleaned thoroughly and oiled before the concrete is placed against them.

(C) **Placing Concrete:** The subgrade and forms shall have been checked and approved by the Engineer before concrete is placed. Concrete shall be deposited on a moist grade. During placing, the concrete shall be thoroughly spaded next to the forms to assure a smooth, dense surface and shall be carefully tamped, using a tamper approved by the Engineer, in uniform layers not exceeding 6 inches in depth until a uniformly dense concrete is obtained. Care shall be taken to work the coarse aggregate well beneath the finish surface. As soon as the concrete curb has set sufficiently to retain its shape without support of the face form, the face forms shall be removed and the curb finished as provided in Subsection 650.04(D). Within 12 to 24 hours after the concrete is placed, unless otherwise required by the Engineer, the back and toe form may be removed. Any honeycombed or rough surfaces shall be immediately corrected when the forms are removed, using mortar where necessary. The ends of all expansion joints shall be cleaned out with a chisel until the expansion material is fully exposed. Where the upper portion of the curb is omitted for driveways or for other cause, the top of the curb shall be constructed slightly higher at the back than at the front, as shown on the standard drawings, or as directed by the Engineer. Such curb shall be classified as "Lip Curb" on the proposal, but unless so classified, shall be considered as regular curb.

SECTION 650 - CONCRETE CURBS AND GUTTERS

(D) Surface Finish: While the concrete is still green the top and front face of other exposed portions of curb shall be thoroughly floated with a moist wooden float, applying clean water ahead of the float when required by the Engineer, and then troweled and brushed. All form marks and other irregularities shall be completely removed. The edges of the curb shall be neatly rounded to the required radii.

The final surface finish shall be obtained by uniformly brushing the surface, using an approved brush, before the concrete sets hard. The brush strokes shall be up the front face and outward across the top and vice versa.

Gutter surface and the upper surface of the lip curb or header curbs having the top portion omitted, shall be finished uniformly true to grade, using a wooden float. Excessive working of the surface shall be avoided. Excess water, laitance and inert material shall be floated off the surface.

The top and front face of the curbs shall be checked for irregularities as soon as the clamps and the face forms have been removed, and gutter surfaces shall be checked during the finishing operation, using a 10 foot straight edge provided by the Contractor.

All variations greater than 1/4 inch in 10 feet or 1/16 inch in 1 foot from the true surface shall be corrected immediately.

The edges of all concrete, including edges at expansion joints shall be neatly edged with a 1/2 inch radius edging tool.

(E) Joints: All joints in curbs and gutters shall be perpendicular to the subgrade, at right angles to the longitudinal axis of the curb or gutter, and shall entirely separate the adjacent sections of concrete.

Expansion joints shall be of the thickness and placed at the locations shown on the plans or as directed by the Engineer. In general, 3/4 inch expansion joints shall be placed between new work and any abutting old work. Preformed expansion joint filler shall be used throughout and shall be set as shown on the plans.

Tooled or sawed contraction joints shall be placed at 20 foot intervals, unless otherwise specified.

Where there are transverse joints in the abutting pavement, similar joints shall in general be placed in the curb, gutter or combination curb and gutter opposite the joints in the pavement.

(F) Extruded Method: When the extruded method is used to construct combined curb and gutter, the extrusion machine shall be operated on a string line, wire line, rails, or forms set at uniform depth above the predetermined finished top of curb grade.

Concrete shall be uniformly fed to the machine and shall be of such consistency that after extrusion the concrete will maintain the shape of the section without support. The finished curb or curb and gutter shall present a well compacted mass with a surface free from voids and honeycomb and reasonably true to established shape, line and grade. Any additional surface finishing required shall be preformed immediately after extrusion.

SECTION 650 - CONCRETE CURBS AND GUTTERS

Joints shall be constructed at the same locations as required when form construction is being used. Contraction joints shall be tooled or sawed and placed on 20 foot intervals, unless otherwise specified.

(G) Header, Marginal and Lip Curb: Header, marginal or lip curb when required at the ends or edges of pavement slab, shall be constructed as shown on the plans and shall be given a wood float finished as specified for gutters.

(H) Placing Dowel Bars: Where shown on the plans, dowel bars or tie bars shall be placed across joints or for tying curbs and gutters to adjacent curbs or slabs in accordance with the requirements of these specifications.

The ends of the tie bars which are to protrude from the edge of a slab, curb or gutter may be carefully bent at right angles so as to lay along the form or header when the concrete is placed. As soon as the form is removed the bent and partially embedded portion of the bar shall be carefully pried out and straightened to its proper position, care being taken to disrupt the concrete as little as possible.

(I) Curing - Protection - Opening to Traffic: Concrete curbs and gutters shall be cured, protected during cold weather, protected from traffic, and opened to traffic in accordance with the requirements specified in Section 504.

(J) Backfill: The back side of curbs and gutters shall be backfilled as soon as the forms have been removed and the required finishing operations completed. The backfill shall be of select earth approved by the Engineer, thoroughly compacted in layers not exceeding 6 inches in depth, and neatly graded off flush with the top of the curb or gutter, or as shown on the plans. Care shall be taken not to damage the concrete in placing or compacting the backfill.

(K) Tests: Tests shall be performed in accordance with Section 504.04(V).

650.05 METHOD OF MEASUREMENT: Concrete curbing will be measured by the linear foot along the face of the curb for Concrete Curb and Combined Curb and Gutter.

Required depression at sewer inlets shown on the specified inlet design, expansion and contraction joints, including the expansion joint filler and expansion joint filler seal, any reinforcing or dowels required by the plans, any extra or special height curb required at inlet depressions and concrete cylinder tests required on the schedule of tests will not be measured for payment.

650.06 BASIS OF PAYMENT: Accepted quantities, measured as provided above, will be paid for at the contract unit price for:

Combined Concrete Curb and Gutter-----LIN. FT.
Integral Concrete Curb-----LIN. FT.
Lip Curb-----LIN. FT.

which shall be full compensation for furnishing all materials, equipment, labor and incidentals to complete the work as specified.