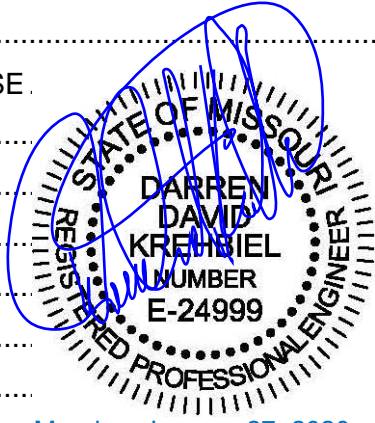


TECHNICAL SPECIFICATIONS

Table of Contents

1.0	OVERALL SITE PREPARATION.....	2
2.0	EXCAVATION OF TRENCHES.....	4
3.0	SANITARY LINES AND APPURTENANCES	10
4.0	ASPHALTIC CONCRETE PAVEMENT – SURFACE/BASE	13
5.0	CONCRETE	24
6.0	REINFORCING STEEL.....	34
7.0	WATERSTOPS.....	36
8.0	CONNECTION TO EXISTING SYSTEM - SEWERLINE	37
9.0	GRADING, SEEDING AND MULCHING	39
10.0	TESTING OF GRAVITY LINES AND MANHOLES.....	41
11.0	CLEAN UP	44



Monday, January 27, 2020

1.0 OVERALL SITE PREPARATION

1.1 Description

This work shall consist of furnishing all labor, materials, and equipment necessary to complete construction in accordance with the plans and as herein specified.

1.2 Construction Procedures

- A. Drainage - All grading shall be done to leave a uniform surface with no ponding and channeling of surface water. Grading shall provide for positive drainage away from all proposed improvements.
- B. Erosion Control - The Contractor shall incorporate all permanent erosion control measures, such as specified in 9.0 GRADING, SEEDING AND MULCHING, as soon as practical. Temporary control measures, such as temporary mulching, will be used when it is not practical to incorporate permanent erosion control measures at that time. Temporary control measures may be required between successive construction stages.
- C. Soil Compaction - All soil compaction under which physical improvements are to be constructed shall be at least 98% of maximum density, as determined by the Standard Compaction Test. All areas, and material, on which improvements are to be placed shall be tested by the Contractor at no additional cost to the Owner. All test results shall be supplied to the Project Engineer.
- D. Landscaping - Damage to existing landscaping will be corrected to the satisfaction of the Owner, at the sole expense of the Contractor.

1.3 Removal of Improvements

- A. Removal of improvements shall include, but is not limited to, removing existing structures, sidewalks, pavement and driveway sections, ponds, fencing, irrigation equipment, and drainage pipes and other underground structures or improvements. The plans will not show a complete list or details of all items to be removed. The Contractor shall determine for himself the amount and extent of the work to be performed under this item and shall base his bid accordingly.

Rock Excavation is unclassified, and no extra compensation will be allowed for rock excavation.

- B. The Contractor shall dispose of all removed improvements, not to be retained by the Owner, in a legal manner off of the project site.

Areas disturbed by the Contractor outside the limits of construction shall be restored at the Contractor's sole expense to a condition similar to, or better than, that prior to construction operations.

It should be noted that a portion of this work is to be completed in the yard of a private residence. Exceptional care shall be taken by the Contractor in this regard pertaining to the removal, handling, installation, and restoration of improvements and materials in this area. The area should be well documented by the Contractor prior to the initiation of construction such that it can be demonstrated, by the Contractor, that the area was returned to a condition equal to, or better than, that which existing prior to construction.

1.4 Clearing and Grubbing

The work shall consist of clearing and grubbing of designated areas by removal and disposal of trees, snags, logs, stumps, shrubs and rubbish, except such vegetation as is designated to remain or to be selectively treated.

- A. The limit of the area to be cleared and grubbed will be marked by the Contractor by means of stakes, flags, tree markings and other suitable methods for approval by the Owner prior to construction operation.
- B. All trees not marked for preservation and all snags, logs, brush, stumps, shrubs and rubbish shall be removed from within the limit of the marked areas. Unless otherwise specified, all stumps, roots and root clusters having a diameter of one inch or larger shall be grubbed out to a depth of at least one foot below the ground surface within the construction limits.
- C. Disposal of stumps, root clusters and other material shall be legally off of the project site or as directed by the Owner.
- D. Topsoil shall be stripped and stockpiled and any material satisfying the

Owner may be used over the finished work. Unused topsoil will be spread uniformly over the adjoining area.

2.0 EXCAVATION OF TRENCHES

2.1 Description

The work in this section consists of furnishing all equipment, labor, and tools necessary for the excavation of trenches as required by the plans and specifications.

Trenches shall be constructed to the lines and grades shown on the plans or as directed by Darren Krehbiel Consultants, LLC. The Contractor shall furnish all laser equipment for establishing grade of trench bottom, bedding material, and pipe inverts.

2.2 Material

The Contractor shall be responsible for the acceptability and storage of all material furnished by him and shall assume responsibility for the replacement of all such material found damaged or defective in manufacture. This shall include the furnishing of all material and labor required for the replacement of installed material discovered to be defective prior to the final acceptance of the work.

2.3 Construction Procedures

A. Trench Excavation and Backfill - All excavation and backfill work shall be done in accordance with pipe manufacturers and industry recommendations, standards and practices.

1. Clearing and Care of Surface Materials. The Contractor shall furnish all the labor, materials, and equipment necessary to complete all clearing of brush, trees, or other obstructions required to complete all work under this heading.

Where existing roads are cut or disturbed by the excavation of the trenches, or otherwise damaged by the Contractor's equipment, the

roads and streets shall be replaced and repaired with surface materials matching the existing paving materials in such a manner satisfactory to the Owner. Fences, power poles, and other property shall be protected by the Contractor, unless their removal is authorized. All property shall be satisfactorily restored by the Contractor at his expense to the approval of the Owner.

2. Protection of Trees and Shrubs. All trees and shrubs adjacent to the proposed property shall be adequately protected by the Contractor. No excavation material shall be placed so as to injure trees or shrubs. Trees and shrubs damaged or destroyed by the Contractor shall be replaced by him with new stocks of a similar size and age, and at the proper season, and at the sole expense of the Contractor.
3. Alignment Grade and Trench Preparation. Trenches shall be located as shown on the drawings, or as directed by Darren Krehbiel Consultants, LLC.

Whenever obstructions not shown on the plans are encountered during the progress of the work and interfere to such an extent that an alteration in the plans is required, Darren Krehbiel Consultants, LLC, shall have the sole authority to change the plans and order a deviation from the line or grade, or arrange with the Owners of the structures for the removal, relocation, or reconstruction of the obstructions. If the change of plans results in a change in the amount of work by the Contractor, such altered work shall be done on the basis of payment to the Contractor for extra work, or credit to the Owner for less work.

The Contractor shall proceed with caution in the excavation and preparation of the trench so that the exact location of the underground structures, both known and unknown, may be determined, and he shall be responsible for the repair of such structures when broken, or otherwise damaged because of carelessness on his part.

4. Trenching and Excavating. Excavation of trenches may be either by hand, or machinery. Contractor shall over dig such that excavation shall extend below the finished grade. Select backfill as directed by Darren Krehbiel Consultants, LLC, thoroughly compacted to the shape and grade required, shall be placed before the placement of the pipe. Backfill material shall be as shown on the plans or as approved by Darren Krehbiel Consultants, LLC. Backfill shall be continuous and uniform and shall not contain objects larger than one inch in diameter unless authorized by Engineer.

The sides of all trenches shall be as nearly as possible vertical. Excessive width of trenches will not be allowed. From a point six inches above the finished grade to the finished grade line, the excavation shall conform as nearly as possible to the size and shape of the pipe so that the pipe may rest on undisturbed soil.

Materials excavated from the trenches shall be deposited along the sides and beyond the reach of possible slides with the banks trimmed so that as little as possible inconvenience to public travel or tenants occupying adjoining property will ensue. The bottom of the trench shall provide continuous uniform bearing for the pipe.

In the event it is necessary to place the excavated materials on any traveled way, the Contractor shall keep the excavated materials a minimum of four feet from the front of all buildings and from the inner portion of the traveled way.

All areas are to be cleaned thoroughly and open to traffic when work is not in progress. Barricades and portable flashing beacons shall be provided at each end, and at such other locations as required by Darren Krehbiel Consultants, LLC, to provide safety for the general public. Where the excavated material has been deposited on green grass plots, the Contractor shall remove the excavated material carefully when backfilling so as not to destroy the grass.

5. Sheeting, Shoring and Bracing. Where necessary to prevent caving, trench excavation in sand, gravel, sandy soils or other unsuitable materials shall be adequately sheeted and braced. Where sheeting and bracing are used, the clear trench width shall not be less than that specified for unsheeted trenches. As back-fill is placed, the sheeting shall be withdrawn in sections for proper compaction of the fill materials.

Excavation surfaces too steep to be safe and stable if unsupported shall be supported as necessary to safeguard the work and workmen, to prevent sliding or settling of the adjacent ground, and to avoid damaging existing improvements. The width of the excavation shall be increased if necessary to provide space for sheeting, bracing, shoring, and other supporting installations. The Contractor shall furnish, place and subsequently remove such supporting installations.

6. Pipe Clearance in Rock. A minimum clearance to rock of at least six (6) inches shall be provided below and on each side of any and all pipe. All rock, boulders, ledge rock and other large stones shall be removed to provide a minimum of six inches clearance.

This minimum specified clearance is a minimum clear distance which will be permitted between any part of the pipe being laid to a point of projection of such rock, boulder, or stone. Before the pipe is installed, all irregularities of the rock shall be filled with earth, or sand that has been well rammed into place and the bottom of the trench brought to the proper grade and shape.

7. Rock Excavation. Trench Excavation is unclassified and no extra compensation will be allowed for rock excavation.
8. Blasting. The use of dynamite or other blasting materials will not be permitted.
9. Dewatering Trenches. Adequate provisions shall be made by the Contractor for the removal and disposal of all water entering the

excavation and for the maintenance of the same in a dry condition until the pipe lines and other parts of the work have been satisfactorily installed.

When large quantities of ground water are encountered, crushed stone or gravel may be used as a subdrain to facilitate drainage to trench or sump pumps. A dam shall be provided in the subdrain to minimize the possibility of undercutting the trench foundation from excessive ground water flows. Ground water will be pumped away from the trenches and area that will be excavated.

When dewatering of a section is completed and the dewatering process is terminated, the termination will be done in such a manner to allow the pressures to increase gradually.

10. Traffic Control. Where traffic must cross open trenches the Contractor shall provide suitable bridges, or bypass, as required for the proper handling of traffic. Barricades and portable flashing beacons shall be provided at such locations and as required by Darren Krehbiel Consultants, LLC, to provide safety for the general public.

B. Backfilling

1. Backfilling the Trench. The pipe will be covered and tamped by hand, or approved mechanical methods, with selected backfill.
 - a. For backfilling under rigid or non-rigid surfacing, crushed limestone shall be placed to the bottom of the surfacing. All replacement surfacing shall be asphalt or concrete complying with these specifications (or MoDOT approved, if allowed) as applicable, to provide replacement surfacing of the same type as existing surfacing.
2. Backfilling and Cleanup. The bottom of the trench shall be backfilled with material as specified above and shall be deposited in the trench simultaneously on both sides of the pipe and to a

distance above the top of the pipe as specified on plans. This backfill shall be tamped in even layers solid bearing and backing.

The upper portion of the trench shall be backfilled with materials as specified above or shown on the plans and shall be compacted by hand tamping, wheel compaction, or other mechanical method, approved by Darren Krehbiel Consultants, LLC.

Upon completing the backfill of the trenches, the trench shall be maintained in a safe condition relative to transportation for a period of twelve (12) months in such manner that no standing water will occur over the trenches. All excess excavation materials shall be moved from the alignment of the trench and disposed of at the direction of the Owner. If extra trench fill is needed, approved material shall be provided by the Contractor at no additional cost to the Owner.

3. Backfill in Unsuitable Material. Where the bottom of the trench at subgrade is found to be unstable or to include ashes, cinders refuse, vegetable or other organic material that in the judgment of Darren Krehbiel Consultants, LLC, should be removed, the Contractor shall excavate any such unsuitable material to the width and depth ordered by Darren Krehbiel Consultants, LLC. Before the pipe is laid, the subgrade shall be made by backfilling with an approved material in six (6) inch layers. These layers shall be thoroughly tamped to provide uniform and continuous bearing for the pipe.

Where the bottom of the trench at subgrade is found to consist of material that is unstable to such a degree that, in the opinion of Darren Krehbiel Consultants, LLC, it cannot be removed and replaced with an approved material thoroughly compacted in place to support the pipe properly, the Contractor shall construct a foundation for the pipe, consisting of piling, timbers, or other materials, in accordance with plans prepared by Darren Krehbiel Consultants, LLC.

4. Restoration of Original Surfaces. All surplus materials, excavated and not required for backfill in the excavations, shall be removed from the area by the Contractor and deposited off of the job site. The cost of hauling, depositing, and otherwise removing waste materials shall be done at the expense of the Contractor. Upon completing the backfill of the trenches, the trench shall be maintained in a safe condition relative to transportation and maintenance.

If extra trench fill is needed, approved material shall be provided by the Contractor at no additional cost to the Owner. The trenches shall be maintained for a period of twelve (12) months in such a manner that no standing water will occur over the trenches.

3.0 SANITARY LINES AND APPURTENANCES

3.1 Description

The work in this section consists of furnishing all new materials, equipment, labor and tools necessary for the construction of sanitary sewers and appurtenances and work required by the plans and specifications.

3.2 Materials

A. PVC Sewer Pipe

1. PVC sewer pipe shall conform to the diameter and location shown on the plans, and shall be constructed of PVC pipe meeting the requirements of the current ASTM D-3034, SDR 35, or latest revision.
2. Gaskets for joints shall be suitable for pipes carrying domestic sewage and shall be of the locked-in Rieber Sealing System type.
3. The industry standard for PVC pipe construction is considered to be the Uni-Bell Plastic Pipe Association.

B. Ductile Iron Pipe

1. Ductile iron pipe shall conform to the diameter and location shown on the plans, and shall be constructed of ductile iron pipe meeting the requirements of the current AWWA C151-76, ASA A 21 15 specifications.
2. Gaskets for joints shall be suitable for pipes carrying domestic sewage.
3. All fittings, couplings and adapters shall be manufactured out of materials conforming to the same standards as the pipe and having a design strength equal to or better than the adjacent pipe.

C. Concrete.

Concrete shall be as specified on the project plans or in 5.0 CONCRETE of these specifications.

D. Manholes.

1. Manholes shall be constructed as shown on the plans, whether of concrete or precast concrete, and have a minimum twenty-eight (28) day strength of thirty five hundred (3500) psi.
2. Manhole frames and covers shall be cast iron, meeting the requirements of the current ASTM A48-Class 30 Specification for gray iron castings, and as shown on plans.
3. Unless otherwise noted, only closed manhole covers shall be used. Frames and covers shall be as specified by Darren Krehbiel Consultants, LLC.

3.3 Construction Procedure

All materials shall be delivered and distributed along the site of the work by the Contractor. Pipe, fittings and material shall be loaded and unloaded so as to avoid shock or damage.

A. Pipe and Sewer Lines

1. The Contractor shall be careful to preserve stakes and survey marks from damage or dislocation.
2. Where it is necessary to cut the pipe, care must be taken not to crack the pipe or damage any lining and to cut straight and true around it. The pipe and fittings shall be inspected for defects and, while suspended above grade or standing on end, shall be rung with a light hammer to detect cracks. Damaged or unsound pipe or fittings will be rejected.
3. All pipe shall be laid with bells uphill. Joints shall be made as specified above. Before joining the pipe, all lumps, blisters, excess coating material and any grease or oil shall be removed from gaskets and the bell and spigot ends of pipes.
4. Every precaution shall be used to protect the pipe against the entrance of foreign material before the pipe is placed in the new line. At the close of the day's work or whenever the workmen are absent from the job, the end of the last laid section of pipe shall be closed to prevent the entry of foreign material except to drain water from the trench.
5. All newly laid sewer lines shall be tested for exfiltration before being placed in service. The time of determining the leakage on each line will be selected by Darren Krehbiel Consultants, LLC. The Contractor shall furnish all water, labor, assistance, etc., necessary for the performance of the tests. If the exfiltration, as determined by the tests, exceeds two hundred (200) gallons per inch of pipe diameter per mile (or if measured infiltration exceeds the above),

the Contractor shall locate the principal leakage and shall make repairs as are required to reduce the total exfiltration or infiltration rate below the rate specified.

6. All newly laid sewer lines shall be lamped before being placed in service. If the lines do not lamp reasonably near a full circle, or if low spots are disclosed, the Contractor shall locate the cause and make such repairs or replacements as may be necessary to correct the defects.
7. The manhole inverts shall be constructed of concrete as specified in these specifications. The invert shall be made smooth and protected from damage by water or other agents or rapid moisture loss during the curing period.

4.0 ASPHALTIC CONCRETE PAVEMENT – SURFACE/BASE

4.1 Description

This item shall consist of a surface course, or base course, composed of mineral aggregate and bituminous material mixed in a central mixing plant and placed on a prepared course in such proportions that the resulting mixture meets the grading requirements of the job-mix formula and in accordance with the plans and these specifications.

Each course shall be constructed to the depth, typical section or elevation required by the plans and shall be rolled, finished and approved before the placement of the next course.

4.2 Materials

A. Aggregate -

1. Coarse Aggregate - All coarse aggregate shall consist of crushed limestones having sound, tough, durable particles, free from adherent coatings of clay, organic matter and other deleterious

substances. It shall show no more than 40% when tested in accordance with ASTM C 131. The gradation of coarse aggregate shall be such that the coarse aggregate, when combined with fine aggregate, will meet the gradation requirements for the type of asphaltic concrete specified.

2. Fine Aggregate - Fine aggregate shall consist of clean, sound, durable, angular particles produced by crushing stone, or gravel and shall be free from coatings of clay, silt or other objectionable matter and shall contain no clay balls.
3. Sampling and Testing - All aggregate samples required for testing shall be furnished by the Contractor. ASTM D 75 shall be used in sampling coarse aggregate and fine aggregate, and ASTM C 183 shall be used in sampling mineral filler. No aggregate shall be used in the production of mixtures without prior written approval.
4. Sources of Aggregate - Sources of aggregate shall be selected well in advance of the time the materials are required in the work. When the source producing aggregates has a satisfactory service record in bituminous pavement construction for at least five years, samples shall be submitted 14 days prior to start of production. An inspection of the producer's operation may be made by Darren Krehbiel Consultants, LLC. When new sources are to be developed, the Contractor shall indicate the sources and shall submit a plan for operation 28 days in advance of starting production. Samples from test pits, borings and other excavations shall be submitted at the same time. Approval of the source of aggregate does not relieve the Contractor in any way of the responsibility for delivery at the job site of aggregates that meet the requirements specified herein.
5. Samples of Aggregate - Samples of aggregates shall be furnished by the Contractor at the start of production and at intervals during production of bituminous mixtures. The intervals and points of sampling will be designated by Darren Krehbiel Consultants, LLC. The samples will be the basis of approval of specific lots of

aggregates from the standpoint of the quality requirements of this section.

The combined coarse and fine aggregate shall have a gradation within the limits designated as follows and shall not vary from the low limit on one sieve to the high limit on the adjacent sieve, or vice versa, but shall be well graded from coarse to fine.

**Table 4-1
Percent Passing**

Sieve Size	Base Course	Surface Course
1 inch	100	100
¾ inch	85-100	100
½ inch	60-90	85-100
No. 4	35-65	50-70
No. 8	25-50	30-55
No. 30	10-35	10-30
No. 200	6-12	5-12

- B. Mineral Filler - If filler, in addition to that naturally present in the aggregate, is necessary, it shall meet the requirements of ASTM D 242. Prior approval shall be required for use of fly ash as a mineral filler.

- C. Bituminous Material - The types, grades, controlling specifications and maximum mixing temperatures for the bituminous materials are given in Table 4-2 below. Regardless of the type and grade of asphalt used, the penetration of the asphalt cement shall not to be less than 60 nor more than 100 without written approval from Darren Krehbiel Consultants, LLC.

The Contractor shall furnish vendor's certified test reports for each carload or equivalent of bitumen shipped to the project. The report shall be delivered to Darren Krehbiel Consultants, LLC, before permission is granted for use of the material. The vendor's certified test report for the bituminous material can be used as a basis for final acceptance; however, Darren Krehbiel Consultants, LLC, reserves the right to have the material

tested and reject it if the asphalt cement does not meet the specifications.

**Table 4-2
BITUMINOUS MATERIAL**

TYPE AND GRADE ASPHALT CEMENT	SPECIFICATION	MAXIMUM MIXING TEMPERATURE		
		F	C	
Penetration Grade	60-70	ASTM D 946	335	170
	85-100		325	165
Viscosity Grade	AC-10	ASTM D 3381	315	155
	AC-20		330	165
Viscosity Grade	AR-4000	ASTM D 3381	325	165
	AR-8000		325	165
Tar	RT-11	ASTM D 490	250	125
	RT-12		250	125

4.3 Composition

- A. Composition of Mixture - The bituminous plant mix shall be composed of a mixture of aggregate, filler, if required, and bituminous material. The aggregate fractions shall be sized, uniformly graded and combined in such proportions that the resulting mixture meets the grading requirements of the job mix formula.

- B. Job Mix Formula - No bituminous mixture shall be produced for payment until a job mix formula has been approved by Darren Krehbiel Consultants, LLC. The samples shall be taken from the source by the Contractor and delivered to the testing laboratory at the Contractor's expense. The samples of materials shall be of the size specified by Darren Krehbiel Consultants, LLC. The Contractor's testing laboratory shall prepare the job mix formula. If the first job mix formula does not meet the requirements of these specifications or the Contractor should decide to change sources of material, the Contractor shall pay for additional job mix formulas.

**Table 4-3
MARSHALL DESIGN CRITERIA
BASE COURSE**

Test Property	Pavement	
No. of Blows	50	
Marshall Stability	1000	
Flow (0.01 in.)	8-20	
Voids Criteria	*Non- Absorptive Aggregate	**Absorptive Aggregate
% Air Voids	3-6	3-8
% Voids Filled With Asphalt	65-85	70-90

* When absorption of blended aggregate is less than 2.5%, use the apparent specific gravity determined in accordance with ASTM C 127 for coarse aggregate and ASTM C 128 for fine aggregate.

** When the absorption of the blended aggregates equals or exceeds 2.5%, the bulk impregnated specific gravity shall be used.

4.4 Construction Procedures

- A. Weather Limitations - The bituminous mixture shall not be placed: upon a wet surface; when the surface temperature of the underlying course is less than 50°F; when weather conditions prevent the proper handling or finishing of the mixture; or between October 1 and April 1 without written approval of Darren Krehbiel Consultants, LLC.

- B. Preparation of Bituminous Material - The bituminous material shall be heated to the specified temperature in a manner that will avoid local

overheating and provide a continuous supply of the bituminous material to the mixer at a uniform temperature. The temperature of the bituminous material delivered to the mixer shall be sufficient to provide a suitable viscosity for adequate coating of the aggregate particles but shall not exceed the application maximum temperature set forth in Table 4.2.

C. Preparation of Mineral Aggregate - The aggregate for the mixture shall be dried and heated to the temperature designated by the job formula within the job tolerance specified. The maximum temperature and rate of heating shall be such that no permanent damage occurs to the aggregates. Particular care shall be taken that aggregates high in calcium or magnesium content are not damaged by overheating. The temperature shall not be lower than is required to obtain complete coating and uniform distribution on the aggregate particles and to provide a mixture of satisfactory workability. The aggregate shall not be heated greater than 25° F above the temperature of the bituminous material.

D. Preparation of Bituminous Mixture - The aggregates and the bituminous material shall be measured or gauged and introduced into the mixer in the amount specified by the job mix formula.

1. The combined materials shall be mixed until complete and uniform coating of the particles and a thorough distribution of the bituminous material throughout the aggregate are secured. Wet mixing time shall be approved by Darren Krehbiel Consultants, LLC, for each plant and for each type aggregate used. Normally, the mixing time after introduction of bituminous material should be less than 30 seconds. For continuous mix plants, the minimum mixing time shall be determined by dividing the weight of its contents at operating level by the weight of the mixture delivered per second by the mixer.

$$\text{Mixing time (seconds)} = \frac{\text{Pugmill dead capacity in pounds}}{\text{Pugmill output in pounds per second}}$$

The dry mixing time in the batch plant shall be the time required to blend the dry aggregate in a uniform mixture. The wet mixing time

begins with the introduction of the asphalt cement to the pugmill and ends with the opening of the discharge gate.

Prolonged exposure to air and heat in the pugmill hardens the asphalt film on the aggregate through oxidation; therefore, the mixing time should be the shortest time required to obtain uniform distribution of aggregate sizes and thorough coating of aggregate particles with the bituminous material.

- E. Transporting, Spreading, and Finishing - The mixture shall be transported from the mixing plant to the point of use in vehicles conforming to the following requirements. Trucks used for hauling bituminous mixture shall have tight, clean, smooth, metal beds which have been thinly coated with a minimum quantity of lime solution, or other approved material to prevent the mixture from adhering to the beds. Use of diesel fuel, fuel oil or other detrimental products as a bed coating will not be allowed. Each truck shall have a securely fastened cover of canvas or other suitable material of such size as to protect the mixture from the weather. When necessary, so that the mixture will be delivered on the road at the specified temperature, truck beds shall be insulated. Deliveries shall be scheduled so that spreading and rolling of all mixtures prepared for one day's run can be completed during daylight, unless adequate artificial lighting is provided. Hauling over freshly placed material shall not be permitted until the material has been compacted, as specified, and allowed to cool to ambient temperature or 6 hours, whichever is longest.

Immediately before placing the bituminous mixture, the underlying course shall be cleared of all loose or deleterious material with power blowers, power brooms or hand brooms, as directed.

The mix shall be placed at a temperature of not less than 250°F when asphalt cement is used and not less than 150°F when tar is used. Moisture content of the mix shall not exceed 0.5%.

The intermediate lifts may be laid in thickness up to three inches provided graded control can be maintained, and no roller marks or signs of asphalt

flushing can be noted in the finished product. The thickness of the final lift shall not be more than two inches nor less than twice the size of the maximum size aggregate in the mix.

Upon arrival, the mixture shall be spread to the full width by an approved bituminous paver. It shall be structured off in a uniform layer of such depth that, when the work is completed, it shall have the required thickness and shall conform to the grade and contour indicated. The speed of the paver shall be regulated to eliminate pulling and tearing of the bituminous mat.

For pavements having a width of 16 to 24 feet, inclusive, the asphaltic concrete pavement shall be laid in lanes approximately one half the full width completed as soon as practicable. Unless otherwise permitted, a single lane of any course shall not be constructed to a length which cannot be completed to full width of the pavement the succeeding operating day. For pavements greater than 24 feet wide, single lane width construction shall be limited to one day's production and completion to full width shall be accomplished as soon as practicable.

No segregation will be permitted in handling the mixture at the plant, from the truck, or during spreading operations on the roadbed. All layers shall be feathered out, by hand raking if necessary, in transitioning the depth of the surface to meet present grades at ends of projects, to provide a uniform, smooth riding surface free of irregularities. Where only the top layer of the surfacing continues across any concrete surfacing, the bottom layers shall be feathered out.

When multilayer asphaltic concrete pavement or an asphaltic concrete surface is being constructed on a base course, the stringline method, or comparable electronic method, shall be used. The Contractor shall set grade stakes and stringlines for each paving lane. If multilifts of asphaltic concrete are being laid and Darren Krehbiel Consultants, LLC, and the Contractor are satisfied that the grades and surface tolerances on the final lift can be met, then long sled and joint matches can be used.

When stringlines are required, they shall consist of piano wire or other approved material. The stringlines shall be supported at a maximum of 25

foot centers. Additional supports shall be installed to prevent sag, if required. The horizontal alignment of the stringlines shall be within ¼" inch per 10 feet. The Contractor shall provide a satisfactory method of securing the stringline where vertical curves are constructed to maintain the proper grade.

After the first lane of each lift is constructed, the joint matcher (short ski) shall be used on the previously laid lane. The free edge shall be controlled as specified herein before. The automatic transverse grade control device shall be used only when one paving lane on each side of the high point of the pavement is to be constructed. Example: One lane pavement or two lane crowned pavement.

On areas where irregularities or unavoidable obstacles make the use of mechanical spreading and finishing equipment impractical, the mixture may be spread, raked and luted by hand tools.

- F. Compaction of Mixture - After spreading, the mixture shall be thoroughly and uniformly compacted with power rollers. Rolling of the mixture shall be discontinued if undue displacement or cracking occurs. Rolling shall be initiated with the drive wheel toward the paving machine. The sequence of rolling for the first paving lane should be to first roll the sides and proceed longitudinally parallel to the road centerline, each trip overlapping one half the roller width, gradually progressing to the crown of the road. When abutting a previously placed lane, the longitudinal joint shall be rolled first followed by the regular rolling procedure. Alternate paths of the roller shall be of slightly different lengths. The rolling pattern may be varied to obtain proper compaction at the direction of Darren Krehbiel Consultants, LLC.

The speed of the roller shall be sufficiently slow to avoid displacement of the hot mixture. The rollers shall not travel faster than the manufacturer's recommended speed and in no case faster than 3 mph. Any displacement occurring as a result of reversing the direction of the roller, or from any other cause, shall be corrected at once by rakes and fresh mixture. The roller shall not be permitted to stand static on the hot material.

Sufficient rollers shall be furnished to handle the output of the plant.

Rolling shall continue until all roller marks are eliminated, the surface is of uniform texture and true to grade and cross section, and the required field density is obtained.

To prevent adhesion of the mixture to the roller, the wheels shall be kept properly moistened, but excessive water will not be permitted.

In areas not accessible to the roller, the mixture shall be thoroughly compacted with hot hand tampers.

Any mixture which becomes loose and broken, mixed with dirt or in any way defective shall be removed and placed with fresh, hot mixture and immediately compacted to conform to the surrounding area. This work shall be done at the Contractor's expense. Skin patching shall not be allowed.

- G. Joints - The construction of all joints shall be made in such a manner as to ensure a continuous bond between old and new sections of the course. All joints shall present the same texture, density and smoothness as other sections of the course. All contact surfaces of previously constructed pavements that have become coated by dust, sand or other objectionable material shall be cleaned by brushing or shall be cut back with an approved power saw, as directed. The faces of these joints may be painted with a thin coating of tack coat material.

When necessary to form a transverse joint, it shall be made by means of placing a bulkhead or by tapering the course, in which case the edge shall be cut back to its full depth and width on a straight line to expose a vertical face. When paving in that lane is continued, the joint shall be heated with the paver screed until the material along the joint is soft. Overheating of the material shall not be permitted. The joint shall be rolled perpendicular to the paving lane with the roller overlapping the new material approximately one foot. Boards or other devices shall be placed on the edge or edges of the paving lane to prevent roll down of the edges.

Longitudinal construction joints shall be constructed so that the surface is one continuous plane and will not pond water. The longitudinal joint shall

be horizontally compacted with an asphalt lute until the surface of the joint is slightly higher than the remainder of the mat immediately after breakdown rolling operations have been completed. After this has been completed, rolling operations shall continue.

If a good longitudinal construction joint cannot be obtained or the desired compaction reached, the joint shall be heated as specified hereinafter. This includes joints that existed prior to the new project or joints created from the previous day's production.

- H. Shaping Edges - While the surface is being compacted and finished, the Contractor shall carefully trim the outside edges of the pavement to 45°F degrees. Edges so formed shall be beveled, while still hot, with the back of a rake or a smooth iron and thoroughly compacted by tampers or by other satisfactory methods.

- I. Acceptance Sampling and Testing of Bituminous Mixture (Compaction) - Pavement density will be determined by taking the average density of four laboratory-prepared specimens, taken from trucks delivering mixture to the site. Temperature of the mixture immediately prior to compaction shall be 250°F ± 5. The sample of mixture can be placed in an oven for not more than 30 minutes to maintain the heat, but it shall not be reheated if it cools before use. Density samples shall not be taken in the pavement where the pavement thickness is less than 12 times the mixture aggregate size. This applies only to wedge courses and tapered transitions.

The average field density shall be equal to or greater than 98% of the average density of the laboratory-prepared specimens. Cores taken from the pavement will be used to test the field density. The density of the laboratory-prepared specimens and the cored samples will be determined in accordance with ASTM D 2726 or D 1188, whichever is applicable. The direct transmission nuclear method of test and/or the backscatter nuclear method of test may be used to determine field density.

The Contractor shall cut samples from any layer of the compacted mixture at locations designated by Darren Krehbiel Consultants, LLC, and shall

deliver to the field laboratory in good condition. Samples may be obtained by either sawing with a power saw or by drilling 4-inch diameter cores.

Tests for conformity with the specified crown and grade shall be made by the Contractor immediately after initial compaction. Any variation shall be corrected by the removal or addition of materials and by continuous rolling. Unless otherwise specified in writing, the Contractor shall provide a 10-foot straight edge on the job at all times.

After completion of final rolling, the smoothness of the course shall again be tested; humps or depressions exceeding the specified tolerances shall be immediately corrected. The finished surface shall not vary more than 1/8 inch for the surface course when tested with a 10-foot straight edge applied parallel with and/or at right angles to the centerline.

The Contractor shall correct pavement areas not meeting these tolerances in excess of this amount by removing and replacing the defective work. If the Contractor elects to construct an overlay to correct the deficiencies, the minimum thickness of the overlay shall not be less than twice the size of maximum size aggregate.

5.0 CONCRETE

5.1 Description

The work to be performed under this section of the specifications shall consist of furnishing all labor, materials and equipment necessary to complete the construction of all concrete structures in accordance with the plans and/or as herein specified, including all necessary excavation, fill and testing.

5.2 Materials

- A. Portland Cement - Portland Cement used in this work shall conform to the latest specifications of the American Society for Testing Materials (ASTM C150), Type I and III. All cement shall be tested before use. Tests shall conform to the latest standards of the American Society for Testing

Materials and a report of cement tests shall be made available to Darren Krehbiel Consultants, LLC, at least 14 days before the placement of any concrete on the project. When the temperature of air is near freezing, it is recommended that the Contractor use high early strength Portland Cement (Type III).

- B. Fine Aggregate - Fine aggregate shall consist of sand having clean, hard, durable uncoated grains, free from deleterious substances. Fine aggregate shall range in size from fine to coarse within the following percentage by weight: (ASTM C 117 and ASTM C 136)

Passing 3/8"	sieve	100%
Passing #4	sieve	95 to 100%
Passing #8	sieve	80 to 100%
Passing #16	sieve	50 to 80%
Passing #20	sieve	40 to 75%
Passing #30	sieve	25 to 60%
Passing #50	sieve	5 to 30%
Passing #100	sieve	0 to 10%

The limits of deleterious substances are as follows:

	Percent by Weight
Clay lumps (ASTM C142)	0.25
Material finer than No. 200 sieve (ASTM C 117)	2.0
Coal and Lignite (ASTM C 40)	0.25

and as further provided in section 1005.2.1 of the Missouri Standard Specifications for Highway Construction.

Fine aggregate shall be free of injurious amounts of organic impurities. Except as herein provided, aggregates subjected to the test for organic impurities and producing a color darker than the standard shall be rejected. A fine aggregate failing in the test may be used provided that the

discoloration is due principally to the presence of small quantities of coal, lignite, or similar discrete particles (ASTM C 40). Fine aggregate subjected to five cycles of the soundness test shall show a loss not greater than 10 percent when sodium sulfate is used or 15 percent when magnesium sulfate is used (ASTM C 88).

C. Coarse Aggregate - Coarse aggregate shall consist of well graded, clean, hard, tough, durable crushed stone or washed gravel. It shall be free from soft, thin, elongated, fossil or laminated pieces, disintegrated stone, vegetable or other deleterious matter. In no case shall coarse aggregate containing lumps of frozen or partially cemented materials be used. Coarse aggregate shall be well graded from coarse to fine within the following percentages by weight:

Passing	1 ½ "	sieve	100%
Passing	1"	sieve	95 to 100%
Passing	¾ "	sieve	70 to 90%
Passing	½ "	sieve	25 to 60%
Passing	⅜ "	sieve	10 to 30%
Passing	# 4	sieve	0 to 8%
Passing	#10	sieve	0 to 3%

The maximum size of coarse aggregate shall, in any case, be not larger than one-fifth the narrowest dimensions between forms of the members to be poured, nor larger than three-fourths of the clear distance between the reinforcing bars and imbedded items.

The limits for deleterious substances are as follows:

	Percent by weight
Clay lumps (ASTM C142)	1.0
Material finer than No. 200 sieve (ASTM C 117)	1.0
Coal and Lignite (ASTM C 40)	0.5

Coarse aggregate subjected to five cycles of the soundness test shall show a loss not greater than 8 percent when sodium sulfate is used or 10 percent when magnesium sulfate is used (ASTM C 88).

Coarse aggregate tested for abrasion shall have a loss of not more than 40%. (ASTM C 131 or ASTM C 535).

All aggregate used on this project shall undergo the above tests and reports of the results shall be made available to Darren Krehbiel Consultants, LLC. No aggregate shall be used without prior approval of test results from Darren Krehbiel Consultants, LLC. Tests shall be scheduled at least 14 days in advance of the scheduled pouring of concrete.

- D. Water - Mixing water shall be free from oil, acid, and injurious amounts of vegetable matter, alkali or other salts. Water known to be of potable quality may be used without testing.

- E. Admixtures - An air-entraining agent shall be used in all concrete. All mixtures shall conform to ASTM C-260 and shall be added to the mixer in the amount necessary to produce the specified air content. The designated quantity of air by volume shall be 5 ½ percent with an operating tolerance of 1 ½ percentage points. The Contractor shall submit certificates indicating that the air-entraining agent meets all of the requirements. The Contractor may be required to submit complete test data from an approved laboratory showing that the material to be furnished meets all of the requirements of the cited specifications. Other admixtures may be used on approval by Darren Krehbiel Consultants, LLC. All certificates and any test data required shall be submitted at least 14 days before the scheduled date for concrete pouring.

- F. Cover Material for Curing - Curing materials shall conform to one of the following specifications:
 - 1. Liquid membrane-forming compounds - ASTM C 309, Type
 - 2. White polyethylene film - ASTM C 171.

3. White burlap-polyethylene sheeting - ASTM C 171.
4. Waterproof paper - ASTM C 171.

The Contractor shall furnish manufacturer's certificates indicating that the cover material selected meets all of the requirements for the cited specifications. Such certificates shall be furnished to Darren Krehbiel Consultants, LLC, at least 45 days before the scheduled date for concrete pouring.

G. Concrete Proportions

1. Proportion Ingredients - Unless otherwise specified or indicated on the plans, concrete shall be made of Portland Cement, fine aggregate, coarse aggregate, water and an air-entraining agent as specified under Section 5.2 A-E. The Contractor shall supply a concrete design mix to Darren Krehbiel Consultants, LLC, at least 21 days prior to the scheduled date of concrete pour. The Contractor shall include in the design mix report test results from a trial batch, to include aggregate gradation, slump, air content, 7 day and 28 day strengths.

Designed mixtures shall be based upon sieve analysis of the aggregates available. In no case shall less than six sacks of cement per cubic yard of concrete be used to obtain the desired strength of 4,500 pounds per square inch. The method of measuring concrete materials in batch-mixes or at ready-mix plants shall be by weight and shall be such that the proportions can be accurately controlled and easily checked at any time during the work.

The above mixtures are stated by volume. Measured quantities shall be placed in mixtures by equivalent weight with due allowances for moisture in the aggregate and bulging of sand.

2. Water-Cement Ratio - The proportioning of materials shall be

based on the requirements of a workable mix containing not more than six gallons of water per sack of cement. Water in the aggregate must be included in the quantity of water specified and shall be subtracted from the amount of water not exceeding that of the approved design mix.

Moisture in the aggregate shall be measured daily during placing of concrete by methods satisfactory to Darren Krehbiel Consultants, LLC, and the specified quantity of water shall be adjusted accordingly to provide for a total amount of water not exceeding that of the approved design mix.

3. Workability - The consistency of the concrete shall be such that the concrete can be readily worked around reinforcing bars and into all angles and corners when vibrated. The slump of the concrete shall be three inches with an allowable range allowing for no more than four inches. The methods of measuring the slump shall conform to ASTM C 143. Any truckload having a slump greater than that specified above shall be rejected. The Contractor shall remove the concrete already placed from such rejected load at his own expense.

- H. Sealant - Exposed concrete floors shall be sealed with Dayton Superior Cure & Seal 25% J22UV, or approved equal.

5.3 Construction Procedures

- A. Control of Concrete Mixes - The Contractor shall be responsible for making and curing concrete test cylinders (ASTM C 31).

Curing of the cylinders will be by covering with approved cover material specified in Section 5.2 F. During the first 24 hours all test specimens shall be stored under conditions that maintain the temperature immediately adjacent to the specimens in the range of 60°F to 80°F and prevent loss of moisture. After 48 hours test specimens shall be removed from the field to the testing laboratory. Care shall be taken during transport to prevent

damage to the specimens from jarring, freezing temperatures, or moisture loss.

Each cylinder shall be labeled on the side with the date, project name and number if any, cylinder I.D. number or letter, and contractor's name. All such information shall appear on the testing laboratory's reports. Such testing laboratory reports shall be in the mail to Darren Krehbiel Consultants, LLC, within 3 working days from the date of testing. Testing of concrete test cylinders taken from the concrete actually placed in the work will be paid for by the Contractor.

Three test cylinders shall be taken from a batch of concrete selected at random from each 50 cubic yards of concrete poured, but in no case shall less than one set of cylinders for each 50 cubic yards of concrete, or each day's pour be taken. Concrete test cylinders shall be broken as follows: one each at seven and twenty-eight days with the remaining cylinder held. The third cylinder tested shall be as directed by Darren Krehbiel Consultants, LLC. The results of each test shall be reported to Darren Krehbiel Consultants, LLC (ASTM C 39). Test cylinder results shall be as follows:

7 day cylinders-75% of the specified strength, or better.

28 day cylinders-100% of the specified strength, or better.

Failure of test cylinders to meet the specified strength will result in the rejection of poured areas from which samples were taken and the Contractor will be required to remove and reconstruct any such condemned areas at his own expense. No concrete shall be placed upon other concrete poured on this project for which the 7 day test cylinder results have not been received and approval given.

Other field tests to be performed are as follows:

Test	Frequency
Aggregate gradation	1 per 750 cubic yards*

ASTM C 136

Slump and air content
ASTM C 143 & ASTM C 138
or ASTM C 231

Every truck load

Yield
ASTM C 138

1 per 750 cubic yards*

* or per day, whichever is the more frequent.

Tests, analysis and inspections shall be made in accordance with pertinent standards of the ASTM and shall meet with the approval of Darren Krehbiel Consultants, LLC.

B. Ready-mix Concrete - The use of plant-mix concrete delivered to the job in revolving drum mixture trucks will be approved if evidence is submitted to establish the adequacy of the proposed concrete plant's equipment and facilities. Plant-mixed concrete shall conform to ASTM C-94. No water shall be added to the ready-mix concrete at the job site without the specific approval of Darren Krehbiel Consultants, LLC.

C. Deposited Concrete - Concrete shall be placed from the transporting vehicle to the place of final deposit as rapidly as practicable by methods approved by Darren Krehbiel Consultants, LLC, which shall prevent the separation or loss of ingredients.

Under no circumstances shall concrete that has partially hardened be deposited in the work. Concrete shall be deposited in the forms as nearly as practicable in its final position to avoid rehandling. It shall be so deposited as to maintain, until completion of the unit, a plastic surface approximately horizontal.

D. Retempering - Retempering of concrete which has partially hardened will not be permitted.

E. Vibrating - Internal vibrators shall be used in all walls, floors, and in all reinforced work. Vibrators shall be of sturdy construction, adequately powered and capable of transmitting to the concrete not less than 3,600

impulses per minute when operating under load. A sufficient number of vibrators shall be used so that, at any rate of placement, complete vibration and compaction will be sustained throughout the entire volume of each layer of concrete. Internal vibrators shall be kept constantly moving in the concrete and shall be applied at points uniformly spaced not farther apart than the radius over which the vibrator is visibly effective. The vibrator shall not be held in one location long enough to draw a pool of laitance from the surrounding concrete.

- F. Curing - Exposed surfaces of concrete shall be protected from premature drying caused by the hot sun, drying winds, or other causes. Freshly placed concrete shall be protected from damage from rain.

When concrete is placed while the air temperature is less than 40°F or when freezing is probable within 48 hours, all sand, aggregate, and water shall be heated, and the concrete, when being placed, shall have a temperature of not less than 70°F nor more than 100°F. Care must be taken to prevent too rapid drying of the concrete when it is heated. During freezing weather suitable means shall be provided for maintaining the temperature of the concrete at not less than 50°F for a period of five days for normal concrete curing.

- G. Finishing - Unless otherwise specified, exposed concrete wall surfaces shall be finished by wetting, thoroughly rubbing with a carborundum brick, and rinsing with water. Floor and wall finishes shall be finished by floating with a wood float in a manner that will thoroughly compact the concrete and will provide a smooth, even surface. Final floor finish will be attained with a steel trowel. Unexposed concrete shall have a float finish.

- H. Patching - If, after the removal of the forms, voids, or other blemishes exist in any concrete surface, the Contractor shall remove all loose material and cut back at least one inch into solid concrete with square edges, after which he shall thoroughly moisten the surface with clean water, apply a coat of neat cement and fill the openings with grout of the same proportions as the original mix. This shall be done immediately upon removal of the forms. Tie holes, left by the withdrawal of tie rods, or holes

left by the removal of ends of ties shall be filled solid with mortar.

- I. Construction Joints - Concrete for tunnels, trenches, and walls shall be poured in units as large as possible in order to lessen the number of construction joints. The location of all joints not shown on the plans shall be approved by Darren Krehbiel Consultants, LLC. Where joints are to be made, the surface of the concrete shall be thoroughly cleaned and all latent removed. In addition to the foregoing, vertical joints shall be thoroughly wetted but not saturated, and slushed with a coat of neat cement grout immediately before the placing of new concrete.
- J. Openings and Recesses - The Contractor shall provide all openings and recesses in the concrete as shown on the plans, or as directed by Darren Krehbiel Consultants, LLC.
- K. Forms and Centering - Forms shall be constructed so that the finished concrete walls will conform to the shape, lines, grades and dimensions indicated on the plans. The forms shall be substantial and sufficiently tight to prevent the leakage of mortar and shall not deflect under the weight of the wet concrete or construction loads.

Forms for exposed surfaces shall be coated with nonstaining mineral oil applied before the reinforcement is placed. After oiling, any surface oil on the reinforcing steel shall be removed. Earth trenches used for footings shall be clean, even, vertical and true. The bottoms of earth footings shall be level, clean and without fill. Where caving of the footings exists, the footings shall be formed with boards to their entire depth as shown on the plans. Forms shall not be removed until it is evident that the concrete has attained sufficient strength to carry all loads to which it shall be subjected.

- L. Form Ties - Unless otherwise specified, form ties shall be of a design approved by Darren Krehbiel Consultants, LLC. Ties shall be such that when forms are removed no metal shall be within one inch of the finished surface. Holes remaining in the concrete after the form ties have been removed shall be filled with mortar.

6.0 REINFORCING STEEL

6.1 Description

This work shall consist of providing all materials, labor and equipment necessary for the placement of reinforcing steel in accordance with the plans and/or as herein specified.

6.2 Materials

- A. Reinforcing Steel - Reinforcing shall be deformed bars meeting the requirements of AASHTO M31, Grade 60.

6.3 Construction Procedure

Under no circumstances shall concrete be poured until the steel placement is approved by Darren Krehbiel Consultants, LLC.

The ends of all reinforcing bars shall be hooked unless specifically noted to the contrary on the drawings or in places where hooks are not feasible because of other construction conditions.

The metal reinforcement shall be protected by the thickness of concrete indicated in the plans. Where not otherwise shown, the thickness of concrete over the reinforcement shall be as follows:

1. Where concrete is deposited against the ground without the use of forms, not less than three inches.
2. Where concrete is exposed to the weather, or exposed to the ground but placed in forms, not less than two inches for bars more than 5/8 inches in diameter and 1½ inches for bars 5/8 inches or less in diameter.
3. In slabs and walls not exposed to the ground or to the weather, not less than 1½ inches.

4. In beams, girders and columns not exposed to the ground or to the weather, not less than ½ inches.
5. In all cases, the thickness of concrete over the reinforcement bars shall be at least equal to the diameter of the bars.
6. Exposed reinforcement bars intended for bonding with future extensions shall be protected from corrosion by concrete or other adequate covering

All reinforcement shall be free from rust, scale or other coatings that will destroy or reduce the bond of the concrete to the steel. Where there may be a delay in depositing concrete, the reinforcement shall be reinspected and when necessary, cleaned to the satisfaction of Darren Krehbiel Consultants, LLC.

Anchor bolts for all equipment shall be provided and placed in the concrete in accordance with the manufacturer's directions. Unless otherwise noted, dowels or continuous reinforcement, shall be provided at all construction joints. The dowels shall be of the same size as the largest reinforcing bar and shall provide a minimum lap of 24 dowel diameters. Corner bars shall be used at the outside of all corners. Corner bars shall be lapped a minimum of 24 diameters.

7.0 WATERSTOPS

7.1 Description

The work in this section shall consist of furnishing all materials, equipment, labor and tools necessary for the installation of waterstops to conform to the plans and these specifications.

All waterstops shall be produced by an extrusion process in such a manner that any cross-section shall be dense, homogeneous and free from porosity and other imperfections. They shall be symmetrical in cross-sectional shape and uniform along their length.

The Contractor must certify in writing that all waterstops are extruded from elastomeric polyvinylchloride compound and that this compound shall be virgin PVC compound and not contain any scrap or reprocessed material whatsoever.

The Contractor must also certify in writing that all waterstops meet or exceed the physical properties requirements set forth in U.S. Corps of Engineers CRD-C572-74 specification and furnish a copy of certified independent laboratory test data showing compliance.

Waterstop shall be positioned correctly according to manufacturer's recommendations during installation and all splices shall have a minimum lap of 12 inches. All splices in length or at intersection shall be performed by heat sealing and in accordance with manufacturer's recommendations.

Waterstops shall be placed as shown on the plans.

8.0 CONNECTION TO EXISTING SYSTEM - SEWERLINE

8.1 Description

This work shall consist of furnishing all materials, equipment, labor, and tools necessary for the reconnection to the existing system. This connection shall be placed where shown on the plans or as ordered by Darren Krehbiel Consultants, LLC, and shall include all piping and appurtenances necessary to provide a complete working installation as shown on the plans.

8.2 Materials

Materials shall be as specified in Section 9.0, Sanitary Lines and Appurtenances.

A. Pipe Fittings and Joints

1. Inspection and Rejection of Pipe - The quality of all materials, the process of manufacture, and the finished pipe shall be subject to inspection and approval by Darren Krehbiel Consultants, LLC. Such inspection may be made on the work after delivery, and the pipe shall be subject to rejection at any time on account of failure to meet any of the specification requirements even though sample pipes may have been accepted.

Any pipe, which has been damaged after delivery, will be rejected and if such pipe is already laid in the conduit line, it shall be removed and replaced, or made good solely at the Contractor's expense.

2. Manufacturer's Requirements - The pipe manufacturer shall furnish three copies of a certification that the pipe furnished is in full compliance with the commercial standards applicable to the pipe specified. The manufacturer shall furnish Darren Krehbiel Consultants, LLC, three copies of data showing the physical properties of the pipe furnished. Properties should include normal bursting pressure, manufacturer's maximum working pressure,

physical dimension, and tolerances. Pipe shall not be purchased until approved by Darren Krehbiel Consultants, LLC.

3. Fittings - All fittings, couplings and adapters shall be manufactured out of materials conforming to the same standards as the pipe and having a design strength equal to or better than the adjacent pipe.
4. Contractor's Guarantee - Contractor shall maintain the pipe lines for a period of one year from date of acceptance by Darren Krehbiel Consultants, LLC. Such remedial measures as required to correct leaks and similar troubles will be done by the Contractor at his own expense.

8.3 Construction Procedures

Construction Procedures shall be as specified in Section 3.0 SANITARY LINES AND APPURTENANCES.

Every pipe shall be cleared of all debris, dirt, etc., before being laid. Care shall be taken to preserve a good alignment and to give the pipe a firm bearing throughout its entire length. Pipe shall be laid in a satisfactory manner, true to line and depth. Pipes shall not be laid in water.

The methods of laying pipe shall be in accordance with the recommendations of the manufacturer and as approved by Darren Krehbiel Consultants, LLC. Each pipe shall be aligned with that already in place, forced home completely with as nearly an axial movement as possible, and held securely in position.

Joints shall not be pulled or cramped more than the manufacturer's recommendation to secure changes in alignment. Special care shall be taken to avoid damage to the rubber-sealing gasket and each joint shall be inspected and checked with an approved device to ensure that the rubber gasket is in place.

Demolition and abandonment of existing manholes shall be as shown on the plans and shall be at the direction of City personnel. Manholes to be taken out

of service shall have the cone, lid, and frame removed to full depth at the existing joint. Salvaged material shall, at the discretion of City personnel, remain the property of the City and be delivered to the City maintenance facility, intact to the greatest extent possible, by the Contractor. The remaining portion of the manhole shall be crushed and filled with approved backfill. All crushed pieces to be one cubic foot or less.

All abandoned pipes, all abandoned manhole entrances to remain, and all other hole no longer in service shall be grouted watertight and capped. The area above the remaining manhole shall be filled with approved backfill material and compacted to a minimum of 95% standard compaction with the approved material placed in no more than six (6) inch layers. These layers shall be thoroughly tamped to provide uniform and continuous bearing.

Upon completing the backfill, the area of excavation shall be maintained in a safe condition for a period of twelve (12) months in such manner that no standing water will occur over the excavation. All excess excavation materials shall be moved from the area and disposed of at the direction of the Owner. If extra, approved material is needed, it shall be provided by the Contractor at no additional cost to the Owner. Excavation spoils shall be used at the sole direction of the City.

9.0 GRADING, SEEDING AND MULCHING

9.1 Description

This work shall consist of preparing, liming, and fertilizing a seedbed, and the furnishing and the sowing of seeds. All disturbed areas, except surfaced areas, shall be seeded.

All seeded areas will be mulched.

9.2 Materials

- A. Seed - Grass seed shall be a blend of varieties composed of 60% (by weight) tall fescue cultivars, 30% (by weight) perennial ryegrass cultivars and 10% (by weight) "Ensylva" creeping red fescue.

Tall fescue component shall consist of equal portions of any three of the following cultivars:

- 1) Arid
- 2) Olympic
- 3) Jaguar
- 4) Falcon
- 5) Apache
- 6)

Perennial reserves component shall consist of equal portions of any three of the following cultivars:

- 1) Citation II
- 2) Manhattan II
- 3) Blazer
- 4) Pennfine
- 5) Yorktown

B. Fertilizer - A general lawn fertilizer, Grade 13-13-13, Nitrogen-13%, Phosphoric Acid-13%; Pot Ash-13% shall be used.

C. Mulch - Vegetative mulch, such as the cereal straw from stalks of oats, rye, wheat, or barley, shall be used. It shall be relatively free of noxious and undesirable seed or foreign material.

9.3 Construction Procedures

The seedbed shall be prepared, limed and fertilized and shall be in a firm but uncompacted condition with a relatively fine texture at the time of seeding. Fertilizer shall be applied at the rate of 500 lbs. per acre.

Seeding shall be done before the proposed seedbed becomes eroded, crusted over or dried out and shall not be done when the ground is in a frozen condition

or covered with snow. Seeds shall be uniformly applied at the rate of not less than 4.5 pounds per 100 square yards of area.

Dry seeding shall be done mechanically with equipment designed for even distribution of dry seed. The equipment may either be hand operated, such as a knapsack seeder, or be tractor drawn, such as a seed drill. Seed scattered on the surface shall be covered with approximately 1/4 inch of soil by raking or other approved methods. Seed placed in soil shall be 1/4 inch below the surface. After completing the seeding operation, the Contractor shall firm the area by rolling, if in the judgment Darren Krehbiel Consultants, LLC, the seedbed is either too loose or contains clods which would reduce the germination of the seed. When rolling is required, a lawn type roller shall be used and care shall be taken to avoid over-compacting the soil.

Seed shall be sown during the appropriate spring or fall planting season. Seeded areas shall be mulched at a rate of 2.5 tons per acre. All mulching shall be done within 24 hours following the seeding operation. Foot or vehicular traffic shall be prohibited over the mulched area. Should any mulch become displaced, the Contractor shall immediately inspect the seeding for damage, repair any damage, and replace the mulch at once at no additional cost to the Owner.

10.0 TESTING OF GRAVITY LINES AND MANHOLES

10.1 Description

The following tests shall be made on all newly laid sewer lines before being placed in service. The time of determining of the leakage of each line will be selected by Darren Krehbiel Consultants, LLC. The Contractor shall furnish all water, equipment, labor, assistance, etc. necessary for the performance of the test.

- A. Infiltration - The allowable infiltration for any portion of sewer system should be measured by a weir or current meter placed in the appropriate manhole and should not exceed 50 gallons per inch of internal pipe diameter per mile per day, including manholes.

- B. Air Testing - The minimum time duration permitted for a prescribed low pressure exfiltration pressure drop between two consecutive manholes should not be less than that shown in Table 10-1. The prescribed drop should not exceed 0.5 psi from 3.5 to 3.0 psi in excess of the ground water pressure above the top of the sewer.

Table 10-1

MINIUM DURATION FOR AIR TEST PRESSURE DROP

<u>Pipe Size Inches</u>	<u>Time Minutes</u>
4	2
6	4
8	5

- C. Deflection Testing - Unless specified otherwise, maximum allowable pipe deflection (reduction in vertical inside diameter) should be <5%. It is required that random deflection tests of pipe be performed before final acceptance at construction locations between successive manholes where the construction encountered unstable trench walls or bottoms, heavy rainfall, frozen soil, high ground water levels, deep lines, or difficulty in attaining compaction. Locations with excessive deflection should be excavated, and repaired by re-bedding or replacement of the pipe.

Optional devices for testing include a deflectometer, calibrated television or photography, or a properly sized "go, no-go" mandrel or sewer ball. For the purpose of deflection measurements the base inside pipe diameters without deflection are determined by Darren Krehbiel Consultants, LLC. The maximum allowable deflection should be applied to these bases inside diameters in determining the minimum permissible diameter. It must be emphasized that to insure accurate testing, the lines must be thoroughly cleaned.

- D. Lamp Testing - All newly laid sewer lines shall be lamped before being placed in service. If the lines do not lamp to reasonably near a full circle, or if low spots are disclosed, the Contractor shall locate the cause and make such repairs or replacements as may be necessary to correct the defects.

- E. Manhole Testing – The Contractor shall perform a vacuum exfiltration test on each manhole. Vacuum testing equipment shall be as manufactured by Cherne Industries, P.A. Glazier, Inc. or approved equal.

Preliminary vacuum testing shall be conducted following manhole construction, including connection to piping, and prior to backfilling. No grout shall be placed in horizontal joints until manhole has passed both vacuum tests. All lifting holes shall be grouted. Manholes which fail the test shall be reconstructed as required to adequately seal the manhole. Grouting of leak from the interior or exterior will not be acceptable. Final vacuum testing shall be performed following backfilling and setting at the lid and frame.

Plug all pipe entering manhole. Securely brace all plugs as required. Install testing lead in manhole frame and inflate seal in accordance with manufacturer's recommendation. A vacuum of 10 inches of mercury shall be drawn and the vacuum pump shut off. With all valves closed, measure the time required for the vacuum to drop to 9 inches of mercury. The manhole shall pass if the time is greater than 120 seconds for a 48-inch diameter manhole and 150 seconds for a 60-inch diameter manhole.

If the manhole fails the initial test, perform necessary repairs and retest until an acceptable test meeting the above requirement is achieved.

- F. Manhole Water Testing – Water testing of manholes, in lieu of the exfiltration test, is prohibited except where otherwise approved by Darren Krehbiel Consultants, LLC. Where water testing is approved, exfiltration tests shall be conducted by blocking off all manhole openings, filling the manhole to the top with water, and measuring the water required to maintain a constant level in the manholes.

Maintain test as necessary to determine leakage but not less than 2 hours. Repeat as necessary after repairs until leakage does not exceed 50 gallons per inch of pipe diameter per day per mile of pipe (0.0375 gallon per inch of pipe diameter per hour per 100 feet of pipe).

For the purposes of determining the maximum allowable leakage, manholes shall be considered as sections of pipe of the diameter and height of the manhole.

11.0 CLEAN UP

11.1 General

- A. Maintain premises and public properties free from accumulations of waste, debris, and rubbish, caused by operations.
- B. At completion of work, remove waste materials, rubbish, tools, equipment, machinery and surplus materials, and clean site; leave project clean and ready for operation.

11.2 During Construction

- A. Execute cleaning to ensure that the construction area and public properties are maintained free from accumulations of waste materials and rubbish.
- B. Wet down dry materials and rubbish to lay dust and prevent blowing dust.
- C. At reasonable intervals during progress of work, clean site and public properties, and dispose of waste materials, debris and rubbish.
- D. Provide on-site dump containers for collection of waste materials, debris and rubbish.
- E. Remove waste materials, debris and rubbish from site and legally dispose of at public or private dumping areas off Owner's property.
- F. Handle materials in a controlled manner with as few handlings as possible; do not drop or throw materials from heights.
- G. Clean all dirt from paved surfaces, not allowing same to pack on the roadway or to create a traffic nuisance. Insofar as practicable, clean all dirt

from gravel and oil aggregate surfaces.

11.3 Final Cleaning

- A. Employ experienced workmen, or professional cleaners, for final cleaning.
- B. In preparation for substantial completion or operation, conduct final inspection of entire project site.
- C. Maintain cleaning until project, or portion thereof, is occupied by Owner.