

**CITY OF BASTROP**

**CONSTRUCTION STANDARDS MANUAL**

**FINAL APPROVED VERSION**



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## **CHAPTER 1 - GENERAL PROVISIONS, REFERENCES, ABBREVIATIONS AND DEFINITIONS**

### **I. SCOPE AND EFFECTIVE DATES**

The criteria, requirements, limitations and specifications included in these Standards shall govern, from the effective date hereinafter set out, all development or improvement of subdivided areas and other water, wastewater, paving and drainage within the City of Bastrop, Bastrop County, Texas and, to the extent legally permitted, in the extraterritorial jurisdiction of the City of Bastrop.

These Standards shall apply to any water, wastewater, paving or drainage improvements within the City of Bastrop which have not been approved by the City prior to the revised date of these Standards, June 28, 2011.

### **II. References, Abbreviations, and Definitions**

Abbreviations, initials, and definitions customarily used in reference to real estate, subdivisions development, engineering and construction standards and specifications, and in some cases used in other Standards, may be used in applications, filings, specifications and other documents and correspondence pertaining to subdivisions within the City of Bastrop, Bastrop County, Texas and, to the extent applicable, to the subdivisions within the extraterritorial jurisdiction of the City, provided, however, no such variance with those set out in this Chapter.

#### **A. Reference to Parties**

As to references to individuals, officials, or entities, who or which may be involved in owning, preparing, developing, sponsoring or otherwise involved in a subdivision, the following definitions apply:

1. City - City of Bastrop, Bastrop County, Texas
2. City's Representative - An individual holding the authority, either by virtue of official position or by virtue of written authorization to give or withhold approval on behalf of the City.
3. Contractor - The person or firm engaged by the owner or Developer of a subdivision to construct water lines, sewer lines, streets, culverts, curbs, sidewalks, and similar facilities in a subdivision.
4. Design Engineer - The engineer or engineering firm who or which, on behalf of the owner or the Developer, prepares the plans and engineering specifications for a subdivision or a subdivision proposal.
5. Developer - The individual or firm, being the owner, or operating on behalf of the owner, of land being subdivided or being proposed for subdivision.
6. Engineer - The engineer or engineering firm designated and authorized by the City to review, inspect, and to approve or withhold approval of aspects of a subdivision or a proposal for a subdivision.

#### **B. References to Organizations**

Initials used to designate agencies of government, technical or trade associations, and similar entities are as follows:

1. AASHTO - American Association of State Highway and Transportation Officials

## GENERAL PROVISIONS, REFERENCES, ABBREVIATIONS AND DEFINITIONS

2. ASTM - American Society for Testing Materials
3. AWWA - American Water Works Association
4. NSF - National Sanitation Foundation
5. TxDOT - Texas Department of Transportation
6. TCEQ – Texas Commission on Environmental Quality

### C. Abbreviations as to Specifications

Abbreviations to represent particular designs, qualities, quantities, or materials or components in specification requirements, limits, or standards are acceptable and used as follows:

1. CI - cast iron
2. DI - ductile iron
3. DR - Dimension Ratio
4. CMP - corrugated metal pipe
5. ppm - parts per million
6. PC - point of curve
7. psi - pounds per square inch
8. PS - pipe stiffness
9. PT - point of tangency
10. PVC - polyvinyl chloride
11. RCP - reinforced concrete pipe
12. SDR - standard dimension ratio

### D. Definitions

Words with very specific meanings in reference to subdivisions, plans, specifications, etc., are:

1. Bid Schedules - Refers to a listing and description of kinds work required for project construction, with unit prices for the various tasks performed.
2. Detail Sheet(s) - Engineering drawings included with these Standards which show typical construction details for water lines, sewer lines, streets and drainage.
3. Manning's Formula -  $V = \frac{1,486}{n} R^{2/3} S^{1/2}$

where

V = velocity in feet per second

n = roughness coefficient

R = hydraulic radius

S = slope of hydraulic grade line

4. Plans - Refers to the Public Improvement Construction Plans submitted by the Developer or the Design Engineer in support of a subdivision request and/or as approved by the City.
5. Specifications - Refers to (i) the specifications submitted by the Developer or the Design Engineer in support of a subdivision request or as approved by the City, or (ii) the specifications which are included in these Standards.

### III. TRENCH SAFETY SYSTEM

This section covers the design and use of devices required to be placed in open trenches over five feet deep to protect the safety of workers. For the purposes of this section, a trench shall include any excavation of material that a worker or inspector is required to be inside. An excavated hole for a manhole is classified as a trench for the purpose of this section. The Contractor shall include in his bid the trench safety method specified below and called for in the bid schedule. The Contractor is also responsible for meeting all trench safety requirements of the U. S. Department of Labor Occupational Safety and Health Administration (OSHA) regulations as contained in Subpart P Part 1926 of the Code of Federal Regulations (CFR).

#### 1. Trench Safety System

System for insuring safe working conditions in trenches shall be one of the follow types, dependent on depth; sloping the sides of the excavation, trench box or an alternate system submitted by the Contractor. Trench depth is the depth from natural ground to the bottom of the excavation, i.e. below the initial embedment material. Alternates proposed by the Contractor to the system described below shall be designed and certified by a Texas Registered Professional Engineer.

For all trench depths over 5 feet but not more than 10 feet deep, either a trench box for the entire height of the trench may be used or a vertical walled sub-trench no more than four feet high may be excavated and the trench above four feet shall be sloped, a slope which meets the OSHA regulations, dependent on soil type.

For all trench depths over 10 feet deep, a trench box or other approved trench safety system shall be used. The trench box shall extend to the surface of natural ground, or a minimum of 8 feet above the bottom of the trench, provided that the trench above the trench box is benched as described above.

#### 2. Trench Box

The trench box shall be placed and moved so that the pipe joints and bedding are not disturbed. The trench box may be placed up to two feet above the initial embedment material to avoid disturbing the bedding. Any voids left in the embedment material by trench box movement removal shall be carefully filled with granular material which is adequately compacted. Removal of the trench box shall only be done when backfilling proceeds and removal shall be done in a manner that does not relax trench support.

Prior to installation of pipe in any trench that is 5'-0" deep for which a trench box is required, the Contractor shall submit to the Engineer information demonstrating the adequacy of the trench box proposed to be used.

The Contractor shall allow ten days for the acceptance of this submittal by the Engineer.

The submittal shall include a general description of the trench box or boxes with dimensions and capacities and in what manner that they will be used. The information shall include the rating of the trench box in pounds per square foot of lateral earth pressure which the box can resist and the depth at which the box can be used. The rating information shall have been prepared by a Registered Professional Engineer licensed in the State of Texas.

## CHAPTER 2 - WATER DISTRIBUTION SYSTEM STANDARDS

### I. GENERAL DESIGN REQUIREMENTS

#### A. Incorporations by Reference

All water line connections shall be in general compliance with the following ordinance, rules, regulations and standards.

- Rules and Regulations for Public Water System, TCEQ, latest edition.
- Key Rate Grading Standards of the Texas Commission on Fire Protection, latest edition.
- Subdivision Ordinance of the City of Bastrop, or the latest revision thereto.

#### B. Design Requirements

The design of water lines within the City of Bastrop shall also comply with the following general requirements:

1. Minimum Pressure. Water lines serving residential areas shall be sized to provide a minimum dynamic pressure of 40 pounds per square inch at an instantaneous demand of 3.5 gallons per minute per connection.
2. Minimum Diameter. Except for service lines, all mains shall have a diameter of not less than 6 inches. Dead-end lines shall not exceed 1800 feet in length.
3. Gate Valves. Gate valves shall be provided on all water mains so that repairs can be made without inactivating more than 500 feet of water mains in commercial and industrial areas or more than 800 feet in residential areas.
4. Water Mains. All water mains must extend to the most distant boundary of the proposed subdivision. A valve, plug, and concrete block shall be provided on the end of each said main such that an extension of the main can be made without removing the main from service.
5. Service Lines. All service lines shall be extended to the lot lines.
6. Fire Hydrants.  
Fire hydrant spacing shall not exceed 300 feet in non-residential areas and shall not exceed 500 feet in residential areas.  
Fire hydrant distance from structures shall be in accordance with the current International Fire Code.
7. Meters. The City of Bastrop will tap, furnish and install the meter.

### II. MATERIALS FOR WATER DISTRIBUTION SYSTEMS

#### A. General.

All pipe used in distribution systems shall be rated for a minimum of 150 psi, shall display the appropriate AWWA specification stamp, and shall display the National Sanitation Foundation (NSF) stamp. All pipe 4" and larger shall be either PVC C-900, or ductile iron (DI), as detailed below. All pipe fittings shall be either cast iron or ductile iron.

#### B. Polyvinyl Chloride Pipe (PVC)

All 4" and larger PVC pipe shall conform to AWWA Specification C 900, DR 18, Class 150 or DR 14, Class 200. Where smaller service lines are permitted, PVC SDR 21 pipe shall be used. Cast iron or ductile iron fittings shall be used with PVC pipe 6 inch diameter and larger as specified below.

### **C. Cast Iron Pipe and Fittings**

1. Cast Iron Pipe. Cast iron pipe and fittings shall conform to the current AWWA specification C 108. Cast iron pipe shall be lined with cement mortar and coated with a bituminous coating.
2. Iron Fittings. All fittings for ductile iron and PVC pipe shall conform to the current AWWA specification C 110 or C 153. Mechanical joints shall be used for all underground fittings and shall be lined with cement mortar and outside coated as per the AWWA specification.

### **D. Ductile Iron Pipe**

Ductile iron pipe shall meet the requirements of the latest revision of AWWA Specification C 151 and shall be Pressure Class 350.

### **E. Fire Hydrants**

1. General. Fire hydrants shall conform to AWWA Specification C 502 and shall have one 4-1/2 inch pumper connection and two 2-1/2 inch hose connections. Threads of hose connections shall be National Standard Threads.
2. Operating Nut. The operating nut shall be designed to prevent the seepage of rain or sleet into the top of the bonnet.
3. Bonnet. The bonnet or hydrant top shall be free-draining, easily replaceable without shutting off the hydrant from the water main, and shall contain means of automatically lubricating all operating threads.
4. Breakaway Design. The hydrant shall be of such design that the entire top barrel may be broken away as by traffic collision without causing leakage, and the broken hydrant shall be repairable without any excavation. The breakaway flange shall be at least 3 inches or no more than 8 inches above finished grade.
5. Main Valve. The main valve shall be compression closed with a 5-1/4 inch valve seat and the pipe connection shall be a 6 inch mechanical joint.
6. Type. Hydrants shall be Mueller Centurion or equal.

### **F. Gate Valves**

1. General. Gate valves shall be resilient seat or resilient wedge, type valves. Valves shall be iron body, bronze mounted and designed for a minimum of 150 psi working pressure conforming to AWWA Specifications C-509.
2. Underground Installations. For underground installations non-rising stem valves with square operating nuts shall be used.
3. Direction of Opening. Direction of opening shall be counter clockwise.
4. Type. Valves shall be Mueller or equal.

### **G. Gate Valve Boxes**

Valve boxes shall be the two piece sliding type, adjustable by sliding the upper section over the lower section. Flanges on both sections shall serve to locate the upper section and hold it in place. Boxes shall be cast iron and shall have a cover designed for easy removal for access to the valve operating nut, and shall be marked "water" for ready identification.

### **H. Service Connections**

Water service shall be provided to each separate tract or lot. Residential and commercial service connections shall include the following items for the service categories as listed below. 1. Double Service (long side).

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1-1/2" saddle, Smith-Blair #313 or equal  
1-1/2" corporation stop, Mueller or equal  
1-1/2" Polyethylene Class 200 tubing  
U-Branch, Mueller H 15362, 1"x3/4", 7-1/2"  
centers with 1-1/2"x1" reducer coupling  
3/4" angle stop, female fitting both  
sides, iron pipe thread  
Straight Coupling, 1-1/2" male  
IPT x 1-1/2" PE tubing

2. Double Service (near side). All items to be the same as set out in paragraph 1. Length of 1-1/2" polyethylene tubing will be as needed.
3. Single Service (long side). All items shall be identical to that set out in paragraph 1, except that the U-branch is not required and the dimensions of the tubing and fittings may be 1 inch instead of 1-1/2 inch.
4. Single Service (near side). All items shall be the same as that required for the long side except length of the polyethylene tubing will be as needed.
5. The Specifications which are common to all service connections numbered 1 through 4 above are:
  - a. Service Line. All service lines from the water main to the meter installation shall be polyethylene flexible tubing. Tubing shall be designed for not less than 200 pounds per square inch.
  - b. Meter Valve. Meter valves shall be single swivel type with flared joint fitting on one end (single service) or female iron pipe thread (double service) and meter coupling nut on other end to connect to meter. Meter valves shall have wings for locking valve in the closed position. Locking holes shall be not less than 7/16 inch diameter.
  - c. Meter Box. Meter boxes shall be plastic (if non-traffic area) with reading lid by a manufacturer approved by the City. In traffic areas a fiber composite box with lid with an AASHTO H-20 32 kip traffic loading.
  - d. Corporation Stop. Brass stops for connecting tubing to service clamps shall be 1" (single service) or 1½ inch (double service) with male iron pipe thread inlet and flare joint outlet.

### III. WATER DISTRIBUTION SYSTEM

#### A. Trench Excavation

The minimum trench width shall be 12 inches wider than the outside diameter of the pipe and not more than 24 inches wider than the outside diameter of the pipe.

Trench safety system shall be in accordance with Chapter 1 Section III.

#### B. Trench Bottom

The soil surface at the trench bottom shall be free of any protrusions which may cause point loading on any portion of the pipe or bell, and shall provide a firm, stable and uniform support for the pipe.

Where an unstable trench bottom condition is encountered, it must be stabilized prior to placing embedment material. Stabilizing shall be provided using the embedment material except that

## WATER DISTRIBUTION SYSTEM STANDARDS

up to 1 ½-inch size rock will be allowed.

During the course of construction, should the Contractor inadvertently over-excavate the trench more than 6 inches below the bottom of the pipe, but less than 12 inches below the bottom of the pipe, he shall fill that area of over-excavation with embedment material and compact to a density approximately equal to the native soil. The Contractor shall fill any area of over-excavation more than 12 inches below the bottom of the pipe with processed stone or processed gravel.

Ledge rock, hard pan, cobbles, boulders, or stones larger than 1½ inches shall be removed from the trench bottom to permit a minimum bedding thickness of 4 to 6 inches under pipe.

### C. Bedding

1. Granular Material. Granular material is defined as a free flowing field sand or pit run sand free from lumps, large stone, clay and organic material. When wet the material shall not form mud or muck. When the pipe has a minimum of 12 inches of cover, the specified testing may be performed.
2. Bedding Requirements as to Types of Pipe.
  - a. PVC Pipe. PVC pipe may not be installed without granular embedment. Embedment shall be as shown on the detail sheet and shall be not less than 12 inches over the pipe.
  - b. Cast Iron and Ductile Iron Pipe. Cast iron and ductile iron pipe shall be installed on a granular bed. If the bottom of the trench is cut true and even, so that the barrel of the pipe will bear uniformly along its full length and bell holes are excavated such that bells will not rest on the bottom of the trench, the requirement for granular beddings may be deleted by the Engineer. Specified bedding material may not be required if material acceptable to the City is removed in the trenching operation.

### D. Installation

Pipe shall be installed in accordance with the manufacturer's recommended procedure for each type of pipe, using trench construction and with bedding as set forth above in these Standards.

After inspection of pipe installation has been finished and approval given on any completed portion of the work, the trench may be backfilled in accordance with these Standards.

When specified by the Engineer or Design Engineer, cast iron and ductile iron pipe shall be polyethylene wrapped with a wrap of at least 8 mils thickness. The polyethylene wrap shall be at least 2 feet longer than the pipe joint to provide overlap at each juncture. Plastic tape used to join pieces of the wrap shall be 1-1/2 inches wide and 10 mils thick. The Developer, at his expense, may elect to have soil resistivity tests performed by an approved independent laboratory. If such tests determine that the soil resistivity is greater than 1500 ohms per c.c., polyethylene wrap may be deleted.

### E. Backfill

1. Backfill Material. Only that backfill material previously approved by the City shall be used. This backfill material may be excavated material if no stones larger than 6 inches in their largest dimension are included, and if the backfill material contains less than 25% stones. Broken concrete, rocks, bituminous pavement or other lumpy material shall not be used in backfill except when lumps are small and are dispersed in the upper section of the backfill in a manner satisfactory to the Engineer. Spongy materials or materials subject to decay shall not be used in the backfill. The top 6 inches of backfill shall be the same as the topsoil removed.

## WATER DISTRIBUTION SYSTEM STANDARDS

Where the pipe crosses travelways including drive entrances, the method of backfilling pipe trenches shall be as follows: The sand shall first be carefully placed on both sides of the pipe simultaneously in layers of not more than 8 inches in loose thickness, and firmly compacted by hand. Such layers shall be sprinkled lightly with water if additional moisture is required for proper compaction. This process of filling and tamping in layers shall be continued until the backfill is brought up to the level of the top of the pipe. A sufficient amount of selected material shall then be carefully placed over the top of the pipe so that, when consolidated in 6 inch lifts, the level of the select material will not be less than 12 inches above the top of the pipe. Before backfilling the remainder of the trench, the select material shall be consolidated to such an extent as to obtain 95 percent density. The remainder of the trench shall then be filled with road base material. Mechanical tamping in 8 inch maximum lifts shall be used to obtain not less than 95 percent density.

2. Backfill Methods and Testing During Backfill. When the pipe has a minimum of 12 inches of cover, the specified testing may be performed. After the pipeline section passes testing, the balance of the backfill may be added as shown on the drawings or as otherwise specified or approved by the Engineer. At ground level, the backfill shall be mounted slightly above the original ground level to allow for any subsequent settlement. Large loose stones removed by the ditching operation shall not be left on the surface along the ditch line right-of-way, but shall be removed from the project site. The top surface or slopes of all backfill shall be neatly graded off in a workman like manner.

### **F. Pressure Taps on Main Lines**

Taps made on main lines for branch lines shall be made under pressure where required by the Director of Water and Wastewater to limit the disruption of water service. The taps shall be made by a qualified contractor, experienced in this type of work who is approved by the City.

Prior to making the tap, a submittal shall be made to the City identifying the name of the company making the tap and a clear description of the materials to be used which shall be in accordance with the following.

The tapping sleeve shall be a cast iron, mechanical joint split sleeve with longitudinal sleeve gaskets and split gaskets for the pipe. A compatible epoxy coated resilient wedge seated tapping valve conforming to AWWA C509 shall be used. Test plugs shall be provided for air pressure testing. Bolts shall be high tensile strength tee head bolts.

A fabricated steel tapping sleeve shall only be allowed at the discretion of the Director of Water and Wastewater if the branch line is 4-inches or smaller. Fabricated steel sleeves shall be epoxy coated and shall have stainless bolts.

The tapping sleeve shall be air pressure tested by the contractor who shall give the City 24 hours notice of the test prior to making the tap. The City shall observe the air test and approve the test prior to the Contractor making the tap.

## **IV. DISTRIBUTION SYSTEM TESTING AND DISINFECTING**

### **A. Pressure Testing**

After the pipeline section has been laid and valved off, and at least 12 inches of backfill has been placed over the top of the pipe, the pipe shall be slowly filled with water in a manner that will expel all air from the pipeline. With the line full, the test pressure shall be applied by means of a pump connected to the pipe in a manner satisfactory to the Engineer. The pump, pipe connection, and necessary apparatus shall be furnished by the Contractor. The duration of the hydrostatic test shall be a minimum of four (4) hours. The pipeline shall be tested so that the

## WATER DISTRIBUTION SYSTEM STANDARDS

pressure at the lowest point in the test section is at least 100%, but not greater than 120% of the pipe pressure class of the pipe, and minimum pressure at the highest point in the test section is not less than 85% of the pipe pressure class of the pipe. One gauge shall be located at the pump and the other shall be located at a remote or high point on the line.

During the test, the pipeline, fittings, valve, and hydrants shall be examined for leakage. The maximum allowable leakage for push-on joints is the number of gallons per hour as determined by the following formula:

$$L = \frac{ND(P)^{\frac{1}{2}}}{7400}$$

where: L = Allowable leakage in gallons per hour

N = Number of joints in the length of pipe tested

D = Nominal diameter of the pipe in inches

P = Average of the max. and min. pressures within the test section in psi.

If there are visible leaks or the leakage in any section exceeds these specified rates, the Contractor shall locate and repair or replace the defective joints or pipe lengths at his own expense. The testing and repairing shall continue until the leakage is less than the maximum allowable.

### B. Disinfection

After each pipeline section has been satisfactorily tested, it shall be disinfected using the procedures set forth in AWWA Standard C651.

1. Flushing. The pipeline section shall be flushed prior to disinfection. Flushing shall be done through a 2 ½ inch fire hydrant opening if there is a hydrant on the end of the section, or through a tap on the end of the line which provides a 2-inch orifice. The line shall be flushed for a period of time equal to one minute for each 100 feet of line, or until the water being discharged is no longer transporting visible particles, whichever is longer. The flushing velocity in the main shall not be less than 2.5 feet per second as tabulated below.

**Table 1: Required Flow and Openings to Flush Pipelines  
(40 psi Residual Pressure in Water Main)**

Pipe Diameter (inches)	Flow Required (gpm)	Number of 2-inch Taps on Pipe	Number of 2 ½- inch Hydrant Outlets
4	100	--	1
6	200	--	1
8	400	1	1
10	600	2	1
12	900	2	2
16	1600	4	2

### C. Chlorination

1. Continuous Feed. The Contractor shall use either the continuous feed or tablet method of chlorination. The chlorine may be added to the water in the new lines by a chlorine gas-water mixture or a chlorine compound-water mixture may be injected as setforth in Section 512 of AWWA Standard C651.

The chlorinating agent selected shall be applied through a tap on the pressure side of the gate valve controlling the flow of water into the new line. The flow of water into the new

## WATER DISTRIBUTION SYSTEM STANDARDS

line shall be limited to approximately 1 foot per second. The chlorinating agent shall be added at a rate such that the application shall be at least 50 ppm.

The application shall be made until the water being discharged at the other end of the new section shows that the chlorine has reached the length of the new section, then the valves shall be closed and the new section isolated for at least 24 hours. All valves and hydrants shall be operated during the chlorination process.

At the end of the detention period of 24 hours, the water shall indicate at least 25 ppm residual. If this residual is not obtained, a second dosage of 25 ppm shall be applied as before and retained for at least 12 hours, with at least a 10 ppm residual at the end of the 12 hour period.

2. **Tablet Method.** The tablet method consists of placing calcium hypochlorite granules in the water main as it is being installed and filling the main with potable water when installation is completed.

This method may be used only if the pipes and appurtenances are kept clean and dry during construction. The procedure to follow shall be as set forth in Section 5.1 of AWWA Standard C651.

Calcium hypochlorite granules shall be placed at the upstream end of the first section of pipe, at the upstream end of each branch main, and at 500 foot intervals. The quantity of granules shall be as shown below:

Ounces of Calcium Hypochlorite Granules to be Placed at Beginning of Main and at Each 500 Foot Interval

**Table 2: Calcium Hypochlorite Granule Requirements per Pipe Diameter**

<b>Pipe diameter</b>	<b>Calcium Hypochlorite Granules</b>
2 inches	0.13 ounces
4 inches	0.5 ounces
6 inches	1.0 ounces
8 inches	2.0 ounces
12 inches	4.0 ounces

When installation has been completed, the main shall be filled with water at a rate such that water within the main will flow at a velocity no greater than 1 foot per second. Precautions shall be taken to assure that air pockets are eliminated. This water shall remain in the pipe for at least 24 hours.

During all chlorination work, care shall be taken to prevent the highly chlorinated water from flowing back into the line supplying the water to the new line.

3. **Final Flushing and Testing.** Following the chlorination of each section, the section shall be thoroughly flushed until the water being discharged has the same chlorine residual as the water being used to feed the system. A sample of water taken at the extremity of the section shall be obtained and submitted to the Texas Commission on Environmental Quality (TCEQ) or a laboratory approved by the TCEQ for this purpose for bacteriological examination, and shall be of the same purity and quality as the water in the existing water lines. Samples shall be taken from taps located and installed in such a way as to prevent outside contamination. Results of the laboratory analysis shall be made available to the City and the analysis shall state that no coliform was found. If the sample shows coliform the line shall be retested at the expense of the contractor until satisfactory results are obtained.
4. **Water for Flushing and Testing.** The Contractor shall make the necessary arrangements for all water required in the construction of the lines. In the event of line failure prior to

## WATER DISTRIBUTION SYSTEM STANDARDS

the acceptance by the City, the Contractor shall reimburse to the City the cost of all water loss. The City will provide a reasonable allowance for flushing and testing equivalent to three (3) times the gallonage of water contained within the new construction. All water required over this amount by the Contractor for additional flushing and testing shall be paid by the Contractor to the City. Payment shall be in the amount determined by the City per each 1,000 gallons used.

## CHAPTER 3 - WASTEWATER COLLECTION SYSTEM STANDARDS

### I. GENERAL DESIGN REQUIREMENTS

All new subdivisions must have wastewater collections facilities constructed in general compliance with Design Criteria of the Texas Natural Resource Conservation Commission. The following design considerations must be observed:

- A. No sewer main shall be less than 6 inches in diameter and shall have a minimum velocity, flowing full or one-half full, of 2 feet per second based on Manning's formula and utilizing an "n" value of 0.013. Minimum grade for a 6 inch line shall be 0.5 percent.
- B. Sewer lines shall be designed with straight alignment where possible. Horizontal radius of bends, where required, shall not be less than 300 pipe diameters or in accordance with the pipe manufacturer requirements.
- C. All lines shall be designed for trench and dynamic loads.
- D. Unless otherwise approved, manholes shall be constructed (i) at all changes in grade if the downstream grade is less; (ii) at changes in pipe size and (iii) at intersections with other mains. In straightaway, manholes shall be spaced at maximum distances of 500 feet or in accordance with Texas Natural Resource Conservation Commission regulations.
- E. Pipe crown elevations of mains flowing into manholes shall be 0.1 feet above the crown of out-flowing mains.
- F. Where water and sewer lines are installed in the same area, a separation of 9 feet between the outside pipe diameters shall be maintained.
- G. Sewer service lines shall be extended to the street right-of-way lines as shown on the detail sheet.
- H. All sewer lines must extend to the most distant boundary of the proposed subdivision.

On-site systems, if allowed by the City, must conform to the City's on site sewer system ordinance.

### II. MATERIALS FOR WASTEWATER COLLECTION SYSTEM

#### A. Gravity Flow Lines

All gravity flow sewer lines shall be constructed of polyvinyl chloride (PVC) pipe which conforms to ASTM standards D 3034 with gasketed joints meeting ASTM standards D 3212. The pipe shall have a minimum pipe stiffness (PS) of 46 psi at 5 percent deflection when tested in accordance with ASTM Method of Test D 2412 unless otherwise called out on the plans. The PVC compound shall be 12454B, 12454C, or 12164B per ASTM D1784.

The lubricant used for assembly shall have no detrimental effect on the gasket or on the pipe. The pipe shall be homogenous throughout and free from visible cracks, holes, foreign inclusions or other injurious defects. All 6-inch pipe and larger shall be PVC SDR 35 Sewer Pipe, unless otherwise noted. Individual service lines shall be 4-inch Schedule 40 PVC, D.W. & V Pipe. Service lines serving two lots shall be 6-inch Schedule 40 PVC, D.W. & V Pipe.

#### B. Pressure Lines

Force mains shall be constructed of 4 inch or larger PVC pipe with PVC gasketed fittings. All plastic pipe and fittings shall be Type 1, Grade 1, with a hydrostatic design stress of 2000 psi for water at 73.4 degrees F, designated as PVC 1120. Pipe shall have a standard dimension ratio of 21 (SDR-21) and a pressure rating of 200 psi.

### **C. Aerial Crossing**

Where aerial crossing of creeks is required to maintain grade, cast iron or ductile iron pipe, Class 150 shall be used with not less than one concrete support per joint.

### **D. Concrete Manholes**

Manholes shall be constructed of 4 foot diameter precast reinforced concrete pipe section meeting the requirements of ASTM C-478 with rubber gasket joints meeting the requirements of ASTM Specification 4 and 3 unless otherwise approved by the City's Engineer. All concrete manholes over 8 feet deep shall have eccentric cones. Concrete rings shall be used to adjust manhole heights to match street grade or to a minimum of 3-inches in nonpaved areas. Cast iron frames and covers shall conform to ASTM Specification A 48, Class 30. Manhole rings and covers shall weigh a minimum of 240 lbs. Outside diameter of the lid shall be 32 inches. Lids are to be solid with no pick holes. Manhole covers shall be marked "sanitary sewer."

Where manholes are in the flood plain the covers shall be stainless steel bolts and gaskets. A minimum of two concrete grade rings shall be set on top of the fiberglass manhole to distribute the load. However, the grade rings shall be no more than 12 inches in height.

Manhole bases shall be precast for all new sewer lines. Precast bases shall meet the same specifications as barrel section and shall have flexible pipe to manhole connections consisting of chemical resistant rubber boot which seals to the interior of the manhole wall with a stainless steel band and to the pipe with a stainless steel clamp.

### **E. Cleanouts**

Cleanouts shall be provided at the end of each line if the line is unlikely to be extended. Where a line will likely be extended in the future, the line shall terminate with a standard manhole. A cast iron cleanout casting, minimum weight of 100 pounds, shall be installed on each cleanout as shown on the standard detail sheet.

## **III. WASTEWATER COLLECTION SYSTEM**

### **A. Trench Excavation**

The The minimum trench width shall be 12 inches wider than the outside diameter of the pipe and not more than 24 inches wider than the outside diameter of the pipe.

Trench safety system shall be in accordance with Chapter 1 Section III.

### **B. Trench Bottom**

The soil surface at the trench bottom shall be free of any protrusions which may cause point loading on any portion of the pipe or bell, and shall provide a firm, stable and uniform support for the pipe.

Where an unstable trench bottom condition is encountered, it must be stabilized prior to placing embedment material. Stabilizing shall be provided using the embedment material except that up to 1 ½-inch size rock will be allowed.

During the course of construction, should the Contractor inadvertently over-excavate the trench more than 6 inches below the bottom of the pipe, but less than 12 inches below the bottom of the pipe, he shall fill that area of over-excavation with embedment material and compact to a density approximately equal to the native soil. The Contractor shall fill any area of over-excavation more than 12 inches below the bottom of the pipe with processed stone or processed gravel.

Ledge rock, hard pan, cobbles, boulders, or stones larger than 1-1/2 inches shall be removed

from the trench bottom to permit a minimum bedding thickness of 4 to 6 inches under pipe.

### **C. Embedment Materials**

Embedment materials shall include the material used for bedding, haunching and initial backfill and shall meet the requirements of ASTM 2321, Class 1 material. Embedment material shall be angular 1/4 to 3/4 inch uniformly graded, hard, durable crushed stone. The embedment material shall have 95 percent passing a 3/4 inch sieve and 95 percent retained on a 1/4 inch sieve (No. 4 sieve). No material which is rounded or has smooth surfaces shall be suitable for embedment material. Sand shall not be used for bedding.

## **VI. METHODS OF PLACING EMBEDMENT MATERIALS**

The following compaction method is recommended as the optimum which will achieve desirable densities with the least effort. Manufactured materials which are angular, such as crushed stone or rock, may be placed by loose dumping with a minimum of compactive effort, except that care shall be taken to assure proper placement of material under pipe haunches.

If compaction equipment is required, care shall be taken to avoid contact between the pipe and compaction equipment. Do not use compaction equipment directly over the pipe until sufficient backfill has been placed to assure that such equipment will not damage or disturb the pipe.

### **A. Bedding**

Bedding is required primarily to bring the trench bottom up to grade. Bedding materials shall be placed to provide uniform and adequate longitudinal support under the pipe. (Blocking shall not be used to bring the pipe to grade.) Bell holes at each joint shall be provided to permit the joint to be assembled properly while maintaining uniform pipe support. A compacted depth of 4 to 6 inches shall be provided. Sand shall not be used for bedding.

### **B. Haunching**

The most important factor affecting pipe performance and deflection is the haunching material and its density. Place and consolidate the material under the pipe haunch to provide adequate side support to the pipe while avoiding both vertical and lateral displacement of the pipe from proper alignment. The same material as used for bedding shall also be used for haunching. The minimum haunching to be provided shall be two-thirds (2/3) of the pipe diameter. The haunching material shall provide complete support between the sides of the pipe and sides of the trench which will necessitate placement of haunching material around all pipes in the trench if there are multiple pipes in the same trench. Sand shall not be used for haunching.

### **C. Initial Backfill**

Initial backfill shall be completed to a point at least 12 inches over the top of the pipe. Use little or no tamping of the initial backfill directly over the top of the pipe to avoid disturbing the embedded pipe, since this area will contribute nothing to the pipe support. The initial backfill shall be the same material as for bedding and haunching.

## **VII. LAYING AND JOINING PIPE FITTINGS**

### **A. General Procedure**

Before being set in place, each component of piping shall be inspected for damage and cleaned. Damaged components shall be rejected or repaired. Pipe bells shall be laid on the upstream end. Sewer laying shall commence at the lowest elevation and shall terminate only at manholes. Trenches shall be dewatered, if necessary, and pipe shall not be laid under water. Whenever pipe laying is interrupted, the end of the pipe shall be temporarily plugged to prevent

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the entrance of water, mud or foreign matter, and the pipe shall be secured to prevent its being dislodged.

### **B. Location and Alignment**

Pipe and fittings shall be embedded in the trench with the invert conforming to the required elevations, slopes, and alignment, and with the pipe bottom uniformly and continuously supported by firm bedding. Where curved alignment is required, the allowable minimum curve radii for PVC sewer pipe shall be based on the formula:

$$R = 300 D;$$

where R = minimum allowable radius of curvature for bending,

D = pipe diameter,

Where R and D are in same dimensional units.

### **C. Joining Pipe and Fittings**

1. Cutting and Beveling Pipe. For shorter than standard pipe lengths, field cuts may be made with either hand or mechanical saws. Ends shall be cut square and perpendicular to the pipe axis. Spigots shall have burrs removed and ends smoothly beveled by hand with a rasp or file. Field spigots shall be stop-marked with felt tip marker or wax crayon for the proper length of assembly insertion. The angle and depth of field bevels and lengths to stop-marks shall be comparable to factory pipe spigots.
2. Bell Holes for Joints. The bell hole shall be no larger than necessary to accomplish proper joint assembly. When the joint has been made, the void under the bell should be filled with bedding or haunching material to provide adequate support to the pipe throughout its entire length.
3. Assembly of Joints. Assemble all joints in accordance with recommendations of the manufacturer. Proper jointing may be verified by rotation of the spigot by hand or with a strap wrench. If unusual joining resistance is encountered or if the insertion mark does not reach the flush position, disassemble the joint, inspect for damage, reclean the joint components and repeat the assembly steps.

### **D. Service Lines, Connections and Incidental Structures**

1. Branch Fittings. Fitting for service branch shall be a molded or tee wye with 4 inch branch.
2. Service Lines. Service lines from the property line to the collection sewer shall be at a minimum depth of 48 inches at the property line and shall be laid to straight alignment and uniform slope of not less than 1/4 inch per foot for 4 inch pipe and 1/8 inch per foot for 6 inch pipe. Where collection sewers are deeper than 7 feet, construction shall conform to the typical service connection detail shown on the Plans.
3. Pipe Caps and Plugs. All caps and plugs shall be set using PVC screw top.

## **VIII. FINAL BACKFILL RESTORATION AND CLEANUP**

### **A. Backfill Material**

The material used in the final backfilling operation need not be as carefully selected as was the bedding, haunching and initial backfill. In selection of final backfill material exclude all rock with any dimension more than 12 inches.

**B. Backfill Compaction**

Unless specified otherwise, the final backfill shall use special compaction under improved surfaces and shoulders of streets, roads, aprons, curbs and walks and natural compaction shall be used under open fields, lawns, unimproved rights-of-way, or grounds which are free of traffic. The special compaction shall provide not less than 95% of the maximum dry density of road base material placed in 8 inch lifts, as determined by THD Test Method TEX-113-E. Natural compaction is attained by the loose placing of material (usually pushed or bladed) into the trench, rolling the surface layer with the placement equipment, mounding the surface, and filling and maintaining all sunken trenches through the warranty period of the work. In natural compaction the main consolidation results from rainfall.

**C. Minimum Cover for Load Application**

Provide at least 30 inches of cover over the top of the pipe before the trench is wheel-loaded. Provide at least 48 inches of cover before using mobile trench compactors of the hydro-hammer or impactor type. Use such compactors only when the pipe embedment has previously been compacted to at least 95% of Standard Proctor Density (see ASTM D698 or AASHTO T99).

The Contractor shall restore and/or replace paving, curbing, sidewalks, gutters, shrubbery, fences, sod or other disturbed surfaces or structures to a condition equal to that which existed before the work began to the satisfaction of the Engineer.

The Contractor shall furnish all labor, materials, and incidentals at no extra compensation for all restoration work.

**D. Clean Up**

Surplus pipeline materials, tools and temporary structures resulting from the work shall be removed by the Contractor. All debris, pavement, and excess earth from excavations shall be removed and disposed of by the Contractor. The construction site shall be left clean, to the satisfaction of the Engineer.

**IX. GREASE TRAPS/SAND TRAP AND PLUMBING INTERCEPTOR**

**A. General**

A pretreatment tank on a wastewater service line known as a grease trap, oil trap or separator, sand trap or plumbing interceptor is required by the Bastrop City Code for any non-residential wastewater service connection which may contribute grease, oil or other floatable material, grit, mud, sand or gravel which could cause a violation of the City's Industrial Waste Ordinance.

A non-residential facility need not plumb the following fixtures to the trap: restroom or bathroom fixtures, clothes washing drains, hand washing or mop sinks and drinking fountains.

The traps (or any other plumbing interceptor as referred to in the proceeding paragraph) shall be an underground watertight vapor tight concrete, two compartment, tank sized, constructed and installed in accordance with the following regulations and the Standard Detail following.

Vehicle wash and maintenance facilities shall have individual grated catch basins under wash racks with a trap (on the wastewater service line prior to connection to the City collection system.)

**B. Capacity**

The trap shall be sized to contain a volume of water equal to or greater than 12 minutes of the peak flow rate through the trap but not less than 250 gallons. Where the flow rate is not known or measured, it can be calculated based on 3 gallons per minute per standard plumbing fixture

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unit (as designated by the Standard Plumbing Code) connected to the trap.

The first compartment shall contain approximately 60% of the total volume and the second compartment shall contain 40%.

Traps for car washes shall have a minimum of 250 gallons capacity for the first wash bay plus 100 gallons capacity for each additional bay.

### **C. Design**

The trap shall be watertight and structurally sound, capable of withstanding the earth backfill loading and wheel loads (Traffic Loading H20 per ASTM A796) in traffic areas.

Concrete for the tank shall be a minimum of 3600 psi strength and shall be reinforced with number 4 ASTM A615, Grade 60 steel bars spaced a maximum of 12" apart in vertical and horizontal. The tank shall have cured a minimum of 7 days before shipping.

The inlet and outlet connections in the tank walls shall be not less than 4", the inlet nozzle shall be a minimum of 12" below the operating level and the outlet nozzle shall be a minimum of 20" below the operating level and shall be pumped to create a minimum 3-inch drop, between the inlet and outlet lines. The first trap chamber shall have a 2" vent and the outlet pipe shall also be vented. The trap vents shall be connected to the building plumbing vents. An outlet cleanout shall be provided and shall be accessible for sampling by the City or an alternate accessible provision for sampling shall be provided on the trap outlet line.

Each compartment shall have a removable, accessible, manhole cover at the ground surface with minimum opening of 20 inches in any dimension. The area around the trap shall be graded so as not to allow surface drainage to enter the manhole.

The trap shall be watertight and sealed between sections and between the walls and the top (although manhole riser, rings and cover do not need to be watertight).

A baffle of at least 20 square inches in area shall be permanently installed not less than 6" nor greater than 18" in front of the inlet nozzle of the first compartment.

### **D. Installation and Inspection**

Traps shall be placed level on a bed of washed sand or pea gravel and shall be tested for water tightness prior to backfilling. The water test requires filling the tank to a point above the underside of the top and observing the water level over a 24 hour period. No noticeable (less than 1/4 inch) drop in water level from the initial measuring point is the passing criteria.

After the water test, the tank may be backfilled and plumbed and an inspection of the piping, grades, backfill and venting shall be made for conformance with this standard.

## CHAPTER 4 - STORM WATER DRAINAGE SYSTEM STANDARDS

### I. GENERAL

All storm water drainage systems shall conform to the requirements of the City of Bastrop Subdivision Ordinance. Storm water drainage characteristics shall be given early consideration in the design of facilities and not given only cursory design considerations after other project requirements have been met. All proposed storm water drainage systems shall be designed in accordance with good engineering practices and not be limited to this criteria if more stringent design considerations are needed.

### II. DESIGN REQUIREMENTS

The following design Specification shall apply to all storm water drainage systems work in subdivisions.

#### A. Curb and Gutter Grade

A minimum grade of 0.4% and a maximum grade of 16% shall be used for street, curb and gutter.

#### B. Inlets

A minimum curb inlet length of ten (10) feet with six (6) inch throat opening shall be provided. Inlets shall be sized to achieve a capacity of one (1) cubic foot per second of opening for a throat height of five (5) inches.

Inlets to storm water drainage systems shall be provided at such locations as are necessary (i) to keep water travel in a gutter to less than six hundred (600) feet and (ii) to prevent street hydraulic capacity from being exceeded.

#### C. Drainage Capacity

Ditches and storm drains should be sized to carry the runoff derived from the Rational Method for drainage areas of five (5) square miles or less. The Rational Method is expressed by the formula:

$$Q = C I A$$

where: Q = Discharge in cubic feet per second.

C = Runoff coefficient which varies with topography, land

use and moisture content of the soil at the time the runoff producing rainfall occurs and the existence or nonexistence of well defined drainage channels.

I = Rainfall intensity in inches per hour.

A = Area in acres contributing runoff to the point of design.

In the above formula, the values for the runoff coefficients "C" recommended for the City of Bastrop are:

**Table 3: Runoff Coefficient "C" Values Recommended for the City of Bastrop**

Land Use Type	Values of "C" for Basin Slopes		
	Less than 2%	2% - 7%	Greater than 7%
Residential Districts	0.40	0.45	0.50
Commercial Districts	0.85	0.87	0.90
Industrial Districts	0.65	0.70	0.75

## STORM WATER DRAINAGE SYSTEM STANDARDS

Retail Districts	0.75	0.80	0.85
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**Table 4: Rainfall Intensities "I" Applicable to the City of Bastrop**

(Based upon twenty-five, and one hundred year frequency)

Time of Concentration (min)	Values of "I" in inches per hour	
	25 yr.	100 yr.
5	12.1	14.9
10	9.5	11.6
15	7.9	9.7
20	6.8	8.4
30	5.4	6.6
1 hr.	3.5	4.3

The storm sewer collection system shall be sized for the twenty-five year storm frequency event with the ability to convey the 100 year storm event through easements.

In applying Manning's formula with the above determined volumes, the capacity of storm sewers shall be determined on the basis of hydraulic gradients rather than the physical slope of the pipe.

Unless justified to and approved by the Engineer, the maximum allowed overland flowtime of concentration to any storm sewer inlet will be fifteen minutes.

### D. Bridge or Culvert Crossing

Any bridge or culvert crossing a principal natural drainage channel shall be designed to provide an open area beneath the crossing of sufficient size to pass a flow resulting from a 100 year storm occurrence.

### E. Minimum Size and Grade

The minimum size of the storm sewer shall be eighteen (18) inches and the minimum grade shall be 0.20 percent.

### F. Outfalls to Natural Drainage

Wherever possible, outfalls from storm sewers and ditches into natural drainage ways shall enter at the grade of the natural drainage channel. The design engineer shall design drop-type outfall structures, or otherwise provide headwalls as specified by the standards of the Texas Department of Transportation, with provisions to minimize erosion.

### G. Manholes

Manholes (inlets or junction boxes) shall be provided at all changes in grade or alignment, at all sewer intersections, and at intervals of no more than 800 feet on straight lines. Design of manholes shall conform to the Specifications set out in III - C, below.

### H. Open Channel Design

1. General. All open channels shall be sized for design flow and shall be concrete lined unless otherwise approved by the City. The minimum grade for concrete channels shall be 0.20 percent. Channel invert and sides shall be a minimum of five (5) inches thick with number 3 reinforcing bars at 24 inches on center each way. Side slopes shall have a horizontal/vertical ratio of two (2) or greater. Earth side slopes above the channel lining shall not be less than a 2 to 1 ratio, horizontal to vertical.

Recorded easements shall be provided for both underground and above ground storm drainage. An easement of fifteen (15) feet width is required for underground drainage

## STORM WATER DRAINAGE SYSTEM STANDARDS

systems. For open channel surface storm drainage, the easement width shall be at least twenty (20) feet wider than the channel top, with at least fifteen (15) feet of the easement continuously on one side of the channel for access purposes and at least five (5) feet of clearance on the opposite side open channels on lots shall not be permitted.

2. Design at Intersections. Concrete valley gutters shall be provided to carry water across all intersections with a grade of 1.0 percent or less.
3. Seepage Conditions. Where subsurface conditions indicate a potential for seepage or underground flow, pipe drains will be required.

### III. MATERIALS FOR STORM WATER DRAINAGE SYSTEMS

#### A. Concrete

All concrete and reinforcing steel used in drainage structures shall be in compliance with the Concrete and Reinforcing Standards standards set out in Chapter 6. Concrete shall be Class A.

#### B. Pipe

Pipe for storm drains shall be concrete pipe in sizes as shown on the approved Plans. Pipe twenty-one (21) inches or larger in diameter shall be reinforced concrete pipe (RCP) ASTM Specification C76, Class 3. Pipe eighteen (18) inches in diameter shall be plain concrete pipe (PC), ASTM Specification C14, standard strength. Where, in the opinion of the Engineer, added strength of pipe is needed for traffic loads over minimum cover or for excessive height of backfill, concrete pipe shall be ASTM Specification C14 Extra Strength or ASTM Specification C76, Class IV or Class V. Pipe shall have a minimum cover of not less than one (1) foot over the top of the pipe. All pipe shall have a integral tongue and groove joints. All concrete pipe bends or fittings for horizontal or vertical changes in alignment, and all special fittings, shall be of prefabricated construction using RCP.

#### C. Manholes

Manholes shall be constructed of 4 foot diameter reinforced sewer pipe and eccentric cone section conforming to ASTM Specification C478. Manhole covers shall be East Jordan Iron Works, or equal, with 32 inch opening and weight of at least 240 pounds. The cover shall be marked "STORM SEWER".

#### D. Pipe Joint Materials

1. Asphalt Compounds. Asphalt compounds shall consist of asphalt base, volatile solvents, and inert filler. The joint compound shall conform to the standards of the Texas Department of Transportation.
2. Mortar Mix. Mortar joint mix shall be composed of one part cement or two parts of mortar sand.
3. O-Ring Joint. Groove and o-rings gasket joints shall conform to ASTM C-443.

### IV. STORM WATER DRAINAGE SYSTEM CONSTRUCTION

#### A. General

The alignment and cuts established on previously approved cut sheets shall be constructed by use of Laser beam with qualified employees available to operate both the instrument and grade rod.

Construction must begin at the lowest pipe elevation and continue upstream with bells facing upstream. Construction shall be continuous with construction of branch mains deferred until the main is constructed to the branch manholes' junction points.

## STORM WATER DRAINAGE SYSTEM STANDARDS

Not more than 300 feet of trench shall be opened in advance of pipe installation and pipe shall be laid in all opened ditch by the end of the work day. A test type plug shall be installed in the open ends of all pipe at the end of each work day.

### **B. Trench Construction**

1. The minimum trench width shall be 12 inches wider than the outside diameter of the pipe and not more than 24 inches wider than the outside diameter of the pipe.
2. Trench safety system shall be in accordance with Chapter 1 Section III.
3. Four to six inches of coarse granular material shall be placed under pipe or conduit for grading purposes. The pipe or conduit shall be assembled in the trench with the barrel resting uniformly on the initial embedment material to the grade shown on the plans.
4. When rock is encountered, a minimum of 6 inches of initial embedment material shall be placed under pipe or conduit.
5. The pipe or conduit shall be assembled in the trench with the barrel resting uniformly on the embedment or undisturbed trench floor, to the grade shown on the plans.

### **C. Embedment and Backfill**

1. Embedment. Embedment, when required, shall be placed to the required depth and compacted. When embedment is not required, select backfill material shall be compacted around pipe to a depth level with the pipe centerline. Embedment material shall be clean washed sand.
2. Inspection and Backfill. The trench may be backfilled after inspection and approval by the City.
3. Backfill Material. The trench may be backfilled with excavated material when the trench does not cross a street, another utility line, or a structure. Backfill material shall not contain rocks or other objects larger than four (4) inches in any dimension. Backfill shall be carefully placed in the trench to avoid damage to the pipe.
4. Trenching at Streets. Trenches that cross or will be under proposed or existing streets shall be backfilled with granular material approved by the City's Engineer. Granular material shall be placed in maximum lifts of 6 inches and compacted. This backfill method is required for a distance of ten feet on each side of a street or utility crossing.

### **D. Joints**

1. Mortar Joints.
  - a. The pipe shall be laid to grade in the trench.
  - b. The joint areas shall be thoroughly wetted.
  - c. The lower one-half of the groove shall be packed with mortar from the interior. The remaining groove area shall be quickly packed with mortar from the interior.
  - d. A mortar bead shall be formed around the pipe joint. The bead shall extend a minimum of one inch on each side of the joint and project outward a distance on one inch.
  - e. The inside of pipe joint shall be finished smooth with the inside of the pipe.
  - f. The joint shall be protected from sun and air by an approved wet wrapping or wet soil cover for a minimum of 48 hours or until backfilled.
  - g. Joints shall not be made when the temperature is 40 degrees Fahrenheit or below.
2. Asphalt Compound Joints.
  - a. Joints shall be made in conformance with manufacturer's recommendations.

## STORM WATER DRAINAGE SYSTEM STANDARDS

- b. The pipe shall be dry.
  - c. Sufficient compound shall be placed in the groove to cause some material to be squeezed from joint when pipe is "pushed home".
  - d. The inside of pipe joints shall be wiped clean after joint has been made.
3. O-Ring Joints.
- a. Pipe shall be dry and clean.
  - b. Bedding shall be in place for proper alignment.
  - c. Joint lubricant in accordance with manufacturers' recommendations shall be used.

## CHAPTER 5 - PAVING STANDARDS FOR STREETS AND SIDEWALKS

### I. STREET DESIGN

#### A. General

All construction of new streets within the City of Bastrop or its Extraterritorial Jurisdiction shall be designed in accordance with of the City of Bastrop Subdivision Ordinance.

#### B. Design Requirements

1. No streets shall be designed having a slope of less than 0.40 feet per 100 feet.
2. Streets shall have standard concrete curb and gutter unless otherwise approved by the City Engineer.
3. Streets shall be constructed per the geotechnical report and pavement recommendations prepared for the Public Improvement Construction Plans.

### II. MATERIALS

#### A. Flexible Base Material

Flexible base material shall consist of a foundation course and a surface course, shall be composed of crusher-run broken limestone, and shall be constructed in two courses as herein specified in conformity with the typical sections shown on the plan detail sheet.

Flexible base material shall be composed of crusher run broken limestone, TxDOT, Type A, Grade 1. The materials shall be obtained from a source approved by the Texas Department of Transportation or the City and shall be crushed, and shall consist of durable particles of stone mixed with approved binding materials. Acceptance of material shall be made upon delivery to the job site. The processed material, when properly tested shall meet the following requirements:

**Table 5: Flexible Base Material**

Retained on 1-3/4" sieve	00%
Retained on 7/8" sieve	10% to 35%
Retained on 3/8" sieve	30% to 50%
Retained on No. 4 sieve	45% to 65%
Retained on No. 40 sieve	70% to 85%

Material passing the No. 4 sieve shall be known as "binder"; that portion of the binder material passing the No. 40 sieve shall be known as the "soil binder" and shall meet the following requirements:

The liquid limit shall not exceed 35%

The plasticity index shall not exceed 10%

The minimum compressive strength, with a lateral pressure of 0 psi, shall be 45 psi

The minimum compressive strength, with a lateral pressure of 15 psi, shall be 175 psi

Before any material is accepted by the Owner, the Supplier shall furnish a report analysis of the proposed material made by an approved laboratory certifying that the materials meet the above Specifications. Preliminary approval of a source does not guarantee acceptability of all material obtained there from; individual loads of material will be accepted as delivered to the site.

Tonnage of base material (without compaction) is calculated as follows:

PAVING STANDARDS FOR STREETS AND SIDEWALKS

$$\begin{aligned} \text{Tons} &= \frac{\text{Length (ft)} \times \text{Width (ft)} \times \text{Thickness (inches)}}{12 \text{ (ft/in)} \times 27 \text{ (cf/cfy)}} \times 1.4 \text{ (tons/cy)} \\ &= L \text{ (ft)} \times W \text{ (ft)} \times T \text{ (inches)} \times 0.00432 \end{aligned}$$

**B. Asphaltic Prime Coat**

This section shall govern the materials and construction method to be used in applying asphaltic prime coat to the completed base course. The asphaltic prime coat material shall be cut-back asphalt, MC-30, and shall meet the TDH standards:

**Table 6: Asphaltic Prime Coat, Grade MC-30**

GRADE MC-30		
	Minimum	Maximum
Water		0.2%
Viscosity, 140°F	30	60
Flash Point T.O.C., degrees F	100	

When distilled by ASTM Method D 402, the distillate off volume shall be as follows:

**Table 7: Asphaltic Prime Coat Distillate Volume**

	Minimum	Maximum
Off at 437°F	25%	
Off at 500°F	40%	70%
Off at 600°F	75%	93%

The residue, when poured from the flask without cooling, immediately upon reaching the maximum temperature specified, shall have the following characteristics:

	<u>Minimum</u>	<u>Maximum</u>
Penetration, 100 grams, 5 sec, 77°F,	120	250
Ductility, 5 cm/min at 77°F	100	
Solubility	99.0%	

The material shall be free from water.

Application Rate: 0.15 gallons per square yard.

**C. Hot Mix, Hot Laid Asphaltic Concrete and Pavement**

Course and fine aggregates used in hot laid asphaltic concrete and pavement shall meet the following grading requirements:

**Table 8: Type D: Fine Graded Surface Course**

	Percent Aggregate by Weight
Passing 1/2" sieve	100
Passing 3/8" sieve	85 to 100
Passing 3/8" sieve, retained on #4 sieve	21 to 53
Passing #4 sieve, retained on #10 sieve	11 to 32
Total retained on #10 sieve	54 to 74

## PAVING STANDARDS FOR STREETS AND SIDEWALKS

Passing #10 sieve, retained on #40 sieve	6 to 32
Passing #40 sieve, retained on #80 sieve	4 to 27
Passing #80 sieve, retained on #200 sieve	3 to 27
Passing #200 sieve	1 to 8

The coarse aggregate shall be crushed rock, uniform in quality throughout and shall be free from dirt, organic or other injurious matter occurring either free or as coating on the aggregate. The rock shall have an abrasion of not more than 40 percent by weight when subject to the Texas Department of Transportation (TxDOT) Test Method Tex-410-A.

The fine aggregate shall consist of sand, rock screenings or a combination of both. Sand shall be composed of sound, durable stone particles free from loams or other injurious foreign matter. Screenings shall be of the same or similar material specified for coarse aggregate. The plasticity index of that part of the fine aggregate passing the #40 sieve shall be not more than 6 when tested TxDOT Test Method Tex-106-E.

The asphaltic material shall form 4.5% to 7% of the mixture weight, and shall be homogenous, free from water, and not foam when heated to 347° F. It shall meet the following specific requirements.

**Table 9: Asphaltic Material Requirements**

Grade Limits	AC-20	
	Minimum	Maximum
Penetration at 77°F, 100g, 5 sec	55	100
Ductility at 77°F, 5 cm/min., cms.	50	
Flash Point (degrees F)	450	
Penetration of Residue, 77°F	55	
Solubility in Trichloroethylene (Percent)	99	

The material shall not be cracked. The asphaltic material shall be oil asphalt and be from a source approved by the Owner.

Laboratory test results shall be submitted to the Owner, if requested, certifying that the material proposed to be used meets the requirements of these standards.

The asphalt for paving mixture shall conform to Texas Department of Transportation AC-20.

### III. CONSTRUCTION METHODS

#### A. Preparation of Sub-Grade

The sub-grade shall be excavated and shaped in conformity with the typical sections shown on the detail sheet. Before base material is placed, the sub-grade shall be thoroughly wetted, bladed and rolled until a minimum of 95% of maximum density has been attained for a 6" depth, as determined by the standard method of test for the moisture-density relation of soils, TxDOT Test Method TEX-113-E, or the most current standard test for density approved by the Texas Department of Transportation. If it has been determined that the sub-grade needs to be lime stabilized, all material, equipment, and construction methods shall be in accordance with standards currently approved by the Texas Department of Transportation.

#### B. First Course

Flexible base material deposited upon the sub-grade shall be spread, shaped and rolled the same day unless otherwise authorized by the City's Engineer, in which case the Engineer will

## PAVING STANDARDS FOR STREETS AND SIDEWALKS

provide directions for avoiding damage from the delay. This base course shall be wetted, bladed and rolled until a minimum of 96% of moisture density has been attained as determined by the standard method of test for the moisture-density relation of soils, AASHTO Designation T 99-57, Method "A", or the most current standard test for density approved by the Texas Department of Highways and Public Transportation.

### **C. Second Course**

Construction methods for the second course shall be the same as prescribed for the first course shall be the same as prescribed for the first course with the addition of the following:

- (a) Any deviation, in the finished surface in excess of 1/4", in cross-section or in a length of 16' measured longitudinally, shall be corrected by loosening, adding or removing material, reshaping and recompacting by sprinkling and rolling.
- (b) When the depth of flexible base as specified is greater than 6 inches, it shall be constructed in equal compacted courses not to exceed 6 inches.
- (c) The completed flexible base shall have a minimum compacted depth as specified.

### **D. Hot Mix Asphaltic Concrete Pavement**

The asphaltic mixture, prime coat or tack coat shall not be placed when the air temperature is below 45 degrees and is falling, but may be placed when the air temperature is above 40 degrees and is steady or rising.

The asphaltic mixture shall not be placed when the air temperature is below 60<sup>o</sup>F and is falling, but may be placed when the air temperature is above 50<sup>o</sup>F and is rising.

The asphaltic concrete mixture, heated and prepared as specified must be hauled to the project in tight vehicles previously cleansed of all foreign material. The mixture, when laid, shall be at a temperature of 200 degrees F. to 350 degrees F. The City will determine the lowest temperature and variance of 30 degrees upward will be allowed. It shall be spread into place with an approved mechanical finishing machine to the compacted depth shown on the Plans. The finishing machine shall be of the screening and/or tamping type.

### **E. Rolling**

While still hot and as soon as it will bear the roller without undue displacement or hair cracking, the surface shall first be compressed thoroughly and uniformly with acceptable power-driven wheel or tandem rollers weighing from 8 to 10 tons. Subsequent compression shall be obtained by starting at the sides, and rolling longitudinally toward the center of the pavement, overlapping on successive trips by at least 1/2 of the width of the rear wheels. Alternate trips of the roller shall be slightly different in length. Rolling shall be continued until no further compression can be obtained and all roller marks are eliminated. To prevent adhesion of the surfacing mixture to the roller, the wheels shall be kept properly moistened with water, but an excess of water will not be permitted. The final rolling shall be done with a tandem roller. A double coverage with an approved pneumatic roller shall be used on the asphaltic concrete surface after flat wheel and tandem rolling has been completed.

### **F. Hand Tamping**

Along curbs and similar structures, and at all places not accessible to the roller, the mixture shall be compacted thoroughly with a lightly oiled hot tamp.

### **G. Surface Tests**

The completed surface, when tested with a 16" straight edge laid parallel to the centerline of the roadway, shall have no deviation in excess of 1/16" per foot from the nearest point of contact

and the maximum ordinate measured from the face of the straight edge shall not exceed 1/4" at any point.

If requested by the City, approved templates shall be furnished by the Contractor for checking sub-grade and finished sections. The templates shall be of such strength and rigidity that if the support is transferred to the center there will not be a deflection of more than 1/8".

#### **H. Construction Joints**

Placing of the course shall be as nearly continuous as possible, and the roller shall pass over the unprotected end of the freshly laid mixture only when the laying of the course is discontinued for such a length of time as to permit the mixture to become chilled. In all such cases when the work is resumed, the material shall be cut back so as to produce a slightly beveled edge for the full thickness of the course. The old material which has been cut away shall be removed from the work and the new mix laid against the fresh cut.

#### **IV. EQUIPMENT**

Mixing plants that will not continuously produce a mixture meeting all of the requirements of this specification will be condemned. Mixing plants may be either the weight-batching type or the continuous mixing type. Both types of plants shall be equipped with satisfactory conveyors, power units, aggregate handling equipment, hot aggregate screens and bins, and dust collectors and shall consist, as a minimum, of equipment in the number, condition, and capacities as follows:

Cold aggregate bin and portioning device, dryer, screens, aggregate weight box and batching scales, mixer asphalt storage and heating devices, and truck scales (if used), shall be of the type to adequately supply materials in accordance with the rated capacity of the plant and produce a finished material within the tolerances as set out in these Specifications.

The aggregate shall be separated into at least three bins for Type 3 aggregate as specified herein. Bin No. 1 will contain aggregates of which 90 to 100 percent will pass the #10 sieve. Bin No. 2 will contain aggregates of which at least 85 percent by weight will be of such size as to pass the 1/4" sieve and be retained on the #10 sieve. Bin No. 3 will contain aggregates of which at least 85 percent by weight will be of such size as to pass the 1/2" sieve and be retained on the #4 sieve.

#### **V. CONCRETE PAVEMENT CONSTRUCTION**

##### **A. General**

All concrete paving shall be in conformity with of the City of Bastrop Subdivision Ordinance and with appropriate typical sections on the detail sheet.

##### **B. Materials**

1. Concrete. Concrete used in paving shall be in accordance with Concrete and Reinforcing Standards (Chapter 6) and as shown on the detail sheets.
2. Reinforcing. Steel for concrete paving shall be in conformity with all requirements of Concrete and Reinforcing Standards (Chapter 6) and as shown on the detail sheets.

##### **C. Construction Methods**

1. Subbase. All loose material shall be removed or compacted. The subbase shall be shaped to conform to the required cross section.
2. Forms. Forms shall be accurately set to grade for a minimum distance of 300 feet. Forms shall be placed at each side of every point. Form sections shall be tightly jointed

## PAVING STANDARDS FOR STREETS AND SIDEWALKS

and keyed to prevent relative displacement. They shall be cleaned and oiled each time they are used. Forms must be inspected by the City's Representative before any concrete is poured. If forms settle and/or deflect over 1/8 inch under finishing operations, paving operations shall be stopped and the forms shall be reset to line and grade.

3. Placement. Concrete shall not be poured when the temperature is below 40 degrees F. and falling. Concrete may be poured when the temperature is above 35 degrees F. and steady or rising. Salt or other chemical additives shall not be added to concrete to prevent freezing. The contractor shall be responsible for replacing any concrete that freezes during curing. All concrete shall be constructed monolithically unless otherwise stated on construction drawings or typical sections.
4. Finishing. Where hand spreading is necessary, concrete shall be distributed by shovels. The use of rakes will not be permitted. Immediately upon unintended stoppage of a pouring operation, a standard bulkhead shall be installed at right angles to the centerline of the pavement. Joint-sealing material shall be placed in sawed and other joints as required. Pavement shall be finished with a belt finish or as directed by the Engineer. After finishing is complete and the concrete is still workable, the gutter surface shall be tested by the contractor for trueness with an approved 10 foot steel straightedge. The maximum ordinate measurement shall be 1/6 inch.

### **D. Curb and Gutter and Valley Gutters**

1. General. Construction of separate concrete curb and gutters and valley gutters shall be in accordance with the following standards:
2. Materials.
  - (a) Concrete. Concrete used in construction of curb and gutter and valley gutters shall be in accordance with Concrete and Reinforcing Standards (Chapter 6) and as shown on the detail sheet.
  - (b) Reinforcing Steel. Where reinforcing steel is required, it shall conform to the requirements given in the Concrete and Reinforcing Standards (Chapter 6) and as indicated on the detail sheet.
3. Formed Curb and Gutter. Curb and gutter or separate gutter installations shall conform to the following standards: Curb and gutter shall be constructed in accordance with the typical sections. In not more than one hour after the concrete has been placed, a thin coating not over 1/4" thick of finish mortar, composed of one part cement to two parts of fine aggregate, shall be worked into the exposed faces of the curb and gutter by means of a "mule". The curb and gutter shall then be finished true to line and grade with the aid of a straight edge, steel trowel, steel "gooseneck" and fine hair brush. The straight edge is to be worked with a steel trowel and "gooseneck" to give the work the appearance of a trowel finish. It is to be edged and jointed in the same manner, as specified for sidewalks in this Chapter at IV - D - 5 and IV - 3 - e, except that the joint material shall be bitumastic fiber instead of red wood. After the work has become firm, it is to be brushed lightly with a final crosswise brushing.
4. Machine Laid Curb. Machine laid curb shall conform to the following standards:
  - (a) Machine laid curb shall be constructed on a compacted flexible base or on the finished roadway surface in accordance with lines and grades of the approved Plans. The cross-sectional configuration of the curb shall be obtained by using an approved template in the machine for the specific curb section desired.
  - (b) Materials shall conform to the requirements as specified in the Concrete and Reinforcing Standards (Chapter 6) except that the slump shall not exceed 1", the concrete shall contain a minimum of 6 sacks of cement per cubic yard and the

coarse aggregate when tested by approved methods shall conform to the following grading requirements:

**Table 10: Machine Laid Curb Aggregate Grading Requirements**

Retained on ½" sieve	0%
Retained on 3/8" sieve	0-5%
Retained on No. 4 sieve	35-60%
Retained on No. 10 sieve	90-100%

5. Immediately prior to placing of the curb, the previously approved foundation shall be thoroughly cleaned. The line for the top of the curb shall be maintained from a guideline set by the Contractor. Curb outline shall strictly conform to the details shown on the Plans. The forming tube of the extrusion machine shall be readily adjustable vertically during the forward motion of the machine to provide required variable height of the curb necessary to conform to the established grade line. To provide a continual check on the curb grade, a pointer or gauge shall be attached to the machine in such a manner that a comparison can be made between the curb and the guideline. Other methods may be used if approved by the Engineer in writing.
6. The approved mix shall be fed into the machine in such manner and at such consistency that the finished curb will present a well compacted mass true to the established shape, line and grade, with a surface free of voids or honeycomb. Any additional surface finishing specified and/or required shall be performed immediately after extrusion. The completed curb shall be cured for a period of not less than 72 hours.

#### **E. Expansion and Contraction Joints**

Expansion and contraction joints shall conform to the following Standards: A one-half inch (½") deep (minimum) transverse tooled joint shall be formed at twenty foot (20') intervals in curbs and gutters and a one-half inch (½") expansion joint shall be installed where a curb intersects, joins or abuts a structure. The joint material shall be bitumastic fiber.

#### **F. Valley Gutters**

Valley Gutters shall be constructed as shown on the Detail Sheet. Valley gutters shall be monolithical with the curb and gutters. The valley gutter shall be extended to include the area formed by the intersection of the backface of the valley gutter, the projections of the gutter face of the intersection street, and the circular curb return.

### **VI. SIDEWALKS AND DRIVEWAYS**

#### **A. General**

Sidewalks and driveways shall be constructed in accordance with the Plans shown on the Detail Sheet.

#### **B. Materials**

1. Concrete used in the construction of sidewalks and driveways shall be in accordance with the Specifications set out in Concrete and Reinforcing Standards (Chapter 6)
2. Reinforcing steel used in driveway and sidewalk construction shall conform to the requirements of Concrete and Reinforcing Standards (Chapter 6) and conform to the Plans on the Detail Sheet.

#### **C. Construction Methods**

1. Sidewalks shall be located in accordance the City of Bastrop Subdivision Ordinance.

## PAVING STANDARDS FOR STREETS AND SIDEWALKS

2. Sidewalks and driveways shall be constructed on a two inch (2") sand cushion over undisturbed natural soil.
3. Mats of wire fabric shall overlap sufficiently to maintain a uniform strength and shall be fastened securely at the ends and edges.
4. No concrete shall be deposited until the City's Representative has inspected and approved the type and placement of the reinforcement steel.
5. A transverse tooled joint of at least one-half inch ( $\frac{1}{2}$ ") depth shall be formed at five (5) foot intervals in the sidewalks. A one-half inch ( $\frac{1}{2}$ ") expansion joint shall be installed where a sidewalk intersects, joins, or abuts another sidewalk, a curb, or a structure. Expansion joints shall be provided at intervals not exceeding forty feet (40') of longitudinal dimension, and at grade breaks. Joint material shall be one inch (1") heart of redwood.

## VII. HIKE AND BIKE TRAIL

### A. General

All work for the installation of Hike and Bike Trail shall conform to the grades, details and instructions on the Standard Detail and shall conform to the standards below.

The Hike and Bike Trail shall be an open coarseway for pedestrians and non-motorized vehicles generally located in parkland, public easements or rights-of-way. The trail shall conform to the natural contours of the existing ground graded to provide gradual and uniform changes in elevation or as called for on the approved plans. The trail shall generally have a uniform cross-section, 10 feet wide, as shown on the Standard Detail and shall be constructed from reinforced concrete with a minimum thickness of 4 inches.

### B. Construction Methods and Materials

1. Excavation and Subgrade Preparation. The route of the trail shall be excavated to the subgrade elevations indicated by the plans or if elevations are not given, to 5 inches below natural ground to provide a gradual and uniform change in elevation. The subgrade shall be cut into undisturbed natural ground where possible. Excavated material shall be disposed of as directed by the City or in the absence of directions spread over the natural ground along the trail in a fashion which will not be detrimental to surface drainage of the surrounding area.

If rock is encountered which would require use of a jackhammer to remove, the City, or its representative, shall be consulted about raising the grade to clear the rock. In no case shall less than the minimum 4 inches of concrete be placed over the rock. In areas of muddy or unstable subgrade material, this shall be excavated and replaced with select granular fill. Select fill material shall have no rock or clods over 2 inches in diameter and shall be placed in lifts of not over 12 inches by ordinary compaction methods, such as; bladed into place and rolled with equipment wheel or tracks. In areas with 2 feet or more of fill, mechanical compaction shall be used.

As the work progresses, special care shall be taken to not use the previously constructed trail as a travelway for construction equipment. Equipment shall not cross or travel upon previously placed concrete.

The Contractor shall take special care after placing concrete to prevent the defacing of unhardened concrete by workers or anyone coming onto the job site. The Contractor shall keep worker(s) on-site until the concrete has sufficiently hardened to prevent defacing of the finished work.

2. Base and Bedding Placement. After completion of subgrade preparation the Contractor shall request an inspection by the Owner prior to placing sand bedding.

## PAVING STANDARDS FOR STREETS AND SIDEWALKS

The preparation for placement of concrete shall consist of laying a cushion bed, setting expansion joints and placing forms for grade control. The cushion bed shall be a minimum of two inches thick over the previously prepared subgrade and shall consist of gravel and sand, crushed rock or coarse sand. The cushion material shall be evenly spread, wetted thoroughly, tamped and leveled. The cushion material shall be moist at the time concrete is placed. If the subgrade is rock or gravel, a cushion bed need not be used. The Engineer will determine if the subgrade is rock or gravel.

3. Concrete Materials and Placement. Reinforcing for concrete trail shall be one layer of #3 deformed reinforcing bars set at 15 inches on center each way tied at all intersections and laps. Reinforcing shall terminate 2 inches from the edge of concrete and be uniformly supported by plastic chairs or concrete blocks. Laps shall be a minimum of 15 inches.

Expansion joint materials shall be 3/4 inch thick, sound, heartwood Redwood free from knots, checks and splits in single pieces. Expansion joints shall be at a minimum spacing of 30 feet and extend the full depth of the concrete. Dummy joints consisting of a groove 1/4 inch wide and 3/4 inch deep across the surface of the concrete to control cracking shall be located at a minimum of 5 foot intervals.

Six, 24 inch long dowels of #3 or #4 smooth bars shall be installed at each expansion joint. The dowel shall be tied on one side of the joint and greased on the other side.

Concrete shall be as setforth in Section 6 and have the following characteristics.

Minimum 28 day compressive strength 3000 psi

Type of mix 5 sacks cement/CY, 6.0 water cement ratio

Maximum coarse aggregate 1 inch

Slump 3 to 6 inches

No admixtures are to be used. Concrete shall be placed within 90 minutes of mixing. Concrete placement is allowed when the temperatures (in shade) is 35° F and rising but not if the temperature is 40° F and falling. Immediately after the concrete is placed it shall be tamped and then struck off with a straight edge. The surface shall then be "floated" and troweled to uniform smooth surface, then finished with a hair brush to a gritty texture. Curing is required using an approved curing agent or by wetting mats. The final surface shall generally have a 1/8 inch per foot cross-slope with no flat areas which would allow pooling of water. The direction of the cross-slope shall be in the direction of natural drainage flow. In locations that are designated on the plans to have surface drainage flowing across the trail, the elevations of the concrete shall be set to match the flow line elevation of the drainage.

The outer edges and joints shall be rounded with 1/4 inch radius tool. Care shall be taken to prevent loss of dummy joints and rounded edges when applying the brush finish.

4. Clean Up. The areas along each side of the trail shall be fine graded with local topsoil material to allow water to run off from the trail. After the trail is in place the Contractor shall call for a final inspection by the Owner. Prior to acceptance, all construction material and debris shall be removed by the Contractor and excavated material shall be wasted in an acceptable manner.

## CHAPTER 6 - CONCRETE AND REINFORCING STANDARDS

### I. DESCRIPTION

The materials and methods employed for the proportioning and mixing concrete used for paving and other concrete structures and the material used for reinforcing such concrete shall conform to the requirements of this Chapter. All concrete structures shall be constructed in accordance with the design requirements and details and in conformity with the special requirements herein set forth.

Concrete shall be of fine and course aggregate, so graded and proportioned, and thoroughly mixed with Portland Cement and water as will produce a homogenous mixture of such quality that concrete shall have a minimum compressive strength of 3,000 psi after 28 days.

The Engineer should be contacted for specific requirements with regard to this Chapter.

### II. MATERIALS

#### A. Cement

The cement shall be Type I of a standard brand of Portland cement conforming to ASTM Designation C-150-70. Only one brand of cement will be permitted in any structure. No flyash filler will be allowed to be used in the mix.

#### B. Mixing Water

The water used with the cement shall be clean and suitable for drinking or for ordinary household use.

#### C. Coarse Aggregate

The coarse aggregate shall consist of gravel, crushed stone, or combinations of these two. Coarse aggregate shall conform to ASTM C-33-67. Gravel shall consist of durable particles of crushed or uncrushed gravel of uniform quality throughout. It shall have wear of not more than 40 percent when tested according to TxDOT Test Method TEX-410-A.

Crushed stone shall consist of durable particles of stone of uniform quality and have the same wear as that required of gravel.

The coarse aggregate shall be free from excess salt, alkali, roots and other objectionable matter. The maximum size aggregate shall be governed by the type of structure in which the concrete is to be used and as shown in **Table 14**.

The grading requirements of the coarse aggregates shall conform to the following:

Table 11: Coarse Aggregate Gradation Chart (Percent Retained)

Grade No.	Maximum Size	2 1/2"	2"	1 1/2"	1"	3/4"	1/2"	3/8"	No. 4	No. 8
1	2 1/2"	0	0-20	15-50		40-60			95-100	
2	1 1/2"		0	0-5		30-65		70-90	95-100	
3	1"			0-5		10-40	40-75		95-100	
4	1"			0	0-5		40-45		70-100	95-100
5	3/4"				0	0-10		45-80	90-100	95-100

#### D. Fine Aggregate

Fine aggregate shall consist of natural sand and be free of broken material, foreign material, excess salt, alkali or vegetable matter. It shall contain not more than 0.5 percent by weight of

clay lumps. Fine aggregate shall conform to ASTM 33-67. The grading requirements of the fine aggregates shall conform to the following:

**Table 12: Fine Aggregate Gradation Chart**

Sieve	Percent Retained
3/8"	0%
No. 4	0-5%
No. 8	0-20%
No. 16	15-50%
No. 30	35-75%
No. 50	65-90%
No. 100	90-100%
No. 200	97-100%

The sand equivalent shall not be less than 80. For Classes A, C, E and F, the fineness modules shall be determined by adding the percentages by weight retained in sieves No. 4, 8, 16, 30, 50 and 100 and then dividing by 100.

**E. Admixtures**

Water reducing admixtures shall conform to Type A or Type D as set forth in ASTM Designation C-494. Air entraining admixtures shall conform to requirements of ASTM Designation C-260.

No cement will be used unless the manufacturer shall have certified that the admixture meets the requirements of either Designation ASTM C-260 or Designation ASTM C-494.

Calcium chloride will not be permitted as an admixture.

**III. MIX DESIGN**

The mix design must meet the requirements for concrete strength, durability and slump. Testing of all mix design specimens will be made in a laboratory.

Trial batches, when required, will be made and tested prior to placing the concrete on the job. When transit mix concrete is used, the batch size shall not be less than 50% of the rated capacity of a representative truck.

Mix design from previous or concurrent jobs may be used without trial batches if it can be shown that no substantial change in any of the proposed ingredients has been made and approval of the Engineer is given.

The coarse aggregate factor shall not be more than 0.82 except that when the voids in the coarse aggregate exceed 48% of the total dry loose volume, the coarse aggregate factor shall not exceed 0.85. The coarse aggregate factor shall not be less than 0.70 for Grades 1, 2 and 3 aggregate.

Water reducing or retarding agents may be used with all classes of concrete at the option of the Contractor. Water reducing or retarding agents are required for hot weather placement and continuous slab placement.

Entrained air will be required for Class A and Class C concrete. The concrete shall be designed to entrain 5% air when Grade 2 coarse aggregate is used and 6% air when Grade 3 coarse aggregate is used. Concrete, as placed in the structure, shall contain the amount as stated above with a tolerance of plus or minus 1-1/2 percent. Occasional variation beyond this tolerance will not be cause for rejection. When the quantity of entrained air is found to be above 7% with Grade 2 coarse aggregate or above 8% with Grade 3 coarse aggregate, additional test beams

## CONCRETE AND REINFORCING STANDARDS

or cylinders will be required. If these beams or cylinders pass the minimum flexural or compressive requirements, the concrete will not be rejected because of the variation in air control.

### IV. CONSISTENCY

Concrete shall be of such consistency as to insure the required workability and result in compact masses having dense, uniform surfaces. The quantities of the mix design shall not be varied unless authorized by the Engineer. In cases where the characteristics of the aggregates are such that, with the maximum allowable amount of water, the consistency requirements cannot be satisfied, additional aggregates, mineral filler or aggregate of a different character may produce the desired results. The Engineer may modify the mix design with additional cement in order to produce proper workability. The addition of water to the approved batch design to provide workability is not permitted.

In general, the consistency of concrete mixture shall be such that:

1. The aggregates will not segregate and mortar will cling to the coarse aggregate.
2. The concrete when dropped from the discharge chute will flatten out at the center of the pile, and the edges will not flow.
3. The concrete will not show free water.
4. The concrete will slide and not flow into place when discharged from metal chutes at an angle of 30 degrees with the horizontal.
5. The surface of the finished concrete will be free of laitance.

Any concrete mix failing to meet the above consistency requirements will be considered unsatisfactory although the concrete meets the required slump test. In cases where the characteristics of the aggregate furnished are such that with the maximum allowable amount of water, the specified slump and consistency requirements are not met, the Contractor may provide aggregates of an improved grading, or the Engineer will modify the mix design to meet the slump and consistency requirements by adding cement.

Slump requirements for designated structures are set out below:

**Table 13: Slump Requirements**

Type of Construction	Minimum Slump	Maximum Slump
Cased Drilled Shafts	3	6
Uncased Drilled Shafts	5	6
Thin Wall (9" or less)	4	5
Pre-stressed Members	4	5
Slabs	1	4
Caps	1	4
Columns	1	4
Piers	1	4
Walls (over 9")	3	4
Rip-rap, Miscellaneous	1	6
Underwater or Seal Concrete	5	6

### V. Classification

Concrete shall be classified as in the **Table 14** as follows. Construction Plans shall indicate the type of concrete to be used in each structure. If the Plans do not designate the classification to be used in a particular structure, then Class A concrete is required to be used.

**Table 14: Classes of Concrete**

Class	Sacks Cement per CY	Strength (28) day	Strength (7) day	Max W/C Ratio	Coarse Agg. Grade No.
A	5	3000	500	6.5	1,2,3,4*,5
B	4	2000	300	8.0	2,3,4*,5
C	6	3600	600	6.0	1**2,3,4,5
D	3	2500	425	7.5	2,3,4*
E	6	3000	500	7.0	2,3,4,5

\* Must have prior approval from Engineer before Grade 4 aggregate may be used.

\*\* Grade I may be used in foundations only, except in foundations poured in drilled shafts.

Class A and Class C concrete shall be air entrained.

## VI. TESTING OF CONCRETE

During the progress of the work, the Engineer or designated laboratory shall cast cylinders or test beams for testing of compressive or flexural strength.

For small placements, such as manholes, culverts, inlets or small rip-rap placements, the Engineer may waive the testing procedures. For placements of twenty-five cubic yards or more the testing will not be waived. A set of test cylinders will be made for each 20 cubic yards of a pour, at the discretion of the Engineer's representative.

If testing is required for removal of forms or falsework, the cylinders or beams shall be cured at the jobsite and in the same method as that concrete which the test represents.

Tests made for design strength concrete shall be cured in accordance with THD Bulletin C-II.

Job control shall be made on seven day compressive strengths which are compatible with the seven day tests made at the mix design. If these seven day tests do not meet the requirements, then a new batch design shall be made.

## VII. GENERAL PLACEMENT REQUIREMENTS

Unless otherwise provided, the following requirements shall govern for the time sequences in which construction operations may be carried on. Forms and falsework for superstructures shall not be erected on concrete footings until the concrete in the footing has cured at least two curing days. Concrete may be placed in the wall or column as soon as the forms and reinforcing steel placement are approved.

A joint formed by placing plastic concrete in direct contact with concrete that has attained its initial set shall be deemed a construction joint. When concrete in a structure or a portion of a structure is specified to be placed monolithic, the term monolithic shall be interpreted to mean that the manner and sequence of concrete placing shall be such that construction joints will not be created.

Construction joints will be of the type and at the locations shown on the plans. Additional joints will not be permitted without written authorization from the Engineer. Any additional construction joints shall have details equivalent to those shown on the plans for joints in similar locations.

The top surface of a concrete placement which terminates at a horizontal construction joint shall have the surface cement film removed and shall be roughened thoroughly as soon as practicable after the concrete has attained initial set.

## CONCRETE AND REINFORCING STANDARDS

Before joining plastic concrete to concrete that has already set, the surface of the concrete in place shall be free from all loose material, laitance, dirt or foreign matter, shall be washed and scrubbed clean with stiff brooms and drenched thoroughly with water until saturated, and shall be kept wet until the plastic concrete has been placed. Immediately prior to the placing of additional concrete, all forms shall be drawn tight against the concrete in place, and the surface of the concrete in place shall be flushed with a coating of grout mixed in the proportions of one part cement to two parts sand.

If shown on the plans, construction joints shall be provided with concrete keyways, reinforcing steel dowels, and/or metal flashing strips or plastic waterstop. The method of forming keys in keyed joints shall be such as to permit the easy removal of forms without chipping, breaking or damaging the concrete in any manner.

All falsework shall be designed and constructed so that no settlement or deformation will occur, so that the necessary rigidity will be provided.

For calculating the loads on falsework, a weight of 150 pounds per cubic foot shall be assumed for concrete, and a live load allowance of 50 pounds per square foot of horizontal surface of the form work shall be included.

All timber used in falsework centering shall be sound, in good condition, and free from defects which will impair its strength. All timber for wedges shall be hardwood.

Upon completion of the structure, all falsework shall be removed to the ground level. Falsework piling shall be pulled or cut off a minimum of 6 inches below ground level. Falsework in a stream shall be removed completely to a point specified by the Engineer to prevent any obstruction to the waterway.

### **VIII. FORMS**

#### **A. General Requirements**

Except where otherwise specified, forms may be constructed of either timber or metal as elected by the Contractor.

Forms for round columns exposed to view shall be of steel except that other materials will be allowed with written permission of the Engineer.

Forms shall be built and maintained mortar-tight and of material sufficient in strength to prevent bulging between supports and shall be set and maintained to the lines designated until the concrete is sufficiently hardened to permit form removal. During the elapsed time between the building of the forms and placing of concrete, the forms shall be maintained in a manner to eliminate warping and shrinkage.

Permission to place concrete will not be given until all of such work is complete to the satisfaction of the Engineer.

If, at any stage of the work, the forms show signs of bulging or sagging, that portion of the concrete causing such condition shall be removed immediately, if necessary, and the forms shall be reset and braced securely against further movement.

#### **B. Timber Forms**

Lumber for forms shall be seasoned properly and of good quality. It shall be free from loose or unsound knots, knot holes, twists, shakes, decay, and other imperfections which would affect its strength or impair the finished surface of the concrete.

Forms may be constructed of plywood not less than one-half inch thickness, with no form lining

## CONCRETE AND REINFORCING STANDARDS

required. The grain of the face plies on such plywood forms shall be laid parallel to the span between the supporting studs or joists.

Plywood used for forms for surfaces which remain exposed shall be equal to that specified as "Exterior Type," of the grade, "Concrete-Form Exterior," of the U.S. Department of Commerce, National Bureau of Standards, Commercial Standard, latest edition.

Forms or form lumber to be re-used shall be maintained clean and in good condition as to accuracy, shape, strength, rigidity, tightness, and smoothness of surface. Forms shall be reworked between each use. Any lumber which is split, warped, bulged, marred, or has defects that will produce work inferior to that resulting from using new material shall not be used.

Forms shall be braced rigidly to prevent movement while placing the concrete. Forms on surfaces not to be finished but exposed to view, shall be placed so that the form panels are symmetrical, i.e. long dimensions set in the same direction. Horizontal joints shall be level and continuous.

Molding specified for chamfer strips or other uses shall be made of redwood, cypress, or pine materials, of such grade that will not split when nailed, and which can be maintained to a true line without warping. The molding shall be mill cut and dressed on all faces. Unless otherwise provided, forms shall be filleted at all sharp corners and edges with triangular chamfer strips. The strips shall be 3/4 inch measured on the sides.

All forms shall be so constructed as to permit removal without damage to the concrete.

Metal form ties of an approved type or a satisfactory substitute shall be used to hold forms in place. Such ties shall be of a type as to permit ease of removal of the metal as hereinafter specified.

All metal appliances used inside of forms to hold them in correct alignment shall be removed to a depth of at least one-half inch from the surface of the concrete and shall be so constructed that the metal may be removed without undue injury to the surface by shipping or spalding. Such devices, when removed, shall leave a smooth opening in the concrete surface. Burning off of rods, bolts, or ties will not be permitted.

Whenever practicable, forms shall be erected complete before the reinforcement is placed. For concrete structures which are to contain water, ties shall be removed to 1 1/2" of the surface and the hole grouted to leave a smooth surface.

For narrow walls and other locations where access to the bottom of the forms is not readily attainable otherwise, adequate cleanout openings shall be provided.

At the time of placing concrete, the forms shall be clean and free entirely from all chips, dirt, sawdust, and other extraneous matter.

The facing of all forms shall be treated with oil before concrete is placed. In hot weather, both sides of face forms may be required to be treated with oil to prevent warping and to secure tight joints. The oils used for this purpose shall be light clear oil which will not discolor or otherwise injuriously affect the concrete surface.

All forms shall be wetted thoroughly before the concrete is placed therein.

### **C. Metal Forms**

The foregoing Specifications for timber forms as regards mortar-tightness, filleted corners, alignment, removal, reuse, oiling, and wetting shall apply equally to metal forms.

The metal used for forms shall be of such thickness that the forms will remain true to shape. Forms may be made in sections of such length as will facilitate the placing of concrete and the

removal of forms. The fit of joints of sections shall not produce offsets. All bolt and rivet heads on the facing sides shall be countersunk. Clamps, pins or other connecting devices shall be designated to hold the forms rigidly together and to allow removal without injury to the concrete. Metal forms which do not present a smooth surface or line up properly shall not be used. Metal shall be kept free from rust, grease, or other foreign material that will tend to discolor the concrete.

**IX. REINFORCING STEEL**

**A. Materials**

Except where otherwise designated on the Plans, all bar reinforcement shall be deformed, and shall conform to ASTM Designation: A615, Grade 60 and shall be open hearth, basic oxygen or electric furnace new billet steel.

The reinforcement shall be bent cold and be true to the shapes indicated on the Plans. Bending shall preferably be done in the shop. Irregularities in bending shall be cause for rejection.

**B. Storing**

Steel reinforcement shall be stored above the surface of the ground upon platforms, skids or other supports and shall be protected as far as practicable from surface deterioration caused by exposure to conditions producing rust. When placed in the work, reinforcement shall be free from dirt, paint, grease, oil or other foreign materials. Rust, surface seams, surface irregularities or mill scale will not be cause for rejection, provided the minimum dimensions, cross-sectional area and tensile properties of a hand wire brushed specimen meet the physical requirements for the size and grade of steel specified.

**C. Splices**

No splicing of bars, except when provided on the Plans, or specified herein, will be permitted. Splices not provided for on the Plans will be permitted, size No. 8 and smaller, subject to the following:

1. Splices will not be permitted in bars less than 20 feet in plan length. Splices which are not shown on the Plans, but permitted hereby, shall be made in accordance with the following TABLE. The specified concrete cover shall be maintained at such splices and the bars placed in contact and securely tied together.
2. Splices will not be permitted in main reinforcement at points of maximum stress. When permitted in main bars, splices in adjacent bars will be staggered a minimum of two splice lengths.

**Table 15: Bar Splicing**

Horizontal Bars w/ 12" of Concrete or less below	20 Bar Diameters*
Horizontal Bars w/ more than 12" of concrete below bar	35 Bar Diameters*
Vertical Bars	30 Bar Diameters*

**\*12 inch minimum**

Welding of reinforcing bars will not be permitted.

**D. Placing**

Reinforcement shall be placed as near as possible in the position shown on the Plans. Unless otherwise shown on the Plans, dimensions shown for reinforcement are to the centers of the bars. In the plane of the steel parallel to the nearest surface of concrete, bars shall not vary from plan placement by more than 1/12 of the spacing between bars. In the plane of the steel

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perpendicular to the nearest surface of concrete, bars shall not vary from plan placement by more than 1/4 inch. Cover of concrete to the nearest surface of steel shall never be less than one inch.

Vertical stirrups shall always pass around the main tension members and be attached securely thereto. The reinforcing steel shall be spaced its required distance from the form surface by means of approved galvanized metal spacers with plastic coated tips or plastic spacers if sufficient numbers are used to maintain the required clearance.

All reinforcing steel shall be tied at all intersections, except that where spacing is less than one foot in each direction, alternate intersections only need to be tied.

Mats of wire fabric shall overlap each other sufficiently to maintain a uniform strength and shall be fastened securely at the ends and edges.

No concrete shall be deposited until the Engineer has inspected the placement of the reinforcing steel and given permission to proceed.

### **X. CONCRETE PLACEMENT**

The Engineer shall be given sufficient advance notice before starting to place concrete to permit the inspection of forms and the reinforcing steel placement. No concrete shall be placed prior to the completion of the formwork and the placement of the reinforcement.

Concrete mixing, placing, and finishing shall be done in daylight hours. Placement shall not commence when it is evident that the work cannot be completed before dark, unless adequate provisions are made to light the entire site of all operations.

Concrete placement will not be permitted when impending weather conditions may result in rainfall or low temperature which will impair the quality of the finished work. In case rainfall should occur after placing operations are started, the Contractor shall provide ample covering to protect the work.

The sequence of placing concrete shall be as provided on the Plans or in the Specifications. The operation of depositing and compacting the concrete shall be conducted to produce a compact, dense, impervious mass of uniform texture which shall show smooth faces on all surfaces.

All forms shall be wetted thoroughly before the concrete is placed therein. The method and manner of placing shall be such as to avoid segregation or separation of the aggregate or the displacement of the reinforcement. Concrete shall not have a free fall of more than 3 feet except in the case of thin walls. The splattering of forms or reinforcement bars shall be prevented if the concrete so splattered will dry or harden before being incorporated in the mass.

Each part of the forms shall be filled by depositing concrete directly as near its final position as possible. The coarse aggregate shall be worked back from the face and the concrete forced under and around the reinforcement bars without displacing them. Depositing large quantities at one point in the forms and running or working it along the forms will not be allowed.

After the concrete has taken initial set, the forms shall not be jarred or any strain placed on projecting reinforcement. Concrete shall be placed in continuous horizontal layers approximately 12 inches in thickness. Not more than one hour shall elapse between the placing of successive layers of concrete in any portion of the structure included in a continuous placement. Unauthorized construction joints shall be avoided.

Laitance or foreign matter of any kind shall not be permitted to accumulate inside the forms.

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All concrete shall be well compacted and the mortar flushed to the surface of the forms by continuous working with mechanical vibrators of an approved type. Vibrators of the type which operate by attachment to forms or reinforcement will not be permitted except that external vibration will be allowed when the forms are of steel.

At least one standby vibrator shall be provided for emergency use in addition to the ones required for placement. The vibrators shall be applied to the concrete immediately after deposit and shall be moved throughout the mass, into the corners and angles of the forms until it has been reduced to a plastic mass. The mechanical vibrator shall not be operated so that it will penetrate or disturb previously placed layers which have become partially set or hardened. The vibration shall be of sufficient duration to accomplish thorough compaction and complete embedment of reinforcement and fixtures but shall not be done to an extent that will cause segregation.

Anchor bolts shall be set to exact locations in concrete when it is placed.

### A. Placement Conditions

The concrete shall be mixed in quantities required for immediate use and concrete not in place within the following time limits shall not be used. Retempering of the mix will not be permitted.

**Table 16: Concrete Maximum Mixer Time Based on Temperature**

Air Temperature or Concrete Temperature (Highest Value – Degrees F)	Maximum Time in Mixer (Minutes)
40 to 70	90
75 to 89	60
90 or above	45

In threatening weather, which may result in conditions that will affect the quality of the concrete, the Engineer may order the postponement of the work. Where work has been started and changes in weather conditions require protective measures, the Contractor shall furnish adequate shelter to protect the concrete against damage from rainfall or freezing temperatures.

Concreting will not be permitted when the temperature is 40 degrees and falling.

All concrete which has not attained an age of 24 hours before the atmospheric temperature falls below 40° F shall be covered with framework and satisfactory covering material, so that the air surrounding the concrete and forms may be heated and maintained at a temperature of not less than 50° F, nor more than 90° F for a total of 5 days.

Concrete shall be placed in the forms without the addition of more water to the concrete than required by the design (slump and consistency), and adequately finished without adding excess water on the surface. Control of the initial set of the concrete and lengthening the time for finishing operations under adverse wind, humidity, and hot weather conditions may be accomplished with the use of an approved cement dispersing agent.

The maximum time interval between the addition of mixing water and/or cement to the batch, and the placing of concrete in the forms shall not exceed that set forth in this Chapter.

Where the top slab and walls are placed monolithically in culverts or similar structures more than 4 feet in clear height, an interval of not less than one nor more than 2 hours shall elapse before placing the top slab to allow for shrinkage in the wall concrete. The base slab shall be finished accurately at the proper time to provide a smooth, uniform surface.

## **XI. CONCRETE CURING**

The Engineer shall be fully informed of the methods and procedures proposed for curing. The proper equipment and material in adequate amounts, and the proposed method, equipment and material approved by the Engineer prior to placing the concrete.

Inadequate curing, procedures, methods or application thereof shall be cause for the Engineer to stop all construction on the project until remedial action is taken.

When the air temperature is expected to drop below 35° F, the water curing mats shall be covered with polyethylene sheeting, burlap, polyethylene blankets, or other protection to prevent any possibility of freezing.

A curing day is defined as a calendar day when the temperature, taken in the shade away from artificial heat is above 50° F for at least 19 hours. The curing period shall begin when all concrete has attained its initial set.

The following methods are permitted or required for each concrete placement:

- a. Form Curing - When forms are left in contact with concrete, other curing methods will not be required, except for cold weather protection.
- b. Wet Mat Curing - The cotton mats shall be weighted down adequately to provide continuous contact with the concrete surface. The surfaces of the concrete shall be kept wet for the required curing time. Surfaces which cannot be cured by contact shall be enclosed with mats, and anchored positively so that air cannot enter the enclosure.
- c. A method consisting of overlapping sprays or sprinklers so as to keep all unformed surfaces continuously wet but without adversely affecting the surface may be used with the authorization of the Engineer.
- d. Membrane Curing - Membrane curing shall be applied immediately after the free moisture has left the concrete. Formed surfaces which have been given a first rub shall be dampened and shall be moist at the time of application of the membrane.

When membrane film has been damaged, the Contractor shall repair the damaged portion by immediately applying new film.

## **XII. REMOVAL OF FORMS AND FINISHING SURFACES**

Except as hereinafter provided, forms for surfaces which are required to be surface finished shall, for normal concrete, be removed when the concrete has aged not less than 4 nor more than 7 days.

Forms under slabs, caps or beams shall be left in place 7 days plus one day for each 10 feet of span.

Any defective work discovered after the forms have been removed shall be repaired immediately. In repairing honeycombed areas, all loose material shall be removed before the repair work is started. Thorite or equal patching mortar shall be used in the patching of defective areas in accordance with the manufacturer's instructions. After stripping forms, cut all tie-wires to a depth of 3/4 inch. Dampen these and all honeycombed areas with clean water and patch flush with Thorite or Tamm's equal product. After patching, finish exposed concrete from 6 inches below grade with one coat of Thoroseal cement based coating mixed with one part of Acryl 60 and three parts of water at two pounds per square yard.

Apply second brush coat at same rate after first coat has set. When finish coat has set, float it to a uniform texture with a sponge float. Do not apply in temperatures below 40 degrees F or

when temperature is expected to fall below 40 degrees F within 24 hours.

### **XIII. TESTING OF HYDRAULIC CONCRETE STRUCTURES**

Concrete structures which are intended to contain liquid shall be tested for water tightness.

Exfiltration testing shall be conducted for large concrete structures. To conduct the test, clean water shall be introduced to the interior of the structure to a level at least one foot above the hydraulic joint to be tested, however, at the discretion of the Engineer, the structure may need to be filled to the operating level. The level of the water shall be measured using a staff gauge, plumb bob, or similar device, by the Engineer or his representative.

After the 24 hour test period the water level shall be remeasured. A calculation of volume change shall be made. The allowable leakage is NONE. If the test does not meet the criteria, repairs shall be made and the structure re-tested.

### **XIV. MISCELLANEOUS**

#### **A. Expansion Joint Material**

Preformed fiber expansion joint material shall be of the dimensions shown on the Plans. "Preformed Bituminous Fiber Material" shall be formed from cane or other suitable fibers of a cellular nature securely bound together and uniformly impregnated with a suitable asphaltic binder and shall meet the requirements of the Standard Specifications for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction, ASTM Designation: DI75I-65.

#### **B. Waterstop**

Waterstops shall be a self sealing extruding plastic strip approximately one square inch in cross-section which does not require the addition of any compound or plasticizer to function. It shall have protective strips which are easily removed for installation. Waterstop shall be Synko-flex or equal. (Synko-flex Products Co. in Houston).

#### **C. Grout**

Where non-shrink grout is indicated on the Plans for plugging holes in concrete and filling concrete pipe sleeves and blockouts, the Contractor shall provide high strength, non-shrink, non-metallic, grout with compressive strength not less than 5000 psi at 3 days and 8000 psi at 28 days.

Where grouting is required for anchor bolts, imbedded items, equipment and machinery bases, the Contractor shall provide high strength, high impact resistant, non-shrink, epoxy grout with compressive strength not less than 12,000 psi and tensile strength not less than 2000 psi.

## APPENDIX 1

Air Test Data Sheet

Mandrel Test Report

Waterline Pressure Test Results

Standard Grease Trap/Sand Trap and Plumbing Interceptor

DR-01: Storm Sewer Line Bedding Detail (Existing Paved Surface)

DR-02: Storm Sewer Line Bedding Detail (Non-Paved Surface)

DR-05: Bolted Storm Sewer Manhole Cover and Frame Detail

DR-06: Non-bolted Storm Sewer Manhole Cover and Frame Detail

DR-07: Storm Sewer Inlet Cover and Frame Detail

EC-01: Stabilized Construction Entrance Detail

EC-02: Silt Fence Detail

EC-03: Curb Inlet Protection Detail

EC-04: Area Inlet Protection Detail

EC-05: Tree Protection Notes

EC-06: Tree Protection Tree Wells

EC-07: Tree Protection Fence Locations

EC-08: Tree Protection Fence-Chain Link

ST-01: Sidewalk Detail

ST-02: Concrete Driveway Detail (Residential)

ST-03: Concrete Driveway Detail (Commercial or Multi-Family)

ST-04: Laydown and Ribbon Curb Detail (with Curb Expansion Joint Dowel Detail)

ST-05: Spill and Catch Curb Detail (with Curb Expansion Joint Dowel Detail)

ST-06: Concrete Valley Gutter Detail

ST-07: Sidewalk Pedestrian Ramp Detail (Type 1)

ST-08: Sidewalk Pedestrian Ramp Detail (Type 2)

ST-10A: Local Street Section – *Reserved for future use*

ST-11A: Collector Street Section – *Reserved for future use*

ST-12: Un-divided Arterial Street Section – *Reserved for future use*

ST-12A: Divided Arterial Street Section – *Reserved for future use*

ST-13: Fire Lane Marking Detail

ST-14: Concrete Driveway Detail (Ribbon Curb or Rural Section)

WT-01: Water Service Casing Detail

WT-02: Single 5/8" or 1" Water Meter Detail

WT-03: Single 1 1/2" or 2" Water Meter Detail

WT-04: Dual 5/8", 3/4" or 1" Water Meters Detail

WT-05: Fire Hydrant Assembly Detail

WT-06: Valve Box Assembly Detail

WT-06A: Valve Box Casting Lid

WT-06B: Valve Box Casting Paving Ring

WT-06B: Valve Box Casting Paving Ring

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- WT-07: Waterline Bedding and Pavement Repair Detail (Existing Paved Surface)
- WT-08: Waterline Bedding and Surface Repair Detail (Non-paved & Proposed Paved Surfaces)
- WT-09: Waterline and Storm Sewer Line Crossing Detail (Type 1)
- WT-10: Waterline and Storm Sewer Line Crossing Detail (Type 2)
- WT-11: Vertical Valve Installation Detail
- WT-12: Horizontal Valve Installation Detail
- WT-13: Compound Water Meter Vault Detail
- WT-14: 1" thru 2" Air Release Valve Installation Detail (Developed Areas)
- WT-15: 1" thru 2" Air Release Valve Installation Details (Undeveloped Areas)
- WT-16: Pipe Encasement Detail
- WW-01: Precast Concrete Wastewater Manhole Detail
- WW-02: Precast Concrete Wastewater Manhole with Drop Connection Detail
- WW-03: Precast Concrete Wastewater Manhole with Drop Service Detail
- WW-05: Manhole Vent for Below Ground Installation Detail (Developed Areas)
- WW-06: Manhole Vent for Above Ground Installation Detail (Undeveloped Areas)
- WW-07: Bolted Wastewater Manhole Cover and Frame Detail
- WW-08: Non-bolted Wastewater Manhole Cover and Frame Detail
- WW-09: Precast 48" Concentric Concrete Cone Section Detail
- WW-10: Flexible "Seal Boot" Resilient Connector Detail
- WW-11: Wastewater Flow Patterns for Invert Channels Detail
- WW-12: Wastewater Service Detail
- WW-13: Wastewater Clean-out Detail (Paved Surface)
- WW-14: Wastewater Clean-out Detail (Non-paved Surface)
- WW-15: Wastewater Manhole Abandonment Detail
- WW-16: Wastewater Lateral Connection to Existing Wastewater Main Detail
- WW-17: Wastewater Line Bedding and Pavement Repair Detail
- WW-18: Wastewater Line Bedding and Surface Repair Detail (Non-paved & Proposed Paved Surfaces)