

PUBLIC IMPROVEMENT SPECIFICATIONS

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SECTION ONE - INTRODUCTION

1.0 PURPOSE - The purpose of this Chapter is to give a general view of the working relationship between the developer and the local government engineer concerning the specifications listed in this manual. This chapter also explains some of the terminology used throughout this manual and lists the references referred to hereinafter.

1.1 GENERAL - These specifications are established under the authority of the Henderson City-County Planning Commission for the convenience of all persons, firms, or corporations constructing improvements which are or may become public facilities under the jurisdiction of the City and County of Henderson. Whenever, in these specifications, the term developer is used, it shall refer to the person, firm or corporation installing the work.

Whenever, in these specifications, the term engineer is used, it shall refer to the Henderson City Engineer, the Henderson County Engineer, or their duly authorized representatives having jurisdiction over the work to be performed.

1.2 REFERENCES - Certain technical aspects concerning construction materials and methods of construction are based on the Kentucky Department of Transportation, standard Specifications for Road and Bridge Construction, current edition, hereafter referred to as the Kentucky Department of Transportation Specifications or K.D.T.S. A copy of said specifications is on file in the office of the Henderson City Engineer.

Other standards or specifications referred to are those of the American Society of Testing Materials (ASTM), American Association of State Highway Officials (AASHO), Portland Cement Association (PCA), American Public Works Association (APWA), and the American Waterworks Association (AWWA).

Standard drawings showing details of certain improvements which may be issued by the Engineer, shall be complementary to and a part of this report.

1.3 INTERPRETATION - The Engineer shall decide on all questions which may arise as to the interpretation of the specifications or plans relating to the work, and all questions as to the acceptable fulfillment of the work performed by the developer. He shall decide any and all questions which may arise as to the quality and acceptability of materials furnished and work performed and as to the manner of performance of the work.

1.4 OBLIGATION OF THE DEVELOPER - The developer shall perform and complete the work to the satisfaction of the Engineer and in accordance with these specifications. The developer shall conduct his work so as to minimize interference with public and private business and traffic. He shall, at his own expense, whenever necessary or required, provide barricades, flagmen, maintain lights, and take other precautions as may be necessary to protect life, property, adjacent buildings, and structures. The developer shall be liable for all damages and injuries received or sustained by any person, persons or property in consequence of any neglect or misconduct by him or his agents, subcontractors, employees, or workmen.

1.5 PLANS - For use during construction of improvements, two (2) complete sets of prints of all improvement plans shall be furnished to the office of the Engineer. These plans shall have been preliminarily approved by the Henderson City-County Planning Commission. All plans of sanitary sewers and sewage handling facilities, storm sewers and associated facilities and street grades shall be certified by a Registered Professional Engineer licensed in the State of Kentucky. In addition, one (1) copy of all design calculations in connection with sanitary and storm drainage facilities shall be furnished at the request of the Engineer.

A complete and accurate set of field notes shall be prepared showing the actual locations of all sanitary sewer and water connections.

Connections shall be located by accurate field measurements relative to manhole structures. One (1) copy of this information shall be furnished to the office of the Engineer.

1.6 COOPERATION - Cooperation with the office of the Engineer concerning construction planning and procedures is required. Reasonable notice shall be given the Engineer or his representative prior to beginning any phase of construction, normally 24 hours prior to work activity but in unusual cases may not be less than 4 hours in advance of work.

1.7 DEFECTIVE MATERIALS AND WORKMANSHIP - Materials not in accordance with the specifications or defective work may be condemned by the Engineer at any time before final approval and acceptance by the Engineer. Failure by the Engineer to condemn defective work shall not be construed as an acceptance of same.

1.8 INSPECTION DURING CONSTRUCTION - All subdivision improvements must conform to the adopted Public Improvement Specifications and be satisfactory to the Engineer.

1.9 FINAL INSPECTION - In addition to normal inspection which may be conducted during construction of development improvements, a final inspection will be made by the Engineer and/or his representative. Final inspection will be made prior to acceptance of any unit for maintenance by the local government and only after all improvements are completed. As part of the final inspection, all sanitary and storm manholes or access openings shall be opened. All sanitary and storm drain facilities shall be cleaned of all dirt, mud, and other foreign matter. The developer shall provide personnel as required to aid in the final inspection.

1.10 EXISTING UTILITIES - Special precautions shall be taken by the Developer to avoid damage to existing overhead and underground utilities owned and operated by the City or by public or private utility companies.

Where existing utilities or appurtenant structures, wither underground or aboveground are encountered, they shall not be displaced or molested unless necessary, and in such cases shall be replaced in as good or better condition than found as quickly as possible.

The developer shall bear the entire responsibility for locating, avoiding or repairing damage to said existing utilities.

1.11 PERMITS, EASEMENTS AND RIGHTS-OF-WAY - Unless otherwise required by the agencies involved, the developer shall make application for, obtain and pay for all licenses, permits, easements, and rights-of-way. The developer shall be required to comply with all State Municipal ordinances, laws, and/or codes which may apply to same.

1.12 SOIL AND/OR MATERIAL TESTING - All such testing may be performed by the local engineer or street inspector, and further provided that if there is a disagreement between the developer or contractor with the results of such testing, and an independent laboratory test is requested by the developer or contractor such testing shall be paid in full by the contractor or developer requesting same. Method of testing to conform to the revised designation by agency identifying such tests.

SECTION TWO - MATERIALS

2.0 PURPOSE - The purpose of this chapter is to give the specifications for the primary materials utilized in the construction of roads, storm sewers, and other related items in the construction of public utilities.

2.1 CEMENT CONCRETE - All cement concrete shall be in accordance with the Kentucky Department of Transportation current specifications.

2.2 BITUMINOUS CONCRETE - All materials shall conform to Kentucky State Department of Transportation current specifications.

2.3 AGGREGATE MATERIALS - All aggregate materials shall conform to Kentucky State Department of Transportation current standards.

2.4 CONCRETE PIPE

- a. Plain Concrete Pipe - Plain concrete pipe shall conform to the requirements of AASHO M-85.
- b. Reinforced Concrete Pipe - Reinforced concrete pipe shall conform to the requirements of AASHO M-170.
- c. Reinforced Elliptical Concrete Pipe - Reinforced elliptical pipe shall conform to the requirements of AASHO M-207.

2.5 CORRUGATED METAL PIPE AND PIPE ARCHES

-These specifications cover riveted corrugated metal culvert pipe and pipe arches intended to be used for the construction of culverts.

All corrugated metal pipe and pipe arches shall be bituminous coated.

The pipe and pipe arches shall be fabricated in full compliance with the specifications of AASHO M-36, except as herein modified.

The coupling bands shall not be less than 12 inches wide for culvert pipe having diameters of 60 inches or greater.

2.6 STEEL CASTING PIPE - Steel casting pipe for highway or railroad crossings shall be bored and/or jacked in place. All joints between lengths shall be solidly welded with a smooth non-obstructing joint inside.

After the pipe has been installed in the casting pipe, inspected and tested, both ends of the cover pipe shall be sealed completely with concrete in a manner acceptable to the Engineer.

Adequate construction methods to be provided as outlined in standard drawing and special care shall be required in placing bedding, tamping the cover materials under and above the pipes.

2.7 ALTERNATIVE PIPES - Any other pipes not covered above will be evaluated on individual basis to provide adequate drainage and structural requirements. Polyethylene storm sewer pipe -- double wall, corrugated exterior with smooth flow interior, HDPE pipe manufactured specifically for use as storm sewer pipe may be used for storm sewer construction. This pipe shall be sized

based on a Manning Number of no less than 0.012 and shall be designed to have a minimum of two foot cover, as for all other storm sewer pipe and select granular backfill may be used. Pipe shall be joined with hands specifically manufactured for use with this type pipe and the corrugations of the bands shall match that of the pipe. These bands shall be of no less than one foot and shall prevent infiltration of surrounding material. All pipe shall meet minimum ASTM standards for storm sewer construction. If deemed necessary by the Local Government Engineer, the design engineer shall submit manufacturer's information to prove that a specified HDPE storm sewer pipe meets these minimum regulations. Where pipe fittings are required or specified these shall meet the same specifications as the pipe.

SECTION THREE: STREETS

3.0 PURPOSE - The purpose of this chapter is to give the standards to which all streets should be designed and built.

3.1 STREET GEOMETRIES - All streets shall conform to the applicable geometric, cross-sections, and intersection standards outlined in the Subdivision Regulations and standard drawings.

3.2 EARTHWORK - All embankments, excavation, grading, stripping, topsoiling, etc., shall be done in accordance with the following outlined specifications.

3.2.1 GENERAL - Only materials acceptable to the Engineer shall be used in embankment formation. No frozen material, stumps, logs, roots or other perishable materials shall be placed in any embankment. No storm or masonry fragment greater than 4 inches in any dimension shall be placed within 12 inches of the finished grade elevation.

All excavation, embankment construction, grading, stumping and topsoiling shall be accomplished at such places as are indicated on the plans and to the lines, grades and elevations shown on the plans, in the specifications or as directed by the Engineer.

3.2.2 EMBANKMENT CONSTRUCTION METHODS - Before embankment placement is begun, all vegetation and rubbish shall be removed from the area within the limits of the embankment. This material shall be disposed of in a method approved by the Engineer.

Embankments shall not be constructed upon frozen areas. All snow and ice shall be removed from the area to be covered prior to placement of embankment material.

Earth embankment shall be formed by distributing the material in successive uniform horizontal layers not exceeding 12 inches in thickness, loose depth, to the full width of the cross section. Each layer of the embankment shall be thoroughly compacted as hereinafter specified. The embankment shall be properly drained at all times.

.a. Clearing and Grubbing - The developer shall accomplish all clearing and/or clearing and grubbing within the limits designated on the plans or as directed by the Engineer, or as required for the construction of the work involved and shall satisfactorily dispose of all materials so removed.

The work under this paragraph shall consist of the curing and removing all trees, stumps, brush, logs, removal of fences, or other loose or projecting material within the designated areas. Unless otherwise specified, it shall also include the grubbing of stumps, roots, and other natural obstructions which, in the opinion of the Engineer, must be removed to properly prosecute the construction work and properly operate the facility upon completion of construction. Disposal shall

be by burning or other methods satisfactory to the Engineer. Trees which are designated to remain shall be properly protected.

.b. Excavation - Shall consist of the removal and satisfactory disposal of all materials taken from between the original ground line and the excavation limits approved by the Engineer as shown on the final cross-sections.

All materials encountered, of whatever nature, within the limits designated shall be removed and disposed of as directed. During the process of excavation, the grade shall be maintained in such condition that it will be well drained at all times. When directed, temporary drains and/or drainage ditches shall be installed at the Developer's own expense to intercept or divert surface water which may affect the prosecution of condition of the work. If at any time it is not possible to place excavated material in its proper section of the permanent construction, it shall be stockpiled in approved areas for later use.

Where rock, shale, clay, hardpan or other unsatisfactory subgrade material is encountered, it shall be excavated to a depth of at least 12 inches below subgrade, or to such greater depth below subgrade as the Engineer may direct. The portion so excavated shall be refilled and compacted as set out herein before in the section "Embankments" or as specified by the Engineer.

.c. Embankment Compaction - Shall be required to bring the soil layers to a uniform density and such density shall not be less than 90 percent of maximum density as determined by the Method of ASTM D1557 Modified Proctor.

Should the subgrade lose its density for any reason prior to construction of a base, it shall be recompacted. Any are in the subgrade which has yielding or unsuitable material shall be excavated and backfilled with approved material properly compacted as directed by the engineer.

Breakage and undercutting, including slides in that portion of any material displaced or loosened beyond the limits of the finished work as shown on the approved plans. All breakage shall be removed by the developer and disposed of as directed by the Engineer.

3.2.3 GRADING - Consists of the preparation, shaping, and compaction of that portion of the roadbed upon which base or pavement, including base and paving for shoulders is to be placed.

.a. Subgrade Preparation - Shall be accomplished by shaping to the lines, grades

and typical sections shown on the plans, Where the Engineer directs that areas of the subgrade are to be stabilized, the subgrade surface in such areas may be left uniformly Material excavated in preparing the subgrade shall be stored or stockpiled in such manner as to not interfere with proper drainage or any of the subsequent operations of placing base or pavement.

Compaction of subgrade shall be accomplished as set out hereinbefore in the section on "Embankments". The developer shall dry or add moisture to the subgrade to achieve a uniformly compacted and acceptable subgrade and to achieve the specified compaction at or near optimum moisture content as determined from test of ASTM D 1557 Modified Proctor.

A tolerance of plus or minus 3/4 inch from the established grade will be permitted in the graded, compacted subgrade. No base or pavement construction shall begin on subgrade which has not been inspected and approved by the Engineer.

3.3 BASE COURSE FOR BITUMINOUS CONCRETE AND CEMENT CONCRETE SURFACES - Base course shall be of Dense Graded Aggregate as hereinbefore specified in Section Two and shall be a minimum of six (6) inches thick after compaction for bituminous concrete pavements. Additional D.G.A. thickness may be required as shown on approved plans. The D.G.A. shall be mixed with water, in a pugmill type mixer approved by the Engineer, so as to contain 4% to 6% moisture by weight at the time of completion.

D.G.A. base shall not be required under cement concrete pavement unless warranted by subgrade conditions as deemed necessary by the Local Government Engineer.

Number 610 crushed stone may be used in lieu of D.G.A. where permitted by the Engineer.

The D.G.A. shall be placed on the prepared subgrade, shaped and compacted to the lines, grades and cross sections shown on the plans or approved by the engineer. It shall have no more than 1/2 inch deviation from the typical section after compaction. The base material may be placed by tail-gating from trucks and spread with a motor grader. Providing such operation produces uniform grade and section satisfactory to the Engineer. The base shall be placed in two (2) approximately equal layers and each layer shall be compacted to the required density.

The D.G.A. base shall be compacted to a density of not less than 90% of solid volume throughout the layer. The density determination will be based on the oven-dry bulk specific gravity, ASTM C-127 and the dry weight of the aggregate from the test hole. The in-place density will be determined by the Method of Test for Density of Soil in place by the Rubber-Balloon Method, ASTM D-2167.

3.4 BITUMINOUS CONCRETE BASE AND SURFACE COURSE - All bituminous concrete shall be hot-mixed and hot-laid on a prepared subgrade, old surface or underlying course. The pavement on new construction shall consist of not less than:

below grade to provide for the addition of stabilizer aggregate.

Three inches of Class I Base Course; and one (1) inch of Class I, Type A Surface Course.

3.4.1 SPREADING AND FINISHING - All bituminous concrete shall be laid using self-propelled pavers which are capable of spreading and finishing all course to the indicated widths and depths, true to lime, grade and cross section as shown on the plans or directed by the Engineer, with a smooth finish uniform in density and texture. The screed shall be preheated uniformly throughout its length. The paver shall be equipped with hopper and distributing screws of the reversing type that will place the material evenly in front of the screed. Mechanical or electronic devices to be provided to confine the edge to true line and to adjust the gradeline so than minor changes in grade elevation will not be reflected in the finished surface.

A string line to be placed by the developer for the first lane of each layer of mixture placed to provide alignment control for the paver, except that a string line will not be required when the first layer is placed adjacent to a curb section.

Pavers shall be equipped with quick and efficient steering mechanism and shall operate at variable speeds consistent with proper laying of materials, but shall not exceed a speed of 50 feet per minute. When placing adjacent lanes of the same course, pavers shall be equipped with a joint matching device which will automatically provide control of the depth of the mixture being placed so that, when compacted, it will match the depth of the existing lane. All paving machines shall be kept in first class mechanical condition.

All bituminous concrete shall be a temperature when laid of not less than 225E F and not more than 300E F. Machine pavers shall spread the mixture as described hereinbefore. After striking off and before rolling, the surface of each course shall be checked for irregularities and corrected as necessary. Over areas where machine paving is impractical, hand spreading may be done. The material shall be uniformly distributed, without segregation, to the depth necessary to provide the required compacted depth. Rakes may be used, but the final leveling and surface adjustment shall be done with mechanical or manually operated screeds or lutes.

3.4.2 COMPACTION - Shall be done by rolling each course as soon as the mixture has cooled sufficiently to bear the weight of the roller without undue displacement. Each paving spread operation shall have a minimum of the following rollers:

One three-wheel, steel-wheeled roller weighing not less than ten (10) tons for initial or breakdown rolling on bituminous base course only.

One two-axle, steel-tire tandem roller weighing not less than eight (8) tons, for final rolling on bituminous base and surface courses. These rollers shall be in good

condition, capable or reversing without backlash. The steel-wheel rollers shall be equipped with wetting devices to prevent the mixture from sticking to the roller wheels, or as approved by the Engineer.

The initial or breakdown rolling shall consist of one complete coverage of the course with a three-wheel roller (10 tons). The final rolling shall be performed with a two-axle tandem roller (8 tons), and shall

In area inaccessible to equipment, the mixture shall be thoroughly compacted by the use of hand tampers or hand operated mechanical tampers.

3.4.3 FINISHED SURFACE TOLERANCE - Shall show no deviation greater than 1/4 inch from a ten (10) foot straight edge placed parallel to the centerline nor more than 1/4 inch from the typical cross-section.

3.4.4 MINIMUM CONSTRUCTION LENGTH - Minimum construction length of street which will be approved to receive bituminous paving shall be 500 feet or the distance between street intersections unless otherwise approved by the Engineer.

Except for streets stubbed out to adjacent property, the subgrade shall be prepared to elevations as shown on the plans for a minimum of 25 feet beyond the end of the base aggregate.

The bituminous base shall be placed no closer than 10 feet from the end of an aggregate base and the bituminous surface no closer than 5 feet from the bituminous base.

3.4.5 JOINTS - When the laying of the mixture is to be suspended long enough to permit the mixture to become chilled, transverse joints shall be constructed. At the end of the days operation, the developer shall construct a sloped wedge ahead of the end of the fill depth pavement to provide for proper compaction and protection of the full depth pavement.

Before paving operations are resumed, the developer shall remove the sloped wedge and cut back into the previously constructed pavement to the point of full pavement depth. Such joints shall be vertical and in a straight line perpendicular to the course.

When multi-lane, multi-layer construction is required, the width of paving spreads shall be adjusted so as to provide for off-setting of longitudinal joints in the base and surface courses.

3.4.6 WEATHER AND SEASONAL LIMITATIONS - No bituminous concrete shall be laid when the air temperature is below 40 E F., nor when the underlying course is wet, nor when other weather conditions are unsuitable.

No hot-mix bituminous concrete shall be laid between December 1 and April 1, unless otherwise directed by the Engineer. Any exceptions shall require prior written approval by the Engineer.

3.5 CEMENT CONCRETE PAVEMENT - Shall consist of a single course, having a minimum depth of at least six (6) inches

operate continuously until all roller marks are eliminated and satisfactory density has been obtained.

Rolling shall begin at the sides and proceed longitudinally parallel to the road center line, each trip overlapping one-half roller width, progressing to the high point of the road. On super-elevated curves rolling shall begin at the low side and progress to the high side with trips overlapping as provided above.

and shall be constructed on a prepared base in close conformity with the lines, grades and cross-sections shown on the plans, in accordance with the specifications contained herein.

D.G.A. base shall not be required under cement concrete pavement unless warranted by subgrade conditions as deemed necessary by the Local Government Engineer.

Number 610 crushed stone may be used in lieu of D.G.A. where permitted by the Engineer.

The pavement shall include longitudinal and transverse joints as shown on the plans in accordance with the specifications contained herein. The concrete pavement shall consist of Type "D" 4000 p.s.i., air entrained concrete in accordance with the KDTS.

Perforated pipe underdraining shall be installed parallel to the centerline of the street as shown on the plans in accordance with the specifications contained herein.

3.5.1 PREPARATION AND CONTROL OF CONCRETE MIXES - Shall be made in accordance with the following specifications and shall meet the approval of the Engineer.

.a. Patching may be performed at a batch plant, central mix plant, or in truck mixers as approved by the Engineer. All such plants or mixers shall have bins, weighing hoppers, and scales which meet the approval of the Engineer.

.b. Proportioning - The Engineer shall approve the proportions for the aggregates and water to obtain a satisfactory mix with the required cement content, and no subsequent changes will be permitted except as directed by the Engineer. The concrete mix shall be designed to contain six (6) bags of cement for each cubic yard produced.

The quantity of fine aggregate shall not be less than 34% nor more than 40% of the total combined solid volumes of the fine and coarse aggregate in a saturated surface dry condition, used in the proportions per bag of cement. The aggregates shall be proportioned to use the maximum percentage of coarse aggregate and the minimum percentage of fine aggregate which will produce a plastic workable mix. When the aggregates are drier than a saturated-surface-dry condition, or when the aggregates contain free moisture, proper adjustments shall be made for aggregate

batch weights to compensate for any such conditions.

The maximum free water content in the mix, including the surface moisture in the aggregates, shall not exceed 5.75 gallons per sack of cement.

..c. Consistency of Concrete - The mixture shall contain no more water than is necessary to produce a workable plastic concrete. The consistency of the concrete

..d. Air Entrainment - Unless otherwise specified, the required air content of the concrete shall be 6, plus or minus 2, percent by volume. The entrainment of air may be accomplished by introducing at the mixer an approved air entraining admixture, by blending normal portland cement with a natural cement having an air entraining agent interground, or by using an air entraining portland cement having an air entraining agent interground.

..e. Strength of Concrete - The minimum expected strength of concrete at 28 days is 4,000 pounds per square inch compressive strength and 500 pounds per square inch modulus of rupture when test in accordance with methods ASTM C-39 and ASTM C-78, respectively.

The Engineer may direct the removal and replacement of sections of the pavement from which the concrete specimens consistently tested at low strength.

..f. Hauling Equipment - The concrete shall be transported in truck mixers or agitator trucks which are approved by the Engineer.

3.5.2 SUBGRADE AND BASE PREPARATION - Beneath portland cement concrete pavement shall be done in accordance with previous sections of this manual, except that the developer shall use an approved machine to produce final subgrade and base surfaces, meeting the lines, grades and cross-sections, required by the plans. When in the judgement of the Engineer the pavement design makes the use of such equipment impractical then this requirement will be waived.

The surface of the base shall be damp at the time the concrete is placed. The developer shall sprinkle the base when necessary to provide a damp surface. The developer shall satisfactorily correct all soft areas in the subgrade or base prior to placing concrete.

Proper protection measures should be taken to prevent disturbance to the subgrade due to hauling over subgrade.

3.5.3 FORMING - Forms shall be of such section and design that they will adequately support the concrete and the construction equipment.

shall be continuously uniform and shall be measured in accordance with the "Slump Test" ASTM C-143.

The slump shall not be less than 1 1/2 inches nor more than 5 inches for concrete to be placed without vibration. The slump shall not be more than 1 1/2 inches when the concrete is to be vibrated during placement.

All forms must be inspected and approved by the local government engineer or his authorized representative, prior to placement of cement concrete mix.

The top face of the form shall not vary from a true plane more than 1/8 inch in ten feet. All forms shall be thoroughly oiled before any concrete is placed. Forms shall be set a sufficient distance in advance of the point where the concrete is being placed to provide for a continuous operation in placing the concrete and for proper inspection of line and grade.

Forms shall not be removed from freshly placed concrete until it has hardened sufficiently to resist spalling, cracking or any other damage, but in no case until at least 12 hours after the concrete has been placed. Any honey-combed areas along the sides or edges of the slab shall be repaired by filling with mortar immediately after the forms have been removed. The mortar shall consist of one part cement and two parts of fine aggregate.

3.5.4 CONCRETE PLACEMENT - Concrete shall be handled in such a manner as to prevent segregation and kept free from mud, soil or any other foreign matter.

All finishing operations must be completed during daytime hours.

Paving operations shall not be undertaken or shall be discontinued when any of the following conditions exist:

..a. When a descending air temperature in the shade and away from artificial heat reaches 40 degrees F.

..b. When the subgrade or base course is frozen.

..c. When aggregates to be used in the mix contain frozen particles.

The mixer and hauling equipment shall not be operated on any new pavement until at least 10 curing days have elapsed. When the mixer is operated on new pavement, the developer shall operate the paver on wood matting or other approved material which will prevent the marking of the pavement and will distribute the load uniformly over the mat area.

3.5.5 SPECIAL DESIGN - Special design may be required by the Engineer if subsoil condition is not adequate for heavily traveled and industrial roads.

3.5.6 SPREADING AND VIBRATING CONCRETE - The concrete shall be spread over the entire area between the forms without segregation. Spreading shall be done with appropriate spreading equipment.

After the concrete has been placed, it shall be uniformly vibrated. This vibrating shall be accomplished by approved methods.

3.5.7 CONCRETE FINISHING - Shall be accomplished with a combination of approved equipment. Hand finishing will be permitted when the use of mechanical finishing equipment is impractical.

Where transverse contraction joints are to be sawed, approved joint filler shall be placed at intervals to control random cracking. Sawing shall be done as soon as the concrete has hardened sufficiently to be sawed without spalling and raveling, usually 6 to 24 hours after placing and before shrinkage cracking occurs.

Transverse contraction joints shall be constructed at 20 foot intervals unless otherwise shown on the plans. Where the pavement is constructed adjacent to an existing concrete pavement, the joint shall be placed to match the existing joints.

.b. Longitudinal Contraction Joints - Shall be constructed in all pavements wider than 20 feet in accordance with the details and dimensions shown on the plans, and shall be formed by an approved joint insert or by an approved concrete saw.

When a joint insert is used, the alignment of the finished joint shall be parallel with the center line of the pavement and shall be free from local irregularities in alignment.

Where longitudinal contraction joints are sawed, sawing shall be done as soon as the concrete has hardened sufficiently to be sawed without spalling and raveling, but not more than 2 days after the concrete is placed.

.c. Transverse Construction Joints - Shall be constructed at the end of each day's operation (planned joint) or whenever the placing of concrete is suspended for more than 30 minutes (emergency joint). The joints shall be formed by placing an approved header shaped to fit the pavement typical section which forms a vertical face on the end of the pavement.

Reinforcing steel tie bars shall be required at transverse construction joints on collector streets and primary and secondary arterial. The header shall be designed to permit the

The concrete shall be screeded and float finished to the required cross-section and then shall be checked by the use of hand-held, 10 foot straightedges for longitudinal surface uniformity.

The final finishing of the pavement shall be accomplished by burlap dragging, brooming or other acceptable methods which will produce a similar surface texture.

3.5.8 JOINTS - Shall be constructed according to the plans.

.a. Transverse Contraction Joints - Shall be formed by an approved joint tool or by sawing with an approved concrete saw.

placement of tie or dowel bars, where required, and shall hold such bars in their correct locations, in accordance with the joint detailed drawings contained herein.

Plan transverse construction joints shall be located at the same spacing required for transverse contraction joints.

The spacing of contraction joints shall not be changed due to emergency construction joints and the emergency construction joint shall be located less than three (3) feet from an contraction joint.

.d. Longitudinal Construction Joints - Where necessary, shall be constructed in accordance with the joint detailed drawings contained herein.

.e. Transverse Expansion Joints - Shall be constructed in accordance with the joint detailed drawings contained herein.

.f. Sealing Joints - The concrete shall be at least 3 days old before the joint is sealed. Joints shall be sealed as soon after this 3 day period as possible, and before any traffic is allowed on the pavement. The joint shall be thoroughly cleaned and dry before sealing.

When the joints have dried, they shall be filled to within approximately 1/8 inch of the surface of the pavement with joint sealer. Care shall be taken in handling the nozzle of the application equipment so that the joint will be filled from the bottom up. Any sealer spilled on the surface of the concrete shall be removed immediately.

A premolded insert shall be used to seal joints where required by plans.

3.5.9 CURING CONCRETE - Immediately after finishing operations have been completed and surface water has disappeared, all exposed surfaces of the pavement shall be cured by one of the methods covered hereinafter.

The total curing period shall be a minimum of three (3) days for all methods.

.a. Liquid Membrane Curing Compounds - The minimum rate of application shall be one (1) gallon per 200 square feet when the application equipment is mechanically operated or one (1) gallon per 150 square feet when the application equipment is hand operated.

.b. Polyethylene Film - The sections of the film shall be spread in such a manner which will prevent damage to the finished pavement surface. Lap joints of the sections will be at least 12 inches wide and suitable precaution shall be taken to prevent the circulation of air beneath the film.

.c. Burlap - The sections of the burlap shall be spread in such a manner which will prevent damage to the finished pavement surface. Lap joints will be at least 6 inches wide.

The burlap shall be thoroughly saturated prior to placing on the concrete and shall be kept thoroughly wet throughout the curing period.

.d. Paper Blankets - The sections of the paper blankets shall be spread in a manner which will prevent damage to the finished pavement surface.

Lap joints of the section shall be at least 12 inches wide and suitable precaution shall be taken to prevent the circulation of air beneath the blankets.

3.5.10 PROTECTION FROM COLD WEATHER

AND RAIN - Concrete less than 72 hours old, which may be subject to damage by freezing, shall be adequately protected until the concrete reaches an age of 72 hours. Concrete damaged as a result of freezing shall be removed and replaced at the expense of the developer.

Protective coverings which will protect the surface of freshly placed pavement from rain shall be readily available at the site of the work. An adequate quantity of other materials shall be stored at the paving train. Concrete damaged as a result of failure on the part of the developer to adequately protect the concrete from rain shall be repaired or removed and replaced at the expense of the developer.

3.5.11 FINAL SURFACE TESTING - As soon as the concrete has set sufficiently to permit walking on it without marring the surface, it shall be tested by the contractor in the presence of the engineer along with the center point and the quarter points of the pavement with a rolling straightedge furnished by the contractor.

The rolling straightedge shall be 10 feet in length between the center of the wheels. It shall be so designed, constructed and adjusted so that it will adequately indicate and mark all pavement areas which deviate from a plan surface by more than 1/4 inch in 10 feet. The rolling straightedge shall be of a design approved by the engineer.

All deviations more than 1/4 inch in 10 feet marked by the straightedge shall be corrected to within this tolerance by being rubbed or ground down and refinished.

SECTION FOUR: SIDEWALKS, CURB AND GUTTER

4.0 PURPOSE - The purpose of this chapter is to outline requirements for proper design, construction, and inspection of concrete sidewalks, curb and gutter.

4.1 SIDEWALKS, CURB AND GUTTER - Shall be in accordance with the following specifications and subject to approval by the engineer.

4.2 CONCRETE SIDEWALKS - Shall be constructed of Portland Cement Concrete in accordance with the requirements shown on the plans and the provisions of this specifications.

4.2.1 Material - Concrete shall have a minimum 28 day compressive strength of 3500 psi. Air-entraining admixture may be used, but will not be required.

Expansion joint material shall conform to the requirements of K.D.H.S.

4.2.2 Construction Methods - The sidewalk and sidewalk aprons shall be constructed on a prepared, compacted smooth subgrade of uniform density formed by trenching or filling, to the required elevation. Large boulders and ledge rock found in the subgrade shall be removed to a minimum depth of 6 inches below the finished subgrade elevation and the space shall be backfilled with suitable material which shall then be thoroughly compacted by rolling or tamping.

The forms shall be of either metal or wood and shall be straight, free from warp, of sufficient strength to resist springing during construction, and of a height approximately equal to the depth to the sidewalk or sidewalk apron to be constructed. Wood forms shall have a minimum thickness of 1 1/2 inches. Metal forms shall be of adequate type and shall have a flat top surface. The forms shall be cleaned, well oiled, securely staked, braced, and held to the required line and grade before any concrete is deposited. The forms shall be set at such elevations that the sidewalk will slope 1/4 inch per foot toward the roadway.

The concrete shall be deposited between the forms on the moistened subgrade, shall be struck off to a minimum 4 inch thickness at driveways, and shall be worked sufficiently to bring the mortar to the surface. The surface shall then be made smooth and even by means of wooden floats and given a broom finish. All edges shall be rounded with an edging tool to 1/4 inch radius. The surface shall be divided into rectangular areas by means of a jointer having a radius of 1/4 inch and forming a groove not less than 1 inch in depth for the full width of the walk. The length of the rectangles formed shall not exceed the width of the sidewalk being constructed, unless otherwise specified by the Engineer.

The developer shall install 1/2 inch premolded expansion joints extending entirely through the sidewalk at intervals not to exceed 40 feet. One-half inch premolded expansion joint material shall be installed to the full depth of the sidewalk where the walk abuts any rigid structure or fixtures such as curbs, columns, castings, buildings, light standards, etc.

The sidewalk and sidewalk aprons shall be cured in the same manner as specified for concrete pavement.

After the concrete has set sufficiently, the developer shall remove the forms and shall backfill the space on each side of the walk. The earth shall be compacted and graded in a satisfactory manner.

4.3 CURB AND GUTTER - All curb and gutter shall be portland cement concrete. Concrete shall have a minimum 28 day compressive strength of 3500 psi. Air-entraining admixture may be used, but will not be required.

4.3.1 Subgrade - The moistened subgrade upon which the curb and gutter is founded shall be compacted to the same density requirements as established hereinbefore for street subgrade.

In the event curb and gutter is constructed prior to establishment of the street subgrade, the curb and gutter subgrade may be compacted by use of the mechanical hand tamper or other approved methods. The width of the subgrade shall be not less than the width of the curb and gutter plus six (6) inches beyond each side of the curb and gutter. No curb and gutter concrete shall be placed until the subgrade has been inspected.

4.3.2 Forms - The side forms for the construction of curbing and gutters shall be of wood or metal, shall be straight, free from warp and of sufficient strength when staked to resist the pressure of concrete without springing; and shall be rigidly set and staked so as to remain true to line and grade during the placing of the concrete.

The surface of the curb and gutter shall be accurately screeded from templet to templet on 8 foot centers. Steel templets conforming to the shape of the curb and gutter as shown on approved plans shall be used.

When indicated on the plans or directed by the Engineer, entrance and drainage openings of the required dimensions shall be formed through the curbing at the designated location. Only where vertical curb is required.

The back of curb and gutter may be rolled down as approved by the Engineer to provide vehicle entrance and exit to private property. Such roll down sections shall be provided at all existing property driveways and at least one roll down section shall be provided for each undeveloped lot, where practical. Then length of the roll down section shall be at least ten (10) feet, but not more than twenty-six (26) feet.

Forms shall be removed in not less than 6 hours nor more than 24 hours after the concrete has been placed.

4.3.3 Concrete Placement - After the subgrade has been prepared, it should be moistened before the concrete is placed. During placement, the concrete shall be thoroughly spaded or vibrated until the mortar entirely covers the surface and all honey-comb and voids are eliminated. The concrete shall be placed in such a manner that no concrete will have reached its initial set before the following layer is placed. The surfaces shall be struck off and floated so that all coarse aggregate is well below the surface.

Reinforcing steel, when included, shall be placed in accordance with the details shown on the plans.

Expansion joints shall not be used when curb and gutter is placed using steel guide templates but shall be used when placed by a concrete curb extruding machine. Expansion joints, when required as noted above, shall be placed at the locations so indicated. When not shown on the plans, and the curb and gutter is constructed adjacent to a concrete pavement, the joint spacing shall coincide with that of the pavement; otherwise the interval shall not be less than 6 feet nor more than 30 feet. Premolded expansion joint material, 1/2 inch thick and cut to conform to the curb, gutter, or curb and gutter section, shall be placed in each expansion joint.

4.3.4 Concrete Finishing - The top surfaces of the gutters shall be given a uniform float finish and the edges shall be rounded with an edging tool having a radius of 1/4 inch.

The top surfaces of the curbs shall be given a uniform float finish and the edges shall be rounded to the radius shown on the plans. All honeycombed areas shall be corrected by filling with mortar, composed of 1/2 mixture by volume of cement and sand. Plastering will not be permitted. The top and face of all curbing shall be finished while the concrete is still green by wetting and rubbing with a soft brick or wooden block. The face of header curbs shall be finished to 2 inches below the gutter line or the finished ground line. The concrete shall be finished to a smooth surface, presenting a uniform texture and color and be given a final broom finish.

4.3.5 Protection and Curing - When required by the Engineer, concrete shall be cured for a period of not less than 7 days after pouring. The method used to provide curing shall be approved by the Engineer. Membrane curing, plastic sheet curing, and wetted burlap curing will be considered satisfactory.

If at any time during the seven (7) day curing period, the air temperature is 40 degrees F. or less, concrete shall be insulated and/or heated as directed by the Engineer to aid curing and to prevent freezing. Protective covering which will protect the surface of freshly placed concrete from rain shall be readily available at the site of the work. Concrete damaged as a result of failure on the part of the developer to adequately protect the concrete from rain or freezing shall be removed and replaced at the expense of the developer.

4.4 RAMPS FOR HANDICAPPED - Ramps for handicapped shall be included in curb and gutter and sidewalk construction as provided by Kentucky State Law as per KRS 66.660:

66.660. Regulation of Cross-walks, Curbs and Gutters, Wheelchair Ramps - (1) The legislative body of any city, county or urban county government shall provide for and regulate cross-walks, curbs, and gutter; provided, that after June 21, 1974, all new curbs and all existing curbs which are a part of any reconstruction, within any block which is contiguous to any highway and in which 50 per cent (50%) of the territory is devoted to or zoned for business, commercial, or industrial use, shall comply with the provisions of subsection (2). (2) In order to enable persons using wheelchairs to travel freely and without assistance, at each cross-walk a ramp with nonslip surface shall be built into the curb so that the sidewalk and street blend to a common level. Such a ramp shall not be less than 32 inches wide and shall not have a slope greater than one inch per 12 inches length, where practicable. In all ramps there shall be a gradual rounding at the bottom of the slope.

See "Typical Installation for Handicapped Ramps" for general construction guidelines.

SECTION FIVE: STORM SEWERS

5.0 PURPOSE - The purpose of this chapter is to outline the requirements for proper storm sewer pipe sizing, construction and inspection.

5.1 DESIGN REQUIREMENTS - Storm water facilities shall be designed in accordance with the procedure of the "Manual of Instruction for Drainage Design", Kentucky Department of Transportation, Bureau of Highways. At the request of the Engineer, a complete set of design calculations for the storm drainage facilities will be provided. Depths of flow and velocity for twenty-five (25) year design flows for the different sizes of sewers proposed shall be provided in tabular form.

5.2 PIPE AND JOINTS - Pipe for storm sewers shall be cement concrete, fully bituminous coated corrugated metal, extra strength clay pipe, or corrugated double walled smooth flow high density polyethylene. All storm sewer pipe shall meet the specifications of Section 2 of these regulations.

5.3 TRENCH EXCAVATION - Unless specifically directed otherwise by the Engineer, not more than 500 feet of trench shall be opened ahead of the pipe laying work of any one crew, and not more than 500 feet of open ditch shall be left behind the pipe laying work of any one crew. Watchmen or barricades, lanterns and other such signs and signals as may be necessary to warn the public of the dangers in connection with open trenches, excavation and other obstructions, shall be provided by and at the expense of the developer.

When so required or when directed by the Engineer, only one-half of street crossings and road crossings shall be excavated before placing temporary bridges over the side excavated, for the convenience of the traveling public. All backfilled ditches shall be maintained in such a manner that they will offer no hazard to the passage of traffic. The convenience of the traveling public and property owners abutting shall be taken into consideration, and shall be promptly backfilled or bridged at the direction of the Engineer. Excavated materials shall be disposed of so as to cause the least interference, and in every case the disposition of materials shall be satisfactory to the Engineer.

Trenches in which pipes are to be laid shall be excavated in open to cut the depths shown on the approved plans, cut sheets or as specified by the Engineer. The minimum allowable trench width shall not be less than the outside diameter of the pipe plus eight (8) inches. Where rock is encountered it shall be removed to a minimum depth of four (4) inches below the pipe bells.

Unless specifically authorized by the Engineer, trenches shall in no case be excavated or permitted to become wider than 2 feet 6 inches plus the nominal diameter of the pipe at the level of or below the top of the pipe. If the trench does become wider than 2 feet 6 inches at the level of or below the top of the pipe, special precautions may be necessary, such as providing compacted granular fill up to the top of the pipe or providing pipe with additional crushing strength as determined by the Engineer after taking into account the actual trench loads that may result and the strength of the pipe being used. The developer shall bear the cost of such special precautions as necessary.

All excavated materials shall be placed a minimum of 2 feet back from the edge of the trench.

Where conditions exist that may be conducive to slides or cave-ins, proper and adequate sheeting, shoring and bracing shall be

installed to provide safe working conditions and to prevent damage to work.

Trenches shall be kept free of water during the laying of the pipe and until the pipeline has been backfilled.

5.4 PIPE BEDDING

5.4.1 Ordinary Bedding - If the foundation is good firm earth and approval is obtained from the Engineer, "Ordinary Bedding" may be used. The machine excavation will be accomplished as set out hereinbefore and the remainder of the material shall be excavated by hand from a point 0.3 diameter above the flow line. The earth shall be pared or molded to give full support to the lower section of the barrel of the pipe. When bell and spigot is involved, bell holes shall be excavated to prevent the bells from being supported on undisturbed earth.

5.4.2 Improved Bedding - Except as specified above in "Ordinary Bedding", all pipes shall, as standard practice, be laid using "Improved Bedding". Such bedding (crush limestone - #8, #9 or #11), shall be placed a minimum depth of 4 inches below the bottom of the pipe barrel and thoroughly tamped along each side of the pipe to a height equal to 0.3 of the pipe diameter.

5.5 LAYING OF PIPE - The laying of sewer pipe in finished trenches shall be commenced at the lowest point so that the spigot or tongue ends point in the direction of flow.

If the developer desires, he may use a laser beam instrument to set the grades on sewer lines in lieu of using a grade string and batter boards set from grade stakes. In using such an instrument, the developer shall be responsible for maintaining grades and elevations as called for on the drawing profiles, and any variances found shall be corrected by the developer at his expense.

All pipe lengths shall be laid with ends abutting and true to line and grade. They shall be fitted and matched so that when laid they will form a sewer with a smooth and uniform invert. Supporting of pipe shall be as set out hereinbefore under "Pipe Bedding" and in no case shall the supporting of pipe on blocks be permitted.

Branches, fittings and specials for sewer lines shall be provided and laid as and where directed by the Engineer or shown on the plans.

Before each piece of pipe is lowered into the trench, it shall be thoroughly inspected to insure its being clean. Each piece of pipe shall be lowered separately unless special permission is given otherwise by the Engineer. No piece of pipe or fitting which is known to be defective shall be laid or placed in the lines. If any defective pipe or fitting shall be discovered after the pipe is laid, they shall be removed and replaced with a satisfactory pipe or fitting without additional charge. In case a length of pipe is cut to fit in a line, it shall be so cut as to leave a smooth end at right angles to the longitudinal axis of the pipe and repair type coupling used as a splicing device.

When laying of pipe is stopped for any reason, the exposed end of such pipe shall be closed with a plywood plug fitted into the pipe bell, so as to exclude earth or other material, and precautions taken to prevent flotation of pipe by runoff into trench.

5.6 JOINTING CONCRETE PIPE - For bell and spigot pipe, the interior surface of the bell shall be thoroughly cleaned with a wet

bruch and the lower portion filled with a stiff mortar thick enough to align the pipe inverts. The spigot end shall be thoroughly cleaned between the bell and spigot and shall be filled with mortar sufficient to form a bead around the inner surface of the spigot end of the pipe. The inside of the joint shall be thoroughly brushed to remove excess mortar.

For tongue and groove pipe, the groove shall be thoroughly cleaned with a wet brush and the bottom half of the groove end buttered with mortar. The tongue end shall be thoroughly cleaned with a wet brush and a layer of mortar applied to the top half of it. The tongue end shall be fitted into the groove end of the joint until mortar is squeezed out into both inner and outer surfaces. The inner surface shall be thoroughly brushed to remove excess mortar and the outside pointed up.

Mortar shall consist of one part Portland Cement to not more than two parts of fine clean sand.

Bituminous mastic joints in accordance with K.D.H.S.

5.7 BACKFILLING PIPELINE TRENCHES – All backfilling shall be accomplished in accordance with the details shown on Std. Drawing.

When directed by the Engineer, the developer shall add water to the backfill material or dry out the material when needed to attain a condition near optimum moisture content for a maximum density of the material when it is tamped. The developer shall obtain a compaction of the backfill of at least 90 percent of standard (ASTM D698) Proctor density where mechanical tamping of backfill is required.

Before final acceptance, the developer will be required to level off all trenches or to bring the trench up to the level of the surrounding terrain. The developer shall also remove from roadways, rights-of-way, and/or private property all excess earth or other materials resulting from construction.

In the event that pavement is not placed immediately following trench backfilling in streets and highways, the developer shall be responsible for maintaining the trench surface in a level condition at proper pavement grade at all times.

In all cases walking or working on the completed pipelines except as necessary in tamping and backfilling, will not be permitted until the trench has been backfilled to a point one foot above the top of the pipe. The filling on the trench and the tamping of the backfill shall be carried on simultaneously on both sides of the pipe in such a manner that the completed pipeline will not be disturbed and injurious side pressures do not occur.

5.8 REMOVAL AND REPLACEMENT OF EXISTING FACILITIES – Shall be accomplished in accordance with the engineering plans and specifications.

5.9 CONCRETE CRADLE, ANCHORS, OR ENCASEMENT – Concrete cradle, anchors, or encasement or sewer lines shall be placed where shown on the plans, required by the specifications, or as directed by the Engineer. Concrete shall be Class “E” and shall be mixed sufficiently wet to permit it to flow under the pipe to form a continuous bed. In tamping concrete, care shall be taken not to disturb the grade or line of the pipe or injure the joints.

5.10 MANHOLES – Manholes of the form and dimensions shown on the plans shall be built as directed. At the option of the developer, the manhole proper shall be constructed of either brick or of precast concrete rings. They shall be constructed on 3000 psi

concrete foundations with adequate structural and geometrical capacities.

5.10.1 Precast Concrete Rings – Precast concrete rings for manholes shall conform to ASTM C-478.

5.10.2 Precast Concrete Cones – Precast concrete cones shall be of the size and shape shown on the plans and shall conform to ASTM C-478.

5.10.3 Brick – The brick used in the construction of manholes shall be sound, hard-burned, firm and compact in structure with the true and square edges, and shall meet all of the requirements of the ASTM C-32 for Grade MM Brick. Cement concrete brick may be used when approved by the Engineer.

5.10.4 Mortar for Brickwork – Mortar for brickwork for manholes shall be composed of one part Portland cement and two parts sand, to which a small amount of hydrated lime putty, not to exceed 10 pounds per bag of cement, may be added.

5.10.5 Laying Brick – The brick wall shall be eight inches thick, except that walls below twelve feet zero inches in depth shall be 12 inches thick, and shall be laid all headers with well bounded joints struck off smoothly on the inside, and all joints completely filled with mortar. The outside of the manhole shall be thoroughly and carefully plastered with ¾ inch of mortar mixed as outlined above.

Extreme care will be exercised to construct watertight manholes with particular reference to brickwork around inlet and outlet pipe. The excavation shall be kept free of water when concrete and brickwork is being constructed, and the manhole shall not be backfilled until inspected by the Engineer and until the outside plastic has set sufficiently so that no damage will occur by backfilling.

5.10.6 Manhole Inverts – Manhole inverts shall be formed from 3000 psi concrete as shown on the plans. Inverts for a “straight-through” manhole may be formed by laying the pipe straight through the manhole, pouring the concrete invert, and then breaking out the top half of the pipe. Curved invert shall be constructed of concrete, as shown, and shall form a smooth, even half-pipe section. The inverts shall be constructed when the manhole is being built using prefabricated forms.

The excavation shall be kept free of water while the manhole is being constructed and the manhole shall not be backfilled until inspected by the Engineer.

5.10.7 Manhole Steps – Cast iron manhole steps shall be of pattern shown on the plans, 10 – ¾ inches by 8 – ½ inches, weighing not less than 10 pounds each, having corrugated treads. The steps shall be made of ASTM A-48 cast iron minimum Class 30. Steel steps coated with plastic may be used as approved by the Engineer.

5.10.8 Manhole Frames and Covers – Manhole castings shall consist of cast iron frames and 22 ¾ inch diameter covers, weighing not less than 300 pounds per frame and cover, dimensioned as shown on the plans. Manhole covers must sit neatly in the rings, with contact edges machined for even bearing and tops flush with ring edge. They shall have sufficient corrugations to prevent a slipperiness. The lides shall have two pick holes about 1 ¼ inches wide and ½ inch deep with 3/8 inch undercut all around.

5.11 CURB INLETS, GRATE INLETS, AND HEADWALLS - Shall be constructed to forms and dimensions shown on Standard Drawings, or as shown on plans approved by the Engineer. Headwalls shall be required on all storm drains which terminate in

an existing or proposed opened waterway. All concrete for reinforced walls and slabs shall have a minimum 28 day compressive strength of 3500 psi. Other concrete may be 2500 psi concrete. Reinforcing steel shall be ASTM A-615, Grade 40 and the size and layout approved by the Engineer.

5.12 TIDE GATES – Whenever storm sewers drain into existing channels and there is a chance of backflow into the drainage system or whenever specified by the Engineer, tide gates shall be used.

5.13 CLEAN UP – Upon completion of the installation of the storm sewers and appurtenances, the developer shall remove all debris and surplus construction materials resulting from the work. The developer shall grade the ground along each side of the pipe trench in a uniform and neat manner leaving the construction area in a shape as near as possible to the original ground line and in as good or better condition than that prior to construction.

SECTION SIX: SANITARY SEWERS

SANITARY SEWERS

6.0 DESIGN REQUIREMENTS - At the request of the Engineer a complete set of computations, in a tabular form, should be made available to him which indicates depths and velocities at minimum, average and maximum daily waste flows for the different sizes of sewers proposed.

6.0.1 Depth - In general, sewers shall be sufficiently deep so as to receive sewage from the first floor of all places served by the sewers and to prevent freezing, but shall not be less than 5 feet deep, unless otherwise approved by the Engineer.

6.0.2 Slope - All sewers shall be designed and constructed so as to give mean velocities, when flowing full of not less than 2.0 feet per second. The following are the minimum slopes which should be provided; however, slopes greater than these are desirable.

<u>Sewer Size</u>	<u>Minimum Slope in Ft. per 100 Ft.</u>
8 inch	0.40
10 inch	0.28
12 inch	0.22
14 inch	0.17
15 inch	0.15
16 inch	0.14
18 inch	0.12
21 inch	0.10
24 inch	0.08
27 inch	0.067
30 inch	0.058
36 inch	0.046

Sewers should be laid with uniform slope between manholes. Sewers on 20 per cent slope or greater or when specified by the Engineer, shall be anchored securely with concrete anchors spaced no further than 36 feet center to center.

6.0.3 Sizing - New sewer systems shall be designed on the basis of an average daily per capita flow of sewage of not less than 100 gallons per day. This figure is assumed to cover normal infiltrations, but an additional allowance should be made where conditions are unfavorable. Generally, the main, trunk and outfall sewers shall be designed to carry, when running full, not less than 250 gallons daily per capita contributions of sewage, exclusive of sewage or other waste flow from industrial plants.

No sewer shall be less than 8 inches in diameter.

6.1 PIPE AND FITTINGS - Sanitary sewers shall be constructed of the following pipe unless otherwise approved by the Engineer.

6.1.1 Clay Pipe - Clay sewer pipe and fittings for main sewers shall be extra strength. The pipes shall be unglazed and shall conform to the requirements of ASTM C-425.

When so required or when directed by the Engineer, only one half of street crossings and road crossings shall be excavated before

Clay sewer pipe and fittings used for house connections shall be extra strength, unglazed pipe, conforming to the requirements of ASTM C-700. Joints for the pipe used for house connections shall be of the factory-fabricated type, conforming to Type III joints described in ASTM C-425.

6.1.2 Plastic Pipe (Gravity) - Polyvinyl chloride plastic pipe and fittings for gravity sanitary sewers shall be Type PSM SDR-35 in accordance with ASTM D-3034.

Pipes and fittings shall have integral molded bells for bell and spigot type joints with elastomeric ring gaskets providing a water tight seal. Gaskets shall be certified by the manufacturer to be chemically immune to normal sewage and sewer gas and the gasket design arrangement on the bell shall be approved by the Engineer.

All pipe fittings shall be molded or otherwise made as one piece integral units.

All connections to manholes or other structures shall be made using one piece elastomeric rings securely fitting to the outside of the pipe with stainless steel bands.

Adapters as furnished by the pipe manufacturer shall be used to connect PVC pipe to all other type of pipes or fittings.

PVC pipe shall not be used in any system which may receive industrial waste or materials with temperatures greater than 140 degrees F.

Construction methods including Trenching, Bedding, Laying, Backfilling, etc., shall be as hereinafter outlined in Chapter 2, except that Bedding material shall extend to 0.5 the pipe diameter and special care shall be required in placing and tamping the cover material above the pipe.

6.1.3 Cast Iron Pipe - The cast iron pipe for gravity sewers and sewage force mains shall conform to the latest ANSI Specifications A21.6 (AWWA-C106) or A21.8 (AWWA-C100) with standard thickness as designated in AWWA-C100 with standard thickness as designated in Table 6.2 or 8.2 for thickness Class 22 pipe.

Pipe fittings shall be mechanical joint Class 250 conforming to ANSI Specification A1.10 (AWWA C-110) for short body cast iron fittings.

6.2 TRENCH EXCAVATION - Unless specifically directed otherwise by the Engineer, not more than 100 feet of trench shall be opened ahead of the pipe laying work of any one crew, and not more than 100 feet of open ditch shall be left behind the pipe laying work of any one crew. Watchmen or barricades, lanterns and other such signs and signals as may be necessary to warn the public of the dangers in connection with open trenches, excavation and other obstructions, shall be provided by and at the expense of the contractor. Conformance to all state highway requirements shall be the responsibility of the contractor when encroachment on highway right-of-way is necessary.

placing temporary bridges over the side excavated for the convenience of the traveling public. All backfilled ditches shall be maintained in such a manner that they will offer no hazard to the

passage of traffic. The convenience of the traveling public and property owners abutting shall be taken into consideration. All public or private drives shall be taken into consideration and shall be promptly backfilled or bridged at the direction of the Engineer. Excavated materials shall be disposed of so as to cause the least interference, and in every case the disposition of materials shall be satisfactory to the Engineer. Trenches in which pipes are to be laid shall be excavated in open cut to the depths shown on the approved plans, cut sheets or as specified by the Engineer. Where rock is encountered, it shall be removed to a minimum depth of four (4) inches below the pipe bells.

Unless specifically authorized by the Engineer, trenches shall be in no case excavated or permitted to become wider than 2 feet 6 inches plus the nominal diameter of the pipe at the level of or below the top of the pipe. If the trench does become wider than 2 feet 6 inches at the level of or below the top of the pipe, special precautions may be necessary, such as providing compacted granular fill up to the top of the pipe or providing pipe with additional crushing strength as determined by the Engineer after taking into account the actual trench loads that may result and the strength of the pipe being used. The contractor shall bear the cost of such special precautions as necessary.

All excavated materials shall be placed a minimum of 2 feet back from the edge of the trench.

Where conditions exist that may be conducive to slides or cave ins, proper and adequate sheeting, shoring and bracing shall be installed (See Section 6.7) to provide safe working conditions and to prevent damage to work. Trenches shall be kept free of water during the laying of the pipe and until the pipeline has been backfilled. Removal of water shall be at the contractor's expense.

Backfilling shall be set out hereinafter.

6.3 PIPE BEDDING - If the natural base of the trench is not satisfactory as a bedding for the sewer pipe one of the following methods shall be used:

6.3.1 Dry Mix Concrete Bedding - In areas where wet mucky soil, unstable soil or "running sand" is encountered or as otherwise directed by the Engineer, sewer pipe shall be laid on Dry Mix Concrete. The concrete shall be minimum 2500 psi 28 day strength Call "B" as per Section 2.1. The cement, sand and stone shall be thoroughly mixed (no water) and placed in the trench to a minimum depth of 4 inches below the bottom of the pipe. Dry mix concrete shall be thoroughly tamped along each side of the pipe to a height equal to .3 of the pipe diameter. Only enough water shall be added to the concrete, after the pipe is in place, to cause hydration of the cement. After water is added the pipe grade shall be rechecked, adjusted as necessary and the concrete retamped along the side. The sewer trench shall be kept water free during the pipe laying and until the concrete has set. (See Exhibit)

6.3.2 Rock Cut Bedding - If the foundation is in rock the excavation shall be undercut to a depth of four (4) inches below the bottom of the pipe. The pipe shall be laid on a bed of granular material to provide continuous support for the lower section of the pipe. Granular bedding shall be #9 crushed stone, fine gravel or sand. (See Exhibit).

6.3.3 Improved Bedding - All sewer pipe shall, as a standard practice, be laid using Improved Bedding.

Such bedding (Crushed limestone, #8, #9 or #11) shall be placed a minimum depth of 4 inches below the bottom of the pipe barrel and thoroughly tamped along each side of the pipe to a height equal to 0.3 of the pipe diameter. (See Exhibit).

6.3.4 Special Subgrade Improvement - When directed by the Engineer, unsuitable materials below the normal trench depth shall be removed to a depth sufficient to provide a layer of crushed limestone (#6 or #78) to support the pipe and prevent settlement. The pipe shall then be laid on Dry Mix Concrete Bedding (.3.1) or "Improved Bedding: 5.3.3 placed over the Subgrade Improvement.

6.4 LAYING PIPE

The laying of the sewer pipe in finished trenches shall be commenced at the lowest point so that the spigot or tongue ends point in the direction of flow.

If the contractor desires, he may use a laser beam instrument to set the grades on sewer lines in lieu of using a grade string and batter boards set from grade stakes. In using such an instrument, the contractor shall be responsible for maintaining grades and elevations as called for on the drawing profiles, and any variances found shall be corrected by the Contractor at his expense.

All pipe lengths shall be laid with ends abutting and true to line and grade as approved by the Engineer. They shall be fitted and matched as that when laid they will form a sewer with a smooth and uniform invert. Supporting of pipe shall be as set out hereinbefore under "Pipe Bedding" and in no case shall the supporting of pipe on blocks be permitted.

Branches, fittings and specials for sewer lines shall be provided and laid as and where directed by the Engineer or shown on the plans.

Before each piece of pipe is lowered into the trench, it shall be thoroughly inspected to insure its being clean. Each piece of pipe shall be lowered separately unless special permission is given otherwise by the Engineer. No piece of pipe or fittings which is known to be defective shall be laid or placed in the lines. If any defective pipe or fitting shall be discovered after the pipe is laid, they shall be removed and replaced with a satisfactory pipe or fitting. In case a length of pipe is cut to fit in a line, it shall be so cut as to leave a smooth end at right angles to the longitudinal axis of the pipe and a repair type coupling used as a splicing device.

When laying of pipe is stopped for any reason, the exposed end of such pipe shall be closed with a plug fitted into the pipe bell, so as to exclude earth or other material, and precautions taken to prevent flotation of pipe by runoff into trench.

6.4.1 Joint Clay Pipe - The sockets and spigots of the joint shall be cleaned of dirt and foreign matter and the plastisol surfaces painted with the pipe manufacturer's combination lubricant - cement. The painting shall be done in the trench as the pipe is laid. The top or one side of the spigot joint shall be carefully positioned into the bell and the pipe pushed together until the joint snaps distinctly in place. The pushing together of the pipe may be done either by hand or by an insulated lever. When the ends of the pipe are so jointed together, they shall be positioned in such a manner that the flow lines of the pipes shall be in true alignment and shall form a smooth, even invert.

6.4.2 Jointing Cast Iron Pipe - The joints for cast iron pipe shall be push-on type, single rubber gasket or mechanical joint conforming to ANSI Specification A2.1.11.

6.6 OBSTRUCTIONS

In cases where storm sewers, gas lines, water lines, telephone lines, and other utilities, or other underground structures are encountered, they shall not be displaced or molested unless necessary, in which case they shall be replaced in as good condition as found as quickly as possible. A-1 lines or underground structures damaged or molested in the construction shall be replaced at the contractor's expense, unless in the opinion of the Engineer, such damage was caused through no fault of the contractor.

The contractor shall notify the utility companies prior to excavation adjacent to their facilities.

The contractor's attention is further directed to Section 1.4 for additional requirements.

6.7 SHORING, SHEETING AND BRACING OF EXCAVATIONS

Where unstable material is encountered or where the depth of excavation in earth exceeds six feet, the sides of the trench or excavation shall be supported by substantial sheeting, bracing or shoring, or the sides sloped to the angle of repose. Sloping the sides of the ditch to the angle of repose will not be permitted in streets, roads, narrow rights-of-way or other constricted areas unless otherwise specified. The design and installation of all sheeting, sheet piling, bracing and shoring shall be based on computations of pressure exerted by the materials to be retained under construction conditions. Adequate and proper shoring of all excavations shall be the entire responsibility of the contractor; however, the Engineer may require the submission of shoring plans (accompanied by supporting computations) for review prior to the contractor undertaking any portion of the work.

Foundations, adjacent to where the excavation is to be made below the depth of the existing foundation, shall be supported by shoring, bracing, or underpinning as long as the excavation shall remain open, or thereafter if required to insure the stability of the structure supported by the foundation, and the contractor shall be held strictly responsible for any damage to said foundations.

Even though computations shall determine the size of the various components, no timber sheeting less than two inches in thickness and not timber bracing, cross bracing or struts less than six inches by six inches will be acceptable.

Solid sheeting will be required for wet or unstable material. It shall consist of continuous vertical sheet piling or timber or steel with suitable walers and braces.

Care shall be taken to avoid excessive backfill loads on the completed pipelines and the requirements that the width of the ditch at the level of the crown of the pipe be not more than two

The lower portion of the trench, from the pipe bedding to a point 12 inches above the pipe shall be backfilled with material free from rock and as acceptable to the Engineer. This material shall be placed in 6" layers along each side of the pipe taking care to keep the level of fill on each side of the pipe equal. Compaction shall be accomplished by hand-tamping or by approved mechanical methods. Upon approval of the Engineer, crushed stone, fine gravel, or sand may be used as backfill in lieu of compacted earth.

The upper portion of the trench above the compacted portion shall be backfilled with material which is free from large rock. Incorporation of rock having a volume exceeding one half cubic foot is prohibited. Backfilling this portion of the trench may be accomplished by any means approved by the Engineer. The trench backfill shall be heaped over or leveled.

6.8.2 Method "B" - Backfilling Under Sidewalks, and Unpaved Driveways - Backfilling of pipeline trenches under sidewalks and unpaved driveways shall be accomplished in the following manner:

The lower portion of the trench from the pipe bedding to a point 12 inches above the top of the pipe, shall be backfilled with material free from rock and/or acceptable to the Engineer. This material shall be placed in 6 inch layers along each side of the pipe

feet six inches plus the nominal diameter of the pipe shall, as set out in Section 6.2 hereinbefore, be strictly observed.

6.8 BACKFILLING PIPELINE TRENCHES - All backfilling shall be accomplished in accordance with the details shown on Standard Drawing Exhibit.

When directed by the Engineer, the contractor shall add water to the backfill material or dry out the material when needed to attain a condition near optimum moisture content for a maximum density of the material when it is tamped. The contractor shall obtain a compaction of the backfill of at least 95 per cent of standard (ASTM D 698) Procter density where mechanical tamping of backfill is required.

Before final acceptance, the contractor will be required to level off all trenches or to bring up the level of the surrounding terrain. The contractor shall also remove from roadways, rights-of-way, and/or private property all excess earth or other materials resulting from construction.

In the event that pavement is not placed immediately following trench backfilling in streets and highways, the contractor shall be responsible for maintaining the trench surface in a level condition at proper pavement grade at all times.

In all cases walking or working on the completed pipelines, except as may be necessary in tamping or backfilling, will not be permitted until the trench has been backfilled to a point one foot above the top of the pipe. The filling of the trench and the tamping of the backfill shall be carried on simultaneously on both sides of the pipe in such a manner that the completed pipeline will not be distributed and injurious side pressures do not occur.

6.8.1 Method "A" Backfilling in Open Terrain - Backfilling of pipeline trenches in open terrain shall be accomplished in the following manner:

taking care to keep the level of fill in each side of the pipe equal.

Compaction shall be accomplished by hand-tamping or by approved mechanical methods. Upon approval of the Engineer, crushed stone, fine gravel or sand may be used to backfill in lieu of compacted earth.

The middle portion of the trench, from a point 12 inches above the top of the pipe to a point 6 inches below the grade line, shall be backfilled with material free from rock and/or acceptable to the Engineer. This material shall be placed and compacted in layers of approximately 6 inches.

Upon approval of the Engineer, the contractor may backfill the middle portion of the trench with crushed stone or fine gravel and sand in lieu of materials which require compaction. The upper portion of the trench shall be temporarily backfilled and maintained with crushed stone or gravel until such time as the sidewalk is constructed or the driveway surface is restored.

6.8.3 Method "C" - Backfilling Under Streets, Roads, and Paved Driveways - Backfilling of pipeline trenches under streets, roadways and paved driveways shall be accomplished in the following manner:

The lower portion of the trench, from the pipe bedding to a point 6 inches below the bottom of the pavement or

concrete sub-slab up to grade, shall be backfilled with crushed stone, fine gravel and sand or DGA.

The upper portion of the trench, from a point 6 inches below the bottom of the pavement or concrete sub-slab up to grade, shall be backfilled with a base course of dense graded aggregate or crushed stone, suitable to the Engineer. At such time that pavement placement is accomplished, the excess base course shall be removed as required.

6.9 TESTING OF LINES

The testing of sewage force mains and gravity sewers shall be accomplished by the contractor in accordance with the procedures listed hereinafter.

6.9.1 Sewage Force Mains - On all projects involving the installation of sewage force mains, the finished work shall comply with the provisions listed below, or similar requirements which will insure equal or better or better results:

- a. Leakage in pipelines, when tested under pressure of 50 psi in excess of normal operating pressures, shall not exceed 50 gallons per 24 hours per inch of diameter per mile of pipe.
- b. Where practicable, pipelines shall be tested between line valves or plugs in lengths of not more than 1500 feet.
- c. Pipelines shall be tested before backfilling at joints except where otherwise required by necessity, local ordinance or public convenience.
- d. Duration of test shall be not less than two hours where joints are exposed and not less than 24 hours where joints are covered.
- e. Where leaks are visible at exposed joints and/or evident on the surface where joints
- d. All lines or sections of lines that are found to be laid improperly with respect to line or grade, that are found to contain broken or leaking sections of pipe, or are obstructed in such a manner that they cannot be satisfactorily corrected otherwise, shall be removed and replaced at the contractor's expense.
- e. The contractor shall lay sewer lines, including house connections so that the ground water filtration shall not average more than 200 gallons per inch of pipe diameter per 24 hours per mile of sewer.

The length of the main sewers shall be used in making the foregoing computation even though the house connections (from the main sewer to the property line) should be in place and included as a part of the system when infiltration is measured. This requirement may be applied to a portion of the contract work, such as the sewers in a separate drainage area or to a single section of the line between two manholes.

are covered, the joints shall be retightened or relayed, and leakage minimized, regardless of total leakage as shown on test.

- f. All pipe, fittings and other materials found to be defective under test shall be removed and replaced at the contractor's expense.
- g. Lines which fail to meet tests shall be repaired and retested as necessary until test requirements are complied with.
- h. Where nonmetallic joint compounds are used pipelines should be held under normal operating pressure for at least three (3) days before testing.

6.9.2 Gravity Sanitary Sewer Lines - On all projects involving installation of sanitary sewer lines, the finished work shall comply with the provisions listed below or similar requirements which will insure equal or better results:

- a. After collecting and/or outfall lines or system have been brought to completion, and prior to final inspection, the contractor will be required to clean all dirt, debris and trash from lines and manholes.
- b. During the final inspection, the Engineer will inspect each individual line, from manhole to manhole, either by use of lights or other means at his disposal to determine whether the completed lines are true to line and grade as laid out or as shown on the plans.
- c. The Engineer may require that the contractor pass through the system under its own momentum a wooden ball of a diameter one inch less than the nominal diameter of the pipe, except that no ball larger than eight inches in diameter shall be used.
- f. To test for leaks, the Engineer will require that all sewers after partial backfilling be tested by the so-called "smoke method" in which smoke is blown into closed-off sections of the sewers under pressure and observation made of any smoke appearing on top of the ground indicating the pressure of such leaks. All such leaks or breaks discovered by the smoke tests shall be repaired and/or corrected by the contractor at his own expense. Equipment and supplies required for smoke tests shall be furnished by the contractor. The contractor will also be required to smoke test the first section (manhole to manhole) of each size of pipe and type of joint on each construction contract prior to backfilling to establish and check laying and jointing procedures. Other supplementary smoke tests prior to backfilling may be performed by the contractor at his option; however, any such tests shall not supplant the final tests of the completed work unless such final tests are waived by the Engineer.

- g. In order to test for infiltration, the Engineer may also require exfiltration tests on each section of pipe between manholes after it has been laid out but prior to backfilling of joints. Exfiltration tests shall be conducted by plugging the lower end of the section of sewer to be tested and filling the sewer with water to a point approximately five feet above the invert at the lower end and at least one foot above the pipe at the upper end, observing for leakage at all joints and measuring the amount of leakage for a given interval of time. Exfiltration shall not exceed 110 per cent times the infiltration limits set out hereinbefore. All observed leaks shall be corrected even though exfiltration is within the allowable limits. Exfiltration tests will normally be required for flat sections of sewer that are expected to be below the wet season, ground water table.
- h. To test for infiltration, the Engineer may also require that the contractor plug the open ends of all lines at the manhole so that measurements may be made at each section of the sewer line. This infiltration test will not be made until the sewer line is completed, and the contractor will be required to correct all conditions that are conducive to excessive infiltration and may be required to relay such sections of the line that may not be corrected otherwise. All observed leaks shall be corrected even though infiltration is within allowable limits.

6.10 MANHOLES

Manholes shall be installed at the end of each line; at all changes in grade, size or alignment; at all intersections; and at distances not greater than 375 feet.

6.10.7 Laying Brick - The brick wall shall be eight inches thick, except that walls below twelve feet zero inches in depth shall be 12 inches thick, and shall be laid all headers with well bonded joints struck off smoothly on the inside, and all joints completely filled with mortar. The outside of the manhole shall be thoroughly and carefully plastered with 3/4 inch of mortar mixed as outlined above. The plaster shall be covered with wet burlap for a period of 48 hours after being placed to aid in curing. After the plaster has thoroughly cured and dried, it shall be painted with an approved type semi-fabricated bituminous damp proofing compound, Hydrocide Semi-Mastic, or approved equal. Extreme care will be exercised to construct watertight manholes with particular reference to brickwork around inlet and outlet pipe. The excavation shall be kept free of water when concrete and brickwork is being constructed, and the manhole shall not be backfilled until inspected by the Engineer and until the outside plaster has set sufficiently so that no damage will occur by backfilling.

6.10.8 Manhole Inverts - Manhole inverts shall be formed from 3500 psi concrete as shown on Exhibit. Inverts for a "straight-through" manhole shall be formed by laying the pipe straight through the manhole, pouring the concrete invert, and then breaking out the

Manholes of the form and dimensions shown on the approved plans shall be built as directed. At the option of the contractor the manhole proper shall be constructed of either brick or of precast concrete rings (See Standard Drawing Exhibit). They shall be constructed on 3500 psi concrete foundations.

6.10.1 Standard Manholes - The standard manhole shall be six feet or more in depth, measured from the base of the cover frame to the top of the concrete footing and shall be of cone type, top construction as shown on Standard Drawing Exhibit.

6.10.2 Shallow Manholes - The shallow manholes shall be five feet or less in depth, measured from the base of the cover frame to the top of the concrete footing and shall be of flat top construction as shown on Standard Drawing Exhibit.

6.10.3 Precast Concrete Rings - Precast concrete rings for manholes shall conform to ASTM C 478.

6.10.4 Precast Concrete Cones - Precast concrete cones shall be of the size and shape shown on the plans and shall conform to the ASTM C 478.

6.10.5 Brick - The brick used in the construction of manholes shall be sound, hard burned, firm and compact in structure with true and square edges, and shall meet all of the requirements of the ASTM C 32 for Grade MM clay brick and ASTM C 55 for U-11 cement brick.

6.10.6 Mortar for Brickwork - Mortar for brickwork for manholes shall be composed of one part Portland cement and two parts sand to which a small amount of hydrated lime putty, not to exceed 10 pounds per bag of cement, may be added.

top half of the pipe. Curved invert shall be constructed of concrete, as shown, and shall form a smooth, even half-pipe section as shown. The inverts shall be constructed when the manhole is being built using prefabricated forms.

The excavation shall be kept free of water while the manhole is being constructed and the manhole shall not be backfilled until inspected by the Engineer.

6.10.9 Manhole Steps - Cast iron manhole steps shall be of pattern shown on the plans, 10 - 3/4 inches by 8 - 1/2 inches, weighing not less than 10 pounds each, having corrugated trends. The steps shall be made of ASTM A 48 cast iron minimum Class 30, resistant to rust and corrosion. Steel steps coated with plastic may be used as approved by Engineer.

6.10.10 Manhole Frames and Covers - Unless otherwise approved manhole castings shall consist of cast iron frames and 22 - 3/4 inch diameter covers, weighing not less than 300 pounds per frame and cover, dimensioned as shown on the plans. Manhole covers must sit neatly in the rings, with contact edges machined for even bearing and tops flush with ring edge. They shall have sufficient corrugations to prevent a slipperiness. The lids shall have two pick

holes about 1 - 1/4 inches wide and 1/2 inch deep with 3/8 inch undercut all around. Lids on sanitary sewer manholes must not be perforated.

6.10.11 Drops into Standard Manholes - Drops into standard manholes shall be built as a part of the standard manhole of 3500 psi concrete. The stack pipe shall be laid in the manhole as shown on the plans and encased with concrete. The pipe which is laid to the drop portion of the manhole shall be supported with 3500 psi concrete extending from the drop stack to the reinforced base of the manhole.

6.11 HOUSE CONNECTIONS

Tees shall be installed on the collector sewers for all house or building connections at locations established by the developer's engineer. At least one connection shall be provided for each platted lot. The contractor shall lay the connection lines from this point to the property line, or easement line.

Each separate dwelling structure, commercial building or industrial building shall be provided with a separate sewer connection. Such connections shall be clay pipe, PVC plastic pipe or Cast Iron pipe. All connections which service single family dwellings shall be not less than 6 inch in diameter pipe. All connections which service multi-family dwellings, commercial buildings and industrial buildings shall be not less than 8 inch diameter pipe. Trenching, pipe laying joints and backfilling shall conform to the requirements set out herein. All open ends shall be sealed with standard clay plugs with hot poured, PVC or compression joints compatible with the pipe bell.

For shallow sewers in rock or earth trench, the tees shall be encased entirely with crushed stone and fully compacted. The pipe shall be laid on a uniform slope from the tee without the use of bends.

For deep sewers in earth, the tees shall be encased entirely with crushed stone as above. House connection pipe in this case shall be extra strength clay sewer pipe from the tee branch to the property line. The pipe shall be laid on a slant from the tee branch to meet the probable building sewer grade. From this point, the pipe shall be laid on a uniform slope to match the probable grade of the building sewer.

For deep sewers in rock, the tees shall be encased entirely with Class "B" concrete. House connection pipe in this case shall be a combination of cast iron pipe, cast iron bends, standard clay adapter, and clay sewer pipe as shown on the drawings extending from the tee to the property line. The pipe shall be laid vertically from the tee branch to a point to meet the probable building sewer

When replacing concrete sidewalks, the existing concrete edges shall be trimmed straight 6 inches back of the trench sides. The existing edges shall be cleaned and kept moist during pouring to insure a good bond with new concrete.

After the trench has been backfilled, a base course of 3 inch thick crushed stone shall be placed and tamped. Immediately prior to pouring the concrete, the crushed stone base shall be thoroughly wetted, or the concrete shall be poured on a layer of heavy building paper.

The paving shall consist of four (4) inches of Class "A" concrete struck off to accurately placed screeds and worked with a wooden float until the mortar appears on the top. After the surface has been thoroughly floated, it shall be brushed to leave markings of a uniform type

grade. From this point, the pipe shall be laid on a uniform slope to match the probable grade of the building sewer.

Under normal conditions, where elevations are not critical, house connection pipes shall be laid on a slope of not less than one foot per 100 feet (approximately 1/8 inch per foot). Where elevations are critical, minimum grade may be 0.5 foot per 100 feet laid with batter boards and grade line string, same as specified for main sewers.

The tapping of house connections into manholes on the newly constructed sewers will not be permitted, except at the end of the collector lines where necessary or required by the Engineer. Where it is necessary to do so, the invert of the house connection shall not be higher than a point three inches below the top of the bench in the manhole and suitable trough shall be provided in the bench to prevent the accumulation of solids on the bench. If necessary, a standard drop connection shall be provided for a house service that is tapped into a manhole.

The installation of house connections shall follow immediately or be concurrent with the construction of the main sewer. This method on construction will permit more advantageous handling of backfilling and will also avoid possible damage to the main sewer by subsequent exposure for connection of the service lines.

6.12 CONNECTIONS TO EXISTING LINES - Connection to existing gravity sewer lines shall be made where indicated on the plans. The connection shall be made by constructing a new manhole and forming the invert channel around the existing sewer line. The top half of the existing sewer line shall be cut away to form the invert channel of the existing line and to accept the invert channel of the new line.

6.13 REMOVAL AND REPLACEMENT OF EXISTING FACILITIES

6.13.1 Concrete Sidewalks - Where concrete sidewalks are cut or disturbed during the construction work, they shall be replaced in fully as good or better condition than that which existed prior to the contractor's operation.

In general, concrete sidewalk shall be tunneled under when encountered in trenching for pipe. In case rock excavation is encountered, or it is found necessary by the Engineer, then sidewalks shall be cut and not tunneled for the pipe. When concrete sidewalks are tunneled under, they shall be backfilled by mechanically tamping earth under the portion undermined so as to prevent settlement. similar to the existing walk. All joints and edges shall be finished with an edging tool. The allowable variation shall be 1/8 inch to 10 feet transversely and longitudinally.

6.13.2 Concrete Pavement - Where Portland Cement concrete streets and driveways are removed, they shall be reconstructed to the original lines and grades and in such manner as to leave all such surfaces in fully as good or better condition than existed prior to the operation.

The existing concreted paving shall be sawed or cut to straight edges 12 inches outside the edges of the trench or broken out to an existing joint.

After trench has been backfilled, a base course of 6 inch thick dense graded aggregate shall be placed and tamped. Immediately prior to pouring the concrete, the crushed stone base shall be thoroughly wetted, or the concrete shall be poured on a layer of heavy building paper.

The paving shall consist of a minimum of 6 inches of Class "A" concrete. It shall be placed, worked and finished according to the requirements for the previous section on concrete pavements.

6.13.3 Bituminous Highway, Street and Driveway Replacement - The contractor shall replace those sections of existing highways, streets and driveways which have been removed during construction. He shall reconstruct same to the original lines and grades and in such manner as to leave all such surfaces in fully as good or better condition than that which existed prior to his operation.

Prior to trenching, the pavement shall be scored or cut to straight edges at least 12 inches outside each edge of proposed trench to avoid unnecessary damage to the remainder of the paving. Edges of the existing pavement shall be recut and trimmed to square, straight edges after the pipeline has been installed and prior to placing the new base and pavement.

Backfilling the trench shall be in accordance with the previous section on backfilling trenches. Base course for the paving shall be Dense Graded Aggregate and shall be placed in accordance with section 3.4 to a depth equal to the existing base course, but not less than 6 inches in highways and 4 inches in driveways.

The wearing surface of the streets and driveways shall be plant-mix bituminous concrete, Class I, furnished and placed in accordance with the current requirements of K.D.H.S. 306 to a depth equal to the existing pavement, but not less than 2 inches in the highways and streets and 1 - 1/2 inches in driveways.

6.14 CONCRETE CRADLE, ANCHORS, OR ENCASEMENT

Concrete cradle, anchors or encasement of sewer lines and/or fittings shall be placed where shown on the plans, required by the specifications, or as directed by the Engineer. Concrete shall be Class "B" and shall be mixed sufficiently wet to permit it to flow under the pipe to form a continuous bed. In tamping concrete, care shall be taken not to disturb the grade or line of the pipe or injure the joints. See standard drawing.

6.19 SEEDING AND SODDING - Shall be accomplished as described hereinafter. Unless otherwise specified by the Engineer, all graded areas shall be left smooth and thickly sown with a mixture of grasses at a rate of not less than 87 pounds per acre. Unless otherwise specified, the mixture shall consist of 60% Ky. Fescue #31 and 40% perennial rye. When the final grading has been completed, the entire area to be seeded shall be fertilized with number 12-12-12 fertilizer at a rate of 1000 lbs. per acre. Agricultural limestone shall be added at a rate of 4.4 tons per acre or as specified by the Engineer. After the fertilizer and agricultural limestone has been distributed, the contractor shall disc or harrow the ground to thoroughly work the fertilizer into the

6.15 LOCATING NEAR WATER MAINS

6.15.1 Horizontal Separation - Whenever possible, sewers should be laid at least 10 feet, horizontally, from an existing or proposed water main. Should local conditions prevent a lateral separation of 10 feet, a sewer may be laid closer than 10 feet to the water main if:

- a. It is laid in a separate trench.
- b. It is laid in the same trench with water mains located on one side on a bench of undisturbed earth.
- c. In either case, the elevation of the crown of the sewer is at least 18 inches below the invert of the water main.

6.15.2 Vertical Separation - Whenever sewers must cross under water mains, the sewers shall be laid at such an elevation that the top of the sewer is at least 18 inches below the bottom of the water main. When the elevation of the sewer cannot be buried to meet the above requirements, the sewer line shall be reconstructed with slip-on or mechanical joint cast iron pipe, pressure pipe or prestressed concrete cylinder pipe for a distance of 10 feet on each side of the water line. One full length of water main should be centered over the sewer so that both joints will be as far from the sewer as possible.

6.16 REPLACEMENT OF EXISTING MAIL BOXES, CULVERTS, CLOTHES LINE POSTS, FENCES AND OTHER SUCH FACILITIES - Existing mail boxes, drainage culverts, clothes line posts, fences, and the like shall not be molested or disturbed unless necessary, in which case, they shall be replaced in as good condition as found as quickly as possible. Existing materials shall be reused in replacing such facilities when materials have not been damaged by the contractor's operations. Existing facilities damaged by the contractor's operations shall be replaced with new materials of the same type at the contractor's expense.

6.17 STEEL, PLAIN END COVER PIPE - Cover pipe shall be steel, plan end, coal tar enameled, mill coated inside and out. The steel pipe shall have welded joints and be at least 18 foot lengths. The wall thickness of the pipe shall be at least 1/4 inch.

6.18 CLEAN-UP - Upon completion of the installation of the sewer pipes and appurtenances, the contractor shall remove all debris and surplus construction materials resulting from the work. The contractor shall grade the ground along each side of the pipe trench in a uniform and neat manner leaving the construction area in a shape as near as possible to the original ground line.

soil. The seed shall then be broadcast either by hand or by approved sowing equipment at the rate specified. After the seed has been distributed, the contractor shall then lightly cover the seed by use of a drag or other approved device. All seed shall be certified. The seeded area shall then be covered with straw to a depth of approximately 1 1/2 inches. Any necessary reseeding or repairing shall be accomplished by the contractor prior to final acceptance.

When sodding is required, it shall be at least 60 per cent of pernicious weeds, and shall be so laid that no voids occur between strips. Weed roots shall be removed as the sod is laid, and the

finished surface shall be true to grade even and equally firm at all points. Well screened topsoil shall be lightly sprinkled over the sodded areas and shall be raked to insure sealing the sod joints. The sodded areas shall be thoroughly watered.