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CITY OF BENTON

DESIGN STANDARDS

AND

STANDARD CONSTRUCTION  
SPECIFICATIONS

for Paving & Drainage Projects

JUNE 2005

PRELIMINARY

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# BENTON STANDARDS

No.	Revision	Date
1	Paving	2005
2	Drainage	2005
3	Sanitary Sewer Design Criteria	2005
4	Water System Criteria	2005

THE CITY  
OF  
BENTON, KANSAS

STANDARD ENGINEERING DESIGN CRITERIA  
AND  
GENERAL IMPROVEMENT POLICY

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STANDARD ENGINEERING DESIGN CRITERIA  
AND  
GENERAL IMPROVEMENT POLICY

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## **I. GENERAL**

### **A. Purpose**

The City of Benton is striving to provide uniformity in construction efforts involving public works. To accomplish this it is important that initial design comply with established standards and specifications approved by the City. In addition to initial design, there are many construction activities which will be performed which will not require design and construction documents which must also comply with uniform City standards. The following document will serve as the standard guideline for all public works construction.

### **B. Scope**

This document includes design criteria and typical construction details for Paving and Drainage Systems. In addition a brief material specification will be outlined.

### **C. Variation from Design Criteria**

Variations will be permitted from the Standard Engineering Design Criteria and General Improvement Policy when a formal request is made to the City. The request will involve the following:

1. List any and all variations being requested.
2. Provide a justification for each variation in writing. In the case of a detail, provide a sketch or an engineered drawing indicating the modification requested.
3. Request a formal meeting with the City to discuss the suggested variation.
4. Obtain in writing an approval of the modification.

Special circumstances may be encountered where a specific item is not included in the Standard Engineering Design Criteria and General Improvement Policy. If this occurs, a formal request shall be made to the City and shall meet the requirements as shown above for a variation.

### **D. Compliance with Applicable Statutory Requirements**

Compliance with all Federal, State and Local Laws will be required. Where permits are required by Federal, State and Local Agencies, the Project Owner will be required to complete all filing, pay all fees, and obtain an approved permit. All information including maps, plans, specifications, etc., required to obtain an approved permit shall be provided to the City.

E. Amendment to Standard Engineering Design Criteria

Amendments to the Standard Engineering Design Criteria and General Improvement Policy will be approved by the City. The Amendments will be made available by the City for insertion into this document. It is the responsibility of the holder of this document to assure themselves that they have all the amendments or a current document.

F. General Development Plan or Plat

Any development plan or proposed plat shall be submitted to the City with utilities and pavement generally located within the boundary of the plan or plat. For plats the utilities will be located within dedicated easements and right-of-ways. The general development plan or plat shall show preliminary elevations for all sanitary sewers, streets, and storm drainage conveyance systems. In addition, the project owner for a plat shall submit a four corner lot grading plan indicating elevations at each corner of the subdivision he is developing. The four corner lot grading plans will be placed on file with the City and will be reviewed during requests for building permits

## II. PAVING

All street improvements shall be designed and constructed to City Engineering Standards and Specifications, as outlined in this section. Standard typical section details for asphalt pavement are included as Figure II-1.

### A. Pavement

#### 1. Types

Standard pavement for City street projects shall generally be one of the following types:

- Asphaltic Concrete
- Concrete (Reinf. or plain)
- Reinf. Concrete Valley Gutter Pavt. (X" Reinf. Conc./X" Bit. Base)

#### 2. Minimum Thicknesses

Thicknesses for the various pavements will vary depending on the intended use. The table below shows minimum pavement depths to be used for City projects.

<u>Type of Pavement</u>	<u>Local Access, Low Volume</u>	<u>Arterial, Commercial, or Industrial</u>
Asphaltic Concrete	7"	8"
Concrete (Reinf. or Plain)	6"	7"

#### 3. Width

In general, the width of City streets shall be determined by the platted right-of-way. Widths may occasionally vary to match existing conditions or to meet special requirements of a particular site. Listed below are common right-of-way widths and the corresponding back-of-curb to back-of-curb dimension requirements for the street to be constructed in that right-of-way.

<u>Right-of-Way Width</u>	<u>Street Width (Back to Back of Curb)</u>
64'	31' (35' Max.)
70'	41'
100'	71'

4. Bituminous Base under Curb & Gutter

On curb & gutter sections with asphalt pavement, the first lift of asphalt base course shall extend to a width of 2" behind each back of curb. The extra width of bituminous base shall be considered a separate bid item and shall be measured and paid for separately from other asphalt pavement items.

B. Treated Subgrade

1. Limits of Treatment

Lime or fly-ash treated subgrade shall be constructed to a depth of 6" and to a width of 12" beyond the back of each curb line, unless otherwise indicated by the plans or specifications.

2. Application Rate

Application rate of the treatment agent shall be as determined by an approved laboratory using standard testing methods. This rate shall be shown on the project construction plans; however, the rate may be adjusted during construction if approved in writing by the Engineer.

3. Compaction Requirements

Compaction of all subgrades, whether treated or not, shall be to 95% of maximum density as determined by ASTM D698.

C. Curb and Gutter

1. Types

See Figures II.2 through II.6 for the following standard types of curb and gutter to be used on City paving projects:

- Combined Curb & Gutter (6 5/8")
- Combined Curb & Gutter (3 5/8" Roll)
- Median Combined Curb & Gutter
- Monolithic Edge Curb (6 5/8")
- Monolithic Edge Curb (3 5/8" Roll)



## 2. Construction Requirements

### a. Joints

Contraction joints shall be placed in curb and gutter at intervals of 10 feet or less. The joints shall be sealed with an approved joint sealing compound which will adhere to the vertical portion of the joint through the curb face. Expansion joints shall be installed at the end of all curb returns and approximately every 250 feet on long runs.

### b. Curb through driveway approaches

Where combined curb & gutter crosses a driveway entrance, the curb portion shall be laid down to a height of 1-1/2" through the entrance.

### c. Markings for valves, meters, and cleanouts

To facilitate locating water valves, water meters, and sanitary sewer cleanouts, a permanent marking shall be placed on the curb adjacent to each item. The marking shall consist of a letter at least 4" in height stamped into the face of the curb while the concrete is green. The letter "V" shall be used to mark water valve locations, "M" shall be used for water meters, and "S" shall mark sanitary sewer cleanouts.

## D. Geometric Design Criteria

### 1. Alignment

#### a. Centerline

Streets shall be centered in the right-of-way unless special circumstances dictate otherwise. Deviations from centering the street in the right-of-way shall be made only by written approval from the Director of Public Works. Where a proposed street is an extension of an existing street, the centerline of the proposed street shall coincide with the centerline of the existing street as closely as is practicable.

#### b. Intersection angle

Intersections shall be designed to be as close to 90° as possible. In no case shall the intersection angle be less than 80°.

2. Street grades

Street grades shall be indicated on plans along the centerline of the roadway, except in cases of non-standard or unusual geometric configurations. On curved roadways, the centerline grade shall be calculated such that the minimum grade requirement is met for curb and gutter along the longest side of the curve.

a. Minimum grade

To provide proper longitudinal drainage, the minimum allowable street grade shall be 0.32%, except as noted below for valley gutters.

b. Minimum grade across valley gutters

The minimum desirable grade along the flowline of valley gutters shall be 0.64%, measured across the entire valley gutter including curb returns. In no case shall the grade across a valley gutter be less than 0.32%.

3. Cross slope

Cross slopes for pavements shall be as indicated below except for localized variations where necessary to match an existing pavement.

<u>Type of Pavement</u>	<u>Minimum Allowable</u>	<u>Maximum Allowable</u>
Asphaltic Pavement	3/8" per foot	1/2" per foot
Concrete Pavement	1/4" per foot	1/2" per foot

4. Minimum/maximum fall around curb returns

The table below shows the minimum and maximum allowable difference in elevations between the PC and PT of curb returns for 90° intersections. For intersections with a "delta" of other than 90°, the elevation difference shall be prorated based on the values shown.

<u>Curb Return Radius</u>	<u>Minimum Allowable</u>	<u>Maximum Allowable</u>
20'	0.25'	1.00'
25'	0.30'	1.25'
30'	0.35'	1.50'
35'	0.40'	1.50'
40'	0.45'	1.50'
45'	0.50'	1.50'

50'

0.55'

1.50'

5. Curb return radii

a. Both streets curb & gutter

Curb return radii for street intersections shall follow the guidelines in the following table when both streets are constructed with curb & gutter.

<u>Type of Roadway</u>	<u>Intersecting With</u>	<u>Minimum Curb Face Radius</u>
Residential	Residential	20 feet
Residential	Collector or Arterial	30 feet
Commercial, Collector or Arterial	Commercial, Collector or Arterial	50 feet

b. Curb & gutter intersecting road with ditch section

Intersection geometrics for intersecting a road without curb & gutter shall be as shown in Figure II.7. Radius requirements shall generally follow the requirements shown above.

6. Walk Grades

The finished elevation at the property lines (referred to as the "walk grade") shall generally be such that the slope between the back of curb and the property line is at least 1/4" per foot, but not more than 4 horizontal to 1 vertical. Exceptions may be made where absolutely necessary to match an existing situation.

7. Cul-de-sacs

Permanent cul-de-sacs shall have a face-of-curb radius of 35' for the main "bulb" and a radius of 20' for the throat returns (see Figure II.8). The bulb may be centered, or may be offset to the left or right as dictated by the right-of-way configuration.

A temporary cul-de-sac shall be constructed for any street which is more than 250 long and is temporarily terminated without an adequate provision for turn-around of emergency or commercial vehicles, such as fire trucks and school busses. Such temporary cul-de-sacs shall have, as a minimum, the same dimensions as a permanent cul-de-sac but are not required to be paved or have curb & gutter. Temporary cul-de-sacs shall include a gravel or light type surface.

**E. Sidewalks**

Sidewalks shall be constructed in conjunction with paving projects when required by the signed petition for the project. Sidewalks shall generally be located immediately adjacent to the right-of-way if possible; however, sidewalk location shall be adjusted where necessary to provide a smooth transition from an existing pedestrian walkway.

**1. Width & Thickness**

As a minimum, sidewalks on City projects shall be constructed to the dimensions shown in Figure II.9. Greater width or thickness is acceptable where requested by the owner or required due to special circumstances of a particular site.

**2. Wheelchair Ramps**

Wheelchair ramps shall be provided at all curbed street crossings and any other locations which would act as a barrier to persons in a wheelchair. See Figure II.10 for minimum requirements for standard wheelchair ramps.

**F. Driveway and Alley Entrances**

Driveway or alley entrances shall be constructed with City paving projects when the paving abuts an existing driveway or alley unless the Owner of the abutting property requests in writing that no entrance be constructed. The entrance or "approach" shall extend from the curb line of the street to the nearest property line.

**1. Width**

For the purposes of design, the width of proposed drive and alley approaches shall match the existing drive or alley. However, the property owner may request, in writing, that a wider or narrower approach be constructed. Except where approved by the City to match an existing condition, the minimum throat dimension shall be 12 feet for driveways or 20 feet for alleys, and the maximum throat width shall be 30 feet.

**2. Return Types/Radii**

Standard drive and alley approaches shall be constructed as shown in Figure II.11. Return radii for standard entrances are shown below.

	<u>Minimum Radius</u>	<u>Maximum Radius</u>
Residential Drive	10'-6"	10'-6"
Commercial Drive	10'-6"	40'
Alley	20'	40'

3. Drive request

All driveway approach construction shall be a direct assessment to the property served by the approach. The owner of the property shall request or confirm, in writing, the width and location of the drive approach. The owner may also request additional thickness or reinforcement if desired. If no request or confirmation is obtained from the Owner, the drive approach shall be constructed to match the existing drive location and width.

G. Street Signing

In general, design of paving projects shall include all necessary signing, including regulatory, warning, and street name signs. However, installation of certain regulatory signs, such as STOP signs, may be subject to approval by the City based on an engineering study.

1. MUTCD Requirements

All signs and other traffic control devices, and the installation and use thereof, shall conform to the requirements of the latest version of the Manual on Uniform Traffic Control Devices for Streets and Highways (MUTCD), published by the Federal Highway Administration. All devices shall be reflectorized on the side facing traffic.

2. Minimum Sizes

The minimum allowable size for regulatory and warning signs shall be the size denoted as "Standard" in the publication Standard Highway Signs published by the Federal Highway Administration.

H. Partial List of Standard Bid Items

To the extent possible, standard bid items shall be used in designing and bidding projects. Additional bid items will occasionally be necessary due to the varying nature of projects. A partial list of common bid items and their units of measurement are listed here for information.

X" Asphaltic Concrete Pavement	Sq. Yd.
X" Bituminous Base	Sq. Yd.
6" Subgrade Manipulation	Sq. Yd.
Hydrated, Pebble, or Carbide Lime	Ton
Combined Curb & Gutter (6 5/8")	Lin. Ft.
Combined Curb & Gutter (3 5/8" Roll)	Lin. Ft.
Monolithic Edge Curb (6 5/8")	Lin. Ft.
Monolithic Edge Curb (3 5/8" Roll)	Lin. Ft.
Median Combined Curb & Gutter	Lin. Ft.
X" Reinforced Valley Gutter Pavement (X" Reinf. Conc. Pavt./X" Bit. Base)	Sq. Yd.
Concrete Pavement (X" Uniform)(AE)	Sq. Yd.
Unclassified Excavation	Cu. Yd.
Asphalt Mat Pavement Removed	Sq. Yd.
Signing	Lump Sum
Seeding, Fertilizing, & Mulching	Lump Sum
XX" RCP Storm Sewer	Lin. Ft.
XX" CMP Storm Sewer	Lin. Ft.
Std. Type 1A Curb Inlet (size)	Each
Reinforced Concrete Manhole	Each
Site Clearing & Restoration	Lump Sum
Concrete Slope Drain	Lin. Ft.
Linear Channel Grading	Lin. Ft.

### III. DRAINAGE

#### GENERAL

Every urban area has four separate and distinct drainage systems: (1) is the major system which frequently consists of open channels and may include storage areas in the channels or in ponds; (2) is the initial system which usually consists of a closed conduit with area inlets and curb inlets; (3) is paved streets which are used to convey runoff from individual lots to the initial system; and (4) is proper individual lot grading to convey runoff from the lot to the paved street and/or area inlets. Obviously the primary function of streets is to convey traffic and drainage must be considered secondary in varying degrees to traffic needs.

The designer must address all 4 systems.

Two manuals have been selected for adoption and are to be used for design. They are titled (1) "Design of Urban Highway Drainage - The State of the Art" (Manual No. 1) prepared by Reitz and Jens, Inc., Consulting Engineers, under the sponsorship of the United States Department of Transportation, reprinted in April 1980; and (2) "Drainage of Highway Pavements" (Manual No. 2) prepared by Tye Engineering, Inc. under the sponsorship of the United States Department of Transportation, dated March, 1984.

These manuals are available from the National Technical Information Service, Springfield, Virginia 22101.

The following statements are to be added to Manual No. 1:

#### A. List of Symbols Comments and Modifications

1. Symbols used in drainage calculations and tabulations shall conform to the list of symbols shown on pages III, IV, V, VI, VII and VIII of the manual. Symbols used in calculations and tabulations which are not shown on this list shall be clearly identified in the calculations or tabulations. All drainage calculations shall be performed using English units of measurement.

#### B. Chapter 1 Comments and Modifications - "General Principles of Stormwater Design"

1. Narrative in Chapter 1 shall be considered as background information and not necessarily adopted as City policy. The City does not presently require treatment of storm water sewer discharges. Consultants are encouraged, however, to incorporate measures in all projects which will reduce pollution especially from soil erosion.

General drainage criteria in the City shall be as identified in the following tables for the initial storm:

**TABLE I**  
**INITIAL DESIGN STORM FREQUENCY**

Land Use	Initial Design Storm Return Period
1. Residential and Public Park Areas	2 years
2. General Commercial Areas	5 years
3. Public Building Areas	5 years
4. Industrial Areas	5 years
5. High Value Downtown Business Areas	5 years

**TABLE II**  
**ALLOWABLE PAVEMENT ENCROACHMENT FOR INITIAL DESIGN STORM**

Street Classification	Allowed Encroachment
1. Local	No curb overtopping. Flow may spread across crown.
2. Collector	One 8' lane width must be free of water.
3. Arterial	One 8' through lane width in each direction must be free of water.

An additional requirement to the initial system criteria is that the runoff from the 100-year frequency major storm for time of concentrations identical to the initial system design must be retained within public rights-of-way in all cases. This 100-year frequency major storm requirement must be evaluated for projects in existing developed areas and when identified as prohibitive because of estimated costs, the consultant shall provide criteria recommendations to the City for such projects which will provide a reasonable cost/benefit ratio for the project.

**C. Chapter 2 Comments and Modifications - "Precipitation"**

1. Precipitation intensity for the various durations and frequencies shall be as shown in the table attached to this document and identified as "Attachment A". When intensities are required for durations not shown in the table in the range between 2-hour and 24-hour durations, such intensities shall be computed as straight line interpolations.



**D. Chapter 3 Comments and Modifications - "Runoff"**

Logic and documentation for the following items shall be provided in writing when final drainage computations are submitted to the City for approval.

1. Interception by vegetation is not a required consideration.
2. Infiltration loss on pervious surfaces shall be considered in those cases where such losses become significant. Infiltration loss for pervious surfaces for use with the S.C.S. dimensionless unit hydrograph method shall conform to the table attached to this document and identified as "Attachment B". Infiltration losses are included in the coefficients of runoff provided for use with the modified rational method.
3. Depression storage loss shall be considered in those cases where such losses become significant. Depression storage loss for pervious and impervious surfaces for use with the S.C.S. dimensionless unit hydrograph method shall conform to the table attached to this document and identified as "Attachment C". Depression storage losses are included in the coefficients of runoff provided for use with the modified rational method.
4. Reduction for gutter storage shall be taken into account where such storage is a significant factor. Use of this reduction will be by specific approval from the City on a case-by-case basis.
5. Reduction of peak flow rate due to conduit storage will not usually be a consideration. Use of this reduction may be a significant factor where large conduits are required. Use of this reduction will be by specific approval from the City on a case-by-case basis.
6. The rational method with required modifications shall be used to compute design runoff for areas of 320 acres or less tributary to the design point being considered. Design runoff from areas between 320 acres and 750 acres shall be computed using both the rational method and the S.C.S. dimensionless unit hydrograph method and whichever method produces the larger peak runoff shall be used to design the system for the area tributary to the design point being considered.
7. Coefficients of runoff used in the rational method shall be as indicated in the table attached to this document and identified as "Attachment D" for the storm frequencies shown. Development of composite runoff coefficients for drainage areas and/or sub-areas shall be documented and correlated with such areas shown on a drainage area map.

8. The minimum inlet time or time of concentration used shall be 15 minutes. Inlet time or time of concentration shall be computed using the procedures identified as follows:
  - a. Travel time in street gutter sections shall be determined using the procedures identified in Section 4.1.3. of Manual No. 2.
  - b. Overland sheet flow time shall be determined using the kinematics wave theory as presented in Section 4.1.3. of Manual No. 2 except that when the product of the rainfall intensity and the length of flow as determined by this method is less than 500, the kinematic wave theory is not valid for this situation and in these cases, the overland flow time shall be determined as identified in (c.) below.
  - c. Overland sheet flow time shall be computed using average flow velocities as determined from the attached table identified as "Attachment E" and the estimated flow lengths involved when the kinematic wave theory is determined to be invalid as identified in (b.) above. Velocities for slopes not shown in "Attachment E" shall be computed as a straight line interpolation and/or extrapolation within the ranges shown.
  - d. When the inlet time or time of concentration computed by the above procedures is less than 15 minutes the minimum of 15 minutes shall be used as the inlet time or time of concentration.
9. Composite infiltration rates for use with the S.C.S. dimensionless unit hydrograph method shall be based on procedures identified in Figure 3-9 of Section 3.3.5.2. of Manual No. 1. See Exhibit Nos. 1 and 2 showing general soil types in the area.
10. Format, computation, and documentation required for the S.C.S. dimensionless unit hydrograph shall be as shown in the example provided in Manual No. 1 beginning with Section 3.3.5.9. Documentation to be included in submittal to City for approval shall include all computations in the order identified in the example, a tabulation of unit hydrograph coordinates, a plot of unit hydrograph, a tabulation of effective rainfall, a tabulation of storm hydrograph coordinates for the drainage area, a plot of the storm hydrograph for the drainage area, a map of the drainage area, and computations showing determination of the percentage of impervious surface. Locations of soil types involved shall be shown on the map of drainage area.

E. Chapter 4 Comments and Modifications - "Storage"

1. The Division of Water Resources of the Kansas State Board of Agriculture has adopted specific requirements governing design of dams for detention storage. Such requirements are contained in documents identified as Engineering Guide - 1 and Engineering Guide - 2. Requirements identified in the latest revision of these two documents shall be adhered to when designing facilities addressed by the documents.

Criteria, standards, and documentation identified in Chapter 4 of Manual No. 1 shall be adhered to in all cases where such criteria and standards do not conflict with the Division of Water Resources requirements contained in their engineering guides.

Documentation as indicated in the example problems in said Chapter 4 shall be submitted in writing when final drainage computations are submitted to the City for approval.

F. Chapter 5 Comments and Modifications - "Roadway Drainage"

1. Criteria standards and documentation identified in Manual No. 2 revises and expands upon such items as contained in Chapter 5 of Manual No. 1. Such criteria, standards, and documentation contained in Manual No. 2 shall supersede, revise, and expand like items as contained in Chapter 5 of Manual No. 1, otherwise criteria, standards, and documentation identified in Chapter 5 of Manual No. 1 shall be in effect.
2. Topics contained in Section 4.0., 4.1., 4.1.1., 4.1.2., 4.1.3., 4.1.4., and 4.2. of Manual No. 2 have been discussed previously in this policy statement; therefore, requirements for topics contained in these sections will be as previously identified.
3. Symbols used in computations related to highway or street pavement drainage shall conform to the list of symbols contained on pages 10, 11, and 12 of Manual No. 2. Such computations shall use English units of measure.
4. Curb opening inlets shall be approved and adopted City standards. Inlets proposed for construction on grades in excess of 3.0% shall include curb openings and gutter grate openings. Adopted standards for such curb opening inlets with gutter grates will be developed with projects as needed. Gutter grates shall be of the curved vane type and incorporate features of existing standard curb opening inlets functioning on the sweeper principle. Inlets with grates must be located to minimize hazards to pedestrians and bicycles. Curved vane gutter grates shall be of the type indicated on page 42 of Manual No. 2.

5. Design and evaluation of City Standard Type I inlets proposed for construction on grade operating as a weir shall follow procedures identified in solution (2) of Example 11 on pages 63 and 64 of Manual No. 2. Design and evaluation of City Standard Type IA inlets proposed for construction on grade operating as a weir shall follow the same procedures as identified above for Type I inlets except the formula used for determining inlet efficiency in Chart 10 shall be revised to  $(L + 1) - L_T$  to compensate for increased efficiency of inlets constructed in the set back location.
6. Design and evaluation of City Standard Type I inlets proposed for construction in sumps operating as a weir shall follow procedures identified by Chart 12 on page 77 of Manual No. 2. Design and evaluation of City Standard Type I inlets proposed for construction in sumps operating as an orifice shall follow procedures identified by Chart 14 on page 79 of Manual No. 2. Water depth ( $d_o$ ) used with Chart 14 shall be based on the formula identified with drawing (b) of Figure 21 on page 75 of Manual No. 2 where  $d_i$  in such formula is the distance from the point shown in the drawing for where the angle  $O$  is measured to the water surface elevation. Design and evaluation of City Standard Type IA inlets proposed for construction in sumps operating as a weir shall follow procedures identified by Chart 12 on page 77 of Manual No. 2 except the formula used for determining  $P$  shall be revised to  $P = L + 1 + 1.8 W$  to compensate for increased efficiency of inlets constructed in the set back location. Design and evaluation of City Standard Type IA inlets proposed for construction in sumps operating as an orifice shall follow procedures identified by Chart 12 on page 77 of Manual No. 2.
7. Design and evaluation of City Standard Type I and Type IA inlets proposed for construction on grade operating as orifices shall follow procedures identified for design and evaluation of such inlets in sumps operating as orifices.
8. Format, computation, and documentation required for design of storm sewer systems shall be as shown in the example provided in Manual No. 1 beginning with Section 5.11. Documentation to be included in submittal to City Engineer, or his authorized representative, for approval shall include all computations in the order identified in the example, a tabulation of design computations as identified in Table 5-7 in Manual No. 1, a plan of the system as identified in Figure 5-38(a) in Manual No. 1, a profile of the system as identified in Figure 5-38(b) in Manual No. 1, and tabulations of inlet design computations as indicated in Exhibit Nos. 4 and 5. The numbering of the various points for design consideration shall follow procedures indicated in Figure 5-39 in Manual No. 1.

## **G. Supplementary Design Information and Criteria**

### **Section I: General Criteria for Open Channels Ditches and Related Appurtenances**

#### **1. Introduction**

Open channels for use in the major drainage system have significant advantage in regard to cost, capacity, multiple use for recreational and aesthetic purposes and potential for detention storage. Disadvantages include right-of-way needs and maintenance costs. Careful planning and design are needed to minimize the disadvantages and to increase the benefits.

#### **2. Geometric Features**

- a. Where possible, a primary and an auxiliary channel shall be employed. Purpose of the primary channel is to carry the design flood discharge. Purpose of the auxiliary channel is to contain daily flow, minimize the portion of channel bottom which is normally wet and reduce bank erosion caused by the natural tendency of stream flow to meander from bank to bank.
- b. Side slopes of the primary channel shall be no steeper than 4 horizontal to 1 vertical.
- c. Minimum bottom width of either primary or auxiliary channel shall be 4 feet.
- d. Side slopes of the auxiliary channel shall be 0.5 horizontal to 1 vertical.
- e. Maximum width of the auxiliary channel shall be 10 feet.
- f. Maximum depth of the auxiliary channel shall be 2 feet.
- g. The auxiliary channel shall be centered in the primary channel wherever sufficient bottom width is available.
- h. Where primary channel bottom width dictates that the auxiliary channel be set to one side of the primary channel, the near side overbank distance shall be a minimum of 2 feet; the far side overbank distance shall be a minimum of 10 feet. The cross-slope on the overbank channel shall be 2%.

- i. Where primary channel width will not accommodate an auxiliary channel the primary channel shall feature a "V" bottom using 2% cross slope.
  - j. Auxiliary or "V" geometric features may be disregarded in hydraulic computations, such as computations for water surface profiles.
3. Manning's formula constants for roughness factor (n).
- a. For grass-lined channel - "n" = 0.030.
  - b. For rip-rap basket gabions, blanket gabions, rock fill - "n" = 0.045.
  - c. For portland cement concrete-lined channels - "n" = 0.013.
4. Channel Surface Protection
- a. Surface protection is an integral part of the design of any channel. Provision for channel surface protection must be made in contract documents and responsibility for maintenance of the channel between the time when earthwork is completed and installation of surface protection should be clearly stated.
  - b. Where computed average velocity in section exceeds 6 feet per second, an energy dissipater, concrete lining, stone rip-rap, rip-rap bags, fabriform or gabions must be used to protect the channel surface from erosion. Surface protection for velocities 6 feet per second or less shall be evaluated consistent with involved soil types.
  - c. Adjustments of channel gradients which are too steep for design conditions are best made by channel drops. Normally it is better to employ several low head drops instead of high drops. Sloped drops which fit channel topography are usually the most cost efficient. Sloped drops should have a rough surface and be no steeper than 2 to 1. All channel drops must be protected from erosion and being washed out.
5. Outfall Structures
- a. Protection from erosion is required at all locations where a side drain or storm water sewer enters an open channel.

- b. If the open channel is grass-lined, the side drain may employ a headwall, apron and wingwalls which are designed to fit the channel bank; or if the side drain is pipe, an end section may be used provided it is supported by a toewall at least 2' in depth using portland cement concrete, grouted stone rip-rap, rip-rap bags, fabriform or gabions,
- c. For grass-lined channels, the erosion protection in the form of portland cement concrete slab, stone rip-rap, rip-rap bags, fabriform or gabions shall extend across the overbank channel, down into and across the auxiliary channel (if applicable) and at least 2 feet up the opposite primary channel bank.
- d. Erosion protection shall extend upstream and downstream from the centerline of any side drain a distance of 1 1/2 pipe diameters each direction or a minimum of 3 feet each direction.

#### 6. Water Surface Profiles

- a. Channel design must be accompanied by water surface profiles in a format which presents not only the profile but the geometric and hydraulic elements which are employed in the profile computations.
- b. Any method which employs the Manning equation in a step-type iterative backwater analysis is acceptable for channel reaches between structures. At structures, an accounting for area reduction and wetted perimeter increase, such as at piers, piles, walls, etc. must be entered into the water surface elevation computations. Suggested text for analysis of flow through structures is "Hydraulics of Bridge Waterways" published by the Bureau of Public Roads, source of which is available by contacting the City/County Engineer.
- c. An excellent example of method for computing water surface profiles is the Hydrologic Engineering Center Computer Program designated "HEC-2, Water Surface Profiles".
- d. Where access to the HEC-2 computer program is not practical, the procedures outlined in Hydrologic Engineering Center Report, Volume 6, Water Surface Profiles, is recommended.
- e. Where the starting elevation of a water surface profile is not known it should be estimated by making a "slope-area" or a "critical depth" computation for the channel being studied.

## 7. Freeboard

- a. To protect against the damaging effects of wave action, air bulking, splash and spray, man-made channels should provide a minimum of one foot of freeboard above the computed water surface profile for the design storm.
- b. The minimum freeboard above flood of record or computed flood insurance base flood water surface profiles for natural rivers, creeks, sloughs, etc. shall be one foot.
- c. Where buildings are immediately adjacent to a natural or man-made channel, the minimum building pad elevation for such structures is recommended to be one foot above the computed 100-year return flood water surface profile.

## Section II: General Criteria for Detention Design and Standards

### 1. Introduction

Storm water detention is a method by which the peak discharge of a drainage system is reduced through temporary storage in a reservoir having a control structure as its outlet. The capacity of the outlet structure limits the outflow of the reservoir to a quantity less than the inflow. Detention is used to decrease the required capacity of new drainage systems and to relieve or prevent over-charging of existing drainage systems. The City desires that detention storage be sized to reduce and/or limit peak runoff for the 5-year and 100-year frequency storms from urbanized areas to the peak runoff for such storms as if the area was not urbanized.

The purpose of this section is to state the procedure and criteria to be used in the design and construction of detention systems.

As per current Kansas State Statutes, all dams capable of impounding thirty acre-feet or more at maximum stage require design approval and a permit from the Division of Water Resources of the Kansas State Board of Agriculture. Those structures of this size or larger must, therefore, meet both the design standards as herein set forth and the design standards and procedures of the Division of Water Resources.



## 2. Design Criteria

### a. Site Exploration

Prior to design of a detention facility, the site shall be explored for surface and subsurface conditions, such as soil composition, water table, and subsurface geology.

### b. Detention Storage Dam Design

All dams to be constructed within the urbanized area of the City shall be designed for Class C High Hazard in accordance with the Engineering Guide - 1 identified previously in comments on Chapter 4 of Manual No. 1.

### c. Design Inflow

#### 1. Peak flow rates

The methods of computing peak inflow are described in the previous discussion of Manual No. 1.

#### 2. Soil Groups

For both urban and rural basins, the hydrologic soil groups will be found using the S.C.S. "Soil Survey of Sedgwick County".

### d. Inflow Hydrograph

Inflow hydrographs for drainage areas ranging from 320 to 750 acres shall be developed using the S.C.S. dimensionless unit hydrograph procedures previously identified in Chapter 3 of Manual No. 1. Inflow hydrographs for drainage areas less than 320 acres shall be developed based on the 10-minute unit hydrograph equations shown in Table 4-5 of Manual No. 1 and the methodology as presented in the example beginning in Section 4.6.4.2. of Manual No. 1. The value for  $t_0$  shall be as identified in the table provided as "Attachment F".

### e. Routing Methods

Routing of the inflow storm through the detention pond shall utilize the procedures identified in Chapter 4 of Manual No. 1. Complete dewatering of the detention portion of the facility shall take no more than 4 days.

f. **Design and Construction of the Facility**

Due to the great variance in soil types and subsurface conditions throughout this area, it is not practical to develop one specification for construction of embankments and ponds. There are, however, several general requirements that can be recommended at this time.

1. As previously mentioned prior to design the site shall be explored for surface and subsurface conditions. This work shall be done by a qualified testing laboratory under the direction of a licensed engineer.
2. The core of the embankment and the core trench shall be composed of impervious material.
3. Side slopes of the pond and embankment will be constructed in accordance with the standards stated in the section on open channel design.
4. Freeboard shall be designed following the same criteria as used in open channel design.
5. All areas above the static pool shall be seeded and mulched or sodded in compliance with the standards of the City.
6. During construction, there will be continual testing and inspection by a qualified testing laboratory under the direction of a licensed engineer with reports submitted to the City.

**Section III: General Criteria for Storm Water Sewer Design and Standards**

1. **Introduction**

Storm water sewer systems shall be designed as pressure systems for the initial storm when possible. Hydraulic grade line shall be a minimum of 6" below the street pavement gutter flow line at locations of inlets and manholes.

## 2. Design Criteria

### a. Manning's coefficient of friction shall be as follows:

Reinforced concrete pipe (all sizes)  $n = 0.013$ ; corrugated metal pipe 2 2/3" x 1/2" helical and circumferential corrugations (all sizes)  $n = 0.024$ ; corrugated metal pipe 3" x 1" helical and circumferential corrugations (all sizes)  $n = 0.027$ ; corrugated metal pipe 6" x 2" helical and circumferential corrugations (all sizes)  $n = 0.033$ .

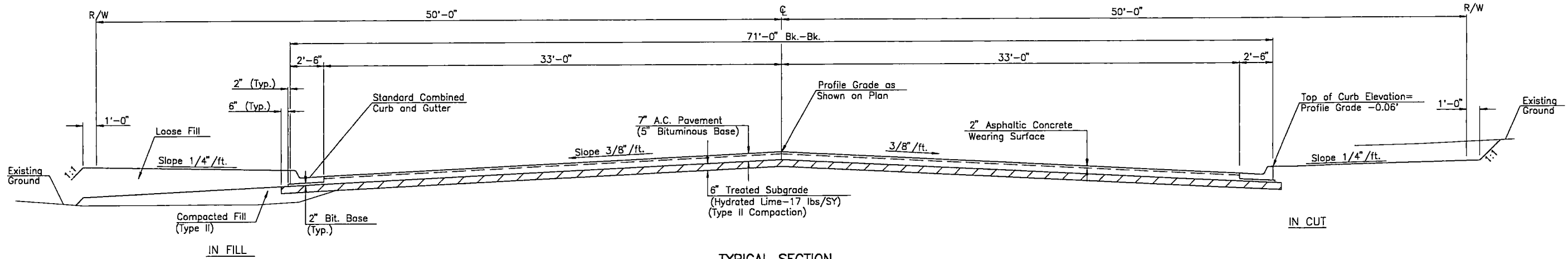
### b. Storm sewers are required to be designed to provide for a minimum cleansing velocity of 2 feet per second at a depth of flow of 0.2 of the diameter or rise of the pipe.

## Section IV: General Rules of Thumb for Design of Drainage and Storm Water Sewers

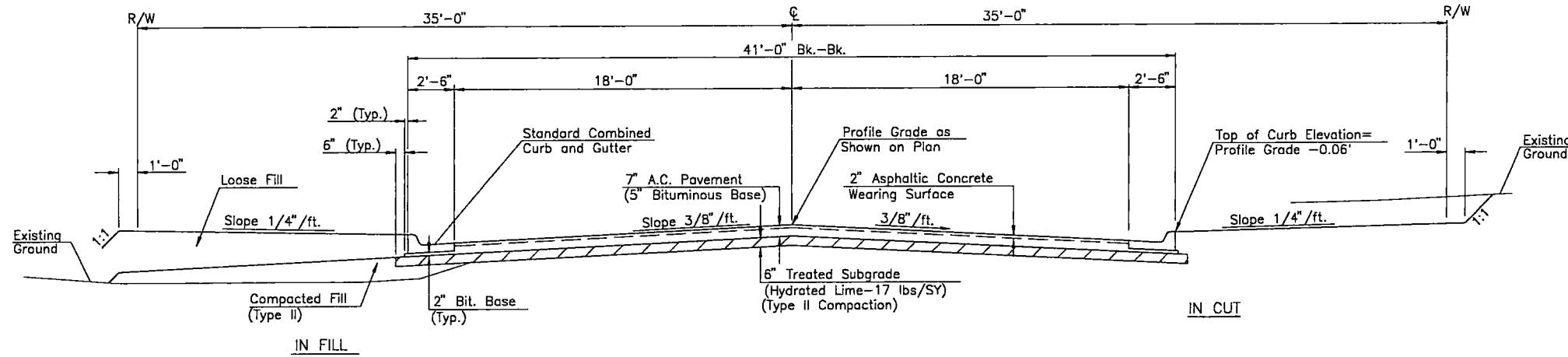
1. Whenever possible, set flow line elevations of pipes in structures such that the crowns of the pipes are at the same elevation.
2. Flow lines of pipes in structures may be set at elevations such that the 0.8 depth points of the pipes are at the same elevation.
3. When main line pipe sizes change at a structure, the drop in flow line through the structure should be equal to the difference in the sizes of the pipe.
4. Provide 0.2 foot drop in the main line pipes through structures when the structures includes one side lateral. Provide 0.3 foot drop in the main line pipes through structures when the structures includes two or more laterals.
5. Provide 0.1 foot drop in the main line pipes through structures whenever the horizontal alignment of the main line pipes changes by 45° or greater.
6. A clearance of 2 feet is required between the top of the outside diameter of the pipe and the bottom of the street pavements when pipes are installed under or in close proximity to such pavement. A clearance of less than 2 feet will require specific approval by the City.
7. Manholes used on storm sewers normally will be City standard shallow Type A, shallow Type B, standard Type A, standard Type B, and standard reinforced concrete. Standard reinforced concrete manholes are normally used with pipe sizes 42" or larger. All openings into structures which are to be utilized to facilitate maintenance operations shall be centered on pipes entering and/or exiting such structures when possible.

8. Inlet, manhole, and headwall structures must always be evaluated to ensure that the structures have sufficient size to accommodate the various inflow and outflow pipes based on the alignment shown on the plan.
9. Drainage plans which require construction of erosion protection will be required to include detail drawings for the placement of such erosion protection for each specific location. Such details must show required elevations and horizontal dimensions.
10. All projects which require construction of channels and/or ponds shall include provisions for establishing grass cover as necessary to minimize erosion. Such projects shall also include provisions for mulching of slopes which are more susceptible to erosion. Types of grass cover specified shall be compatible with the types of soil involved. Projects which have soil types that will not support development of good grass cover will require placement of suitable topsoil.
11. The City prefers inlet-manhole combination structures whenever possible. The City also prefers to construct manholes outside the limits of street pavement whenever possible. When necessary to construct manholes in street pavement, such manholes shall be Type B.
12. State and federal government agencies permit or approval requirements as related to certain types of drainage improvements must be adhered to as follows:
  - a. Construction plan approval is required from the Tulsa Branch of the Corps of Engineers whenever a project requires crossing a Corps constructed levee or discharge into a Corps constructed channel.
  - b. The Kansas City Branch of the Corps of Engineers has jurisdiction of construction within the limits of the high bank or across the Little and Big Arkansas Rivers. Plans requiring construction within these limits must be sent to the Kansas City Branch of the Corps of Engineers for determination of permit requirements.
  - c. A permit is required from the Division of Water Resources of the Kansas State Board of Agriculture when projects require excavation or construction of fill in a floodplain. The application of this permit requirement to projects which require construction in floodplains will be determined on an individual project basis on identification of the type and extent of the work involved.

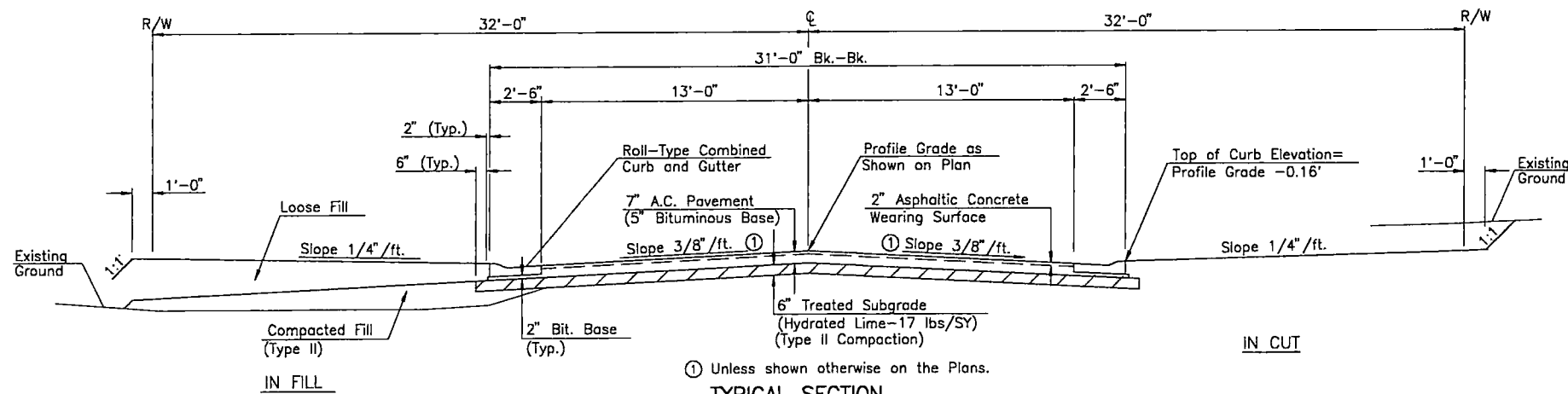
- d. A permit is required from the Division of Water Resources of the Kansas State Board of Agriculture for those projects which include construction of a dam which would impound more than 30 acre-feet of water at the elevation of the top of the dam.
  - e. Contractors are required to obtain a permit from the Division of Water Resources of the Kansas State Board of Agriculture when it is necessary to dewater with wells and well points to facilitate construction.
13. Occasionally exceptions to the above-stated rules of thumb may arise. Such exceptions will be evaluated and approved on an individual case basis.



TYPICAL SECTION  
71'-0" Back-Back Curb



TYPICAL SECTION  
41'-0" Back-Back Curb



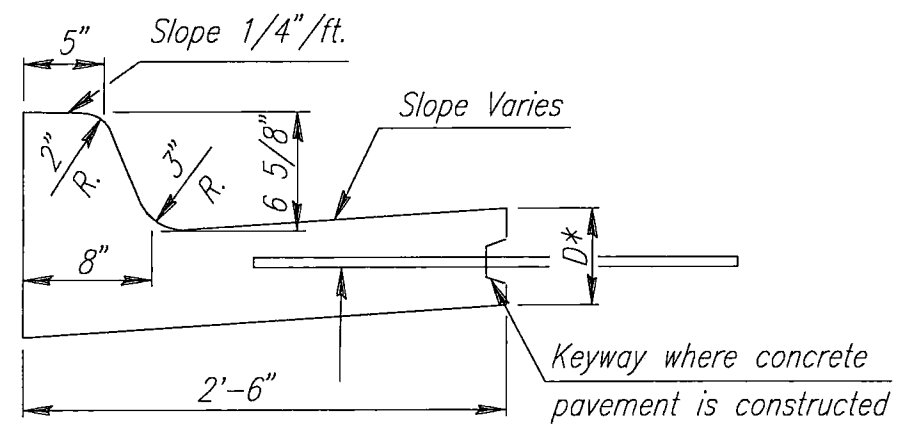
① Unless shown otherwise on the Plans.  
TYPICAL SECTION  
31'-0" Back-Back Curb

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No.		Revision	By	Date
CITY OF BENTON BUTLER COUNTY, KANSAS <b>STANDARD STREET          PAVEMENT SECTIONS</b>				
PROFESSIONAL ENGINEERING CONSULTANTS, P.A. ENGINEERS WICHITA, KANSAS				
Designed by	Job No.		Date	
Drawn by	Date		FIGURE II-1	



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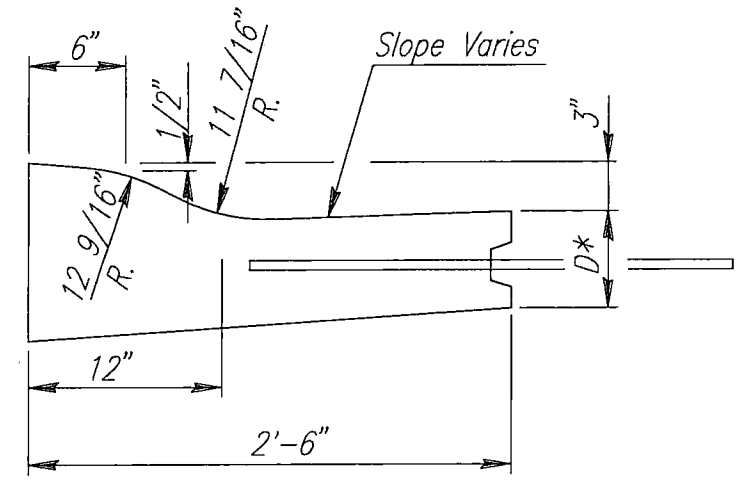
#4 x 30" bars @ 3'-0"  
ctr. where concrete pavement is constructed

MONOLITHIC COMBINED CURB & GUTTER \*

(6 5/8")

\* AS SHOWN ON TYPICAL SECTION

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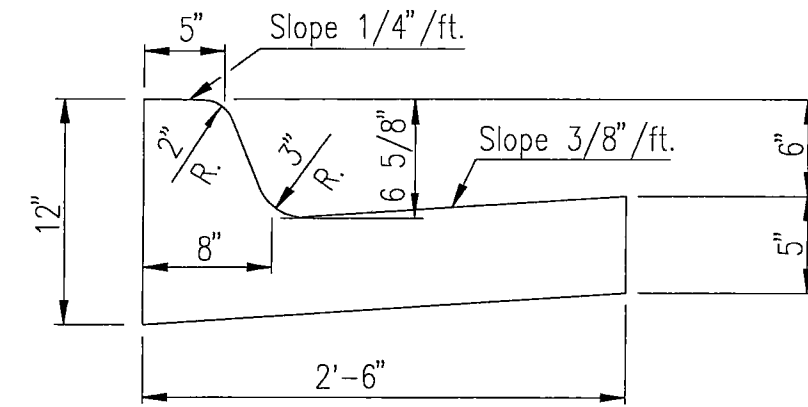


MONOLITHIC COMBINED CURB & GUTTER \*  
(3 5/8")

\* AS SHOWN ON TYPICAL SECTION

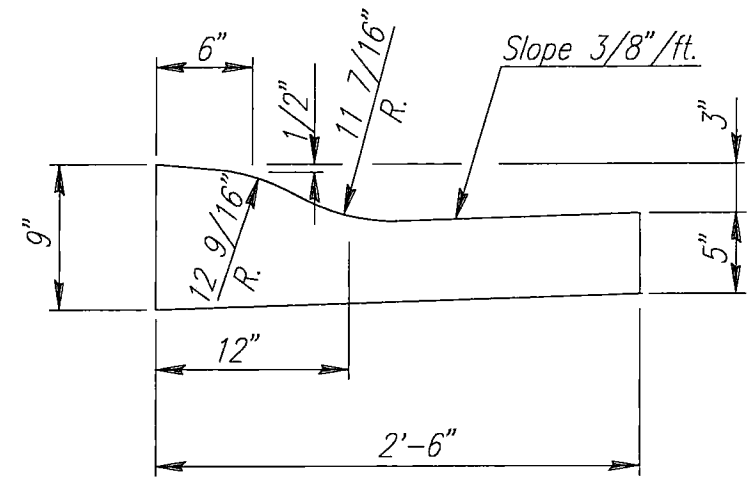


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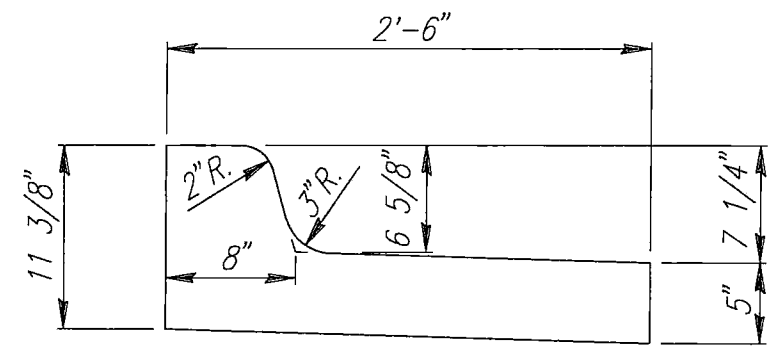
STANDARD COMBINED CURB & GUTTER  
(6 5/8")

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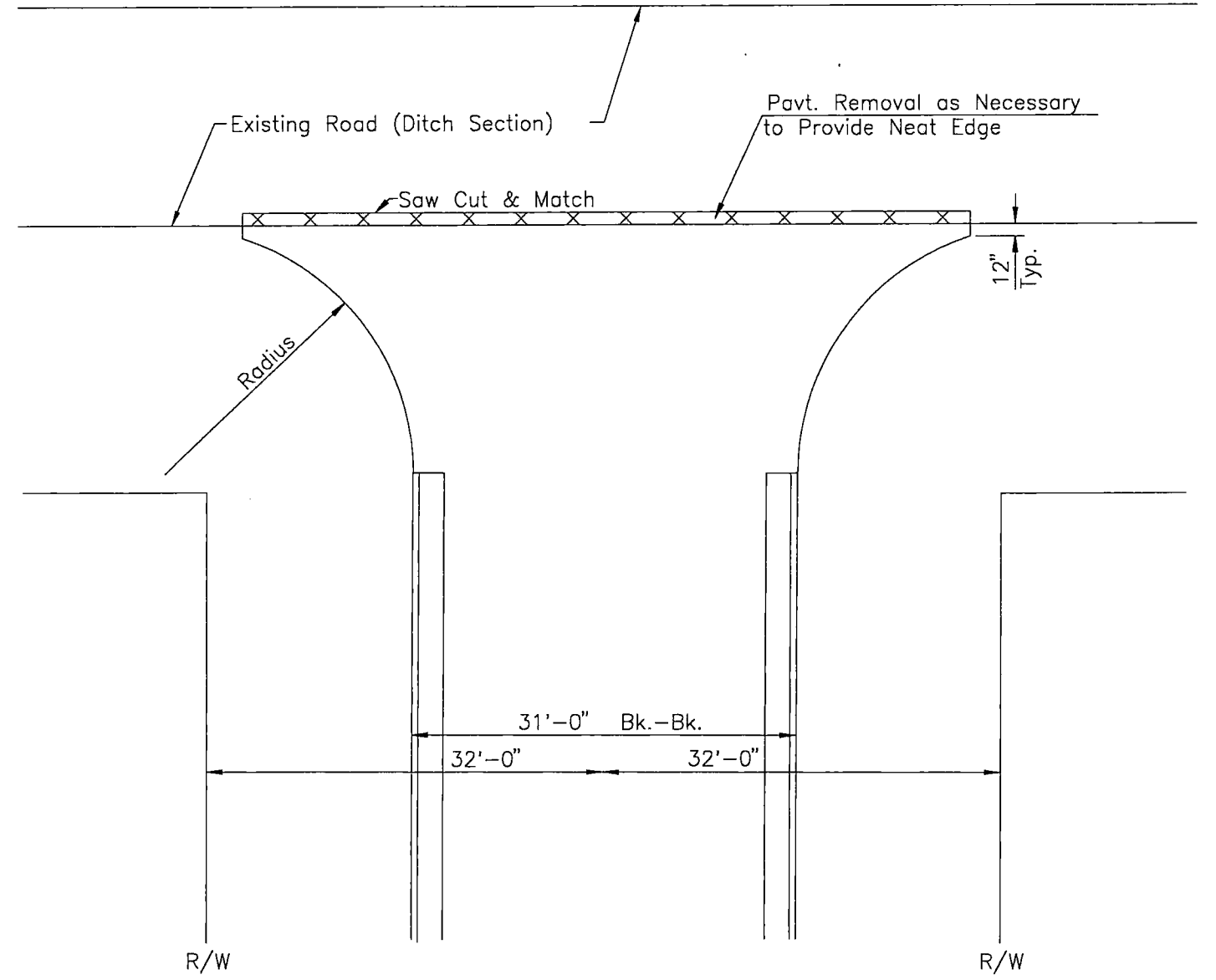


COMBINED CURB & GUTTER  
(3 5/8")

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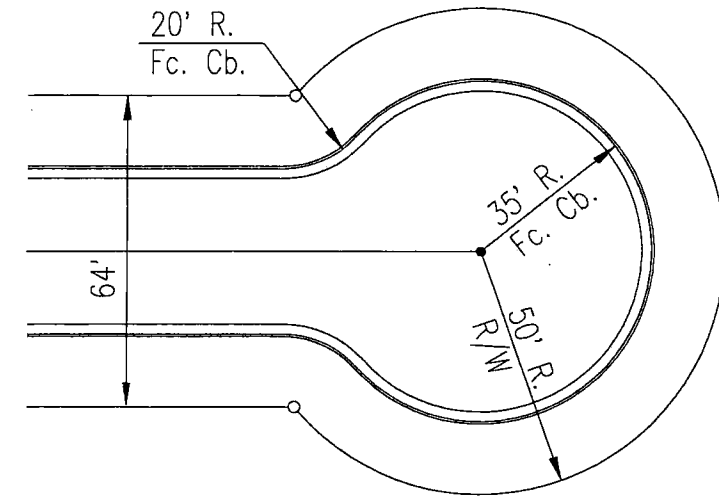
MEDIAN COMBINED CURB & GUTTER  
(6 5/8")



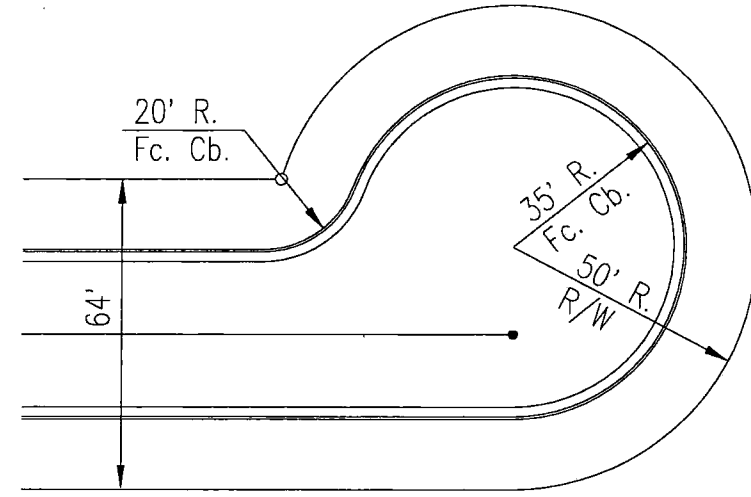
DETAIL OF CURB & GUTTER ROADWAY INTERSECTION ROAD WITH DITCH SECTION

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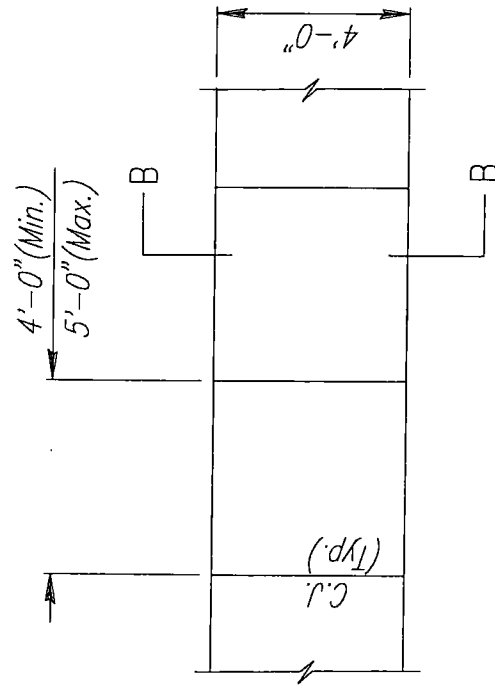
CENTERED



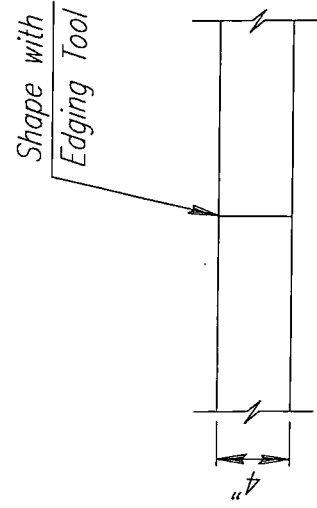
OFF CENTER

STANDARD CUL-DE-SAC LAYOUTS

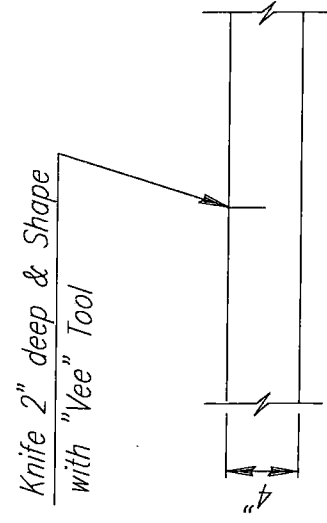
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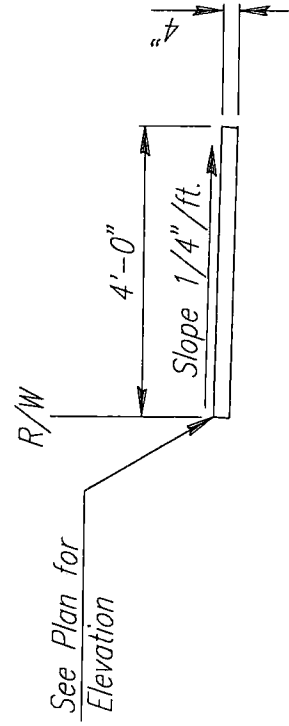
PLAN



CONSTRUCTION JOINT



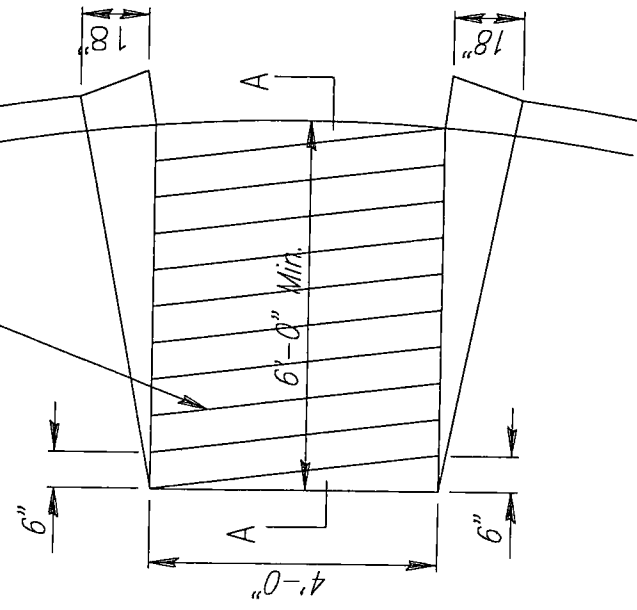
CONTRACTION JOINT



SECTION B-B

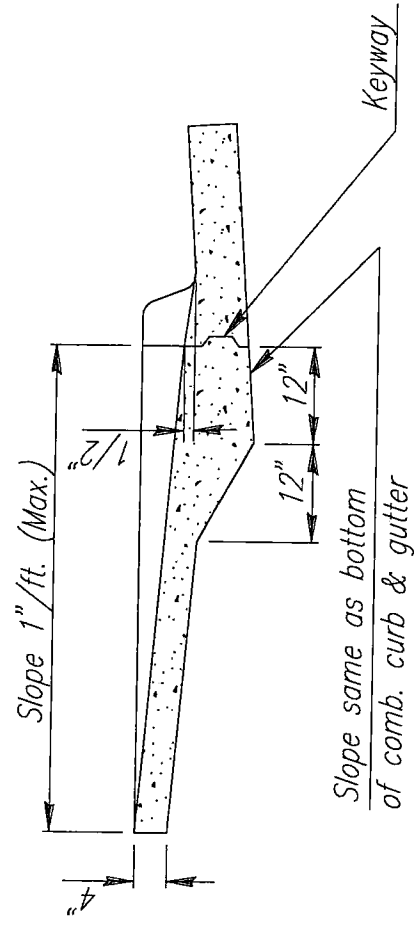
4" WALK DETAILS

Grooves - See Detail  
This Sheet

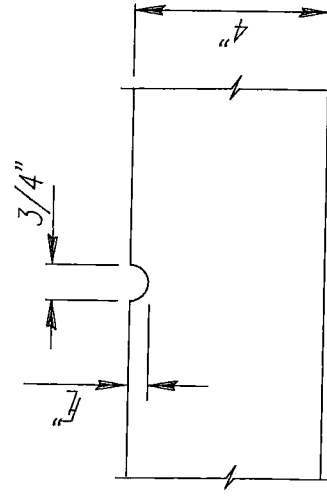


WHEELCHAIR RAMP DETAIL

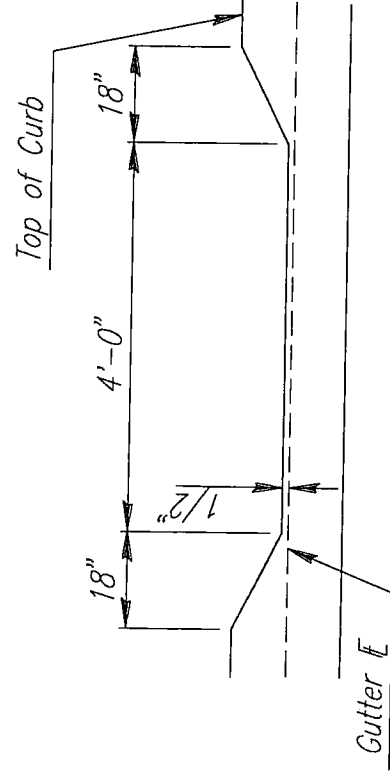
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SECTION A-A

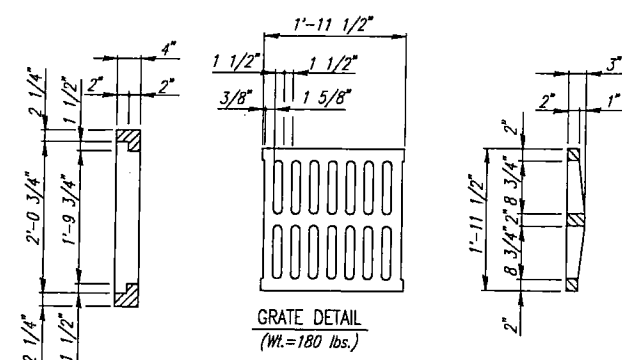
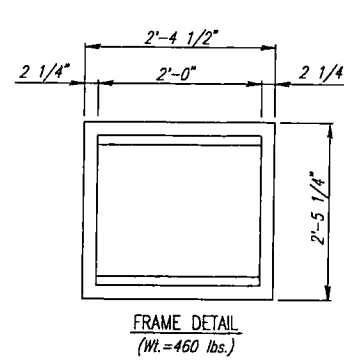
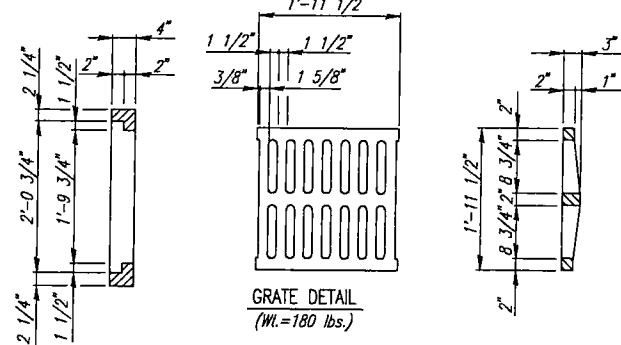
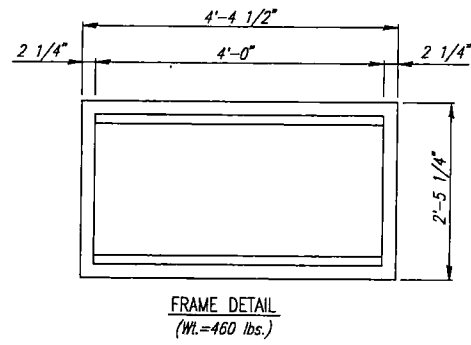


GROOVE DETAIL



DEPRESSED CURB DETAIL

TYPICAL WHEELCHAIR RAMP DETAILS



**GENERAL NOTES**

CONCRETE SHALL BE C.O.W. STANDARD PAVING MIX. ALL EXPOSED EDGES SHALL BE FINISHED WITH AN APPROVED EDGING TOOL.

REINFORCING STEEL SHALL BE A MINIMUM GRADE 40, A.S.T.M. A615. ALL DIMENSIONS RELATIVE TO PLACEMENT OF REINFORCING ARE TO THE CENTERLINE OF BARS UNLESS OTHERWISE NOTED.

INLET CASTINGS SHALL BE MANUFACTURED USING GOOD QUALITY GRAY IRON CONFORMING TO CLASS 30 OF A.S.T.M. DESIGNATION A-48. DIMENSIONS AND WEIGHTS SHOWN ON THE DETAILED DRAWINGS SHALL BE CONSIDERED AS MINIMUM REQUIREMENTS AND ANY DEVIATIONS FROM THE DIMENSIONS SHOWN MUST BE SPECIFICALLY APPROVED. THE FINISHED CASTINGS SHALL BE OF UNIFORM QUALITY, FREE FROM BLOWHOLES, POROSITY, HARD SPOTS, SHRINKAGE DISTORTIONS OR OTHER DEFECTS.

CONSTRUCTION REQUIREMENTS AND MATERIALS FOR MASONRY WALLS SHALL CONFORM TO THE REQUIREMENTS OF THE STANDARD SPECIFICATIONS.

INLET FLOOR SHALL BE SHAPED WITH UNREINFORCED CONCRETE (8 SACK SAND MIX) TO CREATE FLOW CHANNELS AND TO INCREASE HYDRAULIC EFFICIENCY SUCH THAT THE INLET WILL BE SELF CLEANING BETWEEN ALL INLET AND/OR OUTLET PIPES.

AREA INLETS SHALL BE MEASURED AND PAID FOR AT THE CONTRACT UNIT PRICE BID PER EACH. THIS SHALL BE CONSIDERED FULL COMPENSATION FOR ALL EXCAVATION, BACKFILLING, MATERIALS, LABOR, CONNECTION TO EXISTING STRUCTURES (IF REQUIRED), EQUIPMENT, TOOLS, AND INCIDENTALS NECESSARY TO COMPLETE THE WORK.

**GENERAL NOTES**

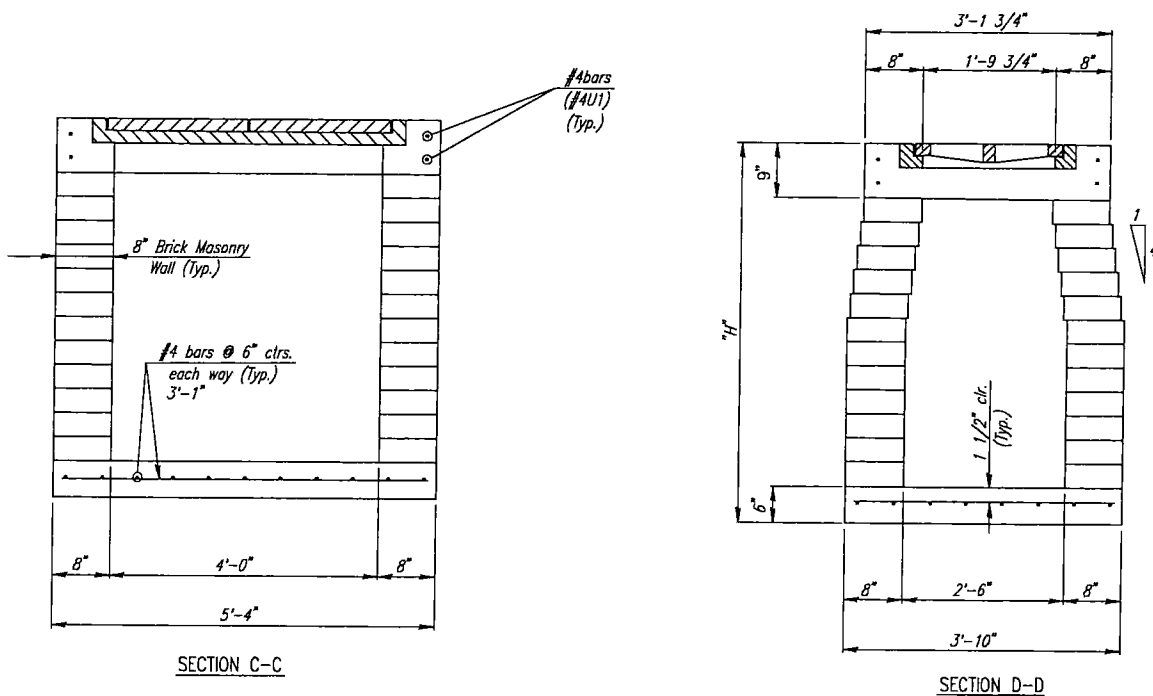
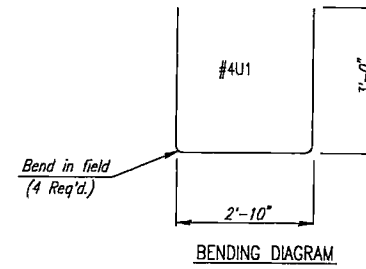
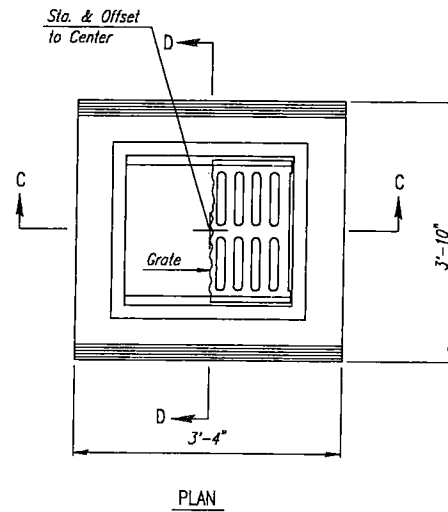
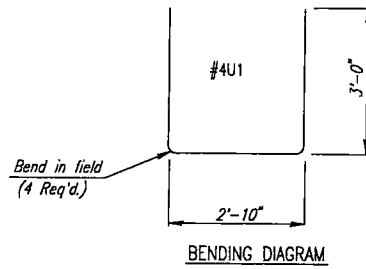
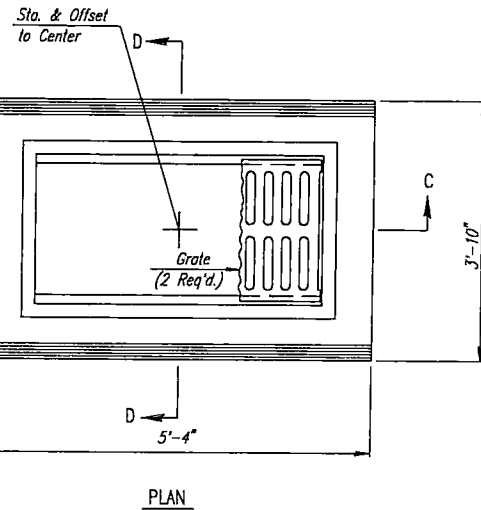
CONCRETE SHALL BE C.O.W. STANDARD PAVING MIX. ALL EXPOSED EDGES SHALL BE FINISHED WITH AN APPROVED EDGING TOOL.

REINFORCING STEEL SHALL BE A MINIMUM GRADE 40, A.S.T.M. A615. ALL DIMENSIONS RELATIVE TO PLACEMENT OF REINFORCING ARE TO THE CENTERLINE OF BARS UNLESS OTHERWISE NOTED.

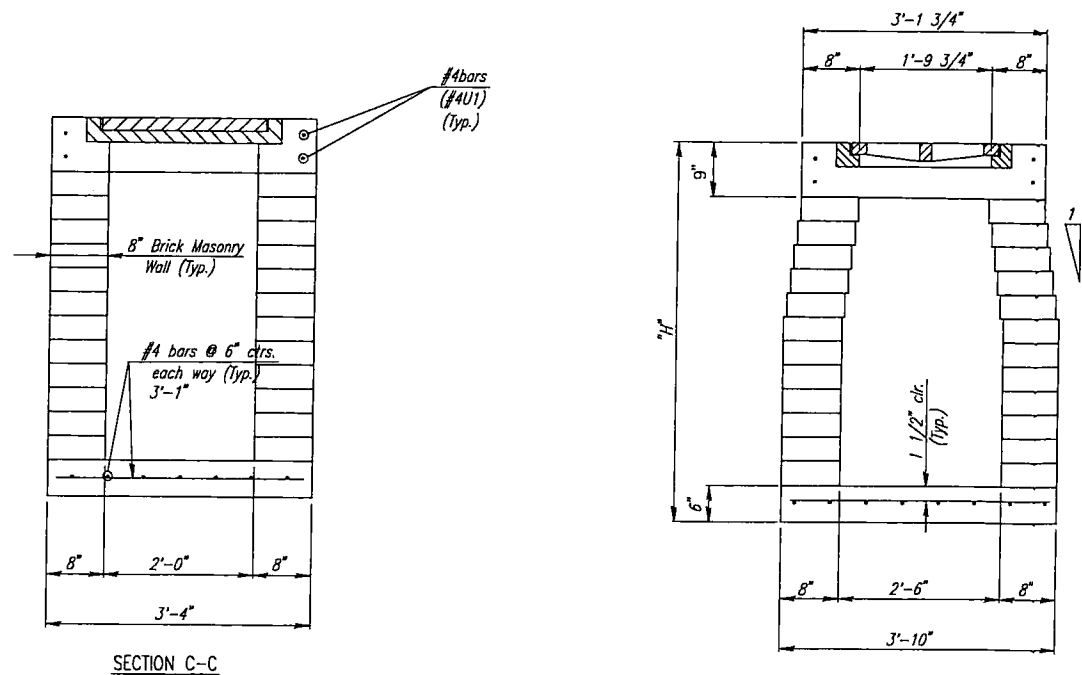
INLET CASTINGS SHALL BE MANUFACTURED USING GOOD QUALITY GRAY IRON CONFORMING TO CLASS 30 OF A.S.T.M. DESIGNATION A-48. DIMENSIONS AND WEIGHTS SHOWN ON THE DETAILED DRAWINGS SHALL BE CONSIDERED AS MINIMUM REQUIREMENTS AND ANY DEVIATIONS FROM THE DIMENSIONS SHOWN MUST BE SPECIFICALLY APPROVED. THE FINISHED CASTINGS SHALL BE OF UNIFORM QUALITY, FREE FROM BLOWHOLES, POROSITY, HARD SPOTS, SHRINKAGE DISTORTIONS OR OTHER DEFECTS.

CONSTRUCTION REQUIREMENTS AND MATERIALS FOR MASONRY WALLS SHALL CONFORM TO THE REQUIREMENTS OF THE STANDARD SPECIFICATIONS.

INLET FLOOR SHALL BE SHAPED WITH UNREINFORCED CONCRETE (8 SACK SAND MIX) TO CREATE FLOW CHANNELS AND TO INCREASE HYDRAULIC EFFICIENCY SUCH THAT THE INLET WILL BE SELF CLEANING BETWEEN ALL INLET AND/OR OUTLET PIPES.



AREA INLET



AREA INLET

DSMR: BOB OPER: APY SCALE: 1=1.00 02\STANDARD\Standards Benton\storm\11-05 05-31-2005 09:56:33 am

No.	Revision	By	Date
CITY OF BENTON BUTLER COUNTY, KANSAS			
<b>STANDARDS</b>			
PROFESSIONAL ENGINEERING CONSULTANTS, P.A. ENGINEERS WICHITA, KANSAS			
Designed by	Job No.	FIGURE III-5	
Drawn by	Date		





5/16" Carriage Bolt, Lock Washer and Hex Nut (As Required).

Regulatory or Warning Sign

3 lb./ft. "U" Channel Steel Sign Post

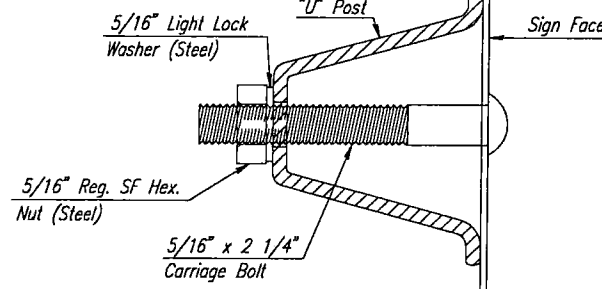
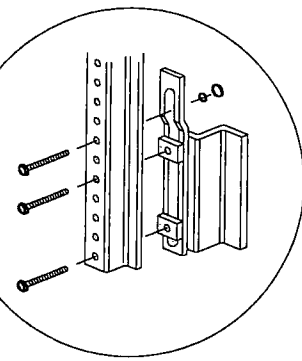
7'-0"

4'-0" (Min.) \*

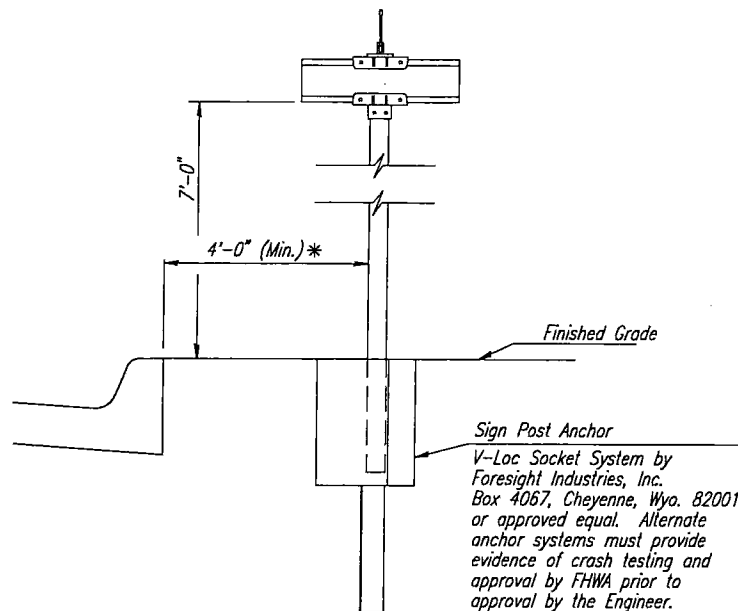
Finished Grade

\* Or as directed by the Engineer

TYPICAL TRAFFIC CONTROL SIGN INSTALLATION CURB AND GUTTER SECTION

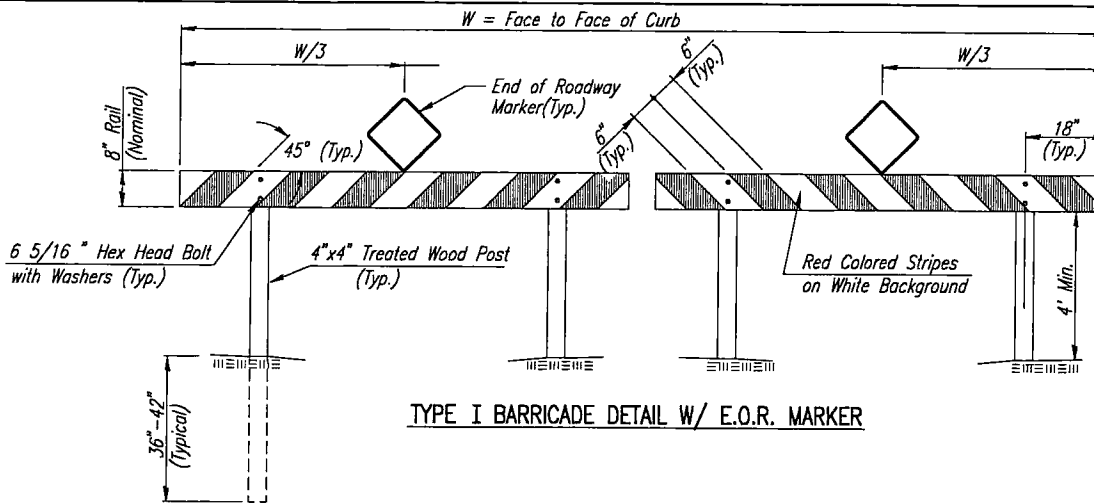


TRAFFIC CONTROL SIGN MOUNTING DETAIL



TYPICAL STREET NAME SIGN INSTALLATION CURB AND GUTTER SECTION

Sign Post Anchor  
V-Loc Socket System by Foresight Industries, Inc. Box 4067, Cheyenne, Wyo. 82001, or approved equal. Alternate anchor systems must provide evidence of crash testing and approval by FHWA prior to approval by the Engineer.



TYPE I BARRICADE DETAIL W/ E.O.R. MARKER



W1-1L (30"x30")

W1-1R (30"x30")

R1-1 (30"x30")



R4-7 (24"x30")

W14-2 (30"x30")

R1-2 (36"x36"x36")



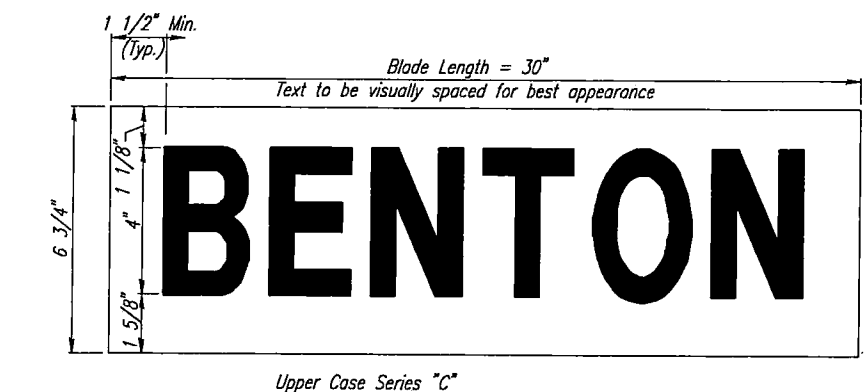
END OF ROAD MARKER EOR (18"x18") (RED)

TYPE 1 OBJECT MARKER T1/OM (18"x18") (YELLOW)

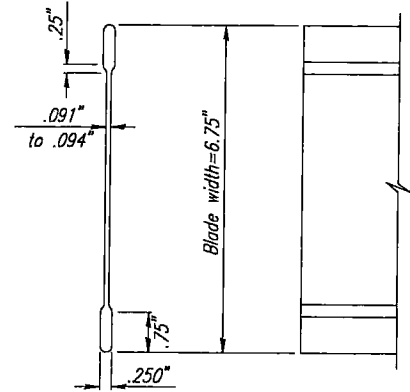
SIGN ASSEMBLY TABLE

STREET	STATION	OFFSET	SIGN	QUANTITY
STERLING	30+85	25' RT.	STREET NAME	1
STERLING	30+85	25' RT.	STREET NAME	1
STERLING	30+85	25' RT.	STREET NAME	1
STERLING	30+85	25' RT.	STREET NAME	1
STERLING	30+85	25' RT.	STREET NAME	1
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STERLING	30+85	25' RT.	STREET NAME	1
STERLING	30+85	25' RT.	STREET NAME	1
STERLING	30+85	25' RT.	STREET NAME	1
STERLING	30+85	25' RT.	STREET NAME	1
TOTAL				1

≠ FOR INFORMATION ONLY



DETAIL A  
6 3/4" STANDARD



STREET NAME SIGN BLADE DETAILS

STREET NAME	NO. BLADES REQ'D
Sterling (Blk. No., Dir.)	6 3/4" STD.
Sterling (Blk. No., Dir.)	1
Sterling (Blk. No., Dir.)	1
Sterling (Blk. No., Dir.)	1
Sterling (Blk. No., Dir.)	1
Sterling (Blk. No., Dir.)	1
Sterling (Blk. No., Dir.)	1
Sterling (Blk. No., Dir.)	1
Sterling (Blk. No., Dir.)	1
Sterling (Blk. No., Dir.)	1
TOTAL	1

GENERAL NOTES - SIGNING

NOTE: REFERENCES BELOW TO "STANDARD SPECIFICATIONS" DENOTE "STANDARD SPECIFICATION FOR STATE ROAD AND BRIDGE CONSTRUCTION, EDITION 1990" BY THE KANSAS DEPARTMENT OF TRANSPORTATION.

- POST ANCHORS. POSTS SHALL BE ANCHORED WITH A YIELDING BASE POST SUPPORT AS DETAILED.
- POSTS FOR TRAFFIC CONTROL SIGNS. POSTS SHALL CONFORM TO THE REQUIREMENTS OF SUBSECTION 1620 OF THE STANDARD SPECIFICATIONS EXCEPT THAT ALL POSTS SHALL WEIGH 3 LBS./FOOT MINIMUM.
- POSTS FOR STREET NAME SIGNS. POSTS SHALL BE 9 FEET LONG, CONSTRUCTED FROM 2 3/8" O.D. GALVANIZED STEEL PIPE WEIGHING A MINIMUM OF 3.65 POUNDS PER FOOT. POSTS SHALL BE POSITIONED SO THAT THE BOTTOM BLADE IS 7 FEET ABOVE GRADE.
- SIGN BLANKS FOR TRAFFIC CONTROL SIGNS. SIGN BLANKS SHALL BE FABRICATED FROM 0.080" ALUMINUM ALLOY 6063-T6 CONFORMING TO THE REQUIREMENTS OF SUBSECTION 1626 OF THE STANDARD SPECIFICATIONS.
- SIGN BLADES FOR STREET NAME SIGNS. EXTRUDED ALUMINUM BLADES SHALL BE ALUMINUM ALLOY CONFORMING TO 6063-T6 OR 5052-H38 (ASTM SPECIFICATION B221, LATEST ISSUE). BLADES SHALL HAVE AN ALODINE OR PHOSPHATE ETCHED FINISH. FIBERGLASS SIGN BLANKS MAY BE USED IN LIEU OF EXTRUDED ALUMINUM, PROVIDED THAT THE FIBERGLASS BLANKS MEET THE SIZE AND SHAPE REQUIREMENTS SHOWN ON THIS SHEET. BLADES SHALL HAVE SQUARE CORNERS AND NO HOLES.  
  
BLADES BEARING THE STREET NAMES SHALL BE FIRMLY ATTACHED TO THE MOUNTING BRACKETS USING ALLEN-TYPE SET SCREWS. THE BLADES SHALL BE ORIENTED PARALLEL TO THE STREET.
- MOUNTING BRACKETS FOR STREET NAME SIGN. DIE-CAST ALUMINUM BRACKETS SHALL BE ALUMINUM ALLOY 360 HAVING A TENSILE STRENGTH OF 44,000 PSI. THE BRACKETS SHALL BE SMOOTHLY FINISHED, FREE OF PITS, BURRS, AND FLAWS. EACH BRACKET SHALL BE TAPPED AND DRILLED FOR 5/16" ZINC-PLATED ALLEN-TYPE SET SCREWS HAVING SELF-LOCKING SAW-TOOTH ENDS.
- FASTENERS. ALL STEEL FASTENERS FOR TRAFFIC CONTROL SIGNS SHALL BE GALVANIZED AND SHALL CONFORM TO THE REQUIREMENTS OF SUBSECTION 1614 OF THE STANDARD SPECIFICATIONS.
- REFLECTIVE SHEETING. ALL SIGNS AND BARRICADES SHALL HAVE RETRO-REFLECTIVE FACES FACING TRAFFIC. REFLECTIVE SHEETING SHALL BE TYPE II - HIGH PERFORMANCE CLASS HA IN ACCORDANCE WITH SUBSECTION 2201 OF THE STANDARD SPECIFICATIONS.
- PROCESS INK. ALL PROCESS INK SHALL CONFORM TO THE REQUIREMENTS OF SUBSECTION 2202 OF THE STANDARD SPECIFICATIONS.
- DETAILS. REGULATORY AND WARNING SIGNS SHALL CONFORM TO THE DETAILS IN "STANDARD HIGHWAY SIGNS", FHWA, 1979.
- DETAILS - STREET NAME SIGNS. THE REFLECTIVE SHEETING FOR THE 6 3/4" STANDARD SIZE STREET NAME SIGN IS TO BE HIGHWAY GREEN REVERSE SCREENED BACKGROUND WITH SILVER-WHITE #2 COPY WITH 4" UPPER CASE PRIMARY COPY AND SUFFIX COPY, SERIES "C". FACES TO TRIM TO A 6 3/4" WIDTH. (SEE DETAIL A).  
  
SHOP DRAWINGS OF LAYOUTS FOR STREET NAME SIGNS SHALL BE SUBMITTED TO THE ENGINEER FOR APPROVAL PRIOR TO FABRICATION. THE FINISHED SIGNS AS SUPPLIED SHALL BE OF GOOD APPEARANCE, FREE FROM RAGGED EDGES, CRACKS, SCALES OR BUSTERS AND SHALL BE PACKED IN SUCH MANNER AS TO PREVENT DAMAGE OR DEFACEMENT DURING SHIPMENT OR STORAGE.
- TRAFFIC CONTROL AND STREET NAME SIGNS. TRAFFIC CONTROL AND STREET NAME SIGNS SHALL BE MEASURED AND PAID FOR AT THE LUMP SUM PRICE FOR SIGNING. THE PAYMENT AS SET FORTH ABOVE SHALL BE CONSIDERED FULL COMPENSATION FOR ALL EXCAVATION, BACKFILLING, POSTS, ANCHORS, FASTENERS, MATERIALS, LABOR, TOOLS AND INCIDENTALS NECESSARY TO COMPLETE THIS WORK.

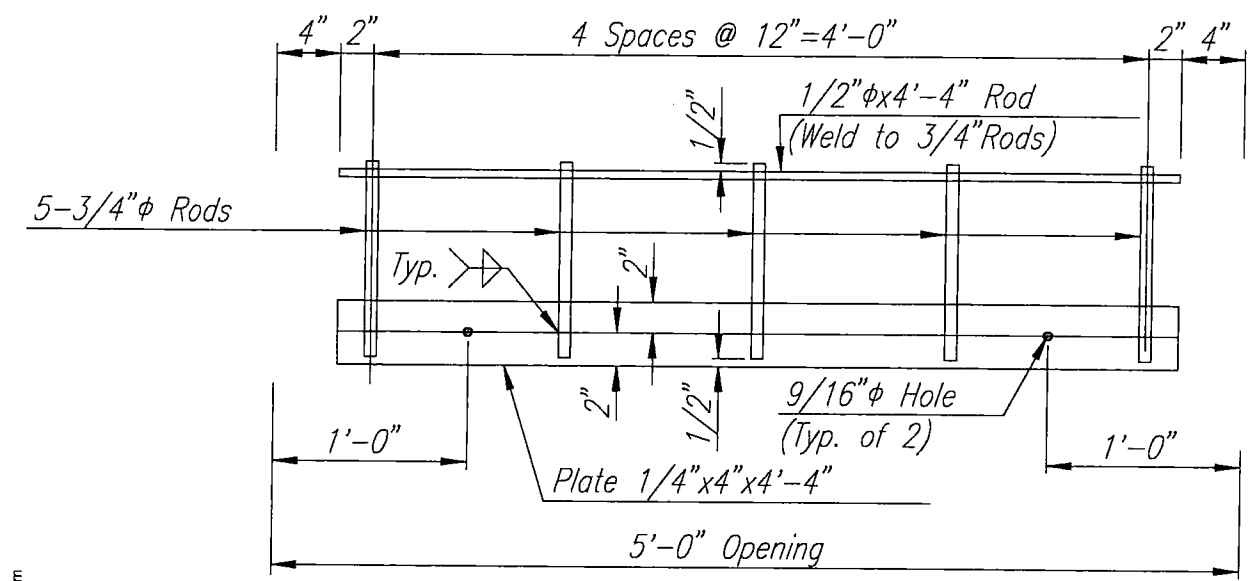
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No.	Revision	By	Date
CITY OF BENTON BUTLER COUNTY, KANSAS			
SIGNING DETAILS			
PROFESSIONAL ENGINEERING CONSULTANTS, P.A. ENGINEERS WICHITA, KANSAS			
Designed by		Job No.	
Drawn by		Date	



FIGURE II-12

DSMR: BDB OPER: APY SCALE: 1=1.00  
C:\STANDARD\Standards Benton\storm\III-06 05-31-2005 09:57:23 am



### TRASH RACK DETAIL

For Curb Inlet  
See Inlet Detail Sheet for  
Installation Details.

Note:  
All parts of rack  
are galvanized.



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00800 SUPPLEMENTARY CONDITIONS

*Section 0700,*

The following revisions apply to the Standard General Conditions of the Contract for Construction (No. 1910-8, 1996 Edition prepared by Engineers Joint Contract Documents Committee).

Where any article, paragraph, or sub-paragraph of the General Conditions is supplemented by one of the following paragraphs, the provisions of such article, paragraph, or sub-paragraph shall remain in effect, and the supplementary provisions of such shall be considered as added thereto. Where any article is superseded by one of the following paragraphs, the provisions of such article, paragraph or sub-paragraph not so amended, voided or superseded shall remain.

1. ARTICLE 1 - DEFINITIONS - No changes, additions, or amendments.

2. ARTICLE 2 - PRELIMINARY MATTERS

2.02 Copies of Documents: A. - delete the phrase "ten copies" from the first sentence and insert the phrase "six copies" in lieu thereof.

2.05 Before Starting Construction: C. - delete the paragraph in its entirety and substitute the following:

"C. Evidence of Insurance: Before any work at the site is started, CONTRACTOR shall file certificates of Insurance acceptable to the OWNER with the OWNER which the CONTRACTOR is required to purchase and maintain in accordance with Article 5."

3. ARTICLE 3 - CONTRACT DOCUMENTS: INTENT, AMENDING, REUSE

3.01 Intent: - add the following paragraph:

"D. Within the Specifications the order of precedence shall be as follows: Addenda, Supplementary General Conditions, Information for Bidders, General Conditions, Technical Provisions."

4. ARTICLE 4 - AVAILABILITY OF LANDS: SUBSURFACE AND PHYSICAL CONDITIONS; REFERENCE POINTS

4.02 Subsurface and Physical Conditions: A.1 and A.2. - delete these paragraphs in their entirety and substitute the following:

"1. See Section 01030 - Special Project Procedures."

4.05 Reference Points: - add the following paragraph:

"B. Surveys to be furnished to the CONTRACTOR by the OWNER will be as specified in Division 1 GENERAL REQUIREMENTS."

*Section 01050*  
*01030-1*  
*WRONG*  
*where?*

5. ARTICLE 5 - BONDS AND INSURANCE

5.01 Performance, Payment and Other Bonds: - add the following sentence to paragraph "B":

"The CONTRACTOR shall furnish a Statutory Bond which is a surety bond, running to the State, conditioned that the CONTRACTOR, as principal, shall pay all indebtedness incurred for labor, supplies, equipment and materials furnished in making the improvements called for by the contract documents."

5.01 Performance, Payment and Other Bonds: - add the following paragraph:

"D. Upon notice of award and prior to execution of the contract, any successful bidder who is not a legal resident of the county in which the work is located shall appoint his process agent in accordance with Section 16113, General Statutes of Kansas, 1949, as amended. The term of appointment of this process agent shall be for the full term of the surety bonds to be furnished by the CONTRACTOR as a part of these contract documents."

5.04 Contractor's Liability Insurance: - add the following paragraph.

"C. The CONTRACTOR shall not commence work under this contract until the insurance required by OWNER is obtained, approved and filed with the OWNER; nor shall the CONTRACTOR allow any subcontractor to commence work until the insurance required of the subcontractor has been obtained, approved and filed with the OWNER. The certified Insurance Policy to be filed by the CONTRACTOR with the OWNER shall provide the following coverages:

- 1. Comprehensive General Liability covering premises--operations, xcu hazards when applicable, Products/Completed operations, Broad Form Property Damage and Contractual Liability with minimum limits as follows:

Bodily Injury Liability                    \$1,000,000 Each Occurrence  
     \$1,000,000 Each Aggregate

Property Damage Liability                \$1,000,000 Each Occurrence  
     \$1,000,000 Each Aggregate

Or

Bodily Injury and Property Damage      \$1,000,000 Each Occurrence  
 Liability (Combined Single Limit)        \$1,000,000 Each Aggregate

- 2. Automobile Liability-Comprehensive Form including all owned, hired and non-owned vehicles with minimum limits for

Bodily Injury Liability                    \$1,000,000 Each Accident  
 Property Damage Liability                \$1,000,000 Each Accident

Or

Bodily Injury and Property Damage  
 Liability (Combined Single Limit)        \$1,000,000 Each Accident

3. Workers' Compensation/Employers Liability for minimum limits of

Employers Liability:

Statutory

In the Insurance Policy, the Insurance Company must state that the Contractual Liability includes the Liability of the OWNER and ENGINEER assumed by CONTRACTOR in the Contract Documents. The Policy must also state that the OWNER will be given written notice if the policy is cancelled or changed within ten (10) days prior to the effective date thereof.

Said Insurance Policy shall be furnished to the OWNER before the agreement is issued."

5.05 Owner's Liability Insurance: A. - delete the paragraph in its entirety and substitute the following:

"A. CONTRACTOR shall include OWNER and ENGINEER as additional insureds under CONTRACTOR'S general liability policy requirements set forth in Article 5.04 of the General Conditions."

5.06 Property Insurance: A.- delete the first sentence and substitute the following in lieu thereof.

"CONTRACTOR shall purchase and maintain property insurance upon the Work at the site to the full insurable value thereof (subject to such deductible amounts as may be provided in the Supplementary Conditions or required by Laws and Regulations)."

5.06 Property Insurance: B. and E. - delete these paragraphs in their entirety. No substitution will be made.

5.07 Waiver of Rights: A. - delete the last sentence of the paragraph in its entirety. No substitutions will be made.

5.08 Receipt and Application of Insurance Proceeds: A. and B. - delete these paragraphs in their entirety. No substitutions will be made.

5.09 Acceptance of Bonds and Insurance; Option to Replace: A. - Delete the first sentence and substitute the following in lieu thereof.

"A. If the OWNER has any objections to the coverage afforded by or other provisions of the Bonds or Insurance required to be purchased and maintained by the CONTRACTOR in accordance with Article 5 on the basis of non-conformance with the Contract Documents, the OWNER shall so notify the Contractor in writing within 10 days after receipt of the certificates (or other evidence required) required by Paragraph 2.05.C."



6. ARTICLE 6 - CONTRACTOR'S RESPONSIBILITIES

6.10 Taxes: - add the following paragraph

"B. For tax exempt status see Section 01060 Regulatory".

6.11 Use of Site and Other Areas: A. Limitation of Use of Site and Other Areas - add the following paragraph:

"4. During the progress of the work the convenience of the local public and of residents along the work shall be considered and, where possible, their rights of access shall be preserved. Temporary driveways, approaches and crossings shall be provided where practicable and maintained in good condition. Construction materials shall be so stored or stockpiled as to cause as little obstruction as possible and still be readily accessible for use or inspection. No material shall be stored within 2 feet of any tree or building nor within 5 feet of any fire hydrant; fire hydrants shall remain ready for immediate use by the fire department. The CONTRACTOR'S proposed schedule for beginning new sections of the work shall be coordinated with and approved by the ENGINEER. To prevent extended inconvenience to the local residents, the CONTRACTOR will not be permitted to open up extensive areas for work during periods when cold or other weather conditions which would curtail the work are normally expected."

Shop Drawings and Samples: 6.17A and B - The number of copies of shop drawings and samples to be submitted will be six.

7. ARTICLE 7 - OTHER WORK - No changes, additions or amendments.

8. ARTICLE 8 - OWNER'S RESPONSIBILITIES - delete paragraph 8.06.A in its entirety, no substitution will be made.

9. ARTICLE 9 - ENGINEER'S STATUS DURING CONSTRUCTION

9.03 Project Representation: - add the following paragraph:

"B. Article 18 - "A LISTING OF THE DUTIES, RESPONSIBILITIES AND LIMITATIONS OF AUTHORITY OF THE RESIDENT PROJECT REPRESENTATIVE" is attached hereto and is a part of these supplemental conditions."

10. ARTICLE 10 - CHANGES IN THE WORK; CLAIMS - No changes, additions, or amendments.

11. ARTICLE 11 - COST OF THE WORK; CASH ALLOWANCES; UNIT PRICE WORK - No changes, additions, or amendments.

12. ARTICLE 12 - CHANGE OF CONTRACT PRICE; CHANGE OF CONTRACT TIMES

Add the following paragraph to 12.01.

"B.4. CONTRACTOR shall not be entitled to a change in the Contract Price, payment, or other compensation at any time due to damages caused by inaccuracy or admission of information referred to in Article 4 of the General Conditions. A claim for an extension of Contract time may be made as provided in Article 12".

13. ARTICLE 13 - TESTS AND INSPECTIONS; CORRECTION, REMOVAL OR ACCEPTANCE OF DEFECTIVE WORK

13.02 Access To Work: - add the following paragraph.

"B. The ENGINEER and/or OWNER may provide one or more Resident Project Representatives to inspect materials to be used in the work and observe construction methods to determine compliance with the Contract Requirements. The ENGINEER and the Resident Project Representatives shall be provided free access to all parts of the work at the project site and to offsite locations where materials or equipment proposed for use in the work are to be produced or fabricated. Resident Project Representatives shall have the authority to reject defective materials; to delay specific construction operations while the acceptability of materials is being determined, or while equipment or machines are being adjusted or calibrated; and to suspend operations on any part of the work not meeting Contract Requirements. Project Representatives shall have no authority to deviate from or waive the requirements of the specifications without written permission of the ENGINEER. Resident Project Representatives will not perform as Superintendent or Foreman for the CONTRACTOR and neither the presence or absence of the Project Representative on the work shall relieve the CONTRACTOR of his responsibility to perform all work in accordance with the Contract Requirements."

13.03 Tests and Inspections: - Add the following paragraph:

"B. So long as the CONTRACTOR'S work progresses in an orderly and reasonable manner the costs of field sample preparation and testing of all specimens will be borne by the OWNER. Should the CONTRACTOR use methods or procedures that require unreasonable or excessive field testing to determine whether specification requirements are being met, or if field testing is performed with continued negative results that indicate the CONTRACTOR'S methods or procedures are not adequate to provide the specified results, the ENGINEER will notify the CONTRACTOR in writing that the costs of all additional testing beyond specific limits, which shall be set out in the written notice for the particular area or material in question, shall be the responsibility of the CONTRACTOR. Such costs will then be deducted from the monies due the CONTRACTOR for the work performed."

14. ARTICLE 14 - PAYMENTS TO CONTRACTOR AND COMPLETION

14.02 Progress Payments: A. Applications for Payment - add the following paragraph:

"4. The Contractor shall submit three (3) copies of each Application for Payment to the Engineer for review."

15. ARTICLE 15 - SUSPENSION OF WORK AND TERMINATION - No changes, additions or amendments.

16. ARTICLE 16 - DISPUTE RESOLUTION - No changes, additions and amendments.

17. ARTICLE 17 - MISCELLANEOUS - Add the following paragraphs:

Nondiscrimination of Employment:

17.06 Contracts for work under this proposal will obligate the contractors and subcontractors not to discriminate in employment practices.

Bidders must submit with their initial bid a signed statement as to whether they have previously performed work subject to the President's Executive Order No. 11246 of September 24, 1965, as amended.

Bidders must, if requested, submit a compliance report concerning their employment practices and policies in order to maintain their eligibility to receive the award of the contract.

Successful bidders must, if requested, submit a list of all subcontractors who will perform work on the project and written signed statement from authorized agents of the labor pools with which they will or may deal for employees on the work together with supporting information to the effect that said labor pools' practices and policies are in conformity with Executive Order No. 11246 of September 24, 1965, as amended, and that said labor pools will affirmatively cooperate in or offer no hindrance to the recruitment, employment and equal treatment of employees seeking employment and performing work under the contract or a certification as to what efforts have been made to secure such statements when such agents or labor pools have failed or refused to furnish same prior to the award of the contract.

Successful Bidders must be prepared to comply in all respects with the Contract Provisions regarding nondiscrimination as contained in the Labor Standards Contract Provisions, May, 1973, a copy is included at the back of this section and indicated as Attachment "C" and Attachment "E".

17.07 By the submission of its bid, each bidder acknowledges that he understands and agrees to be bound by the equal opportunity requirements of EPA regulations (40 CFR Part 8, particularly Section 8.4(b)) which shall be applicable throughout the performance

of work under any contract awarded pursuant to this solicitation. Each bidder agrees that if awarded a contract, it will similarly bind contractually each subcontractor. In implementation of the foregoing policies, each bidder further understands and agrees that if awarded a contract, it must engage in affirmative action directed at promoting and ensuring equal employment opportunity in the workforce used under the contract (and that it must require contractually the same effort of all subcontractors whose subcontracts exceed \$10,000). The bidder understands and agrees that "affirmative action" as used herein shall constitute a good faith effort to achieve and maintain that amount of minority employment in the onsite workforce used in the project which corresponds, for each trade used, to the minority population in the serving labor market area from which workers are reasonably available for hire for the project.

**EPA Construction Grants Contract Requirements:**

17.08 This project is expected to be funded in part by a grant from the United States Environmental Protection Agency and as such will be governed by the Environmental Protection Agency Construction Grants Contract Requirements (Sections 35.936, 35.938, and 35.939 of 40 CFR Part 35, published September 27, 1978 are considered a part of these specifications) which are included at the back of this section and indicated as Attachment "A".

**Access To Project:**

17.09 The Regional Administrator of the U.S. Environmental Protection Agency or his authorized representative, the Chief of Water Pollution Control of the Kansas Department of Health and Environment or his representative shall have access to the work wherever it is in preparation or progress. The Contractor shall provide the proper facilities during inspections.

**Prevailing Wage Rates And Labor Standards:**

17.10 This contract shall be based upon payment by the Contractor and his subcontractors of wage rates not less than the prevailing hourly wage rate for each craft or classification of workmen engaged on the work. Prevailing wage rates shall be as determined by the United States Secretary of Labor.

The Contractor and his subcontractors shall comply with the regulations as set forth in the Labor Standards and the following wage rate decision.

The regulations do not prohibit payment of more than the prevailing rate of wages.

**Historical And Archeological:**

17.11 If during the course of construction evidence of deposits of historical or archeological interest is found, the contractor shall cease operations affecting the find and shall notify the Owner who shall notify the Regional Office of EPA, and Executive Director, Kansas State Historical Society, 6425 SW 6<sup>th</sup> Street, Topeka, Kansas 66615. No further disturbance of the deposits shall ensue until the Contractor has been notified by

the Owner that he may proceed. The Owner will issue a notice to proceed only after the state official has surveyed the find and made a determination to EPA and the Owner. Compensation to the Contractor, if any, for lost time or changes in construction to avoid the find, shall be determined in accordance with changed conditions or change order provisions of the specifications.

Contractor's Payment Schedule:

17.12 The Contractors and Subcontractors must provide in writing, within 30 days after initiation of construction, a monthly schedule of estimated payments; these schedules shall be updated any time there is a variation of more than 10 percent in contract price.

Buy American:

17.13 The Contractor and his subcontractors, materialmen, and suppliers are required to give preference to domestic construction material and equipment for this project in accordance with the Buy American provisions in Public Law 95217 (Section 215 of Public Law 92500 as amended) and implementing EPA regulations and guidelines.

**18. ARTICLE 18 - DUTIES, RESPONSIBILITIES AND LIMITATIONS OF AUTHORITY OF THE RESIDENT PROJECT REPRESENTATIVE**

18.01 General: RPR is ENGINEER's agent at the site, will act as directed by and under the supervision of ENGINEER, and will confer with ENGINEER regarding RPR's actions. RPR's dealings in matters pertaining to the on-site work shall in general be with ENGINEER and CONTRACTOR keeping OWNER advised as necessary. RPR's dealings with subcontractors shall only be through or with the full knowledge and approval of CONTRACTOR, RPR shall generally communicate with OWNER with the knowledge of and under the direction of ENGINEER.

18.02 Duties and Responsibilities of RPR

- A. *Schedules:* Review the progress schedule, schedule of Shop Drawing submittals and schedule of values prepared by CONTRACTOR and consultant with ENGINEER concerning acceptability.
- B. *Conferences and Meetings:* Attend meetings with CONTRACTOR, such as preconstruction conferences, progress meetings, job conferences and other project-related meetings, and prepare and circulate copies of minutes thereof.
- C. *Liaison:*
  - 1. Serve as ENGINEER'S liaison with CONTRACTOR, working principally through CONTRACTOR's superintendent and assist in understanding the intent of the Contract Documents; and assist ENGINEER in serving as OWNER's liaison with CONTRACTOR when CONTRACTOR's operations affect OWNER's on-site operations.

2. Assist in obtaining from OWNER additional details or information, when required for proper execution of the Work.
3. Refer all contacts or inquiries by the general public (any person who does not represent an agency which has jurisdiction over the project) to the Engineer.

*D. Shop Drawings and Samples:*

1. Record date of receipt of shop Drawings and samples.
2. Receive samples which are furnished at the site by CONTRACTOR, and notify ENGINEER of availability of samples for examination.
3. Advise ENGINEER and CONTRACTOR of the commencement of any Work requiring a shop Drawing or sample if the submittal has not been approved by ENGINEER.

*E. Review of Work, Rejection of Defective Work, Inspections and Tests:*

1. Conduct on-site observations of the Work in progress to assist ENGINEER in determining if the Work is in general proceeding in accordance with the Contract Documents.
2. Report to ENGINEER whenever RPR believes that any Work is unsatisfactory, faulty or defective or does not conform to the Contract Documents, or has been damaged, or does not meet the requirements of any inspection, test or approval required to be made; and advise ENGINEER of work that RPR believes should be corrected or rejected or should be uncovered for observation, or requires special testing, inspection or approval.
3. Verify that tests, equipment and systems startups and operating and maintenance training are conducted in the presence of appropriate personnel, and that CONTRACTOR maintains adequate records thereof; and observe, record and report to ENGINEER appropriate details relative to the test procedures and startups.
4. Accompany visiting inspectors representing public or other agencies having jurisdiction over the Project, record the results of these inspections and report to ENGINEER.

*F. Interpretation of Contract Documents:* Report to ENGINEER when clarifications and interpretations of the Contract Documents are needed and transmit to CONTRACTOR clarifications and interpretations as issued by ENGINEER.

- G. *Modifications:* Consider and evaluate CONTRACTOR's suggestions for modifications in Drawings or Specifications and report with RPR's recommendations to ENGINEER. Transmit to CONTRACTOR decisions as issued by ENGINEER.
- H. *Records:*
1. Maintain at the job site orderly files for correspondence, reports of job conferences, Shop Drawings and samples, reproduction of original Contract Documents including all Work Directive Changes, Addenda, Change Orders, Field Orders, additional Drawings issued subsequent to the execution of the Contract, ENGINEER's clarifications and interpretations of the Contract Documents, progress reports, and other Project related documents.
  2. Keep a diary or log book, recording CONTRACTOR hours on the job site, weather conditions, data relative to questions of Work Directive Changes, Change Orders or changed conditions, list of job site visitors, daily activities, decisions, observations in general, and specific observations in more detail as in the case of observing test procedures; and send copies to ENGINEER.
  3. Record names, addresses and telephone numbers of all CONTRACTORS, subcontractors and major suppliers of materials and equipment.
- I. *Reports:*
1. Furnish ENGINEER periodic reports as required of progress of the Work and of CONTRACTOR's compliance with the progress schedule and schedule of Shop Drawing and sample submittals.
  2. Consult with ENGINEER in advance of scheduled major tests, inspections or start of important phases of Work.
  3. Draft proposed Change Orders and Work Directive Changes, obtaining backup material from CONTRACTOR and recommend to ENGINEER Change Orders, Work Directive Changes, and Field Orders.
  4. Report immediately to ENGINEER and OWNER upon the occurrence of any accident.
- J. *Payment Requests:* Review applications for payment with CONTRACTOR for compliance with the established procedure for their submission and forward with recommendations to ENGINEER, noting particularly the relationship of the payment requested to the schedule of values. Work completed and materials and equipment delivered at the site but not incorporated in the Work.

K. *Certificates, Maintenance and Operation Manuals:* During the course of the Work, verify that certificates, maintenance and operation manuals and other data required to be assembled and furnished by CONTRACTOR are applicable to the items actually installed and in accordance with the Contract Documents, and have this material delivered to ENGINEER for review and forwarded to OWNER prior to final payment for the Work.

L. *Completion:*

1. Before ENGINEER issues a Certificate of Substantial Completion, submit to CONTRACTOR a list of observed items requiring completion or correction.
2. Conduct final inspection in the company of ENGINEER, OWNER and CONTRACTOR and prepare a final list of items to be completed or corrected.
3. Observe that all items on final list have been completed or corrected and make recommendations to ENGINEER concerning acceptance.

#### 18.03 Limitations of Authority

A. *Resident Project Representative:*

1. Shall not authorize any deviation from the contract Documents or substitution of materials or equipment, unless authorized by ENGINEER.
2. Shall not exceed limitations of ENGINEER's authority as set forth in the Contract Documents.
3. Shall not undertake any of the responsibilities of CONTRACTOR, subcontractors or CONTRACTOR's superintendent.
4. Shall not advise on, issue directions regarding or assume control over any aspect of the means, methods, techniques, sequences or procedures of construction unless such advice or directions are specifically required by the Contract Documents.
5. Shall not accept Shop Drawings or sample submittals from anyone other than CONTRACTOR.
7. Shall not authorize OWNER to occupy the Project in whole or in part.
8. Shall not participate in specialized field or laboratory tests or inspections conducted by others except as specifically authorized by ENGINEER.



# DIVISION 1 - GENERAL REQUIREMENTS

## SECTION 01030 - SPECIAL PROJECT PROCEDURES

### 1. GUARANTY

The Contractor shall guaranty all materials and equipment as specified in Article 13 of the General Conditions Page 00700-19. It shall be the Contractor's responsibility to notify all suppliers of materials and equipment that the guaranty shall extend one year from the date of substantial completion or as specified otherwise.

### 2. NOTIFICATION

It shall be the Contractor's Responsibility to notify the Owner a minimum of two weeks prior to all construction which requires interfacing with the existing water, sewer, or electrical systems.

### 3. DISPOSAL OF WASTE MATERIALS

The Contractor shall have full responsibility for proper disposal of waste materials. They shall be disposed of at the County Landfill or as otherwise approved in writing by the Engineer.

### 4. TRAFFIC CONTROL

The Contractor shall protect traffic by the use of proper and necessary flags, lights, signals, barricades or other warning devices as needed, all in accordance with the latest edition of the *Manual On Uniform Traffic Control Devices (MUTCD)*, U.S. Department of Transportation, Federal Highway Administration.

### 5. UTILITIES

The Contractor will be required to obtain and pay for all utilities used for the project.

## SECTION 01040 - COORDINATION

### 1. COOPERATION

The Contractor shall cooperate with the Engineer, the Owner and other contractors in performing the work involved in the entire project. Fairness shall prevail as regards to use of access roads, storage space, space for temporary office, utility services, and other facilities. In any arrangement as to the proportion of facilities between contractors, the decision of the Resident Engineer shall be final.

## SECTION 01050 - FIELD ENGINEERING

### 1. SURVEYS

The surveys available to the Contractor have been performed by others for this project.

The Contractor shall re-establish all P.I.'s and Bench Marks. Prior to using any Bench Mark the Contractor shall verify its accuracy.

All other surveys necessary to prosecute the work shall be done by the Contractor with his own surveyors, materials and equipment at his own expense. This will include, but not be limited to, all baseline offset stakes, intermediate elevation hubs, facility or structure offset hubs, batter boards, stringlines, and As-Built dimensions, locations and elevations. No work that requires such surveys are complete and a copy of the field notes are delivered to the Inspector.

No special payment will be made to the contractor for survey work and such work will be considered subsidiary to other related items of work.

## SECTION 01060 - REGULATORY

### 1. PERMITS

All necessary State, City, County, Local and Federal Permits required for construction shall be furnished by the Contractor with the exception of the Kansas Division of Water Resources permits for construction within a stream channel.

### 2. CODES

Execute work in compliance with all applicable Federal, State and Municipal laws, codes, ordinances, and local customs regarding the trade to perform the work.

Codes shall govern in case of any direct conflict between codes and plans and specifications; except when plans and specifications require higher standards than those required by code.

### 3. TAXES

Materials and equipment incorporated for the Street/Drainage and Sanitary Sewer are exempt from the payment of sales tax under the laws of the State of Kansas and shall not be included in the bid of the bidders.

Owner will provide the Contractor with a proper exemption certificate within 10 days of the date of the Agreement. Should the Owner fail to provide an exemption certificate number within the required time period, the Contractor will be reimbursed monthly for sales tax amounts for which he becomes liable until such certificate number is provided.

Upon issuance of a proper exemption certificate number to CONTRACTOR, CONTRACTOR shall assume full responsibility for his own proper use of the certificate number, and shall pay all costs of any legally assessed penalties relating to CONTRACTOR's improper use of the exemption certificate number."

Water line projects are not exempt from the payment of sales tax and shall be included in this bid of the bidders.

## SECTION 01100 - ALTERNATIVES

### 1. SUBSTITUTION OF EQUIPMENT

Whenever a material, article or piece of equipment is identified on the drawings or specifications by reference in brand name or catalog number, it shall be understood that this is referenced for the purpose of defining the performance or other salient requirements and that other products of equal capacities, quality and function shall be considered.

Prior to receiving bids the Contractor may recommend the substitution of a material, article, or piece of equipment of equal substance and function for those referred to in the Contract Documents by reference to brand name or catalog number, and if, in the opinion of the Engineer, such material, article, or piece of equipment is of equal substance and function to that specified, the Engineer may approve its substitution, and an addendum will be issued naming those additional manufacturer's which will be acceptable to the Engineer. The requests for substitutions must be received 10 days prior to bidding.

After execution of the contract, substitution of equipment of makes other than those specifically named in the contract documents will be approved by the Engineers only if the equipment named in the specifications cannot be delivered to the job in time to complete the work in proper sequence to work of other Contractors, due to conditions beyond control of the Contractor.

Requests for substitutions must be accompanied by documentary proof of equality and difference in price and delivery, if any, in form of certified quotations from suppliers of both specified and proposed equipment.

The Owner shall receive all benefits of the difference in cost involved in any substitution, and the contract altered by change order to credit Owner with any savings so obtained.

## SECTION 01150 - MEASUREMENT AND PAYMENT

### 1. GENERAL

The total bid price for each section of the contract shall cover all work shown on the contract drawings and required by the specifications and other contract documents. All costs in connection with the work, including furnishing of all materials, equipment, supplies, and appurtenances; providing all construction plant, equipment, and tools; and performing of all necessary labor to fully complete the work, shall be included in the unit and lump sum prices named in the Proposal. No item that is required by the Contract Documents for the proper and successful completion of the work will be paid for outside of or in addition to the prices submitted in the Proposal. All work not specifically set forth as a pay item in the Proposal shall be considered a subsidiary obligation of the Contractor and all costs in connection therewith shall be included in the prices named in the Proposal.

All incidental, subsidiary and miscellaneous items of work essential to completion of the project in a satisfactory manner shall be done at no additional cost to the Owner. Some, but not all, of the items that shall be considered incidental or subsidiary are as follows:

- a. The support, protection and maintenance of existing utilities such as power and telephone poles, sanitary sewers, manholes, storm drains, and other such items that are to be maintained in place, before, during, and after construction of the proposed improvements.
- b. Traffic control.
- c. Acquisition of additional working space.
- d. Construction Staking.
- e. Other items as noted in these specifications or on the plans.

The method of measurement and basis of payment for each item as listed in the Proposal shall be as stipulated in the following paragraphs. Final Payment to the Contractor will be based on measured quantities, unless otherwise shown.

### 2. PIPE LINES

Pipe Lines shall be paid for on a linear foot basis as measured along the centerline of the pipe, no deductions being made for manholes, valves or fittings. All fittings such as tees, bends, crosses, reducers, couplings, clamps, sleeves, plugs, caps, etc. shown on the plans or required for satisfactory assembly and installation shall be considered subsidiary to the price bid for pipe. Trenching, pipe bedding, backfill, testing, disinfection, etc. shown on the drawings shall be considered subsidiary to the price bid

for pipe. Abandonment of existing waterlines and the filling of existing casing with flowable fill/sand shall be considered subsidiary to the price bid for pipe. Pipelines at structures shall be measured to the outside wall line of the structure. Also included in this item is connecting the newly constructed system.

3. MANHOLES - Type A, B, and C

Manholes shall be paid for at the contract unit prices bid per each for the various types, based on a 6 vertical feet of manhole, which should include the base section, cone section, adjusting rings and frame and cover. The prices bid shall be full compensation for furnishing all materials, including gasketed frames and covers, pipe used for outside drop manholes, coatings, concrete, grout and for all equipment, tools, labor and incidentals necessary to complete the work. Excavation and compaction of earthwork for this item will not be paid for separately. Extra depth of manhole bid item shall include furnishing and installing the required barrel sections to achieve finished grade.

Vacuum testing is subsidiary to Manholes in Place.

4. MANHOLE GRADE ADJUSTMENT

Manhole grade adjustment shall be paid for at the contract unit prices bid per each, which should include the adjusting rings. The prices bid shall be full compensation for furnishing all materials, including gaskets, coatings, concrete, grout and for all equipment, tools, labor and incidentals necessary to complete the work. Excavation and compaction of earthwork for this item will not be paid for separately.

Vacuum testing is subsidiary to Manholes in Place.

5. MANHOLE AND SEWER SERVICE CONNECTIONS

This item shall be paid for at the contract unit price bid per each. The price bid shall be full compensation for pipe, fittings, plugs, caps, marking tape, trenching, backfilling, bedding, testing and incidentals necessary to complete the work.

6. BORING AND STEEL ENCASEMENT

Boring and Steel Encasement shall be paid for by the linear meter as shown on the plans and shall include the boring and receiving pit, steel encasement, wood skids, sand, concrete and all items described and necessary to complete the boring and encasement per the plans and the specifications.

7. STEEL CASING BY OPEN CUT

Steel Encasement shall be paid for by the linear meter as shown on the plans and shall include steel encasement, wood skids, sand, concrete, excavation, trenching, backfill, and all items described and necessary to complete the open cut and encasement per the plans and specifications.

8. VALVE ASSEMBLIES

This item shall be paid for at the contract unit price per each for the respective sizes called for in the plans. The unit price bid shall be full compensation for all excavation, valve, valve box, two feet long sections of DI CL SJ pipe, anchor couplings, thrust blocks other materials, tools, equipment, labor and incidentals necessary to complete the work.

9. FIRE HYDRANT ASSEMBLIES

Fire Hydrant Assemblies shall be paid for at the contract unit price per each and includes the materials and installation of new fire hydrants, hydrant valve and tee. This price shall be full compensation for trench and backfill, anchor tee, fittings, pipe, gate valve, valve box, concrete pad (as necessary), fire hydrant, thrust blocking and drain rock and incidentals necessary to complete the work.

10. TAPPING SLEEVES AND VALVE

Payment for material and installation shall be at the unit price bid per linear foot. Unit price shall be full compensation for all materials and incidentals for a complete installation.

11. REMOVE AND REPLACE PAVED AND GRAVEL PAVEMENT

This item shall be paid for at the contract unit price per Linear Foot to the width as required by trenching operations. The unit price bid shall be full compensation for removal and replacement of the pavement and curb and gutter to the limits shown on the plans and includes the furnishing of all materials, equipment, labor, and incidentals necessary to complete the work. The existing material shall be replaced with either concrete, asphalt, or gravel as required and shown on the plans.

12. ASPHALTIC CONCRETE PAVEMENT. These items shall be paid for at the contract unit prices bid per square yard for the thicknesses shown. The limits of the areas to be paid for are as shown on the plans. Other limits will be measured only as directed by the Engineer. Unit price bid shall be full compensation for all bituminous materials, including tack; aggregates; mixing; hauling; spreading; compacting; sampling; sample testing; and for furnishing all other material, equipment, tools, labor and incidentals necessary to complete the individual item of work.

13. 3" BITUMINOUS BASE. This item shall be paid for at the contract unit price bid per square yard. The limits of the areas to be paid for are as shown on the plans. Other limits will be measured only as directed by the Engineer. Unit price bid shall be full compensation for all bituminous materials, including tack; aggregates; mixing; hauling; spreading; compacting; sampling; sample testing; and for furnishing all other material, equipment, tools, labor and incidentals necessary to complete the individual item of work.



14. CRUSHED ROCK BASE. This item shall be paid for at the unit price bid per square yard. The limits of the area to be paid for are as shown on the plans. Other limits will be measured only as directed by the Engineer. The price bid shall be considered full compensation for furnishing all material, including fabric reinforcement; for completing all preparation, hauling, placement, and compaction, and for all labor, equipment, tools, and other incidentals necessary to complete the work.

15. COMBINED CURB AND GUTTER. Concrete Combined Curb and Gutter shall be paid for at the contract unit price bid per lineal foot. Measurement is along the face of curb; including length across entrance drives, storm drain inlets, flumes, and curb depressions; but excluding length across valley gutters. The unit price bid shall be full compensation for all concrete and concrete placement, finishing, jointing, curing, backfilling, and for furnishing all other materials, equipment, tools, labor and incidentals necessary to complete the work.

16. 4" SIDEWALK CONCRETE PAVEMENT. Concrete Driveway Pavement shall be measured and paid for at the contract unit price bid per square foot, in place, at the thickness shown on the plans. The limits of the area to be measured for individual drives shall be the entire surface area from the back of curb to the property line or to the termination of the drive at a point within public right-of-way, as approved by the property owner. The unit price bid shall be considered full compensation for all excavation and compaction, concrete and concrete placement, reinforcement and its placement, finishing, jointing and joint sealing, curing, and for all other material, equipment, tools, labor and incidentals necessary to complete the work.

17. CONCRETE SIDEWALK PAVEMENT REMOVED. This item shall be paid for at the contract unit price bid per square foot for the area shown on the plans, and shall also include saw cuts, disposal of removed material, and backfilling the removal areas with suitable topsoil where necessary. Payment shall be full compensation for removal and disposal of the specified items; and for furnishing all equipment, tools, labor and incidentals necessary to complete the work.

18. STD. WHEELCHAIR RAMP. Wheelchair ramps shall be paid for at the contract unit price bid per each for the locations shown on the plans. Payment shall be full compensation for all costs of excavating; forming; furnishing, placing, finishing, and curing concrete; grooving; furnishing and placing reinforcing steel; aggregates; mixing; hauling; spreading; compacting; sampling; and for furnishing all other materials, equipment, tools, labor, and incidentals necessary to complete the work.

19. CONCRETE DRIVEWAY REMOVED AND REPLACED. This item shall be paid for at the contract unit price bid per square foot for the area shown on the plans, and shall include saw cuts, removal, disposal of removed material; and for all excavation, compaction, concrete and concrete placement, reinforcement and its placement, forming, finishing, jointing, curing, and for furnishing all equipment, tools, labor and incidentals necessary to complete the work.

20. EMBANKMENT. Embankment shall be paid for at the contract unit price bid per cubic yard on the estimated quantity as shown on the bid form. The price bid for "Embankment" shall be full compensation for constructing roadway embankments, including preparation of the areas on which they are to be placed; compaction; unclassified excavation of on-site material; stripping; hauling; and for the furnishing of all labor, tools, equipment and incidentals necessary to complete the work. Materials which are unsuitable for use as embankment shall be wasted at locations to be provided by the Contractor and approved by the Engineer.

22. STORM SEWER STRUCTURES. Storm Sewer Structures shall be paid for at the contract unit price bid per each. The unit price bid shall be full compensation for all excavation, compaction and backfill; concrete and concrete placement; grates and frames; finishing and curing; and for furnishing all other material, equipment, tools, labor, and incidentals necessary to complete the work including connection of curb inlets to the curb and gutter.

23. STORM SEWER AND CULVERT PIPE. Pipe shall be paid for on a linear foot basis as measured from center-of-structure to center-of-structure or to end of full barrel section on end sections, no deductions being made for manholes or inlets. The contract unit price bid shall be full compensation for excavation, placing of pipe and backfill, bedding, compaction, and for all other material, equipment, tools, labor and incidentals necessary to complete the work. End Sections shall be paid for per each at the contract unit price bid for the various sizes shown in the plans.

24. TEMPORARY AND PERMANENT PROJECT SEEDING. These items shall be paid for at the contract contract unit prices bid per acre. The price bid shall be full compensation for furnishing seed, fertilizer, mulch, and water; ground preparation; application of seed, fertilizer and mulch as required by the plans and specifications; watering as required in Section 02487 of these specifications; and for all tools, labor, and incidentals necessary to complete the work.

25. SITE CLEARING AND RESTORATION. Site Clearing and Restoration shall be paid for at the Contract lump sum price bid and shall be full compensation for clearing, grubbing of shrubs, trimming of trees and plant where permitted; removal of trees; removal and replacement of fences, culverts, and signs; removal of debris, placement of safety fencing, and temporary fencing, barricades and flashers, clean-up, and seeding or sodding of all disturbed areas in kind. Removal, repair, and replacement of damaged pavements and travelways for removal and replacement shown in the drawings shall be considered subsidiary to site clearing and restoration. The price bid shall cover all incidental items affected by the work including furnishing all material, equipment, tools, energy and labor necessary to complete the work.

26. EXCAVATABLE FLOWABLE FILL. This shall be paid for at the unit price bid per linear foot of trench filled regardless of trench depth and/or pipe sizes unless indicated otherwise by plans or contract. The unit price bid shall include all materials, excavation, backfilling, equipment, labor, miscellaneous items and incidentals necessary to complete this work.

27. EROSION CONTROL (BMP's). This item shall be paid for at the contract lump sum bid installed at the locations as shown on the plans or detailed. The unit price bid shall include sediment barriers, inlet protection, temporary construction entrances and all other materials, equipment, labor and incidentals necessary to complete the work. Also included in this item is maintenance of the sediment barriers throughout construction and removal of these barriers once a substantial stand of protective cover is established, as approved by the Engineer.

## SECTION 01300 - SUBMITTALS

### 1. CONSTRUCTION SCHEDULE

The Contractor shall submit his proposed progress schedule for the Engineer's approval within 10 days after the effective date of the Notice To Proceed. The Contractor's progress schedule, when approved by the Engineer, shall be used to establish major construction operations and to check on progress of the work. The Contractor shall provide sufficient materials, equipment and labor to assure completion of the work in accordance with the approved schedule.

The Contractor shall review the construction phasing or sequencing requirements noted on the plans when preparing the construction schedule. Any deviation from the phasing or sequencing requirements shall be noted and an alternative submitted in writing to the Engineer for approval.

If the Contractor's progress falls significantly behind the approved schedule, the Contractor shall, upon the Engineer's request, submit a revised schedule for completion of the work within the contract time and modify his operations to provide such additional materials, equipment and labor necessary to meet the revised schedule. Should the prosecution of the work be discontinued for any reason the Contractor shall notify the Engineer at least 24 hours in advance of resuming operations.

### 2. SUBMITTALS

- a. The Contractor shall within 15 days after award of contract start sending submittals for approval. The Contractor shall prepare or have prepared in a neat and workmanlike manner, submittal drawings and shop details for all equipment and materials furnished under this Contract. The submittals shall contain the following:
  - (1) Six sets of identical submittal data separately stapled with Engineer's submittal form as a cover sheet.
  - (2) Where catalog cuts are used mark them to indicate equipment, capacities, controls, fittings, valves, sizes, model numbers, etc.
  - (3) Reference each item to applicable specification paragraph number and plan sheet number. Reference items not appearing in base specification to applicable alternate numbers, change order numbers, letters of authorization, etc.
  - (4) Shop drawings:
    - (a) All shop drawings shall be checked and signed by the contractor prior to submittal to the Engineer.
    - (b) Shop drawings submitted without contractor's signature or approval and verification will not be approved.

## SECTION 01510 - TEMPORARY UTILITIES

### 1. GENERAL

The Contractor shall furnish and pay for all compressed air, electricity, gas, telephone and potable water service required at the project site. Water necessary for earthwork compaction or other construction operations shall be furnished and paid for by the Contractor. The utilities are as scheduled on the drawings.

### 2. TEMPORARY SANITARY FACILITIES

The Contractor shall furnish and pay for temporary toilet facilities for use by his employees. Facilities shall be serviced regularly and maintained so as to not constitute a nuisance or health hazard.

## SECTION 01700 - CONTRACT CLOSEOUT

### 1. CLEANING

The Contractor shall remove all debris and thoroughly clean the project prior to final inspection.

### 2. FINAL INSPECTION

It is the Contractor's responsibility to schedule the final inspection and notify the Engineer and all subcontractors of the date, time, and place thereof. All work items must be completed. Any deficiencies discovered during the final inspection will be noted and the Contractor will be given 15 days to correct those so noted.

## **DIVISION 2 - SITEWORK**

### **SECTION 02001 - GENERAL**

#### **1. SCOPE OF WORK**

The work covered under this Section shall include clearing and grubbing; all excavation required for construction of roads, streets, drives, and parking areas; formation of embankments, fills, and backfills; demolition, dewatering, excavation for culverts, storm drains, sanitary sewers, water lines, manholes, drainage structures, channels, and ditches; subgrade preparation, area and finish grading; hauling, placing, watering and compacting; disposal of surplus and waste materials; utilities; and all miscellaneous and incidental operations necessary to construct and complete the work in compliance with the dimensions, lines and grades as shown on the plans.

#### **2. OBSTRUCTIONS**

The Contractor shall work around all utilities, structures, fences, trees, shrubs, pavement, and other items shown to remain within the work site, easements, and rights-of-way, unless he determines removal, resetting, replacement, or adjustments will be required to accomplish the work. The Contractor shall bear all costs for the removal, resetting, replacement, and/or adjustment or repair of those items affected as directed by the Engineer, at no additional cost to the Owner.

#### **3. CLEANUP**

Upon completion of construction the Contractor shall remove all debris resulting from construction. All soil banks shall be leveled and excess material disposed of as specified in Section 02201-6 for Type B compaction. The entire area involved in this contract shall be left in a clean and sightly condition.

#### **4. DISPOSAL OF WASTE MATERIALS**

Materials obtained from demolition of the existing facilities; sewer lines, manholes, concrete rubble, concrete encasement excavation, existing fence, trees, shall be removed from the project site and disposed of at the County Landfill or as directed by the Engineer. Material containing vegetation stripped from the site shall be stockpiled during construction and spread for topsoiling of grassed areas after the site grading is completed. Excess soil shall be wasted on site or at other approved sites and placed in accordance with Type B compaction requirements.

## SECTION 02100 - SITE PREPARATION

### 1. STRIPPING

The Contractor shall strip all vegetation and other objectionable material from all areas of original ground on which pavement, concrete slabs, fill or footings are to be placed. Where shown on plans, the strippings shall be deposited at approved locations on the site, but shall not be used for backfilling trenches, or structures. No direct payment will be made for stripping.

### 2. DISPOSAL OF SURPLUS MATERIALS

All material from stripping and all excess excavation or trenching material not required for filling or backfilling shall be wasted at the jobsite, as shown in the plans or as directed by the Engineer.



## SECTION 02200 - EARTHWORK

### 1. GENERAL

1.1 Related Documents: General Conditions and Supplementary Conditions apply to this Section.

1.1.1 Related Work Specified Elsewhere Are Titled:

- (1) "Earthwork - Streets" Section 02201.
- (2) "Excavation, Trenching and Backfilling for Utilities" Section 02206.
- (3) "Manholes and Cleanouts"; Section 02601.
- (4) "Sanitary Sewer Construction": Section 02605.
- (5) "Water Main Construction": Section 02603.
- (6) "Storm Sewerage Systems" Section 02721.

1.2 Description: Upon completion of the backfilling of trenches and placing fill around structures, the entire site of the work included in this Contract shall be graded to form smooth, uniform slopes around structures. All the remaining area included in this Contract shall be graded to the elevations shown on the Plans to provide adequate drainage away from the structures and to present a neat and workmanlike appearance.

1.3 Quality Assurance: Equipment: Type approved prior to use, for capability of equipment to perform work in an acceptable manner. Compact using tamping rollers, pneumatic tired rollers, three-wheeled power rollers or other type equipment.

1.4 Compaction Control: Contractor shall at his expense, make field density tests to assure correct moisture content and compaction.

### 2. MATERIALS

2.1 Satisfactory Materials: All suitable material taken from excavations shall be used in the formation of embankments, subgrade, and backfill to complete the site grading as indicated on the plans or as directed by the Engineer. All unsuitable excavated materials together with all debris, junk, stones, logs, stumps, roots, and other unsuitable materials shall be removed from the site and disposed of by, and at the expense of, the Contractor.

Satisfactory and unsatisfactory materials will be determined by the Engineer.

2.2 Topsoil: If quantity of topsoil is not available on site and additional topsoil is required, provide approved crumbly surface soil having characteristics of soils in vicinity that produce heavy growth of vegetation.

### 3. EXECUTION

3.1 Conservation Of Topsoil: In cut areas, and in areas under proposed paving, walks, structures and/or buildings, remove topsoil without contamination with subsoil. Spread topsoil in areas prepared for topsoil, or when directed stockpile in locations convenient to areas to receive topsoil later. Strip to depth of 6-inches and keep free of roots, stones or other undesirable materials.

3.2 Excavation: General: Excavate to lines and grades indicated. If unsatisfactory material is encountered, stop work and notify Engineer of condition. Use satisfactory excavated material for fills. Remove unsatisfactory material and surplus excavated material not required for fill and dispose of off site, unless specified otherwise.

3.2.1 Under Proposed Walks: Excavate to subgrade elevations.

3.2.2 For excavation under proposed buildings, paving, utilities, sewers and subdrains see the section noted in Paragraph 1.1.

3.2.3 Classification of Excavation: Unclassified regardless of nature of material encountered.

3.2.4 Protection or Removal of Utility Lines: Protect from damage existing utility lines, etc., shown on the drawings or in locations made known to Contractor prior to excavation and to be retained, as well as utility lines constructed during excavation operations; if damaged, repair at Contractor's expense. Existing utility lines not shown on drawings and existing utility lines in locations not known by Contractor, if damaged, shall be repaired and restored to service at Contractor's expense. When utility lines to be removed are encountered, notify Engineer in ample time for necessary measures to be taken to prevent interruption of service.

3.3 Preparation Of Ground Surfaces For Fill: Strip or remove unsatisfactory material within area upon which fill will be placed. Scarify to depth of 9" and compact to required density at a moisture content of at least optimum.

3.4 Fills and Embankments: Construct at locations and to lines and grades indicated; conform to shape of typical section indicated. Provide and haul in approved material for fill, if material is not available from excavated areas. Fill material shall be satisfactory materials, reasonably free of roots, and other organic material and trash, and from stones greater than 6 inches maximum diameter. Frozen materials are not acceptable for fill. Stones over 3" maximum diameter not acceptable in upper six inches in fills or embankments. Place material in successive horizontal layers of 6" to 9" in loose depth. Compact each layer to required density.

3.5 Backfill Adjacent To Structures: Place and compact uniformly in manner to prevent wedging action or eccentric loading upon or against structures. During backfilling and in forming embankments, do not use equipment that will overload structure in compacting fills. Additional requirements for backfilling for pavements, buildings, sewers and utilities are specified in related sections.

### 3.6 Compaction Of Earthwork

3.6.1 General: This item shall consist of the compaction of earthwork by rolling or tamping, or any combination of these methods in accordance with the method and/or type and at the location indicated on the plans or ordered by the Engineer.

3.6.2 Standard Density Tests: This test is designed to determine the moisture content at which maximum compaction is obtained, and to determine the density (dry weight per unit volume) which is obtained at the moisture content and the test will be made as described in the latest edition of ASTM D698.

3.6.3 Moisture Content Requirement: When sufficient moisture does not exist in the soil or earth material to provide thorough bonding under rolling, a sufficient amount of water shall be added to the soil before it is rolled or tamped to insure bonding during the compaction process. Moisture control shall be one of the following types. The type of moisture control to be used at a specific location shall be as depicted on the plans.

3.6.3.1 Moisture Range 03 (MR 0-3). The moisture content of the soil shall be uniform and shall not be higher than three (3) percentage points above optimum nor lower than optimum of the soil involved. If the soil is unstable at this moisture range, the moisture shall be lowered to the point it is stable as determined by the Field Engineer.

3.6.3.2 Moisture Range 90 (MR-90). The moisture content of the soil shall be uniform and shall be such that the soil can be compacted to the requirements of the type of compaction designated on the plans or ordered by the Engineer.

If Type B compaction is specified with this moisture control, the moisture content shall be sufficient to produce a uniform mixture of the soil and moisture. It will be determined by visual inspection that satisfactory compaction and moisture content is obtained.

The water may be added to the material as it is placed in the embankment, or to the cut area and borrow pits. When it is added to the embankment it shall be thoroughly and uniformly mixed with the material before compaction. The mixing shall be accomplished by the use of spring tooth harrows, disc harrows, disc plows or other equipment, or by other methods approved by the Engineer. When water is added to cut areas or borrow pits, the surface of the areas shall be plowed or otherwise roughened or shaped to permit more rapid penetration of the water and to prevent undue loss of the water.

**3.6.4 Compaction Requirements:** Compaction requirements are separated into types, depending upon the nature of the soil to be compacted and the degree of compaction desired. The method of attaining the compaction for each of the several types shall be as herein described.

**3.6.4.1 Type AA** The Contractor shall carefully level up each successive lift or layer and shall make a sufficient number of trips with the roller over the entire surface to insure that all soils are uniformly compacted to a density equal to or greater than ninety-five (95) percent of the Standard Density for each soil in conformance with the latest edition of ASTM-D-698. Each successive lift shall contain only that amount of soil material which will insure sufficient and uniform compaction, but in no instance shall any lift or layer exceed six (6) inches of compacted depth.

**3.6.4.2 Type B** The Contractor shall carefully level up each successive lift or layer and shall make a sufficient number of trips with tamping or sheepsfoot type rollers over the entire surface to insure that all soils are uniformly compacted. Compaction shall be continued until the roller feet ride the surface of the compacted lift. Compaction will be considered as adequate when additional trips do not result in additional compaction or in bringing the roller feet closer to the surface of the lift. Each successive lift shall contain only that amount of material which will insure efficient and uniform compaction, but in no instance shall any lift or layer exceed six (6) inches of compacted depth.

If, due to the sandy material that may be encountered, or due to the high moisture content that may be encountered with some of the soils, the roller will not "build up" so that the tamping feet will ride the surface, or the roller continues to pick up excessive amounts of soil due to excessive moisture content to the soil, the sheepsfoot roller may be discontinued and a pneumatic tired roller used, with the permission of the Engineer. When pneumatic tired rollers, meeting the requirements as set out above or as approved by the Engineer are used, each lift shall be rolled not less than ten (10) trips over its entire surface and not more than fifteen (15) trips will be required.

**3.6.5 Tamping Adjacent to Structures:** Whenever embankments are placed adjacent to structures or at locations where it is not practical to use a roller, the embankment materials shall be tamped by the use of mechanical rammers or tampers. Each layer shall be compacted to a density equal to or greater than that obtained under the above rolling procedure for the type of compaction designated. Each successive lift shall contain only that amount of material which will insure proper compaction, but in no instance shall any layer be greater than six (6) inches of compacted depth. When the quantity of work is small, a hand tamper may be used with the permission of the Engineer.

#### 4. BORROW

4.1 General: If there is insufficient material from the excavations to build the embankments and fills required, the Contractor shall borrow the additional fill material required.

4.2 Dressing of Borrow Pits: Upon completion of work, borrow pits shall be dressed, graded, and sides trimmed to uniform slopes and left in a condition which will present a neat appearance, minimize soil erosion and standing water, and permit accurate measurement.

#### 5. SETTLEMENT

The Contractor shall be responsible for all settlement of backfill, fills, and embankments which may occur within one year after final completion of the contract under which the work was performed.

The Contractor shall make, or cause to be made, all repairs or replacement made necessary by settlement, within 48 hours after notice from the Engineer or Owner.

#### 6. DRAINAGE

6.1 Drainage in Vicinity of Structures: The Contractor shall control the grading in the vicinity of structures and trenches so that the ground surface is properly pitched to prevent water from running into the excavated areas. Water which has accumulated in the excavation through the failure of the Contractor to take proper precautions to prevent such accumulation, shall be removed by the Contractor at his own expense, and the subgrade shall be restored to its proper bearing capacity.

#### 7. TOPSOILING

7.1 Location: Apply topsoil to areas of project other than areas to receive structures, buildings, walks, gravel strips and pavings. Coordinate with landscape drawings and specifications.

7.2 Preparation: Excavate cut areas 4" below finish elevation and scarify and compact to required density. Leave fill areas down 4" below finish elevations.

7.3 Installation: Place and compact to 90% of Standard Proctor Density to a thickness after compaction of 4". Finish to elevations called for on the drawings and to a smoothness suitable for seeding, sprigging or planting as called for on landscape drawings.

7.4 Protection: Protect newly graded areas from traffic and erosion. Repair areas of settlement or washing away that may occur and re-establish grades to required density, elevations and slopes.

## SECTION 02201 - EARTHWORK - STREETS

### 1. GENERAL

The work covered under this Section shall include clearing and grubbing; all excavation required for construction of roads, streets, drives, and parking areas; formation of embankments, fills, and backfills; excavation for culverts, storm drains, manholes, drainage structures, channels, and ditches; subgrade preparation, area and finish grading; hauling, placing, watering and compacting; disposal of surplus and waste materials; and all miscellaneous and incidental operations necessary to construct and complete the work in compliance with the dimensions, lines, and grades as shown on the plans.

### 2. WATER

Water can be obtained from any source such as wells, streams, ponds, lakes, waterlines, etc., provided that the Contractor shall obtain all permits and withstand all costs for obtaining and transporting the water to the work site,

### 3. CLEARING AND GRUBBING

This item shall consist of clearing and/or grubbing, including the disposal of materials, for all areas within the limits designated on the plans or as required by the Engineer.

Clearing and grubbing shall consist of clearing the surface of the original ground of the designated areas, areas to be excavated, or areas to receive embankment of all trees, stumps, down timber, logs, snags, brush, undergrowth, hedges, grass, weeds, fences, debris, and rubbish of any nature to a minimum depth of two feet below grade or subgrade, and the disposal from the project site of all spoil materials resulting from clearing and grubbing operations.

The manner and location of disposal of materials shall be subject to applicable laws and ordinances and to the approval of the Engineer. When the Contractor is required to locate a disposal area outside the limits of the project site, he shall obtain and file with the Engineer, permission in writing from the property owner for the use of his property for this purpose.

### 4. REMOVAL OF EXISTING STRUCTURES

This item shall consist of the removal and satisfactory disposal of such portions of existing structures as provided in the plans and specifications or ordered by the Engineer.

Where pipe culverts, or other items with a salvage value are removed, reasonable care shall be exercised in their removal.

All such salvageable items shall remain the property of the Owner, and shall be stored on the project site at locations approved by the Engineer.

All material which is not considered of value by the Engineer shall be disposed of under the same provisions as listed for clearing and grubbing.

## **5. EXCAVATION FOR STREETS**

This work shall consist of excavating the project proper, removing and satisfactorily disposing of all materials taken from within the limits of the work, also such excavation as is necessary for inlet and outlet ditches, channels, shaping and sloping of embankments, excavation for combined curb and gutter, street, alley, and driveway returns and pavement, strictly to the required alignment, grade and cross sections as shown on the plans.

**5.1 Classification of Excavation.** All material excavated shall be defined as "Unclassified Excavation".

**5.2 Construction Methods.** All suitable materials removed from the excavation shall be used, as far as practicable, in the formation of the embankment, subgrade, and at such other places as directed by the Engineer.

During construction, the roadbed shall be maintained in such condition that it will be well drained at all times. Unsuitable roadbed material encountered in cuts shall be excavated to the lateral limits and depth indicated on the plans or specified by the Engineer. The material removed shall be replaced with suitable embankment material, or with special backfill when so indicated on the plans or in the specifications.

**5.3 Construction Requirements.** The subgrade shall be excavated or filled until it is, after proper compacting, at such an elevation that the pavement or surfacing, when constructed as shown on the plans, will conform to the established grade and cross section.

Included in earth excavation shall be all incidental work such as stripping, plowing, scarifying, refilling, shaping, trimming, watering, compacting, resetting valves, boxes, and all preliminary work required to make the site ready for pavement or surfacing construction.

When the plans do not indicate use of a Subgrade Treatment, the Subgrade for the pavement or surfacing shall be scarified to a depth of eight (8) inches, and worked free of clods by disking and blading to insure a uniform depth of compacted material.

After scarifying, disking, and blading is completed, the entire area shall be compacted as specified hereinafter and a final rolling by means of a pneumatic roller or a smooth steel roller. Pneumatic-tired rollers shall be loaded to provide a gross weight of at least two hundred and twenty-five (225) pounds per inch of width of tire tread. Smooth steel rollers shall weigh not less than two hundred and fifty (250) pounds per inch of roller length. An approved type of subgrade planer shall be used in forming the subbase in lieu of the smooth rolling specified above.

Any irregularities or depressions that develop under rolling shall be corrected by loosening the material at these locations and adding, removing, or replacing material and re-rolling until the proper cross section and density are obtained. Any portion of the area which is not accessible to a roller shall be compacted to the required density by approved mechanical tampers.

In those areas that are to receive pavement or surfacing, the top of the subgrade shall be of such smoothness that, when tested with a 10-foot straightedge applied parallel and at right angles to the centerline, it shall not show any deviation in excess of 3/8 inch or shall not be more than 0.05 foot from true grade as established by grade hubs or pins. The Contractor shall protect the subgrade from damage and keep it effectively drained until surfacing material is placed thereon. In the event of ruts or erosion the subgrade shall be reshaped, refilled, and rerolled as directed by the Engineer.

All surplus excavated material shall be used to uniformly widen embankments, backfill behind curbs, flatten slopes, or shall be deposited in such locations as the Engineer may direct.

## 6. EMBANKMENTS

This item shall consist of the construction of embankments, including preparation of the areas upon which they are to be placed, in accordance with the specifications and to the lines, grades, and sections shown on the plans or as ordered by the Engineer.

**6.1 Construction Requirements.** Immediately prior to the placing of the fill materials, the entire area upon which the embankment is to be compacted to Type B or better, except where limited by rock, shall be scarified and broken by means of a disc harrow or plow, or other approved equipment, to a depth of 6 inches. Scarifying shall be done approximately parallel to the axis of the fill.

Embankments requiring compaction shall be constructed in accordance with the following item on "Compaction of Earthwork". Material to be wasted shall be placed in uniform, horizontal layers not exceeding twelve inches in thickness over the full width of the embankment. Each layer shall be bladed until it is level and uniform before the succeeding layer is placed.



The quantity and quality of equipment in use on the project and the amount of blading and rolling performed shall be sufficient to process the amount of material being delivered to the embankment area. The Engineer shall have the authority to require the suspension of embankment operations at any time until the previously delivered materials are properly placed.

During construction of the embankment, the Contractor shall route his equipment, both when loaded and when empty, over the layers as they are placed and shall distribute the travel evenly over the entire width of the embankment. Starting layers shall be placed in the deepest portion of the fill. Haul road locations from borrow pits shall be routed as approved by the Engineer.

Frozen material shall not be placed in the embankment nor shall embankment be placed upon frozen material.

No payment will be made separately or directly for haul on any part of the work. All hauling will be considered a necessary and incidental part of the work and its cost shall be considered by the Contractor and included in the contract unit price for the pay items involved.

6.2 Topsoil. When topsoil is specified or required, it shall be salvaged from stripping or other grading operations. If at the time of excavation or stripping the topsoil cannot be placed in its proper and final section of finished construction, the material shall be stockpiled at approved locations. Stockpiles shall not be placed on areas which will subsequently require excavation or embankment.

Upon completion of grading operations, topsoil shall be placed as directed by the Engineer.

No direct payment will be made for topsoiling. The quantity removed and placed or stockpiled shall be paid for at the contract unit price for "Unclassified Excavation". No additional payment shall be made for re-handling of stockpiled topsoil.

## 7. COMPACTION OF EARTHWORK

This item shall consist of the compaction of earthwork by rolling or tamping, or any combination of these methods, in accordance with the plans and specifications or at the direction of the Engineer.

7.1 Construction Requirements. The provisions of "Embankments" shall apply to the construction of embankments that are to be compacted, to subgrade compaction except where subgrade stabilization is specified, and to backfill when specified as compacted backfill.

**7.1.1 Tamping or Sheepsfoot Rollers** - These rollers shall consist of metal rollers, drums, or shells surmounted by metal studs with tamping feet projecting at least 6-1/2 inches from the drum surface. The weight of tamping rollers shall be such that, when fully loaded, the load on each tamper foot shall be not less than two hundred (200) pounds per square inch of cross-sectional area. The load per tamper foot will be determined by dividing the total weight of the roller (loaded) by the number of tamping feet in one (1) row parallel to the axis of the roller.

Multiple-wheel pneumatic-tired rollers shall be constructed so that they can be loaded to a gross weight of at least two hundred twenty-five (225) pounds per inch of width of tire tread. The internal pressure of the tires shall be at least forty-five (45) pounds per square inch and the tires on the front and rear axes shall be staggered so that they will cover the entire area over which the roller travels.

**7.1.2 Formation of Compacted Embankments** - Embankments shall be formed of satisfactory materials placed in successive horizontal layers of not more than 8 inches in loose depth for the full width of the cross section and shall be compacted as specified before the next layer is placed.

**7.1.3 Moisture Requirements** - The material in the layers shall be of the proper moisture content before rolling to obtain the desired compaction. Wetting or drying of the material and manipulation when necessary to secure a uniform moisture content throughout the layer shall be required. The addition of water, when required, shall be as the layer is placed on the embankment or prewatered at the source when permitted by the Engineer. Mixing shall be accomplished by the use of spring tooth harrows, disc harrows, disc plows or other approved equipment.

The moisture content of the soil at the time of compaction shall be uniform and within + 3 percentage points of optimum moisture for the soil involved, except for Type B.

The moisture content of the soil being compacted to Type B specification shall be considered too high to insure compaction when, after repeated rollings with a sheepsfoot roller, the roller continues to pick up excessive amounts of soil and refuses to "build up" so that the tamping feet eventually ride the compacted surface. When other types of rollers are used, the moisture content of the soil shall be considered excessive when "bridging" or "building up" of the soil occurs in front of or behind the rear wheels of such rollers, and/or when earth hauling equipment produces ruts in the rolled surface.

Material containing excess water shall be dried by mechanical means or permitted to dry naturally to a moisture content which will allow satisfactory compaction.

**7.1.4 Compaction Requirements** - Compaction requirements are separated into types, depending upon the nature of soil to be compacted and the degree of compaction desired. Unless otherwise indicated on the plans or in the specifications, the minimum compaction shall be Type B as listed below.

Types of Compaction:

**Type I** - Compacted density of the soil shall be equal to or greater than ninety-five (95) percent of Standard Proctor Density at optimum moisture as per ASTM D-698 and the latest revisions thereof.

**Type II** - Compacted density of the soil shall be equal to or greater than ninety (90) percent of Standard Proctor Density at optimum moisture as per ASTM D-698 and the latest revisions thereof.

**Type B** - The Contractor shall carefully level up each successive lift or layer and shall make a sufficient number of trips with tamping or sheepsfoot rollers over the entire surface to insure that all soils in the lift are uniformly compacted. Compaction shall continue until the roller feet "ride out" on the surface of the compacted lift. Compaction shall be considered as adequate when additional trips do not result in additional compaction or in bringing the roller feet closer to the surface of the lift. Each successive lift shall contain only that amount of material which will insure the required uniform compaction, but in no instance shall any lift exceed six (6) inches of compacted depth.

If, due to the sandy material that may be encountered, or due to the high moisture content that may be encountered with some soils, the roller will not "ride out" on the surface, or the roller continues to pick up excessive amounts of soil, the Contractor may discontinue the use of the sheepsfoot roller and, after obtaining permission from the Engineer, use a pneumatic tired roller for such portions of the work as necessary. When pneumatic tired rollers meeting the requirements listed above are used, each lift shall be rolled not less than ten trips over its entire surface and not more than fifteen trips will be required.

**7.1.5 Tamping** - Whenever embankments are placed adjacent to structures or at locations where it is not practical to use a roller and compacted backfill, the embankment and backfill materials shall be tamped by mechanical tampers having a tamping face not exceeding one hundred fifty (150) square inches in area. Each layer shall be compacted to a density equal to or greater than that obtained under the above rolling procedure for the type of compaction designated. Each successive lift shall contain only that amount of material which will insure proper compaction, but in no instance shall any layer be greater than 6 inches compacted depth.

## 8. EXCAVATION AND BACKFILLING FOR STRUCTURES AND PIPE

This item shall consist of all excavation and backfilling for structures including manholes, inlets, storm sewers, and culvert pipe; and shall include all the necessary clearing and grubbing, bailing, drainage, pumping, sheeting, shoring and bracing and construction of cofferdams or cribs, and their subsequent removal. The disposal of all unwanted or excess excavated material is also included under this item of work.

See also Section 02721 - "Storm Sewerage Systems".

8.1 Excavation. All excavation for structures and pipe shall be "Unclassified".

The Contractor shall install shoring required for the safety of personnel and protection of the Engineer during the prescribed excavation and trenching.

Temporary support, adequate protection and maintenance of all underground and surface utility structures, drains, sewers and other obstructions encountered in the progress of the work shall be furnished by the Contractor at his own expense.

Where ground water is encountered in excavating or trenching, the Contractor shall remove or lower the ground water by means of well point systems, sheeting and pumping, or other approved methods which will permit preparation of a satisfactory pipe bed or structural subgrade, free from running water. No additional or separate payment will be made for wet excavating or trenching.

8.1.1 Excavation For Structures. The excavation for structures shall be excavated according to the outlines of the footings as shown on the plans and shall be of sufficient size to permit the placing of the full width and length of the footings including the forms. Rounded or undercut corners and edges of footings will not be permitted.

The excavation shall be carried to the elevation shown on the plans or as established by the Engineer.

Suitable and practically watertight cofferdams shall be used whenever water-bearing strata are encountered above the elevation of the bottom of the excavation. They shall be sufficiently large to give easy access to all parts of the foundation form.

Cofferdams shall be sunk to a depth well below the bottom of the excavation or to an elevation as near the bottom of the excavation as foundation conditions will permit; shall be substantially braced in all directions, and of such construction as will permit them to be pumped free of water. Unless otherwise shown on the plans or agreed upon, cofferdams and all sheeting or bracing shall be removed after the completion of the concrete or masonry.

**8.1.2 Excavating and Forming Bed for Pipe.** The trench shall be excavated to the depth and grade shown on the plans or established by the Engineer. The trench shall be of sufficient width at the top of the pipe, when placed, to permit thorough tamping of the backfill under the haunches and around the pipe, but in no case shall the trench width be less than one foot greater than the external diameter of the pipe with the sides of the trench as nearly vertical as practicable.

All trenching shall be done with a ladder wheel machine (commonly referred to as a trenching machine) or a backhoe. The use of other type machines for trenching will be permitted only by written permission of the Engineer and then only when unusual trenching conditions are encountered. All excavated material not required for fill or backfill shall be removed and wasted as directed by the Engineer. The excavated material shall be laid compactly along the trench and kept trim so as to be of least inconvenience to the public and adjoining tenants. The Contractor shall not obstruct any drainage courses with excavated material.

In excavating, the bottom of the trench shall be so shaped to a template that at least ten percent (10%) of the overall height of the pipe will be in contact with the bottom of the trench as excavated. Recesses shall be excavated to receive bells, or other parts which extend below the outside perimeter of the pipe.

Where a firm foundation is not encountered at the established grade due to soft, spongy, or other unstable soil, all such unstable material under the pipe and for a width equal to the width of the trench shall be removed and replaced with gravel conforming to ASTM C33 size No. 67, properly compacted and of the thickness as required by the Engineer to provide adequate support for the pipe.

When specific details for pipe bedding are shown on the plans they shall control the construction requirements. Specification provisions not in conflict are considered complimentary and shall be complied with in addition to the details provided.

**8.2 Backfilling.** Structures, culverts and sewers shall be backfilled in accordance with the following requirements. Only approved materials that will produce a dense, well compacted backfill shall be used for backfilling. Materials such as sod, frozen soil, debris, and soil that contains a large amount of organic matter shall not be used. When

permitted by the Engineer, compacted sand may be used in lieu of earth for compacted backfill except for the top two feet. Water shall be drained from the areas to be backfilled. If, in the opinion of the Engineer, it is not practicable to drain the areas to be backfilled, the backfill areas shall be dewatered by means of bailing or pumping.

No backfilling shall be placed against any structure until permission is given by the Engineer.

The backfill material shall be deposited on both sides of all structures and sewers at approximately the same elevation and the same time. Special care shall be taken to prevent any wedging action against the structure, or lateral displacement of the pipe.

The material shall be placed in layers and compacted by means of mechanical tampers or hand tampers. Each layer shall be compacted to a minimum density equal to or greater than that of the surrounding undisturbed soil and the top two feet shall be compacted to meet the requirements of Type II Compaction. Each successive layer shall contain only the amount of material that is required for proper compaction, but in no case shall any layer be greater than four (4) inches compacted depth. The moisture content of the soil shall be sufficiently near optimum to insure the required density.

The compaction of the earthwork around any structure shall be carried to the grade as shown on the plans or set by the Engineer. Catch basins, manholes, inlets, sewers, and miscellaneous structures shall be backfilled in accordance with the methods outlined above, except that compaction of the backfill will not be required where structures are outside the roadway right-of-way or any other traveled way. Sewers outside the roadway shall be compacted to the springline of the pipe and the remaining trench backfilled as approved by the Engineer.

When specific details for backfilling in trenches for pipe or culverts, or around structures are shown on the plans they shall control the construction requirements. Specification Provisions not in conflict are considered complimentary and shall be complied with in addition to details provided.

**8.3 Settlement.** The Contractor shall be responsible for all settlement of backfill, fills, and embankments which may occur within one year after final completion of the contract under which the work was performed.

The Contractor shall make, or cause to be made, all repairs or replacement made necessary by settlement, within 48 hours after notice from the Engineer.

## SECTION 02206 - EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITIES

### 1. GENERAL

1.1 Related Documents: General Conditions and Supplementary Conditions apply to this Section.

#### 1.1.1 Related Work Specified Elsewhere Are Titled:

- (1) "Earthwork": Section 02200.
- (2) "Manholes and Cleanouts": Section 02601.
- (3) "Sanitary Sewer Construction": Section 02605.
- (4) "Water Main Construction": Section 02603.
- (5) "Storm Sewerage Systems": Section 02721.

1.2 Description: This Section includes Trenching and Backfilling for Site Utilities from 5 feet outside building lines to the connection with City utilities and/or for City utilities within City or Public Easements. Also included in this Section is the excavation and backfilling for incidental utility structures.

1.3 Quality Assurance: Equipment: Type approved prior to use, for capability of equipment to perform work in an acceptable manner. Compact using vibrating plates, tamping rollers, pneumatic tired rollers, three-wheeled power rollers or other type equipment.

1.4 Compaction Control: Contractor shall at his expense, make field density tests to assure correct moisture content and compaction.

### 2. MATERIALS

#### 2.1 Satisfactory Materials:

##### 2.1.1 Pipe Bedding Material:

2.1.1.1 Granular Bedding Material shall be an approved material consisting of a durable crushed rock conforming with the requirements of the latest revision of ASTM C-33 Size No. 67 (3/4" to No. 4); to be placed in not more than 6" layers and compacted by slicing with a shovel or vibrating. Soundness, abrasion, and absorption limits shall be as required for coarse aggregates in Section 03010-Concrete Work.

2.1.1.2 Sand-Gravel Bedding Material - sand-gravel mix meeting Type UD-1 of the 1990 Kansas Standard Specifications for State Road and Bridge Construction.

2.1.1.3 Compacted Embedment shall be an approved sand material free from debris, organic material, and stones with 100% passing thru 3/4" sieve to be placed in uniform layers not more than 6" thick and compacted to 95 percent maximum density as determined by ASTM D698. Granular Bedding Material may be substituted for all or part of Compact Embedment Materials.

#### 2.1.2 Trench Zone Material:

2.1.2.1 Compacted Granular Backfill material shall be an approved sand material free from debris, organic material and stones with 100% passing the 3/4" sieve and not more than 15% passing a No. 200 sieve; to be jetted and mechanically vibrated into place and compacted to 95% density as determined by ASTM D698.

2.1.2.2 Uncompacted Earth Backfill material may be natural soil free from large clods or stones, brush, roots more than 2 inches in diameter, debris, and junk. Flooding with water shall be provided as directed by the Engineer.

2.1.2.3 Compacted Earth Backfill shall consist of material existing prior to trenching or selected material as directed by the Engineer, and shall be compacted to 90% density as determined by ASTM D698. For backfilling at grade beneath existing streets or proposed streets see paragraph 3.3.5. For backfilling at grade under graveled streets see Paragraph 3.3.6.

2.2 Satisfactory and unsatisfactory bedding and trench backfilling materials will be determined by the (soils) engineer.

2.3 Topsoil: If quantity of topsoil is not available on site and additional topsoil is called for, provide approved crumbly surface soil having characteristics of soils in vicinity that produce heavy growth of vegetation.

### 3. EXECUTION

3.1 Structure Excavation And Backfilling: General: The Contractor shall perform all excavation to the dimensions and elevations indicated on the drawings for all structures and all incidental work thereto. After the completion of excavation, and prior to commencement of foundation footings, floor or slab construction, the excavation will be inspected and approved by the Engineer to insure that suitable subgrade has been reached. Care shall be taken not to excavate below the depths indicated on the drawings. Where the excavation is made below the elevation indicated on the drawings through the fault of the Contractor, the excavation shall be restored to the proper elevation in accordance with the procedure described below for backfill, or the heights of the walls or footings shall be increased, at the expense of the Contractor. Excavation shall extend a sufficient distance from walls and footings to allow for forms, for installation of services and for inspection, except where concrete for walls and footings is authorized to be deposited directly against excavated surfaces.



**3.1.1 Drainage in Vicinity of Structures:** The Contractor shall control the grading in the vicinity of structures and trenches so that the ground surface is properly pitched to prevent water from running into the excavated areas. Water which has accumulated in the excavation through the failure of the Contractor to take proper precautions to prevent such accumulation, shall be removed by the Contractor at his own expense, and the subgrade shall be restored to its proper bearing capacity.

**3.1.2 Shoring:** The Contractor shall do all shoring required for safety of personnel and protection of the Engineer in performing the prescribed excavation and trenching. Shoring and bracing near structures shall remain, when directed by the Engineer.

**3.1.3 Pipes Under Concrete Floors:** All pipes under concrete floors shall be tested before the trenches are backfilled. After testing the pipe lines, the trenches shall be backfilled with sand and compacted to a density equal to that of the adjacent earth.

**3.1.4 Backfill Around Structures:** After completion of foundation footings and walls and other construction below the elevation of the final grades, all forms shall be removed and the excavation cleaned of all trash and debris prior to backfilling. Material for backfilling shall consist of that excavated, or approved borrow, and shall be free of trash, lumber, or other debris. Backfill shall be placed in 6 inch layers properly moistened to approximate optimum requirements. Each layer shall be compacted by hand, machine tampers, or other suitable equipment, to a density equal to that of the adjoining earth.

**3.1.5 Wet Excavation:** Where ground water is encountered in excavating or trenching, the Contractor shall remove or lower the ground water by means of well point systems, sheeting and pumping, or other approved methods which will permit preparation of a satisfactory pipe bed or structural subgrade, free from running water. No additional or separate payment will be made for wet excavating or trenching.

**3.2 Trenching, Backfilling And Compacting:** Classification of Excavated Materials: No classification of excavated materials will be made. Excavation and trenching work shall include the removal and subsequent handling of all materials excavated or otherwise removed in performance of the contract work, regardless of the type, character, composition, or condition thereof.

**3.2.1 Trenching Through Earth:** The Contractor shall perform all trench excavation of every description and of whatever substances encountered, to the depth shown on the plans or as directed by the Engineer. All trenching shall be done with a ladder wheel machine (commonly referred to as trenching machines) or a backhoe. The use of other type machines for trenching will be permitted only by written permission of the Engineer and then only when unusual trenching conditions are encountered. All excavated

material not required for fill or backfill shall be removed and wasted as indicated on the plans, or removed and wasted as directed by the Engineer. The excavated material shall be laid compactly along the trench and kept trim so as to be of least inconvenience to the public and adjoining tenants. The Contractor shall not obstruct any drainage courses with excavated material.

Trenches shall be not less than 12 inches nor more than 18 inches wider than the outside diameter of the pipe to be laid therein. Excavation for manholes and other accessories shall have 12 inches minimum and 24 inches maximum clearance on all sides.

The Contractor shall excavate the trench to a minimum of four inches below the pipe barrel for placement of embedment material in the bedding zone in accordance with paragraph Pipe Zone Backfilling. Bell holes shall provide adequate clearance for tools and methods used in installing pipe. No part of any bell or coupling shall be in contact with the trench bottom, trench walls, or granular embedment when the pipe is jointed.

The ground adjacent to all excavation shall be graded to provide drainage away from the work. The Contractor shall remove by pumping or other means approved by the Engineer, any water accumulated in or encountered in the excavation, as specified under Wet Excavation.

The banks of trenches shall be kept as nearly vertical as possible, and shall be properly shored and braced. Shoring and sheet bracing near structures shall remain, as directed by the Engineer. Any deviation from vertical trench walls must be requested in writing from the Engineer.

Temporary support, adequate protection and maintenance of all underground and surface utility structures, drains, sewers and other obstructions encountered in the progress of the work shall be furnished by the Contractor at his own expense.

**3.2.2 Trenching Through Rock:** Whenever rock is encountered in the trench or elsewhere in any excavation required to be made, the rock shall be excavated to a minimum depth of six (6) inches below bottom of the barrel of the pipe for placement of embedment material in the bedding zone in accordance with paragraph Pipe Zone Backfilling. Special care shall be taken to insure that the bells do not rest on rock.

Rock shall not be drilled and blasted with explosives, unless permitted by the Engineer.

**3.2.3 Trenching Through Pavement:** All concrete or bituminous pavement or stabilized base encountered in the line of trenching shall be removed and replaced in a neat line. The pavement replaced shall conform in type and quality to the pavement removed, and shall be one and one third (1-1/3) times the thickness of the original pavement. The existing pavement shall be cut vertically and horizontally to a straight line.

The original cut in the pavement shall be of the same width as the trench to be excavated. After backfilling and tamping as hereinafter specified, the pavement cut shall be widened to give the new pavement base twelve (12) inches bearing on solid, undisturbed ground on each side of the trench. In the case of concrete pavement, the pavement replaced shall be reinforced with one-half (1/2) inch round bars spaced twelve (12) inches both ways, or equivalent mesh reinforcement.

Whenever the edge of the cut through concrete pavement is within five (5) feet of a joint parallel with the cut, then the pavement shall be removed to the joint and replaced as above.

The provisions of the paragraph "Trenching Through Earth" shall also apply to "Trenching Through Pavement" wherever applicable.

**3.2.4 Trenching Through Graveled Surfacing:** The Contractor shall carefully remove the existing gravel surfacing material over the area to be disturbed, and conserve the material free from admixture with other materials. After the gravel has been removed and the trenching performed as specified under the paragraph "Trenching Through Earth," and backfilled as hereinafter specified, the gravel surfacing material shall be replaced to a depth at least equal to the undisturbed gravel surfacing. If the gravel taken from the disturbed area has been allowed to become mixed with other material, it shall not be re-used but shall be replaced with approved clean gravel.

**3.2.5 Temporary Trench Crossing:** Temporary bridges or crossings over the trench shall be built and maintained by the Contractor where required to maintain traffic.

**3.3 Backfilling:** After the pipe joints are set and approved, backfilling shall be carefully performed and the surface brought to existing grade or to the elevations shown on the plans. Backfilling of open trenches shall be completed prior to the close of each days' work.

**3.3.1 Pipe Zone Backfilling:** Bedding material placement both below and above the bottom of the pipe shall conform to Figure 02206-1 and to the following:

- (1) Class A "Concrete Cradle" and/or Class A "Concrete Encasement" is not required unless specified on the plans. However, where unexpected trench conditions exist or improper trenching is performed Class A Bedding may be required as determined by the Engineer.
- (2) Class B Bedding shall be used for all flexible pipe.
  - a. Class B Normal Bedding shall be used for PVC Pipe.
  - b. Class B Improved Bedding shall be used for other flexible pipe.

- (3) Class C Bedding shall be used for all rigid pipe.
  - a. Class C Ordinary Bedding shall be used for all rigid pipe unless wet conditions are encountered.
  - b. Class C Improved Bedding shall be used for wet conditions existing in the trench, as directed by the Engineer, at no additional cost to the Engineer. The dimensions shall be equal to that required for "rock" excavation.

**3.3.2 Placement and Compaction:** After each pipe has been graded, aligned, shoved home and placed in final position on the bedding material, sufficient pipe embedment material shall be deposited and compacted under and around each side of the pipe and back of the bell or end thereof to hold the pipe in proper position and alignment during subsequent pipe jointing and embedment operations.

Embedment material shall be deposited and compacted uniformly and simultaneously on each side of the pipe to prevent lateral displacement.

**3.3.3 Backfill:** Backfill material and compaction requirements shall conform to either Type I, Type II or Type III as shown on Figure 02206-2. The type of backfill to be used at specific locations shall be as shown on the plans. One year's maintenance will be required on all backfill.

**3.3.4 Backfilling Through Rock:** Backfilling through rock shall be performed as specified in the paragraph Backfill above, except that the Pipe Zone is increased to provide eighteen (18) inches of cover over the pipe. When approved by the Engineer the remainder of the backfill may be excavated rock provided the excavated rock has been broken up so that earth and rock will thoroughly mix and not result in voids around the larger pieces of rock. Any excess rock remaining after the trench has been backfilled shall be removed or wasted as directed by the Engineer.

**3.3.5 Backfilling Under Pavement:** Backfilling under pavement shall be performed as Backfill Type I to a level of two (2) feet from the bottom of the pavement. The remainder of the trench shall be backfilled with selected material, sufficiently damp to be properly compacted in layers not exceeding six (6) inches in depth, compaction shall be performed with mechanical tampers and continued until a relative density of 100 percent of standard density, in conformance with ASTM D698, is attained. Type I backfill shall also be utilized on all proposed streets and shall be used to the limits of the R-O-W.

**3.3.6 Backfilling Under Gravel Streets:** Where the trench crosses or lies in existing gravel surfaced streets, the backfill shall be compacted as provided in the paragraph "Backfilling Under Pavement".

**3.4 Settlement:** The Contractor shall be responsible for all settlement of backfill, fills, and embankments which may occur within one year after final completion of the contract under which the work was performed.

The Contractor shall make, or cause to be made, all repairs or replacement made necessary by settlement, within 48 hours after notice from the Engineer.

**3.5 Borrow: General:** If there is insufficient material from the excavations to build the embankments and fills required, the Contractor shall borrow the additional fill material required. The Engineer will designate the area from which the borrow material is to be secured and the depth to which the cut will be permitted.

**3.6 Tamping:** Whenever embankments are placed adjacent to structures or at locations where it is not practical to use a roller, the embankment materials shall be tamped by the use of mechanical rammers or tampers. Each layer shall be compacted to a density equal to or greater than that obtained under the above rolling procedure for the type of compaction designated. Each successive lift shall contain only that amount of material which will insure proper compaction, but in no instance shall any layer be greater than six (6) inches of compacted depth. When the quantity of work is small, a hand tamper may be used with the permission of the Engineer.

## SECTION 02221 - EXCAVATABLE FLOWABLE FILL

### 1. DESCRIPTION

This work shall consist of a flowable mortar fill material in sewer, water and utility trenches under the pavement at locations as shown on the plans or as specified. The work shall be done in accordance with this specification.

### 2. MATERIALS

All materials shall meet requirements for the respective items in the Standard Specifications with the following exceptions.

- a. Cement shall be Type I.
- b. Fly Ash shall meet requirements of ASTM C 618, Class C, and shall come from a source approved by the engineer.
- c. Fine Aggregate for flowable mortar shall be natural sand consisting of mineral aggregate particles. The gradation of this materials shall be as follows:

Sieve Size	% Passing
3/4	100
200	0 - 10

It is intended that the sand be a fine sand that will stay in suspension in the mortar to the extent required for proper flow. Generally, mortar or plaster sand works well for this purpose. The sand intended for use shall be submitted to the central laboratory before the work begins. The Engineer reserves the right to reject the intended sand if a flowable mortar cannot be produced using the specified proportions. The contractor will not be responsible for certified aggregate testing. The Engineer will provide inspection that he deems appropriate, normally source approval followed by visual inspection.

- d. Mix Design. The mix design for flowable mortar is as follows:

#### Quantity of Dry Materials per Cubic Yard

Cement	75 pounds
Fly Ash	300 pounds
Fine Aggregate	2600 pounds

These quantities of dry materials, with approximately 70 gallons of water will yield approximately one cubic yard of flowable mortar of the proper consistency. It is intended that the mix design produce a 50 to 75 PSI strength at 28 days. Set accelerator will be required when flowable fill is placed at temperature below 85°F to obtain the necessary support required for traffic and subsequent work at the end of the specified 72-hour period.

3. PROPORTIONING AND MIXING EQUIPMENT

Sufficient mixing capacity or mixers shall be provided to permit the intended pour to be placed without interruption.

4. PLACEMENT OF MORTAR

Flowable mortar shall be placed the full depth into the area that covers two feet beyond either side of the pavement by any reasonable means. The fill shall be brought up uniformly to an elevation 12 inches above the top of the pipe or two feet below the bottom of proposed pavement, whichever is higher. Placement of mortar shall then cease and the fill protected from traffic for a period of 72 hours.

5. LIMITATION OF OPERATIONS

- a. Mortar shall not be placed on frozen ground.
- b. Mortar batching, mixing, and placing may be started, if weather conditions are favorable. The cold weather operation shall conform to the same conditions as specified in the Standard Specifications for Concrete Work.
- c. Each filling stage shall be as continuous an operation as is practicable.

6. MEASUREMENT AND PAYMENT

All materials, labor, equipment, tools and incidentals shall be paid for at the unit price bid per linear foot of trench filled regardless of trench depth and/or pipe sizes unless indicated otherwise by plans or contract.

SECTION 02271 - ROCK RIPRAP

1. GENERAL

Rock riprap shall be furnished and installed to the lines, grades, and dimensions as indicated on the plans for the slopes and berms of the embankments.

2. MATERIAL

Material is to consist of individual fragments, dense, sound, resistant to abrasion and free of cracks, seam or other defects which would tend to increase unduly their destruction by water and frost actions. Material is to meet the following requirements:

2.1 Minimum weight per cubic foot, not less than one hundred forty (140) pounds when tested in accordance with A.S.T.M. Standard C-127.

2.2 Loss after ten (10) cycles of freezing and thawing to be less than fifteen percent (15%) when tested in accordance with AASHTO Designation T-103.

2.3 Broken concrete may be used in lieu of stone, unless otherwise noted on the plans, provided that it is sound and durable and meets the above requirements for size. Trim exposed reinforcement to the surface of broken concrete. Large flat pieces and long sections of curb will not be acceptable.

2.4 The material shall have the following gradation:

TABLE 12b SIZE REQUIREMENTS FOR ROCK RIPRAP

Percent Retained on Sieve Size

*wrong table*

D50	12"	10"	9"	8"	6"	5"	4"	3"	2"	1"	1/2"	#4
1"								0	0	35/75	75/90	95/100
2"						0	0/25	10/40	35/65	80/100		
3"					0	0/30	15/50	30/70	50/90	95/100	95/100	
4"				0	0/40	15/150	30/70	45/80	80/100	95/100		
5"		0		15/35		35/65		70/95	85/100			
6"	0		20/40		30/70		65/85	80/100	90/100			

3. PLACEMENT

Rock Riprap shall be a carefully placed layer of rock 12 inches thick on a layer of sand and gravel bedding 6 inches thick. Rock riprap may be placed below water providing it is placed by skip or another approved method which will prevent segregation. Stone riprap shall be placed on a prepared 6" subgrade, unless otherwise noted on the plans, so as to produce a reasonably well-graded mass with a minimum practicable percentage of void. Stone riprap shall be placed to its full course thickness in one



operation without displacing the bedding. Placing rock riprap by dumping into chutes or any other method likely to cause segregation will not be permitted. Placement of stone on the slope and in toe trenches shall be accomplished by controlled dumping directly in place. Bulldozing of stone from the upper banks will not be permitted. Use of a drag line or similar equipment operated from the top of the bank to pull stone into position on the upper slope will be permitted. Larger stones should be well distributed and the entire mass of stones in their final position should be stable and free of pockets of small stones and clusters of larger ones; rearrangement of individual pieces by hand may be required to obtain the results described above. A tolerance of plus six (6) inches from the lines and grades shown on the plans will be allowed in the finished rock riprap surface, except that the extreme tolerance should not be continuous over an area greater than 200 square feet.

#### 4. GROUTED ROCK RIPRAP

Grouted rock riprap material shall be the same as rock riprap. This riprap shall be grouted to the limits shown on the plans or as directed by the engineer. Some hand placing of riprap stones shall be necessary to produce reasonably true surfaces and a close fit of stones. The spaces between the stones shall be filled with Type III concrete with sufficient water to form a plastic mix. The grout shall be poured and broomed into the spaces until they are completely filled.

## SECTION 02400 - DRAINAGE

### 1. DEWATERING

1.1 General: Water encountered during trenching or excavating operations shall be removed or lowered by means of the following dewatering systems which will permit preparation of a satisfactory pipe bed or structural subgrade, free from water.

1.2 Well Points and Pumps: This dewatering system requires the installation of well points and pumps, connecting pipelines and continuous operation in order to permit preparation of a satisfactory pipe bed or structural subgrade.

1.3 Cased Wells and Pumps: This dewatering system requires the use of individually cased wells and pumps, connecting pipelines and continuous operation in order to permit preparation of a satisfactory pipe bed or structural subgrade.

1.4 Discharge: Water from dewatering operations shall be discharged into the drainage ditches adjacent to the sites.

1.5 Permits: The contractor shall be responsible to obtain all permits required for dewatering.

## SECTION 02485 - SEEDING, SPRIGGING AND SODDING

### 1. GENERAL

This work shall consist of the furnishing and planting of seed, sprigs, and/or sod at locations in reasonable conformity with those shown on the Plans or designated by the Engineer and in accordance with these Specifications. The work shall include the preparation of the ground for the planting, fertilizing and mulching, and watering as specified.

### 2. MATERIALS

2.1 Seeds. The Contractor shall provide grass seed of the variety and at the rates as required to produce the live seed rates shown below or as specified on the Plans. The vendor's certified statement for each species of grass and grass mixture stating each variety, percentage by weight, and percentages of purity, germination, and weed seed shall be furnished. Live seed for each grass species is the product of the percentage of purity and the percentage of germination.

The seed shall be new-crop seed complying with and labeled in accordance with U.S. Department of Agriculture "Rules and Regulations under the Federal Seed Act" in effect at date of purchase of seed. All seed shall be furnished in standard containers. Seed which has become moldy, wet, or otherwise damaged in transit or storage shall not be accepted.

A certificate shall be furnished to the Engineer showing the date that the seed was treated. The treated seed shall be planted within twenty-four (24) months after treatment and any treated Buffalo grass seed held by the Contractor or supplied beyond this period shall not be used.

The seed shall be stored in a cool dry place until seeding time. Seed application rate of 8 pounds per 1,000 square feet/K-31 Fescue.

2.2 Sprigs. Sprigs shall be of the grass species specified on the Plans, and shall be healthy, living stems and roots freshly harvested without adhering soil or weeds and obtained from heavy, vigorous growing and mowed turf. After loosening sprigs from the soil, they shall be immediately gathered in piles or windrows and kept moist until planted.

2.3 Sod. Sod shall be of the species and of the size as specified on the Plans. Sod shall be strongly rooted, free of weeds and undesirable grasses, not less than 2 years old, and free of disease. Turf shall be mowed to approximately 2 inches, the sod freshly cut and obtained from areas having similar climatic conditions as the project site. The sod shall have a thickness of 2 to 3 inches, and shall be kept moist until planted.

construction site may be grassed at different periods of time provided that the planting occurs in proper seasons as specified. Any grassed areas damaged by subsequent operations of the Contractor shall be replanted as directed by the Engineer at no additional cost to the Owner.

**3.2 Tillage.** The areas required to be grassed shall be prepared for planting by cultivation, removal of all objectionable material, and filling of gullies or depressions. The soil preparation shall be accomplished by disking, harrowing and firming. (Plowing will also be required if so indicated on the Plans.) The minimum depth of soil preparation shall be three (3) inches. Existing weed stubble, small weeds and grass that can be disked shall be cut by the disk and partially incorporated into the soil. Several diskings and harrowings over some areas may be required to provide a satisfactory seedbed. Areas too steep or otherwise inaccessible for disking shall be prepared by hand methods. The minimum depth of preparation of the seedbed where hand methods must be employed shall be two (2) inches. Disking, harrowing and raking shall be done longitudinally on slope areas.

The soil preparation on all slope areas shall be performed with disks and harrows unless demonstration shows such methods impracticable and that hand methods must be used.

During the process of soil preparation, extreme care shall be exercised to avoid injury to all trees that have been planted or designated by the Engineer to be saved.

The Engineer may designate local areas of desirable native perennial grasses to be omitted during the soil preparation. Areas of annual grasses such as cheat, crab grass, triple-awn, etc., shall be destroyed by thorough disking prior to seeding.

**3.3 Application of Fertilizer.** Fertilizer shall be distributed uniformly at rates shown in Section 2.4 and over the area to be planted, and shall be incorporated into the soil to a depth of at least 2 inches by disking, harrowing or other methods approved by the Engineer. Distribution by means of an approved seed drill or hydro seeder equipped to sow seed and distribute fertilizer at the same time will be acceptable unless otherwise noted on the Plans.

Additional soil conditioners shall be mixed into the soil by disking, harrowing, etc., when specified on the Plans, or as directed by the Engineer and furnished by the Owner.

#### **4. SEEDING**

**4.1 Time of Seeding.** The two general seeding seasons shall be (1) Spring Seeding Season, February 15 to April 20, and (2) Fall Seeding Season, August 15 to September 30. The permissible seeding periods for various seeds may be extended a few days in special cases when mulching is specified to follow the drilling of seeds and fertilizer.

The Engineer reserves the right to delay the drilling or seeding of any seeds or to vary the permissible seeding seasons listed above due to weather or soil conditions or for other causes.

**4.2 Seed Application.** Seeds shall be uniformly distributed with acceptable drills, hydraulic-slurry, or other equipment approved by the Engineer. Broadcasting with a standard grass seeder will be required on areas where it is impossible to operate a drill and this method may also be required for certain small seeds.

When a standard drill with fertilizer attachment is used, certain mixed seeds may be placed in the seed box and the fertilizer placed in the fertilizer compartment. Both may be applied during one (1) operation, unless notes on the Plans require separate applications. Fertilizer may be drilled into the soil or applied by hydraulic-slurry. Broadcasting fertilizers is permissible on rough, rocky slopes where drills cannot operate.

All drills shall be fully adjustable so that they will deliver the seeds and fertilizer at the rates specified on the Plans or ordered by the Engineer. Drills that are in poor repair or that do not deliver the seeds and fertilizer uniformly in each drill furrow, shall not be used. Drills shall be adjustable so that the seeds can be planted and covered a maximum depth of 1/2 inch.

Most of the seeds should be drilled about one-half (1/2) inch deep in a well-prepared and firm seedbed. When the fertilizing and seeding operations start on an area, that area shall be completed as soon as possible. No seeding shall be done during windy weather or when the ground is wet or otherwise non-tillable. The grass seed shall then be covered, using a flexible toothed weeder or other suitable equipment. As soon as this covering operation has been completed, the seeded area shall be rolled again with the Culti-packer, the Culti-packer being run over the area only once parallel with the contours of the ground.

Kentucky bluegrass, Bermuda grass and seeds of similar size shall not be mixed with the coarse types of seeds. The finer seeds may be planted with certain drills by removing the seed tubes or they may be broadcast with hand seeders. Broadcast seeding shall be done when the weather is reasonably calm so that the seed will lodge on the prepared seed bed areas.

#### **4.3 Mulching.**

- (1) **Applying Hay Mulch** - Hay mulch shall be the required mulching material, unless specified otherwise on the Plans or directed by the Engineer. After seeding operations are complete the mulch shall be spaced uniformly by hand, manure spreader, or other suitable equipment. The mulch shall be anchored to the soil by a V-type

wheel land packer, a disk harrow set to cut slightly, or other suitable equipment which will secure the mulch firmly into the ground 2 inches or more to form a soil-binding mulch and prevent loss or bunching by wind. Spacing between disks shall not exceed 8 inches. Apply hay mulch at the rate of 2 tons per acre or 90 lbs. per 1000 sq. ft.

- (2) Applying Asphalt Mulch - Asphalt mulch shall be used only on very sandy soils and shall not be used unless specified on the Plans or directed by the Engineer. Emulsified asphalt may be diluted with additional water, when permitted by the Engineer, and applied with approved distributing equipment. The asphalt shall be applied to all areas regardless of slope and the rate of application shall provide a bituminous residual of not less than 0.12 gallons per square yard after loss of water.
- (3) Applying Wood Cellulose Fiber Mulch - Wood cellulose fiber mulch may be used in lieu of hay mulch, when the Contractor elects to use a hydro seeder and the method is approved by the Engineer. Wood cellulose fiber mulch shall be applied at the minimum rate of 2000 pounds per acre, unless specified otherwise.

4.4 Watering. The Contractor shall water the seeded areas as required to assure an acceptable stand of grass.

## 5. SPRIGGING AND SODDING

5.1 Time of Planting. Cool weather grasses such as bluegrass, fescue, etc. and including Buffalo grass shall be planted in either the spring or fall seasons with periods limited to March 1 to June 15 and September 1 to November 30, except that the spring season can be extended to June 30 for Buffalo grass.

Warm weather grass such as Bermuda grass, etc. shall be planted between April 1 and August 15, except that sprigs shall be planted between April 15 and June 15.

5.2 Planting. The areas to be sodded or sprigged shall be watered prior to planting when the ground is excessively dry.

- (1) Sprigging - Grass sprigs of the variety and spaced as shown on the Plans shall be established by setting root divisions in furrows two (2) inches deep, parallel to the contours, and the roots placed so that they lie end to end in the furrow. The roots shall be covered approximately one (1) inch deep, thoroughly watered and firmed. The furrows shall be left partly open to facilitate additional watering and to hold any mulch applied on slope areas.

Firming shall be done with an approved type roller, so that the top of the sprigs will be slightly below the surrounding surface after the firming process is completed.

- (2) Sodding - Grass sod shall be established by means of setting plugs or strips of sod in the soil. The Plans will show the size of plugs and/or the width of strips required and the required spacing of plugs or strips. Excavation shall be made for each plug or strip so that after tamping, the sod will be flush with the final grade. All plugs or strips shall be firmly tamped and thoroughly watered. After placing, all sods shall be firmed by use of an approved roller, a tamper or other approved methods. On steep slopes the sod may be firmed by compacting with hand shovels. The firming process shall remove all air pockets and shall pack the sod roots firmly into the prepared soil.

On steep slopes, staking of plugs or strips may be required as shown on the Plans or as directed by the Engineer. Stakes shall be of lath or similar materials and shall be driven six (6) inches into the ground, leaving approximately one-half (1/2) inch of the top above the sod line.

### 5.3 Watering.

- (1) Sprigged Areas - Sprigged areas shall be kept thoroughly watered for twenty (20) days. Immediately following, the Contractor shall cultivate all areas between the sprigs with hand tools, to kill all weed growth and leave the soil loose and friable. At the time of cultivating, areas that do not have a satisfactory stand of grass shall be replanted as directed by the Engineer.
- (2) Sodded Areas - The Contractor shall water all sods immediately after placing. All sodded areas shall be kept thoroughly watered by the Contractor for twenty (20) days after laying and as often as required thereafter until completion of other items of work in the Contract.

## 6. PROTECTION AND MAINTENANCE.

The grassed area shall be protected against traffic or other use immediately after planting. The Contractor shall be responsible for the proper care of the grassed area until all work on the entire contract has been completed and accepted, or a minimum period of 30 days, whichever is the longest duration. The Contractor will be relieved from watering grassed areas accepted by the Engineer and the Owner.

All planted areas shall be growing when accepted. Areas not showing a stand of grass or evidence of growth shall be replanted in accordance with these specifications. All costs in connection with replanting grassed areas shall be borne by the Contractor until an acceptable stand of grass is obtained, with no additional cost to the Owner.



## SECTION 02510 - SUBGRADE TREATMENT - FLY ASH

### 1. GENERAL

1.1 Related Documents: General Conditions and Supplementary Conditions apply to this Section.

1.2 Description Of Work: This section covers fly ash treatment of subgrade for pavings called for on the drawings, and as specified herein.

1.3 Compaction Control: Make a minimum of one field density for each 2000 square feet per each lift of fill. Recompact deficient areas as directed by Engineer.

1.4 Reference Standard: Kansas Department of Transportation (KDOT) 1990 edition of "Standard Specifications for State Road and Bridge Construction", referred to hereinafter by basic designation, form a part of this specification to extent indicated by reference thereto. Delete "Basis of Payment" since this is a lump sum contract.

### 2. MATERIALS

2.1 Water: As specified in Kansas Department of Transportation Standard Specifications.

2.2 Fly Ash: Fly ash shall be Class "C" as defined in ASTM C618, Section 32. For Fly Ash equipment, blending of the Fly Ash with subgrade soils shall be accomplished using a pulvi-mixer or similar equipment capable of thoroughly blending the Fly Ash with the materials to be stabilized.

### 3. EXECUTION

3.1 Equipment: Equal to that specified in Kansas Department of Transportation Specification. Type approved, prior to use, for capability of equipment to perform acceptable work.

3.2 Installation: Paving: After cuts and fills are made, prepare, treat and compact upper 6-inches in accordance with Kansas Department of Transportation Standard Specifications with approximately 13% to 16% Class "C" Fly Ash in accordance with Sedgwick County, Kansas Special Provision to the Standard Specifications Addition 1980, Section titled "Fly Ash Modified Subgrade". The exact content of Fly Ash shall be determined by laboratory tests on in place materials.

## SECTION 02512 - LIME TREATED SUBGRADE

### 1. GENERAL

Work performed under this Section consists of constructing one or more courses of a mixture of soil, water, and hydrated lime or pebble quicklime in accordance with the lines, grades, thicknesses and typical sections shown on the Plans or established by the Engineer. Equipment, construction requirements, and materials shall be in accordance with Division 150, Subsection 151 - Equipment; Division 300, Subsection 305 - Lime Treated Subgrade; and Materials Division 1000, Subsection 2002 - Hydrated Lime or Materials Division 1000, Subsection 2003 - Pebble Quicklime; Division 1000, Subsection 2402 - Water and Division 1000, Section 2600 - Materials Certifications respectively; of the Standard Specifications for State Road and Bridge Construction, Kansas Department of Transportation, 1990 Edition (hereinafter referred to as Standard Specifications), except as supplemented or amended herein.

### 2. EXCAVATION

See Section 02201 "Earthwork - Streets".

### 3. MATERIALS

#### 3.1 Lime:

- (1) Hydrated Lime - Subsection 2002 of Standard Specifications, except delete 2002.03(c) and 2002.04.
- (2) Quicklime - Pebble - Subsection 2003 of Standard Specifications, except delete 2003.03(c) and 2003.04.
- (3) Water - Subsection 2402 of Standard Specifications.

### 4. CONSTRUCTION REQUIREMENTS

The rate of application for any type of lime shall be as directed by the Engineer and shall be determined by soil tests performed by an approved laboratory. The Contractor shall pay all costs for sampling and laboratory testing of all soils to be treated. The job shall have a single type and source of lime, unless otherwise permitted by the Engineer. The unit price bid in the proposal for the six inch lime treated subgrade shall be based on a lime application rate of  $3.5\% \pm 0.5\%$ .

The actual rate of lime application will be adjusted as required by the above specified testing. No adjustment will be made in the unit price bid per square yard of lime treated subgrade for any increase or decrease in lime application rates within the range given above.

4.1 Compaction. Delete the entire Article 305.03 (h) and add the following:

- (1) After the materials have satisfactorily mixed, aged, and re-mixed, the mixture shall be laid and compacted to at least 95 percent of Modified Proctor Density in accordance with ASTM D-1557. Light sprinkling with water during laying operations may be required to keep the moisture content a minimum of 2% above optimum. Compaction shall be accompanied with sufficient blading to eliminate all irregularities.

5. DELETE THE ENTIRE ARTICLE 305.04 - METHOD OF MEASUREMENT

6. DELETE THE ENTIRE ARTICLE 305.05 - BASIS OF PAYMENT

## SECTION 02513 - ASPHALTIC CONCRETE PAVING

### 1. GENERAL

Work performed under this section consists of bituminous material to be placed on the prepared subgrade in conformance with the lines, grades, thicknesses, and typical sections shown on the Plans or established by the Engineer. Materials, equipment, and construction requirements shall be in accordance with Division 1200 Materials Details, and Division 600, Section 601 Equipment, Section 602 Asphalt Application Temperatures, and Section 603 Plant Mix Bituminous Construction, of the Standard Specifications for State Road and Bridge Construction, Kansas Department of Transportation, 1990 Edition, except as supplemented herein.

### 2. MATERIALS

2.1 Aggregates: Aggregates for the bituminous mixture shall be following types for each course:

- (1) Bituminous Sub-Base and Bituminous Base  
Aggregates shall be BM-4. *see 0112*
- (2) Asphaltic Concrete Wearing Surface  
Aggregates shall be BM-2.

2.2 Bituminous Material:

- (1) Bituminous materials for base courses shall be Type AC-20. Bituminous materials for the wearing surface shall be Type AC-20.
- (2) Bituminous materials for tack and priming of contact surfaces of gutters, etc., shall be emulsified asphalt Types SS-1H or CSS-1H.
- (3) Certified test reports of bituminous material in current production or stored in tanks shall be submitted to the Engineer for approval.

### 3. CONSTRUCTION REQUIREMENTS

3.1 Job Mix Design: The job mixes for each type of bituminous mixture shall be designed by Marshall tests and submitted to the Engineer for approval.

- (1) Bituminous Base shall meet the following requirements:

Stability (min.)	1000
Flow	0.05 to 0.12
% Voids	3 to 7
% Voids Filled	70 to 80

- Minimum asphalt content shall be 4.5 percent of the dry weight of the aggregates.

- (2) Asphaltic Concrete Wearing Surface shall meet the following requirements:

Stability (min.)	1500
Flow	0.05 to 0.12
% Voids	3 to 7
% Voids Filled	70 to 85

Minimum asphalt content shall be 4.3 percent of the dry weight of the aggregates.

- (3) Certified Marshall test reports of bituminous materials in current production may be submitted to the Engineer for approval and the job mix designs waived if the certified material is acceptable.

### 3.2 Surface Preparations:

- (1) Subgrade Surface - The subgrade surface shall be maintained by the Contractor and shall not be excessively dry or wet prior to placing of bituminous mixture. No asphalt priming of the subgrade surface will be required, but moistening of the surface will be required when directed by the Engineer.
- (2) Bituminous Base Surfaces Bituminous Base Surfaces shall be free of any foreign matter or moisture prior to placing of any additional courses of bituminous material. When in the opinion of the Engineer a tack coat is required, the entire bituminous surface shall be tacked at the rate of 0.1 gallon per square yard prior to placing of the next course of bituminous material.

4. DELETE ENTIRE ARTICLE 603.03 (k) MAINTENANCE OF TRAFFIC
5. DELETE ENTIRE ARTICLE 603.08 METHOD OF MEASUREMENT
6. DELETE ENTIRE ARTICLE 603.09 BASIS OF PAYMENT

**SECTION 02514 - REINFORCED CRUSHED ROCK BASE**

1. **GENERAL:** This item shall consist of hauling, furnishing, placing, and compacting crushed rock at locations shown on the plan and in conformance with the typical sections as detailed. The work shall also include the furnishing and installation of geogrid reinforcement.

2. **MATERIALS:**

- a. **Crushed Rock.** Crushed Rock shall comply with the quality requirements of aggregate for aggregate base construction as specified in Section 1105 of the "Standard Specifications for State Road & Bridge Construction", Kansas Dept. of Transportation, 1990 Edition. Absorption shall not exceed 4%. Gradation of crushed rock shall be as follows:

Sieve	1-1/2"	3/4"	#4	#40	#200
% Retained	-	20-60	50-80	80-94	90-98

- b. **Crushed Concrete.** At the CONTRACTOR'S option, crushed concrete may be used in lieu of crushed rock. The absorption requirement does not apply. All other quality requirements and gradation shall be the same as that specified for crushed rock.
- c. **Geogrid Reinforcement.** Geogrid reinforcement shall be BX 1100 by Tensar Corporation or approved equal. The geogrid reinforcement shall be a regular grid structure formed by biaxially drawing a continuous sheet of select polypropylene material and shall have aperture geometry and rib and junction cross-sections sufficient to permit significant mechanical interlock with the material being reinforced. The geogrid shall have high flexural rigidity and high tensile modulus in relation to the material being reinforced and shall also have high continuity of tensile strength through all ribs and junctions of the grid structure. The geogrid shall maintain its reinforcement and interlock capabilities under repeated dynamic loads while in service and shall also be resistant to ultraviolet degradation, to damage under normal construction practices and to all forms of biological or chemical degradation normally encountered in the material being reinforced.

The geogrid shall also conform in all respects to the property requirements listed below.

PROPERTY	TEST METHOD	UNITS	VALUE
<b>INTERLOCK</b>			
Aperture Size <sup>1</sup>	I.D. Calipered <sup>2</sup>		
MD		in	1.0 (nom)
CMD		in	1.3 (nom)
Open Area	COE Method <sup>3</sup>	%	70 (min)
Thickness	ASTM D 1777-64		
ribs		in	0.03 (nom)
junctions		in	0.11 (nom)
<b>REINFORCEMENT</b>			
Flexural Rigidity	ASTM D 1388-64 <sup>4</sup>	mg-cm	250,000 (min)
<b>Tensile</b>			
-modulus	GRI GG1-87 <sup>5</sup>	lb/ft	13,500 (min)
-@2% strain	GRI GG1-87 <sup>5</sup>	lb/ft	270 (min)
-@5% strain	GRI GG1-87 <sup>5</sup>	lb/ft	540 (min)
-ultimate strength	GRI GG1-87 <sup>5</sup>	lb/ft	850 (min)
Junctions	GRI GG2-87 <sup>6</sup>		
strength		lb/ft	750 (min)
efficiency		%	90 (min)
<b>MATERIAL</b>			
polypropylene	ASTM D 4101	%	98 (min)
	Group 1/Class 1/		
	Grade 2		
carbon black	ASTM 4218	%	0.5 (min)

**NOTES:**

1. MD dimension is along roll length. CMD dimension is across roll width.
2. Maximum inside dimension in each principal direction measured by calipers.
3. Percent open area measured without magnification by Corps of Engineers method as specified in CW 02215 Civil Works Construction Guide, November 1977.
4. ASTM D 1388-64 modified to account for wide specimen testing as described in Tensar test method TTM-5.0 "Stiffness of Geosynthetics".
5. Secant modulus at 2% elongation measured by Geosynthetic Research Institute test method GG1-87 "Geogrid Tensile Strength". No offset allowances are made in calculating secant modulus.
6. Geogrid junction strength and junction efficiency measured by Geosynthetic Research Institute test method GG2-87 "Geogrid Junction Strength".

3. **CONSTRUCTION REQUIREMENTS:** Where shown on the plans, Geogrid reinforcement shall be installed directly on the subgrade and shall be installed in accordance with the manufacturer's recommendations.

The crushed rock base shall be placed and graded so that the material is uniform and segregation is minimal. The crushed rock base shall be compacted with a smooth steel roller until material is dense and to grade.



## SECTION 02515 - COMBINED CURB & GUTTER, VALLEY GUTTER AND MISCELLANEOUS

### 1. GENERAL.

Work under this Section includes the construction of combined curb and gutter, edge curb in conjunction with valley gutter, entrances, slope drains, flumes, sidewalks, handicap ramps and inlet connections when called for on the plans or where directed by the Engineer. All concrete items shall conform to the shape and dimensions as detailed and to the lines and grades as shown on the plans. The dimensions shown are to the face of curbs unless specifically indicated otherwise.

### 2. EXCAVATION AND COMPACTION.

See Section 02201 "Earthwork Streets". Excavation and compaction shall be as shown on the plans and shall be wide and deep enough to accommodate any subgrade treatment. Unless otherwise indicated on the plans, the minimum subgrade treatment for combined curb and gutter, valley gutters, and entrances within public right-of-way shall be 6 inches of compaction Type B. No concrete will be placed on frozen subgrade, and all subgrade exposed to frost action or excessive moisture shall be recompacted when directed by the Engineer.

### 3. MATERIAL.

3.1 Concrete. See Section 03010 "Concrete Work". Concrete shall be Class I (AE), unless otherwise indicated on the plans.

#### 3.2 Concrete Reinforcement.

3.1.1 Steel Reinforcing Bars - Steel reinforcing bars, unless otherwise specified or noted, shall be in accordance with ASTM A615, Grade 40 billet steel. The size, length, and shape shall be as shown and detailed in the plans. Each shipment of billet steel reinforcement bars used on the project shall be tagged and identified for their corresponding mill test reports. Mill test reports shall indicate the steel process, chemical, and physical properties, and shall be certified by the manufacturer and furnished by the Contractor.

3.2.2 Welded Wire Fabric - Welded wire fabric shall be in accordance with ASTM A185 and shall conform to the size and dimensions shown on the Plans.

3.3 Expansion Joint Filler. Expansion joint filler material shall be pre-formed meeting the requirements of Subsection 1503, Type B, of the Standard Specifications for State Road and Bridge Construction, Kansas Department of Transportation, 1990 Edition. Joint filler shall be of the thickness indicated and shall conform to the shape of sections shown in the Plans.

3.4 Joint Sealing Compound. Joint sealing compound shall conform to the requirements of Subsection 1502, Cold Type Joint Sealing Compound, of the Standard Specifications for State Road and Bridge Construction, Kansas Department of Transportation, 1990 Edition or as otherwise shown on the plans.

#### 4. CONSTRUCTION METHODS.

4.1 General. Concrete items shall be constructed to the detailed thicknesses and to the lines and grade as shown on the plans. Concrete shall be placed over moistened and unfrozen subgrade and when the ambient temperature is 40°F or greater and rising. The subgrade shall be void of excessive moisture. If required by the Plans, the concrete shall be reinforced with the type of reinforcement indicated and the reinforcement shall be secured and tied in place prior to depositing any concrete.

4.2 Forms. Forms shall be set for the full depth of the section with the proper shape and strength to support any equipment and concrete placing operations. Forms shall be set to line and grade with adequate devices to secure them without visible spring or settlement from vibrations during the consolidating and finishing of the concrete. Flexible or curved forms shall be of a design acceptable to the Engineer for use on irregular shaped areas and true circular curves. Forms shall be checked for line and grade immediately before placing the concrete and shall not deviate from true line by more than one-fourth inch at any point.

Forms shall be thoroughly cleaned and oiled each time they are used. Builtup, battered, twisted, warped or broken forms shall be removed from the work. Steel forms shall have square ends connected with a rigid lock joint. Curved, flexible or wood forms shall be used on the returns.

4.2.1 Combined Curb and Gutter The Contractor may use a slip-form paver and mechanical finisher in lieu of the forms and metal screed specified for combined curb and gutter. The slip-form paver shall be capable of molding and satisfactorily compacting the concrete to cross section, line and grade. The machine shall be self-propelled and of such weight and traction to maintain straight neat lines.

**4.3 Placing Concrete.** The concrete shall be deposited on the subgrade in successive batches for the full width between forms and in a manner which will require as little rehandling as possible. Necessary hand spreading shall be done with shovels, not rakes. Workmen shall not be allowed to walk over the freshly mixed concrete without use of bridges or other approved means. The amount of material deposited shall be sufficiently in excess of that required to form the required cross section after consolidation in order to provide a roll of concrete ahead for the full length of the screed.

Concrete shall be thoroughly consolidated against and along the faces of all forms and along the full length and on both sides of all expansion joint assemblies, by means of vibrators inserted in the concrete.

Concrete shall be deposited as near to expansion and contraction joints as possible without disturbing them, but shall not be dumped from the discharge bucket or hopper onto a joint assembly unless hopper is well centered on the joint assembly.

Should any concrete material fall on or be worked into the surface of a completed slab, it shall be removed immediately by approved methods.

**4.4 Joints.** All joints shall be constructed at the locations and to the types as detailed and shown on the plans, unless directed otherwise by the Engineer. Failure to construct the joints called for in the best possible manner will be cause for suspension of work until the cause of the defective work is remedied.

**4.4.1 Contraction Joints** - Sawed joints shall be sawed after the concrete has hardened sufficiently to prevent tearing and ravelling, but before the pavement starts shrinking and cracking. Saw cuts will be straight and uniform with a minimum depth of one-fourth the section thickness and shall be in alignment with adjacent previously sawed joints. After the joint has been sawed, it shall be cleaned with air or water jets and the curing period shall be continued.

**4.4.2 Construction Joints** - All construction joints shall be sawed along the abutting previously poured edge as described above for contraction joints, except that the depth shall be one inch or as detailed on the plans.

**4.4.3 Expansion Joints** - Expansion joints shall be constructed as shown on the plans. When not indicated on the Plans, expansion joints shall be placed between curb and gutter blocks at the tangent point of all curves, each side of inlets, at alleys, and at intervals of not more than 250 feet in straight runs. Expansion joints shall be cut to full size and shape of the cross section of the curb and gutter less one-half inch from the finished surface thereof. The edges of the blocks against the joint shall be finished with an edging tool and the joint raked clean of concrete.

4.4.4 Joint Sealer - After the specified curing period, the faces of all joints to be sealed shall be thoroughly cleaned, using compressed air, sweeping, brooming or other methods approved by the Engineer. The faces of the joint shall be dry after being thoroughly cleaned, and filled with joint sealing compound using a nozzle designed to completely fill the joint.

Joints shall be filled to within 1/4" of the top surface, but in no case shall they be overfilled. Upon completion of the joint sealing operations, all excess material and foreign material shall be removed from the concrete surface.

4.5 Finishing. After final screeding is completed, the surface shall be floated in a longitudinal direction and then tested with a ten (10) foot straightedge. All high and low places shall be corrected by wood floating operations until no irregularities exist.

4.5.1 Valley Gutter - The concrete surface shall then be textured in a transverse direction by the use of fiber brooms, canvas or rubber belting. Care shall be exercised in preserving the pavement surface by not digging into concrete pavement. Final concrete belting or brooming shall be adjusted until the texture is uniform and meets approval of the Engineer.

4.5.2 Combined Curb and Gutter - Where forms are used for placement of combined curb and gutter, there shall be provided on the job a metal screed or mule designed to give proper shape to the curb and gutter. It shall be bent to the exact shape of the finished curb and gutter and the forward edge shall be turned up slightly to prevent disturbing the concrete. It shall be designed to ride on the forms, and when properly manipulated, shall leave the face of the curb and gutter in its proper shape and condition.

A gooseneck or "S" trowel shall be used to finish the surface, and minor imperfections shall be corrected with a mason's trowel. A medium broom finish shall be applied to the face of all curbs. Care shall be taken to finish the gutter flow line to a true uniform grade.

4.5.3 Integral (Monolithic) Curb - When shown on the plans, integral curb will be placed immediately after finishing of the concrete pavement. Integral curb shall have joints at all locations to match the joints of the adjoining pavement. A medium broom finish shall be applied to the face of curbs as specified above.

4.5.4 Inlet Hookup - The entire concrete surface shall receive a trowel finish. A gooseneck or "S" trowel shall be used to finish the curb sections. Minor imperfections shall be corrected with a mason's trowel. A medium broom finish shall be applied to the face of curbs.

4.6 Curing. Curing shall be as required in the Section "Concrete Work" and as approved by the Engineer.

4.7 Surface Tolerances. The concrete pavement and gutter flowlines after hardening shall be tested with a 10-foot straightedge. All areas showing surface deviations in excess of 1/4 inch shall be ground down with an approved grinding tool until the deviations are 1/4 inch or less. Where departure from the correct cross sections exceeds 1/2 inch, the pavement shall be removed and replaced by the Contractor at his own expense when directed by the Engineer. Any area so removed and replaced shall be for the full width and a minimum of ten feet in length or between joints. If the remaining portion of the slab is less than 10 feet to the nearest joint, it shall also be removed and replaced.

## 5. ENTRANCES

5.1 Drive Entrances. Drive entrances for residences or commercial establishments, other than as shown on the plans, are not a part of this project. Any such construction shall be by private arrangement between the Contractor and the property owner.

5.2 Private Drives. Private drives outside of the public right-of-way are not a part of this work. All such construction shall be a private arrangement between the Contractor and the Property Owner.

## SECTION 02521 - SIDEWALKS AND WHEELCHAIR RAMPS

### 1. GENERAL

Work under this Section includes the construction of concrete sidewalks and wheelchair ramps when called for on the plans or where directed by the Engineer. All concrete items shall conform to the shape and dimensions as detailed and to the lines and grades as shown on the plans.

### 2. MATERIALS

2.1 Concrete: See Section 03010 "Concrete". Concrete shall be Class I (AE), unless otherwise indicated on the plans.

2.2 Expansion Joints: Expansion joints shall be precast asphalt one-half inch in thickness.

### 3. CONSTRUCTION

3.1 Sidewalks: Sidewalks shall be four inches in thickness and must be cut through into squares not to exceed five feet. Sidewalk not cut completely through will not be accepted.

Sidewalk shall slope one inch to each four feet in width away from the property line, unless otherwise directed by the Engineer. Expansion joints one-half inch in width shall be constructed approximately every twenty-five feet and wherever the sidewalk joins a curb. Additional expansion joints shall be required where the sidewalk adjoins concrete parking lots, concrete driveways, or where the width of the sidewalk is to be greater than five feet, they shall be placed as directed by the Engineer.

The concrete shall be thoroughly tamped after being placed in the forms, giving special attention to the edges and corners of blocks or slabs so that there is no honeycomb in the concrete and the entire mass is well consolidated. The surface must be trowled followed by a light fiber broom finish transversely to construction. All outside edges and joints shall be edged with a one-quarter inch edging tool.

3.2 Wheelchair Ramps: Wheelchair ramps shall be constructed in conformance with the wheelchair ramp detail as shown on the plans. The same construction methods (concrete mixing, tamping, troweling and finishing) for wheelchair ramps will be the same as those utilized for sidewalk construction.

## SECTION 02522 - CONCRETE PAVEMENT

### 1. GENERAL

Work under this Section includes construction of concrete pavement and integral curb. All concrete items shall conform to the shape and dimensions as detailed and to the lines and grades as shown on the plans.

### 2. EXCAVATION AND COMPACTION

See Section 02201. Excavation and compaction shall be as shown on the plans and shall be of adequate width and depth to accommodate the required subgrade treatment. No concrete shall be placed on frozen subgrade and all subgrade exposed to frost action or excessive moisture shall be recompacted when directed by the Engineer.

### 3. MATERIALS

3.1 Concrete. See Section 03010. Concrete for pavement and integral curb shall be Class I (AE).

#### 3.2 Concrete Reinforcement.

3.2.1 Steel Reinforcing Bars and Dowel Bars shall be ASTM A615, Grade 40 billet steel unless otherwise specified or noted. The size, length and shape of the reinforcing bars shall be as shown and detailed on the plans. Each shipment of reinforcing bars used on the project shall be tagged and identified for their corresponding mill test report. Mill test reports, certified by the manufacturer, shall be furnished to the Engineer by the Contractor and shall show the chemical and physical properties of the steel along with the process used in its manufacture.

3.2.2 Welded Steel Wire Fabric shall conform to the requirements of ASTM A185. Fabric shall conform to the size and dimensions shown on the Plans. The Contractor shall furnish a Certification, from the supplier, to the Engineer, stating material compliance with the Plans and specifications.

3.3 Expansion Joint Filler shall be preformed meeting the requirements of Subsection 1503, Type B, of the Standard Specifications for State Road and Bridge Construction, Kansas Department of Transportation, 1990 Edition. Joint filler shall be of the thickness indicated and shall conform to the shape shown on the plans.

**3.4 Joint Sealing Compound** shall be Hot Type, Cold Type, or Silicone Joint Sealant as detailed on the plans. Materials furnished shall meet the requirements stated below and will be accepted on the basis of a certification by the manufacturer, furnished to the Engineer by the Contractor, stating that the materials meet the applicable specifications.

**3.4.1** Hot type sealant materials shall comply with the requirements of Subsection 1501 of the Standard Specifications for State Road and Bridge Construction, Kansas Department of Transportation, 1990 Edition.

**3.4.2** Cold Type sealant material shall comply with the requirements of Subsection 1502 of the Standard Specifications for State Road and Bridge Construction, Kansas Department of Transportation, 1990 Edition.

**3.4.3** Silicone Joint Sealant materials shall comply with the requirements of Subsection 1507 of the Standard Specifications for State Road and Bridge Construction, Kansas Department of Transportation, 1990 Edition.

**3.4.3.1** Backer Rod for use with Silicone Joint Sealant shall be a resilient closed cell polyethylene foam rod as recommended by the manufacturer of the sealant. It shall be compatible with the silicone sealant and no bond or reaction shall occur between the rod and the sealant.

#### **4. CONSTRUCTION METHODS**

**4.1 General**. Concrete pavement and integral curb shall be constructed to the detailed thicknesses and to the lines and grades shown on the plans. Concrete shall be placed over moistened and unfrozen subgrade and the ambient temperature shall be at least 40 deg. F. and rising. The subgrade shall be free of excessive moisture prior to concrete placement.

**4.2 Forms**. Straight forms shall be of metal having adequate thickness to support the equipment and shall be furnished in sections not less than ten feet in length. Forms shall have a depth equal to the prescribed edge thickness of the concrete being placed without any horizontal joints. Forms to be used as track for subgrade planers and finishing machines shall have a base width at least eight inches wide.

Flexible or curved forms of proper radius shall be used for curves of one hundred fifty foot radius or less, except approved straight forms of five foot length may be used for curves of a radius from seventy-five foot to one hundred fifty (150) foot. Flexible or curved forms shall be of a design acceptable to the Engineer. The Engineer may approve the use of wood forms in areas requiring hand finishing. The forms shall have



provisions for locking the ends of abutting form sections together tightly and for secure setting. The top face of the form shall not vary from a true plane more than one-eighth of an inch in ten feet. Forms shall be staked into place with not less than three pins for each ten foot section and a pin shall be placed at each side of every joint. Form sections shall be tightly locked together at the joints and shall be free from play or movement in any direction. Forms with battered top surfaces, and bent, twisted or broken forms shall not be used and shall be removed from the project. Repaired forms shall not be used until inspected and approved by the Engineer.

Forms shall be joined securely and set with exactness to required grade and alignment and supported firmly during the entire operation of placing and finishing so that they will not deviate more than one-eighth of an inch from a straightedge ten feet in length. A form grading machine shall be used to excavate the subgrade in preparation for setting forms to be used as track for subgrade planers and finishing machines. The foundation under the forms shall be hard and true to grade so that the form, when set, will be firmly in contact for its entire length and at the specified grade. The building of pedestals of earth to bring the forms to the required grade will not be permitted. The foundation shall be thoroughly tamped, either mechanically or by hand, at both the inside and outside edges of the forms after the forms have been set. No excessive settlement or springing of forms under the finishing machine will be tolerated. When any form has been disturbed or any grade has become unstable, the form shall be reset. The alignment and grade elevations of the forms shall be checked and corrections made by the Contractor immediately before placing concrete. Forms shall be cleaned before setting and oiled prior to placing any concrete.

4.3 Subgrade Preparation. An approved type of subgrade planer shall be used to form the crown and shape the subgrade to insure that the specified pavement thickness is secured in advance of placing concrete.

An electronically controlled automatic template fine grader may be used provided the unit is capable of cutting consistently within 1/8 of an inch of the required grade. The unit shall be electronically controlled so that the fine grading can be accurately controlled transversely as well as longitudinally, for both line and grade, using an approved reference line. If the concrete mixer is not operated within the strip to be paved, subgrade shall be given final rolling after the final adjustments of the subgrade which are shown to be necessary by the subgrade planer. If the concrete mixer is operated within the space to be concreted, a template having proper contour and elevation shall be dragged over the subgrade immediately behind the mixer. This template may be of either wood or metal but shall have a metal cutting edge. It shall be stiff enough to prevent springing or vertical displacement. It shall be loaded during dragging to hold it down to the forms on each side of space to be paved. No earth or other loose material excepting sand may be placed on the subgrade after the passage of the cutting template. If the subgrade is dry, it shall be thoroughly wet down immediately in advance of placing the concrete.

**4.4 Placement Of Steel Reinforcement.** Before placing any concrete, all reinforcing steel shall be set in proper location and position as shown on the plans. Tie bars at construction joints shall be inserted through predrilled holes in the form and supported to maintain their horizontal alignment. Dowel bars for integral curb may be inserted into the concrete pavement after placement provided care is taken to maintain the specific spacing and alignment and the concrete has not taken its initial set.

#### **4.5 Concrete.**

**4.5.1 Placing** - Concrete shall be placed with an approved self-propelled finishing machine of suitable design, excepting at intersections and other locations of irregular contour. The finishing machine shall be so operated and manipulated that concrete is uniformly distributed without segregation and, after final passage of the machine, is left with uniform thickness and contour and with the surface free from irregularities. Concrete shall be thoroughly spaded or otherwise compacted to avoid honeycombing at each edge of the slab or around structures.

Concrete shall be vibrated with mechanical vibrators attached to the finishing machine and which have a frequency of 3000 revolutions per minute, minimum. Vibrators shall be of the type and number that will thoroughly and completely consolidate the concrete from top to bottom for the full width of slab. At intersections and other locations in the street which do not have uniform cross sections the concrete shall be thoroughly consolidated by spading, hand vibrating, or other means approved by the Engineer.

Where conditions are such that it is not feasible to use a self-propelled finishing machine and vibrator, a screed with a vibrator attachment may be used in place of the finishing machine when approved by the Engineer. The screed may be a manually propelled "Razorback" type or other type as may be approved by the Engineer. The screed operation shall be supplemented with spud-type vibrators to consolidate concrete next to the forms and at other locations as directed by the Engineer to maximize the density of the in-place concrete and provide a uniformly consolidated slab. In the event the finished slab behind the screed operation is not acceptable to the Engineer in terms of thickness, consolidations, surface texture or surface tolerance, paving operations shall cease and necessary adjustments be made to achieve acceptable results.

**4.5.2 Finishing** - After final screeding is completed the surface shall be floated in a transverse direction and then tested with ten (10) foot straightedges. All surface irregularities and high or low spots shall be corrected by additional wood floating.

4.5.2.1 Pavement - After floating operations are completed the surface of the concrete pavement shall be textured in the transverse direction by the use of fiber brooms or by belting with canvas or rubber belts. Final concrete belting or brooming shall be adjusted until the finished surface is uniform as approved by the Engineer.

4.5.2.2 Integral Curb - Integral curb shall be placed immediately after finishing of the concrete pavement. Integral curb shall have joints at all locations to match the joints in the adjoining pavement. A medium broom finish shall be applied to the face of all integral curbs to produce a uniform surface texture.

4.5.3 Curing - Curing shall be in accordance with the requirements of Section 03010, "Concrete Work", except that alternate curing methods described under 9.f. will not be permitted.

4.5.4 Joints - All joints in concrete pavement shall be constructed at the locations and in accordance with the details shown on the plans unless otherwise directed by the Engineer. Failure to construct the specified joints in an acceptable manner will be cause for suspension of the work until the cause of the deficiencies is remedied. The Contractor shall so plan his paving operations that the end of each days placement terminates at a designated joint location.

4.5.4.1 Contraction Joints shall be made by sawing after the concrete has hardened sufficiently to prevent tearing or ravelling but before the pavement has started to shrink. Saw cuts shall be straight and uniform and shall align with adjacent previously sawed joints. After sawing of the joint is completed, it shall be cleaned with air or water jets and the curing period shall be continued.

4.5.4.2 Dowelled Transverse Construction Joints as detailed on the plans shall be used at the end of a days placement in lieu of a Transverse Contraction Joint. Sawing as required shall be completed as specified above for Contraction Joints.

4.5.4.3 Tied Longitudinal Construction Joints shall be made as detailed on the plans at the designated locations. Sawing as required shall be completed as specified for Contraction Joints.

4.5.4.4 Expansion Joints shall be constructed at the locations designated and in accordance with the details shown on the plans. Expansion joint material of the specified thickness shall be cut to the size of the pavement and integral curb less the detailed joint sealant dimension from the surface thereof. Care shall be taken in constructing expansion joints to maintain the joint filler material in a vertical position during placement of adjacent concrete. The edges of the concrete abutting the joint, except those requiring sawing, shall be finished with an edging tool and the joint raked clean of all concrete.

**4.5.4.5 Hot or Cold Type Joint Sealer** - After the specified curing period, the faces of all joints to be sealed shall be thoroughly cleaned using compressed air, sweeping, brooming or other approved methods. After cleaning and when the faces of the joints are dry, the joint shall be filled with sealer material using an approved nozzle so that the joint is completely filled without air voids or vacations. Upon completion of the joint sealing operations all excess sealant and foreign material shall be removed from the concrete surface.

**4.5.4.6 Silicone Joint Sealant** - When the plans require sealing joints with silicone sealant, the following shall apply

**4.5.4.6.1 Sawing** - All transverse joints shall be sawed in accordance with Specifications and Plan details. Should any spalling of the sawed edges occur which would detrimentally affect the joint seal, it shall be patched with an approved epoxy patching compound and allowed to harden prior to installation of the joint material. Each patch shall be true to the intended neat lines of the finished cut joint.

**4.5.4.6.2 Cleaning Joints** - Air compressors used for cleaning joints shall be equipped with suitable traps capable of removing all surplus water and oil in the compressed air. This compressed air will be checked daily by the Engineer for contamination. No contaminated air shall be used.

**Cleaning Freshly Cut Sawed Joints.** Immediately after sawing the joint, the resulting slurry shall be completely removed from the joint and the immediate area by flushing with a jet of water under pressure, and by the use of other tools as necessary. In the event freshly cut sawed joints become contaminated before they are sealed, they shall be cleaned as many times as necessary by the following method:

**High Pressure Water Jet.** The joint shall be thoroughly cleaned of all foreign material. After cleaning, the joint will be allowed to become thoroughly dry before sealant is installed.

**4.5.4.6.3 Installing Backup Material** - A resilient rod type backup material will be installed in a manner that will produce the shape factor specified. If the sealant bonds to the backup material, a bond-breaking tape may be required.

**4.5.4.6.4 Sealing Joints** - The location, size, configuration and acceptable joint sealant shall be shown on the plans.

4.5.4.6.5 Filling the Joint - A joint shall not be sealed until it is thoroughly clean and dry. Sealant shall not be applied to wet or damp concrete or installed during inclement weather. The sealer shall be placed to reasonably close conformity with dimensions shown on the plans. Any unreasonable deviation will be cause for rejection of the joint until satisfactory corrective measures are taken. Joint sealer application will not be permitted when the air temperature near the joint is less than 40°F or is 40°F and falling.

4.5.4.6.6 Equipment - The backer rod shall be installed utilizing a device which will place the rod uniformly at the depth shown on the plans. The joint sealer shall be applied by an approved mechanical device from inside the joint in such a manner which causes it to wet the joint surfaces. The silicone sealant is not self leveling and will not position properly in the joint under its own weight, therefore, sealant surface shall be tooled using the appropriate tool to produce a slightly concaved surface approximately 1/4 inch below the pavement surface as shown on the plans. Tooling shall be accomplished before a skin forms on the surface. The use of soap or oil as a tooling aid will not be permitted. Any failure of the joint material in either adhesion or cohesion will be cause for rejection, and the joint shall be repaired to the Engineer's satisfaction at the contractor's expense.

4.5.4.6.7 Cleaning Pavement - After a joint has been sealed, all surplus joint sealer on the pavement or structure surfaces shall be promptly removed.

4.5.4.6.8 Traffic. Traffic shall not be permitted over sealed joints until the sealer is tack free, or until debris from traffic does not imbed into the sealant.

4.5.5 Surface Tolerances - The concrete pavement after hardening shall be tested with a ten (10) foot straight edge. Areas showing surface deviations in excess of 1/4 inch shall be ground with an approved grinding tool until the deviations are 1/4 inch or less. Where surface deviations exceed 1/2 inch, the pavement shall be removed and replaced by the Contractor at his own expense. Any area so removed and replaced shall extend to the nearest joint on each side of the deficient section.

#### 4.6 Clean-Up

The pavement surface shall be swept and/or washed down to remove all dirt, debris or foreign materials prior to opening to traffic.

4.7 Opening To Traffic. The Contractor shall not permit traffic on the pavement until the concrete has attained a compressive strength of 4000 psi or an age of fourteen (14) days.

## SECTION 02601 - MANHOLES AND CLEANOUTS

### 1. GENERAL

Manholes and cleanouts shall be constructed at the location to the size and with the type as shown on the plans and in accordance with the drawings. The invert channels shall be smooth and semi-circular in shape conforming to the inside of the adjacent sewer section. Changes in direction of flow shall be made with a smooth curve of as large a radius as the size of the manhole will permit. Changes in size and grade of the channels shall be made gradually and evenly. The invert channels shall be formed directly in the concrete of the manhole base, or shall be constructed by laying a full section of sewer pipe through the manhole and cutting out the top half after the surrounding concrete has hardened. The floor of the manhole outside the channels shall be smooth and shall slope toward the channels not less than 1 inch per foot nor more than 2 inches per foot. Free drop inside the manholes (inside drop) shall not exceed 2 feet measured from the invert of the inlet pipe to the top of the floor of the manholes outside the channels. Outside drop manholes shall be constructed whenever the free drop would otherwise be greater than 2 feet and as shown on the plans.

Manholes shall be constructed to be watertight and shall be vacuum tested per Section 02626.

### 2. MATERIALS

2.1 Concrete: Section 03010 except as noted herein.

2.2 Quick Set Hydraulic Cements: Thoro "Waterplug", Quikrete "Waterstop" or equal.

2.3 PreCast Reinforced Concrete Manholes: Precast Reinforced Concrete manholes shall conform to the latest revision of ASTM C478 except for the following modifications:

- (1) Cement, Section 5 shall be revised to read: Cement used in construction of precast reinforced concrete manholes shall conform to the requirements of the Standard Specifications for Portland Cement (ASTM Designation: C150).
- (2) Thickness of precast sections shall be at least one-twelfth of the internal shell diameter plus one inch, or 5 inches total, whichever is greater. The minimum internal diameter of manholes shall be 4 feet.
- (3) Precast reinforced concrete manholes shall not be constructed downstream of a force main, except when two (2) or more standard cast-in-place manholes separate the precast manhole and the force main.

- (4) Joints between precast reinforced concrete sections shall provide for the use of mastics (2 wraps) or rubber gaskets (natural or synthetic) to prevent leakage of infiltration.
- (5) Precast sections shall be adequately reinforced with steel to withstand erection and temperature stresses.
- (6) The Contractor must submit certified test results showing that a random number of precast sections have been sampled and tested in accordance with ASTM C497 prior to moving precast sections to the job site.

All costs to complete the preceding tests are to be at no additional cost to the Owner.

- (7) The exterior of precast manhole sections shall be delivered to the site without any type of coating. Exterior coatings shall be applied after manholes have been tested. Interior coatings may be applied prior to shipment. Interior coating shall include 2 coats Tnemec Series 66 High Build Epoxy or equal an exterior coating shall be 1 coat of Tnemec 46-450 Heavy Tnemecol or equal.
- (8) Each precast manhole section delivered to the site shall have the date of manufacture and the manhole number included on the section when delivered.

2.4 Sand For Mortar: Concrete sand (fine aggregate) sieved through 8 mesh screen.

2.5 Mortar: Eight sacks of Type I cement per cubic yard. Use of hydrated lime shall not be allowed.

2.6 Gaskets:

- (1) Mastic: Fed. Spec. SS-S-210; K. T. Snyder "RamNek" or ConSeal CS-102.
- (2) Rubber: Neoprene or other synthetic, 40 plus or minus 5 hardness when measured by ASTM D2240, Type A durometer.

2.7 Castings: ASTM A48-83, Class 35B. Frames and covers as shown on the plans. All weights as given are approximate and average. Variation will not exceed the specified weights by more than 4 percent. Castings are to be manufactured true to pattern and with satisfactory fit of component parts. Castings shall be free of defects. Dimensions as detailed on plans shall not deviate by +/- 1/16" per foot. Castings shall be furnished with machined horizontal bearing surfaces.

**2.8 Delivery:** Precast concrete section shall not be delivered to the job until representative concrete control cylinders have attained a strength of at least 80 percent of the specified minimum. The date of manufacture and manhole number shall be indicated on each manhole section upon delivery.

**2.9 Inspection:** Precast concrete sections shall be inspected when delivered and all cracked or otherwise visibly defective units rejected.

**2.10 Quality of Materials.** The manufacturer of precast manhole sections shall submit tests from a certified lab detailing quality of aggregates and the mix design, which shall be in accordance with ASTM C478 or the specifications as herein stated.

### **3. CONSTRUCTION METHODS.**

**3.1 Cast-In-Place Manholes:** Forms used in the construction of cast in place circular concrete manholes shall be inspected and approved by the Engineer prior to use. The forms shall be made of metal and fabricated in sections which will permit easy installation and removal without damage to complete manhole. The forms shall be constructed such that the walls will have a thickness of 8 inches without any form marks on the interior or exterior exceeding 1/4 inch. The upper portion of the form shall be constructed such that the finished manhole will taper from 48-inch diameter to 26-inch diameter in a minimum distance of 30 inches and a maximum distance of 48 inches.

The concrete base shall be poured monolithically with the rest of the manhole as approved by the Engineer. Concrete used in the construction of cast-in-place manholes shall be Class I Mix Concrete with a maximum permissible slump of 4 inches. Concrete shall be placed and compacted in the forms in 2-foot layers in such a manner that will prevent segregation. Forms shall not be removed from the walls of the manhole until the concrete has set up sufficiently to prevent damage to the walls by the form removal operation.

Backfilling will not be permitted until a period of 12 hours has expired after the application of field applied exterior coatings.

Manhole locations which require pipe inlets through cast-in-place circular manhole walls will be constructed by cutting an opening in the manhole wall at the proper location after the forms have been removed. The pipe will then be installed in the opening using the correct alignment and grouted in place. The space between the pipe and manhole shall be completely filled with grout. All plugging or grouting shall be done with a quick set hydraulic cement as specified in Section 02601-1.

**3.2 Frames and Covers:** Frames shall be set so that the top of the frames will be flush with all paved surfaces.



**3.3 Precast Reinforced Concrete Manholes:** Thickness of precast sections shall be at least one-twelfth of the internal shell diameter plus one inch, or 5 inches total, whichever is greater. The minimum internal diameter of manholes shall be 4 feet.

All precast sections shall be adequately reinforced to withstand erection and temperature stresses as well as other applied loads.

Joints between precast sections shall provide for the use of mastics or rubber gaskets (natural or synthetic) to prevent leakage or infiltration.

Prior to moving precast sections to the job site, the Contractor shall submit certified test results showing a random number of precast sections have been sampled, tested for compressive strength and absorption and are in compliance with ASTM-C497.

**3.4 Sewer Connections to Manholes.** Sewer Connections to manholes shall be correctly aligned and connected to the manhole with an approved gasket. Where manholes are to be constructed on an existing pipe, the following shall apply: Pipe connections at manhole walls shall be grouted in place with hydraulic cement. Pipes having smooth exterior surfaces, unable to make a watertight bond with manhole walls, shall be installed with a rubber water stop at manhole penetrations. The space between the pipe and manhole shall be completely filled with an approved quick-set hydraulic cement.

All sewers extending from manholes shall be supported by a crushed rock encasement for a distance of 3 feet minimum from the face of the outside wall, for VCP concrete shall extend to a joint. Pipe penetrations that do not utilize an approved gasket precast in the manhole wall shall have the pipe supported a minimum of 3' from the face of the outside wall with Class I concrete.

**3.5 Manholes Adjustment Stacks:** Elevation of the manhole service entry shall be set so that the top of the frames will be flush with all paved surfaces, all other locations will be set as shown in the plans. Vertical stacks shall be constructed of 3 inch and 6 inch Keyed Steel Reinforced Concrete Adjustment Rings (S.R.C.A.R.), complying with ASTM-C150 and ASTM-C478. When more than one S.R.C.A.R. is required, only one 3 inch ring shall be allowed and it shall be placed at the bottom of the stack. The manhole entry frame and the adjustment rings shall be properly sealed using two rings of mastic (Fed. spec. SS-S210) spaced approximately 2 inches apart. The manhole entry frame shall be 'capped' with a ring of Type 1 concrete complying with ASTM-C150. The cap should extend from a maximum of (1") one inch below the top of the frame, to a point beyond the bottom of the frame joint. The surface of the cap shall be hand rubbed to provide a smooth, even texture and appearance. When it is necessary to adjust a reinforced concrete manhole with a corbel section upward more than (12") twelve inches or downward, remove the stack and the corbel section completely, then build-up or lower the barrel to the proper height to facilitate reassembly of the corbel and stack to the required elevation. The barrel may be built-up or lowered by adding and/or removing 4 foot diameter precast barrel sections. These sections can be produced in 6" increments to fulfill the elevation requirements. To meet additional elevation requirements use vertical stacks as described above. Manhole details are shown on the plans.

#### **4. STUBS AND CAPS**

All stubs out of manholes shall terminate with plain end pipe capped by a gasketed cap made for the pipe being installed. Caps shall not be glued or cemented to the stub.

Stubs shall be a minimum of 5' in length, to the sizes shown in the plans. The contractor shall prevent any concrete from being within 1 foot of the end of the stub.

## DIVISION 3 - CONCRETE

### SECTION 03010 - CONCRETE WORK

#### 1. GENERAL

Concrete shall consist of cement, coarse aggregate, fine aggregate, approved admixtures, and water; proportioned and mixed to produce a workable mixture suitable for specific conditions of placement as noted in the following specifications.

All concrete used in the work shall be air-entrained unless otherwise permitted by these specifications or approved by the Engineer.

All reinforcing steel as detailed on the drawings shall be installed and fastened by ties or supports prior to placing any concrete.

#### 2. MATERIALS

##### 2.1 Portland Cement:

- (1) General - Portland Cement shall conform to the requirements of ASTM Designation C150 and shall be Type II. When approved by the Engineer in writing, Type I or Type III cements may be used in lieu of Type II. Use of special cements containing interground admixtures will not be permitted without approval by the Engineer.
- (2) Packaged Cement - Where packaged cement is to be used in the work, it shall be stored in a suitable moisture-proof enclosure with each shipment properly marked and segregated. Bags of cement in which, for any reason, the cement has become partially set, or which contains lumps of caked cement, shall be rejected.
- (3) Bulk Cement - Bulk cement may be used in the work when approved by the Engineer. Methods of transporting, handling and storage shall also be subject to approval.
- (4) Tests - The Contractor shall furnish certified test reports showing that the cement being supplied complies with these specifications.

2.2 Aggregates: - The use of pit run or naturally mixed aggregates will not be permitted. Fine and coarse aggregates shall be separately furnished and stored.

The mixing of different kinds of aggregates from different sources or alternating batches of different aggregates in one stockpile will not be permitted. In no case shall aggregates containing lumps of frozen or partially cemented materials be used. Aggregates proposed for use in the work shall meet the following requirements.

- (1) Deleterious Substances - Deleterious substances in aggregates shall not exceed the following percentages by weight when tested under the designated ASTM method.

	Coarse	Fine	Test
Material Passing No. 200 Sieve	1.0	3.00	C117
Shale	0.5	0.5	C123
Soft Friable Pieces	0.5	0.5	C142
Sticks (wet)	0.10	0.10	
Coal	0.25	0.25	C123
Clay Lumps (wet, on No. 4 Sieve)	1.5	0.25	C142

No one of the above percentages shall be exceeded when taken separately. In addition, any combination of shale, soft friable pieces, sticks, coal or clay lumps shall not exceed 1.5 percent.

- (2) Coarse Aggregate - Coarse aggregate shall be hard, durable, clean uncoated pieces of crushed rock or gravel. Coarse aggregate will be well graded within the following limits (ASTM Size #67) when tested under ASTM Standard C136.

Sieve Size	1	3/4	3/8	4	8
% Retained	0	0-10	45-80	90-100	95-100

- (3) Fine Aggregate - Fine aggregate shall consist of clean, hard, durable, uncoated siliceous or calcareous particles well graded within the following limits.

Sieve Size	3/8	4	8	16	30	50	100
% Retained	0	0-5	0-20	15-50	40-75	70-90	90-99

The Fineness Modulus (F.M.) of the fine aggregate furnished shall be not less than 2.5 nor more than 3.4 when determined by using a sieve series consisting of the No. 4, 8, 16, 30, 50 and 100 sizes. After acceptance of a gradation for use in the work the F.M. shall not vary more than  $\pm 0.2$ .

- (4) Stockpiles - Aggregates shall be stockpiled by building up free-draining horizontal layers not greater than 4 feet in thickness. Aggregates that have become mixed with earth or foreign material shall not be used. If the water content in coarse aggregate is below that which the aggregate will absorb, such aggregate shall be wet down at least 12 hours in advance of the time the mix is to be batched.
- (5) Aggregate Tests
- (a) General - All aggregates proposed by the Contractor for use in the work shall be certified by an approved Testing Laboratory as complying with the above requirements covering deleterious materials and gradation. In addition, unless waived by the Engineer, certified tests also shall be provided in accordance with Paragraphs (b) thru (e) below. All costs of testing shall be borne by the Contractor.
- (b) Soundness - Coarse aggregate for concrete when tested for soundness with magnesium sulphate in accordance with ASTM Standard C88 shall have a total loss not greater than 18% by weight.
- (c) Abrasion - The percentage of wear of the coarse aggregates by the Los Angeles Abrasion Test, ASTM C131, shall be less than 40%.
- (d) Absorption - Coarse aggregate for concrete shall have an absorption limit of 4% or less, as determined by ASTM C127.
- (e) Mortar Strength - Fine aggregates shall be of such quality that when made into a mortar and tested in accordance with ASTM C87 the mortar shall develop a compressive strengths at 7 and 28 days of not less than 100 percent of that developed by the control mortar specified in C87.

### 2.3 Admixtures:

- (1) General - Admixtures are defined by these specifications as a material, other than portland cement, aggregate or water, added to concrete to modify its properties. The following admixtures shall be used when required and may be used when permitted.

- (2) Air Entraining Agent (AEA) - An approved air entraining agent shall be used to produce 5 to 8% air entrainment in the concrete as placed. The AEA shall be a neutralized solution of vinsol resin meeting the requirements of ASTM C260.
- (3) Calcium Chloride - When approved by the Engineer, calcium chloride meeting the requirements of ASTM D-98 may be used as an accelerator in an amount not exceeding two (2) percent of the weight of cement. No calcium chloride, or admixtures containing calcium chloride, shall be used where aluminum conduit, couplings or accessories are embedded in the concrete.
- (4) Water Reducing Admixtures - At the option of the Contractor, subject to approval of the Engineer, a water reducing admixture (WRA) may be used. Water-reducing, set-controlling admixtures shall be of the basic chemical composition described as "hydroxylated carboxylic acid" or "hydroxylated polymers" and shall meet the requirements of ASTM C494, Type A or Type D. Before approval, the compatibility of the proposed admixture, with the other materials to be used in the concrete mixture, shall be established by test. Where a WRA has been approved for use, and design mix test results demonstrate adequate strength, the Cement Factor may be reduced by 0.5 bag below that specified in Paragraph 3.1, "Proportioning".
- (5) Tests - The Contractor shall furnish three (3) copies of certified test results showing that the admixtures proposed for use comply with these specifications.

2.4 Water: Water used in concrete shall be clean, clear, and free from injurious amounts of sewage, oil, acid, strong alkalis or vegetable matter. If the water is of questionable quality, it shall be tested by a comparative mortar strength test in accordance with ASTM C87.

2.5 Metal Reinforcement: Metal reinforcement shall be Grade 60 billet steel in accordance with ASTM A615. The size, length and shape shall be shown and detailed on the drawings.

2.6 Epoxy-Coated Metal Reinforcement. Where shown on the plans, metal reinforcement shall be epoxy-coated in accordance with the requirements of the latest revision of ASTM D3963.

**3. PROPORTIONING**

3.1 Mix Design: Concrete mixes to be used in the work shall be proportioned in accordance with the requirements of Table 1. All materials shall be proportioned by weight considering one sack of cement as 94 pounds and one gallon of water as 8.33 pounds.

Table 1

	Minimum				
Concrete	28-Day Strength		Minimum	Maximum	
Class*	(PSI)		Cement Factor	W/C Ratio	Slump*
	Compressive	Flexural	Bags/C.Y.	Gal./Bag	(in.)
Class I	4000	500	6.5	5.5	1 to 3
Class II	3000	425	5.75	6.0	1 to 3
Class III (sand mix)	3500		8.0	5.75	1 to 3

\*The Class of concrete to be used in the various parts of the work shall be as specified herein or as noted on the drawings. Where no specific class has been designated, Class I concrete shall be used.

\*\*No concrete with slump in excess of 3-inches shall be used in the work without approval of the Engineer.

The Contractor shall design and submit for approval three (3) copies of the proposed design mix for each of the classes of concrete specified for the work. Included with the submittal shall be copies of test reports showing the 7 and 28 day strengths (Flexural and Compressive) for each proposed mix. The proposed design mixes shall be based on the specific materials and the maximum slump to be used in the work. All costs of mix design and testing shall be borne by the Contractor.

3.2 Aggregate Content: The total volume of aggregate used in each cubic yard of concrete shall be the maximum consistent with the requirements of workability.

For Class I and II concretes, the composition of the total aggregate (Fine and Coarse) shall be such that not more than 70% or less than 40% will pass the #4 sieve. The exact proportions of fine and coarse aggregate may be varied within the above limits by the Engineer to produce a concrete mixture more suitable for the work at hand.

For Class III concrete 100% fine aggregate shall be used. Sidewalks and driveways shall be 100% fine aggregate (sand mix) except where an approved mix using coarse aggregate is used due to special construction methods. In such cases, not more than 70% or less than 30% shall pass the #4 sieve.

**3.3 Variations in Mix Proportions:** The initial concrete mixes used on the work for the various classes of concrete shall be in accordance with the proportions used in the approved design mixes. In the event that these mixes do not produce concretes with the required strength, workability, or air content the Engineer may order changes in the mix proportions to obtain the specified requirements, and the changes so ordered, including additional cement, will be made at no additional cost to the Owner.

**3.4 Control:** The Contractor shall provide all equipment necessary to determine and positively control the actual amounts of all materials, including admixtures, entering into the concrete. Batching and weighing devices for aggregates and cement shall be accurate within 0.5 percent, and for water and admixtures within 1.0 percent.

#### **4. FORMS**

Forms shall be steel or wood as approved by the Engineer and shall conform to the shape, lines, grade and dimensions of the concrete as detailed on the drawings. Lumber used in forms for exposed surfaces shall be dressed to a uniform thickness and free from knots and blemishes. Joints in the forms shall be all horizontal or vertical where the finished surface is to be exposed. Forms shall have nails withdrawn and surfaces to be in contact with concrete thoroughly cleaned and oiled prior to each use. Form oil shall be non-staining and shall be applied to the forms before reinforcement is placed. Forms shall be sufficiently tight to prevent leakage of mortar and properly braced to maintain the desired shape, line and grade.

The removal of forms shall not be started until the concrete has attained the necessary strength to support its own weight and any construction loads. Forms shall not be removed before the expiration of 30 hours from any construction. Forms supported by false work shall not be removed until the concrete has attained its design strength. Where forms are removed less than seven days after placement of the concrete, provisions shall be made to insure curing as specified in this Section under, "Curing of Concrete".

#### **5. REINFORCEMENT**

Prior to positioning, reinforcing steel shall be cleaned of all loose mill scale and rust or coatings which might prevent or reduce bond. Reinforcement shall be positioned accurately and secured against any displacement by using annealed iron wire ties or suitable clips and be supported by suitable metal supports, spacers or hangers. All reinforcing shall be in place and securely fastened before placing any concrete. The contractor shall submit shop drawings, bar lists and bending diagrams to the Engineer for approval prior to ordering any reinforcement.



## 6. EPOXY-COATED REINFORCEMENT

6.1 Handling. In order to protect the coated reinforcement from damage, the contractor shall use padded or nonmetallic slings and padded straps. Bundled bars shall be handled in a manner which will prevent excessive sagging of bars which will damage the coating. The bundled bars shall not be dropped or dragged and must be stored on wooden cribbing. If, in the opinion of the engineer, the coated bars have been extensively damaged, the material will be rejected. The contractor may propose for the approval of the engineer, alternate precautionary measures.

6.2 Fabrication and Placement. The bars shall be fabricated and placed as shown on the plans and as specified. All bending should be done around nylon coated pins or wooden mandrels. The rate of bending may have to be reduced for some bar sizes to minimize cracking or disbonding of the coating. Any visible evidence of cracking or disbonding of the coating in the bent area of bars bent in accordance with the plan requirements may be patched with approval of the engineer, except that a hairline crack, 0.003 inch or less, at the base of the deformation will not be cause for rejection nor will patching of these cracks be required. All patching shall be done promptly after bending. Bars shall not be shipped until patching material has lost all tackiness.

Plastic-coated tie wires approved by the engineer shall be used in the assembly of the coated bars in the structure to protect them from physical damage.

6.3 Patching. Patching material shall be applied to all sheared ends and contact areas for hangers or couplers. Patching materials shall be applied to all damaged areas at the points of occurrence, such as the initial application, fabrication, destination or installation points with the following exception. Damaged areas of coating not more than 0.2 inch across at the widest point of exposed area of bare steel and occurring no more than six in any lineal foot of coated bar need not be repaired.

Areas to be patched shall be clean and free of surface contaminants. They shall be promptly treated in accordance with the resin manufacturer's recommendations and before detrimental oxidation occurs.

## 7. MIXING

7.1 Job-Mixed Concrete: The equipment used for mixing concrete on the project site shall be capable of combining the aggregates, cement and water into a thoroughly mixed and uniform mass, and of discharging the mixture without segregation. The concrete shall be mixed in quantities required for immediate use. Concrete shall not be used which has developed its initial set or that has not been placed within one-half (1/2) hour after the water has been added. Retempering concrete by adding water or by any other means will not be permitted.

The concrete shall be mixed not less than sixty seconds. When a double compartment mixer is used, the minimum mixing time in the first compartment shall be thirty seconds and the total mixing time, including transfer time, shall not be less than sixty-five seconds.

Concrete may be mixed by a paving mixer into which the materials, including the water, can be precisely and regularly proportioned, and which will produce a concrete of uniform consistency, uniform color, and thoroughly and uniformly mixed. The paving mixer shall be equipped with a batch meter and an automatic locking timing device. The water tank shall be equipped with a scale graduated in gallons and fractions thereof. The water measuring device shall be capable of accurate measurement to within one percent of the required amount. The paving mixer shall be equipped with a boom and bucket, fully power controlled, which shall be so operated that the batches may be uniformly distributed on the subgrade.

**7.2 Ready-Mixed Concrete:** Ready-Mixed (Transit-mixed) concrete may be used in lieu of concrete mixed at the project site. When used, transit-mixed concrete shall comply with the applicable provisions of Division 150, Equipment and Division 400, Portland Cement Concrete of the Standard Specifications for State Road and Bridge Construction, 1990 Edition, Kansas Department of Transportation, except that testing will be in accordance with the requirements of "Control Tests" in this Section.

## **8. PLACING CONCRETE**

**8.1 General:** Before beginning placement of concrete, hardened concrete and foreign materials shall be removed from the inner surface of the conveying equipment. Before depositing concrete, all debris shall be removed from the space to be occupied by the concrete; forms, if constructed of lumber, shall be thoroughly wetted (except in freezing weather) or oiled. Reinforcement shall be secured thoroughly in position and approval by the Engineer obtained before concrete is placed.

**8.2 Removal of Water:** Water shall be removed from the space to be occupied by the concrete before concrete is deposited, unless otherwise directed by the Engineer. Any flow of water into an excavation shall be diverted through proper side drains to a sump, or be removed by other approved methods which will avoid washing the freshly deposited concrete. If directed by the Engineer, water vent pipes and drains shall be filled by grouting, or other approved means, after the concrete has thoroughly hardened.

**8.3 Handling:** Concrete shall be handled from the mixer, or in the case of ready-mixed concrete from the transporting vehicle, to the place of final deposit as rapidly as practicable by methods which shall prevent the separation or loss of the ingredients. Under no circumstances shall partially hardened concrete be deposited in the work. Concrete shall be deposited in the forms as nearly as practicable in its final position to

avoid rehandling. It shall be deposited as to maintain, until the completion of the unit, an approximately horizontal plastic surface. Forms for walls or thin sections of considerable height shall be provided with openings or other devices that will permit the concrete to be placed in a manner that will prevent segregation and accumulations of hardened concrete on forms or metal reinforcement above the level of concrete. Regardless of the type of transporting vehicle, concrete shall have the quality required when deposited in the forms.

**8.4 Chuting:** When concrete is conveyed by chutes, the equipment shall be of such size and design as to insure a continuous flow in the chute. Chutes shall be of metal or metal lined and the different portions shall have approximately the same slope. The slope shall not be less than one vertical to two horizontal and shall be such as to prevent segregation of the ingredients. The discharge end of the chute shall be provided with a baffle plate to prevent segregation. If the distance of the discharge end of chute above surface of the concrete is more than 3 times the thickness of the layer being deposited, but not more than 5 feet above surface of concrete, a spout shall be used and the lower end maintained as near the surface of deposit as practicable. When the operation is intermittent, the chute shall discharge into a hopper. The chute shall be thoroughly cleaned before and after each run and all debris and cleaning water shall be discharged outside the forms.

**8.5 Compacting:** During and immediately after depositing, concrete shall be compacted thoroughly by means of suitable tools. In general, concrete shall be compacted by mechanical vibration. Number and type of vibrators shall be subject to the approval of the Engineer.

For thin walls or inaccessible portions of forms where spading, rodding, or forking is impracticable, concrete shall be worked into place by vibrating or tapping forms lightly opposite the freshly deposited concrete. Concrete shall be worked thoroughly around reinforcement, and around embedded fixtures, and into corners of forms.

Accumulations of water on surface of concrete, during placement and compacting, due to water gain, segregation or other causes shall be prevented as far as possible by adjustments in the mixture. Provisions shall be made for removal of such water as may accumulate so that, under no circumstances, will fresh concrete be placed in such accumulations.

**8.6 Depositing Continuously:** Concrete shall be deposited continuously or in layers of such thickness that no fresh concrete will be deposited on concrete which has hardened sufficiently to cause formation of seams and planes of weakness within the section. If a section cannot be placed continuously, construction joints shall be located at points as provided for in the drawings or approved by the Engineer.

**8.7 Depositing in Cold Weather:** Concrete when deposited shall have a temperature of not less than 50° F. nor more than 100° F. The Contractor shall submit for the approval of the Engineer the methods he proposes to use for protecting the concrete from freezing temperatures during the first 72 hours where Type I or II Portland cement is used, or 24 hours where Type III (high early strength) Portland cement is used.

Before placing concrete, forms or subgrade shall be free from frost and ice. Methods of heating materials shall be approved by the Engineer. Salts, chemicals or other foreign materials shall not be mixed with the concrete for the purpose of preventing freezing. Calcium Chloride may be used as an accelerator when specifically approved by the Engineer.

**8.8 Bonding:** Before depositing fresh concrete on or against concrete which has hardened, forms shall be retightened. The surface of the hardened concrete shall be roughened, in a manner that will not leave loosened particles of aggregate or damaged concrete at the surface, cleaned thoroughly of foreign matter and saturated with water. To provide adequate mortar at the juncture of the hardened and newly deposited concrete, the cleaned and saturated surfaces, including vertical and inclined surfaces, shall be first covered thoroughly with a coating of mortar or neat cement grout, against which new concrete shall be placed before the grout has attained its initial set.

**8.9 Wet Pour Method:** When approved by the Engineer, the Contractor may place a wet pour if he cannot prevent the flow of water into the area as defined in 8.2. At the time a wet pour is made the water level shall be static and below the concrete form surface elevation, unless approved otherwise by the Engineer. A wet pour shall be placed by the tremie method or by pump after the reinforcing and forms are determined to be acceptable by the Engineer. A tremie shall consist of a watertight tube having a diameter of not less than 10 inches with a hopper at the top. When a batch is dumped into the hopper, the flow of concrete shall be induced by slightly raising the discharge end, always keeping it in the deposited concrete.

Concrete pump discharge tubes and tremie tubes used to deposit concrete in water shall be equipped with a device that will prevent water from entering the tube while charging the tube with concrete. Such tubes shall be supported so as to permit free movement of the discharge end over the entire top surface of the work and to permit rapid lowering, when necessary to control or stop the flow of concrete. The tubes shall be filled by a method that will prevent washing of the concrete. The discharge end shall be completely submerged in concrete at all times and the tube shall contain sufficient concrete to prevent any water entry. The flow shall be continuous until the work is completed and the resulting concrete seal shall be monolithic and homogeneous. The wet pour shall be placed in one continuous pour until the form is filled to the plan elevation and all water and unsound concrete has been removed.

When requested by the Engineer the method selected by the Contractor to place the concrete shall be submitted for approval along with sufficient details and data to review the procedure. Concrete for a wet pour shall be the same class of concrete as specified on the plans with a minimum of 10% additional cement and a slump not to exceed six (6) inches.

## 9. CURING OF CONCRETE

All concrete surfaces shall be protected to insure that loss of moisture from the surface is held to a minimum for a period of at least seven (7) days following initial set. Where Type III (high early strength) Portland cement is used, the period shall be not less than three (3) days. Concrete damaged by improper curing shall be subject to removal and replacement as directed. The method of curing, regardless of type, will not relieve the Contractor of his responsibility to provide concrete having required strength and surface finish. Unless otherwise specified for a specific item of work, the prevention of the loss of moisture from the concrete surface shall be accomplished by one of the following alternate methods:

- a. Surface maintained continuously wet by sprinkling or inundation;
- b. Covering with burlap mats kept continuously wet;
- c. Covering surfaces with white or translucent polyethelene sheeting not less than .004 inch in thickness. Splices shall be made with a minimum lap of 4 inches and sealed with adhesive tape approved by the Engineer;
- d. Application of a membrane curing compound such as Protex Industries "Triple Seal"; Carter-Waters' "Chlorcure"; or an equal product approved by the Engineer. Application shall be at a rate of not more than 200 square feet of surface per gallon of compound;
- e. Forms left in place during the specified curing period shall be sprinkled and maintained moist as required to prevent rapid drying of the concrete;
- f. Other methods of curing as may be approved by the Engineer.

## 10. CONTROL TESTS

All concrete and concrete materials used in the work shall be tested as directed by the Engineer. The Contractor shall provide material for all samples and test specimens required.

So long as the Contractor's work progresses in an orderly and reasonable manner the costs of field sample preparation and testing of all specimens will be borne by the Owner. Should the Contractor use methods or procedures that require unreasonable or excessive field testing to determine whether specification requirements are being met, or if field testing is performed with continued negative results that indicate the

Contractor's methods or procedures are not adequate to provide the specified results, the Engineer shall notify the Contractor in writing that the costs of all additional testing beyond specific limits, which shall be set out in the written notice for the particular area or material in question, shall be the responsibility of the Contractor. Such costs will then be deducted from the monies due the Contractor for the work performed.

Control tests which will be conducted on a continuing basis include:

10.1 Slump Test: (ASTM-C143) as directed during concrete placement.

10.2 Yield Test: (ASTM-C138) as directed during concrete placement, generally once each day during concrete placement.

10.3 Compressive Strength: (ASTM-C39) two (2) test specimens for each 50 cubic yards or less of each class of concrete placed during one days operation to be tested at 7 and 28 days. Test specimens to be prepared in accordance with ASTM-C31.

10.4 Flexural Strength: (ASTM-C78) as directed during concrete placement, generally two (2) test specimens for each days placement of more than 50 CY. Test specimens to be prepared in accordance with ASTM-C31.

10.5 Air Entrainment: (ASTM-C231) as directed during concrete placement, generally at least once each day during concrete placement.

## 11. DEFECTIVE CONCRETE

11.1 Deficient Strength: Where the results of strength tests indicate concrete which fails to conform to these specifications, additional test specimens shall be taken, in accordance with ASTM C42, from the questioned areas, as directed by the Engineer. If the strength indicated by these core samples meets the specification requirements the concrete will be accepted. In the event that the core tests fail to meet the specifications, all concrete represented by the deficient test specimen shall be removed and replaced by the Contractor at no additional cost to the Owner. The cost of all coring and testing, including satisfactory patching of core holes, shall be borne by the Contractor.

11.2 Defective Area: Areas of concrete which are defective for reasons other than strength (i.e. Honeycombs, finish irregularities, misalignment of forms, etc.) shall be repaired by methods approved by the Engineer. When in the opinion of the Engineer satisfactory repairs cannot be made the defective concrete shall be removed and replaced by the Contractor at no additional cost to the Owner.

## 12. CONSTRUCTION

12.1 General: The Contractor shall ensure all pipe, pipe sleeves, reinforcing and other embedments are properly set and placed prior to any concrete pours. Concrete items shall be constructed to the detailed thickness and to the lines and grade as shown on the plans. Concrete shall be placed over moistened and unfrozen subgrade and when the ambient temperature is 40°F or greater and rising. The subgrade shall be void of excessive moisture. The concrete shall be reinforced with the type of reinforcement indicated and the reinforcement shall be secured and tied in place prior to depositing any concrete.

12.2 Expansion Joints: Asphalt Expansion Joints shall be composed of asphalt, vegetable fibres, and mineral fillers, formed under heat and pressure between two asphalt-saturated felt liners. Asphalt Expansion Joints shall conform to AASHTO M33 or ASTM D994, shall be 1/2" thick and weigh approximately 3 pounds per square foot, unless shown otherwise on the plans.

12.3 Waterstop: Waterstop shall be extruded P.V.C. material with multiple ribs and center bulb for construction joints. It shall be 4-7/16" wide and 3/16" thick (min.). P.V.C. waterstop for expansion joints shall be 3/16" thick (min) and be designed for 1/2" expansion (min). The waterstops shall be Labyrinth Model B3 as manufactured by Water Seals, Inc., Chicago, Illinois, phone 1-312-332-6765 or approved equal.

12.4 Joint Sealer: After the specified curing period, the faces of all joints to be sealed shall be thoroughly cleaned, using compressed air, sweeping, brooming or other methods approved by the Engineer. The faces of the joint shall be dry after being thoroughly cleaned, and filled with joint sealing compound using a nozzle designed to completely fill the joint.

Joints shall be filled to within the top surface, but in no case shall they be overfilled. Upon completion of the joint sealing operations, all excess material and foreign material shall be removed from the concrete surface.

Joint Sealant to be polysulfide base which cures to a flexible seal with good bonding characteristics or as shown otherwise in the plans.

12.5 Finishing of Related Unformed Surface: Surfaces to receive concrete Class III (grout) or equipment foundations shall have a rake finish or broom finish. Equipment or structure foundations, floor slabs and steps not to receive concrete Class III (grout) shall receive a troweled finish. Slabs to receive a coating shall have a finish as recommended by coating manufacturer.

Sidewalks shall receive a light broomed finish.

**12.6 Finishing of Formed Surfaces:** All surfaces exposed to view which have been in contact with the forms shall receive a smooth rubbed finish in accordance with Section 10.3.1 of ACI 301-72 after the surfaces have been prepared as specified in Chapter 9 of ACI 301-72. All air bubbles shall be filled with a bonding grout and rubbed down with sacks before final rubbing as specified above. This shall include all exposed edges and surfaces of walls.



